# Optimal Redistribution: Rising Inequality vs. Rising Living Standards


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# Motivation

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

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

# What We Do

- **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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- **Quantify** the relative effects of rising inequality vs. rising living standards in Aiyagari setup
  - Calibrated 1950 $t\&T$ sytem with inverse optimum Pareto weights
  - Optimal 2010 $t\&T$ system with: 1. only rising inequality; and 2. also rising living standards

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- Mirrlees setup: two main effects of rising living standards
  - Lowers dispersion in marginal utilities $\Rightarrow$ Lower distribution gains from redistribution
  - Lowers income effects $\Rightarrow$ Ambiguous effects on efficiency costs of redistribution
- Quantitatively large effects of rising living standards
  - Rising living standards calls for less redistribution
  - Dampens by about 30% 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 $\theta$
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  - Isoelastic labor preferences $v(n) = Bn^{1+\varphi}/(1+\varphi)$
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  - $c = (c_1, \ldots, c_J)$ denotes a basket of consumption goods
- Let $u$ denote the indirect utility function

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

  - $e$: nominal expenditures
  - $\bar{p}$: vector of relative prices, kept constant (drop it!)
  - $\Lambda$: **level** of the economy

# Optimal Taxation Problem

- Household's static maximization problem:

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

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- Government's maximization problem:

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

  - 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 $\forall\theta^*$

  Heathcote and Tsujiyama (2021)

Efficiency Redistribution

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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-$\theta$ worker
  - Let $u_e(\theta;\Lambda)$ denote the marginal utility of expenditure of type-$\theta$ worker

- Changes in $\Lambda$ can alter: $\eta(\theta;\Lambda)$, $u_e(\theta;\Lambda)$; $y(\theta;\Lambda)$, $e(\theta;\Lambda)$

# Homothetic Benchmark Neutrality Result

- Assume homothetic CRRA preferences

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

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- **Proposition** When $u(e;\Lambda)$ satisfies CRRA
  - $D_\Lambda(\theta,\Lambda) = E_\Lambda(\theta,\Lambda) = 0$
  - Expenditures and incomes grow at same constant rate

  $\Rightarrow$ Optimal marginal and average tax rates are independent of $\Lambda$ $\forall\theta$

Details

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+ DRRA supported by empirical evidence
  Ogaki and Zhang (2001), Blundell, Browning, and Meghir (1994), Attanasio and Browning (1995), ...

# 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

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

  – $\varepsilon_j$ governs income elasticity of demand for good $j$, $\sigma$ 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 $\sigma < 1$

# Non-Homothetic CES Relative Risk Aversion

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

DRRA Cond. 2 goods

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

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- Non-homothetic: $\varepsilon_i \neq \varepsilon_j \Rightarrow$ Elasticity of $\mathcal{C}$ w.r.t. $e$ decreasing in $e$

  $\Rightarrow$ The larger $\gamma$ the stronger DRRA

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Empirically:

- Consumption baskets govern $\mathcal{C}$
- How to discipline $\gamma$? Level of RRA at one point in time, or dynamics of labor supply

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  · Closed-form NH CES (Bohr, Mestieri, and Yavuz 2023): DRRA $\Leftrightarrow$ labor supply falls with growth

  · Quantitative model with 3 goods: DRRA

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- **Proposition:** Consider an economy at the Laissez-Faire at a given level $\Lambda$.
  A marginal increase in $\Lambda$ implies an optimal $t\&T$ schedule that becomes regressive.

# 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 $\theta$ and assets $a$:

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

s.t.

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

  - Productivity $\theta$ follows a stochastic process
  - Discount factor $\beta$
  - Fixed interest rate $r$ (partial equilibrium)

# Calibration Overview

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- 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 4.1 in 2010
  Piketty and Zucman (2014) [NIPA]
  - Untargeted wealth-to-income ratio in 1950 of 3.2 [data: 3.65]

# Calibration Government

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

    Ferriere, Grübener, Navarro, and Vardishvili (2023)

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

    - $\lambda$: level of the tax rates; $\tau$: progressivity; $T$: transfers

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- Changes over time
  - $T$ to match spending on means-tested transfers
    NIPA
    - $T/Y = 1.2\%$ in 1950 → 4.0% in 2010
  - $\tau$ 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 spending
    - Constant over time: $G/Y \approx 22.0\%$

# Calibration Inequality

- Wages follow AR(1) in logs, with appended Pareto tail
  - Persistence $\rho$ fixed at $0.9$
  - Time-varying Pareto tail parameter
    Aoki and Nirei (2017)
  - Shock innovation set to match variance of log income from SCF+
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| 1950 | Income Share by Quintile | | | | |
|---|---|---|---|---|---|
| Model | 6% | 10% | 14% | 21% | 50% |
| 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% |

SCF+ Expenditure Inequality

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| 1950 | Wealth Share by Quintile | | | | |
|---|---|---|---|---|---|
| Model | 0% | 2% | 7% | 17% | 74% |
| Data (SCF+) | 0% | 1% | 4% | 11% | 84% |

| 2010 | Wealth Share by Quintile | | | | |
|---|---|---|---|---|---|
| Model | 0% | 1% | 5% | 14% | 80% |
| 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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    - Untargeted 1950: agriculture 17% [data 22%], goods 49% [39%], services 34% [39%]

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- Remaining preference parameters
  - Fix Frisch elasticity $1/\varphi$ to standard value of $0.5$
  - Consumption curvature $\gamma$ to match RRA $= 1$ in 2010

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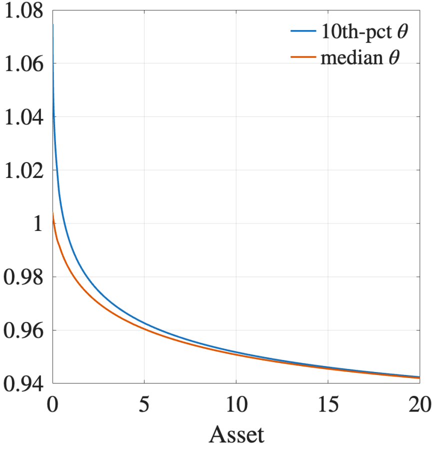

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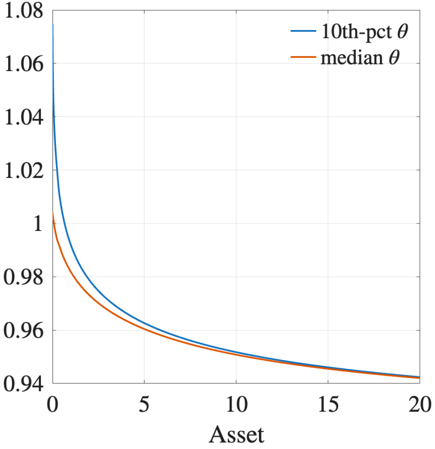
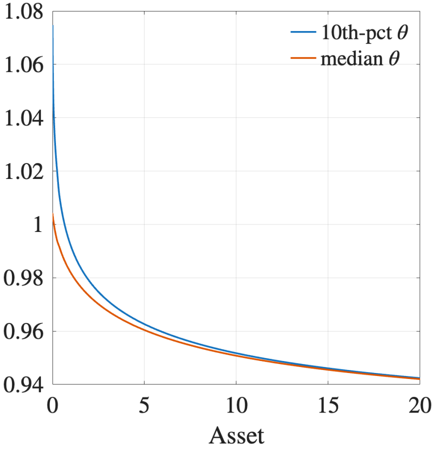
- Implied labor supply dynamics
  - Falling labor supply over time: 7%
    Ramey and Francis (2009), Boppart and Krusell (2020)
  - Cross-section correlation between hours and wages
    Costa (2000), Mantovani (2022)




Literature IES & RA | MPC & Wealth effects

# 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: 7%
    Ramey and Francis (2009), Boppart and Krusell (2020)
  - Cross-section correlation between hours and wages
    Costa (2000), Mantovani (2022)
- Relation between RRA, wealth effects, and MPC
  - Wealth effects: 0.02 in 2010
    Golosov, Graber, Mogstad, and Novgorodsky (2023)
  - Model MPC: 17% in 2010
    Johnson, Parker, and Souleles (2006), Kaplan and Violante (2022), ...




Literature IES & RA | MPC & 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

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- Pareto weights
  - Inverse optimum in 1950

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

$$\omega\left(p_i\right) = \exp(\mu p_i(e_i) + \nu p_i(e_i)^2)$$

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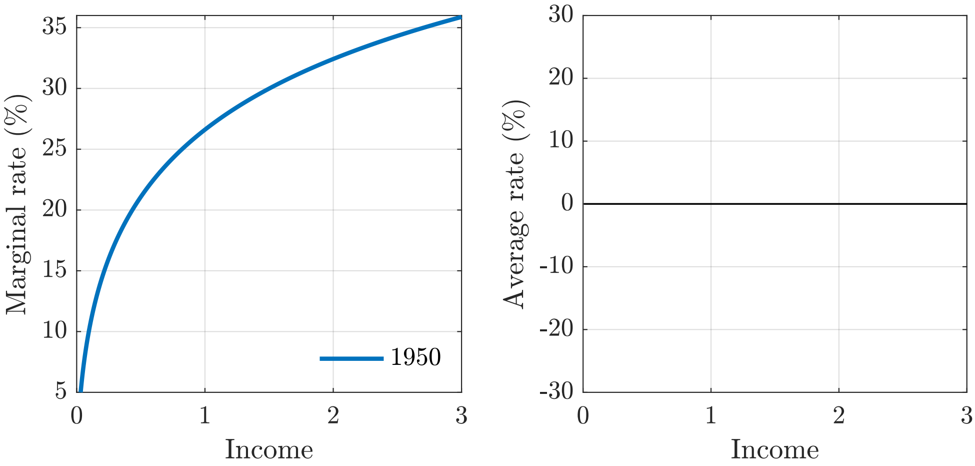
$$\omega(p_i) = \exp(\mu p_i(e_i) + \nu p_i(e_i)^2)$$

- 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
  - Look at two measures: $T/Y$ and $\mathcal{R}$

Weights

# Optimal Marginal & Average Rates




- Calibration in 1950: $T/Y = 1.2\%$

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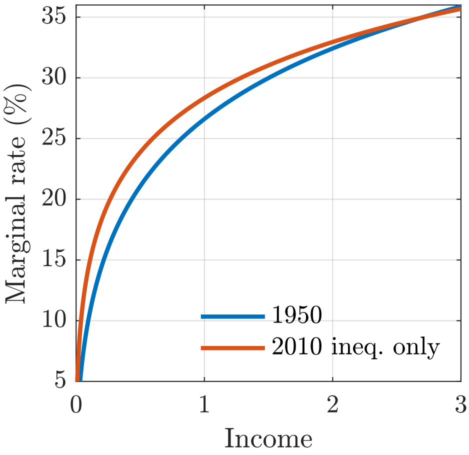


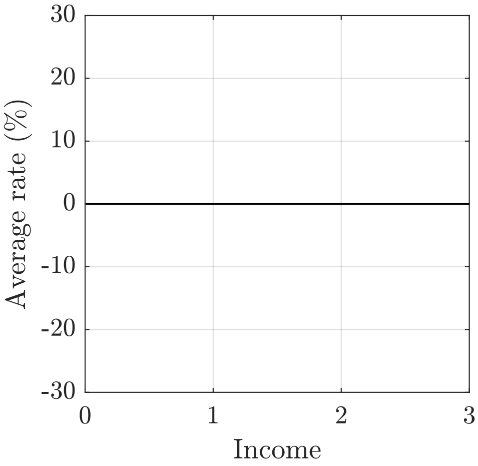


- 1950: $T/Y = 1.2\%$ $\Rightarrow$ 2010 higher inequality: $T/Y = 4.7\%$

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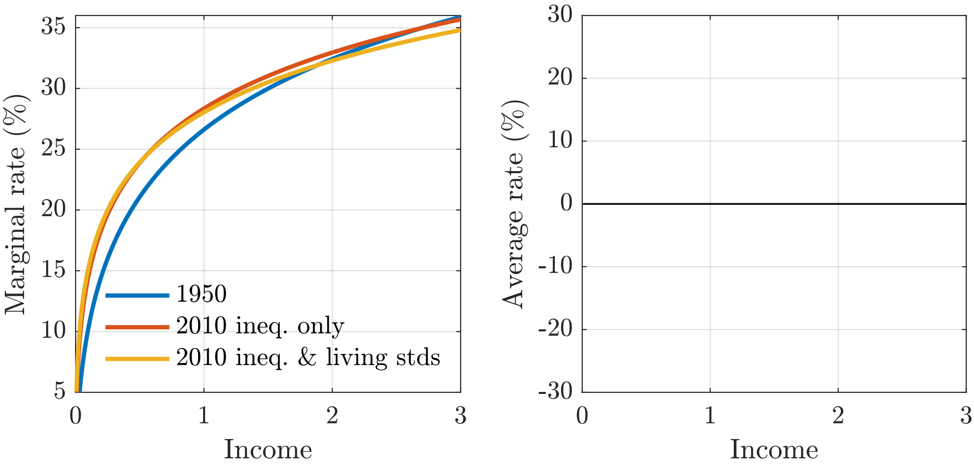


- 1950: $T/Y = 1.2\% \Rightarrow$ 2010 higher ineq & living standards: $T/Y = 3.7\%$

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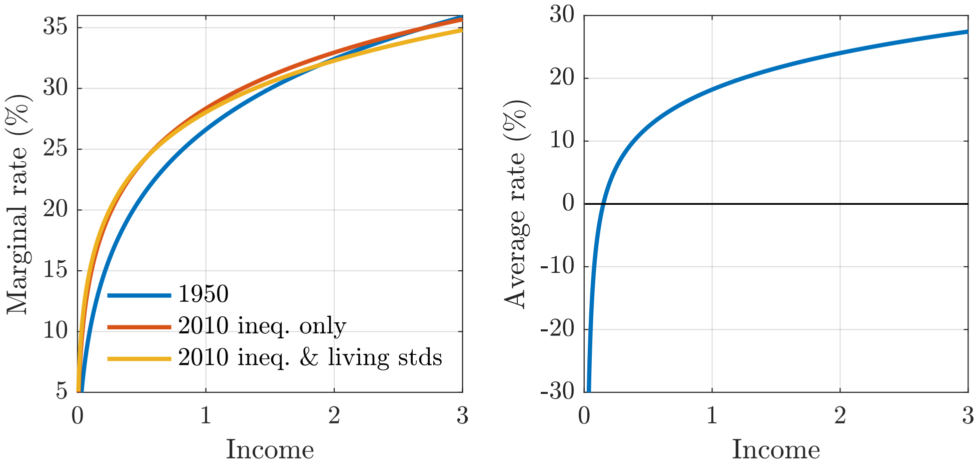


- $\mathcal{R}$ in 1950: 24p.p.

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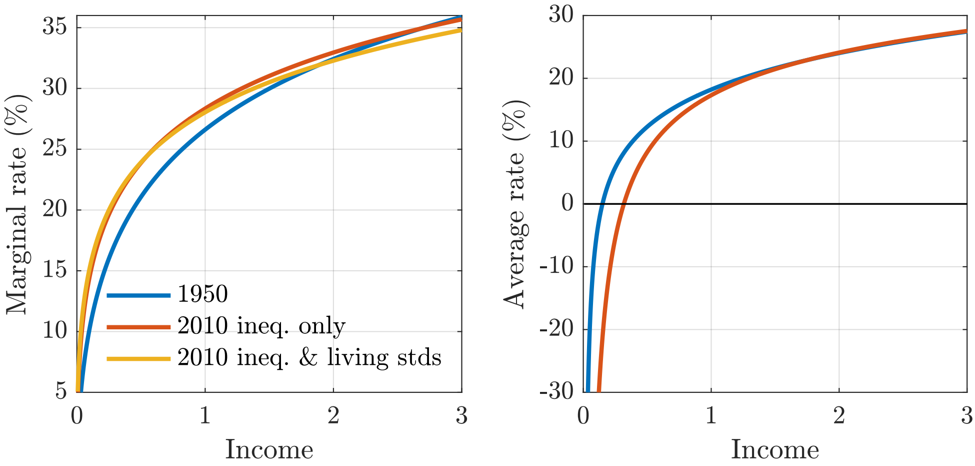


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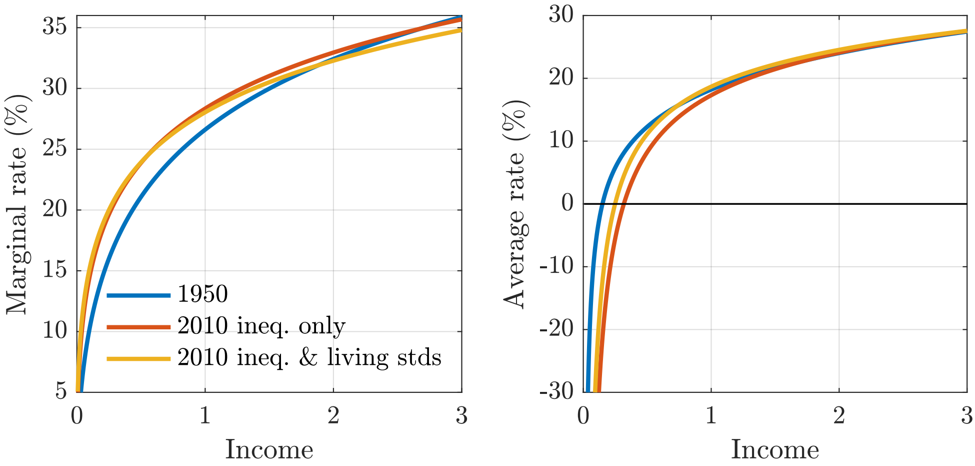


- $\mathcal{R}$ in 1950: 24p.p. $\Rightarrow$ 53p.p. with higher inequality $\Rightarrow$ 45p.p. with higher living standards
  - Rising Living Standards reduce increase in $\mathcal{R}$ by 30%

# Quantitative Mirrlees Setup

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  - Target consumption dispersion of the quantitative model in 1950 and 2010

- Replicate the main quantitative exercise
  - Obtain similar effects of rising living standards relative to rising inequality

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**Thank you!**

# Appendix

# Theory Appendix

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

- Efficiency costs of taxes and transfers depend on elasticities $\varphi^{-1}$ and income effects $\eta$

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

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Back

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

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

$$D(\theta^*; \mathcal{T}, \Lambda) = 1 - \frac{\int_{\theta^*}^{\bar{\theta}} u_e(\theta; \Lambda) w(\theta) \frac{dF(\theta)}{1-F(\theta^*)}}{\int_{\underline{\theta}}^{\bar{\theta}} u_e(\theta; \Lambda) w(\theta) dF(\theta)}$$

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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

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

Back

# Homothetic Benchmark Neutrality Result

- **Proposition:** The level $\Lambda$ is irrelevant to the optimal level of redistribution.

  Under the optimal tax-and-transfer system:

  - 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 $\alpha$.

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

- Extends to $G > 0$ as long as $G$ also grows at constant rate $\alpha$

Back

# 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)

- Low interest elasticity of savings in poor countries
  Rebelo (1992), Ogaki, Ostry, and Reinhart (1996), Chatterjee and Ravikumar (1999)

- 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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- Theory: Conditions on $V(.)$ such that NH implies more DRRA
- Quantitative: Dynamic model with dynamic policy functions
- Atkeson and Ogaki (1996): *"There exist at least two intuitive reasons why the IES might be smaller for the poor than it is for the rich [...]"* ... *"This intuition is based entirely on our own introspection."*

Back

# Non-Homothetic Preferences Stone-Geary Preferences

Geary (1950)

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

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

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

$\Rightarrow$ Implies decreasing relative risk aversion (DRRA)

- Counterfactual: vanishing non-homotheticities

## IA Preferences Alder, Boppart, and Müller (2022)

- Preferences defined over expenditures $e$

$$u(e;\Lambda) = \frac{1-\iota}{\iota}\left(\frac{1}{\mathbf{B}(\Lambda)}\left(e - \underbrace{\sum_j \frac{\hat{p}_j}{\Lambda}\bar{c}_j}_{\mathbf{A}(\Lambda)}\right)\right)^{\iota} - \mathbf{D}\left(\Lambda\right), \text{ with } \iota > 0$$

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

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- Relative risk aversion:

$$\text{RRA}(e;\Lambda) = (1-\iota) \times \frac{e}{e - \mathbf{A}(\Lambda)}$$

  - Proposition: Decreasing in $e \Leftrightarrow A > 0$
  - Falling labor supply $\Rightarrow A > 0$

Back

# IA Preferences Alder, Boppart, and Müller (2022)

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

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

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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

# Non-Homothetic CES DRRA with Two/Three Goods

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

# Data Appendix

# Government Spending

- Data averaged for 1955-1958 (avoid Korean War) and 2004-2007 (avoid Great Recession)
- Programs included in transfers
  - Food stamps (SNAP)
  - Supplemental Security Income (SSI)
  - Refundable tax credits
  - Unemployment insurance, workers' compensation, temporary disability insurance
  - Other assistance
  - Medicaid
- Government spending
  - All remaining federal, state, and local spending
  - Purposefully chosen such that $G/Y$ constant
    - + Spending has risen in the data, but largely deficit-financed

# 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

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# 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

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# 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)

# Quantitative Model Appendix

# Calibration Expenditure Inequality

- Variance of log expenditure in 2010: 0.42, top-quintile expenditure share of 44%
- Less expenditure inequality in 1950
- Variance of log expenditure in 1950: 0.33, top-quintile expenditure share of 38%

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# Implied RRA in the Model MPCs and Wealth Effects

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

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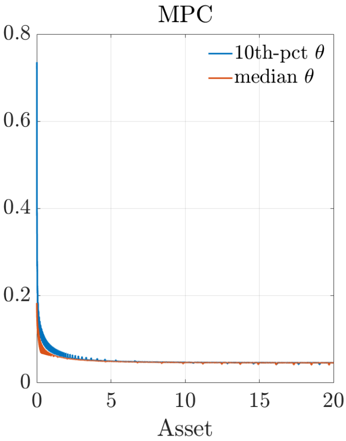


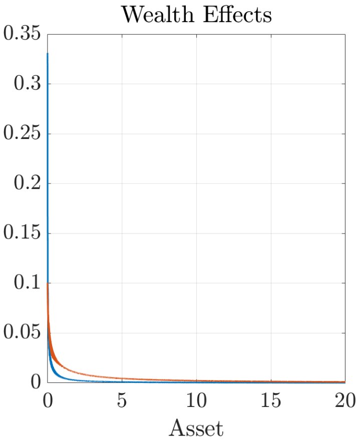


- Model MPC: 18% in 2010
  Johnson, Parker, and Souleles (2006), Fagereng, Holm, and Natvik (2021), Kaplan and Violante (2022)

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

Wealth Effects Back

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

- How does income respond to unexpected wealth shocks?
  - Golosov, Graber, Mogstad, and Novgorodsky (2023) merge US tax data with 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 $2.2\$$ per $100\$$ of win

# 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

$$\omega\left(p_i\right) = \exp(\mu p_i(e_i) + \nu p_i(e_i)^2), \text{ with } \mu = -16.46, \; \nu = 16.63.$$

- See also Le Grand, Ragot, and Rodrigues (2025)

# Calibration: Inequality

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

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

- In 2010, data on income and expenditure inequality
  - Dispersion: $\mathbb{V}[\log y] = 0.78$; $\mathbb{V}[\log e] \approx 0.36$

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

- In 1950, data on income inequality only
  - Dispersion: $\mathbb{V}[\log y] = 0.57$; $\Rightarrow$ infer $\mathbb{V}[\log e] \approx 0.26$

    SCF+ (Kuhn, Schularick, and Steins 2020)
  - Pareto tail: $\lambda_y = 2.2 \Rightarrow$ infer $\lambda_e = 4.4$

    Aoki and Nirei (2017)

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# Calibration: Expenditure Inequality

| **1950** | Expenditure Share by Quintile | | | | |
|---|---|---|---|---|---|
| Dynamic model | 8% | 14% | 18% | 22% | 38% |
| Static model | 9% | 13% | 17% | 23% | 38% |

| **2010** | Expenditure Share by Quintile | | | | |
|---|---|---|---|---|---|
| Dynamic model | 7% | 12% | 16% | 21% | 44% |
| Static model | 8% | 12% | 16% | 22% | 42% |

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# Inverse Optimum Weights

- In Mirrlees environment, 1950 inverse optimum weights can be computed uniquely by $\theta$
- Kept constant as a function of percentiles of the distribution for 2010 / inequality only
- Bottom and top weight (close to zero mass) kept constant across all cases

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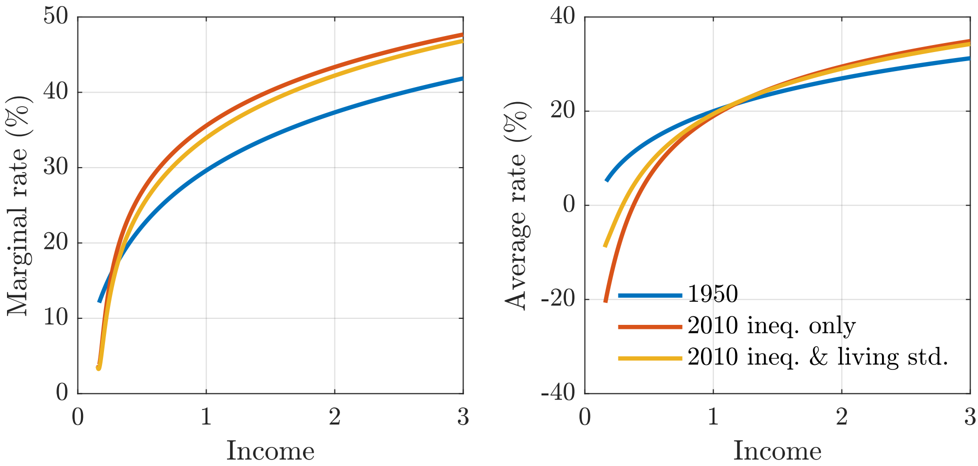
# Optimal Marginal Rates Mirrlees




- Calibration in 1950: $T/Y = 1.2\% \;\Rightarrow T/Y = 3.9\%$ with higher inequality

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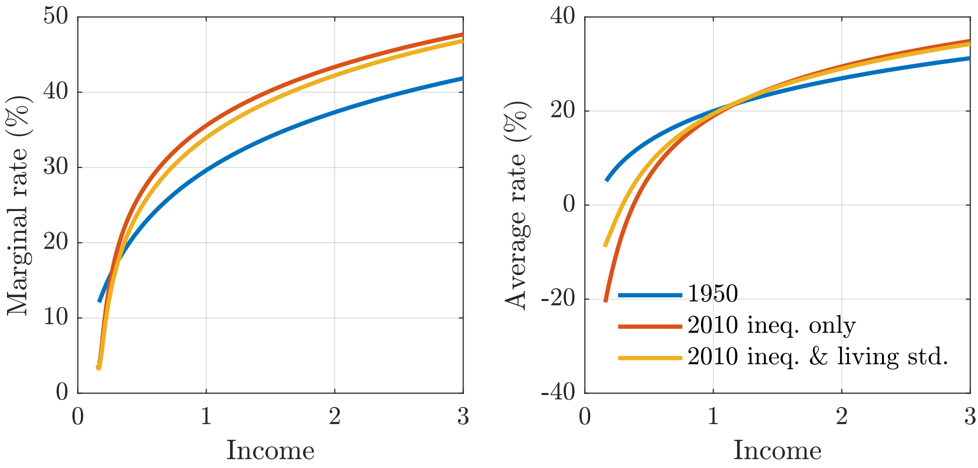
# Optimal Marginal Rates Mirrlees




- Calibration in 1950: $T/Y = 1.2\%$ $\Rightarrow T/Y = 1.9\%$ with higher inequality and growth
  - Rising Living Standards reduce increase in $\mathcal{R}$ by 32%

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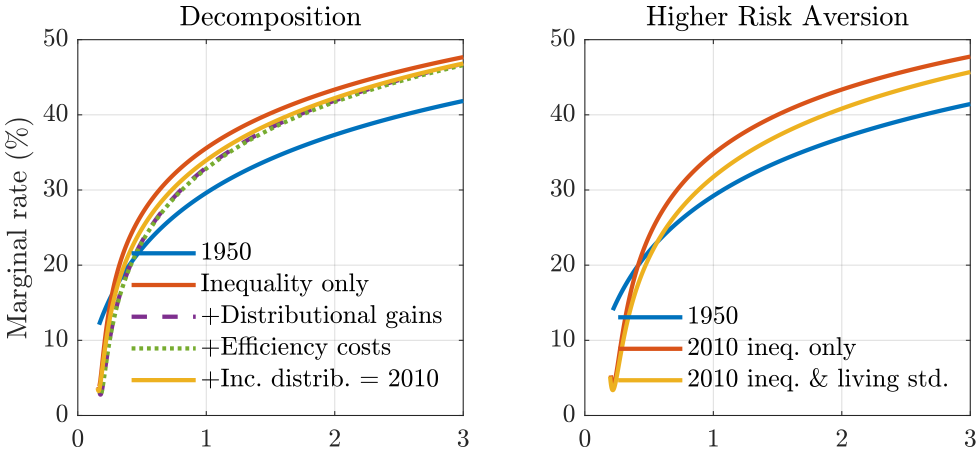
# Optimal Marginal Rates Mirrlees Robustness

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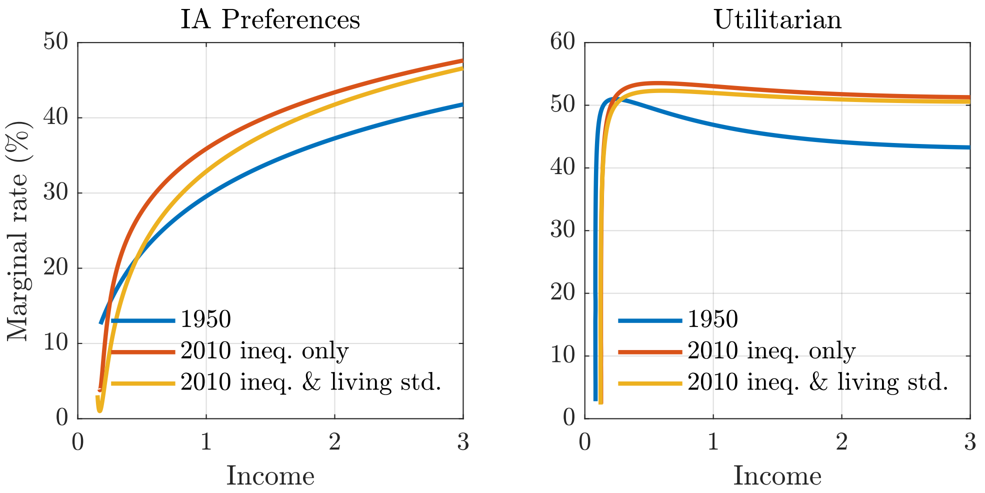
# Optimal Marginal Rates Mirrlees Robustness

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