AEA Continuing Education Program

Inequality and Innovation

Ufuk Akcigit,
University of Chicago

January 6-8, 2019

Inequality and Innovation

Lecture Slides 1: Innovation and Inventors of the Golden Age [1]

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[1] Based on Akcigit, Grigsby, Nicholas (2017)

Motivation

- Innovation is the engine of long-run growth.
- However little empirical work over long horizons.
- Little is known about the creators of new ideas and their backgrounds.
- Particularly important to discipline alternative growth theories on
  - agglomeration,
  - market size,
  - reallocation,
  - misallocation,
  - direction of technical change, and
  - **inequality**.

  And to understand the "inclusivity" of economic growth.

Akcigit, Grigsby, Nicholas'18 (AGN)

Major data collection effort. AGN generate novel **microdata** to study regional performance as well as the background of the Inventors of the Golden Age.

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- Digitize the USPTO patents (OCR + hand entry).
- Newly-released decennial census data (1880-1940) and merge.
- Present key facts about innovation at regional and individual levels.

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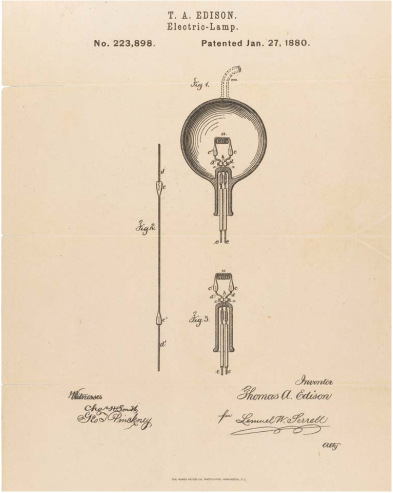
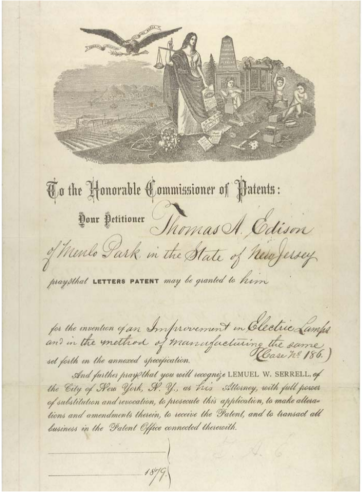
- Digitize the USPTO patents (OCR + hand entry).
- Newly-released decennial census data (1880-1940) and merge.
- Present key facts about innovation at regional and individual levels.

Main Goal:

AGN use this new data to test the basic predictions of the innovation-based growth models and identify the missing pieces.



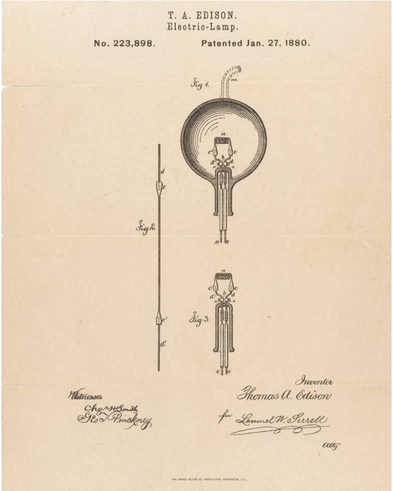


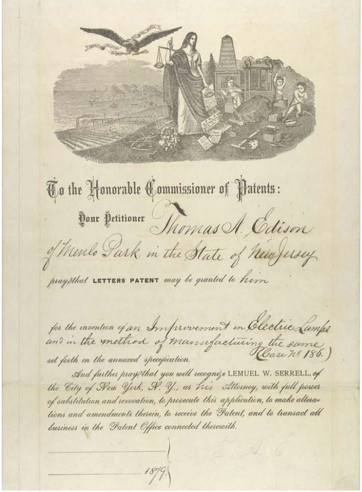
To the Honorable Commissioner of Patents:

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 alterations and amendments therein, to receive the Patent, and to transact all business in the Patent Office connected therewith.

1879.

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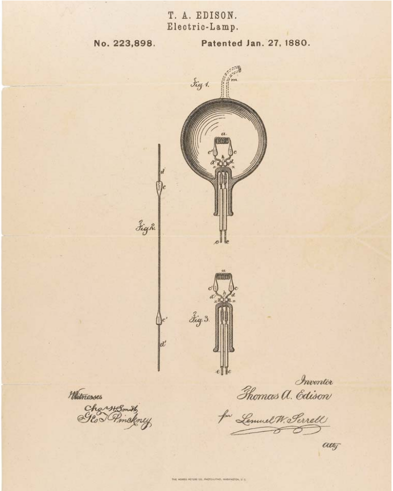

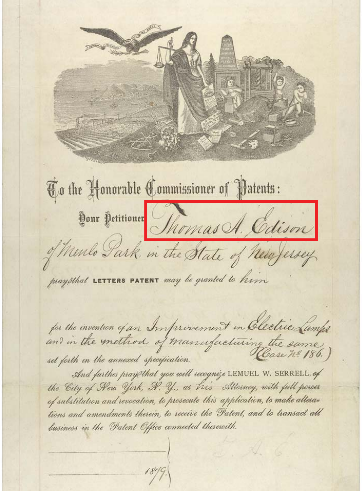
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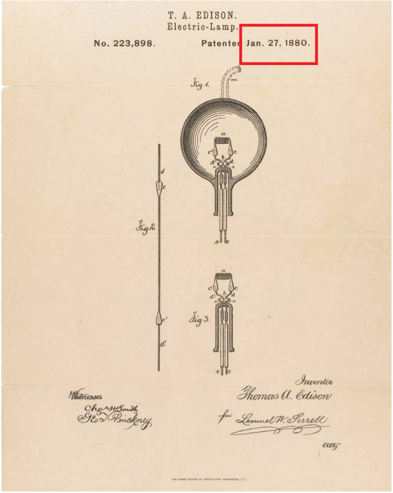

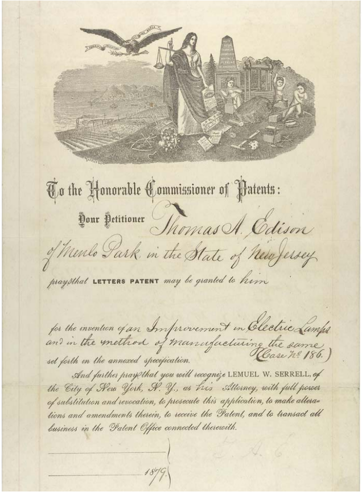
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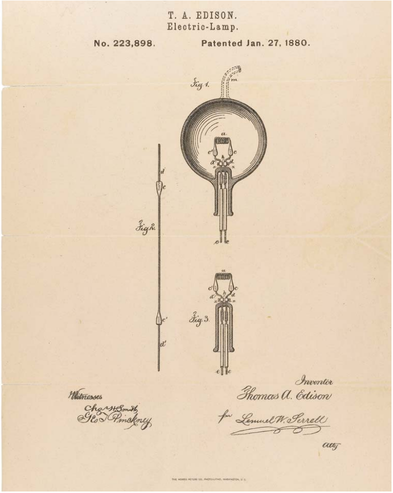

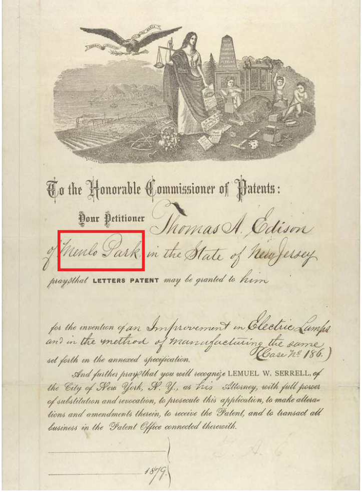
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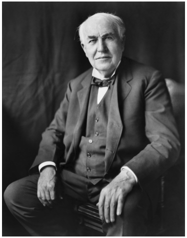
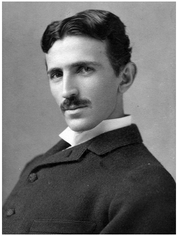
Fathers of American Innovation



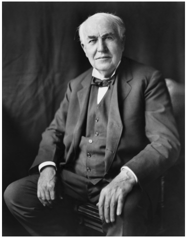
Thomas A. Edison

Melvin De Groote



Nikola Tesla

Fathers of American Innovation



Thomas A. Edison
Light bulb.
Holds 1093 patents.
Moved, OH $\rightarrow$ NJ.
Built Menlo Park Lab.
Had to borrow:
Bank + Patent Sale

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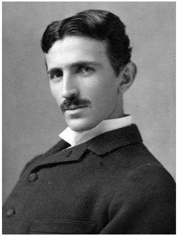

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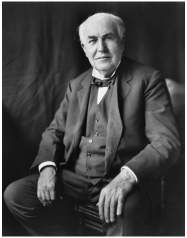

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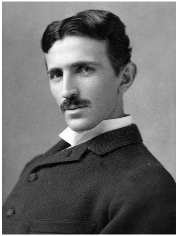

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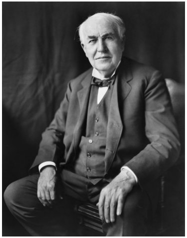

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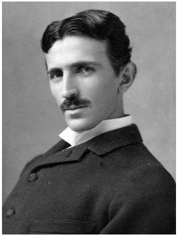


Nikola Tesla
Alternating Current.
Holds 278 Patents.
Immigrant from Croatia.
College dropout.
Asocial, never married.

Additional Data Sources

1. **State-level Output**.
   - Bureau of Economic Analysis (BEA) for 1929 - present.
   - Gross state products in 1880, 1890, 1900, 1910 from Klein (2013).
   - State incomes from 1919 to 1938 from Martin (1939).

2. **Sector Output and Full-time Equivalent Employment**. BEA.

3. **Financial Development Measures**. Federal Deposit Insurance Corporation (FDIC) data from the University of Michigan's ICPSR repository. It provides information on the amount of lending in 1920-1936.

4. **Transportation Cost**. Donaldson and Hornbeck (2016).

5. **Scientific Research and Development (SRD) Contracts**. Library of Congress on Office of SRD contracts for technological development efforts during WW II.

Summary Statistics

Data Sources & Summary

DATA:

1. Complete-count data from 1880, 1900-1940 U.S. Censuses
   - Name, residence, age, race, sex, marital status, occupation, birthplace
   - 1940: labor income, education, labor force status

2. USPTO patent documents, 1836-2004
   - Inventor names, patent class, patent filing location, grant year, assignee, citation counts (1947-2008)

SUMMARY:

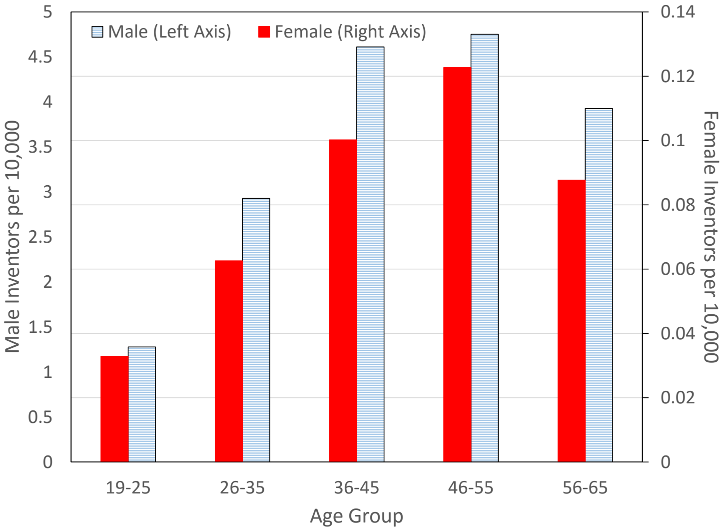
- Working age population (18-65) in U.S.
- Over 320 million individual observations
- 63,515 inventors
- 380,338 patents.

Patent

Summary Statistics

	Inventors	Full U.S.
Percent White	97.9%	89.4%
Percent Black	1.8%	9.1%
Percent Male	97.9%	51.0%
Single	16.1%	27.7%
Married	80.2%	65.4%
Percent 19-25	8.4%	22.6%
Percent 26-35	23.8%	27.5%
Percent 36-45	31.0%	22.5%
Percent 46-55	24.1%	16.6%
Percent 56-65	12.7%	10.8%
Av. # Children: $\leq$ 35 yrs old	1.9	2.3
Av. # Children: $>$ 35 yrs old	3.2	4.7
Percent Interstate Migrant	58.8%	42.8%
Percent International Migrant	21.1%	17.4%
Percent of Population	0.02%	99.98%

Inventors More Likely To Be Middle Aged



marriage

Baseline Model

Baseline Model (1/5) - Production Side

- Final good (Y) production:

$$\ln Y = \int_0^1 \ln y_i di$$

- Intermediate good (y_i) production by monopolists:

$$y_i = q_i l_i$$

  - l_i: production worker paid w

- Labor productivity (q_i) improves through innovation:

$$q_i^{new} = (1 + \lambda) q_i^{old}$$

Baseline Model (2/5) - Production Side Equilibrium

-

$$\ln Y = \int_0^1 \ln y_i di$$

$$\max_{y_i}\{\exp\left[\int_0^1 \ln y_i di\right] - \int_0^1 p_i y_i di\} \implies \boxed{y_i = Y^{demand}/p_i} \quad (1)$$

-

$$y_i = q_i l_i$$

$$\pi_i = \max_{y_i,p_i}\{p(y_i)y_i - \frac{w}{q_i}y_i\} \text{ subject to (1)}$$

-

$$q_i^{new} = (1+\lambda)q_i^{old}$$

$$\implies \quad \pi_i = \frac{\lambda}{1+\lambda}Y^{demand}$$

Baseline Model (3/5) - Value of Innovation

- Moreover, the equilibrium output is:

$$Y^{demand} = L_P \times Q \quad \text{where} \quad L_P \equiv \int_0^1 l_i di \quad \text{and} \quad Q \equiv \exp\left[\int_0^1 \ln q_i di\right]$$

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- Market value of an invention:

$$\rho V_i = \pi_i - \tau V_i$$

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- Hence:

$$V_i = \frac{\pi_i}{\rho + \tau}$$

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- Hence:

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- Inventor "sells" its invention with Nash bargaining power β:

$$P_t = \beta V_t$$

Baseline Model (4/5) - Labor Market

- Measure $1 + L$ individuals working in three capacities:
  - 1) firm owners of measure 1,
  - 2) production workers of measure L_P,
  - 3) inventors of measure L_I.

Baseline Model (4/5) - Labor Market

- Measure $1 + L$ individuals working in three capacities:
  - 1) firm owners of measure 1,
  - 2) production workers of measure L_P,
  - 3) inventors of measure L_I.
- Hence:

$$L = L_P + L_I$$

Baseline Model (4/5) - Labor Market

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  - 1) firm owners of measure 1,
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- Hence:

$$L = L_P + L_I$$

- Each person decides for his/her career:
  - production worker: w
  - inventor:
    - Has an idea with probability h.
    - j pays ηQ as monetary education cost and Q/a hassle cost.
    - j has schooling ability a_j that comes from Pareto: $P(\tilde{a} > a) = \left(\frac{a_{min}}{a}\right)^{\zeta}$
    - ξ fraction can borrow against their future return.

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- Measure $1 + L$ individuals working in three capacities:
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    - ξ fraction can borrow against their future return.
- Occupational choice:

$$hP - \eta Q - \frac{Q}{a} = w$$

Model (5/5) - Results

Equilibrium share of inventors:

$$s^* = \xi\left([h\beta V/Q - \eta - \omega]a_{min}\right)^{\zeta}$$

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Equilibrium share of inventors:

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Predictions:

1) More inventive (τ) economies grow (g) faster.

Model (5/5) - Results

Equilibrium share of inventors:

$$s^* = \xi \left([h\beta V/Q - \eta - \omega] a_{min} \right)^{\zeta}$$

Predictions:

2) Market size (L : population, geographical connection) increases demand, and therefore, innovation.

Model (5/5) - Results

Equilibrium share of inventors:

$$s^* = \xi \left([h\beta V/Q - \eta - \omega] a_{min} \right)^{\zeta}$$

Predictions:

3) Financially-developed economies are more inventive.

Model (5/5) - Results

Equilibrium share of inventors:

$$s^* = \xi \left([h\beta V/Q - \eta - \omega] a_{min} \right)^{\zeta}$$

Predictions:

4) Innovation is done by new entrants. Innovation incentives decline once becoming an incumbent (Arrow's replacement effect).

Model (5/5) - Results

Equilibrium share of inventors:

$$s^* = \xi \left([h\beta V/Q - \eta - \omega] a_{min} \right)^{\zeta}$$

Predictions:

5) Higher quality innovations (λ) are associated with higher income (Π).

Model (5/5) - Results

Equilibrium share of inventors:

$$s^* = \xi \left([h\beta V/Q - \eta - \omega] a_{min} \right)^{\zeta}$$

Predictions:

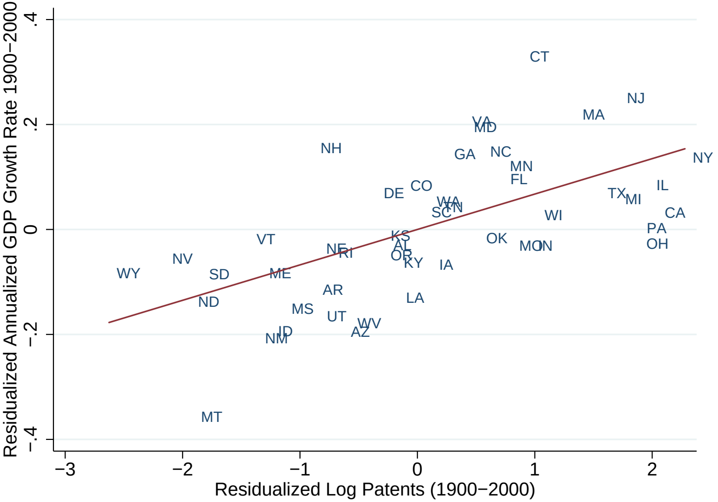
6) Innovation is associated with turnover in the society (social mobility).

Empirical Analysis

Innovation and Growth

- 25-year old Endogenous Growth literature on innovation and aggregate growth (e.g., Romer, 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1991).
- Empirical evidence comes from modern, firm-level data. No historical evidence at the aggregate level.
- We will look at state- and sector-level performance using data from Bureau of Economic Analysis.

Inventive States Rise up over Long Run: 1900-2000



Fact 1: *More inventive states grew faster on average.*

Inventive Sectors Rise up over Long Run: 1948-1986

Panel A: Growth in Value Added

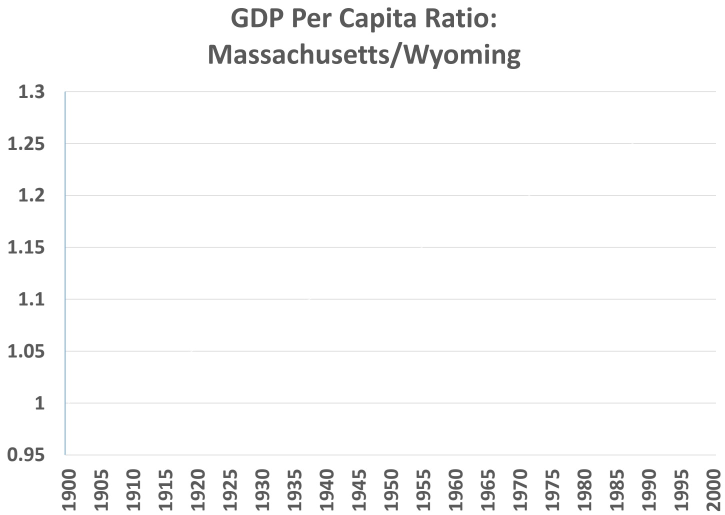
Panel B: Growth in FTE Employees

100-year Growth and Innovation: 1900-2000

Table 4: Innovation and Long Run Growth: US States between 1900-2000

	Annualized Growth Rate		DHS Growth Rate	
	(1)	(2)	(3)	(4)
Log Patents	0.066***	0.054***	0.031***	0.026***
	(0.013)	(0.012)	(0.008)	(0.007)
Initial GDP per Capita	-0.877***	-0.891***	-0.324***	-0.330***
	(0.036)	(0.036)	(0.025)	(0.026)
Population Density		1.145*		0.517*
		(0.588)		(0.304)
Observations	48	48	48	48
Mean Growth	2.154	2.154	1.552	1.552
Std. Dev. of Growth	0.417	0.417	0.159	0.159

Interpretation of the 100-year Growth Regressions



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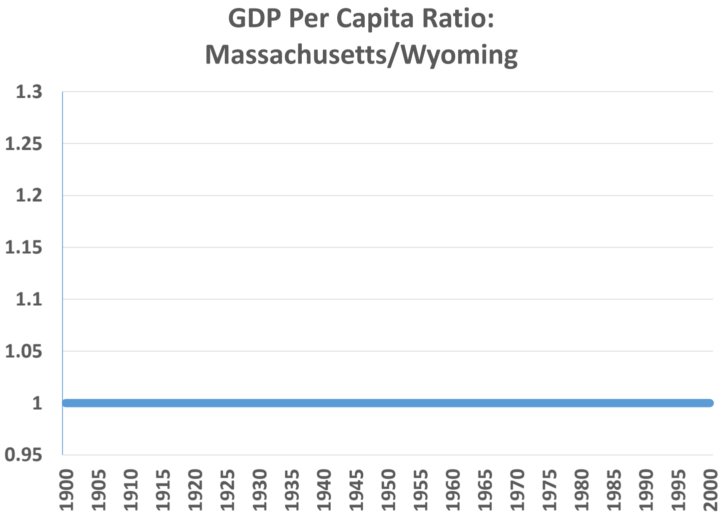

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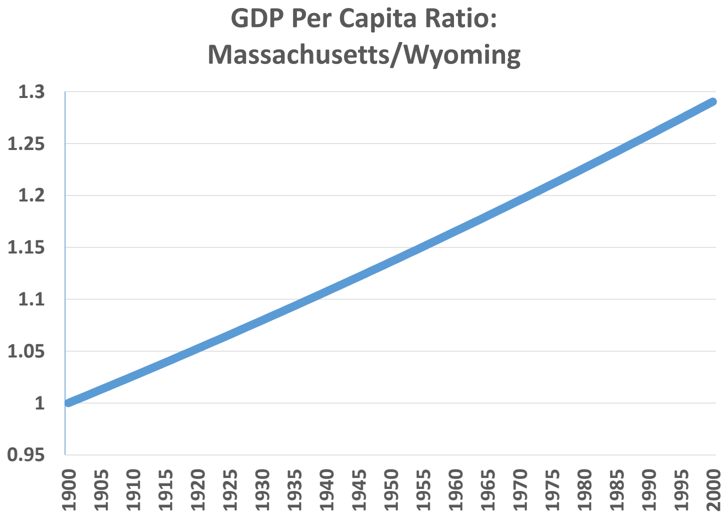


Shift in Innovation: Wartime Government Projects

- The OSRD (Office of Scientific Research and Development) was established under Roosevelt's Executive Order (1941-47).
- The OSRD was responsible for major wartime innovations:
  - proximity fuze, navigation systems, solid fuel rockets, detonators, and most famously the basic science used in the Manhattan Project.
- OSRD spent \$450 million ($= 6,5\times$ the 1940 federal budget for science).
- We collected data on all contracts granted by the OSRD during its operation from OSRD archives held at the Library of Congress.
- We observe **1,717** contracts across **39** U.S. States.

State-level Cross-Section: Patent Counts, 1947-1987

Table 6: Innovation and Long Run Growth: U.S. States between 1947-1987

	Annualized Growth Rate	
	OLS	OLS
	(1)	(2)
Log Patents (1945-1950)	0.123***	0.101***
	(0.028)	(0.031)
OSRD Contracts		
Log GDP per Capita (1945)	-1.655***	-1.688***
	(0.148)	(0.148)
Population Density (1945)		1.064
		(0.652)
Observations	48	48
Mean Growth	2.501	2.501
Std. Dev. of Growth	0.439	0.439
F-Statistic		

robustness

State-level Cross-Section: Patent Counts, 1947-1987

Table 6: Innovation and Long Run Growth: U.S. States between 1947-1987

	Annualized Growth Rate		
	OLS	OLS	IV
	(1)	(2)	(3)
Log Patents (1945-1950)	0.123***	0.101***	0.127***
	(0.028)	(0.031)	(0.038)
OSRD Contracts			
Log GDP per Capita (1945)	-1.655***	-1.688***	-1.738***
	(0.148)	(0.148)	(0.147)
Population Density (1945)		1.064	0.798
		(0.652)	(0.575)
Observations	48	48	48
Mean Growth	2.501	2.501	2.501
Std. Dev. of Growth	0.439	0.439	0.439
F-Statistic			

robustness

State-level Cross-Section: Patent Counts, 1947-1987

Table 6: Innovation and Long Run Growth: U.S. States between 1947-1987

	Annualized Growth Rate				1^{st} Stage
	OLS	OLS	IV	IV	OLS
	(1)	(2)	(3)	(4)	(5)
Log Patents (1945-1950)	0.123***	0.101***	0.127***	0.082**	
	(0.028)	(0.031)	(0.038)	(0.039)	
OSRD Contracts					0.698***
					(0.083)
Log GDP per Capita (1945)	-1.655***	-1.688***	-1.738***	-1.511***	0.250
	(0.148)	(0.148)	(0.147)	(0.125)	(0.638)
Population Density (1945)		1.064	0.798	0.820	0.574
		(0.652)	(0.575)	(0.588)	(2.291)
1900-1940 GDP/cap. Annual Growth Rate				0.146**	0.391*
				(0.067)	(0.214)
Observations	48	48	48	48	48
Mean Growth	2.501	2.501	2.501	2.501	6.698
Std. Dev. of Growth	0.439	0.439	0.439	0.439	1.502
F-Statistic					66.126

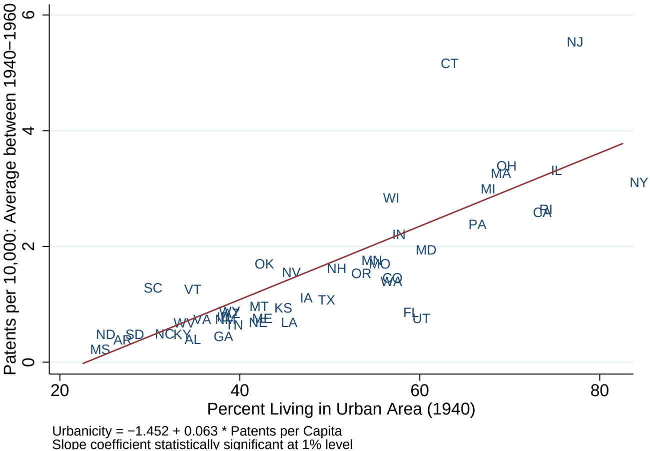
robustness

Why Might Population Density Matter?

- Often hypothesized that exchange of ideas central to growth
  - Lucas (2009), Benhabib, Perla & Tonetti (2014), Perla and Tonetti (2014), Lucas & Moll (2014), Luttmer (2014), Caicedo, Lucas, & Rossi-Hansberg (2014), Akcigit, Caicedo, Stantcheva, Miguelez, & Sterzi (2016) etc.
  - Ellison & Glaeser (1999), Glaeser & Kahn (2001), Ellison, Glaeser, & Kerr (2010), Duranton & Puga (2001) etc
- Close geographic proximity $\Rightarrow$ exchange of ideas?
- Growth of cities

Population Density and Innovation

Panel A: Percent Living in Urban Area



Fact 2: *Densely-populated states were more inventive.*

Population Density and Innovation (robustness)

Table 8: Population Density and Innovation: County-Level Results

	(1)	(2)	(3)	(4)
% Urban	0.817***	0.414**		
	(0.139)	(0.176)		
% Living on Farm			-0.858***	-0.484**
			(0.096)	(0.242)
% Agricultural Occupation		-0.426***		-0.391**
		(0.112)		(0.163)
% Manufacturing Occupation		-0.021		-0.142
		(0.093)		(0.107)
State Fixed Effects	N	Y	N	Y
Observations	3087	3062	3087	3062

Market Size, Geographical Connectedness

- Market size is argued to be important for innovation
  - Sokoloff (1988) in early 19th century US, Murphy, Shleifer, Vishny (1989) for the big push into industrialization, Acemoglu and Linn (2004) in Pharma, Aghion et al (2016) in Auto industry.
- We construct two measures to capture market size.
- 1) Cost Advantage: Average cost to ship goods (weighted by the average income $\omega_{c'}$):

$$\bar{\kappa}_c = \frac{1}{N} \sum_{c'} \omega_{c,c'} \kappa_{c,c'} \quad \text{and} \quad \text{Cost\_Advantage} = \frac{\mu - \bar{\kappa}_c}{\sigma}$$

  where $\kappa_{c,c'}$: cost of shipment from c to c'.
- 2) Market size:

$$\text{Market\_Size}_c = \sum_{c' \in M(c)} P_c$$

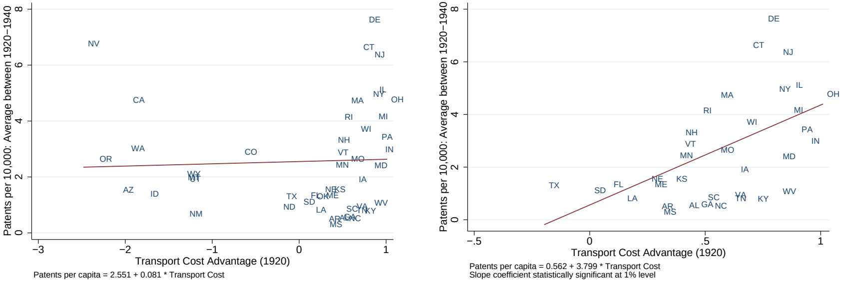
  where $M(c) = c' : \kappa_{c,c'} \leq \pi^{50}$ and $P(c)$=population in county c.

Transportation: Market Size Effect

Figure: Transportation Cost Advantage

Panel A: All states

Panel B: Non-Western States



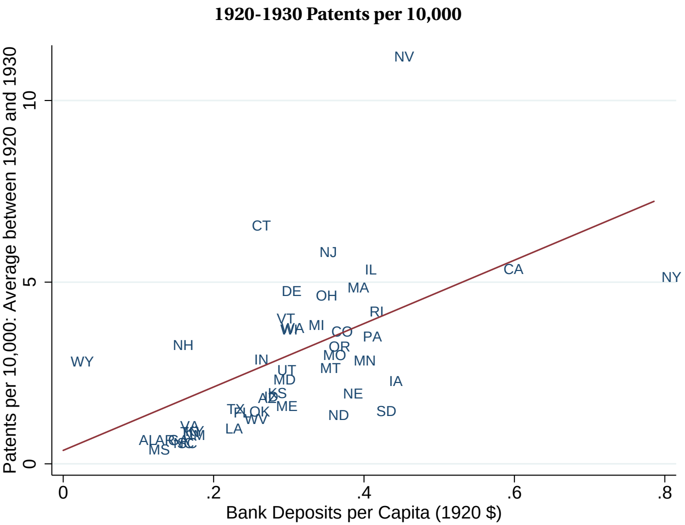
Fact 2: *Geographically-connected states were more inventive.*

robustness rr

Banking & Finance

- Large literature on the importance of finance for innovation and growth.
  - Schumpeter (1912), Aghion and Tirole (1994), Acemoglu and Zilibotti (1997), Rajan and Zingales (1998), Gompers and Lerner (2004), Levine (2005), Aghion et al (2007), among many others.
- We will focus on Bank lending in 1920.
- Banking data comes from FDIC: Federal Deposit Insurance Corporation Data on Banks in the U.S.

Banking



Fact 3: *Financially-developed states were more inventive.*

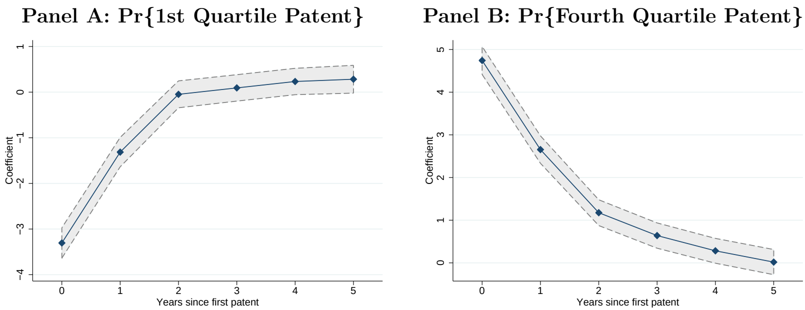
Banking

Table: Financial Development and Innovation: County-Level Results

	Non-Corporate Patents			Corporate Patents		
	County	County	State	County	County	State
	(1)	(2)	(3)	(4)	(5)	(6)
Deposits per Capita	0.300***	0.185*	0.400***	0.164***	0.034	0.125
	(0.114)	(0.103)	(0.139)	(0.062)	(0.035)	(0.146)
% Agricultural Occupation		-0.383***	-0.184		-0.400***	-0.614
		(0.085)	(0.308)		(0.057)	(0.681)
% Manufacturing Occupation		-0.027	0.142		0.116**	0.244
		(0.067)	(0.314)		(0.059)	(0.574)
State Fixed Effects	N	Y	N	N	Y	N
Observations	3013	2279	48	3013	2279	48

Innovation Quality

Innovation Quality over the Life Cycle

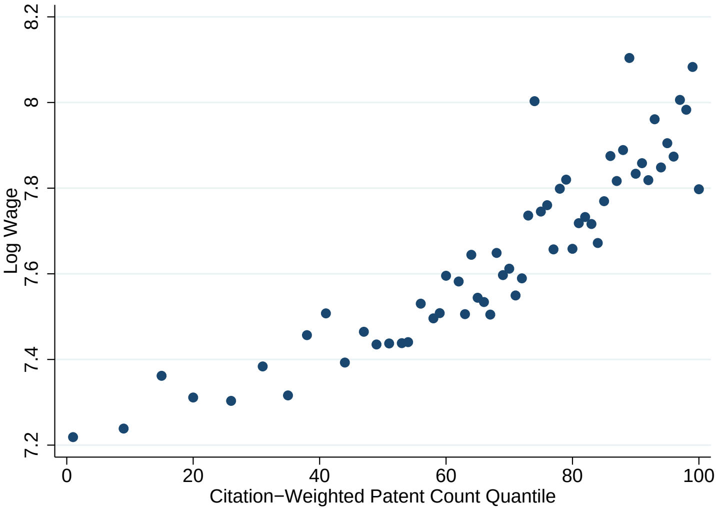


Fact 4. *New inventors received more citations on average.*

Return to Innovation

- Thin literature due to lack of micro data:
  - Toivanen and Vaananen (2012, 2015)
  - Aghion, Akcigit, Hyytinen, Toivanen (2016)
  - Bell, Chetty, Jaravel, Petkova, Van Reenen (2016)

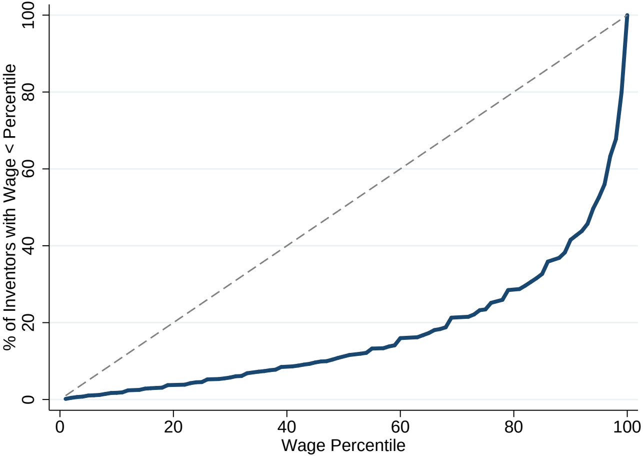
The Rewards to Innovation



Fact 5. *Inventor's income was correlated with the quality of invention.*

Income Distribution of Inventors

Figure: Share of Inventors with Incomes Below Each Income Percentile



Income of Inventors

Table 16: What determined inventor income? Regressions of log wages on innovation measures

	Age: Under 35		Age: Over 35	
	(1)	(2)	(3)	(4)
Log Patents Pre-1940	-0.022		0.060***	
	(0.018)		(0.014)	
Log Patents Post-1940	0.087***		0.040***	
	(0.016)		(0.011)	
Log Citations Pre-1940		0.002		0.030***
		(0.009)		(0.007)
Log Citations Post-1940		0.039***		0.030***
		(0.010)		(0.008)
Observations	1602	1602	4458	4458
R-squared	0.482	0.480	0.302	0.302
Mean of Dep. Var.	7.275	7.275	7.765	7.765
S.D. of Dep. Var.	0.927	0.927	0.781	0.781

robustness

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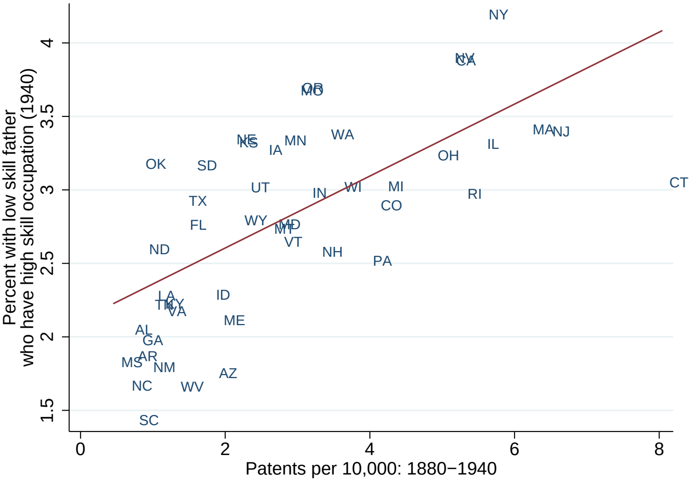
robustness

Social Mobility Positively Correlated w/ Innovation



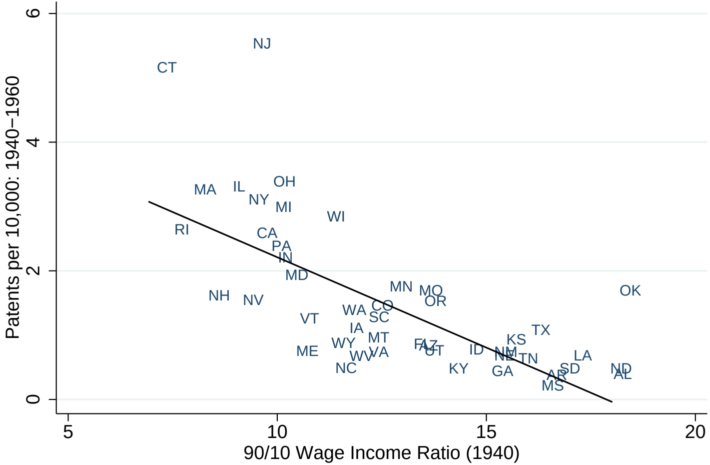
Fact 6. *Innovation was positively correlated with social mobility.*

Evaluation of the Stylized Facts So Far...

- ✓ More inventive states and sectors **grew faster** on average.
- ✓ **Densely-populated and geographically-connected** states were more inventive.
- ✓ **Financially-developed** states were more inventive.
- ✓ The patents of **new inventors received more citations** on average.
- ✓ Inventor's income was correlated with the **quality of invention**.
- ✓ Innovation was positively correlated with **social mobility**.

What About Inequality and Innovation?

Inequality and Innovation



Patents per Capita = 5.020 −0.281 * 90/10 Wage Income Ratio (1940)
Slope coefficient statistically significant at 1% level

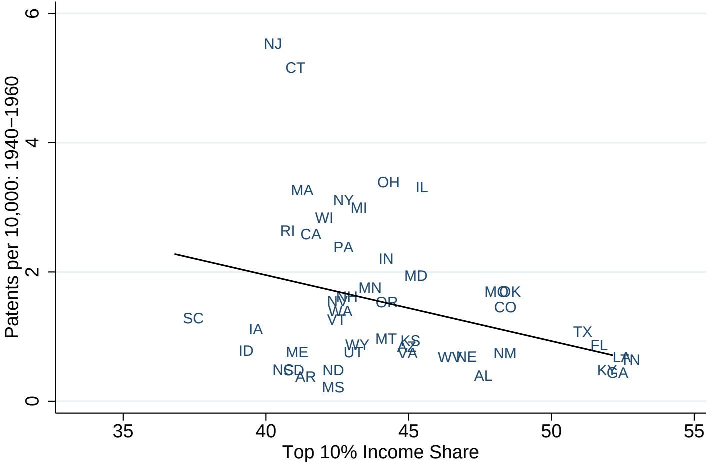
Fact 7. *Inequality (90/10 ratio) is negatively associated with innovation.*

Inequality and Innovation

Patents per Capita = 9.801 −18.540 * Gini Coefficient of Wage Income (1940)
Slope coefficient statistically significant at 1% level

Fact 7. *Inequality (Gini) is negatively associated with innovation.*

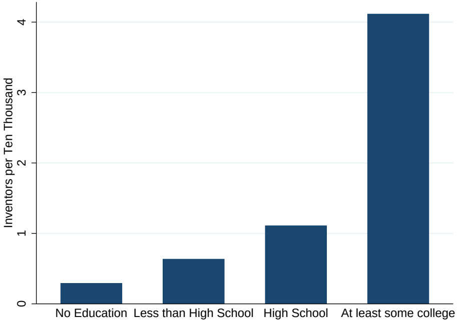
Inequality and Innovation



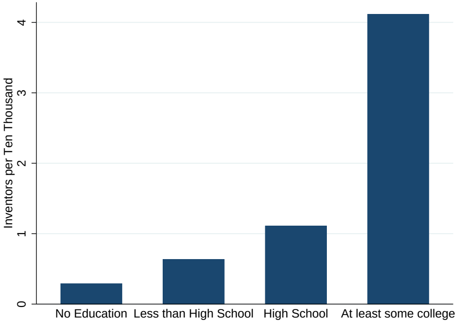
Patents per Capita = 6.034 −0.102 * Top 10% Income Share
Slope coefficient statistically significant at 5% level

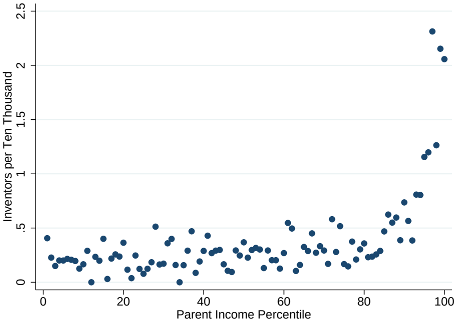
Fact 7. *Inequality (Top10 fraction) is negatively associated with innovation.*

Who Becomes an Inventor?



Who Becomes an Inventor?





Fact 8. *More educated kids, and kids with richer parents were more likely to be an inventor.*

What Did the Standard Model Fail to Explain?

Standard model has been silent on:

- The link between parental resources, child education, and becoming an inventor.
- The interaction between financial development, inequality, and becoming an inventor.

Remark: This could shed light on Goolsbee or Jones critique!

Back to the Model

Model Ingredients

- Endogenous growth where population is split into two groups:
  1. production workers
  2. inventors
- We consider a new environment:
  $\rightarrow$ A model with inequality and financial frictions.

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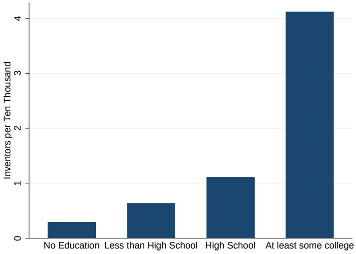
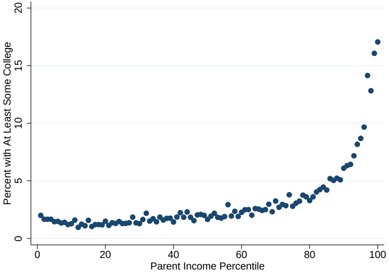
Education vs Inventing



Parental Income vs Education



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- We consider a new environment:
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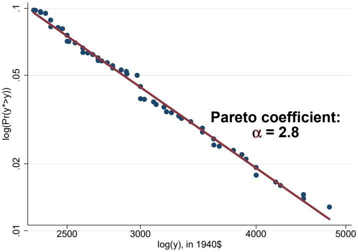
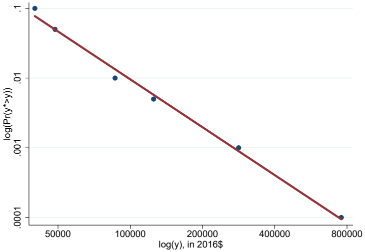
1940 Census Data



1940 Piketty-Saez Data



Extension with Financial Frictions (1/3)

- Assume parental resources (y_j) are distributed with Pareto:

$$P\left(y^* > y\right) = \left(\frac{y_{\min}}{y}\right)^{\alpha} \text{ for } y \geq y_{\min} \text{ and } \alpha \geq 1$$

- Children rely on parental resources to pay for schooling cost η. Assume there are sufficient resources to send everybody to school:

$$y_{\min} = \frac{\alpha - 1}{\alpha}\eta.$$

- Individuals are heterogeneous in terms of their schooling ability a_j. Then the total cost of schooling is

$$\eta + \frac{1}{a_j}.$$

- For $\beta \in [0, 1]$ of the population, perfect assortative matching

$$a_j = y_j$$

- For $1 - \beta$, ability cost is independent of parental type (resources).

Extension with Financial Frictions (2/3)

- Note that:

$$\text{"90-10 RATIO"} \equiv \frac{y_{90}}{y_{10}} = 9^{\frac{1}{\alpha}} \tag{M1}$$

$$\text{"GINI COEFFICIENT"} \equiv G = \frac{1}{2\alpha - 1} \tag{M2}$$

$$\text{"TOP-}q\text{ INCOME SHARE"} \equiv \left(\frac{q}{100}\right)^{\frac{\alpha-1}{\alpha}} \tag{M3}$$

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- Moreover:

$$\frac{d\text{"90-10 RATIO"}}{d\alpha} < 0,$$

$$\frac{d\text{"GINI COEFFICIENT"}}{d\alpha} < 0,$$

$$\frac{d\text{"TOP-}q\text{ INCOME SHARE"}}{d\alpha} < 0.$$

Extension with Financial Frictions (3/3)

- Then the occupational choice becomes:

$$hP - \eta Q - Q/a_j = w$$

- In this version of the model, the inventor fraction is

$$\begin{aligned} s &= \beta \times \Pr(a_j > a^*) + (1-\beta) \times \Pr(a_j > a^*) \times \Pr(y_j > \eta) \\ &= \left[\beta + (1-\beta) \times \left(\frac{\alpha - 1}{\alpha}\right)^{\alpha}\right] \times [(hV - \omega - \eta)a_{\min}]^{\zeta} \end{aligned}$$

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Proposition *The kids of the rich parents are more likely to be an inventor.* $\beta = 1$, *this is due to higher ability, if* $\beta = 0$ *this is due to financial frictions*

Who Becomes Regressions

Table: Who Becomes an Inventor?

	(1)	(2)	(3)	(4)
Father Income $90^{th} - 95^{th}$ %ile	0.411^{***}	0.409^{***}	0.297^{**}	-0.070
	(0.119)	(0.120)	(0.124)	(0.127)
Father Income 95^{th} %ile and above	1.084^{***}	1.061^{***}	0.770^{***}	0.009
	(0.227)	(0.228)	(0.193)	(0.147)
Father Inventor		16.074^{**}	15.859^{**}	15.464^{**}
		(7.545)	(7.544)	(7.552)
Father: High School Graduate			0.563^{***}	-0.173
			(0.150)	(0.144)
Father: At least Some College			1.034^{***}	-0.250^{**}
			(0.165)	(0.102)
Self: High School Graduate				0.841^{***}
				(0.111)
Self: At least Some College				3.558^{***}
				(0.499)
Observations	82810258	82810258	82810258	82810258
Mean of Dep. Var.	1.091	1.091	1.091	1.091

Notes. Standard errors clustered at the state-level reported in parentheses. All regressions include state fixed effects, and controls for race, sex, migration status, and a quadratic in age. Columns (2) through (5) include indicators for father being between the 50^{th} and 75^{th} percentile of income, and between the 75^{th} and 90^{th} percentile of income as independent variables. The omitted categories are below median income and less than high school eduction.

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Mean of Dep. Var.	1.091	1.091	1.091	1.091

Notes. Standard errors clustered at the state-level reported in parentheses. All regressions include state fixed effects, and controls for race, sex, migration status, and a quadratic in age. Columns (2) through (5) include indicators for father being between the 50^{th} and 75^{th} percentile of income, and between the 75^{th} and 90^{th} percentile of income as independent variables. The omitted categories are below median income and less than high school eduction.

Who Becomes Regressions

Table: Who Becomes an Inventor?

	(1)	(2)	(3)	(4)
Father Income $90^{th} - 95^{th}$ %ile	0.411^{***}	0.409^{***}	0.297^{**}	-0.070
	(0.119)	(0.120)	(0.124)	(0.127)
Father Income 95^{th} %ile and above	1.084^{***}	1.061^{***}	0.770^{***}	0.009
	(0.227)	(0.228)	(0.193)	(0.147)
Father Inventor		16.074^{**}	15.859^{**}	15.464^{**}
		(7.545)	(7.544)	(7.552)
Father: High School Graduate			0.563^{***}	-0.173
			(0.150)	(0.144)
Father: At least Some College			1.034^{***}	-0.250^{**}
			(0.165)	(0.102)
Self: High School Graduate				0.841^{***}
				(0.111)
Self: At least Some College				3.558^{***}
				(0.499)
Observations	82810258	82810258	82810258	82810258
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Who Becomes Regressions

To sum up:

- Parental income is strongly correlated with becoming an inventor.
- This could be due to:
  1. Parental types,
  2. Financial frictions.
- We find suggestive evidence for both margins.
  1. Parental types proxies are statistically significant.
  2. Controlling for child's education absorbs parental income completely.

Fact 9. *Father's income was correlated with becoming an inventor. This effect disappears once child's education is controlled for.*

Who Becomes Regressions and State Characteristics

Table: Who Becomes an Inventor, Father Income, and State Characteristics

	(1)	(2)	(3)	(4)	(5)
Father's Incomec	0.036*	0.047***	0.052**	0.053**	0.042**
	(0.018)	(0.016)	(0.021)	(0.020)	(0.019)
Father's Income		-0.028***			
× Deposits/Cap		(0.009)			
Father's Income			0.048***		
× Gini Coefficient			(0.012)		
Father's Income				0.046***	
× 90/10 Ratio				(0.009)	
Father's Income					0.030**
× Top 10 Share					(0.012)
Observations	82810258	82650789	82810258	82810258	82810258
Mean of Dep. Var.	1.091	1.092	1.091	1.091	1.091
S.D. of Dep. Var.	104.430	104.479	104.430	104.430	104.430

Notes: Standard errors clustered at the state level reported in parentheses. Dependent variable in all regressions is an indicator equal to 100 if the individual is granted at least one patent in 1940. All regressions control for race, sex, international migrant status, father's age, occupation skill, and a quadratic in age. Father's income and state characteristics standardized to have zero mean and unit standard deviation. *Source*: FDIC, 1940 Census, USPTO Historical Patent Records.

Who Becomes Regressions and State Characteristics

Table: WHO BECOMES AN INVENTOR, FATHER INCOME, AND STATE CHARACTERISTICS

	(1)	(2)	(3)	(4)	(5)
Father's Incomec	0.036*	0.047***	0.052**	0.053**	0.042**
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Who Becomes Regressions and State Characteristics

To sum up:

- Parental income is strongly correlated with becoming an inventor but less so
    1. in more financially-developed states.
    2. in more equal states.

Fact 10. *Father's income was correlated with becoming an inventor but less so in more financially developed regions.*

Evaluation of the Stylized Facts

- ✓ More inventive states and sectors **grew faster** on average.
- ✓ **Densely-populated, financially-developed, geographically-connected** states were more inventive.
- ✓ The patents of **new inventors received more citations** on average.
- ✓ Inventor's income was correlated with the **quality of invention**.
- ✓ Innovation was positively correlated with **social mobility**.
- ✗ Broad measures of **income inequality (90/10, Gini)** were negatively correlated with innovation.
- ✗ Inventors were more **educated**.
- ✗ **Father's income** was correlated with becoming an inventor. This effect disappears once **child's education** is controlled for.
- ✗ In more financially-developed areas, father's income was less correlated with child being an inventor.

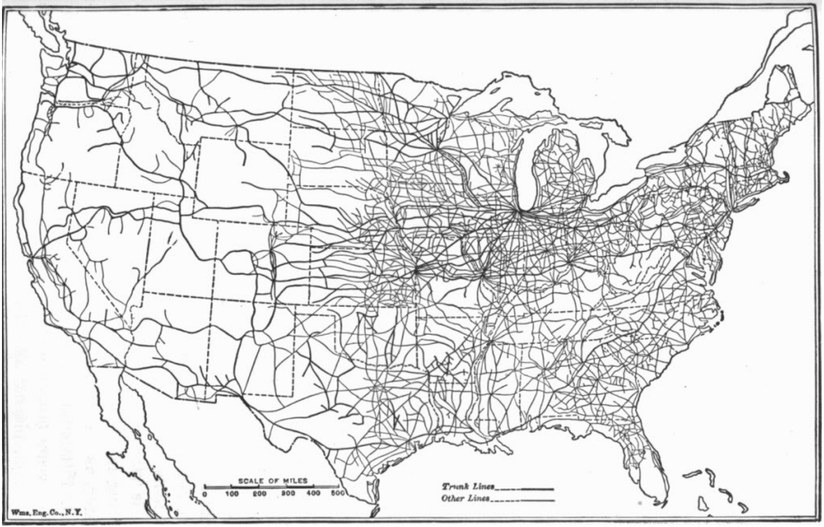
Aghion, Philippe and Peter Howitt, "A Model of Growth through Creative Destruction," *Econometrica*, 1992, *60* (2).

Donaldson, Dave and Richard Hornbeck, "Railroads and American Economic Growth: A Market Access Approach," *Quarterly Journal of Economics*, 2016, *31* (2), 799–858.

Grossman, Gene M and Elhanan Helpman, "Quality Ladders in the Theory of Growth," *Review of Economic Studies*, 1991, *58* (1), 43–61.

Romer, Paul Michael, "Endogenous Technological Change," *Journal of Political Economy*, 1990, *98* (5), S71–102.

Railroads in 1920



back

Inequality and Innovation

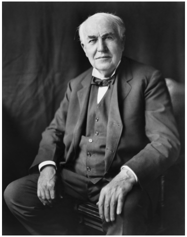
Lecture Slides 2: Taxation and Innovation in the 20th Century[1]

Ufuk Akcigit
University of Chicago

January 7, 2019

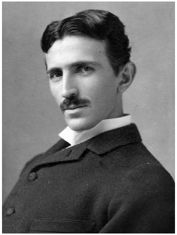
[1]Based on Akcigit, Grigsby, Nicholas, Stantcheva (2018)

Taxation and Innovation



Thomas A. Edison
Light bulb.
Holds 1093 patents.

Melvin De Groote
Chocolate ice cream.
Holds 925 Patents.



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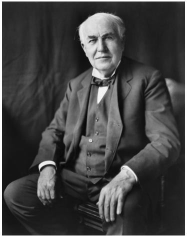
Taxation and Innovation



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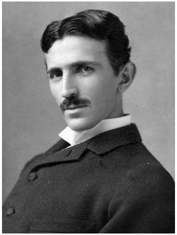

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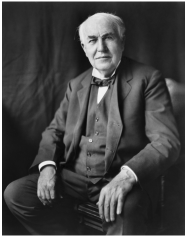
Mad geniuses? Scientific pioneers not considering net returns?

Taxation and Innovation



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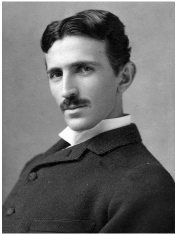

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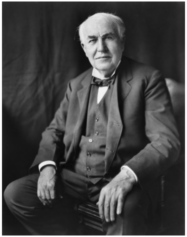
Or were these inventors affected by taxes?

Taxation and Innovation



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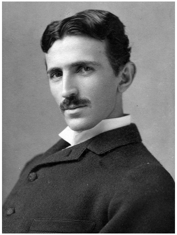

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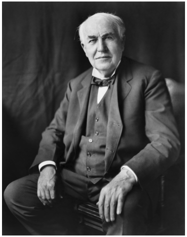
Personal taxes? Corporate taxes?

Taxation and Innovation



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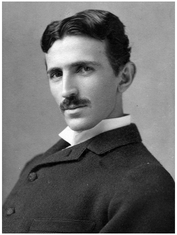

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Response margins? Patents produced? Quality of patents produced? Location choice? What firms they work for? Where they open research labs?

Akcigit, Grigsby, Nicholas, Stantcheva'18 (AGNS)

- How do taxes affect innovation?

Akcigit, Grigsby, Nicholas, Stantcheva'18 (AGNS)

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- Challenging question, to a large extent unanswered because of:
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- Study systematically the effects of **personal and corporate income taxes** since 1920 on:
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  - ii) Firms that do R&D (micro level).
  - iii) Innovation in states (macro level).

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- 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..)

Outline

Inventors, Firms, and Innovation in the Long Run

Personal and Corporate Income Taxation in the Long Run

Macro Effects of Taxation

Event and Case Studies

Micro Effects of Taxation

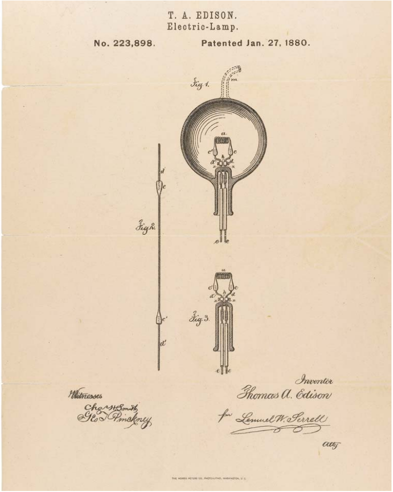
Data from Akcigit, Grigsby, Nicholas (2017)

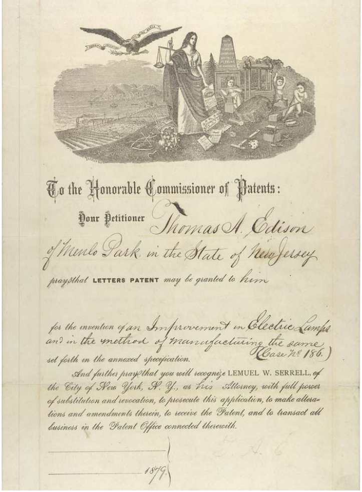
Major data collection effort. AGN generate novel **microdata** to study regional performance as well as the background of the Inventors of the Golden Age.

Data from Akcigit, Grigsby, Nicholas (2017)

Major data collection effort. AGN generate novel **microdata** to study regional performance as well as the background of the Inventors of the Golden Age.

- Digitize the USPTO patents (OCR + hand entry).
- Newly-released decennial census data (1880-1940) and merge.

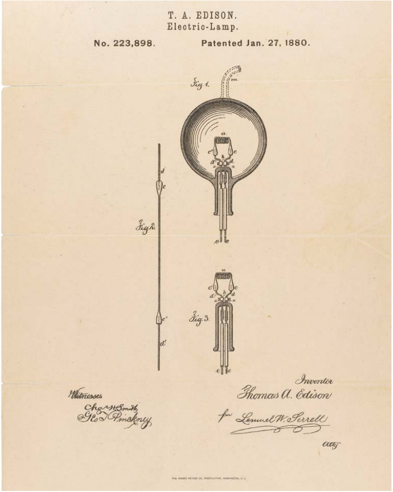


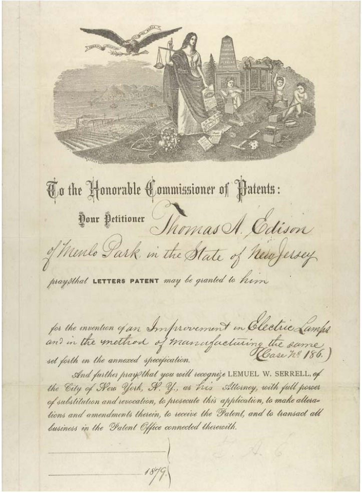

To the Honorable Commissioner of Patents:

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 alterations and amendments therein, to receive the Patent, and to transact all business in the Patent Office connected therewith.

1879.





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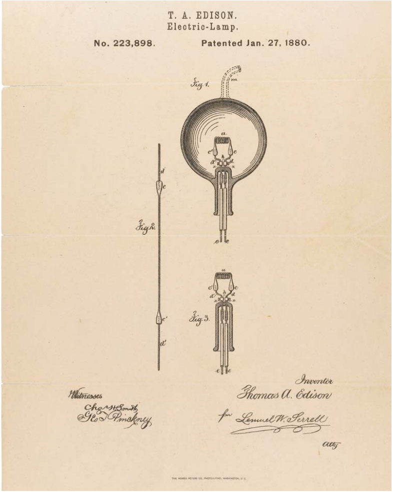

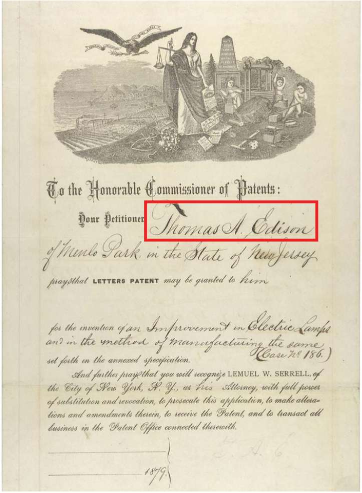
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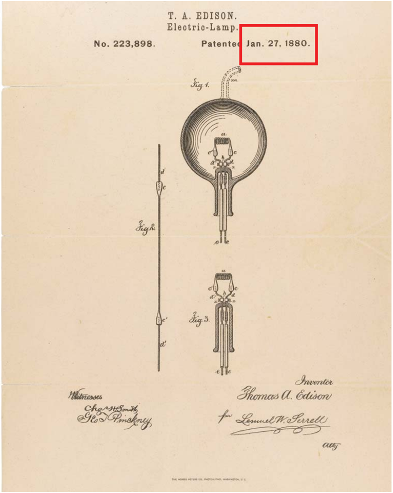

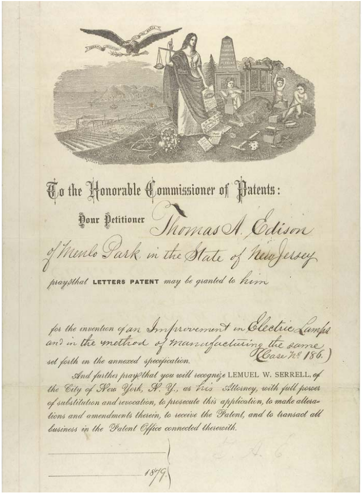

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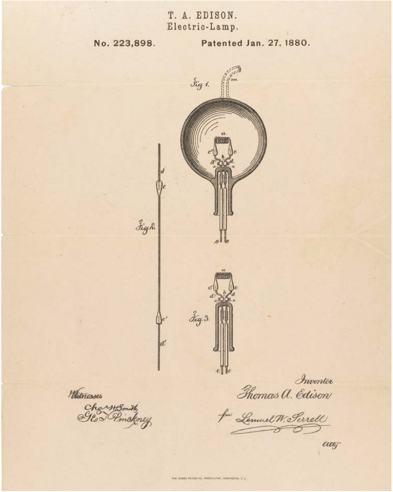

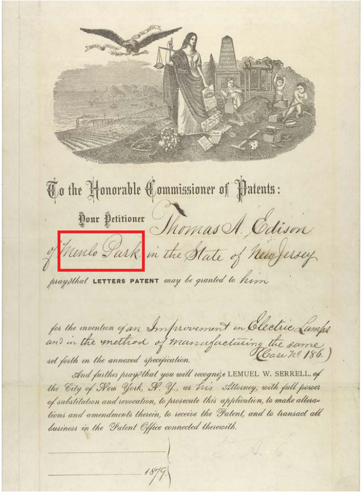

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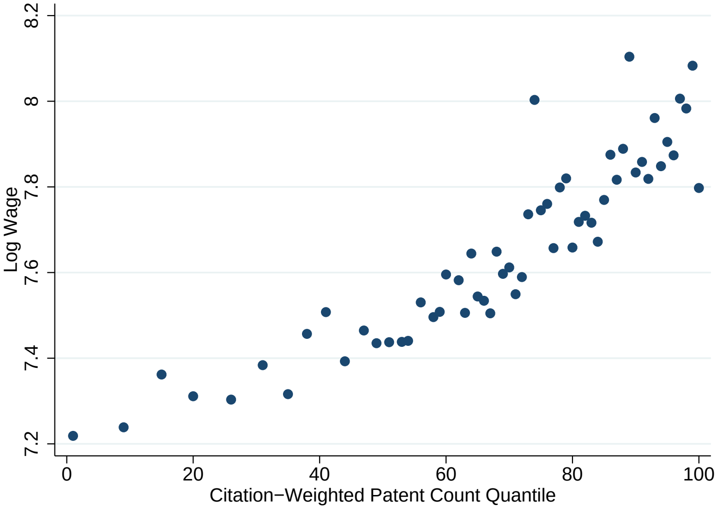
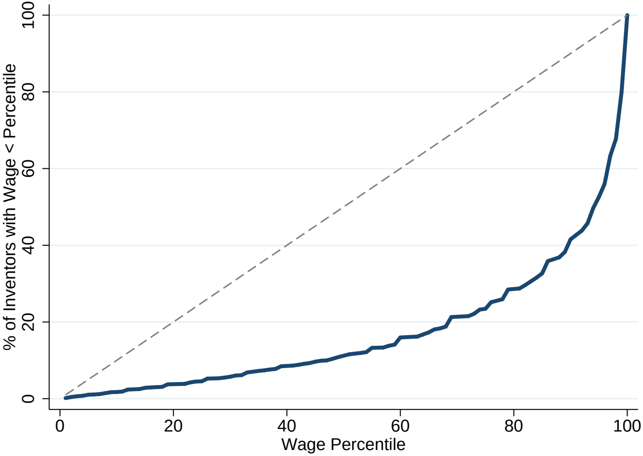
The Rewards to Innovation



Fact 5. *Inventor's income was correlated with the quality of invention.*

Income Distribution of Inventors

Figure: Share of Inventors with Incomes Below Each Income Percentile



Data I: 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
2. Disambiguate within blocks by considering record pairs' similarity on
   - Name
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Result: 4.9 mil. inventors, 6.4 mil. patents;
U.S.: 2.73 mil. inventors, 4.2 mil. patents.

Data II: 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. (C*p*)

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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Contains inputs to R&D: Number of research workers, number and location of labs.

We match it to "output" of R&D, i.e., patents & citations using firm names.

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

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Contains inputs to R&D: Number of research workers, number and location of labs.

We match it to "output" of R&D, i.e., patents & citations using firm names.

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

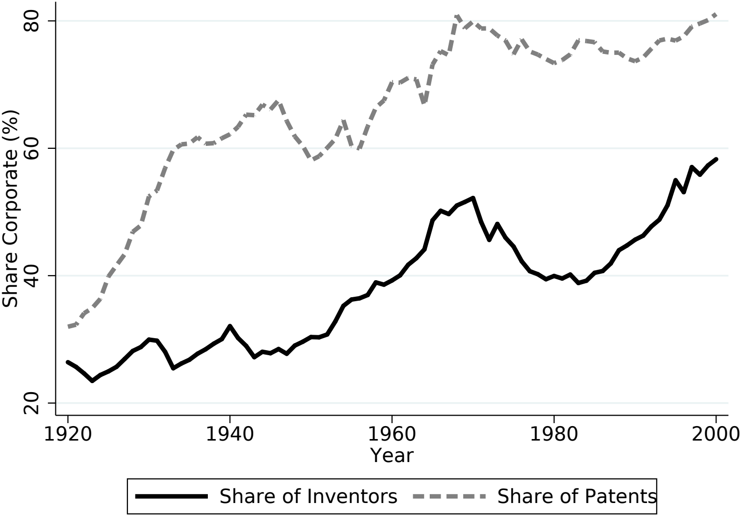
Data III: Tax Data Sources

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)

Share of Corporate Patents & Inventors Working in Firms



Empirical Strategies and Identification

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

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.

Outline

Inventors, Firms, and Innovation in the Long Run

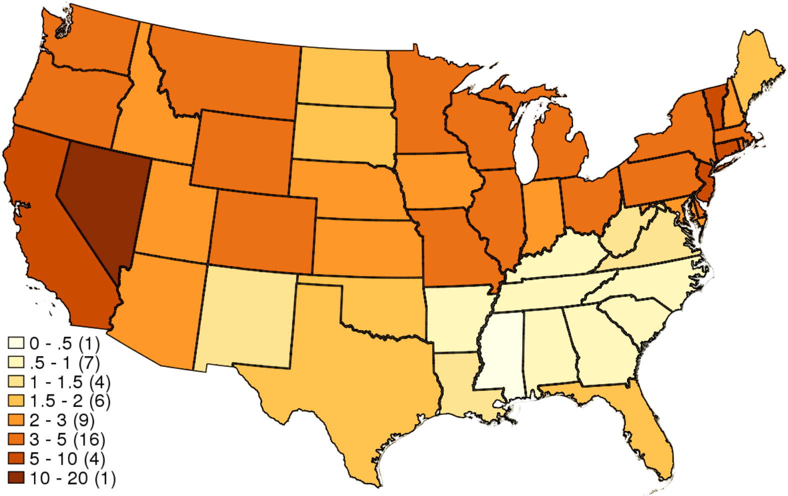
Personal and Corporate Income Taxation in the Long Run

Macro Effects of Taxation

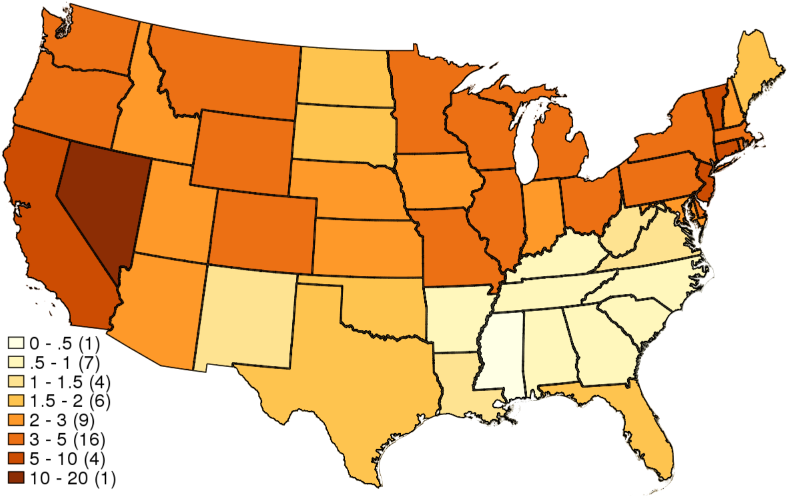
Event and Case Studies

Micro Effects of Taxation

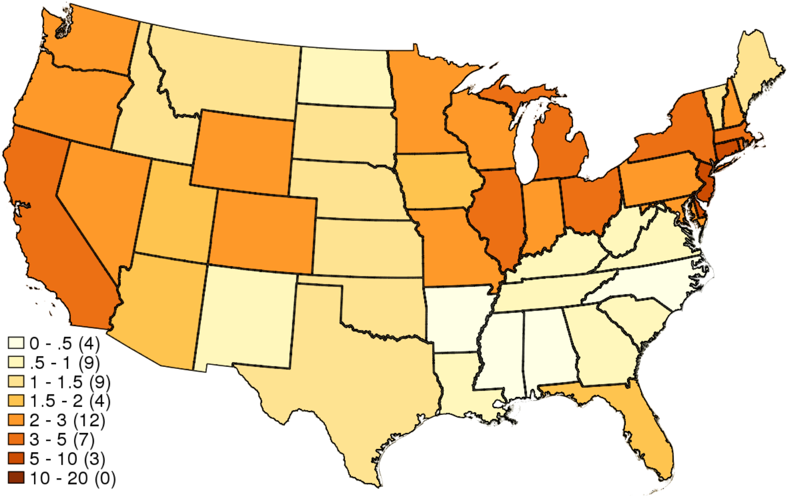
Geography of innovation. Inventors per 10,000: 1920



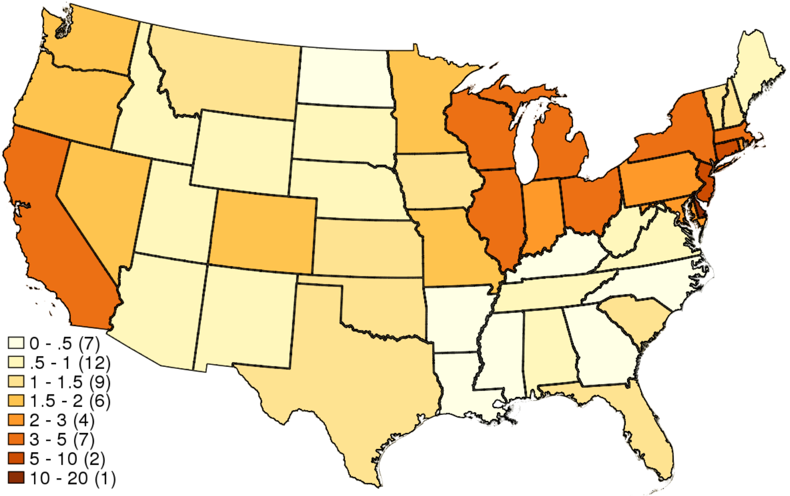
Geography of innovation. Inventors per 10,000: 1920-1930



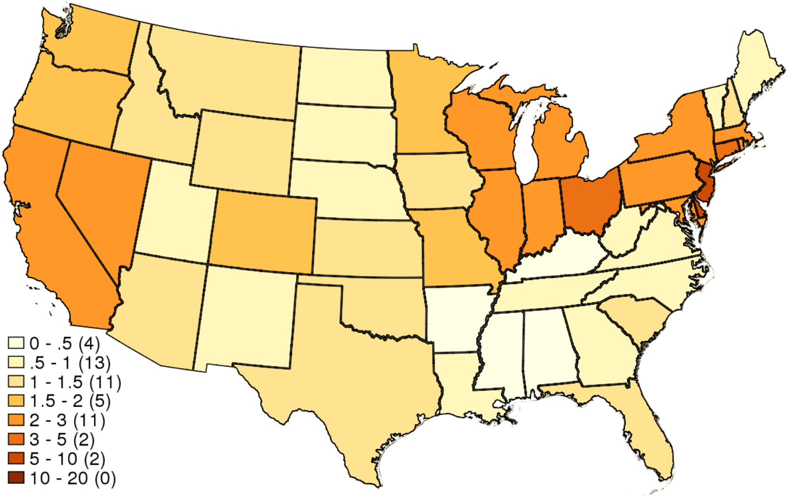
Geography of innovation. Inventors per 10,000: 1930-1940



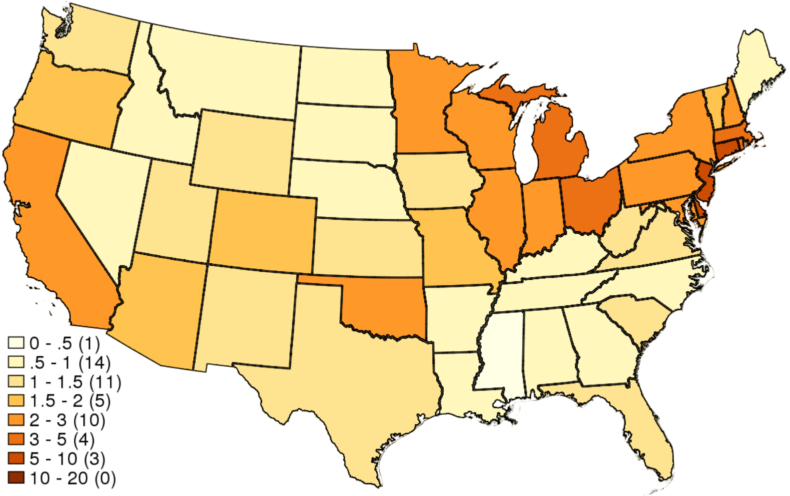
Geography of innovation. Inventors per 10,000: 1940-1950



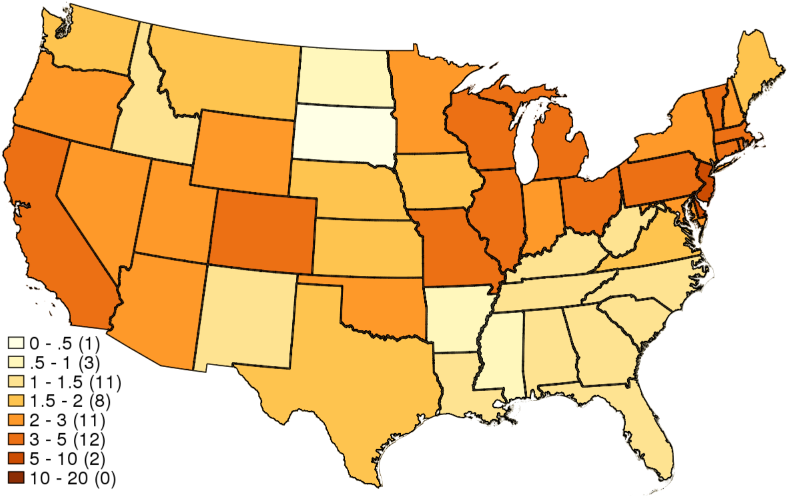
Geography of innovation. Inventors per 10,000: 1950-1960



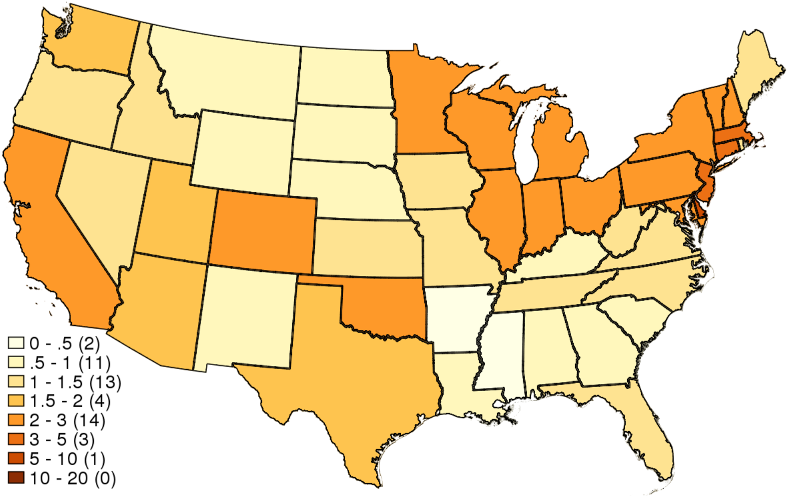
Geography of innovation. Inventors per 10,000: 1960-1970



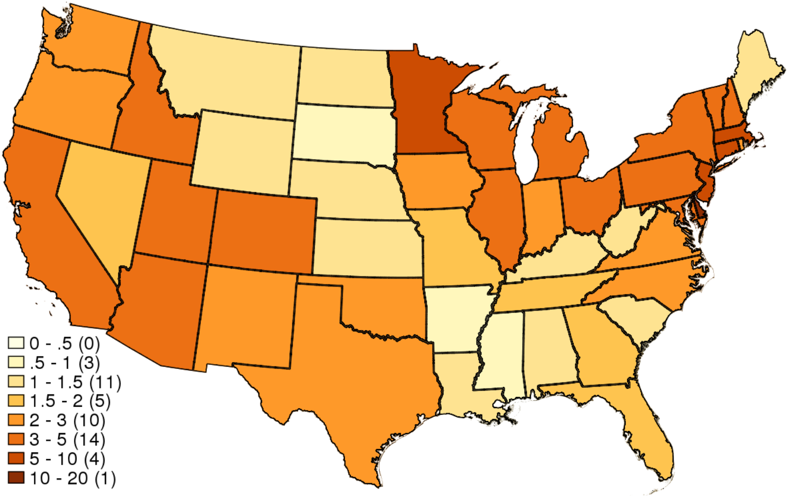
Geography of innovation. Inventors per 10,000: 1970-1980



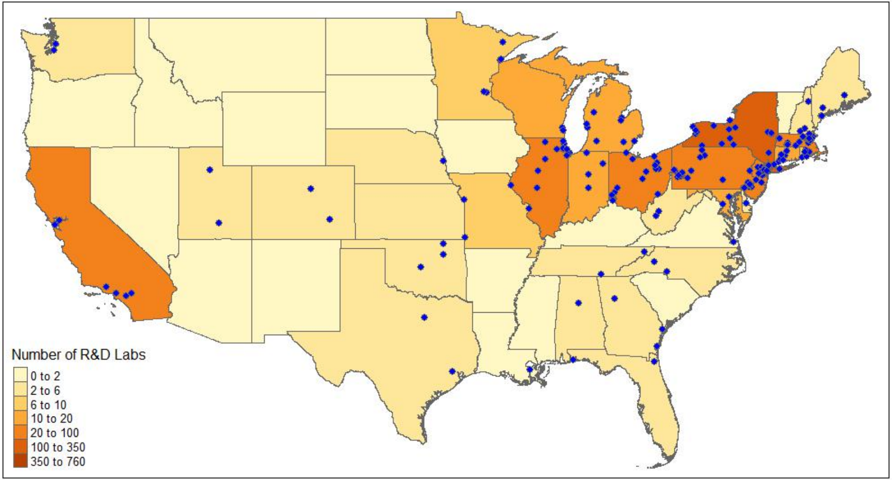
Geography of innovation. Inventors per 10,000: 1980-1990



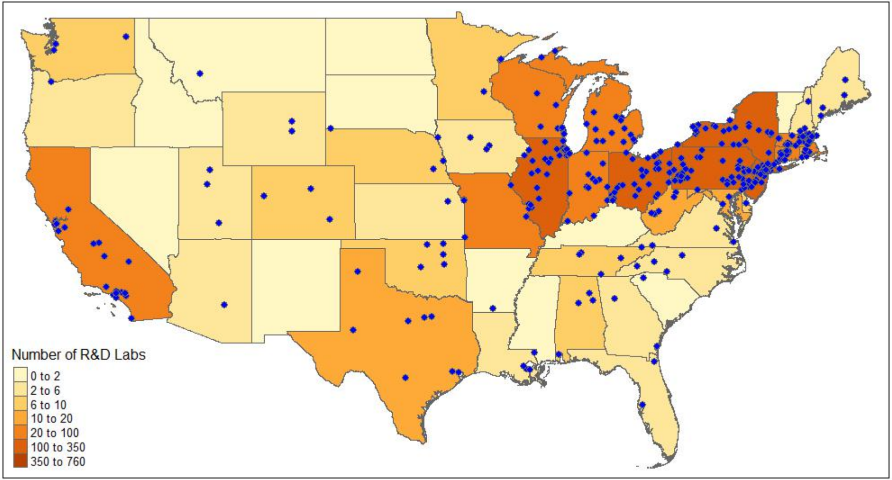
Geography of innovation. Inventors per 10,000: 1990-2000 ▸ Pat.



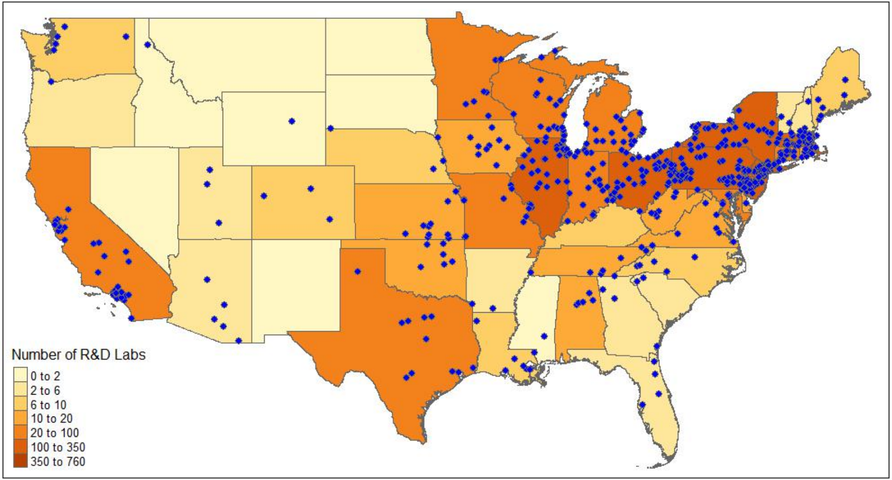
Location of R&D Labs - 1921



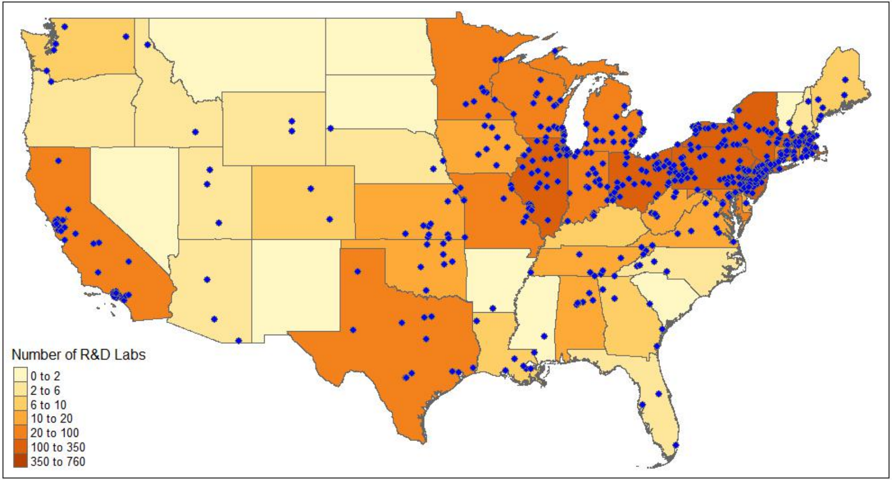
Location of R&D Labs - 1927



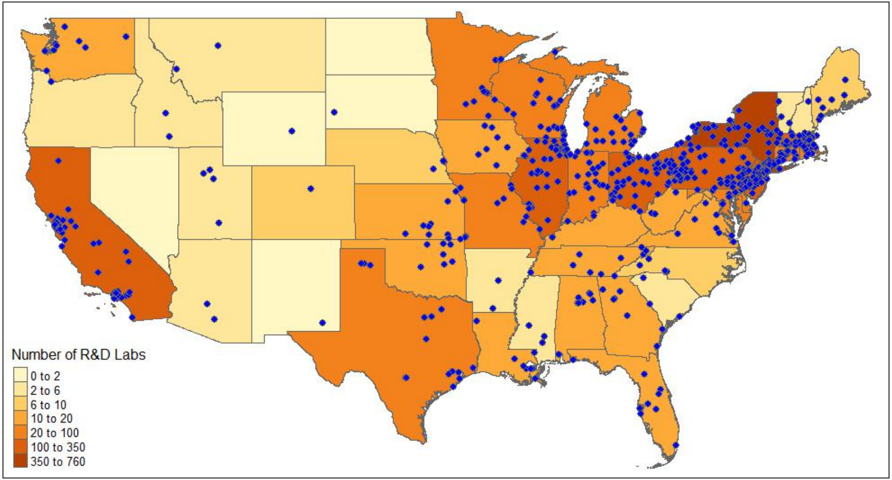
Location of R&D Labs - 1931



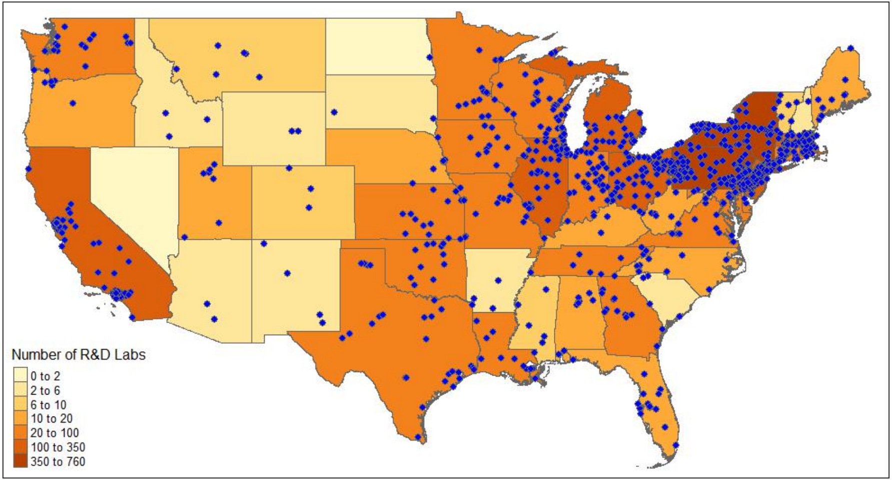
Location of R&D Labs - 1933



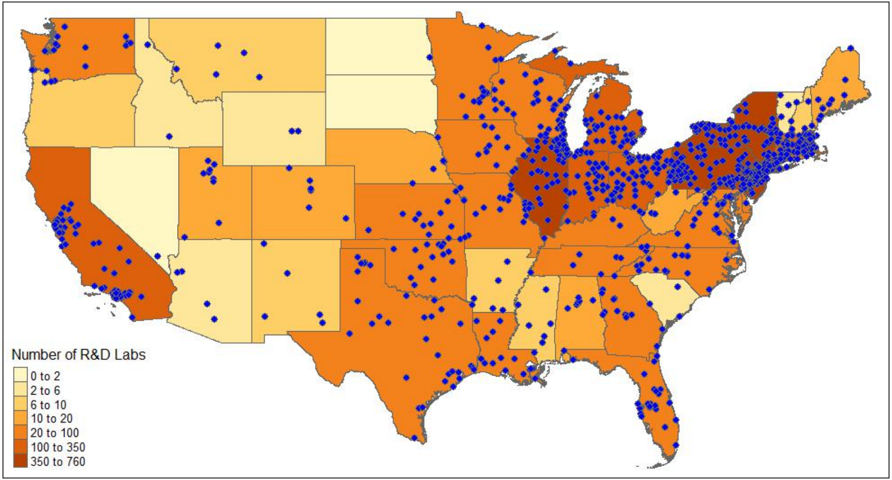
Location of R&D Labs - 1938



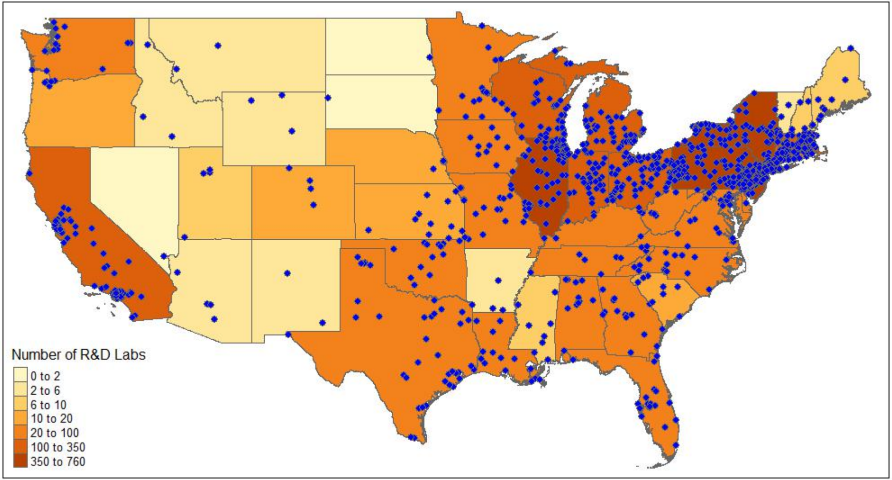
Location of R&D Labs - 1940



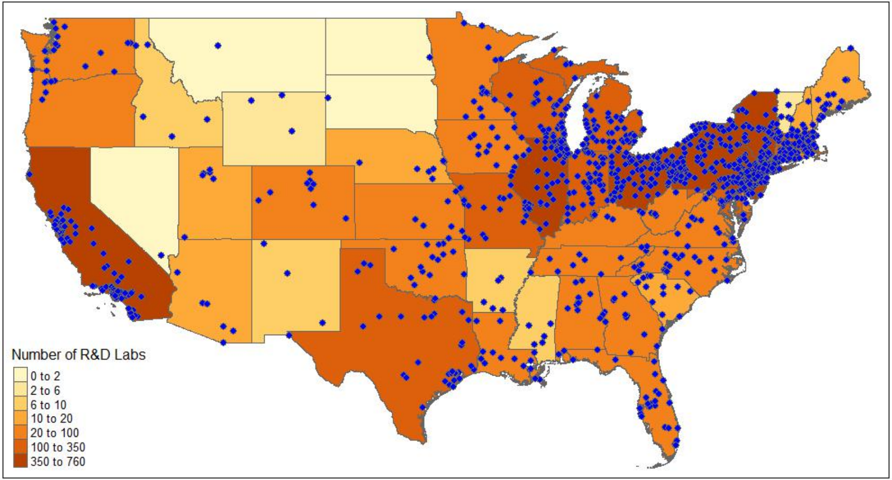
Location of R&D Labs - 1946



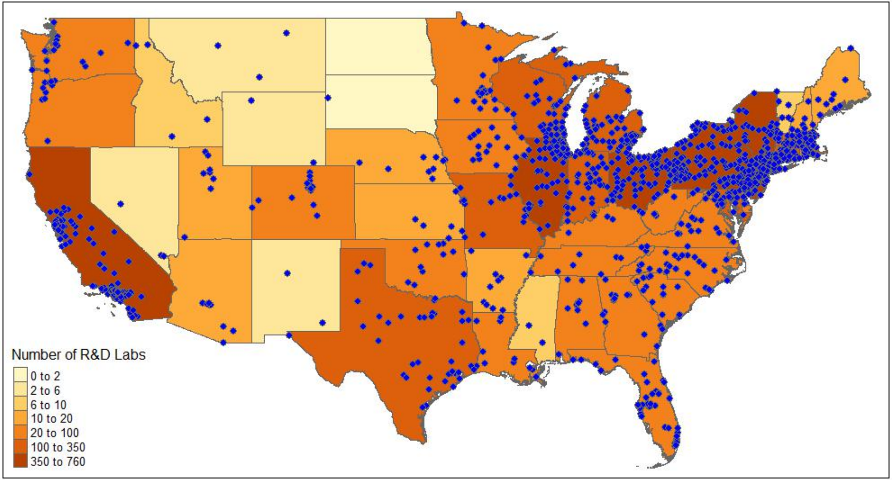
Location of R&D Labs - 1950



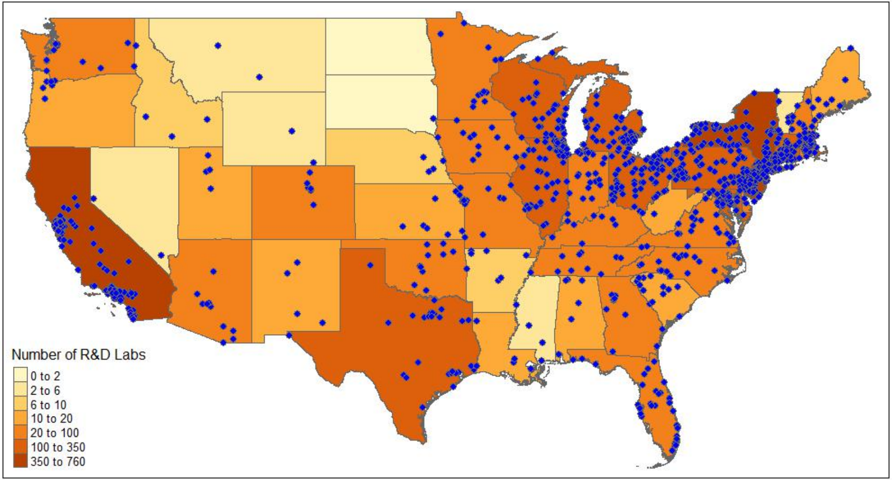
Location of R&D Labs - 1956



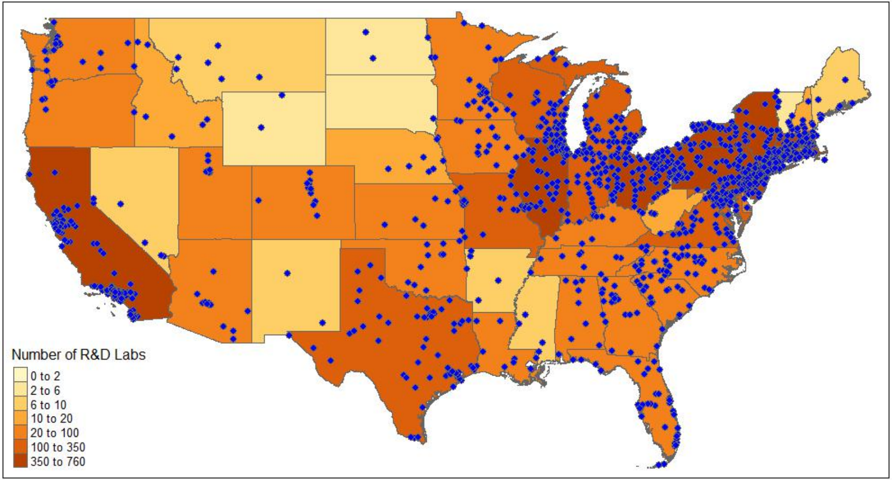
Location of R&D Labs - 1960



Location of R&D Labs - 1965



Location of R&D Labs - 1970



Outline

Inventors, Firms, and Innovation in the Long Run

Personal and Corporate Income Taxation in the Long Run

Macro Effects of Taxation

Event and Case Studies

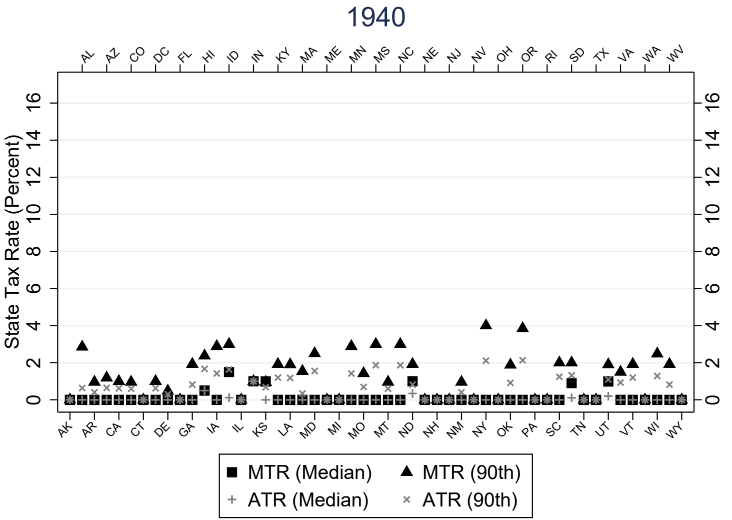
Micro Effects of Taxation

Personal Income Taxes

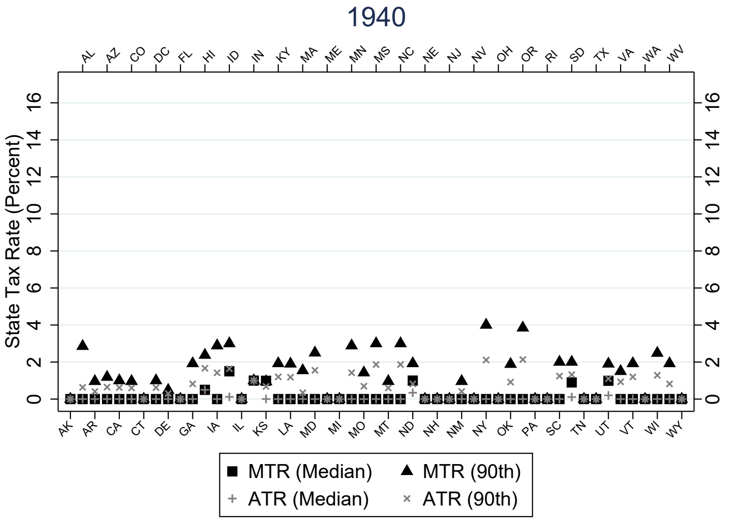
- Many states have progressive tax system (but much less progressive than Federal one).
  - Some states have flat taxes throughout (e.g.: CT, MA, and IL)
  - Some have very progressive systems (e.g.: CA, NY, NJ)
- Use Jon Bakija's historical tax calculator (takes into account deductions) $\approx$ historical 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

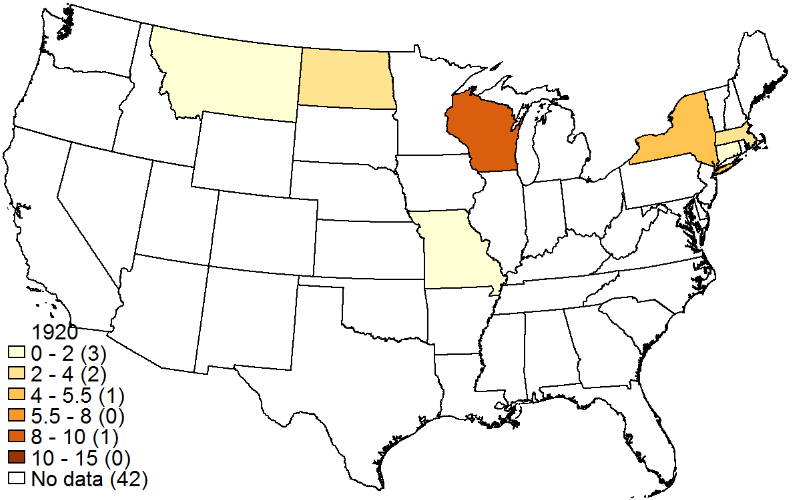


State Tax Rate Distributions over Time

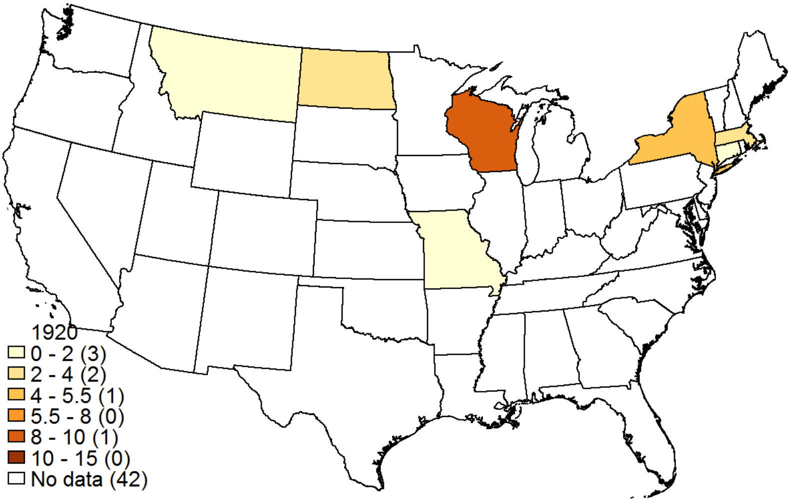


State Top Marginal Corporate Tax Rate: 1920

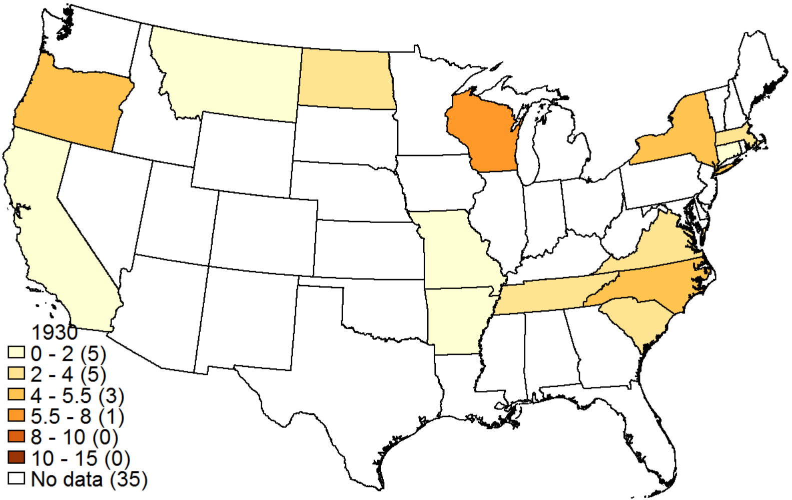
▸ More



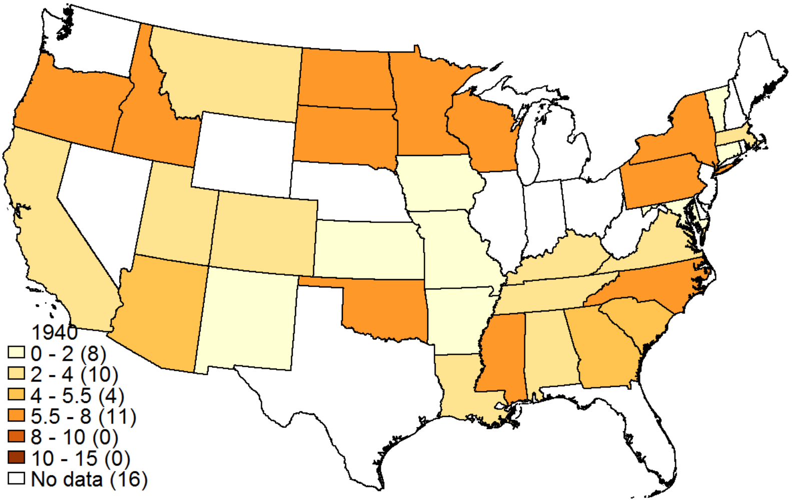
State Top Marginal Corporate Tax Rate: 1920-1930



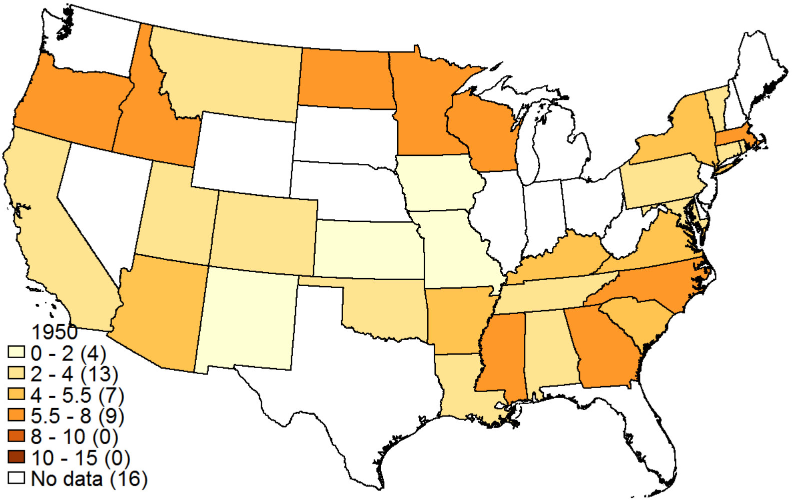
State Top Marginal Corporate Tax Rate: 1930-1940



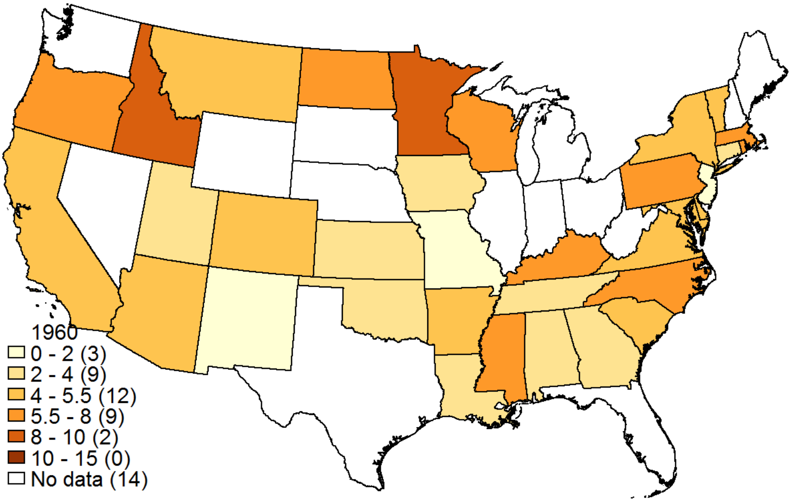
State Top Marginal Corporate Tax Rate: 1940-1950



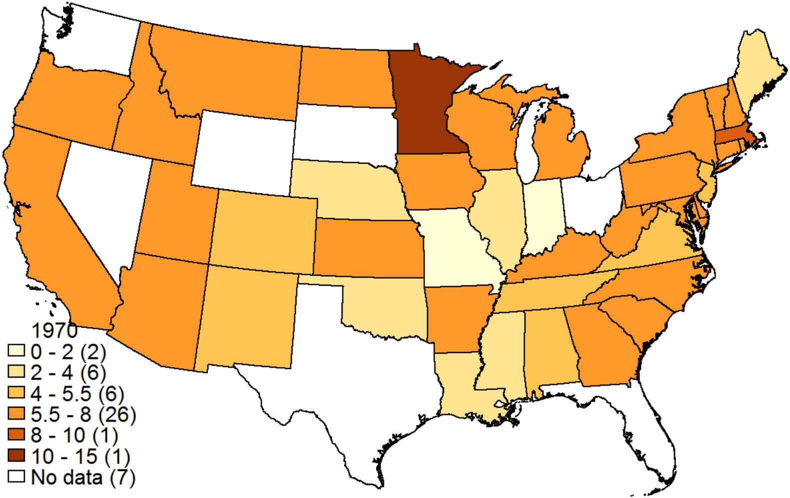
State Top Marginal Corporate Tax Rate: 1950-1960



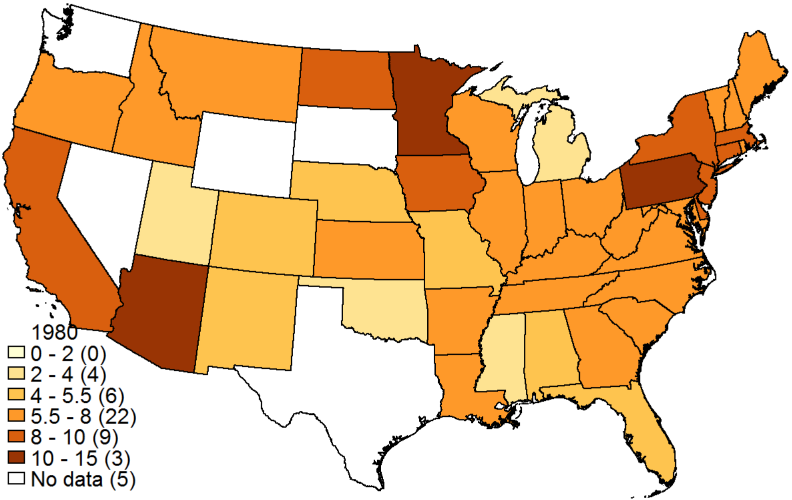
State Top Marginal Corporate Tax Rate: 1960-1970



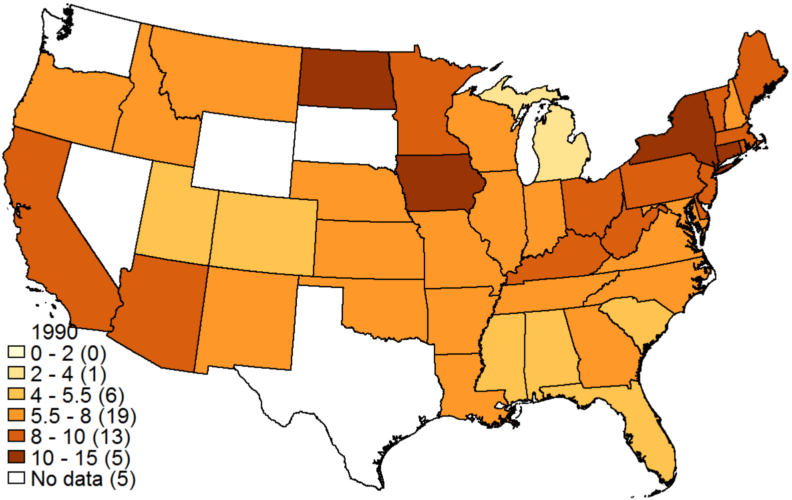
State Top Marginal Corporate Tax Rate: 1970-1980



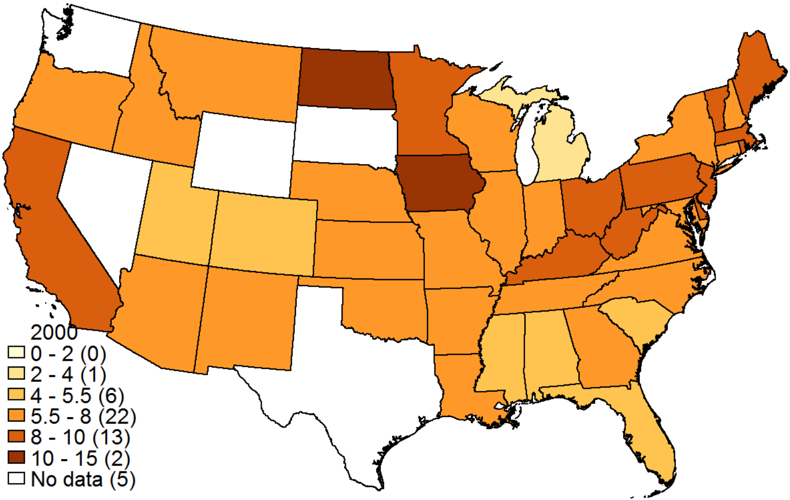
State Top Marginal Corporate Tax Rate: 1980-1990



State Top Marginal Corporate Tax Rate: 1990-2000

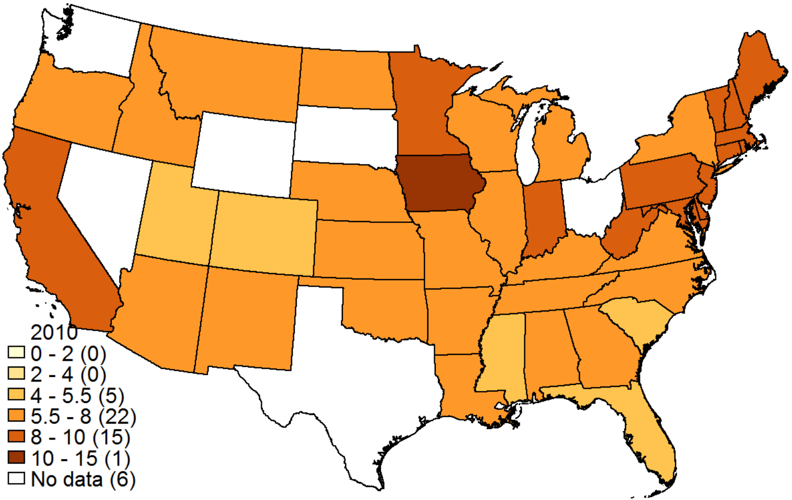


State Top Marginal Corporate Tax Rate: 2000-2010



State Top Marginal Corporate Tax Rate: 2010-2016

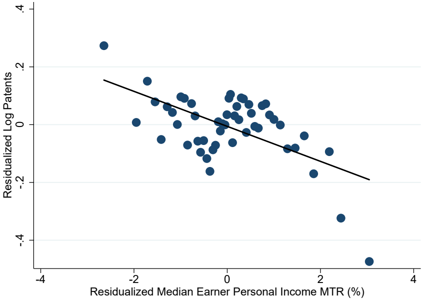
▸ More



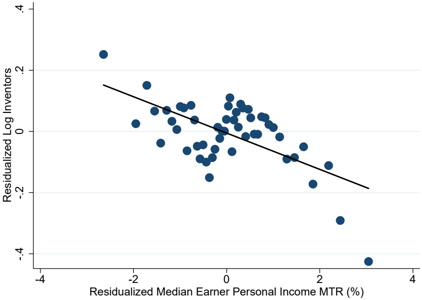
Outline

Macro Effects of Personal Income Taxes 1940-2000

Log Patents & MTR at median

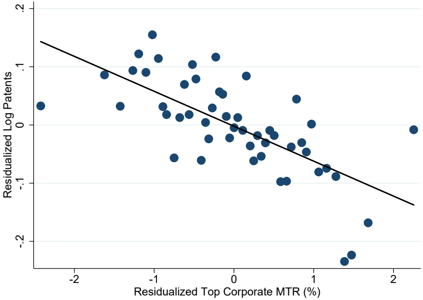


Log Inventors & MTR at median

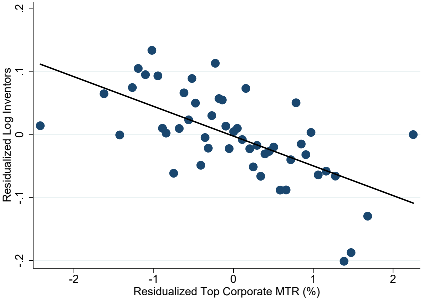


Macro Effects of Corporate Income Taxes 1940-2000

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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	(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

Macro Effects of Taxes 1940-2000: OLS

Panel A: OLS

Dependent Variable:	Log Patents (1)	Log Citations (2)	Log Inventors (3)	Share Assigned (4)
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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***	-0.059***	-0.051***	-1.090***
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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

Outline

Inventors, Firms, and Innovation in the Long Run

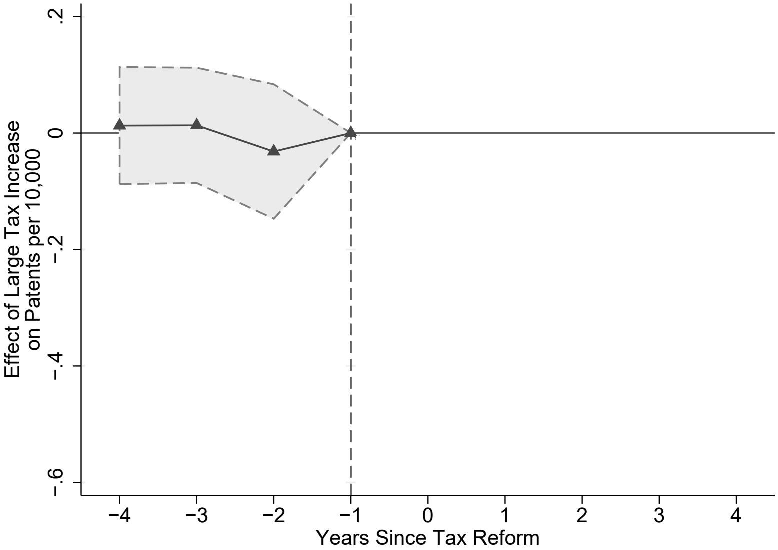
Personal and Corporate Income Taxation in the Long Run

Macro Effects of Taxation

Event and Case Studies

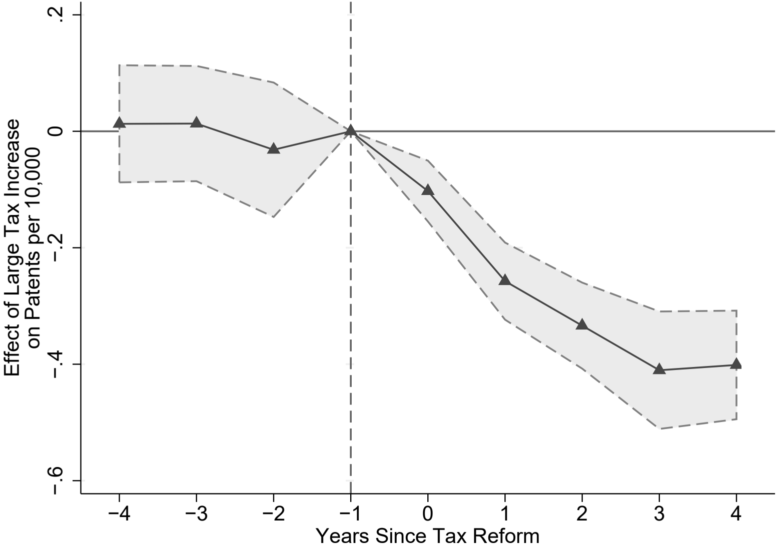
Micro Effects of Taxation

Event Study: Large **Personal** Tax Change on **Patent**



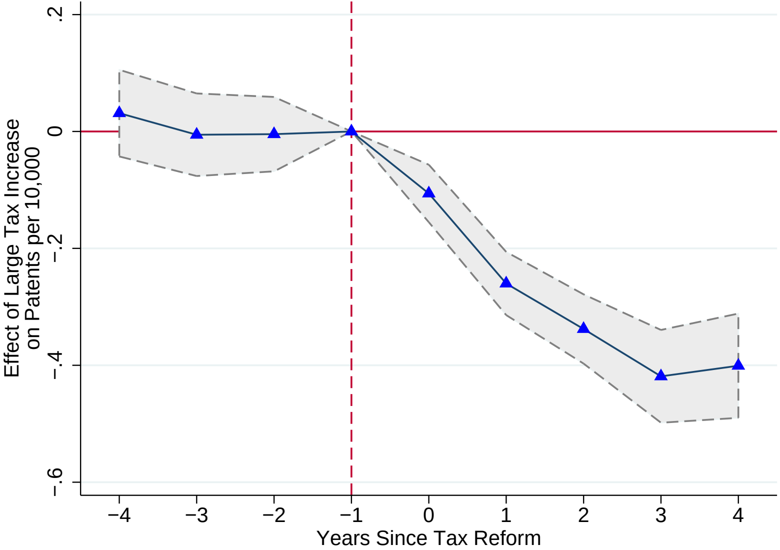
ΔT^y = 6.85 pp increases, 3.6 pp decreases.

Event Study: Large **Personal** Tax Change on **Patent**



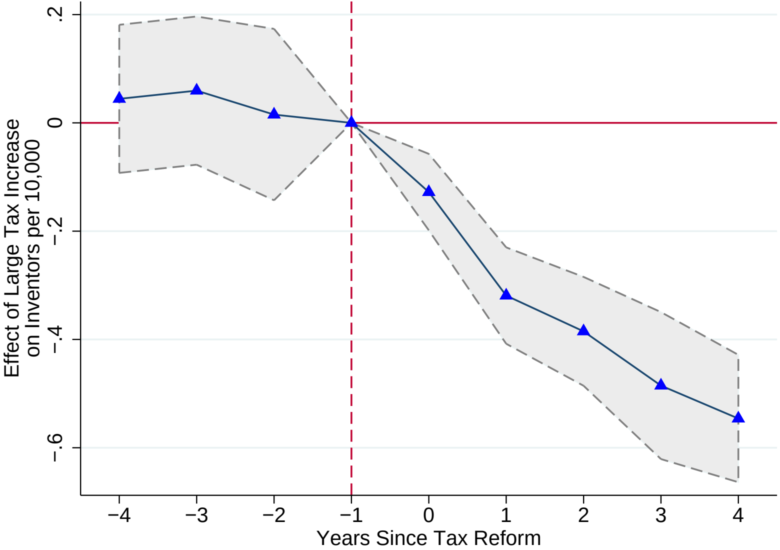
$\Delta T^y = 6.85$ pp increases, 3.6 pp decreases.

Event Study: Large **Corporate** Tax Change on **Patent**



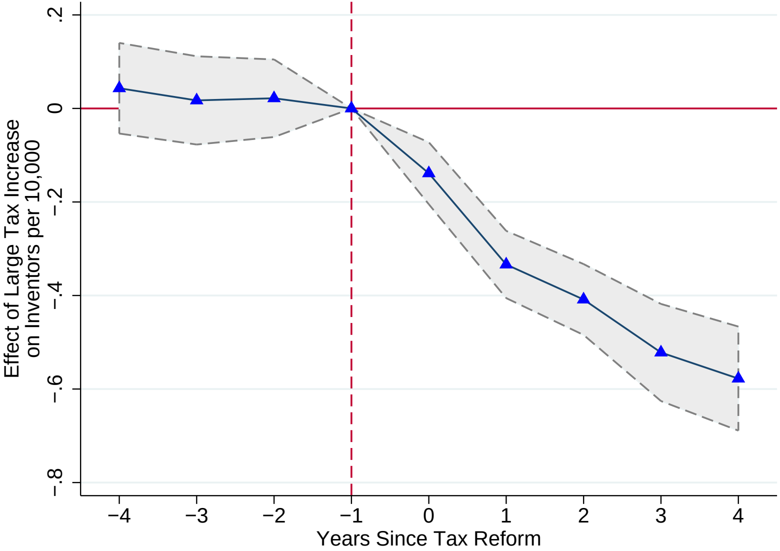
$\Delta T^c = 14.8$ pp increases, 9.3 pp decreases.

Event Study: Large **Personal** Tax Change on **Inventor**

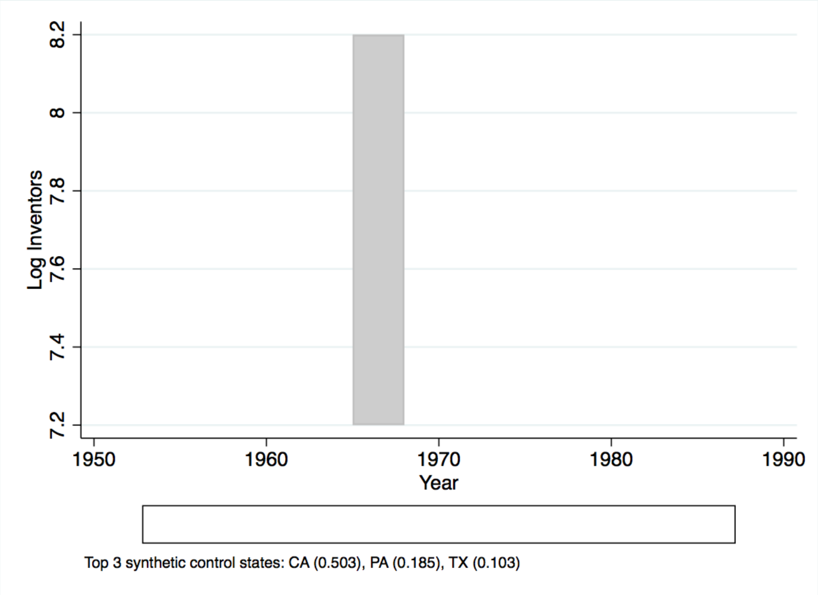


ΔT^y = 6.85 pp increases, 3.6 pp decreases.

Event Study 4: Large **Corporate** Tax Change on **Inventor**

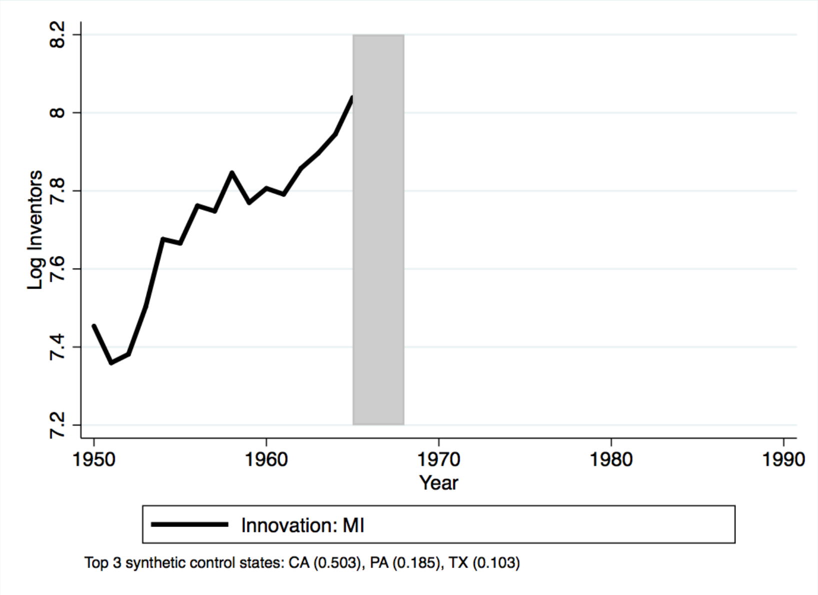


Case Study 1A. Michigan 1967-1968: Inventors



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

Case Study 1A. Michigan 1967-1968: Inventors



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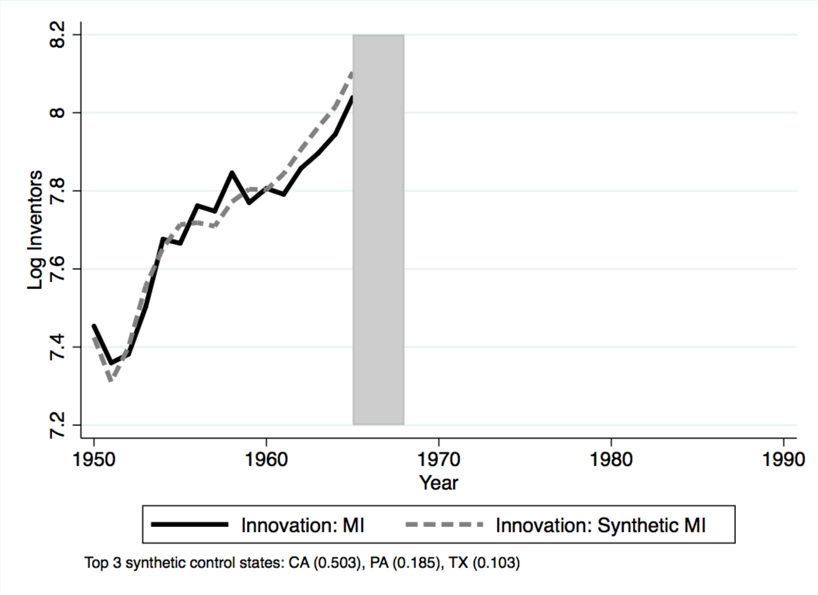
Case Study 1A. Michigan 1967-1968: Inventors



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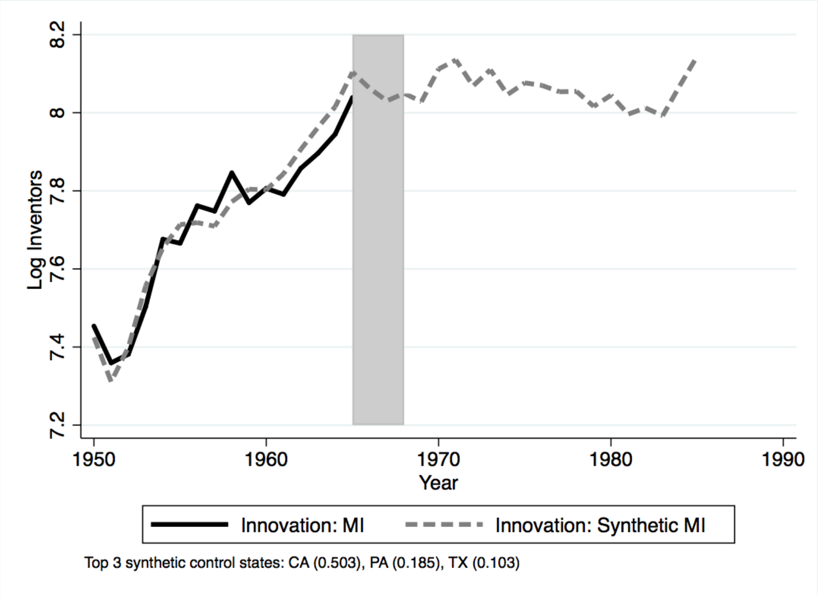
Case Study 1A. Michigan 1967-1968: Inventors



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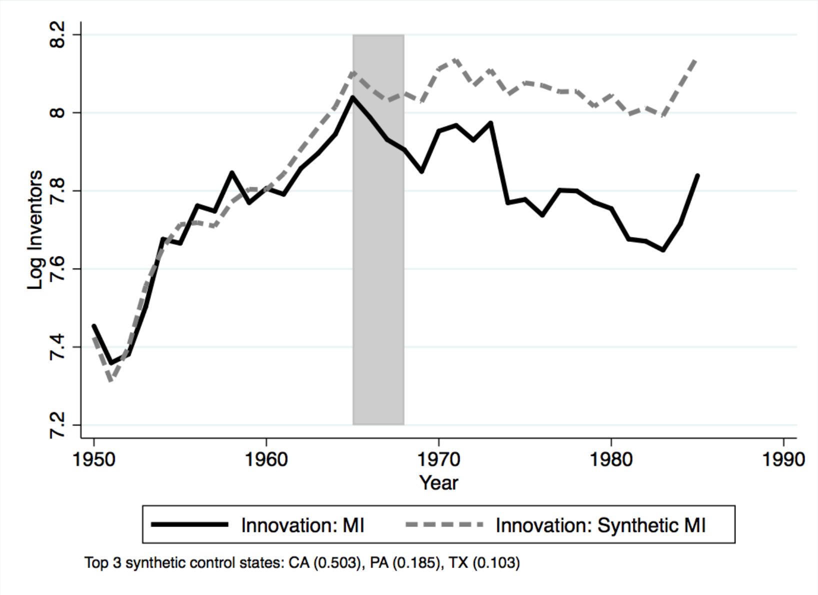
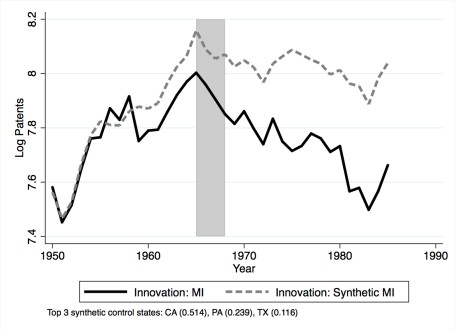
Case Study 1A. Michigan 1967-1968: Inventors



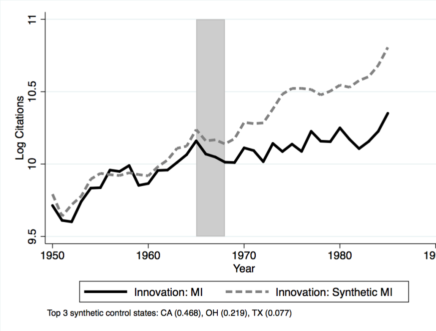
1967: intro of pers. tax at 2.6%; 1968: intro of corp. tax at 5.6%.

Case Study 1B. Michigan 1967-1968: Patents and Citations

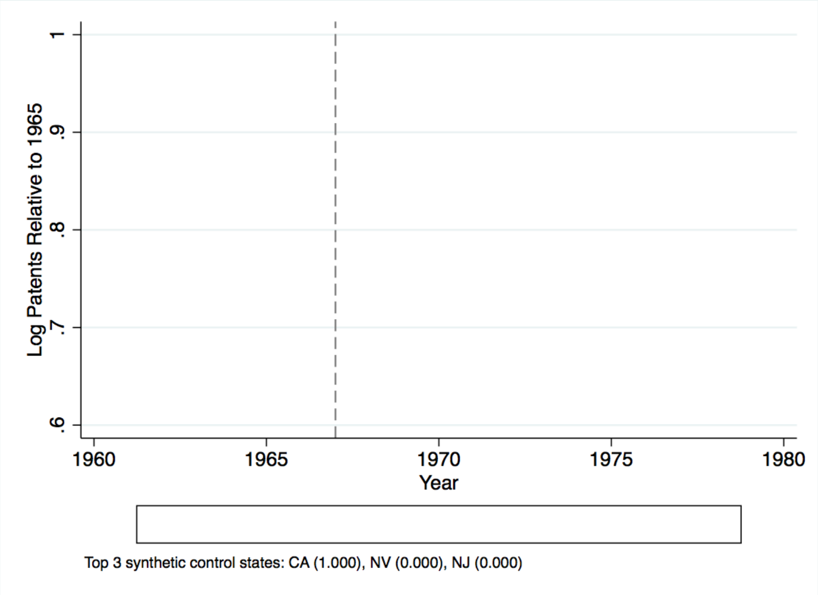
Patents



Citations

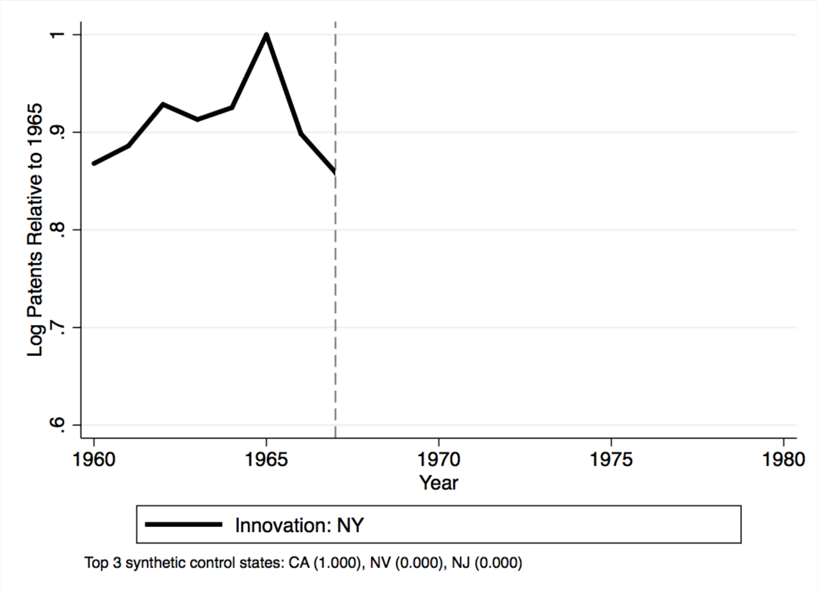


Case Study 2A. New York 1968: Patents



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

Case Study 2A. New York 1968: Patents



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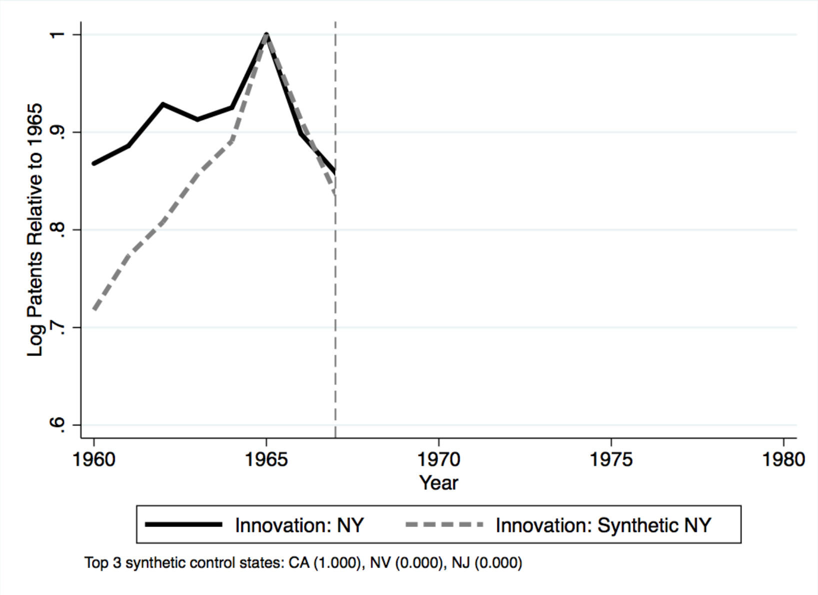

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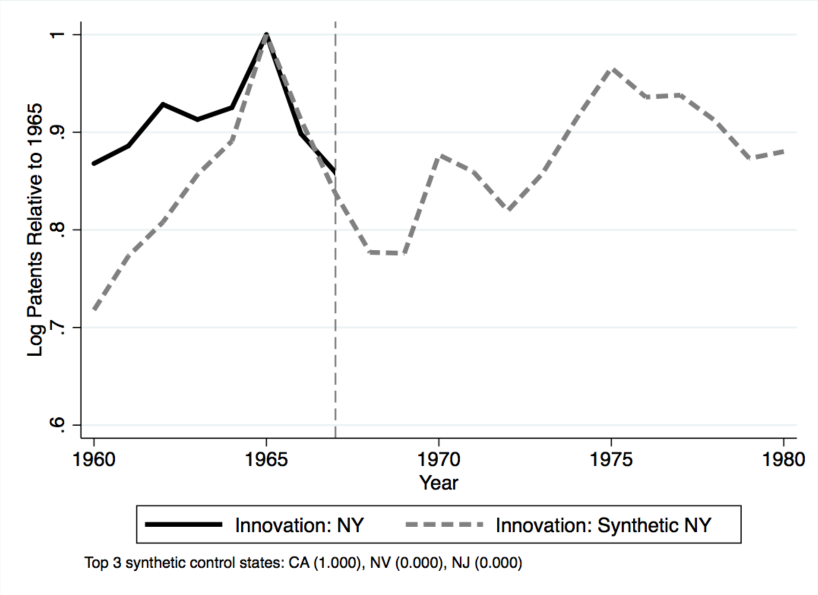
Case Study 2A. New York 1968: Patents



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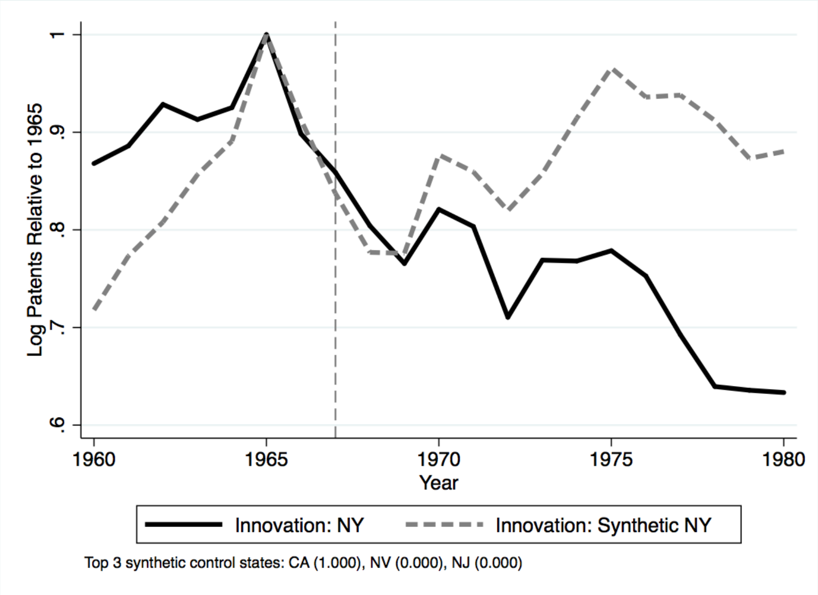
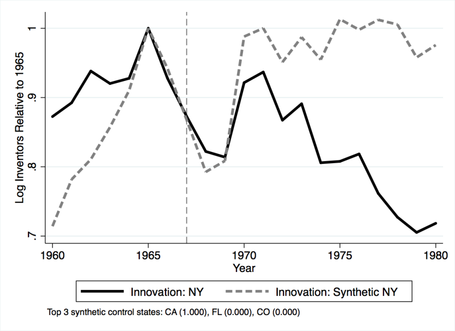
Case Study 2A. New York 1968: Patents



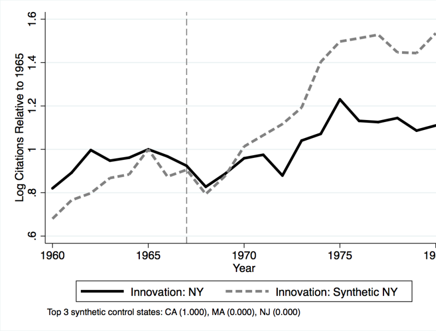
1968: pers. tax 10% ↑ 14%; corp tax 5.5% ↑ 7%.

Case Study 2B. New York 1968: Inventors and Citations

Inventors



Citations



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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.

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 $\times$ 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

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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
Inventor FE	Y	Y	Y	Y	Y
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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

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Year FE	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y

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	(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) (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***	-0.620***	-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

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Location Choice Model

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

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

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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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- 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.

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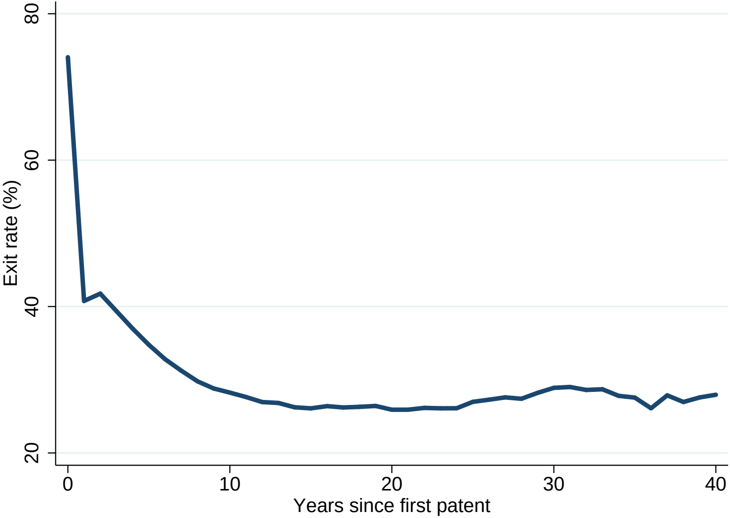
Conclusion

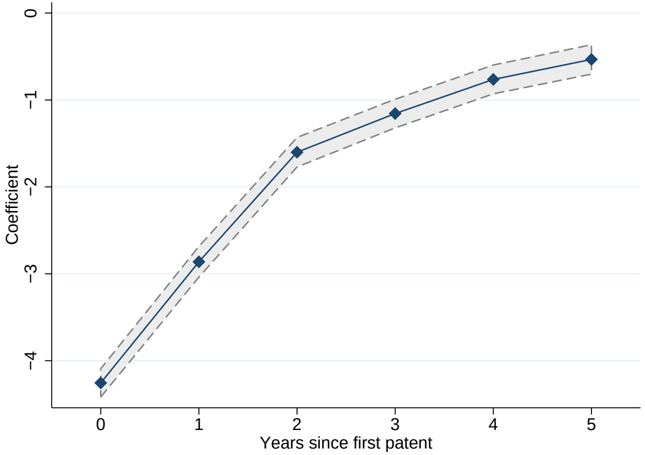
- Taxes matter for innovation.
  - At the macro and micro levels (individual firm and inventor level).
  - Quantity, quality, and location choices are affected.
- Identification based on exploiting different taxes within state-year cells (individual tax brackets for the personal income tax), IV using 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

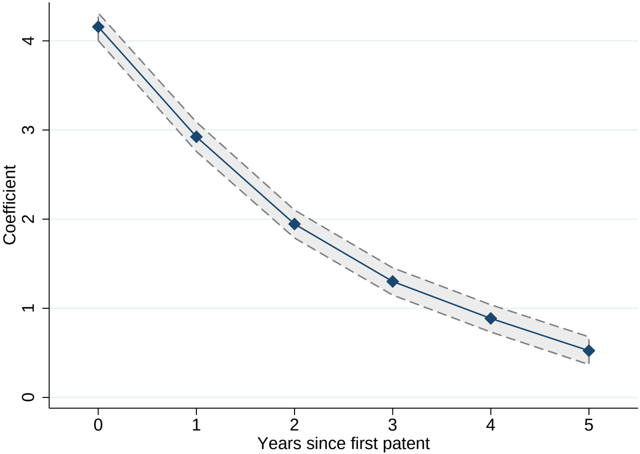


Probability of Low Quality Patent Throughout Career



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

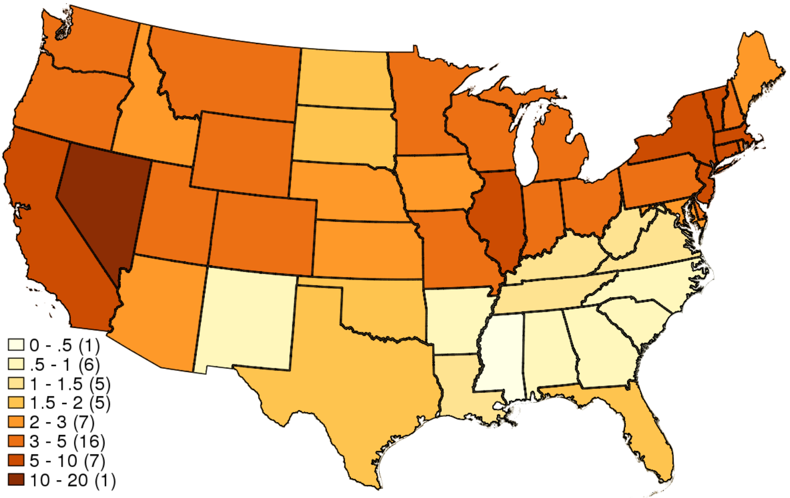
Probability of High Quality Patent Throughout Career



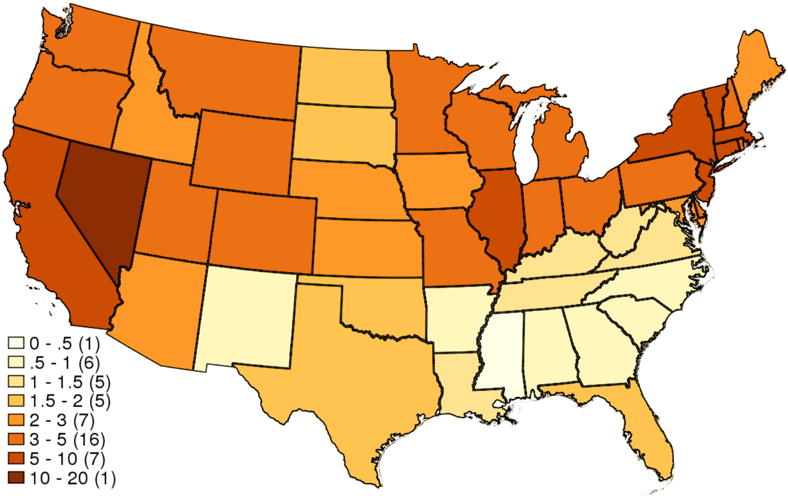
Plots regression coefficients from a patent level regression of **1**{Patent in 4^{th} quartile of citations} on inventor fixed effects, technology class × year fixed effects, and year of career effects.: 6+ years into career.

Geography of innovation. Patents per 10,000: 1920

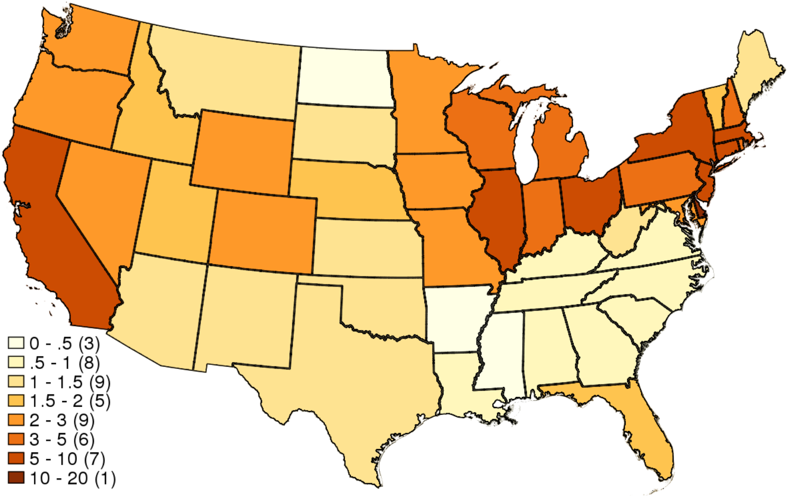
▸ Back



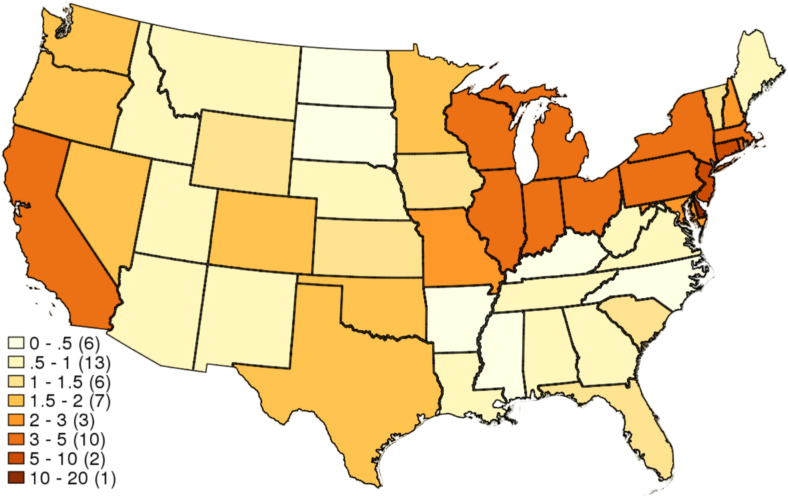
Geography of innovation. Patents per 10,000: 1920-1930



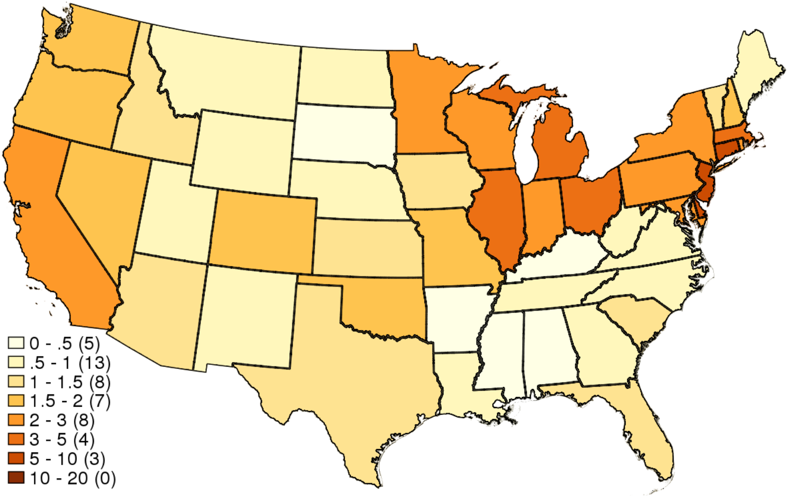
Geography of innovation. Patents per 10,000: 1930-1940



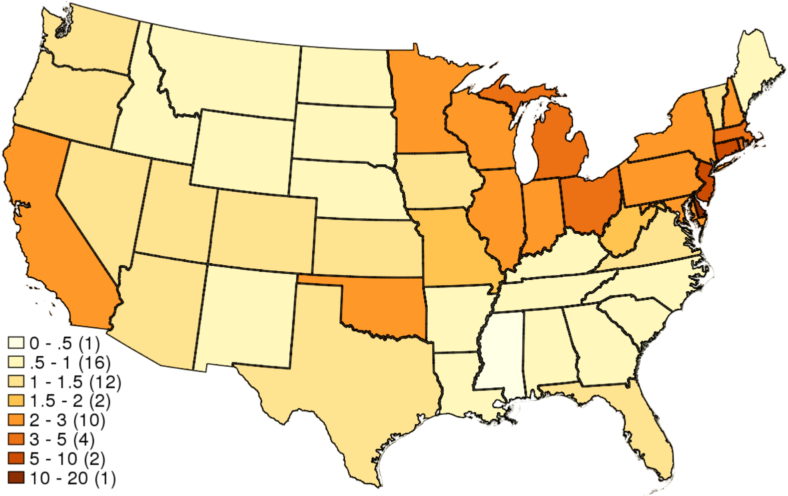
Geography of innovation. Patents per 10,000: 1940-1950



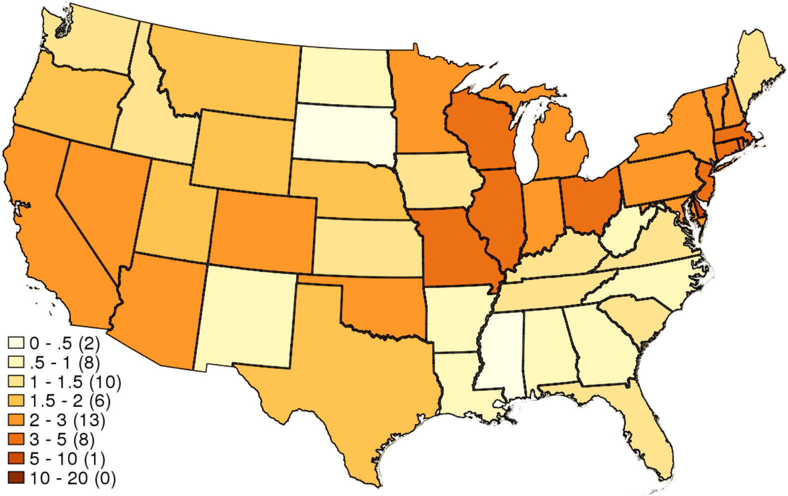
Geography of innovation. Patents per 10,000: 1950-1960



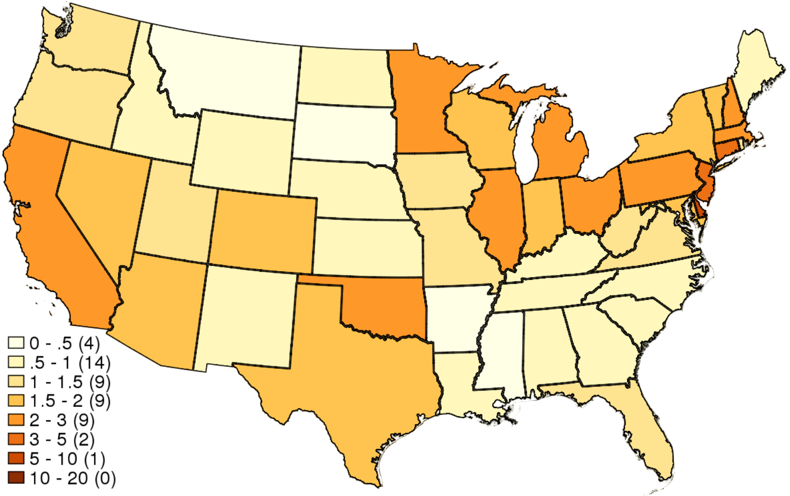
Geography of innovation. Patents per 10,000: 1960-1970



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

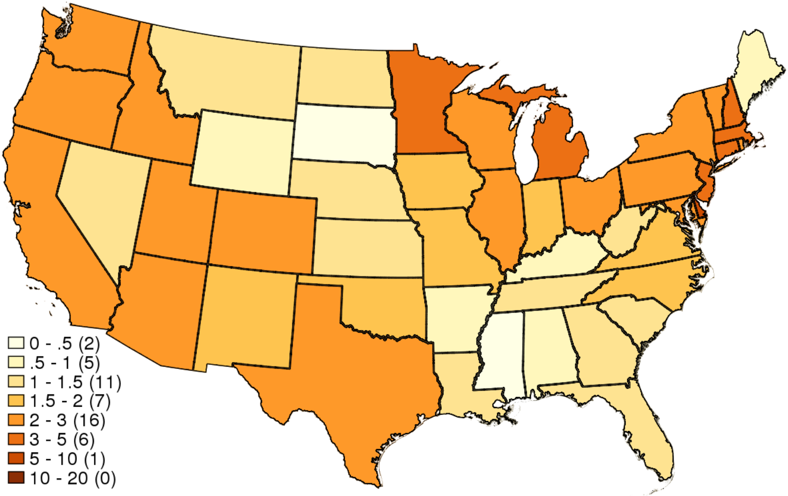


Geography of innovation. Patents per 10,000: 1980-1990

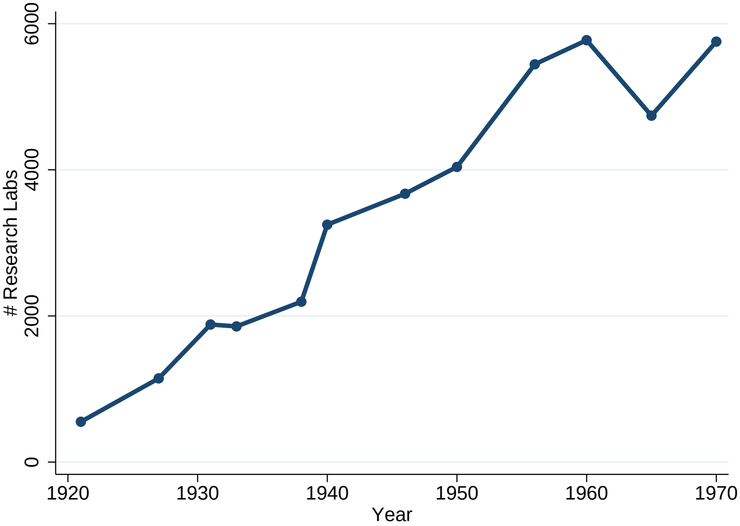


Geography of innovation. Patents per 10,000: 1990-2000

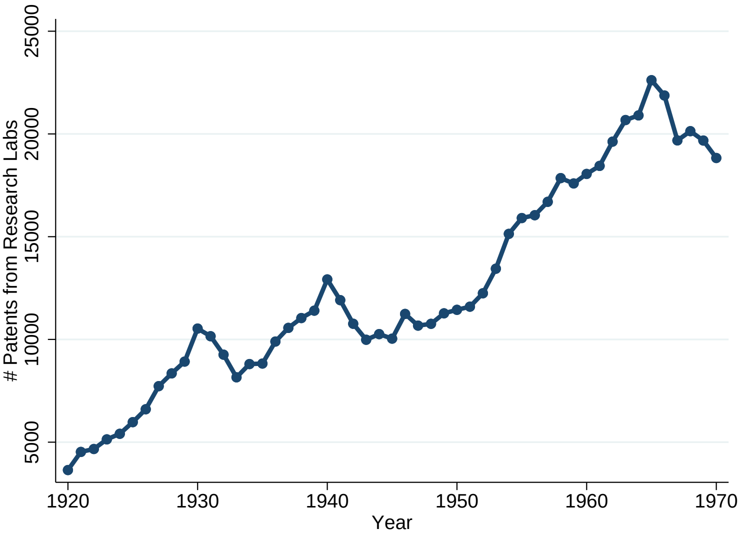
▸ Back



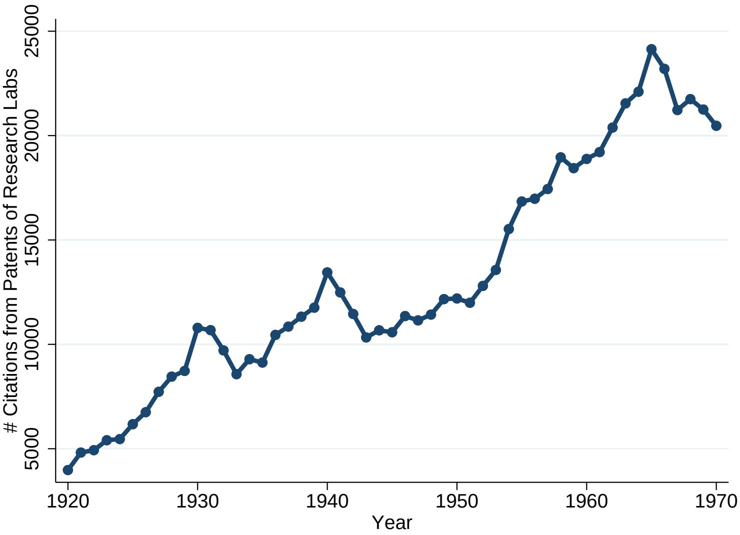
Number of R&D Labs



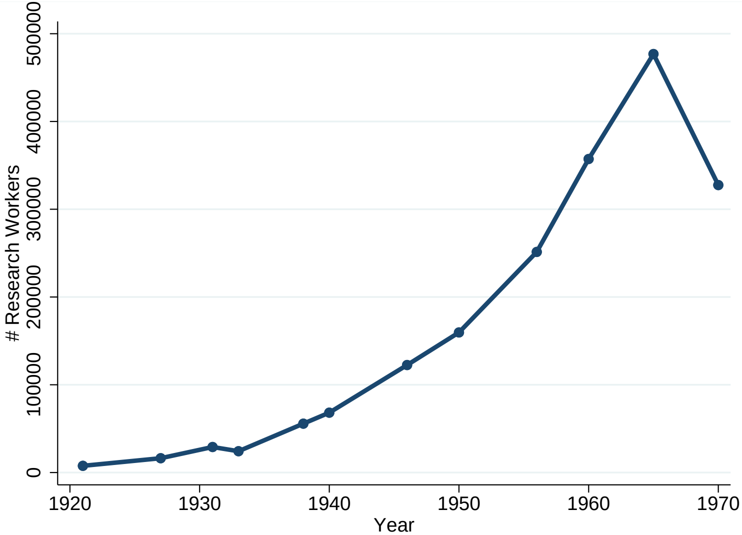
R&D Labs: Total Patents



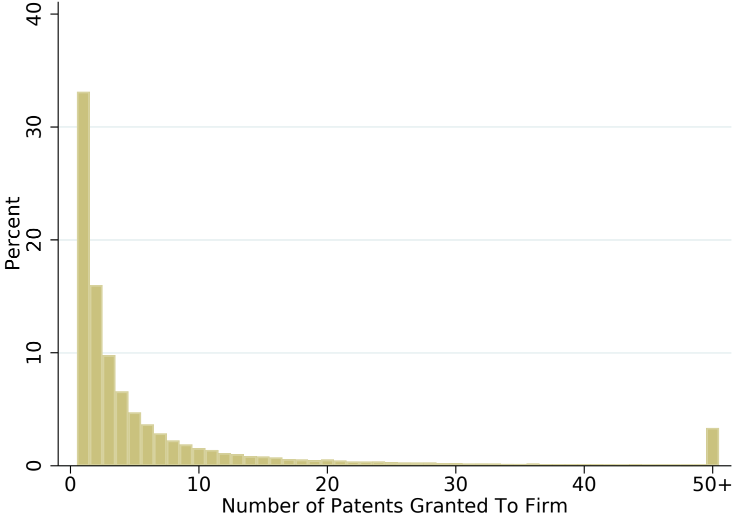
R&D Labs: Total Citations



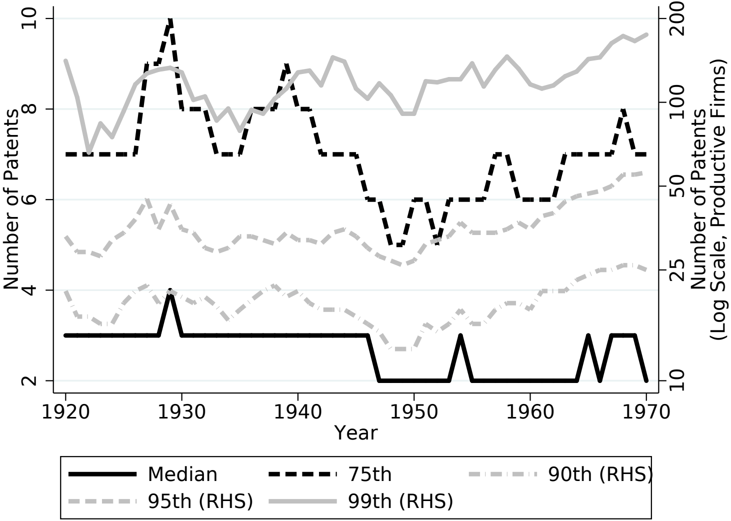
R&D Labs: Total Research Workers



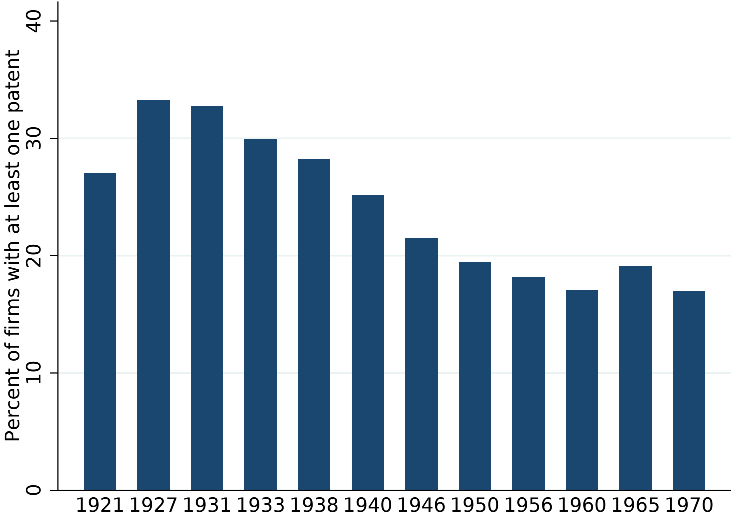
Distribution of Patents per Firm-Year (Conditional on > 0



Distribution of Firm Patents over Time

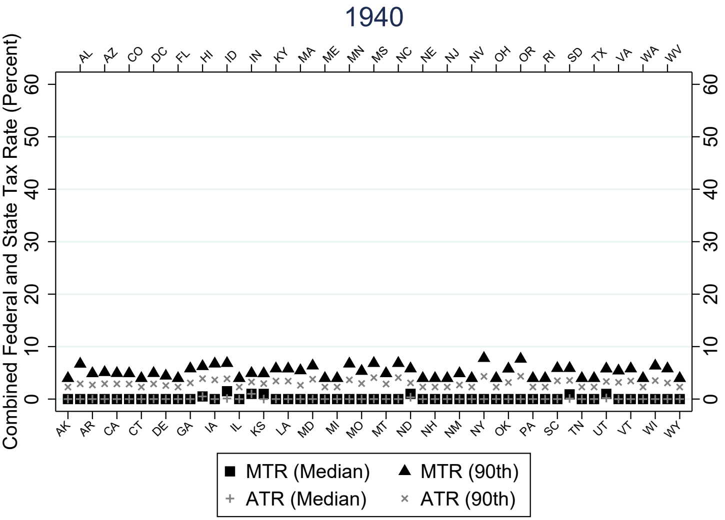


Share of Firms with Patent over Time



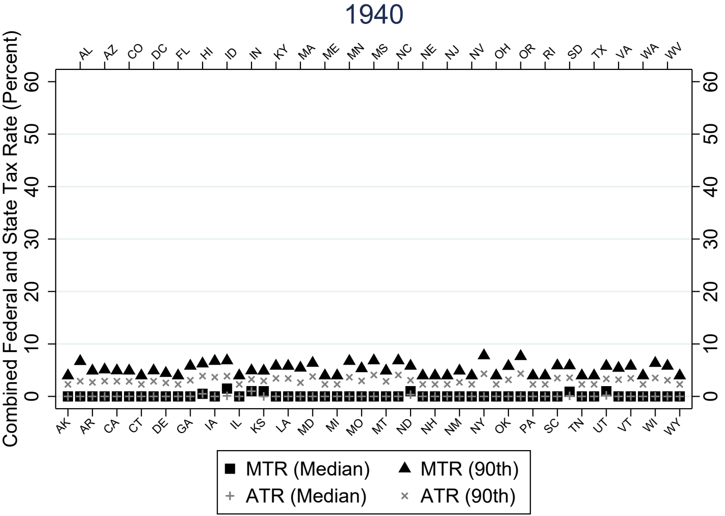
◂ Workers Per Lab

State Tax Rate Distributions: Effective incl. Federal

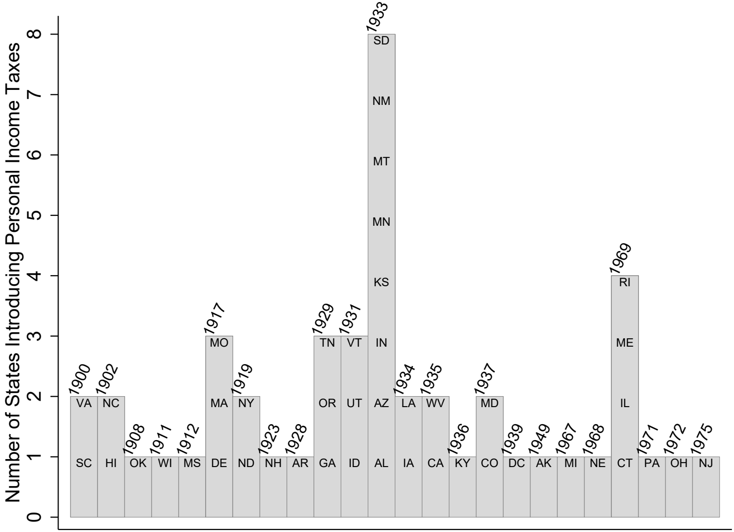


State Tax Rate Distributions: Effective incl. Federal

Historic Distribution

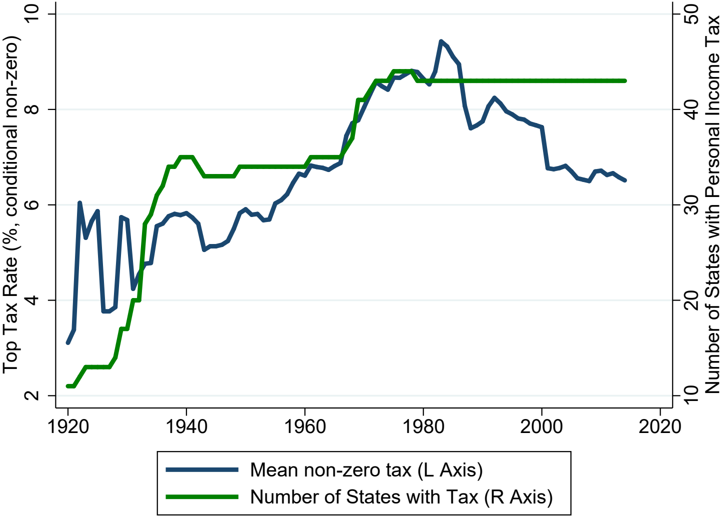


Introduction of State Personal Income Taxes



Before the 1940s, often affects mostly very high earners. ▸ Back to Main

Intensive vs Extensive Margin of Personal Income Taxation



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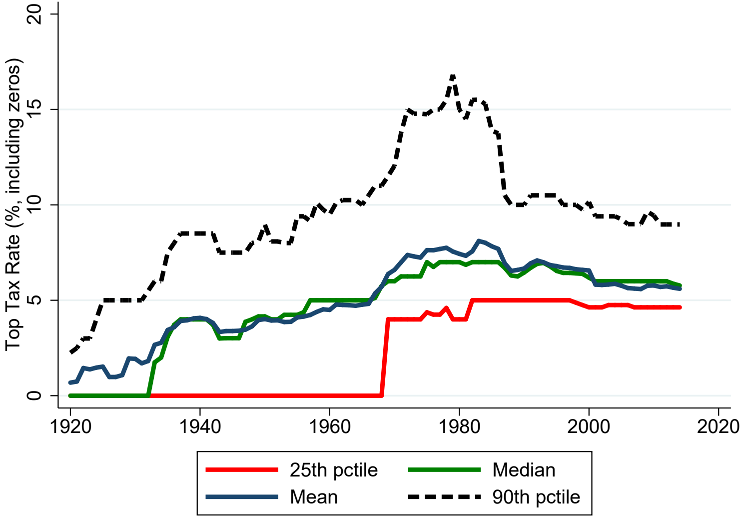
Distribution of Top Personal Income Tax Rates (incl. 0s)



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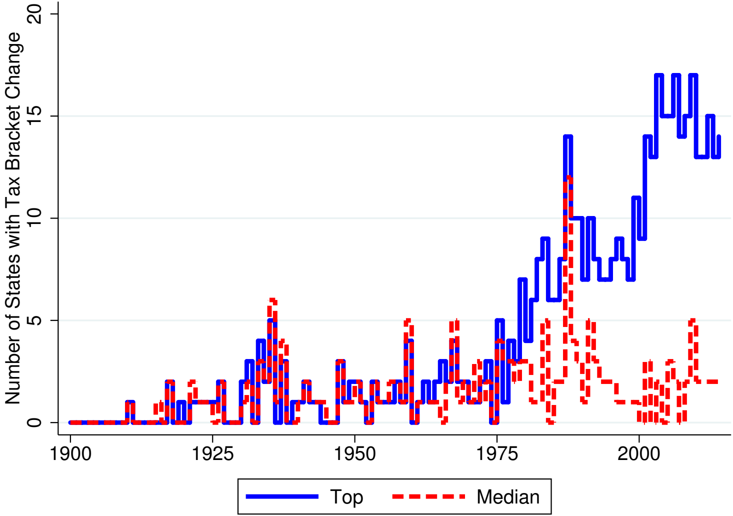
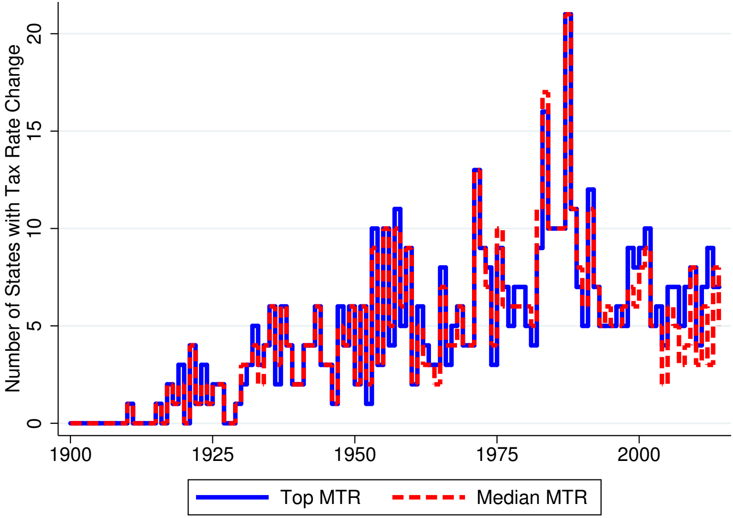
Number of State Tax Bracket Changes



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

Number of State Tax Rate Changes



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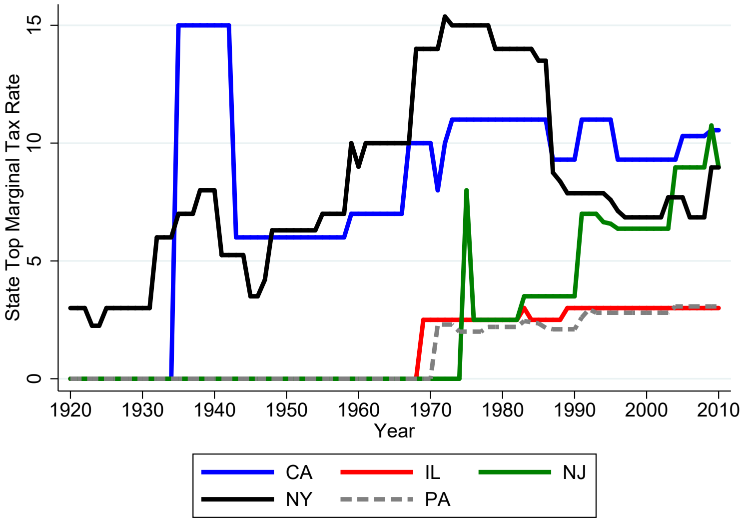
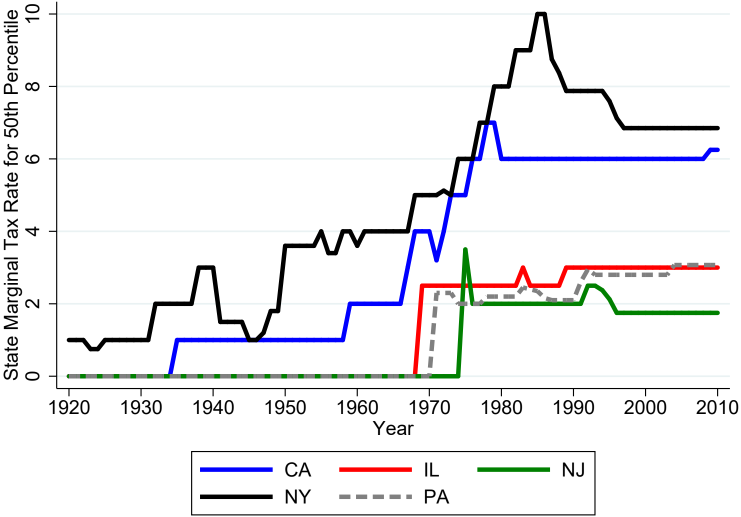
Top MTR in Selected States over Time



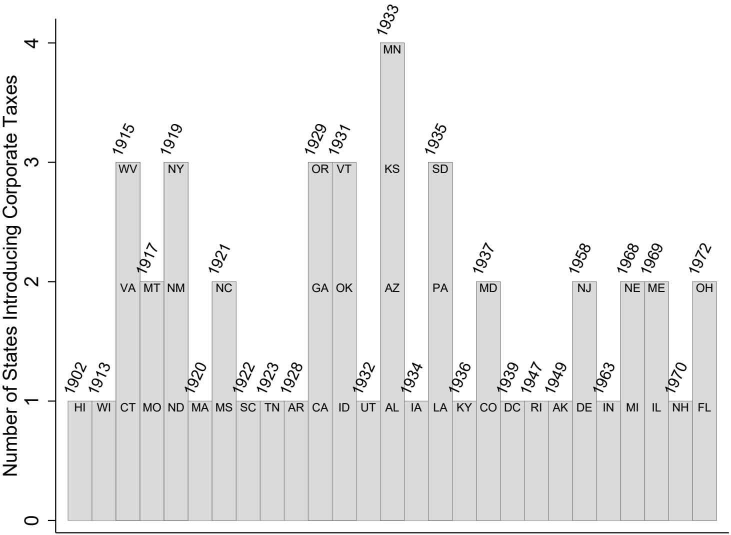
▸ Back to Main

MTR at Median Income in Selected States over Time

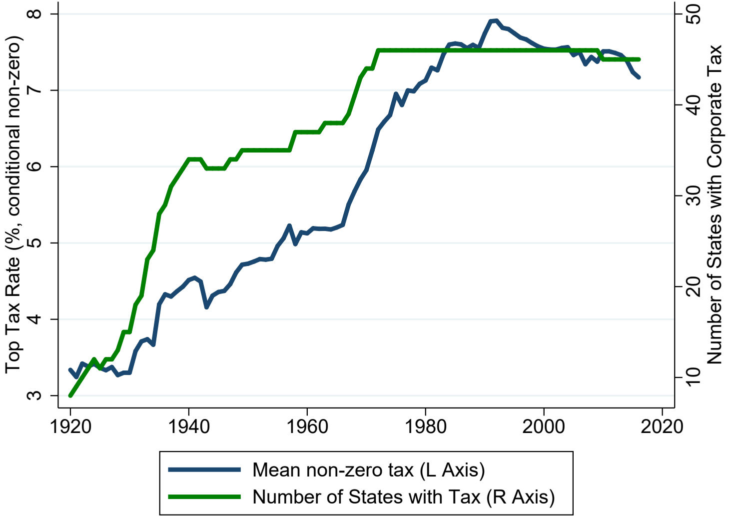


Back to Main

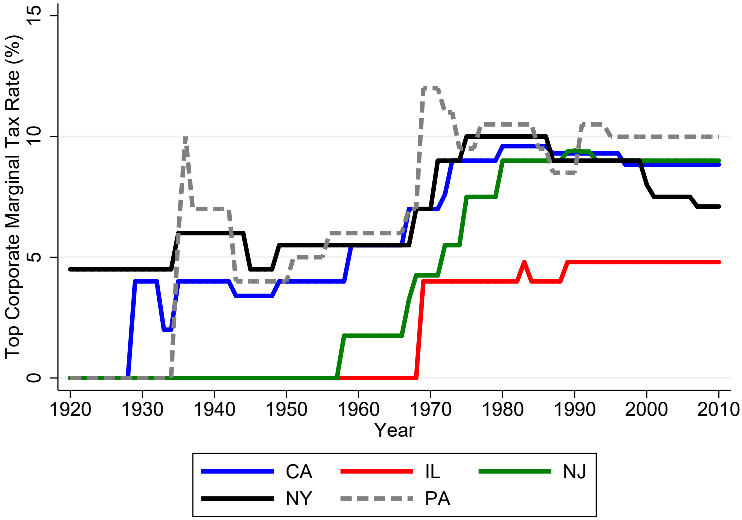
Introduction of State Corporate Taxes



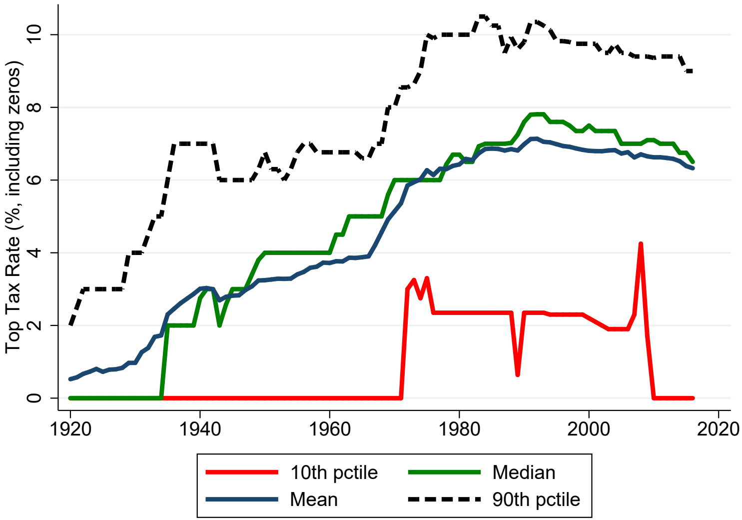
States with a Corporate Tax and Mean Level Over time



Time Series of Key States Top Corporate Tax



Distribution of Top Corporate Tax Rates (including 0s)



◂ Back

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),

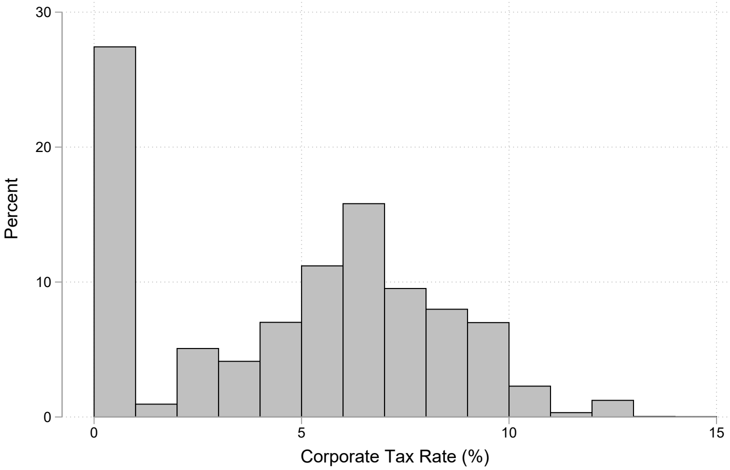
Some states have statutes that make direct taxes unconstitutional. Franchise taxes get around this.

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

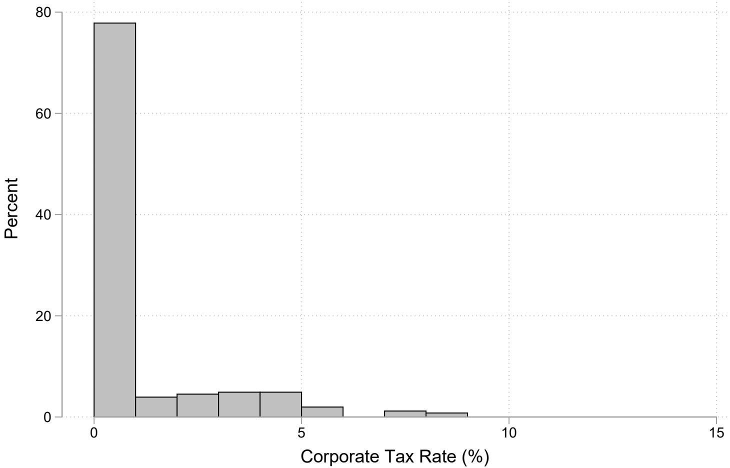
Type of franchise taxes:

- Net income
- Business Enterprise tax (NH, tax on income).

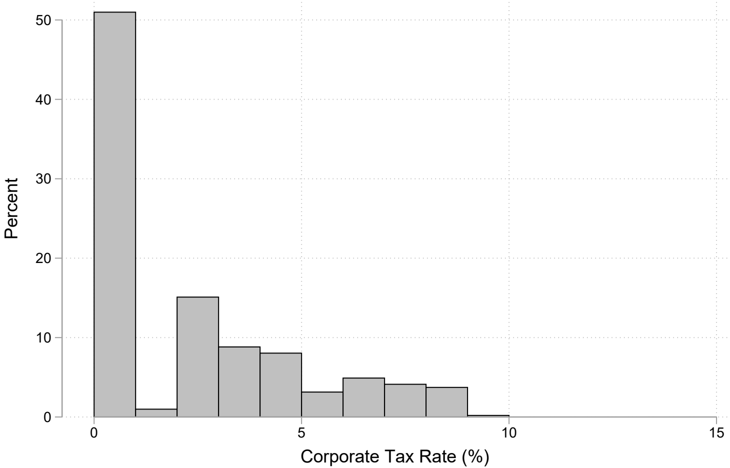
State Corporate Tax Distribution: 1920-2016



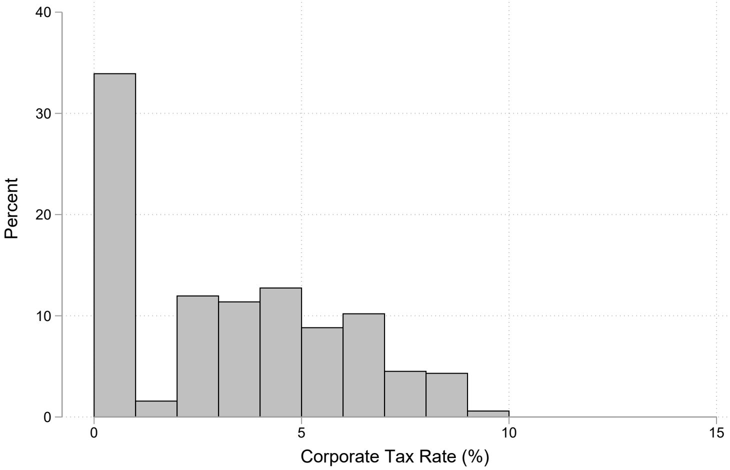
State Corporate Tax Distribution: 1920s



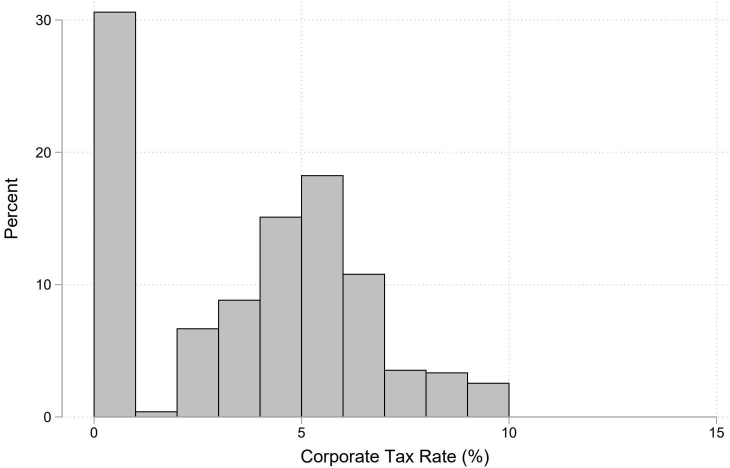
State Corporate Tax Distribution: 1930s



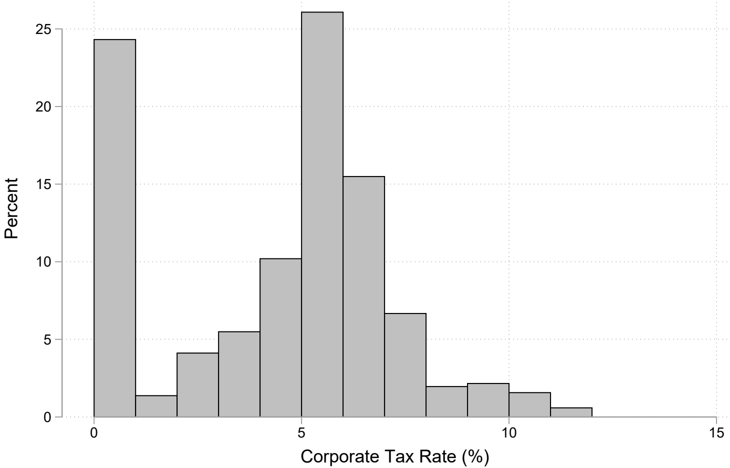
State Corporate Tax Distribution: 1940s



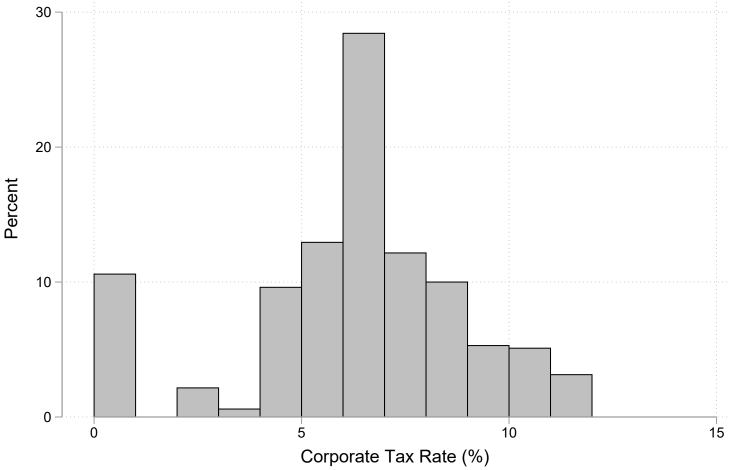
State Corporate Tax Distribution: 1950s



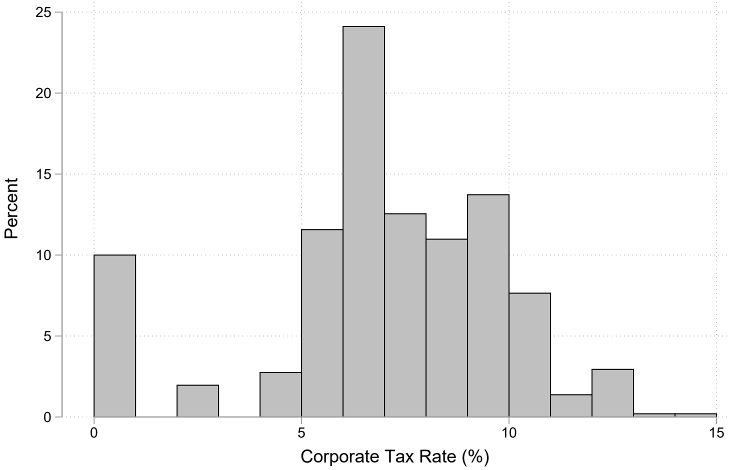
State Corporate Tax Distribution: 1960s



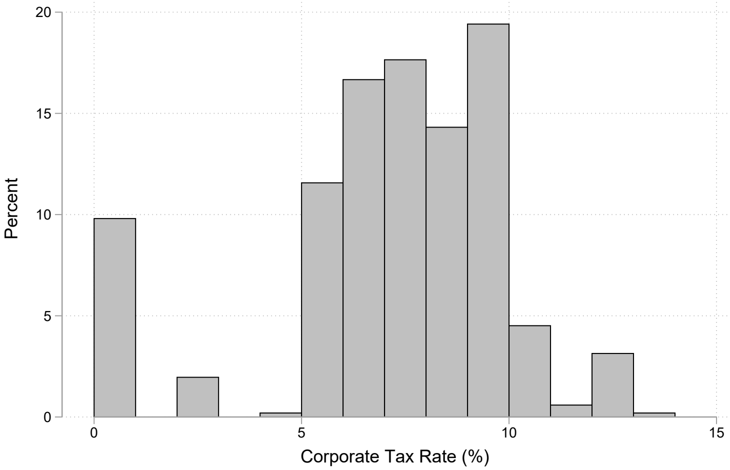
State Corporate Tax Distribution: 1970s



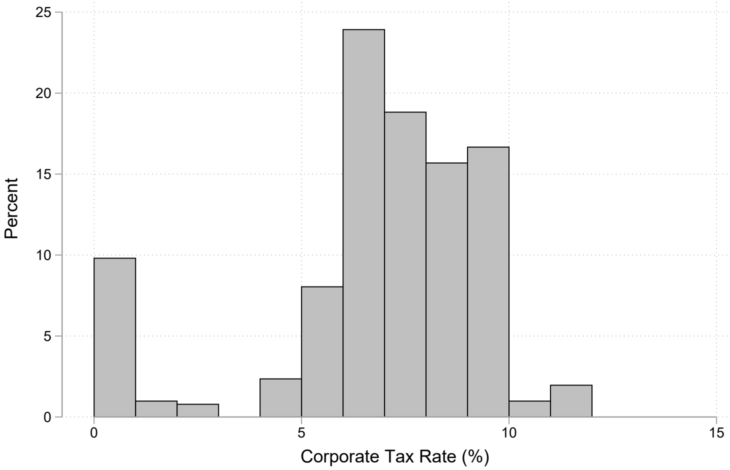
State Corporate Tax Distribution: 1980s



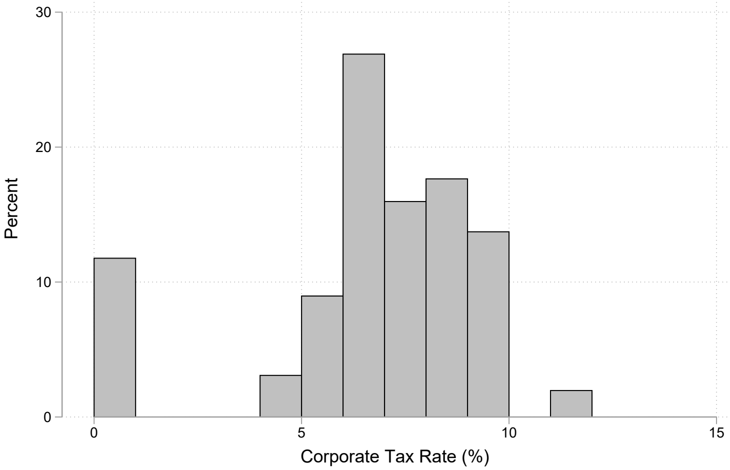
State Corporate Tax Distribution: 1990s



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

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

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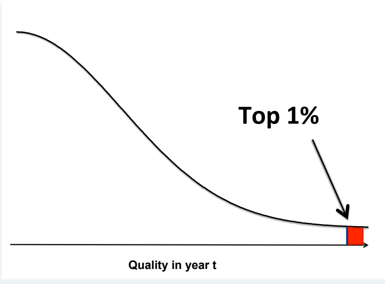

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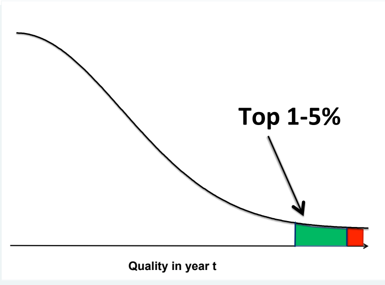

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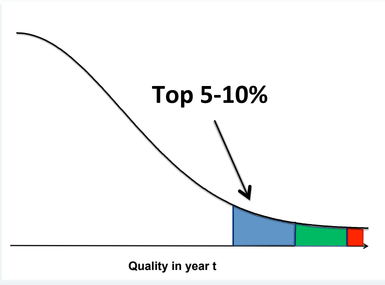

Inventor Quality Measures and Ranking ▸ M

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1. Citations-weighted patents
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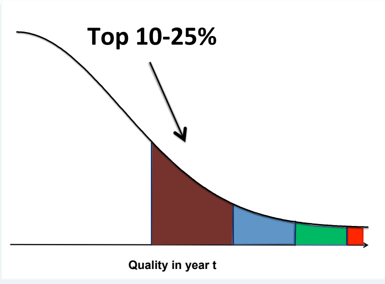
Inventor Ranking National level (robustness: state-level).



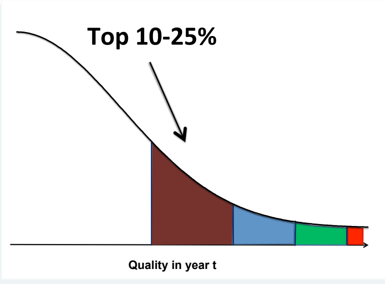
Inventor Quality Measures and Ranking ▸ M

Quality measures (dynamic and lagged)

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

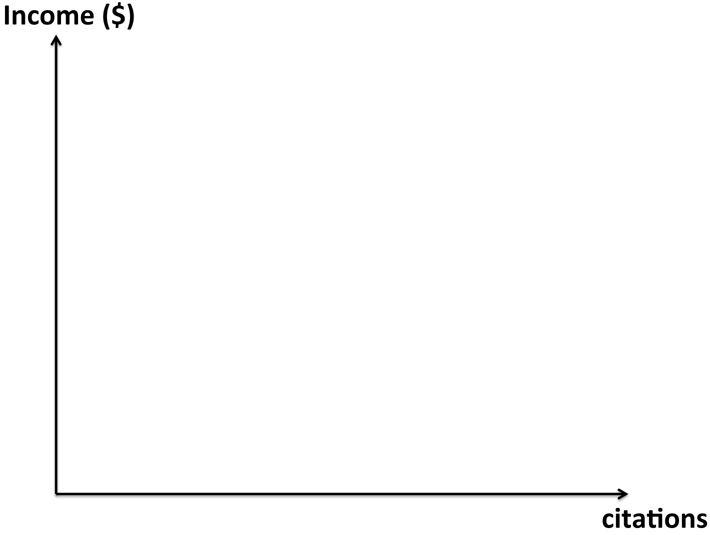
→ Dynamic, Persistent, Life-time ranking

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



Link between Inventor Quality and Income in IRS data

▸ M



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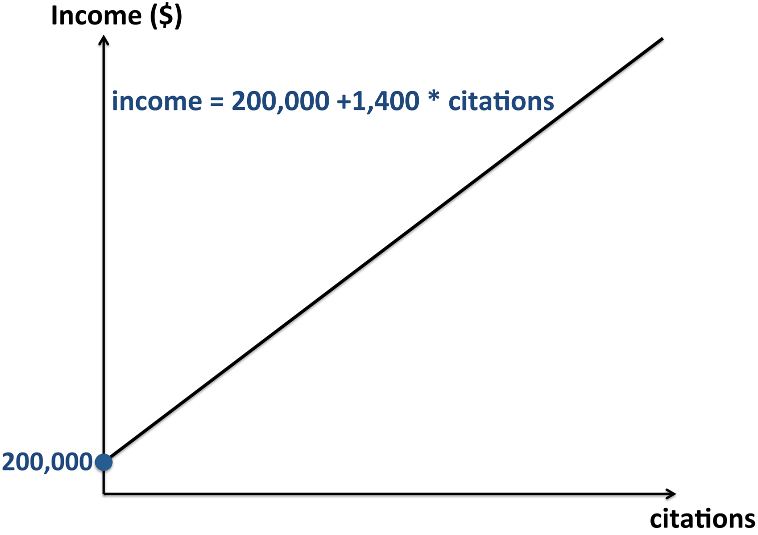

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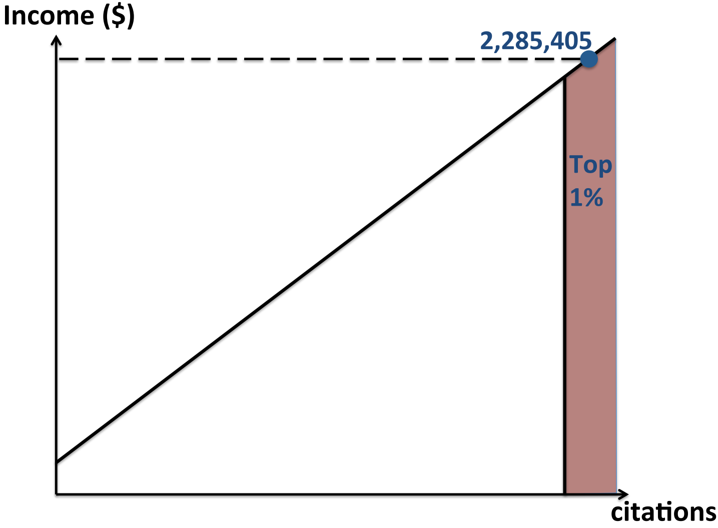

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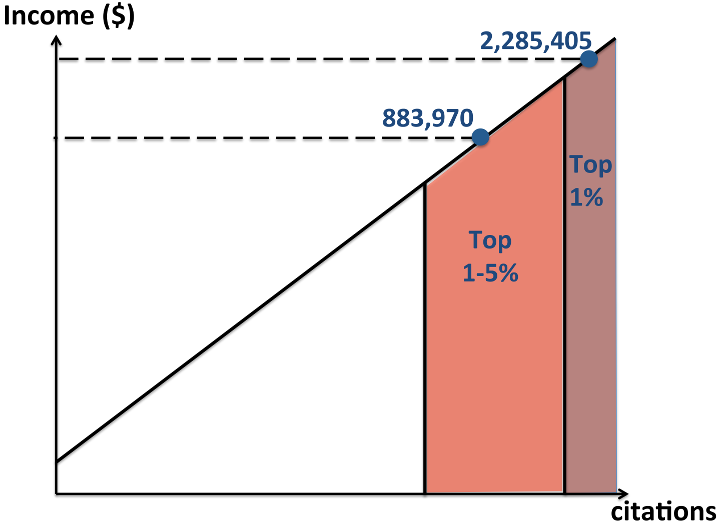

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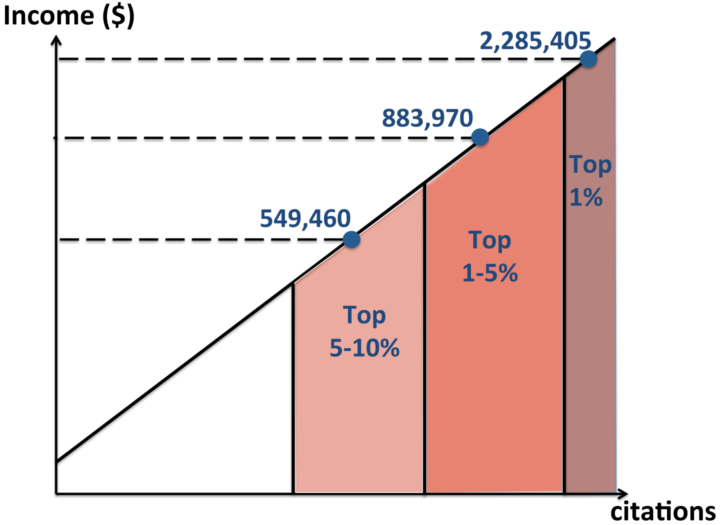

Link between Inventor Quality and Income in IRS data

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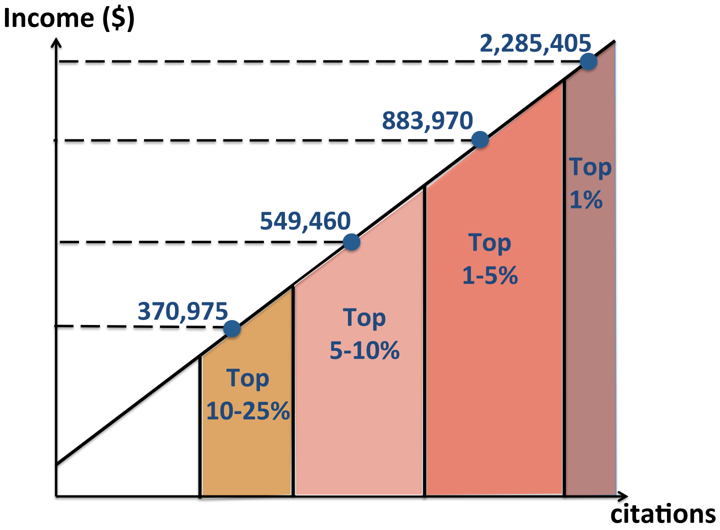
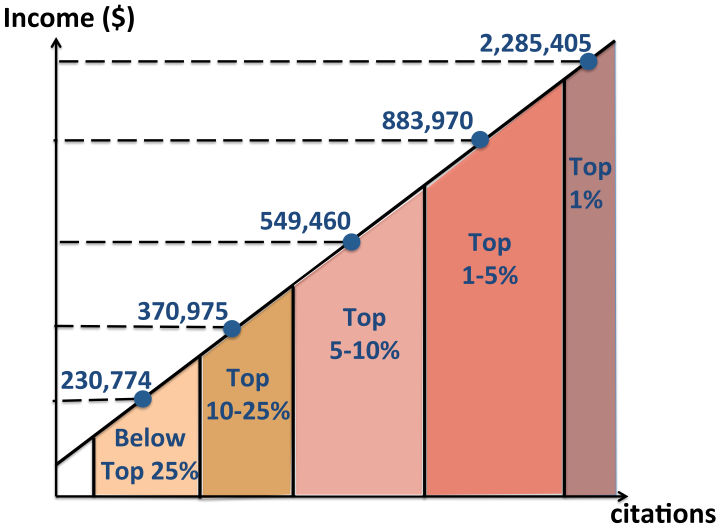
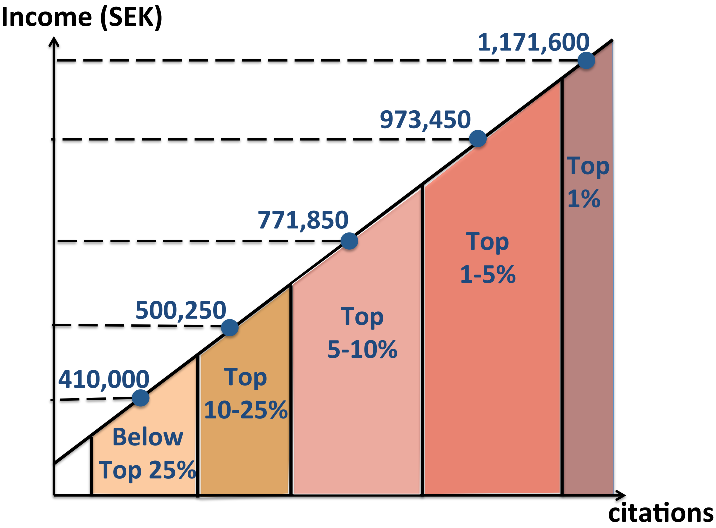


Link between Inventor Quality and Income in IRS data

▸ M



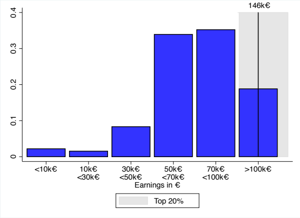
Link between Inventor Quality and Income in Swedish and Finnish Admin data ‣ M



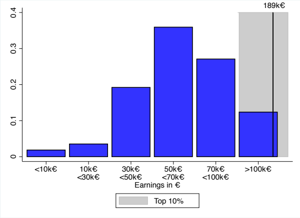
Source: Olof Ejermo and Otto Toivaannen.

Survey Income Distributions + Link Quality-Income

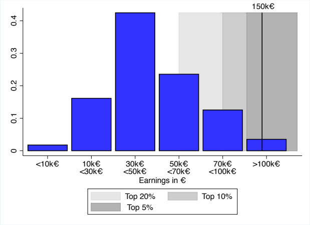
▸ M



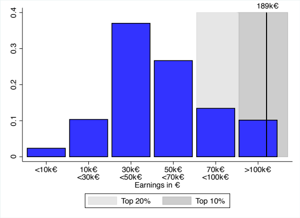
(a) Switzerland



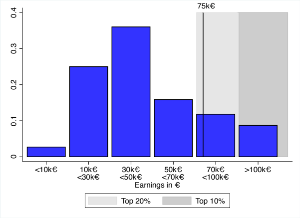
(b) Germany



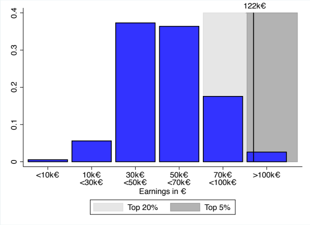
(c) France



(d) Great Britain



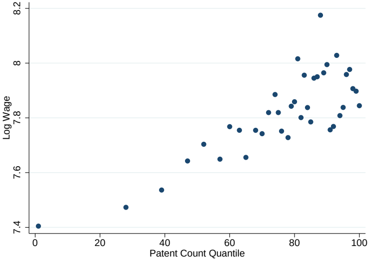
(e) Italy



(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)	Share Assigned (5)
Effective MTR	-0.865***	-0.817***	-0.015***	-0.022***	-0.195***
	(0.029)	(0.029)	(0.001)	(0.001)	(0.019)
Top Corporate MTR	0.001	-0.021	-0.001*	-0.001	-0.015
	(0.044)	(0.042)	(0.001)	(0.001)	(0.030)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Effective MTR	-0.781***	-0.773***	-0.015***	-0.021***	-0.177***
	(0.027)	(0.027)	(0.001)	(0.001)	(0.018)
Top Corporate MTR	0.041	0.023	-0.000	-0.001	0.034
	(0.046)	(0.045)	(0.001)	(0.002)	(0.031)
State FE	Y	Y	Y	Y	Y
State Trends	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Inventor FE	Y	Y	Y	Y	Y
Observations	5956315	5956315	4545384	4392312	4545384
Mean of Dep. Var.	76.312	45.079	0.442	2.758	79.377
S.D. of Dep. Var.	42.517	49.757	0.664	1.453	39.747

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

Inequality and Innovation

Lecture Slides 3: Social Origins of Inventors[1]

Ufuk Akcigit
University of Chicago

January 7, 2019

[1] Based on Aghion, Akcigit, Hyytinen, Toivanen (2018)

Motivation

- Who becomes an inventor? Does innovation attract the most talented individuals or is there misallocation of talents into innovation?
- The data shows some striking patterns:

Motivation

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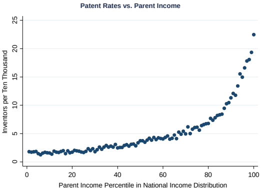
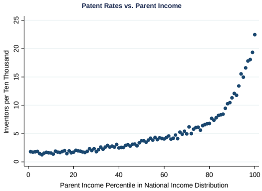


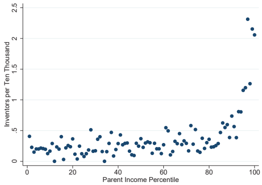
Bell et al (2017)
US IRS Data

Motivation

- Who becomes an inventor? Does innovation attract the most talented individuals or is there misallocation of talents into innovation?
- The data shows some striking patterns:



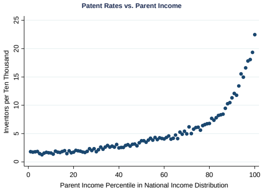
Bell et al (2017)
US IRS Data



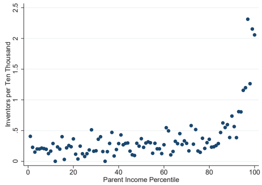
Akcigit et al. (2017)
US Historical Census

Motivation

- Who becomes an inventor? Does innovation attract the most talented individuals or is there misallocation of talents into innovation?
- The data shows some striking patterns:



Bell et al (2017)
US IRS Data



Akcigit et al. (2017)
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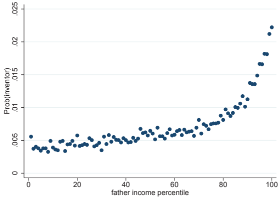
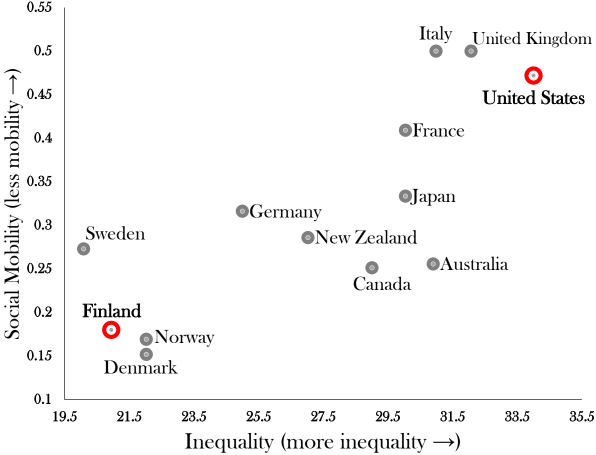


Aghion et. al (2018)
Finnish Census

FIGURE 2: THE GREAT GATSBY CURVE



SOURCE: CORAK (2004)

Research Questions & Outline

1. Does becoming an inventor depend on **socio-economic background**, **education**, or **innate ability**?

2. Who benefits from innovation?

Data

- We merge four Finnish datasets, 1988-2012:
    1. **Individual data** on income, education and other characteristics, from Statistics Finland (SF)
    2. **Firm-level data** (inventors' co-workers, senior/junior managers, entrepreneurs), from Statistics Finland (SF)
    3. **Patent data** from European Patent Office (EPO)
    4. **IQ data** from the Finnish Defence Force (FDF)

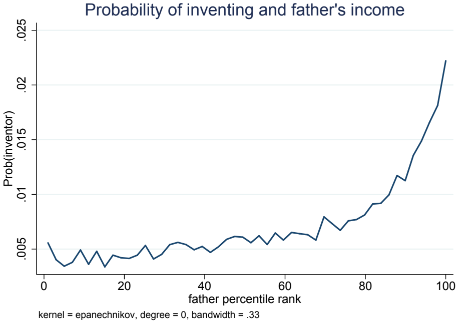
Summary Statistics

- Our initial sample covers 1988-2012 and consists of
  - 700,000 individuals,
  - 12 575 inventors,
  - 6 395 inventors in the IQ sample.

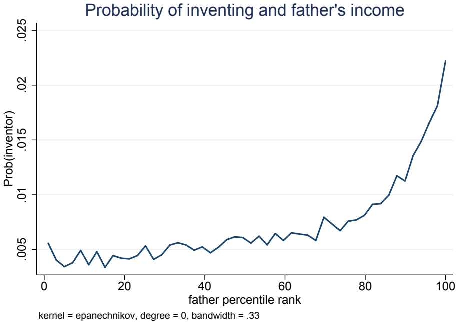
Section 1:

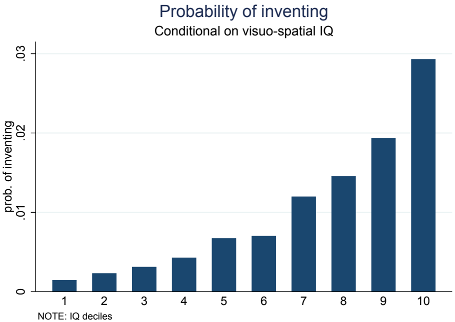
Who Becomes an Inventor?

Who Becomes an Inventor? Father's Income vs Education



Who Becomes an Inventor? Father's Income vs Education





Who Becomes an Inventor?

TABLE 1: WHO BECOMES INVENTOR REGRESSIONS

VARIABLES
fa income 91-95
fa income 96-100
mo income 91-95
mo income 96-100
fa bluecollar
mo bluecollar
fa MSc
fa PhD
mo MSc
mo PhD
IQ 91-95
IQ 96-100
Nobs

Who Becomes an Inventor?

Table 1: Who Becomes Inventor Regressions

VARIABLES	(1)
fa income 91-95	0.0149***
fa income 96-100	0.0246***
mo income 91-95	0.0126***
mo income 96-100	0.00260**
fa bluecollar	
mo bluecollar	
fa MSc	
fa PhD	
mo MSc	
mo PhD	
IQ 91-95	
IQ 96-100	
Nobs	352,668

Who Becomes an Inventor?

Table 1: Who Becomes Inventor Regressions

VARIABLES	(1)	(2)
fa income 91-95	0.0149***	0.00919***
fa income 96-100	0.0246***	0.0154***
mo income 91-95	0.0126***	0.00627**
mo income 96-100	0.00260**	0.00216*
fa bluecollar		-0.00121**
mo bluecollar		-0.00101*
fa MSc		
fa PhD		
mo MSc		
mo PhD		
IQ 91-95		
IQ 96-100		
Nobs	352,668	352,668

Who Becomes an Inventor?

Table 1: Who Becomes Inventor Regressions

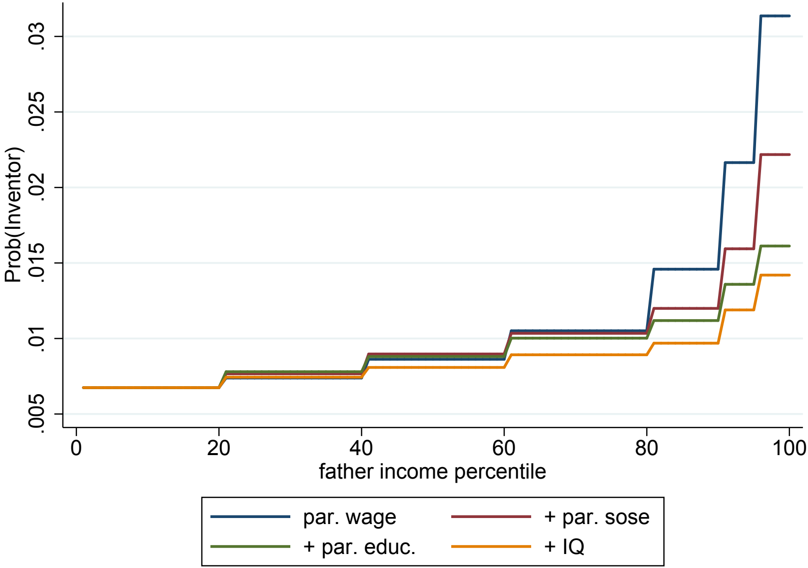
VARIABLES	(1)	(2)	(3)
fa income 91-95	0.0149***	0.00919***	0.00684***
fa income 96-100	0.0246***	0.0154***	0.00938***
mo income 91-95	0.0126***	0.00627**	-0.000846
mo income 96-100	0.00260**	0.00216*	0.000139
fa bluecollar		-0.00121**	-0.000999*
mo bluecollar		-0.00101*	-0.000263
fa MSc			0.0119***
fa PhD			0.0310***
mo MSc			0.0152***
mo PhD			0.0123
IQ 91-95			
IQ 96-100			
Nobs	352,668	352,668	352,668

Who Becomes an Inventor?

Table 1: Who Becomes Inventor Regressions

VARIABLES	(1)	(2)	(3)	(4)
fa income 91-95	0.0149***	0.00919***	0.00684***	0.00515***
fa income 96-100	0.0246***	0.0154***	0.00938***	0.00745***
mo income 91-95	0.0126***	0.00627**	-0.000846	-0.00186
mo income 96-100	0.00260**	0.00216*	0.000139	-0.000410
fa bluecollar		-0.00121**	-0.000999*	-0.000759
mo bluecollar		-0.00101*	-0.000263	4.32e-05
fa MSc			0.0119***	0.00876***
fa PhD			0.0310***	0.0275***
mo MSc			0.0152***	0.0119***
mo PhD			0.0123	0.00826
IQ 91-95				0.0236***
IQ 96-100				0.0351***
Nobs	352,668	352,668	352,668	352,668

Who Becomes an Inventor? Visual Representation



Decomposing the "Who Becomes" Regression

Table 2: Decomposing the Explained Impact on Becoming an Inventor

– *B. Fraction of Partial R-squared* –	
Explanatory variables	**Inventor**
Base controls	0.148
Parental income	0.017
Parental socecon	0.017
Parental education	0.157
IQ	0.661

Base controls: A 4th order polynomial in log(age), 21 region dummies, dummies for suburban and urban regions, dummies for mother tongue, and dummies for parental decade of birth.

Decomposing the “Who Becomes” Regression

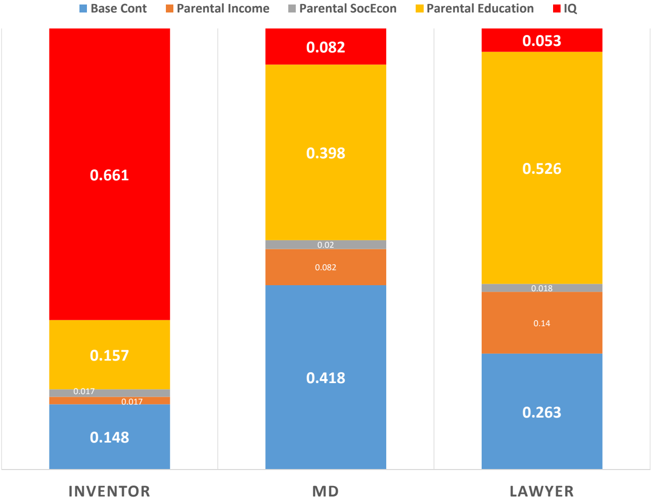
Table 2: Decomposing the Explained Impact on Becoming an Inventor

– B. Fraction of Partial R-squared –

Explanatory variables	**Inventor**	**MD**	**Lawyer**
Base controls	0.148	0.418	0.263
Parental income	0.017	0.082	0.140
Parental socecon	0.017	0.020	0.018
Parental education	0.157	0.398	0.526
IQ	0.661	0.082	0.053

Base controls: A 4th order polynomial in log(age), 21 region dummies, dummies for suburban and urban regions, dummies for mother tongue, and dummies for parental decade of birth.

Decomposing the “Who Becomes” Regression



Endogeneity of IQ: Close Brother Comparison

Endogeneity of IQ: Close Brother Comparison

Table 1: Comparing Close Brothers

	(1)	(2)
first born	-0.00209**	-0.000933
fa income 91-95	0.00277	-0.0101
fa income 96-100	0.0113***	-0.0272
mo income 91-95	0.00375	-0.00512
mo income 96-100	0.00393	0.00693
fa bluecollar	0.000190	
mo bluecollar	-0.00127	
IQ 91-95	0.0216***	0.0202***
IQ 96-100	0.0353***	0.0320***
Family Fixed Effect	NO	YES
Observations	82,054	82,054
Number of families		41,605

Family Structure

Family Structure

Table 2: Role of Family Structure and Resources

	(1)	(2)	(3)	(4)
biol fa away	-0.00399***	-0.00309***	-0.00311***	-0.00295***
biol mo away	-0.00343**	-0.00410**	-0.00398**	-0.00417**
biol fa income 91-95	0.00500***	0.00528***	0.00577***	0.00574***
biol fa income 96-100	0.00730***	0.00772***	0.00845***	0.00836***
biol fa income 91-95 x away		-0.00625*	-0.00669*	-0.00613*
biol fa income 96-100 x away		-0.0118**	-0.0125***	-0.00993**
step fa income 91-95			-0.00327	-0.00329
step fa income 96-100			-0.00501*	-0.00504*
step mo income 91-95			-0.00381	-0.00344
step mo income 96-100			-0.0191**	-0.0190**
biol fa MSc	0.00874***	0.00874***	0.00880***	0.00884***
biol fa PhD	0.0275***	0.0275***	0.0275***	0.0278***
biol mo MSc	0.0117***	0.0117***	0.0121***	0.0125***
biol mo PhD	0.00794	0.00808	0.00908	0.0110
biol fa MSc x away				-0.000712
biol fa PhD x away				-0.0128
biol mo MSc x away				-0.00776
biol mo PhD x away				-0.0346***
Observations	352,668	352,668	352,668	352,668

Who Becomes an Inventor? Family Structure

- We see a negative and significant effect of not living with one or the other the biological.
- The positive direct impact of a high income father only materializes if the individual grows with the biological father.
- Step parents obtain negative coefficients throughout, suggesting that step parent income at best plays no role in leveling the road towards innovation.

Overall, these results suggest that the association of father income on the probability of becoming an inventor is conditional on the father living with the individual, whereas this is not the case for the effects of parental education.

Potential Misallocation

Table 3: Potential Misallocation

	(1)	(2)	(3)	(4)	(5)	(6)
fa income 91-95	0.00527***	0.00515***	0.00527***	-0.00979	-0.0102	-0.00984
fa income 96-100	0.00617***	0.00745***	0.00615***	-0.0280	-0.0273	-0.0281
mo income 91-95	-0.00192	-0.00185	-0.00192	-0.00368	-0.00522	-0.00403
mo income 96-100	-0.000202	-0.000400	-0.000231	0.00561	0.00693	0.00562
IQ 91-95	0.0237***	0.0236***	0.0237***	0.0204***	0.0203***	0.0204***
IQ 96-100	0.0331***	0.0350***	0.0331***	0.0268***	0.0319***	0.0269***
fa inc 96-100 x IQ 96-100	0.0144***		0.0147***	0.0256*		0.0270*
mo inc 96-100 x IQ 96-100	-0.00358		-0.00275	0.0339		0.0336
Sample	IQ	IQ	IQ	Brothers	Brothers	Brothers
Estimator	OLS	OLS	OLS	FE	FE	FE
Observations	352,668	352,668	352,668	82,054	82,054	82,054
Number of families				41,605	41,605	41,605

Role of Own Education

Table 4: Role of Own Education

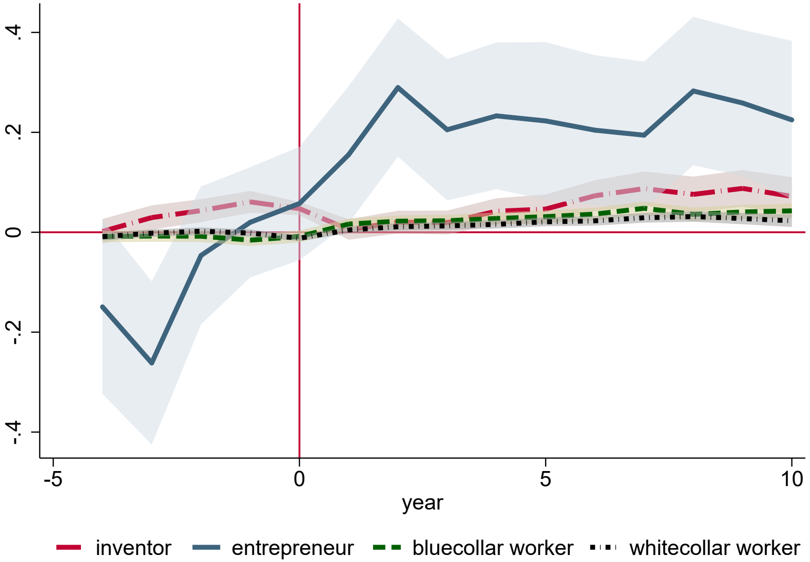
fa income 91-95	0.00224**	fa MSc	0.000430
fa income 96-100	0.00404***	fa PhD	0.00974**
mo income 91-95	-0.00189	mo MSc	0.00129
mo income 96-100	-0.000279	mo PhD	-0.00546
fa bluecollar	-0.000736	fa STEM	0.00460***
fa jr whitec.	-1.99e-05	mo STEM	-0.000634
fa sr whitec.	0.000491	IQ 91-95	0.0103***
mo bluecollar	0.000166	IQ 96-100	0.0157***
mo jr whitec.	0.000315	STEM MSc	0.104***
mo sr whitec.	0.000723	STEM PhD	0.225***
Observations: 352,668			

Role of Own Education

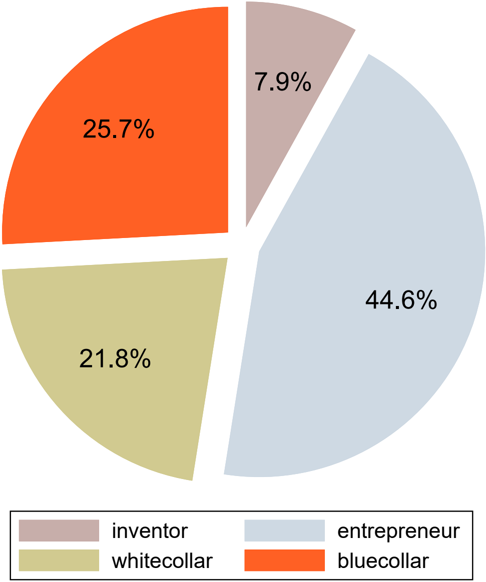
Table 8: Decomposition with Education

– B. Fraction of Partial R-squared –	
Base controls	0.0064
Parental income	0.0000
Parental socecon	0.0000
Parental education	0.0048
IQ	0.0209
Education	0.9678

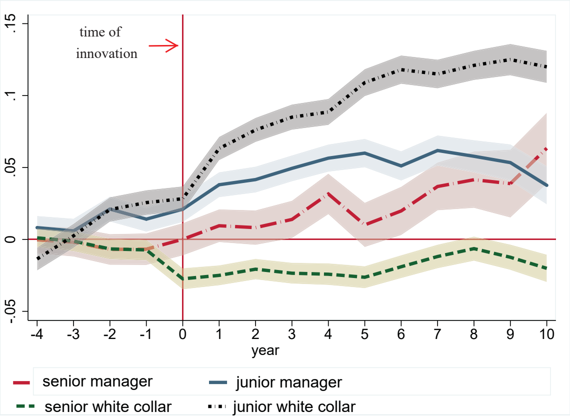
Returns to Innovation



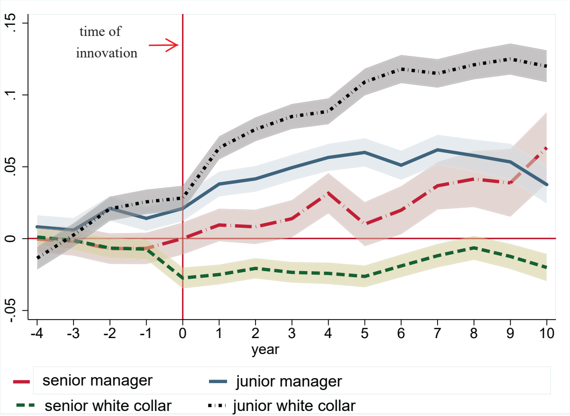
Returns to Innovation



Within-firm Income Dynamics Upon Innovation I/II

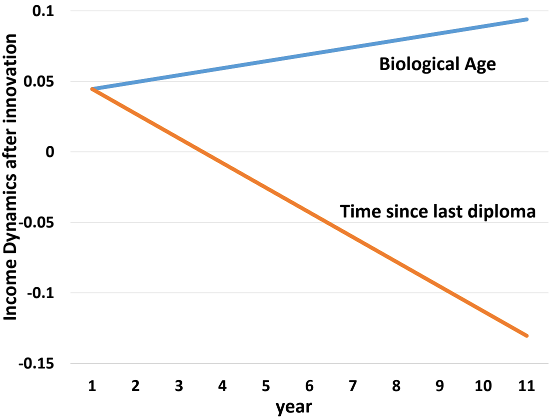


Within-firm Income Dynamics Upon Innovation I/II

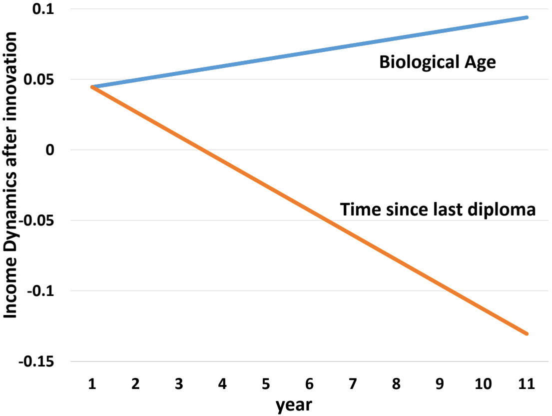


Senior white collars are hurt by innovation!

Within-firm Income Dynamics Upon Innovation II/II



Within-firm Income Dynamics Upon Innovation II/II



Negative impact comes from distance to frontier!
Retraining programs could be helpful to make growth more "inclusive"!

Taking Stock

- Overall, the above findings suggest a prominent role for own education and for IQ when explaining an individual's probability of becoming an inventor.
- Innovation has heterogeneous impacts on different types of workers.
- Re-training/education could be key for more inclusive growth!

Inequality and Innovation

Lecture Slides 3B: Innovation and Top Income Inequality[1]

Ufuk Akcigit
University of Chicago

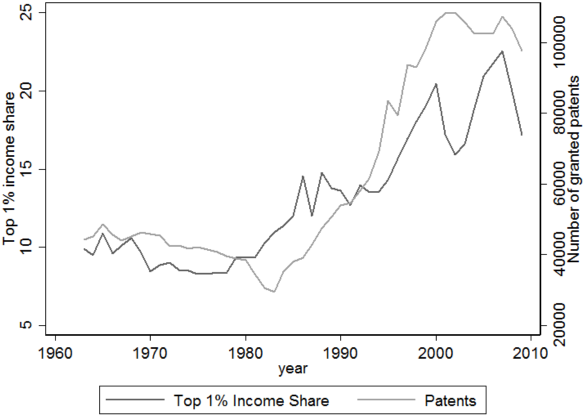
January 7, 2019

[1] Based on Aghion, Akcigit, Bergeaud, Blundell, Hemous (2019)

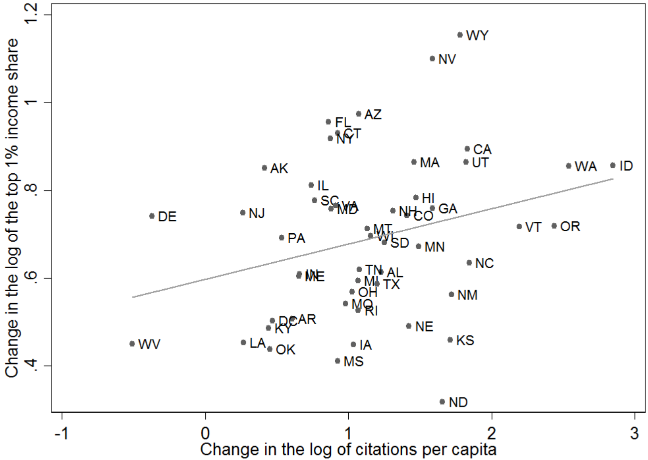
Introduction

- Past decades have witnessed a sharp increase in top income inequality worldwide and particularly in developed countries.
- However no consensus has been reached as to the main underlying factors behind this surge in top income inequality.
- In their work AABBH argue that innovation is certainly one such factor and that it also affects social mobility.

Top Income Share and Patenting



Top Income Share and Patenting



Theory and predictions (1)

- Simple Schumpeterian growth model where:
  1. Growth results from quality-improving innovations by incumbents and potential entrants.
  2. Innovations allow firms to increase their mark-ups, while reducing their labor demand

  ⟶ **Prediction 1**: *Innovation increases the entrepreneurial share of income at the expense of workers' share*

- Incumbents can block entrant innovations through lobbying

  ⟶ **Prediction 2**: *Entrant innovation increases top income inequality, but less so in high-lobbying states*

Theory and predictions (2)

- Simple Schumpeterian growth model where:
  1. Growth results from quality-improving innovations by incumbents and potential entrants.
  2. Innovations allow firms to increase their mark-ups, while reducing their labor demand

  $\longrightarrow$ **Prediction 1**: *Innovation increases the entrepreneurial share of income at the expense of workers' share*

- Incumbents can block entrant innovations through lobbying
  $\longrightarrow$ **Prediction 2**: *Entrant innovation increases top income inequality, but less so in high-lobbying states*

Theory and predictions (3)

- A successful entrant replace the incumbent who inherited a firm from her parent
  $\longrightarrow$ then the incumbent becomes a worker and the entrant becomes an entrepreneur
  $\longrightarrow$ **Prediction 3**: *Entrant innovation enhances social mobility but less so in high-lobbying states*

Empirical strategy

- Our core empirical analysis is carried out at the US state level
- Our dataset covers the period 1975-2010, a time range imposed upon us by the availability of patent data
- Regressing top income inequality on innovativeness:

$$\log(y_{it}) = A + B_i + B_t + \beta_1 \log(innov_{i(t-1)}) + \beta_2 X_{it} + \varepsilon_{it}$$

Innovation data

- The US patent office (USPTO) provides complete statistics for patents granted between the years 1975 and 2010.
  - Information on the state of residence of the patent inventor, the date of application of the patent and a link to every citing patents granted before 2010.
  - We correct for truncation bias in patent count and patent citations following Jaffe, Hall and Trajtenberg (2001).
- We use several measure of innovativeness
  1. *number of patents*
  2. *3, 4 and 5 year windows citations counter*
  3. *is the patent among the 5% most cited in the year by 2010?*
  4. *total corrected citation counter*
  5. *has the patent been renewed?*

Results

Measure of Inequality Innovation	**(1)** Top 1% patent_pc	**(2)** Top 1% 3YWindow	**(3)** Top 1 % 4YWindow	**(4)** Top 1% 5YWindow	**(5)** Top 1% Citations	**(6)** Top 1% Share5	**(7)** Top 1% Renew
Innovation	0.027*	0.029***	0.042***	0.041***	0.048***	0.024***	0.032***
	(1.89)	(3.47)	(4.58)	(4.24)	(5.78)	(4.84)	(3.15)
Gdppc	-0.060	-0.062	-0.068	-0.055	-0.091*	-0.067	-0.144**
	(-0.52)	(-1.13)	(-1.21)	(-0.94)	(-1.66)	(-1.25)	(-2.06)
Popgrowth	0.280	0.450	0.024	-0.174	0.068	0.007	1.018
	(0.37)	(0.71)	(0.04)	(-0.24)	(0.10)	(0.01)	(1.36)
Sharefinance	0.013	0.020	0.024*	0.026*	0.024*	0.022*	0.018
	(0.57)	(1.48)	(1.74)	(1.76)	(1.87)	(1.72)	(1.28)
Outputgap	-1.954	-2.648**	-2.302	-2.143	-2.115	-2.149	-3.308**
	(-1.37)	(-2.01)	(-1.64)	(-1.46)	(-1.53)	(-1.53)	(-1.98)
Gvtsize	-0.070	-0.091**	-0.109**	-0.139***	-0.090**	-0.098**	-0.058
	(-0.76)	(-2.13)	(-2.51)	(-3.09)	(-2.16)	(-2.32)	(-1.14)
R^2	0.920	0.922	0.916	0.908	0.921	0.921	0.885
N	1785	1632	1581	1530	1632	1632	1435

Instrumentation 1

- Following Aghion et al (2004), we consider the time-varying State composition of the appropriation committees of the Senate and the House of Representatives.
- A Committee member often push towards subsidizing research education in her State, in order to increase her chances of reelection in that State.
  $\longrightarrow$ a state with one of its congressmen seating on the committee is likely to receive more funding for research education, which should increase its innovativeness in following years

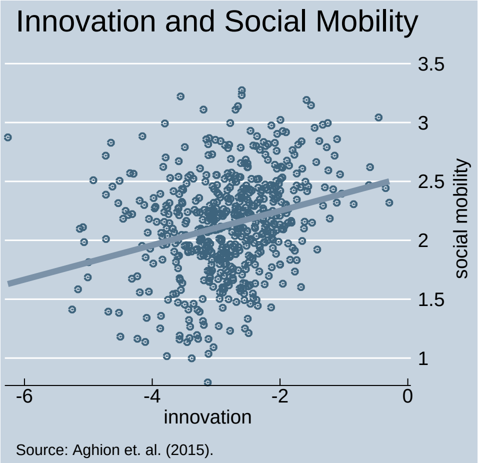
Instrumentation 2

- Second instrument based on knowledge spillovers
  $\longrightarrow$ The idea is to instrument innovation in a state by the sum of innovation intensities in other states weighted by the relative innovation spillovers from these other states

Magnitude of the effects

- When measured by the number of patent per capita, innovativeness accounts on average for about 17% of the total increase in the top 1% income share between 1975 and 2010 according to either IV regression

Innovation and Social Mobility



Innovation and Social Mobility

Measure of Mobility Innovation	(1) AM25 patent_pc	(2) P1-5 patent_pc	(3) P2-5 patent_pc	(4) AM25 patent_pc	(5) P1-5 patent_pc	(6) P2-5 patent_pc	(7) AM25 patent_pc
Innovation from Entrants	0.016** (2.61)	0.058** (2.39)	0.038** (2.11)				0.018** (2.61)
Innovation from Incumbent				0.007 (0.87)	0.032 (0.97)	0.020 (0.75)	-0.006 (-0.64)
Gdppc	-0.136*** (-3.08)	-0.381* (-1.78)	-0.330** (-2.11)	-0.136*** (-2.96)	-0.405* (-1.87)	-0.340** (-2.14)	-0.128*** (-2.83)
Popgrowth	0.287 (1.00)	0.757 (0.66)	0.827 (0.98)	0.272 (0.92)	0.708 (0.61)	0.792 (0.93)	0.290 (1.02)
Gvtsize	0.000 (0.04)	-0.000 (-0.22)	-0.001 (-0.80)	0.000 (0.08)	-0.000 (-0.21)	-0.001 (-0.76)	0.000 (0.07)
Participation Rate	0.785*** (4.61)	2.291*** (3.44)	1.815*** (3.25)	0.758*** (4.48)	2.180*** (3.30)	1.743*** (3.14)	0.799*** (4.71)
School Expenditure	0.109** (2.09)	0.467** (2.38)	0.322** (2.04)	0.102* (1.95)	0.442** (2.24)	0.306* (1.95)	0.111** (2.10)
College per capita	0.081* (1.70)	0.068 (0.36)	0.090 (0.57)	0.075 (1.57)	0.036 (0.19)	0.071 (0.44)	0.084* (1.81)
Employment Manuf	-0.312*** (-3.16)	-1.508*** (-4.12)	-1.212*** (-3.95)	-0.366*** (-3.70)	-1.705*** (-4.54)	-1.341*** (-4.34)	-0.307*** (-3.04)
R^2	0.260	0.233	0.221	0.243	0.217	0.209	0.261
N	541	541	541	541	541	541	541

Inequality and Innovation

Lecture Slides 4: What Happened to the U.S. Business Dynamism?[1]

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University of Chicago

January 7, 2019

[1] Based on Akcigit, Ates (2018, 2019)

Introduction

- Firm and industry dynamics have shown striking trends over the past several decades.
- Business dynamism and entrepreneurship in the U.S. and in many parts of Europe have declined.
- Labor share has decreased and market concentration has increased.
- What do these facts tell us about competition policy?
- Need a unifying theoretical framework to discuss positive and normative implications.

Today's Roadmap

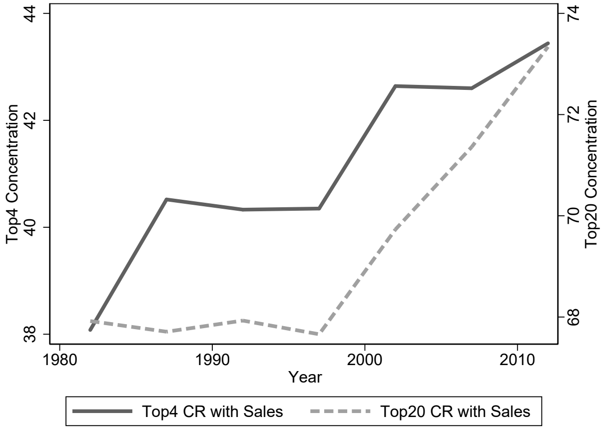
1. Summarize various empirical trends on firm dynamics.
2. Use growth theory to discuss the underlying mechanism.
3. Conclude with some new supporting facts.

Empirical Trends

(Mostly based on the US data)

Fact 1: Market concentration has risen.

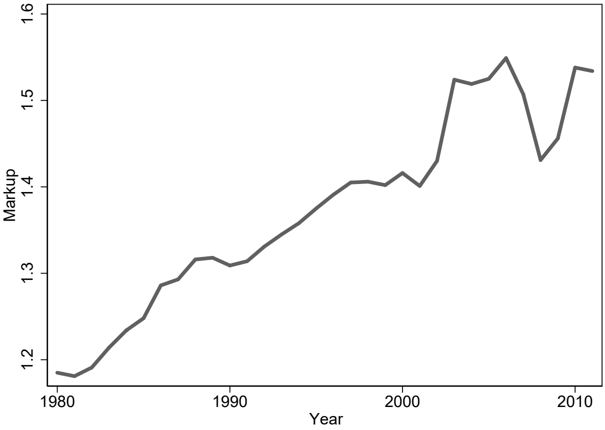
Figure: MARKET CONCENTRATION IN MANUFACTURING



Source: Autor, Dorn, Katz, Patterson, and Van Reenen (2017).

Fact 2: Average markups have increased.

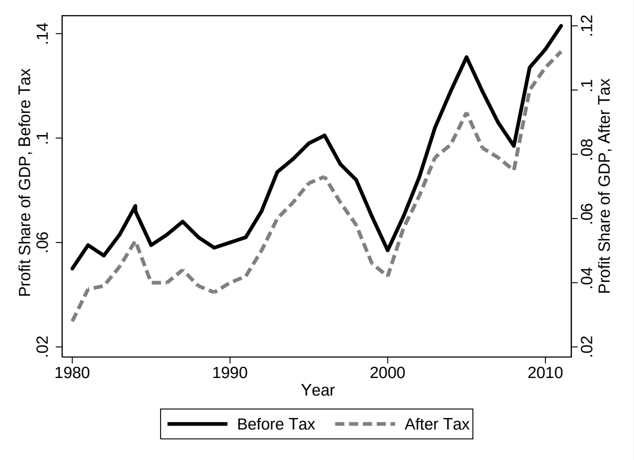
Figure: AVERAGE MARKUP OVER TIME



Source: De Loecker and Eeckhout (2017).

Fact 3: Profit share of GDP has increased.

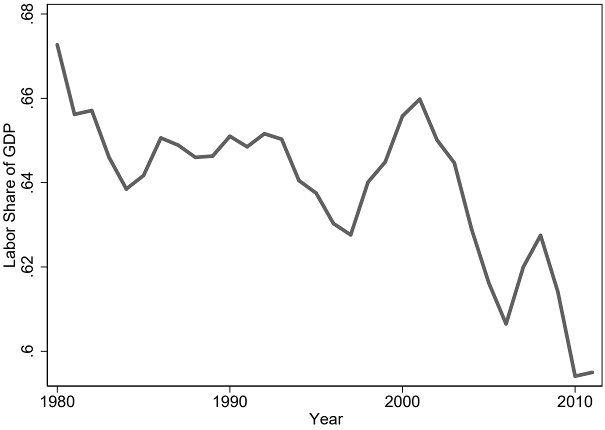
Figure: PROFITS AS A FRACTION OF GDP OVER TIME



Source: Authors' own calculation using the BEA NIPA Table 1.15.

Fact 4: The labor share of output has gone down.

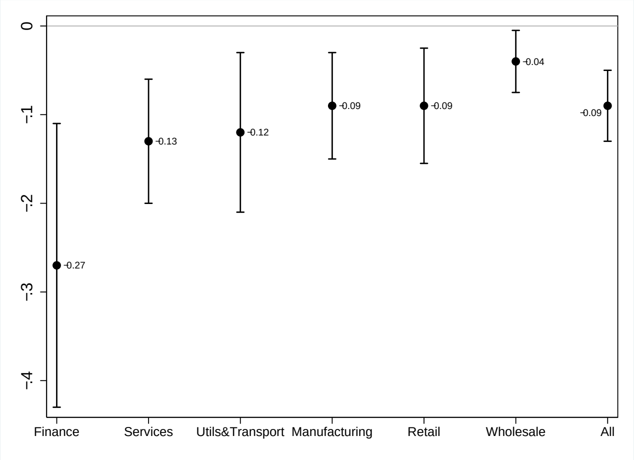
Figure: LABOR SHARE



Source: Karabarbounis and Neiman (2013).

Fact 5: Positive correlation of concentration and labor share.

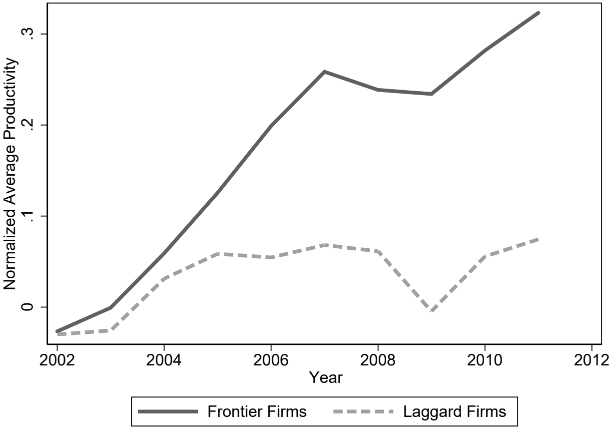
Figure: SECTOR-LEVEL CHANGES IN CONCENTRATION AND LABOR SHARE



Source: Autor, Dorn, Katz, Patterson, and Van Reenen (2017).

Fact 6: Larger gap btw. frontier and laggards.

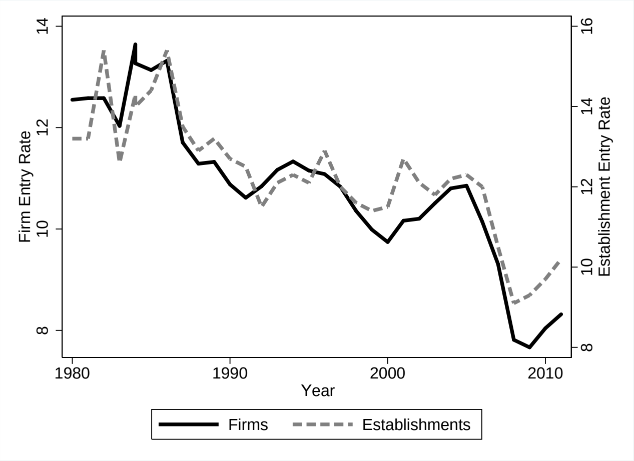
Figure: Labor productivity of frontier and laggard firms



Source: Andrews, Criscuolo, and Gal (2016).

Fact 7: Firm entry rate has declined.

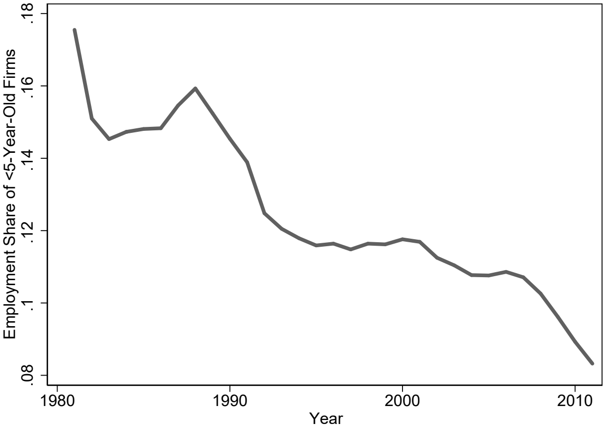
Figure: FIRM AND ESTABLISHMENT ENTRY RATES IN THE UNITED STATES



Source: Authors' calculations from BDS database [see also Decker, Haltiwanger, Jarmin, and Miranda (2016a)].

Fact 8: Employment share of young firms has fallen.

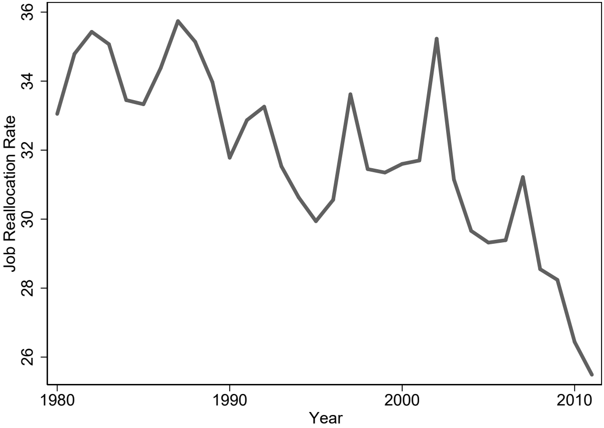
Figure: EMPLOYMENT SHARE OF ¡5-YEAR OLD FIRMS



Source: Decker, Haltiwanger, Jarmin, and Miranda (2016a).

Fact 9: Job reallocation has slowed down.

Figure: GROSS JOB REALLOCATION



Source: Decker, Haltiwanger, Jarmin, and Miranda (2016a).

Fact 10: Dispersion of firm growth has decreased.

Figure: GROWTH RATE DISPERSION HAS SHRUNK

Source: Decker, Haltiwanger, Jarmin, and Miranda (2016a).

Model

Ingredients

- Schumpeterian step-by-step innovation model

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$\Longrightarrow$ incumbents innovate to increase their markups.

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$\Longrightarrow$ incumbents innovate to increase their markups.

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- Similarly, entrants enter if and only if they have the hope of taking down the incumbents.

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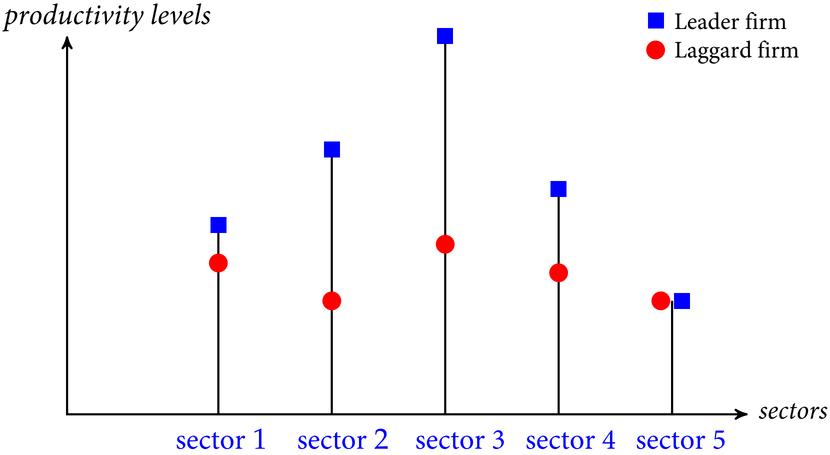
  - R&D benefits, and
  - intellectual property rights protection.

Model Economy



Household preferences:

$$U_t = \int_t^{\infty} \exp\left(-\rho\left(s-t\right)\right) \ln C_s ds$$

Final-good production: using intermediate varieties

$$\ln Y_t = \int_0^1 \ln[\sum_{i=1}^{2} y_{ijt}]dj$$

Intermediate-goods production: using labor

$$y_{ijt} = q_{ijt} l_{ijt}$$

R&D technology: using labor

$$\text{incumbents:} \quad x_{jt} = \left(\gamma \frac{h_{jt}}{\alpha}\right)^{\frac{1}{\gamma}}$$

$$\text{entrants:} \quad \tilde{x}_{jt} = \left(\tilde{\gamma} \frac{\tilde{h}_{jt}}{\tilde{\alpha}}\right)^{\frac{1}{\tilde{\gamma}}}$$

Value function:

$$r_t V_{nt} - \dot{V}_{nt} = \max_{x_{nt}} \left\{ (1-\tau)\left(1-\frac{1}{\lambda^n}\right) Y_t - (1-s)\,\alpha \frac{x_{nt}^{\gamma}}{\gamma} w_t \right.$$

$$+ x_{nt}\left[V_{n+1t} - V_{nt}\right]$$

$$+ \left(\phi_f x_{-nt} + \phi_e \tilde{x}_{-nt} + \delta\right)\left[V_{0t} - V_{nt}\right]$$

$$\left. + \left(\left(1-\phi_f\right) x_{-nt} + \left(1-\phi_e\right)\tilde{x}_{-nt}\right)\left[V_{n-1t} - V_{nt}\right] \right\}$$

Entrant problem:

$$\max_{\tilde{x}_{-nt}} \left\{ -(1+c)\tilde{\alpha}\frac{\tilde{x}_{-nt}^{\gamma}}{\gamma} w_t + \tilde{x}_{nt}\left[\left(1-\phi_e\right) V_{-n+1t} + \phi_e V_{0t} - 0\right] \right\}$$

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Policies:

1- τ: Incumbent tax
2- s: R&D subsidy
3- δ: IP protection
4- c: Entry cost

Optimal innovation:

$$\text{incumbents:} \quad x_{nt} = \left[\frac{1}{\alpha \left(1 - \tau \mathbb{I}_{n>0}\right) \omega_t} \left\{ v_{n+1t} - v_{nt} \right\} \right]^{\frac{1}{\gamma - 1}}$$

$$\text{entrants:} \quad \tilde{x}_{nt} = \left[\left(\tilde{\alpha} \omega_t\right)^{-1} v_{-n+1t} \right]^{\frac{1}{\tilde{\gamma} - 1}}$$

Evolution of gaps:

$$\frac{\mu_{nt+\Delta t} - \mu_{nt}}{\Delta t} = x_{n-1t}\mu_{n-1t} + \left(\left(1-\phi_f\right) x_{-n-1t} + \tilde{x}_{-n-1t}\right) \mu_{n+1t} - \left(x_{nt} + x_{-nt} + \tilde{x}_{-nt} + \delta\right) \mu_{nt}$$

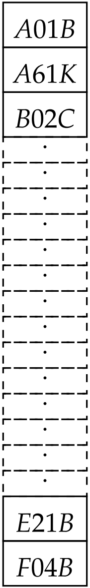
Growth:

$$\ln Q_{t+\Delta t} - \ln Q_t = \ln \lambda \left[\mu_{0t}\left(2x_{0t} + \tilde{x}_{0t}\right) + \sum_{1}^{\bar{n}} \mu_{nt} x_{nt}\right] \Delta t + o\left(\Delta t\right)$$

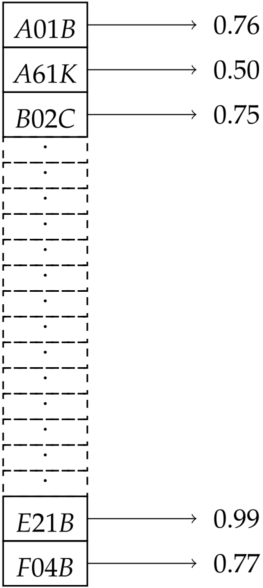
Quantitative Investigation

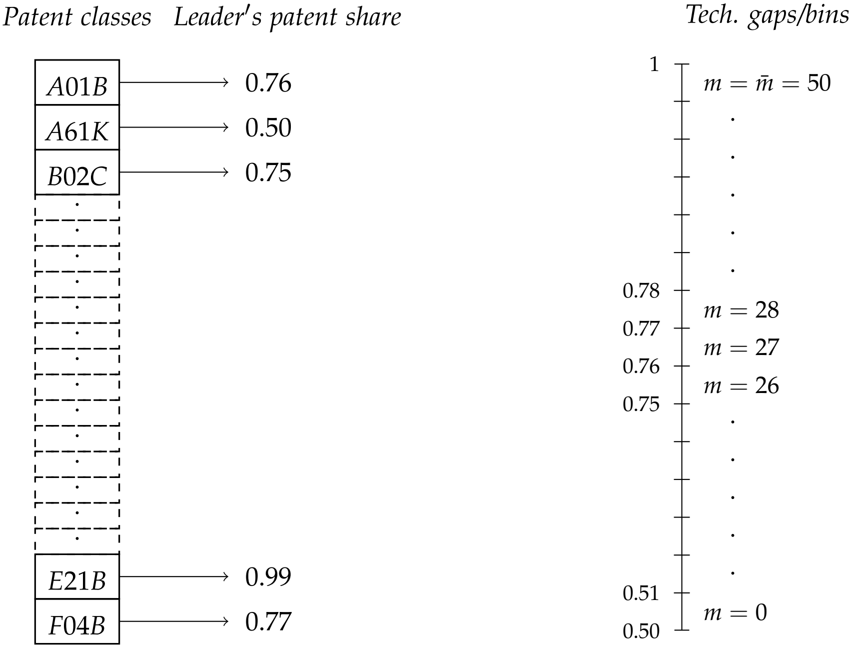
- Calibrate the model to steady-state U.S. economy in 1980.
- Shock the economy with
  - rising entry costs
  - incumbent favoring policies:
    - tax cut,
    - increased R&D benefits, and
    - improved intellectual property protection.

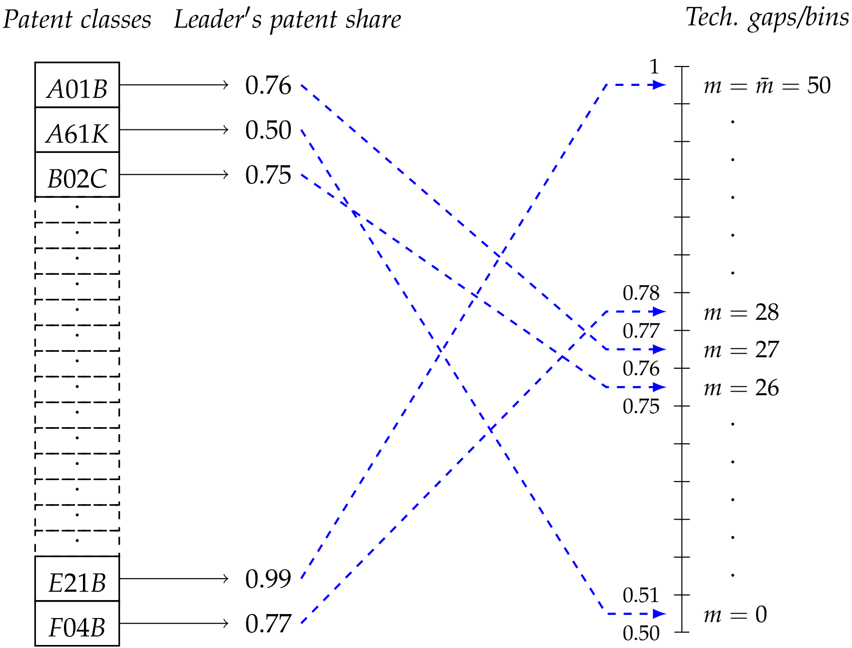
Patent classes



Patent classes *Leader's patent share*




Patent classes
Leader's patent share
Tech. gaps/bins
A01B
0.76
A61K
0.50
B02C
0.75
E21B
0.99
F04B
0.77
1
$m = \bar{m} = 50$
0.78
$m = 28$
0.77
$m = 27$
0.76
$m = 26$
0.75
0.51
$m = 0$
0.50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A01B
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0.76
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0.75
0.51
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$m = \bar{m} = 50$
$m = 28$
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Calibration

Parameters to be calibrated: $\alpha, \tilde{\alpha}, \lambda, \delta$

Table: Parameters set externally

Parameter	Value	Source
Inverse R&D curvature $(\gamma^{-1}, \tilde{\gamma}^{-1})$	0.35	Acemoglu&Akcigit (2012)
Effective corporate income tax (τ)	30%	CRS (2006)
R&D subsidy (s)	5%	Akcigit, Ates, Impullitti (2018)

Table: Model fit

Moment	Estimate	Target	Source
1. Entry	11.4%	12.5%	BDS 1980-81
2. Long-run TFP growth	1.4%	1.6%	FRBSF 1950-81
3. R&D to GDP	3.3%	2.4%	OECD 1981-82
4. Concentration distribution	n/a	n/a	See next slide

Experiments

- Exercise 1) Increase entry costs: $c = 0\% \to 400\%$
- Exercise 2) Reduce taxes: $\tau = 30\% \to 0$
- Exercise 3) Increase subsidy: $s = 5\% \to 50\%$
- Exercise 4) Increase IP protection: $\delta = 2.5\% \to 1\%$

Data vs Model Predictions

	Data
Growth	$\downarrow$
Entry	$\downarrow$
Labor share	$\downarrow$
Markups	$\uparrow$
Profit share	$\uparrow$
Job reallocation	$\downarrow$
Growth dispersion	$\downarrow$

Data vs Model Predictions

	Data	Higher entry cost
Growth	$\downarrow$	$\downarrow$
Entry	$\downarrow$	$\downarrow$
Labor share	$\downarrow$	$\longleftrightarrow$
Markups	$\uparrow$	$\longleftrightarrow$
Profit share	$\uparrow$	$\longleftrightarrow$
Job reallocation	$\downarrow$	$\longleftrightarrow$
Growth dispersion	$\downarrow$	$\uparrow$

Data vs Model Predictions

	Data	Lower corporate tax
Growth	$\downarrow$	$\uparrow$
Entry	$\downarrow$	$\longleftrightarrow$
Labor share	$\downarrow$	$\longleftrightarrow$
Markups	$\uparrow$	$\uparrow$
Profit share	$\uparrow$	$\uparrow$
Job reallocation	$\downarrow$	$\downarrow$
Growth dispersion	$\downarrow$	$\downarrow$

Data vs Model Predictions

	Data	Higher R&D subsidies
Growth	↓	↑
Entry	↓	⟷
Labor share	↓	⟷
Markups	↑	↑
Profit share	↑	↑
Job reallocation	↓	↓
Growth dispersion	↓	↓

Data vs Model Predictions

	Data	Higher IPR protection
Growth	↓	↓
Entry	↓	↓
Labor share	↓	↓
Markups	↑	↑
Profit share	↑	↑
Job reallocation	↓	↓
Growth dispersion	↓	↓

Data vs Model Predictions

	Data	Higher entry cost	Lower corporate tax	Higher R&D subsidies	Higher IPR protection
Growth	$\downarrow$	$\downarrow$	$\uparrow$	$\uparrow$	$\downarrow$
Entry	$\downarrow$	$\downarrow$	$\longleftrightarrow$	$\longleftrightarrow$	$\downarrow$
Labor share	$\downarrow$	$\longleftrightarrow$	$\longleftrightarrow$	$\longleftrightarrow$	$\downarrow$
Markups	$\uparrow$	$\longleftrightarrow$	$\uparrow$	$\uparrow$	$\uparrow$
Profit share	$\uparrow$	$\longleftrightarrow$	$\uparrow$	$\uparrow$	$\uparrow$
Job reallocation	$\downarrow$	$\longleftrightarrow$	$\downarrow$	$\downarrow$	$\downarrow$
Growth dispersion	$\downarrow$	$\uparrow$	$\downarrow$	$\downarrow$	$\downarrow$

Markups

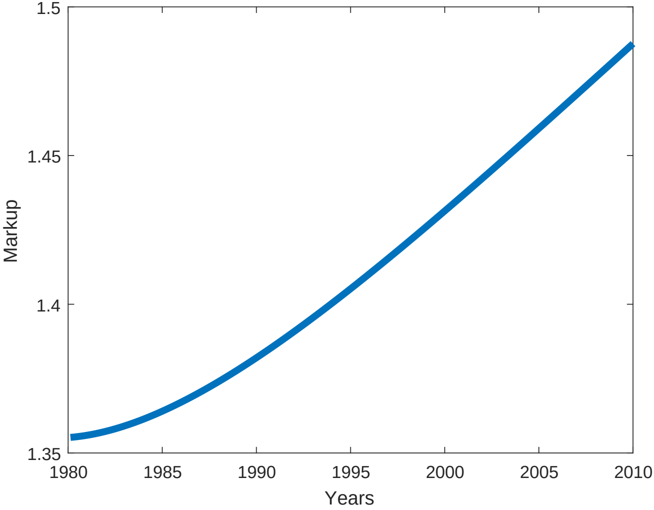


Figure: Average markup

Profits

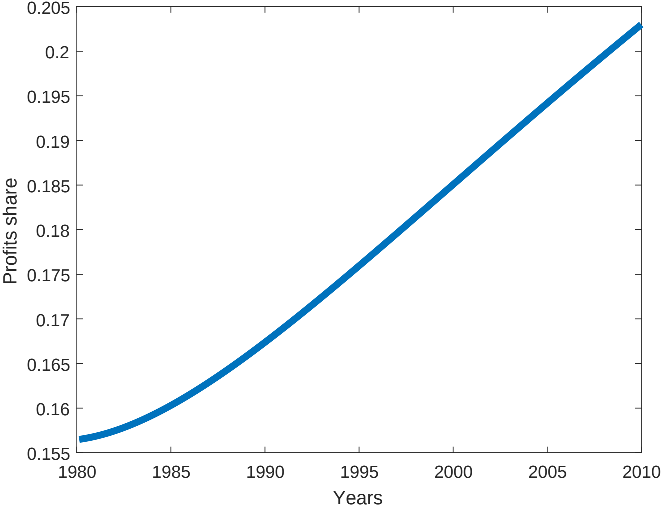


Figure: Average profitability

Labor share

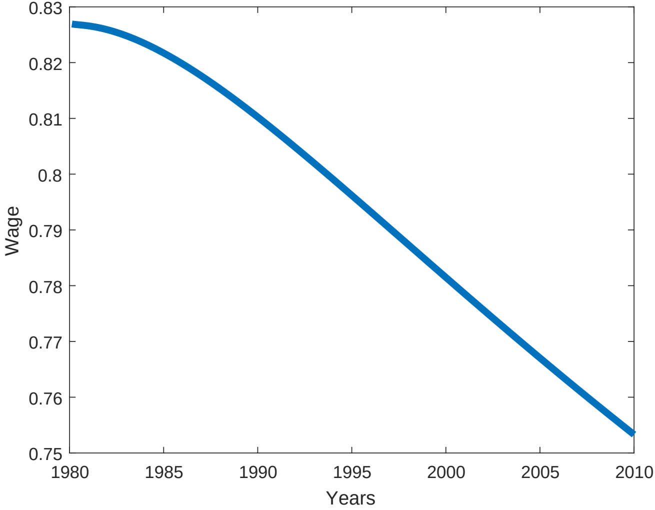
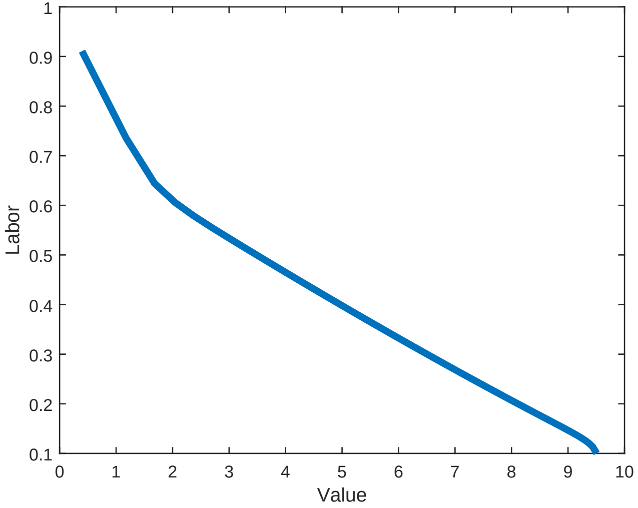


Figure: Labor share

Labor Share and Firm Size



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Frontier vs. Laggards

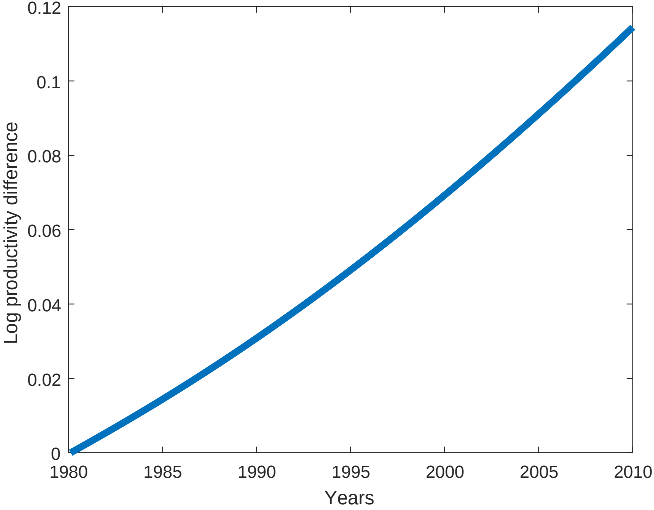

Figure: Log Productivity Difference between the Leader and the Follower

Job reallocation

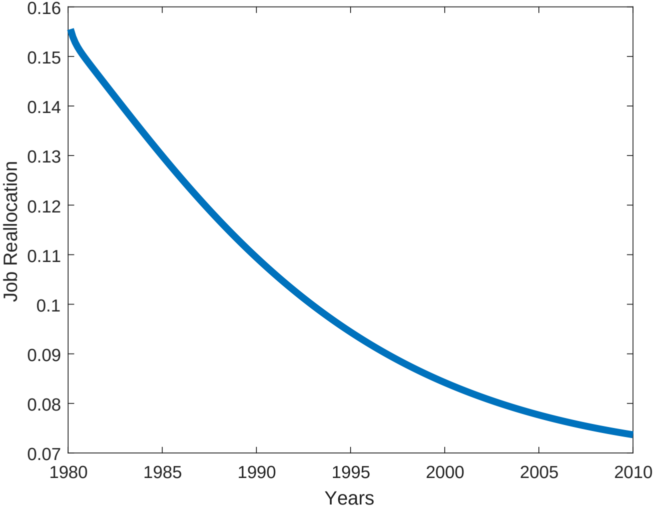

Figure: Gross job reallocation

Firm growth dispersion

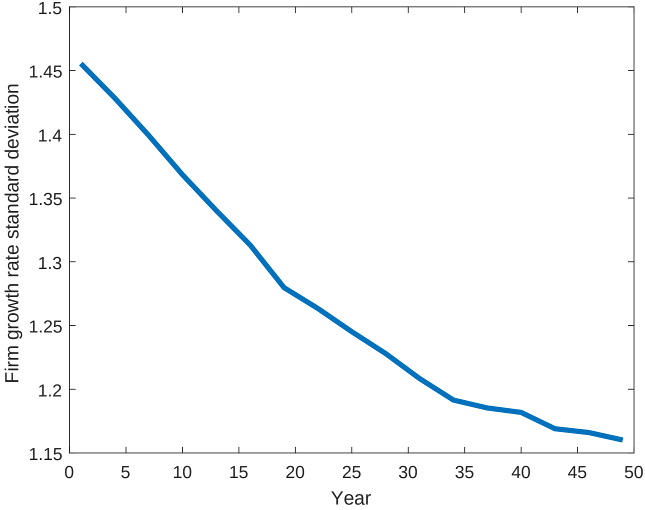

Figure: Firm growth dispersion

Entry

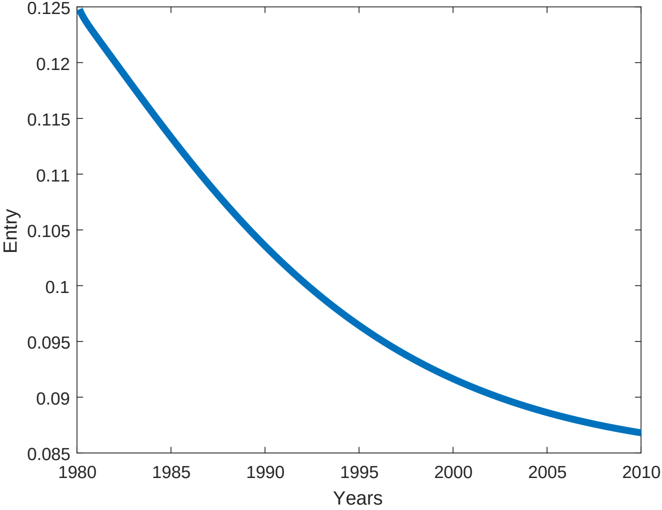

Figure: Entry

Economic Activity by Young Firms

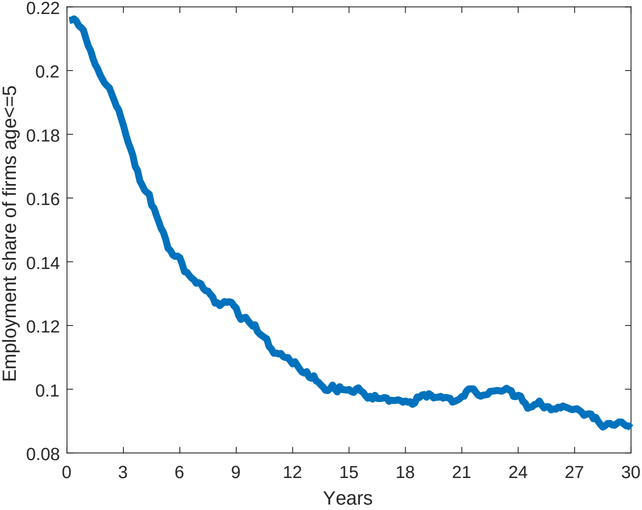

Figure: Employment Share of Young Firms

Interest Rate

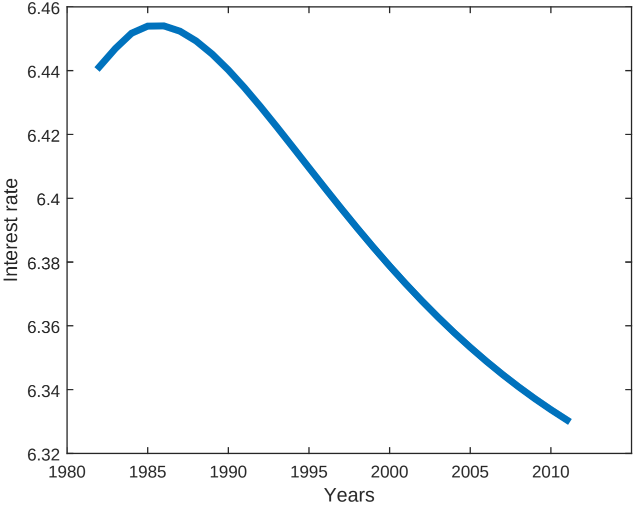

Figure: Interest rate path

Why Do We Observe Slower Knowledge Diffusion?

- the increasingly data-dependent nature of production;
- regulations that favor established firms;
- increased off-shoring of production abroad;
- anti-competitive (ab)use of intellectual property.

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Empirical Trends on IP and Innovation

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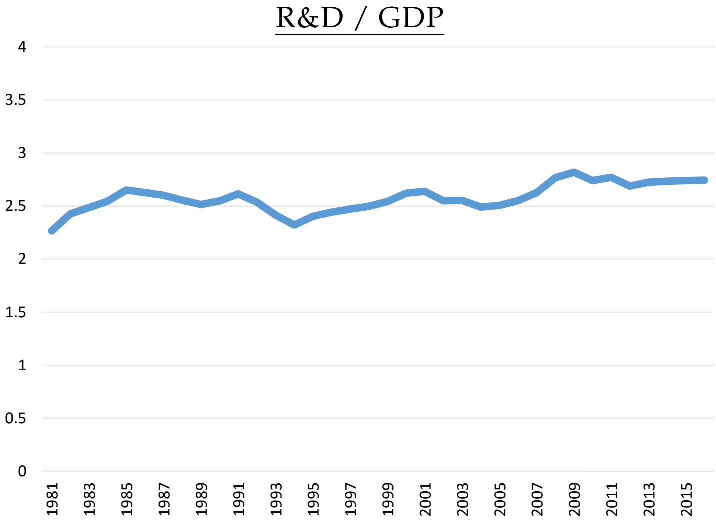

Source: Akcigit and Ates (2018)

Empirical Fact (2)

$\rightarrow$ *Patent per incumbent firms has increased.*

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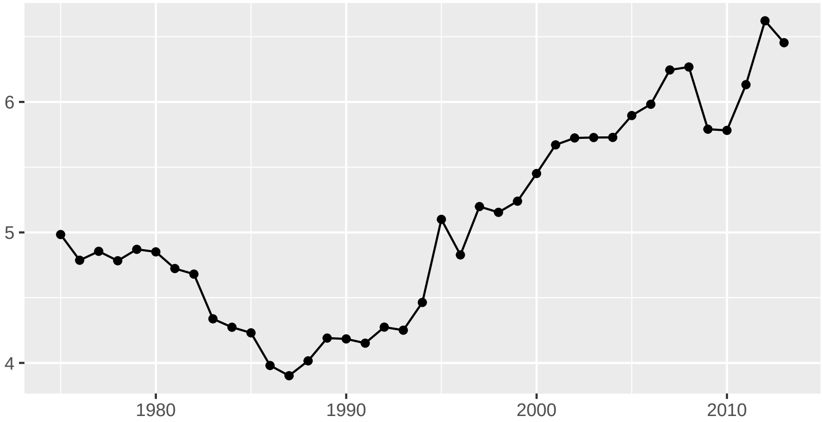
PATENT PER FIRM



Source: Akcigit and Ates (2018)

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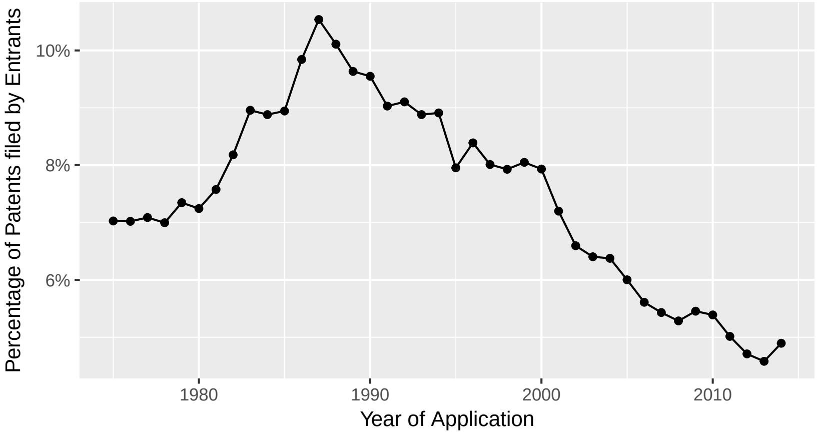
PATENTING SHARE BY NEW ENTRANTS



Source: Akcigit and Ates (2018)

Empirical Fact (4)

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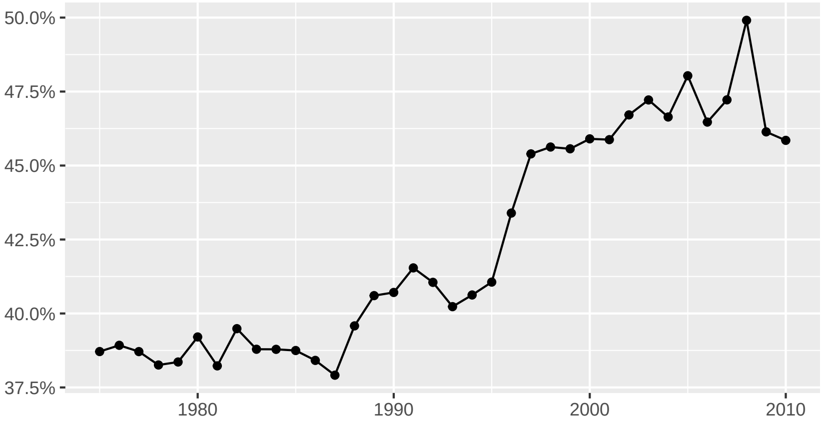
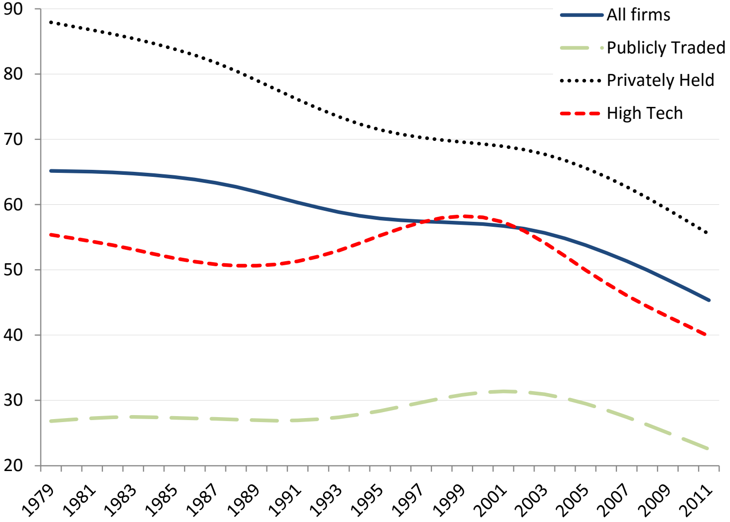
→ *Patenting concentration has increased.*

TOP-1% PATENTING SHARE



Source: Akcigit and Ates (2018)

90-10 Gap by Sector



Source: Decker, Haltiwanger, Jarmin, and Miranda (2016b)

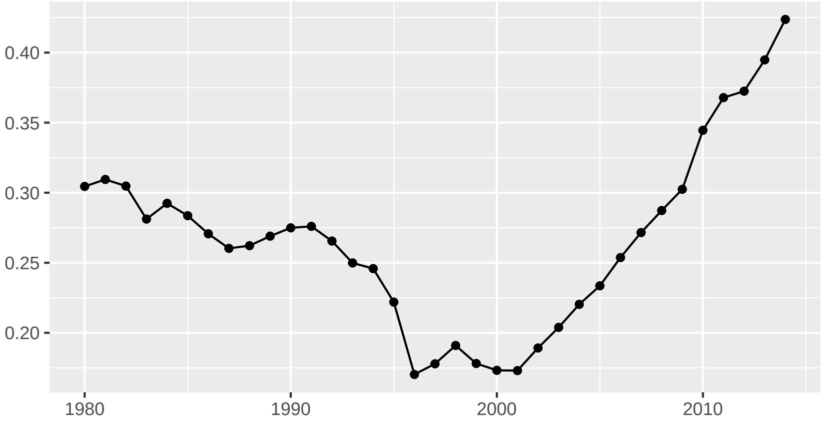
Empirical Fact (5)

→ *Patents have become less exploratory.*

Empirical Fact (5)

→ Patents have become less exploratory.

FRACTION OF SELF CITATIONS



Source: Akcigit and Ates (2018)

Conclusions

We find that:

- Trends cannot be explained by rising entry costs.
- They are more consistent with incumbent favoring IP policies.
- Intuition: Entrants lose hope of competing with incumbents, hence they give up.
- Empirically, innovation has been more concentrated and become less radical.
- Policy implications: Reduced entry barriers might not be effective since firms are forward looking and incumbents are hard to compete with.
- Policies should influence the competition dynamics "after" entry and this can have a positive trickle-down effect on incentives.

Thank You...

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Inequality and Innovation

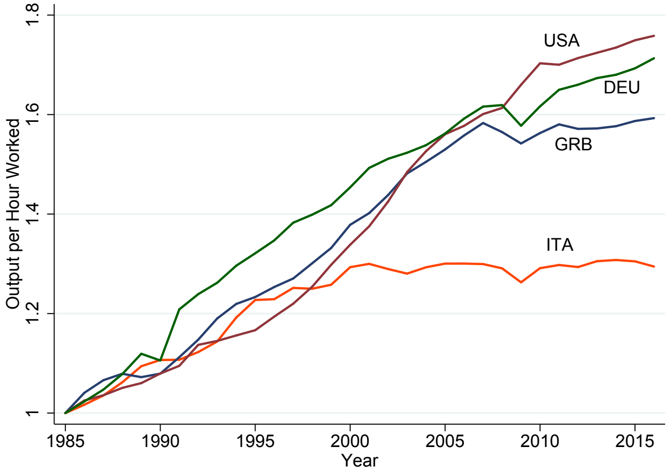
Lecture Slides 5: Political Connections and Innovation[1]

Ufuk Akcigit
University of Chicago

January 7, 2019

[1]Based on Akcigit, Baslandze, Lotti (2018)

Performance of the Italian Economy



Political Connections I

Silvio Berlusconi (Entrepreneur) vs **Bettino Craxi** (PM)

Political Connections II

"The mayor is a close friend. I have to say that he contacted me a long way before his election, telling me that he would definitely be elected and offered me to buy his agricultural land in Cassano, known as La Taranta, for which I would have had to pay as if it was a building area already. Moreover, he said he had to get rid of the land before becoming mayor. He also told me that he would take care of granting permission to build on that area."

La Repubblica (May 26, 2011, p. 7)

"There are public officials who, instead of serving the interests of the community, put themselves at the service of private individuals. It's a devastating situation: those firms that have political and administrative support, thanks to the "good" friend, manage to obtain illicit benefits, while honest companies look astonished at what happens."

Carmelo Zuccaro, Chief Prosecutor of Catania[1]

La Sicilia, May 3rd, 2018

Motivation

- A growing empirical literature emphasizes the importance of factor reallocation from less productive to more productive firms
  $\rightarrow$ *Bartelsman and Doms, 2000; Foster, Haltiwanger, and Krizan, 2001, 2006; Hsieh and Klenow, 2014*.

- Theoretically, the basic premise of creative destruction models is that it is sufficient for an entrant to come up with a better technology or quality product to replace an incumbent
  $\rightarrow$ *Aghion and Howitt, 1992; Grossman and Helpman, 1991*.

Motivation

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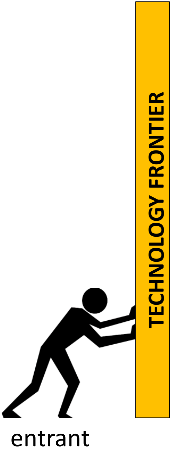
  $\rightarrow$ *Aghion and Howitt, 1992; Grossman and Helpman, 1991*.

IS THIS REALLY THE CASE?

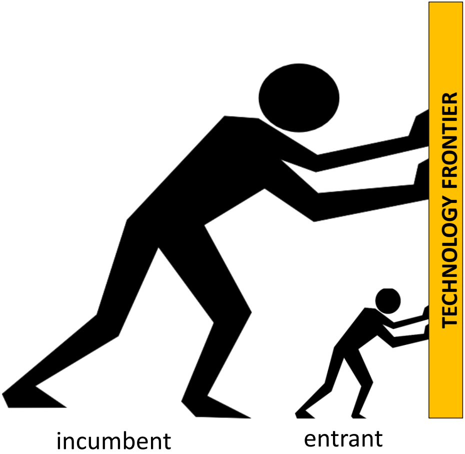
Pushing the Frontier via Creative Destruction

ALTERNATIVE MODELS

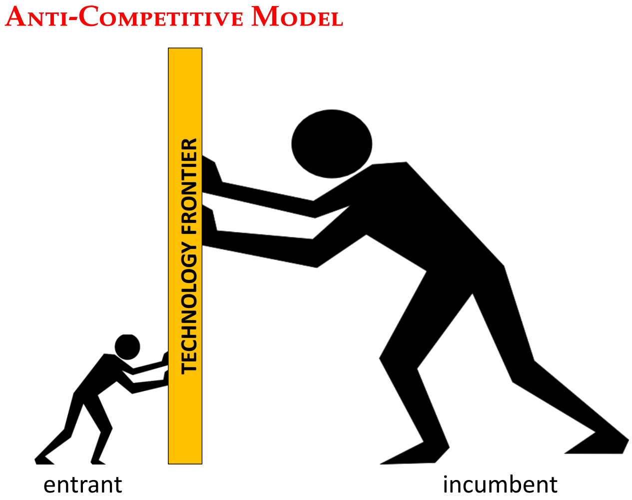


Pushing the Frontier via Creative Destruction

PRO-COMPETITIVE MODEL



Pushing the Frontier via Creative Destruction



Research Question

$\Longrightarrow$

$\Longleftarrow$

Research Question

$\Longrightarrow$

$\Longleftarrow$

Research Question:

How do political connections affect firm dynamics, innovation and creative destruction?

Which Politicians?

Local Politicians – distinct feature of our analysis.

- More pervasive, harder to detect.
- Substantial power:
  - Issue permits and licenses,
  - construction planning,
  - provide local public goods and services
    $\rightarrow$ public utilities, health care, transport, waste management
  - taxes (in some cases).
- Further increase of power since the 90's.

Akcigit, Baslandze, Lotti'18 (ABL)

Empirical Analysis

- **A brand-new data** from Italy linking:
  1. Social security data on individuals;
  2. Firm-level data;
  3. Registry of 500K local politicians between 1985-2014;
  4. Election data;
  5. Patent data.
- **Main analysis**:
  - Macro level: industry performance;
  - Micro level: firm performance.
- **Causal identification**:
  - Exploit marginal election outcomes.

Theoretical Analysis

- **A new theory of innovation and firm dynamics**:
  - Entrants replace incumbents through creative destruction;
  - Firms decide on innovation and political connections;
  - Helps with the interpretation and identification the mechanism.

Literature

Reallocation, firm dynamics:

- Foster, Haltiwanger, Krizan (2000, 2006), Bartelsman and Doms (2000), Restuccia and Rogerson (2008), Acemoglu et al. (2013) ; Aghion and Howitt (1992), Grossman and Helpman (1991), Klette and Kortum (2004).

Private returns from political connections:

- Fisman (2001), Johnson and Mitton (2003), Khwaja and Mian (2005), Dinc (2005), Faccio and Parsley (2006), Goldman et al. (2013), Schoenherr (2015), Acemoglu et al. (2017).

Social costs from political connections:

- Greasing wheels hypothesis: Shleifer and Vishny (1994), Kauffman and Wei (1999)
  Grabbing hands hypothesis: Shleifer and Vishny (1998).
- Public good provision – Cingano and Pinotti (2013); misallocation – Garcia-Santana et al. (2016) and Arayavechkit et al. (2017).

Empirical Analysis

Data

Social Security Data

Source: INPS

Universe of private sector (except agriculture), 1985-2014.

Individual level:

Demographics,
Employment history,
Labor income,
Job characteristics.

Firm-level:

Entry/exit
Size
Worker characteristics,
Industry,
Location.

Data

Social Security Data

Source: INPS

Universe of private sector (except agriculture), 1985-2014.

Individual level:

Demographics,
Employment history,
Labor income,
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Firm-level:

Entry/exit
Size
Worker characteristics,
Industry,
Location.

- *5 mln unique firms*
- *42 mln firm-year obs*

Data

Firm Level

Firm-level Data

Source: Cerved.

- Universe of limited companies, 1993-2014.
- Balance sheet, income statement, measure of firm's credit worthiness.

- *1 mln unique firms*
- *7 mln firm-year obs*

Social Security Data

Source: INPS

Universe of private sector (except agriculture), 1985-2014.

Individual level:

Demographics,
Employment history,
Labor income,
Job characteristics.

Firm-level:

Entry/exit
Size
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Data

Firm Level

Social Security Data

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Universe of private sector (except agriculture), 1985-2014.

Individual level:

Demographics,
Employment history,
Labor income,
Job characteristics.

Firm-level:

Entry/exit
Size
Worker characteristics,
Industry,
Location.

- *66K patent families*
- *14K innovating firms*

Patent Data

Source: PATSTAT.

- All EPO patents filed by Italian firms in 1990-2014.
- Patent characteristics: patent families, grant status, technology classification, citations received, claims.

Data

Social Security Data

Source: INPS

Universe of private sector (except agriculture), 1985-2014.

Individual level:

Demographics,
Employment history,
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Job characteristics.

Firm-level:

Entry/exit
Size
Worker characteristics,
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Data

Individual Level

Registry of Local Politicians (RLP)

Source: Ministry of the Interior.

- Universe of local politicians (regional, province, municipality level) 1985-2014.
- Demographics, education, position attributes, party affiliation.

- *515K unique politicians*
- *2.8 mln observations*
- *11% (vice)mayor/(vice)president*
  20% executive positions
  69% council members
- *31% work in private firms*
- *145K firms ever get connected*

Social Security Data

Source: INPS

Universe of private sector (except agriculture), 1985-2014.

Individual level:

Demographics,
Employment history,
Labor income,
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Size
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Individual Level

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Elections Data

Source: Ministry of the Interior + own data collection.

- Local elections (regional, province, municipality) 1993-2014.
- Candidates, parties/coalitions, allocation of votes and seats.
- Identify marginally contested elections and its winners and losers.

Social Security Data

Source: INPS

Universe of private sector (except agriculture), 1985-2014.

Individual level:

Demographics,
Employment history,
Labor income,
Job characteristics.

Firm-level:

Entry/exit
Size
Worker characteristics,
Industry,
Location.

- *36K elections*
- *5K with 5% margin of victory*

Data

Individual Level

Registry of Local Politicians (RLP)

Source: Ministry of the Interior.

- Universe of local politicians (regional, province, municipality level) 1985-2014.
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- Candidates, parties/coalitions, allocation of votes and seats.
- Identify marginally contested elections and its winners and losers.

Social Security Data

Source: INPS.

Universe of private sector employment, 1985-2014 (except agriculture), .

Individual level:	**Firm-level:**
Demographics, Employment history, Labor income, Job characteristics.	Entry/exit Size Worker characteristics, Industry, Location.

Firm Level

Firm-level Data

Source: Cerved.

- Universe of limited companies, 1993-2014.
- Balance sheet, income statement.

Patent Data

Source: PATSTAT.

- All EPO patents filed by Italian firms in 1990-2014.
- Patent characteristics: patent families, grant status, technology classification, citations received, claims.

Firms' Connections with Local Politicians

- *Connection*: dummy equal to one at t if a firm employs any local politician at time t.
- *High-rank Connection*: dummy equal to one at t if a firm employs at least one mayor/president/vice-mayor/vice-president at t.
- Italy has:
  - 8000 municipalities
  - 110 provinces
  - 20 regions

Empirical Analysis: Outline

I. Summary Statistics.

II. Firm Moments:

1. Connection vs innovation;
2. Survival;
3. Firm Size Growth;
4. Productivity growth.

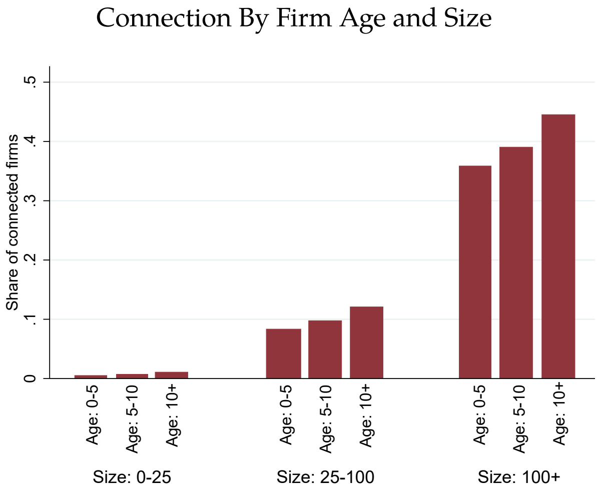
III. Politicians' Facts.

Summary Statistics

Table 2: Statistics on Local Politicians

Category	Position	Share
Regional Rank:	Region	0.8%
	Province	2.6%
	Municipality	96.6%
Hierarchical Rank:	Mayor, President, Vice-mayor, Vice-president	11.3%
	Executive councilor	19.6%
	Council member	69.1%
Majority Affiliation:	Majority	73%

Share of Connected Firms



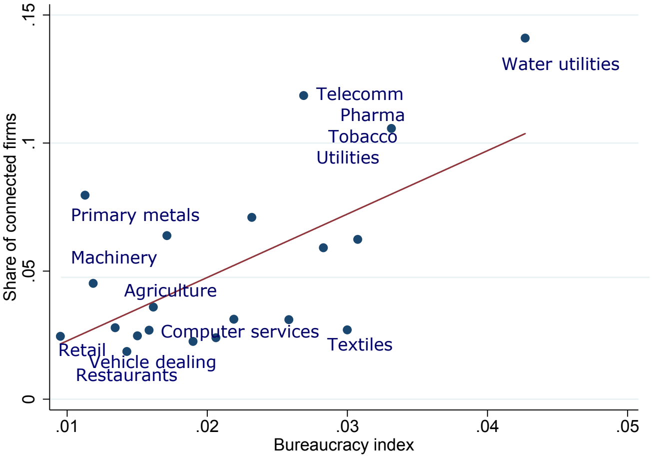
- Connected firms account for 32% of employment.

Which Industries Are Connected?

- Look at newspaper articles from four large news providers: Bloomberg, Dow Jones Adviser, Financial Times, The Wall Street Journal
- Keywords: regulation*, regulated, regulator, bureaucracy, bureaucratic, deregulation, deregulated, paperwork*, red tape, license and licenses
- ABL calculate the "Bureaucracy Index" of sector i as follows:

$$Bureaucracy\_Index(i) = \frac{[\text{All articles related to } i] \;\cap\; [\text{All articles that contain keywords}]}{\text{All articles related to } i}.$$

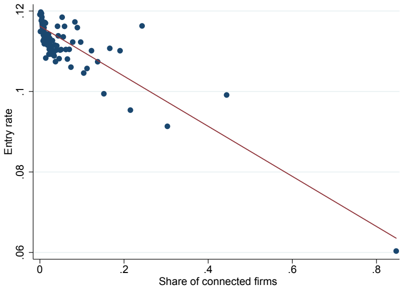
Which Industries Are Connected?



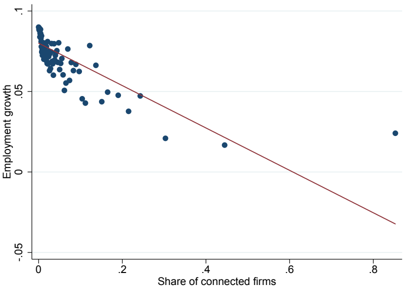
Summary Statistics, ctd

CONNECTIONS AND INDUSTRY DYNAMICS

Entry Rate and Connections



Growth and Connections



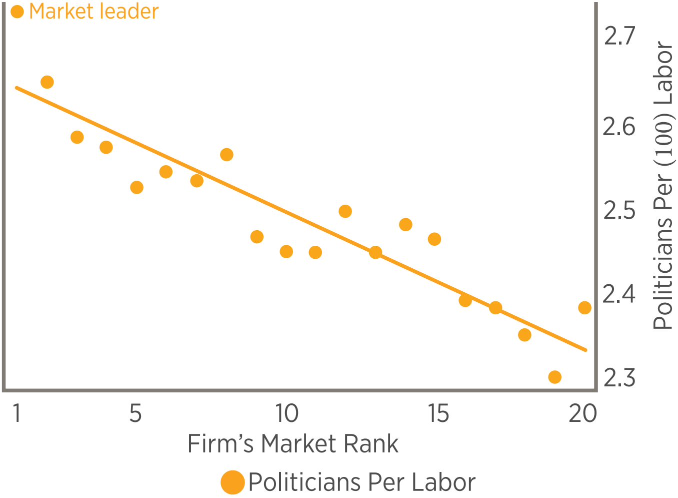
Notes: Binscatter plots from industry × region × year level regressions. Variables on Y axis are adjusted for industry, year, and region fixed effects. Variables on X axis: share of firms connected. Details More

II. Firm Moments

Leadership Paradox: Connection vs Innovation

Market = 6-digit industry × 20 Regions × 1993-2014
Rank: by employment share

Leadership Paradox: Leadership and Connection



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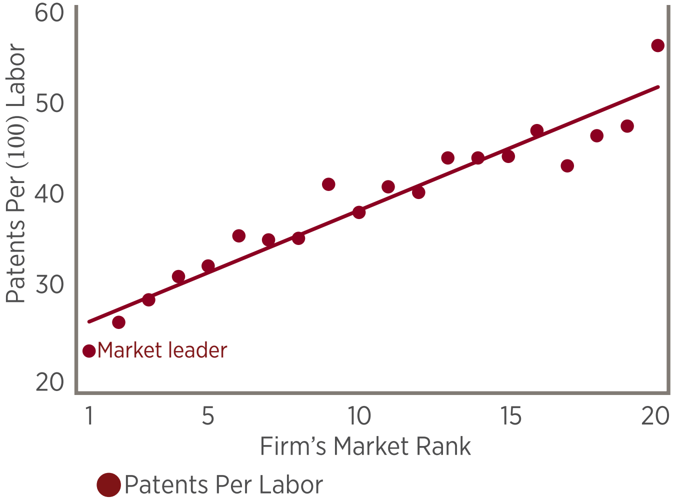

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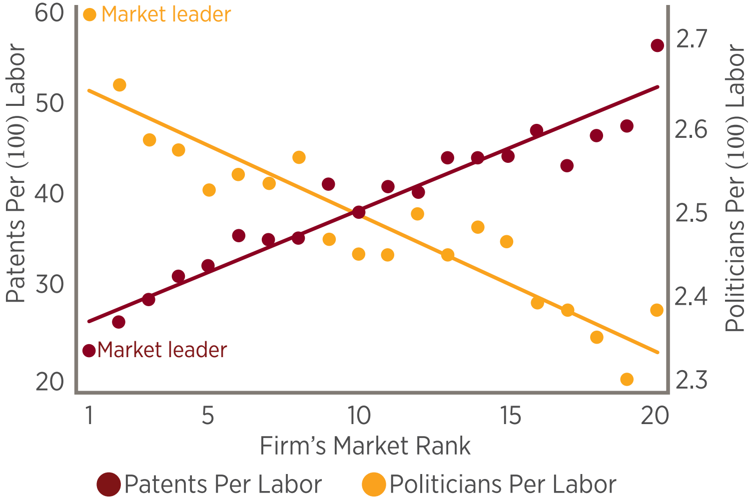
Leadership Paradox: Innovation and Connection



Market = 6-digit industry × 20 Regions × 1993-2014
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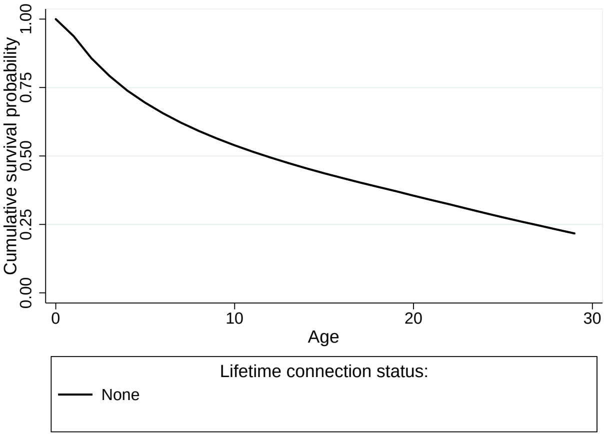
2. **Firm Performance:** Firm Survival and Connection



- *Average (any) connection* → 9% ↓ exit hazard rate.

Cox

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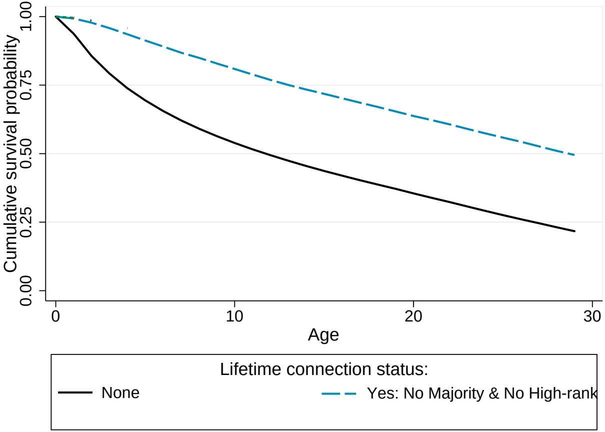

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▸ Cox

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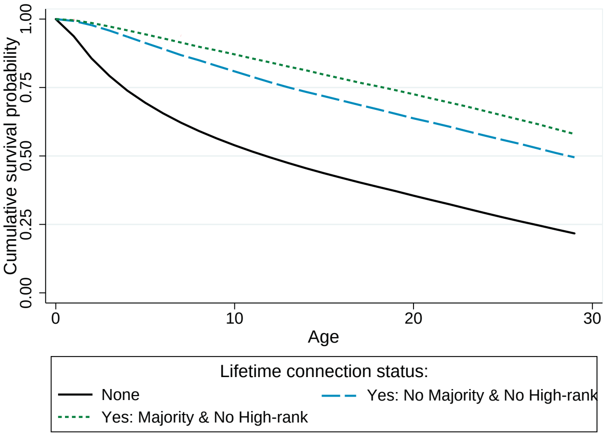

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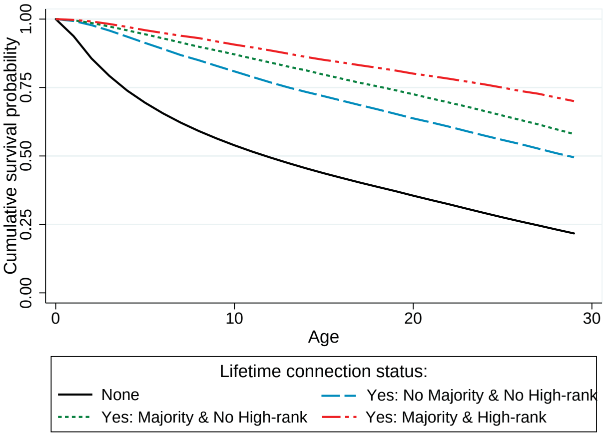

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▸ Cox

3. **Firm Performance:**
Firm Growth and Political Connection

	Empl growth (OLS)	Empl growth (FE)	VA growth (OLS)	VA growth (FE)
Connection	0.032***	0.040***	0.039***	0.014***
	(0.001)	(0.002)	(0.002)	(0.002)
Connection major	0.003*	0.007***	0.010***	0.002
	(0.001)	(0.002)	(0.002)	(0.002)
Log Assets	0.065***	0.203***	0.036***	-0.091***
	(0.000)	(0.001)	(0.000)	(0.001)
Log Size	-0.077***	-0.384***	-0.080***	-0.235***
	(0.000)	(0.001)	(0.000)	(0.001)
Age	-0.002***	-0.011***	-0.004***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Industry FE	YES	NO	YES	NO
Firm FE	NO	YES	NO	YES
Observations	6545131	6585740	5684519	5710338

Notes: Firm-level regressions. *Connections*/*Connection major* are dummy variables equal to one if firm is connected with any/majority-party politician at time t. Results using connection definition using high-rank politicians is here

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Year FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Industry FE	YES	NO	YES	NO
Firm FE	NO	YES	NO	YES
Observations	6545131	6585740	5684519	5710338

Notes: Firm-level regressions. *Connections*/*Connection major* are dummy variables equal to one if firm is connected with any/majority-party politician at time t. Results using connection definition using high-rank politicians is here.

4. **Firm Performance:**
Productivity Growth and Political Connection

	LP growth (OLS)	LP growth (FE)	TFP growth (OLS)	TFP growth (FE)
Connection	-0.014***	-0.028***	-0.008***	-0.019***
	(0.002)	(0.002)	(0.001)	(0.002)
Connection major	-0.001	-0.004	0.000	-0.003
	(0.002)	(0.003)	(0.002)	(0.002)
Log Assets	-0.028***	-0.274***	-0.001***	-0.106***
	(0.000)	(0.001)	(0.000)	(0.001)
Log Size	0.021***	0.274***	-0.006***	0.125***
	(0.000)	(0.001)	(0.000)	(0.001)
Age	-0.001***	-0.002***	-0.001***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Industry FE	YES	NO	YES	NO
Firm FE	NO	YES	NO	YES
Observations	5598367	5623077	5271002	5291979

Notes: Firm-level regressions. *Connections*/*Connection major* are dummy variables equal to one if firm is connected with any/majority-party politician at time t. Results using connection definition using high-rank politicians is

▸ here

4. **Firm Performance:**
Productivity Growth and Political Connection

	LP growth (OLS)	LP growth (FE)	TFP growth (OLS)	TFP growth (FE)
Connection	-0.014***	-0.028***	-0.008***	-0.019***
	(0.002)	(0.002)	(0.001)	(0.002)
Connection major	-0.001	-0.004	0.000	-0.003
	(0.002)	(0.003)	(0.002)	(0.002)
Log Assets	-0.028***	-0.274***	-0.001***	-0.106***
	(0.000)	(0.001)	(0.000)	(0.001)
Log Size	0.021***	0.274***	-0.006***	0.125***
	(0.000)	(0.001)	(0.000)	(0.001)
Age	-0.001***	-0.002***	-0.001***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Industry FE	YES	NO	YES	NO
Firm FE	NO	YES	NO	YES
Observations	5598367	5623077	5271002	5291979

Notes: Firm-level regressions. *Connections*/*Connection major* are dummy variables equal to one if firm is connected with any/majority-party politician at time t. Results using connection definition using high-rank politicians is here

4. **Firm Performance:** Productivity Growth and Political Connection

	LP growth (OLS)	LP growth (FE)	TFP growth (OLS)	TFP growth (FE)
Connection	-0.014***	-0.028***	-0.008***	-0.019***
	(0.002)	(0.002)	(0.001)	(0.002)
Connection major	-0.001	-0.004	0.000	-0.003
	(0.002)	(0.003)	(0.002)	(0.002)
Log Assets	-0.028***	-0.274***	-0.001***	-0.106***
	(0.000)	(0.001)	(0.000)	(0.001)
Log Size	0.021***	0.274***	-0.006***	0.125***
	(0.000)	(0.001)	(0.000)	(0.001)
Age	-0.001***	-0.002***	-0.001***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Industry FE	YES	NO	YES	NO
Firm FE	NO	YES	NO	YES
Observations	5598367	5623077	5271002	5291979

Notes: Firm-level regressions. *Connections*/*Connection major* are dummy variables equal to one if firm is connected with any/majority-party politician at time t. Results using connection definition using high-rank politicians is is here

Firm Performance: Causal Inference

Causality: RD Design

- **Causal identification** of the effect of connections on growth.
- **Regression discontinuity (RD) design**:
  - Discontinuities in local elections decided on a thin margin.
  - Close races determined by a "chance" (Lee, 2008):
    $\rightarrow$ *random assignment of treatment*.
  - Compare firms connected with politicians from marginally winning vs marginally losing parties right before the election.
- 37,005 elections at municipality, province, and regional level.
- 2.3K (5.7K) with 2% (5%) margin of victory.

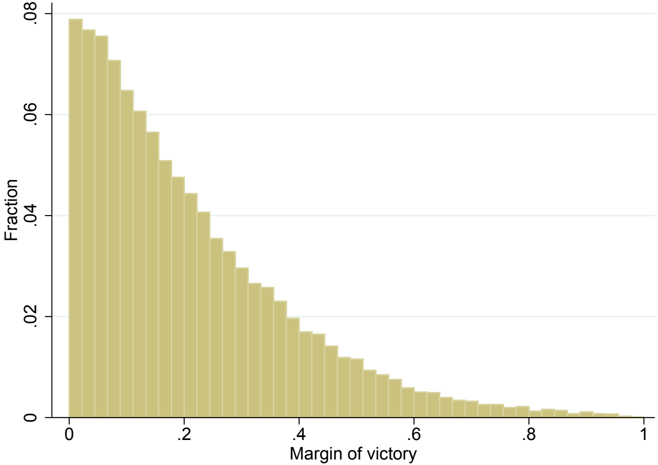
Marginal Election Counts by Provinces

2% victory margin

- 37,005 elections at municipality, province and regional level;
- 2.3K (5.7K) with 2% (5%) margin of victory.

Election Margin Distribtuion

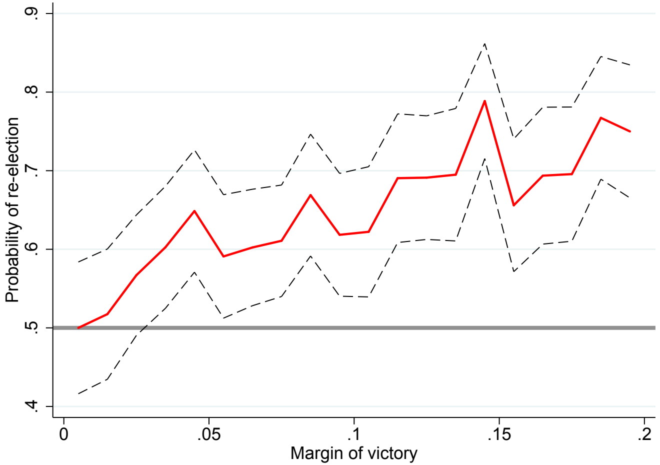
Figure 8: Distribution of Elections by Margins of Victory



$$\text{Margin of victory} = p_{winner} - p_{loser}$$

Probability of Re-election

Probability of Re-election against the Victory Margin



▸ Composition

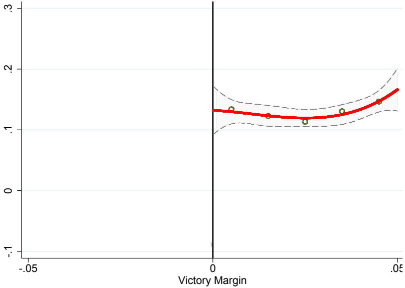
RD Estimation

$$y_{iT(m)} = \alpha + \beta Win_{iT(m)-1} + f(margin_m) + (\delta_1 X_{iT(m)} + \delta_2 X_m + \delta_3 X_T) + \nu_{iT(m)}$$

- $T(m)$ - time of a marginal election m.
- $y_{iT(m)}$ - outcome for firm i at $T(m)$.
- $Win_{iT(m)-1}$ - dummy equal to one if at $T(m) - 1$ i is connected with a member of a marginally winning party in the election m at $T(m)$.
- $Margin_m$ - victory margin: difference in vote shares btw a winner and the runner-up.
- $f(margin_m)$ is a third-order smooth polynomial estimated on both sides of the threshold.
- $X_{iT(m)}, X_m, X_T$: firm controls, time, location F.E.

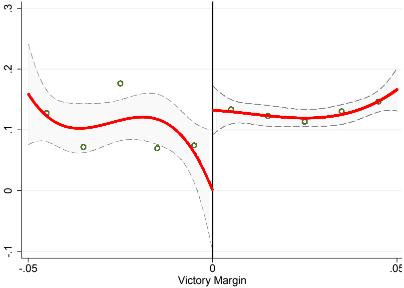
Employment Growth (within 5%, 10% Margins)

Empl Growth After Election $(T \rightarrow T+1, 5\%)$ Empl Growth After Election $(T \rightarrow T+1, 10\%)$



Employment Growth (within 5%, 10% Margins)

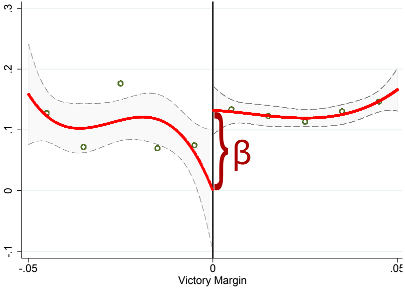
Empl Growth After Election ($T \to T+1, 5\%$)



Empl Growth After Election ($T \to T+1, 10\%$)

Employment Growth (within 5%, 10% Margins)

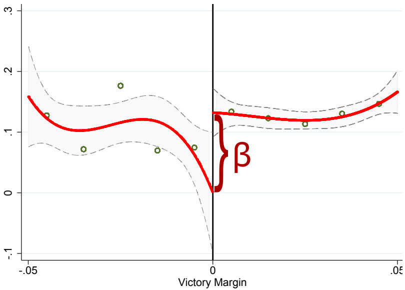
Empl Growth After Election ($T \to T+1$, 5%)



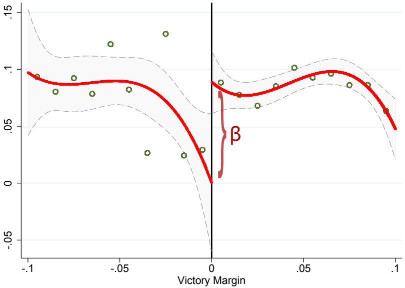
Empl Growth After Election ($T \to T+1$, 10%)

Employment Growth (within 5%, 10% Margins)

Empl Growth After Election $(T \to T+1, 5\%)$

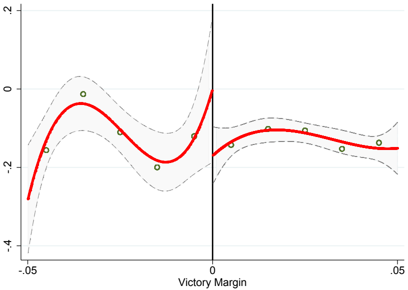


Empl Growth After Election $(T \to T+1, 10\%)$

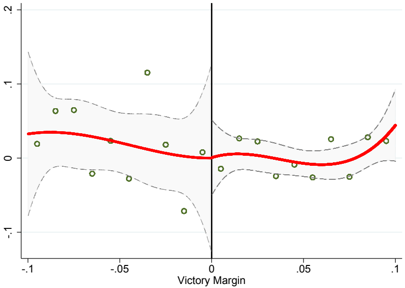


Productivity Growth (within 5%, 10% Margins)

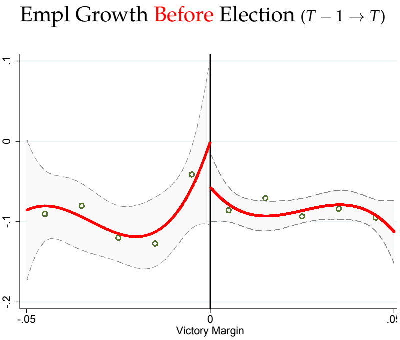
LP Growth After Election $(T \rightarrow T+1, 5\%)$

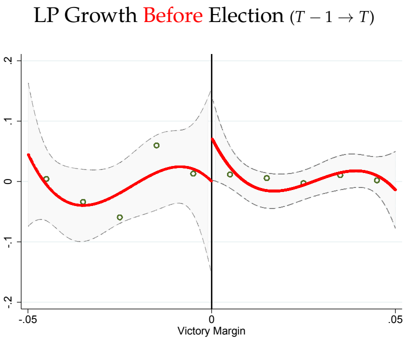


LP Growth After Election $(T \rightarrow T+1, 10\%)$



RD Validation: Pre-Trends in Firm Growth





RD Validation: Balancing Test

— Panel A. Sample of 2% Victory Margin —

Dependent variable:	Log Size	Log Value Added	Log Assets	Log Intangibles	Log Labor Productivity
Win Dummy	0.0665	0.0718	-0.000265	0.0404	-0.0636
	(0.0676)	(0.112)	(0.120)	(0.183)	(0.0581)
Controls	none	none	none	none	none
Observations	2,444	1,354	1,398	1,319	1,336

Dependent variable:	Log Profits	Age	Center	North
Win Dummy	-0.100	-1.242	-0.0268	-0.0120
	(0.163)	(0.654)	(0.0194)	(0.0245)
Controls	none	none	none	none
Observations	999	2,521	2,523	2,523

— Panel B. Full Specification with the Sample of 20% Victory Margin —

Dependent variable:	Log Size	Log Value Added	Log Assets	Log Intangibles	Log Labor Productivity
Win Dummy	0.0678	-0.0443	-0.0993	-0.143	-0.0575
	(0.0849)	(0.136)	(0.149)	(0.227)	(0.0703)
Controls	yes	yes	yes	yes	yes
Observations	23,790	13,127	13,505	12,700	12,986

Dependent variable:	Log Profits	Age	Center	North
Win Dummy	-0.142	-0.903	-0.00687	-0.0252
	(0.203)	(0.839)	(0.0245)	(0.0310)
Controls	yes	yes	yes	yes
Observations	9,741	24,414	24,453	24,453

Robustness and RD Validation

- Robustness with various margins of victory bands;
- Pre-trends in outcomes;
- Balancing tests;
- 1^{st}- or 2^{nd}-order polynomial;
- Regressions with or without controls.
- Firm survival using RD.

III. Politicians' Facts

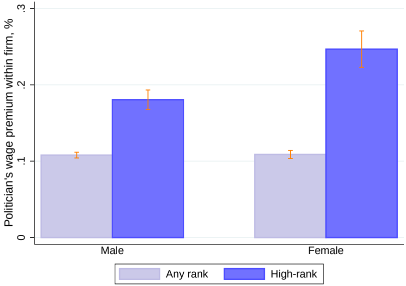
1. Within group

2. Within individual

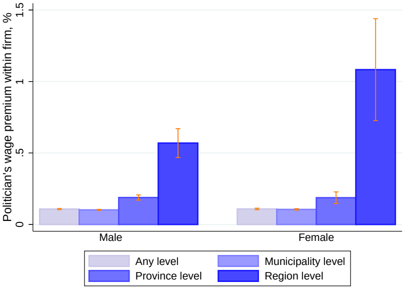
Politician's Compensation: Within Group

Within-group wage premium (within white-collar)

Hierarchical Rank



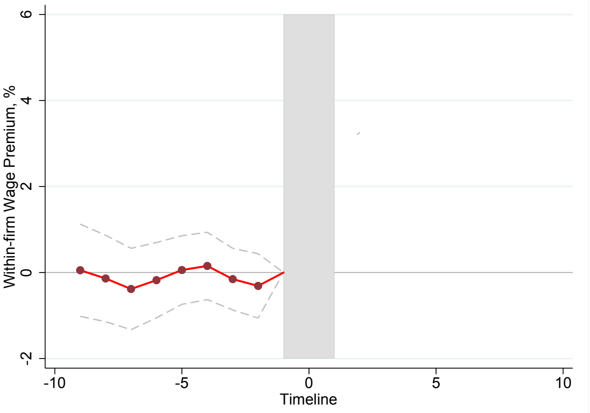
Regional Rank



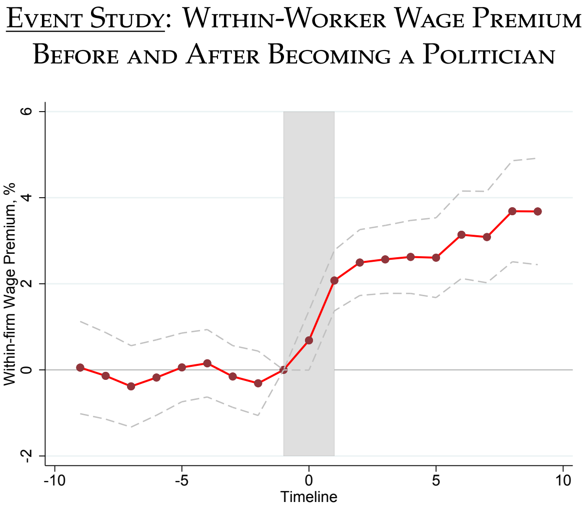
Notes: Wage premium – politician's wage relative to same job collar and gender co-workers' average wage minus one. Figure reports premium for the white-collar workers.

Politician's Compensation: Within Individual

Event Study: Within-Worker Wage Premium
Before and After Becoming a Politician

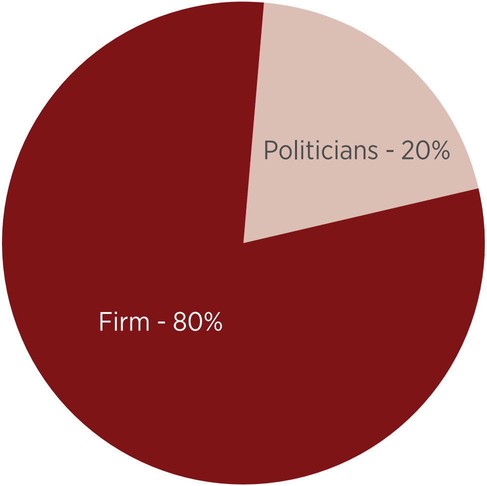


Politician's Compensation: Within Individual



Surplus Division

- Back of the envelope calculation for the rent division:
  - Politician: Estimated yearly wage premium in a firm.
  - Firm: Estimated profit gain from connection.



Stylized Facts, Summary

1. Market **leadership** is associated with:
   - higher politicians intensity;
   - lower innovation intensity.

2. Connected firms are older.

3. Connected firms are less likely to exit.

4. Connected firms experience
   - higher employment and sales growth;
   - lower productivity growth.

   } **Causality** using RD design.

5. **Industries** with more politically connected firms have
   - lower entry and higher share of connected entrants;
   - lower share of young firms, firm growth and productivity.

6. **Politicians** have significant wage premia over co-workers.

Motivating Model

Model

- Starting point: **Benchmark Schumpeterian Model**
- **Frictions**: at each time, firms face wedges in the input market.
  - Hsieh and Klenow (2009) – reduced form representation;
  - Example of various employment regulations:
    $\rightarrow$ form a "work council",
    $\rightarrow$ union representation,
    $\rightarrow$ health & safety committee,
    $\rightarrow$ benefits, hiring & firing costs,
    $\rightarrow$ regulation/bureaucracy costs
  - Relevant for Italy: Firms' spending on bureaucracy is estimated 1.6% of GDP (private R&D/GDP = 0.6%).
- Political connections reduce these frictions but come at a cost.
- Start from a model where connections are "well-intended".
- Model highlight **static** gains vs **dynamic** losses.

Static Problem 1

- Unique sectoral output (Y) is produced as:

$$Y = \frac{1}{1-\beta}\left[\sum_{m=1}^{M} q_m^{\frac{\beta}{1-\beta}} y_m\right]^{1-\beta}$$

- y_m: quantity of vintage $m \in \{1, .., M\}$.
- Different vintages are perfect substitutes after adjusting for their quality.
- Incumbents or entrants can introduce $M+1st$ vintage
  $\rightarrow$ **yet it might not get implemented**.

Static Problem 2

- Final good producer solves:

$$\max_{y_m} \left\{ \frac{1}{1-\beta} \left[\sum_{m=1}^{M} q_m^{\frac{\beta}{1-\beta}} y_m \right]^{1-\beta} - \sum_{m=1}^{M} p_m y_m \right\} \tag{1}$$

- Monopolist j produces with the following technology

$$y_j = l_j. \tag{2}$$

Static Problem 3

- Regulations create "wedges" à la Hsieh and Klenow (2009).
  $\implies$ For each unit of input, wedge implies extra τ cost.
  $\implies$ Political connection removes the wedge but introduces cost of the politician w^p.

- **Non-connected firm**:

$$\pi^n = \max_l \{py - (1+\tau)wl\} \quad \text{subject to (1) and (2).}$$

- **Politically connected firm**:

$$\pi^p = \max_l \{py - wl - w^p\} \quad \text{subject to (1) and (2).}$$

w^p : exogenous politician compensation (*later endogenized*).

Static Problem 4

	If *not* connected		If connected	Change
Labor	$\left[\frac{(1-\beta)}{(1+\tau)w}\right]^{\frac{1}{\beta}} q$	vs	$\left[\frac{(1-\beta)}{w}\right]^{\frac{1}{\beta}} q$	$\uparrow$
Revenue	$\left[\frac{(1-\beta)}{(1+\tau)w}\right]^{\frac{1-\beta}{\beta}} q$	vs	$\left[\frac{(1-\beta)}{w}\right]^{\frac{1-\beta}{\beta}} q$	$\uparrow$
LP	$\frac{(1+\tau)w}{(1-\beta)}$	vs	$\frac{w}{(1-\beta)}$	$\downarrow$

PREDICTION 1: *Connections lead to higher employment, revenue and profits BUT lower labor productivity.*

Static Problem 5

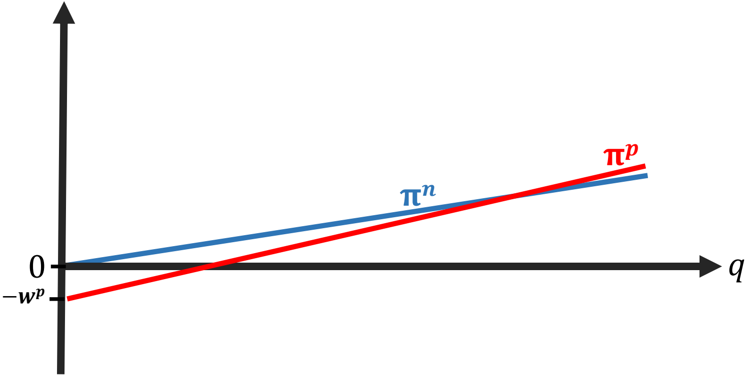
- Define: $\Pi \equiv \beta \left[\frac{1-\beta}{w}\right]^{\frac{1-\beta}{\beta}}$ and set $\beta = 1/2$:

$$\pi^n = \frac{\Pi q}{1+\tau} \quad \text{and} \quad \pi^p = \Pi q - w^p$$

- Connect iff $\pi^p > \pi^n$, i.e.,

$$q_i > \hat{q}^s \equiv \frac{w^p}{\Pi}\frac{(1+\tau)}{\tau}.$$

Static Connection Decision



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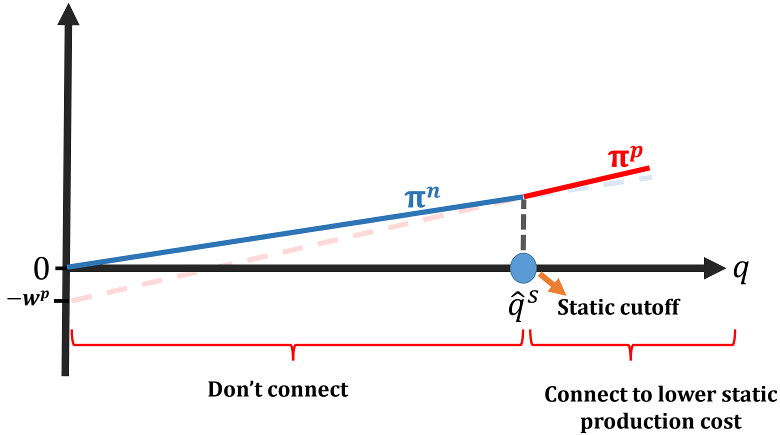

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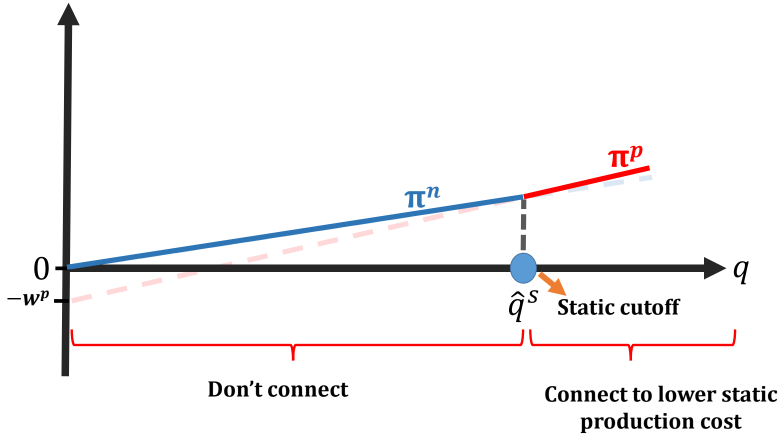

Prediction 2: *Large firms are more likely to get connected.*

Prediction 3: *For any given size, firms are more likely to get connected if the industry is more regulated* ($\tau \uparrow$).

Dynamics 1

- Introduce entry and innovation.

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Entry. Connections:

- Share of firms α enters as type=1.
- Switch from type=0 to type=1 at a Poisson arrival rate of ζ.

Dynamics 2

Endogenous Entry:

- Innovation arrival rate is p.
- Draw an innovation size $\lambda \sim F(0, \infty)$:

$$q_{M+1} = (1 + \lambda) q_M.$$

Dynamics 3

Entrants have better technology but are usually disadvantaged in removing regulatory burden:

- Case 1: incumbent type=0, entrant type=0: $\lambda > 0$

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- Case 3: incumbent type=0, entrant type=1: $\lambda > 0$
- Case 4: incumbent type=1, entrant type=0:
  - Subcase 1 ($q < \hat{q}^d$): incumbent $\rightarrow$ do not connect: $\lambda > 0$
  - Subcase 2 ($q \geq \hat{q}^d$): incumbent $\rightarrow$ connect: $\lambda > \lambda^* \equiv \tau$

Hence, when $q \geq \hat{q}^d$, probability of replacement is:

$$\tilde{p} = p[\alpha + (1 - \alpha) \Pr(\lambda > \lambda^*)]$$

Dynamics 4

We need to solve for $\hat{q}^d$

- V_{-1}: Firm value for $q < \hat{q}^d$
- V_1: Firm value for $q \geq \hat{q}^d$ when type=1
- V_0: Firm value for $q \geq \hat{q}^d$ when type=0

$$rV_{-1} = \Pi (1+\tau)^{-1} q - pV_{-1}$$

$$rV_1 = \Pi q - w^p - \tilde{p} V_1$$

$$rV_0 = \Pi (1+\tau)^{-1} q - pV_0 + \zeta [V_1 - V_0]$$

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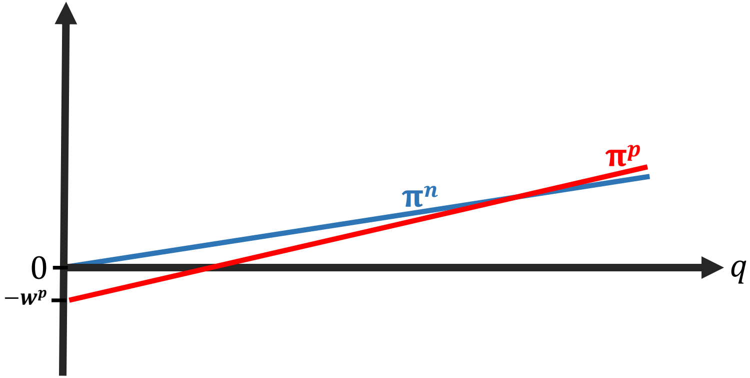
Dynamics. Connection Decision



Preemptive motives to connect: firms connect earlier to reduce incentives of others to enter and compete.

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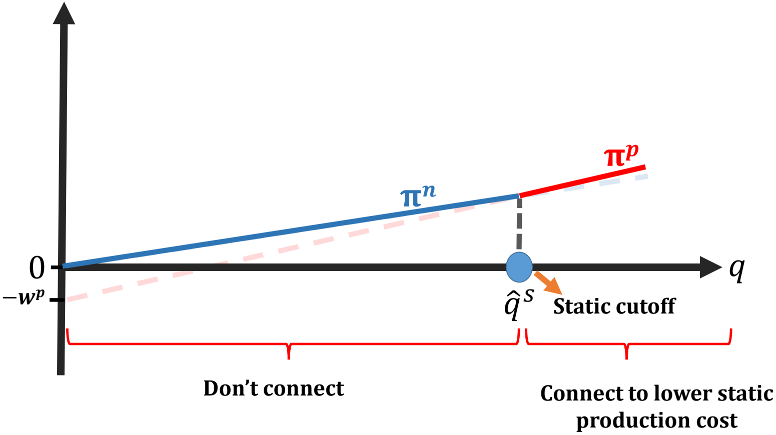

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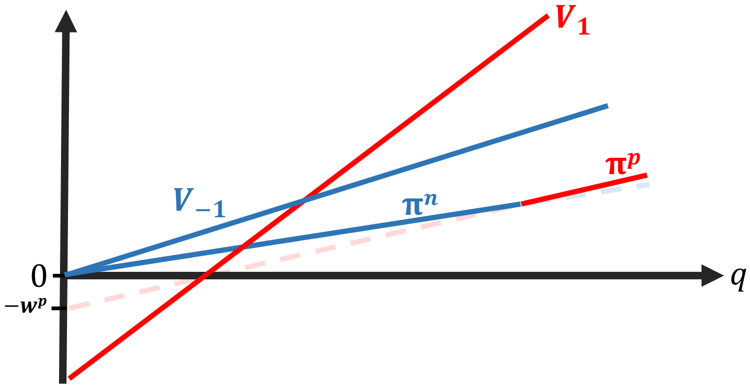

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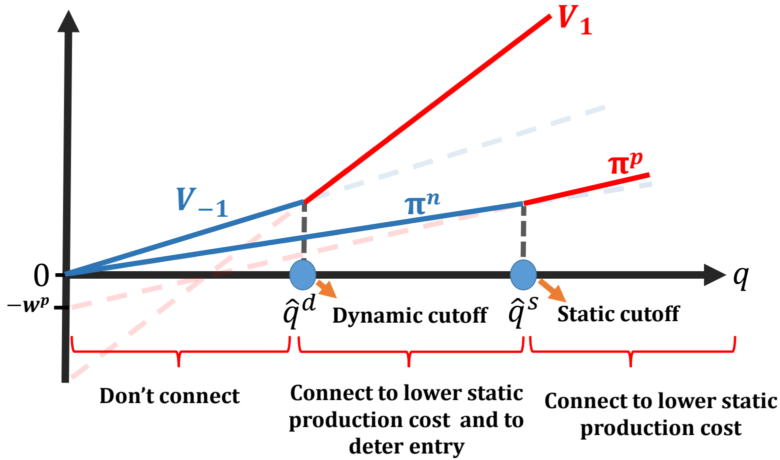


Preemptive motives to connect: firms connect earlier to reduce incentives of others to enter and compete.

Model. Discussion

$$\overbrace{\hat{q}^s \equiv \frac{w^p}{\Pi[1-\frac{1}{1+\tau}]}}^{\textbf{Static cut-off:}} \quad \text{VS} \quad \overbrace{\hat{q}^d \equiv \frac{w^p}{\Pi[1-\underbrace{\left(\frac{r+\tilde{p}}{r+p}\right)}_{\textit{strategic}}\frac{1}{1+\tau}]}}^{\textbf{Dynamic cut-off:}}$$

Recall:

$$\tilde{p} = p[\alpha + (1-\alpha)\Pr(\lambda > \tau)]$$

PREDICTION 4: *Connected incumbents are less likely to exit.*

PREDICTION 5: *Connected incumbents are more likely to be replaced by connected entrants.*

PREDICTION 6: *Connected industries have lower reallocation.*

Model. Discussion

Static

- Gains by removing frictions in the economy. ”Well-intended” connections.

Dynamic

Two reasons for lower entry and reallocation:

1. Response to the unequal distribution ($\alpha < 1$) of power;
2. Strategic anticipation by incumbents.

Model Predictions

Rent-seeking incentives:

1. *Large firms are more likely to get connected , BUT are least innovative.*
2. *For any given size, firms are more likely to get connected if the industry faces bigger bureaucratic/regulatory burden.*

Private returns:

3. *Connections lead to higher employment, revenue and profits BUT lower labor productivity.*
4. *Connected incumbents are less likely to exit.*

Aggregate implications:

5. *In industries with more connected incumbents, entrants are also more connected.*
6. *In more connected industries: lower entry and reallocation, larger and older firms with lower productivity, lower average growth.*

Model Extension:

Endogenous Politician Compensation

Endogenous Politician Compensation I/II

- Politicians have different political power, $\phi \in (0,1)$:
$$\frac{\pi q}{1+(1-\phi)\,\tau}.$$

- Nash bargaining (γ, politician's bargaining power):

$$\begin{aligned}
\bar{w}^p(\phi) &\equiv \arg\max_{\bar{w}^p(\phi)} \left[V_1^{\phi}(q) - V_{-1}(q) - \bar{w}^p(\phi)\right]^{1-\gamma} \left[\bar{w}^p(\phi) - \eta(\phi)\right]^{\gamma} \\
&= \gamma\pi q\left(\frac{1}{[1+(1-\phi)\,\tau]\,[r+\tilde{p}(\phi)]} - \frac{1}{[1+\tau]\,[r+p]}\right) + (1-\gamma)\,\eta(\phi)
\end{aligned}$$

Endogenous Politician Compensation II/II

The rate of creative destruction:

$$\tilde{p}(\phi) = p[\alpha + (1-\alpha)\Pr(\lambda > \phi\tau)],$$

which implies $\tilde{p}'(\phi) < 0$.

> PREDICTION 7: *A firm that is connected to a more powerful politician is more likely to survive.*

> PREDICTION 8: *Politician's compensation $\bar{w}^p(\phi)$ increases in his/her political power ϕ.*

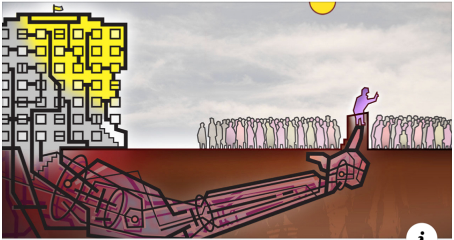
Final Remarks

- New empirical findings on the relation between political connections and number of micro and macro moments in Italy.
- A new model of firm dynamics, innovation, and political connections.
- Future work: quantify importance for aggregate productivity and welfare.

The Economist

Bought and paid for

Cosy relationships between firms and politicians are undermining competition



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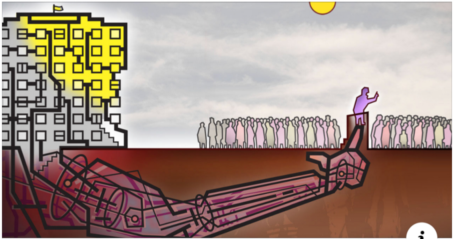

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IMPLICATIONS FOR THE U.S.:

Return on lobbying investment in the U.S. = 22,000%.

Financial institutions that spent more on lobbying benefited disproportionately from bank bail-outs.

Thank You...

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