

Taxation and Innovation

Stefanie Stantcheva

Interplay between Taxation and Innovation

Two ways to study **interplay between taxation and innovation**:

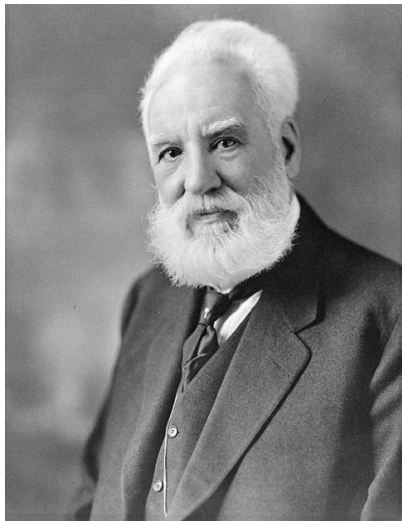
- ① Effects of general taxes on innovation are unwelcome byproduct that we need to consider and quantify.
- ② Tax policy could be designed intentionally so as not to hurt, or even to stimulate, innovation.

1. Taxation and Innovation in the U.S. over the 20th Century.
2. International effects of top-income taxation since 1975 on innovation.
3. Designing corporate tax and R&D policies to foster innovation.

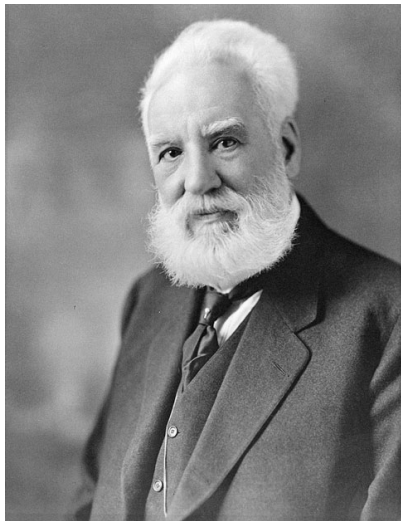
Outline

- 1 Taxation and the International Migration of Superstar Inventors
- 2 Taxation and Innovation in the 20th Century

Alexander G. Bell



Alexander G. Bell



- Inventor of the telephone (1876).
- Created Bell Telephone Company (1877).
- By 1886: more than 150,000 people in U.S. own telephones.

James L. Kraft



James L. Kraft



- Invented a pasteurization technique for cheese and established his company.
- Created Kraft Foods Inc.
- His company grew into a conglomerate responsible for creating some of the United States' most popular food products and employing more than 100,000 people.

Ralph Baer



Ralph Baer



- Created TV game unit with paddle controls.
- Today, the video gaming industry is worth \$66 billion.

Introduction

- ... and the list goes on.
- In addition to being very prolific inventors, these innovators had something else in common:
- They were all **immigrants**.
- What determines the patterns of migration of highly skilled people?

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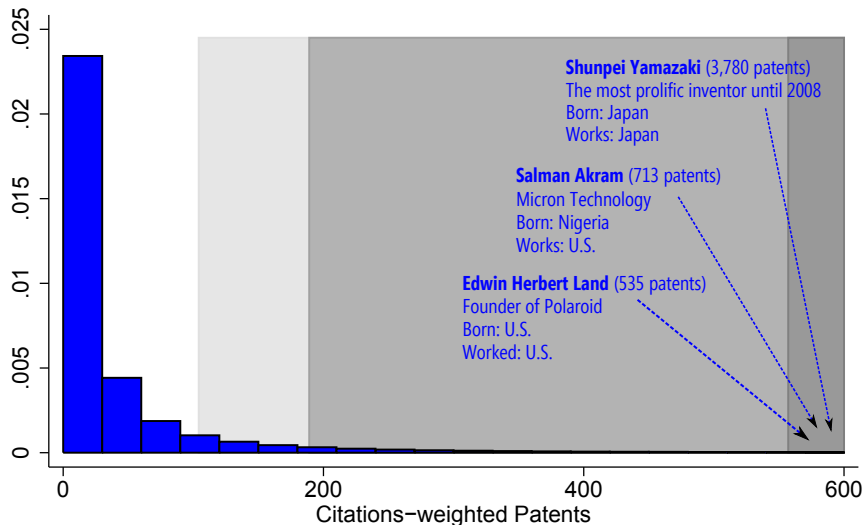
Study the Effects of Taxes on Migration using Patent Data

- Use a **unique international panel data** to overcome challenges:
 - ▶ **Patent data** from the USPTO and EPO, 1977-2000.
 - ▶ Track inventors in 8 big patenting countries: CA, CH, DE, FR, IT, JP, UK, US through residential addresses.
- Study effects of **top tax rates** on “**superstar**” inventors’ locations.
- Patent data gives direct measures of inventor quality.
- Detailed controls for *counterfactual* earnings in each potential location.

Three levels of analysis:

- ① Macro country-year level migration flows (country-by-year variation).
- ② Country case studies (quasi-experimental variation from reforms).
- ③ Micro inventor level location choice model
(differential impact of top MTR within country-year.
Inventor quality → ↑ propensity to be treated).

Superstar Inventors in a Highly Skewed Quality Distribution



Inventor Quality Measures and Ranking

Patent quality increases inventor income, directly and *indirectly*.

Quality measures

(dynamic and lagged)

- 1 Citations-weighted patents (benchmark)
- 2 Patent count
- 3 Average citations per patent
- 4 Max citations per patent
- 5 Patent breadth (claims-weighted patents)
- 6 Impact breadth (# tech classes citing patent).

▸ Correlations

▸ Patent breadth, breadth of impact

Inventor Ranking

- Group countries by patenting intensity (robust):
 1. U.S., 2. JP, 3. EU + CA
- Assign inventors to group based on home country.

→ Dynamic, Persistent, Life-time ranking

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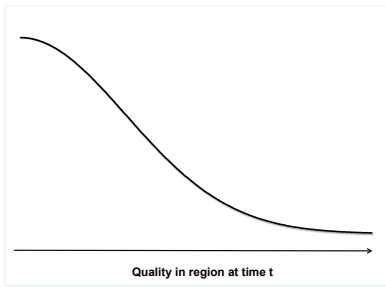
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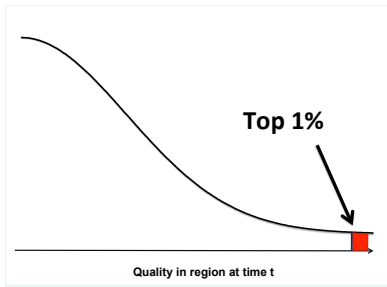
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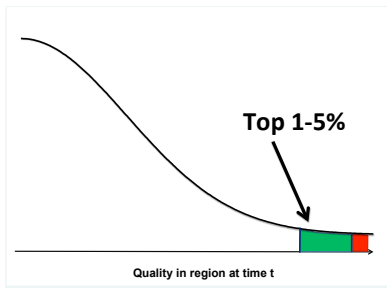
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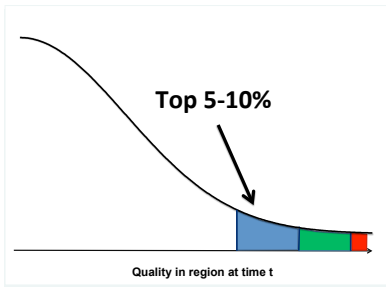
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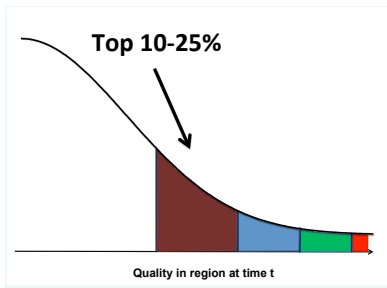
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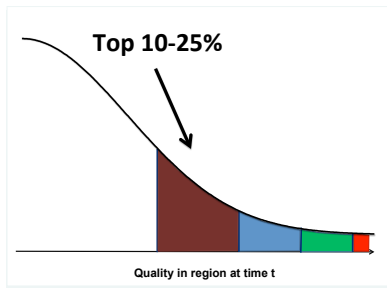
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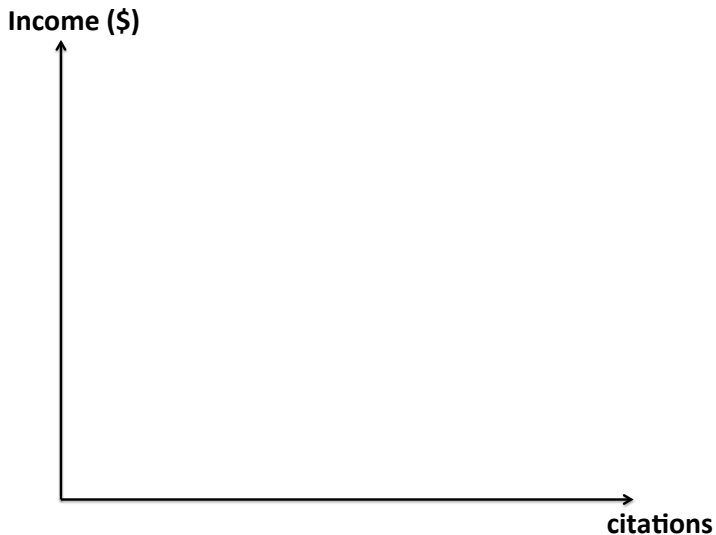
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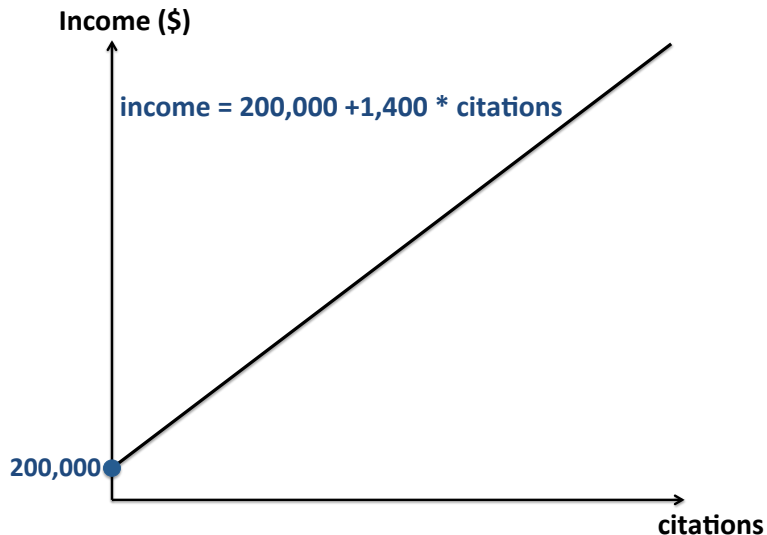


Link between Inventor Quality and Income in IRS data

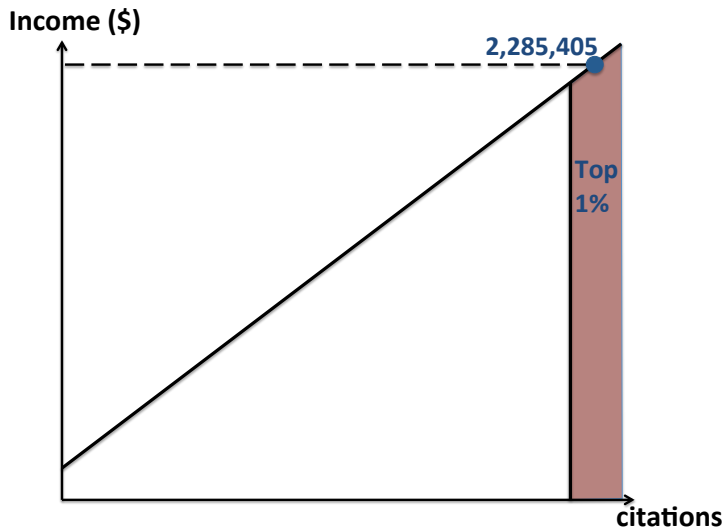


Source: Bell *et al.* (2015).

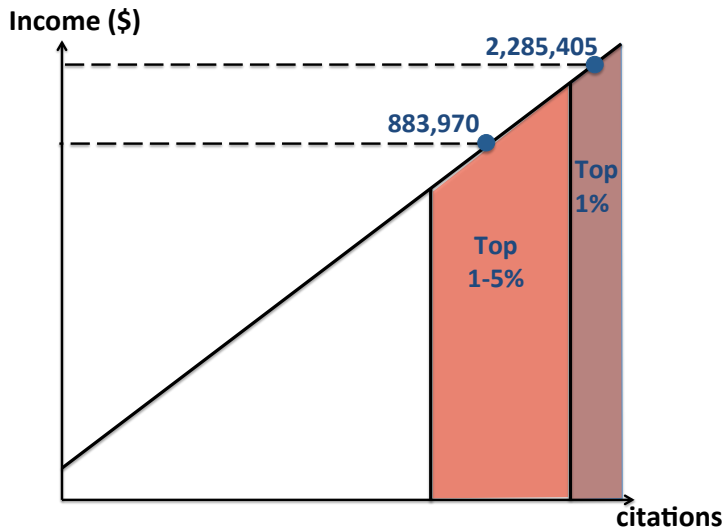
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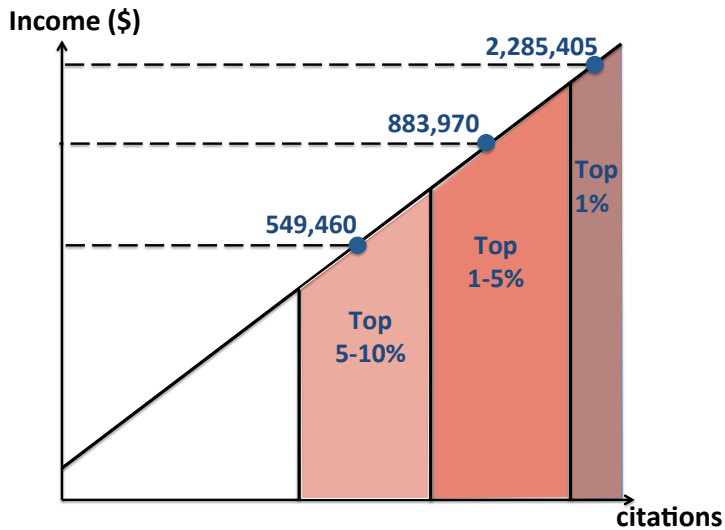
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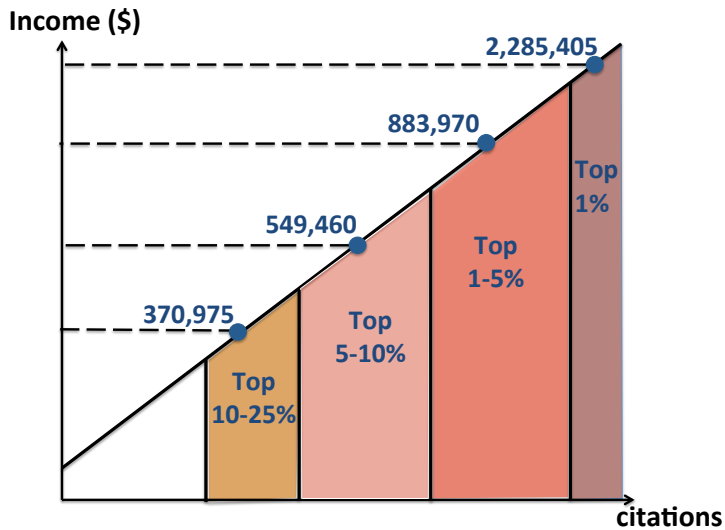
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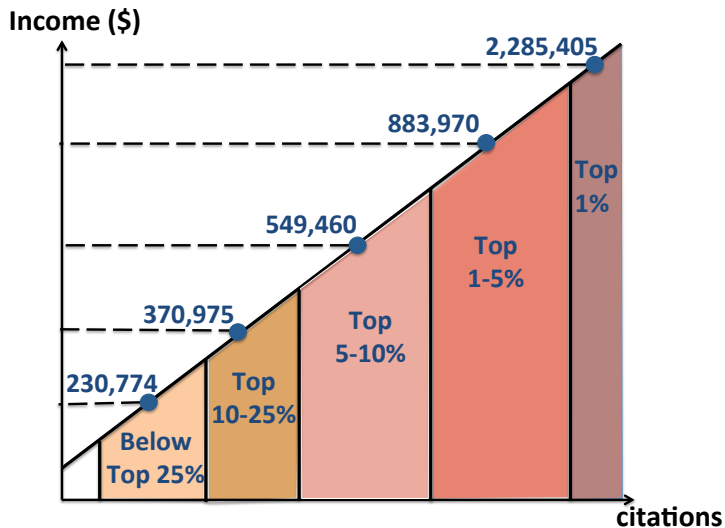
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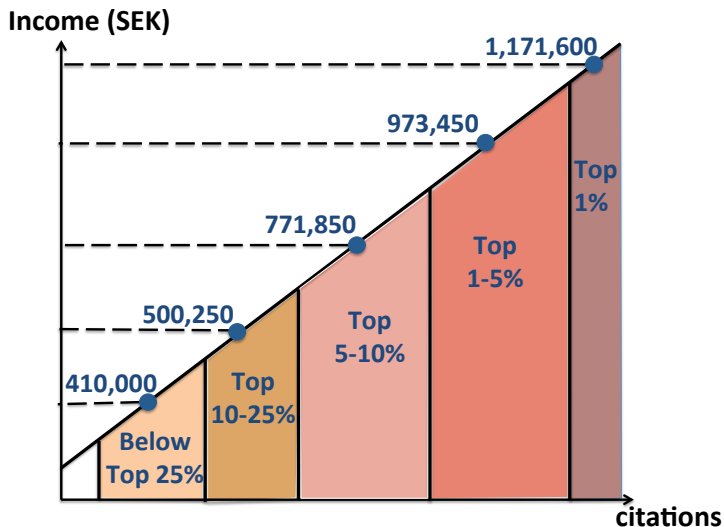
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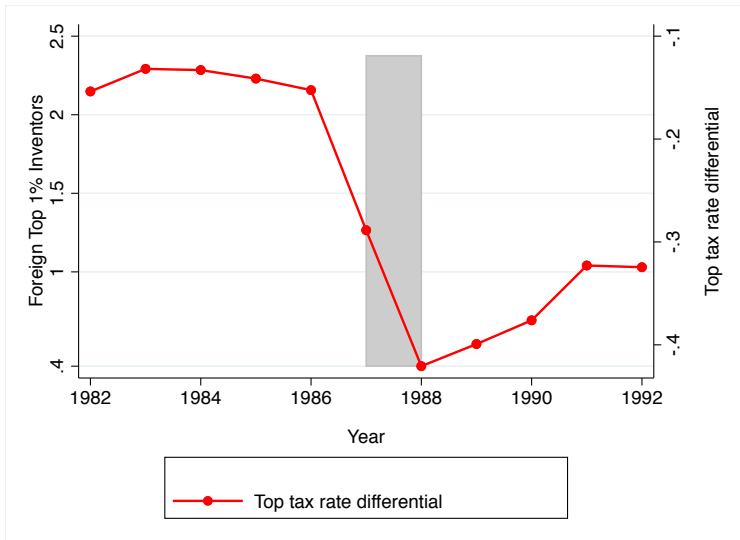


Link between Inventor Quality and Income in Swedish and Finnish Admin data

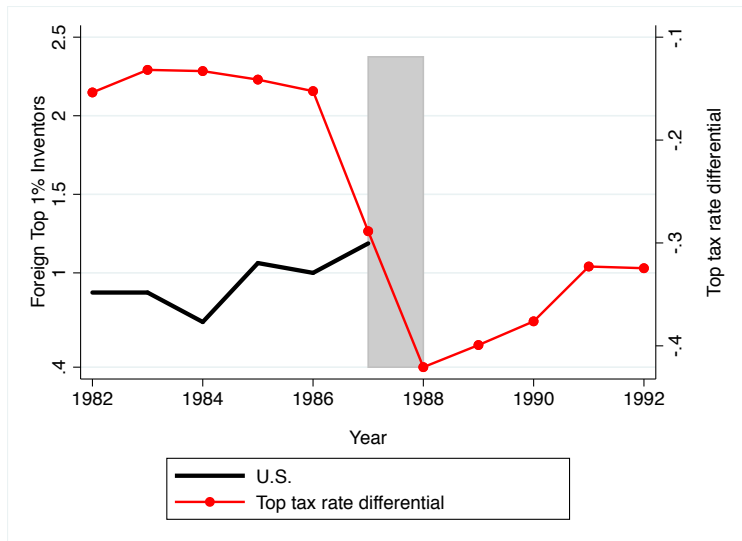


Source: Olof Ejermo and Otto Toivaannen.

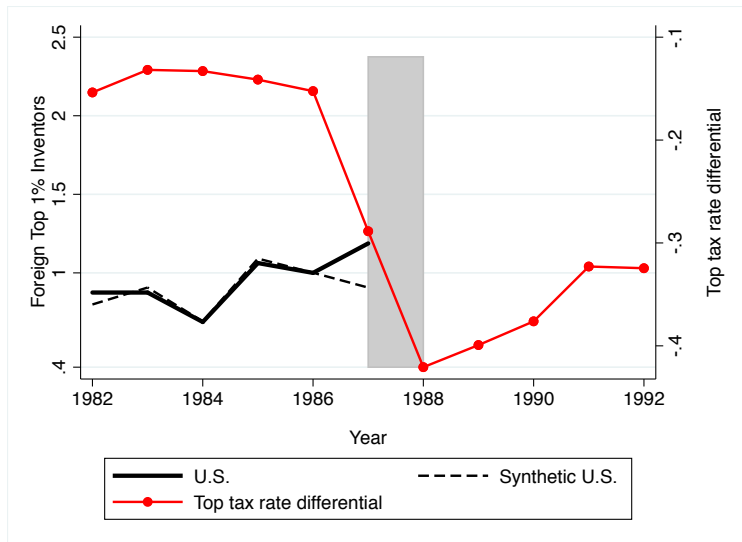
Case Study: U.S. TRA 1986



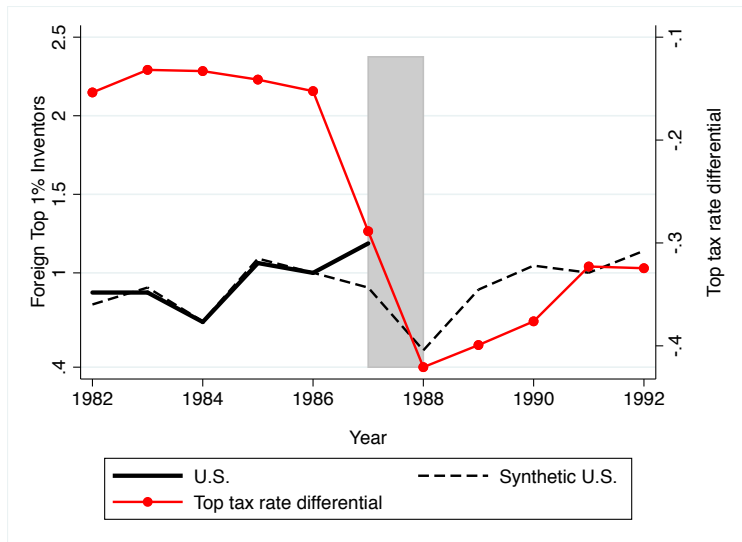
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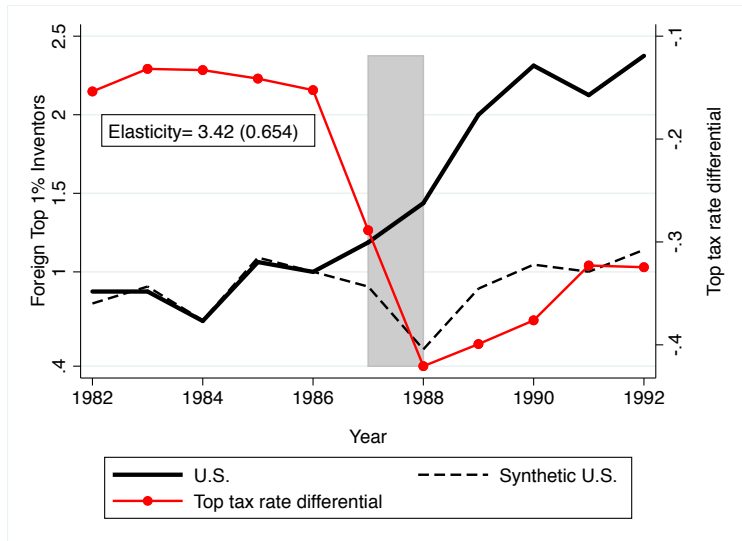
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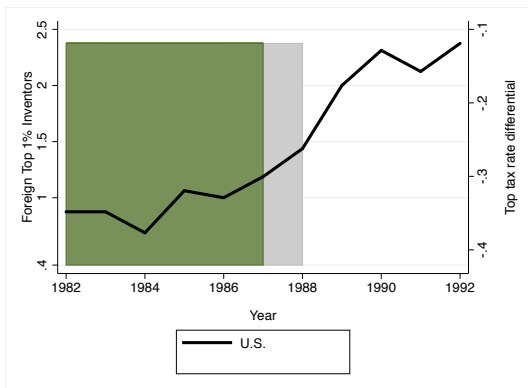
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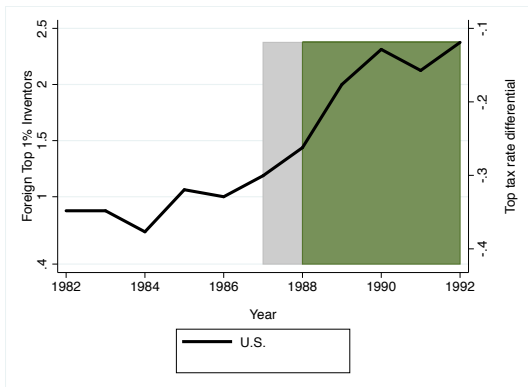
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Structural break in growth of foreign top 1% relative to lower quality inventors.

Inventor quality	Pre T.R.A 1986	Post T.R.A 1986
Top 1%	6.8%	16.4%
Top 10-25%	13%	11.4%

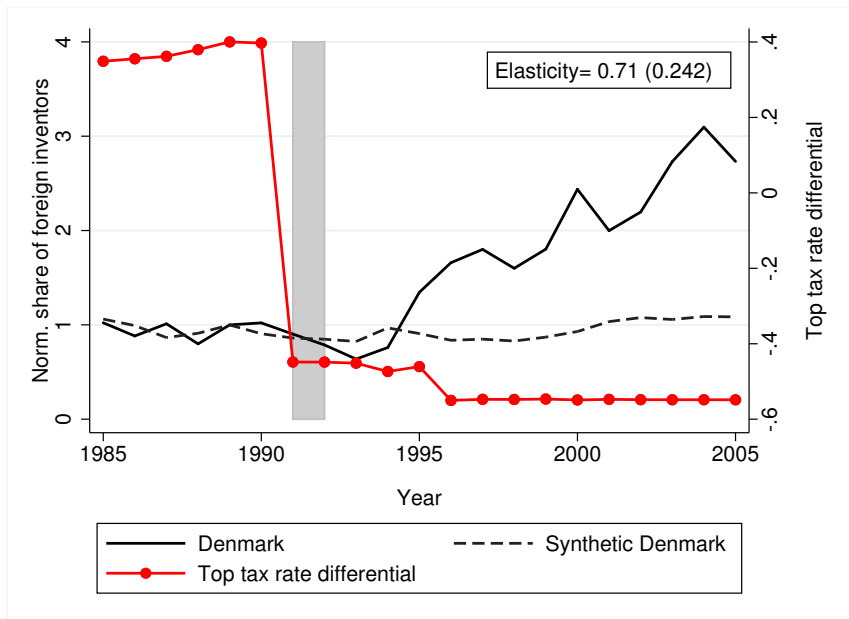
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Case Study: Denmark's 1992 Preferential Tax Reform



$$Pr(y_{it} = c) = f(\alpha_{rit} \log(1 - \text{top MTR}_{ct}^i) + \beta_c \mathbf{x}_{ti} + \eta \mathbf{x}_{cti} + \zeta \mathbf{x}_{ct})$$

\mathbf{x}_{ti} : individual covariates (\times country FE), control for *counterfactual* earnings. Age, tech field, works for multinational, ranking

+ quality \times country FE

+ quality \times country FE \times trend

+ quality \times country FE \times trend \times tech field.

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- **Country-by-year variation:** patent stock, GDP per capita, country FEs, year FEs, country-specific time trends.
 - ▶ Contemporaneous country-specific policies?
 - ▶ Loads general equilibrium effects and sorting on coefficient of top tax (e.g.: inflow of higher ability inventors could displace low ability inventors if rigid demand).

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- **Superstars vs. Non-superstars**: include country \times year FE.

- ▶ Logic: Top 1% and slightly lower quality inventors very comparable.

- ▶ Only inventors actually in top tax bracket are directly affected by top tax.

- ▶ Higher quality \rightarrow Higher income \rightarrow higher propensity to be treated by top MTR (MTR \approx ATR).

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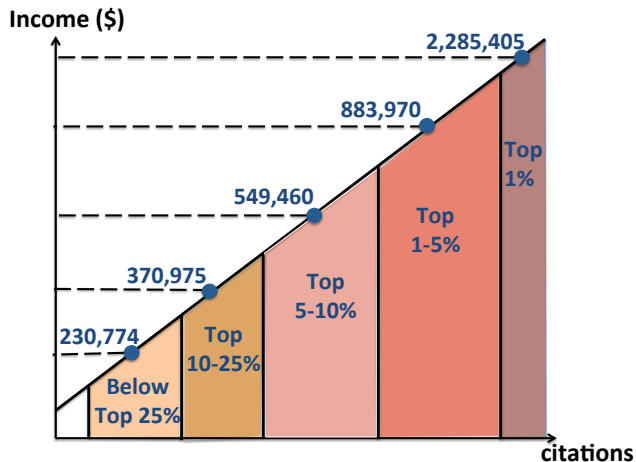
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Choice of the Control Group?



Trade-off in the choice of the control group.

→ Provide set of effects of $(1 - MTR)$ on all quality groups.

→ Provide elasticity of top 1% relative to several control groups

$g \in \{\text{top 5-10\%, top10-25\%, below top 25\%}\}$.

Country-by-year Variation and General Equilibrium Effects

	(1)	(2)	(3)	(4)
Log Retention Rate \times Top 1	0.890** (0.365)	0.891** (0.377)	0.965** (0.384)	0.951** (0.383)
Log Retention Rate \times Top 1-5	0.447** (0.182)	0.456** (0.197)	0.527*** (0.199)	0.507** (0.203)
Log Retention Rate \times Top 5-10	0.141 (0.142)	0.155 (0.148)	0.227 (0.147)	0.202 (0.148)
Log Retention Rate \times Top 10-25	-0.131 (0.113)	-0.107 (0.114)	-0.0296 (0.108)	-0.0533 (0.106)
Log Retention Rate \times Below Top 25	-0.415*** (0.150)	-0.358** (0.171)	-0.275 (0.176)	-0.285 (0.176)
Quality \times Country FE	NO	YES	YES	YES
Quality \times Country FE \times Year	NO	NO	YES	YES
Quality \times Country FE \times Year \times Field FE	NO	NO	NO	YES
Domestic elasticity s.e	0.02 (0.009)	0.02 (0.009)	0.024 (0.009)	0.023 (0.009)
Foreign elasticity s.e	0.75 (0.305)	0.751 (0.319)	0.807 (0.324)	0.798 (0.322)
Observations	8,645,464	8,617,464	8,617,464	8,617,464

Superstars vs. Non-Superstars

	(1)	(2)	(3)	(4)
Log Retention Rate × Top 1	1.328** (0.644)	1.456** (0.642)	1.399** (0.667)	1.352** (0.669)
Log Retention Rate × Top 1-5	0.885* (0.514)	1.022** (0.514)	0.961* (0.532)	0.907* (0.536)
Log Retention Rate × Top 5-10	0.576 (0.495)	0.719 (0.483)	0.658 (0.501)	0.599 (0.506)
Log Retention Rate × Top 10-25	0.303 (0.486)	0.456 (0.466)	0.398 (0.481)	0.341 (0.484)
Log Retention Rate × Below Top 25	0.022 (0.493)	0.207 (0.471)	0.153 (0.478)	0.110 (0.482)
Quality × Country FE	NO	YES	YES	YES
Quality × Country FE × Year	NO	NO	YES	YES
Quality × Country FE × Year × Field FE	NO	NO	NO	YES
Control: Top 5-10				
Domestic elasticity	0.02	0.02	0.02	0.02
s.e	(0.009)	(0.009)	(0.009)	(0.009)
Foreign elasticity	0.63	0.62	0.62	0.63
s.e	(0.314)	(0.321)	(0.318)	(0.319)
Control: Top 10-25				
Domestic elasticity	0.03	0.02	0.02	0.02
s.e	(0.009)	(0.009)	(0.009)	(0.009)
Foreign elasticity	0.86	0.84	0.84	0.85
s.e	(0.323)	(0.334)	(0.335)	(0.334)
Control: Below Top 25				
Domestic elasticity	0.03	0.03	0.03	0.03
s.e	(0.009)	(0.010)	(0.011)	(0.011)
Foreign elasticity	1.09	1.05	1.04	1.04
s.e	(0.340)	(0.376)	(0.382)	(0.381)
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s.e	(0.009)	(0.010)	(0.011)	(0.011)
Foreign elasticity	1.09	1.05	1.04	1.04
s.e	(0.340)	(0.376)	(0.382)	(0.381)
Observations	8,645,464	8,617,464	8,617,464	8,617,464

Superstars vs. Non-Superstars

	(1)	(2)	(3)	(4)
Log Retention Rate × Top 1	1.328** (0.644)	1.456** (0.642)	1.399** (0.667)	1.352** (0.669)
Log Retention Rate × Top 1-5	0.885* (0.514)	1.022** (0.514)	0.961* (0.532)	0.907* (0.536)
Log Retention Rate × Top 5-10	0.576 (0.495)	0.719 (0.483)	0.658 (0.501)	0.599 (0.506)
Log Retention Rate × Top 10-25	0.303 (0.486)	0.456 (0.466)	0.398 (0.481)	0.341 (0.484)
Log Retention Rate × Below Top 25	0.022 (0.493)	0.207 (0.471)	0.153 (0.478)	0.110 (0.482)
Quality × Country FE	NO	YES	YES	YES
Quality × Country FE × Year	NO	NO	YES	YES
Quality × Country FE × Year × Field FE	NO	NO	NO	YES
Control: Top 5-10				
Domestic elasticity	0.02	0.02	0.02	0.02
s.e	(0.009)	(0.009)	(0.009)	(0.009)
Foreign elasticity	0.63	0.62	0.62	0.63
s.e	(0.314)	(0.321)	(0.318)	(0.319)
Control: Top 10-25				
Domestic elasticity	0.03	0.02	0.02	0.02
s.e	(0.009)	(0.009)	(0.009)	(0.009)
Foreign elasticity	0.86	0.84	0.84	0.85
s.e	(0.323)	(0.334)	(0.335)	(0.334)
Control: Below Top 25				
Domestic elasticity	0.03	0.03	0.03	0.03
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Outline

- 1 Taxation and the International Migration of Superstar Inventors
- 2 Taxation and Innovation in the 20th Century

How do taxes affect innovation?

- Challenging question, to a large extent unanswered because of:
 - i) Lack of long-run systematic data on innovation in the U.S.,
 - ii) Difficulty in identifying effects of taxes.
- We leverage three newly constructed datasets for the U.S.:
 - i) Panel of the universe of U.S. inventors since 1920 and their patents.
 - ii) Panel of all R&D labs (employment, location, patents) since 1921.
 - iii) Historical state-level corporate tax database.
- Study systematically the effects of **personal and corporate income taxes** since 1920 on:
 - i) Individual inventors (micro level).
 - ii) Firms that do R&D (micro level).
 - 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..)

Historical Patent Data

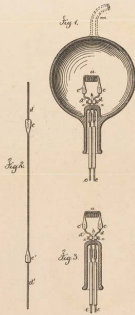
Akcigit, Grigsby, and Nicholas (2017): digitize historical patent records.

Match them to decennial Censuses by names.

T. A. EDISON.
Electric-Lamp.

No. 223,898.

Patented Jan. 27, 1880.



Witnesses
Charles D. Smith
H. S. Pringle

Inventor
Thomas A. Edison

By Lemuel W. Serrell

cus

THE UNITED STATES PATENT OFFICE, WASHINGTON, D. C.



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*
(*Case No. 186.*)
set forth in the annexed specification.

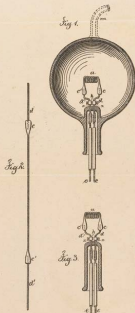
And further prays that you will recognize **LEMUEL W. SERRELL**, of
the City of *New York, N. Y.*, as his Attorney, with full power
of substitution and revocation, to prosecute this application, to make altera-
tions and amendments therein, to receive the Patent, and to transact all
business in the Patent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

1879

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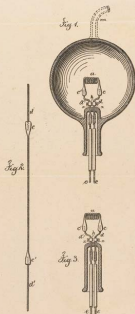
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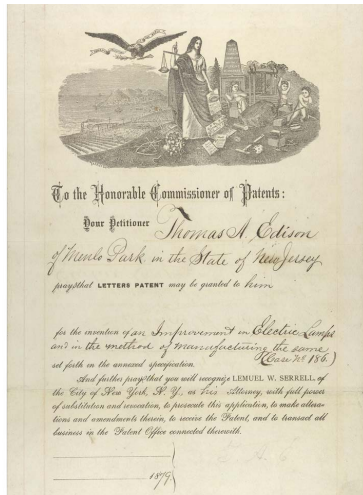
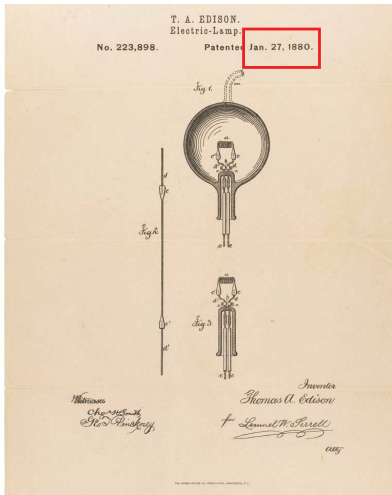
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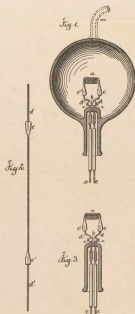


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Inventor Data Disambiguation Algorithm

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

- 1 Build training dataset using selection of Li et al. matches
- 2 Disambiguate within blocks by considering record pairs' similarity on
 - ▶ Name
 - ▶ Location
 - ▶ Assignee
 - ▶ Patent class
 - ▶ Common coauthors
- 3 Form posterior probability of match using training dataset
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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.

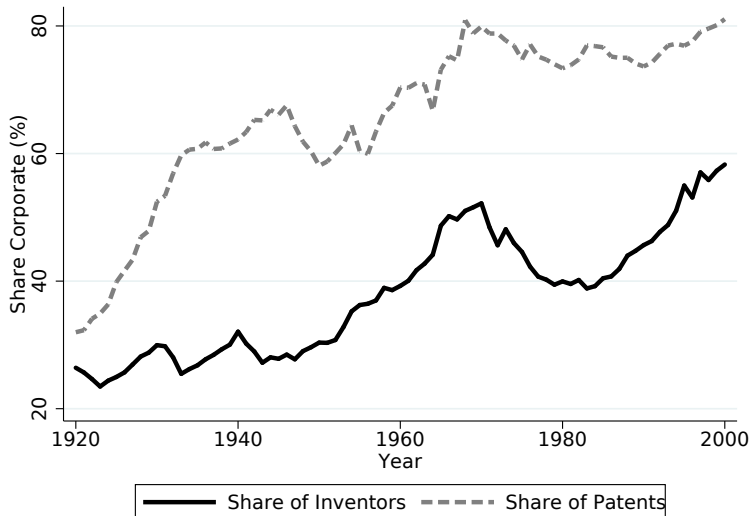
HeinOnline Session Laws, HeinOnline State Statutes, ProQuest Congressional, Commerce Clearing House (State Tax Handbooks, State Tax Review), State Tax reports, Willis Report, Council of State Governments Book of States, National Tax Association Proceedings.

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 = $\beta_1 \times \text{Income tax} + \beta_2 \times \text{Corporate tax} + \text{Controls}$.

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.

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.

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

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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](#)

Macro State Level: Empirical Strategy (II)

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

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

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

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

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

IV Strategy: “Predicted tax rate”

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

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

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

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

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

Macro Effects of Personal Income Taxes 1940-2000

Log Patents & MTR at median



Log Inventors & MTR at median



Macro Effects of 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*** (0.007)	-0.059*** (0.008)	-0.051*** (0.006)	-1.090*** (0.159)
90 th Pctile Income MTR (% , lag)	-0.041*** (0.005)	-0.040*** (0.005)	-0.040*** (0.004)	-0.334*** (0.077)
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Observations	2867	2867	2867	2867
Mean of Dep. Var.	7.18	9.87	7.31	71.74
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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*** (0.007)	-0.059*** (0.008)	-0.051*** (0.006)	-1.090*** (0.159)
90 th Pctile Income MTR (% , lag)	-0.041*** (0.005)	-0.040*** (0.005)	-0.040*** (0.004)	-0.334*** (0.077)
Median Income MTR (% , lag)	-0.045*** (0.005)	-0.046*** (0.005)	-0.046*** (0.004)	-0.065 (0.087)
90 th Pctile Income ATR (% , lag)	-0.063*** (0.004)	-0.060*** (0.005)	-0.062*** (0.004)	-0.135 (0.100)
Median Income ATR (% , lag)	-0.100*** (0.008)	-0.108*** (0.011)	-0.091*** (0.007)	-0.672*** (0.146)
Observations	2867	2867	2867	2867
Mean of Dep. Var.	7.18	9.87	7.31	71.74
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Top Corporate MTR (% , lag)	-0.063*** (0.007)	-0.059*** (0.008)	-0.051*** (0.006)	-1.090*** (0.159)
90 th Pctile Income MTR (% , lag)	-0.041*** (0.005)	-0.040*** (0.005)	-0.040*** (0.004)	-0.334*** (0.077)
Median Income MTR (% , lag)	-0.045*** (0.005)	-0.046*** (0.005)	-0.046*** (0.004)	-0.065 (0.087)
90 th Pctile Income ATR (% , lag)	-0.063*** (0.004)	-0.060*** (0.005)	-0.062*** (0.004)	-0.135 (0.100)
Median Income ATR (% , lag)	-0.100*** (0.008)	-0.108*** (0.011)	-0.091*** (0.007)	-0.672*** (0.146)
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Median Income MTR (% , lag)	-0.045*** (0.005)	-0.046*** (0.005)	-0.046*** (0.004)	-0.065 (0.087)
90 th Pctile Income ATR (% , lag)	-0.063*** (0.004)	-0.060*** (0.005)	-0.062*** (0.004)	-0.135 (0.100)
Median Income ATR (% , lag)	-0.100*** (0.008)	-0.108*** (0.011)	-0.091*** (0.007)	-0.672*** (0.146)
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Macro Effects of Taxes 1940-2000: OLS

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Top Corporate MTR (% , lag)	-0.063*** (0.007)	-0.059*** (0.008)	-0.051*** (0.006)	-1.090*** (0.159)
90 th Pctile Income MTR (% , lag)	-0.041*** (0.005)	-0.040*** (0.005)	-0.040*** (0.004)	-0.334*** (0.077)
Median Income MTR (% , lag)	-0.045*** (0.005)	-0.046*** (0.005)	-0.046*** (0.004)	-0.065 (0.087)
90 th Pctile Income ATR (% , lag)	-0.063*** (0.004)	-0.060*** (0.005)	-0.062*** (0.004)	-0.135 (0.100)
Median Income ATR (% , lag)	-0.100*** (0.008)	-0.108*** (0.011)	-0.091*** (0.007)	-0.672*** (0.146)
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Macro Effects of Taxes 1940-2000: OLS

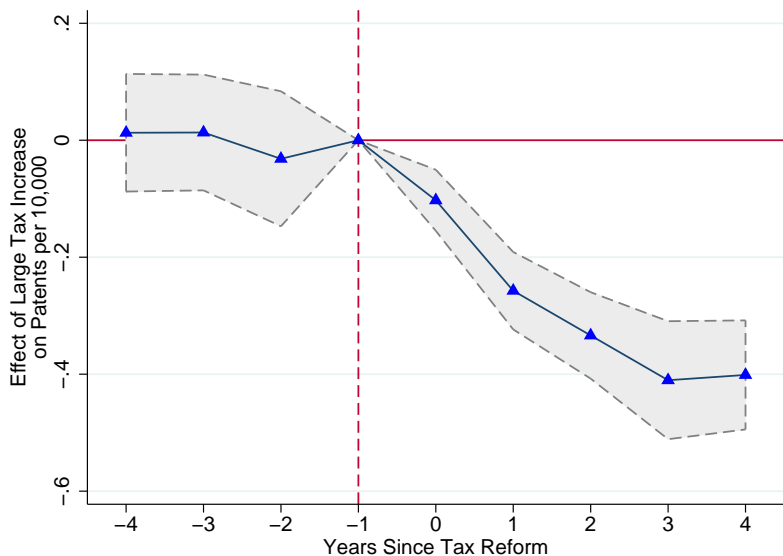
PANEL A: OLS				
Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Share Assigned (4)
Top Corporate MTR (% , lag)	-0.063*** (0.007)	-0.059*** (0.008)	-0.051*** (0.006)	-1.090*** (0.159)
90 th Pctile Income MTR (% , lag)	-0.041*** (0.005)	-0.040*** (0.005)	-0.040*** (0.004)	-0.334*** (0.077)
Median Income MTR (% , lag)	-0.045*** (0.005)	-0.046*** (0.005)	-0.046*** (0.004)	-0.065 (0.087)
90 th Pctile Income ATR (% , lag)	-0.063*** (0.004)	-0.060*** (0.005)	-0.062*** (0.004)	-0.135 (0.100)
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S.D. of Dep. Var.	1.31	1.59	1.33	14.01

Macro Effects of Taxes 1940-2000: OLS

PANEL A: OLS

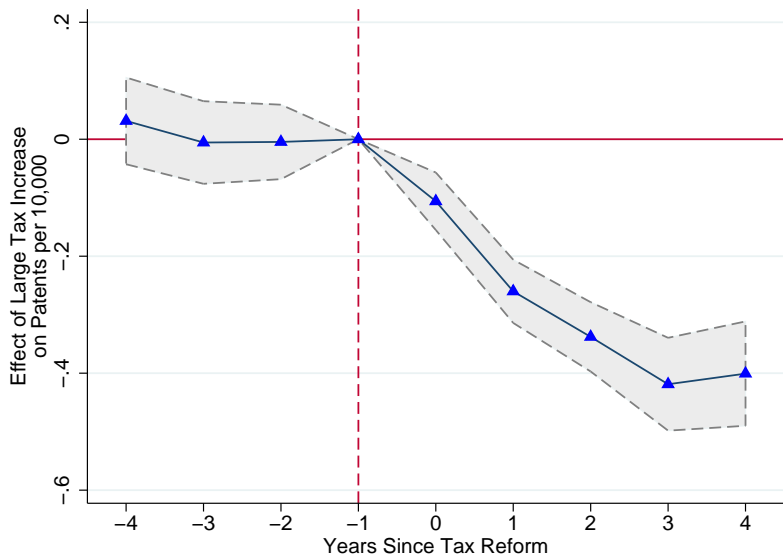
Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Share Assigned (4)
Top Corporate MTR (% , lag)	-0.063*** (0.007)	-0.059*** (0.008)	-0.051*** (0.006)	-1.090*** (0.159)
90 th Pctile Income MTR (% , lag)	-0.041*** (0.005)	-0.040*** (0.005)	-0.040*** (0.004)	-0.334*** (0.077)
Median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

Event Study: Large Personal Tax Changes on Patents



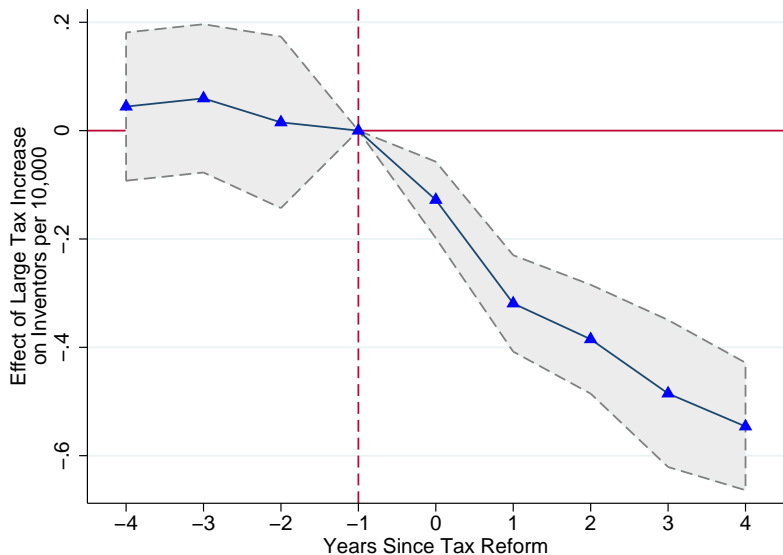
$\Delta T^y = 6.85$ pp increases, 3.6 pp decreases.

Event Study: Large Corporate Tax Changes on Patents



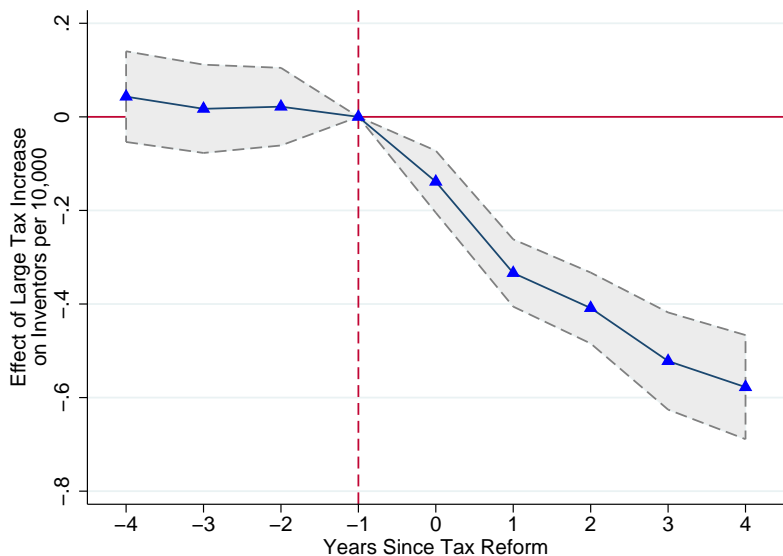
$\Delta T^c = 14.8$ pp increases, 9.3 pp decreases.

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.

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 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..)

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

\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 $T_{st}^{yj} \approx \tau_{ft}^{yj}(1 - \tau_{st}^{yj}) + \tau_{st}^{yj} - D_{st}^y \cdot \tau_{st}^{yj} \tau_{ft}^{yj}$ can be instrumented with \hat{T}_{st}^{yj} ; same for corporate tax rate.

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*** (0.101)	-0.602*** (0.109)	-0.012*** (0.003)	-0.016*** (0.003)	-0.667*** (0.082)
Top Corporate MTR	-0.201* (0.104)	-0.100 (0.102)	-0.002 (0.002)	-0.001 (0.003)	-0.091 (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*** (0.103)	-0.569*** (0.109)	-0.011*** (0.003)	-0.013*** (0.003)	-0.642*** (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)
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Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
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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*** (0.103)	-0.569*** (0.109)	-0.011*** (0.003)	-0.013*** (0.003)	-0.642*** (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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Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
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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*** (0.103)	-0.569*** (0.109)	-0.011*** (0.003)	-0.013*** (0.003)	-0.642*** (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 (0.203)	-0.535*** (0.165)	-0.014*** (0.003)	-0.026*** (0.005)
MTR × Corp. Inv.	-0.605*** (0.175)	-0.094 (0.114)	0.002 (0.002)	0.009*** (0.003)
Top Corporate MTR	0.044 (0.177)	0.238 (0.143)	0.005* (0.003)	0.013** (0.005)
Corp. MTR × Corp. Inv.	-0.201 (0.173)	-0.348*** (0.105)	-0.007*** (0.002)	-0.015*** (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 (0.156)	-0.298** (0.135)	-0.009*** (0.003)	-0.015*** (0.003)
MTR × Corp. Inv.	-0.708*** (0.106)	-0.285*** (0.046)	-0.002** (0.001)	0.002 (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 (0.203)	-0.535*** (0.165)	-0.014*** (0.003)	-0.026*** (0.005)
MTR × Corp. Inv.	-0.605*** (0.175)	-0.094 (0.114)	0.002 (0.002)	0.009*** (0.003)
Top Corporate MTR	0.044 (0.177)	0.238 (0.143)	0.005* (0.003)	0.013** (0.005)
Corp. MTR × Corp. Inv.	-0.201 (0.173)	-0.348*** (0.105)	-0.007*** (0.002)	-0.015*** (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 (0.156)	-0.298** (0.135)	-0.009*** (0.003)	-0.015*** (0.003)
MTR × Corp. Inv.	-0.708*** (0.106)	-0.285*** (0.046)	-0.002** (0.001)	0.002 (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) (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	-0.635*** (0.102)	-0.620*** (0.109)	-0.012*** (0.003)	-0.017*** (0.003)	-0.669*** (0.083)
Effective MTR × Agglom.	0.082 (0.061)	0.277*** (0.080)	0.004* (0.002)	0.006* (0.003)	0.022 (0.057)
Top Corporate MTR	-0.200* (0.104)	-0.098 (0.102)	-0.002 (0.002)	-0.001 (0.003)	-0.091 (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*** (0.104)	-0.591*** (0.109)	-0.011*** (0.003)	-0.014*** (0.003)	-0.646*** (0.084)
Effective MTR × Agglom.	0.114* (0.064)	0.325*** (0.085)	0.004* (0.002)	0.008** (0.003)	0.058 (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) (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	-0.635*** (0.102)	-0.620*** (0.109)	-0.012*** (0.003)	-0.017*** (0.003)	-0.669*** (0.083)
Effective MTR × Agglom.	0.082 (0.061)	0.277*** (0.080)	0.004* (0.002)	0.006* (0.003)	0.022 (0.057)
Top Corporate MTR	-0.200* (0.104)	-0.098 (0.102)	-0.002 (0.002)	-0.001 (0.003)	-0.091 (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*** (0.104)	-0.591*** (0.109)	-0.011*** (0.003)	-0.014*** (0.003)	-0.646*** (0.084)
Effective MTR × Agglom.	0.114* (0.064)	0.325*** (0.085)	0.004* (0.002)	0.008** (0.003)	0.058 (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

Location Choice Model

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

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

Location Choice Model

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

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

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

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

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- Location choice estimated on *15 most inventive states*, as measured by total patents (1940-2000), including only progressive spells.
 - ⇒ 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, assignee has patent dummy, state \times year FE.

Location Choice Model: Results

	(1)	(2)	(3)	(4)	(5)
Effective ATR	-0.093*** (0.009)	-0.025** (0.012)	-0.026** (0.012)	-0.026** (0.012)	-0.121*** (0.013)
Agglomeration Forces	1.217*** (0.029)	1.216*** (0.030)	1.216*** (0.030)	0.994*** (0.072)	1.112*** (0.030)
Home State Flag	3.866*** (0.016)	3.868*** (0.016)	3.869*** (0.016)	3.868*** (0.016)	3.690*** (0.016)
<i>Interaction coefficients:</i>					
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

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MICRO EFFECTS 2: FIRM-LEVEL

At the Firm Level: OLS and IV Results

Panel A: OLS						
Dependent Variable:	# of Patents (1)	Log Patents (2)	# of Citations (3)	Log Citations (4)	# of Research Workers (5)	Location Choice (6)
Top Corporate MTR	-0.392** (0.171)	-0.042*** (0.012)	-23.524*** (4.282)	-0.039*** (0.015)	-9.829 (7.948)	-0.026** (0.013)
90th Percentile MTR	0.076 (0.105)	0.018 (0.011)	-1.318 (3.691)	0.013 (0.014)	-9.655** (3.826)	-0.049*** (0.015)
50th Percentile MTR	-0.331** (0.162)	-0.028 (0.018)	-9.097* (5.310)	-0.025 (0.022)	-9.749 (7.062)	-0.072*** (0.035)
Observations	147777	34572	147777	33679	28918	11901

Panel B: Instrumental Variables

Top Corporate MTR	-0.639** (0.299)	-0.059*** (0.017)	-31.352*** (6.325)	-0.053** (0.021)	-42.246** (18.718)
90th Percentile MTR	0.089 (0.118)	0.024* (0.013)	2.059 (4.035)	0.021 (0.016)	-5.977* (3.506)
50th Percentile MTR	-0.375 (0.229)	-0.025 (0.022)	-16.512*** (6.384)	-0.022 (0.028)	-40.111** (16.158)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y

At the Firm Level: OLS and IV Results

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At the Firm Level: OLS and IV Results

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