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One Size Fits All? Estimating Tax Elasticities Across Time

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The views expressed in this presentation are those of the authors and **do not** necessarily represent the views of the Bank of Spain and the Eurosystem.

Motivation

Main Contribution: We estimate, quantify and disentangle how the tax policy transmission mechanism varies across time, i.e. 1983 vs. 2016.

i. We study the effects of tax changes both on **macro aggregates**, e.g. GDP, as well as on more **micro variables**, such as wealth inequality, individual saving behaviour and labour supply.

ii. We disentangle how the **overall effects** of tax changes depend on **specific features** of the economy, such as the the increased dispersion of **labour productivity**, the decline in the **progressivity** of the income tax schedule; and the **concentration** of wealth. *et cetera*.

What We Do

- We estimate a **life-cycle** model with **uninsurable labor** and **capital income risk** that captures:
  - **Key behavioral elasticities – i.e.** labor supply and consumption/saving choice;
    - Crucial to capture agents' responses to tax changes.
  - **Right tail of earnings and wealth distribution** across time.
    - Crucial to quantify the effects of fiscal policy, **rich top 1% paid 42% of overall federal taxes in 2016**.
- We use the estimated model as **laboratory** for our policy experiments.
  - Policy experiment today: across-the-board tax cut that is financed by allowing government spending to fall
  - Compare two steady-states, with and without policies in 1983 vs. 2016, i.e. **long-run effects**.

What We Find

- : **Macroeconomic result:** We estimate that **$1** decrease in fiscal revenues increases GDP by **$2.38** in 1983 and **$1.17** in 2016.
- **Public Economics result:** The long-run elasticity of taxable income (ETI) to the net of AMTR is around **0.68** in 1983 and **0.47** in 2016.
- The effects of marginal tax policies are **larger** in 1983 than in 2016 along the whole distribution of income but even more so for **the top 1% of the distribution**.
- Most of the differences between 1983 and 2016 are due to general equilibrium effects of: i) the **progressivity** of the tax function; ii) the distribution of **talents** and iii) the distribution of **returns**;

Motivation

Novel complementary evidence on the transmission mechanism of tax policies

- Issues and shortcomings of the empirical literature, see Saez *et al.* (JEL, 2012):
  - Mainly **short-run** effects of tax changes, e.g. Feldstein (JPE, 1995), Mertens and Motiel-Olea (QJE, 2018). However many effects appear only in the long-run (wealth inequality).
  - Best available estimates of LRETI around **0.25**, Saez *et al.* (JEL, 2012).
  - **Mixed results** on the transmission mechanism, i.e. whether due to top or bottom income groups: **top 1%** Mertens and Montiel-Olea (QJE, 2019), **bottom 90%** Zidar (JPE, 2019);
  - **Same effects** in 1948 and 2015, fundamentally different economy, it matters for the transmission mechanism;
- Our approach **overcomes** most of the points above, at the cost of **imposing** a DGP on the system, e.g. we ignore human capital accumulation and tax avoidance.

Model

General Setting

- Consider a **life-cycle economy** (incomplete markets and borrowing constraints):
  - Agents live up to age J, but there is an exogenous probability of **early death**;
  - **Labour supply** is endogenous;
- **Idiosyncratic labor productivity risk + ex-ante heterogeneity in ability**
  e.g. Conesa *et al.* (AER, 2009) and Kaplan and Violante (Eca, 2014);
- **Return on wealth is risky**
  See empirical evidence of Fegereng *et al.* (Eca, 2019), Saez and Zucman (QJE, 2016) and models by Behabib *et al.* (Eca, 2011), Behabib *et al.* (AER, 2019) and Hubmer, Krussel and Smith (2019).

Preferences

- All age-1 agents have identical preferences for **consumption** c_j and **hours worked** h_j over their lifetime,

$$E\left\{\sum_{j=1}^{J}\beta^{j-1}\underbrace{\left(\prod_{k=1}^{j}s_k\right)}_{\text{surv prob.}}u(c_j,h_j)\right\}$$

- $\prod_{k=1}^{j}s_k$ is the unconditional probability an age-1 agent will survive to age j;

- We assume

$$u(c,h)=\frac{\left(c^{\gamma}(1-h)^{1-\gamma}\right)^{1-\sigma}}{1-\sigma}$$

Labor Earnings Risk

- Labor earnings is defined as whe, where e is labor productivity:

$$\log e(i,j,z_h) = \bar{e}_i + \underbrace{(\alpha_0 + \alpha_1 j + \alpha_2 j^2 + \alpha_3 j^3 + \alpha_4 j^4)}_{\text{life-cycle profile}} + z_h$$

  - Fixed heterogeneity via $\bar{e}_i$
  - A life-cycle component, modeled as a quartic polynomial
  - Idiosyncratic shocks via AR(1) residual, z_h

- z_h is AR(1):

$$z_h' = \rho_h z_h + \varepsilon_e \quad \varepsilon_e \sim N(0, \sigma^2_{\varepsilon h})$$

  where initial z_h is fixed at zero.

- We assume $e = 0$ once individual reaches retirement age ($j = R$).

Asset Return Risk

- Return on wealth is risky
  see Saez and Zucman (QJE, 2016) and Fagereng, Guiso, Malacrino and Pistaferri (Eca, 2019);

- Households choose
  - lending to other households at rate r
  - becoming an entrepreneur using backyard technology $q = z_r k$ to produce intermediate good q with exogenous collateral constraint $k \leq \lambda a$, that is traded at price p
  - entrepreneurial productivity is stochastic:

$$\log z_r' = \rho_r \log z_r + \varepsilon_r, \quad \varepsilon_r \sim N\left(0, \sigma_{\varepsilon r}^2\right)$$

    where initial z_r is drawn from $N\left(0, \sigma_{\varepsilon r}^2/(1-\rho_r^2)\right)$.
  - total return on wealth is

$$r_a(z_r) = r + \lambda \max\{p z_r - (r+\delta), 0\}$$

  - endogenous entrepreneurial threshold $\bar{z}_r = (r+\delta)/p$

- The supply is entirely standard. Firms adopts a CRS production technology in capital and labour, $Y = F(Q, L) = AQ^{\alpha} L^{1-\alpha}$;
- Optimal behaviour and perfect factor markets imply $w = F_L$ and $\bar{r} + \delta = F_Q$;

Government

- Government runs social security scheme

$$\begin{aligned} \bar{b}_i &= \chi w L_i && \text{(S.S. retirement benefit)} \\ T_{ss} &= \tau_{ss} \min(weh, \bar{y}) && \text{(Flat S.S. tax up to a cap)} \end{aligned}$$

- Labor and income are jointly taxable; taxable income is:

$$y = weh + ra - \frac{1}{2} \underbrace{\min(weh, \bar{y})}_{\text{S.S. contrib}}$$

- The income tax function is from Gouveia and Strauss (1994):

$$\mathcal{T}(y; \tau_0, \tau_1, \tau_2) = \tau_0 \left[y - \left(y^{-\tau_1} + \tau_2 \right)^{-\frac{1}{\tau_1}} \right],$$

τ_0 is the top marginal tax rate, and (τ_1, τ_2) jointly determine the progressivity of the tax function.

Quantitative Assessment

Quantitative Strategy

- Three groups of parameters:

1. Estimate some parameters outside the model using Survey of Consumer Finances (SCF) and TAXSIM data

   e.g., labor productivity age-profile; tax function

2. We fix some parameters / or set to match macro ratios

   e.g., risk aversion, discount factor

3. Remaining parameters estimated via Simulated Method of Moments (SMM) to match key wealth and earnings moments from the SCF

   e.g., capital income risk, labor productivity risk/fixed effect

Directly Estimated Parameters: 1983 vs. 2016

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Parameter	**Notation**	**1983 Value**	**2016 Value**
Survival prob.	$\{s_{j+1}\}_{j=1}^{J}$	[...]	[...]
Income tax:			
Max. tax rate	τ_0	0.370	0.278
Progessivity 1	τ_1	1.55	2.85
Progessivity 2	τ_2	1.82×10^{-3}	1.14×10^{-5}
Labor ability:			
Age profile, 0	α_0	3.31	4.20
Age profile, 1	α_1	0.12	0.10
Age profile, 2	α_2	-6.41×10^{-3}	-3.72×10^{-3}
Age profile, 3	α_3	$+1.38 \times 10^{-4}$	$+6.37 \times 10^{-5}$
Age profile, 4	α_4	-1.08×10^{-6}	-4.20×10^{-7}

Note: Survival probabilities were obtained from the 1959-2016 Period Life Tables from the US Mortality Database.

Tax Functions: 1983 vs. 2016

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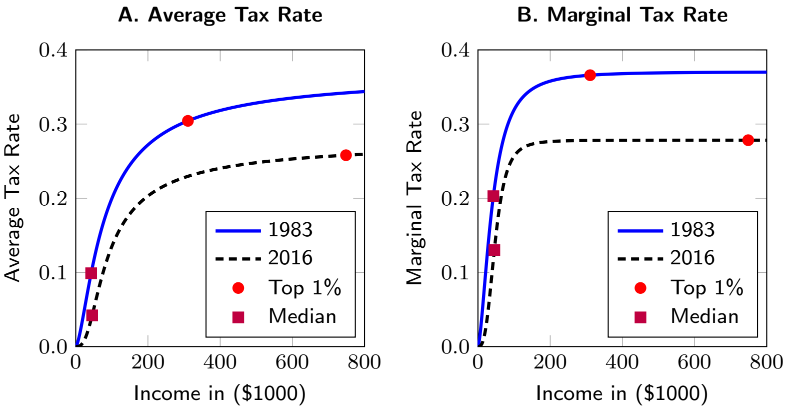
Tax Functions. Progressivity: 1983=0.273; 2016=0.221.



Note: We use NBER's TAXSIM to measure income taxes in SCF and we fit our tax function to the data using non-linear least squares. We compute progressivity for income p50 (y_1) vs income p99 (y_2), $P(y_1, y_2) = 1 - \frac{1-\mathcal{T}'(y_2)}{1-\mathcal{T}'(y_1)}$.

Calibrated Parameters: 1983 vs. 2016

	Notation	Value	Description
Number of types	I	6	
Maximum age	J	70	Age 90
Retirement age	R	45	Age 65
Risk aversion	σ	2	Typical
Population growth rate	n	0.012	
Capital share	α	0.36	Typical
Depreciation rate	δ	0.06	Typical
Replacement rate	χ	0.70	
Discount factor	β	0.99	Target $K/Y = 3$
Persistence labor shock	ρ_h	0.95	Typical

	Notation	1983 Model	2016 Model
S.S. tax rate	τ_{ss}	0.108	0.124
S.S. income cap	$\bar{y}$	70.9	107.7

Estimated Parameters

		1983		2016	
Panel A: Parameters	**Notation**	**Value**	**Std. Err.**	**Value**	**Std. Err.**
Lab. fixed effect	$Std.Dev.(\bar{e}_i)$	0.613	(0.088)	0.852	(0.233)
Lab. idios. shock	$\sigma_{\varepsilon h}$	0.170	(0.030)	0.228	(0.076)
Consumption share	γ	0.362	(0.004)	0.372	(0.026)
Return persistence	ρ_r	0.952	(0.012)	0.951	(0.108)
Return std. dev.	$\sigma_{\varepsilon r}$	0.296	(0.019)	0.305	(0.099)
		1983		**2016**	
Panel B: Moments		**Model**	**Data**	**Model**	**Data**
Wealth gini		0.81	0.78	0.88	0.86
Wealth share, top 1%		0.32	0.32	0.40	0.39
Wealth share, top 5%		0.54	0.55	0.66	0.65
Wealth share, top 20%		0.83	0.80	0.91	0.88
Earnings gini		0.60	0.57	0.67	0.68
Earnings top 1%		0.09	0.07	0.15	0.17
Tax shares top 1%		0.25	0.23	0.39	0.42
Tax shares top 5%		0.45	0.42	0.68	0.66
Average Hours		0.33	0.30	0.32	0.30
Wealth-Income Cov.		0.52	0.57	0.49	0.58

Policy Experiment

Cut in Marginal Tax Rates

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Main Exercise: Cut τ_0 by 5pp

- This policy changes the AMTR as well as ATR, hence it affects the progressivity of the tax system;
- We compensate this variation with adjustments in G;
- We compare two steady-states (hence these are long-run values)
- We calculate the \$ on \$ GDP Multipliers and ETI

$$Mult = \frac{\Delta Y}{-\Delta T_y} \qquad ETI = \frac{\%\Delta y}{\%\Delta(1 - AMTR)}$$

General Effects: \$ on \$ Multipliers

Variable	**1983**	**2016**	**Difference**
Multiplier-GDP	2.40	1.16	-51.50%
Multiplier-Tax.Inc.-Aggr.	1.91	0.86	-55.06%
Multiplier-Tax.Inc. Top 1%	2.15	0.68	-68.10%
Multiplier-Tax.Inc. Top 5%	1.61	0.68	-57.65%
Multiplier-Tax.Inc. Top 10%	1.59	0.70	-56.46%
Multiplier-Tax.Inc. Bottom 99%	1.81	0.94	-48.17%
Multiplier-Tax.Inc. Bottom 90%	2.65	1.27	-51.93%

General Effects: Elasticity of Taxable Income

Variable	1983	2016	Difference
ETI-Aggregate	0.68	0.47	-29.91%
ETI Top 1%	0.77	0.42	-45.06%
ETI Top 5%	0.61	0.41	-31.62%
ETI Top 10%	0.59	0.42	-28.62%
ETI Bottom 99%	0.63	0.50	-21.06%
ETI Bottom 90%	0.79	0.58	-26.48%

General Effects: Distributional Effects

Variable	1983	2016
Wealth Gini	0.14	0.02
Wealth top 1%	0.57	0.01
Wealth top 5%	0.34	0.05
Wealth top 20%	0.15	0.04
Earning Gini	0.02	-0.01
Earning top 1%	-0.05	-0.02
Earning top 5%	-0.01	-0.02
Earning top 20%	0.01	-0.01

Disentangling the Results: PE vs GE

Response at the top is much stronger in partial equilibrium (PE) compared to general equilibrium (GE):

	1983		**2016**	
	GE	**PE**	**GE**	**PE**
ETI Aggregate	0.68	2.00	0.48	1.06
ETI Top 1%	0.77	3.77	0.42	2.53
ETI Top 5%	0.61	2.48	0.42	1.64
ETI Top 10%	0.59	2.11	0.42	1.37
ETI Bottom 99%	0.63	1.10	0.50	0.46
ETI Bottom 90%	0.79	1.29	0.58	0.44
$\%\Delta w$	2.6%	0.0%	2.7%	0.0%
$\%\Delta p$	-4.5%	0.0%	-4.6%	0.0%

Disentangling the Results: Model Features

	1983			
	Bench.	No Cap. Inc. Risk	No Lab. Inc. Risk	Flat Tax
ETI Aggregate	0.68	0.35	0.94	0.40
ETI Top 1%	0.77	0.26	0.95	0.34
ETI Top 5%	0.61	0.31	0.80	0.35
ETI Top 10%	0.59	0.33	0.79	0.36
ETI Top Bottom 99%	0.63	0.37	0.86	0.41
ETI Top Bottom 90%	0.79	0.33	1.00	0.44

	2016			
	Bench.	No Cap. Inc. Risk	No Lab. Inc. Risk	Flat Tax
ETI Aggregate	0.48	0.27	0.52	0.39
ETI Top 1%	0.42	0.25	0.49	0.32
ETI Top 5%	0.42	0.26	0.47	0.36
ETI Top 10%	0.42	0.27	0.45	0.37
ETI Top Bottom 99%	0.50	0.27	0.54	0.42
ETI Top Bottom 90%	0.58	0.27	0.62	0.43

Disentangling the Results: Differences

Variable	1983 Bench.	1983 + 2016 Tax	1983 + 2016 Ability	1983 + 2016 Returns
Multiplier-GDP	2.40	1.91	1.50	2.35
Multiplier-Tax.Inc.-Aggr.	1.91	1.49	1.06	1.91
Multiplier-Tax.Inc. Top 1	2.15	1.31	1.01	2.11
Multiplier-Tax.Inc. Top 10	1.59	1.11	0.92	1.62
Multiplier-Tax.Inc. Bottom 99	1.81	1.59	1.07	1.61
Multiplier-Tax.Inc. Bottom 90	2.65	2.73	1.38	1.82
ETI-Aggregate	0.68	0.66	0.46	0.68
ETI Top 1	0.77	0.71	0.47	0.77
ETI Top 10	0.59	0.55	0.43	0.60
ETI Bottom 99	0.63	0.63	0.46	0.63
ETI Bottom 90	0.79	0.81	0.51	0.79

Conclusions

Conclusions/1

- We **develop** a quantitative life cycle model to assess the effects of tax changes
  i. We discipline the model with external and internal estimates;
  ii. The model captures well the right tail of the wealth distribution and key behavioural elasticities.

- We **quantify** the transmission mechanism of tax policy across time:
  i. \$ on \$ multiplier is **50% lower** in 2016 than in 1983;
  ii. The long-run elasticity of taxable income (ETI) is **30% lower** in 2016 than in 1983;
  iii. Difference along the income distribution.

- **Important insights** into the transmission mechanism:
  i. The progressivity of taxation matters more for the transmission on the aggregate level;
  ii. The dispersion of productivity matters more for the transmission on the individual level.

Conclusions/2

- **Main take home**:

    i. Substantial **quantitative difference** in the effects of tax policies in post 80s US data;

    ii. Modelling the **right tail** of the distribution is crucial to evaluate the transmission mechanism of fiscal policies;

    iii. **GE effects and non-linearities** extremely important for policy evaluations.

Appendices

- We estimate the remaining parameters using a Simulated Method of Moments (SMM) estimator, see Taylor (JoF, 2010) and Benhabib et al. (AER, 2019):
  1. we select some relevant moments of the income and wealth process from the SCF (1983 and 2016);
  2. we estimate the parameters by matching the targeted moments generated by the stationary distribution induced by the model and those in the data.

- Specifically we use the formula

$$\hat{\Theta} = \arg\min_{\Theta} \left(\hat{M} - \frac{1}{S} \sum_{s=1}^{S} \hat{m}^s\left(\Theta\right) \right)' W \left(\hat{M} - \frac{1}{S} \sum_{s=1}^{S} \hat{m}^s\left(\Theta\right) \right),$$

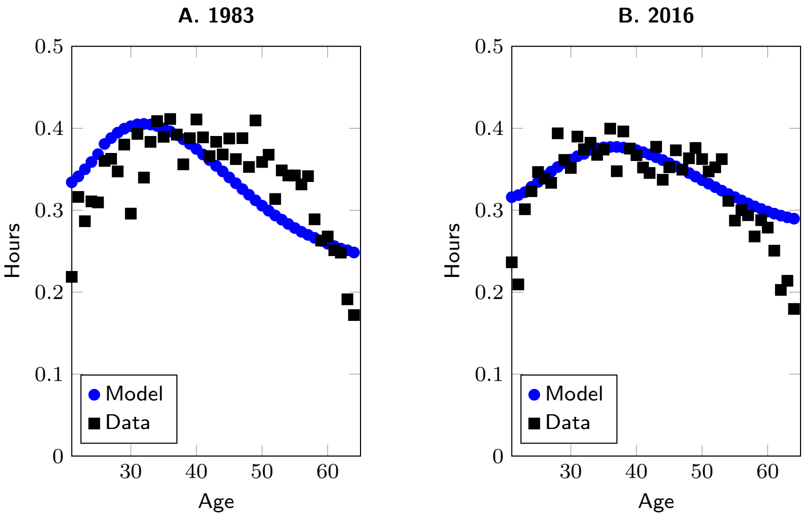
  with $\hat{M}$=Data moments; $\hat{m}^s(\Theta)$=Model moments; W=Efficient weighting matrix;

- Standard errors computed using

$$\sqrt{N}(\Theta - \Theta_0) \rightarrow \mathcal{N}(0, V) \quad \text{where } V = (1 + 1/S)(G'WG)^{-1}$$

  with N=no. of data observations; G = gradient matrix of moments

Hours-Age Profile



The Return Profile

Table: Implied excess return profiles

Wealth	**1983**	**2016**
Top 1%	9.3%	6.6%
Top 5%	5.1%	3.2%
Top 10%	3.5%	2.1%
Top 20%	2.1%	1.2%
Bottom 50%	-2.9%	-3.0%
Median	0	0

Labor Productivity Age Profiles: 1983 vs. 2016