Optimal Progressivity of Personal Income Tax
A General Equilibrium Evaluation for Spain

Darío Serrano-Puente (2020)

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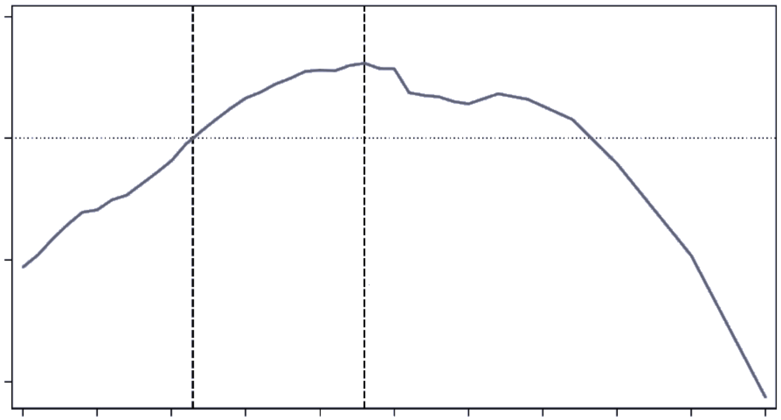

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Banco de España
DG of Economics, Statistics and Research

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- ❑ Is the Spanish economy positioned at its **optimal progressivity level in personal income tax**?

- ❑ What are **the aggregate, distributional, and welfare consequences** of moving towards such an optimal level?

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- Piketty (2015), Kopczuk (2019), Saez and Zucman (2019) → what are the **most effective policies to address economic inequality**?
- Now in Spain:
  - How to **finance the fiscal stimulus recovery plans** to alleviate the economic consequences of **COVID-19** crisis and the upcoming unavoidable **fiscal consolidation process**.
  - PGE 2021 → a **personal income tax (PIT) rate increase for the high-income earners**, i.e. an increase in the progressivity of the PIT.
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- A **heterogeneous households general equilibrium** model featuring:
  - **life-cycle** profiles → households face **uninsurable idiosyncratic labor productivity shocks** defining aging and retirement.
  - **dynastic** elements → households are born **inheriting some earnings abilities from their predecessors** (they are altruistic toward their descendants).
- Households decide **how much to work** and **how much to save**.
- Household income (labor, capital and other incomes) **taxed** with a **progressive** schedule.
- Social planner finds a **welfare-maximizing degree of progressivity** in the PIT.
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Main Findings

- Aggregate **social welfare maximized** when **progressivity level is increased** → average increase of 3.08% of consumption.
- The **poorest** working and non-working households **benefiting the most** and the **most efficient** working households and the **wealthiest** ones experiencing the **largest welfare losses**.
- **Reductions in** wealth and income **inequality** but negative effects on capital, labor, and output (**efficiency loss**).
- Households **between p20 and p80** → **decrease** in their effective average tax rates.
  - Ex.: Effective average tax rate within p40 and p60 would drop from 0.067 to 0.056.
- Households **above p80** → **drastic increment** in their effective average tax rate.
  - Ex.: Top 1% households from with an effective average tax rate change from 0.284 to 0.330.

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Broader Connections to Literature

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- **Tax reform** evaluation with **GE** models for **Spain** → Pijoan-Mas and González Torrabadella (2006), Viegas and Ribeiro (2015).
- **Optimal taxation** & **progressivity** in a GE framework:
  - Conesa et al. (2009), Diamond and Saez (2011), Guner et al. (2017), Kindermann and Krueger (2018).
  - Conesa and Krueger (2006), Bakis et al. (2015), Heathcote et al. (2017), Díaz-Giménez and Pijoan-Mas (2019), Storesletten (2019).

Closest Match in Literature

- **Theoretical** framework → Castañeda et al. (2003).
- **Topic** (Spain) → Guner, N., J. López-Segovia, and **R. Ramos** (2020).

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- Setup → Castañeda et al. (2003 → modified version of the **stochastic neoclassical growth** model with **uninsured idiosyncratic risk** and no **aggregate uncertainty**.
- **Tax function** specification → Heathcote, J., K. Storesletten, and G. L. Violante (2017).

Main Features

- HHs that are **ex-ante identical**.
- Uninsured household-specific **shock** to HHs' **endowments of efficiency labor units**.
- HHs go through life cycle → **workers** or **retirees**.
- Once HHs retired → **probability of dying** → if HH dies, it is **replaced by working-age descendant**.
- HHs **altruistic towards** their **descendants**.

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I. Population & Endowment Dynamics

A measure one continuum of heterogeneous dynastic households endowed with ℓ **units of disposable time each period.**

Uncertainty in the model $\rightarrow$ **Age** and **endowment of efficiency** labor units

Controlled by one-dimensional shock, s, taking values:

- Worker $\rightarrow s \in E = \{1, 2, \dots, J\}$
  - **Uninsured idiosyncratic stochastic process** determining their endowment of efficiency labor units $\rightarrow e(s) > 0$
  - Exogenous positive **probability of retiring** $\rightarrow p_r \rightarrow$ Jump from $s \in E$ to $s' \in R$.
- Retiree $\rightarrow s \in R = \{J+1, J+2, \dots, 2J\}$
  - $e(s) = 0$
  - Exogenous positive **probability of dying** $\rightarrow 1 - p_s$.
    - If HH **dies** $\rightarrow$ Jump from $s \in R$ to $s' \in R \rightarrow$ **replaced by a working-age descendant** that **inherits** the deceased household **estate**, a, and, possibly, some of its **earnings abilities**.

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- Finite state **Markov chain**.
- Conditional transition probabilities given by $2J$x $2J$ matrix $\Gamma_{SS'}$.

$$\Gamma_{SS'} = \begin{bmatrix} \Gamma_{EE'} & \Gamma_{ER'} \\ \Gamma_{RE'} & \Gamma_{RR'} \end{bmatrix}$$

- $\Gamma_{EE'} \rightarrow$ **working phase** of life cycle $\rightarrow$ stationary distr. of working HHs, γ_E^*.
- $\Gamma_{RR'} \rightarrow$ **retirement phase** of life cycle $\rightarrow \Gamma_{RR'} \coloneqq \mathbf{I}p_s$.
- $\Gamma_{ER'} \rightarrow$ **retirement** $\rightarrow \Gamma_{ER'} \coloneqq \mathbf{I}p_r$.
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II. Preferences & Production Possibilities

- HHs value **consumption**, c, and **leisure**, $\ell - h \rightarrow$ they maximize:

$$E_0\left[\sum_{t=0}^{\infty} \beta^t u(c, \ell - h) | s\right]$$

- Time discount factor $\rightarrow \beta$

Utility function

$$u(c,h) = \frac{c^{1-\sigma}}{1-\sigma} + \chi\frac{(\ell - h)^{1-\varphi}}{1-\varphi}$$

- Intertemporal elasticity of substitution of consumption $\rightarrow \frac{1}{\sigma}$
- Intertemporal elasticity of substitution of leisure $\rightarrow \frac{1}{\varphi}$
- Frisch elasticity of labor supply $\rightarrow \frac{(\ell - h)}{\varphi \cdot h}$

The Model Economy

II. Preferences & Production Possibilities

- Production technology transforms agg. capital, K, and agg. labor, L, into output, Y.

Production function

$$Y = A \cdot K^{\alpha} \cdot L^{1-\alpha}$$

- Total factor productivity $\longrightarrow A = 1$
- Capital share $\longrightarrow \alpha$
- Capital is assumed to depreciate geometrically at a constant rate $\longrightarrow \delta$

- Wage, w, and interest rate, r $\longrightarrow$ from firms' profit maximization problem.

The Model Economy

III. Government Sector

- **Total tax revenue**, T, is used to finance **government consumption**, G, and **transfers to retirees**, Tr.

$$T = G + Tr$$

- Taxes levied on **household income** (from labor, capital and pensions), $y \rightarrow \tau(y)$.

Tax function → Augmented version of Heathcote et al. (2017)

$$\tau(y) = [y - \lambda^{1-\tau}] + \kappa \cdot y$$

- **PIT schedule** → $[y - \lambda^{1-\tau}]$, with **average level of taxes**, λ, and **progressivity**, τ.
- Other taxes (proportional to income) →$\kappa \cdot y$ → To **match total tax revenues**

- **Transfers** to retirees → $\omega(s)$

Recall

- If HH retired → $e(s) = 0$ and $\omega(s) > 0$ (**constant** for every retired HH, **no dependent on past SS contributions**)
- If HH worker → $e(s) > 0$ and $\omega(s) = 0$

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IV. Households' Decision Problem

- **No insurance markets** for the household-specific shock.
- Agents can **save** in the form of **riskless capital**, a, but they **cannot borrow**.

Bellman equation

Given individual state variables $\rightarrow s$ and a

$$v(a,s) = \max_{c,a',h} u(c, \ell - h) + \beta \sum_{s \in S} \Gamma_{SS'} v(a', s')$$

$$s.t. \qquad c + a' = y - \tau(y) + a$$

$$y = ar + e(s)hw + \omega(s)$$

$$\tau(y) = [y - \lambda y^{1-\tau}] + \kappa y$$

$$c \geq 0 \quad a' \in A \quad 0 \leq h \leq \ell$$

Solving household policy $\rightarrow \{c(a,s), a'(a,s), h(a,s)\}$

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IV. Households' Decision Problem

- **No insurance markets** for the household-specific shock.
- Agents can **save** in the form of **riskless capital**, a, but they **cannot borrow**.

Bellman equation

Given individual state variables → s and a

$$v(a,s) = \max_{c,a',h} u(c, \ell - h) + \beta \sum_{s \in S} \Gamma_{ss'} v(a', s')$$

$$\begin{aligned} s.t. \qquad & c + a' = y - \tau(y) + a \\ & y = ar + e(s)hw + \omega(s) \\ & \tau(y) = [y - \lambda y^{1-\tau}] + \kappa y \\ & c \geq 0 \quad a' \in A \quad 0 \leq h \leq \ell \end{aligned}$$

Solving household policy → $\{c(a,s), a'(a,s), h(a,s)\}$

Calibration

Calibration

36 parameters

7 parameters

Normalization conditions

29 parameters

Match characteristics of Spanish economy

Model Period → 1 Year
Base Calibration Year → 2015

7 parameters

Direct identification

22 parameters

Method of simulated moments

Calibration

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Calibration

I. Normalization Conditions

- Endowment of **disposable time** $\rightarrow \ell = 3.2$
- **Possible states** in which a HH can stay when worker or retiree $\rightarrow J = 4$
- Endowment of efficiency **labor units of least productive** HHs $\rightarrow e(1) = 1$
- **Diagonal** elements of submatrix $\Gamma_{EE'} \rightarrow \Gamma_{EE'_{1,1}}$, $\Gamma_{EE'_{2,2}}$, $\Gamma_{EE'_{3,3}}$ and $\Gamma_{EE'_{4,4}}$

Endowment process of working HHs

	$e(s)$	$\Gamma_{EE'}$			
		$s' = 1$	$s' = 2$	$s' = 3$	$s' = 4$
$s = 1$	$e(1)$	$\Gamma_{EE'_{1,1}}$	$\Gamma_{EE'_{1,2}}$	$\Gamma_{EE'_{1,3}}$	$\Gamma_{EE'_{1,4}}$
$s = 2$	$e(2)$	$\Gamma_{EE'_{2,1}}$	$\Gamma_{EE'_{2,2}}$	$\Gamma_{EE'_{2,3}}$	$\Gamma_{EE'_{2,4}}$
$s = 3$	$e(3)$	$\Gamma_{EE'_{3,1}}$	$\Gamma_{EE'_{3,2}}$	$\Gamma_{EE'_{3,3}}$	$\Gamma_{EE'_{3,3}}$
$s = 4$	$e(4)$	$\Gamma_{EE'_{4,1}}$	$\Gamma_{EE'_{4,2}}$	$\Gamma_{EE'_{4,3}}$	$\Gamma_{EE'_{4,4}}$

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Calibration

II. Macro and Demographic Targets

- Time discount factor, $\beta = 0.96 \rightarrow {}^{K}/_{Y} = 4.25$ capital-to-output $\rightarrow$ BdE (2017,2019), Eurostat (2020), INE (2016) Learn more…
- Capital income share, $\alpha = 0.48 \rightarrow$ labor income share was $0.52 \rightarrow$ EU KLEMS (2020)
- Depreciation of capital, $\delta = 0.05 \rightarrow {}^{I}/_{Y} = 0.22$ investment-to-output $\rightarrow$ INE (2020)
- Curvature of consumption, $\sigma = 1.5 \rightarrow {}^{1}/_{\sigma} = 0.66$ intertemporal elasticity of substitution of consumption $\rightarrow$ Standard in literature
- Relative share of consumption and leisure in utility, $\chi = 0.5 \rightarrow {}^{H}/_{\ell} = 0.31$ average hours worked $\rightarrow$ INE (2011)
- Curvature of leisure, $\varphi = 2.65 \rightarrow {}^{(\ell - h)}/_{h \cdot \varphi}$ Frisch elasticity of labor supply between 0.5 and 1.5 (Range in literature for Spain) and economy matching rest of targets

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Calibration

II. Macro and Demographic Targets

- Probability of retiring, $p_r = 0.03 \rightarrow$ expected duration of working lives is $35 \rightarrow$ Eurostat (2020)
- Probability of surviving, $p_s = 0.96 \rightarrow$ expected duration of retirement is $22.8 \rightarrow$ OECD (2015,2017)
- Life-cycle profile controller, $\phi_1 = 0.99 \rightarrow$ ratio of the average annual wage of agents between ages 45 and 49 to that of agents between ages 25 and 29 is $1.56 \rightarrow$ INE (2017)
- Intergenerational income mobility controller, $\phi_2 = 0.9715 \rightarrow$ correlation between the average income of one generation and the average income of its immediate descendants is $0.5 \rightarrow$ Llaneras et al. (2020)

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Calibration

III. Government Policy

Recall → tax function specification:

$$\tau(y) = [y - \lambda^{1-\tau}] + \kappa \cdot y$$

Using **administrative microdata on tax returns** from AEAT(2019) at household level and an estimation methodology presented by García-Miralles, E., N. Guner, and **R. Ramos** (2019).

- ❑ Average level of taxes of PIT, $\lambda = 0.89$
- ❑ Progressivity of PIT, $\tau = 0.11$

See fitting of the estimation.

- ❑ Normalized transfers to retirees, $\omega = 3.22 \rightarrow {}^{Tr}/_{Y} = 0.11$ transfers-to-output (social security contributions) → OECD (2020)
- ❑ Linear term on remaining taxes, $\kappa = 0.05 \rightarrow {}^{T}/_{Y} = 0.33$ tax-revenue-to-output, ${}^{G}/_{Y} = 0.22$ tax-revenue-to-output → OECD (2020)

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Calibration

IV. Income and Wealth Distributions

Remaining parameters of the endowment process of working HHs calibrated to match → **Gini coefficients** and **shares** p0-p40, p40-p60, p60-p80, p80-p100, p90-p95, p95-p99, p99, p100 of:

- ❑ Income (before taxes after transfers) → AEAT (2019)
- ❑ Wealth (net) → BdE (2017, 2019)

Endowment process of working HHs

	$e(s)$	$\Gamma_{EE'}$			
		$s' = 1$	$s' = 2$	$s' = 3$	$s' = 4$
$s = 1$	$e(1)$	$\Gamma_{EE'_{1,1}}$	$\Gamma_{EE'_{1,2}}$	$\Gamma_{EE'_{1,3}}$	$\Gamma_{EE'_{1,4}}$
$s = 2$	$e(2)$	$\Gamma_{EE'_{2,1}}$	$\Gamma_{EE'_{2,2}}$	$\Gamma_{EE'_{2,3}}$	$\Gamma_{EE'_{2,4}}$
$s = 3$	$e(3)$	$\Gamma_{EE'_{3,1}}$	$\Gamma_{EE'_{3,2}}$	$\Gamma_{EE'_{3,3}}$	$\Gamma_{EE'_{3,3}}$
$s = 4$	$e(4)$	$\Gamma_{EE'_{4,1}}$	$\Gamma_{EE'_{4,2}}$	$\Gamma_{EE'_{4,3}}$	$\Gamma_{EE'_{4,4}}$

Calibration - Recap

36 parameters

7 parameters

Normalization conditions

29 parameters

Match characteristics of Spanish economy

Model Period → 1 Year
Base Calibration Year → 2015

7 parameters

Direct identification

22 parameters

Method of simulated moments

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Normalization conditions

$J, \ell, e(1)$, and diagonal $\Gamma_{\mathbf{EE}'}$

29 parameters

Match characteristics of Spanish economy

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Direct identification

$\alpha, \delta, \sigma, \lambda, \tau, p_r$ and p_s

22 parameters

Method of simulated moments

Calibration - Recap

36 parameters

Normalization conditions

$\boldsymbol{J}, \boldsymbol{\ell}, \boldsymbol{e(1)}$, **and diagonal** $\boldsymbol{\Gamma_{EE'}}$

Match characteristics of Spanish economy

Model Period → 1 Year
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Direct identification

$\boldsymbol{\alpha, \delta, \sigma, \lambda, \tau, p_r}$ **and** $\boldsymbol{p_s}$

22 parameters

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$J, \ell, e(1)$, **and diagonal** $\Gamma_{EE'}$

Match characteristics of Spanish economy

Model Period → 1 Year
Base Calibration Year → 2015

Direct identification

$\alpha, \delta, \sigma, \lambda, \tau, p_r$ **and** p_s

Method of simulated moments

$\beta, \varphi, \chi, \omega, \kappa, \phi_1, \phi_2, \mathrm{e}(2), \mathrm{e}(3), \mathrm{e}(4)$, **off-diagonal** $\Gamma_{EE'}$

Calibration - Recap

36 parameters

Normalization conditions

$\boldsymbol{J}, \boldsymbol{\ell}, \boldsymbol{e}(\mathbf{1})$, **and diagonal** $\boldsymbol{\Gamma}_{\mathbf{EE'}}$

Match characteristics of Spanish economy

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Base Calibration Year → 2015

Direct identification

$\boldsymbol{\alpha}, \boldsymbol{\delta}, \boldsymbol{\sigma}, \boldsymbol{\lambda}, \boldsymbol{\tau}, \boldsymbol{p_r}$ **and** $\boldsymbol{p_s}$

Method of simulated moments

$\boldsymbol{\beta}, \boldsymbol{\varphi}, \boldsymbol{\chi}, \boldsymbol{\omega}, \boldsymbol{\kappa}, \boldsymbol{\phi_1}, \boldsymbol{\phi_2}, \mathbf{e}(\mathbf{2}), \mathbf{e}(\mathbf{3}), \mathbf{e}(\mathbf{4})$, **off-diagonal** $\boldsymbol{\Gamma_{EE'}}$

Calibration algorithm

Calibration

V. Calibration Outcomes

- Stochastic process of **endowment of efficiency labor units**

	$e(s)$	$\gamma^*_{\mathcal{E}}$	$\Gamma_{\mathcal{E}\mathcal{E}}$ from s to s'			
			$s'=1$	$s'=2$	$s'=3$	$s'=4$
$s=1$	1.00	15.17	89.58	10.36	0.01	0.05
$s=2$	2.71	65.15	2.42	96.54	1.03	0.01
$s=3$	7.80	18.39	0.01	3.60	96.34	0.04
$s=4$	90.00	1.28	0.01	1.73	0.01	98.25

Note: $e(s)$ denotes the relative endowment of efficiency labor units; $\gamma^*_{\mathcal{E}}$ denotes the stationary distribution of working-age households; $\Gamma_{\mathcal{E}\mathcal{E}}$ denotes the transition probabilities of the process on the endowment of efficiency labor units for working-age households that are still workers one period later.

- Joint stochastic process of age and endowment of efficiency labor units.

Calibration

V. Calibration Outcomes

- Stochastic process of **endowment of efficiency labor units**

	$e(s)$	$\gamma^*_{\mathcal{E}}$	$\Gamma_{\mathcal{E}\mathcal{E}}$ from s to s'			
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- Joint stochastic process of age and endowment of efficiency labor units.

Calibration

V. Calibration Outcomes

- Fitness of the **baseline (BE) model economy**

Macroeconomic and fiscal ratios								
Economy	K/Y	I/Y	G/Y	T/Y	Tr/Y	$^{H}/ell$	$\rho_{o,y}$	$\rho_{f,s}$
Spain	4.25	21.94	22.27	33.63	11.36	30.83	1.56	0.50
BE	4.26	22.00	22.27	33.51	11.24	30.78	1.53	0.50

Distributional statistics								
Economy	Gini	Percentiles (%)				Top groups (%)		
		< 40	40-60	60-80	80-100	90-95	95-99	99-100
The distribution of income (before all taxes and after transfers)								
Spain	0.48	12.72	13.84	21.19	52.25	11.01	13.40	12.07
BE	0.45	14.72	13.72	21.32	50.24	10.85	13.35	13.57
The distribution of wealth								
Spain	0.68	3.62	9.65	18.11	68.62	12.93	19.79	20.27
BE	0.68	3.80	9.32	17.45	69.43	13.54	19.68	19.63

Note: $^{H}/ell$ denotes the share of disposable time allocated to market activities; $\rho_{o,y}$ denotes the ratio of the average income of agents between ages 45 and 49 (old) to that of agents between ages 25 and 29 (young); $\rho_{f,s}$ denotes the correlation between the average income of one generation (fathers) and the average income of their immediate descendents (sons).

Calibration

V. Calibration Outcomes

- Fitness of the **baseline (BE) model economy**

Macroeconomic and fiscal ratios								
Economy	K/Y	I/Y	G/Y	T/Y	Tr/Y	$^H/_{ell}$	$\rho_{o,y}$	$\rho_{f,s}$
Spain	4.25	21.94	22.27	33.63	11.36	30.83	1.56	0.50
BE	4.26	22.00	22.27	33.51	11.24	30.78	1.53	0.50

Distributional statistics								
Economy	Gini	Percentiles (%)				Top groups (%)		
		< 40	40-60	60-80	80-100	90-95	95-99	99-100
The distribution of income (before all taxes and after transfers)								
Spain	0.48	12.72	13.84	21.19	52.25	11.01	13.40	12.07
BE	0.45	14.72	13.72	21.32	50.24	10.85	13.35	13.57
The distribution of wealth								
Spain	0.68	3.62	9.65	18.11	68.62	12.93	19.79	20.27
BE	0.68	3.80	9.32	17.45	69.43	13.54	19.68	19.63

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Optimal Progressivity

Optimal Progressivity

I. Selection of Optimal Progressivity Level

- **Grid of progressivity levels in PIT** $\rightarrow 0.00 \leq \tau \leq 0.50$
- For each τ, compute a **GE economy** with a combination of **progressivity**, τ, **average level of taxes**, λ, and **transfers** to retirees, ω, that delivers:

1. **Markets clear**
   For new r and w
2. **Budget Balance**
   $T = Tr + G$
3. **Same aggregate tax level**
   Fixed $^{T}/_{Y}$
4. **Same spending structure**
   Fixed $^{Tr}/_{Y}$ and $^{G}/_{Y}$

- A **Benthamite social planner** (identical weights to every household in the economy) maximizes social or aggregate welfare
- **Social welfare** is **maximized** where the **aggregate consumption equivalent variation (CEV)** reaches its maximum.

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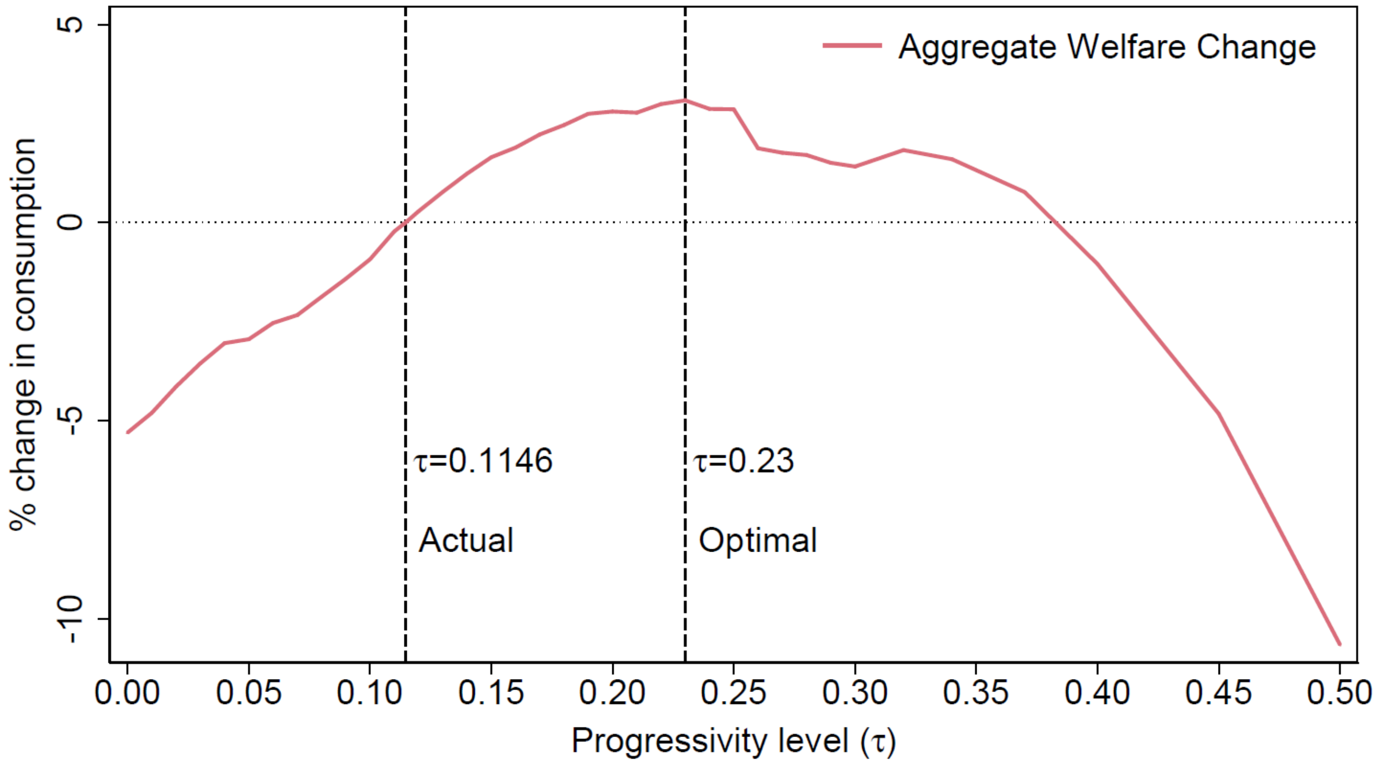
Optimal Progressivity

II. Aggregate Welfare Change

- Aggregate or **social welfare is increased** for a GE economy if **progressivity raises.**
- The **welfare-maximizing progressivity level** is $\tau = 0.23 \rightarrow \text{CEV} = 3{,}08\%$.



Optimal Progressivity

III. Decomposition of Aggregate Welfare Changes

Compute **optimal economy** (o):

- **Ignoring** changes in **stationary distribution** of households (a)
- **Ignoring** changes both in **stationary distribution** of households **and** in **equilibrium prices** (b)

Aggregate **CEV can be decomposed** as:

$$\mathrm{CEV_o} = \underbrace{\mathrm{CEV_b}}_{1} + \underbrace{(\mathrm{CEV_a} - \mathrm{CEV_b})}_{2} + \underbrace{(\mathrm{CEV_o} - \mathrm{CEV_a})}_{3}$$

Aggregate consumption equivalent variation	3.08%
Decomposition - Contributions (in %) to the aggregate welfare change by changes in:	
Tax system	121.38%
Equilibrium prices	-19.25%
Equilibrium distribution	-2.13%

Note: Each contribution to the aggregate welfare change is computed by dividing the consumption equivalent variation from changes in each factor by the aggregate consumption equivalent variation. Adding up three contributions makes one hundred percent.

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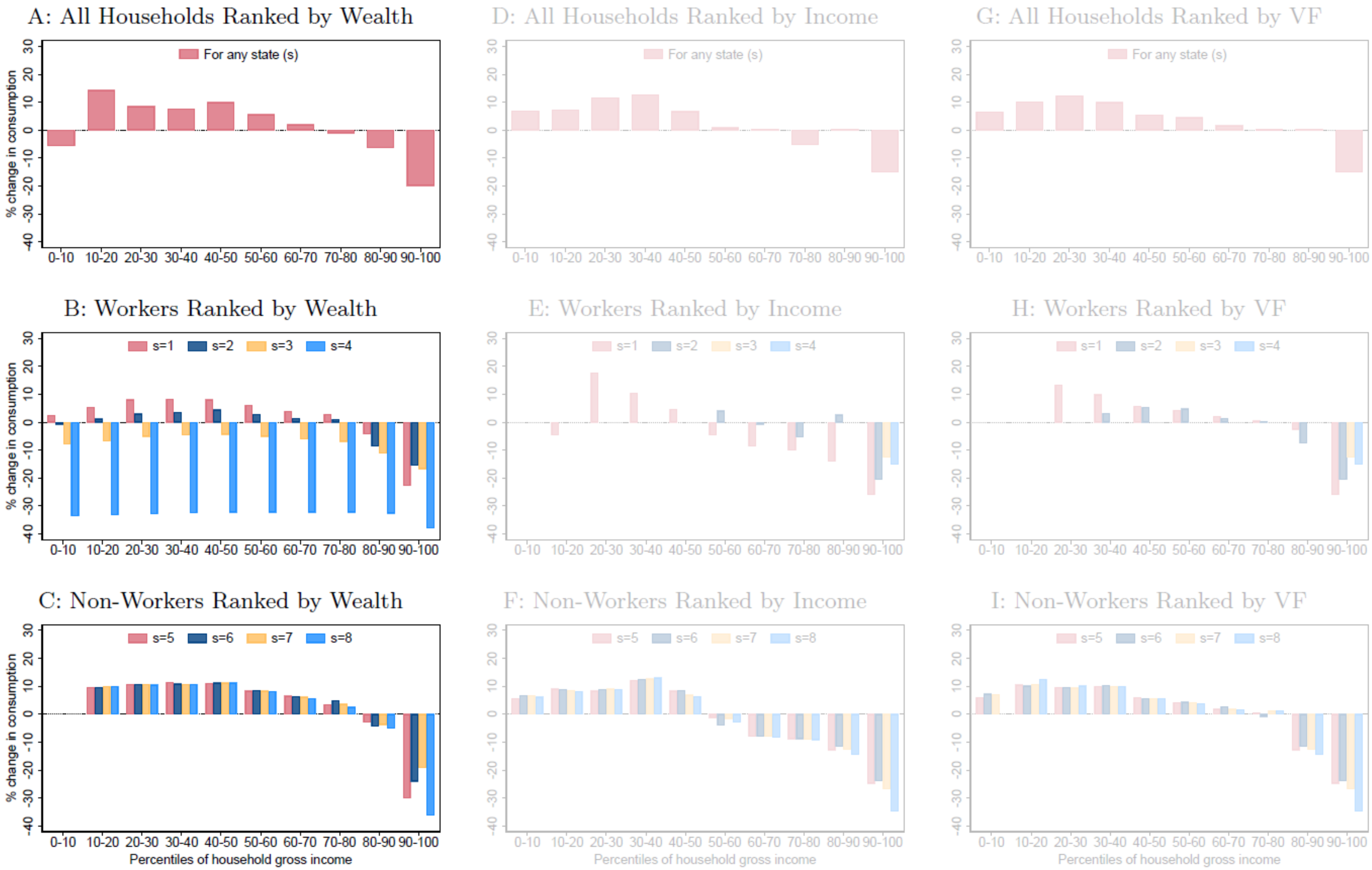
Optimal Progressivity

IV. Welfare Changes by Household Type



Optimal Progressivity

IV. Welfare Changes by Household Type

Optimal Progressivity

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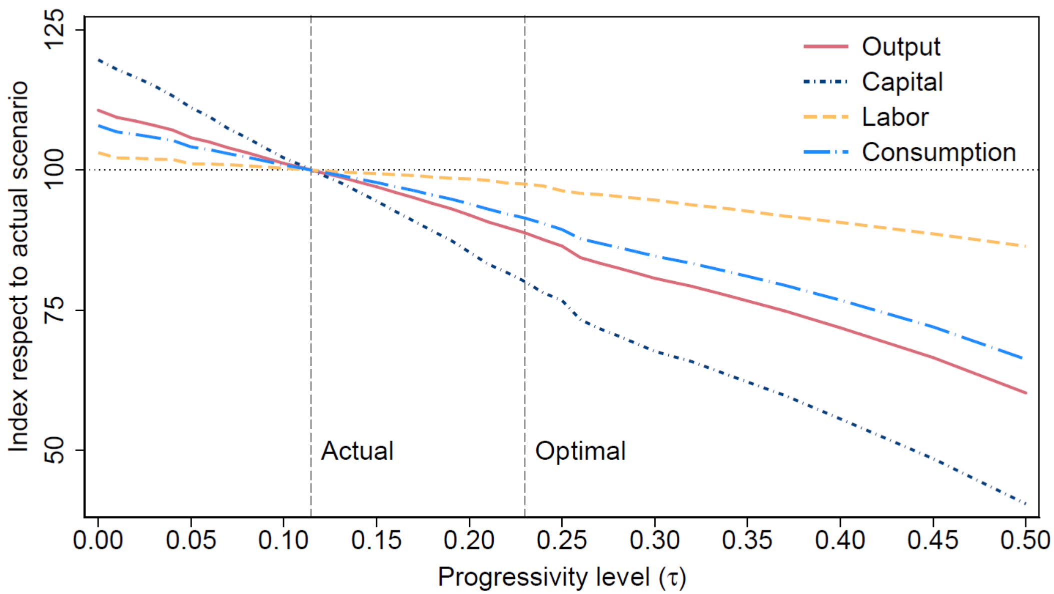
Optimal Progressivity

V. Effects on Macroeconomic and Fiscal Aggregates



Economy	Y	K	L^*	H^{**}/ℓ	K/L	L/H	Y/H	K/Y	I/Y	G/Y	T/Y	Tr/Y
E_{BE}	11.29	48.12	3.03	30.78	15.88	3.08	11.46	4.26	22.00	22.27	33.51	11.24
$E_{0.23}$	10.02	38.55	2.96	29.66	13.05	3.11	10.56	3.85	19.85	22.27	33.51	11.24
% change	-11.25	-19.89	-2.31	-3.64	17.84	1.17	-7.86	-9.79	-9.80	0.00	0.00	0.00

Note: * L denotes aggregate labor input; ** H/ℓ denotes the share of disposable time allocated to market activities.

Optimal Progressivity

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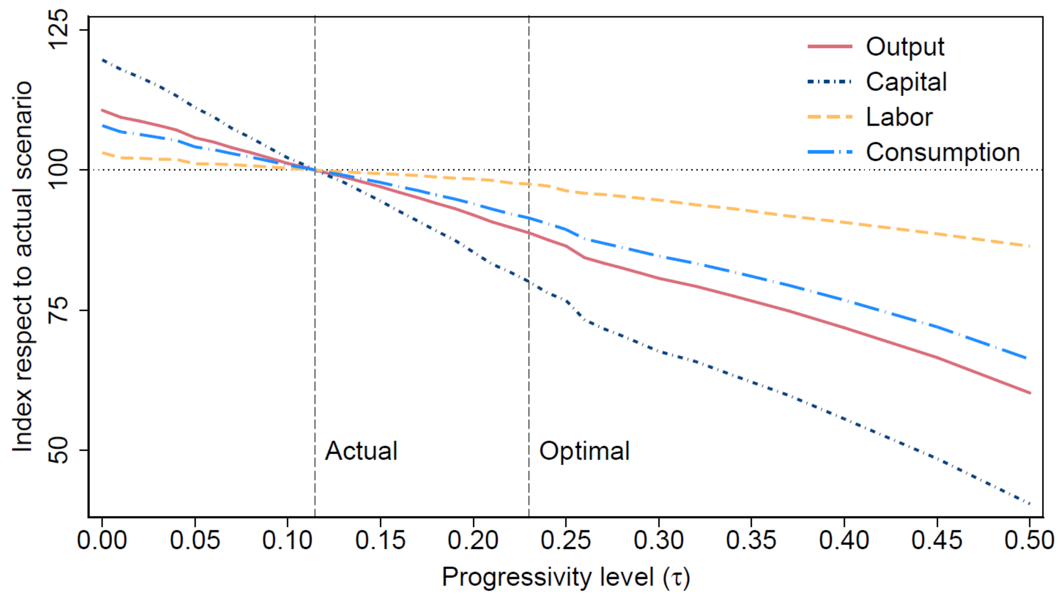

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E_{BE}	11.29	48.12	3.03	30.78	15.88	3.08	11.46	4.26	22.00	22.27	33.51	11.24
$E_{0.23}$	10.02	38.55	2.96	29.66	13.05	3.11	10.56	3.85	19.85	22.27	33.51	11.24
% change	-11.25	-19.89	-2.31	-3.64	-17.84	1.17	-7.86	-9.79	-9.80	0.00	0.00	0.00

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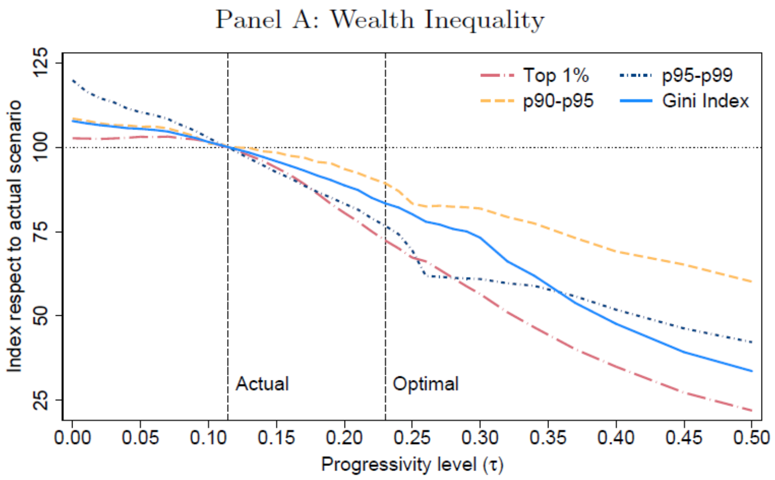
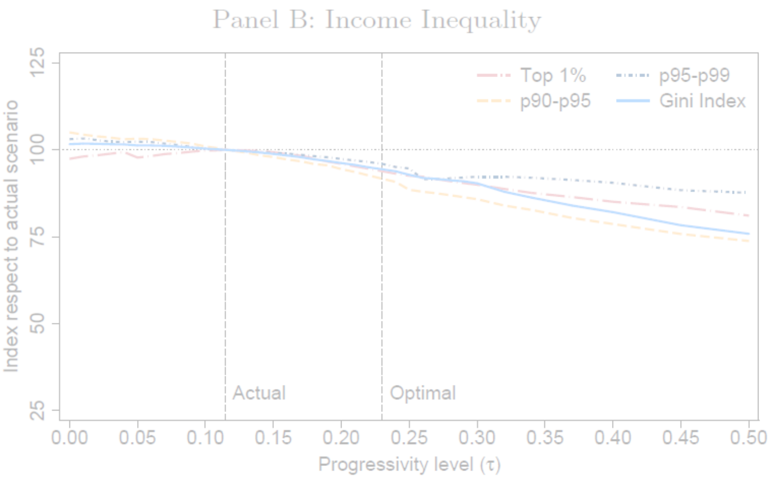
Optimal Progressivity

VI. Effects on Income and Wealth Inequality





Optimal Progressivity

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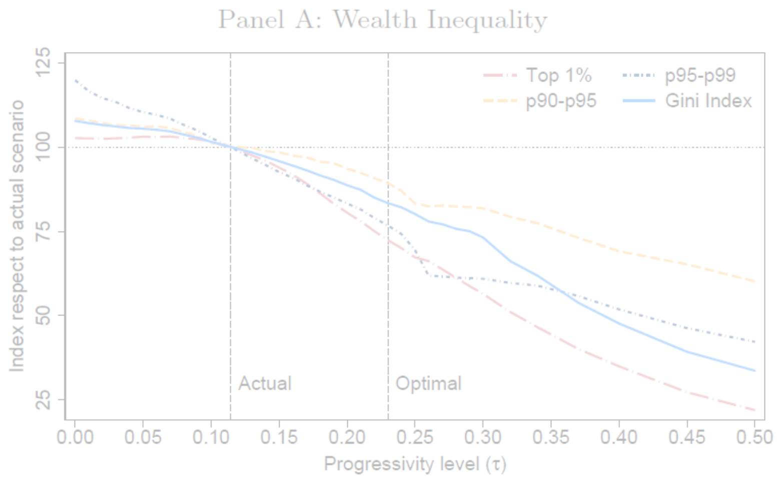

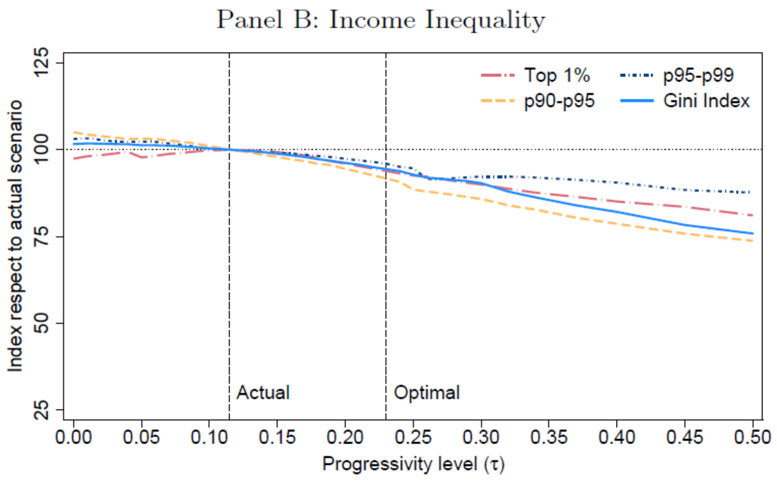

Optimal Progressivity

VI. Effects on Income and Wealth Inequality

Economy	Gini	Percentiles (%)				Top groups (%)		
		< 40	40-60	60-80	80-100	90-95	95-99	99-100
The distribution of income (before all taxes and after transfers)								
E_{BE}	0.45	14.72	13.72	21.32	50.24	10.85	13.35	13.57
$E_{0.23}$	0.42	15.96	14.55	21.40	48.09	9.95	12.81	12.73
% change	-5.60	8.41	6.09	0.36	-4.28	-8.32	-4.04	-6.15
The distribution of wealth								
E_{BE}	0.68	3.80	9.32	17.45	69.43	13.54	19.68	19.63
$E_{0.23}$	0.56	7.57	13.41	21.47	57.55	12.10	15.10	14.21
% change	-16.62	99.05	43.98	23.02	-17.11	-10.66	-23.28	-27.62

Optimal Progressivity

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$E_{0.23}$	0.56	7.57	13.41	21.47	57.55	12.10	15.10	14.21
% change	-16.62	99.05	43.98	23.02	-17.11	-10.66	-23.28	-27.62

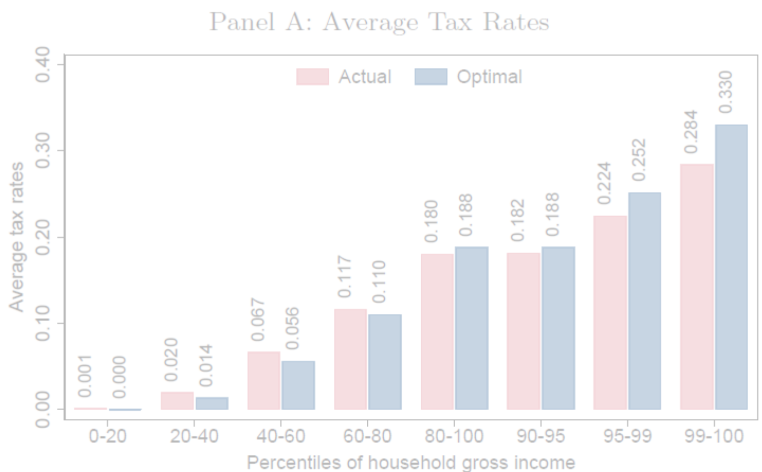
Optimal Progressivity

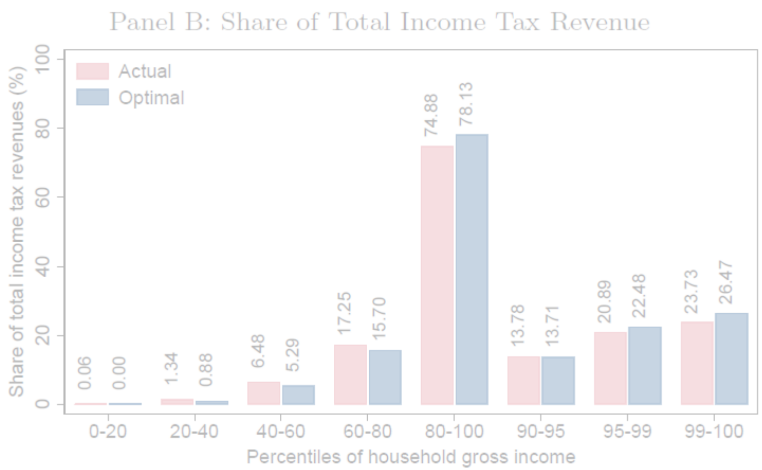
VII. Who Pays the Reform?

- Compute **changes** in **effective average PIT rate** over the **model** income distribution.

	Income percentiles (%)					Income top groups (%)		
	< 20	20-40	40-60	60-80	80-100	90-95	95-99	99-100
% change	-53.42	-34.64	-16.17	-5.33	4.04	3.68	12.13	16.21

- Evaluate **changes** in **effective average PIT rate** over the **actual** income distribution with administrative tax microdata at HH level → AEAT (2019).





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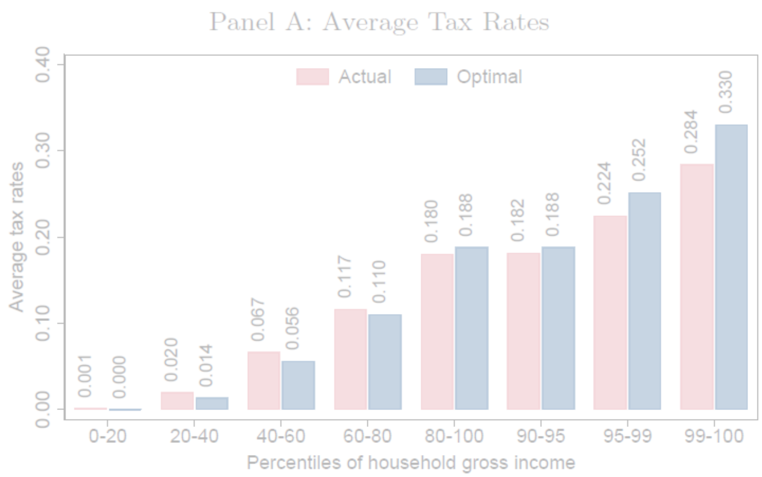

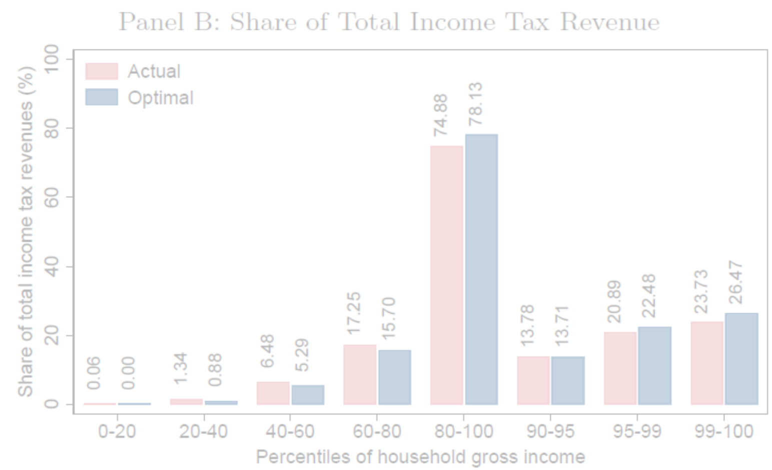

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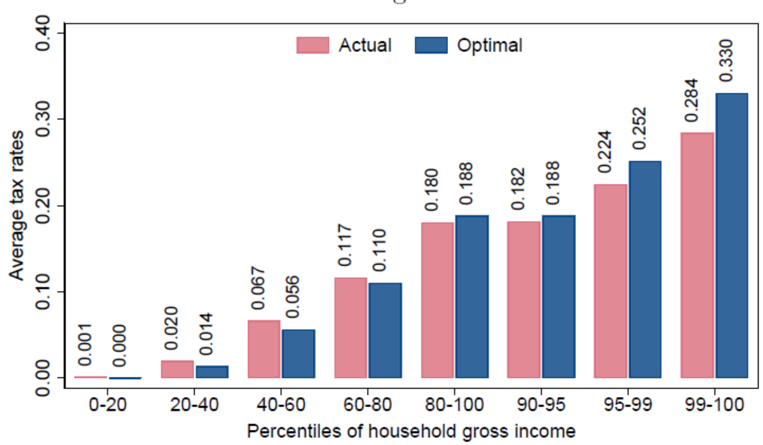
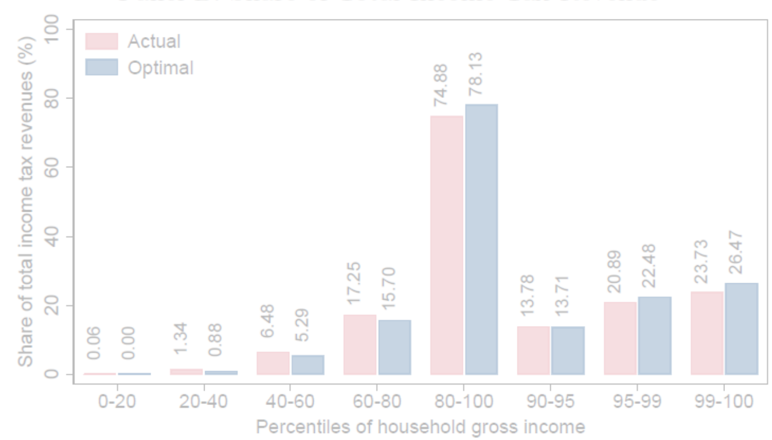


Panel B: Share of Total Income Tax Revenue



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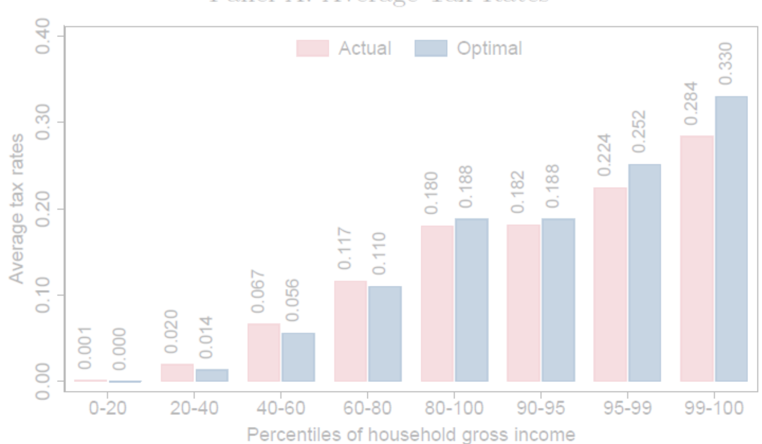

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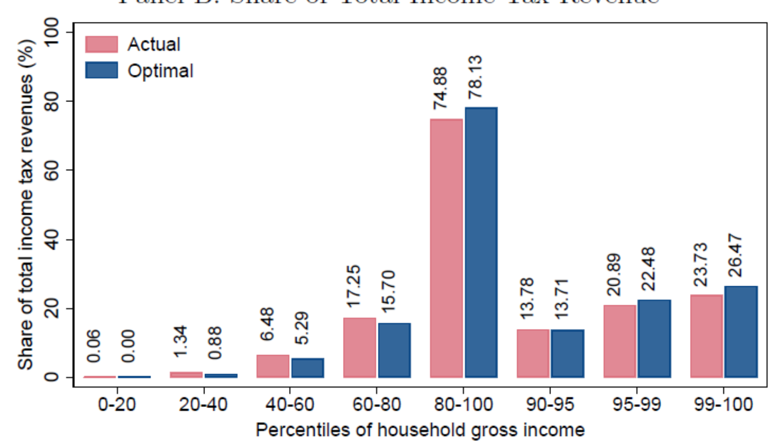

Concluding Remarks

Conclusions – Q&A

- A **heterogeneous households general equilibrium** model featuring **life-cycle** and **dynastic** elements.
- Evaluate bunch of **progressivity reforms in PIT**.
- **Elevating progressivity** to a higher level than actual → **aggregate welfare gains**.
- **Welfare-maximizing progressivity** reform → τ from 0.11 to 0.23 → $\text{CEV} = 3.08\%$.
- Most of gains → **poorest households** facing **lower effective** income tax rates and **richest households** affronting **higher effective** income tax rates.
- The **poorest working and non-working** households **benefiting the most** and the **most efficient working** households and the **wealthiest** ones experiencing the **largest trade-off** and **welfare losses**.
- **Reductions in wealth and income inequality** but negative effects on capital, labor, and output (**efficiency loss**).
- Households **between p20 and p80** → **decrease** in their **effective** average tax rates.
  - Ex.: Effective average tax rate within p40 and p60 would drop from 0.067 to 0.056.
- Households **above p80** → **drastic increment** in their **effective** average tax rate.
  - Ex.: Top 1% households from with an effective average tax rate change from 0.284 to 0.330.

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- Households **above p80** → **drastic increment** in their **effective** average tax rate.
  - Ex.: Top 1% households from with an effective average tax rate change from 0.284 to 0.330.

Conclusions – Q&A

- A **heterogeneous households general equilibrium** model featuring **life-cycle** and **dynastic** elements.
- Evaluate bunch of **progressivity reforms in PIT**.
- **Elevating progressivity** to a higher level than actual → **aggregate welfare gains**.
- **Welfare-maximizing progressivity** reform → τ from 0.11 to 0.23 → $\mathrm{CEV} = 3.08\%$.
- Most of gains → **poorest households** facing **lower effective** income tax rates and **richest households** affronting **higher effective** income tax rates.
- The **poorest working and non-working** households **benefiting the most** and the **most efficient working** households and the **wealthiest** ones experiencing the **largest trade-off** and **welfare losses**.
- **Reductions in wealth and income inequality** but negative effects on capital, labor, and output (**efficiency loss**).
- Households **between p20 and p80** → **decrease** in their **effective** average tax rates.
  - Ex.: Effective average tax rate within p40 and p60 would drop from 0.067 to 0.056.
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Conclusions – Q&A

Other research questions:

- Laffer curve / What is the **revenue-maximizing progressivity** level? → Guner, N., J. López-Segovia, and **R. Ramos** (2020).
- **Transitional dynamics** → here only **steady-state comparisons**
- **Different parametrization / specification** for each **different tax** (labor, capital, corporate, consumption, estate tax, social contributions, etc.) → Guner, N., J. López-Segovia, and **R. Ramos** (2020).
- **Progressive retirement pension** vs. constant.
- **Endogenous retirement decision** vs. exogenous.
- Endogenous **retirement pension dependent on past SS contributions** vs. exogenous.
- **Aggregate uncertainty** → here only individual/household uncertainty.
- **Firm heterogeneity** (some degree of monopolistic power) → here only representative firm.
- **Heterogeneity in HHs' MPCs** (heterogeneity in HHs' preferences)

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Conclusions – Q&A

Thank you!

Appendix

Appendix

I. Transition between Retirees and Descendants

Return

- Mass-shifting procedure to depict submatrix $\Gamma_{RE'}$

  - Step 1

$$p_{51} = \gamma_1^* + \phi_1\gamma_2^* + \phi_1^2\gamma_3^* + \phi_1^3\gamma_4^*$$
$$p_{52} = (1-\phi_1)[\gamma_2^* + \phi_1\gamma_3^* + \phi_1^2\gamma_4^*]$$
$$p_{53} = (1-\phi_1)[\gamma_3^* + \phi_1\gamma_4^*]$$
$$p_{54} = (1-\phi_1)\gamma_4^*$$
$$p_{61} = (1-\phi_1)\gamma_1^*$$
$$p_{62} = \phi_1\gamma_1^* + \gamma_2^* + \phi_1\gamma_3^* + \phi_1^2\gamma_4^*$$
$$p_{63} = (1-\phi_1)[\gamma_3^* + \phi_1\gamma_4^*]$$
$$p_{64} = (1-\phi_1)\gamma_4^*$$
$$p_{71} = (1-\phi_1)\gamma_1^*$$
$$p_{72} = (1-\phi_1)[\phi_1\gamma_1^* + \gamma_2^*]$$
$$p_{73} = \phi_1^2\gamma_1^* + \phi_1\gamma_2^* + \gamma_3^* + \phi_1\gamma_4^*$$
$$p_{74} = (1-\phi_1)\gamma_4^*$$
$$p_{81} = (1-\phi_1)\gamma_1^*$$
$$p_{82} = (1-\phi_1)[\phi_1\gamma_1^* + \gamma_2^*]$$
$$p_{83} = (1-\phi_1)[\phi_1^2\gamma_1^* + \phi_1\gamma_2^* + \gamma_3^*]$$
$$p_{84} = \phi_1^3\gamma_1^* + \phi_2^2\gamma_2^* + \phi_1\gamma_3^* + \gamma_4^*$$

  - Step 2

$$p_{i1} = p_{i1} + \phi_2 p_{i2} + \phi_2^2 p_{i3} + \phi_2^3 p i_{i4}$$
$$p_{i2} = (1-\phi_2)[p_{i2} + \phi_2 p_{i3} + \phi_2^2 p_{i4}]$$
$$p_{i3} = (1-\phi_2)[p_{i3} + \phi_2 p_{i4}]$$
$$p_{i4} = (1-\phi_2)p_{i4}$$

Appendix

II. Help for Target Calculation

Return

- $\frac{K}{Y}$ is calculated:

$$\frac{\text{HH net wealth}}{\frac{\text{GDP}}{\left(\frac{\text{Population}}{\text{People per household}}\right)}} = \frac{247{,}523€}{\frac{1{,}007{,}590{,}000€}{\left(\frac{46{,}449{,}565}{2.51}\right)}} = 4{,}25$$

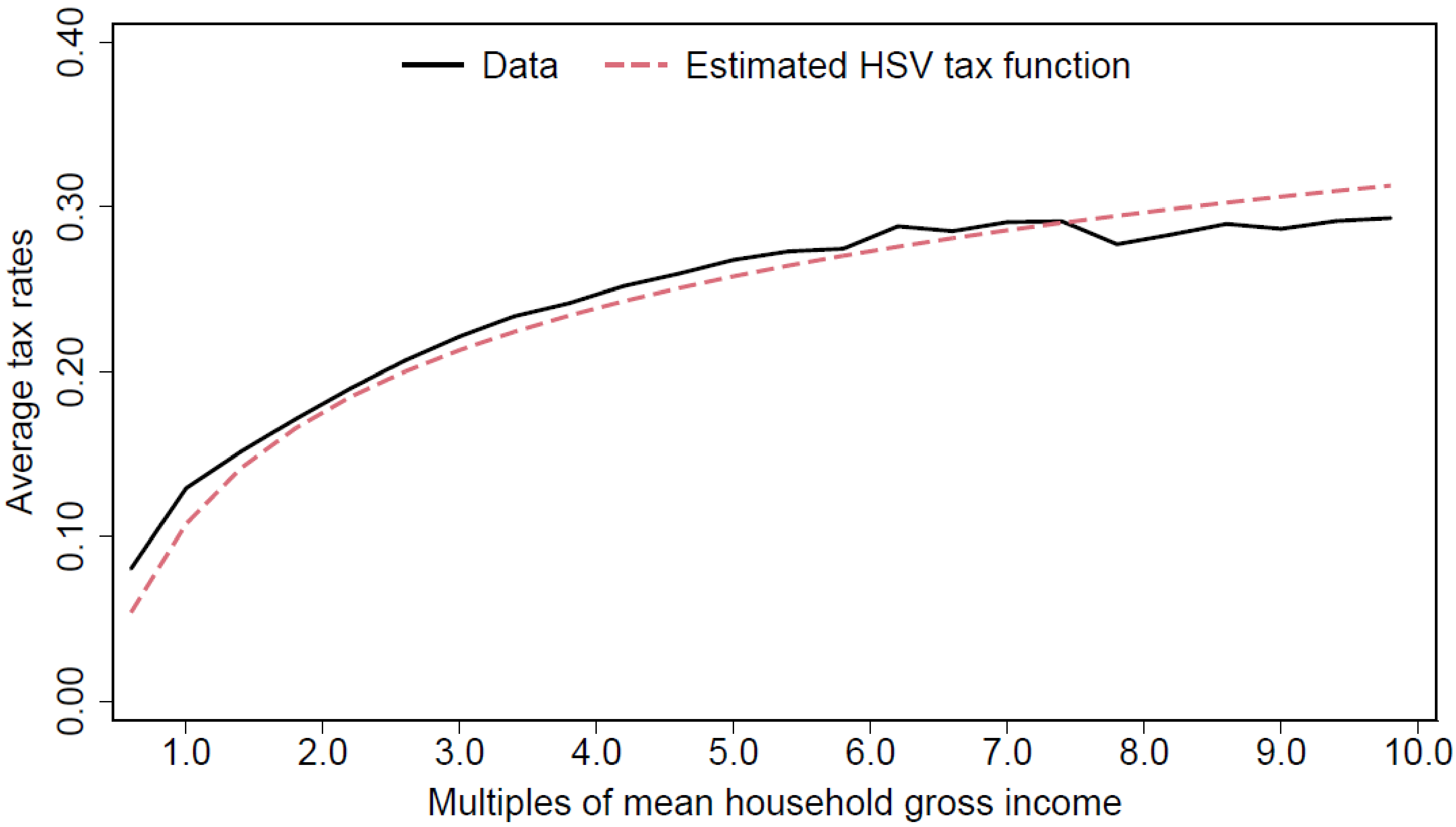
- I is the sum of:
  - gross private fixed domestic investment
  - change in business inventories
  - 75% of the private consumption expenditures in consumer durables (durables share in the total reported private consumption expenditures is 5%)

- $\delta = \frac{K}{Y} = \frac{\frac{I}{Y}}{\frac{K}{Y}} = 0.0516$

Appendix

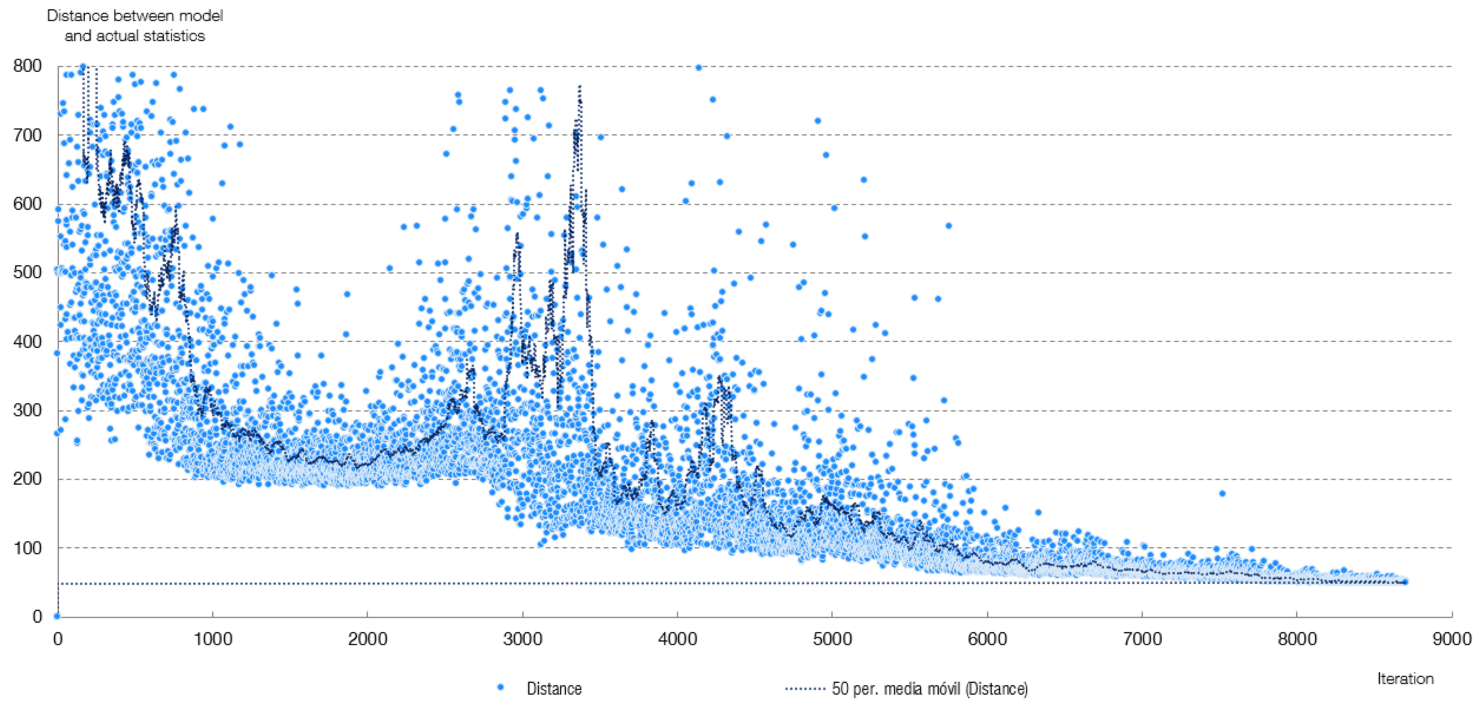
III. Fitting of The HSV Specification to Data (HHs, 2015)

[Return]



Appendix

IV. Calibration Algorithm (Last 9,000 iterations) Return



- ❑ Find in whole parameter space → Covariance-Matrix Adaptation - Evolutionary Strategy
- ❑ Minimize distance between model statistics and observed statistics
- ❑ 25,000 iterations of the model
- ❑ 1 minute per iteration in workstation → 38,192,544 search points per iteration

Appendix

V. Joint Age and Endowment Stochastic Process

Return

- Joint stochastic process of **age and endowment of efficiency labor units**

	$e(s)$	γ^*	Γ_{SS} from s to s'							
			$s'=1$	$s'=2$	$s'=3$	$s'=4$	$s'=5$	$s'=6$	$s'=7$	$s'=8$
$s=1$	1.00	19.43	87.02	10.06	0.01	0.05	2.86	0.00	0.00	0.00
$s=2$	2.71	35.18	2.35	93.78	1.00	0.01	0.00	2.86	0.00	0.00
$s=3$	7.80	5.59	0.01	3.50	93.59	0.04	0.00	0.00	2.86	0.00
$s=4$	90.00	0.35	0.01	1.68	0.01	95.44	0.00	0.00	0.00	2.86
$s=5$	0.00	12.66	4.39	0.01	0.02	0.01	95.61	0.00	0.00	0.00
$s=6$	0.00	22.92	4.26	0.13	0.02	0.02	0.00	95.61	0.00	0.00
$s=7$	0.00	3.64	4.14	0.12	0.13	0.01	0.00	0.00	95.61	0.00
$s=8$	0.00	0.23	4.03	0.12	0.23	0.13	0.00	0.00	0.00	95.61

Note: $e(s)$ denotes the relative endowments of efficiency labor units; γ^* denotes the stationary distribution households; Γ_{SS} denotes the transition probabilities of the process on the endowment of efficiency labor units and age.

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Appendix

VI. PGE 2021 – PIT proposed reform

Return

- Increase of the marginal labor income tax by 2 p.p. for people who earn above 130,000€ and 4 percentage points for people with earnings above 300,000€.
- Increase of the marginal capital income tax by 4 percentage points for all capital incomes above €140,000.
- Elimination or decrease of tax deductions due to contributions to private pension plans.
- Change in estimated progressivity $\rightarrow$ from $\tau = 0.1146$ to $\tau = 0.1203$ $\rightarrow$ **no welfare effect**

EL PAÍS — ESPAÑA

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Los dos partidos presentan unas cuentas expansivas que dejan atrás la austeridad y los ajustes

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