Taxation and Innovation in the 20th Century

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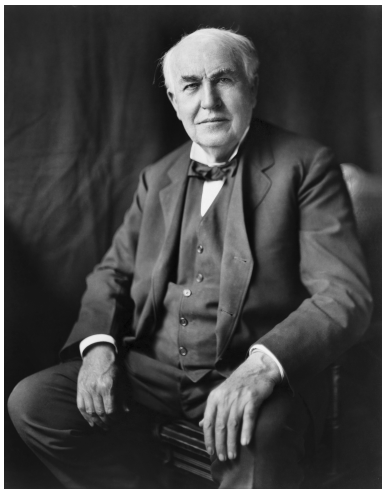
John Grigsby (Chicago)

Tom Nicholas (Harvard Business School)

Stefanie Stantcheva (Harvard)

October 12, 2018

Taxation and Innovation



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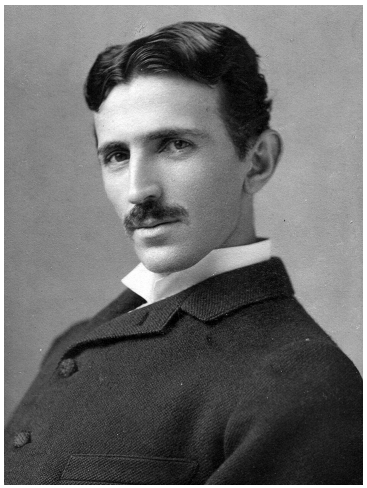

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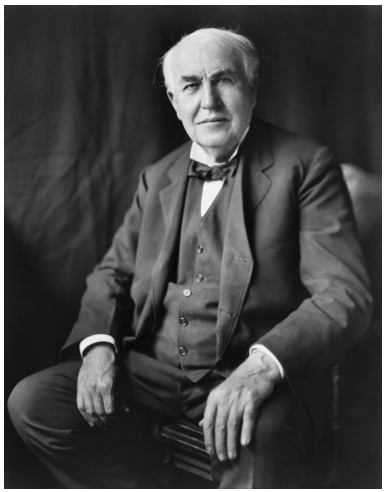

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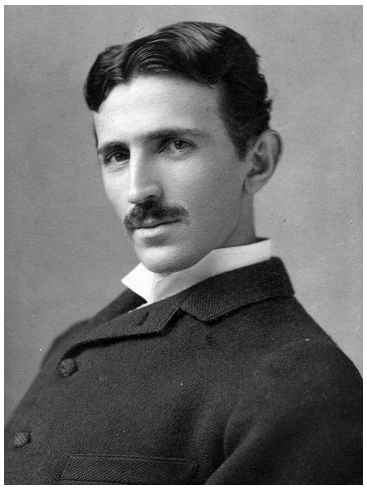

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Mad geniuses? Scientific pioneers not considering net returns?

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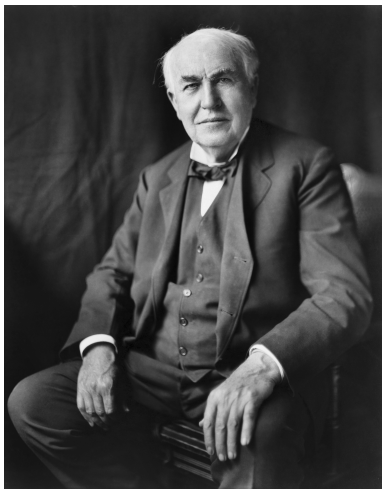

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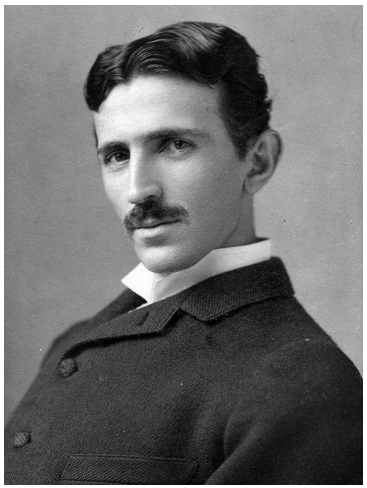

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Or were these inventors affected by taxes?

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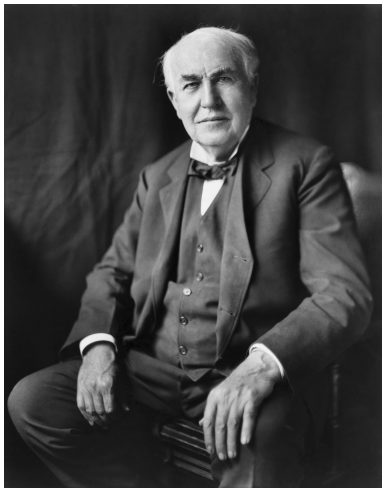

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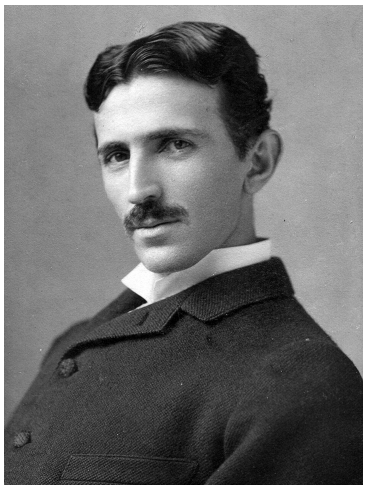

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Personal taxes? Corporate taxes?

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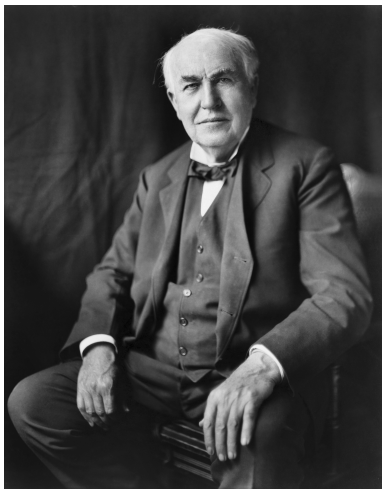

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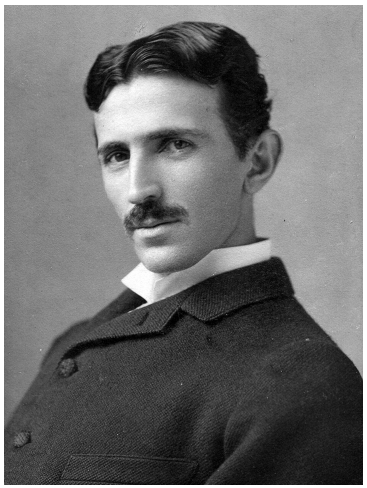

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Response margins? Patents produced? Quality of patents produced? Location choice? What firms they work for? Where they open research labs?

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  - iii) Historical state-level corporate tax database.

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  i) Individual inventors (micro level).
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  iii) Innovation in states (macro level).
- Because long-run panel data basically non-existent, our study sheds light on taxation more generally (entrepreneurship, mobility, labor supply..)

Outline

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Historical Patent Data

Akcigit, Grigsby, and Nicholas (2017): digitize historical patent records.

Match them to decennial Censuses by names.

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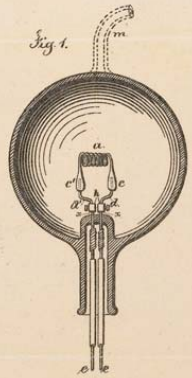
No. 223,898. Patented Jan. 27, 1880.

Fig 1.



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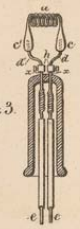


Witnesses
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
for Lemuel W. Serrell
atty

To the Honorable Commissioner of Patents:

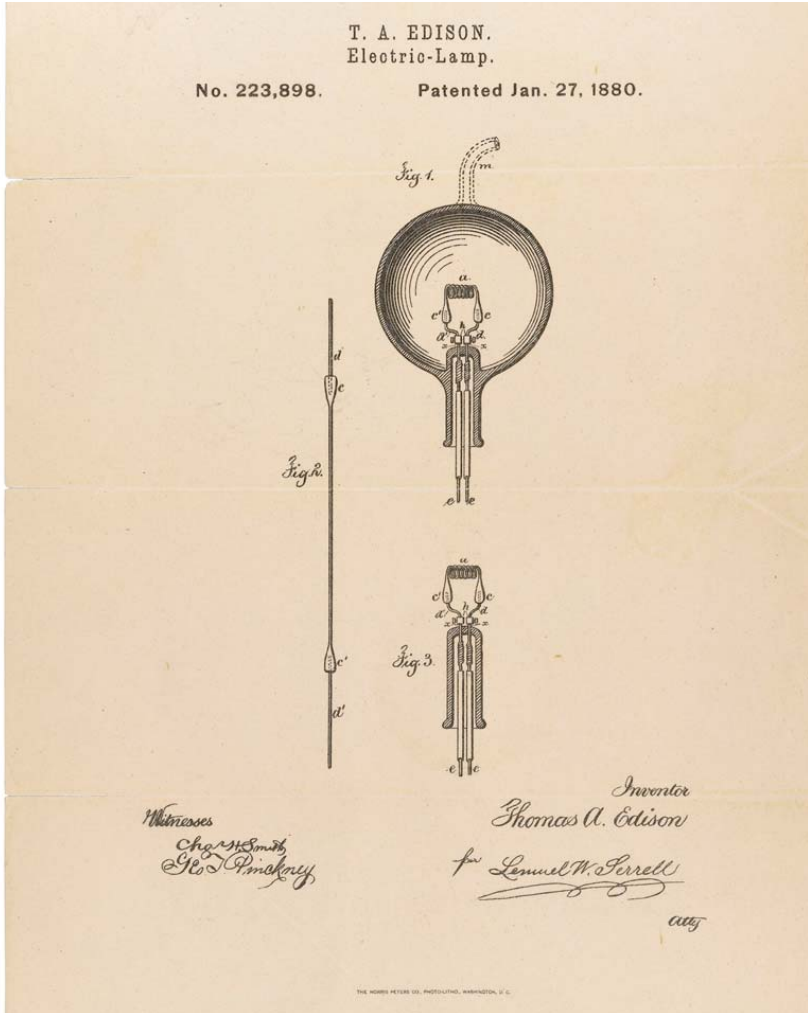
Your Petitioner Thomas A. Edison of Menlo Park in the State of New Jersey prays that LETTERS PATENT may be granted to him

for the invention of an Improvement in Electric Lamps and in the method of manufacturing the same set forth in the annexed specification. (Case No. 186.)

And further pray that you will recognize LEMUEL W. SERRELL, of the City of New York, N. Y., as his Attorney, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the Patent, and to transact all business in the Patent Office connected therewith.

_____)

_____ 1879.)



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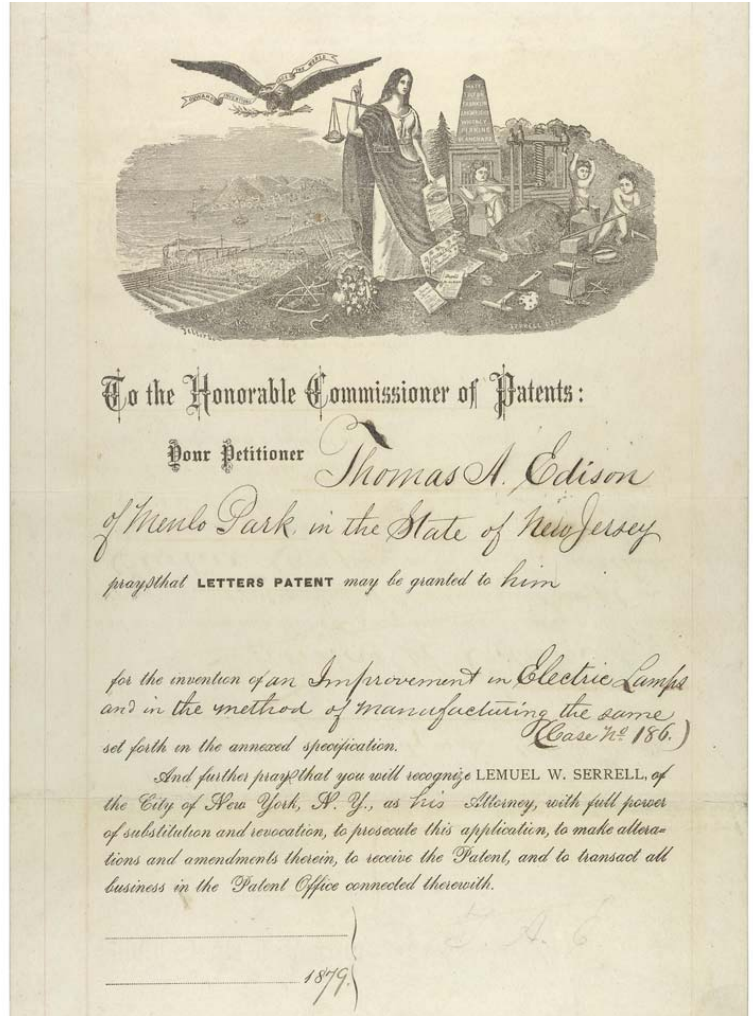

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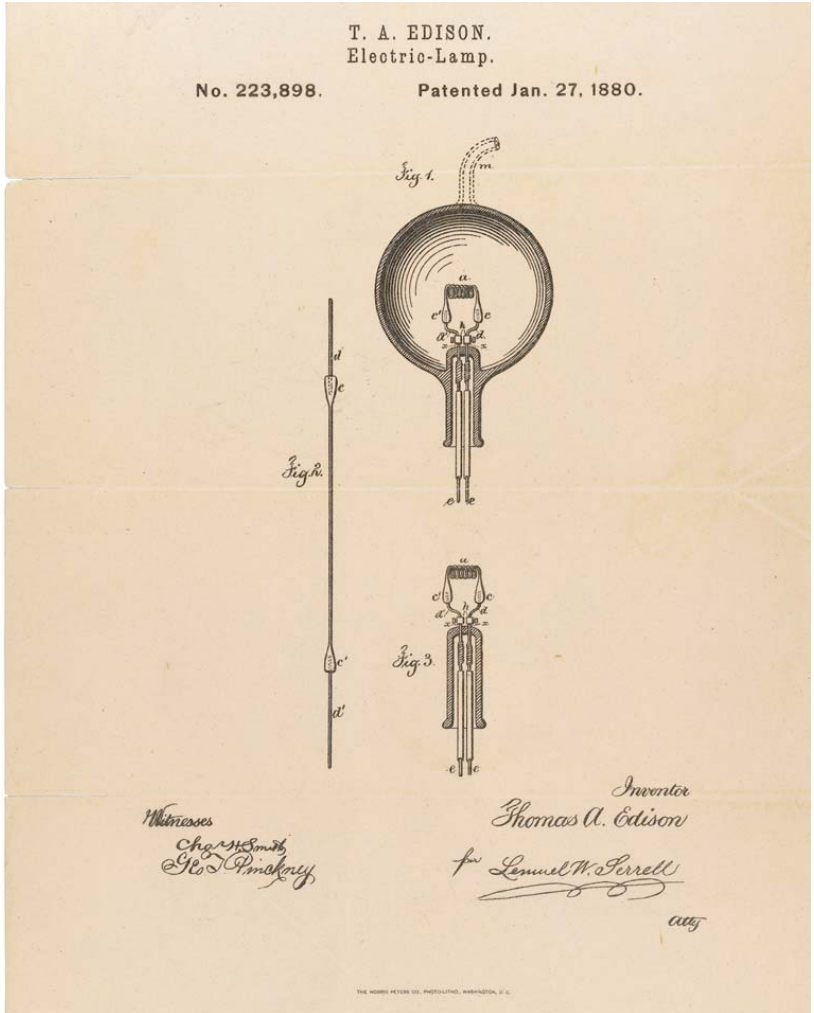

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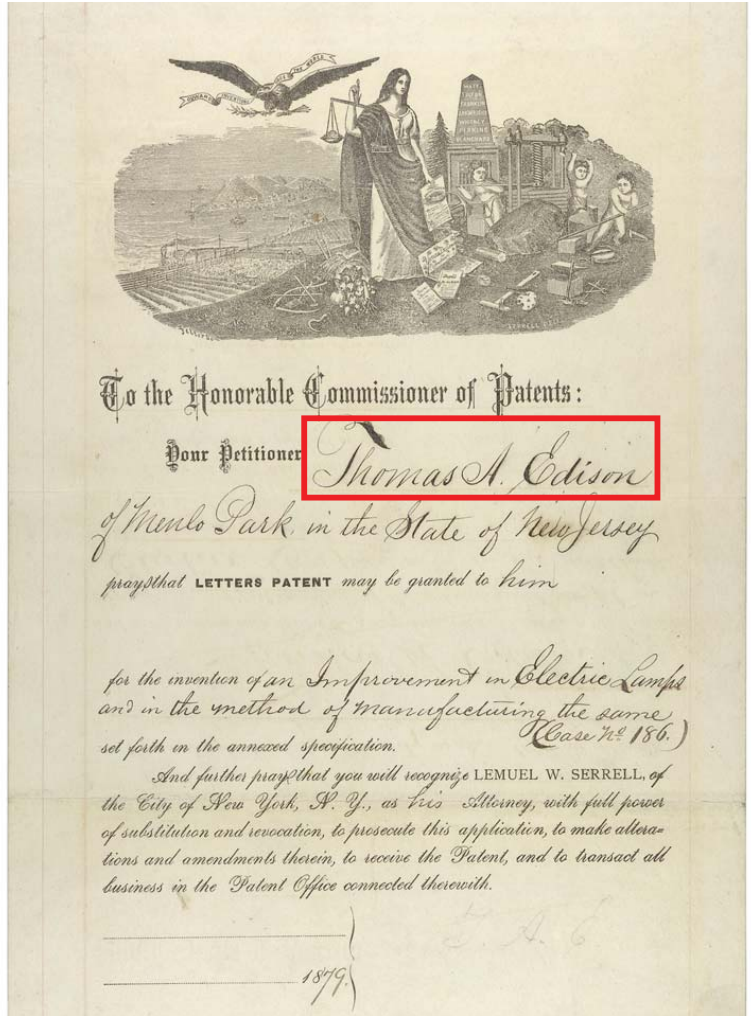

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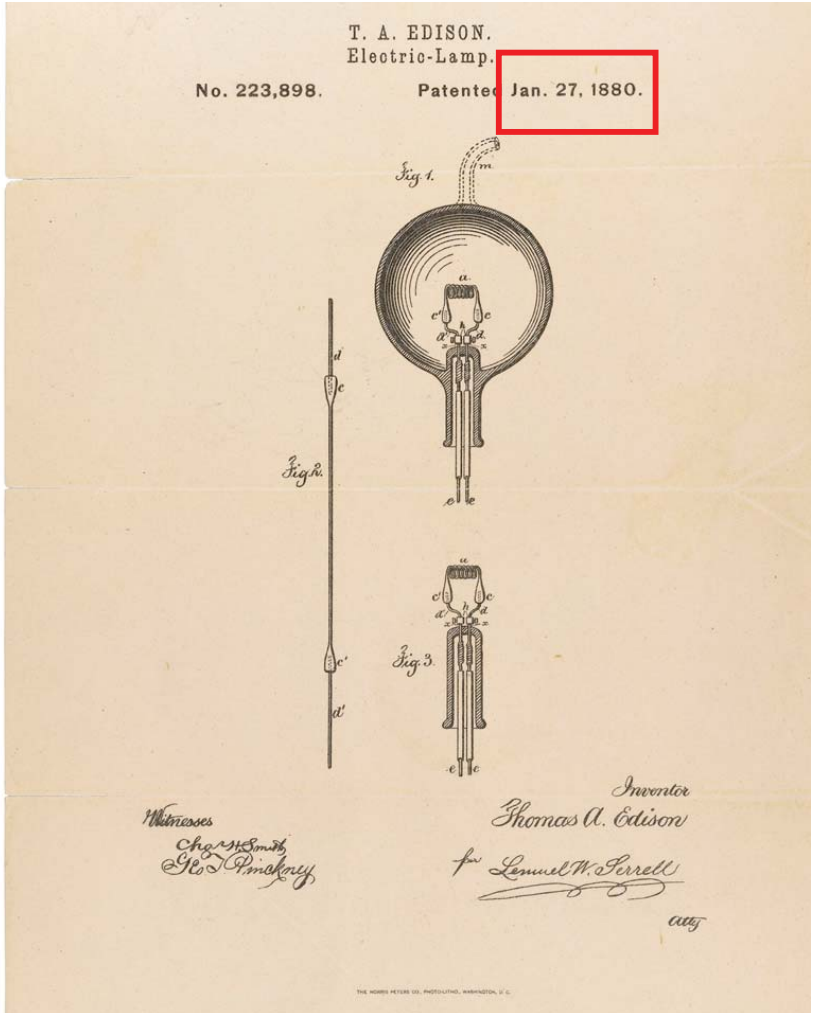

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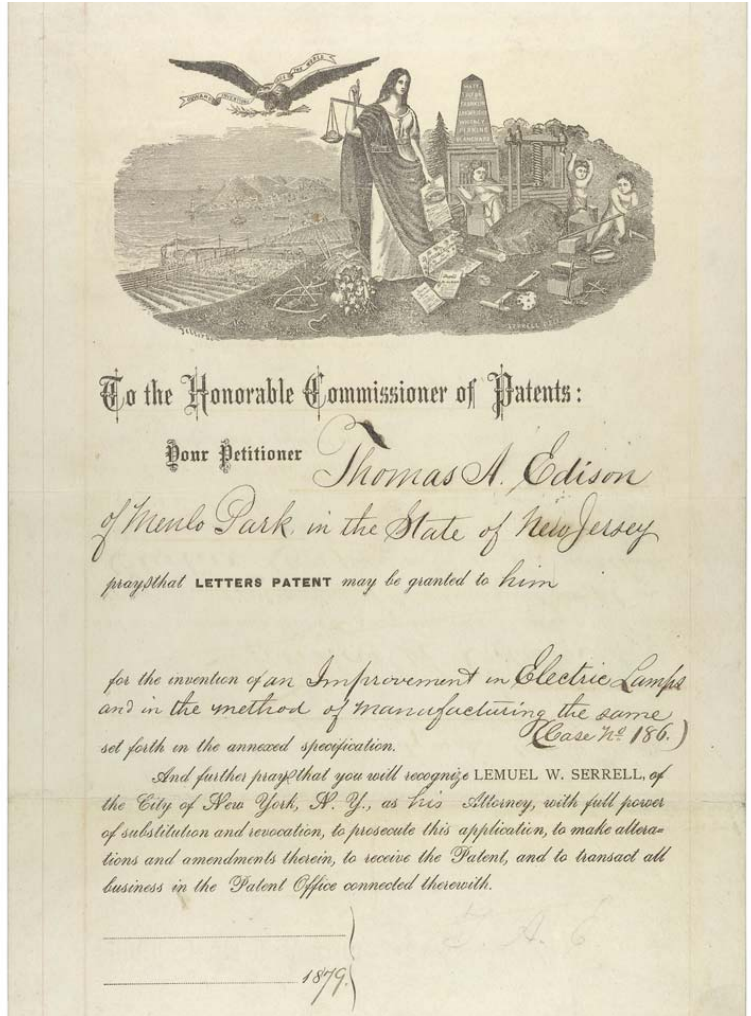

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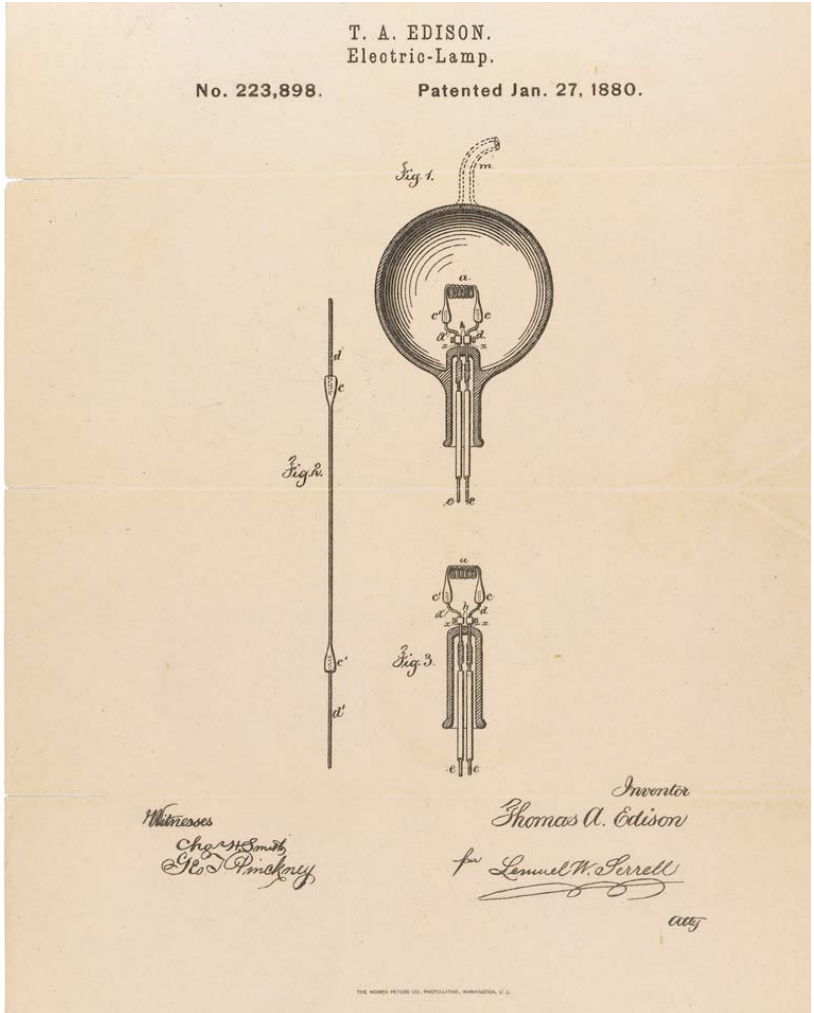

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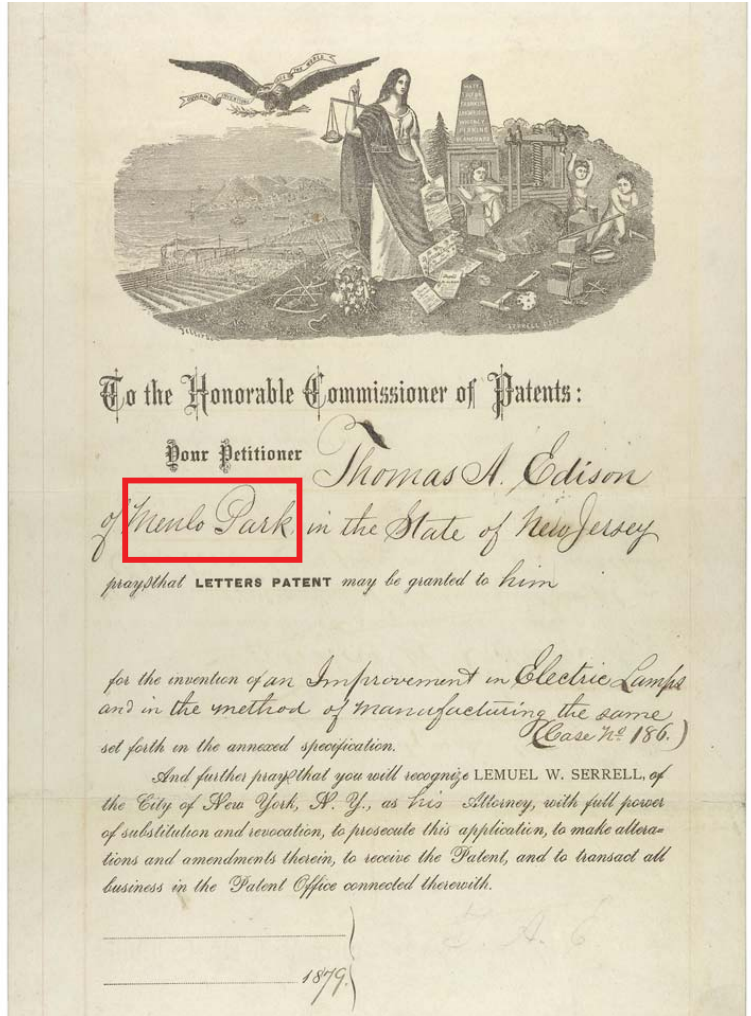

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This Paper: Inventor Data Disambiguation

Apply new machine learning algorithm starting from Li et al. (2014):

1. Build training dataset using selection of Li et al. matches
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Result: 4.9 mil. inventors, 6.4 mil. patents;
U.S.: 2.73 mil. inventors, 4.2 mil. patents.

R&D Labs Data

Compiled from National Research Council (NRC) Surveys of *Industrial Research Laboratories of the United States* (IRLUS)

The NRC sent firms questionnaires – the IRLUS volumes contain the firm-level summary data responses.

- Data were hand entered from the 1921, 1927, 1931, 1933, 1938, 1940, 1946, 1950, 1956, 1960, 1965 and 1970 editions of IRLUS

Sample NRC Survey of IRLUS: Polaroid

3004. Polaroid Corp., 730 Main St., Cambridge 39, Mass. (Cp)

Research staff: Edwin H. Land, President and Director of Research; Robert M. Palmer, Manager, College Personnel Relations; 50 chemists, 5 engineers, 1 mathematician, 9 physicists, 90 technicians, 18 auxiliaries.

Research on: One-step, three-dimensional, and color photography; color vision; chemistry of photographic processes; polarized light; polymers; absorption of light; organic chemistry; physics and crystallography, especially as related to phenomena involving radiation; spectroscopy; electronics.

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Result: Dataset $\approx$ NBER patent database matched to the Business Register of the Census Bureau for pre 1975!

Tax Data Sources

Historical personal income tax rates: Jon Bakija's state tax calculator.

Historical corporate income tax rates: Starting $\approx$ 1920- 2016.

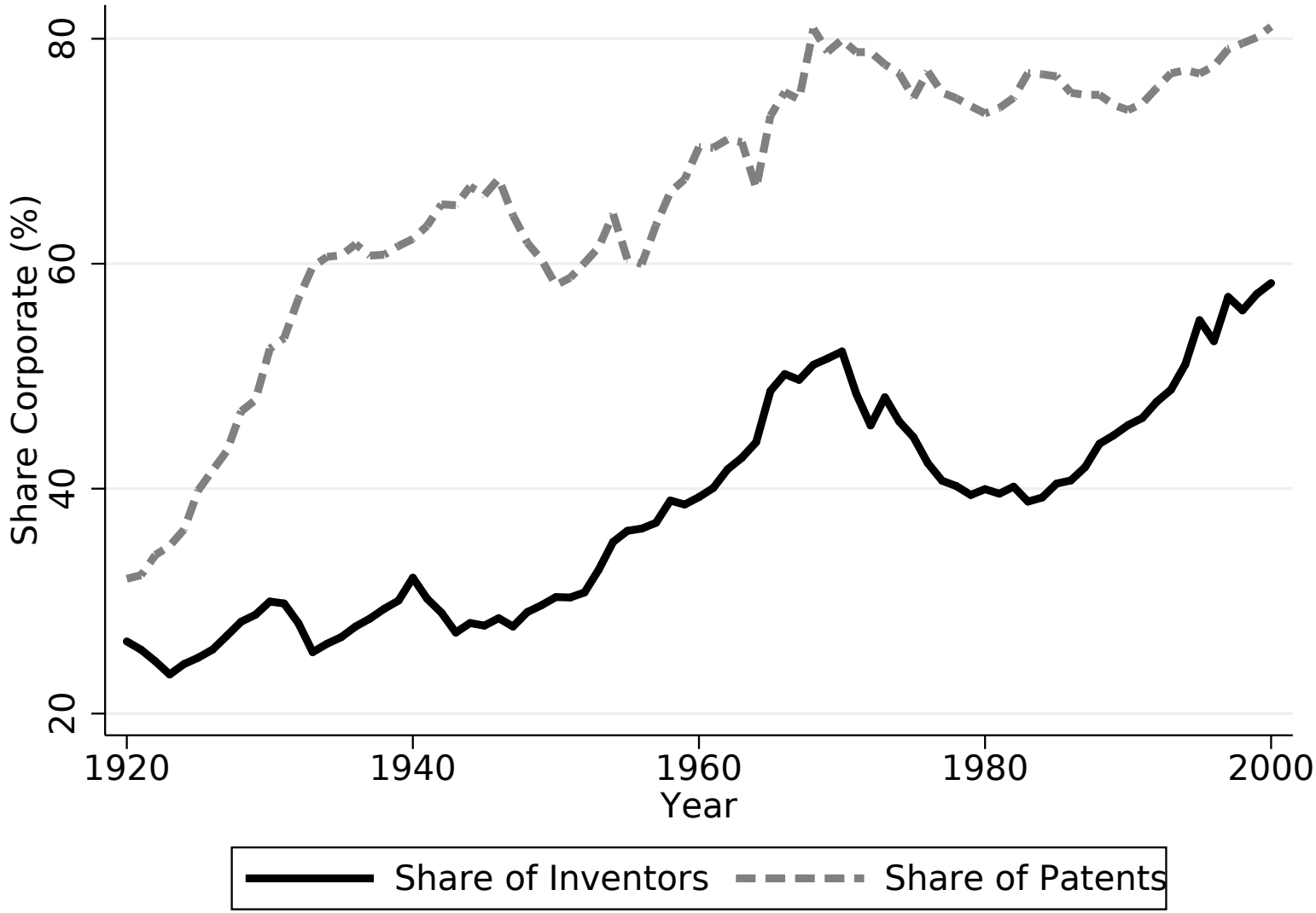
HeinOnline Session Laws, HeinOnline State Statutes, ProQuest Congressional, Commerce Clearing House (State Tax Handbooks, State Tax Review), State Tax reports, Willis Report, Council of State Governments Book of States, National Tax Association Proceedings.

We collect corporate income tax rates (brackets and rates, if applicable)

Net income franchise taxes (since extremely similar).

Surtaxes and surcharges.

Share of Corporate Patents & Inventors Working in Firms



Barebones Conceptual Framework: Taxes and Innovation

Innovation quantity/quality require inputs: effort/labor & material resources.

Inventors' & firms' response margins i) Inputs (intensive and extensive margin) ii) Occupational choice: employee or not?; iii) Tax base: incorporate, sell innovation? iv) Location; v) Research employment.

Corporate & personal taxes can affect firms & inventors: surplus sharing rule, tax base choice.

Tax elasticities depend on behavioral & technological elasticities, empirical question, $\neq$ for quality vs. quantity; Newton under the tree?

Corporate vs non-corporate inventors: different exposures to taxes, motives for innovation.

At macro level: extra cross-state spillovers and business stealing.

Dynamic effects: Lag to innovation? Forward-looking behavior.

Empirical Strategies and Identification

Innovation Outcome $= \beta_1 \times$ Income tax $+ \beta_2 \times$ Corporate tax $+$ Controls.

Macro level (state) and micro level (individual inventor and firm).

Fixed effects: 1) within-state tax changes: state + year FE + inventor FE + time-varying controls specification.

2) within-state-year tax differences: state $\times$ year FE using different personal income tax brackets within state-year.

IV strategy: at macro and micro levels: exploit only federal level tax changes in personal and corporate income taxes.

Border Counties strategy: Neighboring counties in different states.

Event Studies and Case Studies: Episodes with sharp tax changes.

Main Results

Personal income and corporate income taxes– negatively influence:

1. Quantity of innovation,
2. Quality of innovation,
3. Location of innovation.

   Micro inventor elasticities to personal taxes 0.6-0.9; location elasticities: 0.11 for inventors from state, 1.23 for non-state inventors.

At the macro level, cross-state spillovers and business-stealing are important, but not the full story.

Corporate inventors more elastic to personal, but especially to corporate taxes (to net returns in general?).

Agglomeration appears to matter: inventors are less sensitive to taxation where there is already more innovation in their own field.

Related Literature

Compiling large-scale new data: Piketty and Zucman (2014); Saez and Zucman (2015); Smith, Yagan, Zidar and Zwick (2016).

Empirical Effects of Taxes: Saez, Slemrod, Giertz (2012); Chetty et al. (2011); Kleven and Waseem (2013); Saez (2010); Piketty et al. (2014); Zidar (2017); Kleven et al. (2018).

Entrepreneurship and Taxes: Cullen and Gordon (2006, 2007).

Corporate taxation effects: Yagan (2015); Gordon and Slemrod (2000); Slemrod (2007); Mahon and Zwick (2017); Auerbach, Hines and Slemrod (2007).

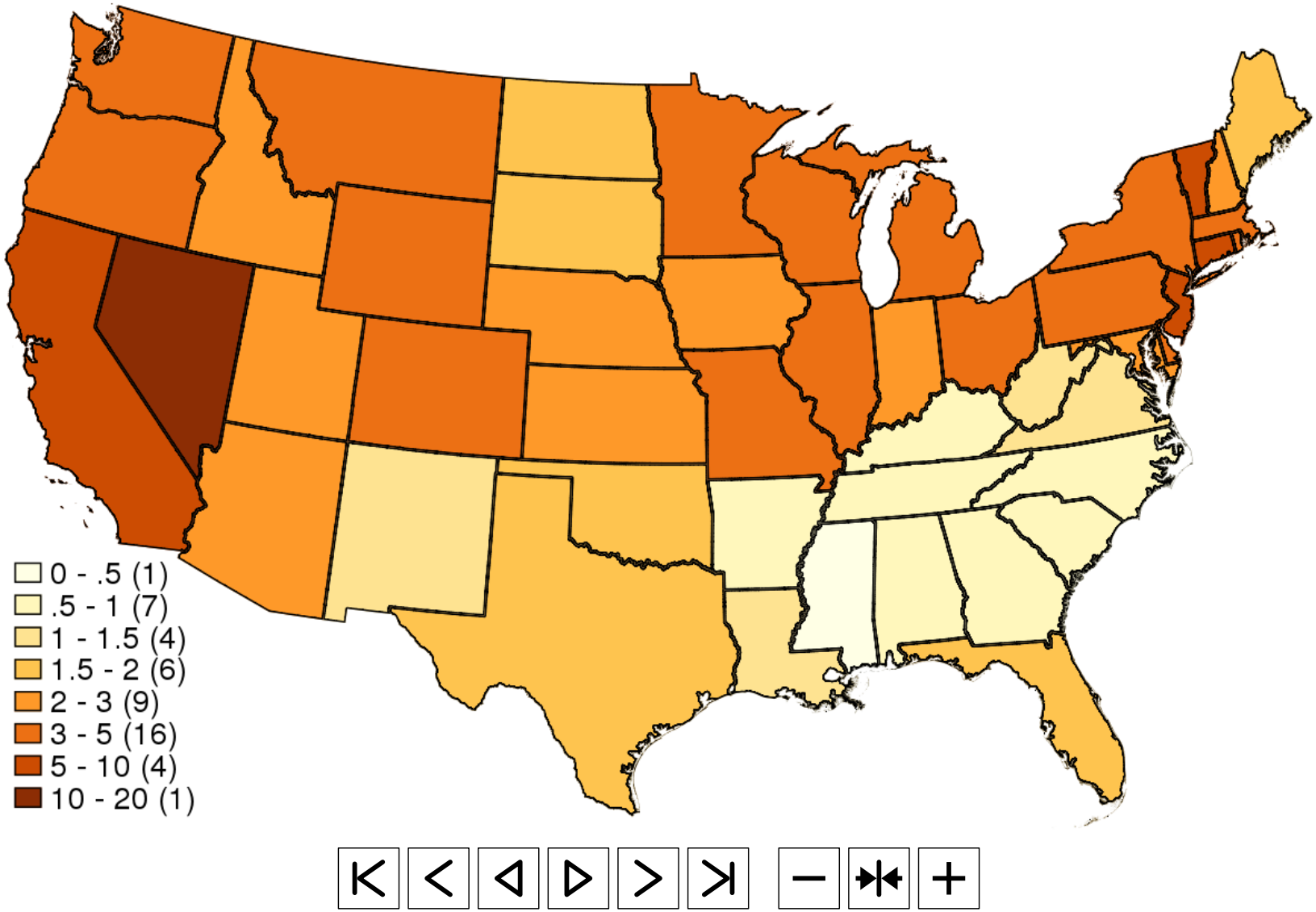
State-level taxes and location: Suárez Serrato and Zidar (2016); Fajgelbaum, Morales, Suárez Serrato and Zidar (2016).

Taxes and Mobility: Kleven at al. (2014); Kleven et al. (2013); Akcigit et al. (2016); Bakija and Slemrod (2004); Moretti and Wilson (2014, 2017).

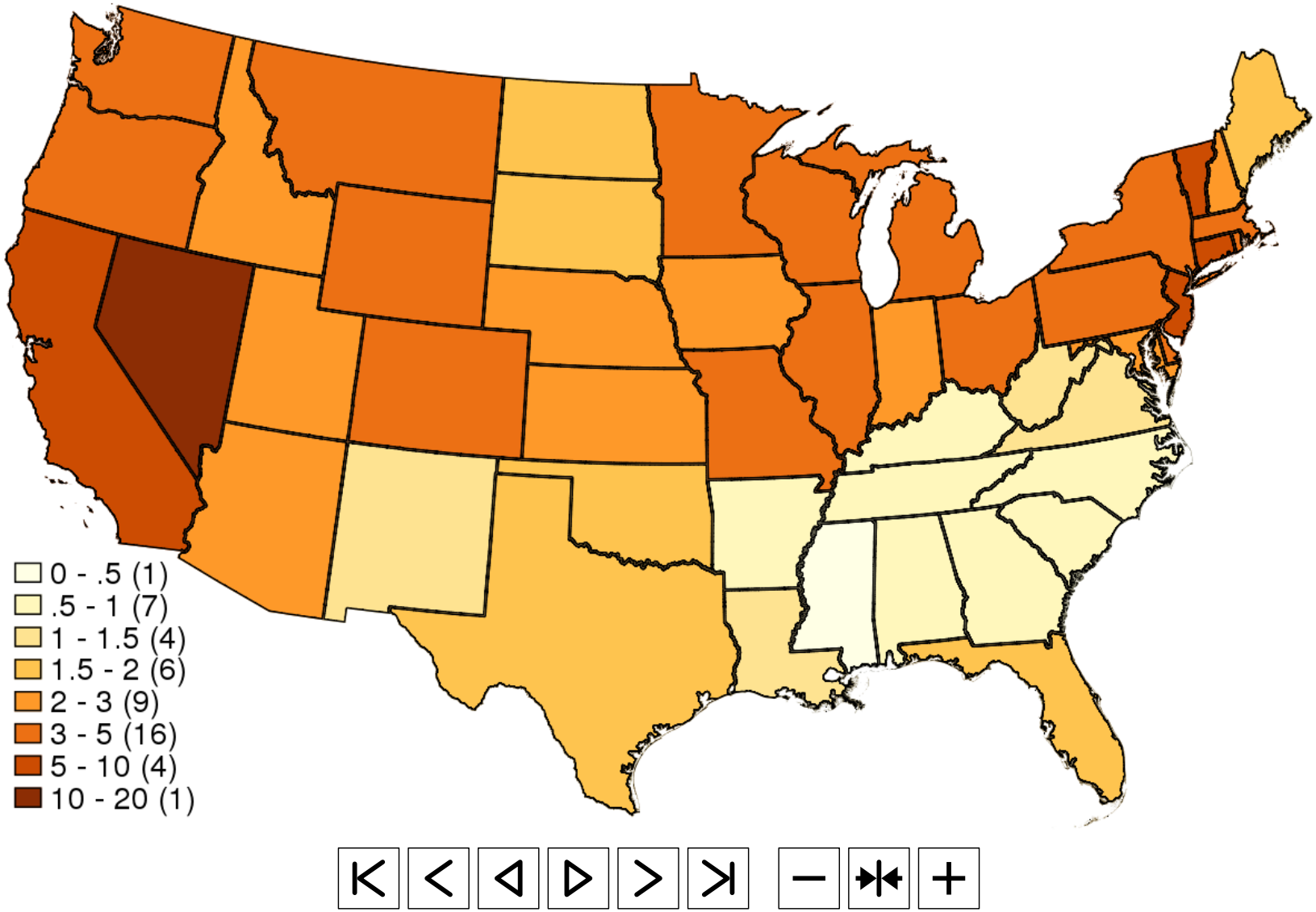
Growth and innovation: Romer (1990); Aghion and Howitt (1992); Akcigit (2017); Bloom et al. (2002, 2013); Goolsbee (1998, 2003); Jones (2009, 2010); Jones and Weinberg (2011); Jones et al. (2008).

Outline

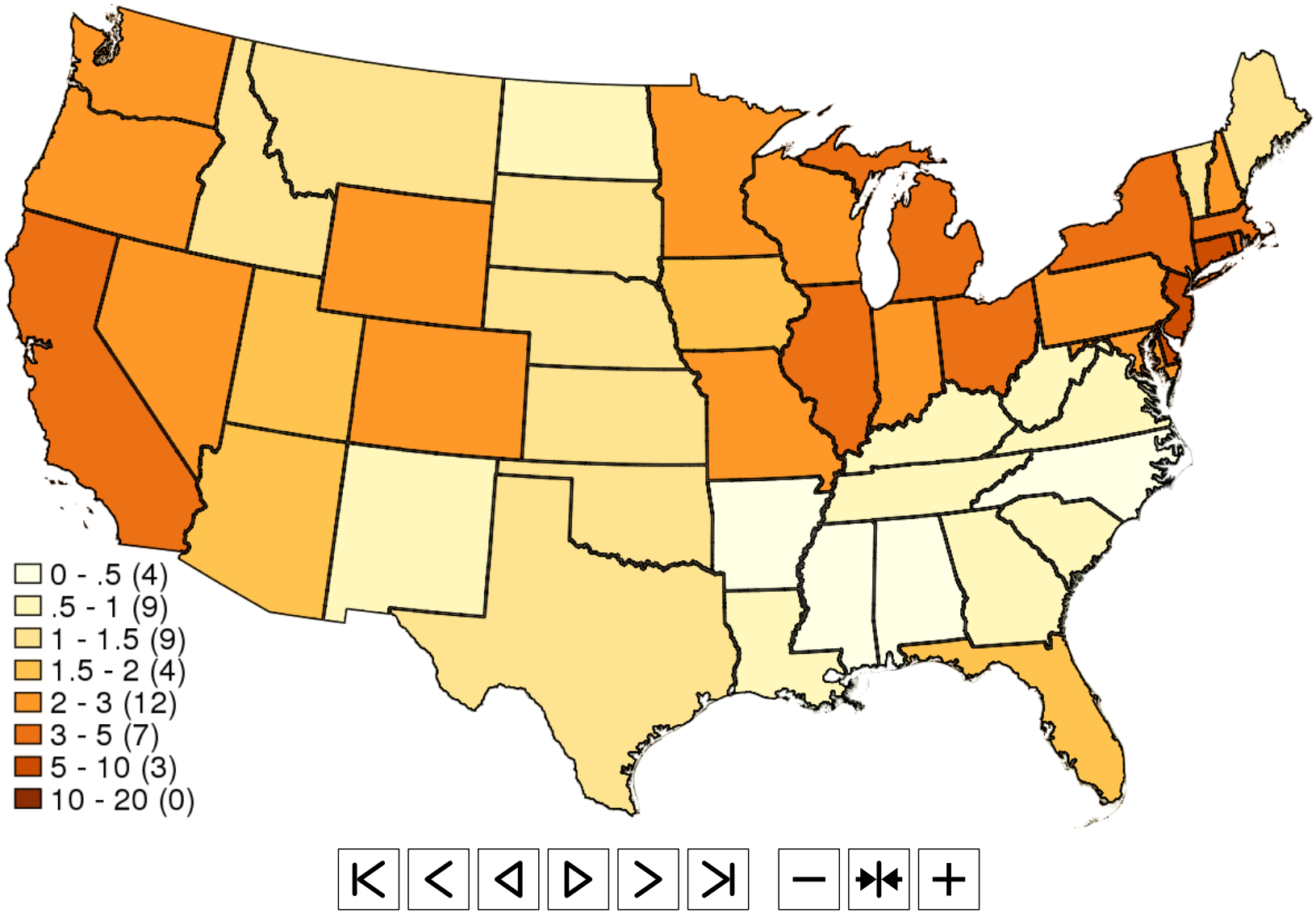
Geography of innovation. Inventors per 10,000: 1920



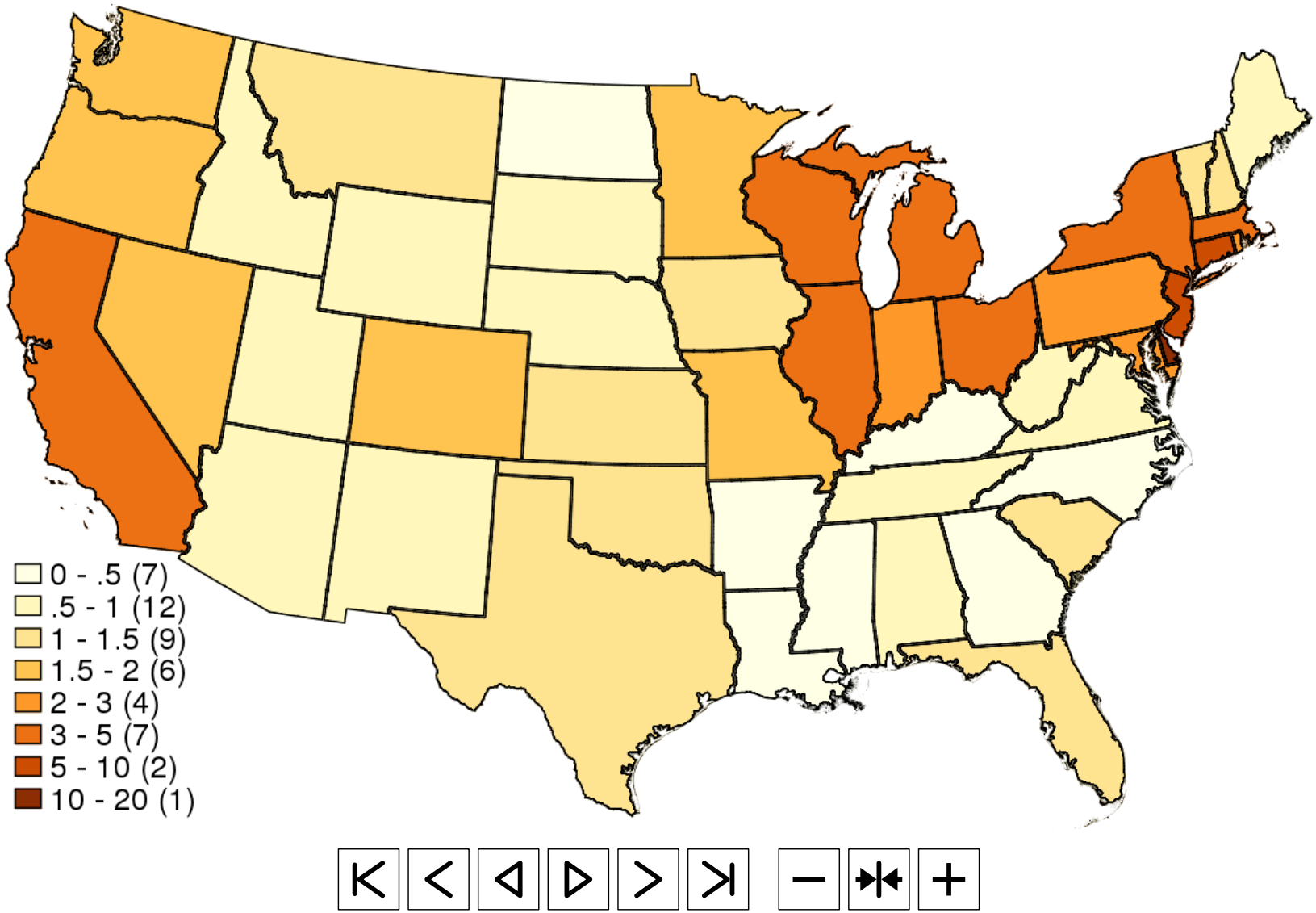
Geography of innovation. Inventors per 10,000: 1920-1930



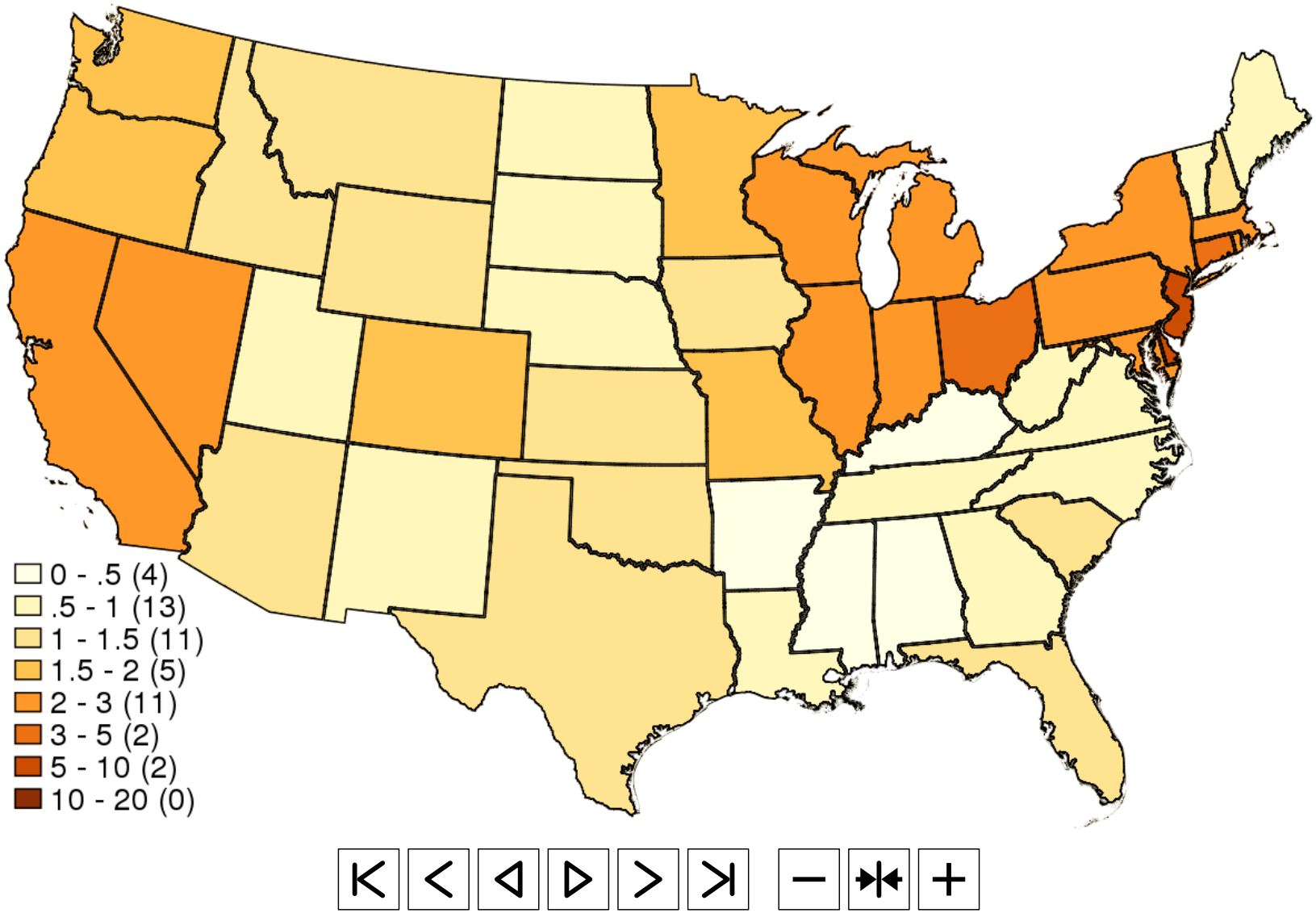
Geography of innovation. Inventors per 10,000: 1930-1940



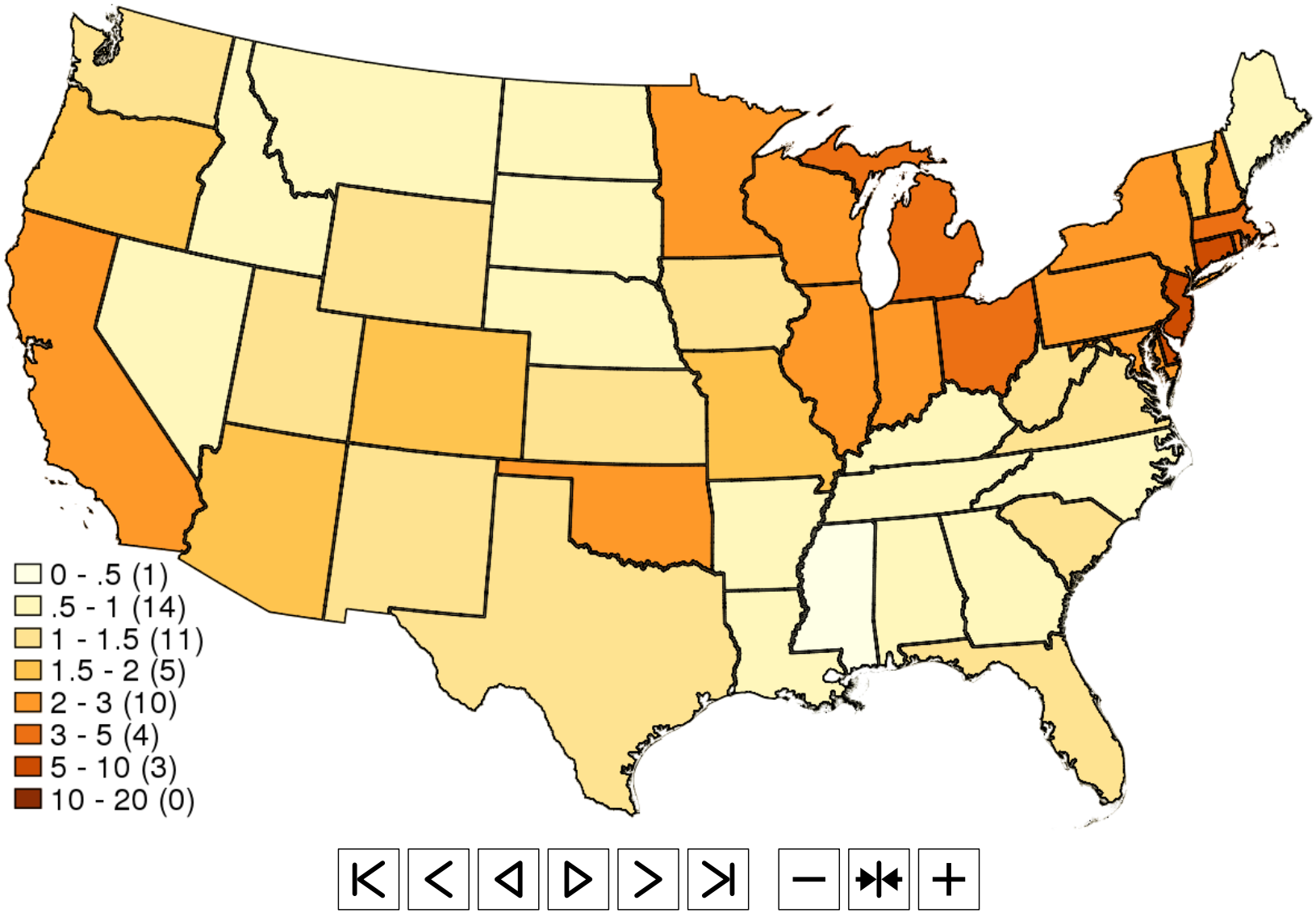
Geography of innovation. Inventors per 10,000: 1940-1950



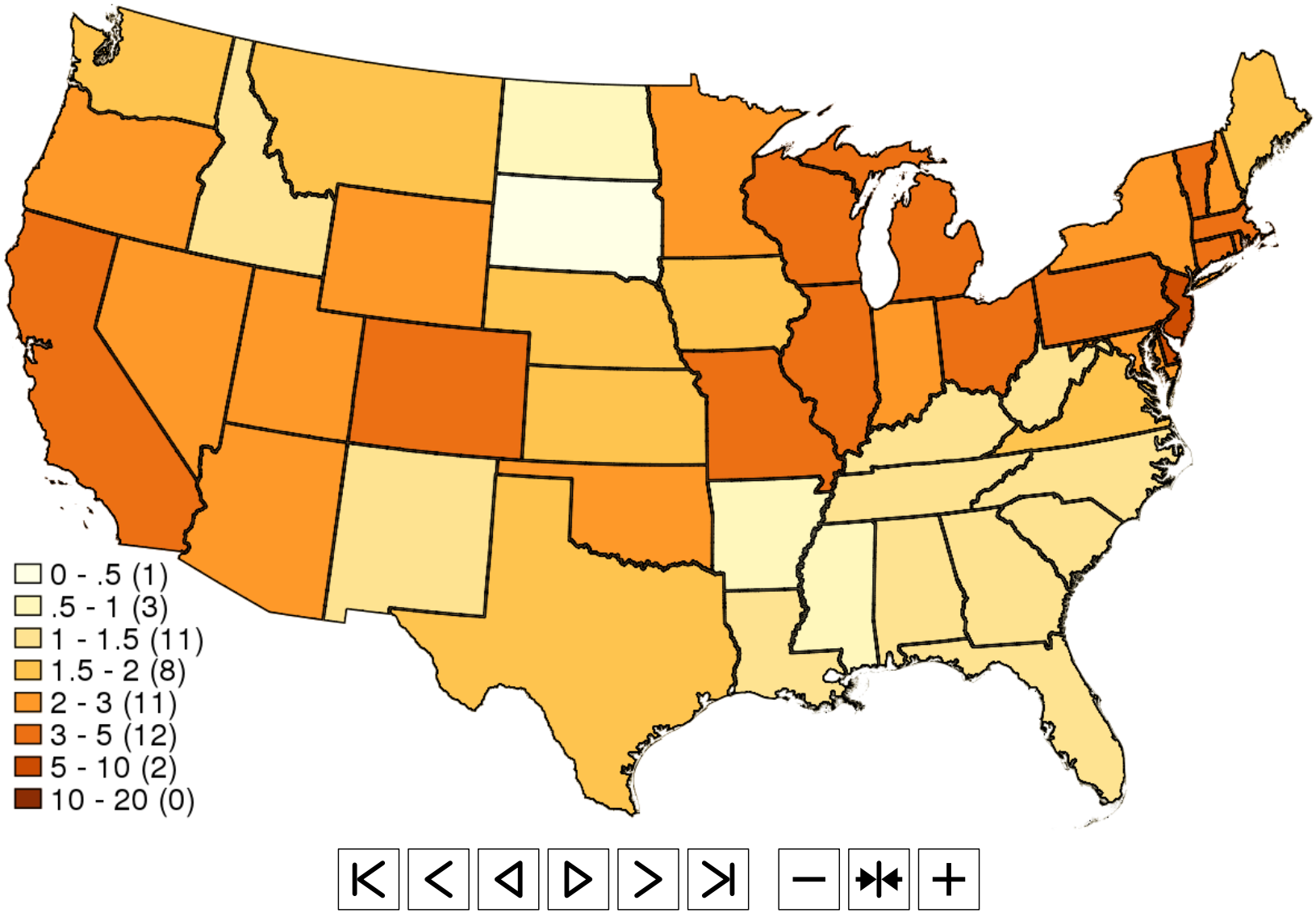
Geography of innovation. Inventors per 10,000: 1950-1960



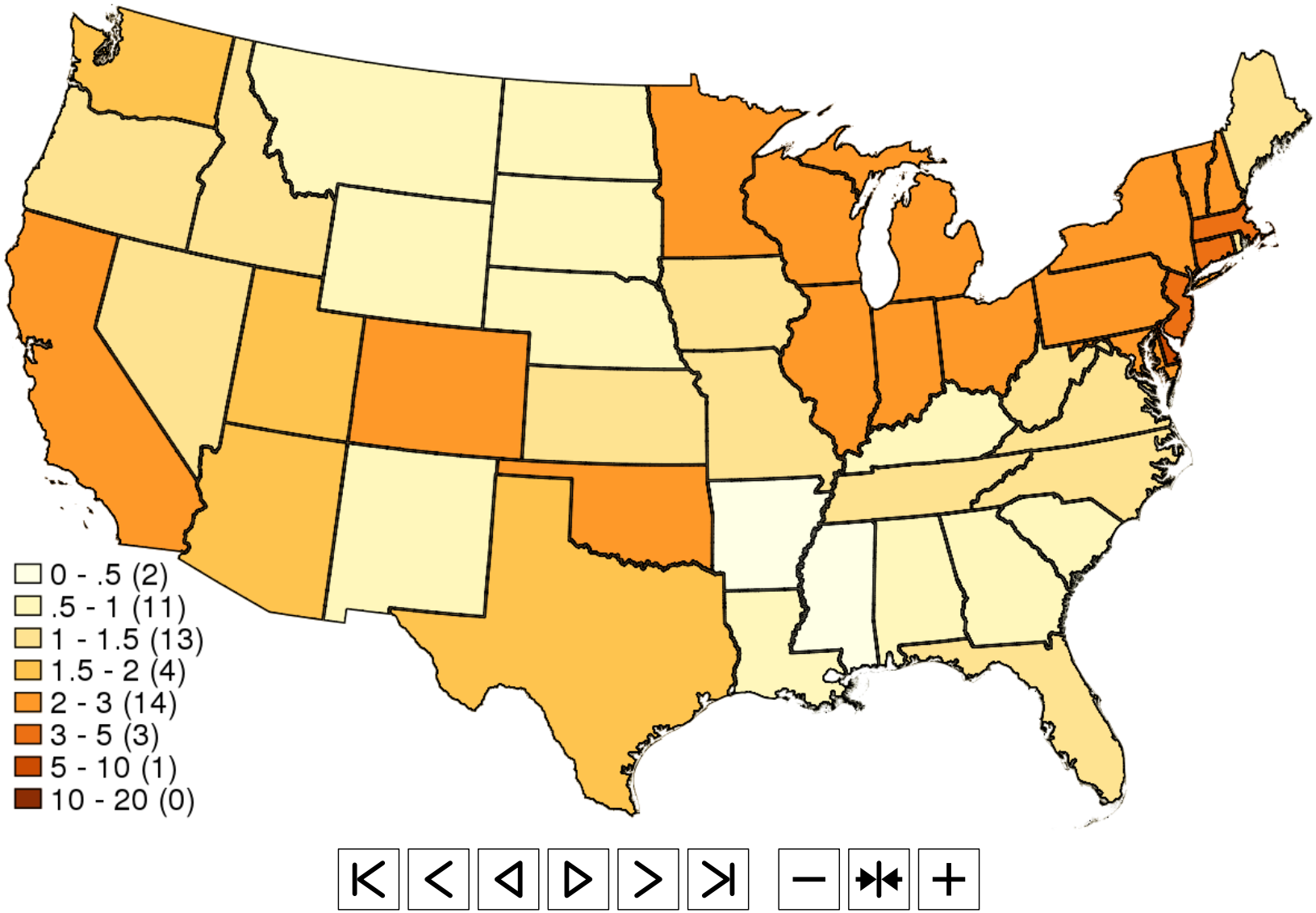
Geography of innovation. Inventors per 10,000: 1960-1970



Geography of innovation. Inventors per 10,000: 1970-1980

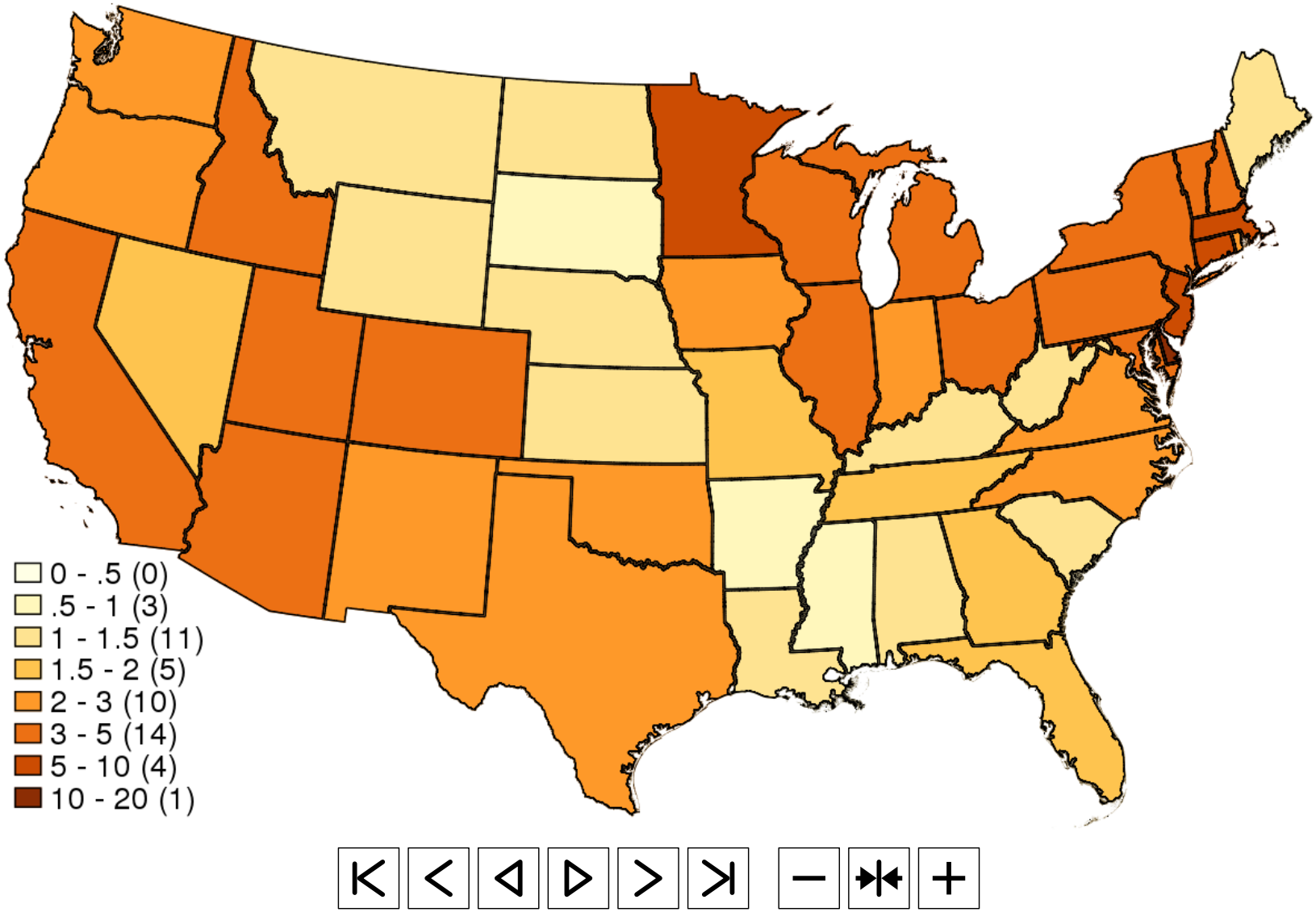


Geography of innovation. Inventors per 10,000: 1980-1990

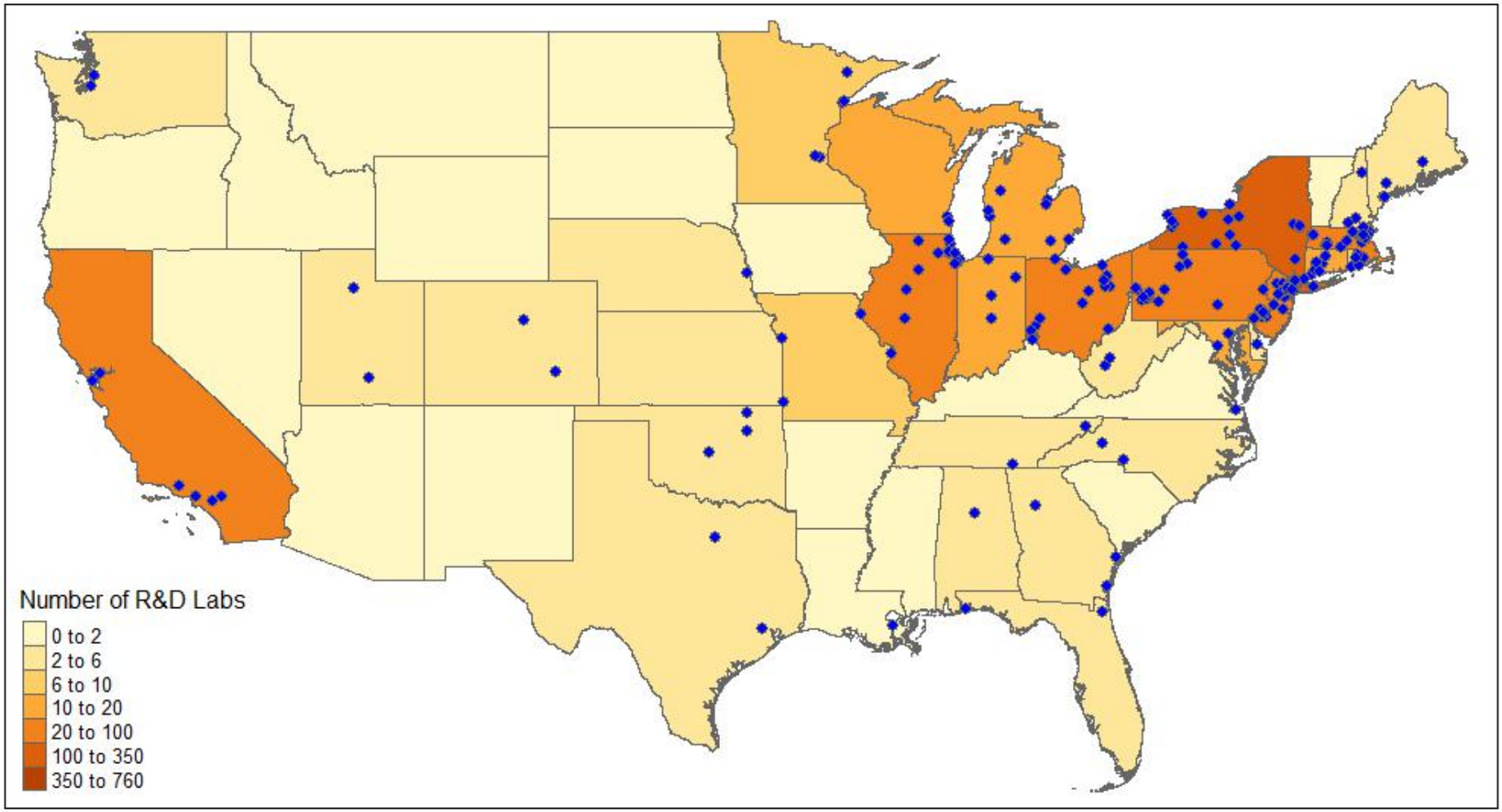


Geography of innovation. Inventors per 10,000: 1990-2000

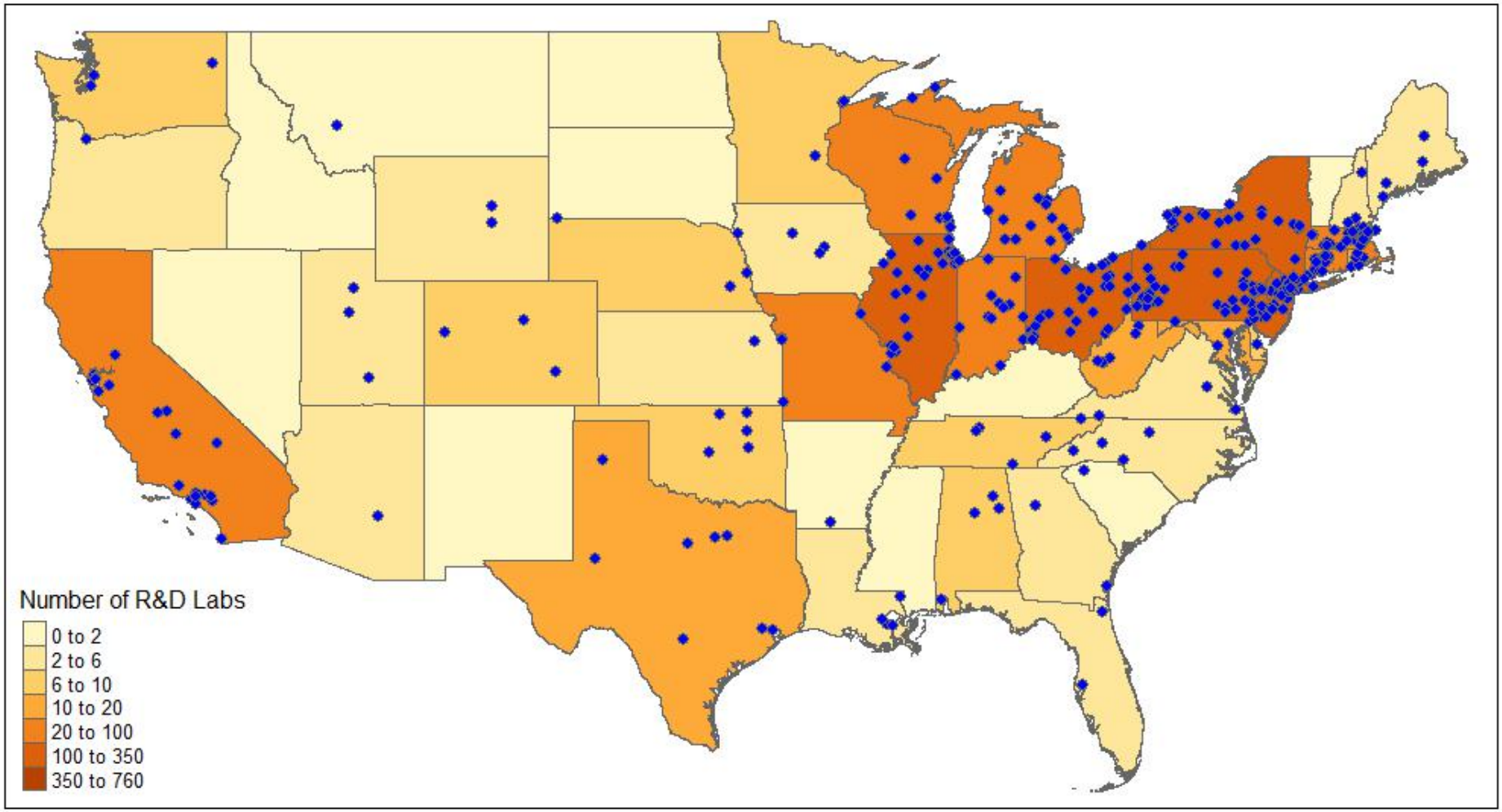
▸ Pat.



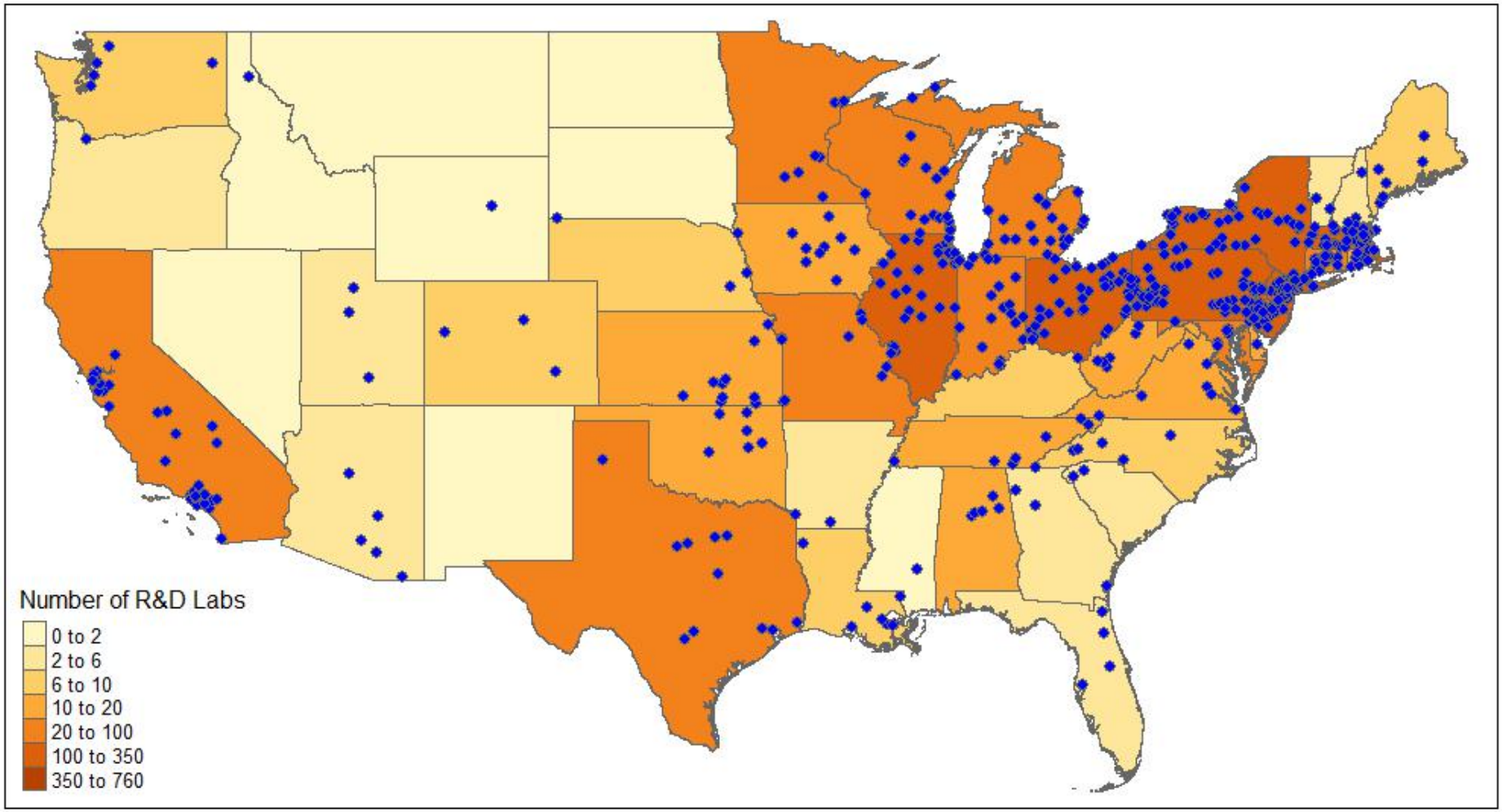
Location of R&D Labs - 1921



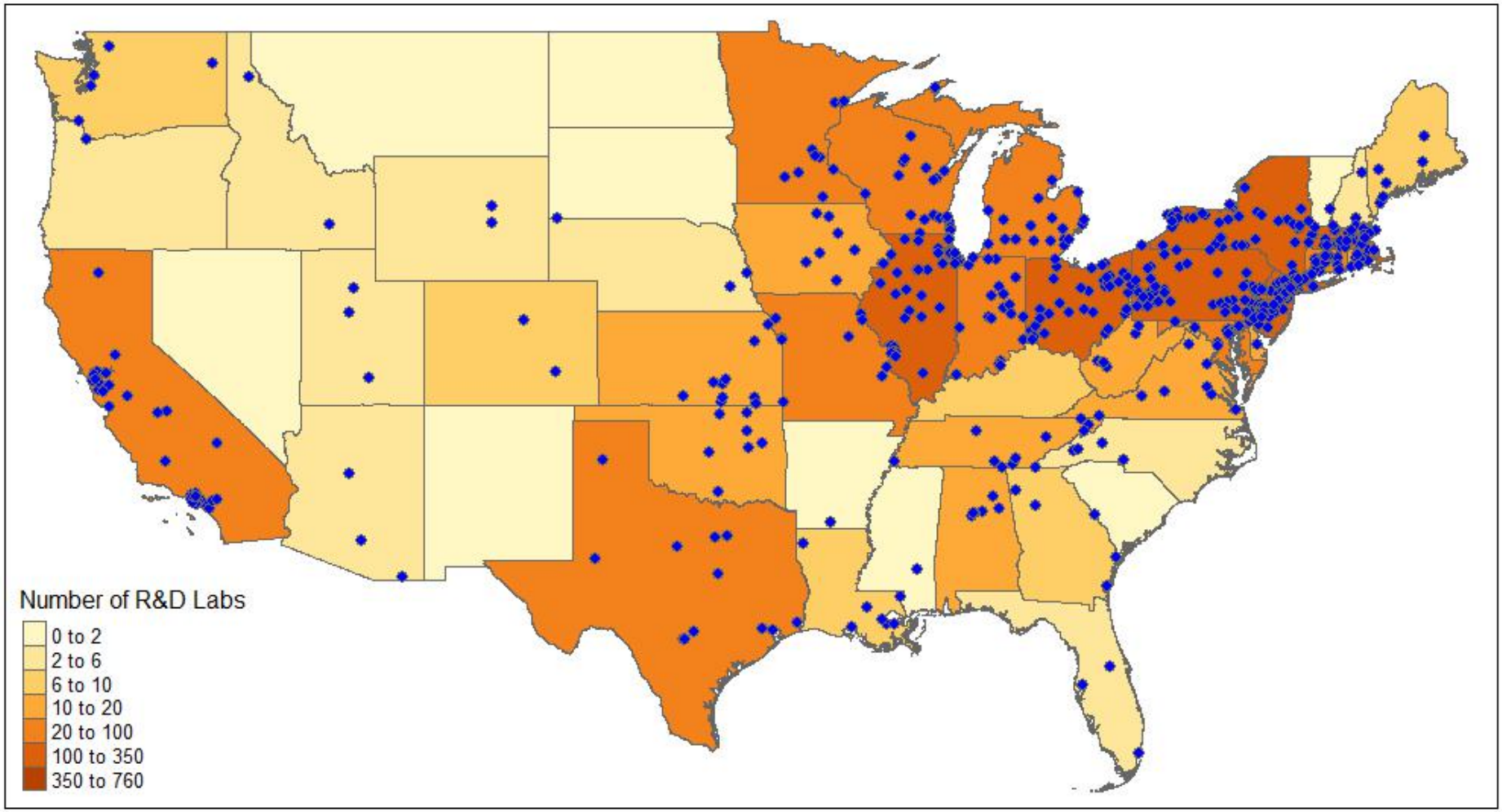
Location of R&D Labs - 1927



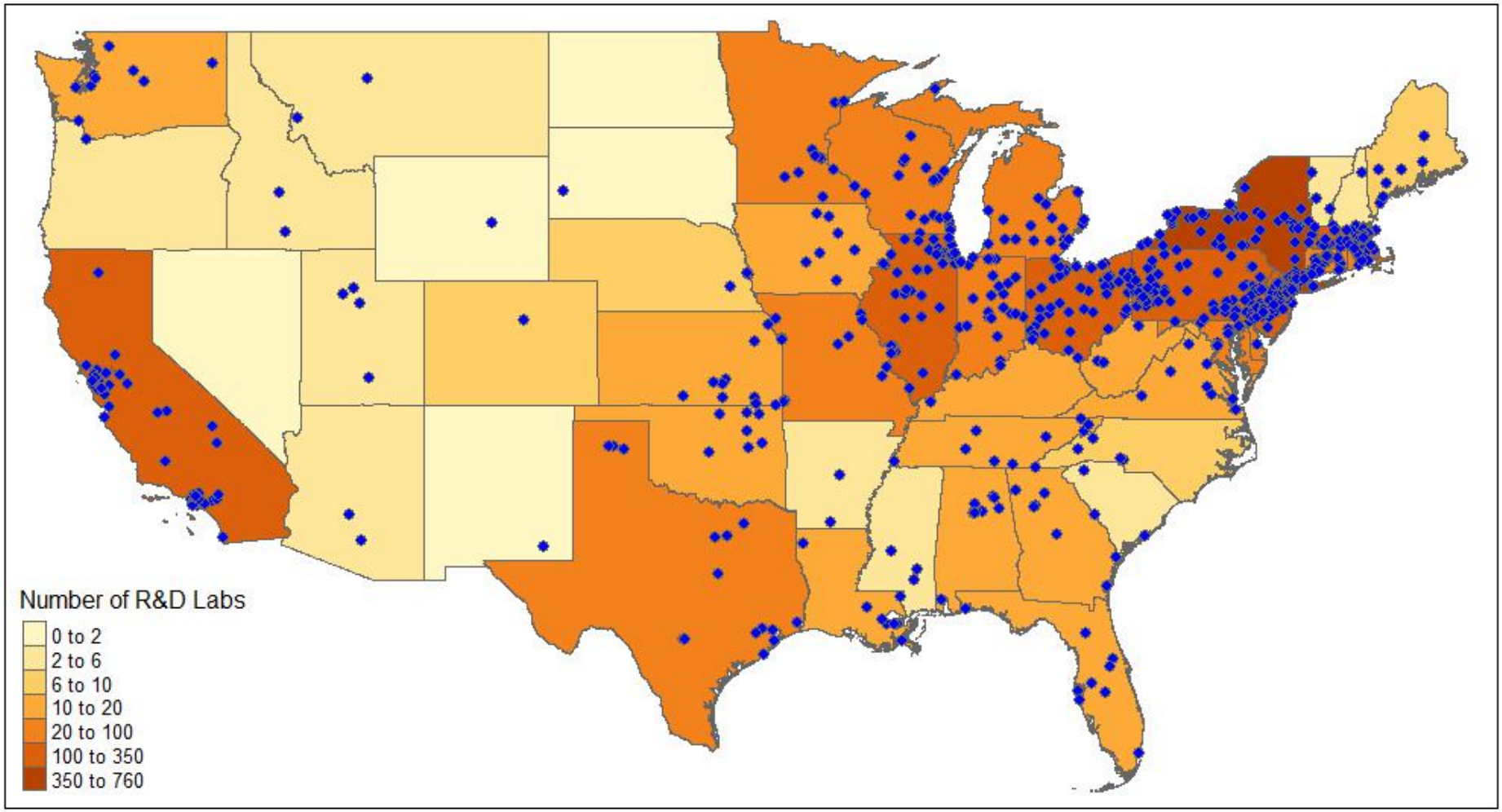
Location of R&D Labs - 1931



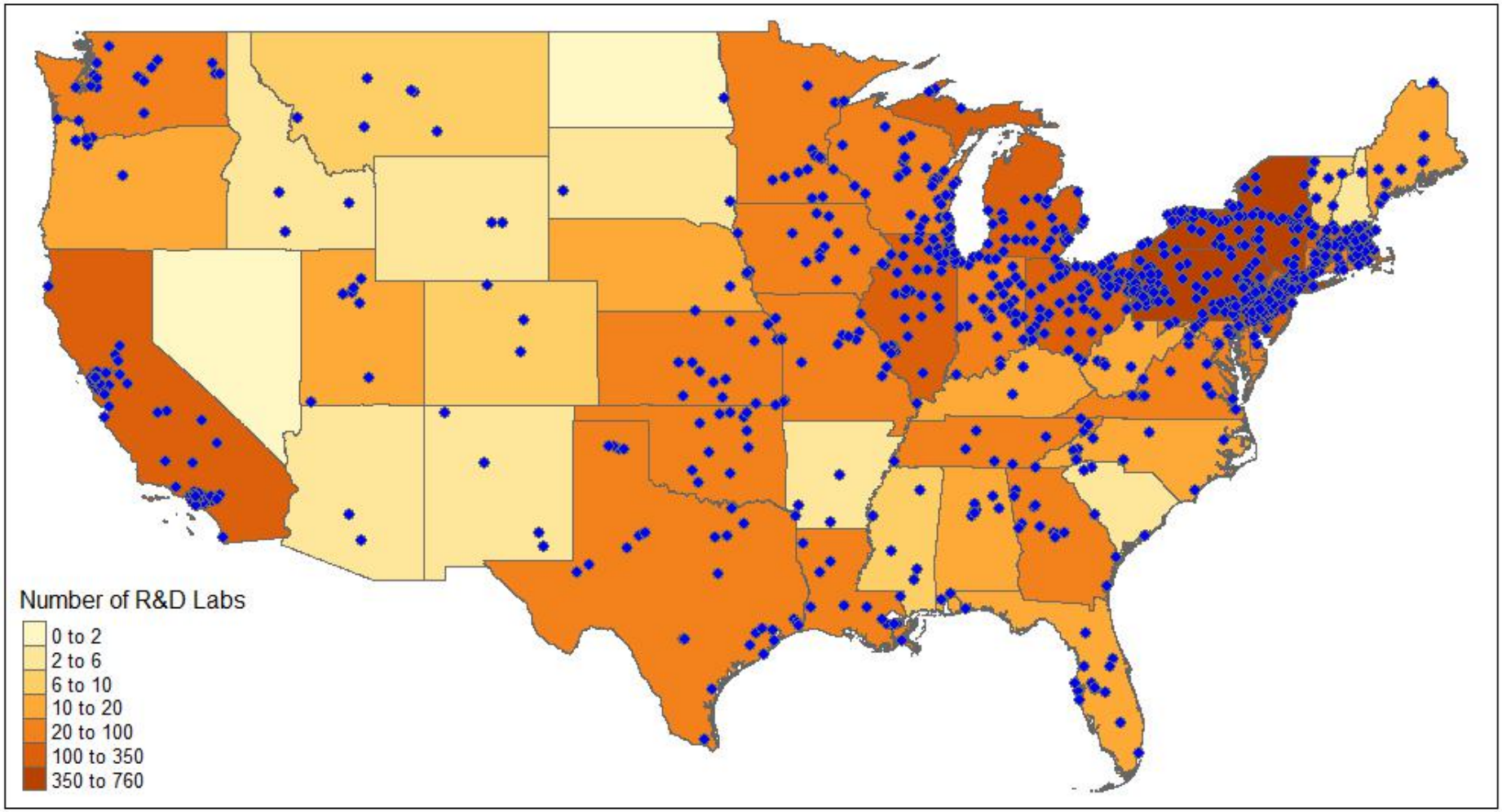
Location of R&D Labs - 1933



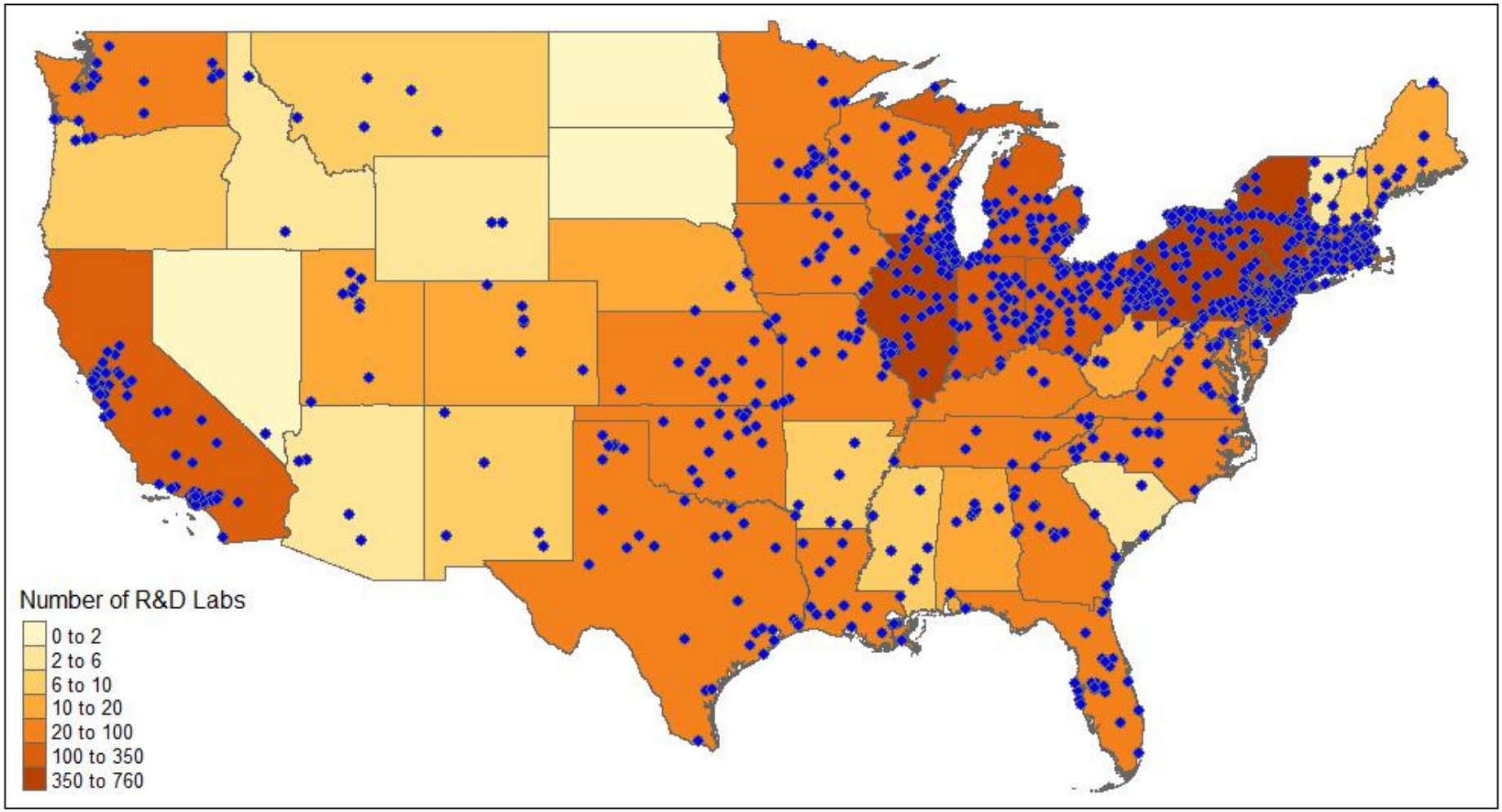
Location of R&D Labs - 1938



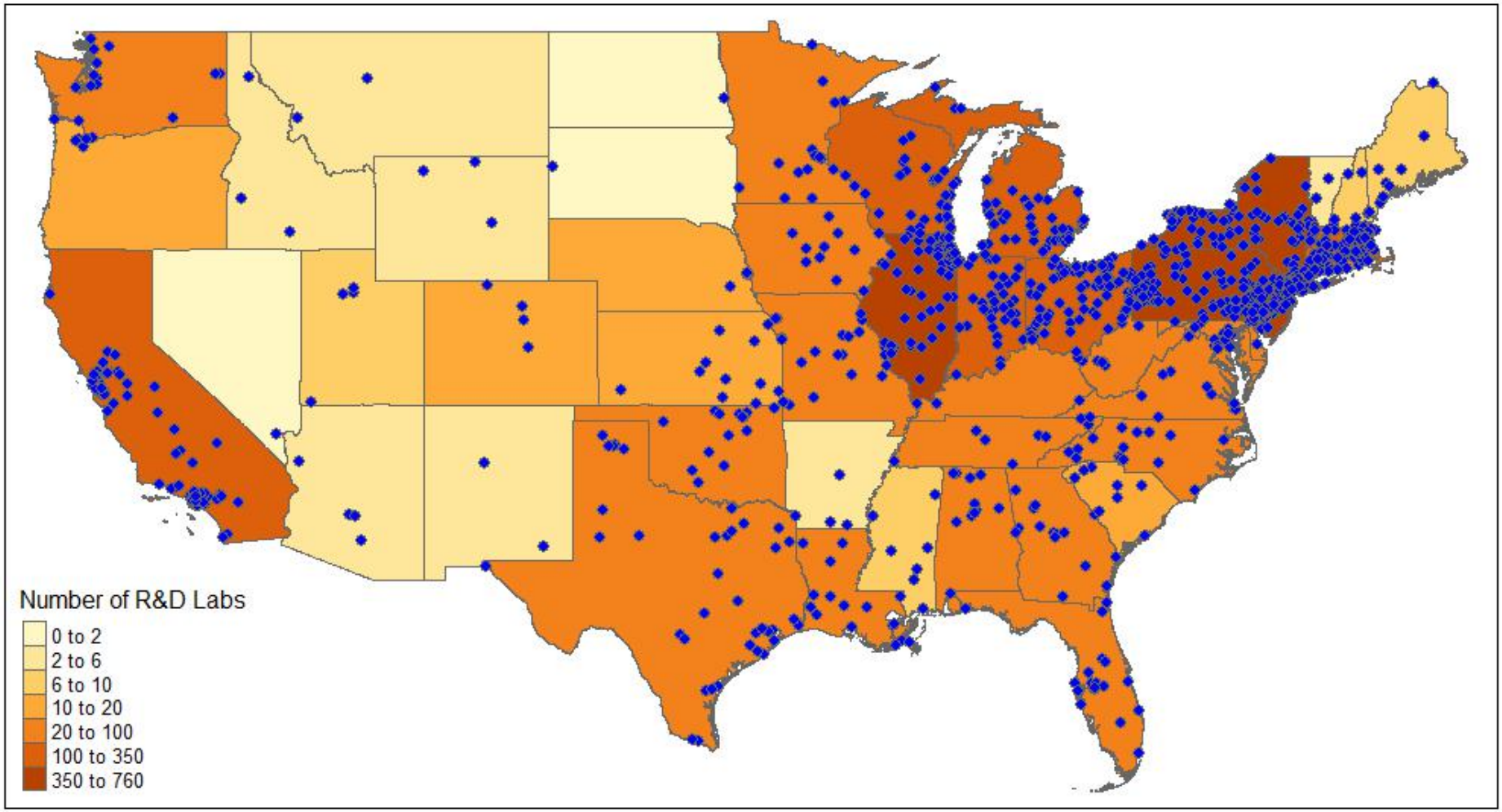
Location of R&D Labs - 1940



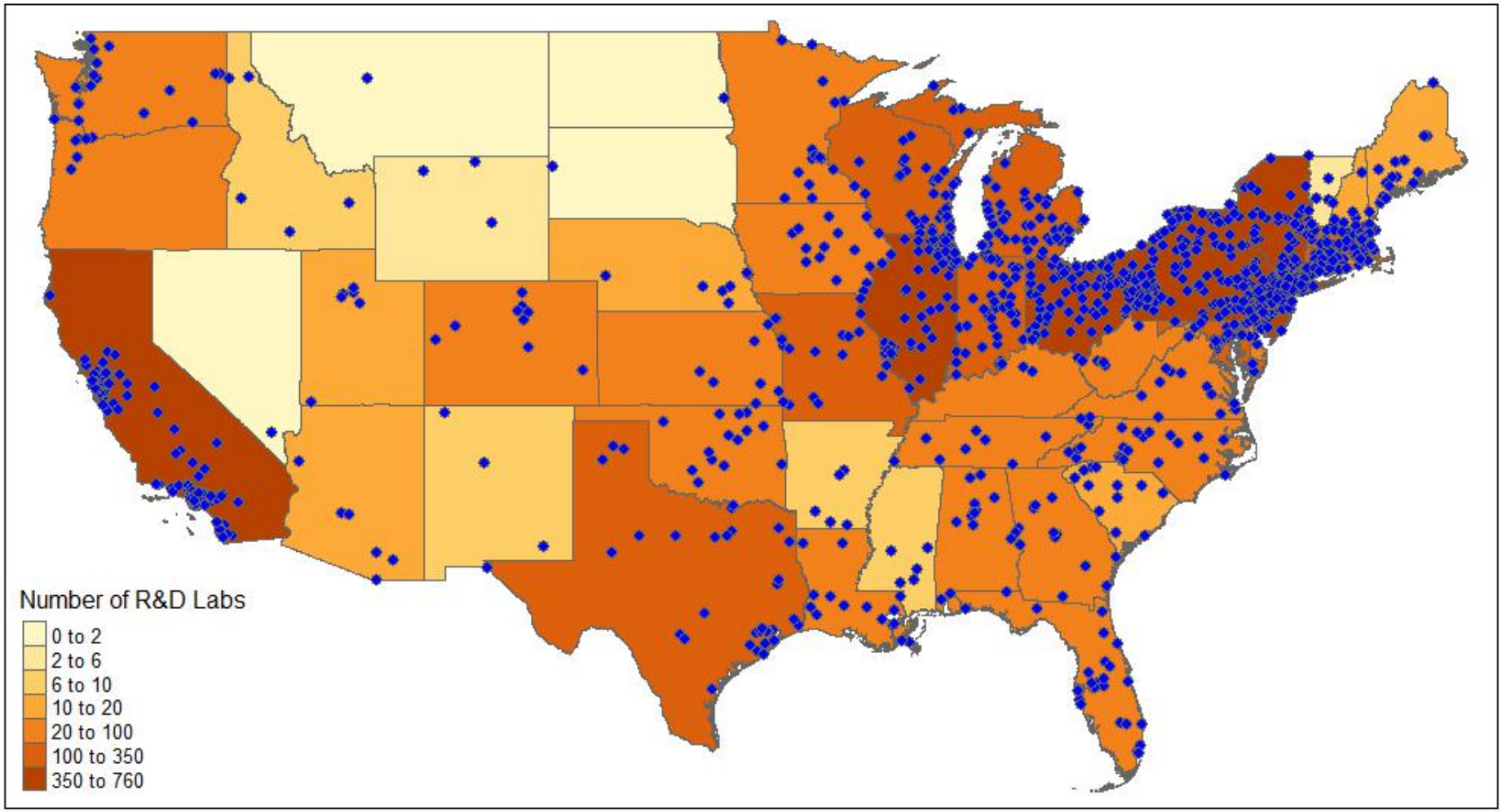
Location of R&D Labs - 1946



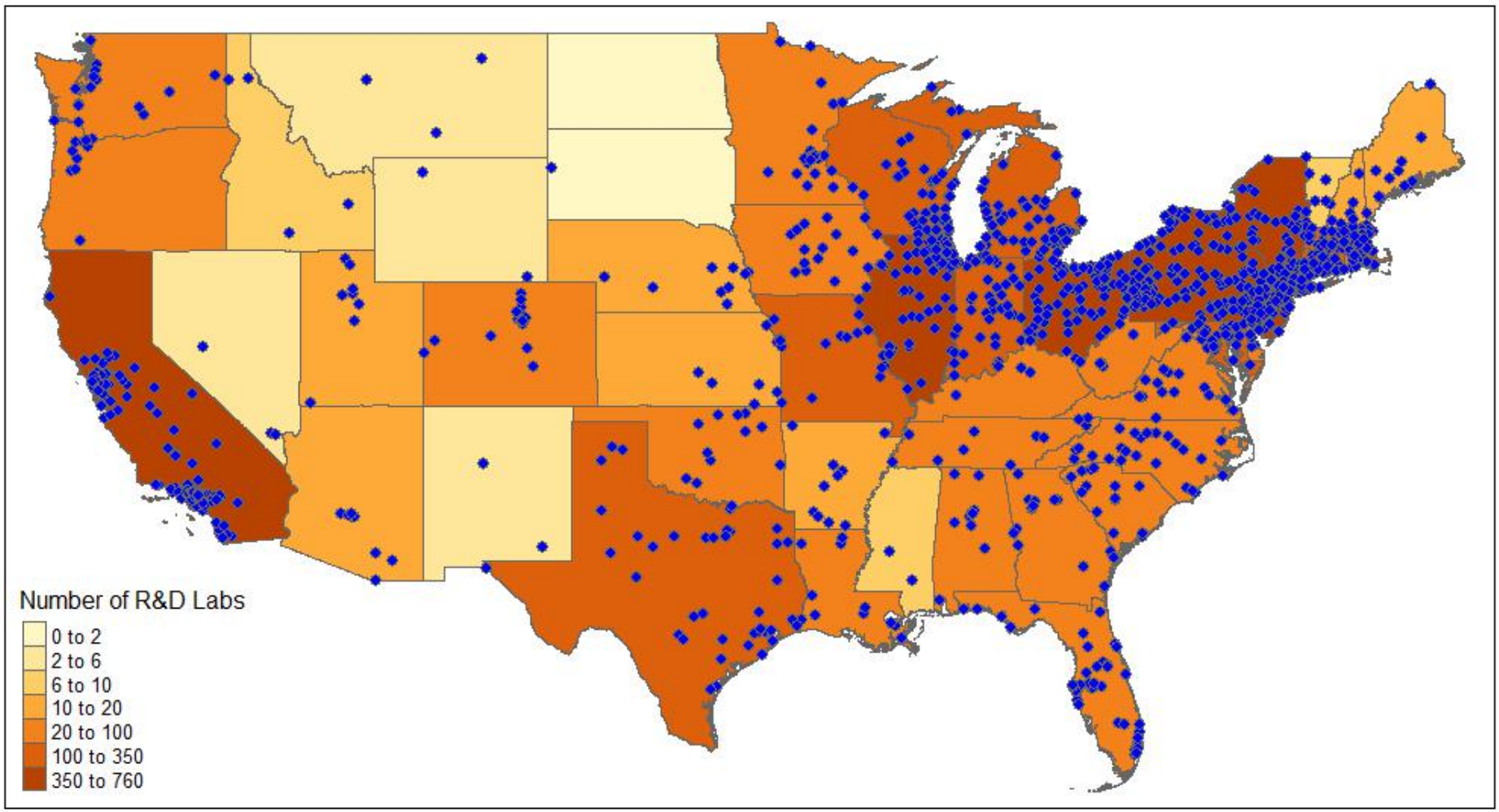
Location of R&D Labs - 1950



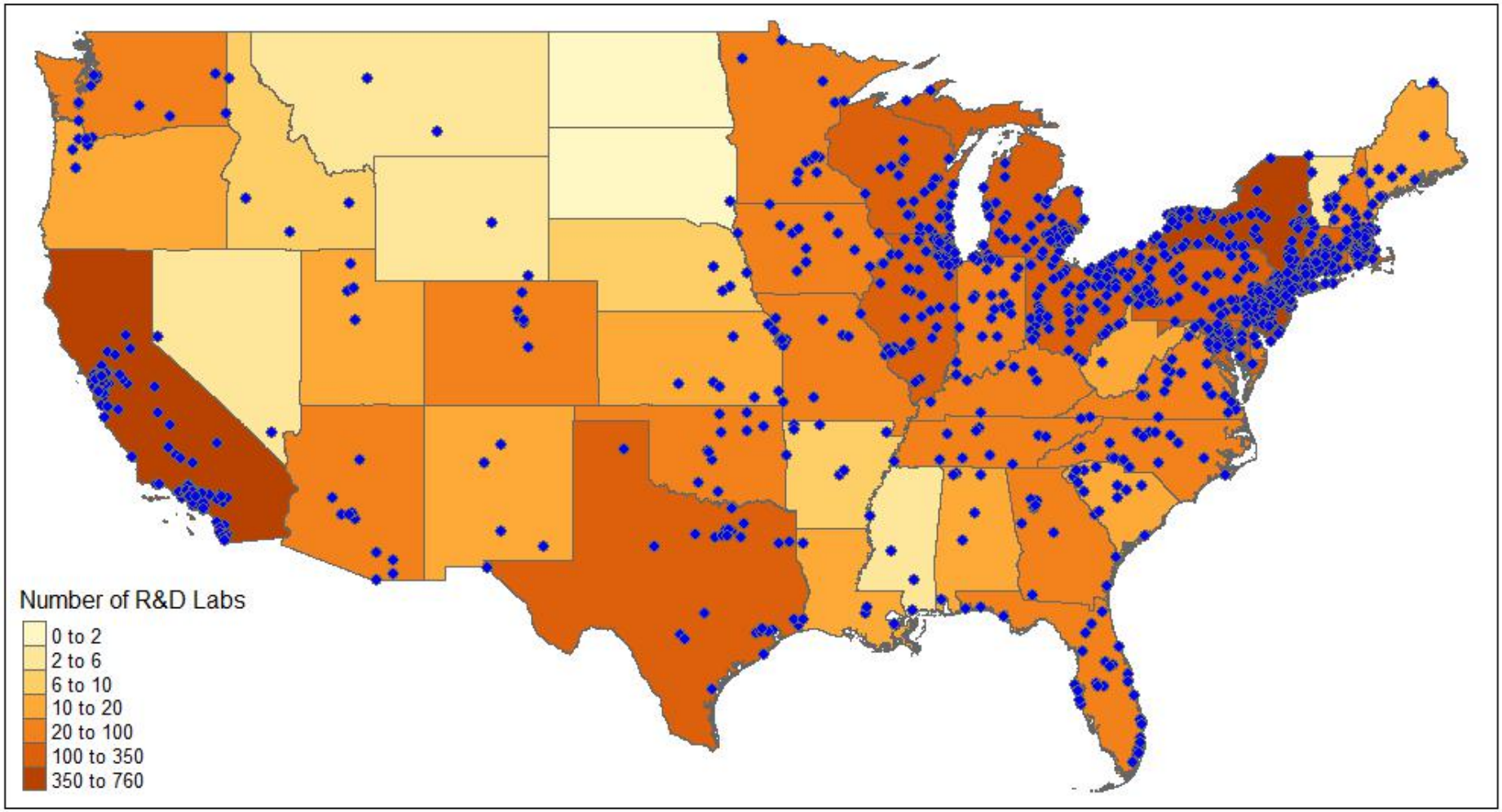
Location of R&D Labs - 1956



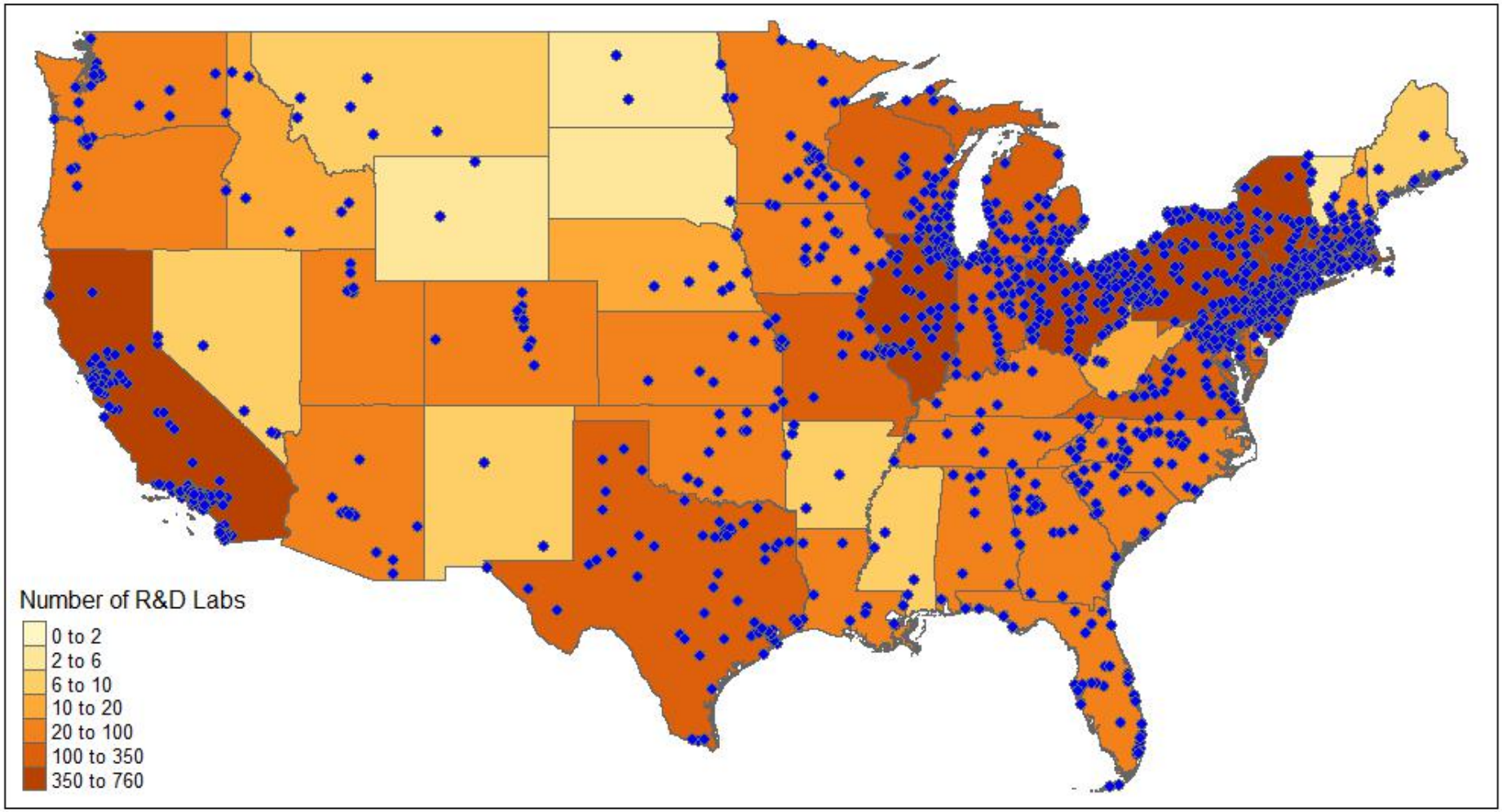
Location of R&D Labs - 1960



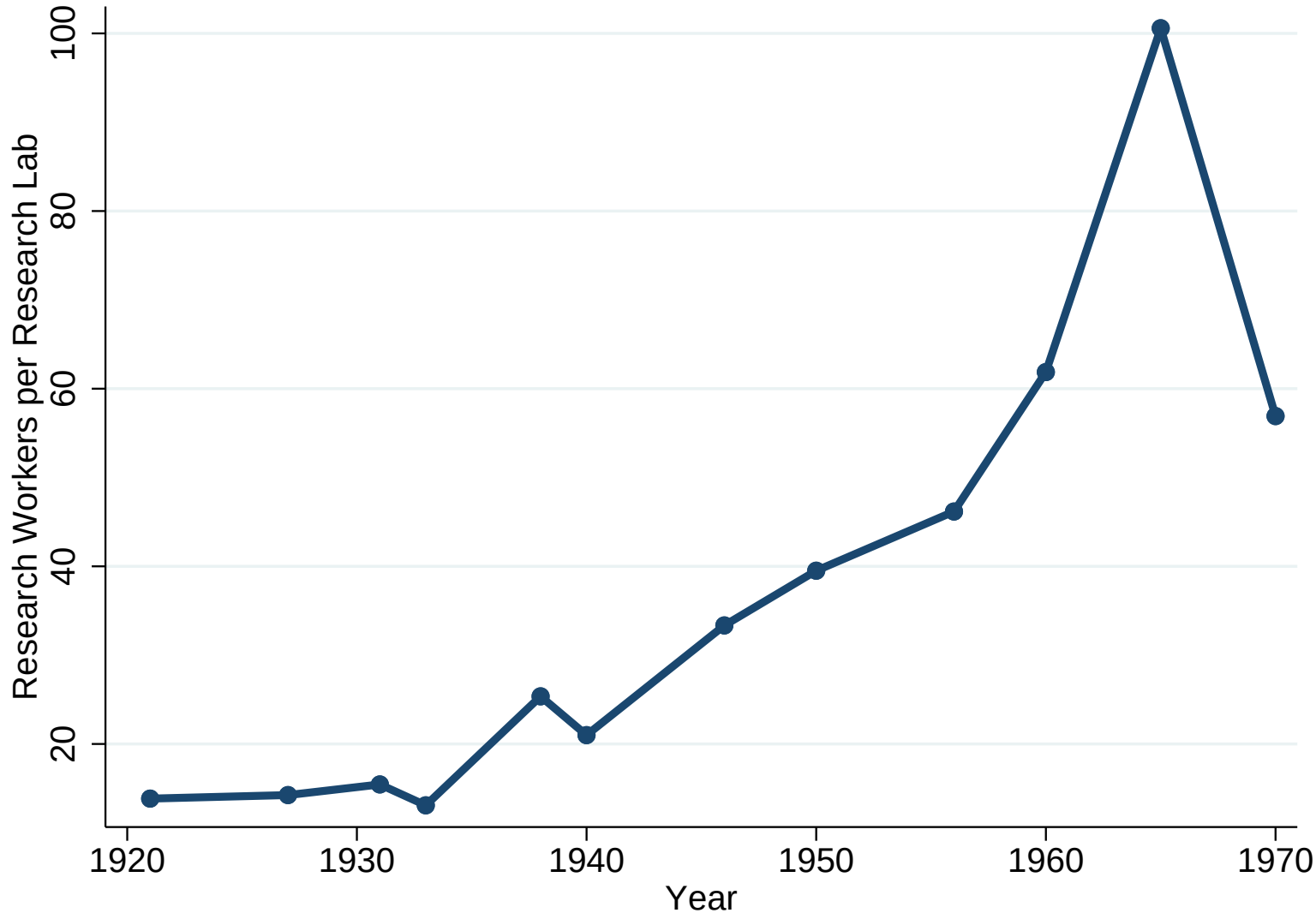
Location of R&D Labs - 1965



Location of R&D Labs - 1970



Research Workers Per Lab



▸ Lab Statistics

Outline

Personal Income Taxes

Many states have progressive tax system (but much less progressive than Federal one).

Some states have flat taxes throughout (e.g.: CT, MA, and IL)

Some have very progressive systems (e.g.: CA, NY, NJ)

Use Jon Bakija's historical tax calculator (takes into account deductions) $\approx$ historical state-level NBER TAXSIM.

Tax brackets change a lot at state-level: thus compute effect tax rates for single filers at $\neq$ income levels:

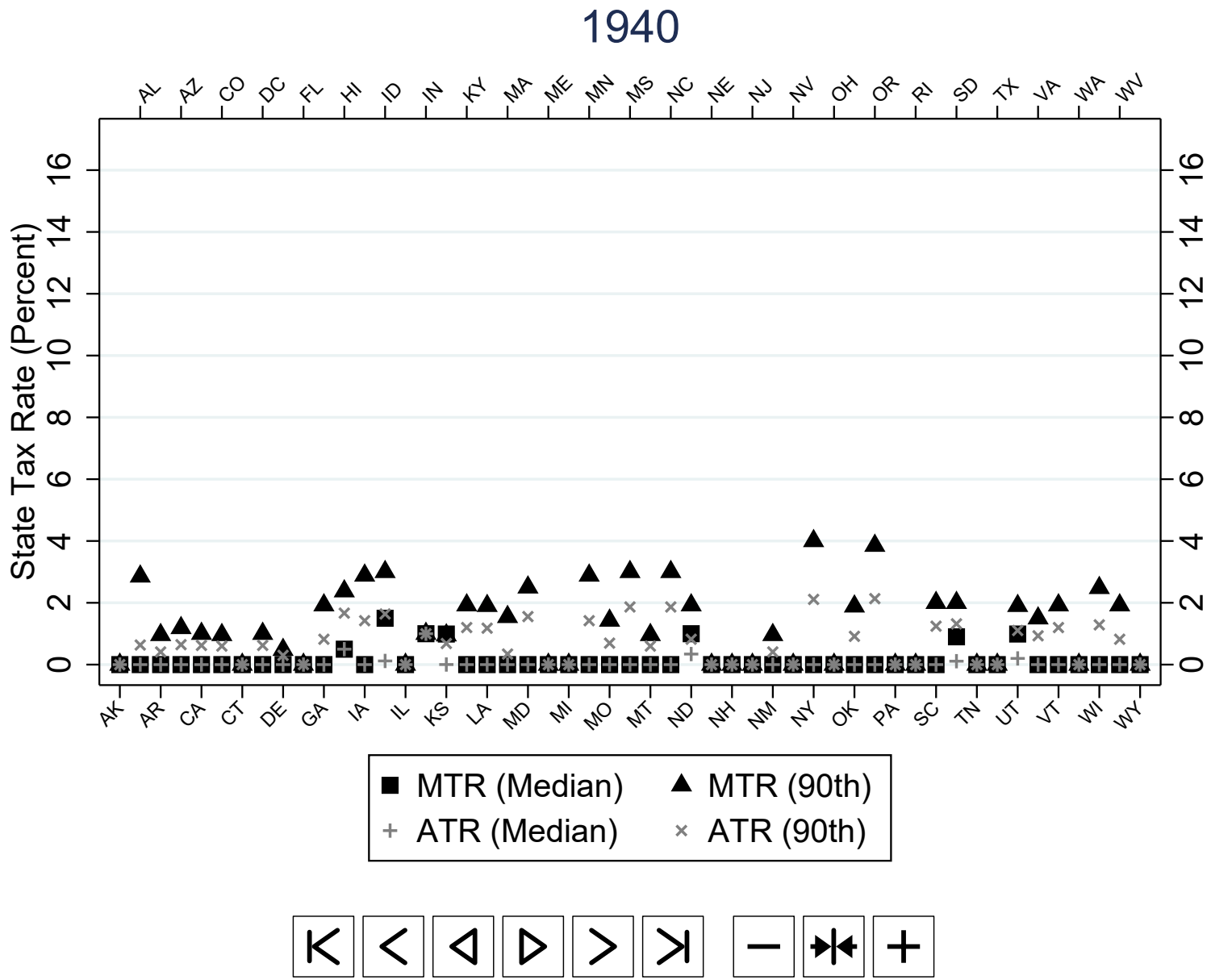
90th percentile MTR; 90th percentile ATR

median MTR; median ATR

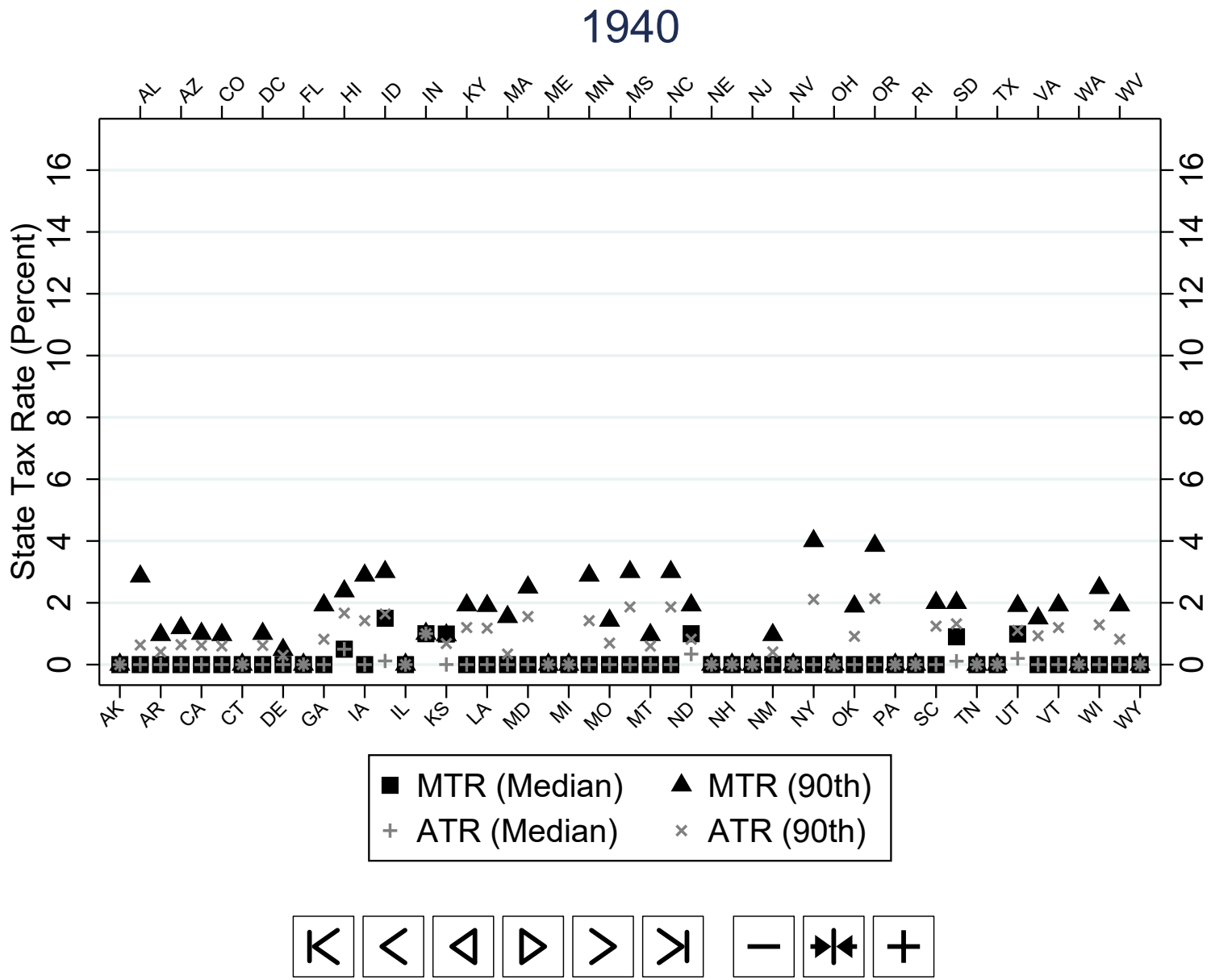
A lot of tax variation to exploit: any given year, 12-40% of states change their tax.

▸ Introduction, Distribution ▸ MTRs in Selected States ▸ Tax Rate and Bracket changes

State Tax Rate Distributions over Time

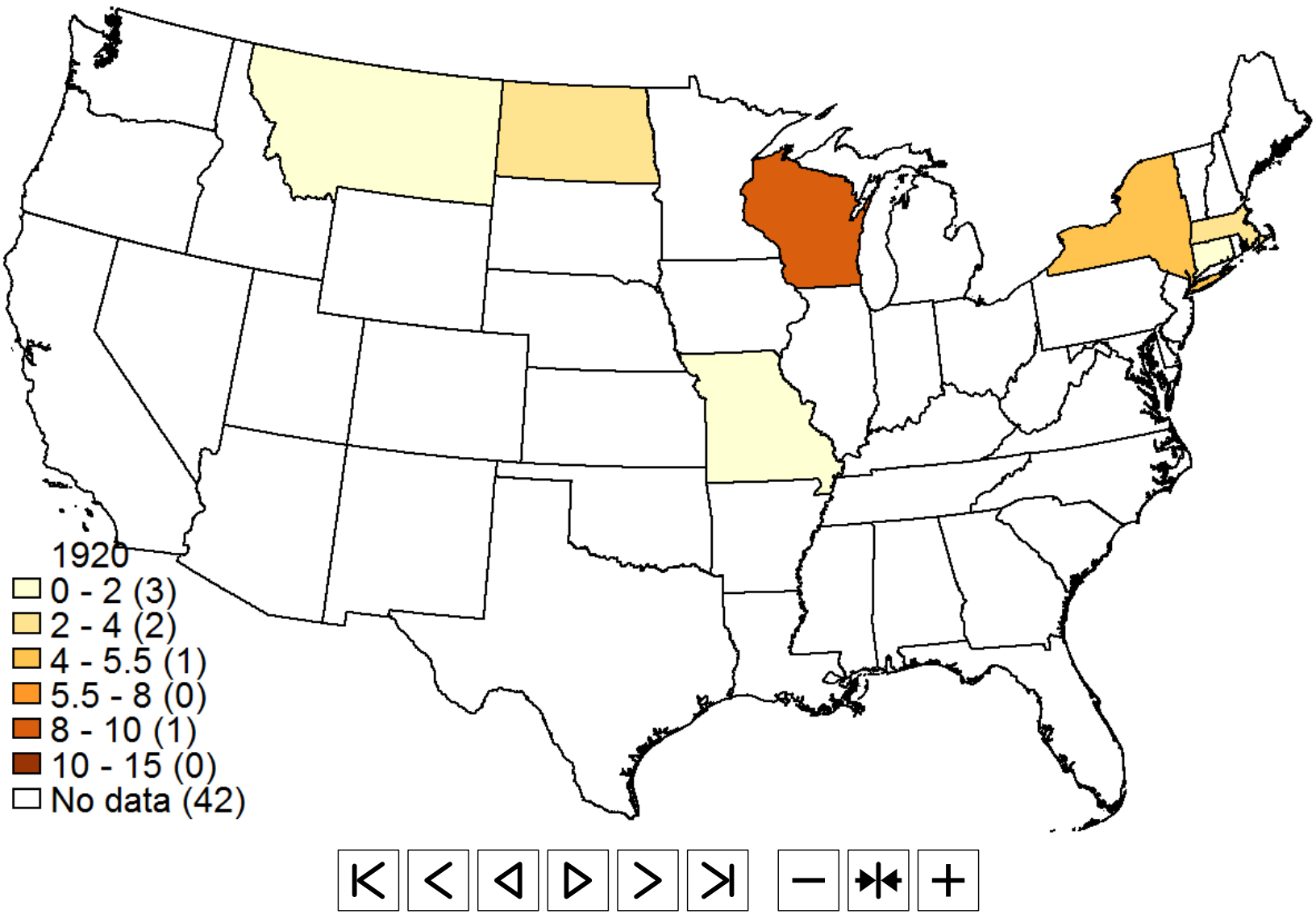


State Tax Rate Distributions over Time

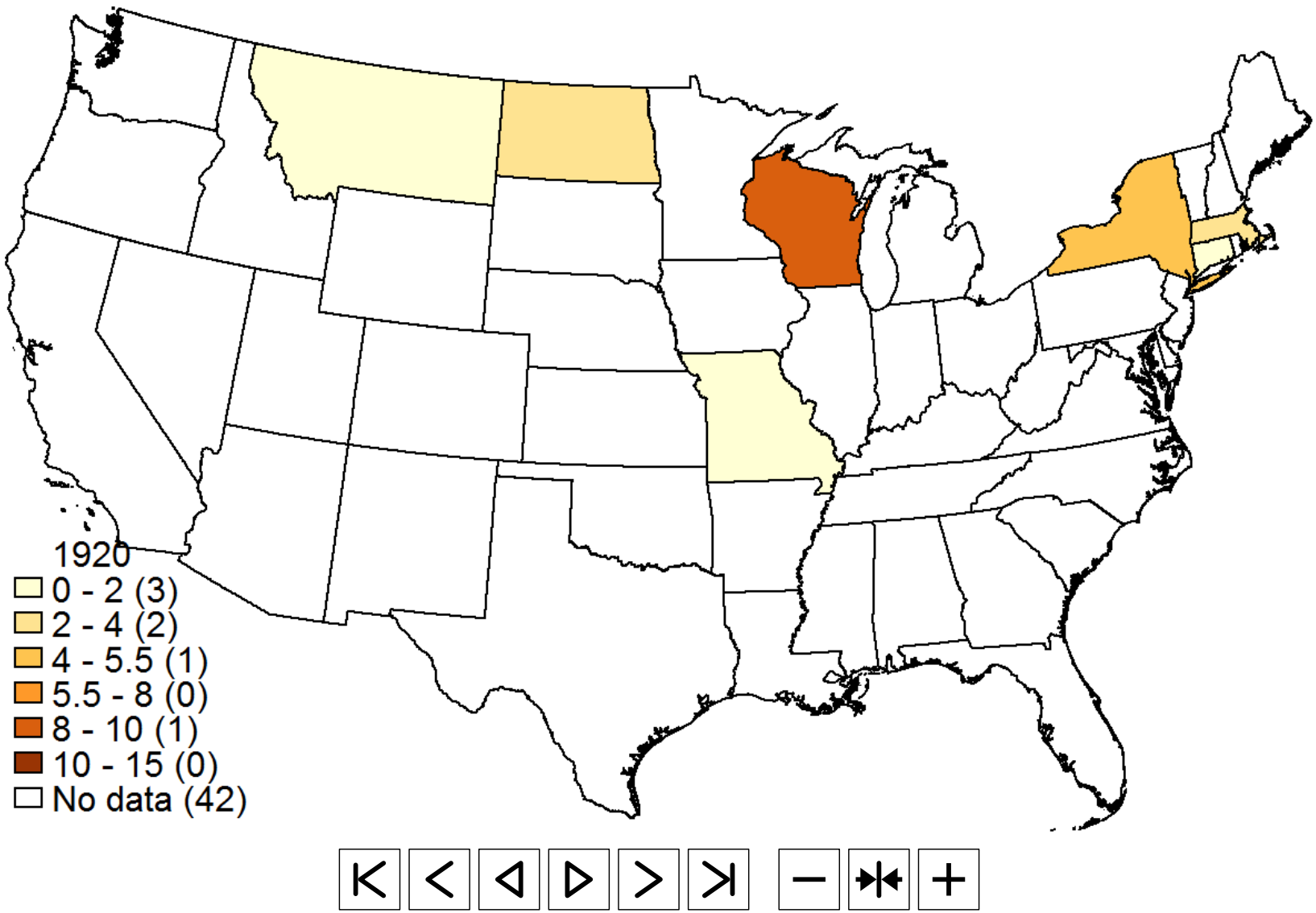


State Top Marginal Corporate Tax Rate: 1920

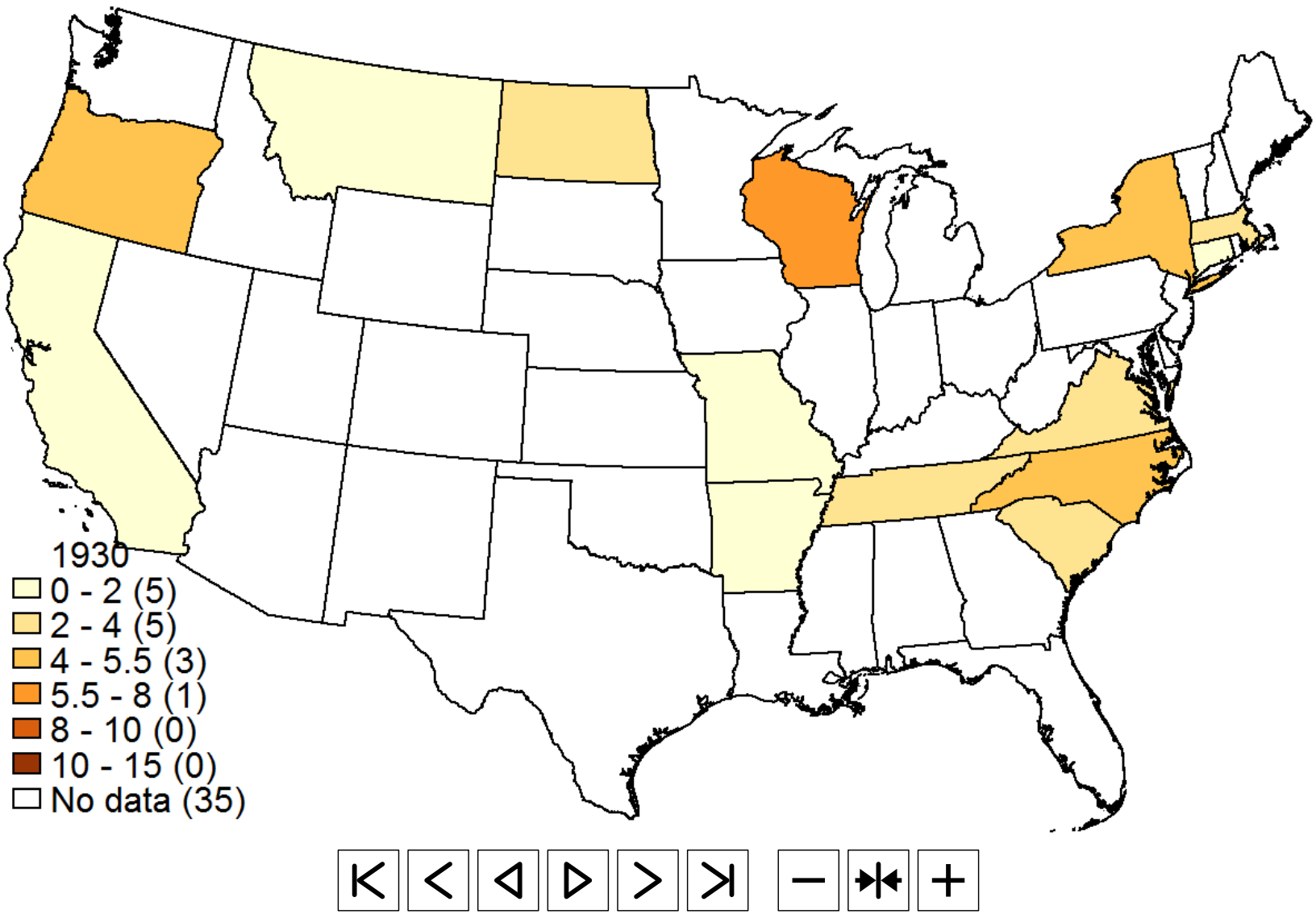
More



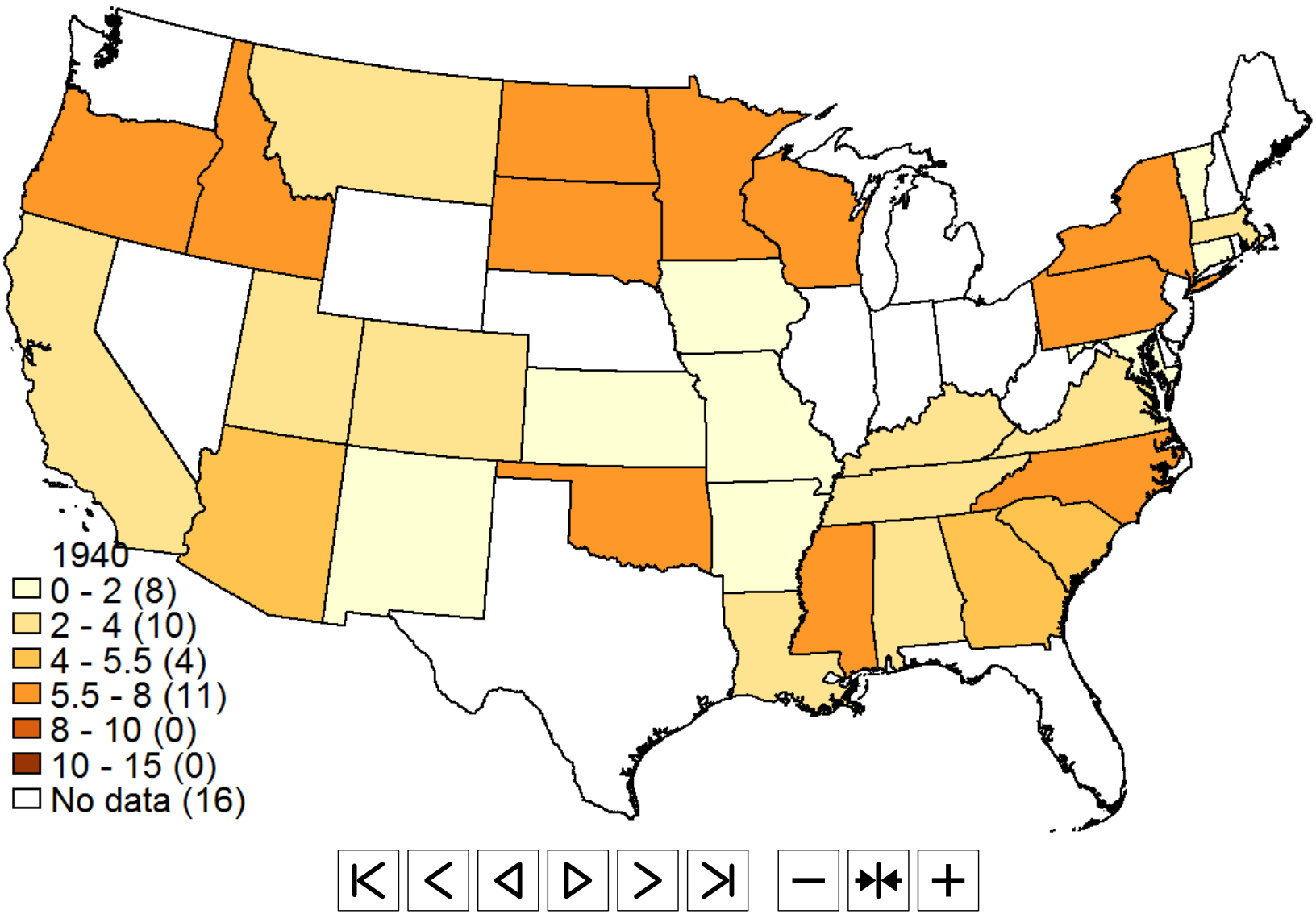
State Top Marginal Corporate Tax Rate: 1920-1930



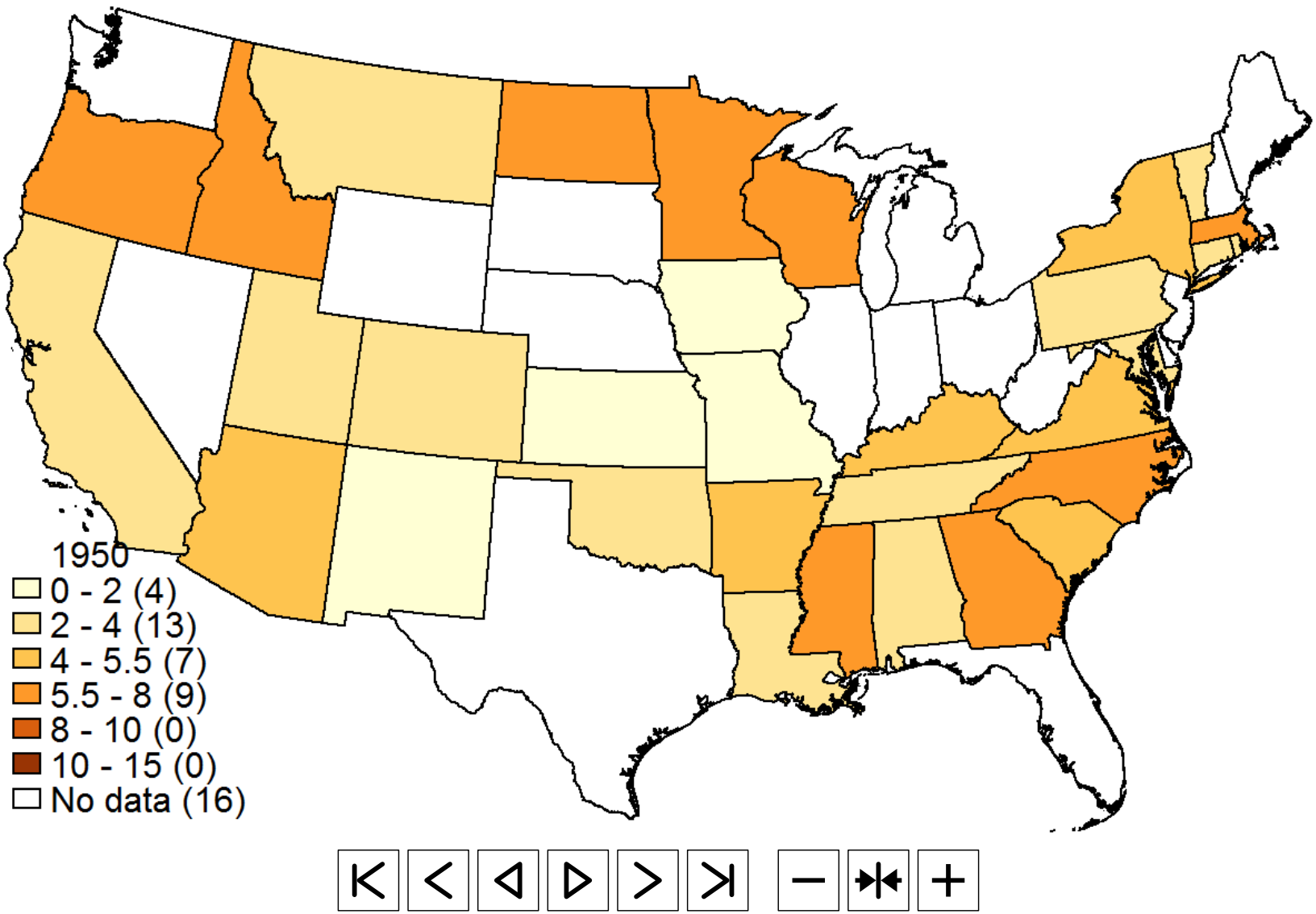
State Top Marginal Corporate Tax Rate: 1930-1940



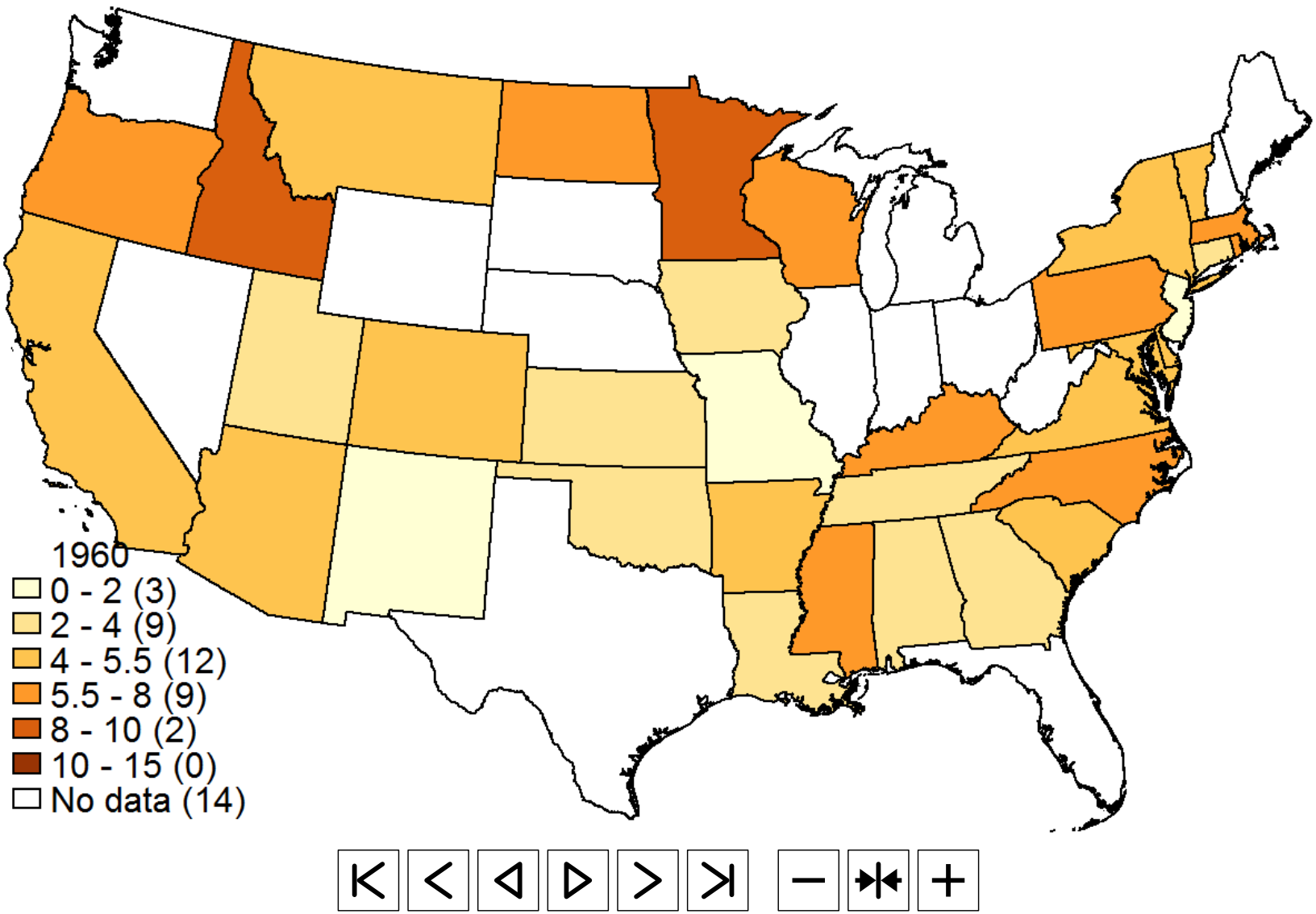
State Top Marginal Corporate Tax Rate: 1940-1950



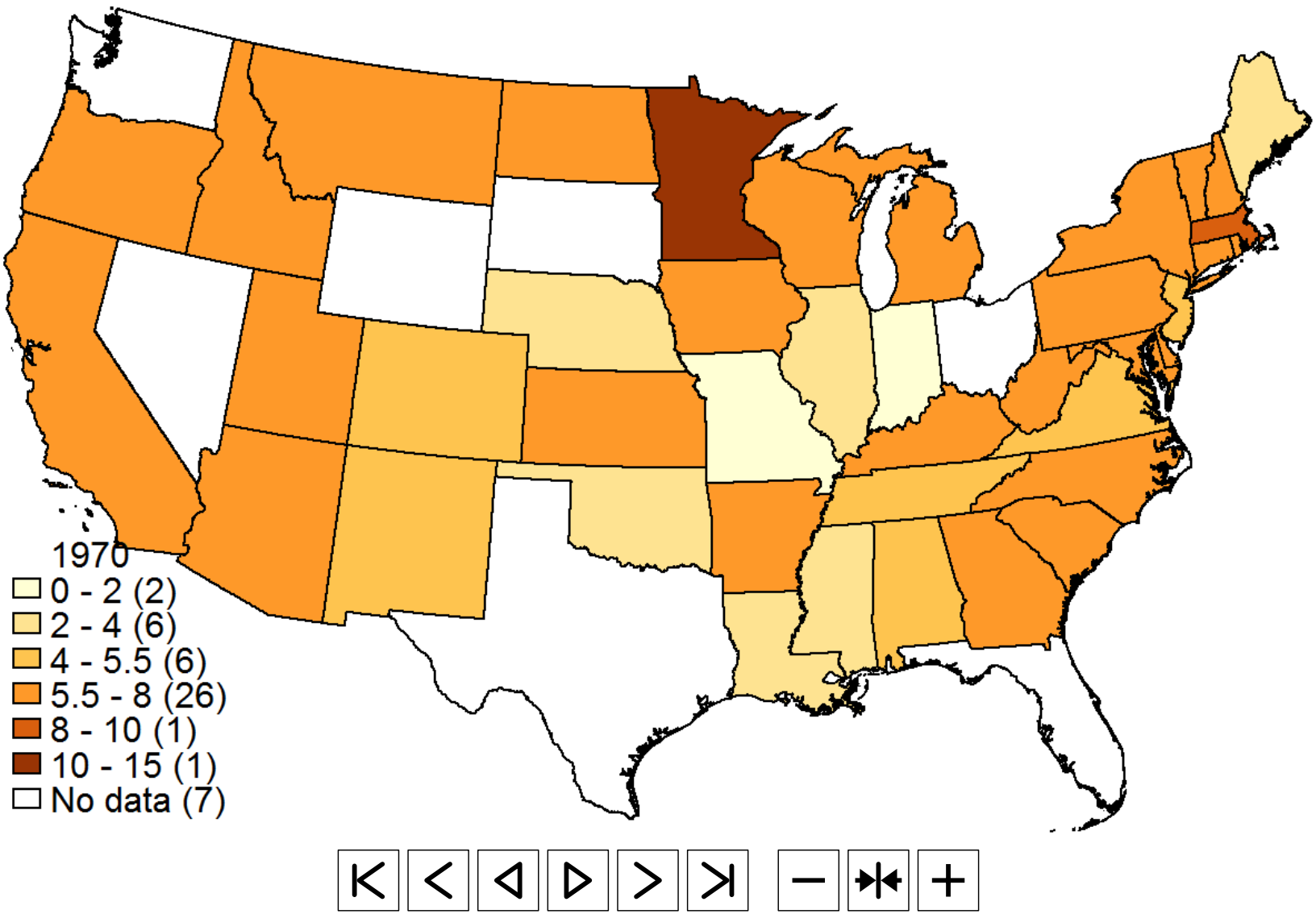
State Top Marginal Corporate Tax Rate: 1950-1960



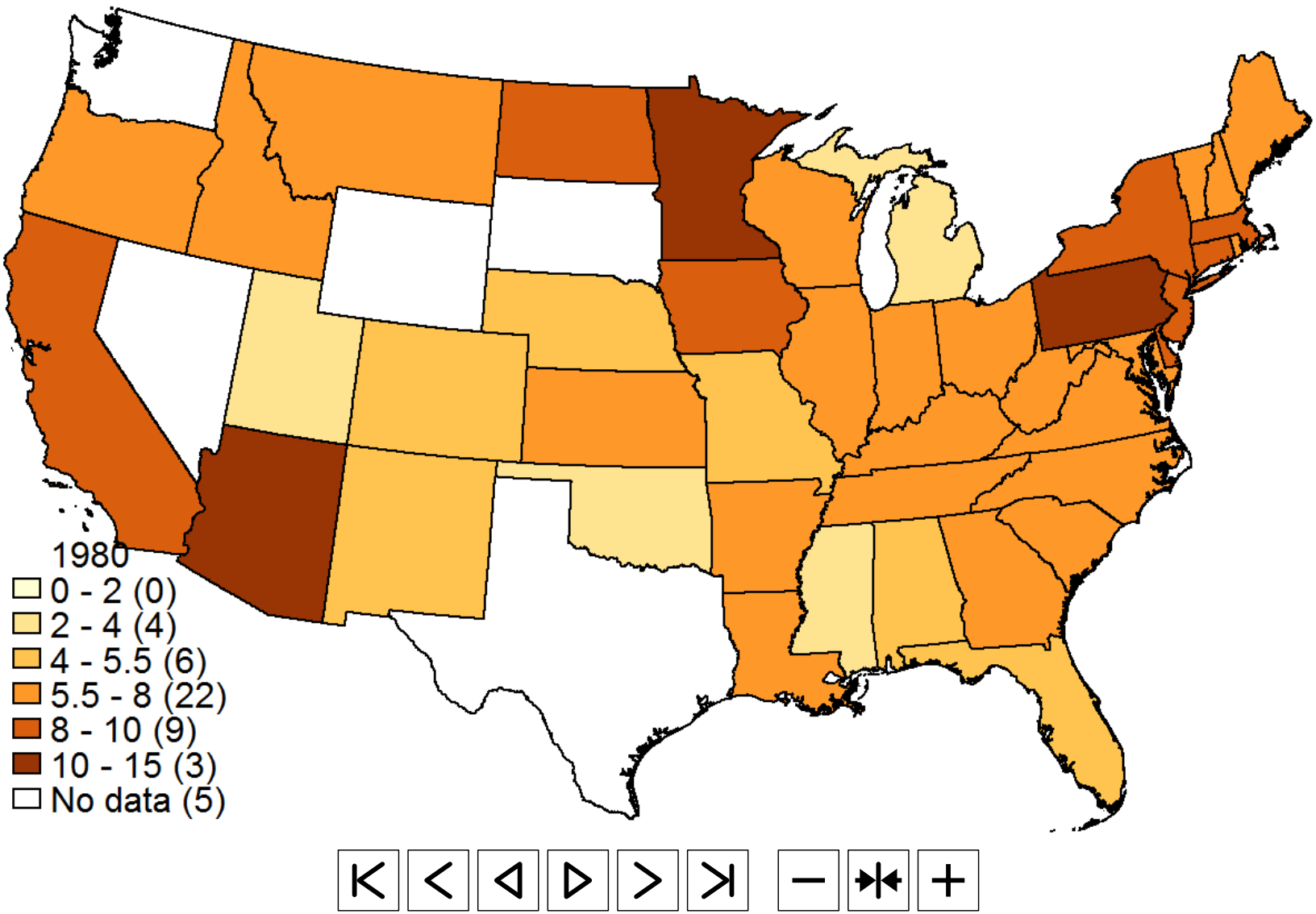
State Top Marginal Corporate Tax Rate: 1960-1970



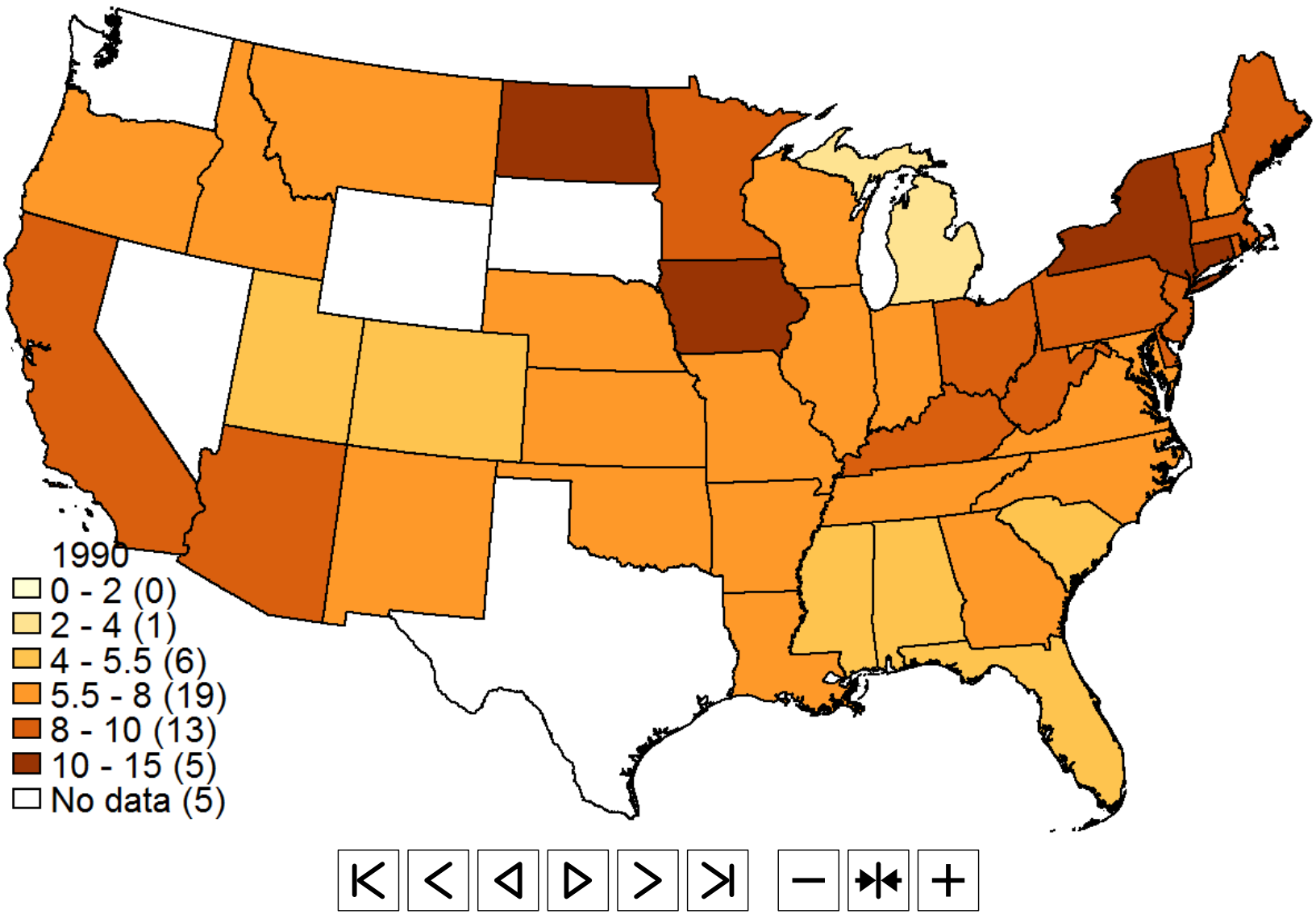
State Top Marginal Corporate Tax Rate: 1970-1980



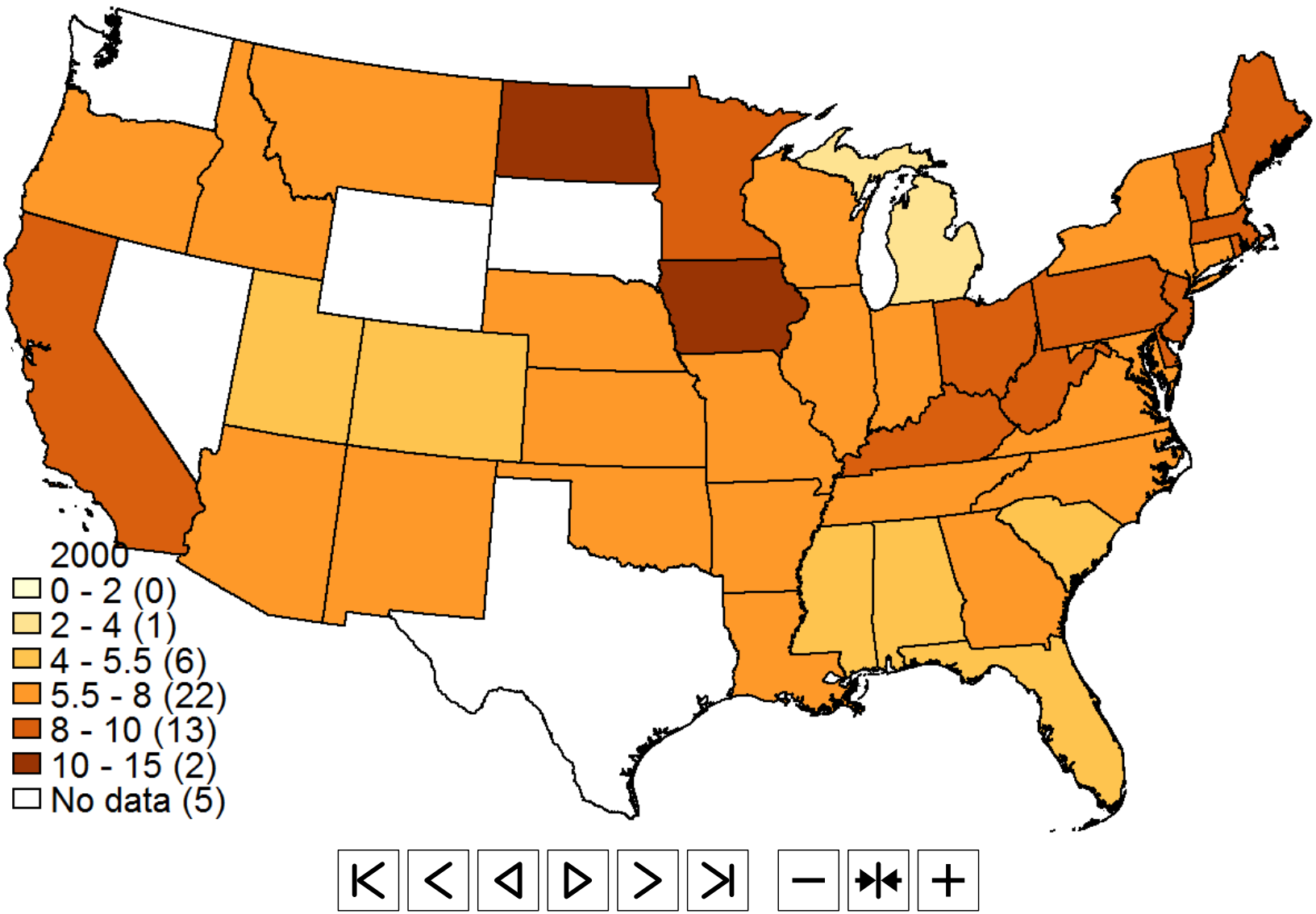
State Top Marginal Corporate Tax Rate: 1980-1990



State Top Marginal Corporate Tax Rate: 1990-2000

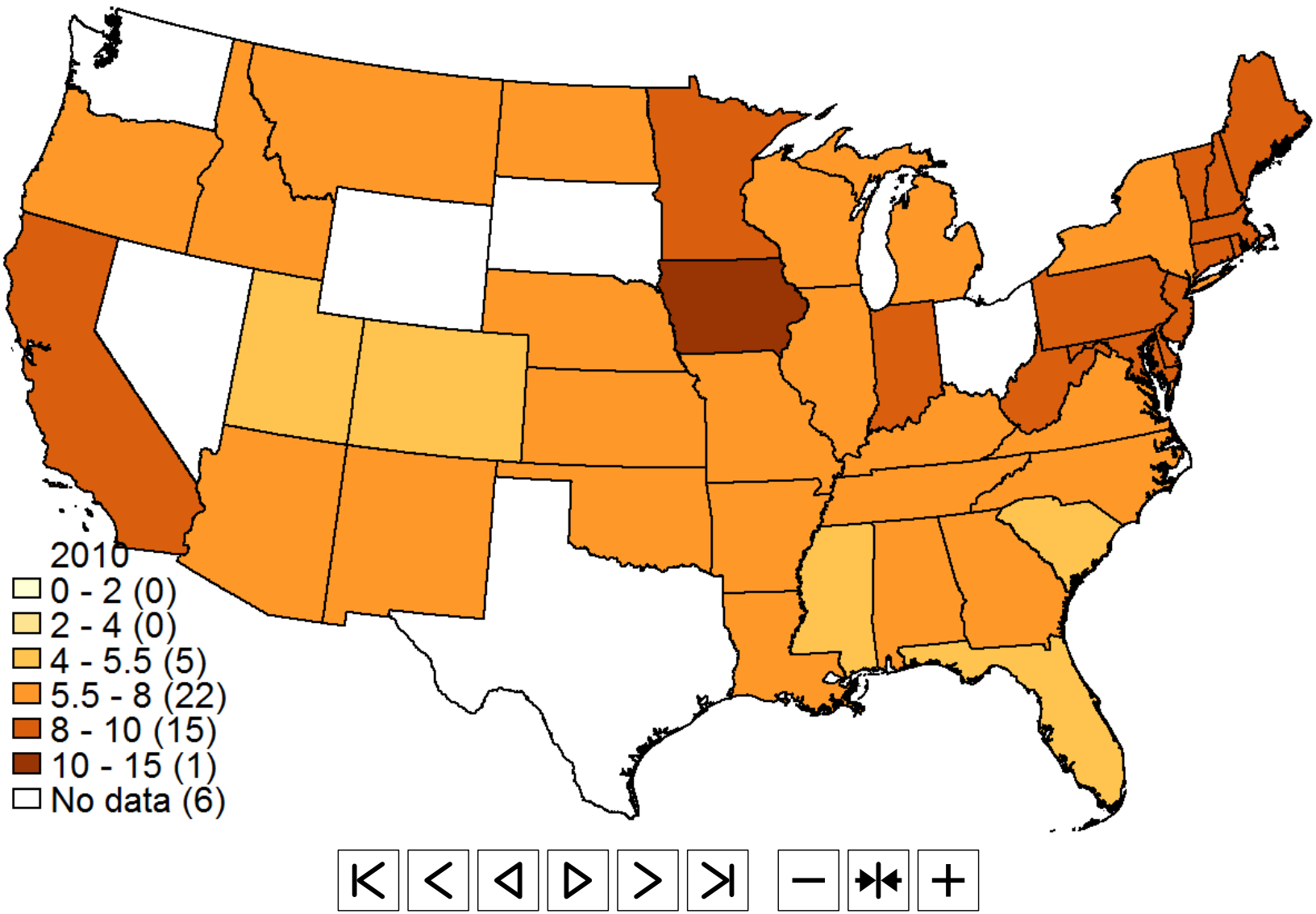


State Top Marginal Corporate Tax Rate: 2000-2010



State Top Marginal Corporate Tax Rate: 2010-2016

More



Outline

Macro State Level: Empirical Strategy

τ^c_{st}: corporate tax in state s; τ^c_{ft}: federal corporate tax in year t.

τ^{yj}_{st}: personal income tax at j^{th} percentile in state s; τ^{yj}_{ft}: federal rate in year t.

D^y_{st}, D^c_{st}: indicator for federal tax deductibility.

Total tax rate for inventor at the j^{th} percentile in state s, time t:

$$T^{yj}_{st} \approx \tau^{yj}_{ft}(1-\tau^{yj}_{st}) + \tau^{yj}_{st} - D^y_{st} \cdot \tau^{yj}_{st}\tau^{yj}_{ft}$$

In practice: comes from calculator.

Total tax rate for firm in state s in year t is:

$$T^c_{st} \approx \tau^c_{ft}(1-\tau^c_{st}) + \tau^c_{st} - D^c_{st} \cdot \tau^c_{st}\tau^c_{ft}$$

Macro State Level: Empirical Strategy (II)

Y_{st} innovation outcome in state s, year t.

$$Y_{st} = \alpha + \beta_y T^{yj}_{st-1} + \beta_c T^{c}_{st-1} + \gamma \mathbb{X}_{st} + \delta_t + \delta_s + \varepsilon_{st}$$

Y_{st} = patents, citations, inventors, % of patents to companies.

T^{yj}_{st-1} can be MTR90, MTR50, ATR90, or ATR50.

$\mathbb{X}_{st}$: pop. density, real GDP pc., R&D tax credits.

IV Strategy: "Predicted tax rate"

IV for personal tax: $\hat{T}^{yj}_{st} = \tau^{yj}_{ft}(1 - \tau^{yj}_{st-k}) + \tau^{yj}_{st-k} - D^{y}_{st-k} \cdot \tau^{yj}_{st-k}\tau^{yj}_{ft}$

for different lags $k = 1, ..., 5$. (Benchmark $k = 5$).

IV for corporate tax: $\hat{T}^{c}_{st} = \tau^{c}_{ft}(1 - \tau^{c}_{st-k}) + \tau^{c}_{st-k} - D^{c}_{st-k} \cdot \tau^{c}_{st-k}\tau^{c}_{ft}$

Border counties strategy: Combined with IV. For pair of counties i

$$\Delta Y_{it} = \beta_1 \Delta T^{yj}_{it-1} + \beta_2 \Delta T^{c}_{it-1} + \gamma \Delta \mathbb{X}_{it} + \delta_i + \varepsilon_{it}$$

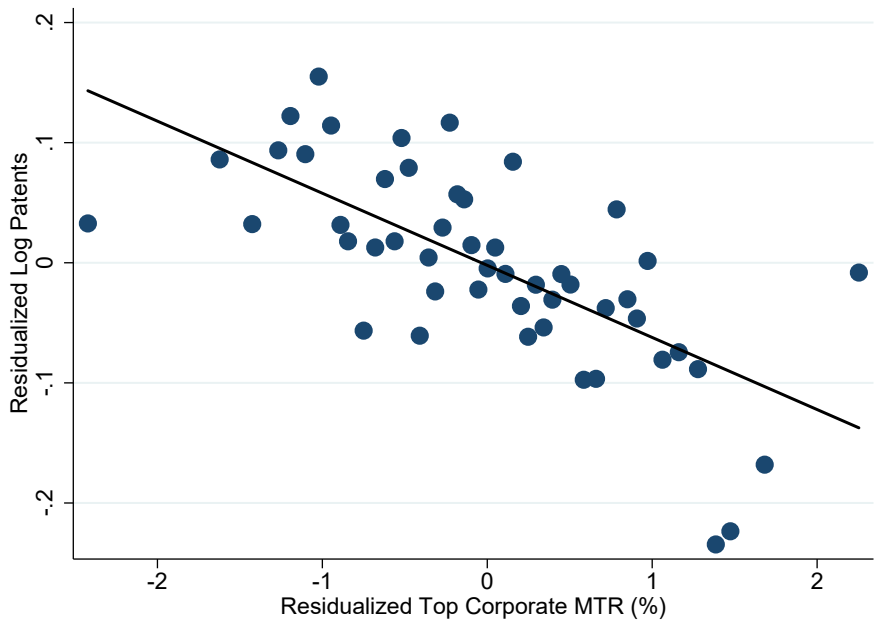
Macro Effects of Personal Income Taxes 1940-2000

Log Patents & MTR at median

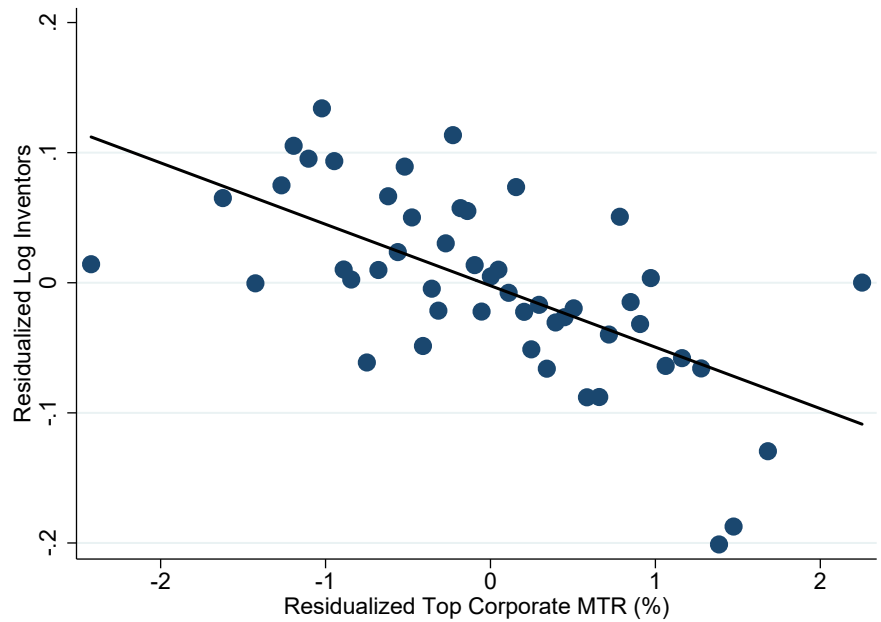
Log Inventors & MTR at median

Macro Effects of Corporate Income Taxes 1940-2000

Log Patents & Top Corporate Tax



Log Inventors & Top Corporate Tax



Macro Effects of Taxes 1940-2000: OLS

Panel A: OLS

Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Share Assigned (4)
Top Corporate MTR (%, lag)	-0.063***	-0.059***	-0.051***	-1.090***
	(0.007)	(0.008)	(0.006)	(0.159)
90^{th} Pctile Income MTR (%, lag)	-0.041***	-0.040***	-0.040***	-0.334***
	(0.005)	(0.005)	(0.004)	(0.077)
Median Income MTR (%, lag)	-0.045***	-0.046***	-0.046***	-0.065
	(0.005)	(0.005)	(0.004)	(0.087)
90^{th} Pctile Income ATR (%, lag)	-0.063***	-0.060***	-0.062***	-0.135
	(0.004)	(0.005)	(0.004)	(0.100)
Median Income ATR (%, lag)	-0.100***	-0.108***	-0.091***	-0.672***
	(0.008)	(0.011)	(0.007)	(0.146)
Observations	2867	2867	2867	2867
Mean of Dep. Var.	7.18	9.87	7.31	71.74
S.D. of Dep. Var.	1.31	1.59	1.33	14.01

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Median Income ATR (%, lag)	-0.100***	-0.108***	-0.091***	-0.672***
	(0.008)	(0.011)	(0.007)	(0.146)
Observations	2867	2867	2867	2867
Mean of Dep. Var.	7.18	9.87	7.31	71.74
S.D. of Dep. Var.	1.31	1.59	1.33	14.01

Macro Effects of Taxes 1940-2000: OLS

Panel A: OLS

Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Share Assigned (4)
Top Corporate MTR (%, lag)	-0.063***	-0.059***	-0.051***	-1.090***
	(0.007)	(0.008)	(0.006)	(0.159)
90^{th} Pctile Income MTR (%, lag)	-0.041***	-0.040***	-0.040***	-0.334***
	(0.005)	(0.005)	(0.004)	(0.077)
Median Income MTR (%, lag)	-0.045***	-0.046***	-0.046***	-0.065
	(0.005)	(0.005)	(0.004)	(0.087)
90^{th} Pctile Income ATR (%, lag)	-0.063***	-0.060***	-0.062***	-0.135
	(0.004)	(0.005)	(0.004)	(0.100)
Median Income ATR (%, lag)	-0.100***	-0.108***	-0.091***	-0.672***
	(0.008)	(0.011)	(0.007)	(0.146)
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	(0.005)	(0.005)	(0.004)	(0.087)
90^{th} Pctile Income ATR (%, lag)	-0.063***	-0.060***	-0.062***	-0.135
	(0.004)	(0.005)	(0.004)	(0.100)
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Panel A: OLS

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Macro Effects of Taxes 1940-2000: OLS

Panel A: OLS

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Top Corporate MTR (%, lag)	-0.063***	-0.059***	-0.051***	-1.090***
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	(0.005)	(0.005)	(0.004)	(0.087)
90^{th} Pctile Income ATR (%, lag)	-0.063***	-0.060***	-0.062***	-0.135
	(0.004)	(0.005)	(0.004)	(0.100)
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Observations	2867	2867	2867	2867
Mean of Dep. Var.	7.18	9.87	7.31	71.74
S.D. of Dep. Var.	1.31	1.59	1.33	14.01

Macro Effects of Taxes 1940-2000: IV and Border Counties

IV results and border counties results are very similar to, but even stronger than OLS.

▸ IV Results ▸ Border Counties Results

Cross-state Spillovers

- Macro effects estimated are relevant "reduced-form" effect for state considering unilateral tax change.
- Possible spillovers: inventors or factors or demand moving.
- We will show that inventors and firms move (at micro level) in response to taxes.
  - But dropping movers does not change macro or border-county results much (where we could expect movements to be strongest): ▸ No Movers ▸ No Movers BC
- Estimate also net effects by comparing to average county in neighboring state excluding border county.
  - $\approx$ 50% of total effect of corporate tax is spillovers; stronger on inventors.
  - $\approx$ 50-80% of personal taxes due to spillover; stronger for ATRs, stronger for citations (higher quality research relocating?)

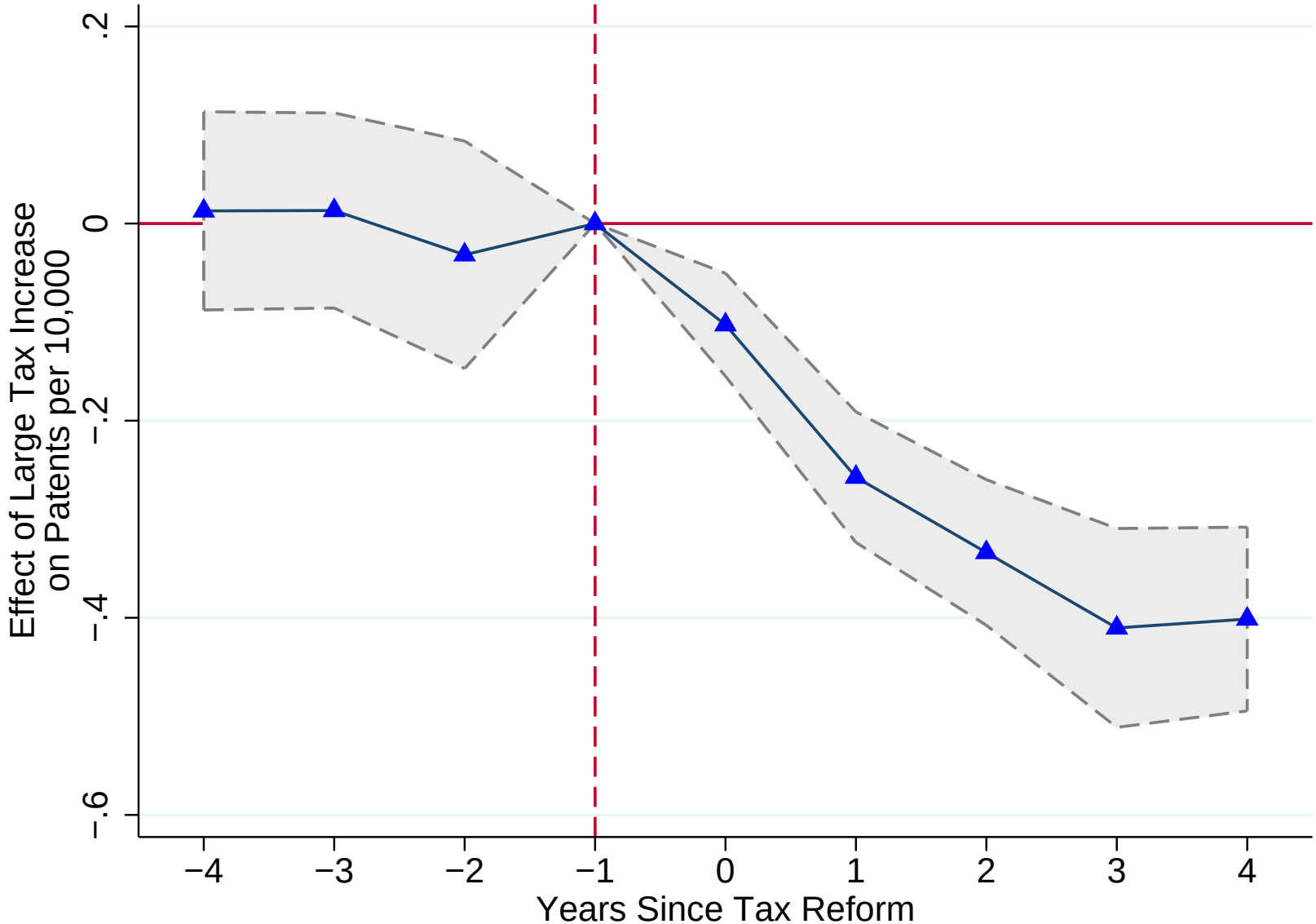
Cross-state "Net Effects" ▸ No Movers ▸ No Movers BC

Panel B: Border Counties Net Effects

Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Log Corp. Patents (4)
Top Corporate MTR (%, lag)	-0.021**	-0.030***	-0.012	-0.029***
	(0.008)	(0.010)	(0.008)	(0.010)
90^{th} Pctile Income MTR (%, lag)	-0.016***	-0.009**	-0.015***	-0.016***
	(0.003)	(0.004)	(0.003)	(0.003)
Median Income MTR (%, lag)	-0.035***	-0.034***	-0.030***	-0.025***
	(0.006)	(0.007)	(0.006)	(0.007)
90^{th} Pctile Income ATR (%, lag)	-0.043***	-0.032***	-0.038***	-0.035***
	(0.006)	(0.008)	(0.005)	(0.008)
Median Income ATR (%, lag)	-0.025**	-0.010	-0.027***	-0.010
	(0.010)	(0.011)	(0.010)	(0.011)
Observations	8737	8736	8737	8658
Mean of Dep. Var.	0.04	-0.06	0.01	-0.02
S.D. of Dep. Var.	1.51	1.71	1.52	1.60

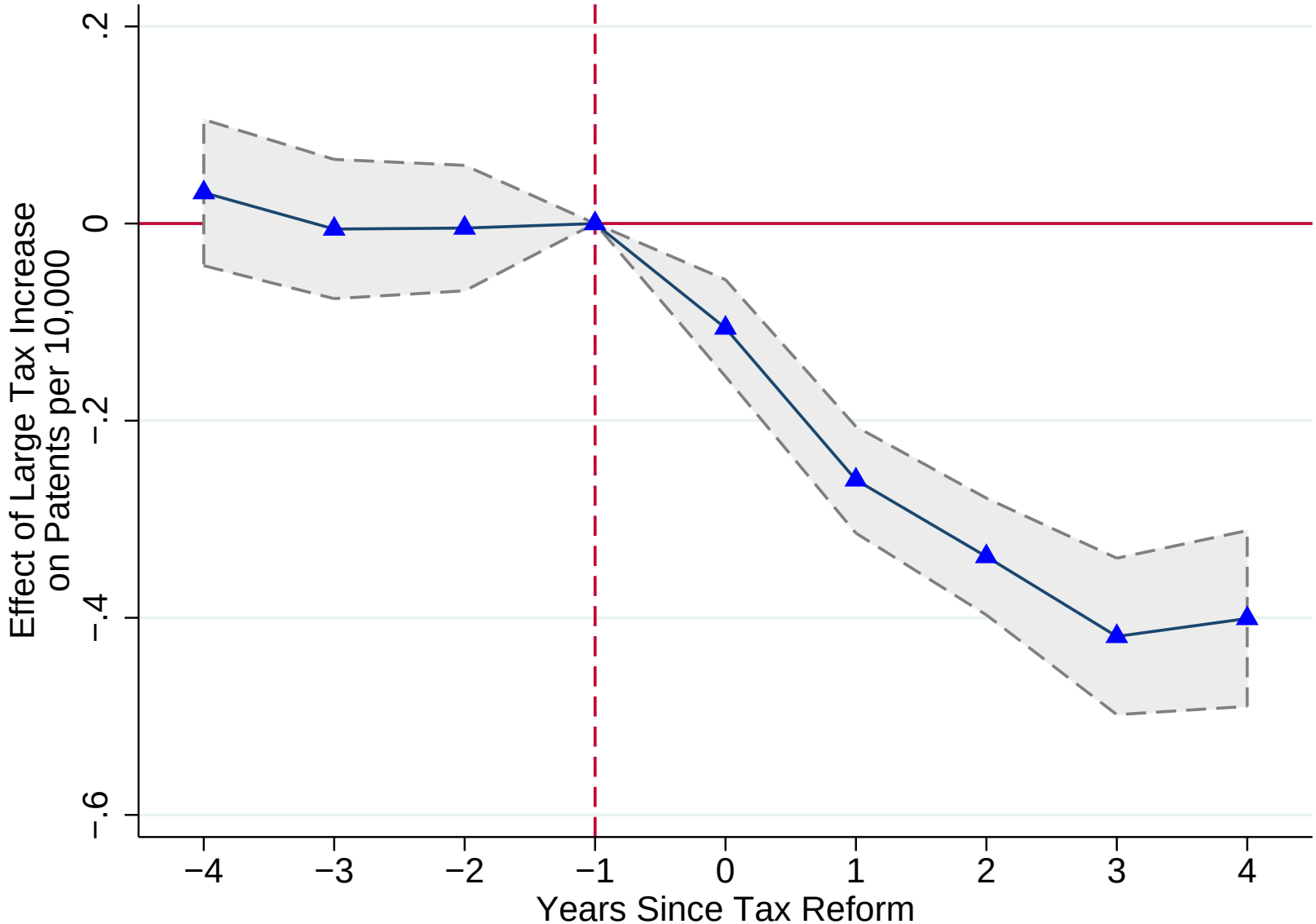
Outline

Event Study: Large Personal Tax Changes on Patents



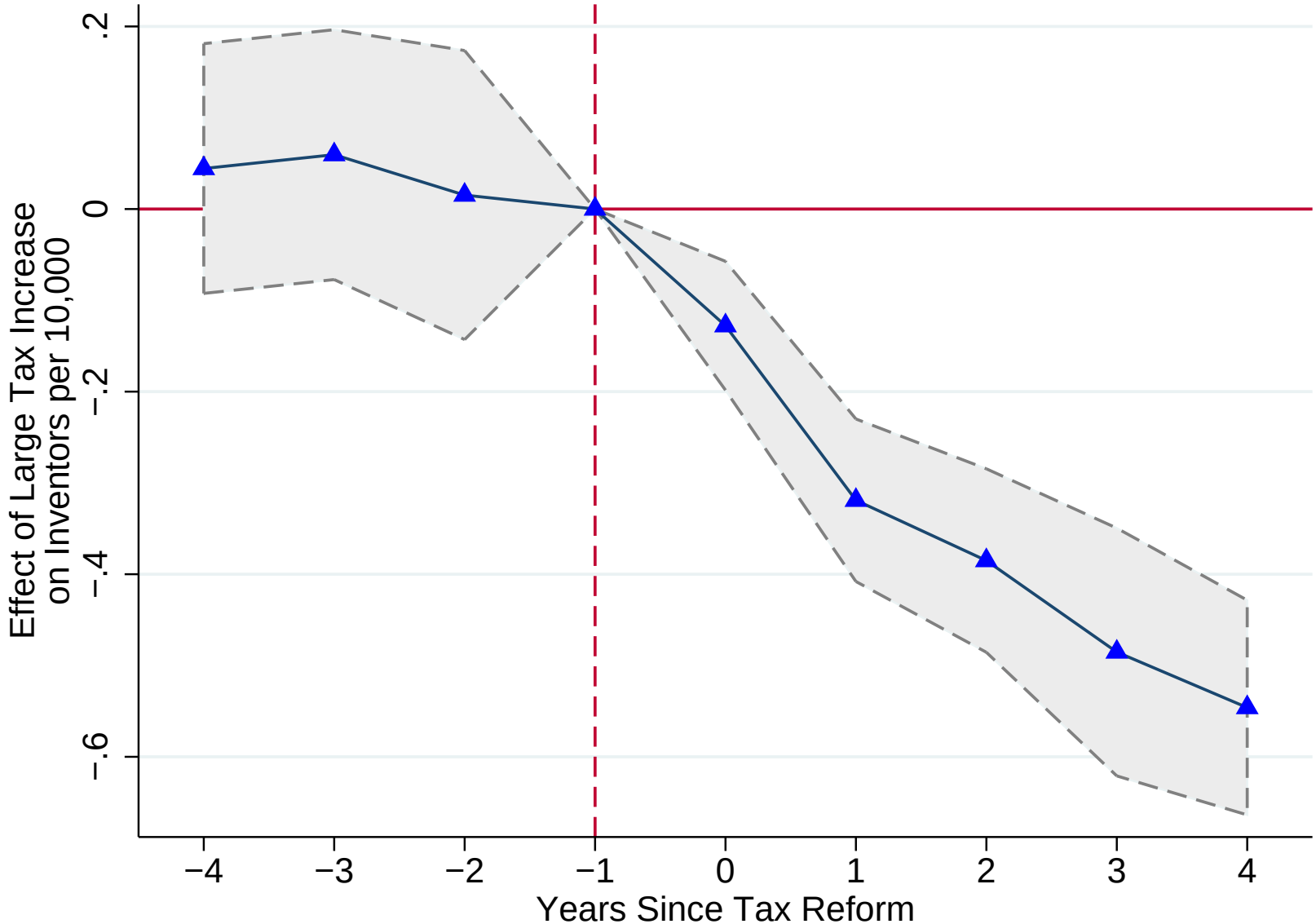
$\Delta T^y = 6.85$ pp increases, 3.6 pp decreases.

Event Study: Large Corporate Tax Changes on Patents



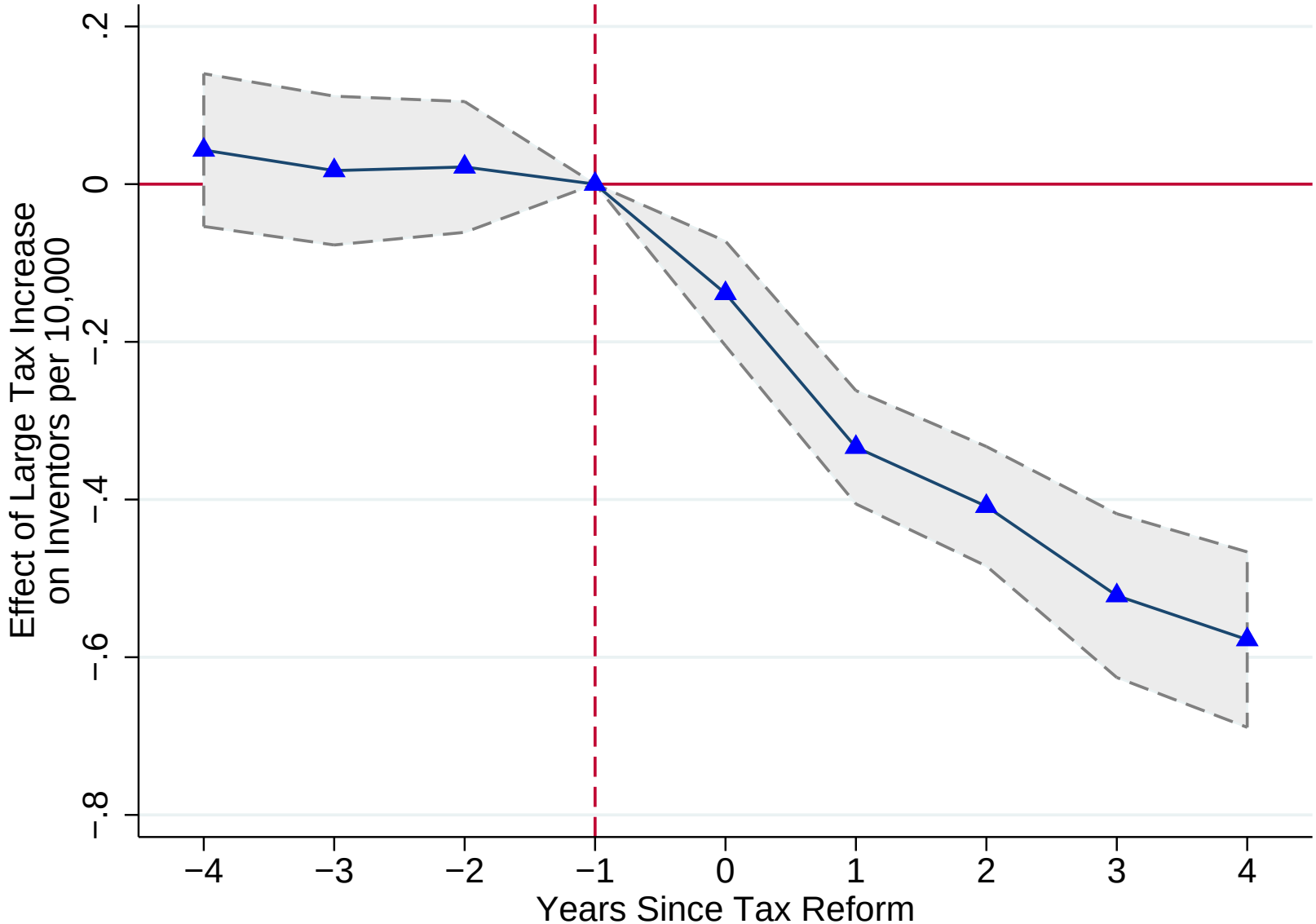
$\Delta T^c = 14.8$ pp increases, 9.3 pp decreases.

Event Study: Large Personal Tax Changes on Inventors



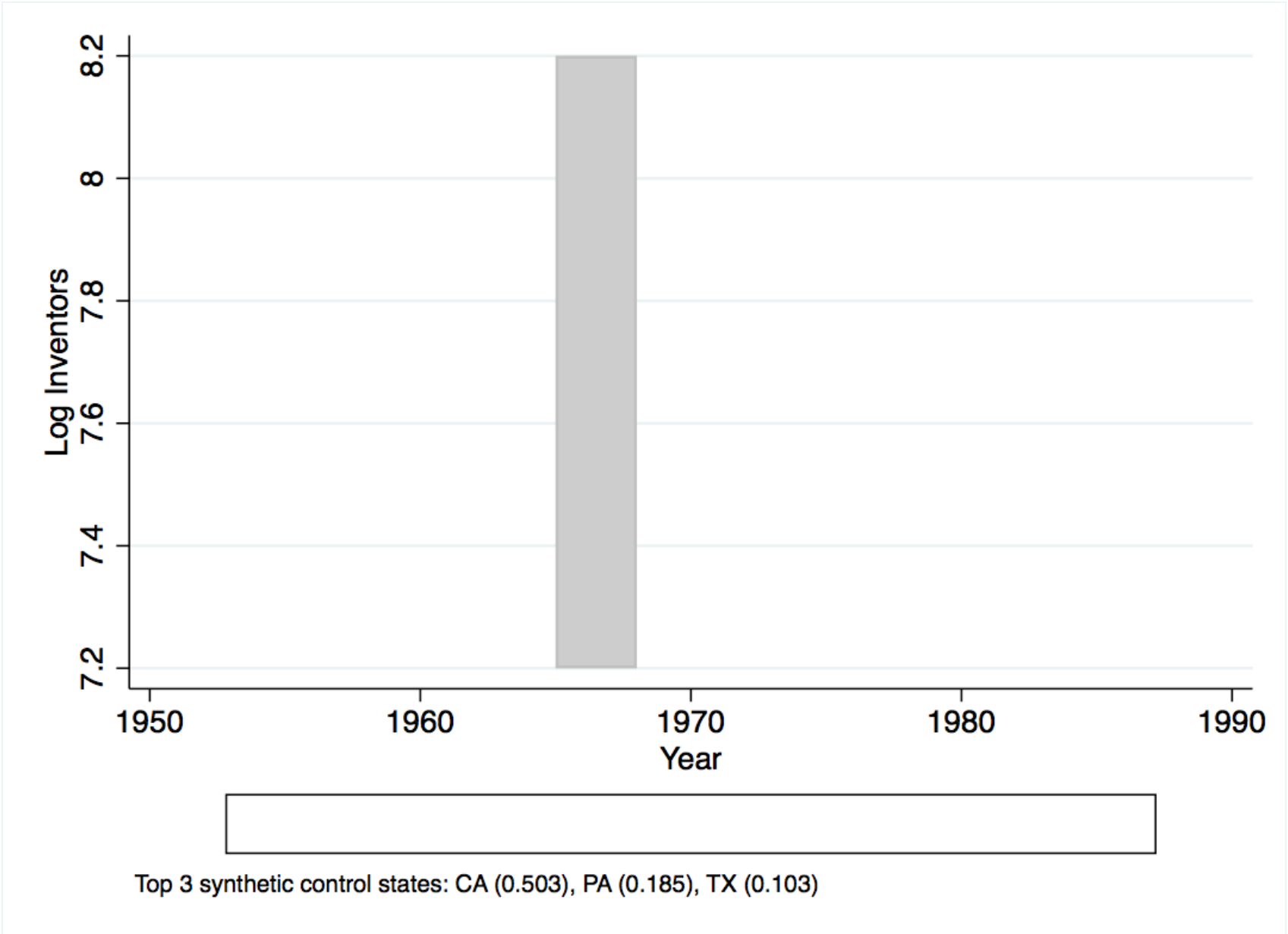
$\Delta T^y = 6.85$ pp increases, 3.6 pp decreases.

Event Study: Large Corporate Tax Changes on Inventors



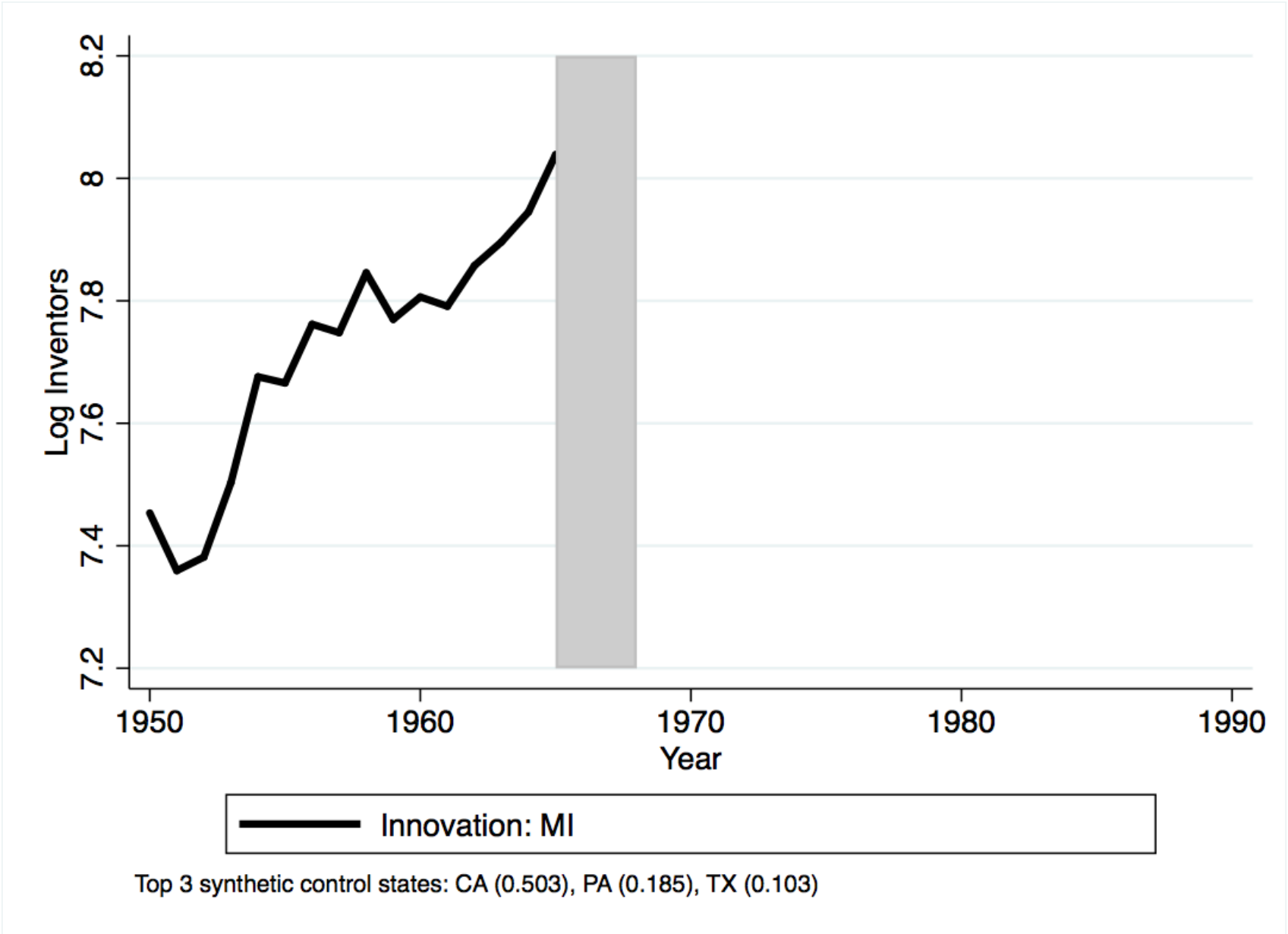
$\Delta T^c = 14.8$ pp increases, 9.3 pp decreases.

Michigan 1967-1968: Inventors



1967: intro of pers. tax at 2.6%; 1968: intro of corp. tax at 5.6%.

Michigan 1967-1968: Inventors



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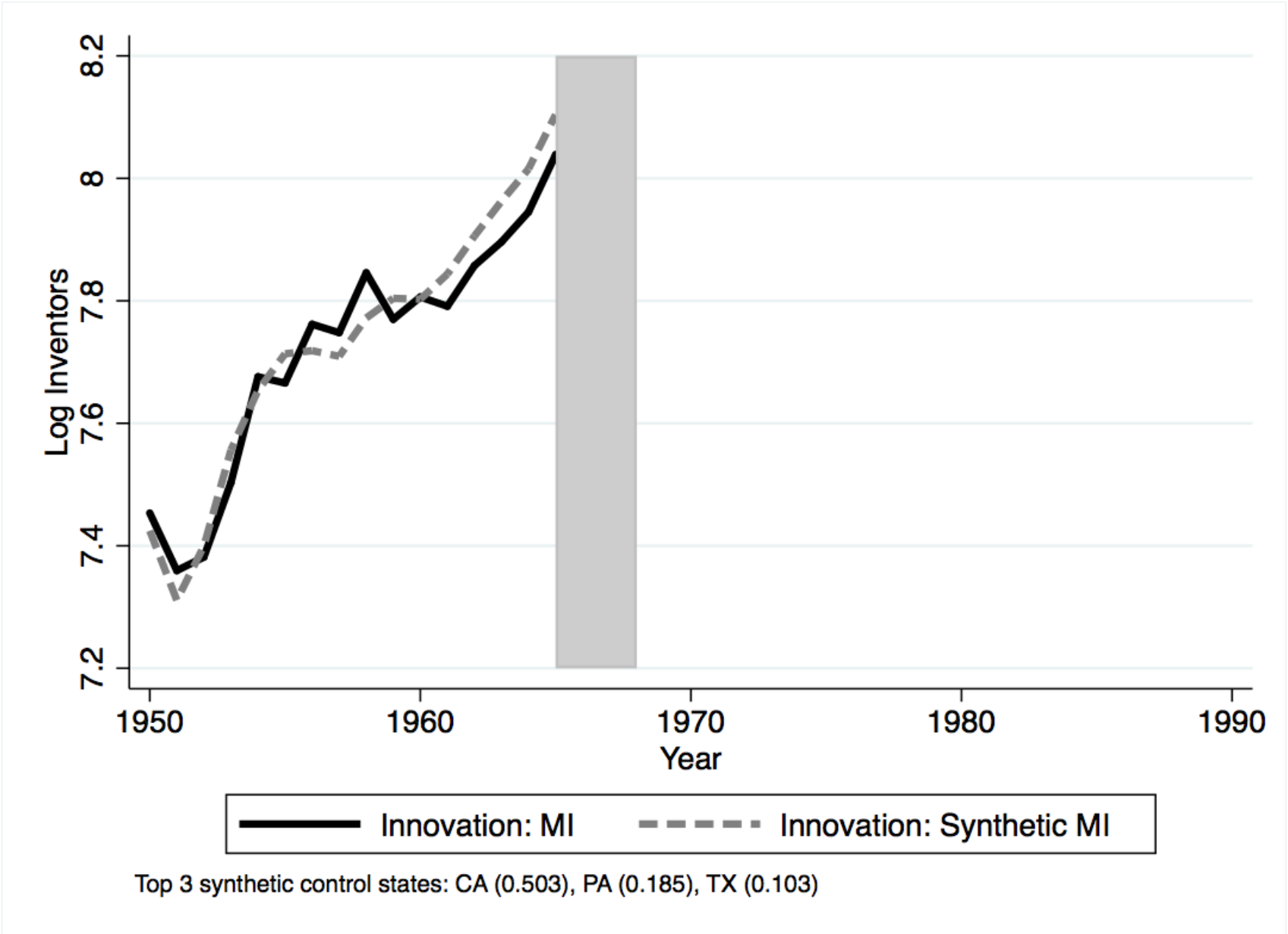

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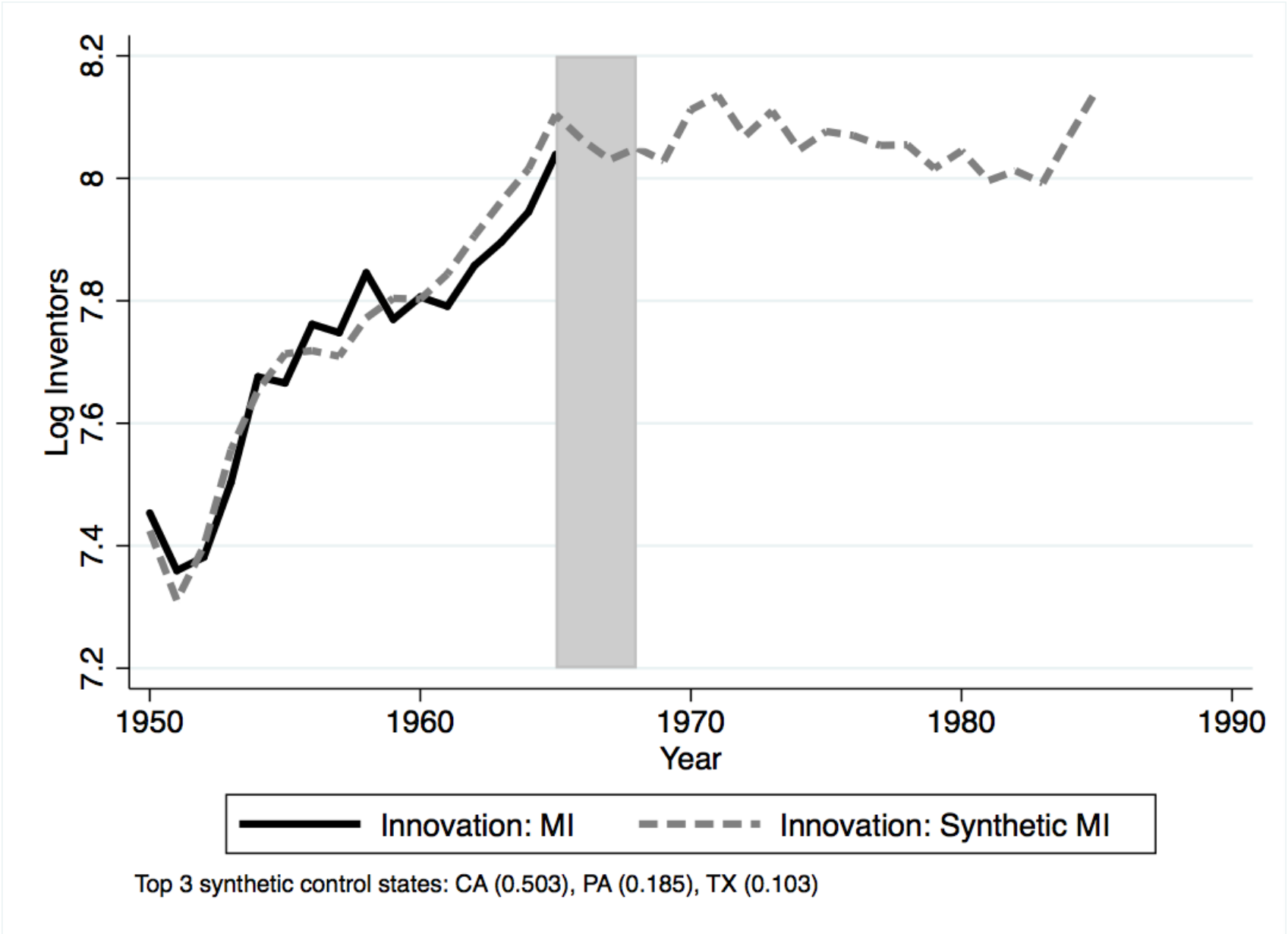

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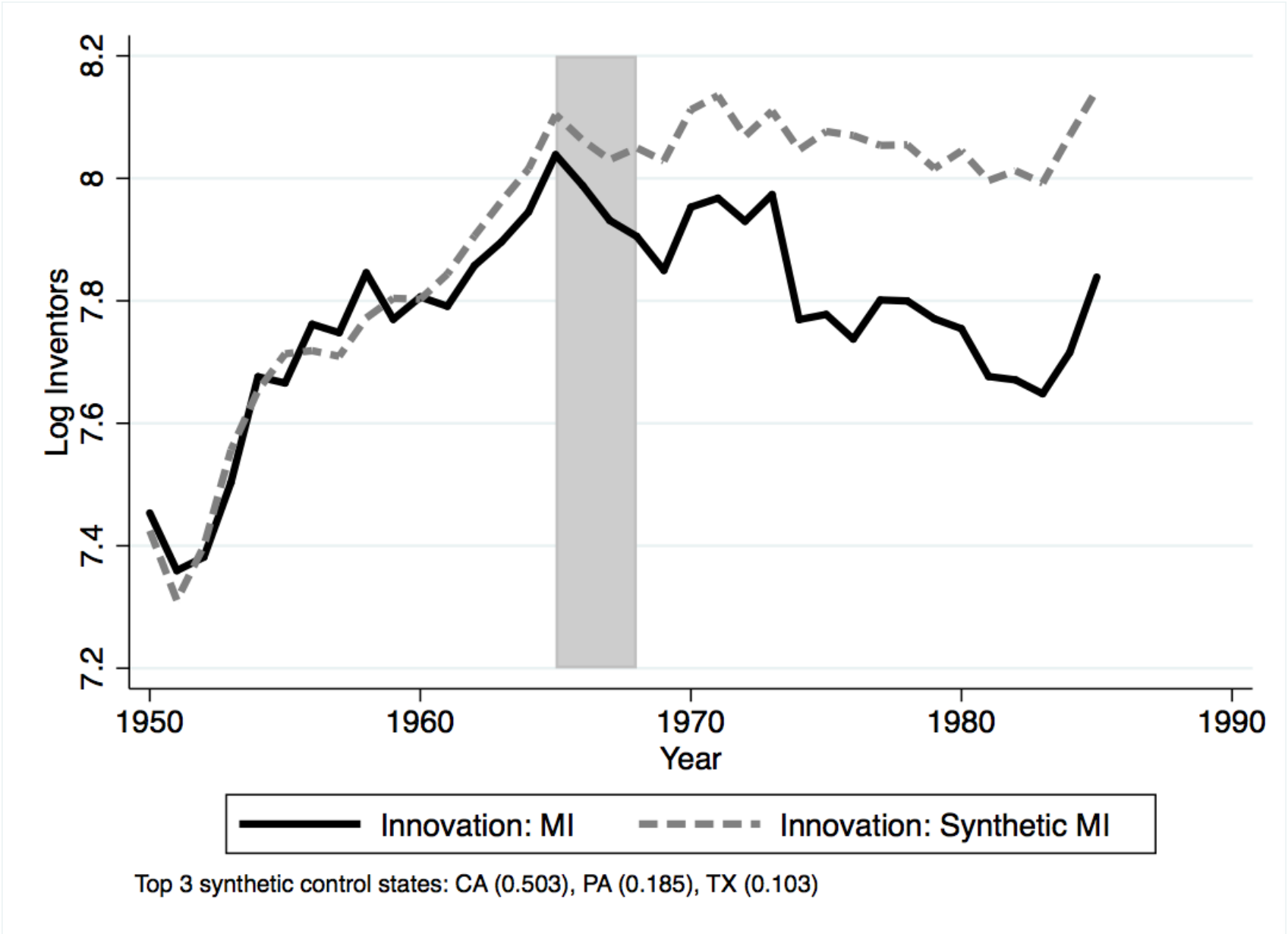
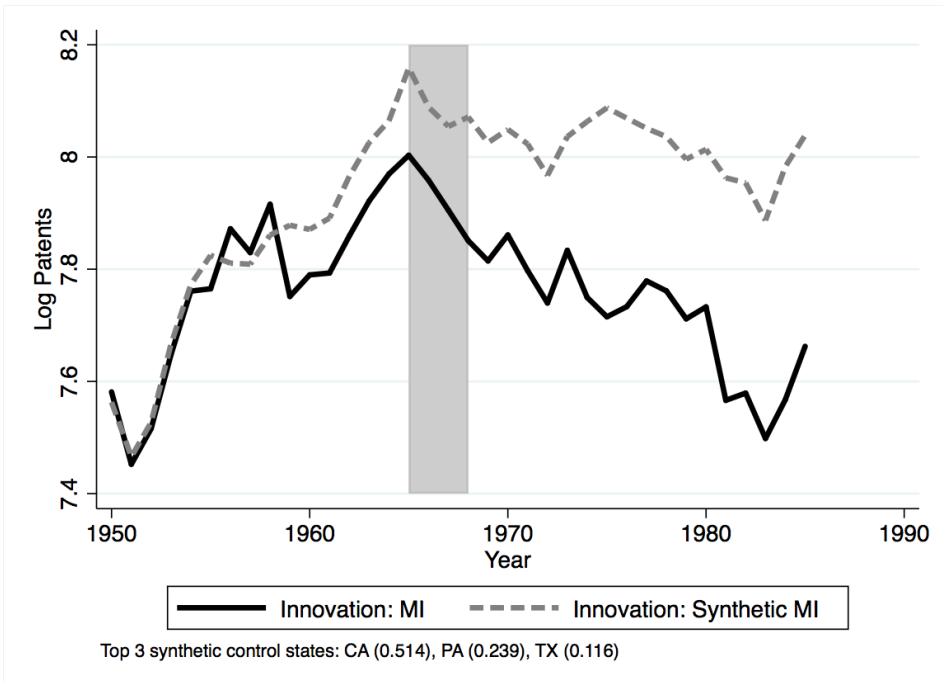
Michigan 1967-1968: Inventors



1967: intro of pers. tax at 2.6%; 1968: intro of corp. tax at 5.6%.

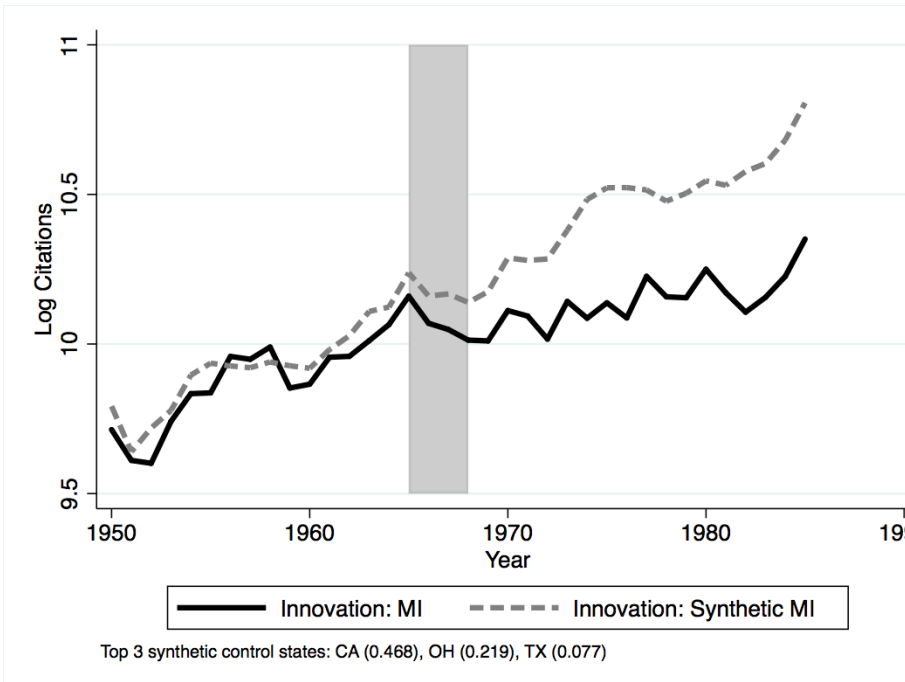
Michigan 1967-1968: Patents and Citations

Patents



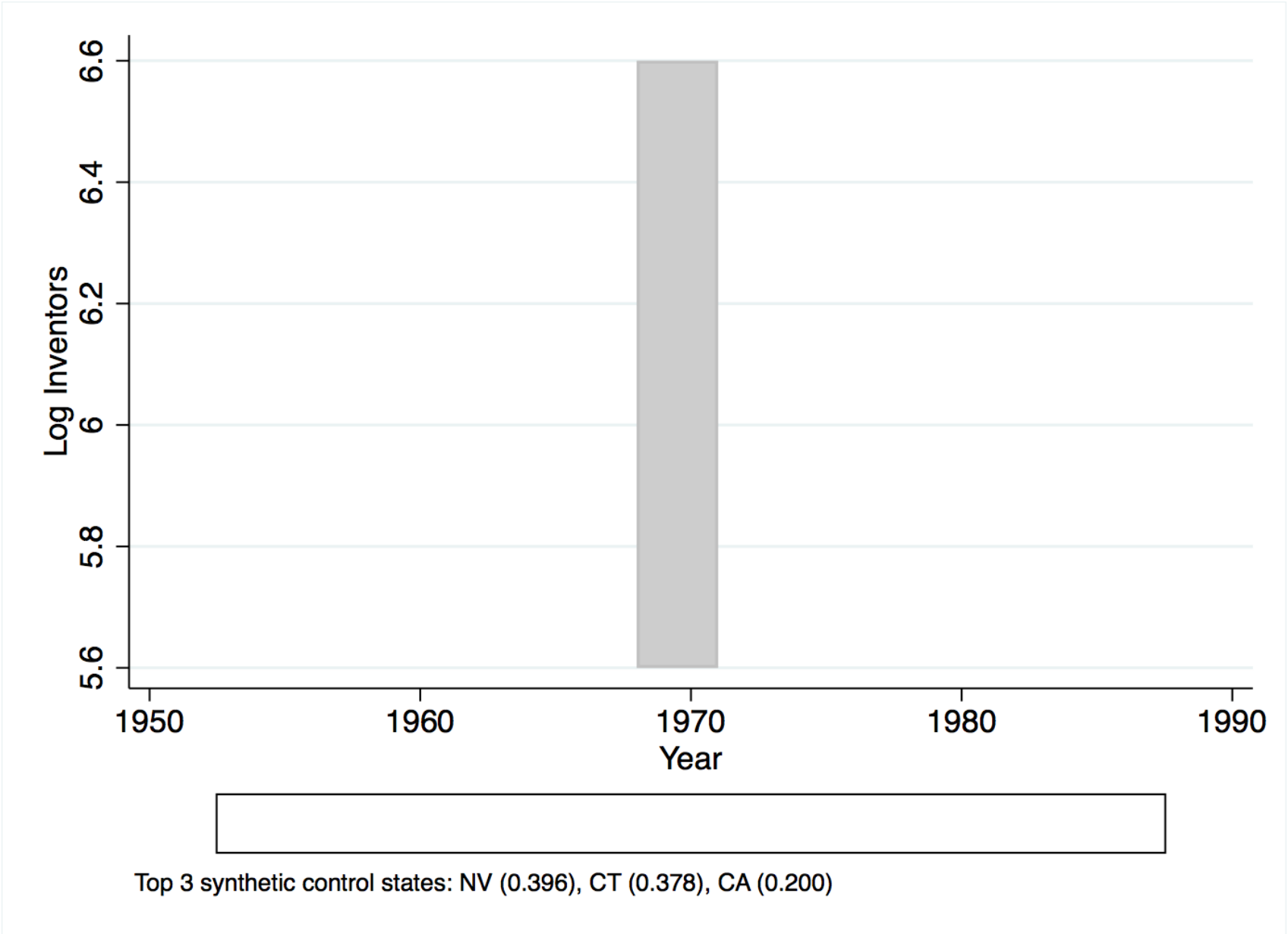
Top 3 synthetic control states: CA (0.514), PA (0.239), TX (0.116)

Citations



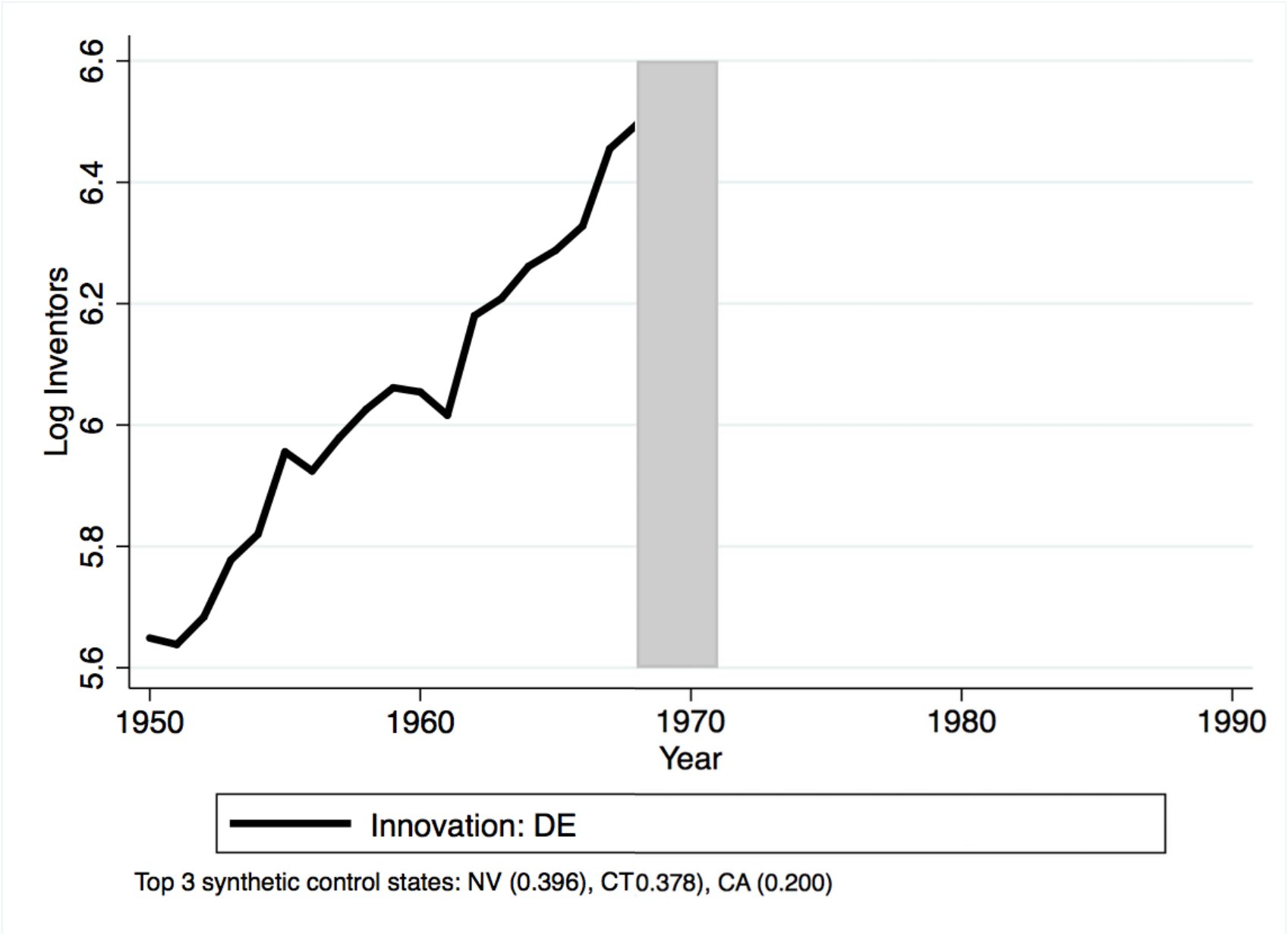
Top 3 synthetic control states: CA (0.468), OH (0.219), TX (0.077)

Delaware 1969-1970: Inventors



1969, corp tax 5% ↑ 6%, 1971 surcharge of 20%. 1970, pers. tax 11% ↑ 18%.

Delaware 1969-1970: Inventors



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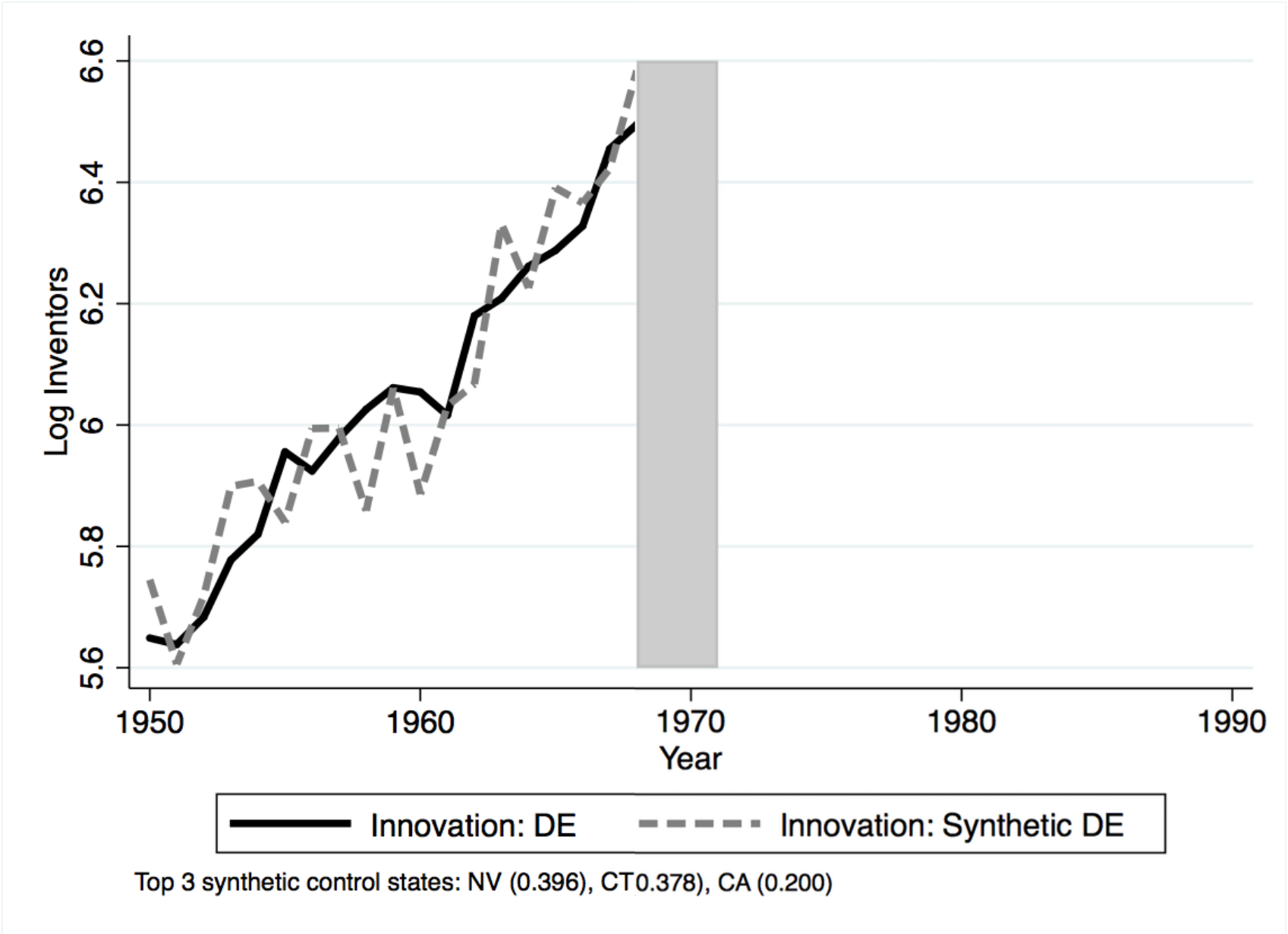

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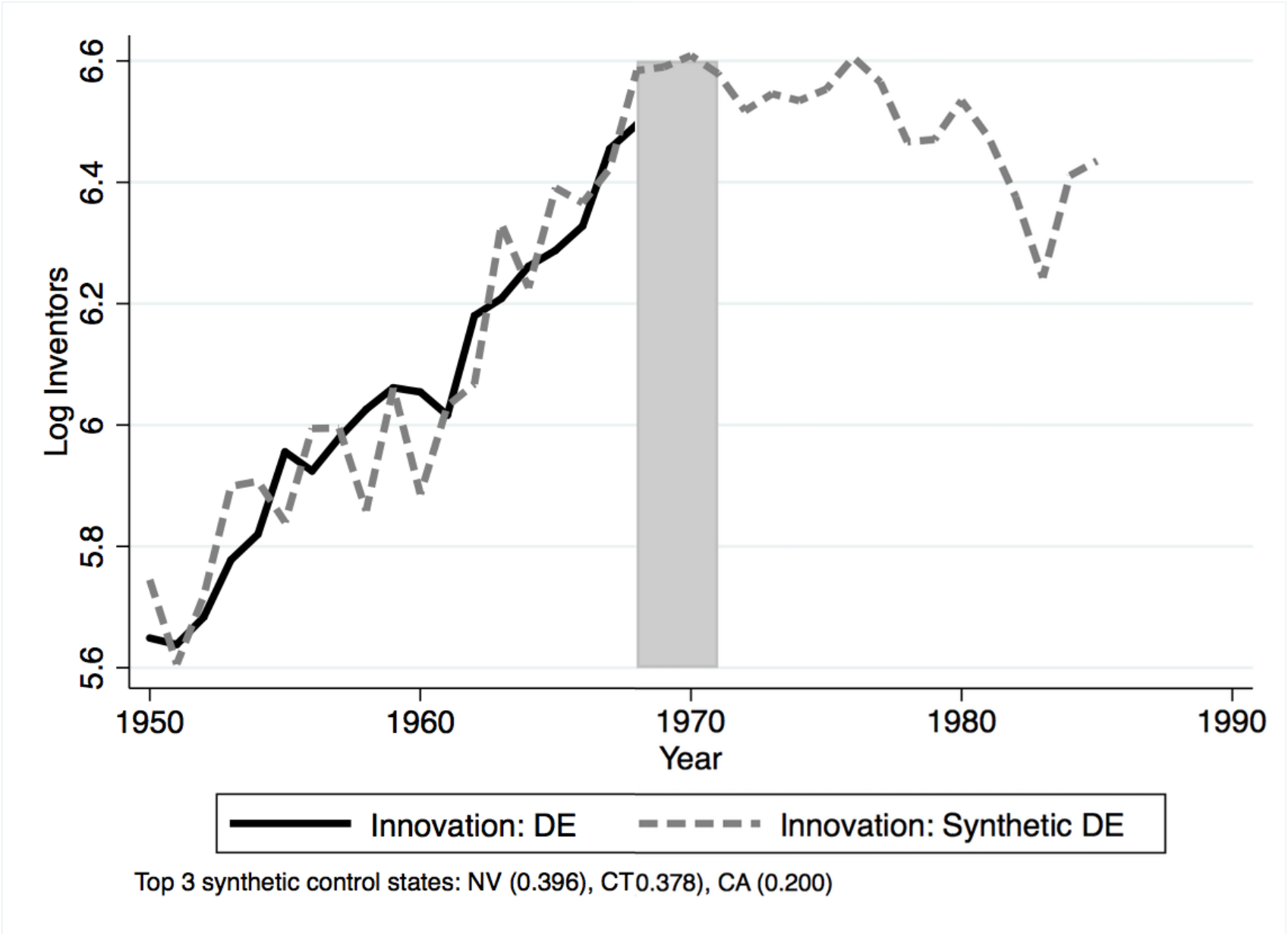

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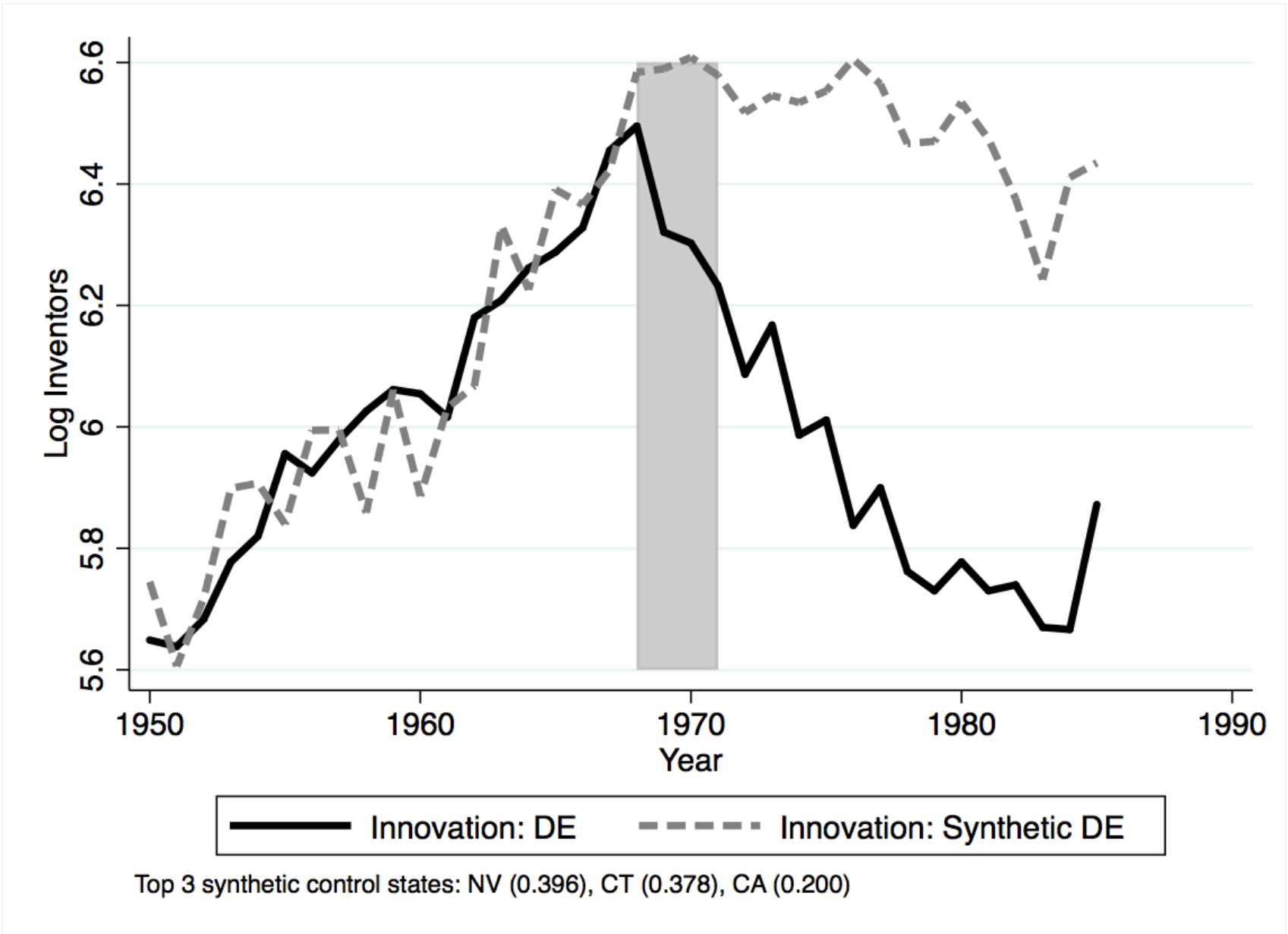

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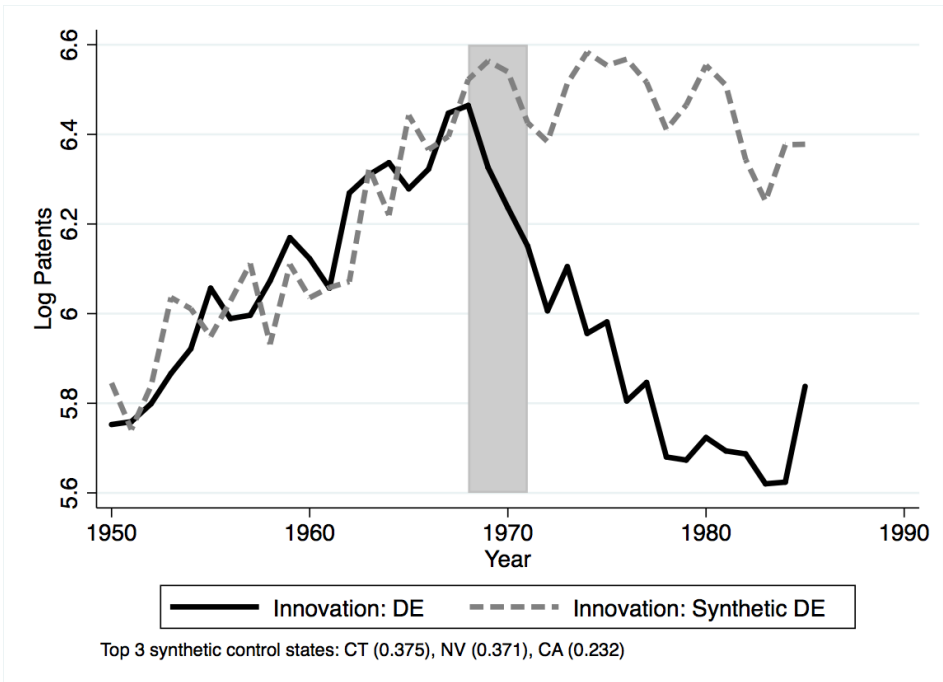
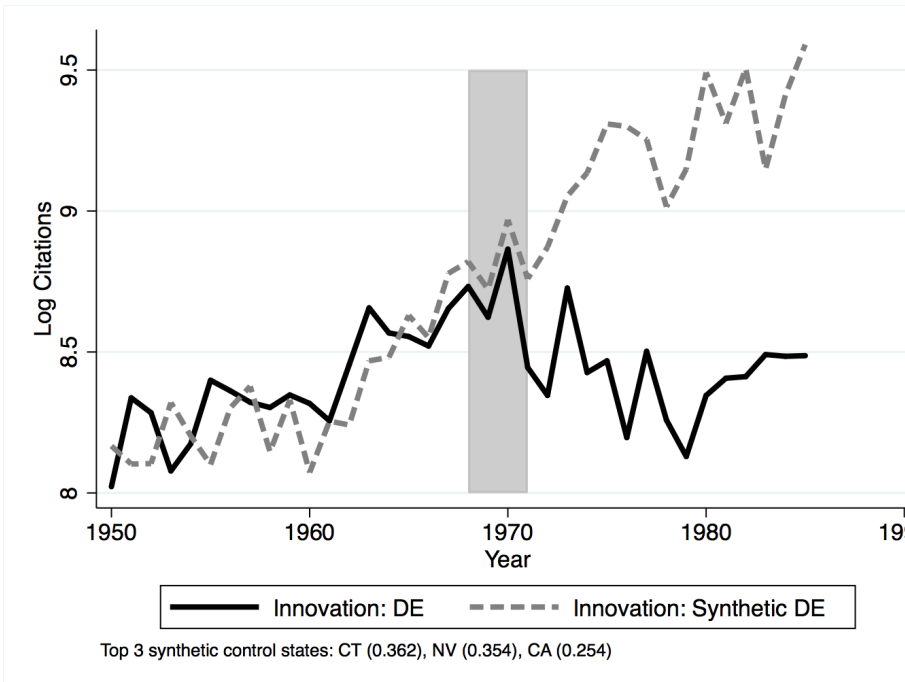
Delaware 1969-1970: Patents and Citations

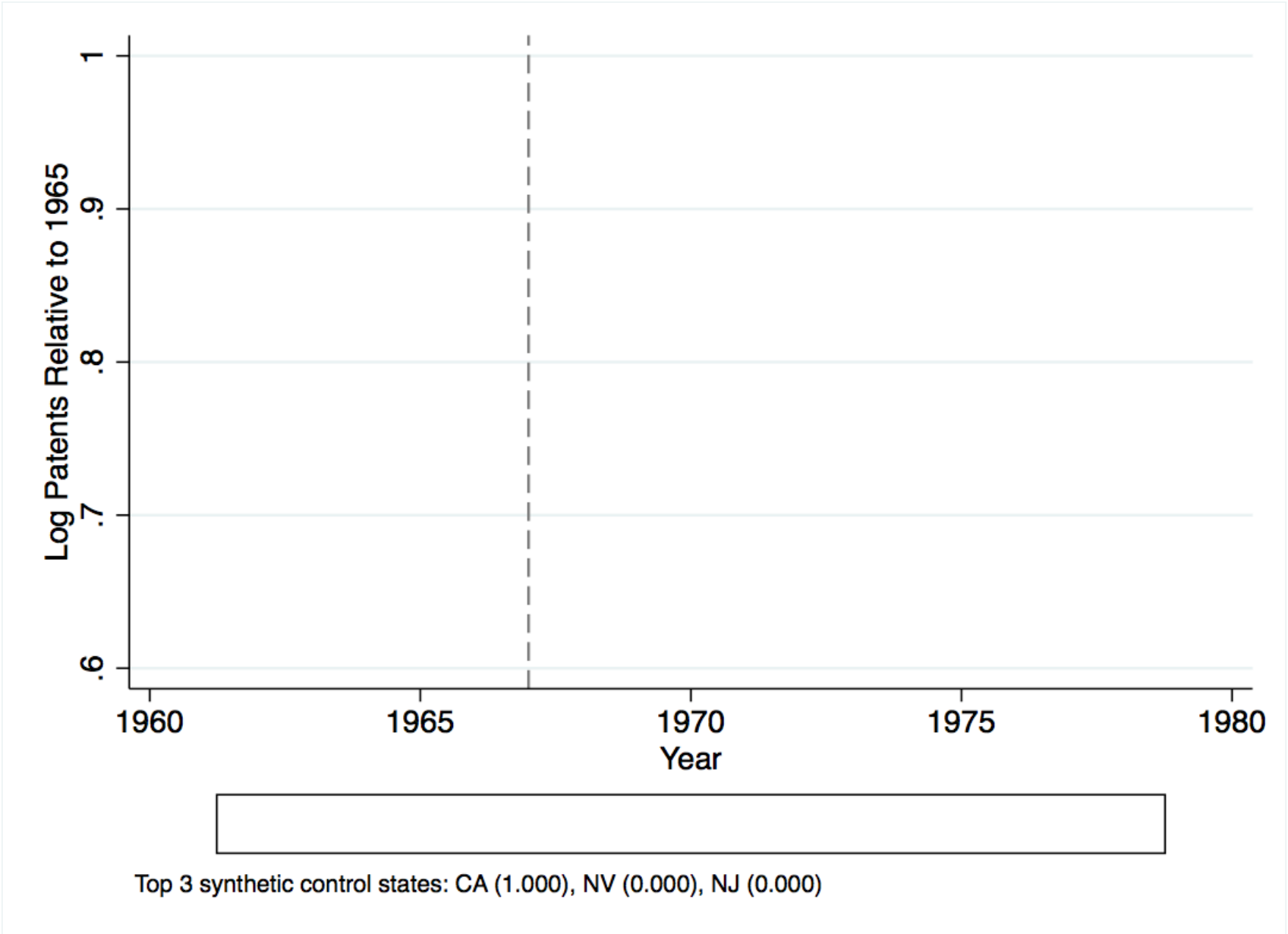
Patents



Citations

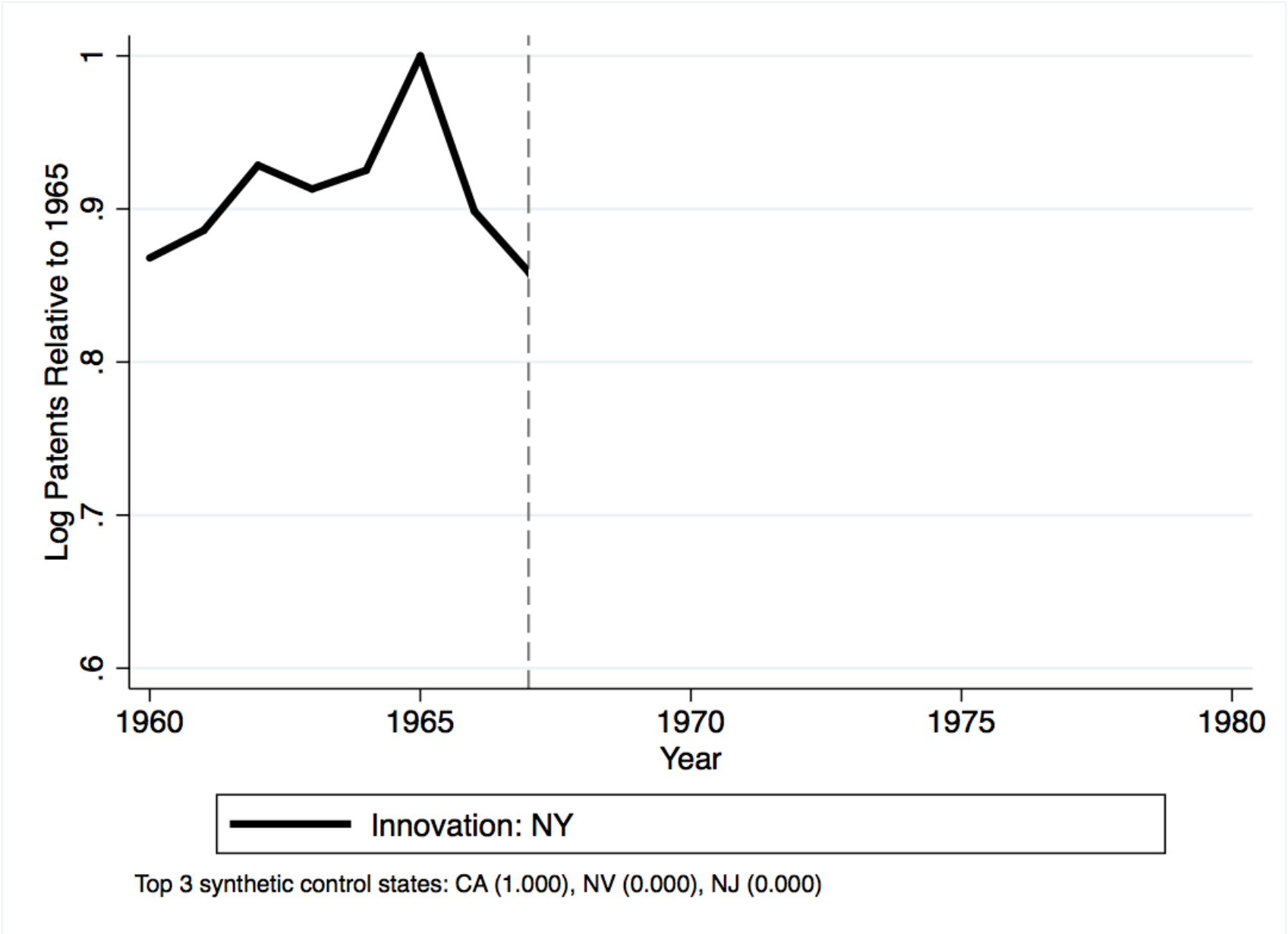


New York 1968: Patents



1968: pers. tax 10% ↑ 14%; corp tax 5.5% ↑ 7%.

New York 1968: Patents



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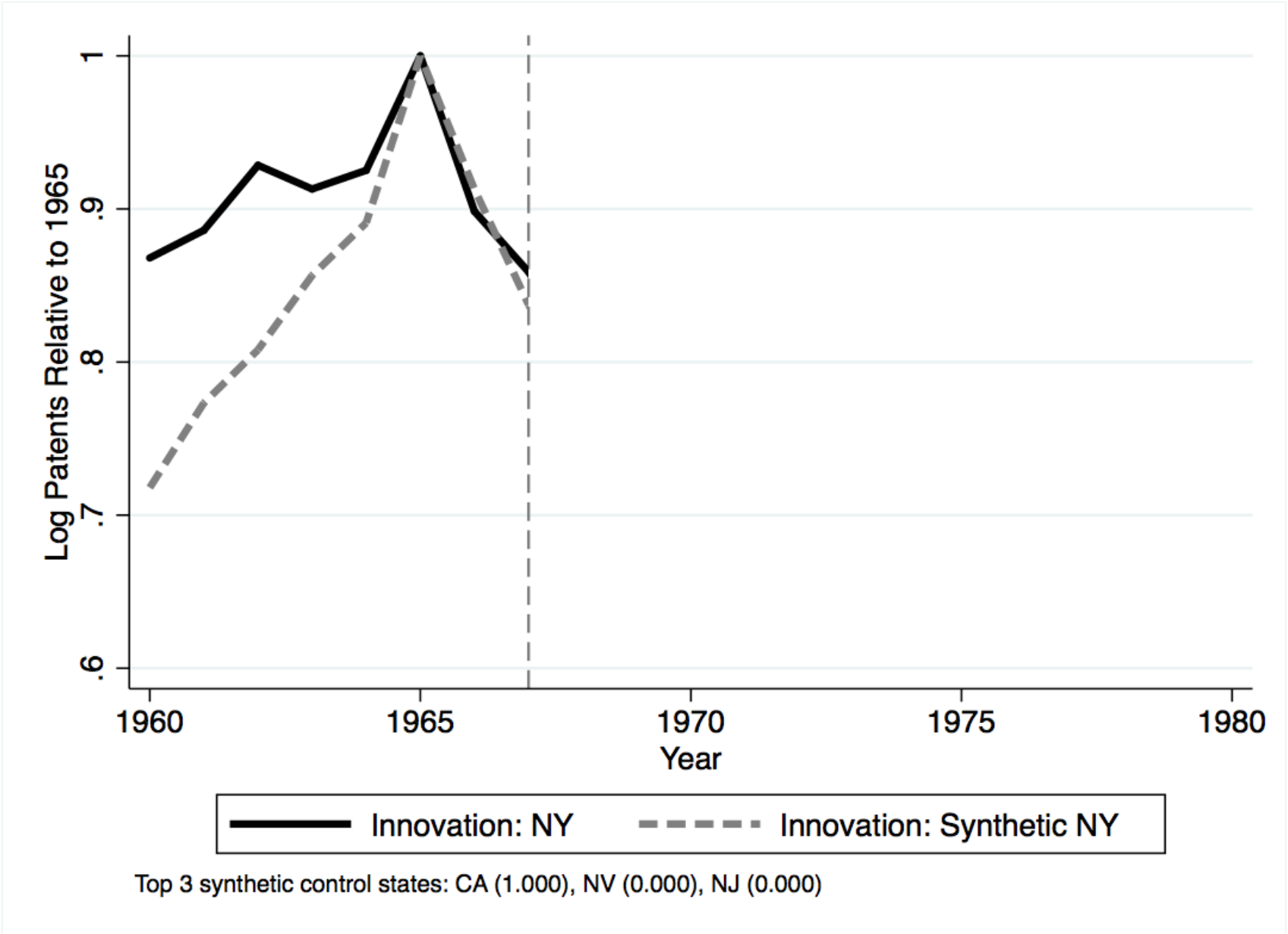
New York 1968: Patents



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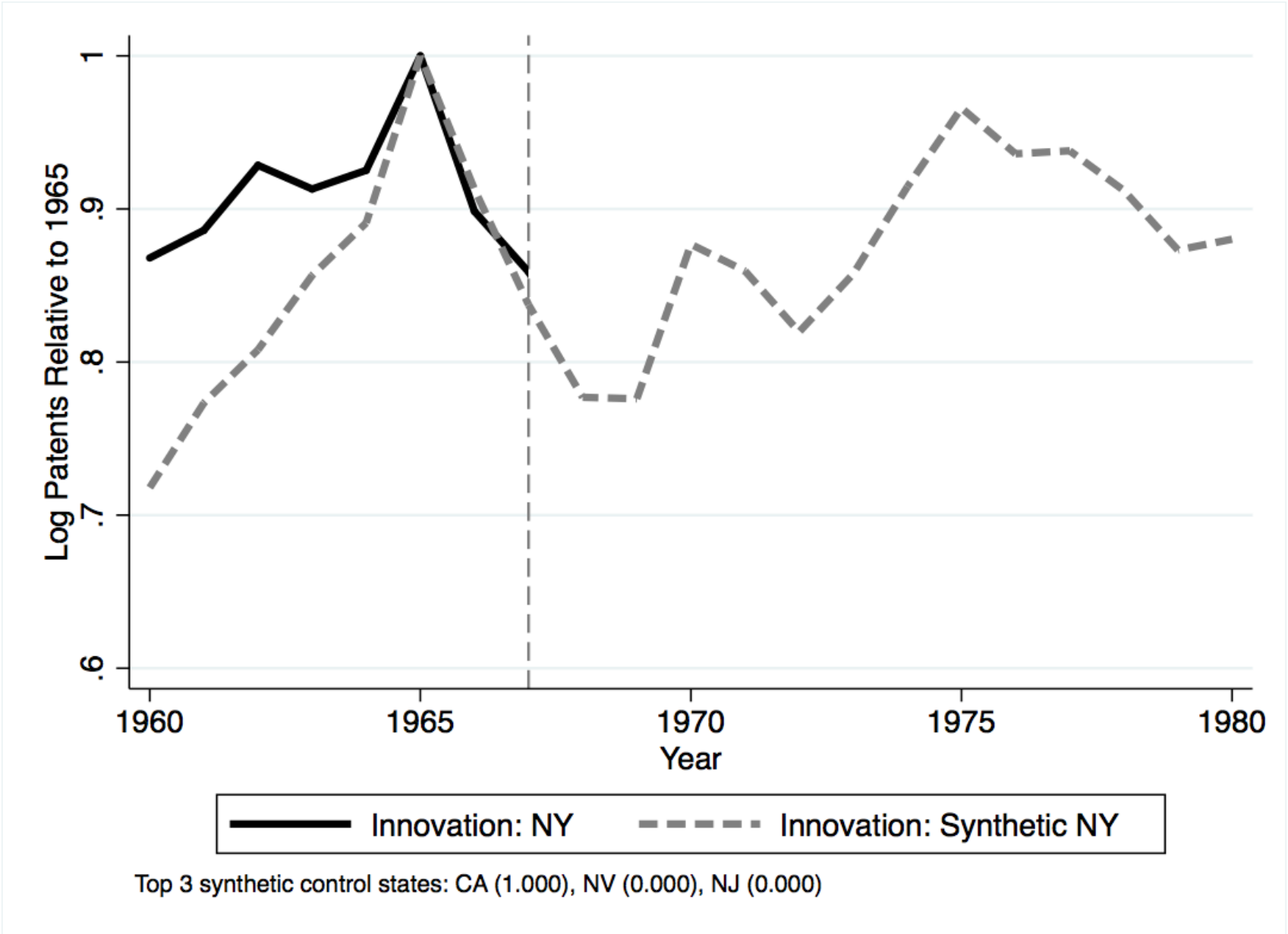

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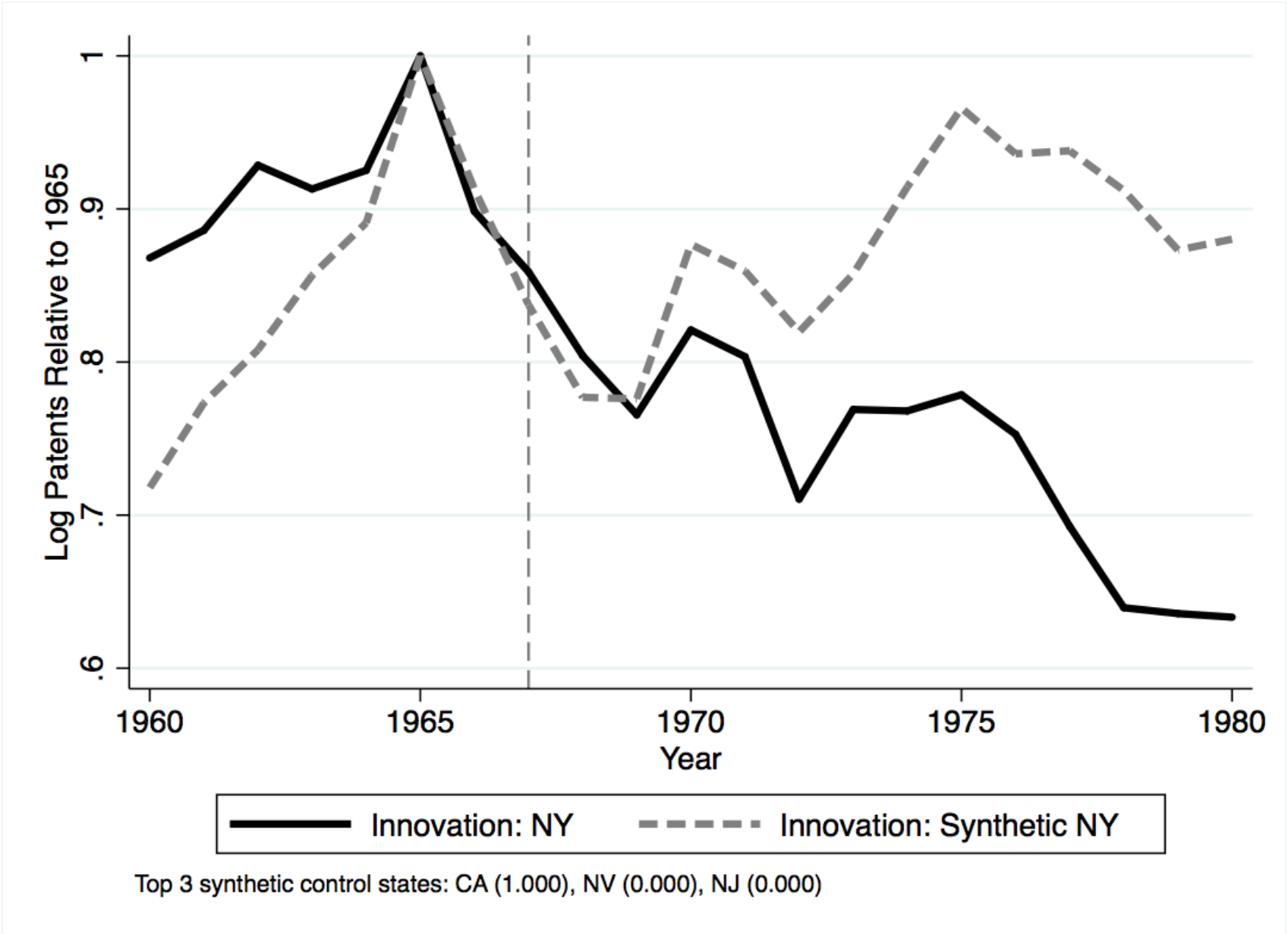
New York 1968: Patents



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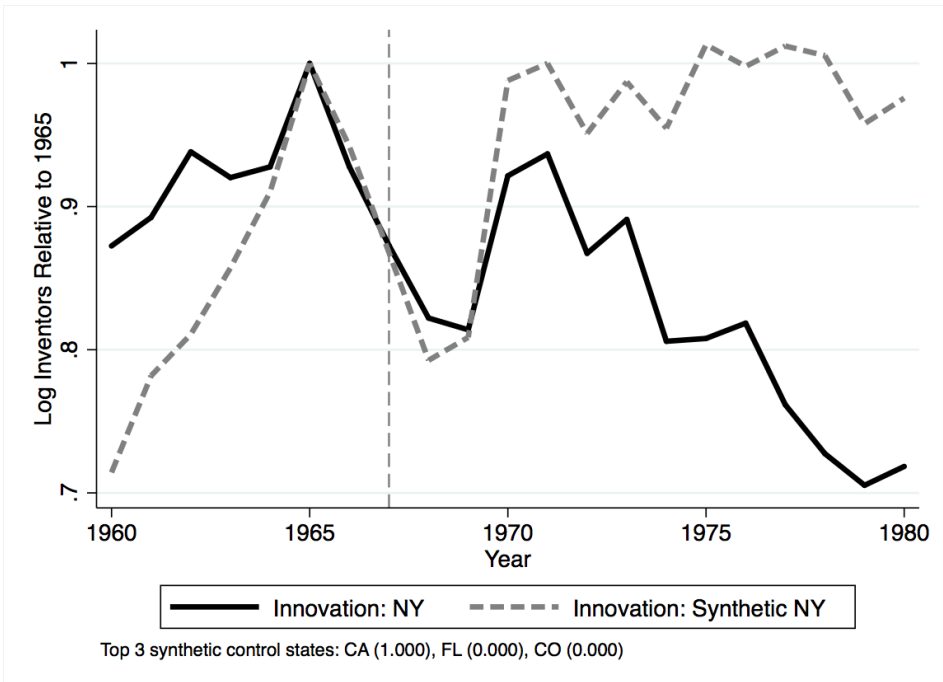
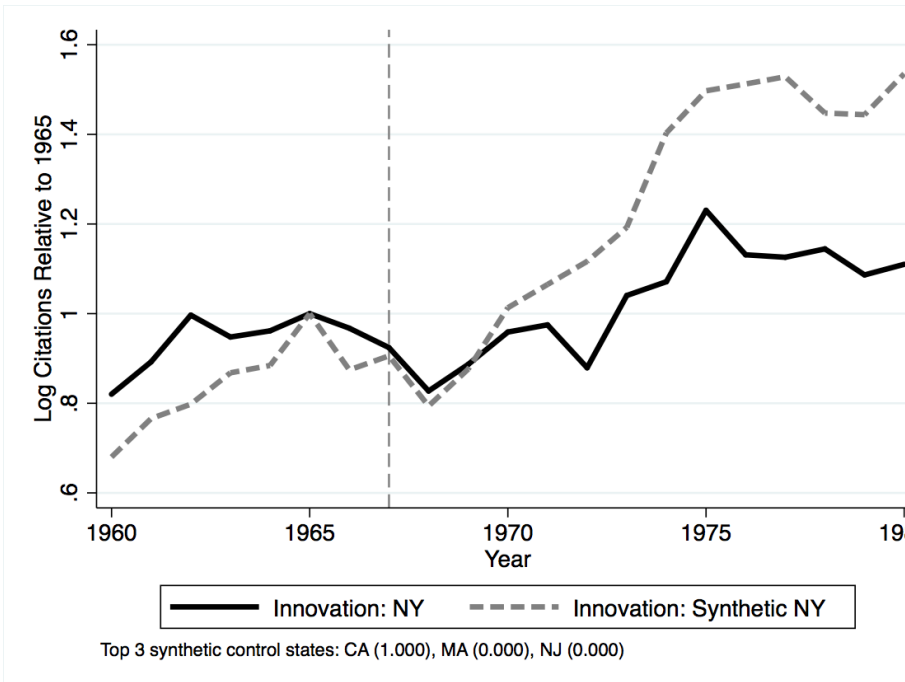
New York 1968: Inventors and Citations

Inventors



Citations



Outline

MICRO EFFECTS 1: INVENTOR-LEVEL

Assigning tax rates to individual inventors.

Established: Inventor productivity strongly related to income: ▸ Quality

Productivity can be number of patents (benchmark) or citations-weighted patents (robustness).

Bell et al. (2017) ▸ IRS, Akcigit, Grigsby and Nicholas (2017) ▸ Historical

Akcigit, Baslandze, Stantcheva (AER, 2016) ▸ EU Surveys ▸ Sweden

Rank inventors by productivity nation-wide in each year t.

Benchmark: Tax rate assigned to inventor in year t is:

90th pctile tax if if in top 10% at $t-1$; 50th pctile tax otherwise.

Robustness:

Rank state-wide.

Use cutoffs 5% and 20% instead.

Use three cutoffs: top 10% $\rightarrow$ 90th pctile tax); top 10-25% $\rightarrow$ 75th pctile tax; else $\rightarrow$ 50th pctile. tax.

At the Inventor Level: Identification in OLS and IV

Y_{ist} innovation outcome of inventor i in state s, year t, assigned to tax group j (patents, citations, etc..)

$$Y_{ist} = \alpha + \beta_y T^{yj}_{st-1} + \beta_c T^{c}_{st-1} + \gamma \mathbb{X}_{ist}$$

$\mathbb{X}_{ist}$: state + year + inventor FE, pop. density, real GDP per cap., R&D tax credits, inventor quality dummy, inventor tenure (+ square).

"Agglomeration:" number of patents (or inventors) in same tech class in state that year, excluding inventor.

Within state-year tax differences: Include state $\times$ year FE $\rightarrow$ exploit within state-year variation in taxes across agents with different incomes (productivities).

IV strategy: Total tax rate $T^{yj}_{st} \approx \tau^{yj}_{ft}(1 - \tau^{yj}_{st}) + \tau^{yj}_{st} - D^{y}_{st} \cdot \tau^{yj}_{st}\tau^{yj}_{ft}$ can be instrumented with $\hat{T}^{yj}_{st}$; same for corporate tax rate.

At the Inventor Level: Effects of Taxes ▸ IV

Dependent Variable:	Has Patent (3-year)	Has 10+ Cites (3-year)	Log Patents (3-year)	Log Citations (3-year)	Has Corporate Patent (3-yr)
	(1)	(2)	(3)	(4)	(5)
Effective MTR	-0.629***	-0.602***	-0.012***	-0.016***	-0.667***
	(0.101)	(0.109)	(0.003)	(0.003)	(0.082)
Top Corporate MTR	-0.201*	-0.100	-0.002	-0.001	-0.091
	(0.104)	(0.102)	(0.002)	(0.003)	(0.093)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.626***	-0.569***	-0.011***	-0.013***	-0.642***
	(0.103)	(0.109)	(0.003)	(0.003)	(0.084)
State × Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Observations	5956315	5956315	4545384	4392312	5956315
Mean of Dep. Var.	76.312	45.079	0.442	2.758	61.421
S.D. of Dep. Var.	42.517	49.757	0.664	1.453	48.678

At the Inventor Level: Effects of Taxes ▸ IV

Dependent Variable:	Has Patent (3-year)	Has 10+ Cites (3-year)	Log Patents (3-year)	Log Citations (3-year)	Has Corporate Patent (3-yr)
	(1)	(2)	(3)	(4)	(5)
Effective MTR	-0.629***	-0.602***	-0.012***	-0.016***	-0.667***
	(0.101)	(0.109)	(0.003)	(0.003)	(0.082)
Top Corporate MTR	-0.201*	-0.100	-0.002	-0.001	-0.091
	(0.104)	(0.102)	(0.002)	(0.003)	(0.093)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.626***	-0.569***	-0.011***	-0.013***	-0.642***
	(0.103)	(0.109)	(0.003)	(0.003)	(0.084)
State × Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Observations	5956315	5956315	4545384	4392312	5956315
Mean of Dep. Var.	76.312	45.079	0.442	2.758	61.421
S.D. of Dep. Var.	42.517	49.757	0.664	1.453	48.678

At the Inventor Level: Effects of Taxes ▸ IV

Dependent Variable:	Has Patent (3-year) (1)	Has 10+ Cites (3-year) (2)	Log Patents (3-year) (3)	Log Citations (3-year) (4)	Has Corporate Patent (3-yr) (5)
Effective MTR	-0.629***	-0.602***	-0.012***	-0.016***	-0.667***
	(0.101)	(0.109)	(0.003)	(0.003)	(0.082)
Top Corporate MTR	-0.201*	-0.100	-0.002	-0.001	-0.091
	(0.104)	(0.102)	(0.002)	(0.003)	(0.093)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.626***	-0.569***	-0.011***	-0.013***	-0.642***
	(0.103)	(0.109)	(0.003)	(0.003)	(0.084)
State × Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Observations	5956315	5956315	4545384	4392312	5956315
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State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.626***	-0.569***	-0.011***	-0.013***	-0.642***
	(0.103)	(0.109)	(0.003)	(0.003)	(0.084)
State × Year FE	Y	Y	Y	Y	Y
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Observations	5956315	5956315	4545384	4392312	5956315
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State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.626***	-0.569***	-0.011***	-0.013***	-0.642***
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Inventor FE	Y	Y	Y	Y	Y
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At the Inventor Level: Effects of Taxes

▸ IV

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Effective MTR	-0.629***	-0.602***	-0.012***	-0.016***	-0.667***
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	(0.104)	(0.102)	(0.002)	(0.003)	(0.093)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.626***	-0.569***	-0.011***	-0.013***	-0.642***
	(0.103)	(0.109)	(0.003)	(0.003)	(0.084)
State × Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Observations	5956315	5956315	4545384	4392312	5956315
Mean of Dep. Var.	76.312	45.079	0.442	2.758	61.421
S.D. of Dep. Var.	42.517	49.757	0.664	1.453	48.678

Corporate Inventors are More Elastic To Taxes

Dependent Variable:	Has Patent (3-year) (1)	Has 10+ Cites (3-year) (2)	Log Patents (3-year) (3)	Log Citations (3-year) (4)
Effective MTR	-0.075	-0.535***	-0.014***	-0.026***
	(0.203)	(0.165)	(0.003)	(0.005)
MTR × Corp. Inv.	-0.605***	-0.094	0.002	0.009***
	(0.175)	(0.114)	(0.002)	(0.003)
Top Corporate MTR	0.044	0.238	0.005*	0.013**
	(0.177)	(0.143)	(0.003)	(0.005)
Corp. MTR × Corp. Inv.	-0.201	-0.348***	-0.007***	-0.015***
	(0.173)	(0.105)	(0.002)	(0.004)
State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y

Dependent Variable:	Has Patent (3-year) (1)	Has 10+ Cites (3-year) (2)	Log Patents (3-year) (3)	Log Citations (3-year) (4)
Effective MTR	0.053	-0.298**	-0.009***	-0.015***
	(0.156)	(0.135)	(0.003)	(0.003)
MTR × Corp. Inv.	-0.708***	-0.285***	-0.002**	0.002
	(0.106)	(0.046)	(0.001)	(0.001)
State × Year FE	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y

Corporate Inventors are More Elastic To Taxes

Dependent Variable:	Has Patent (3-year) (1)	Has 10+ Cites (3-year) (2)	Log Patents (3-year) (3)	Log Citations (3-year) (4)
Effective MTR	-0.075	-0.535***	-0.014***	-0.026***
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MTR × Corp. Inv.	-0.605***	-0.094	0.002	0.009***
	(0.175)	(0.114)	(0.002)	(0.003)
Top Corporate MTR	0.044	0.238	0.005*	0.013**
	(0.177)	(0.143)	(0.003)	(0.005)
Corp. MTR × Corp. Inv.	-0.201	-0.348***	-0.007***	-0.015***
	(0.173)	(0.105)	(0.002)	(0.004)
State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y

Dependent Variable:	Has Patent (3-year) (1)	Has 10+ Cites (3-year) (2)	Log Patents (3-year) (3)	Log Citations (3-year) (4)
Effective MTR	0.053	-0.298**	-0.009***	-0.015***
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MTR × Corp. Inv.	-0.708***	-0.285***	-0.002**	0.002
	(0.106)	(0.046)	(0.001)	(0.001)
State × Year FE	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y

Agglomeration Effects Dampen the Effects of Taxes

Dependent Variable:	Has Patent (3-year)	Has 10+ Cites (3-year)	Log Patents (3-year)	Log Citations (3-year)	Has Corporate Patent (3-yr)
	(1)	(2)	(3)	(4)	(5)
Effective MTR	-0.635***	-0.620***	-0.012***	-0.017***	-0.669***
	(0.102)	(0.109)	(0.003)	(0.003)	(0.083)
Effective MTR × Agglom.	0.082	0.277***	0.004*	0.006*	0.022
	(0.061)	(0.080)	(0.002)	(0.003)	(0.057)
Top Corporate MTR	-0.200*	-0.098	-0.002	-0.001	-0.091
	(0.104)	(0.102)	(0.002)	(0.003)	(0.093)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.634***	-0.591***	-0.011***	-0.014***	-0.646***
	(0.104)	(0.109)	(0.003)	(0.003)	(0.084)
Effective MTR × Agglom.	0.114*	0.325***	0.004*	0.008**	0.058
	(0.064)	(0.085)	(0.002)	(0.003)	(0.057)
State × Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Observations	5960366	5960366	4548116	4394959	5960366
Mean of Dep. Var.	76.306	45.078	0.442	2.758	61.408
S.D. of Dep. Var.	42.521	49.757	0.664	1.454	48.681

Agglomeration Effects Dampen the Effects of Taxes

Dependent Variable:	Has Patent (3-year)	Has 10+ Cites (3-year)	Log Patents (3-year)	Log Citations (3-year)	Has Corporate Patent (3-yr)
	(1)	(2)	(3)	(4)	(5)
Effective MTR	-0.635***	-0.620***	-0.012***	-0.017***	-0.669***
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	(0.104)	(0.102)	(0.002)	(0.003)	(0.093)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.634***	-0.591***	-0.011***	-0.014***	-0.646***
	(0.104)	(0.109)	(0.003)	(0.003)	(0.084)
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Location Choice Model

Value to inventor i of inventing in state s in year t is

$$U_{ist} = \alpha \log\left(\text{Eff. Tax}_{st}^{i}\right) + \beta_s \mathbf{x}_{ist} + \nu_{ist}$$

Location Choice Model

Value to inventor i of inventing in state s in year t is

$$U_{ist} = \alpha \log\left(\text{Eff. Tax}^{i}_{st}\right) + \beta_s \mathbf{x}_{ist} + \nu_{ist}$$

If ν_{ist} i.i.d. distributed Type 1 Extreme Value, can estimate

$$Pr\{i \text{ chooses } s \text{ in } t\} = \frac{\exp\left(\alpha \log\left(\text{Eff. Tax}^{i}_{st}\right) + \beta_s \mathbf{x}_{ist}\right)}{\sum_{s'} \exp\left(\alpha \log\left(\text{Eff. Tax}^{i}_{s't}\right) + \beta'_s \mathbf{x}_{is't}\right)}$$

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Value to inventor i of inventing in state s in year t is

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- Location choice estimated on *15 most inventive states*, as measured by total patents (1940-2000), including only progressive spells.
  - $\Rightarrow$ California, Massachusetts, Maryland, Minnesota, New York, New Jersey, Ohio, Wisconsin.
- Controls: home state, agglomeration forces, high productivity dummy, agglomeration $\times$ high productivity, quadratic in experience $\times$ state FE, corporate inventor, assigne has patent dummy, state $\times$ year FE.

Location Choice Model: Results

	(1)	(2)	(3)	(4)	(5)
Effective ATR	-0.093***	-0.025**	-0.026**	-0.026**	-0.121***
	(0.009)	(0.012)	(0.012)	(0.012)	(0.013)
Agglomeration Forces	1.217***	1.216***	1.216***	0.994***	1.112***
	(0.029)	(0.030)	(0.030)	(0.072)	(0.030)
Home State Flag	3.866***	3.868***	3.869***	3.868***	3.690***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Interaction coefficients:					
Non-Corporate Inventor			0.071***		
			(0.017)		
Agglomeration				0.016***	
				(0.004)	
Assignee Has Patent					0.130***
					(0.001)
Fixed Effects	State + Year	State × Year	State × Year	State × Year	State × Year
Observations	1951513	1951513	1951513	1951513	1951513

Elasticity to $1-\tau$ number of inventors residing in state is 0.11 (s.e. 0.058) for inventors from state and 1.23 (s.e. 0.655) for inventors not from state.

Location Choice Model: Results

	(1)	(2)	(3)	(4)	(5)
Effective ATR	-0.093***	-0.025**	-0.026**	-0.026**	-0.121***
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MICRO EFFECTS 2: FIRM-LEVEL

At the Firm Level: OLS and IV Results

Dependent Variable:	# of Patents (1)	Log Patents (2)	# of Citations (3)	Log Citations (4)	# of Research Workers (5)	Location Choice (6)
Panel A: OLS						
Top Corporate MTR	-0.392**	-0.042***	-23.524***	-0.039***	-9.829	-0.026**
	(0.171)	(0.012)	(4.282)	(0.015)	(7.948)	(0.013)
90th Percentile MTR	0.076	0.018	-1.318	0.013	-9.655**	-0.049***
	(0.105)	(0.011)	(3.691)	(0.014)	(3.826)	(0.015)
50th Percentile MTR	-0.331**	-0.028	-9.097*	-0.025	-9.749	-0.072***
	(0.162)	(0.018)	(5.310)	(0.022)	(7.062)	(0.035)
Observations	147777	34572	147777	33679	28918	11901
Panel B: Instrumental Variables						
Top Corporate MTR	-0.639**	-0.059***	-31.352***	-0.053**	-42.246**	
	(0.299)	(0.017)	(6.325)	(0.021)	(18.718)	
90th Percentile MTR	0.089	0.024*	2.059	0.021	-5.977*	
	(0.118)	(0.013)	(4.035)	(0.016)	(3.506)	
50th Percentile MTR	-0.375	-0.025	-16.512***	-0.022	-40.111**	
	(0.229)	(0.022)	(6.384)	(0.028)	(16.158)	
State FE	Y	Y	Y	Y	Y	
Year FE	Y	Y	Y	Y	Y	

At the Firm Level: OLS and IV Results

Dependent Variable:	# of Patents (1)	Log Patents (2)	# of Citations (3)	Log Citations (4)	# of Research Workers (5)	Location Choice (6)
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90th Percentile MTR	0.089	0.024*	2.059	0.021	-5.977*	
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50th Percentile MTR	-0.375	-0.025	-16.512***	-0.022	-40.111**	
	(0.229)	(0.022)	(6.384)	(0.028)	(16.158)	
State FE	Y	Y	Y	Y	Y	
Year FE	Y	Y	Y	Y	Y	

At the Firm Level: OLS and IV Results

Dependent Variable:	# of Patents (1)	Log Patents (2)	# of Citations (3)	Log Citations (4)	# of Research Workers (5)	Location Choice (6)
Panel A: OLS						
Top Corporate MTR	-0.392**	-0.042***	-23.524***	-0.039***	-9.829	-0.026**
	(0.171)	(0.012)	(4.282)	(0.015)	(7.948)	(0.013)
90th Percentile MTR	0.076	0.018	-1.318	0.013	-9.655**	-0.049***
	(0.105)	(0.011)	(3.691)	(0.014)	(3.826)	(0.015)
50th Percentile MTR	-0.331**	-0.028	-9.097*	-0.025	-9.749	-0.072***
	(0.162)	(0.018)	(5.310)	(0.022)	(7.062)	(0.035)
Observations	147777	34572	147777	33679	28918	11901
Panel B: Instrumental Variables						
Top Corporate MTR	-0.639**	-0.059***	-31.352***	-0.053**	-42.246**	
	(0.299)	(0.017)	(6.325)	(0.021)	(18.718)	
90th Percentile MTR	0.089	0.024*	2.059	0.021	-5.977*	
	(0.118)	(0.013)	(4.035)	(0.016)	(3.506)	
50th Percentile MTR	-0.375	-0.025	-16.512***	-0.022	-40.111**	
	(0.229)	(0.022)	(6.384)	(0.028)	(16.158)	
State FE	Y	Y	Y	Y	Y	
Year FE	Y	Y	Y	Y	Y	

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State FE	Y	Y	Y	Y	Y	
Year FE	Y	Y	Y	Y	Y	

Conclusion

Taxes matter for innovation.

- At the macro and micro levels (individual firm and inventor level).
- Quantity, quality, and location choices are affected.

Identification based on exploiting different taxes within state-year cells (individual tax brackets for the personal income tax), IV using federal tax changes, sharp episodes, and border county strategy.

Corporate inventors more sensitive to all taxes.

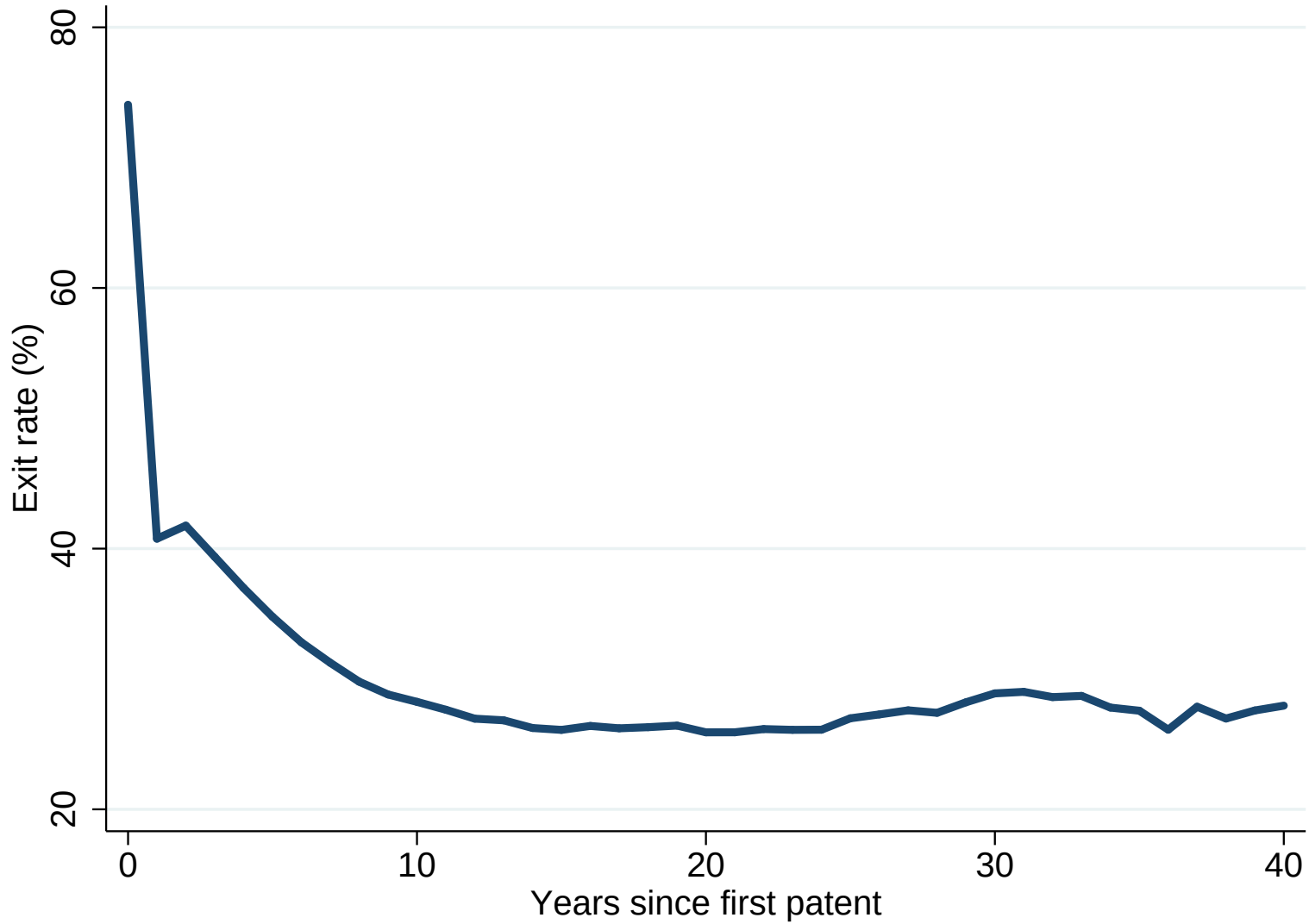
Spillovers across states important, but not the full story.

Agglomeration also matters.

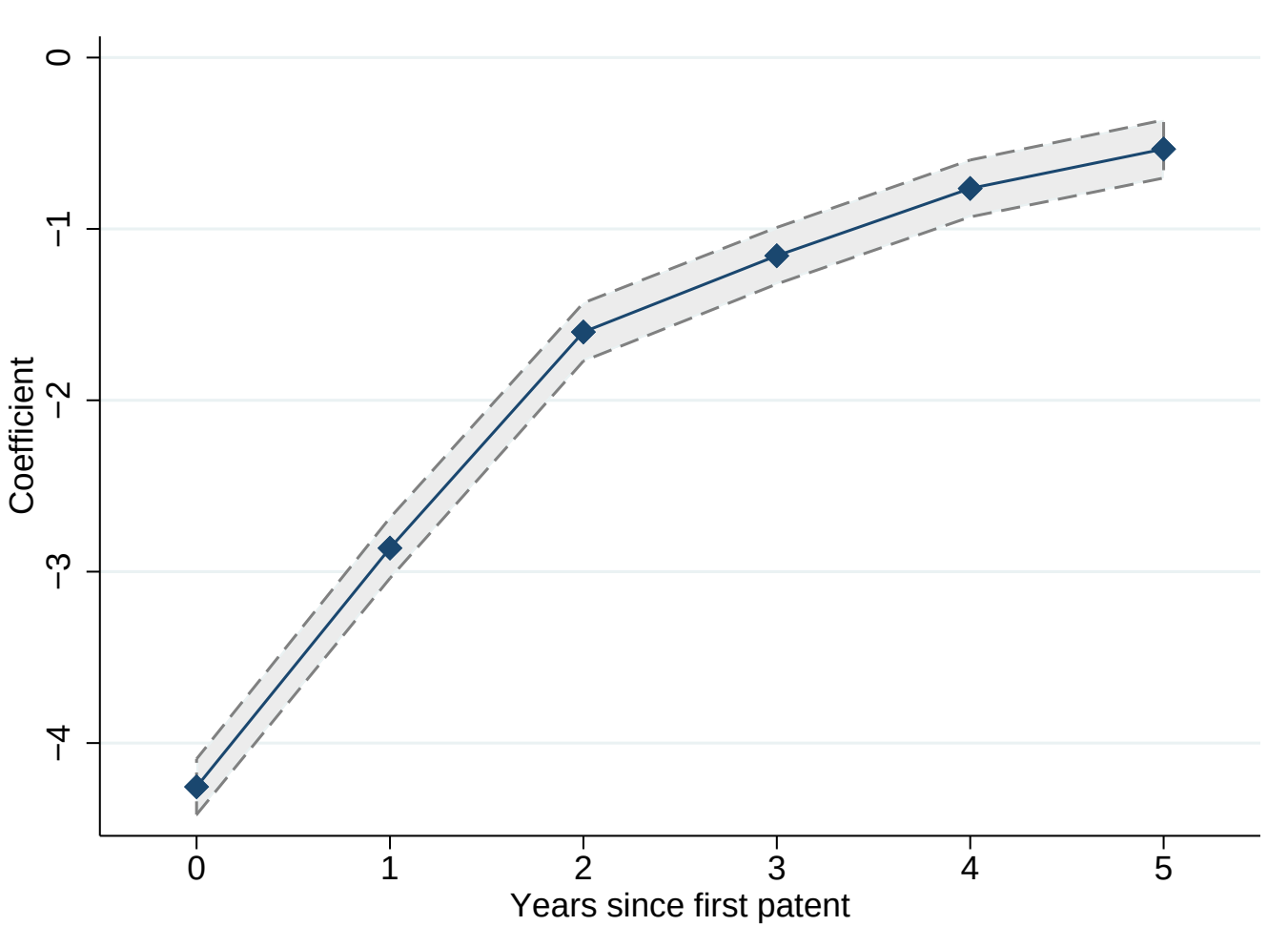
What are long-run implications of this when thinking about tax policy?

APPENDIX

Probability of Exit over the Career Cycle

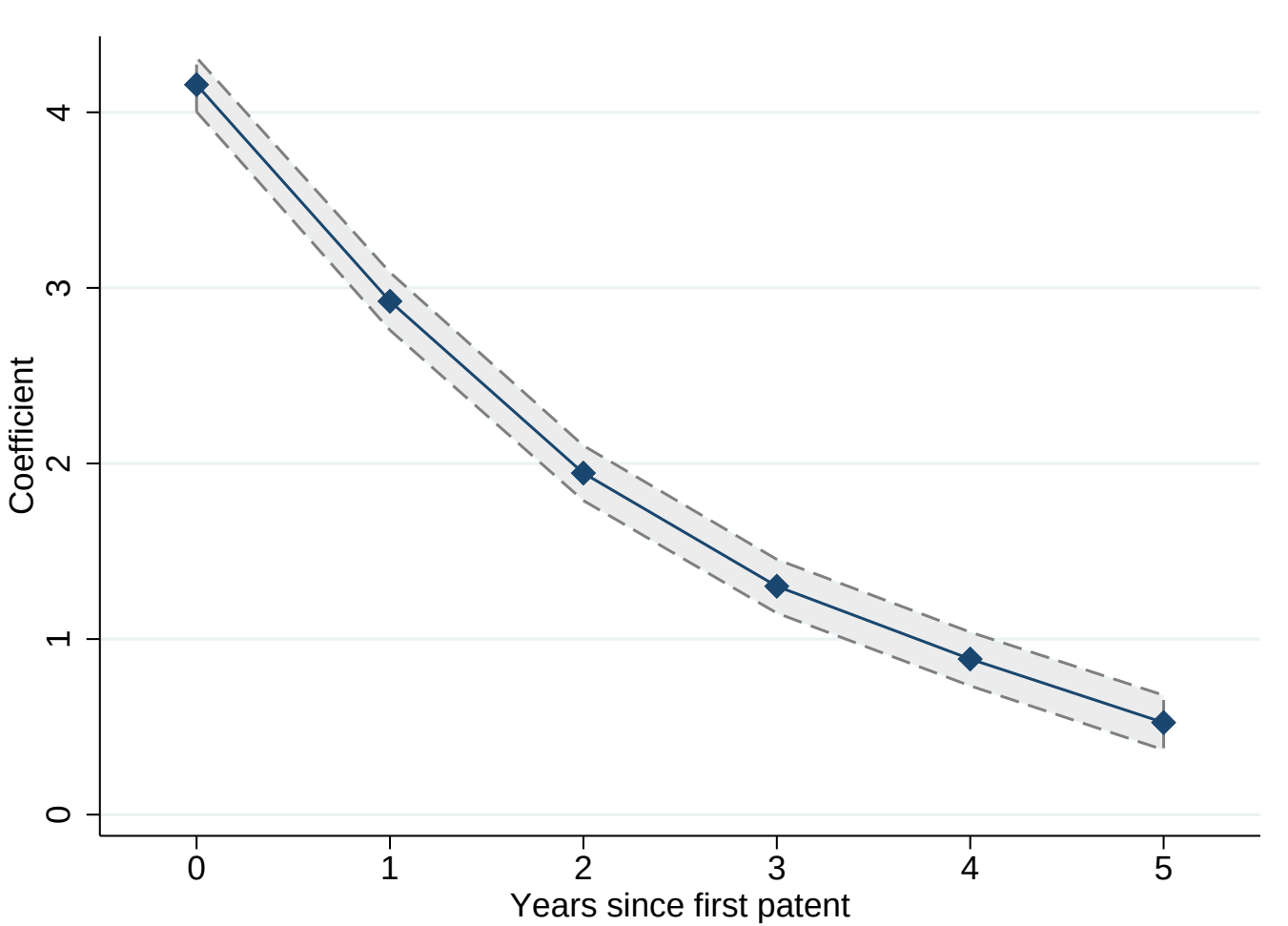


Probability of Low Quality Patent Throughout Career



Plots regression coefficients from a patent level regression of $\mathbf{1}\{\text{Patent in } 1^{st} \text{ quartile of citations}\}$ on inventor fixed effects, technology class $\times$ year fixed effects, and year of career effects.: 6+ years into career.

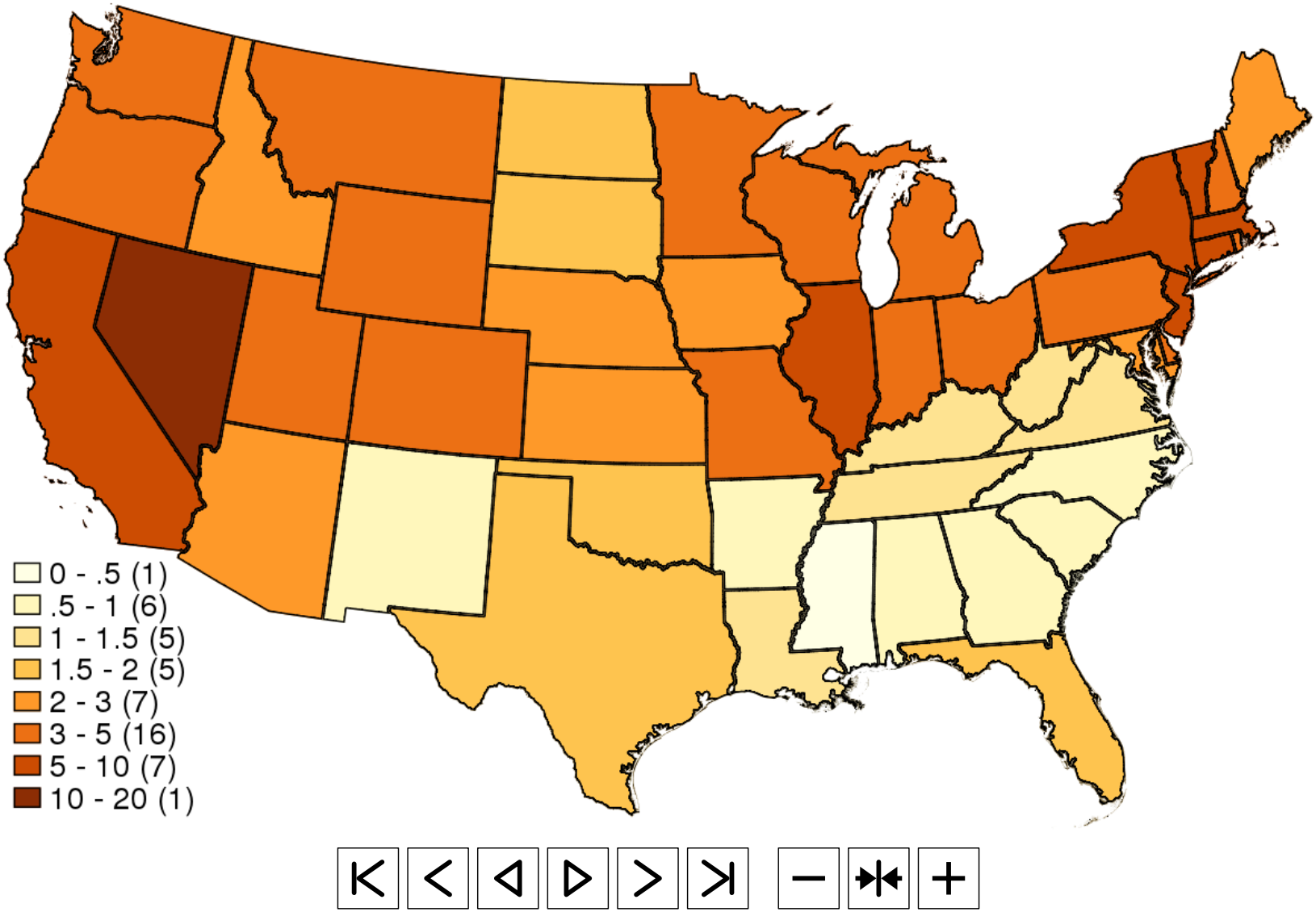
Probability of High Quality Patent Throughout Career



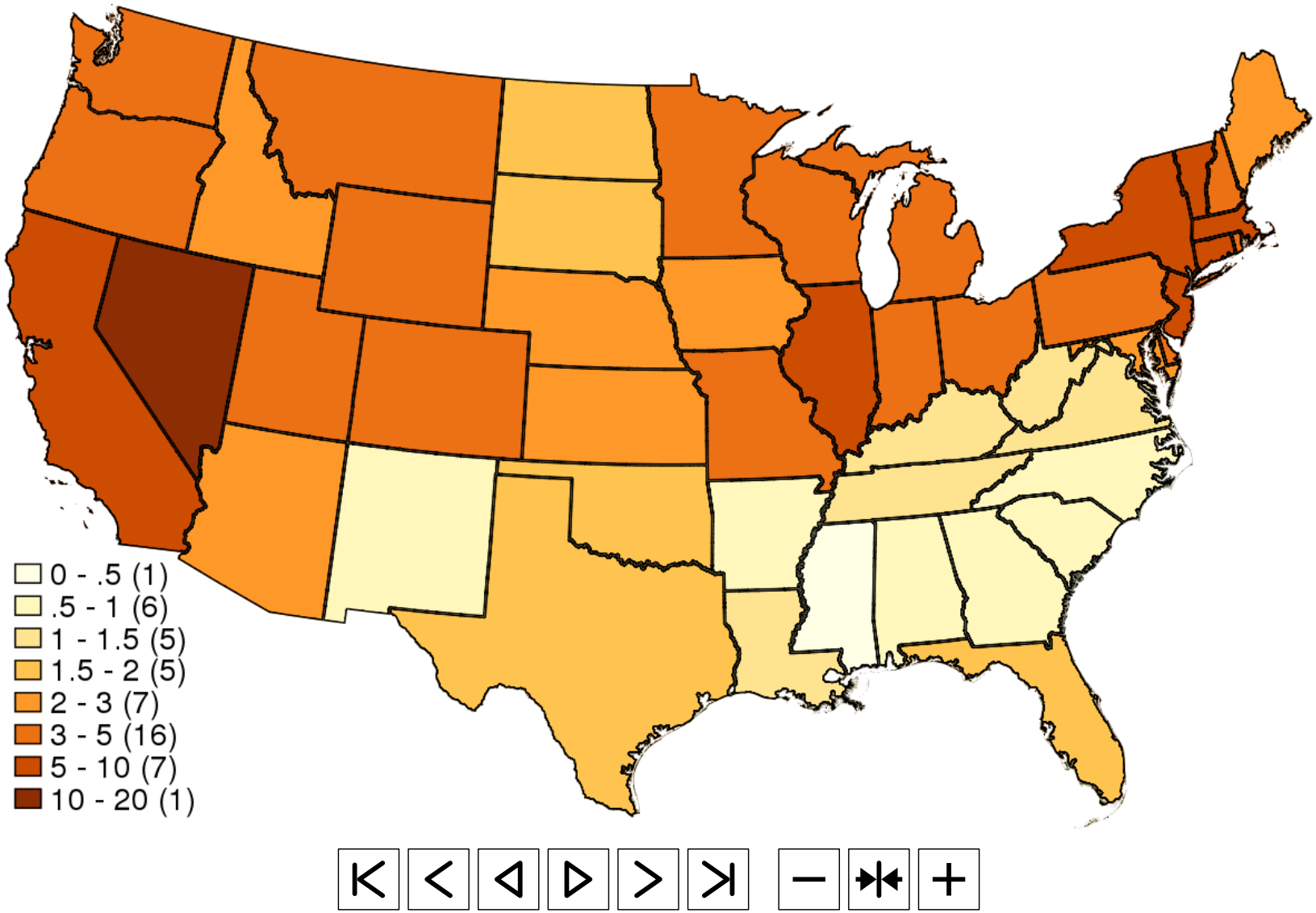
Plots regression coefficients from a patent level regression of $\mathbf{1}\{\text{Patent in } 4^{th} \text{ quartile of citations}\}$ on inventor fixed effects, technology class $\times$ year fixed effects, and year of career effects.: 6+ years into career.

Geography of innovation. Patents per 10,000: 1920

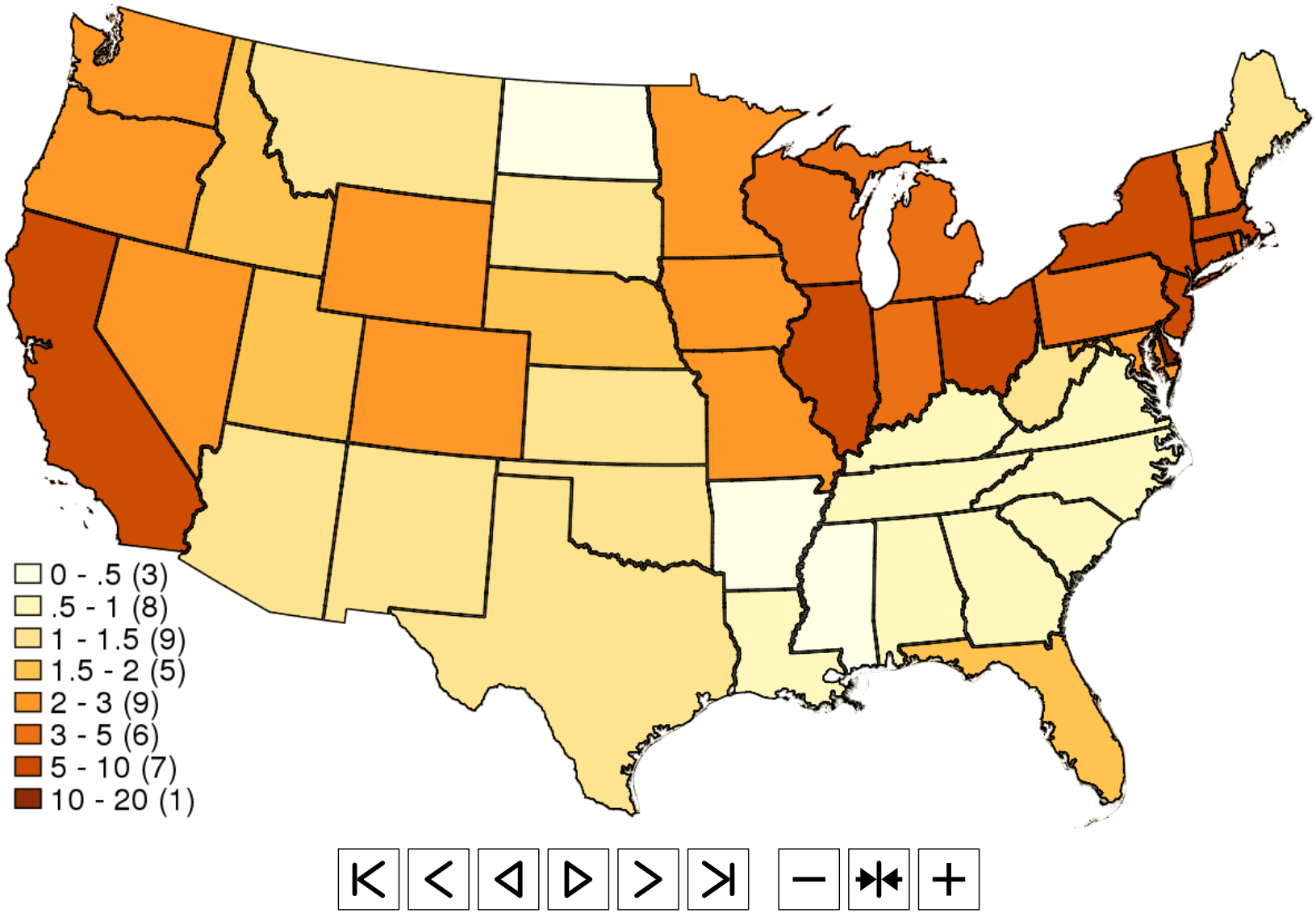
Back



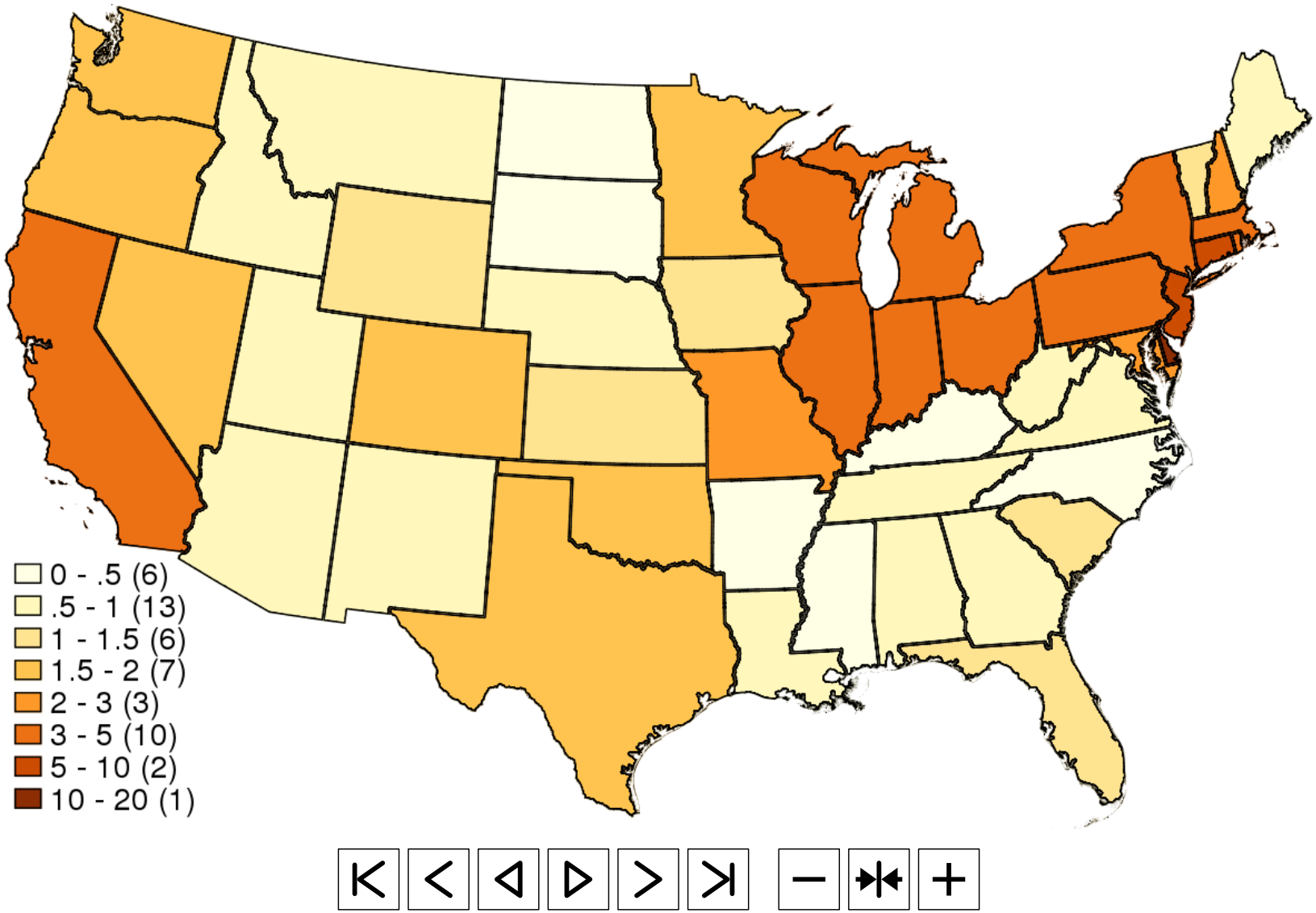
Geography of innovation. Patents per 10,000: 1920-1930



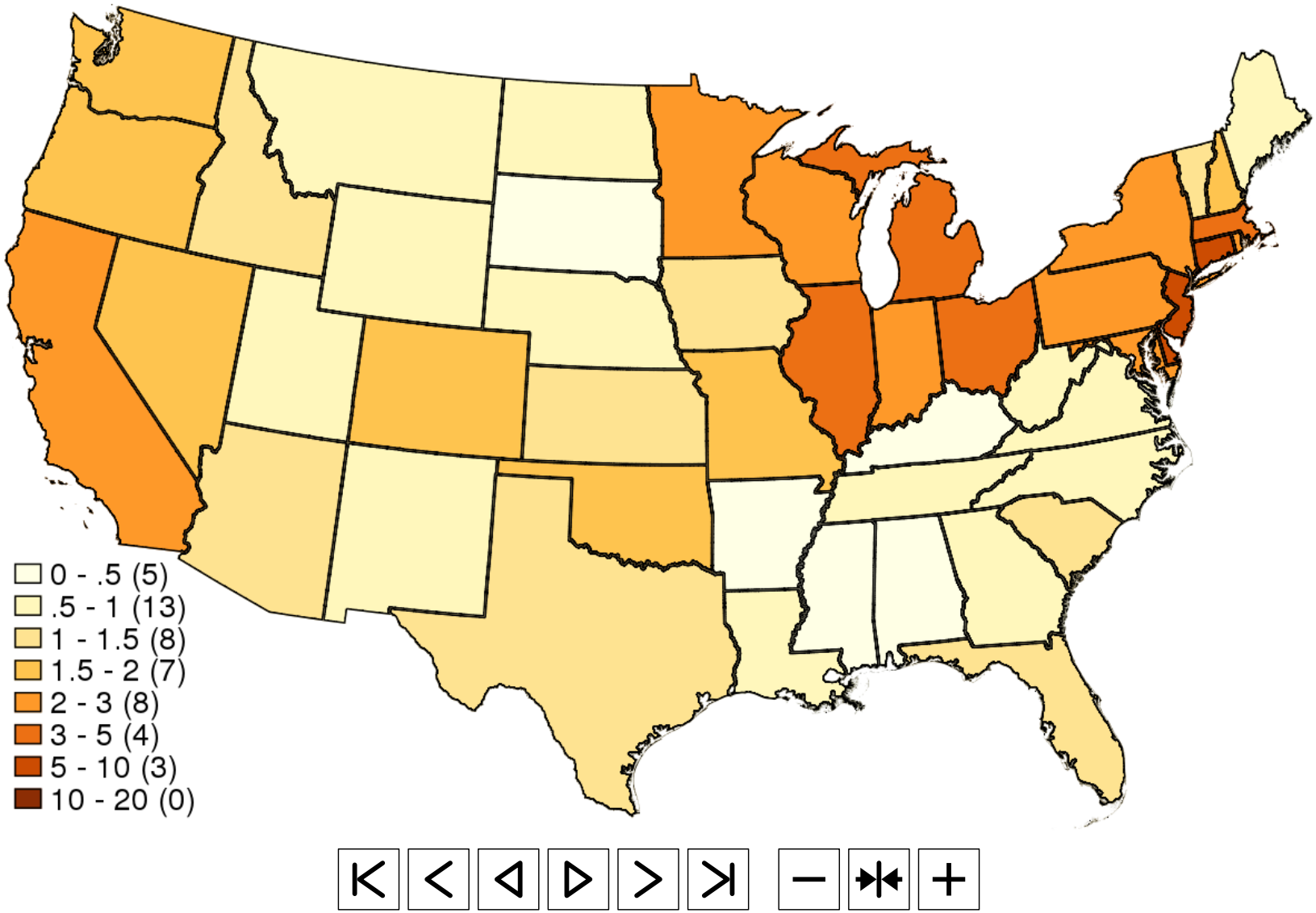
Geography of innovation. Patents per 10,000: 1930-1940



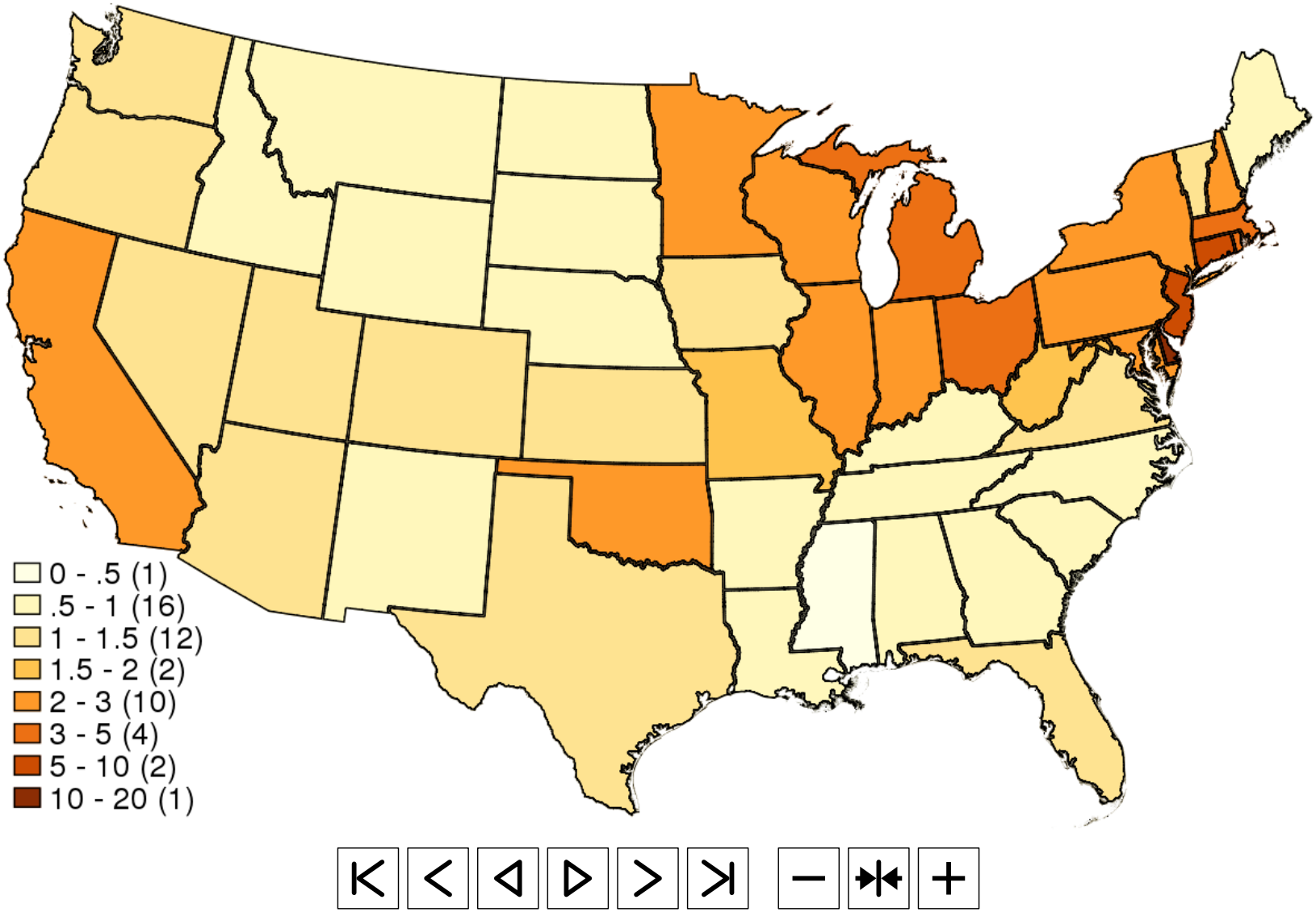
Geography of innovation. Patents per 10,000: 1940-1950



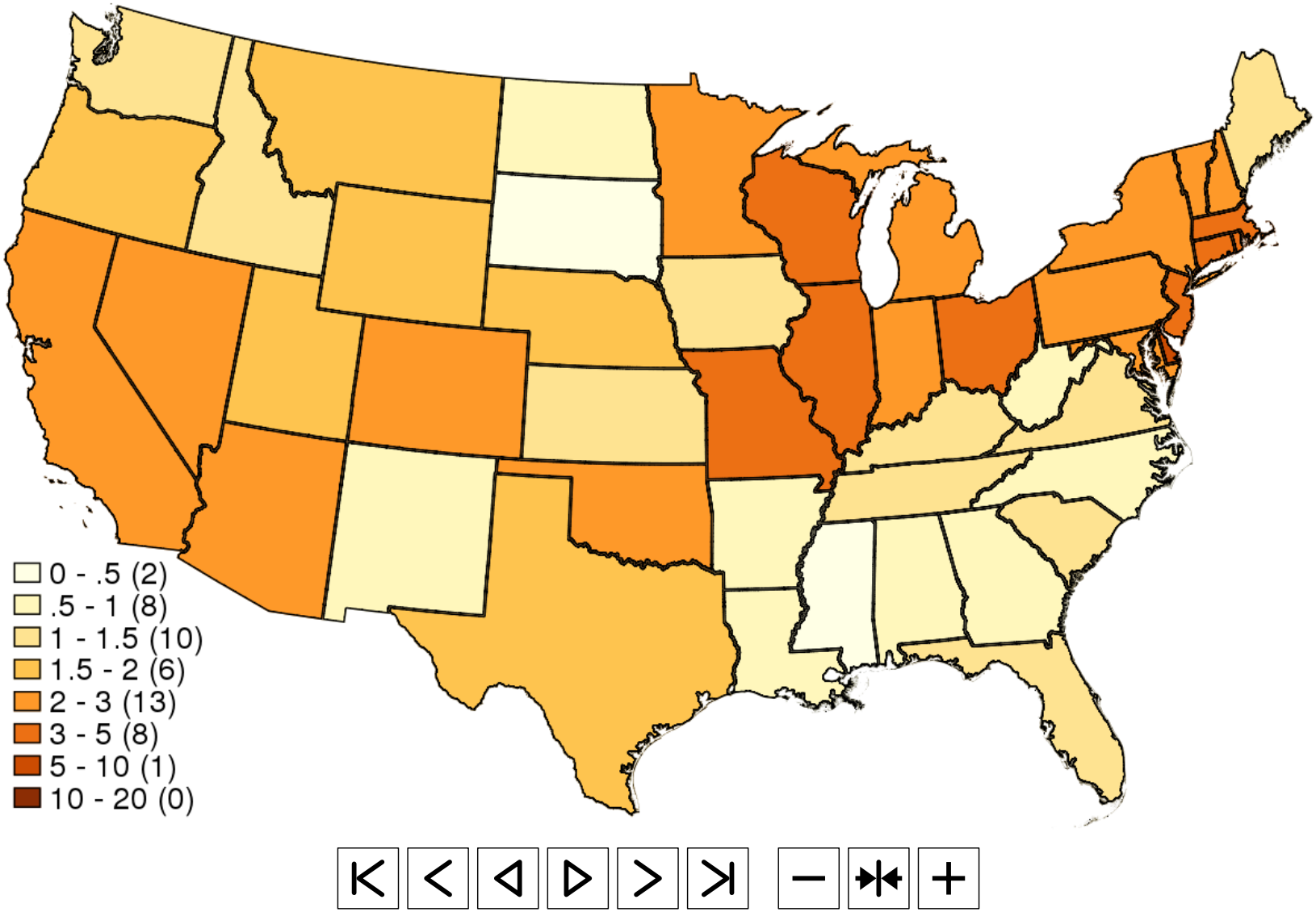
Geography of innovation. Patents per 10,000: 1950-1960



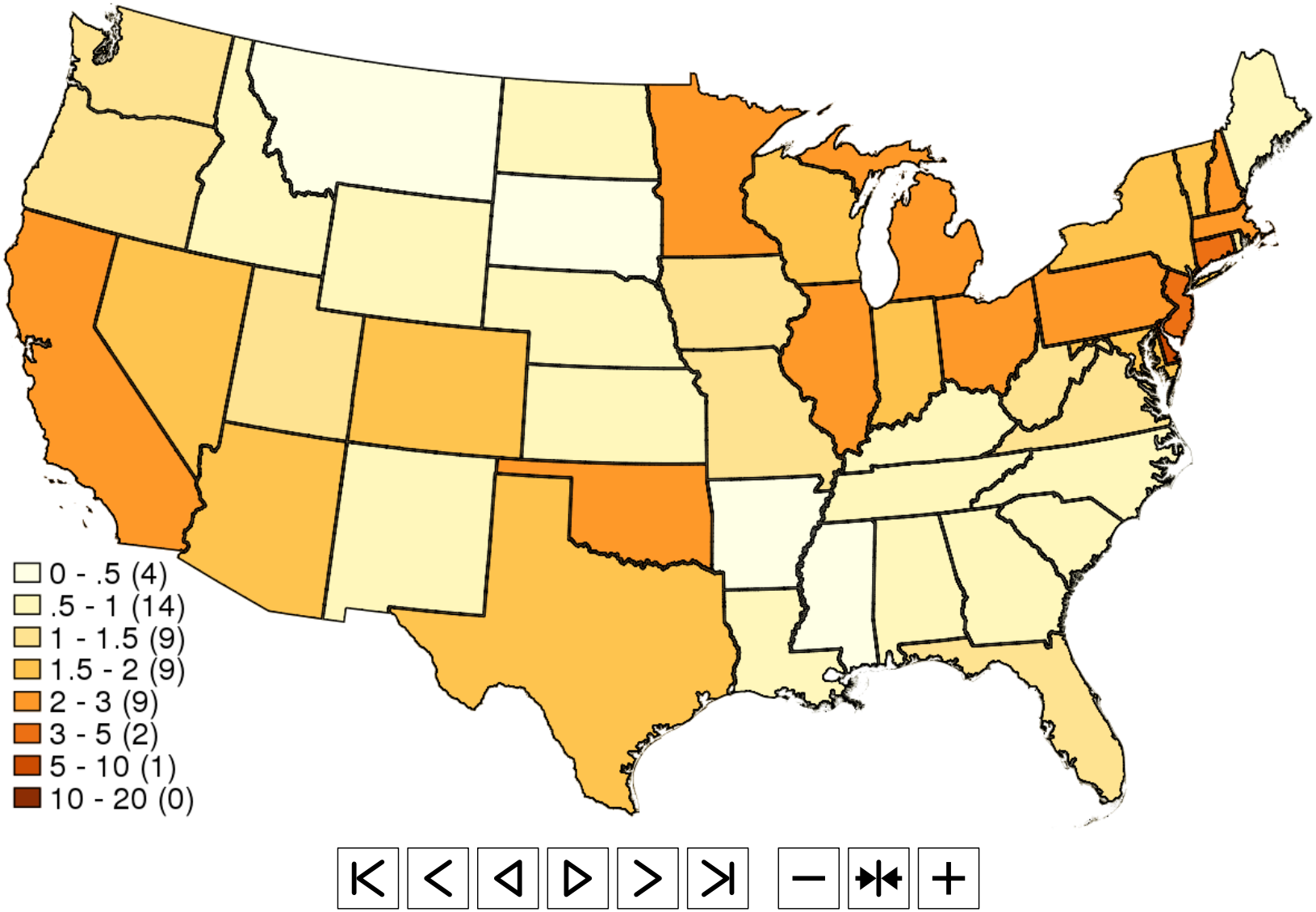
Geography of innovation. Patents per 10,000: 1960-1970



Geography of innovation. Patents per 10,000: 1970-1980

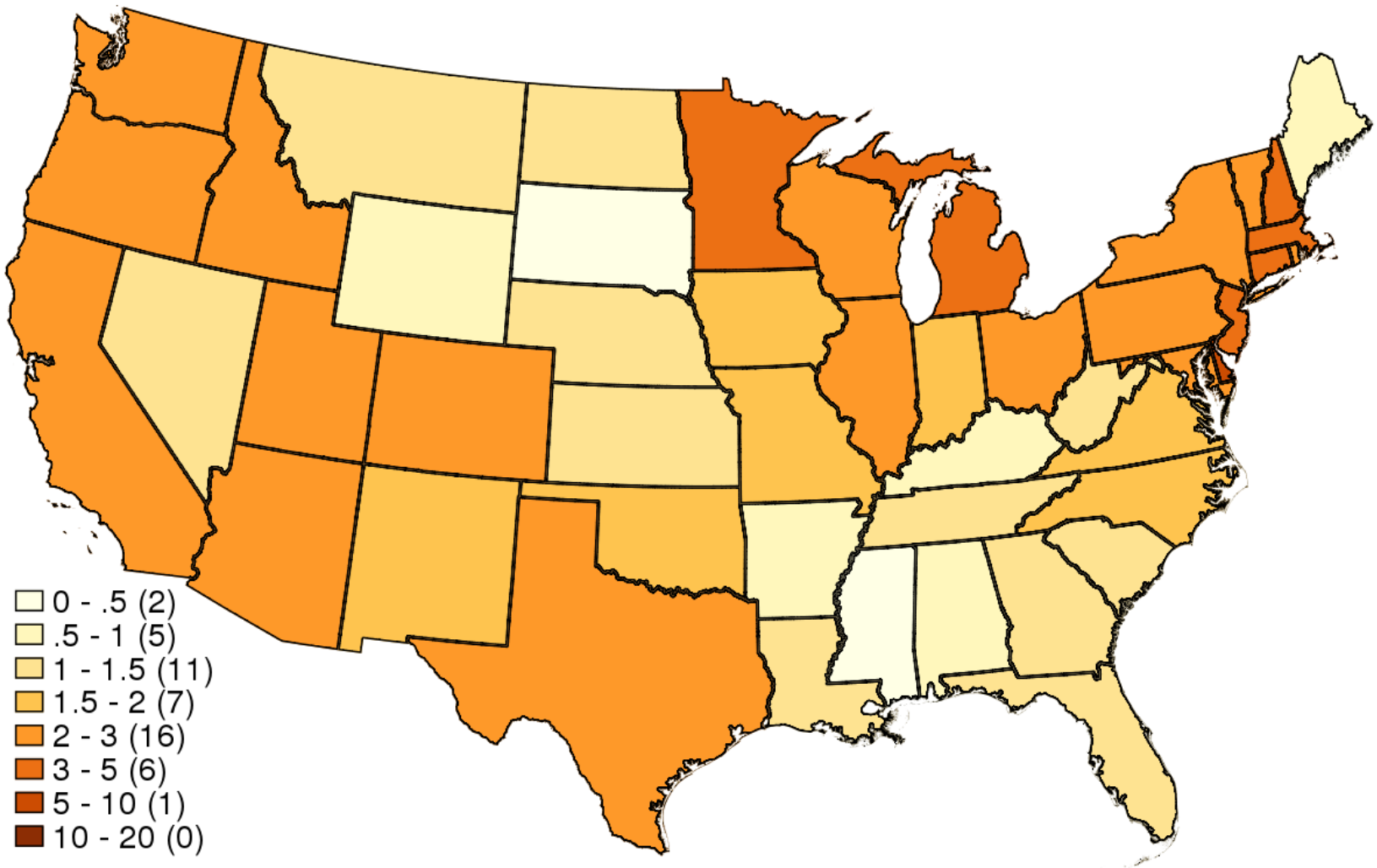


Geography of innovation. Patents per 10,000: 1980-1990

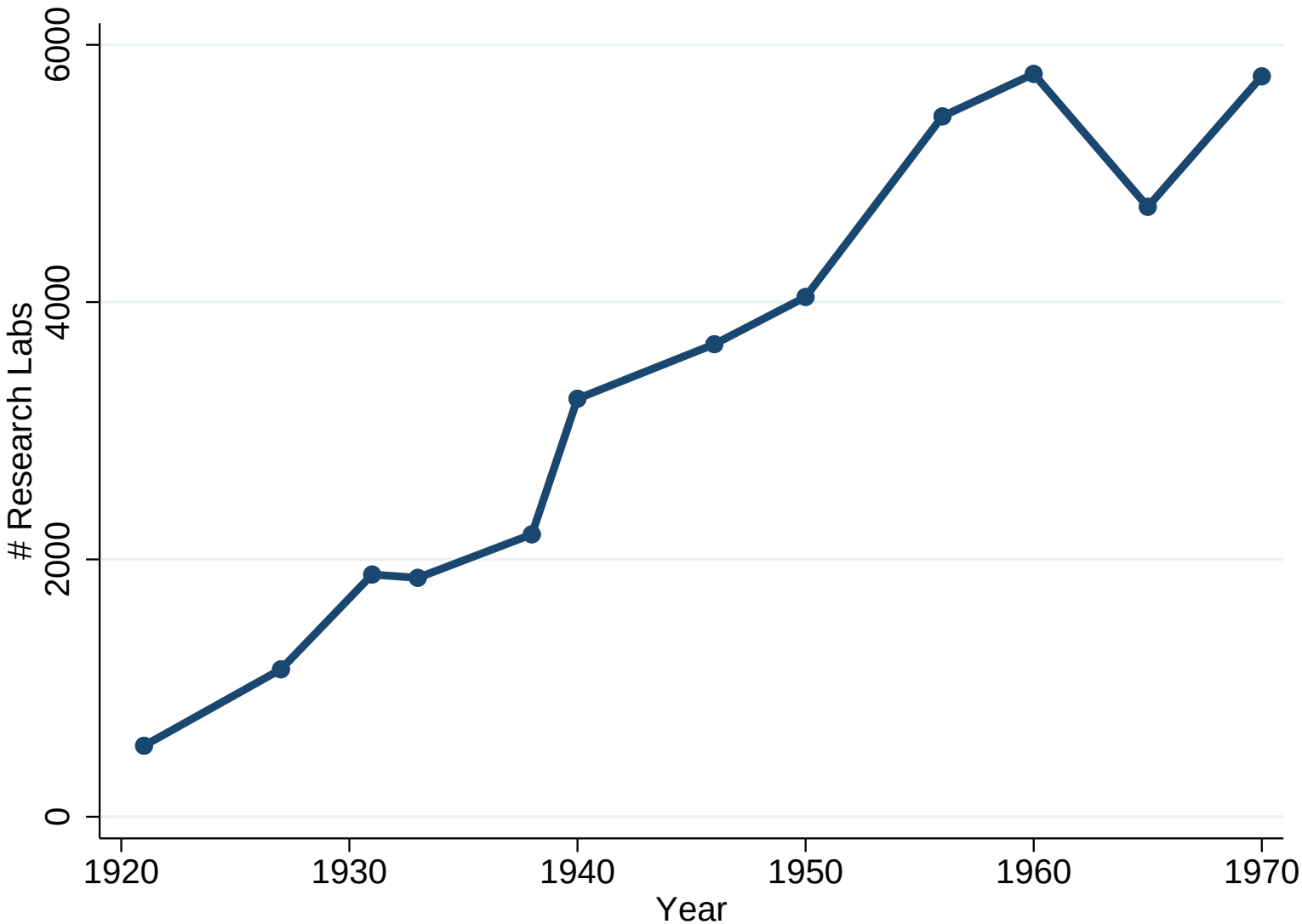


Geography of innovation. Patents per 10,000: 1990-2000

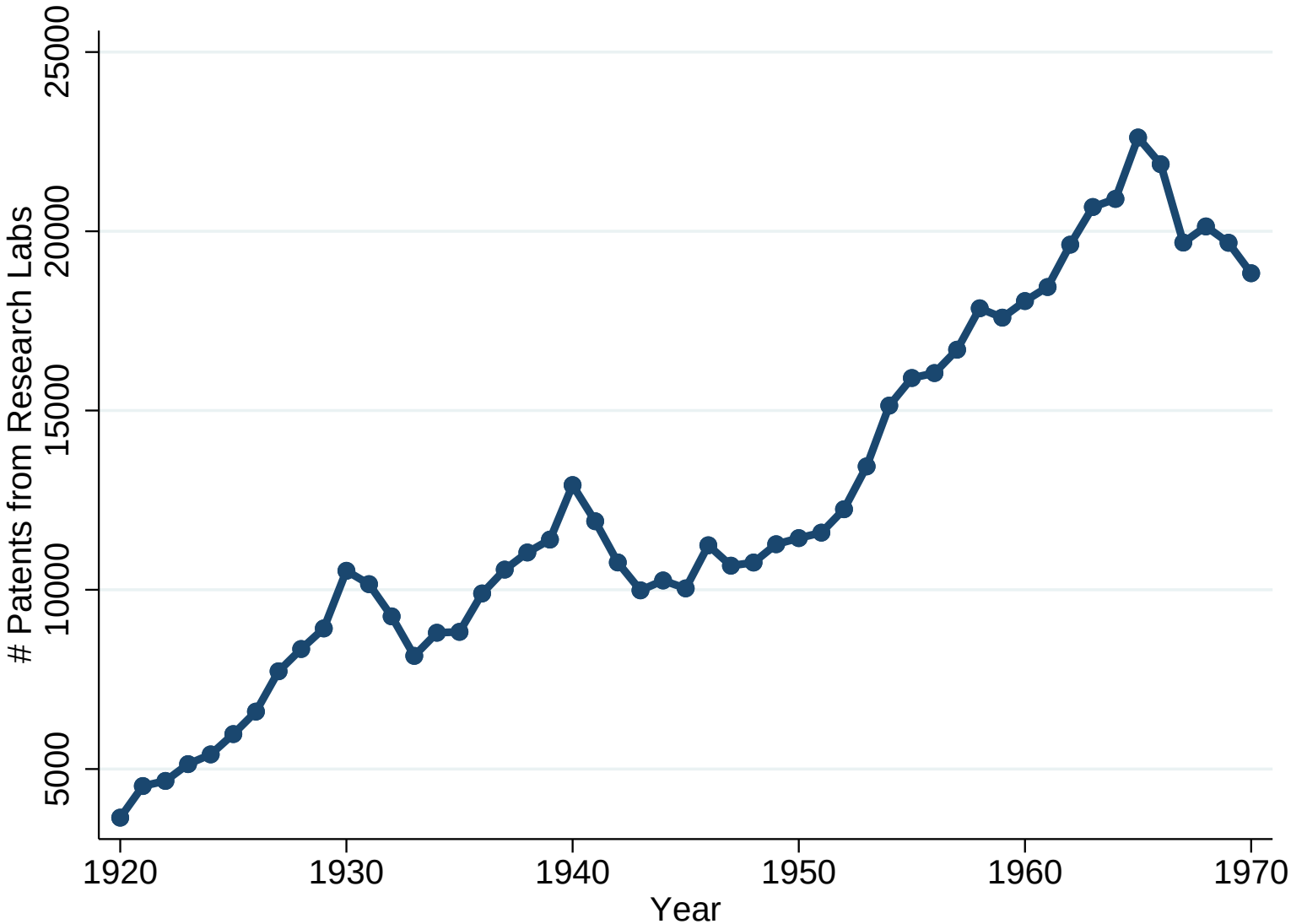
Back



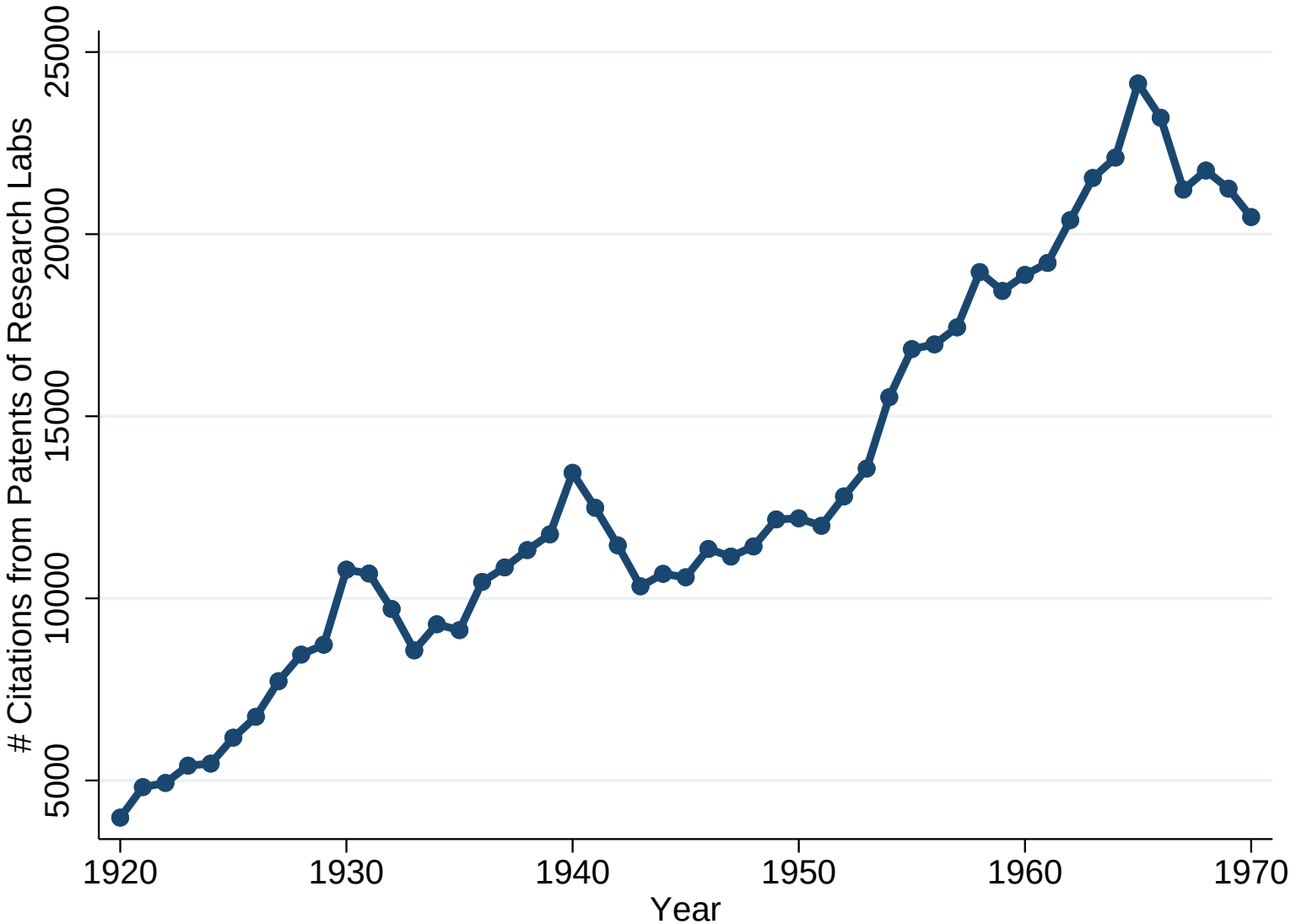
Number of R&D Labs



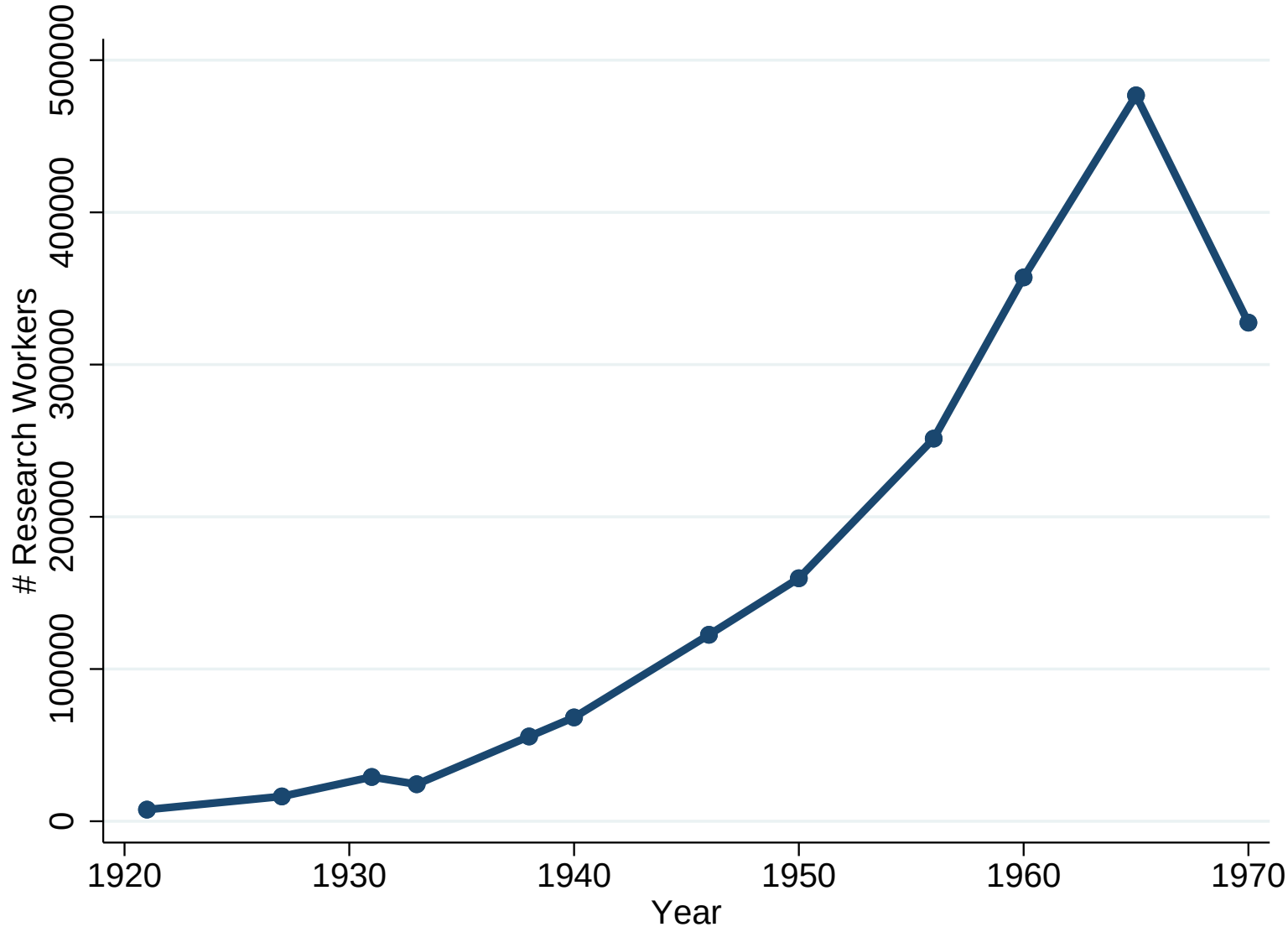
R&D Labs: Total Patents



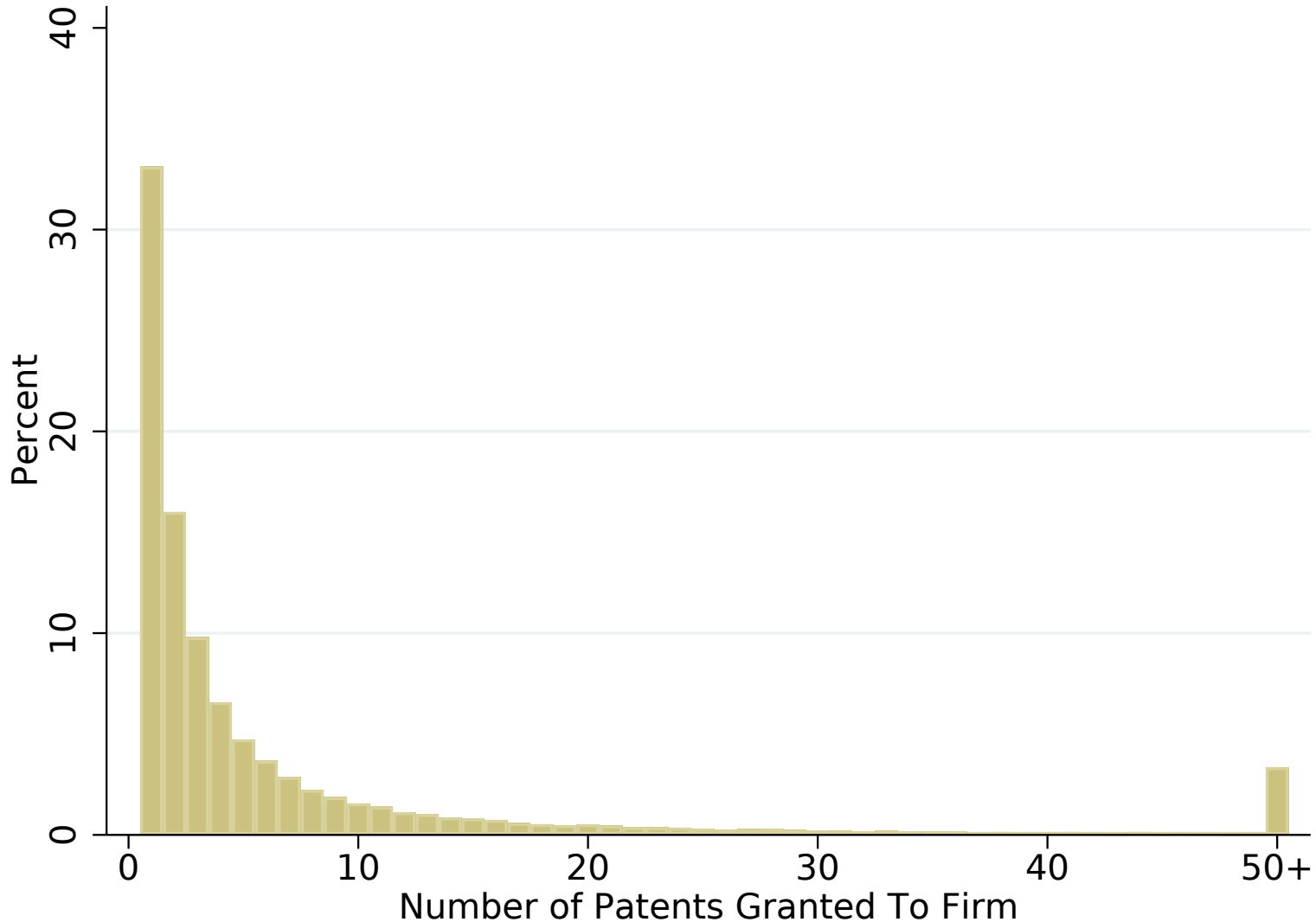
R&D Labs: Total Citations



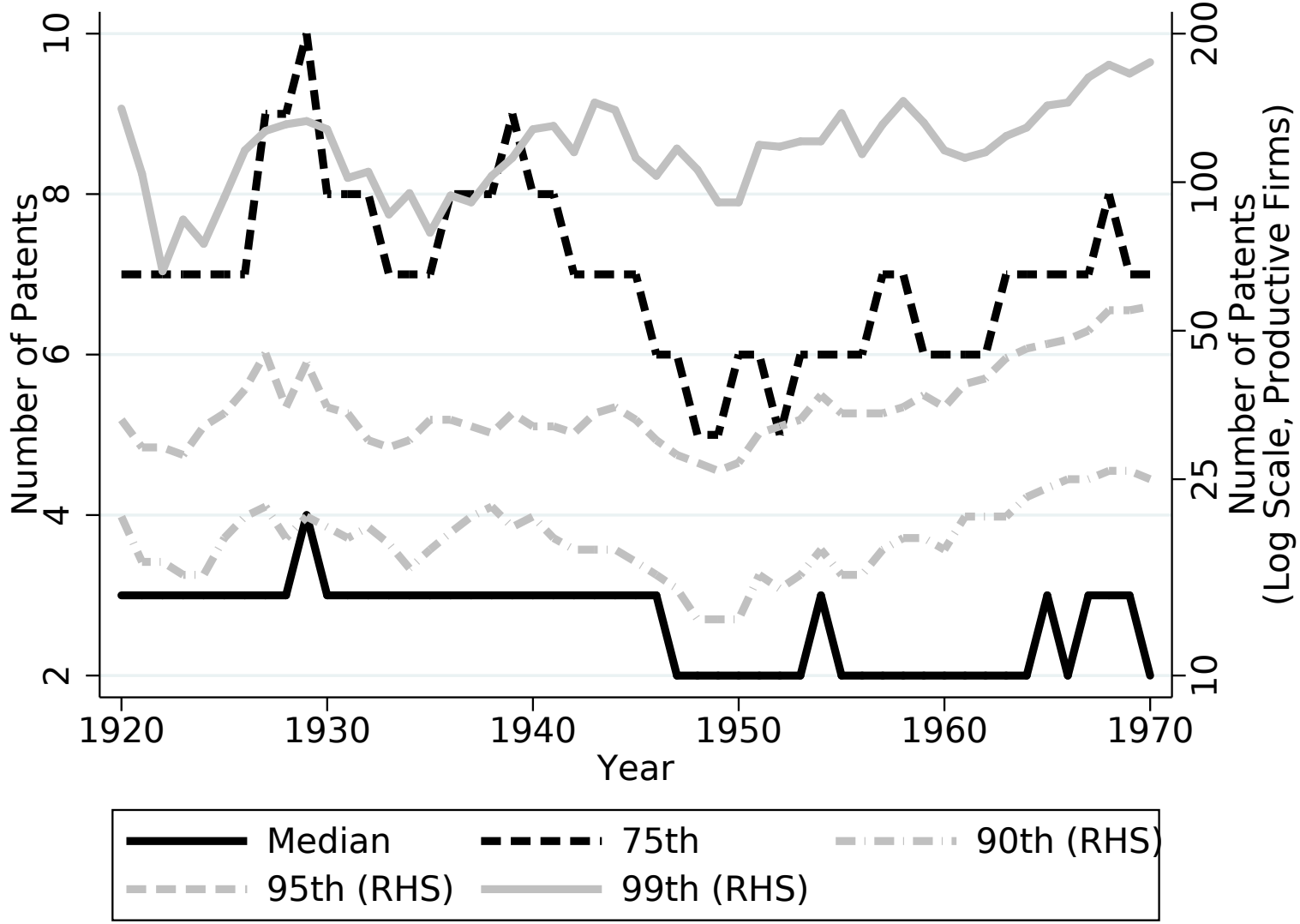
R&D Labs: Total Research Workers



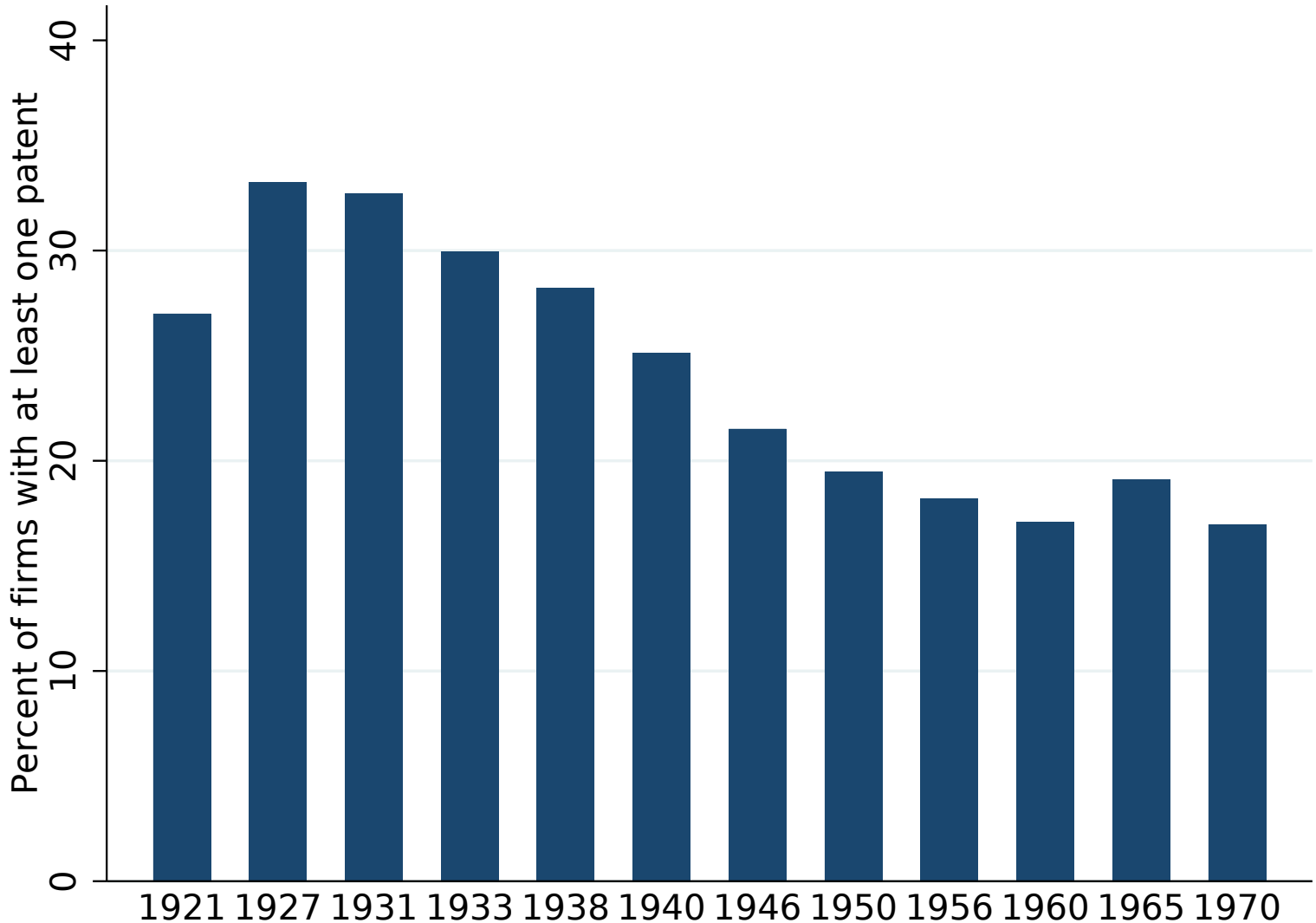
Distribution of Patents per Firm-Year (Conditional on > 0



Distribution of Firm Patents over Time

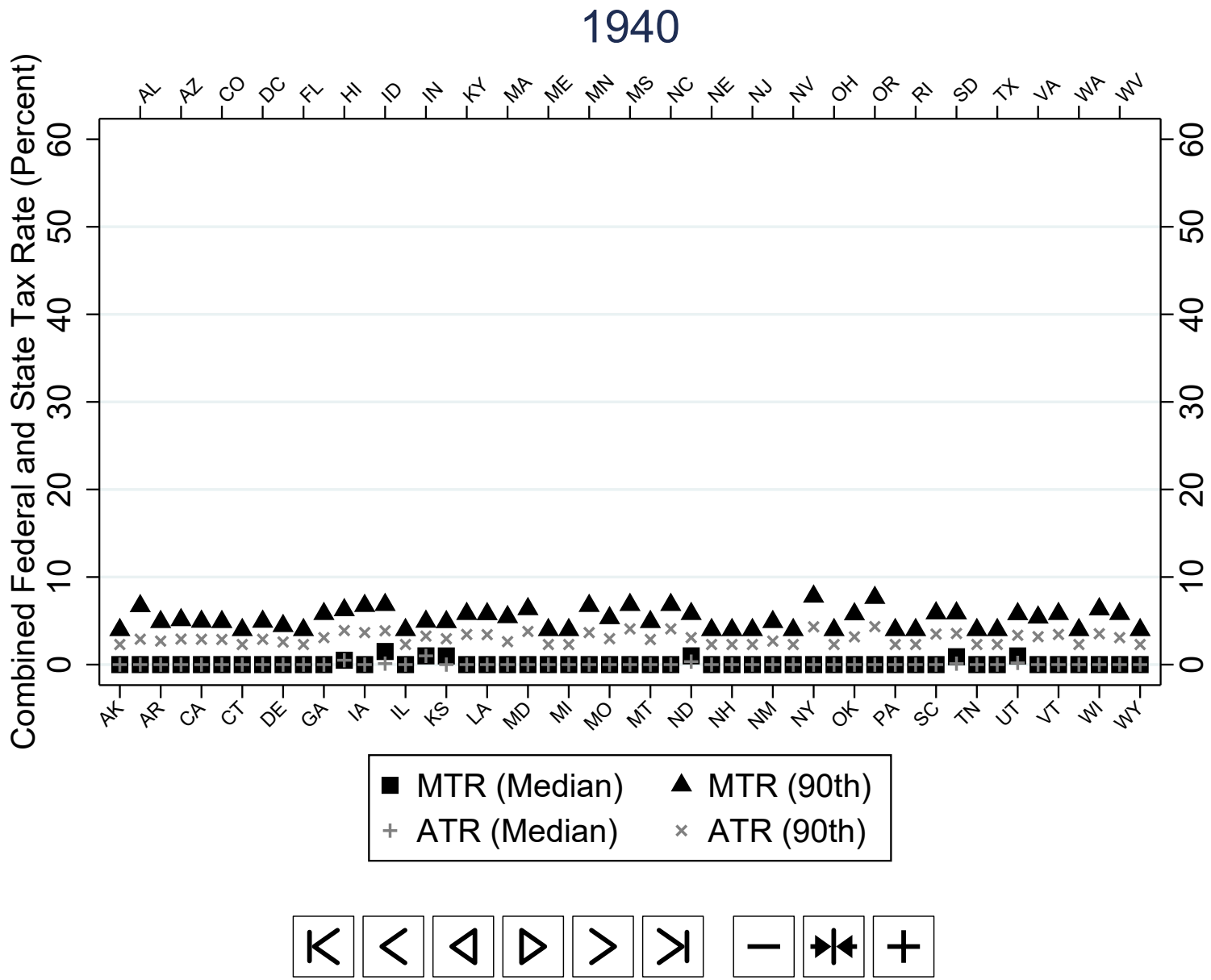


Share of Firms with Patent over Time



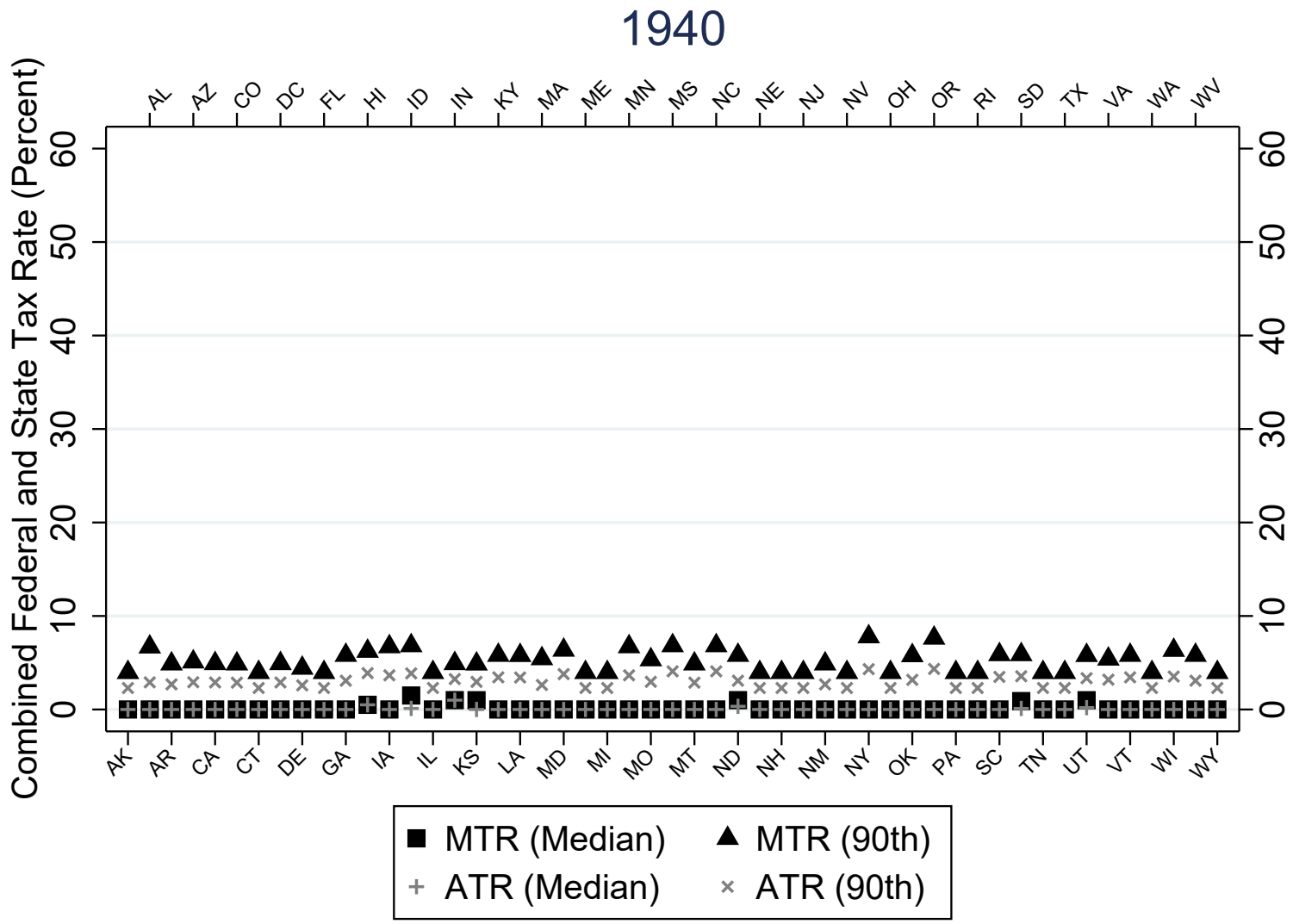
◂ Workers Per Lab

State Tax Rate Distributions: Effective incl. Federal

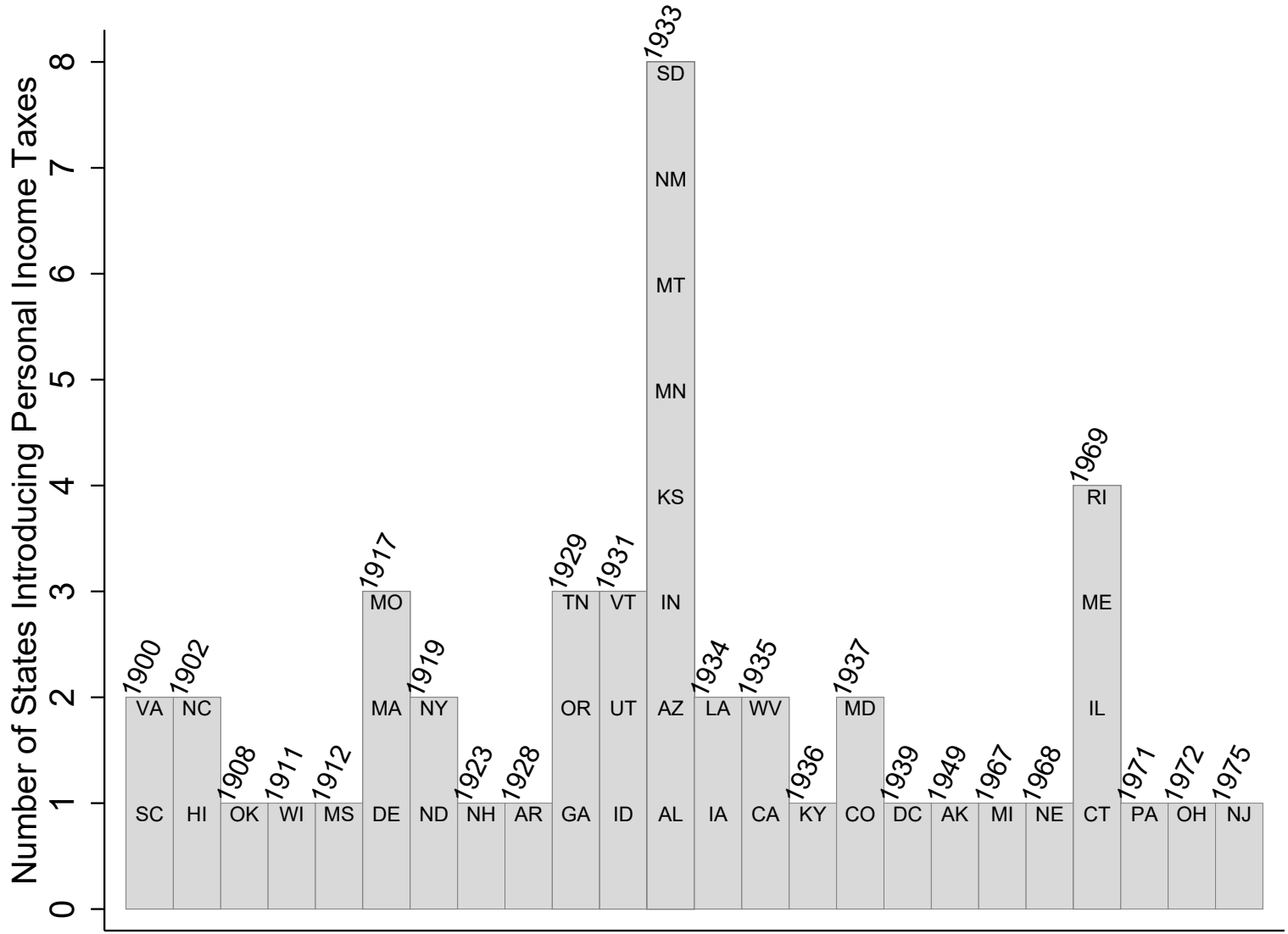


State Tax Rate Distributions: Effective incl. Federal

◂ Historic Distribution



Introduction of State Personal Income Taxes



Before the 1940s, often affects mostly very high earners.

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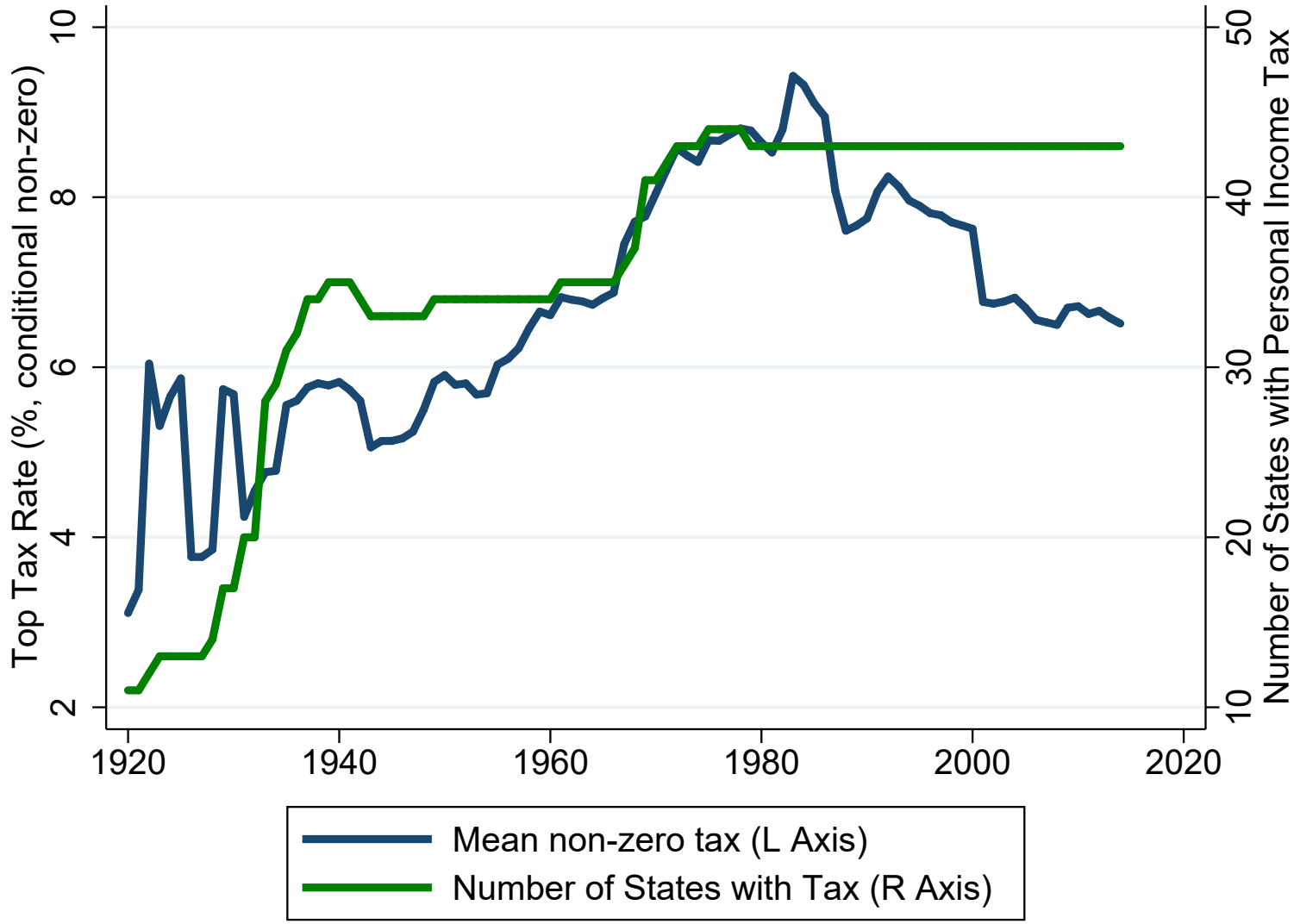
Intensive vs Extensive Margin of Personal Income Taxation



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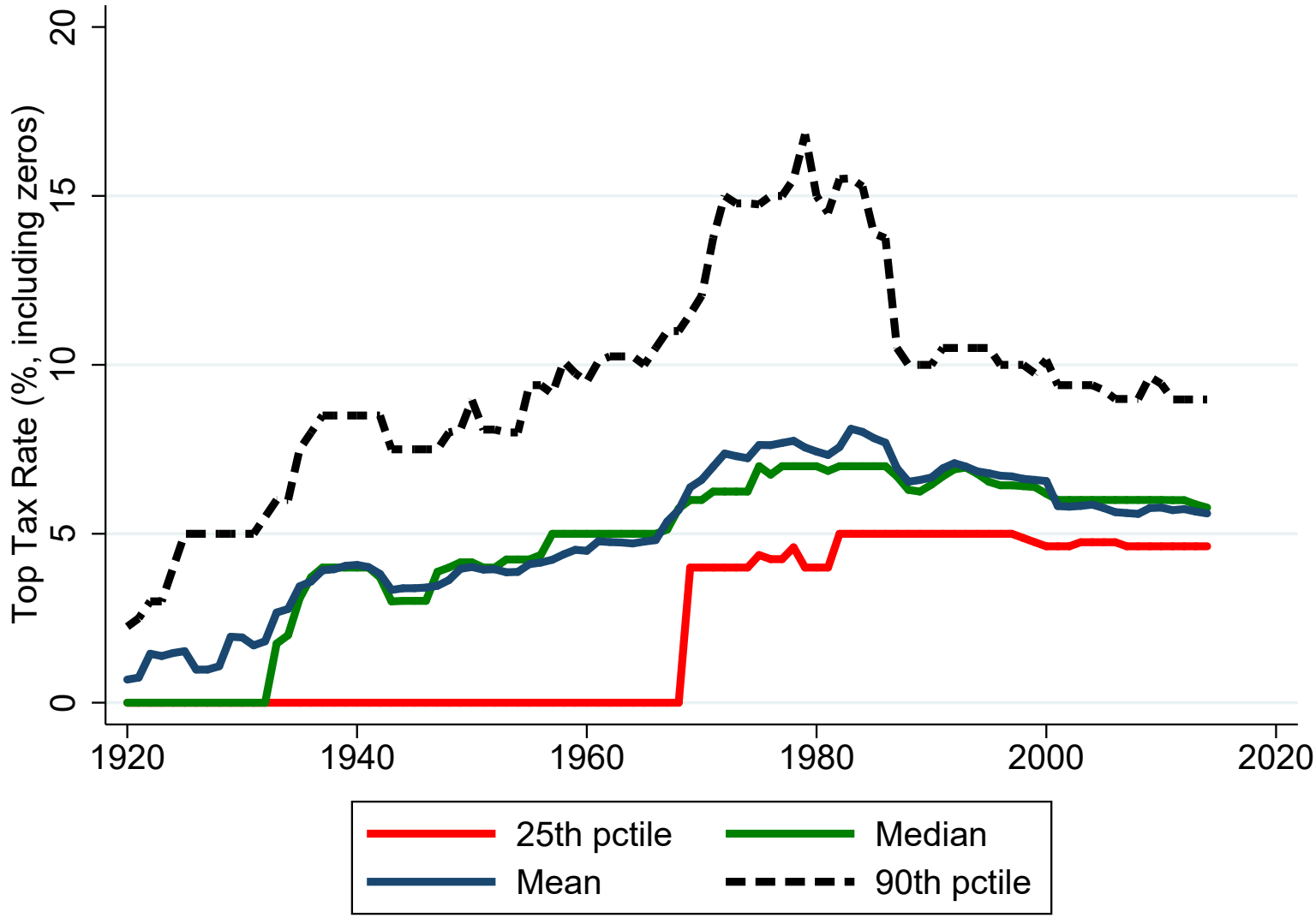
Distribution of Top Personal Income Tax Rates (incl. 0s)



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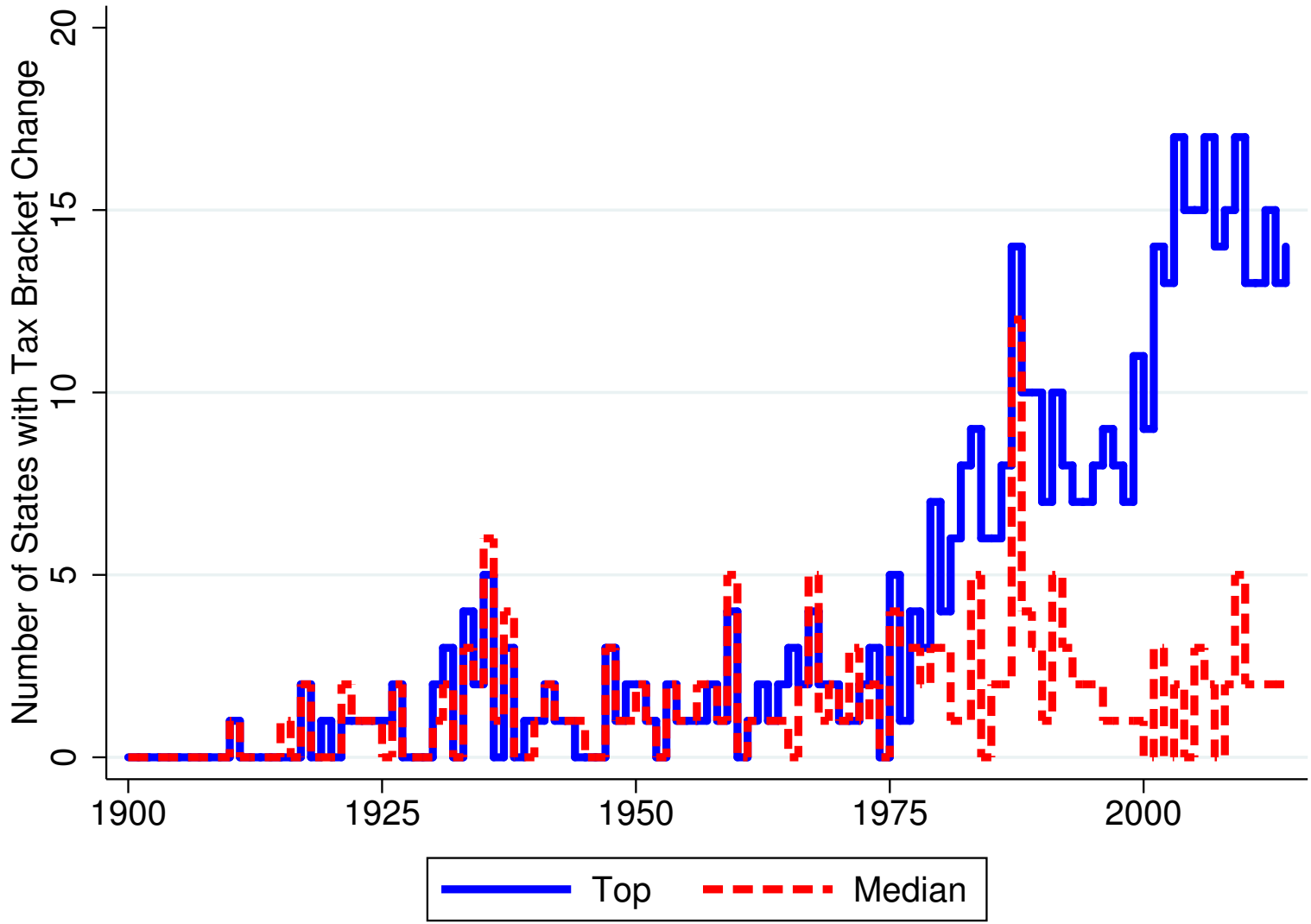
Number of State Tax Bracket Changes



Contrary to Federal level, changes in brackets and tax rates very correlated – justifies use of tax rate measures at given income levels.

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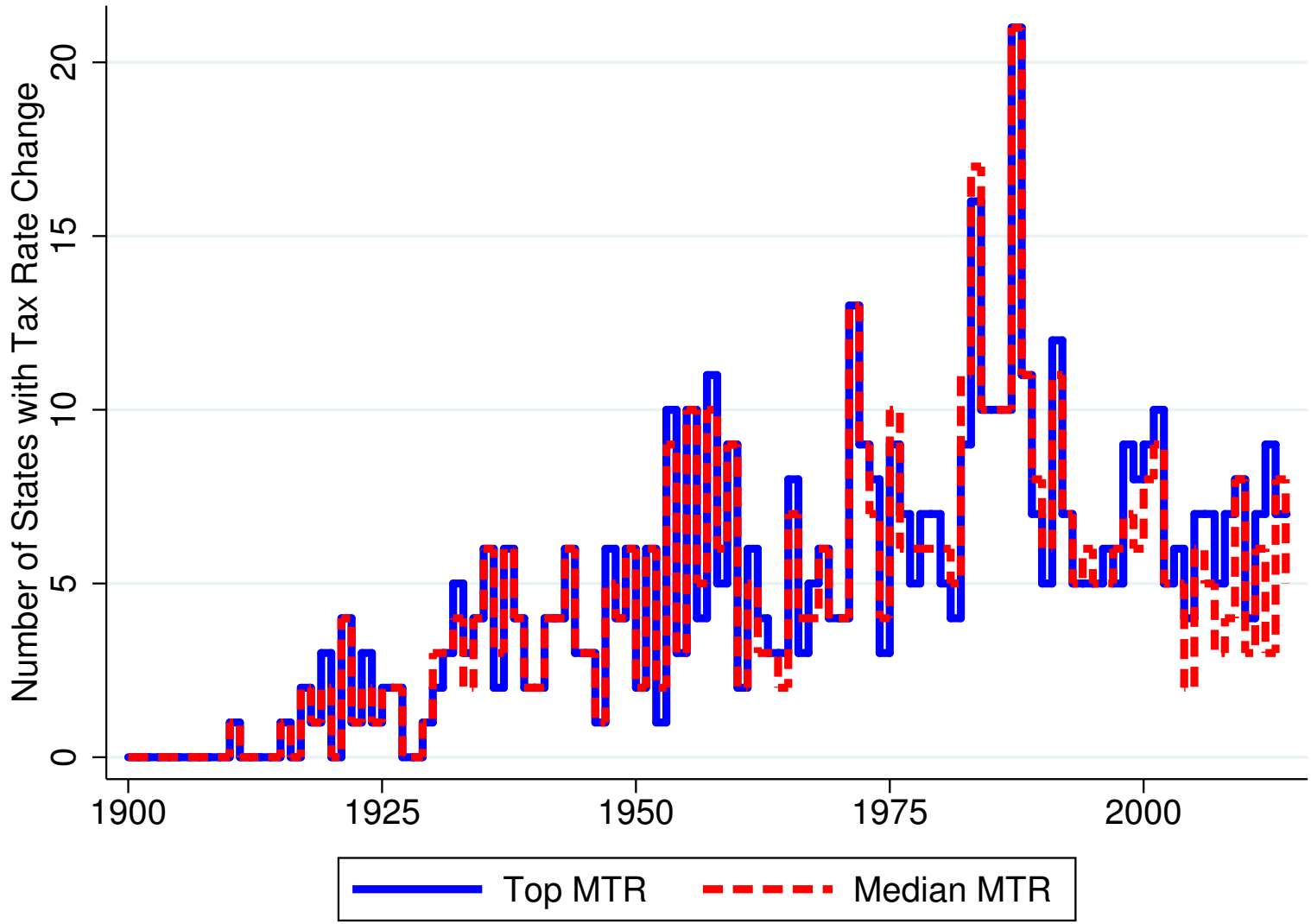
Number of State Tax Rate Changes



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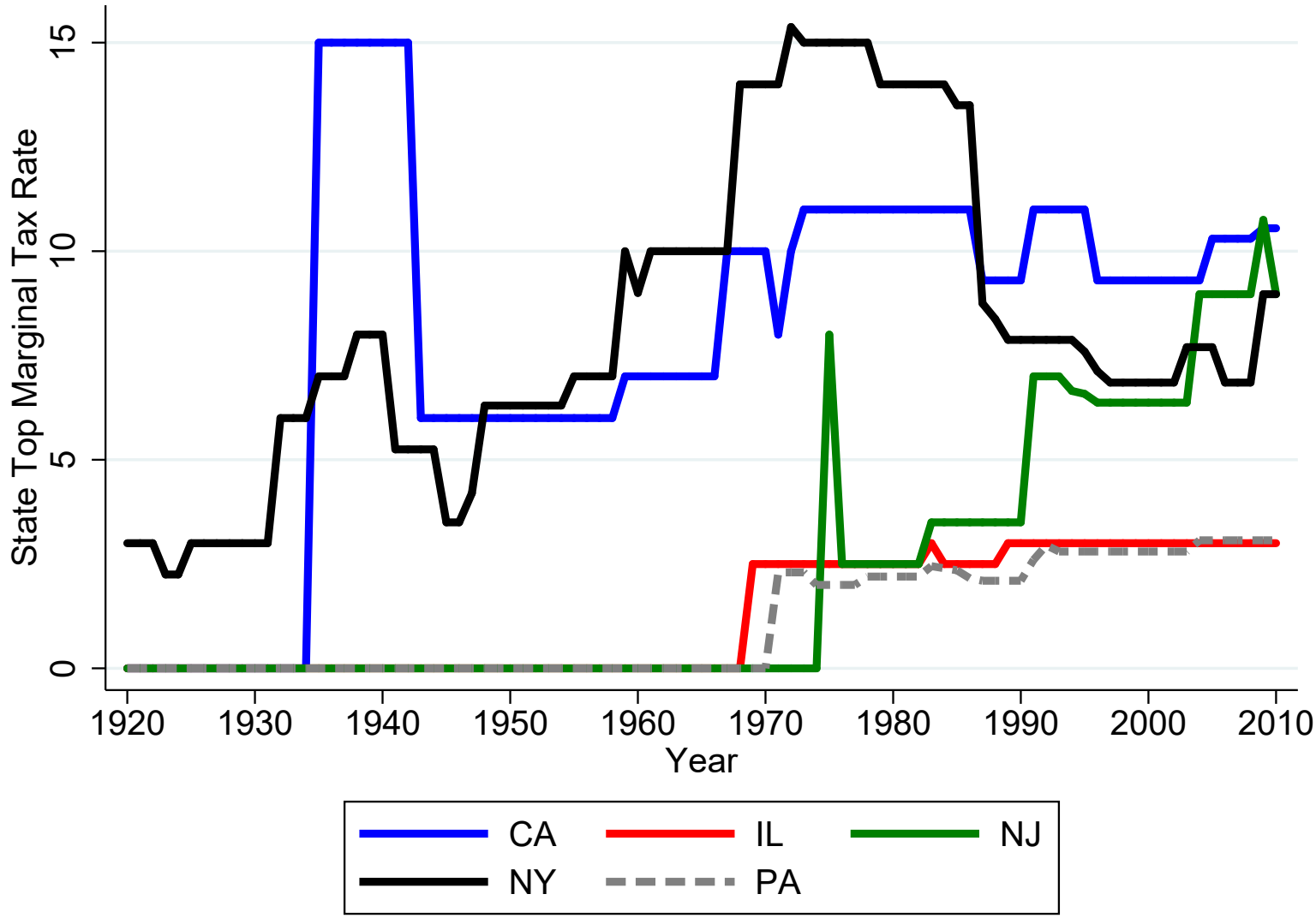
Top MTR in Selected States over Time



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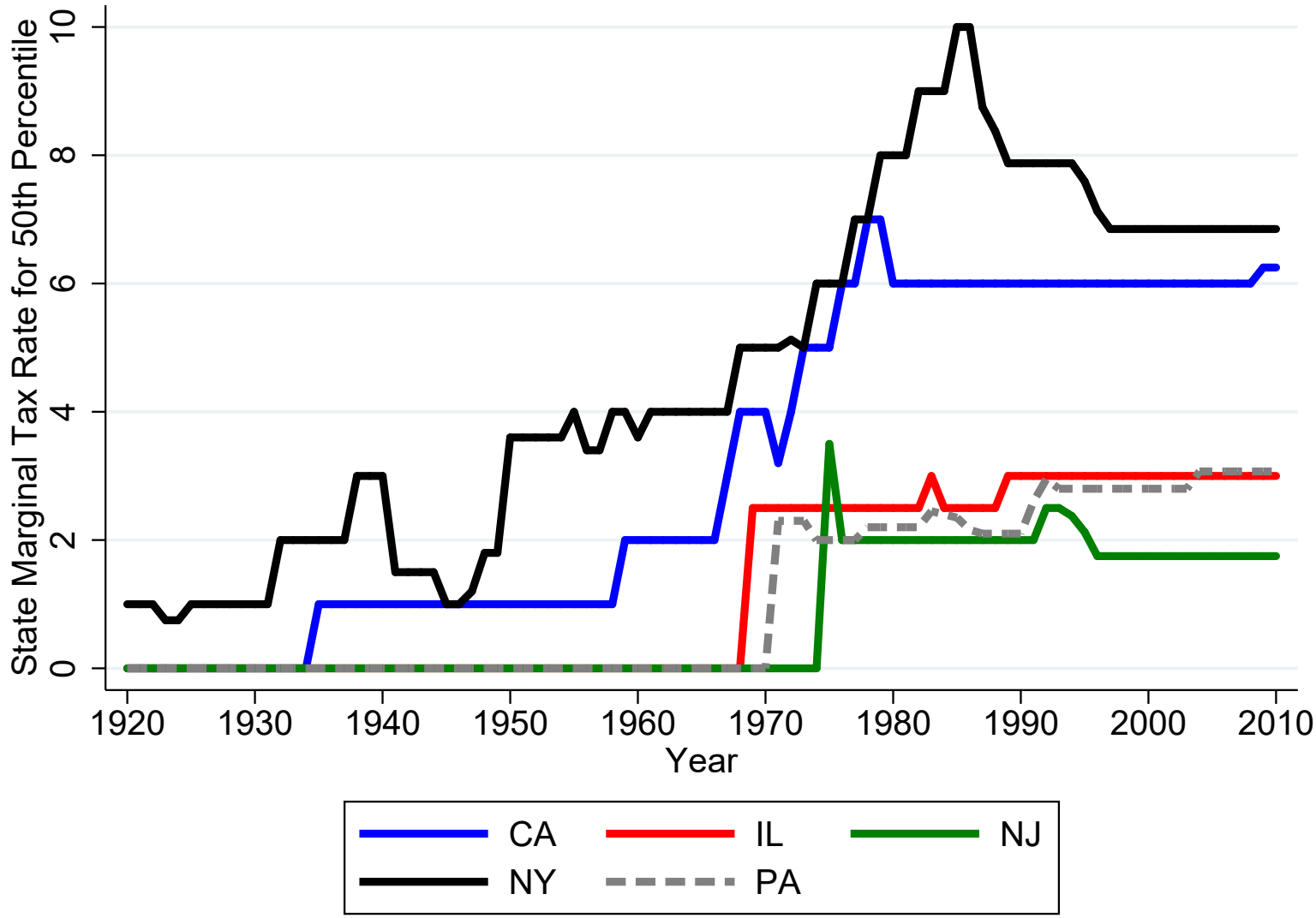
MTR at Median Income in Selected States over Time



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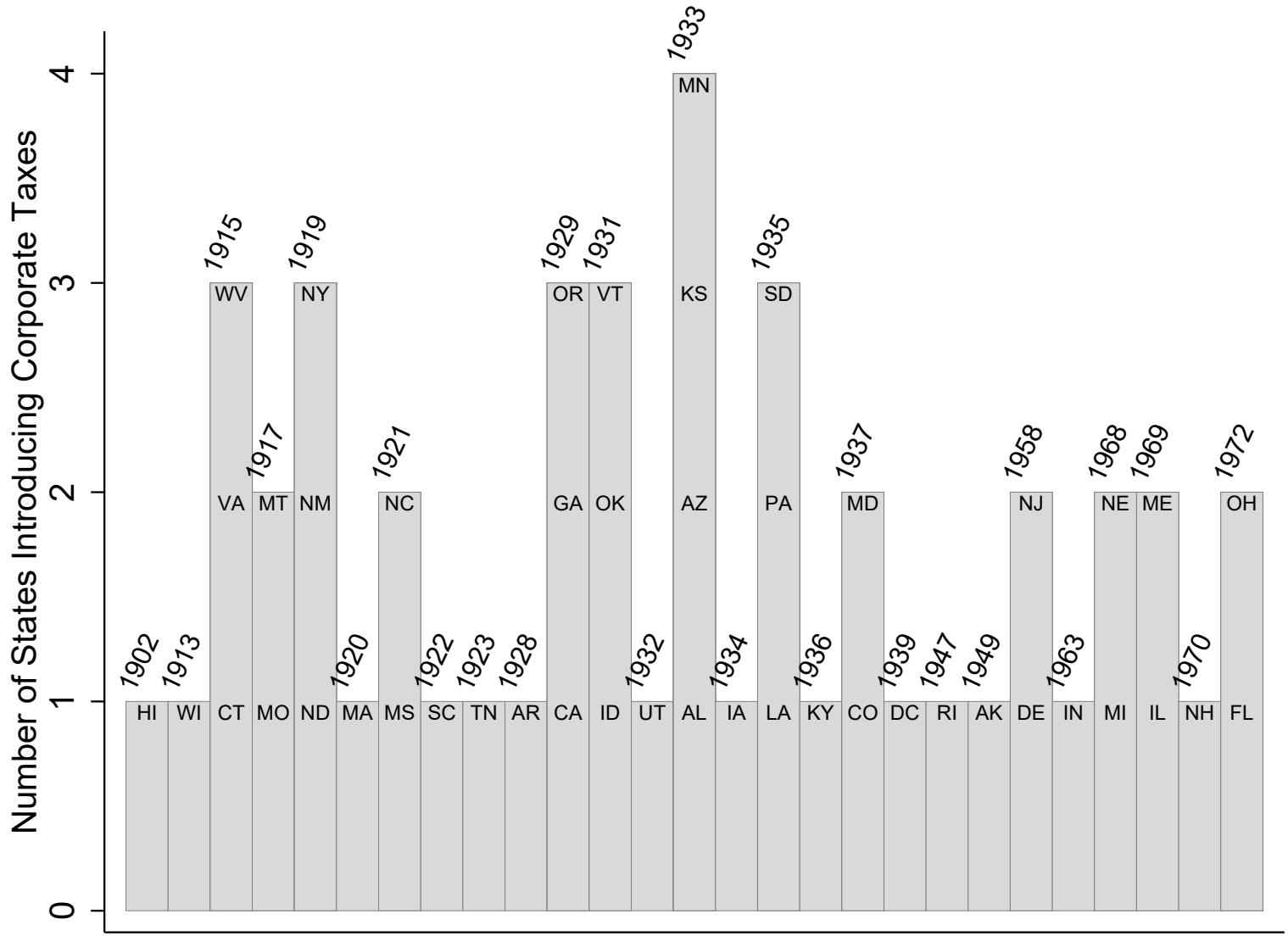
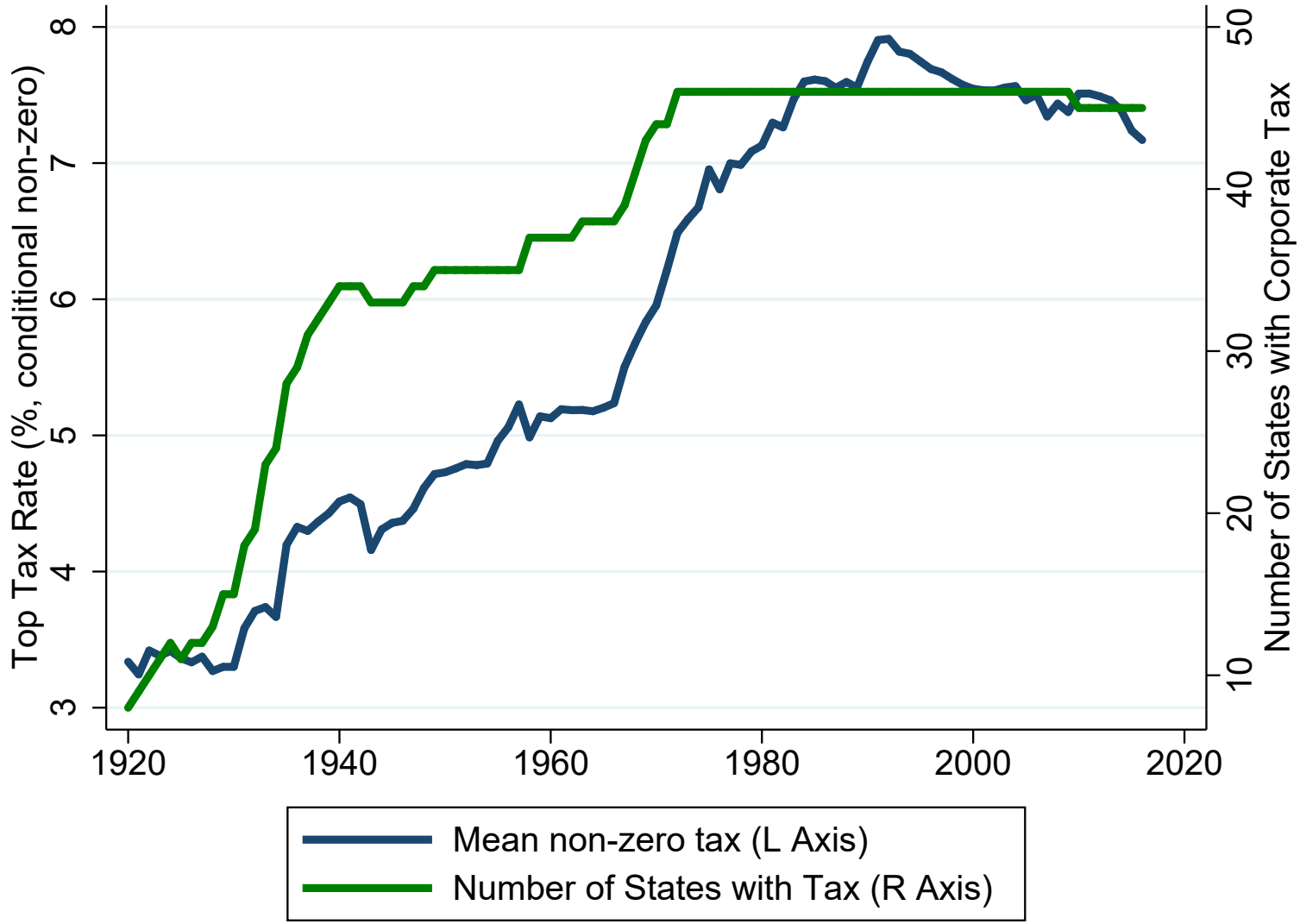
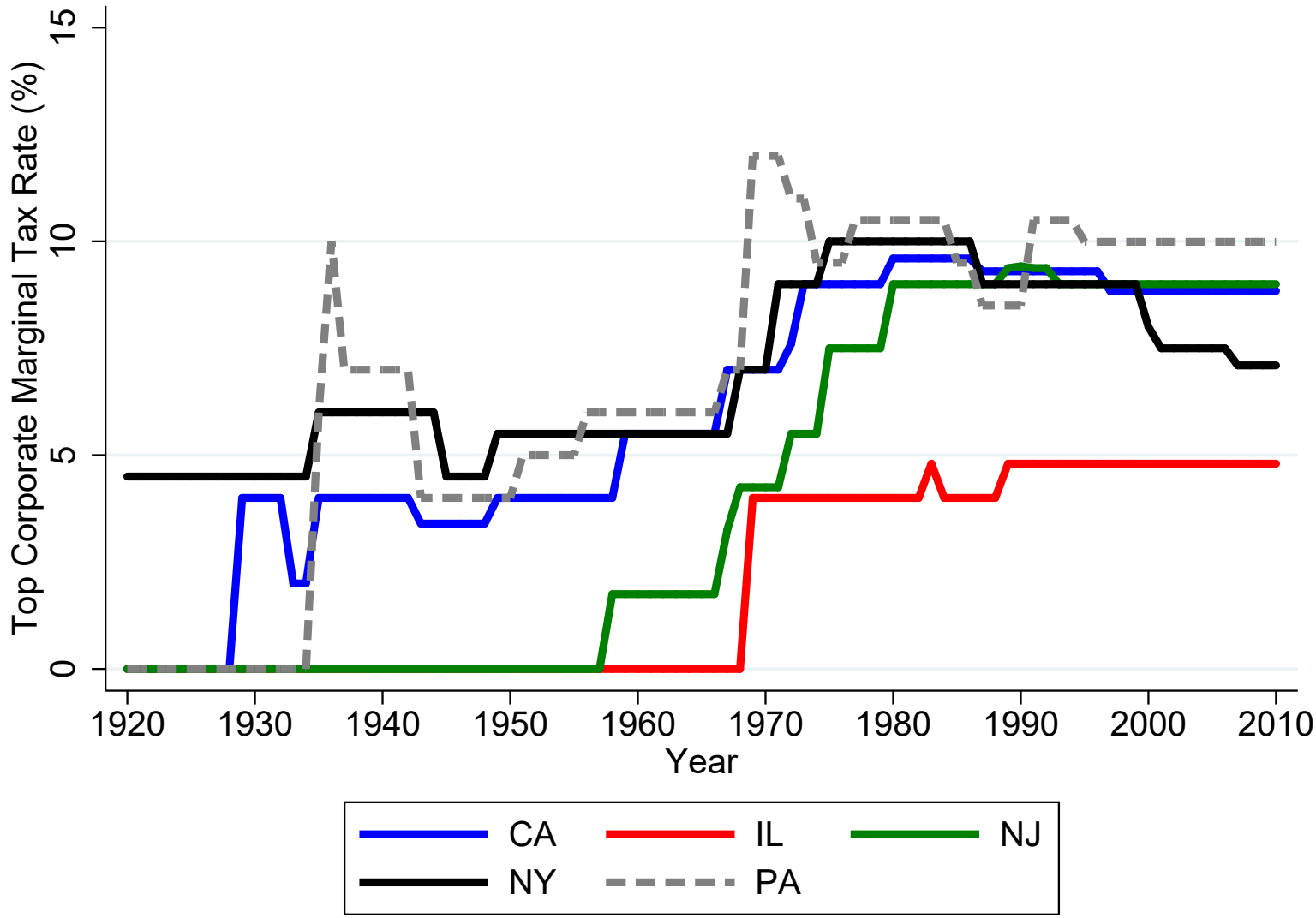
Introduction of State Corporate Taxes



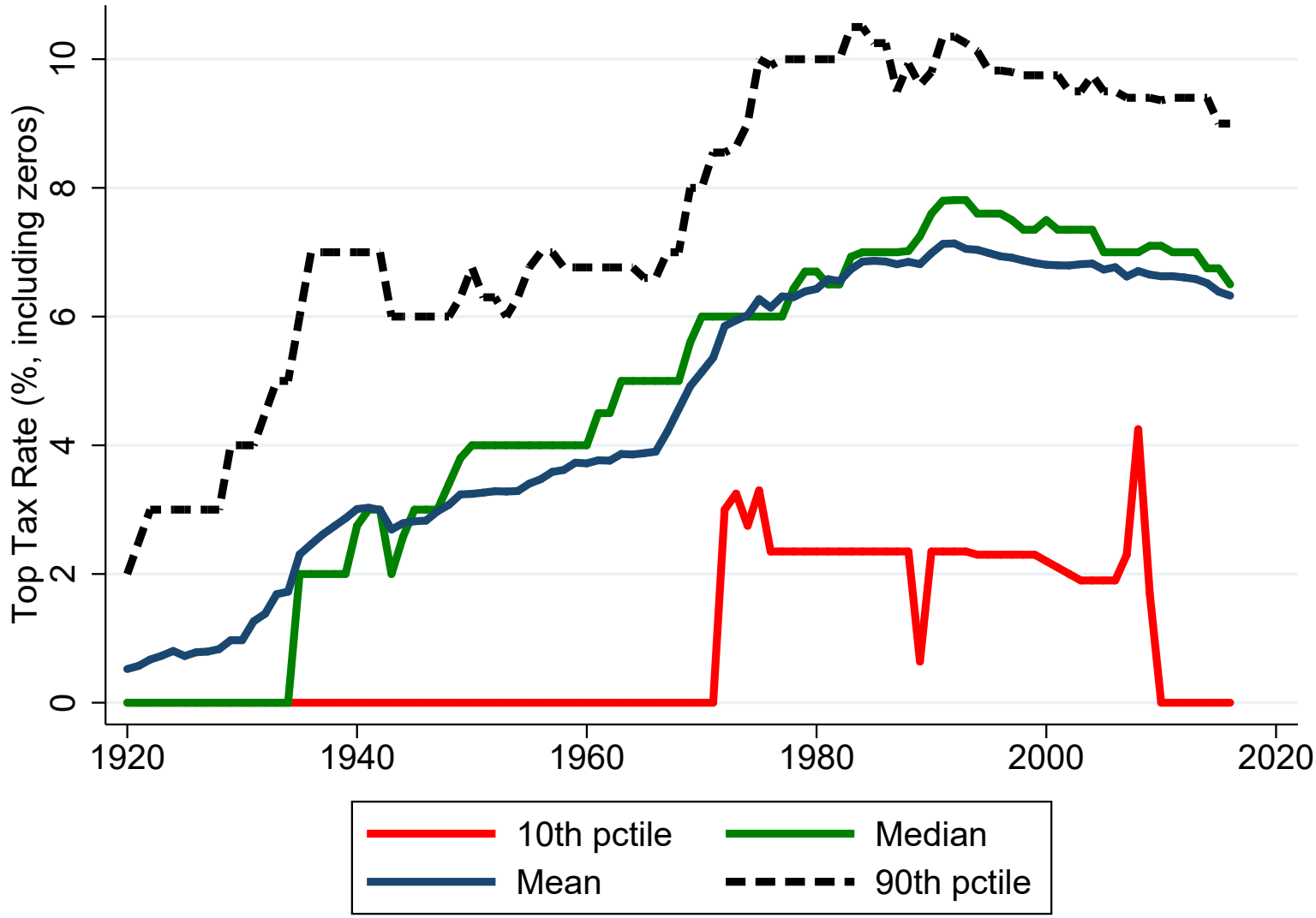
States with a Corporate Tax and Mean Level Over time



Time Series of Key States Top Corporate Tax



Distribution of Top Corporate Tax Rates (including 0s)



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Types of corporate taxes

Franchise tax: imposed on corporations for the privilege of doing business in a state (considered indirect tax).

Corporate income tax: on profits (direct tax),

Some states have statutes that make direct taxes unconstitutional. Franchise taxes get around this.

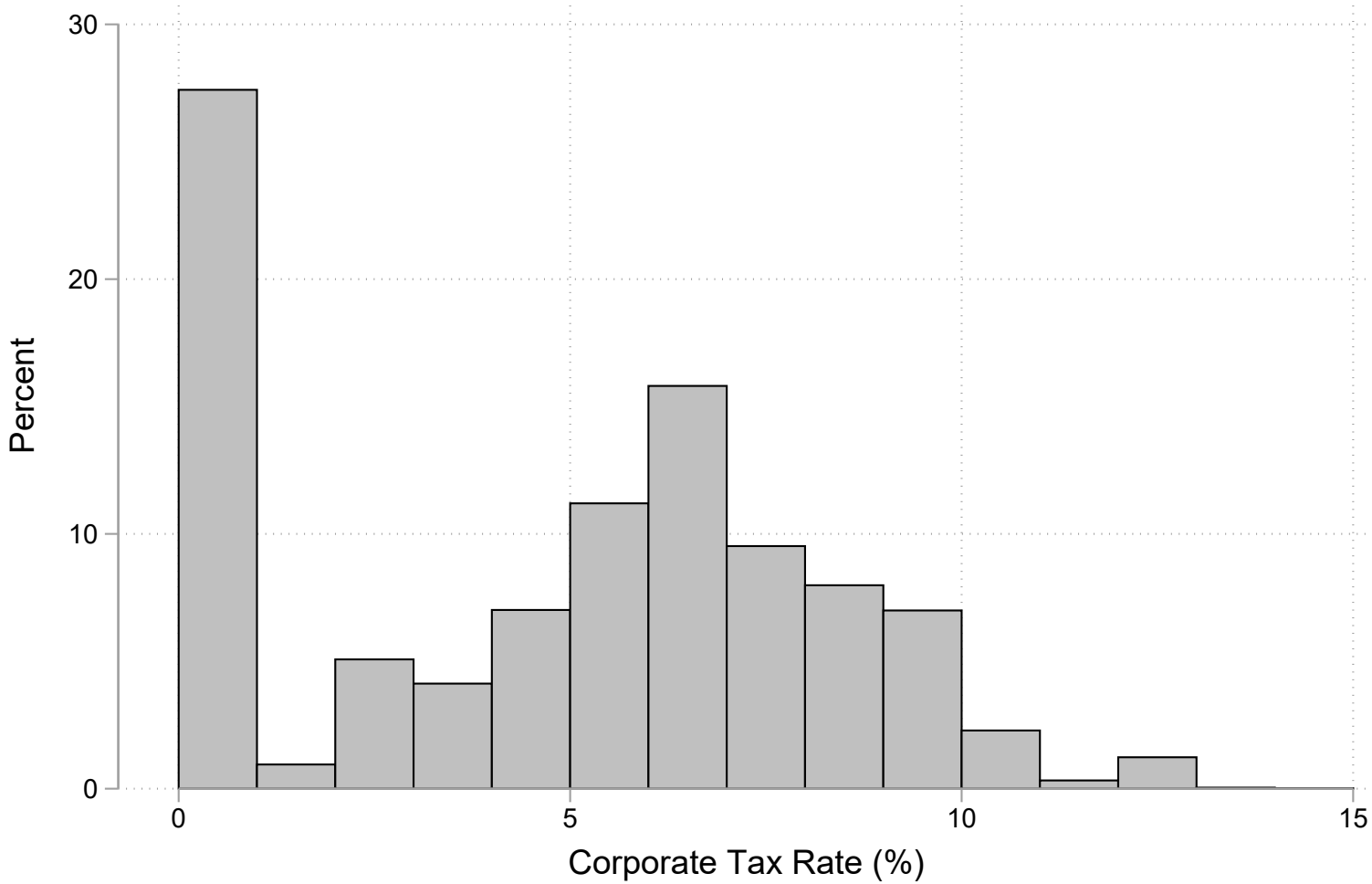
Some states have one or the other, or both (companies pay one or the other, not both, typically the max).

Type of franchise taxes:

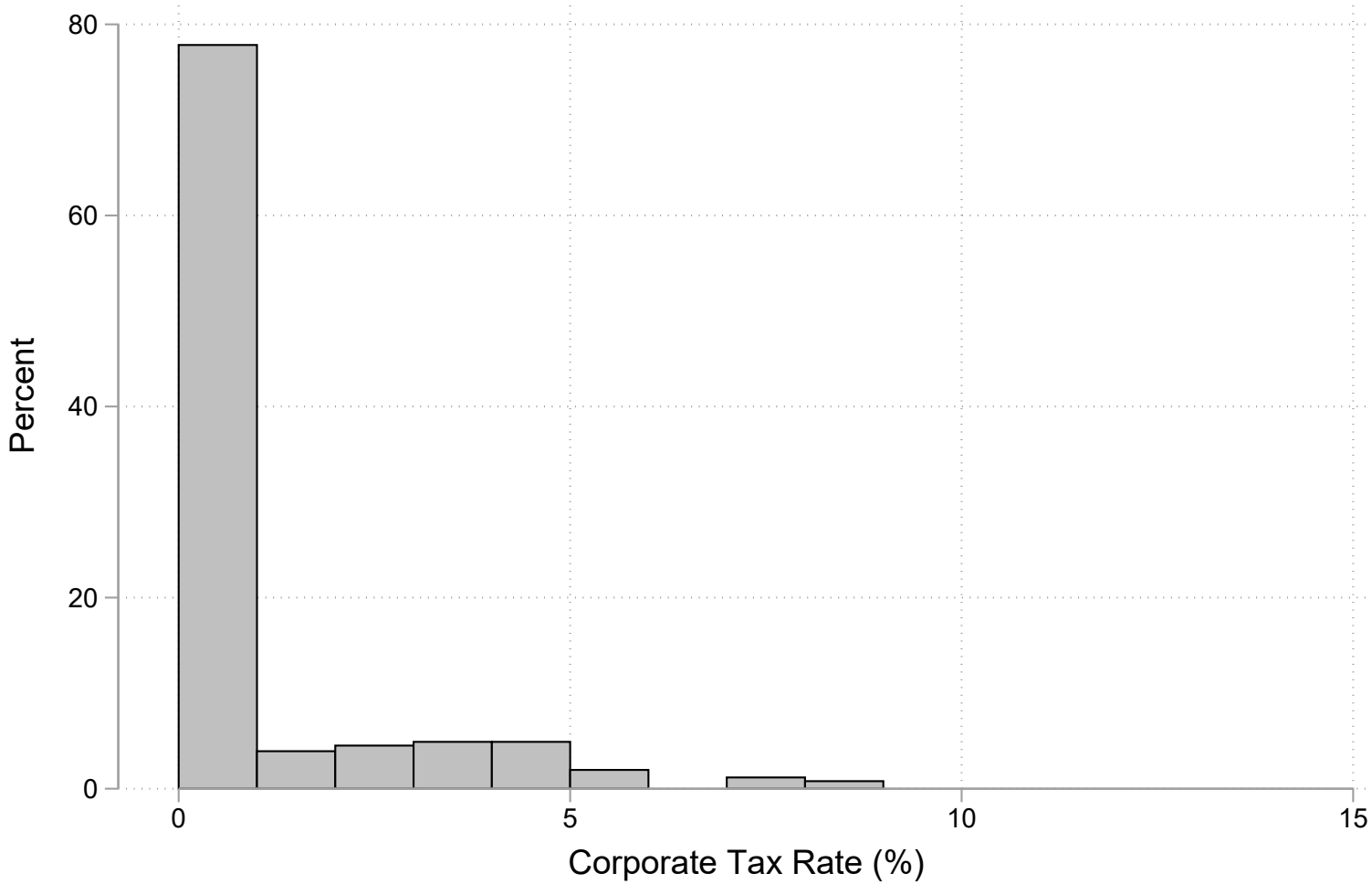
Net income

Business Enterprise tax (NH, tax on income).

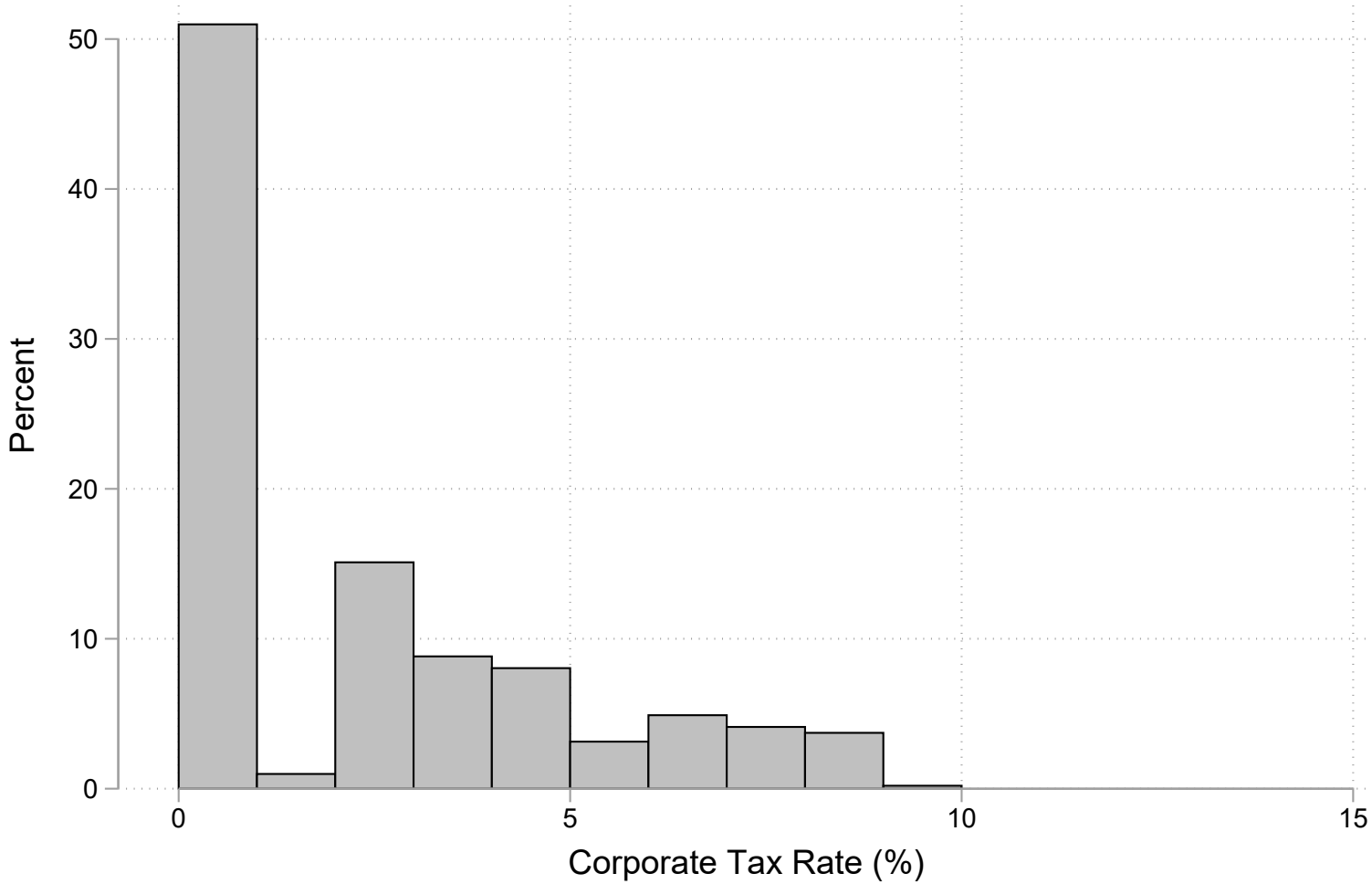
State Corporate Tax Distribution: 1920-2016



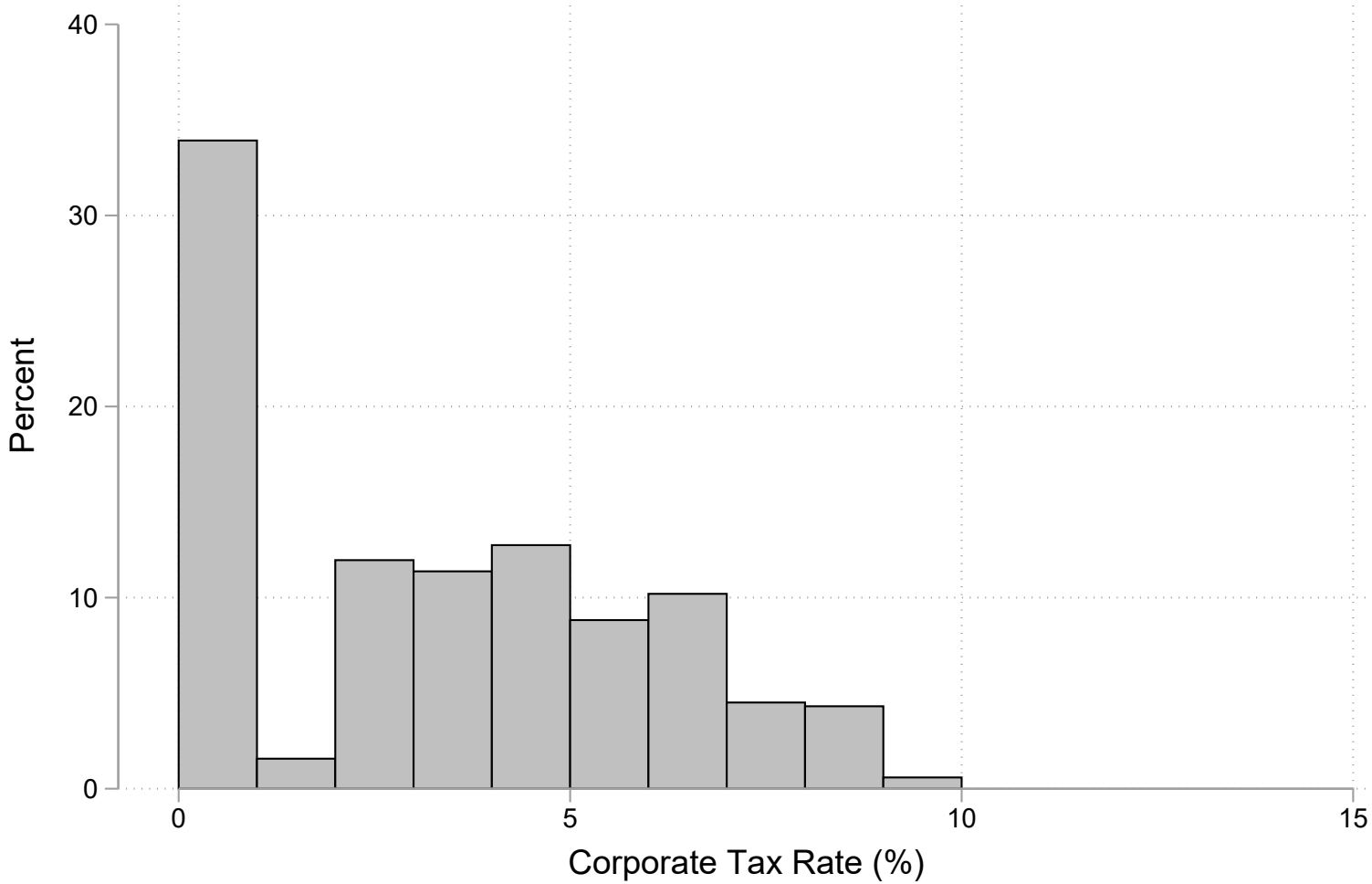
State Corporate Tax Distribution: 1920s



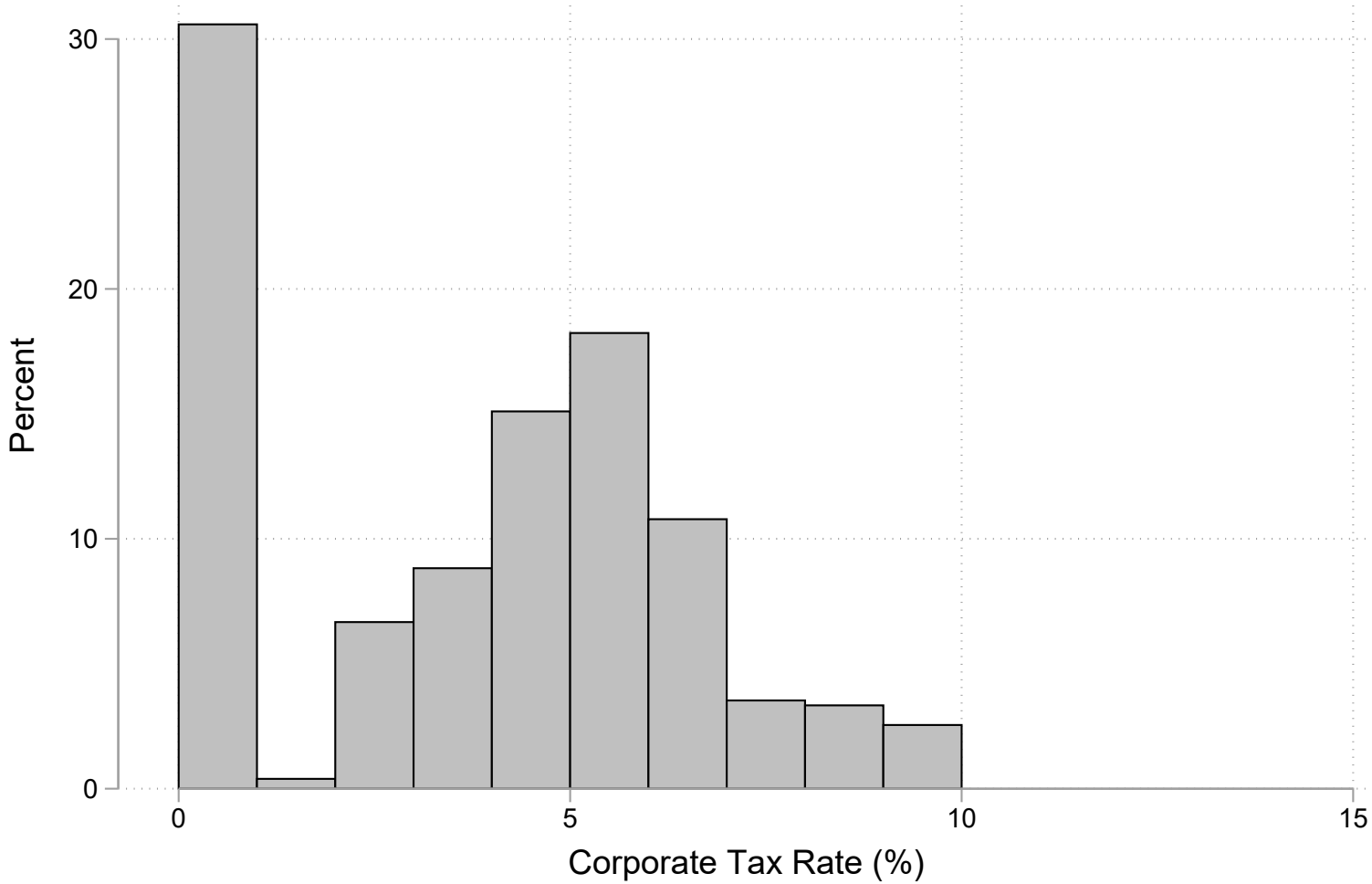
State Corporate Tax Distribution: 1930s



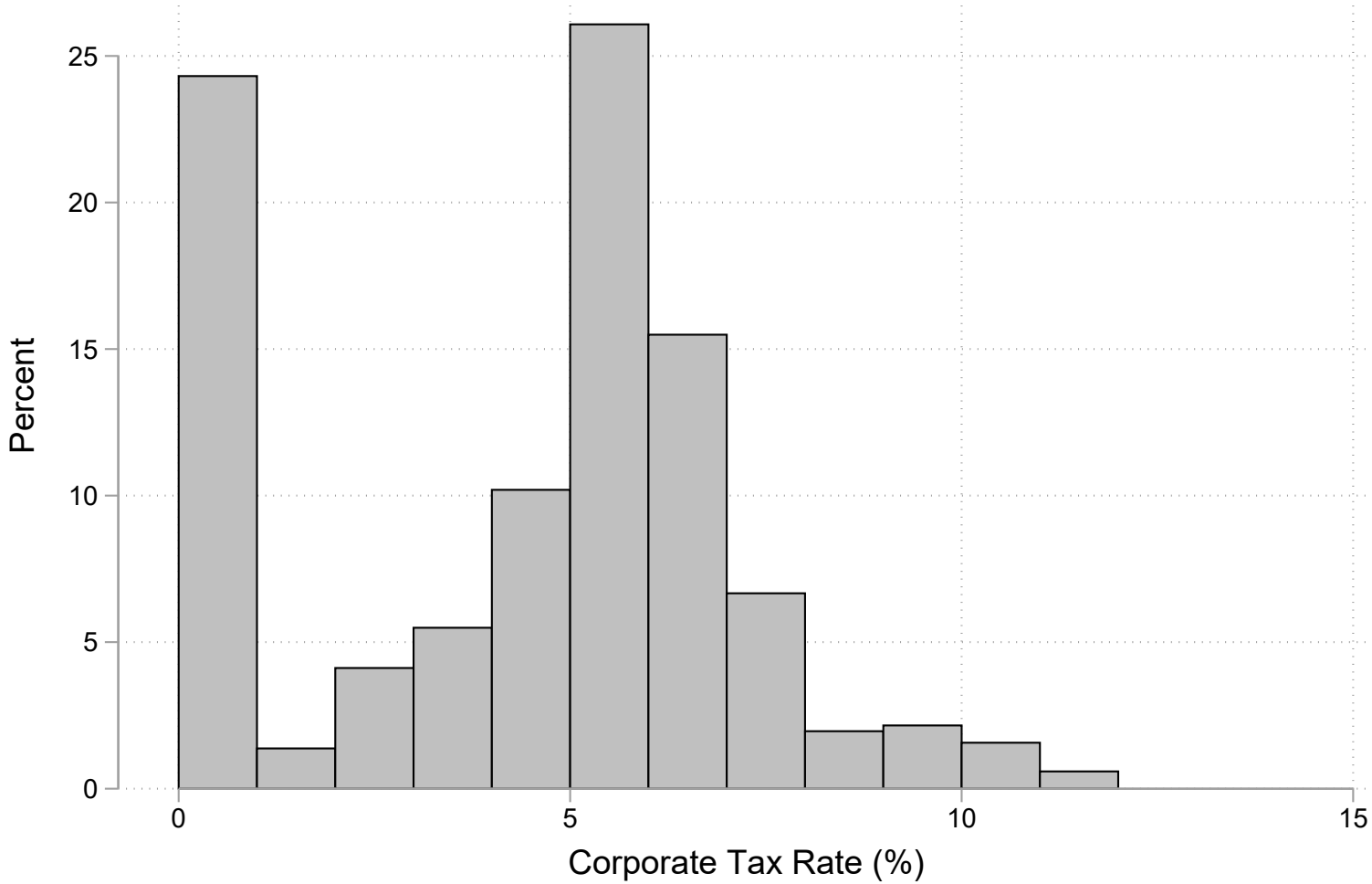
State Corporate Tax Distribution: 1940s



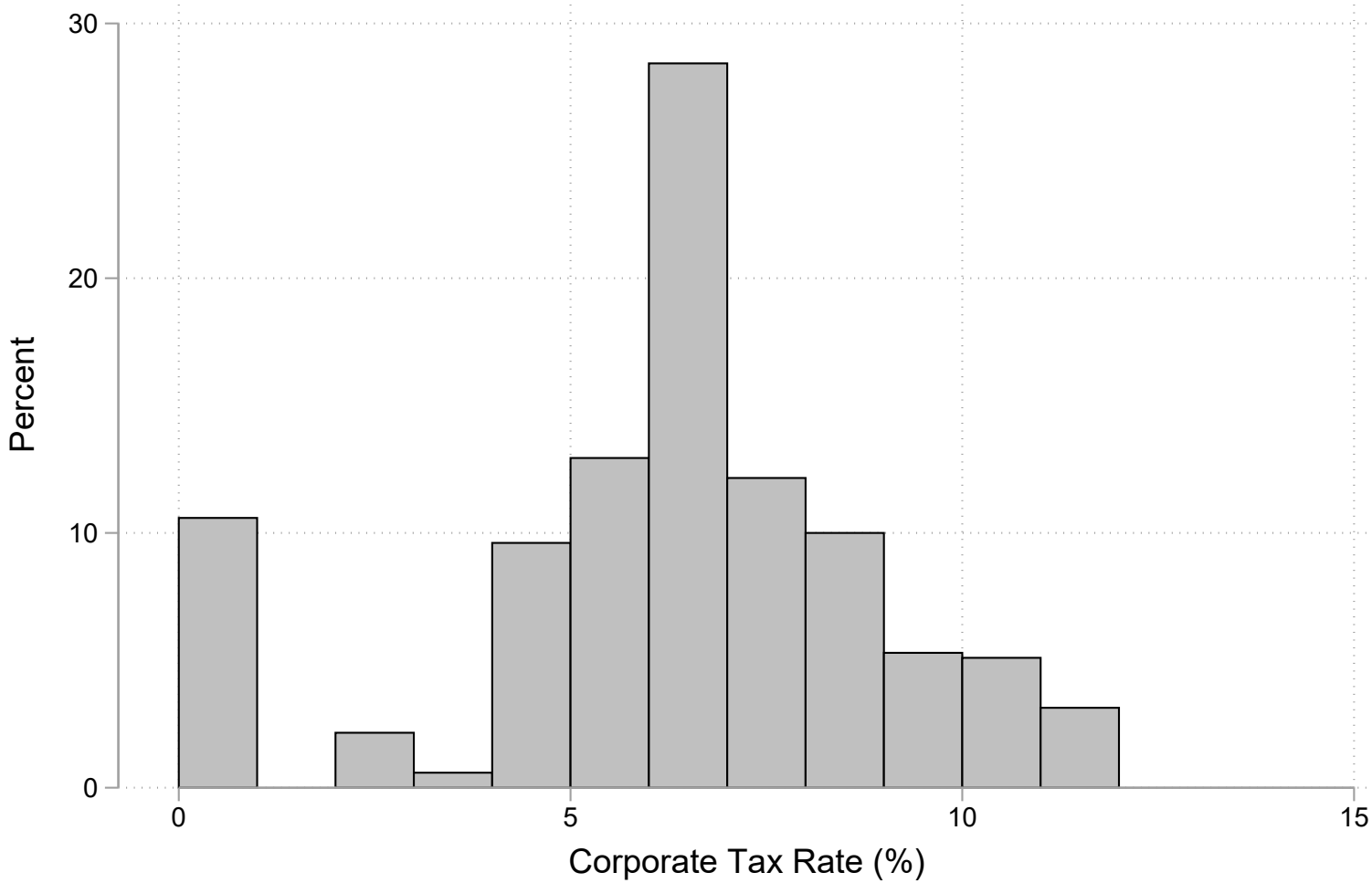
State Corporate Tax Distribution: 1950s



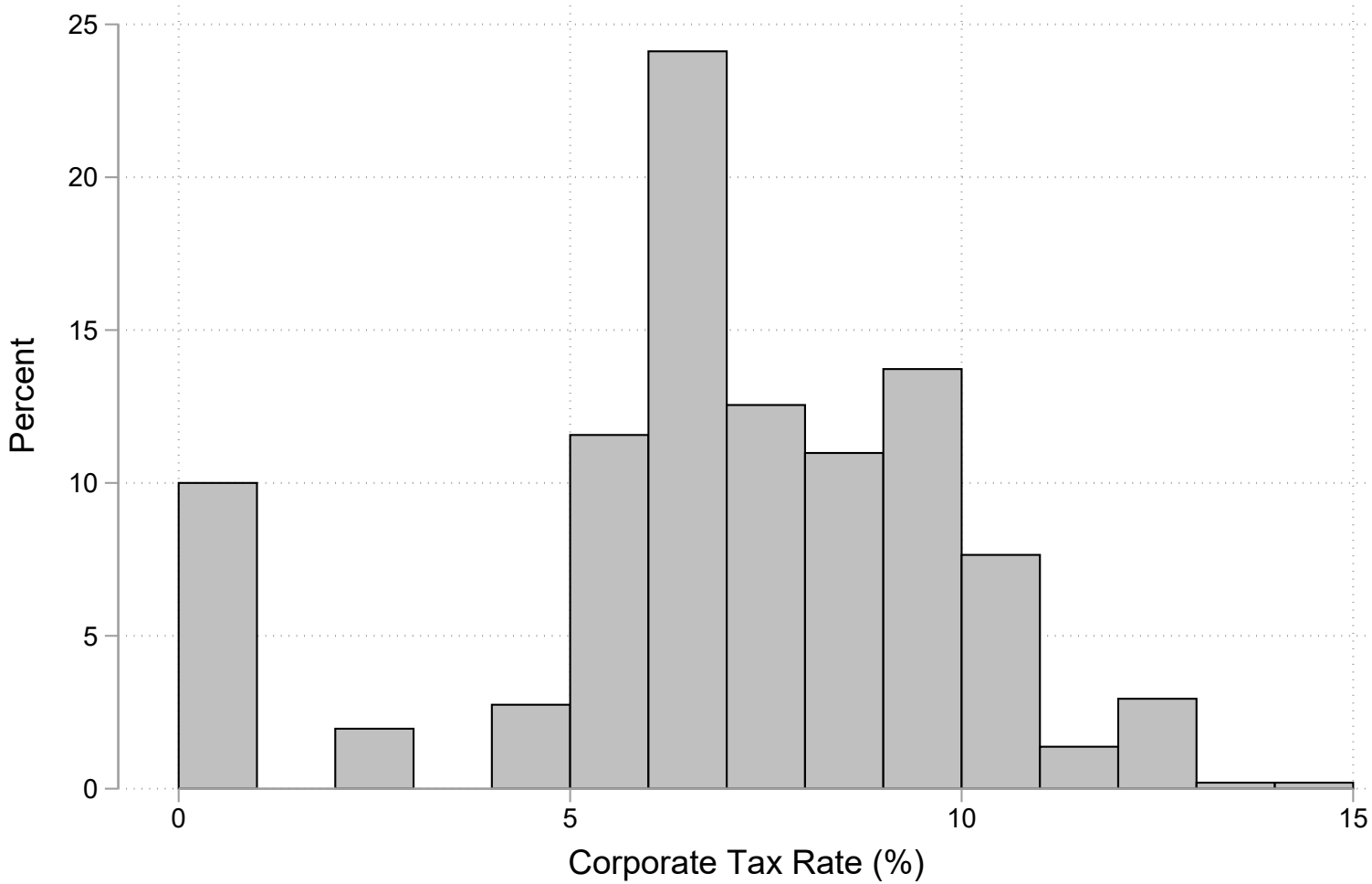
State Corporate Tax Distribution: 1960s



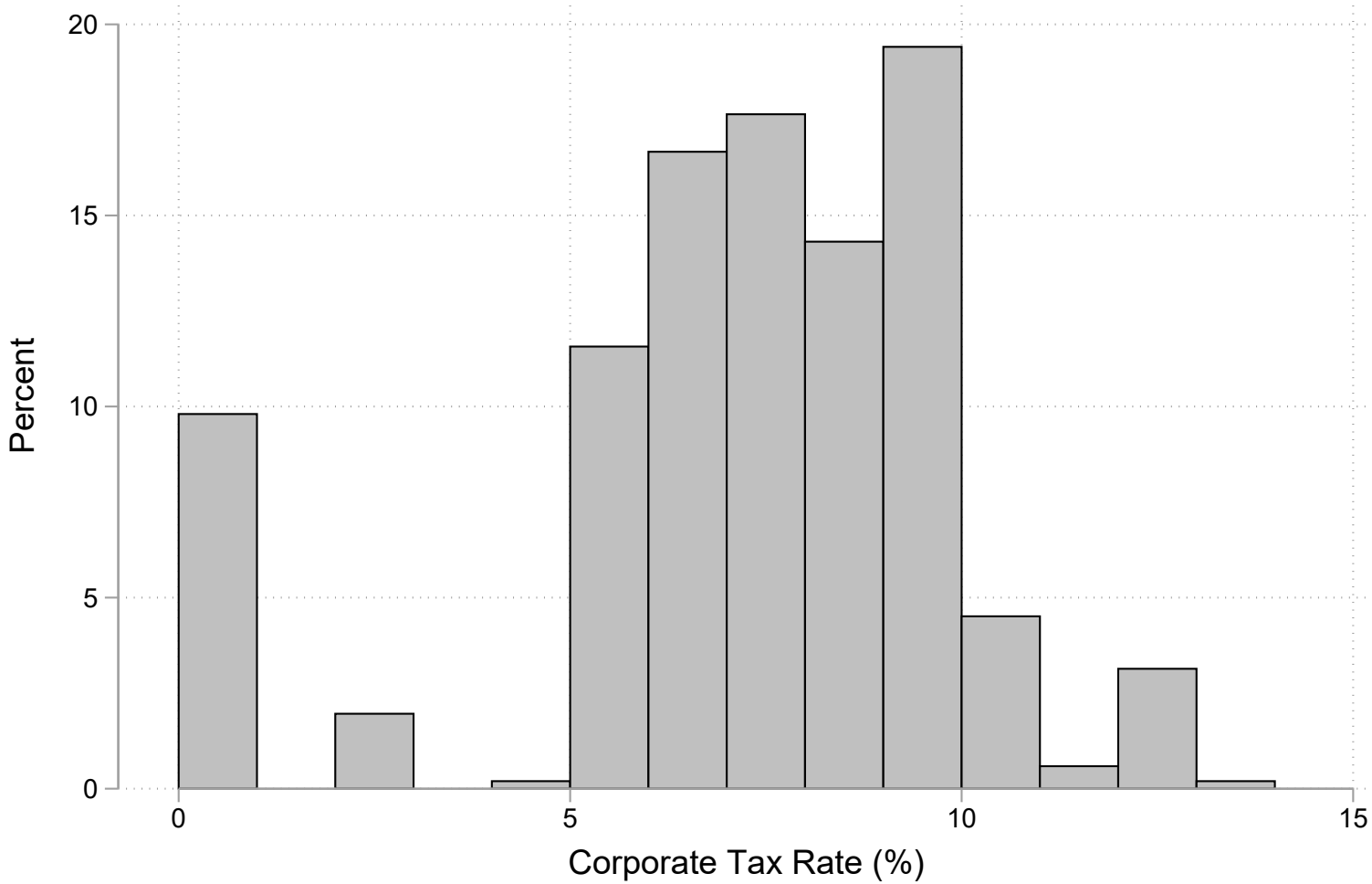
State Corporate Tax Distribution: 1970s



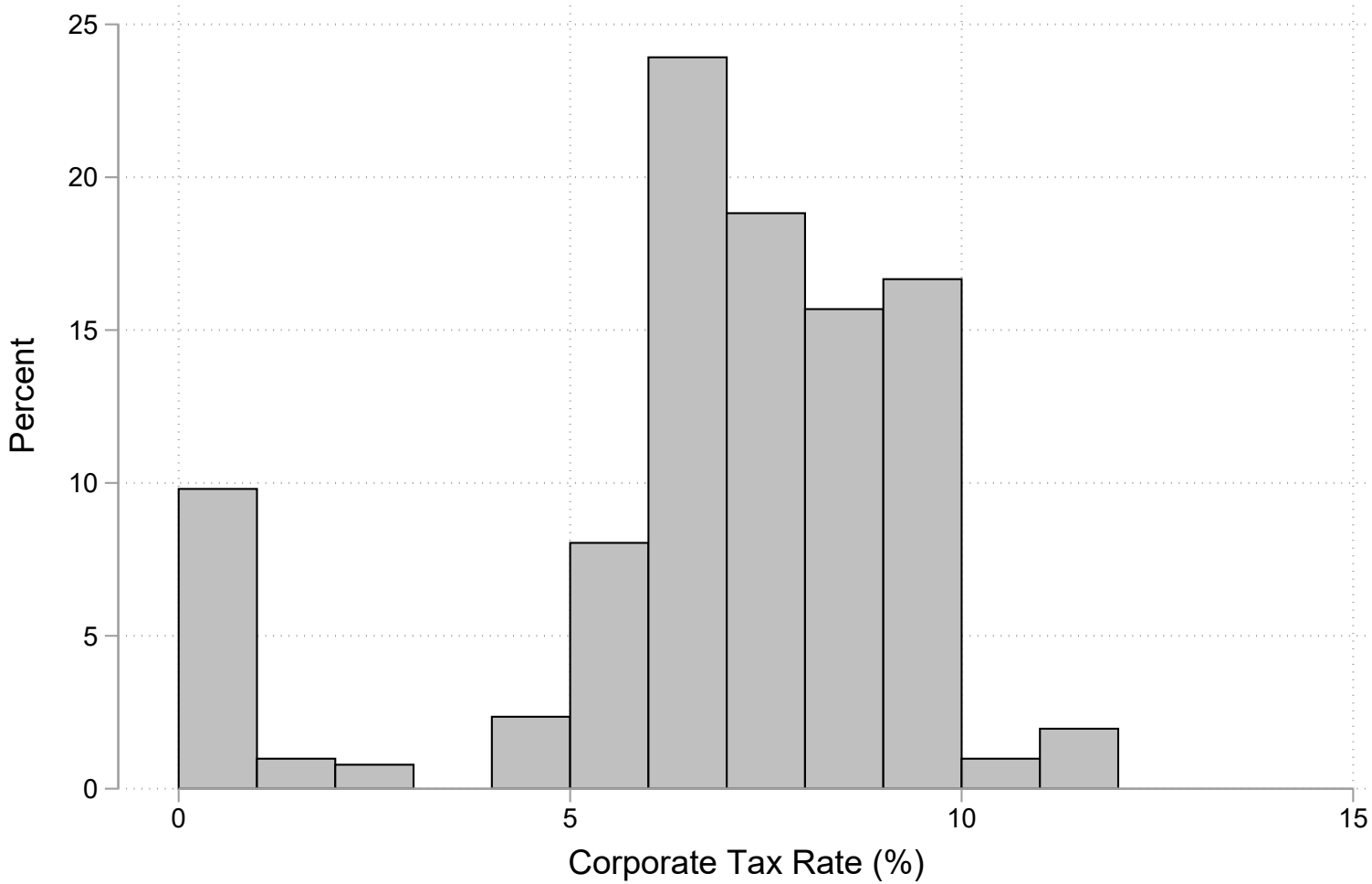
State Corporate Tax Distribution: 1980s



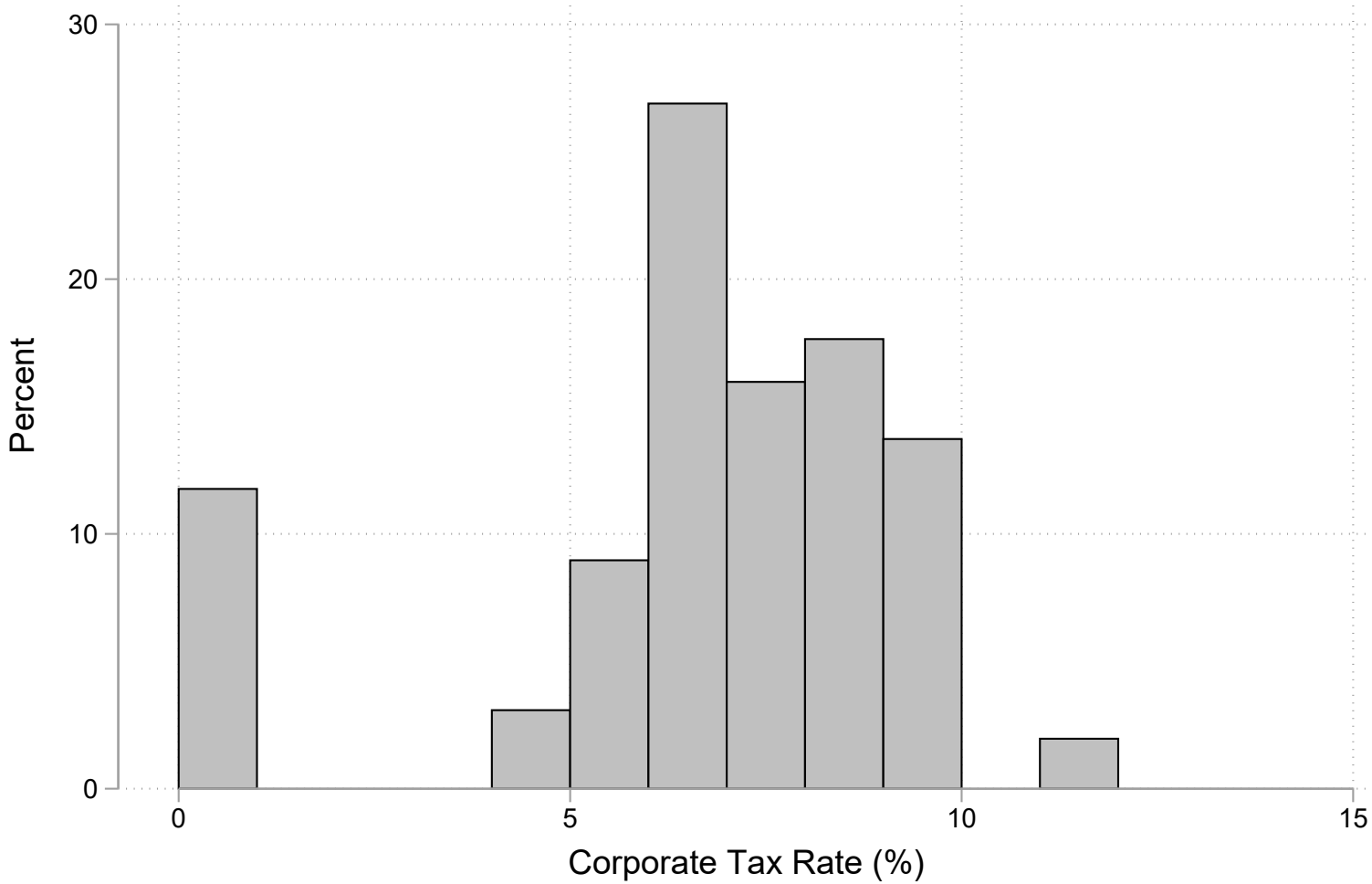
State Corporate Tax Distribution: 1990s



State Corporate Tax Distribution: 2000s



State Corporate Tax Distribution: 2010s



Macro Effects of Taxes 1940-2000: IV ▸ M

Panel B: Instrumental Variables

Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Share Assigned (4)
Top Corporate MTR (%, lag)	-0.068***	-0.059***	-0.056***	-1.008***
	(0.008)	(0.010)	(0.007)	(0.188)
90^{th} Pctile Income MTR (%, lag)	-0.048***	-0.046***	-0.046***	-0.349***
	(0.006)	(0.007)	(0.005)	(0.086)
Median Income MTR (%, lag)	-0.032***	-0.029***	-0.034***	0.252***
	(0.003)	(0.005)	(0.003)	(0.088)
90^{th} Pctile Income ATR	-0.060***	-0.057***	-0.060***	0.038
	(0.006)	(0.008)	(0.005)	(0.120)
Median Income ATR (%, lag)	-0.101***	-0.108***	-0.091***	-0.370**
	(0.012)	(0.016)	(0.010)	(0.180)
Observations	2867	2867	2867	2867
Mean of Dep. Var.	7.18	9.87	7.31	71.74
S.D. of Dep. Var.	1.31	1.59	1.33	14.01

Macro Effects of Taxes 1940-2000: Border Counties

▸ M

Panel A: Border Counties Total Effects

Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Log Corp. Patents (4)
Top Corporate MTR (%, lag)	-0.028***	-0.054***	-0.022**	-0.023**
	(0.009)	(0.012)	(0.010)	(0.010)
90^{th} Pctile Income MTR (%, lag)	-0.019***	-0.021***	-0.021***	-0.021***
	(0.004)	(0.006)	(0.004)	(0.005)
Median Income MTR (%, lag)	-0.068***	-0.074***	-0.054***	-0.059***
	(0.006)	(0.009)	(0.006)	(0.007)
90^{th} Pctile Income ATR (%, lag)	-0.078***	-0.086***	-0.067***	-0.072***
	(0.007)	(0.010)	(0.007)	(0.008)
Median Income ATR (%, lag)	-0.104***	-0.122***	-0.102***	-0.098***
	(0.014)	(0.016)	(0.015)	(0.016)
Observations	8289	8289	8289	8217
Mean of Dep. Var.	0.04	0.05	0.05	0.05
S.D. of Dep. Var.	1.45	1.64	1.49	1.57

Inventor Quality Measures and Ranking ▸ M

Different possible measures of inventor quality:

Inventor Quality Measures and Ranking ▸ M

Quality measures
(dynamic and lagged)

1. Citations-weighted patents
2. Patent count
3. Average citations per patent
4. Max citations per patent

Inventor Quality Measures and Ranking ▸ M

Quality measures
(dynamic and lagged)

1. Citations-weighted patents
2. Patent count
3. Average citations per patent
4. Max citations per patent

Inventor Ranking National level
(robustness: state-level).

Inventor Quality Measures and Ranking ▸ M

Quality measures
(dynamic and lagged)

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Inventor Ranking National level
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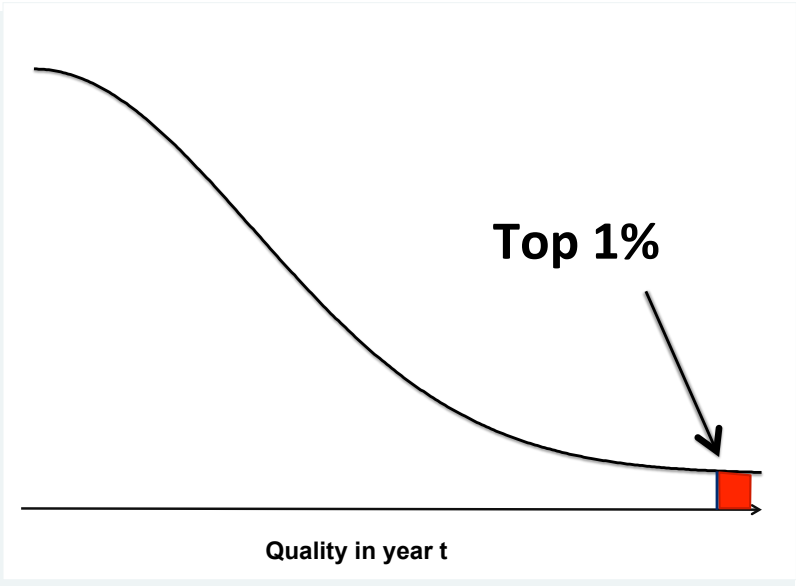
Inventor Ranking National level
(robustness: state-level).

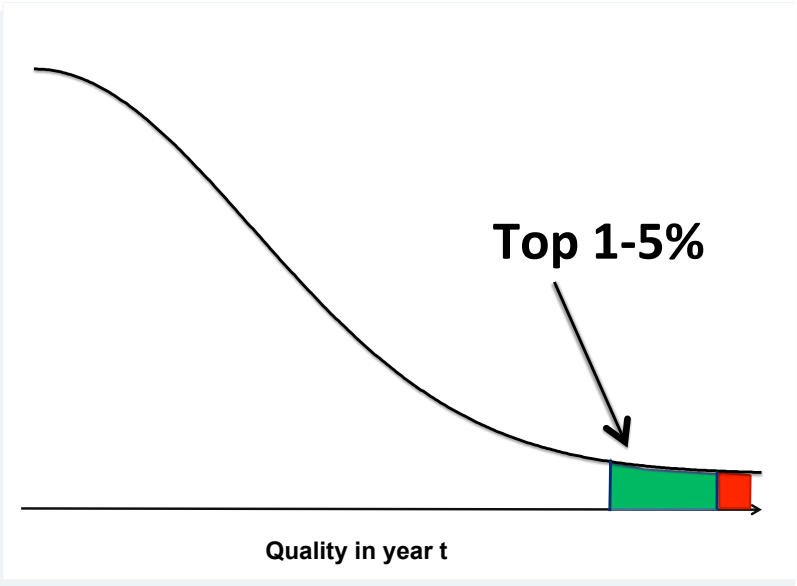


Inventor Quality Measures and Ranking ▸ M

Quality measures
(dynamic and lagged)

1. Citations-weighted patents
2. Patent count
3. Average citations per patent
4. Max citations per patent

Inventor Ranking National level
(robustness: state-level).

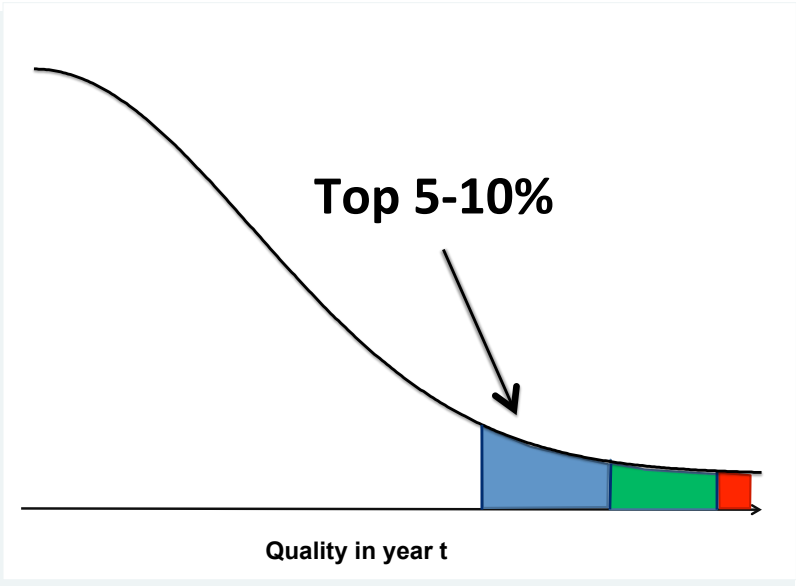


Inventor Quality Measures and Ranking ▸ M

Quality measures
(dynamic and lagged)

1. Citations-weighted patents
2. Patent count
3. Average citations per patent
4. Max citations per patent

Inventor Ranking National level
(robustness: state-level).

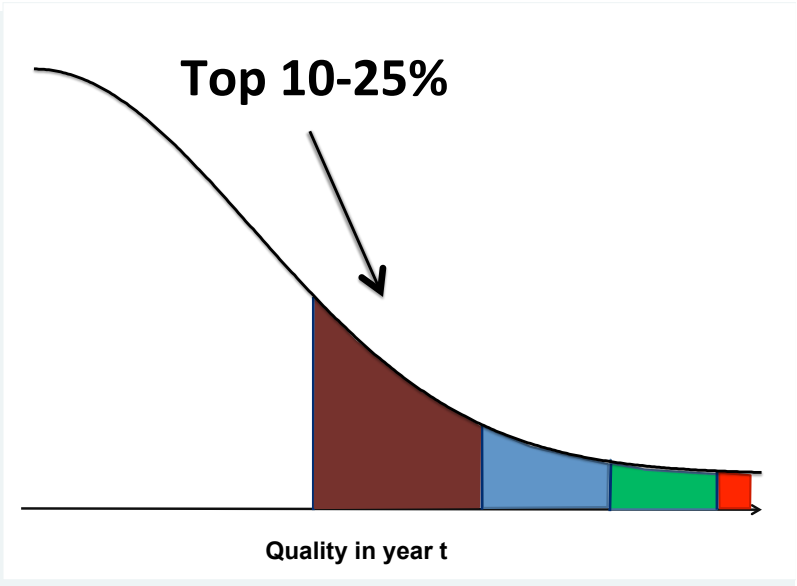


Inventor Quality Measures and Ranking ▸ M

Quality measures
(dynamic and lagged)

1. Citations-weighted patents
2. Patent count
3. Average citations per patent
4. Max citations per patent

Inventor Ranking National level
(robustness: state-level).



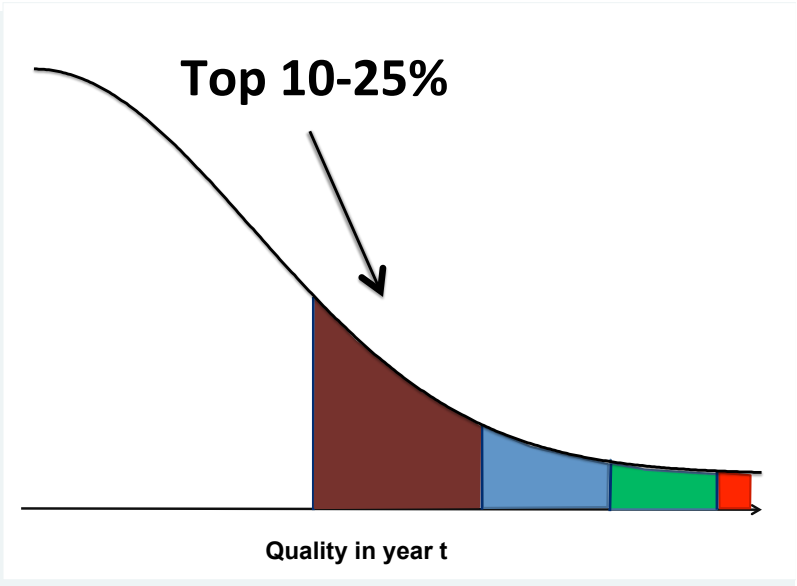
Inventor Quality Measures and Ranking ▸ M

Quality measures
(dynamic and lagged)

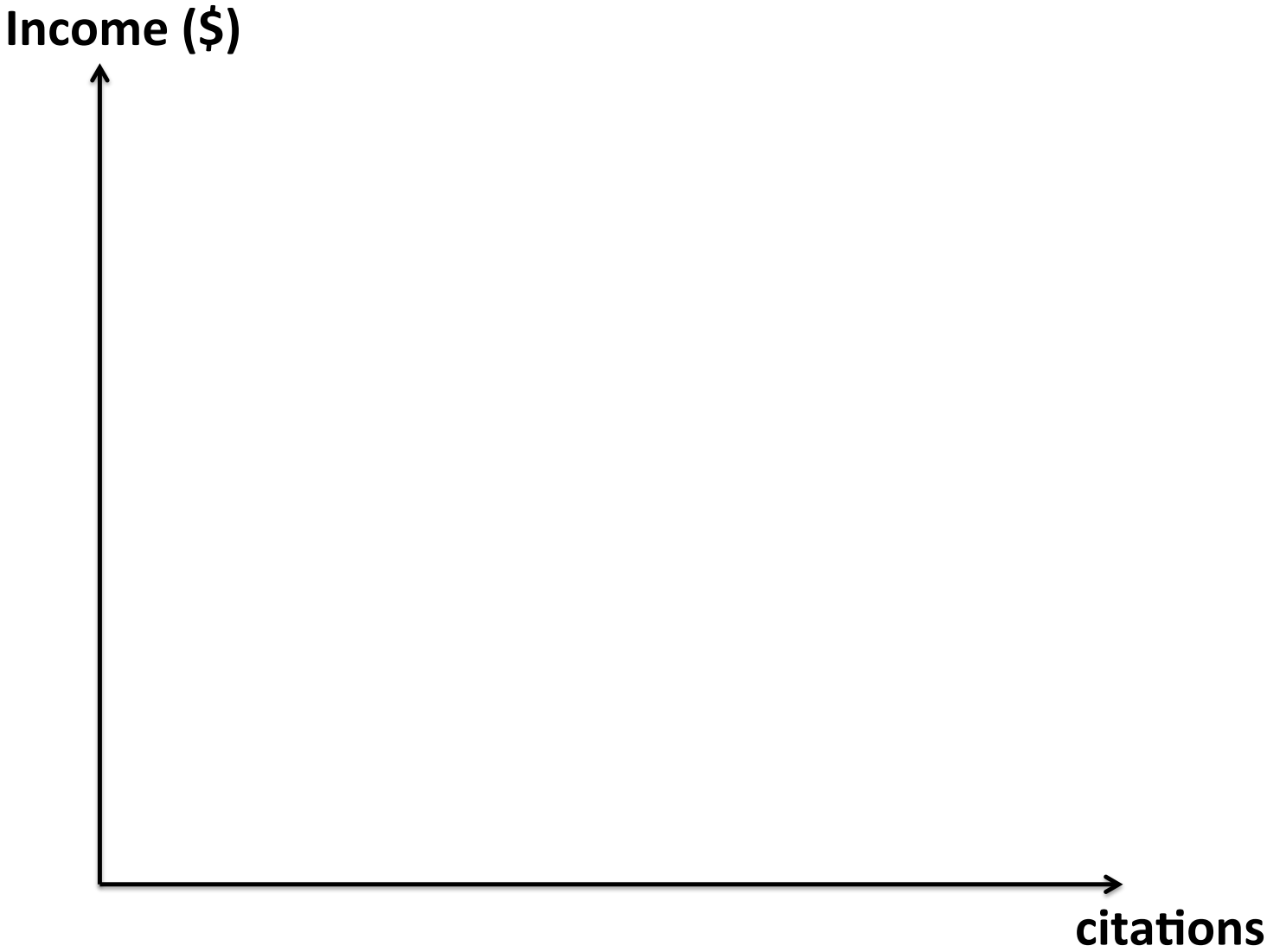
1. Citations-weighted patents
2. Patent count
3. Average citations per patent
4. Max citations per patent

→ Dynamic, Persistent, Life-time ranking

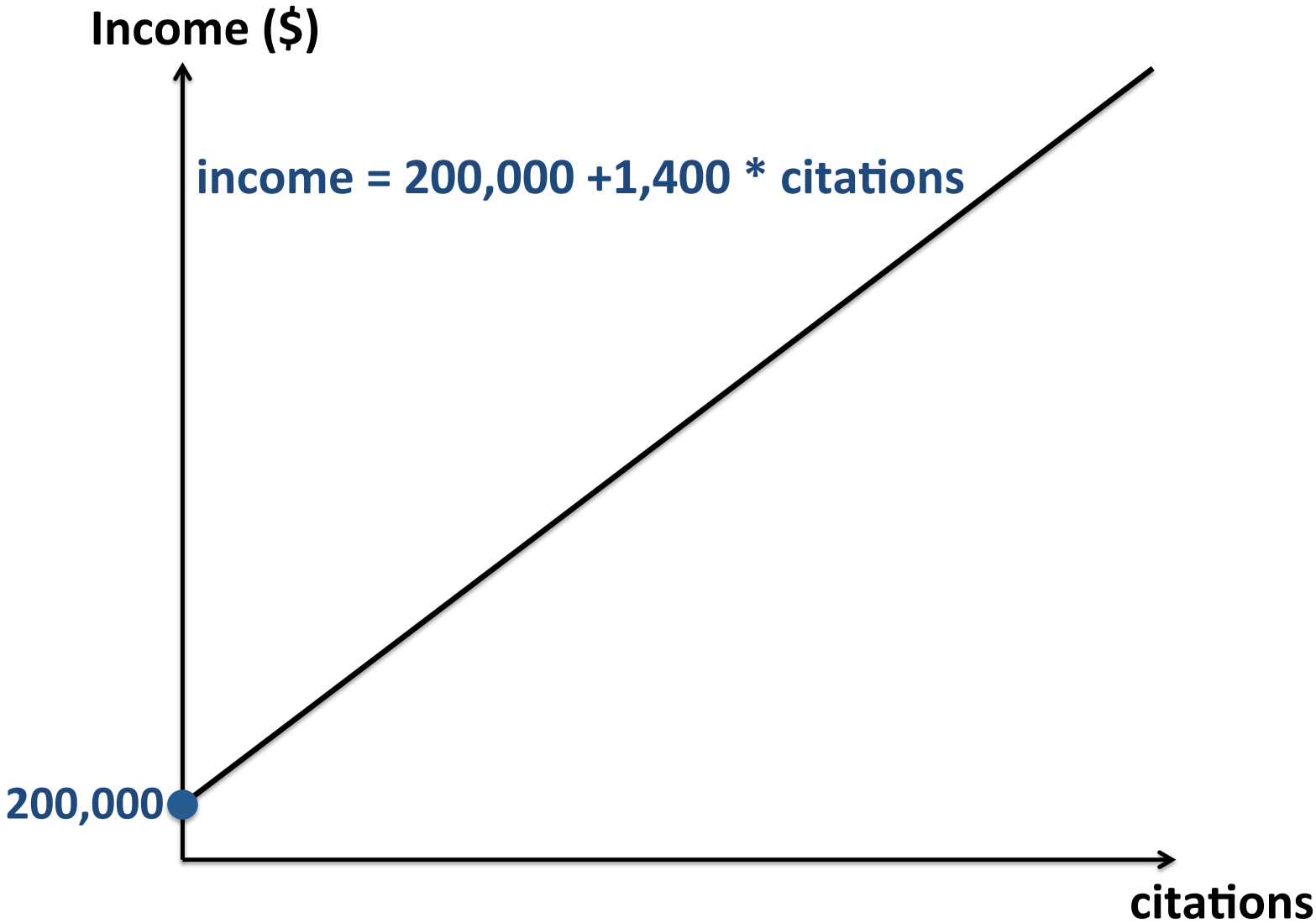
Inventor Ranking National level (robustness: state-level).



Link between Inventor Quality and Income in IRS data

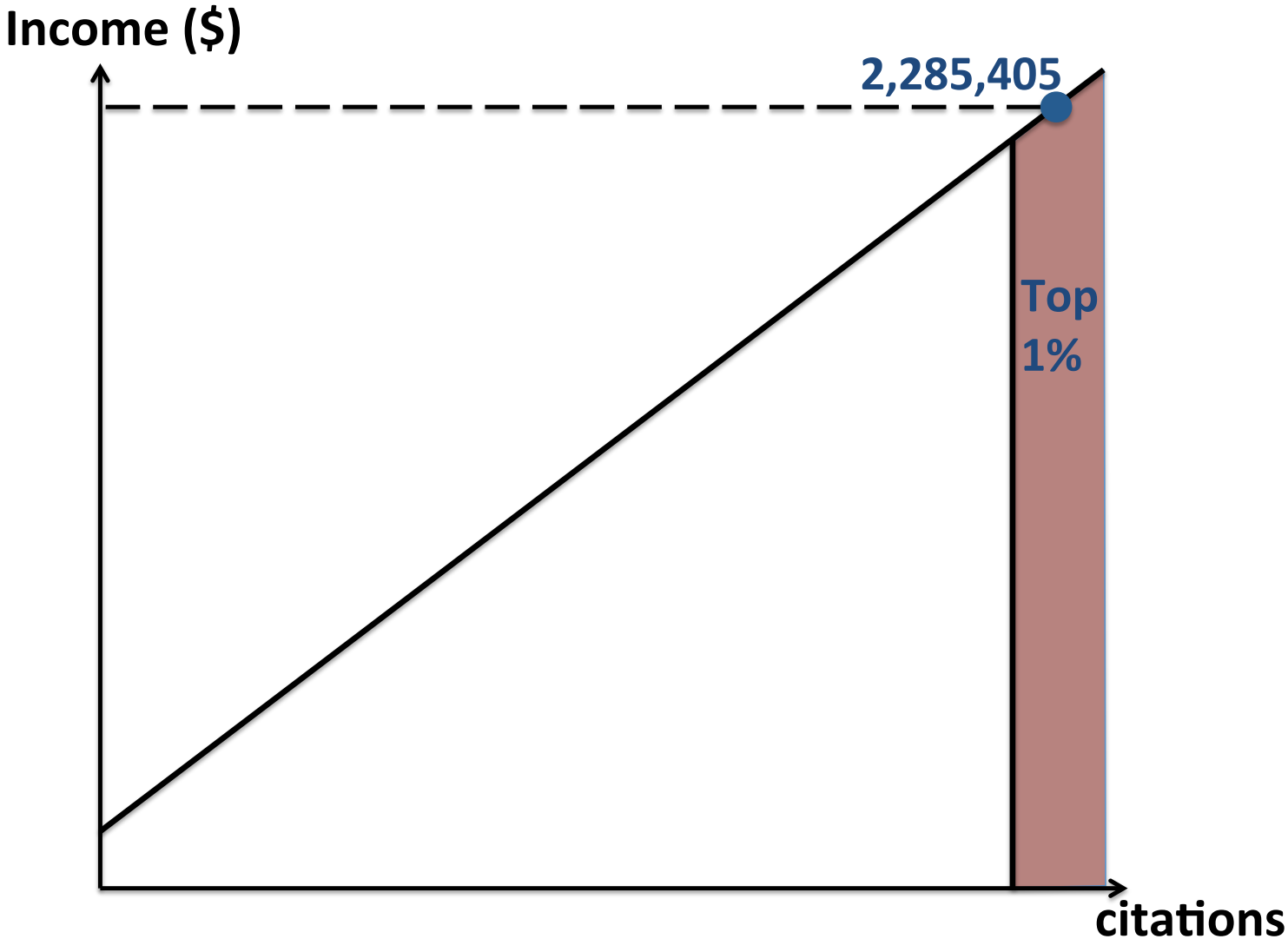


Link between Inventor Quality and Income in IRS data



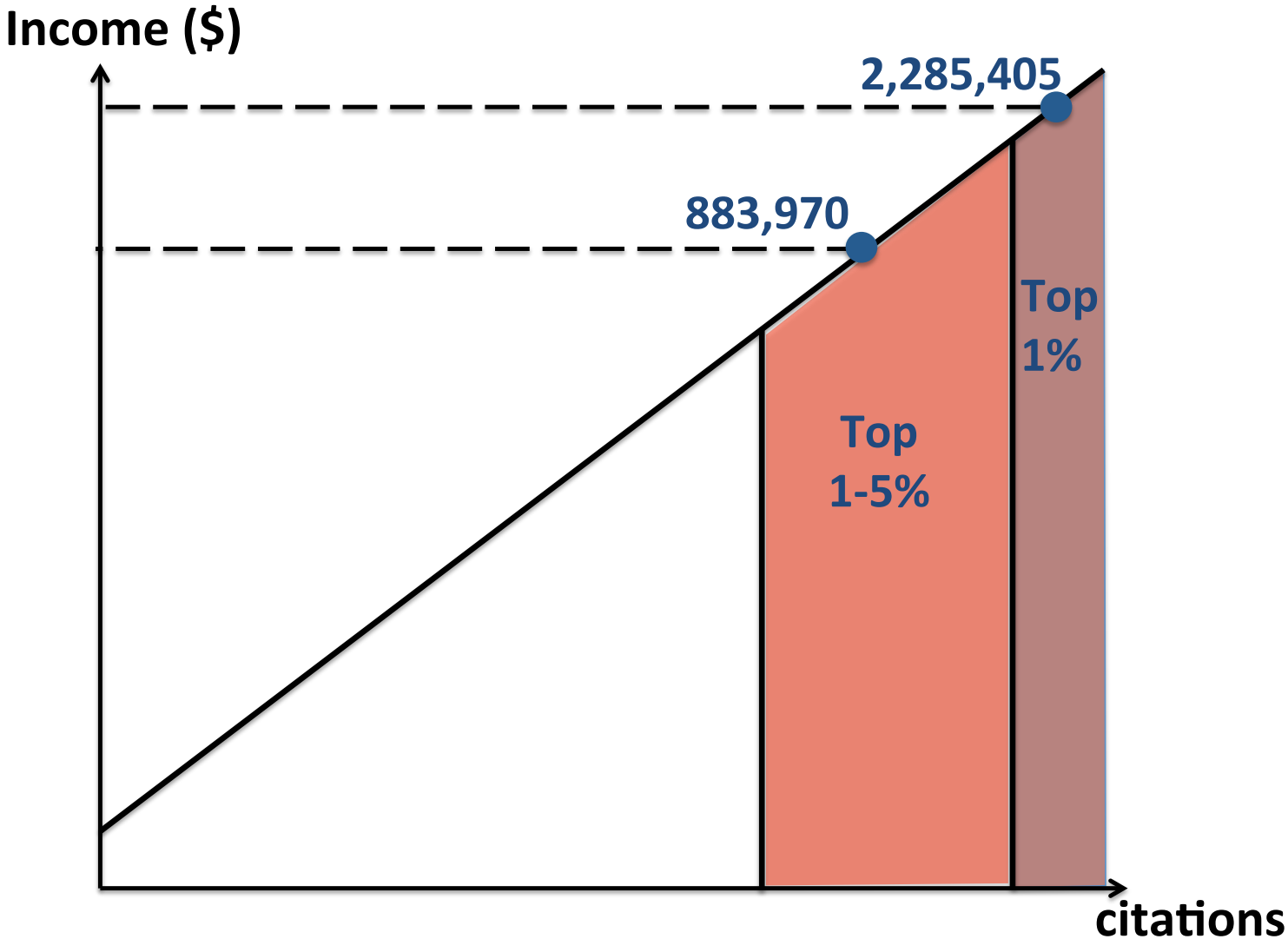
Source: Bell *et al.* (2015).

Link between Inventor Quality and Income in IRS data



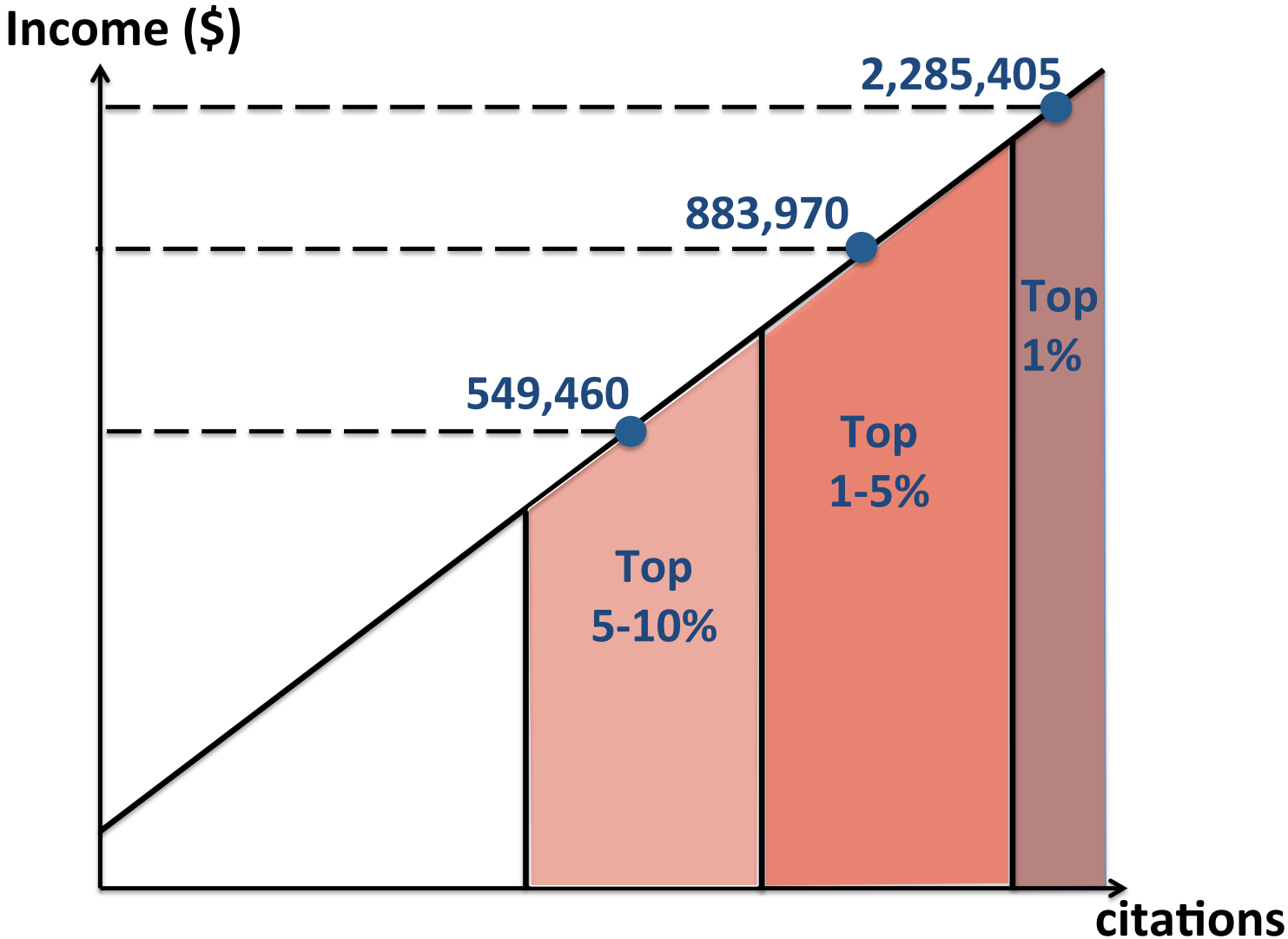
Source: Bell *et al.* (2015).

Link between Inventor Quality and Income in IRS data



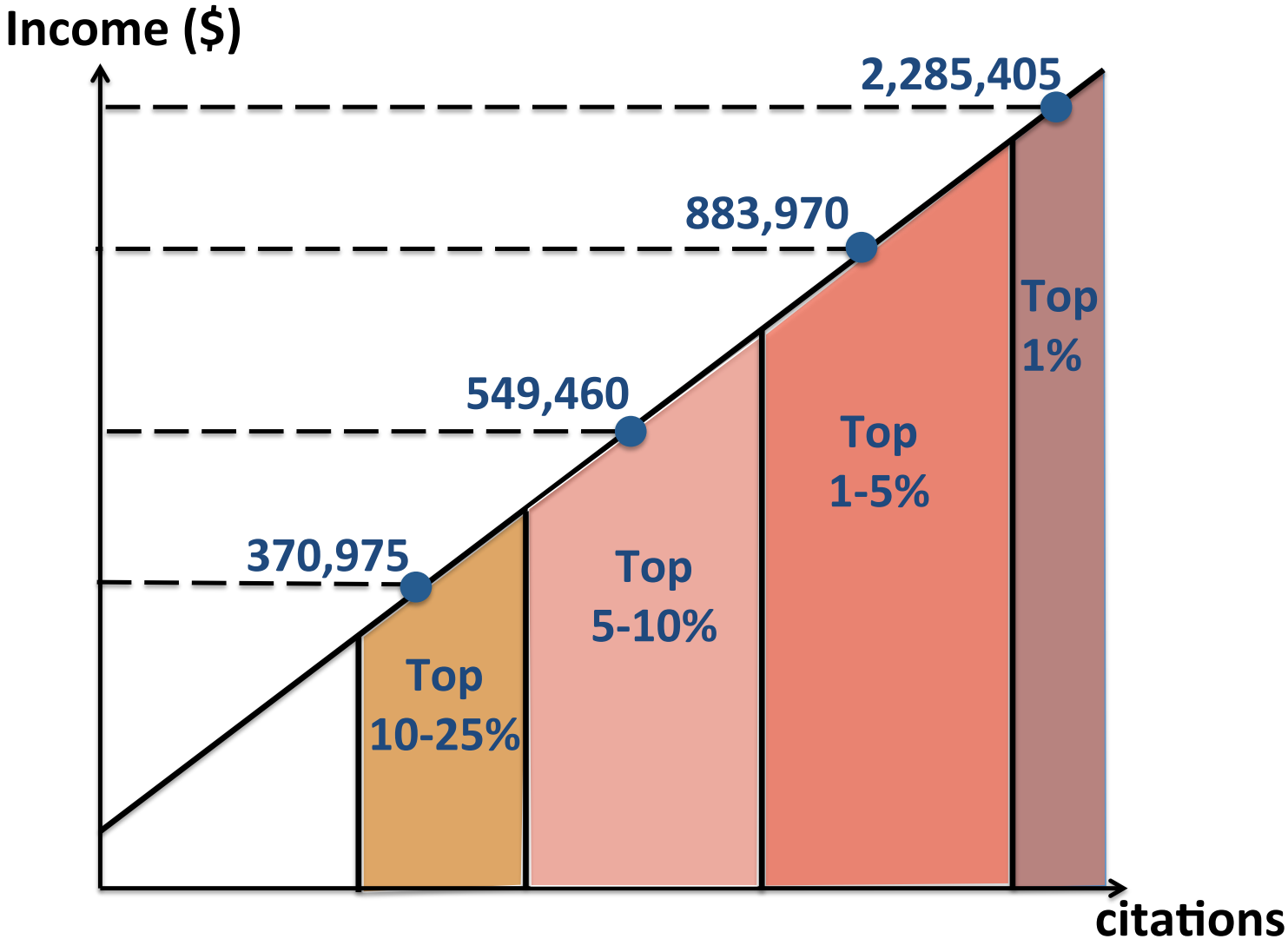
Source: Bell *et al.* (2015).

Link between Inventor Quality and Income in IRS data



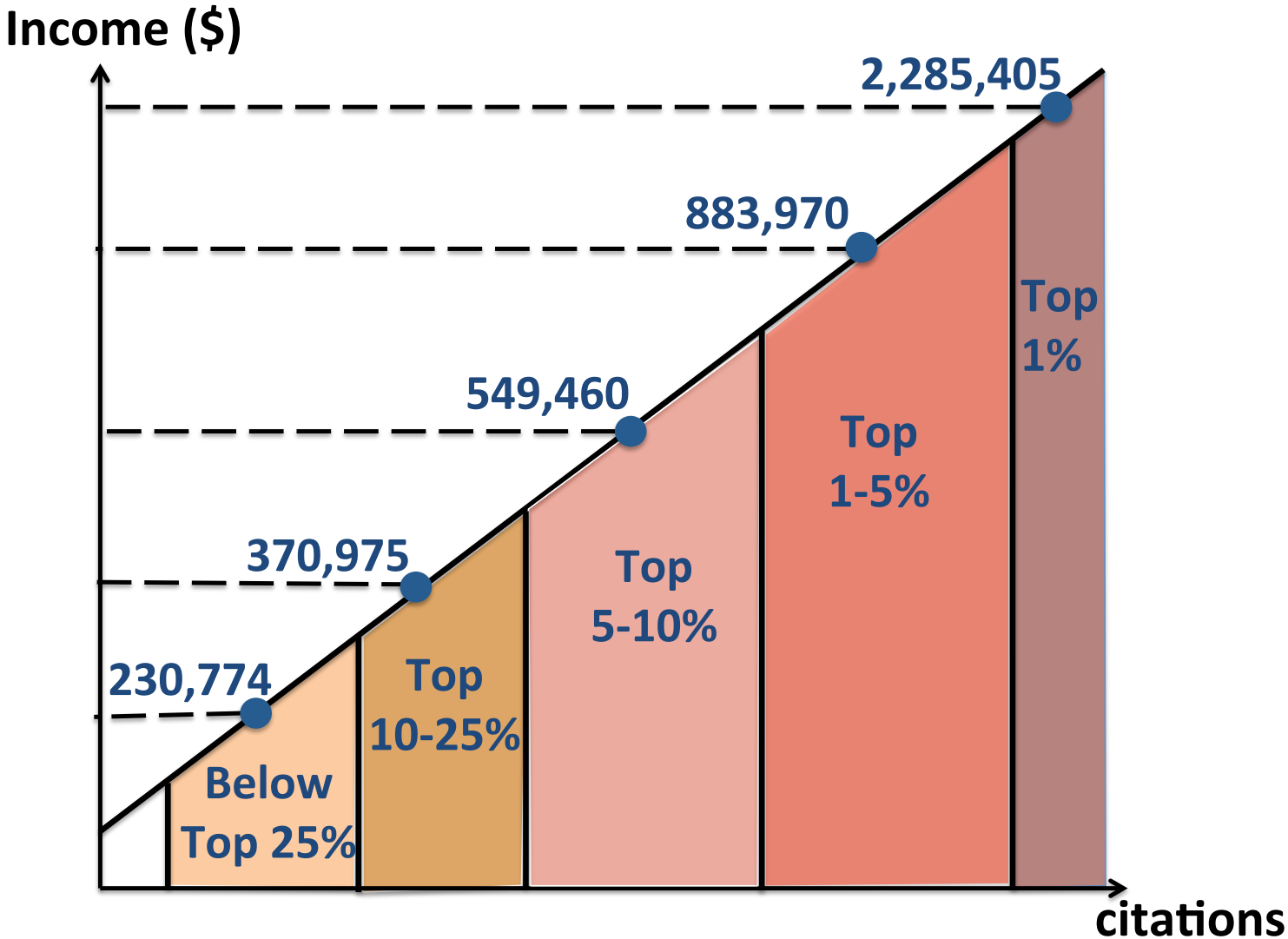
Source: Bell *et al.* (2015).

Link between Inventor Quality and Income in IRS data



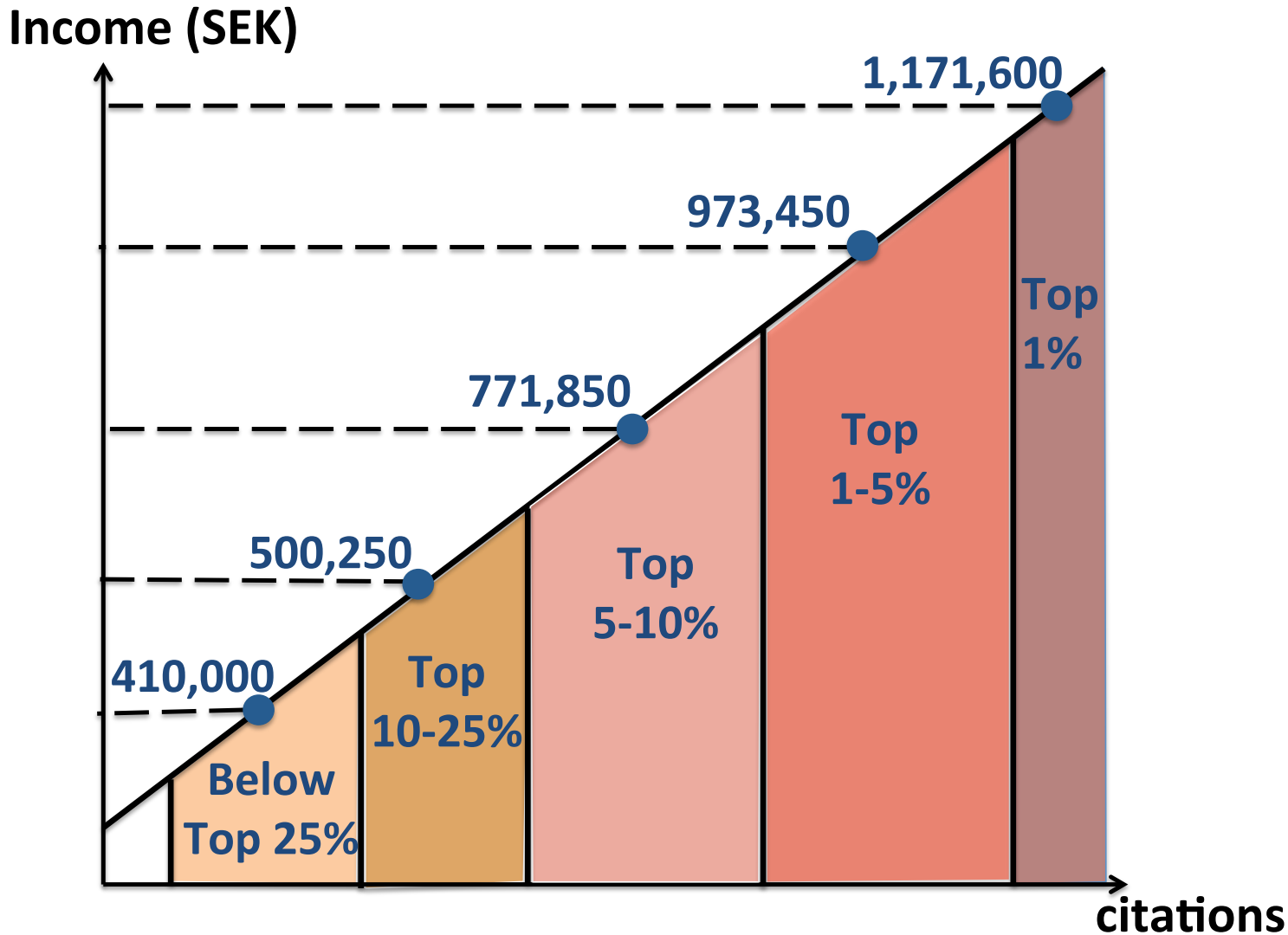
Source: Bell *et al.* (2015).

Link between Inventor Quality and Income in IRS data



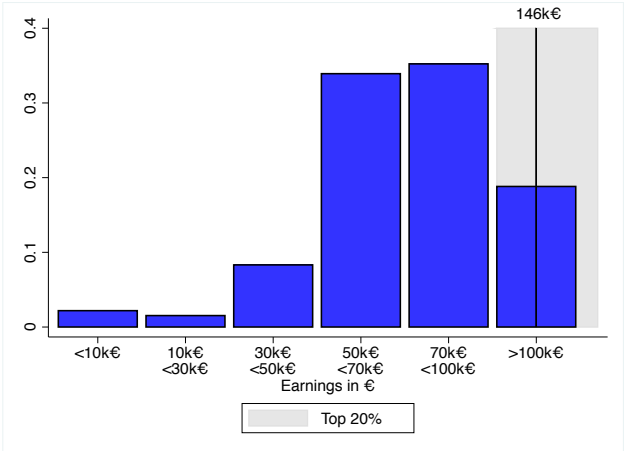
Source: Bell *et al.* (2015).

Link between Inventor Quality and Income in Swedish and Finnish Admin data ▸ M

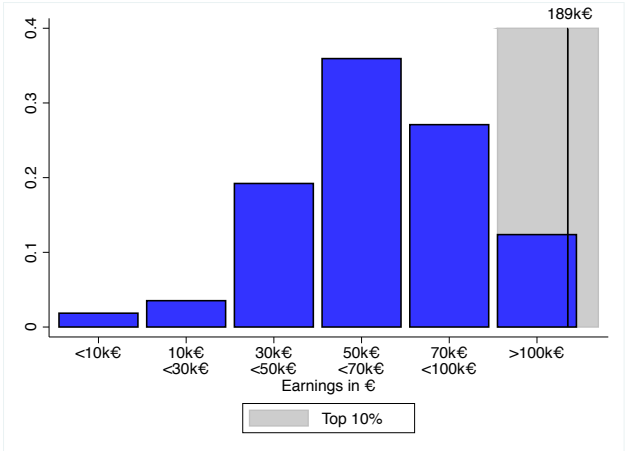


Source: Olof Ejermo and Otto Toivaannen.

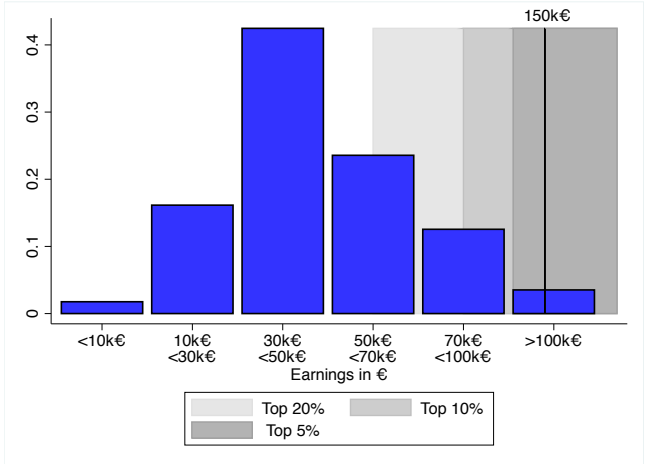
Survey Income Distributions + Link Quality-Income ▸ M



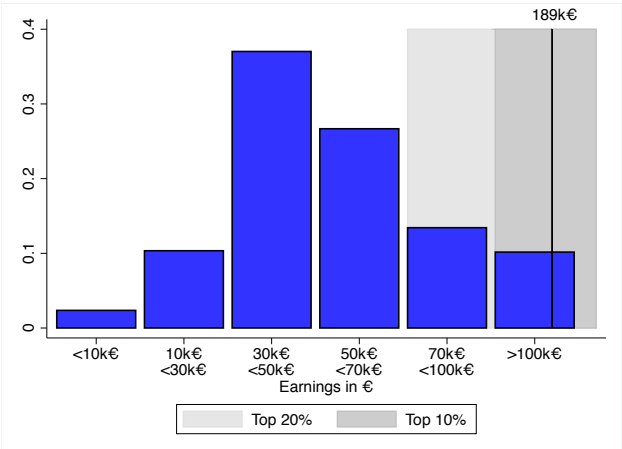
(a) Switzerland



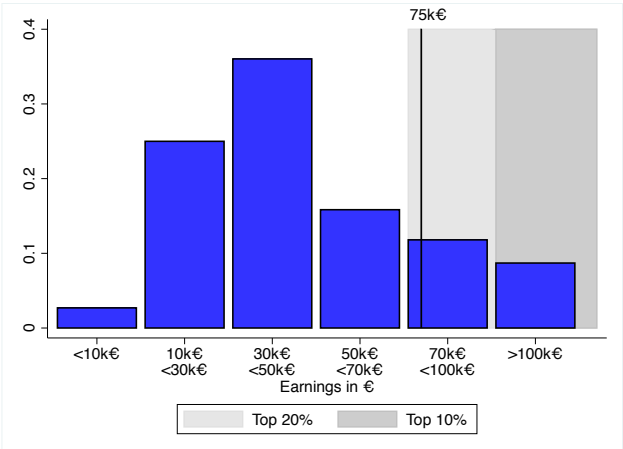
(b) Germany



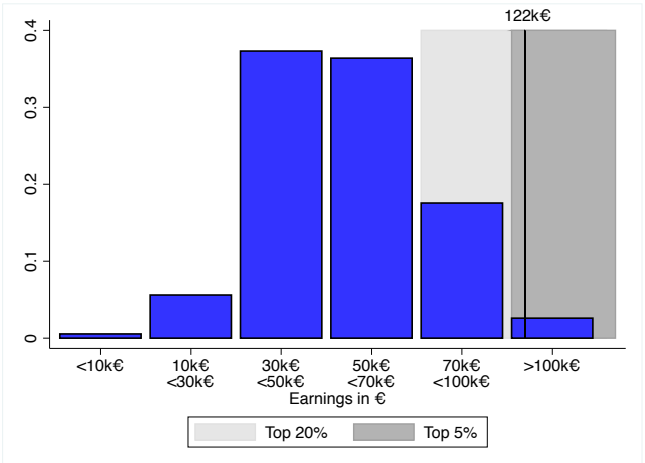
(c) France



(d) Great Britain



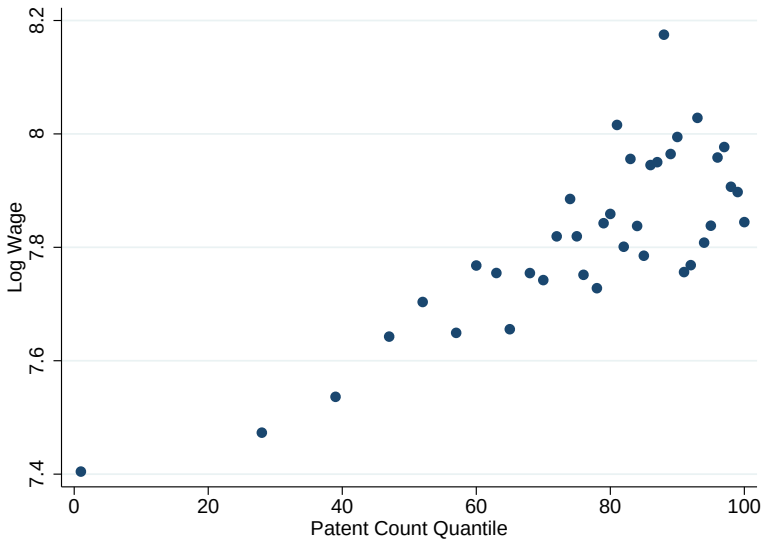
(e) Italy



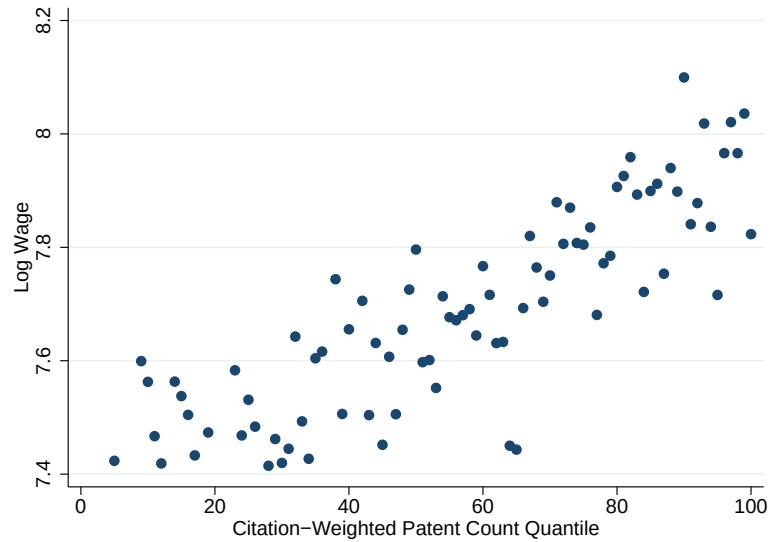
(f) Japan

Historical link between Income and Patents ▸ M

Unweighted Patent Counts



Citation-Weighted Patent Counts



At the Inventor Level: IV Strategy

▸ OLS

Dependent Variable:	Has Patent (3-year) (1)	Has 10+ Cites (3-year) (2)	Log Patents (3-year) (3)	Log Citations (3-year) (4)	Has Corporate Patent (3-yr) (5)
Effective MTR	-0.647***	-0.622***	-0.013***	-0.017***	-0.695***
	(0.025)	(0.026)	(0.000)	(0.001)	(0.025)
Top Corporate MTR	-0.172**	-0.063	0.000	0.004*	0.047
	(0.072)	(0.071)	(0.001)	(0.002)	(0.070)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.119***	-0.184***	-0.005***	-0.006***	-0.136***
	(0.025)	(0.029)	(0.001)	(0.001)	(0.021)
State × Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Observations	5956315	5956315	4545384	4392312	5956315
Mean of Dep. Var.	76.312	45.079	0.442	2.758	61.421
S.D. of Dep. Var.	42.517	49.757	0.664	1.453	48.678

Macro Effects of Taxes, Excluding Movers (IV) ▸ M

	Log Patents (1)	Log Citations (2)	Log Inventor (3)	Citations/ Patent (4)	Share Assigned (5)
90th Pctile Income MTR	-0.048***	-0.048***	-0.046***	-0.081	-0.427***
	(0.005)	(0.007)	(0.005)	(0.057)	(0.083)
Top Corporate MTR	-0.068***	-0.068***	-0.055***	-0.052	-1.055***
	(0.008)	(0.009)	(0.007)	(0.069)	(0.182)
Median Income MTR	-0.033***	-0.025***	-0.034***	0.332***	0.169*
	(0.003)	(0.005)	(0.003)	(0.109)	(0.087)
Top Corporate MTR	-0.073***	-0.076***	-0.059***	-0.230**	-1.304***
	(0.009)	(0.010)	(0.007)	(0.093)	(0.186)
90th Pctile Income ATR	-0.062***	-0.055***	-0.060***	0.185**	-0.088
	(0.006)	(0.008)	(0.005)	(0.088)	(0.118)
Top Corporate MTR	-0.063***	-0.065***	-0.050***	-0.159**	-1.195***
	(0.008)	(0.009)	(0.007)	(0.077)	(0.188)
Median Income ATR	-0.096***	-0.102***	-0.088***	-0.474***	-0.525***
	(0.011)	(0.014)	(0.010)	(0.141)	(0.176)
Top Corporate MTR	-0.067***	-0.066***	-0.055***	0.015	-1.119***
	(0.008)	(0.010)	(0.007)	(0.064)	(0.176)
Observations	2867	2867	2867	2867	2867
Mean of Dep. Var.	6.90	9.56	7.11	16.85	68.40
S.D. of Dep. Var.	1.30	1.57	1.32	11.31	14.66

Border County Effects of Taxes, Excluding Movers ▸ M

Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Citations/ Patent (4)	Log Corp. Patents (5)
90^{th} Pctile Personal Income MTR (%, lag)	-0.017***	-0.013*	-0.016***	0.076	-0.015***
	(0.004)	(0.007)	(0.005)	(0.107)	(0.005)
Top Corporate MTR (%, lag)	-0.009	-0.030**	-0.007	-0.605**	-0.001
	(0.009)	(0.014)	(0.010)	(0.250)	(0.010)
Median Personal Income MTR (%, lag)	-0.064***	-0.065***	-0.051***	-0.198	-0.059***
	(0.007)	(0.011)	(0.007)	(0.186)	(0.008)
Top Corporate MTR (%, lag)	-0.008	-0.029**	-0.007	-0.568**	-0.000
	(0.010)	(0.014)	(0.011)	(0.233)	(0.012)
90^{th} Pctile Personal Income ATR (%, lag)	-0.073***	-0.070***	-0.061***	-0.176	-0.069***
	(0.007)	(0.010)	(0.007)	(0.172)	(0.008)
Top Corporate MTR (%, lag)	-0.004	-0.025*	-0.003	-0.561**	0.004
	(0.010)	(0.013)	(0.010)	(0.232)	(0.011)
Median Personal Income ATR (%, lag)	-0.107***	-0.123***	-0.106***	-0.421**	-0.111***
	(0.015)	(0.020)	(0.015)	(0.197)	(0.017)
Top Corporate MTR (%, lag)	-0.015	-0.036**	-0.013	-0.591**	-0.007
	(0.011)	(0.015)	(0.012)	(0.243)	(0.013)
Observations	8302	8295	8307	8302	8131
Mean of Dep. Var.	0.050	0.052	0.060	-0.235	0.078
S.D. of Dep. Var.	1.527	1.774	1.558	15.055	1.666