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
  - ⇒ Calls for more redistribution in workhorse models of optimal income taxation

    Mankiw, Weinzierl, and Yagan (2009), Diamond and Saez (2011)

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⇒ How does the standard of living affect the optimal fiscal system?

What We Do

- **Optimal income 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") $\Rightarrow$ Rising living standards

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  - Changes in levels ("growth") ⇒ Rising living standards

- **Formalize** the effects of rising living standards on optimal taxes
  - ⋆ Distribution vs. efficiency concerns

    Heathcote and Tsujiyama (2021)

- **Quantify** the relative effects of rising inequality vs. rising living standards
  - ⋆ Inverse optimum approach in 1950, optimal $t\&T$ system in 2010

What We Find

- Non-homotheticities $\Rightarrow$ Increasing Intertemporal Elasticity of Substitution (IES)
  - Intratemporal allocations informative on intertemporal properties of utility function

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  - Lowers dispersion in marginal utilities ⇒ Lower distribution gains from redistribution
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  - Intratemporal allocations informative on intertemporal properties of utility function
- 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
  - Calls for less redistribution
  - Dampens significantly 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)

Intratemporal Allocations and

Intertemporal Properties of the Utility Function

Intratemporal and Intertemporal Properties Theory

- Consumption patterns across goods require non-homothetic preferences
  - Food shares are falling over time and with income in the cross-section

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+ Increasing IES: "Luxuries Are Easier to Postpone"
  Browning and Crossley (2000)
  - "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)
  - "Because they are close to subsistence, risk is [...] particularly painful to the poor."
    Duflo (2006)

Intratemporal and Intertemporal Properties **Evidence**

- Increasing IES/Decreasing RRA supported by ample empirical evidence

  Ogaki and Zhang (2001), Zhang and Ogaki (2004); Blundell, Browning, and Meghir (1994), Attanasio and Browning (1995), Atkeson and Ogaki (1996); Graber et al. (2026); Calvet and Sodini (2014), Meeuwis (2022); Vissing-Jørgensen (2002), Attanasio, Banks, and Tanner (2002); . . .

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  - Euler equation estimation using subjective expectations
    Crump, Eusepi, Tambalotti, and Topa (2022), Kim and Binder (2023)
  - Structural Euler equation estimation
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$\widehat{\text{IES}}$ [90% CI]	Low food share	High food share
Subjective Euler eq. (SCE)	0.64 [0.60, 0.69]	0.55 [0.51, 0.60]
Structural Euler eq. (BPS)	0.88 [0.47, 1.30]	0.20 [0.10, 0.30]

Intratemporal and Intertemporal Properties Evidence

- Consumption baskets and curvature of the utility function in models
  Ait-Sahalia, Parker, and Yogo (2004), Andreolli, Rickard, and Surico (2025), Sonnervig (2025); Wachter and Yogo (2010); Andreolli and Surico (2026); Donovan (2021), Adamopoulos and Leibovici (2025); ...

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- Evidence on consumption baskets and curvature of the utility function
  - Consumption volatility by food share: PSID based on Aguiar, Bils, and Boar (2025)
    - Controlling for constrainedness, high-food households have lower volatility of consumption
    - But not lower volatility of income!
  - MPC by food share: SHIW based on Andreolli and Surico (2026)
    - Controlling for constrainedness, high-food households have lower MPC

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

- Denote $\mathcal{C}(e;p)$ under optimal consumption choice c s.t. $\sum_j p_j c_j = e$

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

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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 γ the stronger the pattern of Decreasing RRA (Increasing IES)

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Empirically:

  – Consumption baskets govern $\mathcal{C}$

  – γ disciplines both level of RRA/IES and heterogeneity across households

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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- Separable utility over consumption and leisure: $U(c) - v(n)$
  - Isoelastic labor preferences $v(n) = Bn^{1+\varphi}/(1+\varphi)$
  - $c = (c_1, \ldots, c_J)$ denotes a basket of consumption goods

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- 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

Optimal Taxation Problem

- Household's static maximization problem:

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

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

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- Government's maximization problem:

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

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

Nonlinear Taxes: General Formula

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

  Heathcote and Tsujiyama (2021)

  – Efficiency costs $E(\theta; \Lambda)$ depend on

    + $\eta(\theta; \Lambda) \equiv dy(\theta; \Lambda)/d\mathcal{T}(0; \Lambda)$ the income effect of type-θ worker

  – Redistribution gains $D(\theta; \Lambda)$ depend on

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

  – Allocations: $y(\theta; \Lambda)$, $e(\theta; \Lambda)$ income and expenditure choices of type-θ worker

Homothetic Benchmark Neutrality Result

- Assume homothetic CRRA preferences

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

Details

Homothetic Benchmark Neutrality Result

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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 $\forall\theta$

Non-Homothetic Preferences & Rising Living Standards

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   $\rightarrow$ Redistribution should decrease with rising living standards

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   (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

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; Government; Inequality; Preferences

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

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 1950
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    - Agriculture (food) 21%, goods 39%, services 39%
    - Untargeted 2010: agriculture 9% [data 8%], goods 20% [25%], services 71% [67%]

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- Remaining preference parameters
  - Fix Frisch elasticity $1/\varphi$ to 0.2: income effect of 0.3
  - Consumption curvature γ to match IES in 2010 by food shares: 0.69 and 0.64

Calibration Government

- Government: Taxes, transfers and spending
  - Cubic polylogarithmic tax function
    - + Transfer /output and moments of marginal tax rate distribution in 1950 and 2010 Mertens and Montiel Olea (2018)
  - Exogenous government spending: $G/Y = 22.0\%$

Calibration Inequality

- Government: Taxes, transfers and spending
  - Cubic polylogarithmic tax function
    - + Transfer /output and moments of marginal tax rate distribution in 1950 and 2010
      Mertens and Montiel Olea (2018)
  - Exogenous government spending: $G/Y = 22.0\%$
- Inequality: Partial Insurance approach
  - Wages follow an Exponentially Modified Gaussian distribution
  - Variance of log expenditures in 1950 and 2010: 0.24, 0.36
    CEX, Kuhn, Schularick, and Steins (2020)
  - Pareto tail in 1950 and 2010: 2×2.2, 2×1.6
    Aoki and Nirei (2017), Gaillard, Hellwig, Wangner and Werquin (2026)

Rising Living Standards vs. Rising Inequality

- Quantify the effects 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)

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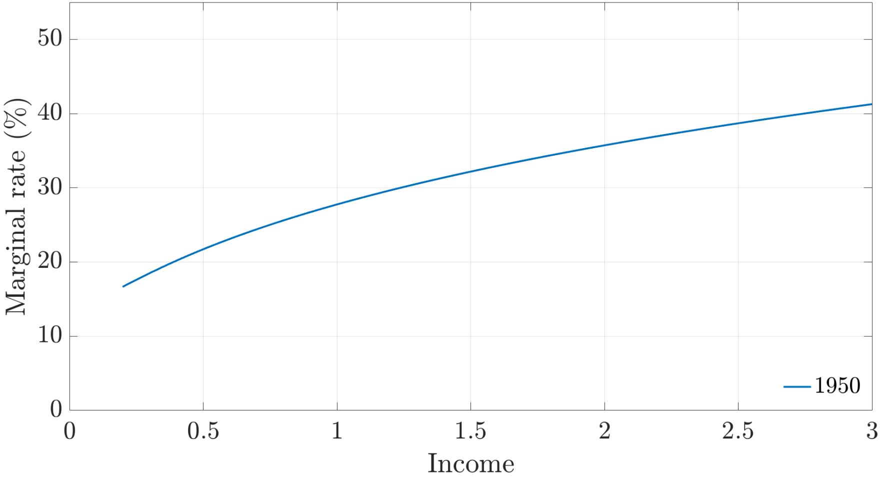
- Quantify the effects of rising living standards relative to rising inequality
- Pareto weights
  - Inverse optimum in 1950

    Bourguignon and Spadaro (2012), Lockwood and Weinzierl (2016), Hendren (2020)
- 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

Optimal Marginal Tax Rates



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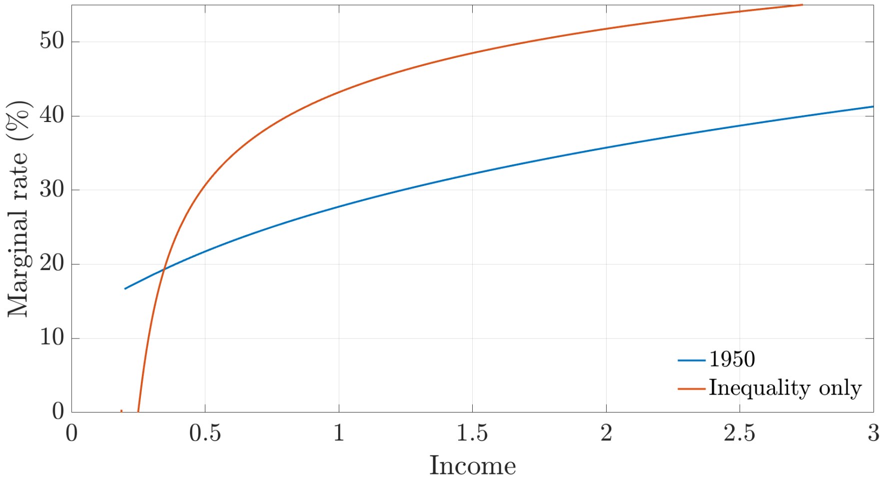

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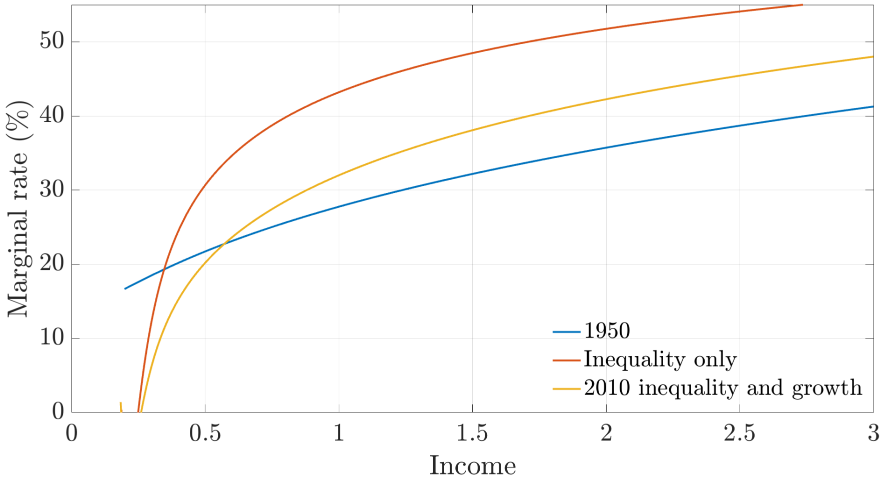


Optimal Average Tax Rates

	1950
Bottom 30%	15.2%
Top 30%	24.4%
Measure $\mathcal{R}$	9.2%

- Redistribution measure $\mathcal{R}$: top 30% *minus* bottom-30% average rates

Optimal Average Tax Rates

	1950	2010 Ineq only
Bottom 30%	15.2%	−11.6%
Top 30%	24.4%	30.6%
Measure $\mathcal{R}$	9.2%	42.2%

- Redistribution measure $\mathcal{R}$: top 30% *minus* bottom-30% average rates

Optimal Average Tax Rates

	1950	2010 Ineq only	2010 Ineq & Growth
Bottom 30%	15.2%	−11.6%	7.7%
Top 30%	24.4%	30.6%	26.1%
Measure $\mathcal{R}$	9.2%	42.2%	18.3%

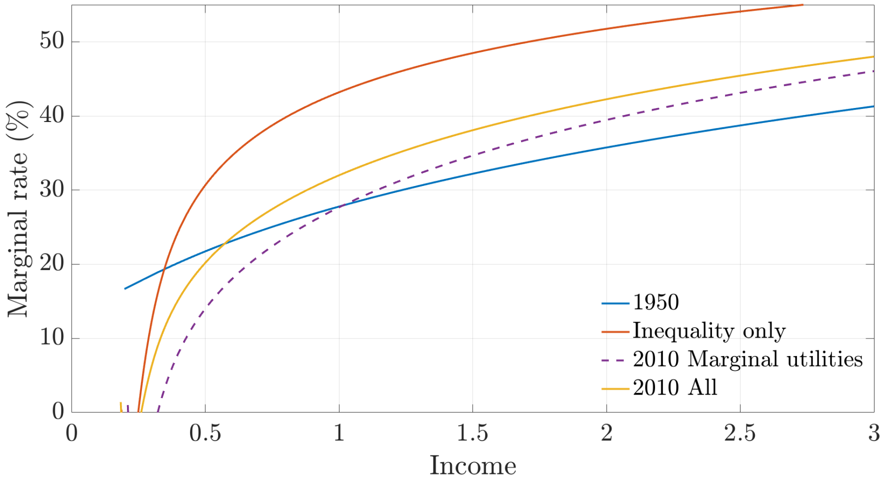
- Redistribution measure $\mathcal{R}$: top 30% *minus* bottom-30% average rates

Optimal Average Tax Rates

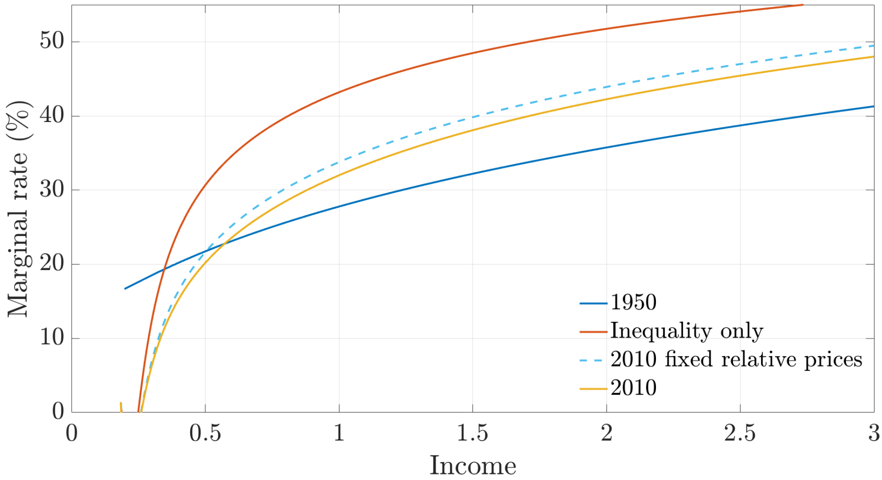
	1950	2010 Ineq only	2010 Ineq & Growth	2010 Calibration
Bottom 30%	15.2%	−11.6%	7.7%	9.2%
Top 30%	24.4%	30.6%	26.1%	24.8%
Measure $\mathcal{R}$	9.2%	42.2%	18.3%	15.6%

- Redistribution measure $\mathcal{R}$: top 30% *minus* bottom-30% average rates

Decomposition 1/2 Dispersion of Marginal Utilities



Decomposition 2/2 Relative Prices



Conclusion

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  - Affect efficiency and distribution concerns
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Thank you!

Appendix

French data: PATER

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

French data: PATER

- Broad questionnaire
  - Questions on hh preferences
    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	☐	☐	☐	☐	☐
• 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	☐	☐	☐	☐	☐

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French data: PATER

- Broad questionnaire
  - Questions on hh preferences
    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
- Luxuries are easier to postpone

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	☐	☐	☐	☐	☐

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Euler Equation Estimation using Expectations Data

- Crump, Eusepi, Tambalotti, and Topa (2022) and Kim and Binder (2023)
  - Estimate IES from Euler equation with expectations data
  - Data from Survey of Consumer Expectations (SCE)
  - Estimating Equation:

$$\mathrm{ExpCG}^i_{t,t+12} = -\sigma \cdot \mathrm{Exp}^i\mathrm{Infl}_{t,t+12} + \delta' \kappa_{g_{it}} + \theta' x_{it} + \epsilon_{it}$$

    + $\mathrm{ExpCG}^i_{t,t+12}$: expected real consumption growth
    + $\mathrm{Exp}^i\mathrm{Infl}_{t,t+12}$: expected inflation
    + $\kappa_{g_{it}}$: group-specific time effects based on demographic characteristics
    + x_{it}: demographic controls

- We extend this approach by splitting the sample by food share

Euler Equation Estimation using Expectations Data

	OLS			IV		
	Pooled (1)	Low FS (2)	High FS (3)	Pooled (4)	Low FS (5)	High FS (6)
Expected inflation	-0.649^{***}	-0.643^{***}	-0.553^{***}	-0.581^{***}	-0.567^{***}	-0.494^{***}
	(0.028)	(0.028)	(0.029)	(0.041)	(0.042)	(0.036)
× High food share	0.110^{***}			0.098^{*}		
	(0.035)			(0.049)		
High food share (level)	-0.136			-0.097		
	(0.145)			(0.178)		
Real exp. income growth	0.220^{***}	0.217^{***}	0.239^{***}	0.227^{***}	0.225^{***}	0.243^{***}
	(0.013)	(0.013)	(0.011)	(0.013)	(0.013)	(0.012)
× High food share	0.022			0.020		
	(0.015)			(0.015)		
Macro & credit controls	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Het. interest-rate FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	63,506	31,677	30,724	63,358	31,600	30,651
R^2 (centered)	0.202	0.189	0.207	0.202	0.189	0.207

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Structural Euler Equation Estimation

- Blundell, Pistaferri, and Saporta-Eksten (2016):
  life-cycle model linking wage shocks to consumption and hours

- Parameter of interest: $\eta_{c,p}$, Frisch (intertemporal) elasticity of consumption (IES)

- **Estimation**: two-step minimum-distance (GMM) on second moments
  - Step 1: estimate the wage process from wage-growth covariances
  - Step 2: recover $\eta_{c,p}$ by matching consumption, earnings, hours covariances

- **Our three deviations** from BPS:
  - Longer panel: extend the PSID sample to 1999–2019.
  - Split households by food share: low = richer, high = poorer
  - Separable preferences (BPS robustness case)

- Test — H_1: low-food-share (richer) households have strictly higher $\eta_{c,p}$ (one-sided Wald)

Structural Euler Equation Estimation

	Low food share (richer)	High food share (poorer)
$\hat{\eta}_{c,p}$	0.882 (0.252)	0.200 (0.058)
$H_1: \eta_{c,p}^{\text{low}} > \eta_{c,p}^{\text{high}}$	$t = 2.64^{***}$,	$p = 0.004$

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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 (2026)
- Waves: 2016, 2020, 2022

Italian data: SHIW

	MPC	High risk aversion
	(1)	(2)
Food-at-home top 50%	-0.046^{***}	0.123^{***}
	(0.004)	(0.006)
H2M	0.014^{*}	0.082^{***}
	(0.008)	(0.012)
Cash-on-hand percentile (ref. = p1):		
p10	-0.075^{***}	0.031
	(0.026)	(0.038)
p25	-0.011	-0.041
	(0.026)	(0.037)
p50	-0.087^{***}	-0.067^{*}
	(0.026)	(0.037)
p75	-0.100^{***}	-0.037
	(0.026)	(0.038)
p90	-0.168^{***}	-0.204^{***}
	(0.026)	(0.038)
p100	-0.191^{***}	-0.314^{***}
	(0.027)	(0.038)
Cash-on-hand dummies (100)	Yes	Yes
Demographic controls	Yes	Yes
Year fixed effects	Yes	Yes
Observations	29,599	29,599
R^2	0.040	0.106

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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

	$\lvert\Delta \ln c\rvert$ (1)	$\lvert\Delta \ln(y+ra)\rvert$ (2)
Panel A: No household fixed effects		
H2M_{NW}	0.020***	0.018***
	(0.003)	(0.003)
H2M_{LIQ}	0.007**	0.020***
	(0.003)	(0.004)
High food share (top 50%)	−0.006***	−0.002
	(0.002)	(0.002)
R^2	0.012	0.013
Panel B: With household fixed effects		
H2M_{NW}	0.001	0.005
	(0.004)	(0.004)
H2M_{LIQ}	−0.005*	0.007*
	(0.003)	(0.004)
High food share (top 50%)	−0.010***	0.002
	(0.002)	(0.003)
R^2	0.381	0.441
Controls	Yes	Yes
Observations	24,214	24,214

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Theory Appendix

Nonlinear Taxes: General Formula

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

  Heathcote and Tsujiyama (2021)

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

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

$$\eta(\theta)=\varepsilon^F\frac{\gamma(e)\frac{\theta n(1+g)}{e}}{1+\varepsilon^F\gamma(e)\frac{n\theta(1-\tau)(1+g)}{e}}$$

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

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

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

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

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

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

    + Decreases labor supply of worker with $y(\theta^*)$: elasticity φ^{-1}

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    + Decreases labor supply of worker with $y(\theta^*)$: elasticity φ^{-1}
    + Increases labor supply of workers with $y > y(\theta^*)$: income effect η

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  - **Denominator:** Effects of higher lump-sum transfer...

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  - **Denominator:** Effects of higher lump-sum transfer...
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    - + Decreases labor supply of all workers: income effect η

- No behavioral responses: $\eta = 0$

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    + Decreases labor supply of all workers: income effect η

- 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

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

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  – **Numerator:** Welfare loss from taxing workers with $y > y(\theta^*)$

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  - **Denominator:** Welfare gains from increasing lump-sum transfer

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  - **Numerator:** Welfare loss from taxing workers with $y > y(\theta^*)$
  - **Denominator:** Welfare gains from increasing lump-sum transfer

- 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

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

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

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

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- Intratemporal allocations do rule out constant RRA

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

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  Stiglitz (1969), Hanoch (1977), Crossley and Low (2011)
- Theory: Conditions on $V(.)$ such that NH implies more DRRA
- (Quantitative: Dynamic model with dynamic policy functions)
- Evidence: DRRA and food shares

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Cardinalization

- Infer intertemporal properties of utility from intratemporal allocations
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  - One can always add a monotonic $V(.)$ function to $u(e;\Lambda) - B\frac{n^{1+\varphi}}{1+\varphi}$
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- Theory: Conditions on $V(.)$ such that NH implies more DRRA
- (Quantitative: Dynamic model with dynamic policy functions)
- Evidence: DRRA and food shares
- 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 $\bar{c} > 0$

⇒ Implies decreasing relative risk aversion (DRRA)

- Counterfactual: vanishing non-homotheticities

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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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- 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 $\mathbf{B}(\Lambda) = \left(\sum_j \Omega_j p_j^{1-\sigma}\right)^{\frac{1}{1-\sigma}} = \Lambda^{-1}\left(\sum_j \Omega_j \hat{p}_j^{1-\sigma}\right)^{\frac{1}{1-\sigma}} = p^{\star}$
  - Generalized Stone-Geary $\mathbf{A}\left(\Lambda\right)$, $\mathbf{D}\left(\Lambda\right)$ price function independent of e (PIGL)

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 $\Rightarrow A > 0$

IA Preferences Alder, Boppart, and Müller (2022)

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

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

IA Preferences Alder, Boppart, and Müller (2022)

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

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

- 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 or Continuum

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

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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

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)

References

References

Adamopoulos, Tasso and Fernando Leibovici (2025). "Trade Risk and Food Security". Working Paper.

Aguiar, Mark and Mark Bils (2015). "Has consumption inequality mirrored income inequality?" The American Economic Review 105.9, pp. 2725–56.

Aguiar, Mark, Mark Bils, and Corina Boar (2025). "Who are the Hand-to-Mouth?" Review of Economic Studies 92.3, pp. 1293–1340.

Ait-Sahalia, Yacine, Jonathan A. Parker, and Motohiro Yogo (2004). "Luxury goods and the equity premium". The Journal of Finance 59.6, pp. 2959–3004.

Alder, Simon, Timo Boppart, and Andreas Müller (2022). "A theory of structural change that can fit the data". American Economic Journal: Macroeconomics 14.2, pp. 160–206.

Andreolli, Michele, Natalie Rickard, and Paolo Surico (2025). "Non-essential business-cycles". Working Paper.

Andreolli, Michele and Paolo Surico (2026). "'Less is More': Consumer Spending and the Size of Economic Stimulus Payments". American Economic Journal: Macroeconomics 18.1, pp. 34–68.

Aoki, Shuhei and Makoto Nirei (2017). "Zipf's Law, Pareto's Law, and the Evolution of Top Incomes in the United States". American Economic Journal: Macroeconomics 9.3, pp. 36–71.

References (cont.)

Atkeson, Andrew and Masao Ogaki (1996). "Wealth-varying intertemporal elasticities of substitution: Evidence from panel and aggregate data". Journal of Monetary Economics 38.3, pp. 507–534.

Attanasio, Orazio P., James Banks, and Sarah Tanner (2002). "Asset holding and consumption volatility". Journal of Political Economy 110.4, pp. 771–792.

Attanasio, Orazio P. and Martin Browning (1995). "Consumption over the Life Cycle and over the Business Cycle". The American Economic Review, pp. 1118–1137.

Attanasio, Orazio P. and Luigi Pistaferri (2014). "Consumption inequality over the last half century: some evidence using the new PSID consumption measure". The American Economic Review 104.5, pp. 122–126.

Blundell, Richard, Martin Browning, and Costas Meghir (1994). "Consumer demand and the life-cycle allocation of household expenditures". The Review of Economic Studies 61.1, pp. 57–80.

Blundell, Richard, Luigi Pistaferri, and Itay Saporta-Eksten (2016). "Consumption inequality and family labor supply". The American Economic Review 106.2, pp. 387–435.

Bohr, Clement, Marti Mestieri, and Emre Enes Yavuz (2023). "Aggregation and Closed-Form Results for Nonhomothetic CES Preferences". Working Paper.

References (cont.)

Boppart, Timo (2014). "Structural change and the Kaldor facts in a growth model with relative price effects and non-Gorman preferences". Econometrica 82.6, pp. 2167–2196.

Bourguignon, François and Amedeo Spadaro (2012). "Tax–benefit revealed social preferences". The Journal of Economic Inequality 10.1, pp. 75–108.

Brinca, Pedro, João B Duarte, Hans Aasnes Holter, and João Henrique Barata Gouveia de Oliveira (2022). "Technological Change and Earnings Inequality in the US: Implications for Optimal Taxation". Working Paper.

Browning, Martin and Thomas F. Crossley (2000). "Luxuries are easier to postpone: A proof". Journal of Political Economy 108.5, pp. 1022–1026.

Calvet, Laurent E and Paolo Sodini (2014). "Twin picks: Disentangling the determinants of risk-taking in household portfolios". The Journal of Finance 69.2, pp. 867–906.

Chatterjee, Satyajit and B. Ravikumar (1999). "Minimum consumption requirements: Theoretical and quantitative implications for growth and distribution". Macroeconomic Dynamics 3.4, pp. 482–505.

Cioffi, Riccardo A. (2021). "Heterogeneous Risk Exposure and the Dynamics of Wealth Inequality". Working Paper.

References (cont.)

Comin, Diego, Danial Lashkari, and Martí Mestieri (2021). "Structural change with long-run income and price effects". Econometrica 89.1, pp. 311–374.

Crossley, Thomas F. and Hamish W. Low (2011). "Is the Elasticity of Intertemporal Substitution Constant?" Journal of the European Economic Association 9.1, pp. 87–105.

Crump, Richard K., Stefano Eusepi, Andrea Tambalotti, and Giorgio Topa (2022). "Subjective intertemporal substitution". Journal of Monetary Economics 126, pp. 118–133.

Diamond, Peter A. (1998). "Optimal income taxation: an example with a U-shaped pattern of optimal marginal tax rates". The American Economic Review, pp. 83–95.

Diamond, Peter A. and Emmanuel Saez (2011). "The case for a progressive tax: From basic research to policy recommendation". Journal of Economic Perspectives 25.4, pp. 165–190.

Donovan, Kevin (2021). "The equilibrium impact of agricultural risk on intermediate inputs and aggregate productivity". The Review of Economic Studies 88.5, pp. 2275–2307.

Duflo, Esther (2006). "Poor but rational". Understanding poverty 24, pp. 367–379.

References (cont.)

Fagereng, Andreas, Martin B. Holm, and Gisle J. Natvik (2021). "MPC heterogeneity and household balance sheets". American Economic Journal: Macroeconomics 13.4, pp. 1–54.

Ferriere, Axelle, Philipp Grübener, Gaston Navarro, and Oliko Vardishvili (2023). "On the Optimal Design of Transfers and Income Tax Progressivity". Journal of Political Economy Macroeconomics 1.2, pp. 276–333.

Geary, Roy C. (1950). "A note on A constant-utility index of the cost of living". The Review of Economic Studies 18.1, pp. 65–66.

Golosov, Mikhail, Michael Graber, Magne Mogstad, and David Novgorodsky (2023). "How Americans respond to idiosyncratic and exogenous changes in household wealth and unearned income". Forthcoming in the Quarterly Journal of Economics.

Graber, Michael, Morten Håvarstein, Magne Mogstad, Gaute Torsvik, and Ola L. Vestad (2026). "Substitution and income effects of labor income taxation". Working Paper.

Hanoch, Giora (1977). "Risk aversion and consumer preferences". Econometrica, pp. 413–426.

Heathcote, Jonathan, Fabrizio Perri, and Giovanni L. Violante (2010). "Unequal we stand: An empirical analysis of economic inequality in the United States, 1967–2006". Review of Economic Dynamics 13.1, pp. 15–51.

References (cont.)

Heathcote, Jonathan, Kjetil Storesletten, and Giovanni L. Violante (2017). "Optimal tax progressivity: An analytical framework". The Quarterly Journal of Economics 132.4, pp. 1693–1754.

— (2020). "Presidential Address 2019: How Should Tax Progressivity Respond to Rising Income Inequality?" Journal of the European Economic Association 18.6, pp. 2715–2754.

Heathcote, Jonathan and Hitoshi Tsujiyama (2021). "Optimal income taxation: Mirrlees meets Ramsey". Journal of Political Economy 129.11, pp. 3141–3184.

Hendren, Nathaniel (2020). "Measuring economic efficiency using inverse-optimum weights". Journal of Public Economics 187, p. 104198.

Herrendorf, Berthold, Richard Rogerson, and Akos Valentinyi (2013). "Two perspectives on preferences and structural transformation". The American Economic Review 103.7, pp. 2752–2789.

— (2014). "Growth and structural transformation". Handbook of Economic Growth. Vol. 2. Elsevier, pp. 855–941.

Jaravel, Xavier and Alan Olivi (2024). "Prices, Non-homotheticities, and Optimal Taxation". Working Paper.

Johnson, David S., Jonathan A. Parker, and Nicholas S. Souleles (2006). "Household expenditure and the income tax rebates of 2001". The American Economic Review 96.5, pp. 1589–1610.

References (cont.)

Kaplan, Greg and Giovanni L. Violante (2022). "The marginal propensity to consume in heterogeneous agent models". Annual Review of Economics 14, pp. 747–775.

Kim, Gwangmin and Carola Binder (2023). "Learning-through-survey in inflation expectations". American Economic Journal: Macroeconomics 15.2, pp. 254–278.

Kuhn, Moritz, Moritz Schularick, and Ulrike I Steins (2020). "Income and wealth inequality in America, 1949–2016". Journal of Political Economy 128.9, pp. 3469–3519.

Le Grand, François, Xavier Ragot, and Diego Rodrigues (2025). "From Homo Economicus to Homo Moralis: A Bewley Theory of the Social Welfare Function". Working Paper.

Lockwood, Benjamin B. and Matthew Weinzierl (2016). "Positive and normative judgments implicit in US tax policy, and the costs of unequal growth and recessions". Journal of Monetary Economics 77, pp. 30–47.

Mankiw, N. Gregory, Matthew Weinzierl, and Danny Yagan (2009). "Optimal taxation in theory and practice". Journal of Economic Perspectives 23.4, pp. 147–74.

Meeuwis, Maarten (2022). "Wealth fluctuations and risk preferences: Evidence from US investor portfolios". Working Paper.

References (cont.)

Mertens, Karel and José Luis Montiel Olea (2018). "Marginal tax rates and income: New time series evidence". The Quarterly Journal of Economics 133.4, pp. 1803–1884.

Mirrlees, James A. (1971). "An exploration in the theory of optimum income taxation". The Review of Economic Studies 38.2, pp. 175–208.

Ogaki, Masao, Jonathan D. Ostry, and Carmen M. Reinhart (1996). "Saving behavior in low-and middle-income developing countries: A comparison". Staff Papers 43.1, pp. 38–71.

Ogaki, Masao and Qiang Zhang (2001). "Decreasing relative risk aversion and tests of risk sharing". Econometrica 69.2, pp. 515–526.

Oni, Mehedi Hasan (2023). "Progressive income taxation and consumption baskets of rich and poor". Journal of Economic Dynamics and Control 157, p. 104758.

Ramsey, Frank P. (1927). "A Contribution to the Theory of Taxation". The Economic Journal 37.145, pp. 47–61.

Rebelo, Sergio (1992). "Growth in open economies". Carnegie-Rochester Conference Series on Public Policy. Vol. 36. Elsevier, pp. 5–46.

References (cont.)

Saez, Emmanuel (2001). "Using elasticities to derive optimal income tax rates". The Review of Economic Studies 68.1, pp. 205–229.

Scheuer, Florian and Iván Werning (2017). "The Taxation of Superstars". The Quarterly Journal of Economics 132.1, pp. 211–270.

Sonnervig, Marcos (2025). "Unequal Business Cycles". Working Paper.

Stiglitz, Joseph E. (1969). "Behavior towards risk with many commodities". Econometrica, pp. 660–667.

Straub, Ludwig (2019). "Consumption, Savings, and the Distribution of Permanent Income". Working Paper.

Toda, Alexis Akira and Kieran Walsh (2015). "The double power law in consumption and implications for testing Euler equations". Journal of Political Economy 123.5, pp. 1177–1200.

Vissing-Jørgensen, Annette (2002). "Limited asset market participation and the elasticity of intertemporal substitution". Journal of Political Economy 110.4, pp. 825–853.

Wachter, Jessica A. and Motohiro Yogo (2010). "Why do household portfolio shares rise in wealth?" The Review of Financial Studies 23.11, pp. 3929–3965.

References (cont.)

Werning, Ivan (2007). "Optimal fiscal policy with redistribution". The Quarterly Journal of Economics 122.3, pp. 925–967.

Zhang, Qiang and Masao Ogaki (2004). "Decreasing relative risk aversion, risk sharing, and the permanent income hypothesis". Journal of Business & Economic Statistics 22.4, pp. 421–430.