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
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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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- **Formalize** the effects of rising living standards in a static Mirrlees setup
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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

What We Find

- Non-homotheticities $\Rightarrow$ decreasing relative risk aversion (DRRA)
  - Intratemporal allocations informative on intertemporal properties of utility function

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- Non-homotheticities $\Rightarrow$ decreasing relative risk aversion (DRRA)
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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 θ
  - Pre-tax labor income $y = \theta n$, where n is labor; distribution $f(\theta)$

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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!)
  - Λ: **level** of the economy $\Rightarrow$ **Living standards**

Optimal Taxation Problem

- Household's static maximization problem:

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

  – $\mathcal{T}(\cdot;\Lambda)$: fully nonlinear tax-and-transfer schedule
  – Let $n(\theta; \mathcal{T}(\cdot), \Lambda)$ denote the labor policy

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  - $\mathcal{T}(\cdot;\Lambda)$: fully nonlinear tax-and-transfer schedule
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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

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  - 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: $\eta(\theta;\Lambda)$, $u_e(\theta;\Lambda)$; $y(\theta;\Lambda)$, $e(\theta;\Lambda)$

Efficiency Redistribution

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

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

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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 Λ $\forall \theta$

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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

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

- Focus on gross complements $\sigma < 1$

Non-Homothetic CES Relative Risk Aversion

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

DRRA Cond. 2 goods

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

DRRA Cond. 2 goods

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$\Rightarrow$ The larger γ the stronger DRRA

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– Consumption baskets govern $\mathcal{C}$

– How to discipline γ? Level of RRA at one point in time, or dynamics of labor supply

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- How to discipline γ? Level of RRA at one point in time, or dynamics of labor supply
  - Closed-form NH CES (Bohr, Mestieri, and Yavuz 2023): DRRA $\Leftrightarrow$ labor supply falls with growth
  - Quantitative model with 3 goods: DRRA

DRRA Cond. 2 goods

Non-Homothetic Preferences Relative Risk Aversion

- Similar logic with IA preferences

- **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

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

   $\rightarrow$ Redistribution should decrease with rising living standards

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   (a) Efficiency cost of taxes increases $\rightarrow$ Redistribution should decrease
   (b) Efficiency cost of lump-sum transfer decreases $\rightarrow$ Redistribution should increase

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- **Proposition:** Consider an economy at the Laissez-Faire at a given level Λ.
  A marginal increase in Λ 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 θ and assets a:

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

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
  - Growth; Government; Inequality; Preferences

Calibration Growth

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- Growth: Fall in prices
  - Aggregate growth in GDP per capita: 3.3
    NIPA
  - Prices relative to goods
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    - 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)

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

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

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

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

Calibration Inequality

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

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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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    + Agriculture (food) 8%, goods 26%, services 67%
    + 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 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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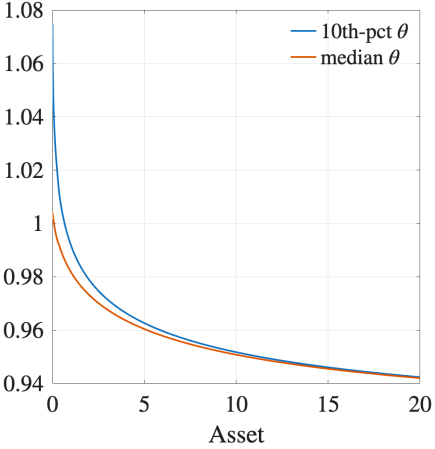
  - RRA falls from 1.07 in 1950 to 1, small dispersion



Implied RRA in the Model Decreasing RRA

- Calibrated non-homothetic preferences imply DRRA
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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
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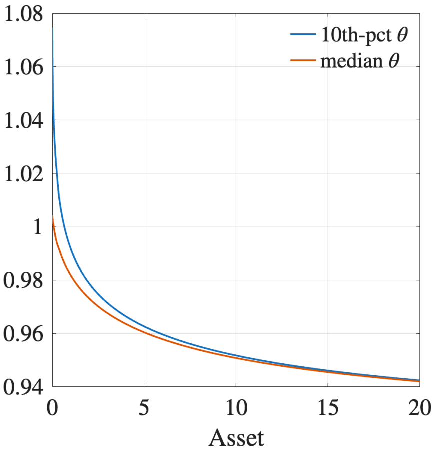

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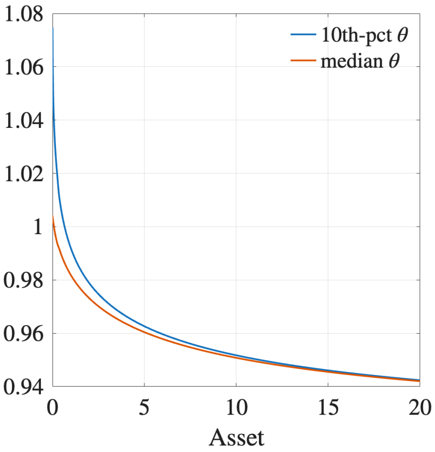
    Costa (2000), Mantovani (2022)
- Relation between RRA, wealth effects, and MPC
  - Wealth effects: 0.02 in 2010
    Golosov, Graber, Mogstad, and Novgorodsky (2023)
  - Model MPC: 17% in 2010
    Johnson, Parker, and Souleles (2006), Kaplan and Violante (2022), . . .



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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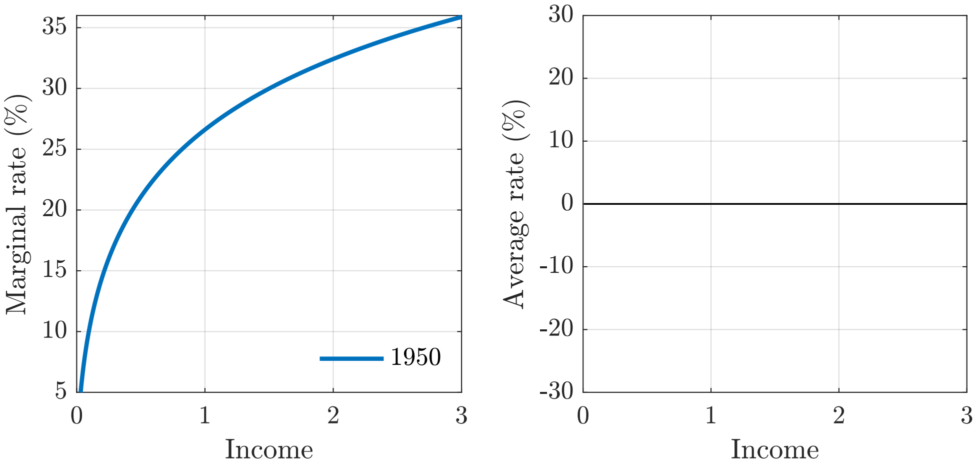
  - Weights as a function of the expenditure percentile

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

- 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 $\mathcal{R}$

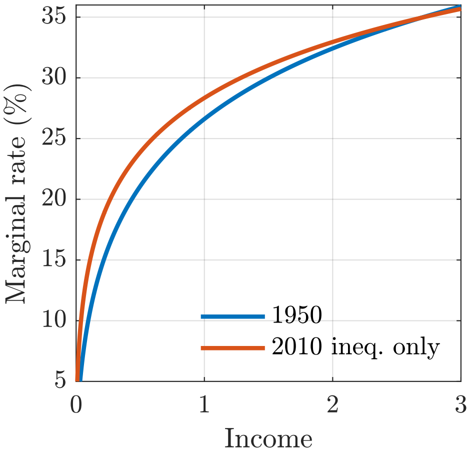
Weights

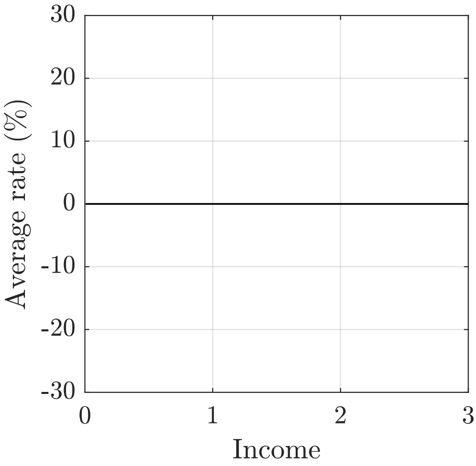
Optimal Marginal & Average Rates



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

Optimal Marginal & Average Rates





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

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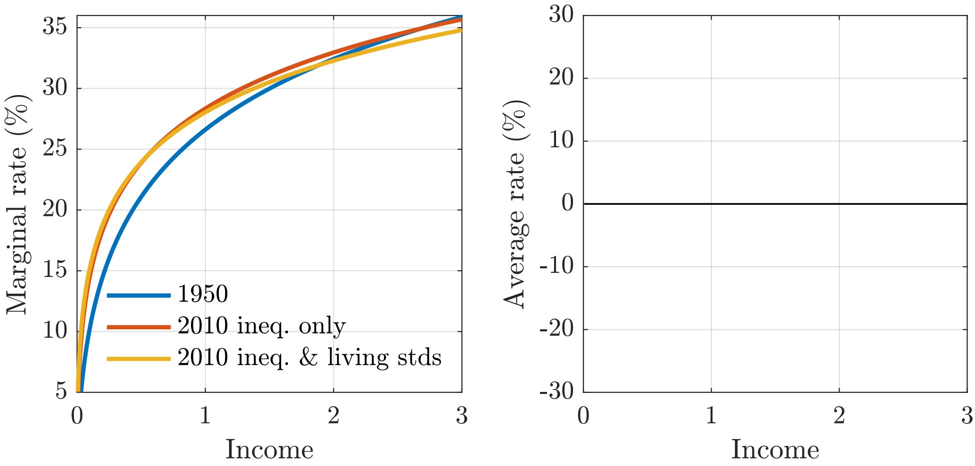

- 1950: $T/Y = 1.2\%$ $\Rightarrow$ 2010 higher ineq & living standards: $T/Y = 3.7\%$

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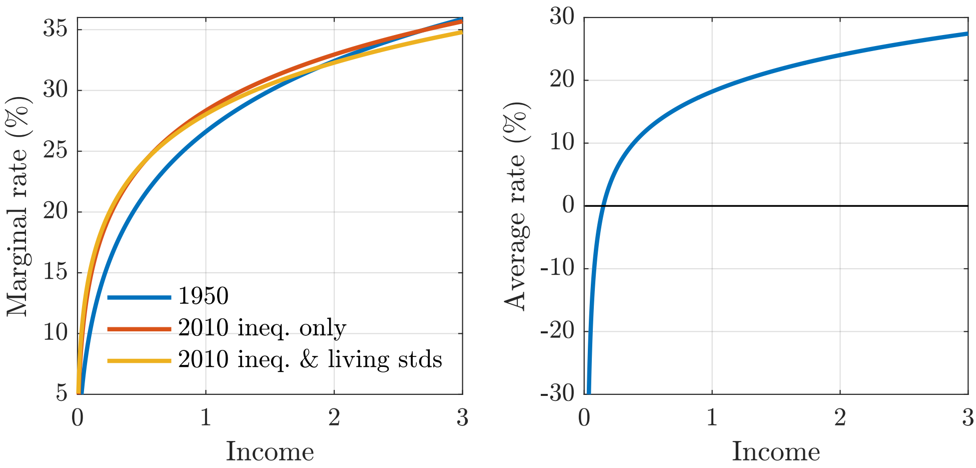
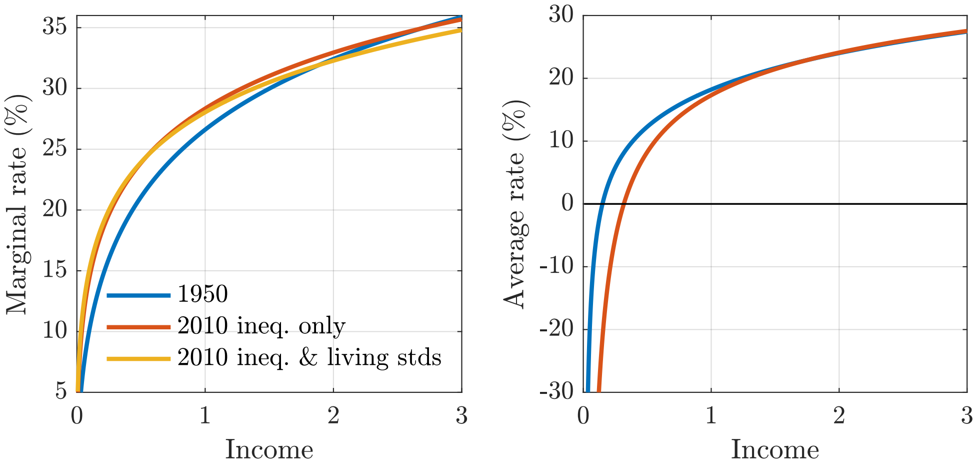


- $\mathcal{R}$ in 1950: 24p.p.

Optimal Marginal & Average Rates



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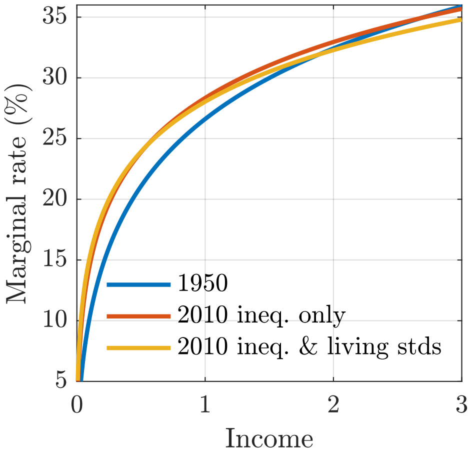

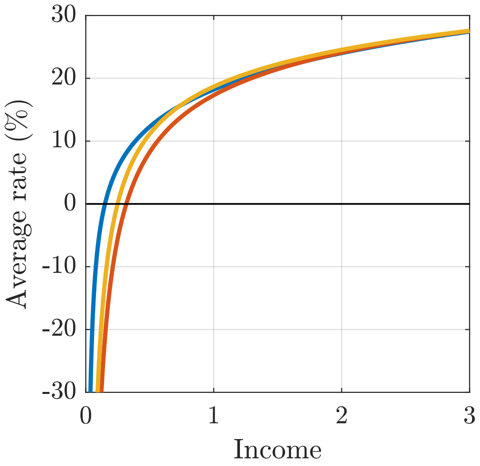

- $\mathcal{R}$ in 1950: 24p.p. $\Rightarrow$ 53p.p. with higher inequality $\Rightarrow$ 45p.p. with higher living standards
  - Rising Living Standards reduce increase in $\mathcal{R}$ by 30%

Quantitative Mirrlees Setup

- Calibration following a partial-insurance approach
  - Target expenditure dispersion in 2010... and in 1950

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  - Marginal utilities vs. Income effects vs. new hours and expenditures

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    -9p.p. vs. -9p.p. vs. -7p.p.
- Robustness: higher risk aversion, Utilitarian, IA preferences

Conclusion

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  - Affect efficiency and distribution concerns
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Thank you!

French data: PATER

H11 Personnellement, pour chacune des dépenses suivantes, diriez-vous qu'en raison de la crise vous avez ou vous allez changer vos pratiques d'achat… *1 réponse par ligne*

	En achetant plus	En achetant en moins grande quantité ou moins cher	En repoussant des dépenses ou en renonçant	Non, je n'ai pas changé et ne vais pas changer	Pas concerné
• L'alimentation	☐	☐	☐	☐	☐
• Les dépenses de santé non remboursées...........	☐	☐	☐	☐	☐
• Les travaux dans votre logement	☐	☐	☐	☐	☐
• L'énergie (chauffage et électricité...)....................	☐	☐	☐	☐	☐
• Les équipements de la maison (meubles, électroménagers, décoration...), matériel de bricolage, de jardinage,....	☐	☐	☐	☐	☐
• Les produits technologiques (TV, ordinateur, téléphone portable...).....................	☐	☐	☐	☐	☐
• Les transports en commun	☐	☐	☐	☐	☐
• L'entretien, la réparation de votre voiture	☐	☐	☐	☐	☐
• Les sorties (restaurant, cinéma...)	☐	☐	☐	☐	☐
• Les livres, DVD, disques.........................	☐	☐	☐	☐	☐
• Les vêtements et chaussures....................	☐	☐	☐	☐	☐
• Les produits et soins de beauté	☐	☐	☐	☐	☐

- Food vs. luxuries
- Buy cheaper, postpone, do not adjust, (buy more)

Appendix

Theory Appendix

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 Λ 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 α.

- 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 α

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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Back

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Cardinalization

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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."*

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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 decreasing relative risk aversion (DRRA)

- Counterfactual: vanishing non-homotheticities

Back

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

Back

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  - Generalized Stone-Geary $\mathbf{A}\left(\Lambda\right)$, $\mathbf{D}\left(\Lambda\right)$ price function independent of e (PIGL)

Back

IA Preferences Alder, Boppart, and Müller (2022)

- Preferences defined over expenditures e

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

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

  – Generalized Stone-Geary $\mathbf{A}(\Lambda)$, $\mathbf{D}(\Lambda)$ price function independent of e (PIGL)

- 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:

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

Back

IA Preferences Alder, Boppart, and Müller (2022)

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

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

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

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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

Back

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)

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Quantitative Model Appendix

Calibration Expenditure Inequality

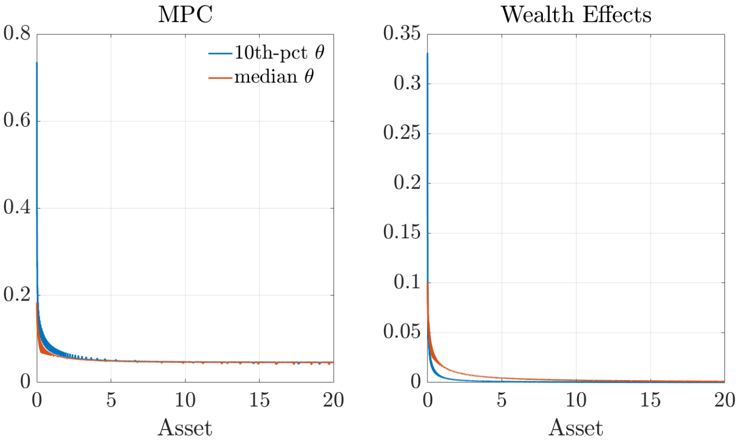
- Variance of log expenditure in 2010: 0.42, top-quintile expenditure share of 44%
- Less expenditure inequality in 1950
- Variance of log expenditure in 1950: 0.33, top-quintile expenditure share of 38%

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

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



- 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

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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

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

- 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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Calibration: Inequality

- 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)

Back

Calibration: Inequality

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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 $\mathbb{V}[\log e] \approx 0.26$
    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 θ
- 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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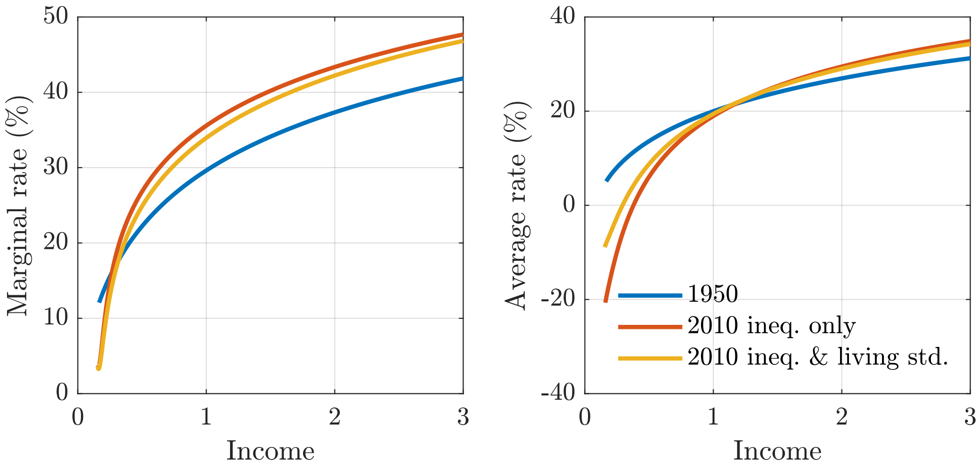
Optimal Marginal Rates Mirrlees



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

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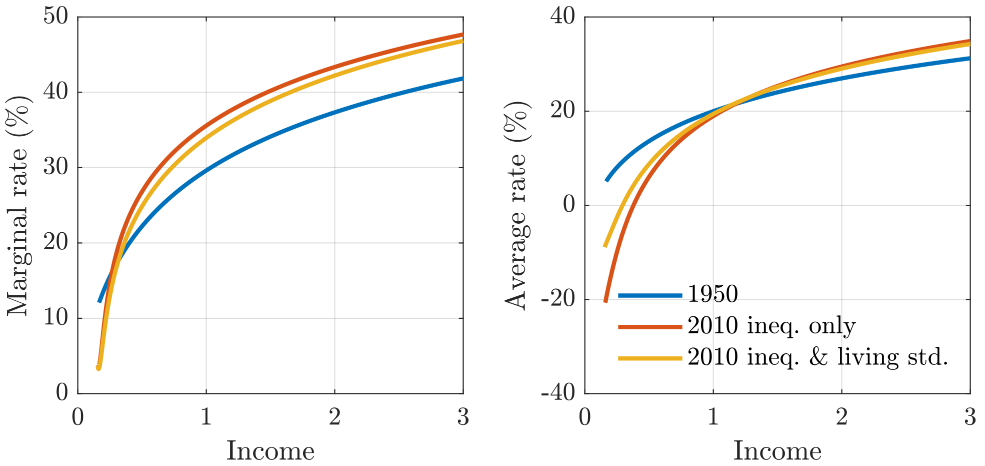
Optimal Marginal Rates Mirrlees



- 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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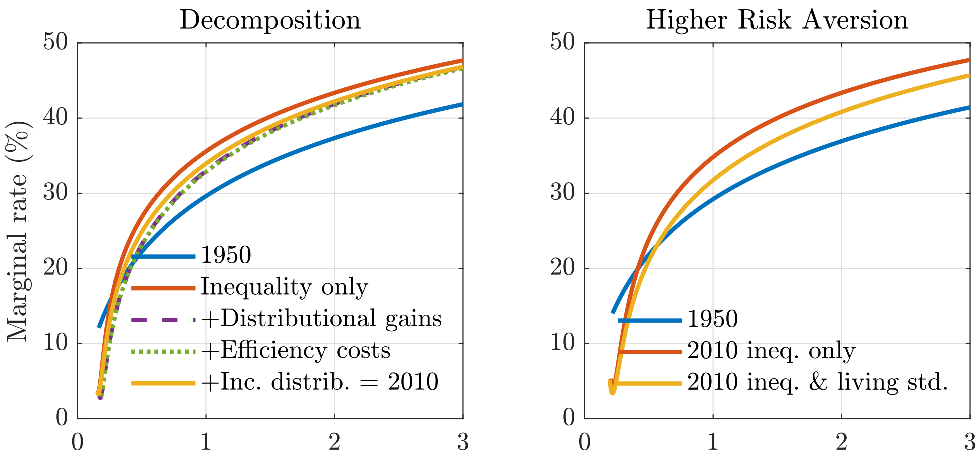
Optimal Marginal Rates Mirrlees Robustness



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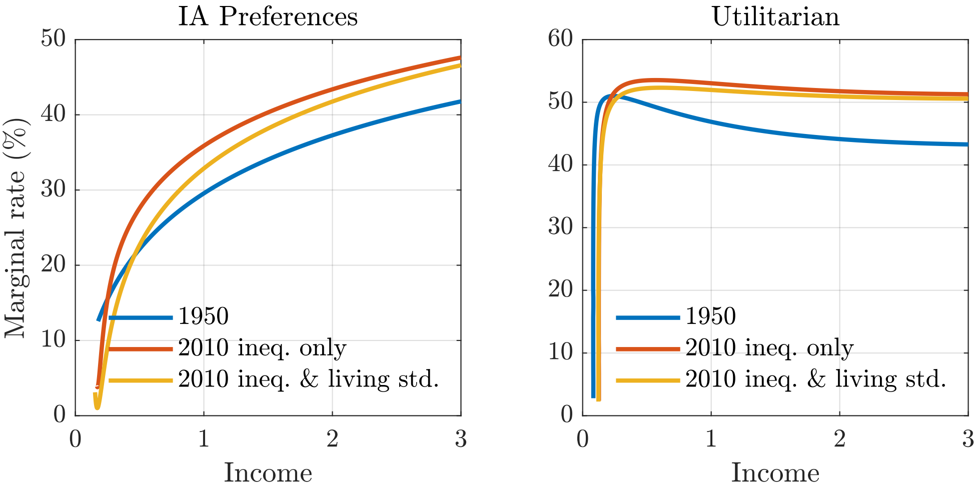
Optimal Marginal Rates Mirrlees Robustness



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