

# Lecture 5: Taxable Income Elasticities

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Fall 2016

## GOALS OF THIS LECTURE

- 1) Cover empirical studies looking at *broader* effects of taxation (beyond labor supply). Contributes to our highly important “internal paper wikipedia” (IPW).
- 2) Understand key methodologies such as diff-in-diff and time series methods.
- 3) Critically discuss papers’ methodologies and results so as to practice our research skills.

## TAXABLE INCOME ELASTICITIES

Modern public finance literature focuses on taxable income elasticities instead of hours/participation elasticities

Two main reasons:

- 1) What matters for policy is the total behavioral response to tax rates (not only hours of work but also occupational choices, avoidance, etc.)
- 2) Data availability: taxable income is precisely measured in tax return data

Recent overview of this literature: Saez-Slemrod-Giertz JEL'12

## FEDERAL US INCOME TAX CHANGES

Tax rates change frequently over time. Biggest tax rate changes have happened **at the top**

Key recent reforms:

Reagan I: ERTA'81 (Econ Recovery Tax): top rate ↓ 70% to 50% (1981-1982)

Reagan II: TRA'86: top rate ↓ 50% to 28% (1986-1988)

Clinton: OBRA'93 (Omnibus Budget Reconciliation Act): top rate ↑ 31% to 39.6% (1992-1993)

Bush: EGTRRA '01: top rate ↓ 39.6% to 35% (2001-2003)

Obama '13: top rate ↑ 35% to 39.6%+3.8% (2012-2013)

Taxable Income = Ordinary Income + Realized Capital Gains - Deductions  
⇒ Each component can respond to *MTRs*

## US Top Marginal Tax Rate (Federal Individual Income Tax)



**Table A1.**  
**Top Federal Marginal Tax Rates**

Year	Ordinary Income	Earned Income	Capital Gains	Corporate Income
	(1)	(2)	(3)	(4)
1952-1963	91.0	91.0	25.0	52
1964	77.0	77.0	25.0	50
1965-1967	70.0	70.0	25.0	48
1968	75.3	75.3	26.9	53
1969	77.0	77.0	27.9	53
1970	71.8	71.8	32.3	49
1971	70.0	60.0	34.3	48
1972-1975	70.0	50.0	36.5	48
1976-1978	70.0	50.0	39.9	48
1979-1980	70.0	50.0	28.0	46
1981	68.8	50.0	23.7	46
1982-1986	50.0	50.0	20.0	46
1987	38.5	38.5	28.0	40
1988-1990	28.0	28.0	28.0	34
1991-1992	31.0	31.0	28.0	34
1993	39.6	39.6	28.0	35
1994-2000	39.6	42.5	28.0	35
2001	39.1	42.0	20.0	35
2002	38.6	41.5	20.0	35
2003-2009	35.0	37.9	15.0	35

Notes: MTRs apply to top incomes. In some instances, lower income taxpayers may face higher MTRs because of income caps on payroll taxes or the so-called 33 percent "bubble" bracket following TRA 86. From 1952 to 1962, a 87% maximum average tax rate provision made the top marginal tax rate 87% instead of 91% for many very top income earners. From 1968 to 1970, rates include surtaxes. For earned income, MTRs include the Health Insurance portion of the payroll tax beginning with year 1994. Rates exclude the effect of phaseouts, which effectively raise top MTRs for many high-income filers. MTRs on realized capital gains are adjusted to reflect that, for some years, a fraction of realized gains were excluded from taxation. Since 2003, dividends are also tax favored with a maximum tax rate of 15%.

## LONG-RUN EVIDENCE IN THE US

Goal: evaluate whether top **pre-tax** incomes respond to changes in one minus the marginal tax rate (=net-of-tax rate)

Focus is on pre-tax income before deductions and excluding realized capital gains

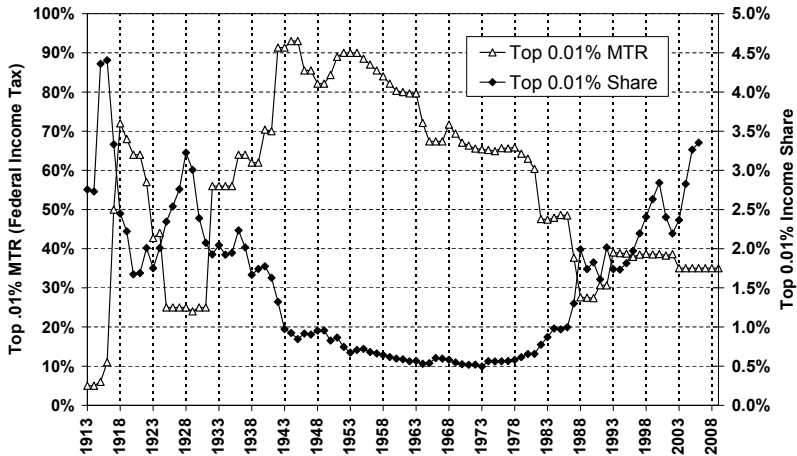
Pioneered by Feenberg-Poterba TPE'93 for period 1951-1990

Piketty-Saez QJE'03 estimate top income shares since 1913 [IRS tabulations for 1913-1959, IRS micro-files since 1960]

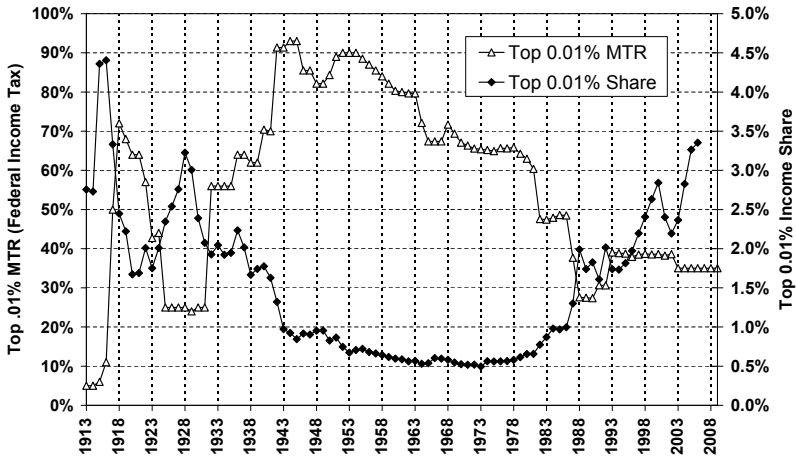
Saez TPE'04 proposes detailed analysis for 1960-2000 period using TAXSIM calculator at NBER linked to IRS micro-files

Piketty-Saez-Stantcheva AEJ'14 look at 1913-2010 period for the US

US Top 0.01% Income Share and MTR (Piketty-Saez and Landais)



### US Top 0.01% Income Share and MTR (Piketty-Saez and Landais)



$$\log(\text{share}) = a + 0.617 (0.077) * \log(1 - \text{MTR}) + e$$

$$\log(\text{share}) = a + b * t + 0.666 (0.071) * \log(1 - \text{MTR}) + e$$

## INCOME SHARE BASED ELASTICITY ESTIMATION

1) **Tax Reform Episode:** Compare top **pre-tax** income shares at  $t_0$  (before reform) and  $t_1$  (after reform)

$$e = \frac{\log sh_{t_1} - \log sh_{t_0}}{\log(1 - \tau_{t_1}) - \log(1 - \tau_{t_0})}$$

where  $sh_t$  is top income share and  $\tau_t$  is the average MTR for top group

Identification assumption: absent tax change,  $sh_{t_0} = sh_{t_1}$

2) **Full Time Series:** Run regression:

$$\log sh_t = \alpha + e \cdot \log(1 - \tau_t) + \varepsilon_t$$

and adding time controls to capture non-tax related top income share trends

ID assumption: non-tax related changes in  $sh_t \perp \tau_t$

Table 1.

## Elasticity estimates using top income share time series

	Top 1%	Next 9%
	(1)	(2)
<b>A. Tax Reform Episodes</b>		
1981 vs. 1984 (ERTA 1981)	0.60	0.21
1986 vs. 1988 (TRA 1986)	1.36	-0.20
1992 vs. 1993 (OBRA 1993)	0.45	
1991 vs. 1994 (OBRA 1993)	-0.39	
<b>B. Full Time Series 1960-2006</b>		
No time trends	1.71 (0.31)	0.01 (0.13)
Linear time trend	0.82 (0.20)	-0.02 (0.02)
Linear and square time trends	0.74 (0.06)	-0.05 (0.03)
Linear, square, and cube time trends	0.58 (0.11)	-0.02 (0.02)

Notes: Estimates in panel A are obtained using series from Figure 1 and using the formula  $e = [\log(\text{income share after reform}) - \log(\text{income share before reform})] / [\log(1 - \text{MTR after reform}) - \log(1 - \text{MTR before reform})]$

## LONG-RUN EVIDENCE IN THE US

- 1) Clear correlation between top incomes and top income rates both in several short-run tax reform episodes and in the long-run [but hard to assess long-run tax causality]
  - 2) Correlation largely absent below the top 1% (such as the next 9%)
  - 3) Top income shares sometimes do not respond to large tax rate cuts [e.g., Kennedy Tax Cuts of early 1960s]
- 2) and 3) suggest that context matters (such as opportunities to respond / avoid taxes matter), response not due to a universal labor supply elasticity

## SPECIFIC TAX REFORM STUDIES

Literature initially developed by analyzing specific tax reforms (instead of full time series)

Lindsey JpubE'87 analyzes ERTA'81 using **repeated cross-section** tax data and finds large elasticities

Feldstein JPE'95 uses **panel** tax data to study TRA'86

Goolsbee JPE'00 uses **executive compensation** data to study OBRA'93

Gruber-Saez JpubE'02 uses 1979-1990 **panel** tax data

Many other studies in the US and abroad (survey by Saez-Slemrod-Giertz JEL'12)

## FELDSTEIN JPE'95: METHODOLOGY

Feldstein (1995) estimates the effect of TRA86 on taxable income for top earners using **panel** tax data

1) Constructs three income groups  $M$  (Medium),  $H$  (High),  $HH$  (Highest) based on before reform income in 1985

2) Looks at how incomes and MTRs evolve from 1985 to 1988 for individuals in each group using panel: forms DD estimates

$$\hat{e} = \frac{\Delta \log(z^H) - \Delta \log(z^M)}{\Delta \log(1 - \tau^H) - \Delta \log(1 - \tau^M)}$$

where  $z^H$ ,  $z^M$  and  $\tau^H$ ,  $\tau^M$  are income and MTRs of the  $H$  and  $M$  groups

TABLE 1

RESPONSE OF TAXABLE INCOME OF NONAGED MARRIED TAXPAYERS TO CHANGES IN MARGINAL TAX RATES BETWEEN 1985 AND 1988

1985 MARGINAL TAX RATE	1985 AGI (\$000) (1)	OBSERVATIONS (2)	PERCENTAGE CHANGES OF				
			Net of Tax Rate (3)	Adjusted Full AGI (4)	Adjusted AGI Excluding Capital Gains (5)	Adjusted Taxable Income (6)	Adjusted Taxable Income Plus Gross Loss (7)
22	30.7	800	9.0	9.4	8.4	13.6	13.4
25	36.1	909	13.3	4.5	2.4	3.5	3.7
28	42.7	713	16.3	3.9	4.7	6.0	5.0
33	51.5	771	8.7	2.2	2.2	2.5	2.5
38	67.5	345	16.1	8.0	8.1	9.6	8.8
42	94.3	152	24.1	18.8	14.7	22.0	22.3
45	126.9	45	30.9	12.4	14.8	18.5	15.3
49	177.7	35	41.2	27.1	29.6	42.7	33.9
50	479.0	22	44.0	18.4	70.6	92.4	51.1
22-38		3,538	12.2	5.1	4.6	6.2	6.4
42-45		197	25.6	17.0	14.7	21.0	20.3
49-50		57	42.2	21.3	53.7	71.6	44.8

NOTE.—All observations pertain to married taxpayers under age 65 who filed joint tax returns for 1985 and 1988 with no age exemption in 1988. Taxpayers who created a subchapter S corporation between 1985 and 1988 are eliminated from the sample.

**TABLE 2**  
**ESTIMATED ELASTICITIES OF TAXABLE INCOME WITH RESPECT TO NET-OF-TAX RATES**

Taxpayer Groups Classified by 1985 Marginal Rate	Net of Tax Rate (1)	Adjusted Taxable Income (2)	Adjusted Taxable Income Plus Gross Loss (3)
	Percentage Changes, 1985–88		
1. Medium (22–38)	12.2	6.2	6.4
2. High (42–45)	25.6	21.0	20.3
3. Highest (49–50)	42.2	71.6	44.8
	Differences of Differences		
4. High minus medium	13.4	14.8	13.9
5. Highest minus high	16.6	50.6	24.5
6. Highest minus medium	30.0	65.4	38.4
	Implied Elasticity Estimates		
7. High minus medium		1.10	1.04
8. Highest minus high		3.05	1.48
9. Highest minus medium		2.14	1.25

NOTE.—The calculations in this table are based on observations for married taxpayers under age 65 who filed joint tax returns for 1985 and 1988 with no age exemption in 1988. Taxpayers who created a subchapter S corporation between 1985 and 1988 are eliminated from the sample.

## FELDSTEIN JPE'95: RESULTS

**Results:** Feldstein obtains very high elasticities (above 1) for top earners

⇒ US was on the wrong side of the Laffer curve for the rich

⇒ Laffer rate  $\tau = 1/(1 + a \cdot e) = 1/(1 + 2 \cdot 1) = 33\%$  Cutting top tax rate from 50% to 28% raised revenue

## FELDSTEIN JPE'95: ISSUES

- 1) Non-tax related **changes in inequality** [same criticism as top share analysis]: panel helps only if inequality changes due to arrival of new people
- 2) Short-term vs. Long-term response [same criticism as top share analysis]
- 3) **Mean reversion**: rich people in year  $t$  tend to revert to the mean in year  $t + 1 \Rightarrow$  Panel analysis introduces downward bias in  $e$  [when  $\tau \downarrow$  for rich]
- 4) **Very small sample** in panel data [57 tax filers in  $HH$  group]  
[Auten-Carroll RESTAT'99 use larger Treasury panel data and find smaller elasticity 0.65]

In net, not clear panel data adds value relative to repeated-cross-section

## FELDSTEIN JPE'95: ISSUES

5) DD can give very biased results when elasticity differs across groups:

Example: (a)  $M$  group has  $e^M = 0$  so that  $\Delta \log(z^M) = 0$  and that  $H$  group has  $e^H = e > 0$  so that  $\Delta \log(z^H) = e \Delta \log(1 - \tau^H)$ .

Suppose that  $\Delta \log(1 - \tau^M) = 0.5 \cdot \Delta \log(1 - \tau^H)$ .

Then, the estimated elasticity

$$\hat{e}^{DD} = e \Delta \log(1 - \tau^H) / [\Delta \log(1 - \tau^H) - \Delta \log(1 - \tau^M)] = 2e$$

In Feldstein JPE'95: Simple Difference  $\Delta \log(z) / \Delta \log(1 - \tau)$  uniformly smaller than DD

⇒ Better to focus on a single group as in top share analysis than on the comparison with lower income group control

## GRUBER AND SAEZ JPUBE'02

Generalization of Feldstein JPE'95 using IV regression analysis

Use panel data from 1979-1990 on all tax changes available rather than a single reform

**Model:**  $z_{it} = z_{it}^0 \cdot (1 - \tau_{it})^e$  where  $z_{it}^0$  is potential income (if MTR=0),  $e$  is elasticity

$$\log \left( \frac{z_{it+3}}{z_{it}} \right) = \alpha + e \cdot \log \left( \frac{1 - \tau_{it+3}}{1 - \tau_{it}} \right) + \varepsilon_{it}$$

$\tau_{it+3}$  and  $\varepsilon_{it}$  are correlated [because  $\tau_{it+3} = T'_{t+3}(z_{it+3})$ ]

**Instrument:** predicted change in MTR assuming income stays constant:  
 $\log[(1 - \tau_{it+3}^p)/(1 - \tau_{it})]$  where  $\tau_{it+3}^p = T'_{t+3}(z_{it})$

Isolates changes in tax law ( $T_t(\cdot)$ ) as the only source of variation in tax rates

Table 4  
Basic elasticity results<sup>a</sup>

Income controls	None		Log income		Log income 10-piece spline	
	Broad income (1)	Taxable income (2)	Broad income (3)	Taxable income (4)	Broad income (5)	Taxable income (6)
Elasticity	-0.300 (0.120)	-0.462 (0.194)	0.170 (0.106)	0.611 (0.144)	0.120 (0.106)	0.400 (0.144)
Dummy for marrieds	-0.008 (0.010)	-0.062 (0.018)	0.045 (0.014)	0.049 (0.023)	0.050 (0.012)	0.055 (0.021)
Dummy for singles	-0.037 (0.012)	-0.053 (0.019)	-0.034 (0.013)	-0.032 (0.022)	-0.036 (0.013)	-0.027 (0.021)
Log(income) control			-0.083 (0.015)	-0.167 (0.021)		

Source: Gruber and Saez 2002

## GRUBER AND SAEZ JPUBE'02

Find an elasticity of roughly 0.3-0.4 BUT results are very fragile  
[Saez-Slemrod-Giertz JEL'12]

- 1) Sensitive to exclusion of low incomes
- 2) Sensitive to controls for mean reversion
- 3) Subsequent studies find smaller elasticities using data from other countries [Kleven-Schultz AEJ-EP'14 for Denmark]
- 4) Bundles together small tax changes and large tax changes: if individuals respond only to large changes in short-medium run, then estimated elasticity is too low [Chetty et al. QJE'11]

## FISCAL EXTERNALITIES

Tax changes due to tax avoidance often generate **fiscal externalities**

A **Fiscal externality** is a change in tax revenue that occurs in any tax base  $z^B$  other than  $z$  due to the behavioral response to the tax change in the initial base  $z$

(1)  $z^B$  can be a different tax base in the same time period (such as corporate income tax base)  $\Rightarrow$  **Income shifting**

(2)  $z^B$  can be the same tax base in a different time period (such as future income)  $\Rightarrow$  **Inter-temporal Substitution**

Efficiency and optimal tax analysis depend on effect on **total** tax revenue so critical to identify fiscal externalities

## Inter-Temporal Substitution: Realized Capital Gains

Realized capital gains occur when individual sells asset at a higher price than buying price

Individuals have flexibility in the timing of asset sales and capital gains realizations

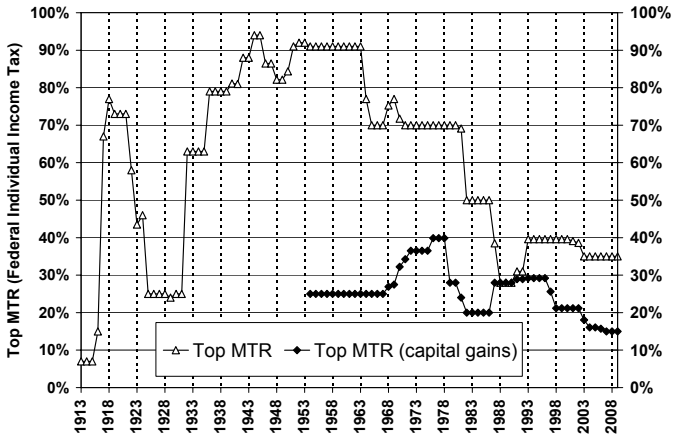
TRA'86 lowered the top tax rate on ordinary income from 50% to 28% but increased the top tax rate on realized capital gains from 20% to 28%

⇒ Surge in capital gains realizations in 1986 [and depressed capital gains in 1987] to take advantage of low 20% rate before 28% tax rate applies

Recently: Surge in realized capital gains in 2012 (KG tax rate 15%) to avoid high 2013 tax rates (KG tax rate of 20%+3.8%)

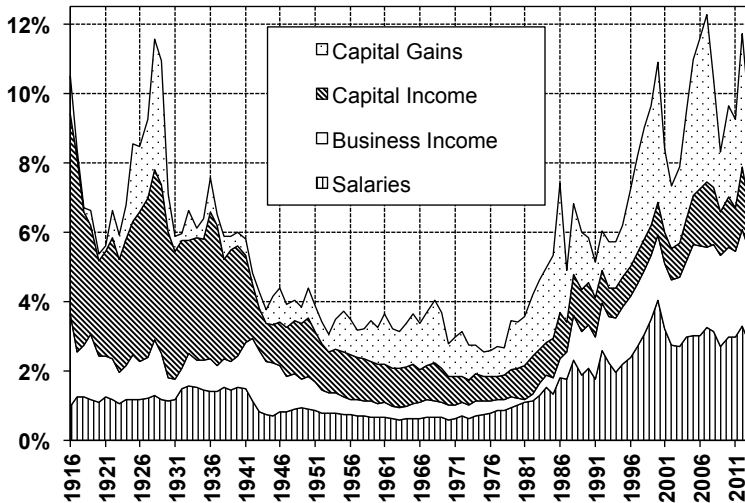
⇒ Short-term elasticity is very large but long-term elasticity is certainly much smaller

### US Top MTR ordinary income vs. capital gains



Source: statistics computed by the author

## US Top 0.1% Pre-Tax Income Share and Composition



Source: Piketty and Saez, 2003 updated to 2013. Series based on pre-tax cash market income including or excluding realized capital gains, and always excluding government transfers.

## INTER-TEMPORAL SUBSTITUTION: STOCK-OPTIONS

Goolsbee JPE'00 analyzes CEO pay around the 1993 Clinton top tax rate increase ↑ [from 31% in 1992 to 39.6% in 1993 announced in late 1992] on executive pay

Finds a strong re-timing response through stock-option exercise (executive can choose the timing of their stock-option exercises)

⇒ Large short-term response due to re-timing, small long-term response

## STOCK OPTIONS

Major form of compensation of US top executives. Theoretical goal is to motivate executives to increase the value of the company (stock price  $P(t)$ )

Stock-option is granted at date  $t_0$  allow executives to buy  $N$  company shares at price  $P(t_0)$  on or after  $t_1$  (in general  $t_1 - t_0 \simeq 3 - 5$  years = vesting period)

Executive exercise option at (chosen) time  $t_2 \geq t_1$ : pays  $N \cdot P(t_0)$  to get shares valued  $N \cdot P(t_2)$ . Exercise profit  $N[P(t_2) - P(t_0)]$  (considered and taxed as wage income in the US)

After  $t_2$ , executive owns  $N$  shares, eventually sold at time  $t_3 \geq t_2$ : realized capital gain  $N[P(t_3) - P(t_2)]$  (taxed as capital gains)

TABLE 2  
 AVERAGE COMPENSATION BY TYPE FOR HIGH-INCOME EXECUTIVES  
 (in Thousands)

	1991	1992	1993	1994	1995
Taxable income	911	1,153	974	965	1,173
Salary	347	336	336	351	373
Bonus	198	207	241	284	330
LTIP payout	57	72	57	64	89
Options exercised	268	496	293	235	381
Other income (nontaxed)	36	37	66	54	78

SOURCE.—Author's calculations for executives with permanent income greater than \$275,000 per year.

## INCOME SHIFTING: CORPORATE AND INDIVIDUAL TAX BASE

Businesses can be organized as **corporations** or **unincorporated businesses** [also called **pass-through** entities]

Corporate profits are first taxed by corporate tax [tax rate  $\tau_c$  ]

Net-of-tax profits are taxed again when finally distributed to shareholders.

2 distribution options:

a) dividends [tax rate  $\tau_d$  ]

b) retained profits increase stock price: shareholders realize capital gains when finally selling the stock [tax rate  $\tau_{cg}$ ]

For **unincorporated businesses** (sole proprietorships, partnerships, S-corporations) profits are taxed directly and solely as individual income (rate  $\tau_i$ )

## CORPORATE AND INDIVIDUAL TAX BASE

Corporate form best if  $(1 - \tau_c)(1 - \tau_{cg}) > 1 - \tau_i$

US fed taxes in 2014:  $\tau_c = 35\%$ ,  $\tau_{cg} = 20\%$  (less because of deferral value),  
 $\tau_d = 20\%$   $\tau_i = 39.6\%$ , (top rate)

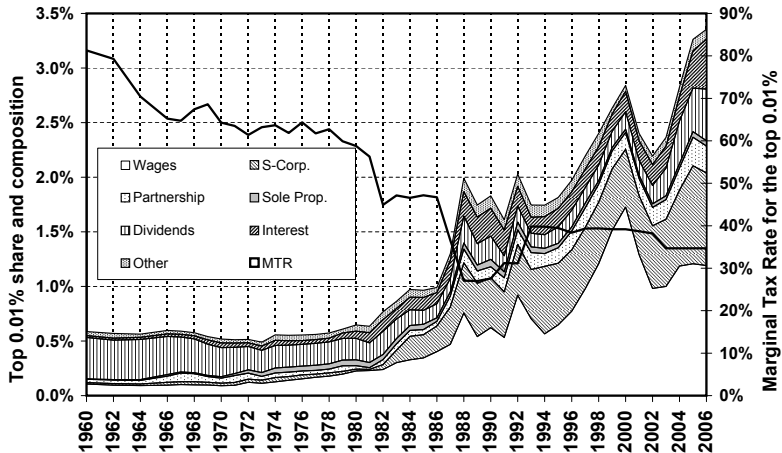
Today, individual form is best

Before TRA'86 (and especially before ERTA'81), top individual rate  $\tau_i$  was much higher so corporate form was best

Shifts from corporate to individual base increases business profits at the expense of dividends and realized capital gains

Large part of TRA'86 response is due to such shifting

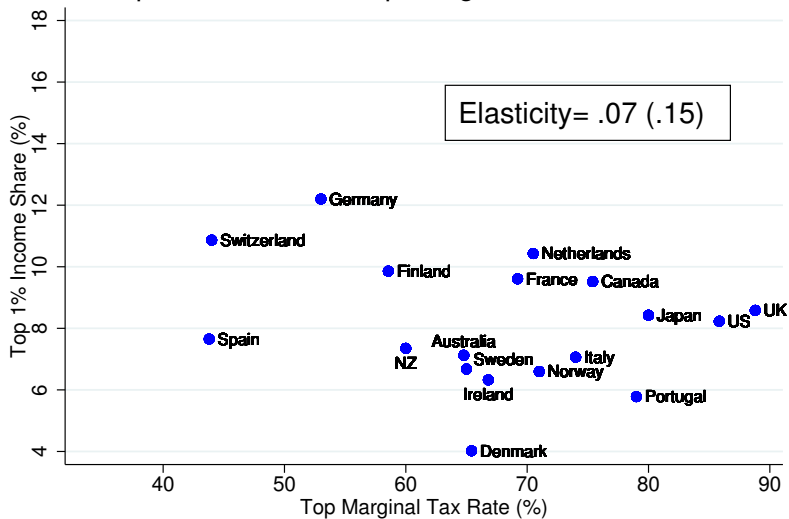
## The Top 0.01% US Income Share, Composition, and MTR



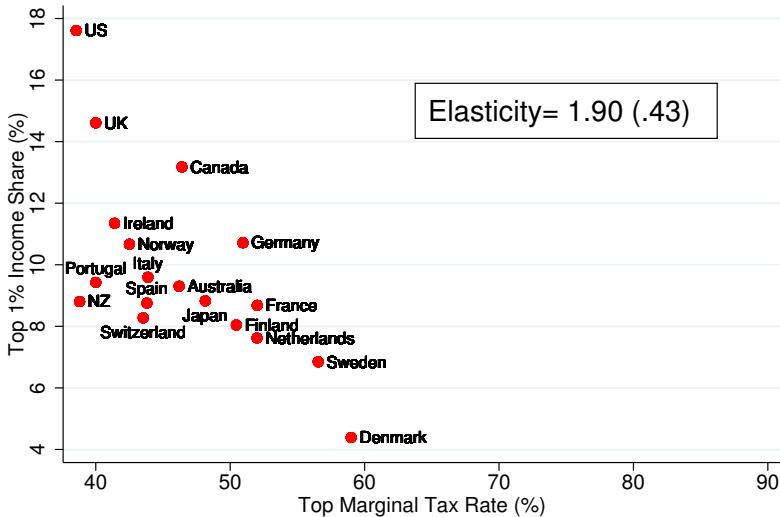
## TOP RATES AND TOP INCOMES INTERNATIONAL EVIDENCE

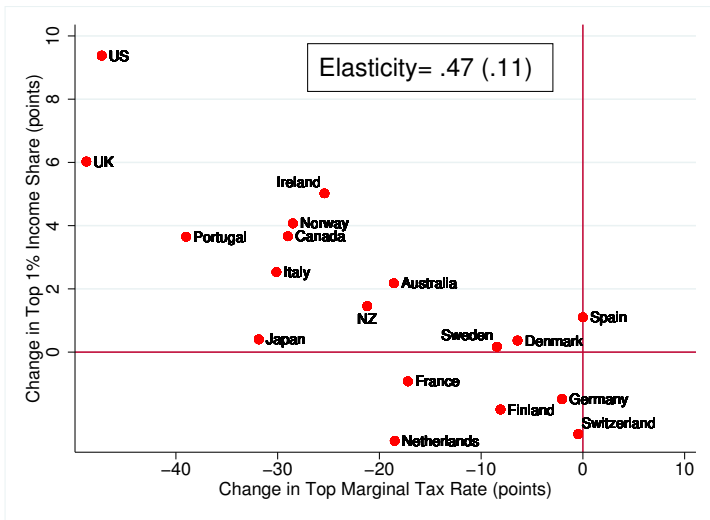
- 1) Use pre-tax top 1% income share data from 18 OECD countries since 1960 using the **World Top Incomes Database**
  - 2) Compute top (statutory) individual income tax rates using OECD data [including both central and local income taxes].
- Plot top 1% pre-tax income share against top MTR in 1960-4, in 2005-9, and 1960-4 vs. 2005-9

## A. Top 1% Share and Top Marginal Tax Rate in 1960–4



## B. Top 1% Share and Top Marginal Tax Rate in 2005–9





Change in Top Tax Rate and Top 1% Share, 1960-4 to 2005-9

# Top tax rates and top 1% income share 1960-2009

**Table 2: International Evidence on Top Income Elasticities**

	All 18 countries and fixed periods			Bootstrapping period and country set		
	1960-2010	1960-1980	1981-2010	Median	5th percentile	95th percentile
	(1)	(2)	(3)	(4)	(5)	(6)

**A. Effect of the Top Marginal Income Tax Rate on Top 1% Income Share**

Regression:  $\log(\text{Top 1\% share}) = a + e \cdot \log(1 - \text{Top MTR}) + \varepsilon$

No controls	0.324 (0.034)	0.163 (0.039)	0.803 (0.053)	0.364 (0.043)	0.128 (0.085)	0.821 (0.032)
Time trend control	0.375 (0.042)	0.182 (0.030)	0.656 (0.056)	0.425 (0.045)	0.191 (0.091)	0.761 (0.032)
Country fixed effects	0.314 (0.025)	0.007 (0.039)	0.626 (0.044)	0.267 (0.035)	0.008 (0.070)	0.595 (0.026)
Number of observations	774	292	482	286	132	516

## ECONOMIC EFFECTS OF TAXING THE TOP 1%

Strong empirical evidence that **pre-tax** top incomes are affected by top tax rates

3 potential scenarios with very different policy consequences

**1) Supply-Side:** Top earners work less and earn less when top tax rate increases ⇒ Top tax rates should not be too high

**2) Tax Avoidance/Evasion:** Top earners avoid/evade more when top tax rate increases

⇒ a) Eliminate loopholes, b) Then increase top tax rates

**3) Rent-seeking:** Top earners extract more pay (at the expense of the 99%) when top tax rates are low ⇒ High top tax rates are desirable

## Real changes vs. tax Avoidance? (Piketty-Saez-Stantcheva)

Correlation between **pre-tax** top incomes and top tax rates

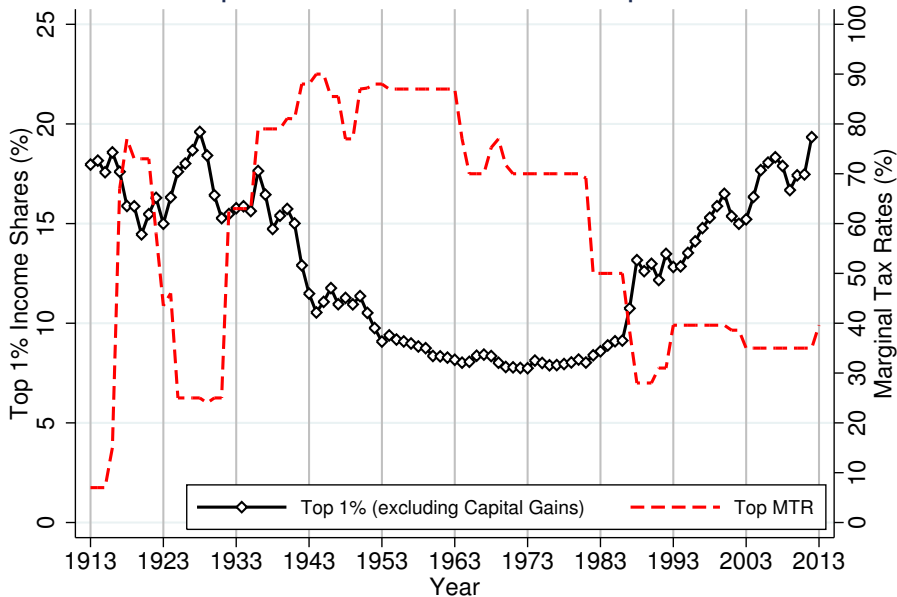
If this is due to tax avoidance, US real top income shares were as high as today in the 1960s-70s but top earners reported a smaller fraction of their incomes

⇒ correlation should be much stronger when using narrow taxable income definition than when using comprehensive income definition (including realized capital gains)

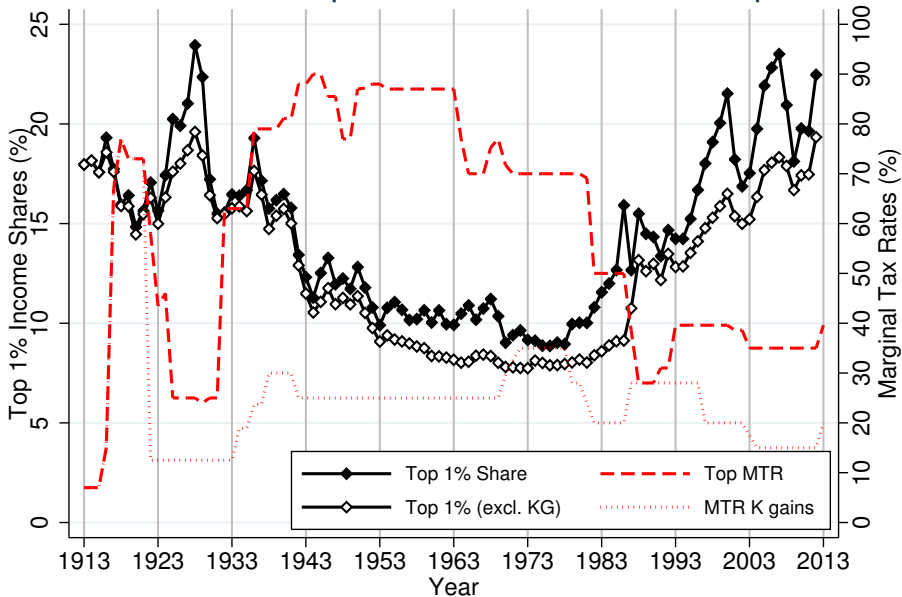
Empirical correlation is very similar ruling out the pure tax avoidance scenario

Future work: construct even broader measures of comprehensive top incomes (unrealized capital gains, non-taxable income forms, etc.)

# Top 1% Income Share and Top MTR



# Tax Avoidance: Top 1% Income Shares and Top MTR



## Real changes vs. tax Avoidance? Charitable giving

Test using charitable giving behavior of top income earners

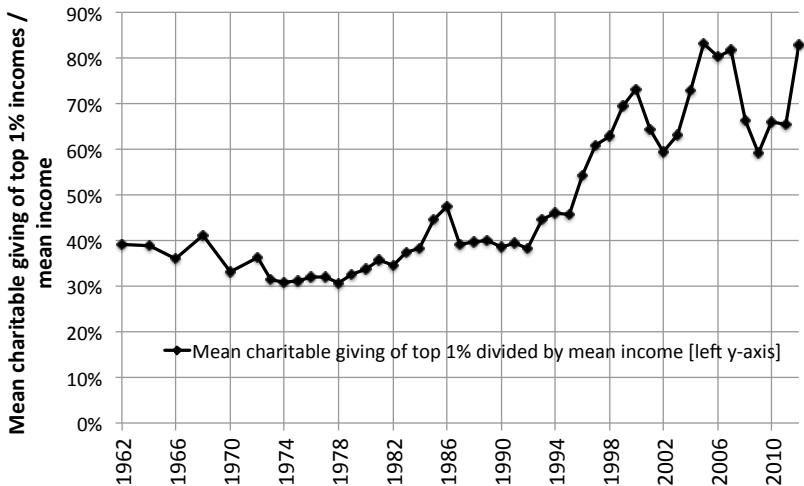
Because charitable is tax deductible, incentives to give are stronger when tax rates are higher

Under the tax avoidance scenario, reported incomes and reported charitable giving should move in opposite directions

Empirically, charitable giving of top income earners has grown in close tandem with top incomes

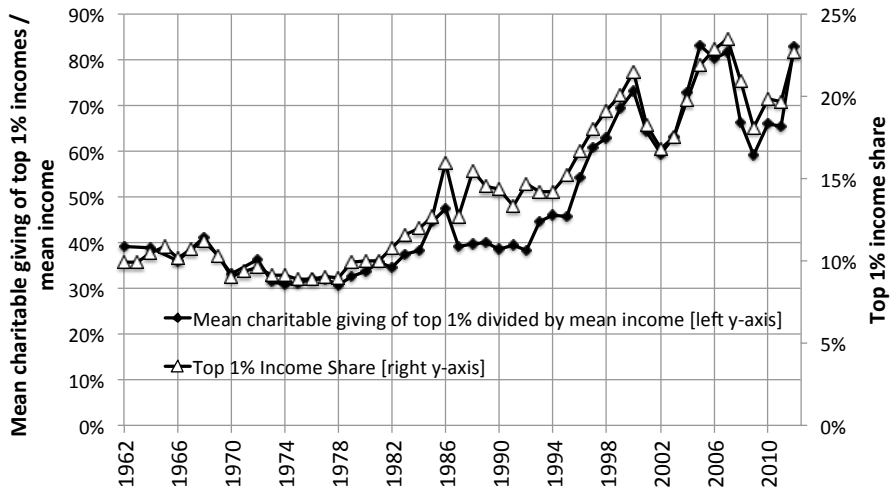
⇒ Incomes at the top have grown for real

## Charitable Giving of Top 1% Incomes



Source: Appendix Table XX. The figure depicts average charitable giving of top 1% incomes (normalized by average income per family) on the left y-axis.

## Charitable Giving of Top 1% Incomes, 1962-2012



Source: Appendix Table XX. The figure depicts average charitable giving of top 1% incomes (normalized by average income per family) on the left y-axis. For comparison, the figure reports the top 1% income share (on the right y-axis).

## Supply-Side or Rent-Seeking? (Piketty-Saez-Stantcheva)

Correlation between **pre-tax** top incomes and top tax rates

If rent-seeking: growth in top 1% incomes should come at the expense of bottom 99% (and conversely)

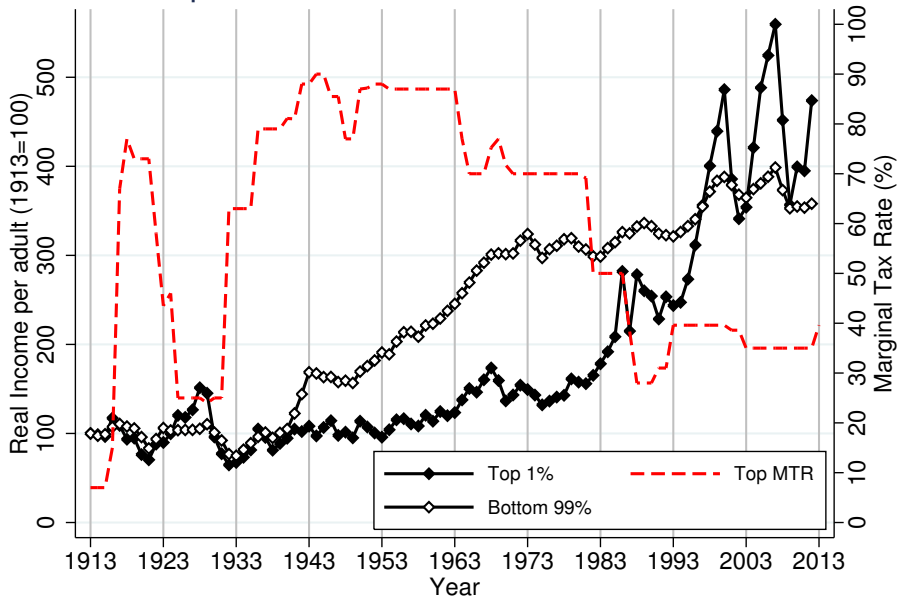
Two macro-preliminary tests:

1) In the US, top 1% incomes grow slowly from 1933 to 1975 and fast afterwards. Bottom 99% incomes grow fast from 1933 to 1975 and slowly afterwards ⇒ Consistent with rent-seeking effects

2) Look at cross-country correlation between economic growth and top tax rate cuts ⇒ No correlation supports trickle-up

One micro-test using CEO pay data

# Top 1% and Bottom 99% Income Growth

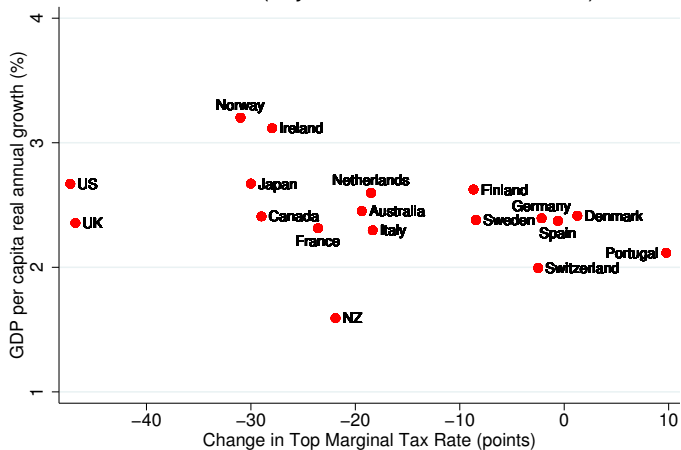


## A. Growth and Change in Top Marginal Tax Rate



Change in Top Tax Rate and GDP per capita growth since 1960

## B. Growth (adjusted for initial 1960 GDP)



Change in Top Tax Rate and GDP per capita growth since 1960

# Top tax rates and average growth 1960-2009

**Table 2: International Evidence on Top Income Elasticities**

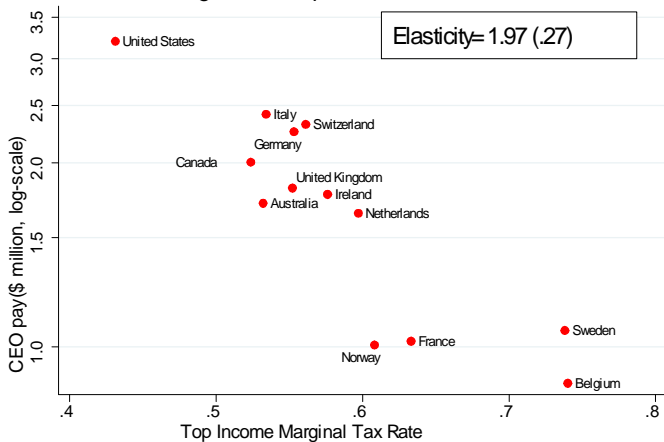
	All 18 countries and fixed periods			Bootstrapping period and country set		
	1960-2010	1960-1980	1981-2010	Median	5th percentile	95th percentile
	(1)	(2)	(3)	(4)	(5)	(6)
<b>B. Effect of the Top Marginal Income Tax Rate on real GDP per capita</b>						
Regression: $\log(\text{real GDP per capita}) = a + b \cdot \log(1 - \text{Top MTR}) + c \cdot \text{time} + \varepsilon$						
No country fixed effects	-0.064 (0.033)	-0.018 (0.041)	-0.097 (0.043)	0.002 (0.042)	-0.214 (0.080)	0.173 (0.026)
Country fixed effects	-0.029 (0.014)	-0.082 (0.016)	0.037 (0.019)	-0.004 (0.016)	-0.087 (0.031)	0.071 (0.011)
Initial GDP per capita	-0.095 (0.019)	-0.025 (0.016)	-0.023 (0.014)	-0.054 (0.017)	-0.149 (0.030)	0.022 (0.011)
Initial GDP per capita, time*initial GDP per cap	-0.088 (0.017)	0.004 (0.011)	-0.037 (0.014)	-0.060 (0.016)	-0.160 (0.030)	0.012 (0.011)
Country fixed effects, time*initial GDP per cap	-0.018 (0.011)	0.000 (0.014)	0.008 (0.017)	-0.015 (0.013)	-0.069 (0.031)	0.040 (0.009)
Number of observations	918	378	540	317	152	576

## INTERNATIONAL CEO PAY EVIDENCE

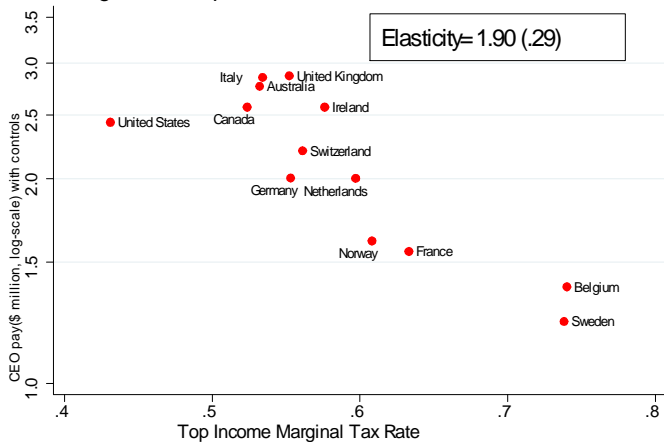
Recent micro-data for 2006 gathered by Fernandes, Ferreira, Matos, Murphy RFS'12.

- 1) CEO pay across countries strongly negatively correlated with top tax rates
  - 2) Correlation remains as strong even when controlling for firms' characteristics and performance
- ⇒ Consistent with bargaining effects

## A Average CEO compensation



## B. Average CEO compensation with controls



**Table 4: International CEO Pay Evidence**

Outcome (LHS variable)	Log(CEO pay)	Log(CEO pay)	Log(CEO pay)	Log(CEO pay)	Log(CEO salary)	Log(CEO bonus and equity pay)
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Explanatory variables (RHS variables)</b>						
log(1-Top MTR)	1.97*** (0.27)	1.90*** (0.286)	1.92*** (0.336)	1.90*** (0.328)	0.35* (0.189)	4.68*** (0.782)
Governance index			-0.10*** (0.020)	-0.19*** (0.038)	-0.02 (0.072)	-0.26 (0.201)
log(1-Top MTR)*Governance index				-0.13** (0.057)	0.06 (0.089)	-0.03 (0.281)
Firm and CEO controls	no	yes	yes	yes	yes	yes
Number of observations	2,959	2,844	2,711	2,711	2,691	2,711

## INTERNATIONAL MIGRATION

Public debate concern that top skilled individuals move to low tax countries (e.g., in EU context) or low tax states (within US Federation, see Moretti-Wilson 15, Young et al. 14)

Migration concern bigger in public debate than supply-side within a country debate

Little work on tax induced international migration of top skilled workers

Hard to get data but interesting variation due to proliferation of special low tax schemes for highly paid foreigners in Europe

Kleven-Landais-Saez AER'13 look at **football players** in Europe (highly mobile group, many tax reforms) ⇒ Find significant migration responses to taxes after football market was de-regulated in '95

Akcigit-Baslandze-Stantcheva AER'16 look at **innovators** (using patent data) mobility and find significant tax effects for top innovators

## KLEVEN-LANDAIS-SAEZ-SCHULTZ '13

Exploit the 1991 Danish tax scheme: high earnings immigrants ( $\geq 103,000$  Euros/year) taxed at flat 25% rate (instead of regular tax with top 59% rate) for 3 years

Use population wide Danish tax data and DD strategy: compare immigrants above eligibility earnings threshold (treatment) to immigrants below threshold (control)

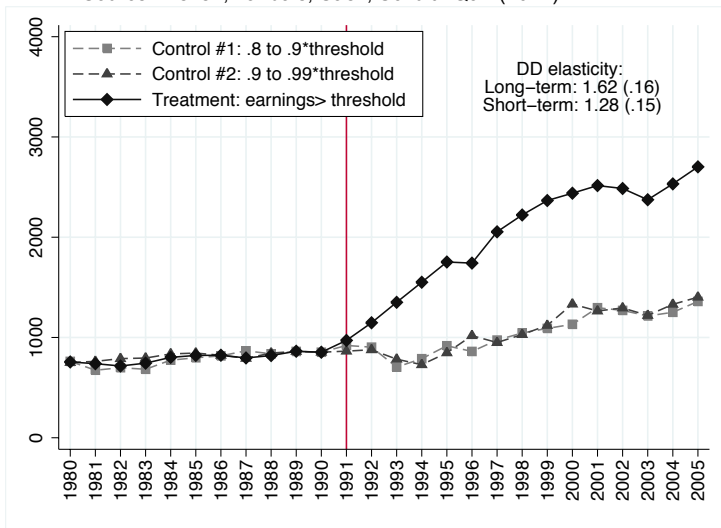
**Key Finding:** Scheme doubles the number of highly paid foreigners in Denmark relative to controls

⇒ Elasticity of migration with respect to the net-of-tax rate above one (much larger than the within country elasticity of earnings)

⇒ Tax coordination will be key to preserve progressive taxation in the EU

Figure 1 : Total number of foreigners in different income groups

Source: Kleven, Landais, Saez, Schultz QJE (2014)

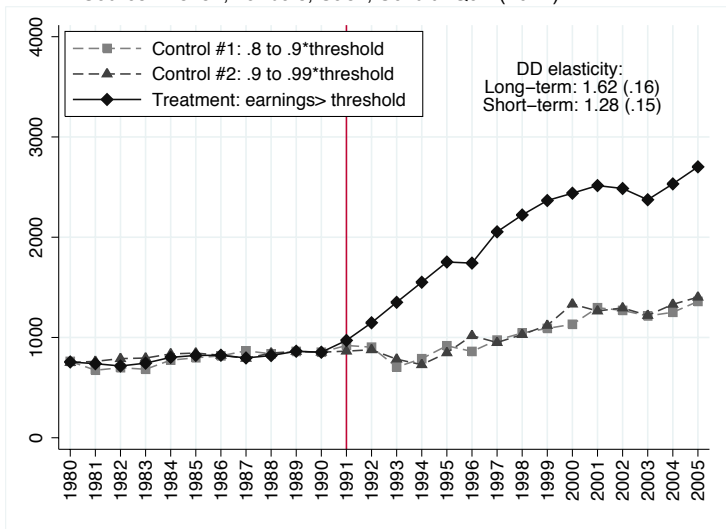


Control 1= annualized income between .8 and .9 of threshold

Control 2= annualized income between .9 and .995 of threshold.

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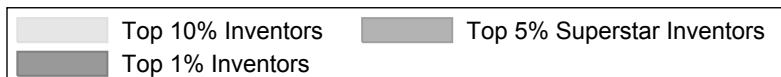
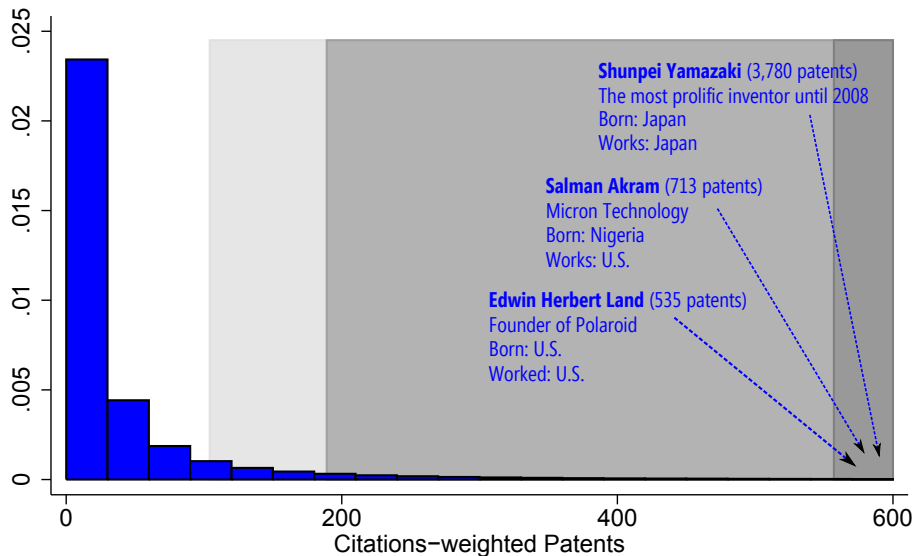
# Study the Effects of Taxes on Migration using Patent Data

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

## Three levels of analysis:

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

# Superstar Inventors in a Highly Skewed Quality Distribution



## Three Data sources: DID, EPO, PCT

- Inventors: employees, researchers, self-employed.
- “Assignee” is legal owner (firm or individual), can be  $\neq$  from inventor. Focus on employees.

### Main Data: Disambiguated Inventor Data

- USPTO: 4.2 million patent records, 3.1 million inventors in 1975-2010.
- 18% of worldwide direct patent filings (26% of all patents).
- Disambiguated names with residential addresses (Lai *et al.*, 2012).

### Additional Data 1: European Patent Office (EPO) data

- Very recent disambiguation, higher representation of EU patents.

### Additional Data 2: Patent Cooperation Treaty (PCT) data

▶ USPTO Stats

▶ EPO Stats

▶ Details

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# Inventor Quality Measures and Ranking

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

## Quality measures

(dynamic and lagged)

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

▸ Correlations

▸ Patent breadth, breadth of impact

## Inventor Ranking

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

→ Dynamic, Persistent, Life-time ranking

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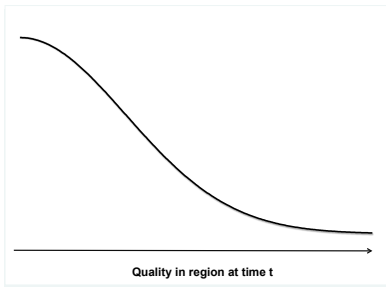
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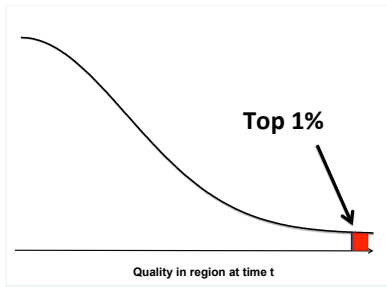
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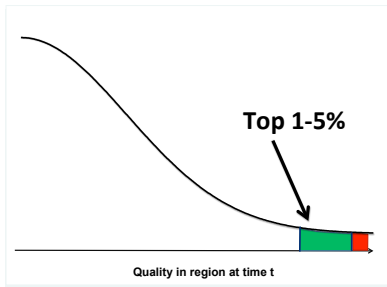
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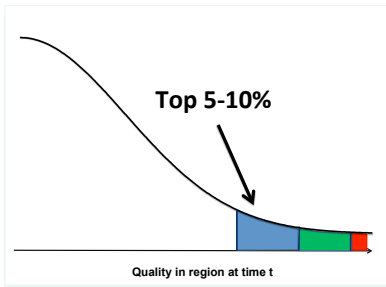
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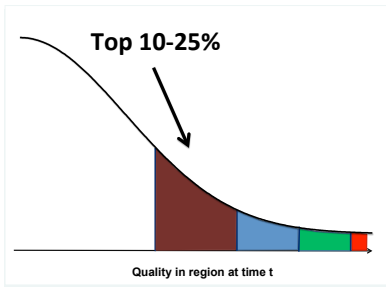
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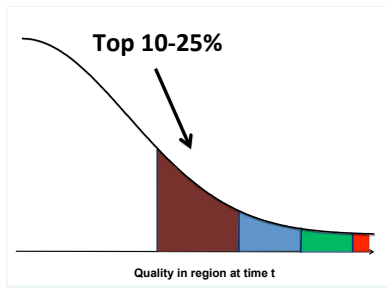
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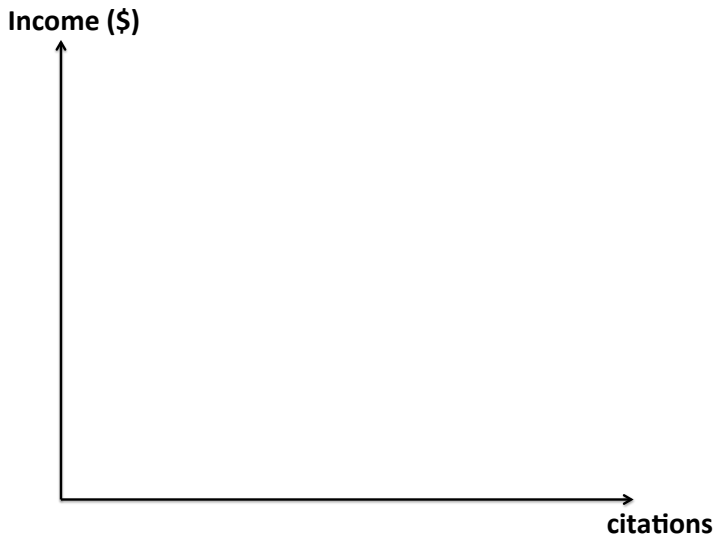
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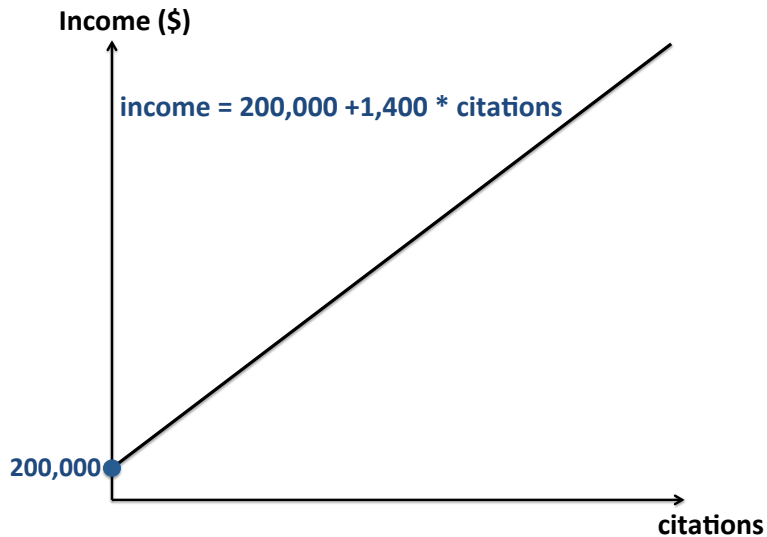


## Link between Inventor Quality and Income in IRS data

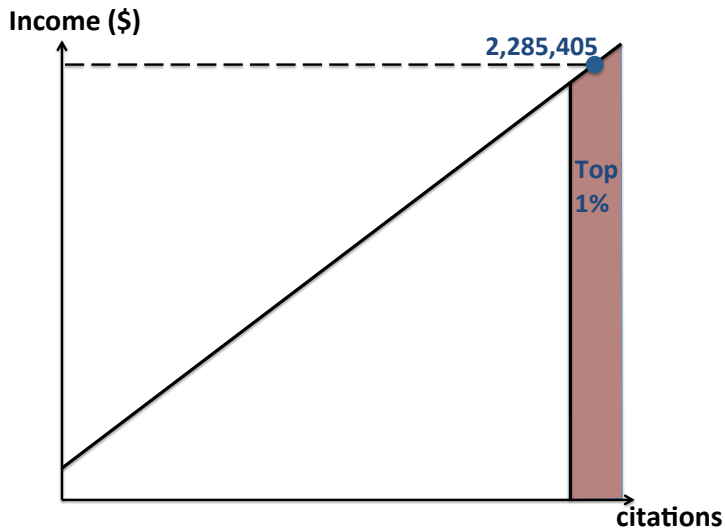


Source: Bell *et al.* (2015).

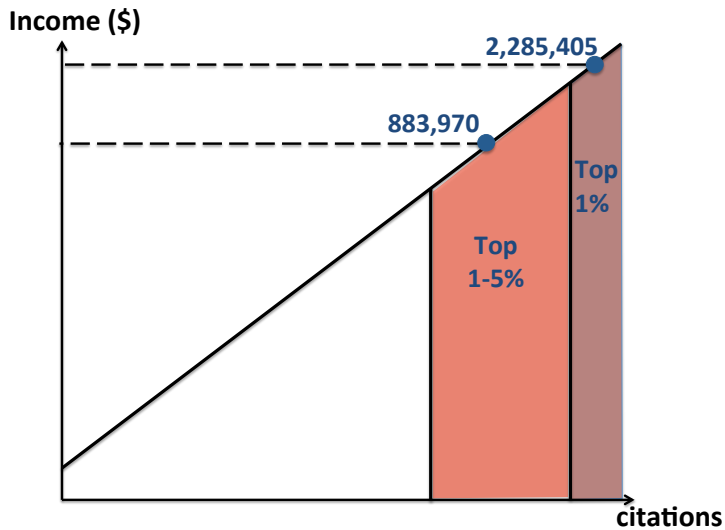
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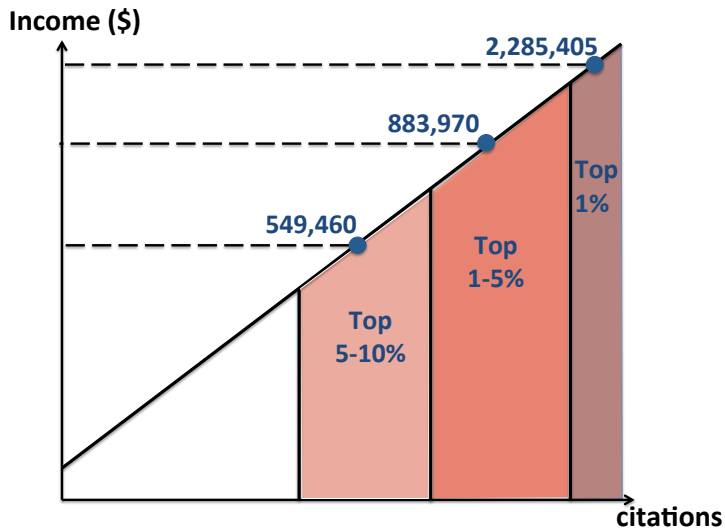
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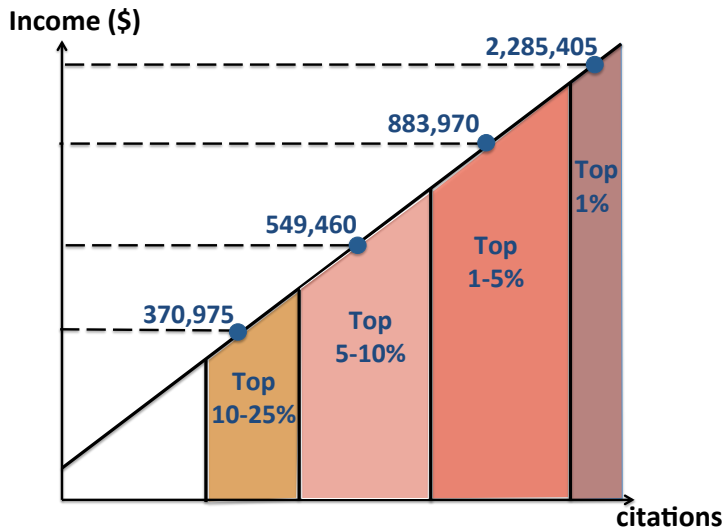
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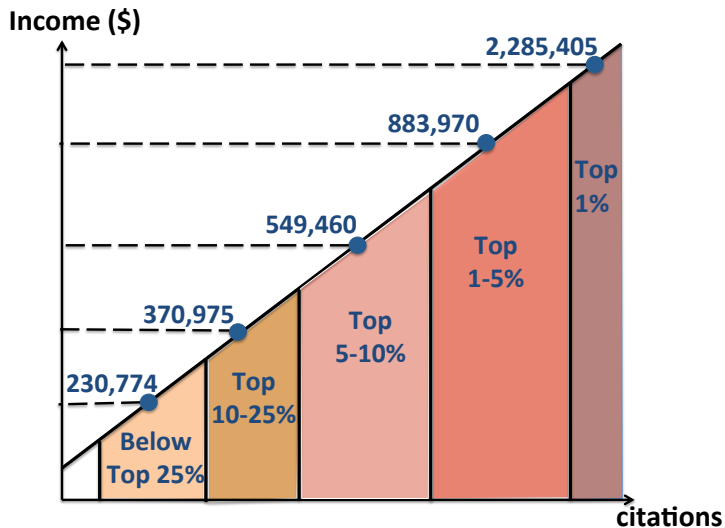
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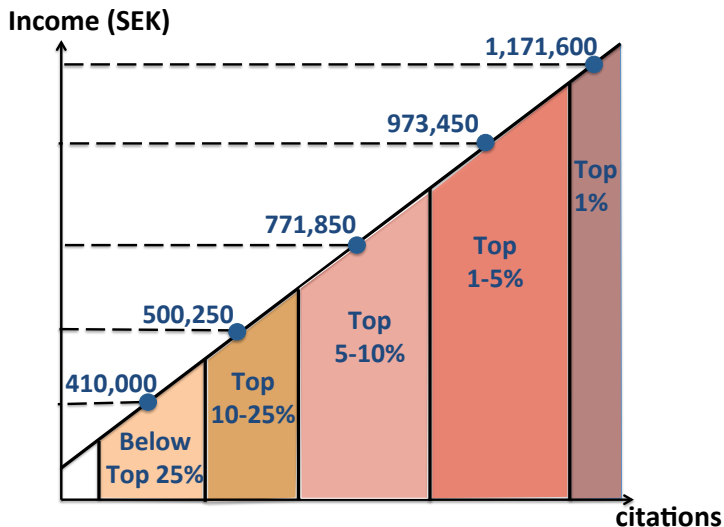
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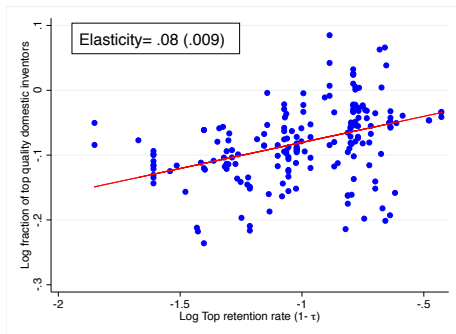


## Link between Inventor Quality and Income in Swedish and Finnish Admin data

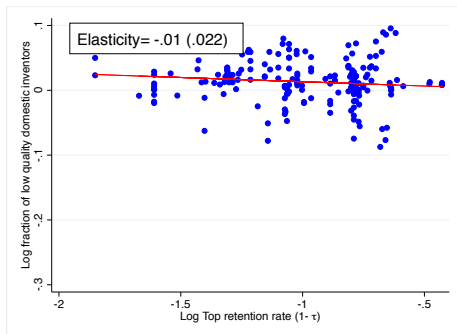


Source: Olof Ejermo and Otto Toivaanen.

# Top $(1 - \tau)$ and % of Domestic Inventors in Home Country



(a) Top quality inventors

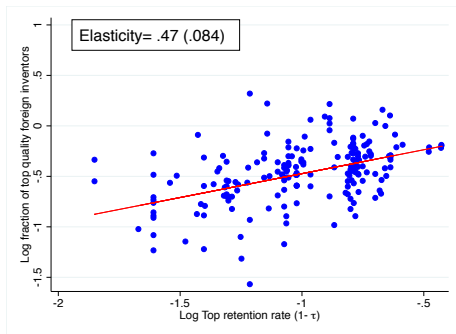


(b) Low quality inventors

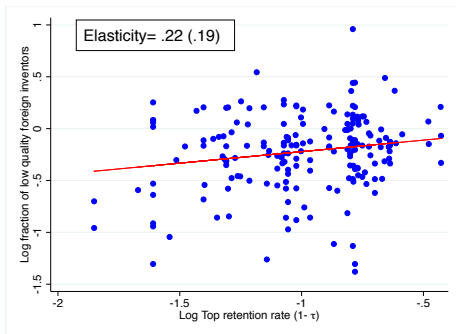
Additional macro level results in the paper:

- Domestic and Foreign inventors.
- For different quality levels, in different datasets.
- With leads and lags.

# Top $(1 - \tau)$ and % of Foreign Inventors



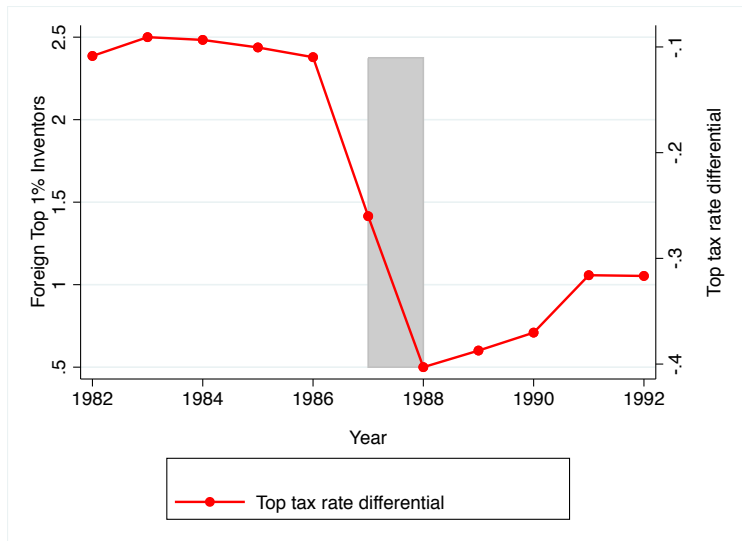
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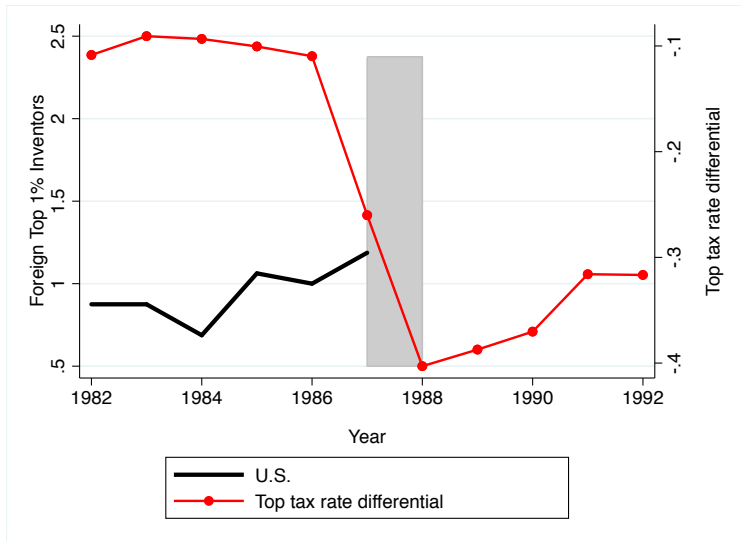
(b) Low quality inventors

Log outcomes at the country-year level. Partial residual plots controlling for country's patent stock, GDP per capita, country fixed effects, year fixed effects. Elasticities reported (standard errors clustered at the country level).

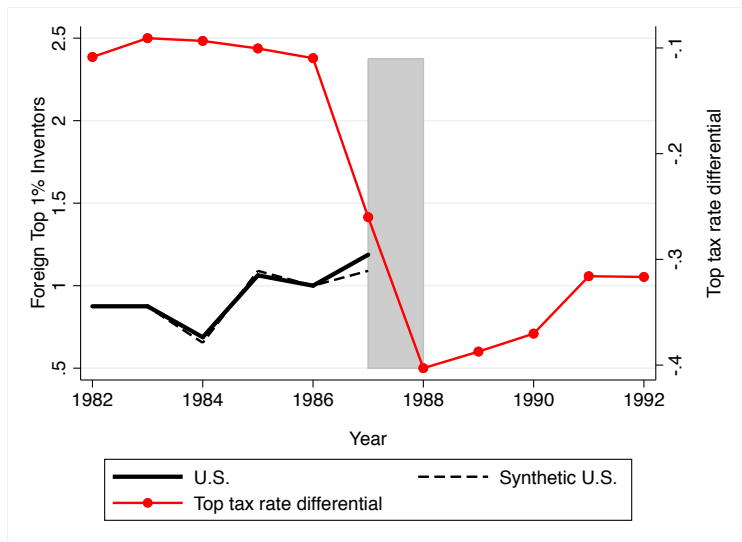
## Case Study: U.S. TRA 1986



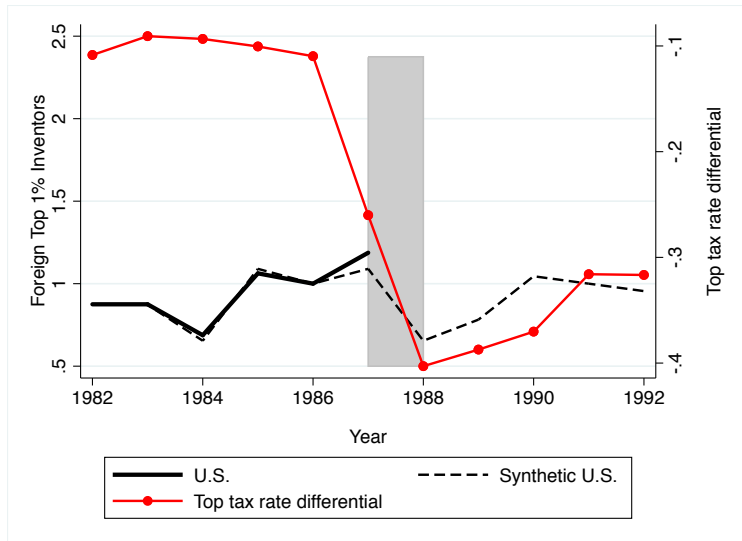
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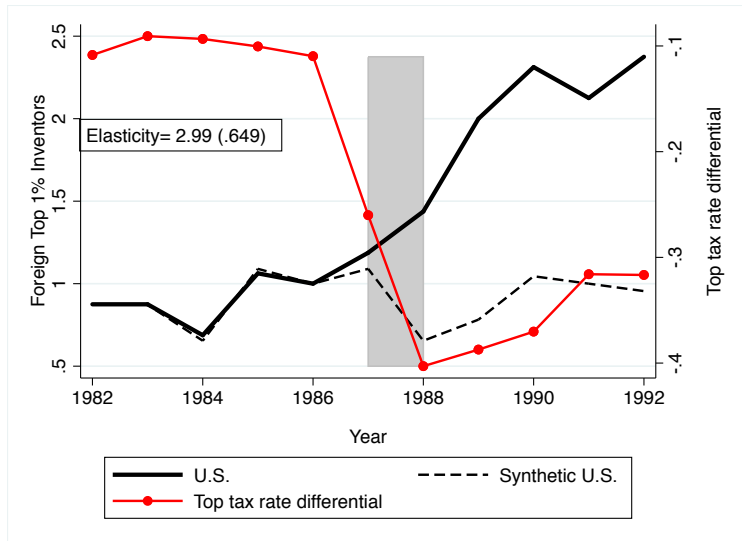
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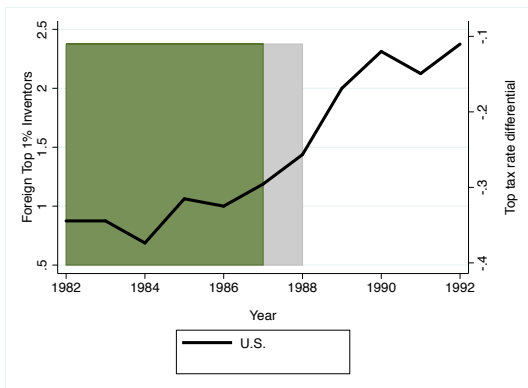
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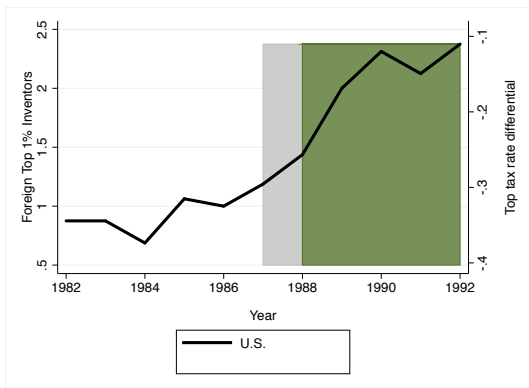
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Structural break in growth of foreign top 1% relative to lower quality inventors.

Inventor quality	Pre T.R.A 1986	Post T.R.A 1986
Top 1%	6.8%	16.4%
Below Top 1%	10.5%	11.3%

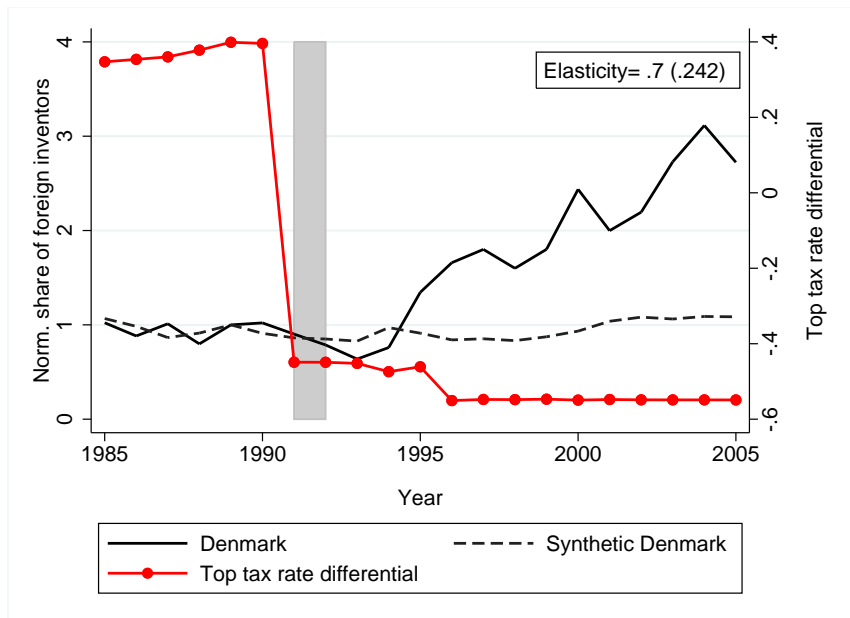
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# Case Study: Denmark's 1992 Preferential Tax Reform



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

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

+ quality  $\times$  country FE

+ quality  $\times$  country FE  $\times$  trend

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

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- $\mathbf{x}_{ct}$ : country covariates.

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

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

+ quality  $\times$  country FE

+ quality  $\times$  country FE  $\times$  trend

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

$\mathbf{x}_{cti}$ : individual-country pair covariates: home dummy, patent stock in inventor's tech field, distance, common language.

- $\mathbf{x}_{ct}$ : country covariates.

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

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

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

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

$\mathbf{x}_{cti}$ : individual-country pair covariates: home dummy, patent stock in inventor's tech field, distance, common language.

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

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

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

+ quality  $\times$  country FE

+ quality  $\times$  country FE  $\times$  trend

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

$\mathbf{x}_{cti}$ : individual-country pair covariates: home dummy, patent stock in inventor's tech field, distance, common language.

- $\mathbf{x}_{ct}$ : country covariates.

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

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

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

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

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

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

+ quality  $\times$  country FE

+ quality  $\times$  country FE  $\times$  trend

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

$\mathbf{x}_{cti}$ : individual-country pair covariates: home dummy, patent stock in inventor's tech field, distance, common language.

- $\mathbf{x}_{ct}$ : country covariates.

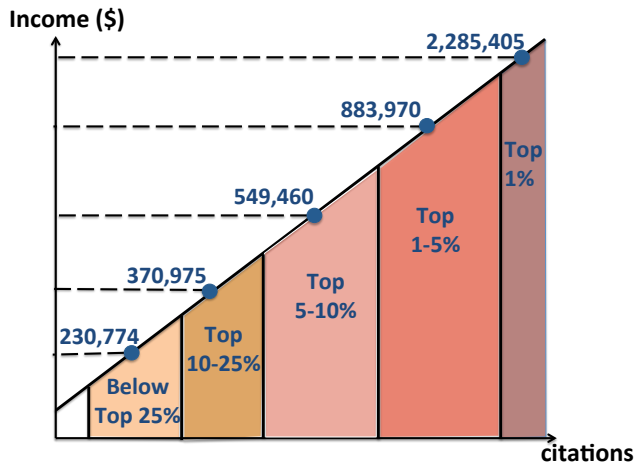
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## Choice of the Control Group?



Trade-off in the choice of the control group.

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

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

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

# Country-by-year Variation and General Equilibrium Effects

	(1)	(2)	(3)	(4)
Log Retention Rate $\times$ Top 1	0.894*** (0.206)	0.895*** (0.208)	0.969*** (0.210)	0.955*** (0.212)
Log Retention Rate $\times$ Top 1-5	0.443*** (0.133)	0.452*** (0.134)	0.522*** (0.133)	0.502*** (0.134)
Log Retention Rate $\times$ Top 5-10	0.148 (0.114)	0.162 (0.114)	0.233** (0.111)	0.209* (0.112)
Log Retention Rate $\times$ Top 10-25	-0.123 (0.0934)	-0.0987 (0.0933)	-0.0222 (0.0890)	-0.0460 (0.0895)
Log Retention Rate $\times$ Below Top 25	-0.405*** (0.113)	-0.349*** (0.119)	-0.267** (0.119)	-0.278** (0.120)
Quality $\times$ Country FE	NO	YES	YES	YES
Quality $\times$ Country FE $\times$ Year	NO	NO	YES	YES
Quality $\times$ Country FE $\times$ Year $\times$ Field FE	NO	NO	NO	YES
Domestic elasticity	.02	.02	.024	.024
s.e	(.0047)	(.0047)	(.005)	(.005)
Foreign elasticity	.75	.754	.811	.811
s.e	(.174)	(.175)	(.177)	(.177)
Observations	8644280	8616336	8616336	8616336

# Superstars vs. Non-Superstars

	(1)	(2)	(3)	(4)
Log Retention Rate $\times$ Top 1	1.376*** (0.478)	1.508*** (0.486)	1.451*** (0.489)	1.404*** (0.489)
Log Retention Rate $\times$ Top 1-5	0.926** (0.449)	1.065** (0.455)	1.004** (0.458)	0.950** (0.457)
Log Retention Rate $\times$ Top 5-10	0.629 (0.449)	0.773* (0.455)	0.713 (0.457)	0.654 (0.456)
Log Retention Rate $\times$ Top 10-25	0.357 (0.441)	0.511 (0.447)	0.454 (0.448)	0.396 (0.447)
Log Retention Rate $\times$ Below Top 25	0.0775 (0.444)	0.263 (0.451)	0.210 (0.449)	0.166 (0.449)
Quality $\times$ Country FE	NO	YES	YES	YES
Quality $\times$ Country FE $\times$ Year	NO	NO	YES	YES
Quality $\times$ Country FE $\times$ Year $\times$ Field FE	NO	NO	NO	YES
Control: Top 5-10				
Domestic elasticity	.02	.02	.02	.02
s.e	(.005)	(.005)	(.005)	(.005)
Foreign elasticity	.63	.62	.62	.63
s.e	(.18)	(.18)	(.19)	(.19)
Control: Top 10-25				
Domestic elasticity	.03	.02	.02	.02
s.e	(.005)	(.005)	(.005)	(.005)
Foreign elasticity	.85	.84	.83	.84
s.e	(.18)	(.18)	(.18)	(.18)
Control: Below Top 25				
Domestic elasticity	.03	.03	.03	.03
s.e	(.005)	(.005)	(.006)	(.006)
Foreign elasticity	1.09	1.05	1.04	1.04
s.e	(.190)	(.196)	(.201)	(.203)
Observations	8644280	8616336	8616336	8616336

# Superstars vs. Non-Superstars

	(1)	(2)	(3)	(4)
Log Retention Rate × Top 1	1.376*** (0.478)	1.508*** (0.486)	1.451*** (0.489)	1.404*** (0.489)
Log Retention Rate × Top 1-5	0.926** (0.449)	1.065** (0.455)	1.004** (0.458)	0.950** (0.457)
Log Retention Rate × Top 5-10	0.629 (0.449)	0.773* (0.455)	0.713 (0.457)	0.654 (0.456)
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Log Retention Rate × Below Top 25	0.0775 (0.444)	0.263 (0.451)	0.210 (0.449)	0.166 (0.449)
Quality × Country FE	NO	YES	YES	YES
Quality × Country FE × Year	NO	NO	YES	YES
Quality × Country FE × Year × Field FE	NO	NO	NO	YES
Control: Top 5-10				
Domestic elasticity	.02	.02	.02	.02
s.e	(.005)	(.005)	(.005)	(.005)
Foreign elasticity	.63	.62	.62	.63
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Log Retention Rate × Below Top 25	0.0775 (0.444)	0.263 (0.451)	0.210 (0.449)	0.166 (0.449)
Quality × Country FE	NO	YES	YES	YES
Quality × Country FE × Year	NO	NO	YES	YES
Quality × Country FE × Year × Field FE	NO	NO	NO	YES
Control: Top 5-10				
Domestic elasticity	.02	.02	.02	.02
s.e	(.005)	(.005)	(.005)	(.005)
Foreign elasticity	.63	.62	.62	.63
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Domestic elasticity	.03	.03	.03	.03
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Log Retention Rate × Below Top 25	0.0775 (0.444)	0.263 (0.451)	0.210 (0.449)	0.166 (0.449)
Quality × Country FE	NO	YES	YES	YES
Quality × Country FE × Year	NO	NO	YES	YES
Quality × Country FE × Year × Field FE	NO	NO	NO	YES
Control: Top 5-10				
Domestic elasticity	.02	.02	.02	.02
s.e	(.005)	(.005)	(.005)	(.005)
Foreign elasticity	.63	.62	.62	.63
s.e	(.18)	(.18)	(.19)	(.19)
Control: Top 10-25				
Domestic elasticity	.03	.02	.02	.02
s.e	(.005)	(.005)	(.005)	(.005)
Foreign elasticity	.85	.84	.83	.84
s.e	(.18)	(.18)	(.18)	(.18)
Control: Below Top 25				
Domestic elasticity	.03	.03	.03	.03
s.e	(.005)	(.005)	(.006)	(.006)
Foreign elasticity	1.09	1.05	1.04	1.04
s.e	(.190)	(.196)	(.201)	(.203)
Observations	8644280	8616336	8616336	8616336

# The Role of Companies

	(1)	(2)
Log Retention Rate × Top 1	1.400*** (0.500)	0.980* (0.537)
Log Retention Rate × Top 1-5	0.868* (0.473)	0.548 (0.493)
Log Retention Rate × Top 5-10	0.514 (0.473)	0.199 (0.491)
Log Retention Rate × Top 10-25	0.181 (0.468)	-0.0974 (0.481)
Log Retention Rate × Below Top 25	-0.254 (0.472)	-0.560 (0.485)
Log Retention Rate × Not Multinational	-0.216* (0.129)	
Log Retention Rate × Activity abroad		-1.470*** (0.137)
Quality × Country FE	YES	YES
Quality × Country FE × Year	YES	YES
Quality × Country FE × Year × Field FE	YES	YES
Control: Top 5-10	Domestic elasticity s.e	.018 (.0045)
	Foreign elasticity s.e	.420 (.154)
Control: Top 10-25	Domestic elasticity s.e	.024 (.0045)
	Foreign elasticity s.e	.579 (.151)
Control: Below Top 25	Domestic elasticity s.e	.034 (.0047)
	Foreign elasticity s.e	.828 (.159)
Observations	7059856	6168504

# The Role of Companies

	(1)	(2)
Log Retention Rate × Top 1	1.400*** (0.500)	0.980* (0.537)
Log Retention Rate × Top 1-5	0.868* (0.473)	0.548 (0.493)
Log Retention Rate × Top 5-10	0.514 (0.473)	0.199 (0.491)
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Log Retention Rate × Below Top 25	-0.254 (0.472)	-0.560 (0.485)
Log Retention Rate × Not Multinational	-0.216* (0.129)	
Log Retention Rate × Activity abroad		-1.470*** (0.137)
Quality × Country FE	YES	YES
Quality × Country FE × Year	YES	YES
Quality × Country FE × Year × Field FE	YES	YES
Control: Top 5-10	Domestic elasticity s.e	.018 (.0045)
	Foreign elasticity s.e	.420 (.154)
Control: Top 10-25	Domestic elasticity s.e	.024 (.0045)
	Foreign elasticity s.e	.579 (.151)
Control: Below Top 25	Domestic elasticity s.e	.034 (.0047)
	Foreign elasticity s.e	.828 (.159)
Observations	7059856	6168504

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