Optimal Redistribution: Rising Inequality vs. Rising Living Standards

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- Large increase in **income inequality** in the US from 1950 to 2010
  - Larger top income shares, thicker Pareto tail

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⇒ How does the standard of living affect the optimal tax-and-transfer ($t\&T$) system?

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- **This paper:** Optimal taxation with non-homothetic preferences
  - Heterogeneous income elasticities of demand across sectors (Engel's law)

    NH CES Comin, Lashkari, and Mestieri (2021), IA Preferences Alder, Boppart, and Müller (2022)

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  - Calibrated 1950 $t\&T$ sytem with inverse optimum Pareto weights
  - Optimal 2010 $t\&T$ system: 1. if only rising inequality; and 2. when also accounting for growth

What We Find

- Non-homotheticities $\Rightarrow$ decreasing relative risk aversion (DRRA)
  - More curvature in utility function of the poor
- Mirrlees formula: two main effects of growth
  - Growth lowers dispersion in marginal utilities $\Rightarrow$ Lower distribution gains from redistribution
  - Growth lowers income effects $\Rightarrow$ Ambiguous effects on efficiency costs of redistribution

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- Quantitatively large effects of rising living standards
  - Growth calls for less redistribution
  - Dampens by at least 25% the optimal increase in redistribution due to rising inequality

Literature

- **Optimal taxation**
  - Stationary economies and business cycle fluctuations in homothetic one sector economies
    Mirrlees (1971), Diamond (1998), Saez (2001); Ramsey (1927), Werning (2007), Heathcote, Storesletten, and Violante (2017)
  - Optimal tax system over time in homothetic economies
    Mankiw, Weinzierl, and Yagan (2009), Diamond and Saez (2011), Scheuer and Werning (2017), Heathcote, Storesletten, and Violante (2020), Brinca, Duarte, Holter, and Oliveira (2022)
  - Optimal taxation with non-homothetic preferences
    Oni (2023), Jaravel and Olivi (2024)

- **Consumption patterns, Engel curves, and non-homothetic preferences**
  Geary (1950), Herrendorf, Rogerson, and Valentinyi (2013), Boppart (2014), Herrendorf, Rogerson, and Valentinyi (2014), Aguiar and Bils (2015), Comin, Lashkari, and Mestieri (2021), Alder, Boppart, and Müller (2022)

Mirrleesian Optimal Nonlinear Income Taxation with Non-Homothetic Preferences

Households

- Continuum of heterogeneous households with labor productivity θ
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  - $c = (c_1, \ldots, c_J)$ denotes a basket of consumption goods
- Let u denote the indirect utility function

$$u(e; p, \Lambda) \equiv \max_{\{c_j\}_j} U(c) \text{ s.t. } \sum_j p_j c_j = e, \quad \text{where } p_j \equiv \frac{\hat{p}_j}{\Lambda}$$

  - e: nominal expenditures
  - $\hat{p}$: vector of relative prices, kept constant (drop it!)
  - Λ: level of the economy $\Rightarrow$ **aggregate growth**

Optimal Taxation Problem

- Household's static maximization problem:

$$V(\theta; \mathcal{T}(\cdot), \Lambda) \equiv \max_{e,n} u(e; \Lambda) - B\frac{n^{1+\varphi}}{1+\varphi} \quad \text{s.t.} \quad e = n\theta - \mathcal{T}(n\theta)$$

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- Government's maximization problem:

$$\max_{\mathcal{T}(\cdot;\Lambda)} \int_{\underline{\theta}}^{\overline{\theta}} V(\theta; \mathcal{T}(\cdot;\Lambda), \Lambda) w(\theta) f(\theta) d\theta \quad \text{s.t.} \quad \int_{\underline{\theta}}^{\overline{\theta}} \mathcal{T}(n(\theta; \mathcal{T}(\cdot;\Lambda), \Lambda)\theta; \Lambda) f(\theta) d\theta \geq 0$$

  - Pareto weights distribution $\{w(\theta)\}$, balanced budget with no spending

Nonlinear Taxes: General Formula

- Optimal marginal rate equates efficiency costs of taxation to distribution gains $\forall \theta^*$

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$$\underbrace{1 - \frac{1 - \frac{\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}{1-\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)} \frac{1}{1+\varphi} \frac{\theta^* f(\theta^*)}{1-F(\theta^*)} + \int_{\theta^*}^{\bar{\theta}} \mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda) \frac{dF(\theta)}{1-F(\theta^*)}}{1 + \int_{\underline{\theta}}^{\bar{\theta}} \mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)dF(\theta)}}_{E(\theta^*;\mathcal{T},\Lambda)} = \underbrace{1 - \frac{\int_{\theta^*}^{\bar{\theta}} u_e(\theta;\Lambda)w(\theta)\frac{dF(\theta)}{1-F(\theta^*)}}{\int_{\underline{\theta}}^{\bar{\theta}} u_e(\theta;\Lambda)w(\theta)dF(\theta)}}_{D(\theta^*;\mathcal{T},\Lambda)}$$

  - Let $\eta(\theta;\Lambda) \equiv dy(\theta;\Lambda)/d\mathcal{T}(0;\Lambda)$ denote the income effect of type-θ worker
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- Changes in Λ can alter: $\eta(\theta;\Lambda)$, $u_e(\theta;\Lambda)$; $y(\theta;\Lambda)$, $e(\theta;\Lambda)$

Nonlinear Taxes: Efficiency Cost $E(\theta^*; \mathcal{T}, \Lambda)$

- Efficiency costs of taxes and transfers depend on elasticities φ^{-1} and income effects η

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Nonlinear Taxes: Distribution Gains $D(\theta^*; \mathcal{T}, \Lambda)$

- Distribution gains of taxes and transfers depend on dispersion of marginal utilities u_e

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- No heterogeneity: $\mathbb{E}[u_e(\theta; \Lambda) | \theta \geq \theta^*] = \mathbb{E}[u_e(\theta; \Lambda)] \; \forall \theta^* \Rightarrow D = 0$

Homothetic Benchmark Neutrality Result

- Assume homothetic CRRA preferences

$$U(c) = \frac{\mathcal{C}(c)^{1-\gamma}}{1-\gamma}, \text{ where } \mathcal{C}(c) = \left(\sum_j \Omega_j^{\frac{1}{\sigma}} c_j^{\frac{\sigma-1}{\sigma}}\right)^{\frac{1-\sigma}{\sigma}}$$

  - Indirect utility function reads

$$\frac{(e/p^\star)^{1-\gamma}}{1-\gamma} - B\frac{n^{1+\varphi}}{1+\varphi}, \text{ with } p^\star = \frac{1}{\Lambda}\left(\sum_j \Omega_j \hat{p}_j^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$$

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  - Expenditures and incomes grow at constant rate $\alpha \equiv (1-\gamma)/(\gamma+\varphi)\ \forall\theta$

$$y(\theta;\Lambda(1+g)) = (1+\alpha g)y(\theta;\Lambda),\ \ e(\theta;\Lambda(1+g)) = (1+\alpha g)e(\theta;\Lambda),$$

  - Marginal and average tax rates are constant $\forall\theta$:

$$\mathcal{T}'(y(\theta;\Lambda(1+g));\Lambda(1+g)) = \mathcal{T}'(y(\theta;\Lambda);\Lambda),$$
$$\frac{\mathcal{T}(y(\theta;\Lambda(1+g));\Lambda(1+g))}{y(\theta;\Lambda(1+g))} = \frac{\mathcal{T}(y(\theta;\Lambda),\Lambda)}{y(\theta;\Lambda)}.$$

  - T also grows at rate α.

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  - T also grows at rate α.

- Sketch of a proof: Ratios of marginal utilities are constant; Income effects are constant

- Extend to $G>0$ as long as G also grow at constant rate α

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\+ Decreasing relative risk aversion (DRRA), or "Luxuries Are Easier to Postpone"
  Atkeson and Ogaki (1996), Browning and Crossley (2000)

Non-Homothetic CES Comin, Lashkari, and Mestieri (2021)

- Utility from aggregated consumption:

$$\frac{\mathcal{C}(c)^{1-\gamma}}{1-\gamma}$$

- Consumption aggregator $\mathcal{C}(c)$ implicitly defined by

$$\sum_{j}^{J} \left(\Omega_j (\mathcal{C}(c))^{\varepsilon_j}\right)^{\frac{1}{\sigma}} c_j^{\frac{\sigma-1}{\sigma}} = 1$$

  – ε_j governs income elasticity of demand for good j, σ is elasticity of substitution btw. goods

  $\Rightarrow \frac{\partial c_j}{\partial e} = \sigma + (1-\sigma)\frac{\varepsilon_j}{\bar{\varepsilon}}$

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$$\frac{\mathcal{C}(c)^{1-\gamma}}{1-\gamma}$$

- Consumption aggregator $\mathcal{C}(c)$ implicitly defined by

$$\sum_{j}^{J} \left(\Omega_j (\mathcal{C}(c))^{\varepsilon_j}\right)^{\frac{1}{\sigma}} c_j^{\frac{\sigma-1}{\sigma}} = 1$$

  - ε_j governs income elasticity of demand for good j, σ is elasticity of substitution btw. goods
    $\Rightarrow \frac{\partial c_j}{\partial e} = \sigma + (1-\sigma)\frac{\varepsilon_j}{\bar{\varepsilon}}$

- Focus on gross complements $\sigma < 1$

IA Preferences Alder, Boppart, and Müller (2022)

- Preferences defined over expenditures e

$$u(e;\Lambda) = \frac{1}{1-\gamma}\left(\frac{1}{\mathbf{B}(\Lambda)}\left(e - \underbrace{\sum_j \frac{\hat{p}_j}{\Lambda}\bar{c}_j}_{\mathbf{A}(\Lambda)}\right)\right)^{1-\gamma} - \mathbf{D}(\Lambda)$$

  - Price function $\mathbf{B}(\Lambda) = \left(\sum_j \Omega_j p_j^{1-\sigma}\right)^{\frac{1}{1-\sigma}} = \Lambda^{-1}\left(\sum_j \Omega_j \hat{p}_j^{1-\sigma}\right)^{\frac{1}{1-\sigma}} = p^\star$

D-Term

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  - Generalized Stone-Geary $\mathbf{A}\left(\Lambda\right)$
  - Price function $\mathbf{D}\left(\Lambda\right)$ is independent of expenditures e (PIGL)
    + Regularity condition when $\mathbf{D}\neq 0$: $\gamma<1$

D-Term

Non-Homothetic Preferences Relative Risk Aversion

- Non-Homothetic CES preferences

$$\text{RRA}(e;\Lambda) = \gamma \times \quad \underbrace{\frac{\mathcal{C}_e(e;\Lambda)e}{\mathcal{C}(e;\Lambda)}}_{\substack{\text{Elasticity of } \mathcal{C} \text{ w.r.t. } e \\ \text{Decreasing in } e}} \quad - \quad \underbrace{\frac{\mathcal{C}_{ee}(e;\Lambda)e}{\mathcal{C}_e(e;\Lambda)}}_{\substack{\text{Elasticity of } \mathcal{C}_e \text{ w.r.t. } e \\ \text{Ambiguous}}}$$

DRRA Conditions for 2 goods

Non-Homothetic Preferences Relative Risk Aversion

- Non-Homothetic CES preferences

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  – Homothetic: $\mathcal{C}(e;\Lambda) \propto e \Rightarrow \text{RRA} = \gamma$

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    - The larger γ the stronger DRRA

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  - Empirically: consumption baskets govern $\mathcal{C}$, what about γ?

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    - Proposition: DRRA $\Leftrightarrow$ labor supply falls with growth

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  – DRRA in quantitative model with 3 goods and falling labor supply

DRRA Conditions for 2 goods

Non-Homothetic Preferences Relative Risk Aversion

- IA preferences

$$\text{RRA}(e; \Lambda) = \gamma \times \frac{e}{e - \mathbf{A}(\Lambda)}$$

  - Proposition: Decreasing in $e \Leftrightarrow A > 0$
    - The larger γ the stronger DRRA

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  - Falling labor supply $\Rightarrow A > 0$

- **Taking stock:**

  Dynamics of consumption baskets & dynamics of labor supply $\Rightarrow$ DRRA

- Evidence for DRRA/increasing IES

  Ogaki and Zhang (2001), Blundell, Browning, and Meghir (1994), Attanasio and Browning (1995), ...

Non-Homothetic Preferences & Growth

$$\underbrace{1-\frac{1-\frac{\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}{1-\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}\frac{1}{1+\varphi}\frac{\theta^* f(\theta^*)}{1-F(\theta^*)}+\int_{\theta^*}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)\frac{dF(\theta)}{1-F(\theta^*)}}{1+\int_{\underline{\theta}}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)dF(\theta)}}_{E(\theta^*;\mathcal{T},\Lambda)} = \underbrace{1-\frac{\int_{\theta^*}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)\frac{dF(\theta)}{1-F(\theta^*)}}{\int_{\underline{\theta}}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)dF(\theta)}}_{D(\theta^*;\mathcal{T},\Lambda)}$$

1. **DRRA** $\Rightarrow$ Dispersion of **marginal utilities** decreases with growth

   $\rightarrow$ Redistribution should decrease with growth

Non-Homothetic Preferences & Growth

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- Proposition [1+3]
  - Assume $\{w(\theta)\}$ s.t. at a given Λ
    - *a.* $\overline{\mathcal{T}}'(.) \equiv \mathcal{T}'(.;\Lambda) = 0\ \forall y$ (Laissez-faire)
    - *b.* $\overline{\mathcal{T}}(.) \equiv \mathcal{T}(.;\Lambda)$ is loglinear (HSV)

$\Rightarrow$ $D(\theta;\overline{\mathcal{T}},\Lambda(1+g)) < D(\theta;\overline{\mathcal{T}},\Lambda)$ for $g>0$

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- Quantitatively, decreasing dispersion in marginal utilities dominates

Quantification in a Dynamic Model with Private Insurance

Quantification in a Dynamic Model

- Dynamic incomplete markets model with private saving
  - To disentangle inequality in expenditure, income, and wealth
  - To discipline DRRA with dynamic savings decisions
- Parametric tax-and-transfer system

  Ferriere, Grübener, Navarro, and Vardishvili (2023)

Households: Value Function

- Household's value function with productivity θ and assets a:

$$V(a,\theta) = \max_{e,a',n} \left\{ u(e;\Lambda) - B\frac{n^{1+\varphi}}{1+\varphi} + \beta \mathbb{E}_{\theta'}\left[V(a',\theta')\,|\theta\right] \right\}$$

s.t.

$$e + a' \leq \theta n + (1+r)a - \mathcal{T}(\theta n), \quad a' \geq 0$$

  - Productivity θ follows a stochastic process
  - Discount factor β
  - Fixed interest rate r (partial equilibrium)

Calibration Overview

- Calibration to the US economy in 1950 and 2010 with three sectors
  - Preferences; Government; Growth; Inequality

Calibration Growth

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  - Preferences; Government; Growth; Inequality

- Growth: Fall in prices
  - Aggregate growth in GDP per capita: 3.3
    NIPA
  - Prices relative to goods
    Computed based on Herrendorf, Rogerson, and Valentinyi (2013) [NIPA]
    - Agriculture (food) $\rightarrow$ 1.00, 1.87
    - Services $\rightarrow$ 1.00, 3.16

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- Interest rate fixed at 2%; discount factor to match wealth-to-income ratio of 4 in 2010
  Piketty and Zucman (2014) [NIPA]
  - Untargeted wealth-to-income ratio in 1950 of 3 [data: 3.65]

Calibration Government

- Functional form
  - Parametric tax function plus lump-sum transfer

    Ferriere, Grübener, Navarro, and Vardishvili (2023)

    $$\mathcal{T}(y) = \exp\left[\log(\lambda)\left(y^{-2\tau}\right)\right] y - T$$

    + λ: level of the tax rates; τ: progressivity; T: transfers

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- Changes over time
  - T to match spending on income security
    White House Office of Management & Budget
    - $T/Y = 1.1\%$ in 1950 → 3.6% in 2010
  - τ to match difference in average marginal tax rate between top 10% and bottom 90%
    Mertens and Montiel Olea (2018)
    - AMTR is 13% in 1950 → 9% in 2010
  - Exogenous government spending to capture all remaining federal spending
    - Constant over time: $G/Y \approx 14\%$

Calibration Inequality

- Wages follow AR(1) in logs, with appended Pareto tail
  - Persistence ρ fixed at 0.9
  - Shock innovation set to match variance of log income from SCF+
    Kuhn, Schularick, and Steins (2020)
  - Time-varying Pareto tail parameter
    Aoki and Nirei (2017)

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1950	Income Share by Quintile				
Model	6%	11%	13%	21%	49%
Data (SCF+)	6%	11%	15%	21%	48%

2010	Income Share by Quintile				
Model	4%	9%	11%	19%	56%
Data (SCF+)	4%	9%	13%	21%	53%

SCF+ Expenditure Inequality

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1950	Wealth Share by Quintile				
Model	0%	2%	6%	17%	76%
Data (SCF+)	0%	1%	4%	11%	84%

2010	Wealth Share by Quintile				
Model	0%	1%	5%	13%	81%
Data (SCF+)	-1%	1%	3%	10%	87%

SCF+ Expenditure Inequality

Calibration Preferences

- Non-homothetic CES parameters
  - Income elasticities of demand and elasticity of substitution between goods
    Estimates of Comin, Lashkari, and Mestieri (2021) based on CEX micro data
    - $\sigma = 0.3$; $\varepsilon_A = 0.1, \varepsilon_G = 1.0, \varepsilon_S = 1.8$

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  - Ω_j: match aggregate sector shares in 2010
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    + Agriculture (food) 8%, goods 26%, services 67%
    + Untargeted 1950: agriculture 17% [data 22%], goods 49% [39%], services 34% [39%]

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    - Untargeted 1950: agriculture 17% [data 22%], goods 49% [39%], services 34% [39%]
- Remaining preference parameters
  - Fix Frisch elasticity $1/\varphi$ to standard value of 0.5
  - Consumption curvature γ to match RRA ≈ 1 in 2010

Implied RRA in the Model Decreasing RRA

- Calibrated non-homothetic preferences imply DRRA

Implied RRA in the Model Decreasing RRA

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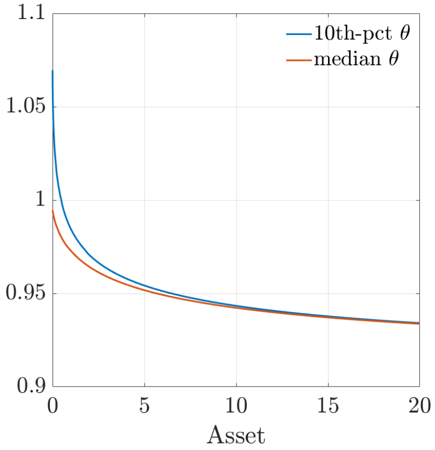
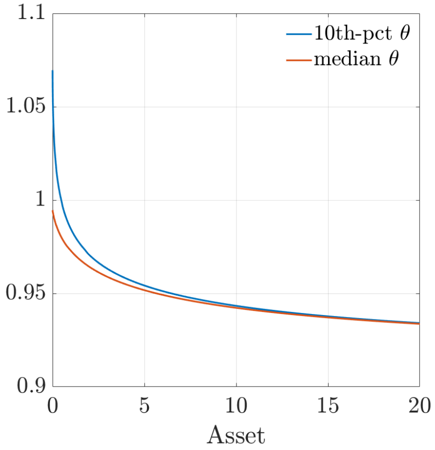


Implied RRA in the Model Decreasing RRA

- Calibrated non-homothetic preferences imply DRRA
  - RRA falls from 1.07 in 1950 to 1, small dispersion
- Implied labor supply dynamics
  - Falling labor supply over time
    - Fall in average hours by 7%

      Ramey and Francis (2009), Boppart and Krusell (2020)
  - Cross-section correlation between hours and wages
    - Roughly flat hours profile in 1950, positive in 2010

      Costa (2000), Mantovani (2022)



Implied RRA in the Model MPCs and Wealth Effects

- Relation between RRA, wealth effects, and MPC: $\text{RRA} \times \text{MPC} = \eta \left(\varphi \frac{e}{y} + \frac{e\mathcal{T}''(y)}{\mathcal{T}'(y)} \right)$

Implied RRA in the Model MPCs and Wealth Effects

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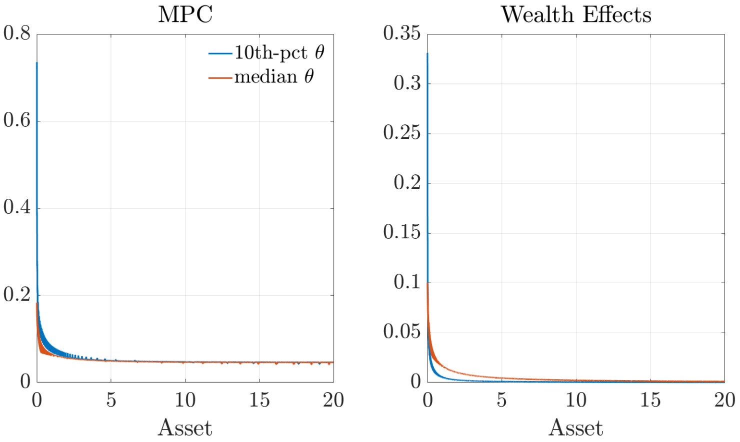


- Model MPC: 18% in 2010
  Johnson, Parker, and Souleles (2006), Fagereng, Holm, and Natvik (2021), Kaplan and Violante (2022)

- Wealth effects: 0.02 in 2010
  Golosov, Graber, Mogstad, and Novgorodsky (2023)

Wealth Effects

Rising Living Standards vs. Rising Inequality

- Use dynamic model to quantify effect of rising living standards relative to rising inequality

Weights

Rising Living Standards vs. Rising Inequality

- Use dynamic model to quantify effect of rising living standards relative to rising inequality
- Pareto weights
  - Inverse optimum in 1950

    Bourguignon and Spadaro (2012), Lockwood and Weinzierl (2016), Hendren (2020)
  - Weights as a function of the expenditure percentile

$$\omega\left(p_i\right) = \mu + p_i(e_i)^{\nu}, \text{ with } \mu = 0.05, \ \nu = 116.4$$

Weights

Rising Living Standards vs. Rising Inequality

- Use dynamic model to quantify effect of rising living standards relative to rising inequality
- Pareto weights
  - Inverse optimum in 1950

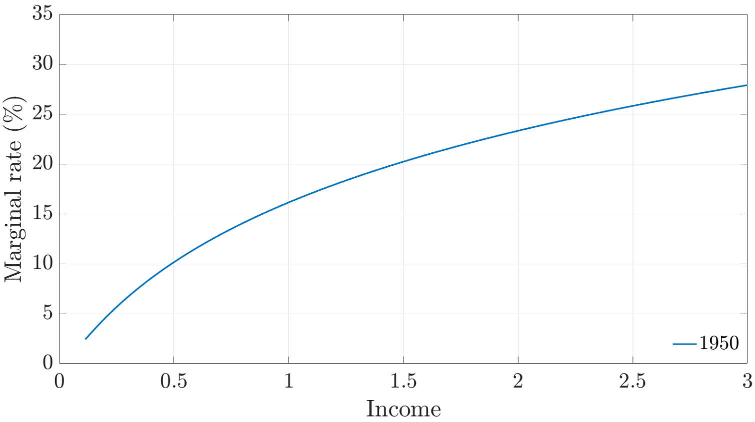
    Bourguignon and Spadaro (2012), Lockwood and Weinzierl (2016), Hendren (2020)
  - Weights as a function of the expenditure percentile

$$\omega\left(p_i\right) = \mu + p_i(e_i)^{\nu}, \text{ with } \mu = 0.05,\ \nu = 116.4$$

- Experiment in two steps
  - First add inequality only
  - Second compare optimal 2010 with inequality and growth
    - Growth: fall in prices and changes in relative prices

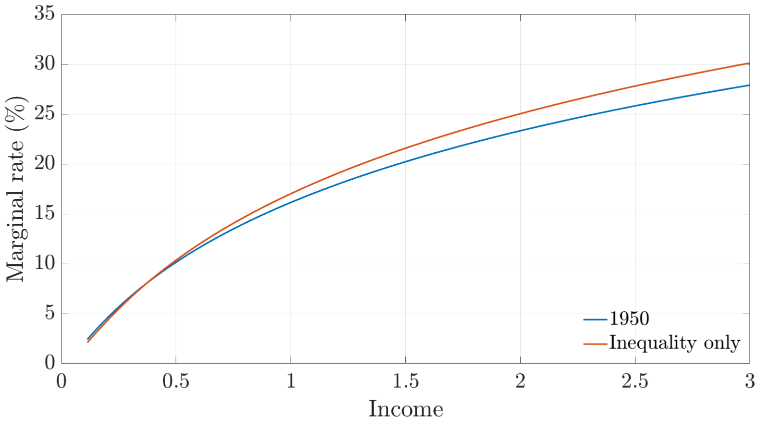
Weights

Optimal Marginal Rates



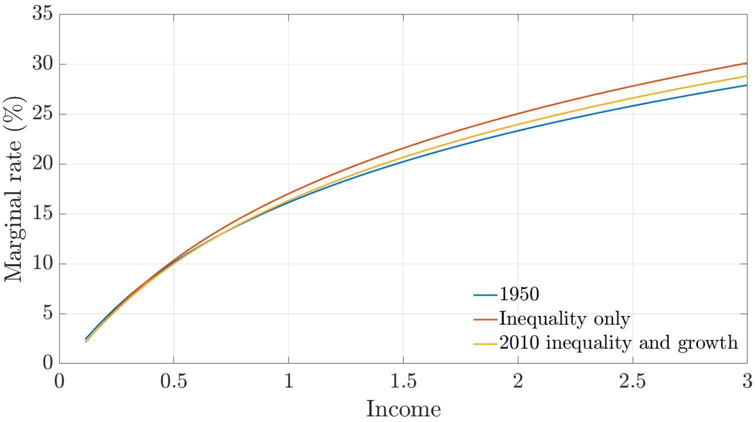
- Calibration in 1950: $T/Y \approx 1\%$

Optimal Marginal Rates



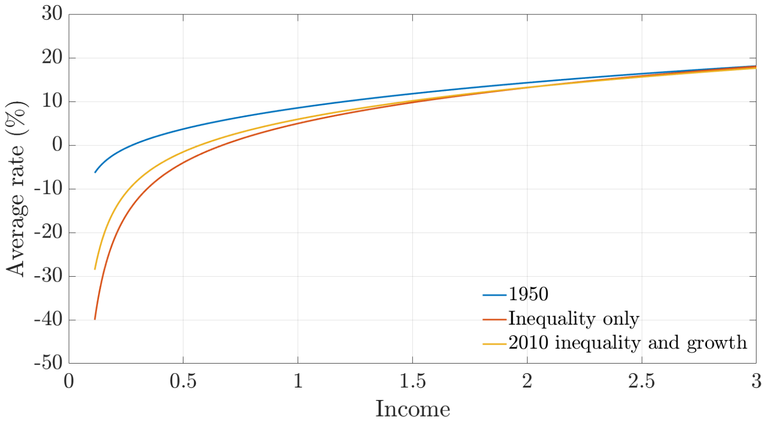
- Calibration in 1950: $T/Y \approx 1\%$ $\Rightarrow T/Y = 4.6\%$ with higher inequality

Optimal Marginal Rates



- Calibration in 1950: $T/Y \approx 1\% \;\Rightarrow T/Y = 3.3\%$ with higher inequality and growth
  - Growth reduces increase in T/Y by 35%

Optimal Average Rates



- Growth reduces increase in top-10 minus bottom-10 average rates by 30%

Quantitative Mirrlees Setup

- Calibration following a partial-insurance approach
  - Target consumption dispersion of the quantitative model in 1950 and 2010

Quantitative Mirrlees Setup

- Calibration following a partial-insurance approach
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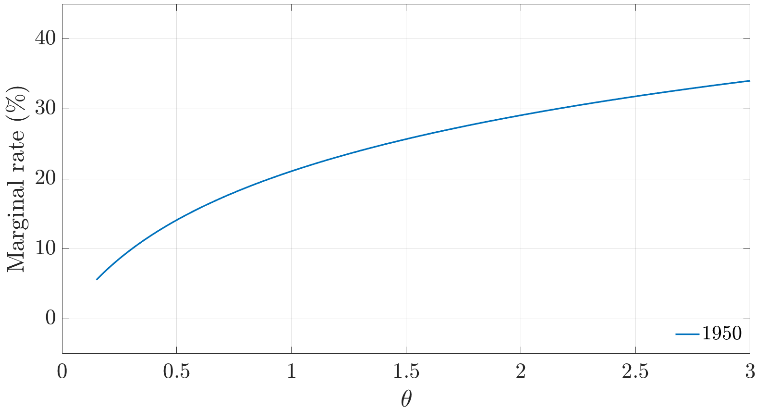
- Replicate the main quantitative exercise
  - Obtain similar effects of rising living standards relative to rising inequality

Calibration

Optimal Marginal Rates Mirrlees



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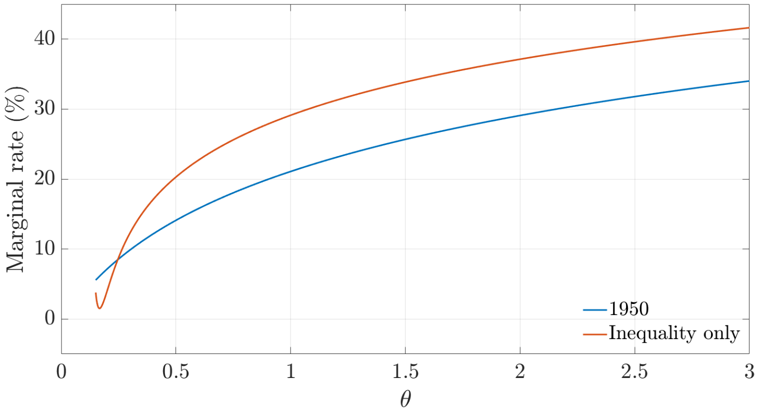
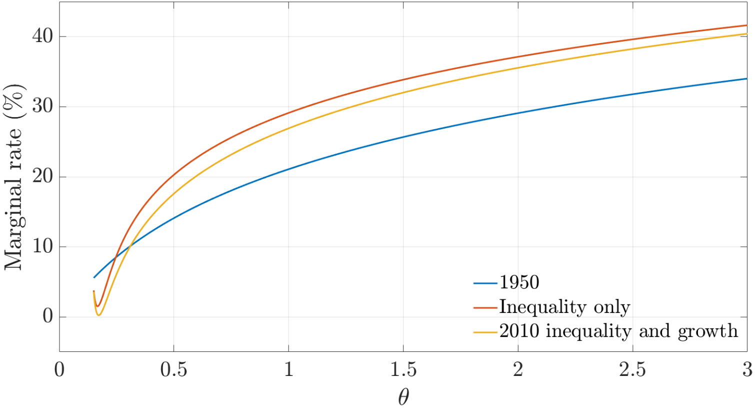
Optimal Marginal Rates Mirrlees



- Calibration in 1950: $T/Y \approx 1\%$ $\Rightarrow T/Y = 6.7\%$ with higher inequality

Optimal Marginal Rates Mirrlees



- Calibration in 1950: $T/Y \approx 1\% \;\Rightarrow T/Y = 4.5\%$ with higher inequality and growth
  - Growth reduces increase in T/Y by 40%

Quantitative Mirrlees Setup

- Calibration following a partial-insurance approach
  - Target consumption dispersion of the quantitative model in 1950 and 2010
- Replicate the main quantitative exercise
- Decompose the different channels using the optimal tax formula
  - Decomposition into effects of marginal utilities, income effects, and the hours distribution

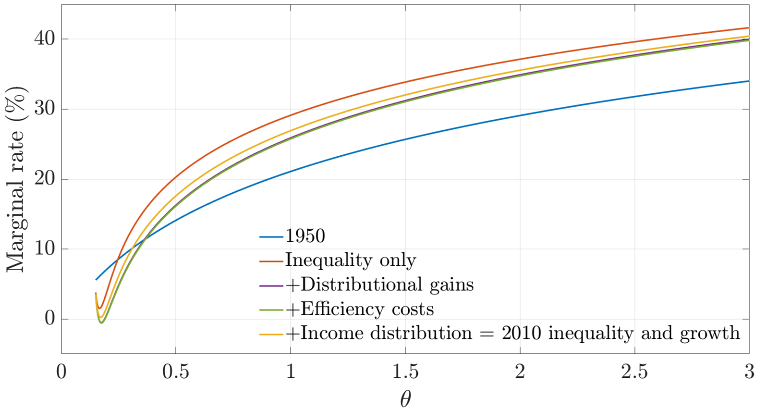
Optimal Marginal Rates Decomposition

- In 1950, calibrated/optimal $T/Y \approx 1\%$
- Optimal T/Y in 2010
  - Accounting for inequality only: $T/Y = 6.7\%$
  - Accounting for growth as well: $T/Y = 4.5\% \Rightarrow$ -2.2 p.p.

Optimal Marginal Rates Decomposition

- In 1950, calibrated/optimal $T/Y \approx 1\%$
- Optimal T/Y in 2010
  - Accounting for inequality only: $T/Y = 6.7\%$
  - Accounting for growth as well: $T/Y = 4.5\% \Rightarrow$ -2.2 p.p.
    - + Fall in **dispersion in marginal utilities**: -2.9 p.p.
    - + Also accounting for lower income effects: -0.1 p.p.
    - + Also accounting for the more compressed distribution of hours: $+$0.8 p.p.

Optimal Marginal Rates Decomposition



- 1950: $T/Y = 1.2\%$ $\Rightarrow$ $T/Y = 6.7\%$ with inequality, $T/Y = 4.5\%$ with growth
  $\Rightarrow$ $T/Y = 3.8\%$ with marginal utilities only, $T/Y = 3.7\%$ adding efficiency concerns

Quantitative Mirrlees Setup

- Calibration following a partial-insurance approach
- Replicate the main quantitative exercise
- Decompose the different channels using the optimal tax formula
- Robustness

Conclusion

Conclusion

- Optimal taxation with rising living standards
  - Affect efficiency and distribution concerns
- Dampen optimal increase in redistribution due to rising inequality

Appendix

Literature

Evidence: Risk Aversion and IES

- DRRA supported by consumption data from Indian villages
  Ogaki and Zhang (2001), Zhang and Ogaki (2004)
- IES increasing in consumption/wealth, based on estimating consumption Euler equation
  Blundell, Browning, and Meghir (1994), Attanasio and Browning (1995), Atkeson and Ogaki (1996)
- DRRA powerful in matching portfolio choices across the wealth distribution
  Wachter and Yogo (2010), Straub (2019), Cioffi (2021), Meeuwis (2022)

Cardinalization

- Infer intertemporal properties of utility from intratemporal allocations
  - Cardinalization?
  - One can always add a monotonic $V(.)$ function to $u(e;\Lambda) - B\frac{n^{1+\varphi}}{1+\varphi}$

Back

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  Stiglitz (1969), Hanoch (1977), Crossley and Low (2011)

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- Quantitative: Dynamic model with dynamic policy functions

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Back

Data Appendix

SCF+

- Long-run data on income and wealth inequality in the US
  Compiled by Kuhn, Schularick, and Steins (2020)
  - Based on historical waves of the Survey of Consumer Finances (SCF)
  - Time period 1949-2016
- Income components
  - Wages and salaries
  - Income from professional practice and self-employment
  - Business and farm income
  - Excluded: rental income, interest, dividends, transfers

Back

SCF+ (cont.)

- Net worth/wealth components (assets - debt)
  - Assets
    - Liquid assets: checking, savings, call/money market accounts, certificates of deposit
    - Housing and other real estate
    - Bonds, stocks and business equity, mutual funds
    - Cash value of life insurance
    - Defined-contribution retirement plans
    - Cars
  - Debt
    - Housing debt: debt on owner-occupied homes, home equity loans and lines of credit
    - Other debt: car loans, education loans, consumer loans

Back

SCF+ (cont.)

- Sample selection
  - Head of household aged 25 to 60
  - Minimum income restriction
    - $5,000 for 2010 (in 2016 dollars)
    - In 1950 such that ratio of minimum income to median is the same ($2,700)

Back

Government Spending

- Programs included in transfers

  White House Office of Management & Budget

  - General retirement and disability insurance (excluding social security)
  - Federal employee retirement and disability; Unemployment compensation
  - Housing assistance; Food and nutrition assistance; Other income security

- Government spending
  - Supposed to capture all remaining federal spending
  - Purposefully chosen such that G/Y constant
    - Spending has risen in the data, but largely deficit-financed

Back

Model Appendix

Non-Homothetic Preferences Non-Homothetic CES

Comin, Lashkari, and Mestieri (2021)

- Conditions for DRRA with two goods: $\varepsilon_1 < \varepsilon_2 = 1$
  - Necessary condition: $\gamma > \varepsilon_1$
  - Sufficient condition: $\gamma + \varepsilon_1 \geq 2$
- Typical calibration with three goods $\Rightarrow$ quantitatively true

Back

Non-Homothetic Preferences Stone-Geary Preferences

Geary (1950)

- **One-sector** Stone-Geary preferences

$$u(c) = \frac{(c - \bar{c})^{1-\gamma}}{1-\gamma}$$

- Subsistence consumption level $\bar{c} > 0$

$\Rightarrow$ Implies increasing elasticity of intertemporal substitution (DRRA)

- Counterfactual: vanishing non-homotheticities

IA Preferences Alder, Boppart, and Müller (2022)

- $\mathbf{D}(.)$ term defined as:

$$\mathbf{D}(\Lambda) = \frac{\nu}{\eta}\left(\left[\left(\sum_{j\in J}\theta_j {p_j}^{1-\iota}\right)^{\frac{1}{1-\iota}}\mathbf{B}(\Lambda)^{-1}\right]^{\eta} - 1\right)$$

Back

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- Consumption share $cs_j \equiv p_j c_j / e$

$$cs_j = \frac{\mathbf{A}_j p_j}{e} + \frac{\mathbf{B}_j p_j}{\mathbf{B}}\left(1 - \frac{\mathbf{A}}{e}\right) + \frac{\mathbf{D}_j}{\gamma} p_j \left(\frac{e}{\mathbf{B}} - \frac{\mathbf{A}}{\mathbf{B}}\right)^{\gamma}\left(\frac{e}{\mathbf{B}}\right)^{-1}$$

$$cs_j = \frac{\mathbf{A}_j p_j}{e} + \frac{\mathbf{B}_j p_j}{\mathbf{B}}\left(1 - \frac{\mathbf{A}}{e}\right) + \frac{\mathbf{D}_j}{\gamma} p_j \frac{\mathbf{B}^{1-\gamma}}{e^{1-\gamma}}\left(1 - \frac{\mathbf{A}}{e}\right)^{\gamma}$$

where $\mathbf{X}_j = \partial \mathbf{X} / \partial p_j$.

Back

Calibration Aggregates

- Prices for all goods p_A, p_G, p_S pinned down by growth and relative price changes
  - Aggregate growth in GDP per capita: 3.3
    NIPA
  - Prices relative to goods
    Computed based on Herrendorf, Rogerson, and Valentinyi (2013) [NIPA]
    - Agriculture (food) $\rightarrow$ 1.00, 1.87
    - Services $\rightarrow$ 1.00, 3.16

- Interest rate fixed at 2%; discount factor to match wealth-to-income ratio of 4 in 2010
  Piketty and Zucman (2014) [NIPA]
  - Untargeted wealth-to-income ratio in 1950 of 3 [data: 3.65]

Calibration Preferences

- Non-homothetic CES parameters
  - $\{\varepsilon_j\}$ and σ: estimates of Comin, Lashkari, and Mestieri (2021) with CEX micro data
    - $\sigma = 0.3$; $\varepsilon_A = 0.1, \varepsilon_G = 1.0, \varepsilon_S = 1.8$

Back

Calibration Preferences

- Non-homothetic CES parameters
  - $\{\varepsilon_j\}$ and σ: estimates of Comin, Lashkari, and Mestieri (2021) with CEX micro data
    - $\sigma = 0.3$; $\varepsilon_A = 0.1, \varepsilon_G = 1.0, \varepsilon_S = 1.8$
  - Ω_j: match aggregate sector shares in 2010
    Computed based on Herrendorf, Rogerson, and Valentinyi (2013) [NIPA]
    - Agriculture (food) 8%, goods 26%, services 67%
    - Untargeted 1950: agriculture 17% [data 22%], goods 49% [39%], services 34% [39%]

Back

Labor Supply in the Time Series and Cross-Section

- Fall in average hours across time: 7%

  Ramey and Francis (2009), Boppart and Krusell (2020)

- Correlation between hours and hourly wage in the cross-section
  - Roughly flat hours profile in 1950
  - Positive in 2010

  costa2000wage, Mantovani (2022)

Back

Calibration Income inequality

- Wages follow AR(1) in logs, with appended Pareto tail
  - Time-varying Pareto tail parameter
    Aoki and Nirei (2017)
  - Time-varying innovation to AR(1) set to match variance of log income from SCF+
    Kuhn, Schularick, and Steins (2020)

1950	**Income** Share by Quintile				
Model	6%	11%	13%	21%	49%
Data (SCF+)	6%	11%	15%	21%	48%

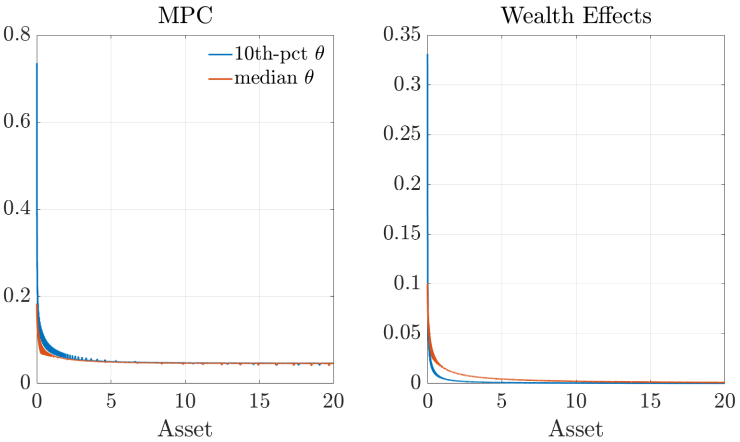
2010	**Income** Share by Quintile				
Model	4%	8%	12%	19%	56%
Data (SCF+)	4%	9%	13%	21%	53%

Calibration Expenditure Inequality

- Variance of log consumption in 2010: 0.46, top-quintile expenditure share of 45%
- Less expenditure inequality in 1950
- Variance of log consumption in 1950: 0.33, top-quintile expenditure share of 39%

Back

Implied RRA in the Model MPCs and Wealth Effects



- Model MPC: 18% in 2010
  Johnson, Parker, and Souleles (2006), Fagereng, Holm, and Natvik (2021), Kaplan and Violante (2022)

- Wealth effects: 0.02 in 2010
  Golosov, Graber, Mogstad, and Novgorodsky (2023)

Back Wealth Effects

Wealth Effects: Evidence Golosov, Graber, Mogstad, and Novgorodsky (2023)

- How does income respond to unexpected wealth shocks?
  - Golosov et al. merge US tax data with data on lottery winnings
  - Compute earnings change over five years after lottery win
  - Earnings drop by on average $2.3\$$ per $100\$$ of win
- Replicate in model using mean post-tax win
  - Earnings drop by on average $2.1\$$ per $100\$$ of win

Back

Calibration: Inequality

- A partial-insurance approach
  - Calibrate $f(.)$ as exponentially modified Gaussian (EMG) to match dispersion in expenditures

Back

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- In 2010, data on income and expenditure inequality
  - Dispersion: $\mathbb{V}[\log y] = 0.78$; $\mathbb{V}[\log e] \approx 0.35$

    SCF+ (Kuhn, Schularick, and Steins 2020); Attanasio and Pistaferri (2014), Heathcote, Perri, and Violante (2010)
  - Pareto tail: $\lambda_y = 1.65$; $\lambda_e \approx 3.3$

    Aoki and Nirei (2017); Toda and Walsh (2015)

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  - Pareto tail: $\lambda_y = 1.65$; $\lambda_e \approx 3.3$
    Aoki and Nirei (2017); Toda and Walsh (2015)

- In 1950, data on income inequality only
  - Dispersion: $\mathbb{V}[\log y] = 0.57$; $\Rightarrow$ infer $\mathbb{V}[\log e] \approx 0.25$
    SCF+ (Kuhn, Schularick, and Steins 2020)
  - Pareto tail: $\lambda_y = 2.2 \Rightarrow$ infer $\lambda_e = 4.4$
    Aoki and Nirei (2017)

Back

Calibration: Expenditure Inequality

1950	Expenditure Share by Quintile				
Dynamic model	8%	13%	17%	23%	39%
Static model	9%	13%	17%	23%	38%
2010	**Expenditure Share by Quintile**				
Dynamic model	7%	11%	16%	21%	45%
Static model	7%	12%	16%	23%	43%

Back

Efficiency vs. Distribution with Growth

- Use Mirrlees formula to quantify how growth changes efficiency vs. distribution concerns
  - Static "partial insurance" setup with expenditure distribution as in dynamic model

Efficiency vs. Distribution with Growth

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    + Pareto weights such that calibrated 1950 tax system is optimal

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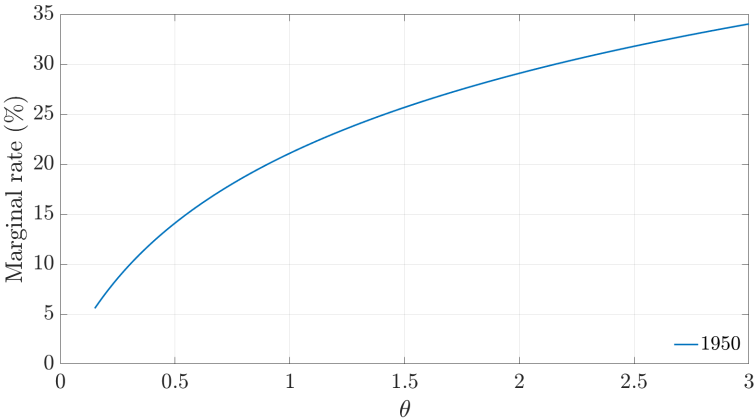
Back

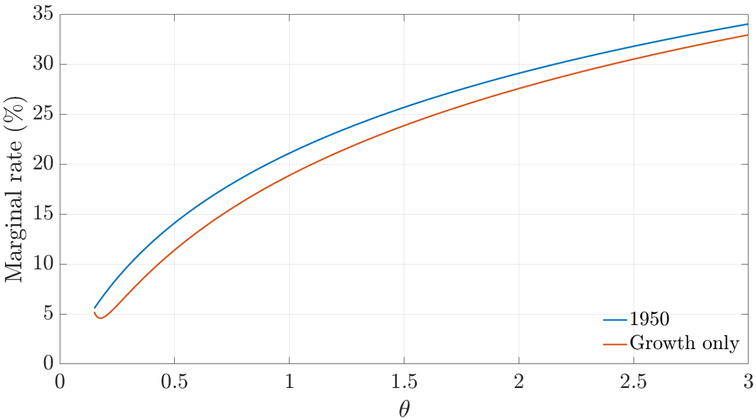
Optimal Marginal Rates with Growth



- Optimal 1950 transfers: $T/Y = 1.2\%$

Formula Back

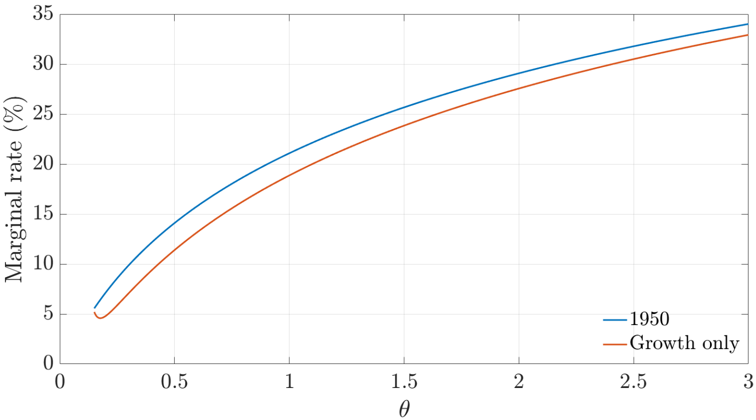
Optimal Marginal Rates with Growth



- Optimal 1950 transfers: $T/Y = 1.2\%$ $\Rightarrow$ With 2010 growth, $T/Y = -0.7\%$

Formula Back

Optimal Marginal Rates with Growth



- With 2010 growth, $T/Y = -0.7\%$

Formula Back

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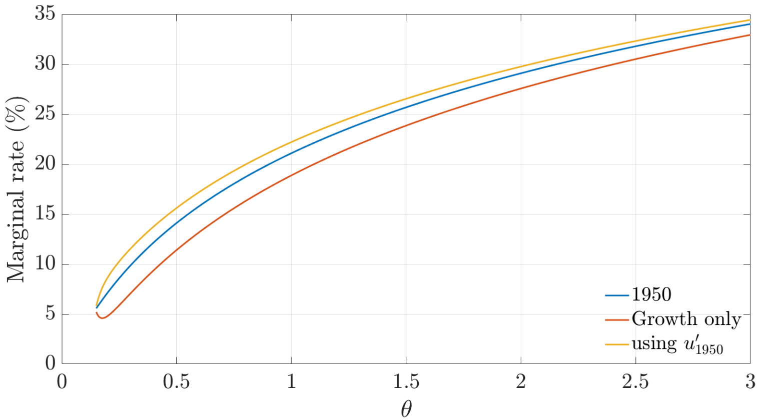
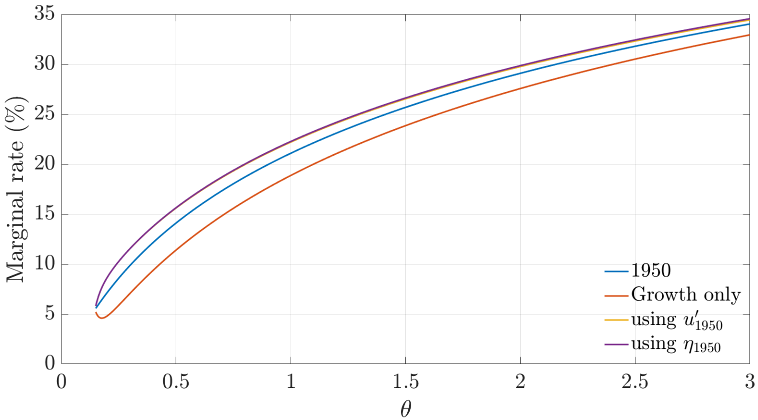


- With 2010 growth, $T/Y = -0.7\%$ $\Rightarrow$ With 1950 marg. u dispersion, $T/Y = 2.4\%$

Formula Back

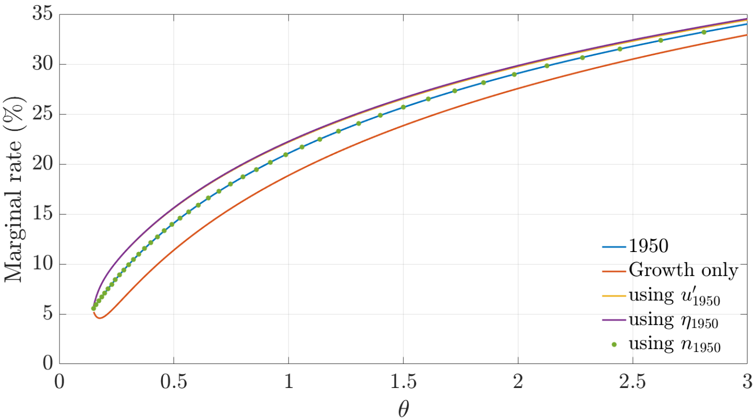
Optimal Marginal Rates with Growth



- With 2010 growth, $T/Y = -0.7\%$ $\Rightarrow$ With 1950 income effects, $T/Y = 2.4\%$

Formula Back

Optimal Marginal Rates with Growth



- With 2010 growth, $T/Y = -0.7\%$ $\Rightarrow$ With 1950 hours worked, $T/Y = 1.2\%$ (1950 level)

Formula Back

Efficiency vs. Distribution Decomposition

- Decomposition into effects of marginal utilities, income effects, and the hours distribution

$$\underbrace{1-\frac{1-\frac{\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}{1-\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}\frac{1}{1+\varphi}\frac{\theta^* f(\theta^*)}{1-F(\theta^*)}+\int_{\theta^*}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)\frac{dF(\theta)}{1-F(\theta^*)}}{1+\int_{\underline{\theta}}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)dF(\theta)}}_{E(\theta^*;\mathcal{T},\Lambda)}=\underbrace{1-\frac{\int_{\theta^*}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)\frac{dF(\theta)}{1-F(\theta^*)}}{\int_{\underline{\theta}}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)dF(\theta)}}_{D(\theta^*;\mathcal{T},\Lambda)}$$

- Starting from optimal taxes with growth

Efficiency vs. Distribution Decomposition

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- Starting from optimal taxes with growth

  1. Optimal taxes with $u_e(\cdot)$ computed using p_{1950}

Efficiency vs. Distribution **Decomposition**

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- Starting from optimal taxes with growth
  1. Optimal taxes with $u_e(\cdot)$ computed using p_{1950}
  2. Adding $\eta(\cdot)$ using p_{1950}

Efficiency vs. Distribution Decomposition

- Decomposition into effects of marginal utilities, income effects, and the hours distribution

$$\underbrace{1-\frac{1-\frac{\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}{1-\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}\frac{1}{1+\varphi}\frac{\theta^* f(\theta^*)}{1-F(\theta^*)}+\int_{\theta^*}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)\frac{dF(\theta)}{1-F(\theta^*)}}{1+\int_{\underline{\theta}}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)dF(\theta)}}_{E(\theta^*;\mathcal{T},\Lambda)}=\underbrace{1-\frac{\int_{\theta^*}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)\frac{dF(\theta)}{1-F(\theta^*)}}{\int_{\underline{\theta}}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)dF(\theta)}}_{D(\theta^*;\mathcal{T},\Lambda)}$$

- Starting from optimal taxes with growth

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2. Adding $\eta(\cdot)$ using p_{1950}
3. Adding $n(\cdot)$ using p_{1950}

Efficiency vs. Distribution Decomposition

- Decomposition into effects of marginal utilities, income effects, and the hours distribution

$$\underbrace{1-\frac{1-\frac{\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}{1-\mathcal{T}'(y(\theta^*;\Lambda);\Lambda)}\frac{1}{1+\varphi}\frac{\theta^* f(\theta^*)}{1-F(\theta^*)}+\int_{\theta^*}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)\frac{dF(\theta)}{1-F(\theta^*)}}{1+\int_{\underline{\theta}}^{\bar{\theta}}\mathcal{T}'(y(\theta;\Lambda);\Lambda)\eta(\theta;\Lambda)dF(\theta)}}_{E(\theta^*;\mathcal{T},\Lambda)}=\underbrace{1-\frac{\int_{\theta^*}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)\frac{dF(\theta)}{1-F(\theta^*)}}{\int_{\underline{\theta}}^{\bar{\theta}}u_e(\theta;\Lambda)w(\theta)dF(\theta)}}_{D(\theta^*;\mathcal{T},\Lambda)}$$

- Starting from optimal taxes with growth

  1. Optimal taxes with $u_e(\cdot)$ computed using p_{1950}
  2. Adding $\eta(\cdot)$ using p_{1950}
  3. Adding $n(\cdot)$ using p_{1950}

  $\Rightarrow$ Back to 1950

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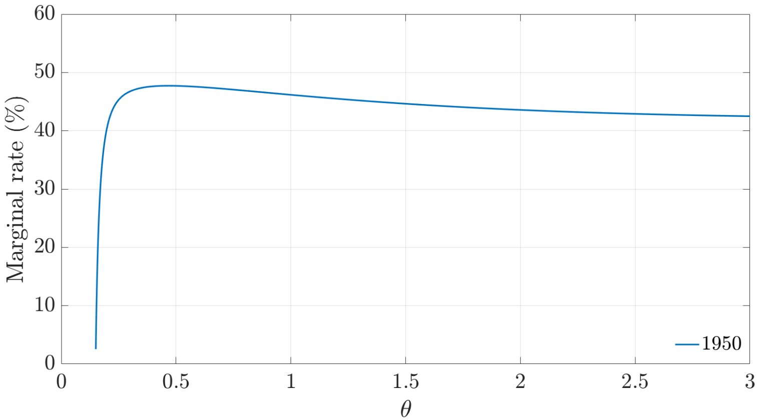
Optimal Marginal Rates with Growth **Utilitarian**



- Optimal 1950 transfers: $T/Y = 25.2\%$

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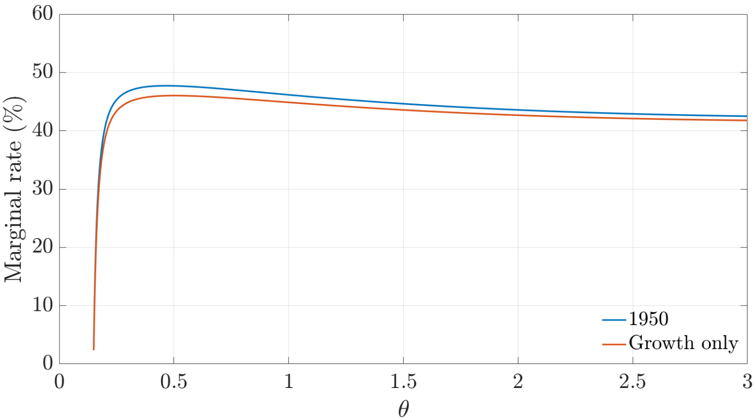
Optimal Marginal Rates with Growth Utilitarian



- Optimal 1950 transfers: T/Y = 25.2% ⇒ With 2010 growth, $T/Y = 24.0\%$

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Weights

- More degrees of freedom in finding inverse optimum weights
- Restriction to functional form motivated by instruments: lump sum and progressivity
- Weights as function of percentiles of the expenditure distribution

$$\omega\left(p_i\right) = \mu + p_i(e_i)^{\nu}$$

- $\mu = 0.05$, $\nu = 116.4$

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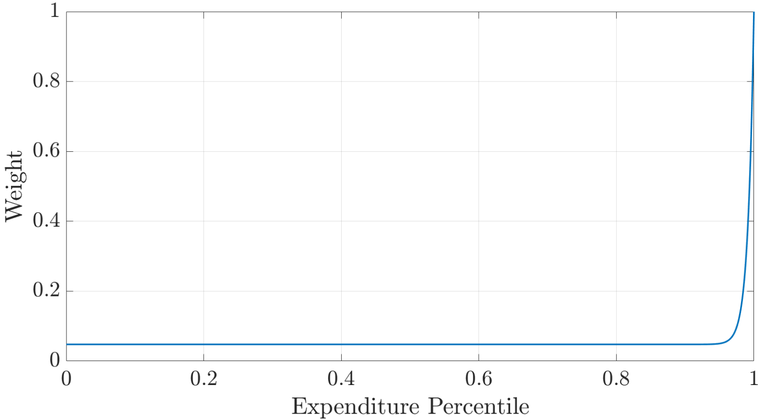
Weights



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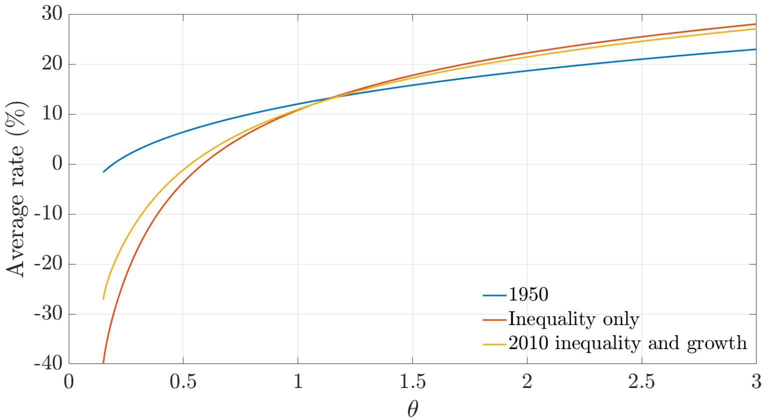
Optimal Average Rates **Mirrlees**



- Growth reduces increase in top-10 minus bottom-10 average rates by almost 30%

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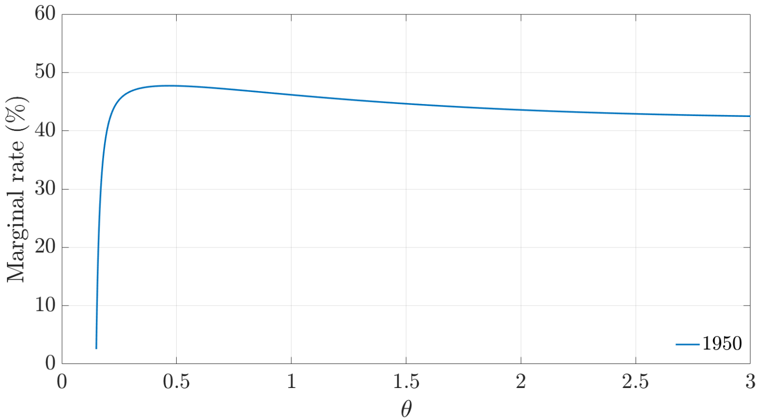
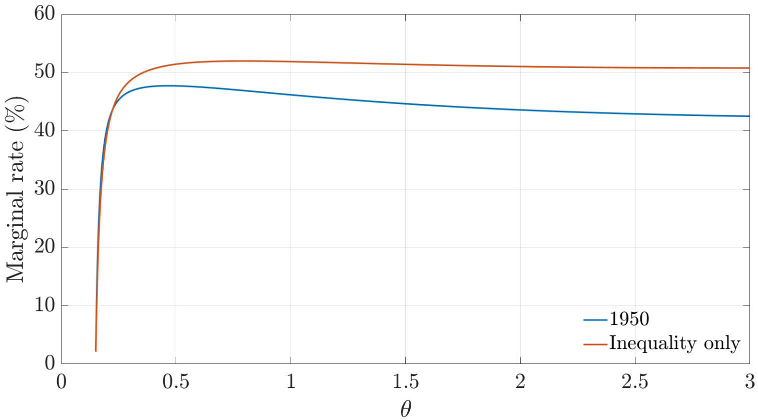
Optimal Marginal Rates **Mirrlees Utilitarian**



- Optimum in 1950: $T/Y = 25.2\%$

Optimal Marginal Rates Mirrlees Utilitarian



- Optimum in 1950: $T/Y = 25.2\% \Rightarrow T/Y = 29.2\%$ with higher inequality

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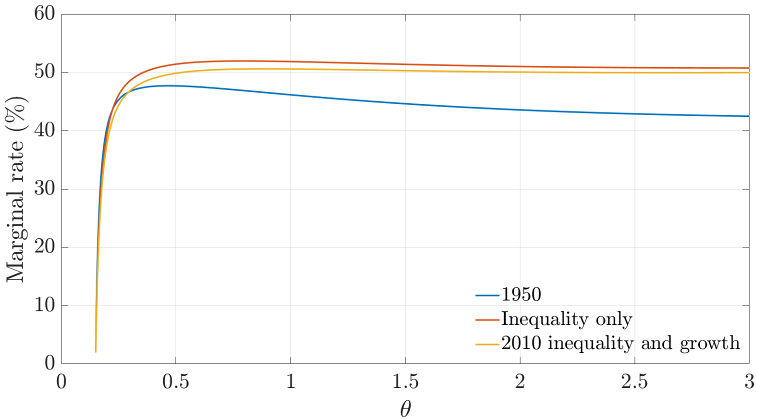
Optimal Marginal Rates Mirrlees Utilitarian



- Optimum in 1950: $T/Y = 25.2\%$ $\Rightarrow T/Y = 27.6\%$ with higher inequality and growth
  - Growth reduces increase in T/Y by 39%

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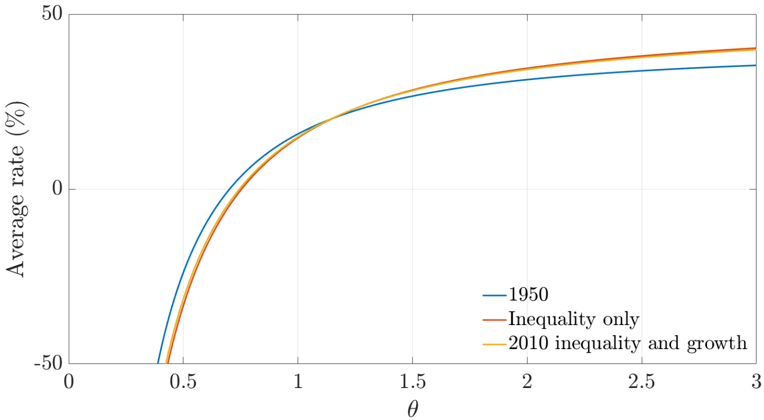
Optimal Average Rates **Mirrlees Utilitarian**



- Growth reduces increase in top-10 minus bottom-10 average rates by 9%

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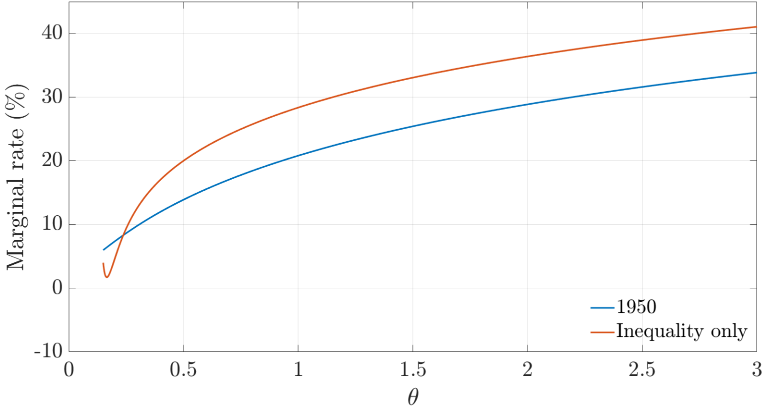
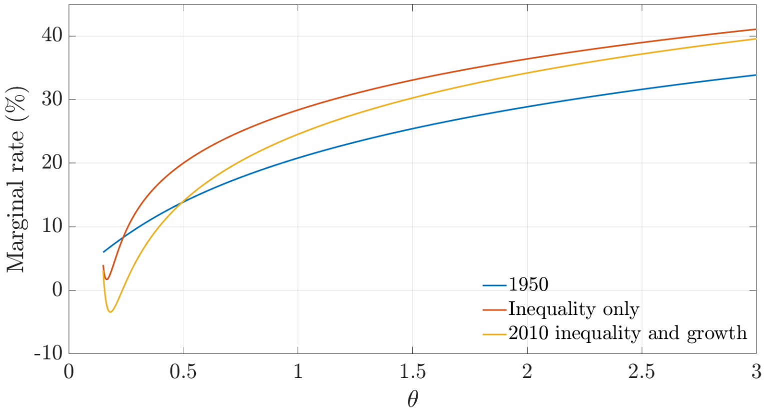
Optimal Marginal Rates Mirrlees IA Preferences



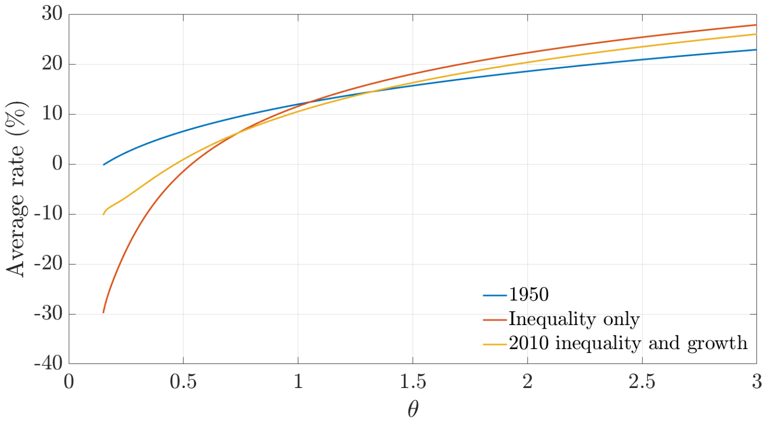
- Calibration in 1950: $T/Y = 1.1\%$ $\Rightarrow T/Y = 5.6\%$ with higher inequality

Optimal Marginal Rates Mirrlees IA Preferences



- Calibration in 1950: $T/Y = 1.1\%$ $\Rightarrow T/Y = 2.0\%$ with higher inequality and growth
  - Growth reduces increase in T/Y by more than 80%

Optimal Average Rates **Mirrlees IA Preferences**



- Growth reduces increase in top-10 minus bottom-10 average rates by almost 50%

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IA Parameters

- $1 - \eta = \gamma = 0.9$
- A-term
  - $\bar{c}_A = 0.03$, $\bar{c}_G = 0.00$, $\bar{c}_S = 0.005$
- B-term
  - $\sigma = 0.001$
  - $\omega_A = 0.06$, $\omega_G = 0.4$, $\omega_S = 1 - \omega_A - \omega_G$
- D-term
  - $\nu = 15$
  - $\iota = 2$
  - $\theta_A = 0.22$, $\theta_G = 0.62$, $\theta_S = 1 - \theta_A - \theta_G$

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