

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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Workhorse models of optimal income taxation

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 - Large increase in **standard of living**
 - Income per capita tripled, spending share on necessities dropped
- ⇒ 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)
 - Changes in levels ("growth") ⇒ Rising living standards

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- **Formalize** the effects of **rising living standards** in a static **Mirrlees** setup
 - Distribution vs. efficiency concerns
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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** $t\&T$ system 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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 - Intratemporal allocations informative on intertemporal properties of utility function
- 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 Valentini (2013), Boppart (2014), Herrendorf, Rogerson, and Valentini (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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 - $c = (c_1, \dots, c_J)$ denotes a basket of consumption goods
- Let u denote the indirect utility function

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

- 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:

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

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- Government's maximization problem:

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

- 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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- Let $\eta(\theta; \Lambda) \equiv dy(\theta; \Lambda)/d\mathcal{T}(0; \Lambda)$ denote the income effect of type- θ worker
- Let $u_e(\theta; \Lambda)$ denote the marginal utility of expenditure of type- θ worker

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

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

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- **Nonlinear Engel curves** \Rightarrow **non-constant** relative risk aversion
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 - “Because they are close to subsistence, risk is [...] particularly painful to the poor.”
Duflo (2006)
 - “The consumption in excess of subsistence of necessary goods (such as food) may be less substitutable across time than is the consumption of luxury goods.”
Atkeson and Ogaki (1996)

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

$$\sum_j^J (\Omega_j (\mathcal{C}(c))^{\varepsilon_j})^{\frac{1}{\sigma}} c_j^{\frac{\sigma-1}{\sigma}} = 1$$

– 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

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

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

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 \Rightarrow The larger γ the stronger DRRA

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Empirically:

- 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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Empirically:

- Consumption baskets govern \mathcal{C}
- 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

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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\rightarrow Redistribution should decrease with rising living standards

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2. **DRRA** \Rightarrow **Income effect** η decreases with Λ
 - (a) Efficiency cost of taxes increases → Redistribution should decrease
 - (b) Efficiency cost of lump-sum transfer decreases → Redistribution should increase

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→ Redistribution should increase
- **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 :

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

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

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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) → 1.00, 1.87
 - + Services → 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)

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

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

Calibration Government

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Ferriere, Grübener, Navarro, and Vardishvili (2023)

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

+ 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+
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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%

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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%

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

Computed based on Herendorf, Rogerson, and Valentini (2013) [NIPA]

$$+ \text{Agriculture (food)} 8\%, \text{goods} 26\%, \text{services} 67\%$$

$$+ \text{Untargeted 1950: agriculture } 17\% \text{ [data } 22\%], \text{goods } 49\% \text{ [39\%]}, \text{services } 34\% \text{ [39\%]}$$

Calibration Preferences

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Computed based on Herrendorf, Rogerson, and Valentinyi (2013) [NIPA]
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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

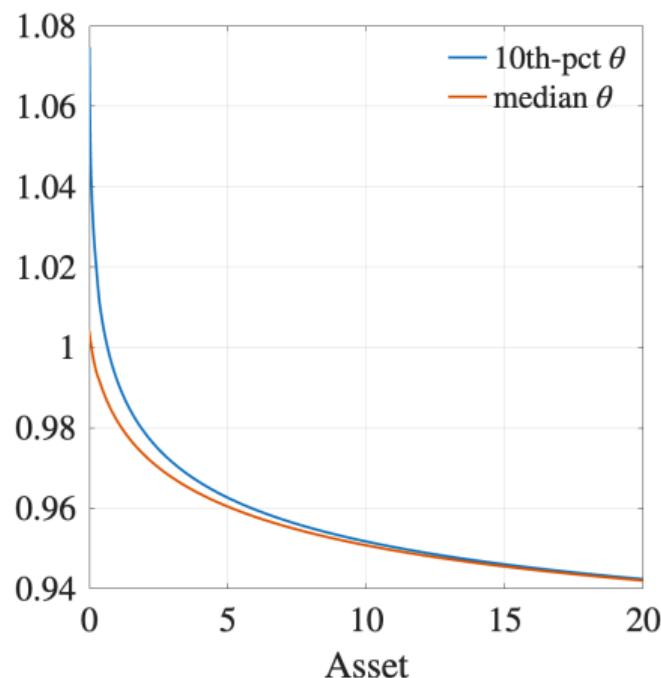
Decreasing RRA

- Calibrated non-homothetic preferences imply DRRA

Implied RRA in the Model

Decreasing RRA

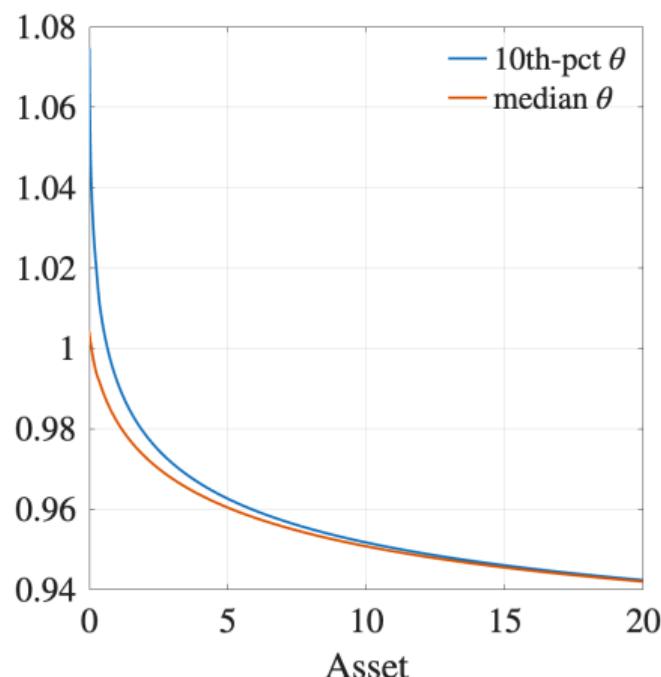
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 - RRA falls from 1.07 in 1950 to 1, small dispersion



Implied RRA in the Model

Decreasing RRA

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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)



Implied RRA in the Model

Decreasing RRA

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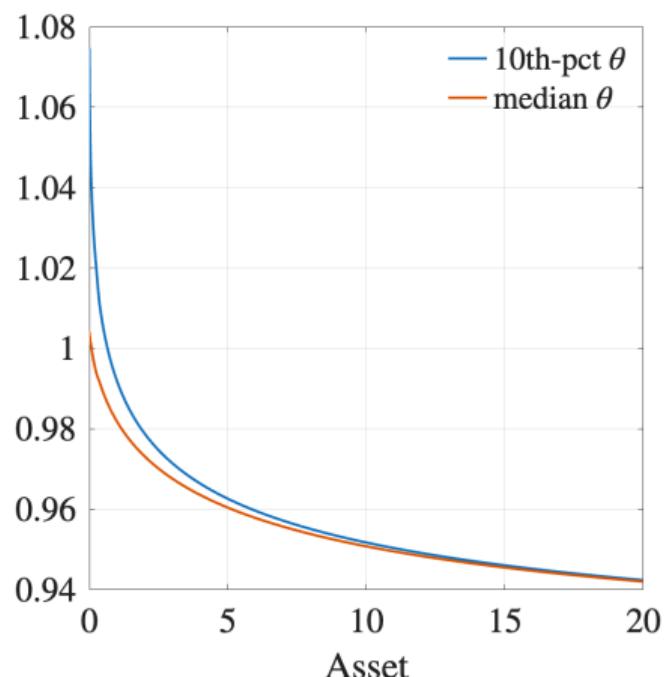
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 - Cross-section correlation between hours and wages
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- Relation between RRA, wealth effects, and MPC

- 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

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**

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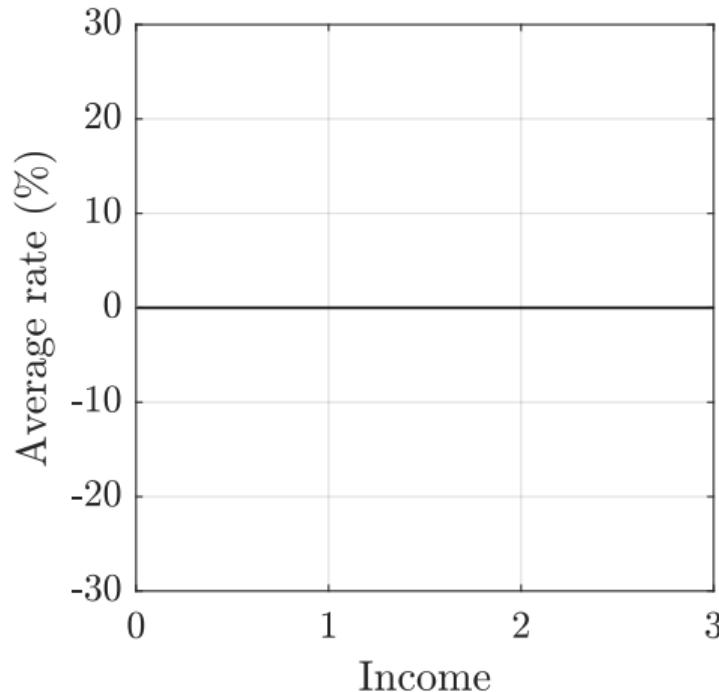
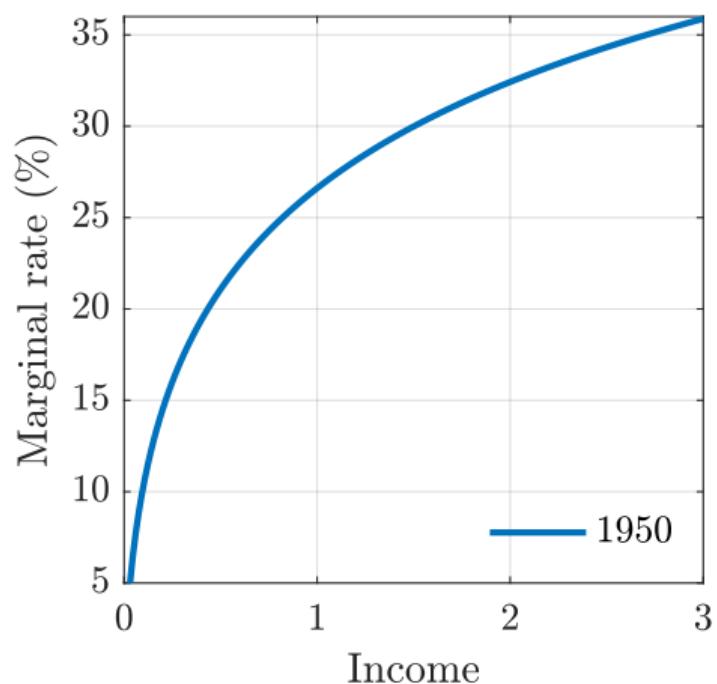
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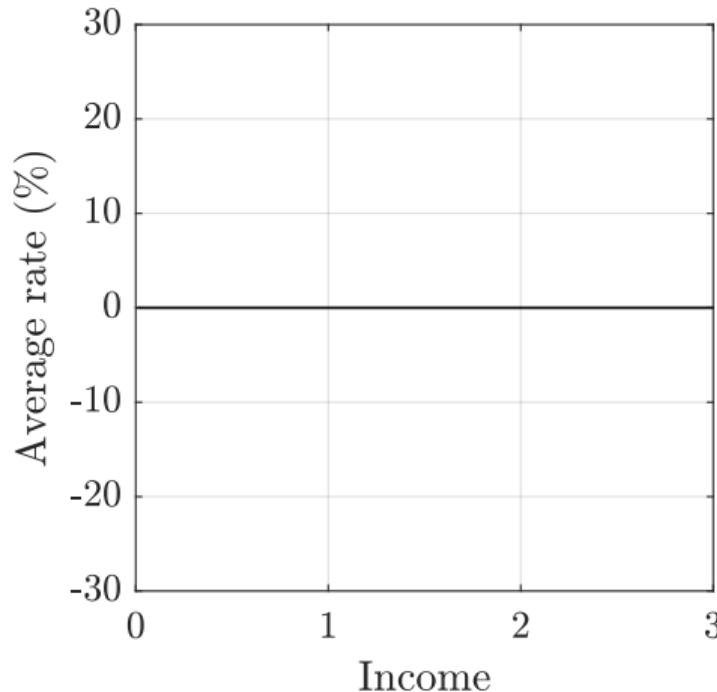
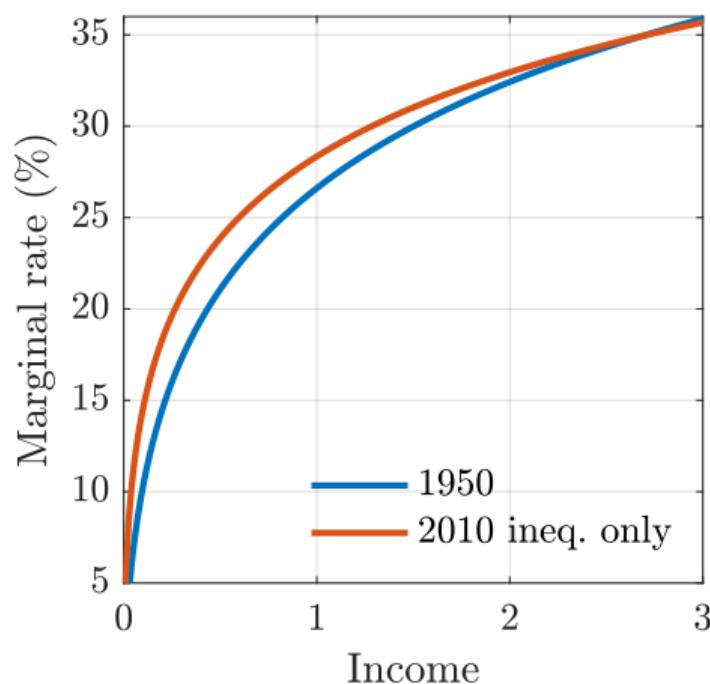
- Experiment in two steps
 - First add **inequality only**
 - Second compare optimal 2010 with **inequality and growth**
 - + Growth: fall in prices and changes in relative prices
 - Look at two measures: T/Y and \mathcal{R}

Optimal Marginal & Average Rates



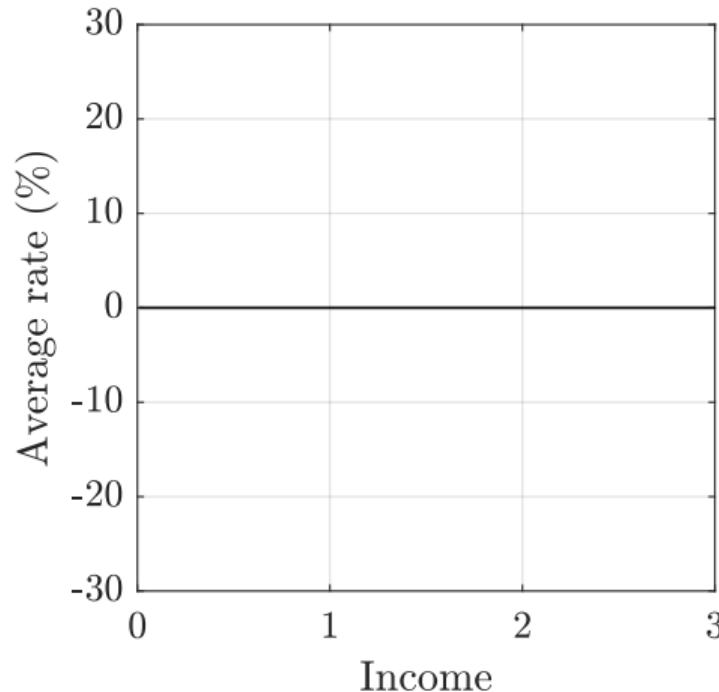
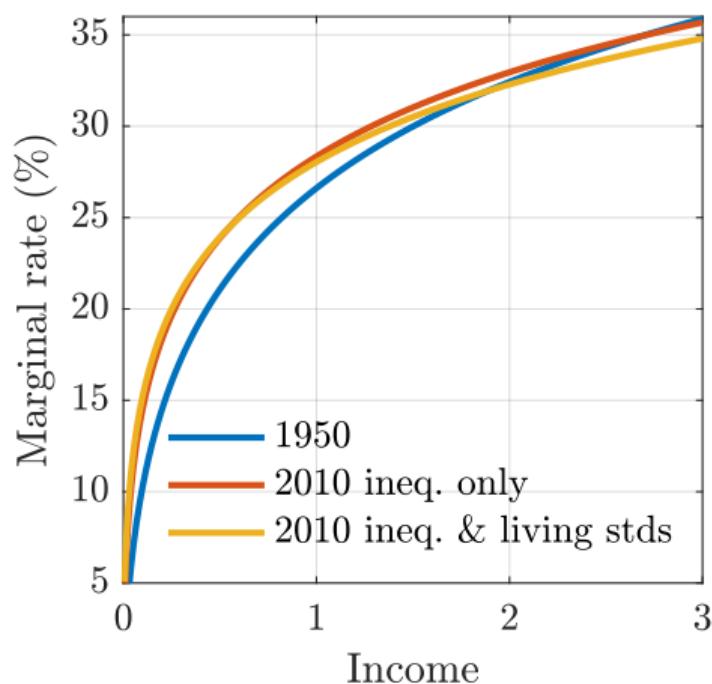
- Calibration in 1950: $T/Y = 1.2\%$

Optimal Marginal & Average Rates



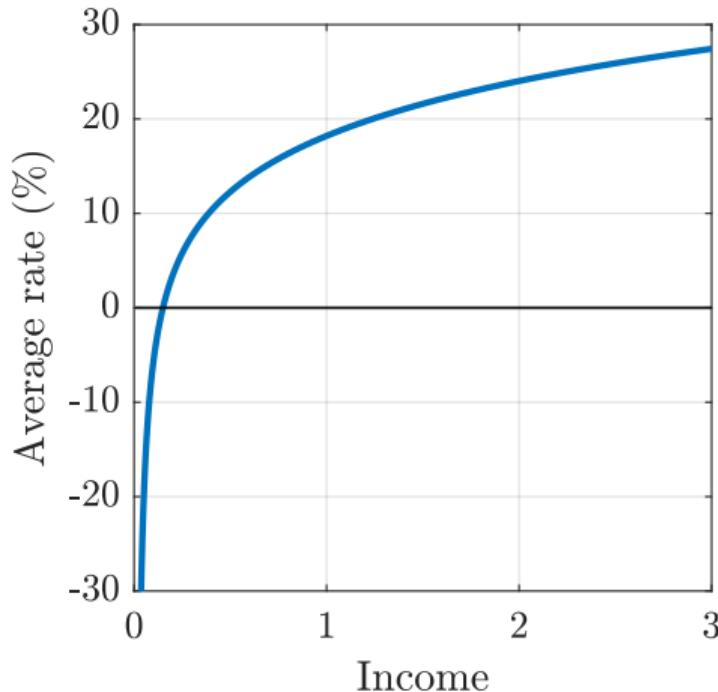
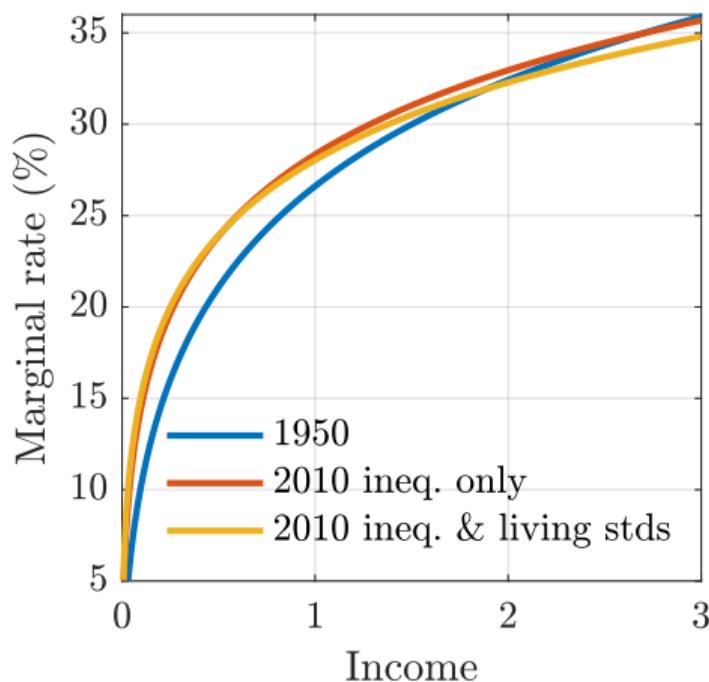
- 1950: $T/Y = 1.2\% \Rightarrow$ 2010 higher inequality: $T/Y = 4.7\%$

Optimal Marginal & Average Rates



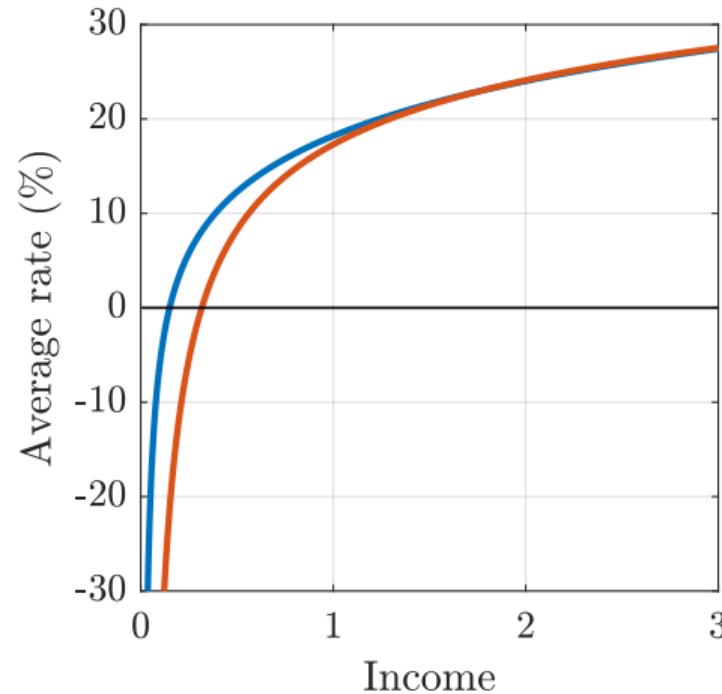
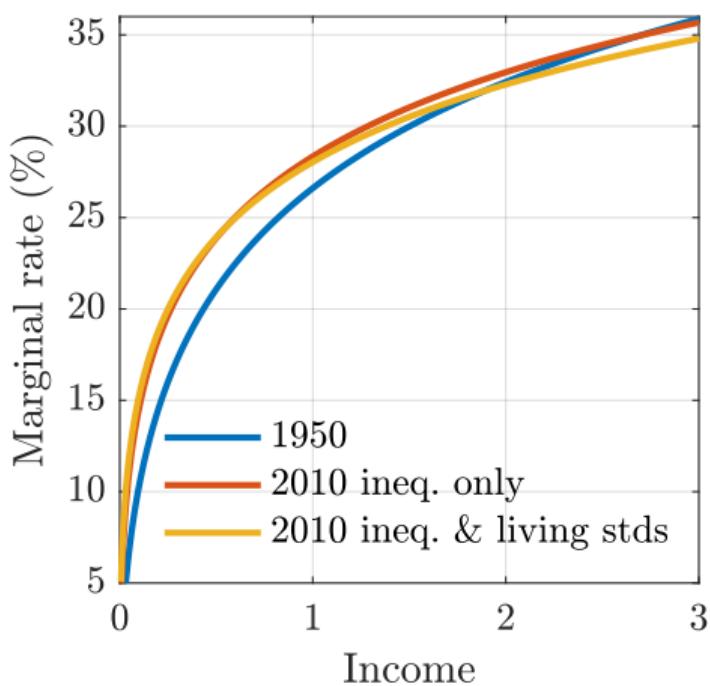
- 1950: $T/Y = 1.2\% \Rightarrow$ 2010 higher ineq & living standards: $T/Y = 3.7\%$

Optimal Marginal & Average Rates



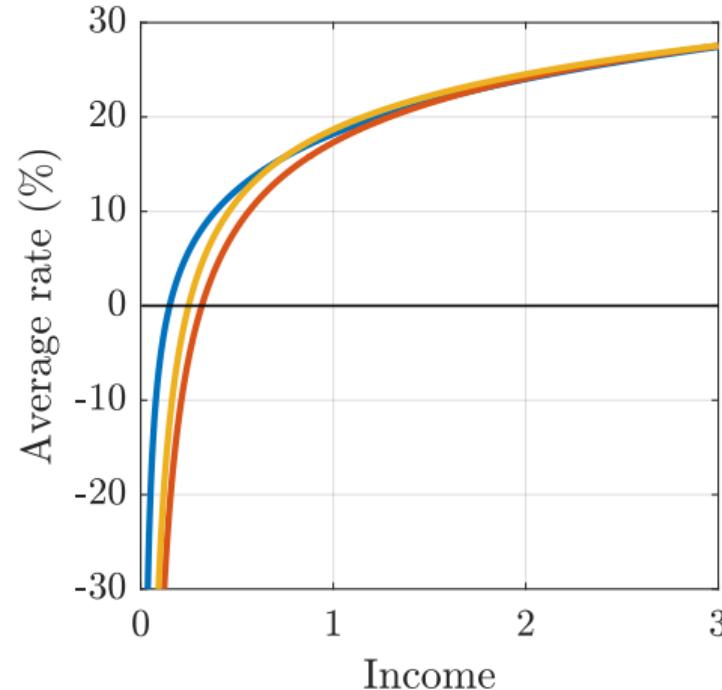
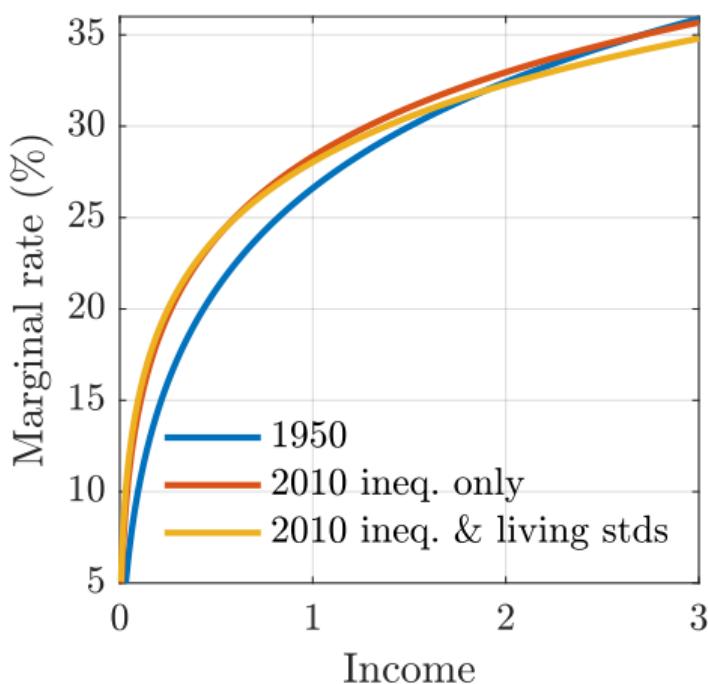
- \mathcal{R} in 1950: 24p.p.

Optimal Marginal & Average Rates



- \mathcal{R} in 1950: 24p.p. \Rightarrow 53p.p. with higher inequality

Optimal Marginal & Average Rates



- \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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-9p.p. vs. **-9p.p.** vs. **-7p.p.**

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

Evidence

From Intra to Intertemporal Behaviors

Work in Progress

- Direct evidence on food shares and marginal utility
 - Relative risk aversion/IES
 - Savings behaviors: MPC, consumption volatility

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- Datasets: French (PATER), Italian (SHIW), US (PSID), German (SOEP), ...

French data: PATER

- Broad questionnaire
 - Questions on hh preferences
Arrondel & Masson (2003, . . . , 2019)

French data: PATER

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Arrondel & Masson (2003, ..., 2019)

■ Adjustment in expenditures after the GFC (2009, 2011)

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

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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les dépenses de santé non remboursées	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les travaux dans votre logement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• L'énergie (chauffage et électricité...)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les équipements de la maison (meubles, électroménagers, décoration...), matériel de bricolage, de jardinage,....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les produits technologiques (TV, ordinateur, téléphone portable...)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les transports en commun	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• L'entretien, la réparation de votre voiture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les sorties (restaurant, cinéma...)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les livres, DVD, disques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les vêtements et chaussures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Les produits et soins de beauté	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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■ Luxuries are easier to postpone

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Italian data: SHIW

- Measures of income and wealth: **cash-on-hand**
- Incomplete measures of **expenditure**
 - Food at home, food away from home
 - Dummy: 1 if in the top-50 of the ratio
- Some measure of **risk aversion**
 - Hypothetical financial investment: Are you willing to take risks to earn higher returns?
 - Dummy: 1 if answer No
- Measures of **MPC** (small, large shocks)
Andreolli and Surico (forthcoming)
- Waves: 2016, 2020, 2022

Italian data: SHIW

	(1)	(2)
	Risk aversion	MPC
Food share dummy	0.132*** (0.007)	
Cash on hand deciles: 2	-0.001 (0.013)	
Cash on hand deciles: 3	-0.021 (0.013)	
Cash on hand deciles: 4	-0.053*** (0.013)	
Cash on hand deciles: 5	-0.044*** (0.014)	
Cash on hand deciles: 6	-0.087*** (0.014)	
Cash on hand deciles: 7	-0.108*** (0.015)	
Cash on hand deciles: 8	-0.130*** (0.015)	
Cash on hand deciles: 9	-0.161*** (0.016)	
Cash on hand deciles: 10	-0.283*** (0.019)	
Controls		
Observations	22,500	
R-squared	0.095	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Italian data: SHIW

	(1)	Risk aversion	(2)	MPC
Food share dummy	0.132***	(0.007)	-0.028***	(0.005)
Cash on hand deciles: 2	-0.001	(0.013)	-0.054***	(0.009)
Cash on hand deciles: 3	-0.021	(0.013)	-0.059***	(0.009)
Cash on hand deciles: 4	-0.053***	(0.013)	-0.093***	(0.009)
Cash on hand deciles: 5	-0.044***	(0.014)	-0.126***	(0.009)
Cash on hand deciles: 6	-0.087***	(0.014)	-0.146***	(0.010)
Cash on hand deciles: 7	-0.108***	(0.015)	-0.144***	(0.010)
Cash on hand deciles: 8	-0.130***	(0.015)	-0.151***	(0.010)
Cash on hand deciles: 9	-0.161***	(0.016)	-0.164***	(0.011)
Cash on hand deciles: 10	-0.283***	(0.019)	-0.175***	(0.013)
Controls				
Observations	22,500		22,500	
R-squared	0.095		0.048	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

US data: PSID

- Measures of income and wealth: cash-on-hand or hand-to-mouth status
- Measures of expenditure
 - Food at home, total expenditure
 - Dummy: 1 if in the top-50 of the ratio
- Bi-annual since 1999, panel
 - Consumption and income volatility
Aguiar, Bils and Boar (2024)

US data: PSID

	(1) Volatility e	(2) Volatility y
Food share dummy	-0.009***	(0.002)
Cash on hand deciles: 2	-0.006	(0.006)
Cash on hand deciles: 3	-0.022***	(0.006)
Cash on hand deciles: 4	-0.028***	(0.005)
Cash on hand deciles: 5	-0.032***	(0.005)
Cash on hand deciles: 6	-0.035***	(0.005)
Cash on hand deciles: 7	-0.039***	(0.005)
Cash on hand deciles: 8	-0.042***	(0.005)
Cash on hand deciles: 9	-0.046***	(0.005)
Cash on hand deciles: 10	-0.033***	(0.006)
Controls		
Observations	26,384	
R-squared	0.021	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

US data: PSID

	(1)		(2)	
	Volatility e		Volatility y	
Food share dummy	-0.009***	(0.002)	-0.002	(0.002)
Cash on hand deciles: 2	-0.006	(0.006)	-0.031***	
Cash on hand deciles: 3	-0.022***	(0.006)	-0.045***	(0.007)
Cash on hand deciles: 4	-0.028***	(0.005)	-0.061***	(0.007)
Cash on hand deciles: 5	-0.032***	(0.005)	-0.065***	(0.007)
Cash on hand deciles: 6	-0.035***	(0.005)	-0.065***	(0.007)
Cash on hand deciles: 7	-0.039***	(0.005)	-0.072***	(0.006)
Cash on hand deciles: 8	-0.042***	(0.005)	-0.073***	(0.007)
Cash on hand deciles: 9	-0.046***	(0.005)	-0.068***	(0.007)
Cash on hand deciles: 10	-0.033***	(0.006)	-0.042***	(0.009)
Controls				
Observations	26,384		26,384	
R-squared	0.021		0.033	

Standard errors in parentheses

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Conclusion

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- Optimal taxation with rising living standards
 - Affect efficiency and distribution concerns
- Dampen optimal increase in redistribution due 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 φ^{-1} and income effects η

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

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

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- Numerator: Fiscal effect of higher marginal rate at $y(\theta^*)\dots$

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- No behavioral responses: $\eta = 0, \varphi^{-1} = 0 \Rightarrow E = 0$

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

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

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

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- Numerator: Welfare loss from taxing workers with $y > y(\theta^*)$
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-
- No heterogeneity: $\mathbb{E}[u_e(\theta; \Lambda) | \theta \geq \theta^*] = \mathbb{E}[u_e(\theta; \Lambda)] \quad \forall \theta^* \Rightarrow D = 0$

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

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

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** $\alpha \equiv (1 - \gamma)/(\gamma + \varphi) \forall \theta$

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

- 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

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 $V(\cdot)$ function to $u(e; \Lambda) - B \frac{n^{1+\varphi}}{1+\varphi}$

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

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Stiglitz (1969), Hanoch (1977), Crossley and Low (2011)
- Theory: Conditions on $V(\cdot)$ 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.*"

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 $\bar{c} > 0$

⇒ Implies decreasing relative risk aversion (DRRA)

- Counterfactual: vanishing non-homotheticities

IA Preferences Alder, Boppart, and Müller (2022)

- Preferences defined over expenditures e

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

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

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■ Preferences defined over expenditures e

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- 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** $\Rightarrow A > 0$

IA Preferences Alder, Boppart, and Müller (2022)

- $D(\cdot)$ term defined as:

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

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

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

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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

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

- 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

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

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

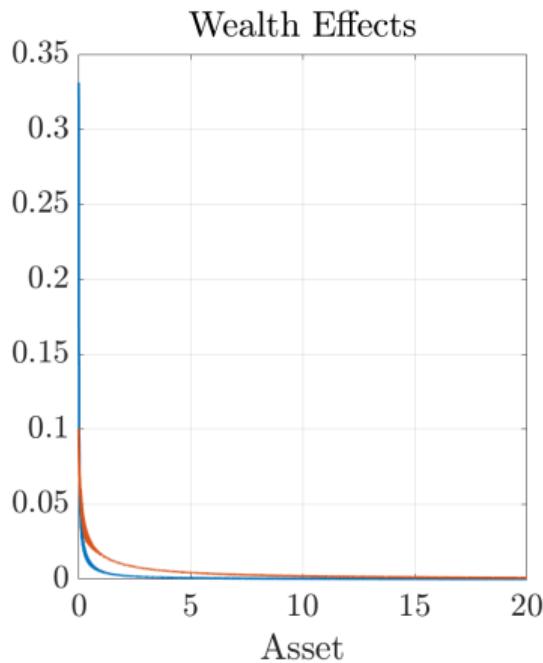
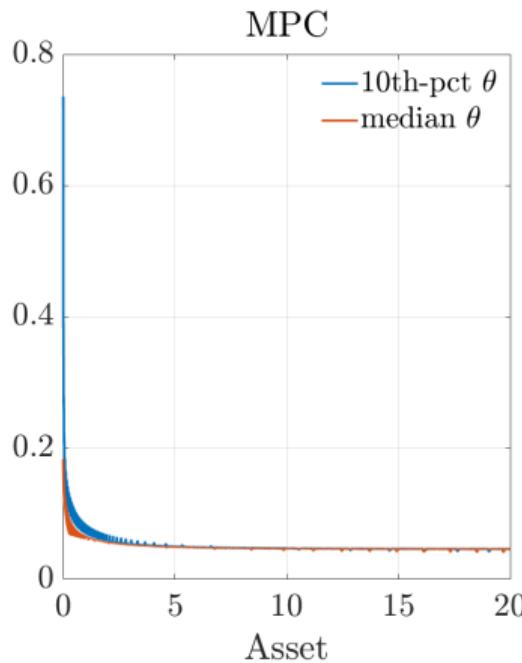
- Variance of log expenditure in 2010: 0.42, top-quintile expenditure share of 44%
- Less expenditure inequality in 1950
- Variance of log expenditure in 1950: 0.33, top-quintile expenditure share of 38%

Implied RRA in the Model MPCs and Wealth Effects

- Relation between **RRA**, **wealth effects**, and **MPC**: $RRA \times MPC = \eta \left(\varphi \frac{e}{y} + \frac{e\tau''(y)}{\tau'(y)} \right)$

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



- 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: 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

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

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

Calibration: Inequality

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

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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)

Calibration: Expenditure Inequality

1950

Expenditure Share by Quintile

Dynamic model	8%	14%	18%	22%	38%
Static model	9%	13%	17%	23%	38%

2010

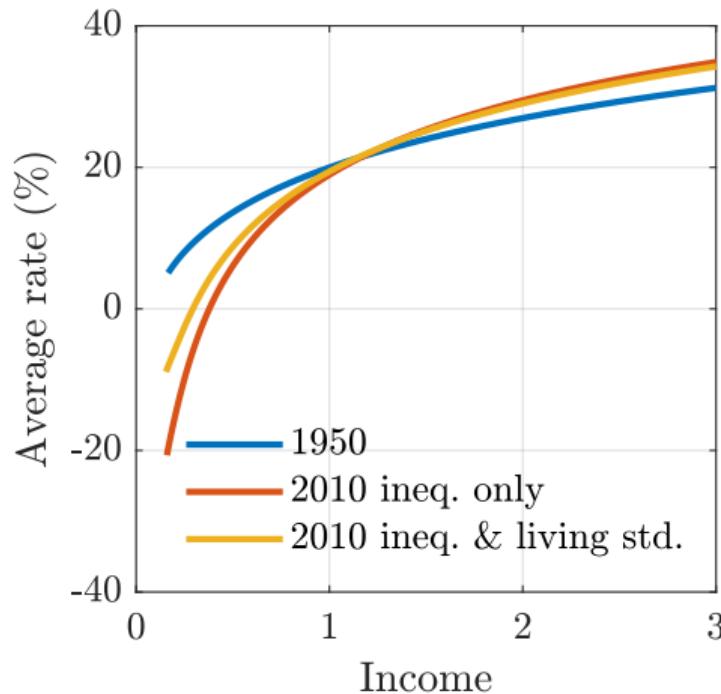
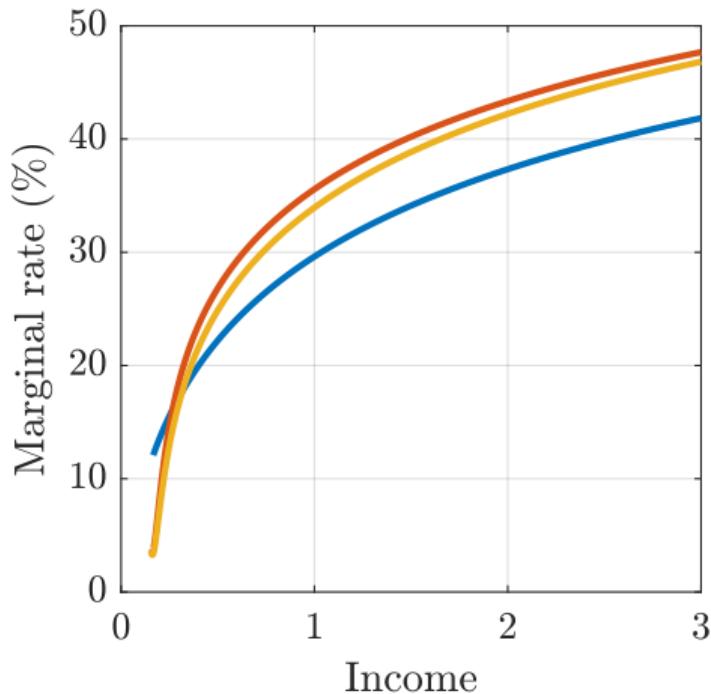
Expenditure Share by Quintile

Dynamic model	7%	12%	16%	21%	44%
Static model	8%	12%	16%	22%	42%

Inverse Optimum Weights

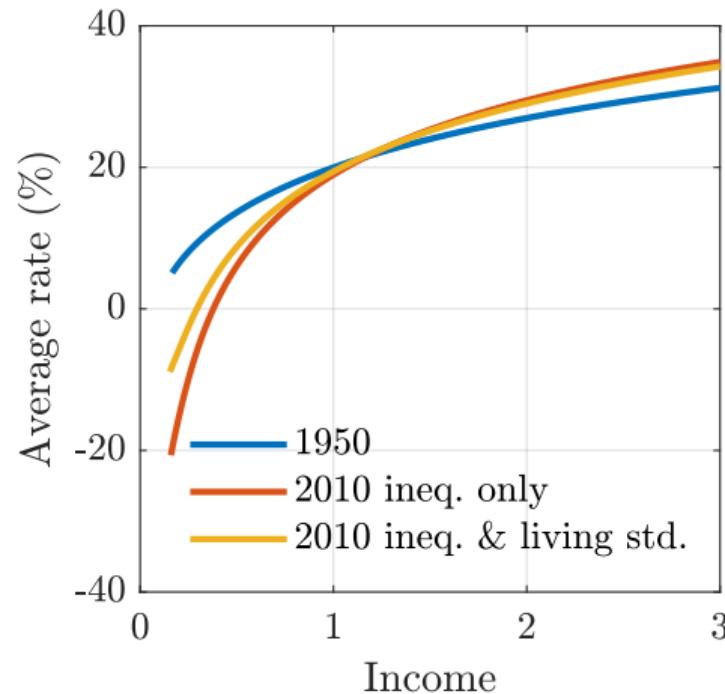
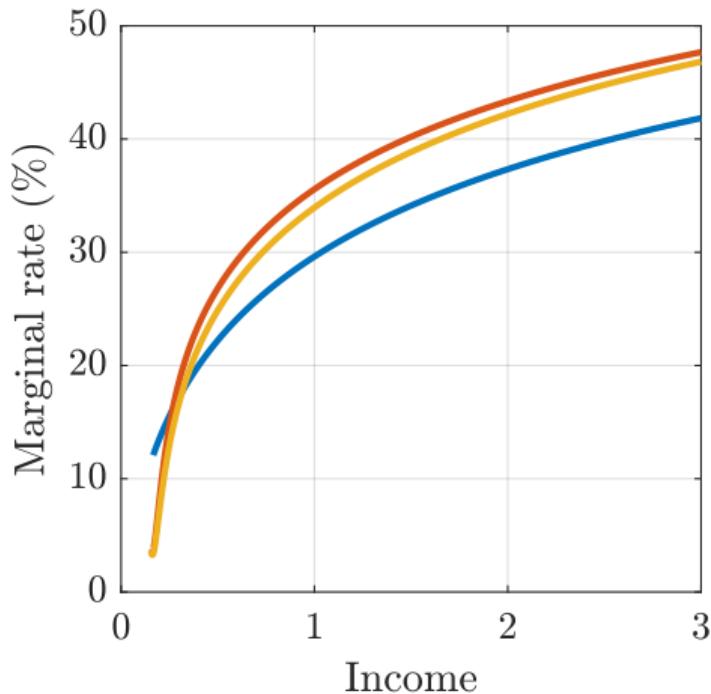
- In Mirrlees environment, 1950 inverse optimum weights can be computed uniquely by θ
- Kept constant as a function of percentiles of the distribution for 2010 / inequality only
- Bottom and top weight (close to zero mass) kept constant across all cases

Optimal Marginal Rates Mirrlees



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

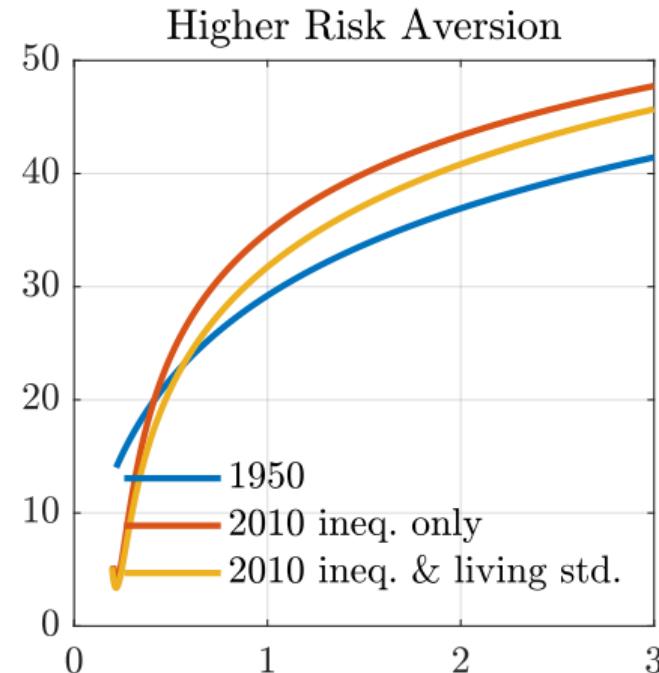
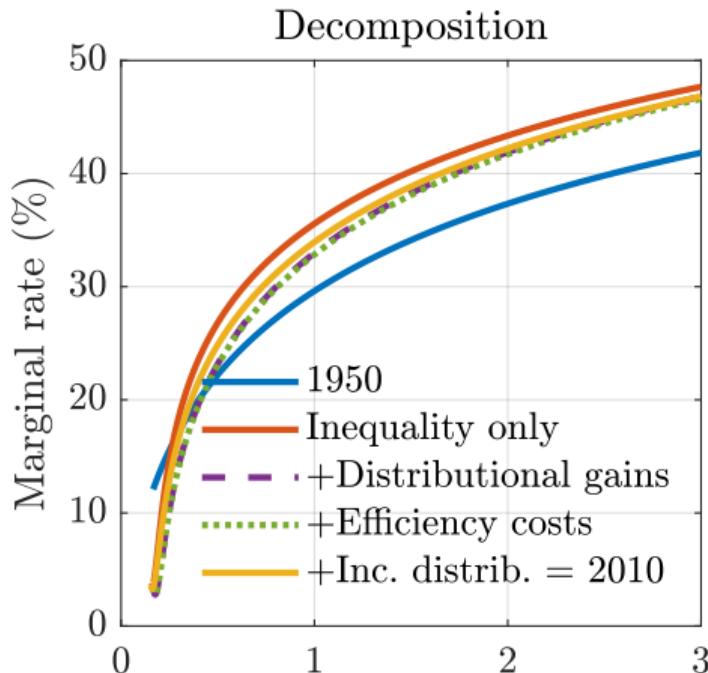
Optimal Marginal Rates Mirrlees



- 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%

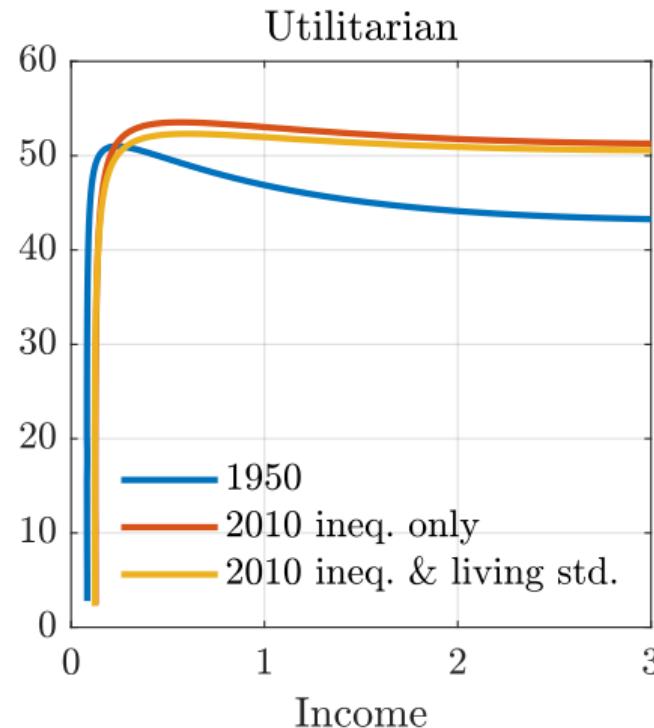
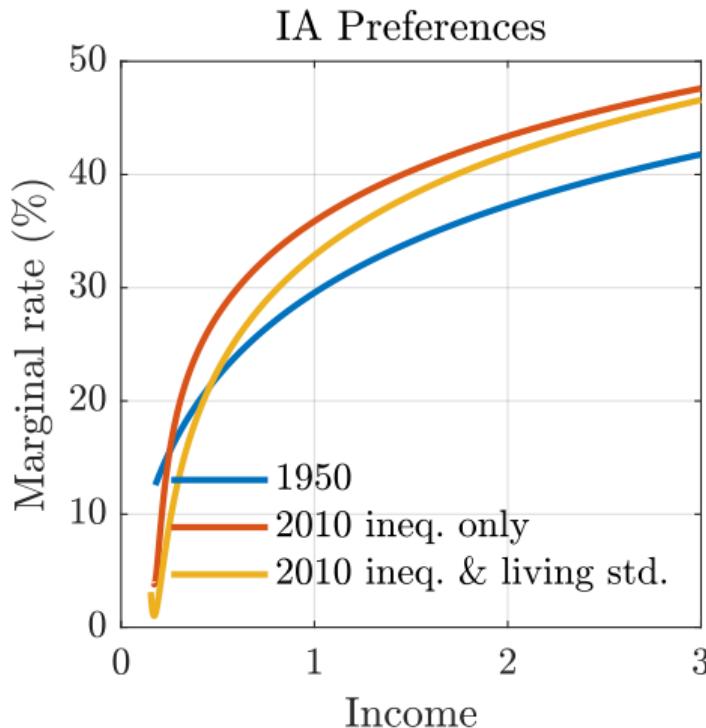
Optimal Marginal Rates

Mirrlees Robustness



Optimal Marginal Rates

Mirrlees Robustness



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