Optimal Progressivity with Age-Dependent Taxation

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- Arguments in favor of progressivity: missing markets
  - Unequal initial conditions
  - Labor market shocks
  - Rising wage-experience profile

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- Q: Life-cycle $\rightarrow$ should optimal progressivity vary with age?

This paper

- OLG equilibrium model with:
  - differential disutility of work & learning ability [ex-ante heter.]
  - uninsurable labor earnings risk [ex-post uncertainty]
  - age profile for productivity and disutility of work [life cycle]
  - flexible labor supply [static choice]
  - skill investment [dynamic choice]

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  - flexible labor supply [static choice]
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- Baseline: analytical model to isolate forces at work
- Extension: numerically solved model with borrowing and saving

Ramsey approach

$$T(y) = y - \lambda y^{1-\tau}$$

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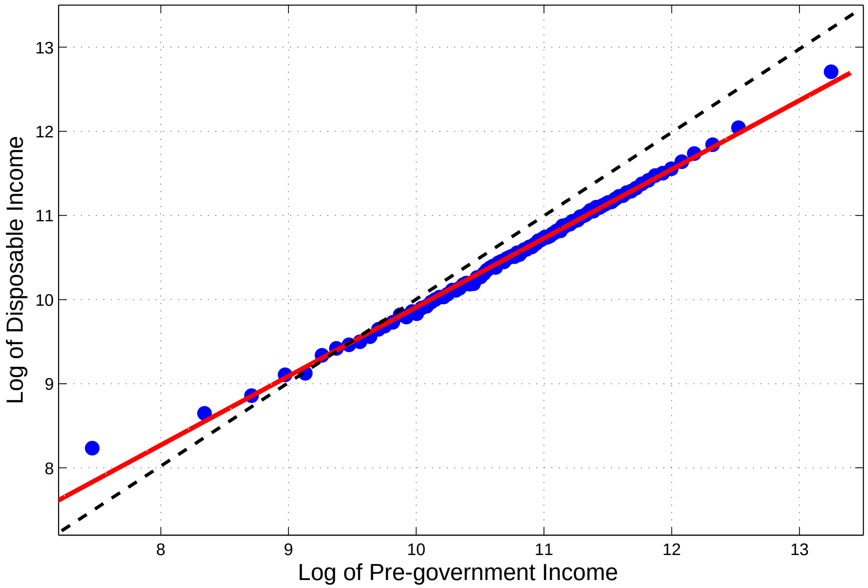
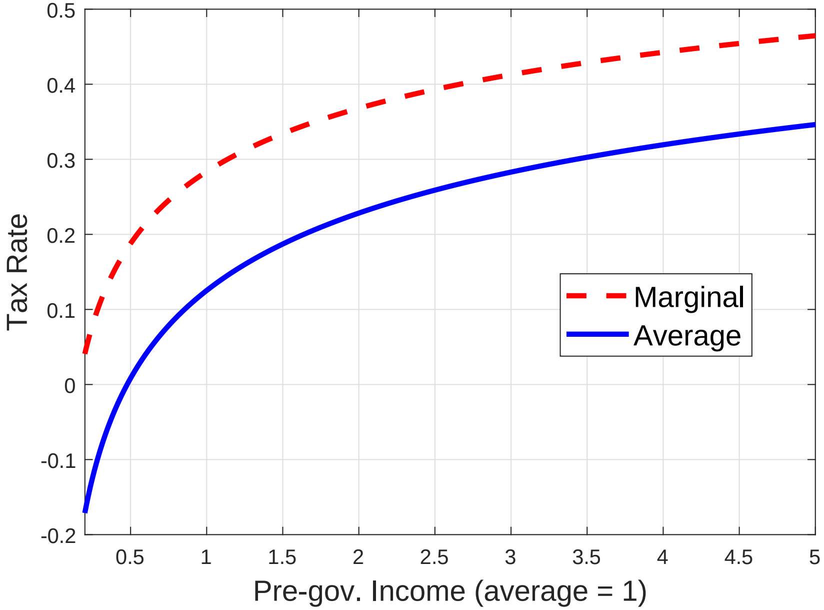
- It preserves analytical tractability
- It closely approximates U.S. ($\tau^{US} = 0.181$)





Ramsey approach

- We generalize tax/transfer system to allow for age variation:

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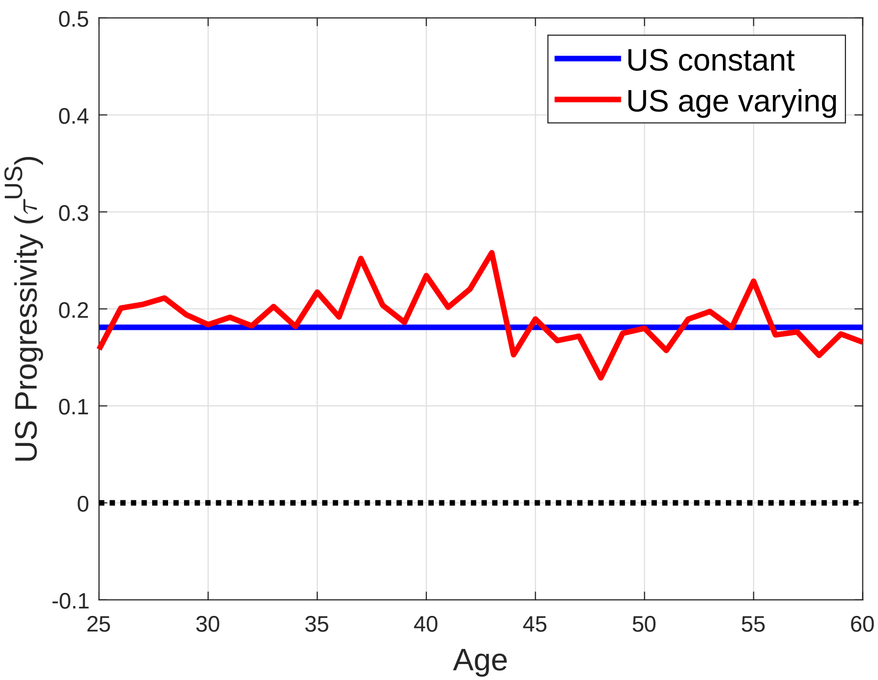
- Does the US tax/transfer system display age dependence?
- Estimate $\{\tau_a\}$ by household age



Related Literature

- Human capital: Best and Kleven (2013), Guvenen, Kuruscu, and Ozkan (2014), Kapicka and Neira (2016), Stantcheva (2017)

- Labor supply: Erosa and Gervais (2002), Karabarbounis (2016), Ndiaye (2017)

- Efficiency profile: Weinzierl (2009), Gorry and Oberfield (2012)

- Uninsurable risk: Farhi and Werning (2013), Golosov, Troshkin, and Tsyvinski (2016)

ENVIRONMENT

Preferences

- Preferences over consumption (c), hours (h), publicly-provided goods (G), and skill-investment (s) effort:

$$U_i = -v_i(s_i) + \mathbb{E}_0 \sum_{a=0}^{A} \beta^a u_i(c_{ia}, h_{ia}, G)$$

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$$v_i(s_i) \quad = \quad \frac{1}{(\kappa_i)^{1/\psi}} \cdot \frac{s_i^{1+1/\psi}}{1+1/\psi}$$

$$\kappa_i \quad \sim \quad Exp\,(1)$$

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$$u_i\,(c_{ia}, h_{ia}, G) \quad = \quad \log c_{ia} - \frac{\exp\left[(1+\sigma)\,(\varphi_i + \bar{\varphi}_a)\right]}{1+\sigma}\,(h_{ia})^{1+\sigma} + \chi \log G$$

$$\varphi_i \quad \sim \quad \mathcal{N}\left(\frac{v_\varphi}{2}, v_\varphi\right)$$

Technology

- Output is a CES aggregator over continuum of skill types s:

$$Y = \left[\int_0^\infty N(s)^{\frac{\theta-1}{\theta}}\, ds\right]^{\frac{\theta}{\theta-1}}, \quad \theta \in [1, \infty)$$

  - $N(s)$: effective hours of type s

- Aggregate resource constraint:

$$Y = \sum_{a=0}^{A} \int_{i=0}^{1} c_{i,a}\, di + G$$

  - WLOG: $G = gY$

Individual Wages and Earnings

- Hourly wages:

$$\log w_{ia} = \log p(s_i) + x_a + \alpha_{ia}$$

  - $p(s)$: skill price = marginal product of labor of type s
  - x_a: deterministic age-productivity profile
  - $\alpha_{ia} = \alpha_{i,a-1} + \omega_{ia}, \quad \omega_{ia} \sim \mathcal{N}\left(-\frac{v_\omega}{2}, v_\omega\right)$

- Autarky: no insurance against ω and no inter-temporal trade

- Gross earnings:

$$y_{ia} = \underbrace{p(s_i)}_{\text{skill investment}} \times \underbrace{\exp(x_a)}_{\text{life-cycle}} \times \underbrace{\exp(\alpha_{ia})}_{\text{shocks}} \times \underbrace{h_{ia}}_{\text{labor supply}}$$

Government

- Government budget constraint (no government debt):

$$gY = \sum_{a=0}^{A} \int_0^1 \left[y_i - \lambda_a y_i^{1-\tau_a} \right] di$$

- Government chooses vector $\{\lambda_a^*, \tau_a^*\}_{a=0}^{A}$ and g^*

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- Government chooses vector $\{\lambda_a^*, \tau_a^*\}_{a=0}^{A}$ and g^*
  - Optimal public good provision: $g^* = \frac{\chi}{1+\chi}$
  - Samuelson condition: $MRS_{C,G} = MRT_{C,G} = 1$

Equilibrium Allocations

Skill Prices and Skill Investment

- Skill price has the Mincerian form:

$$\log p(s) = \pi_0(\bar{\tau}) + \pi_1(\bar{\tau}) s(\kappa; \bar{\tau})$$

- Closed form expressions for $\pi_0(\bar{\tau})$ and $\pi_1(\bar{\tau})$

- Optimal skill investment is linear in κ:

$$s(\kappa; \bar{\tau}) = \left[(1 - \bar{\tau}) \pi_1 (\bar{\tau})\right]^{\psi} \cdot \kappa$$

where: $\bar{\tau} = \frac{1-\beta}{1-\beta^{A+1}} \sum_{a=0}^{A} \beta^a \tau_a$

- Distribution of $p(s)$ is Pareto with parameter θ

Consumption and Hours

$$\log c_a \quad = \quad \log \lambda_a + (1-\tau_a)\left[\frac{\log(1-\tau_a)}{1+\sigma} - (\varphi + \bar{\varphi}_a) + \log p(s) + x_a + \alpha\right]$$

- Progressivity determines the pass-through of shocks/inequality

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- Note: insurable productivity shocks enters h but not c

Social Welfare

Social Welfare Function

- Utilitarian: equal weight on welfare of all currently alive agents, discounts welfare of future cohorts at rate β
- Start with policy that maximizes steady state welfare
- Then consider policy that maximizes welfare including transition
  - Initial condition: steady-state under τ^{US}
  - Transition driven by irreversible skill choice of existing cohorts
  - Allow $\{\lambda_{at}\}$ to balance budget every period t along transition
- Easy to optimize over large vector of $\{\lambda_a^*, \tau_a^*\}_{a=0}^{A}$ because social welfare has a closed-form

Social Welfare Function

$$
\begin{aligned}
\mathcal{W}^{ss}(\{\tau_a\}) \;=\;& -\frac{1}{A}\sum_{a=0}^{A-1} \underbrace{\frac{1-\tau_a}{1+\sigma}}_{\text{Disutility of labor}} \\
&+ (1+\chi)\underbrace{\log\left[\sum_{a=0}^{A-1}(1-\tau_a)^{\frac{1}{1+\sigma}}\cdot \exp\left(x_a-\bar{\varphi}_a\right)\right]}_{\text{Effective hours } N_a} \\
&+ (1+\chi)\underbrace{\frac{1}{(1+\psi)(\theta-1)}\left[\psi\log\left(1-\bar{\tau}\right)+\log\left(\frac{1}{\eta\theta^{\psi}}\left(\frac{\theta}{\theta-1}\right)^{\theta(1+\psi)}\right)\right]}_{\text{Productivity: } \log(\text{average skill price}) = \log(E[p(s)])} \\
&- \underbrace{\frac{\psi}{1+\psi}\frac{1-\bar{\tau}}{\theta}}_{\text{Avg. education cost}} + \frac{1}{A}\sum_{a=0}^{A-1}\underbrace{\left[\log\left(1-\left(\frac{1-\tau_a}{\theta}\right)\right)+\left(\frac{1-\tau_a}{\theta}\right)\right]}_{\text{Cost of consumption dispersion across skills}} \\
&- \frac{1}{A}\sum_{a=0}^{A-1}\underbrace{\frac{1}{2}\left(1-\tau_a\right)^2\left(v_{\varphi}+a v_{\omega}\right)}_{\text{Cons. dispersion due to unins. risk and pref. heter.}}
\end{aligned}
$$

Qualitative Analysis

Optimal Policy: Conditions for Age Invariance of τ_a

1. Optimal $\{\tau_a^*, \lambda_a^*\}$ are age-invariant if:
   (a) $\beta = 1$: no discounting
   (b) $v_\omega = 0$: flat profile of uninsurable productivity dispersion
   (c) flat age profile of efficiency net of disutility $\{x_a - \bar{\varphi}_a\}$

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   - Regressivity corrects the externality linked to valued G
3. Given any profile for $\{\tau_a\}$, the optimal profile for $\{\lambda_a^*\}$ equates average consumption by age

Optimal Age-Varying Progressivity

- Three separate channels that shape age profile of progressivity:

  (a) Discounting Channel
  $\beta < 1$ *implies an optimal profile* for $\{\tau_a^*\}$ *increasing in age*

  (b) Uninsurable Risk Channel
  Permanent uninsurable risk $(v_\omega > 0)$ *implies an optimal profile* for $\{\tau_a^*\}$ is *increasing in age*

  (c) Life-Cycle Channel
  Introducing an age profile in $\{x_a - \bar{\varphi}_a\}$ *implies an optimal profile for* $\{\tau_a^*\}$ *which is its mirror image*.

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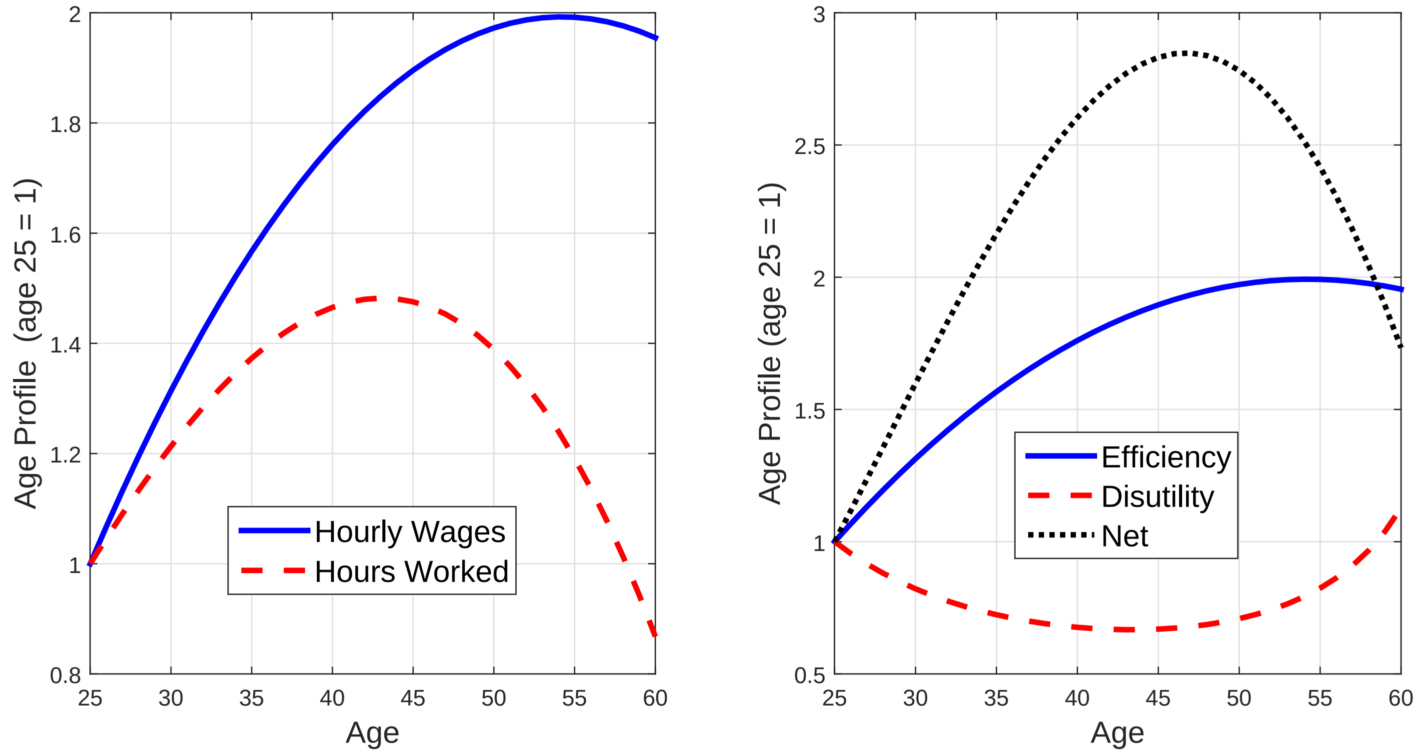
- The optimal $\{\lambda_a^*, \tau_a^*\}$ equate labor wedge, i.e. $1 - MTR_a$ and the MUC_a, i.e. consumption, by age

PARAMETERIZATION

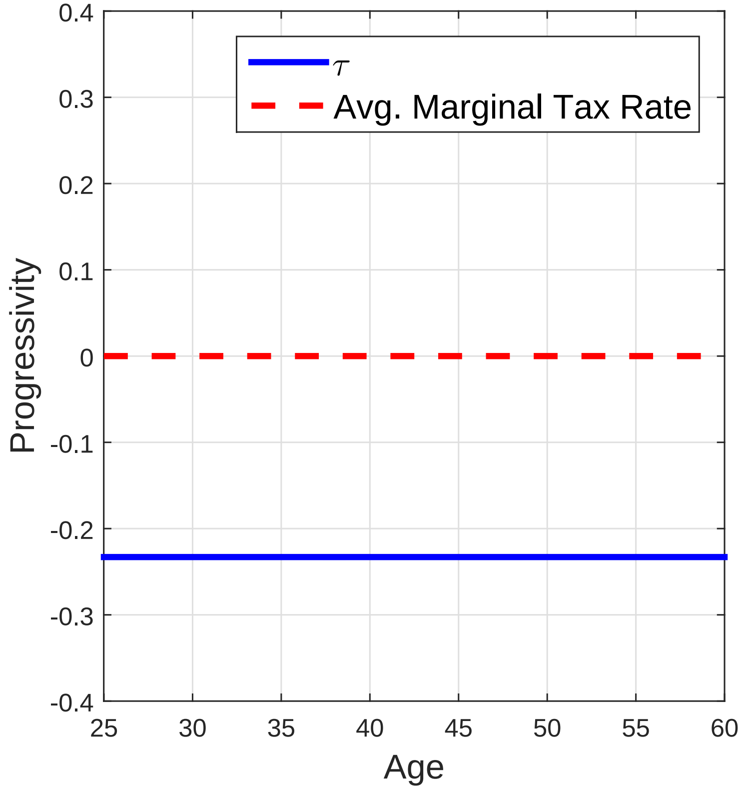
Age Profile for Efficiency and Disutility of Work

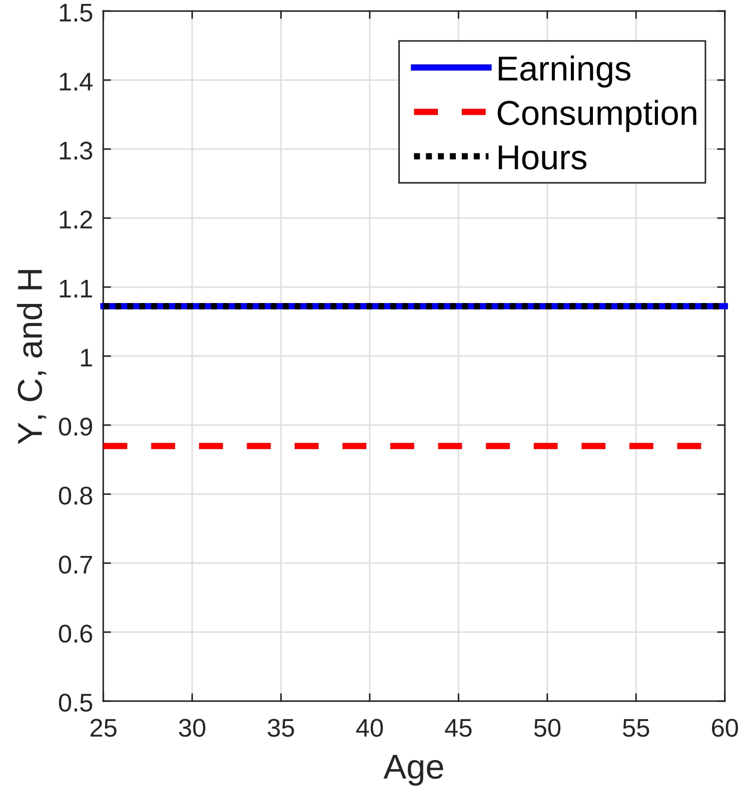


- Important: $\{x_a - \bar{\varphi}_a\}$ is strongly hump-shaped

QUANTITATIVE RESULTS

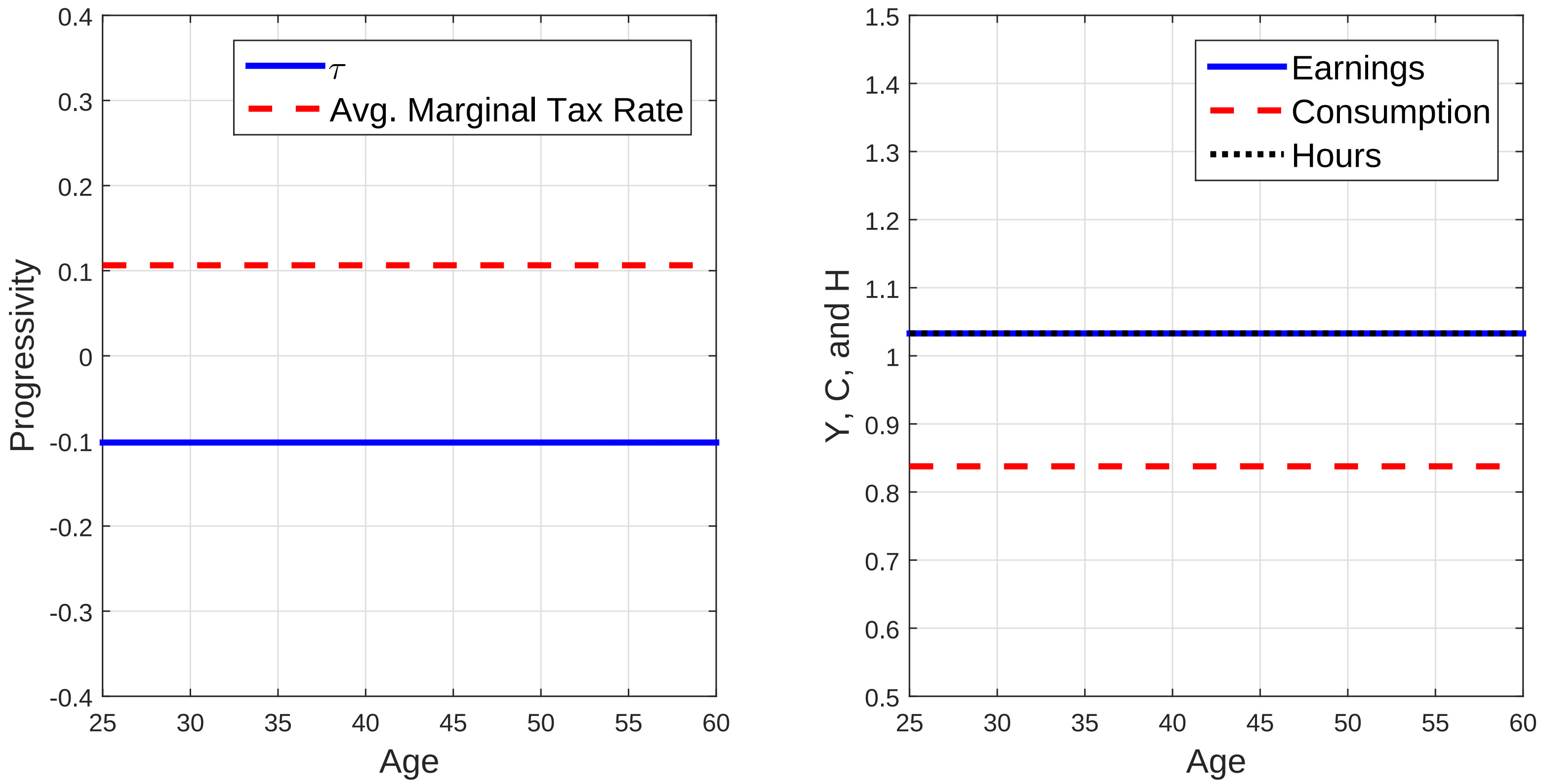
Representative Agent





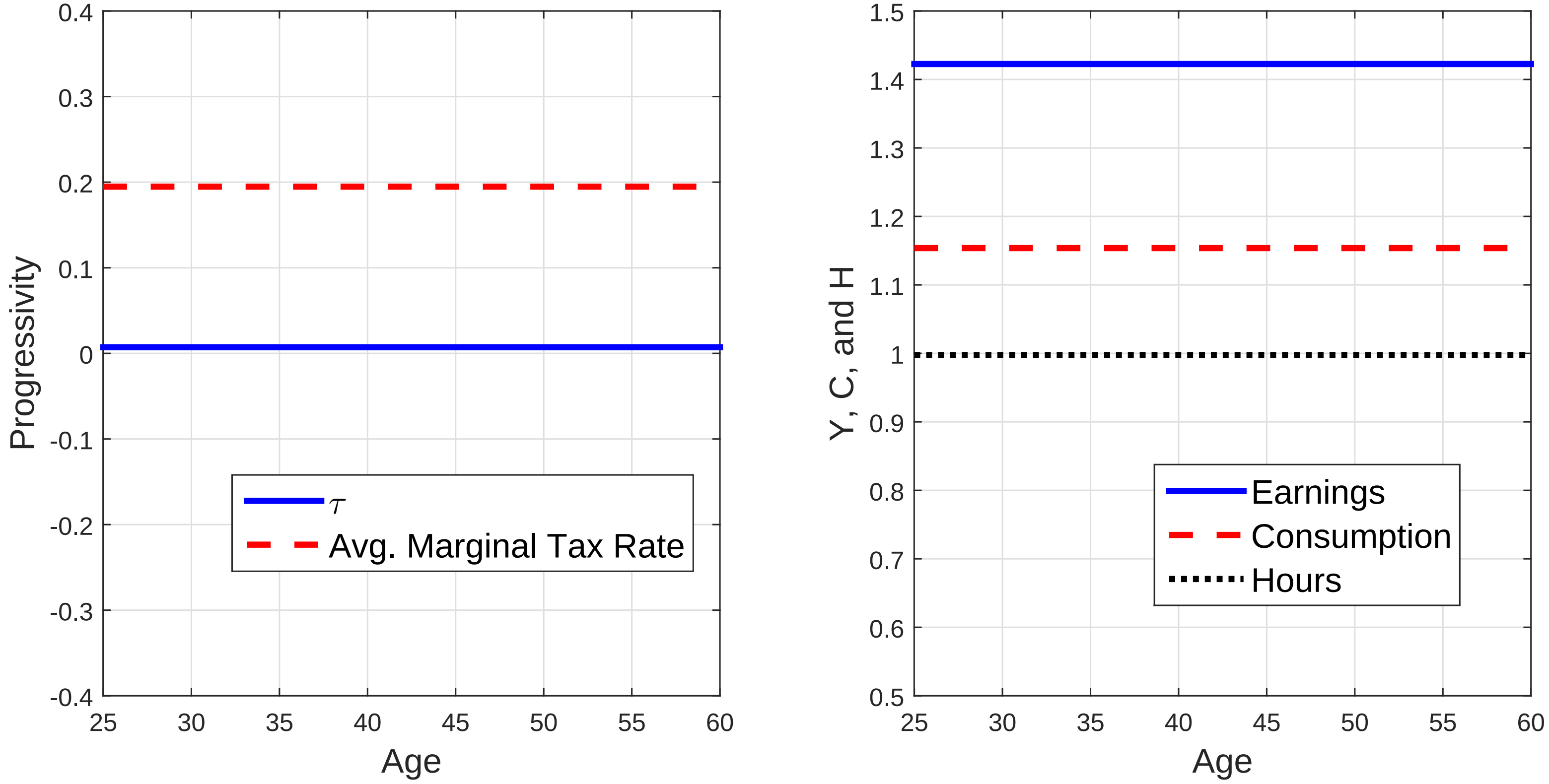
- Optimality: $\tau_a^* = -\chi$

Add Heterogeneity in Disutility of Work (φ)



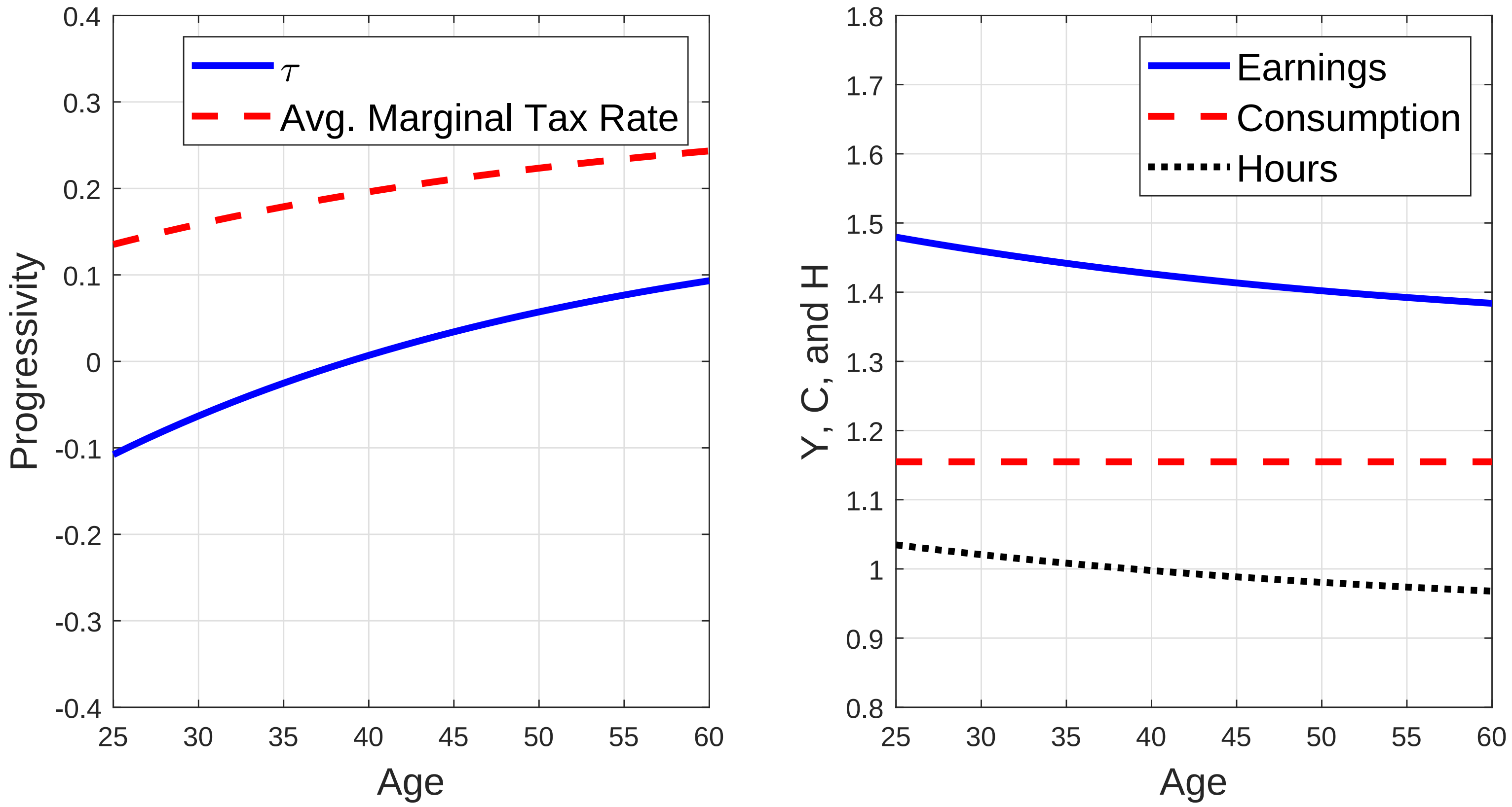
- τ_a^* still flat but shifted up (redistribution) $\Rightarrow$ lower labor supply

Add Heterogeneity in Ability (θ finite)



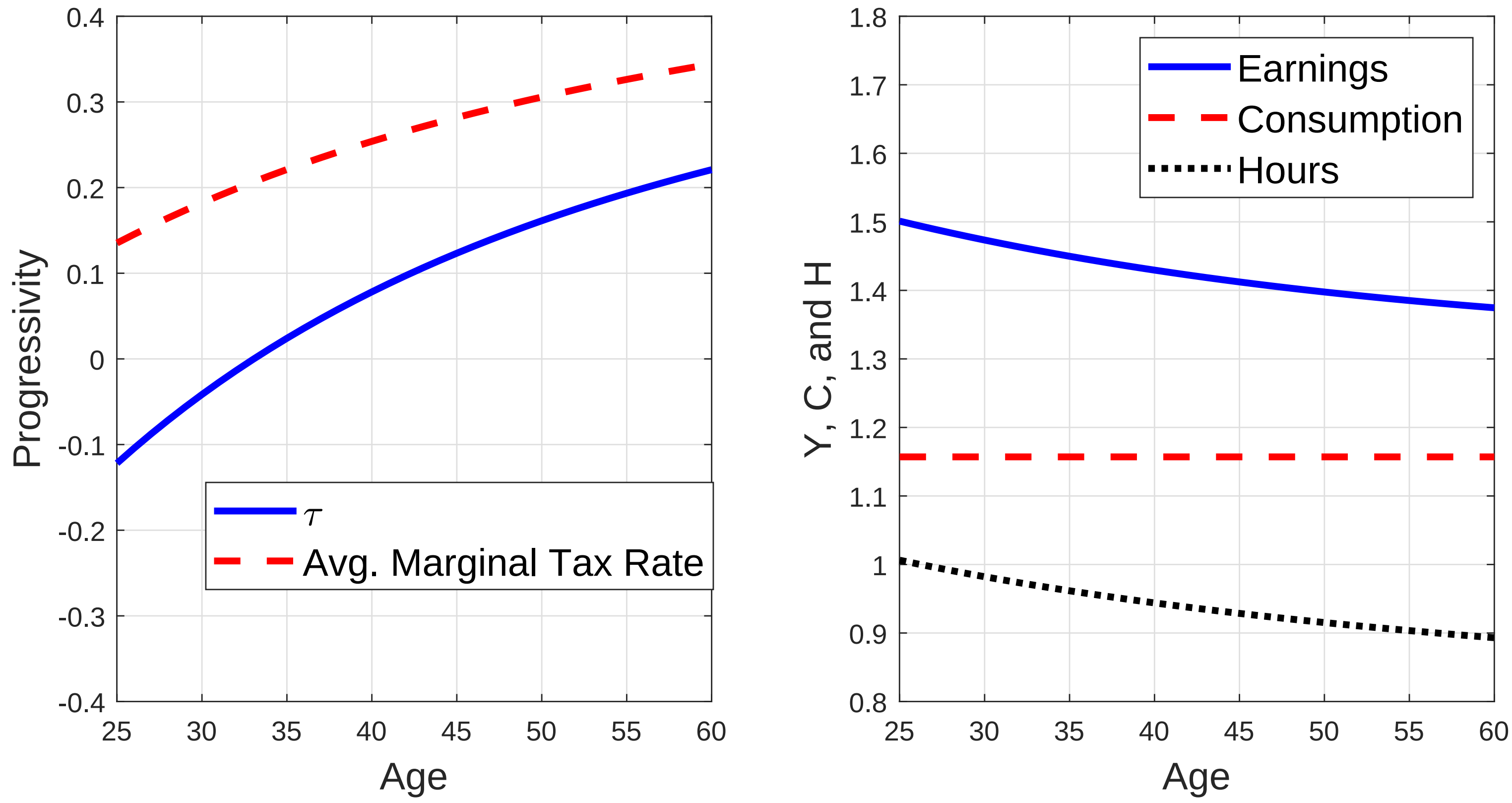
- τ_a^* still flat but shifted further up (redistribution > distortion)

Add Discounting ($\beta < 1$)



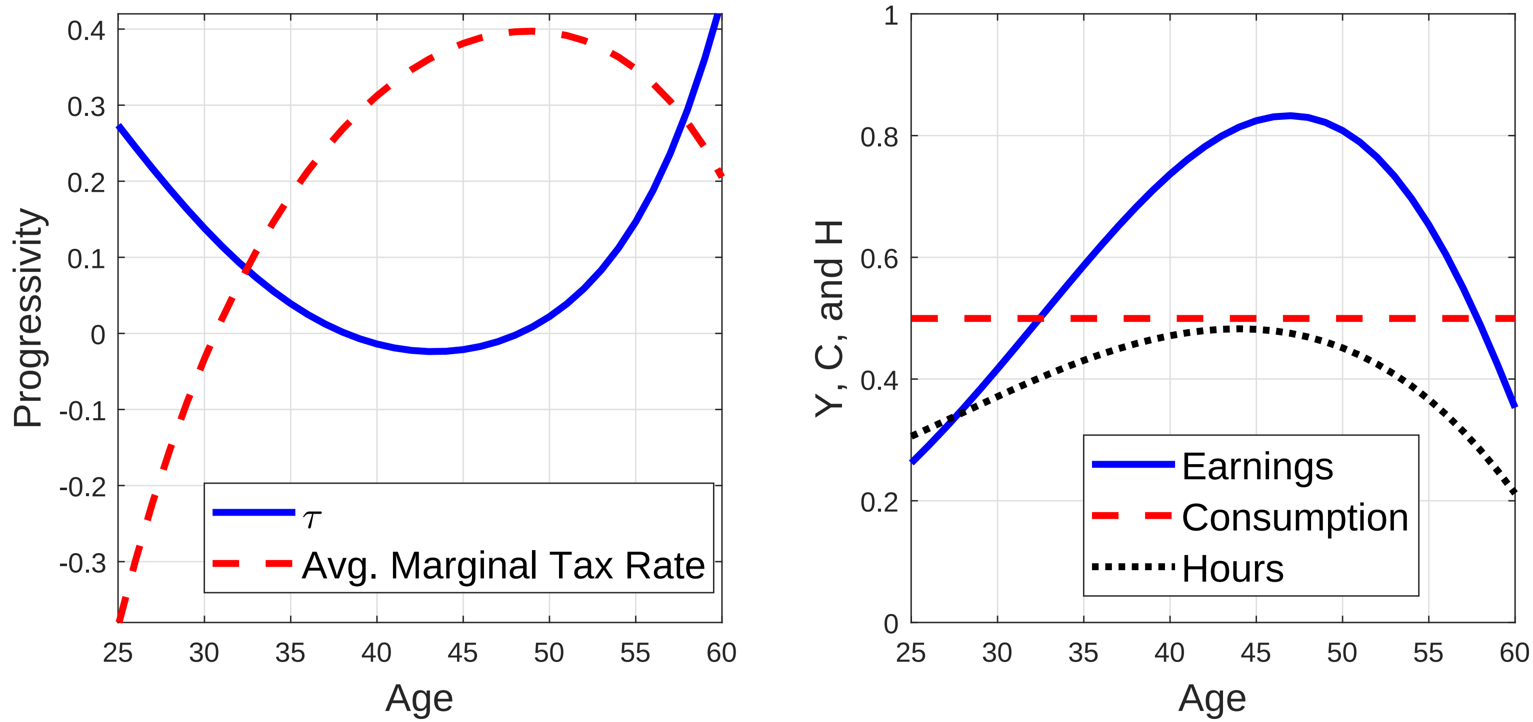
- Skill choice depends on $\bar{\tau}^* = \frac{1-\beta}{1-\beta^{A+1}} \sum_{a=0}^{A} \beta^a \tau_a^*$

Add Labor Market Risk ($v_\omega > 0$)



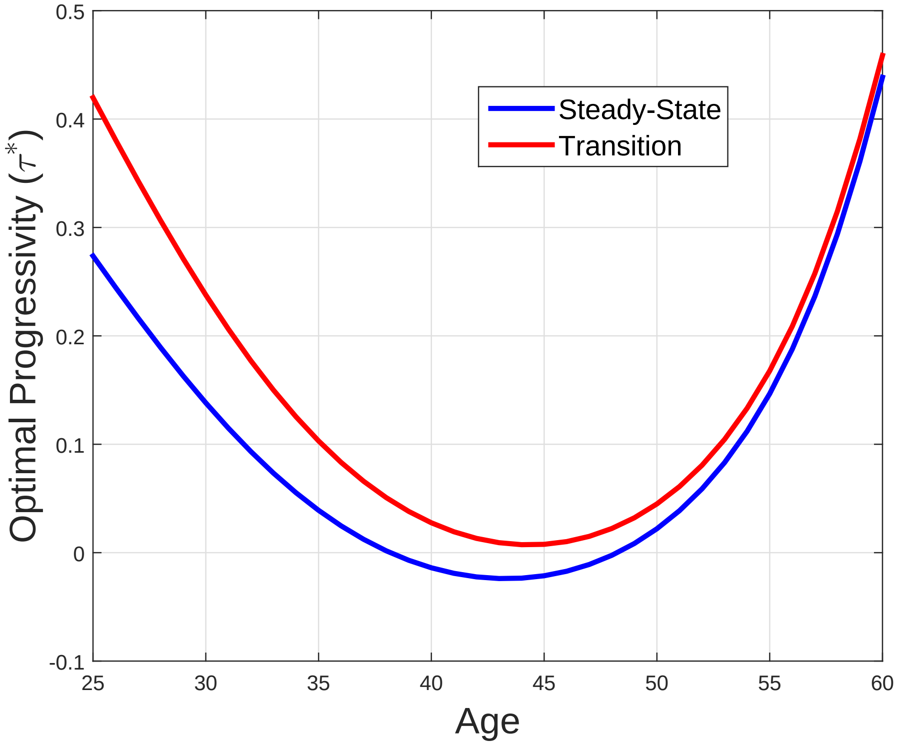
- Profile for τ_a^* steeper: more redistribution needed later in life since uninsurable risk cumulates

Add Life Cycle $\{x_a, \bar{\varphi}_a\}$



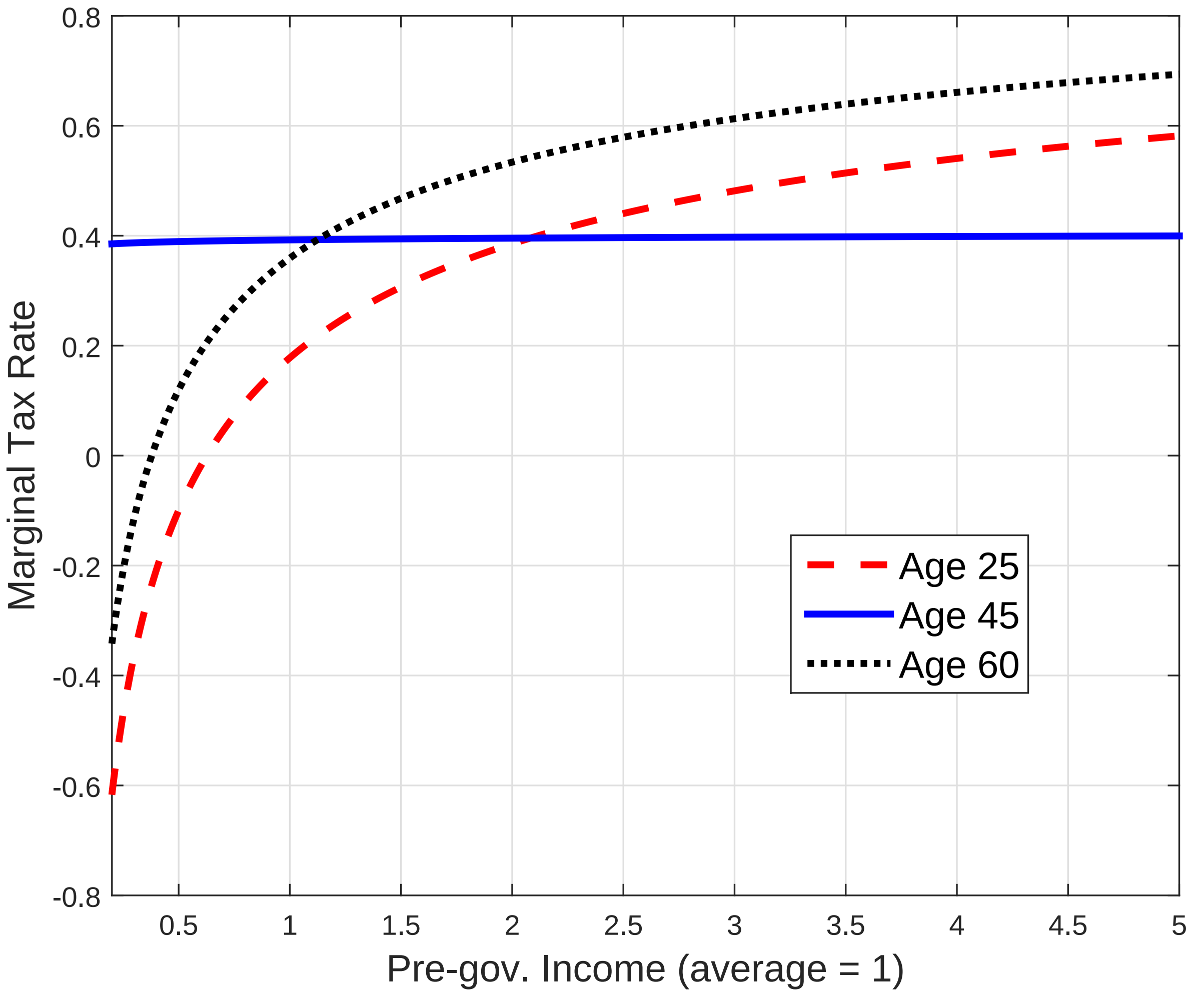
- $x_a - \bar{\varphi}_a$ hump-shaped + τ_a distorts labor supply $\Rightarrow \tau_a^*$ U-shaped

Transitional Dynamics: All Channels



- Sunk skill investment channel: $\Rightarrow \tau_a^*$ higher at all ages
- Discounting channel weaker: $\Rightarrow$ profile for τ_a^* flatter

All Channels: Marginal Tax Rates by Age



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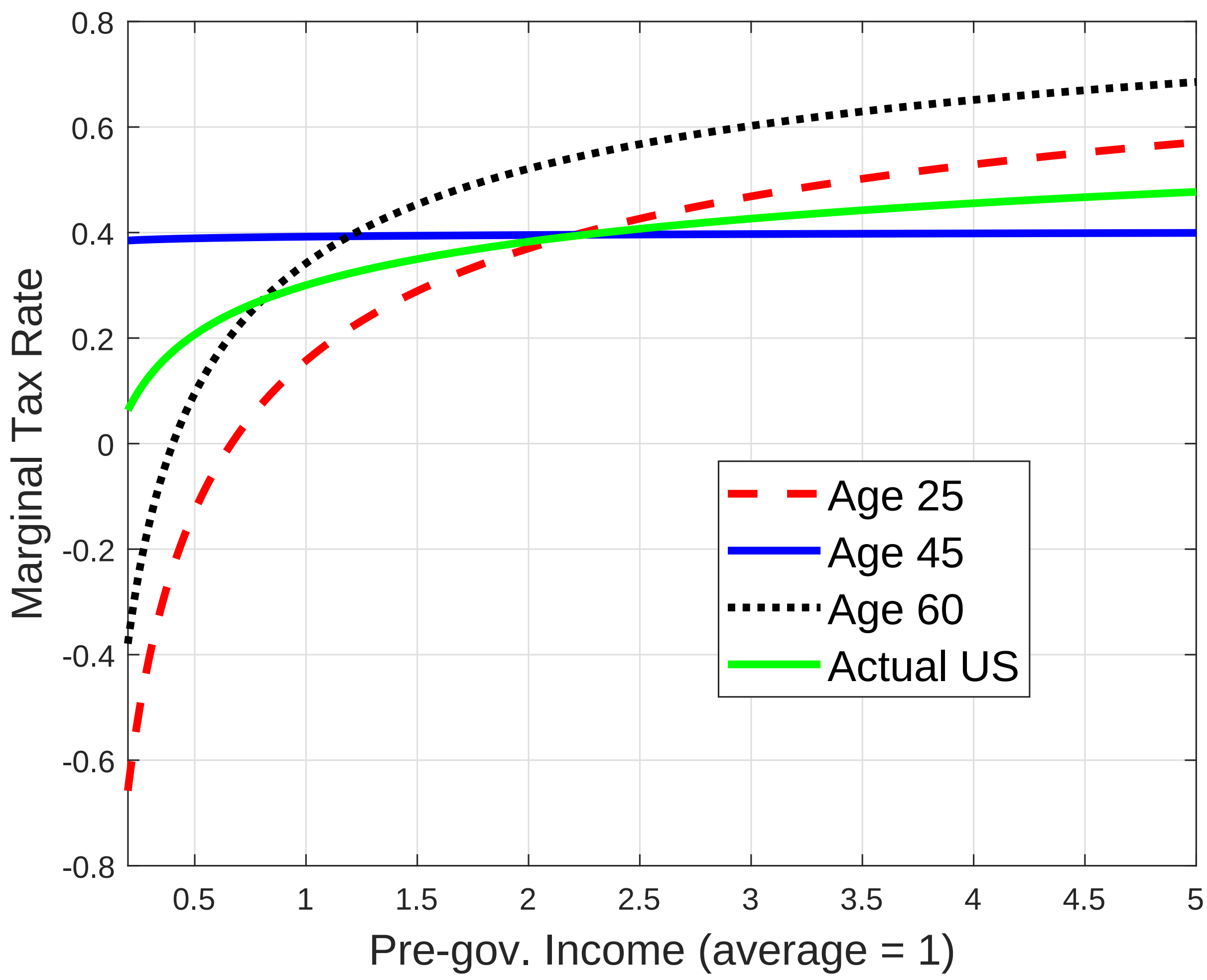

Welfare Gains

- Equivalent variation: % of lifetime consumption
- Computed relative to the US tax/transfer system

	Benchmark	U.S. BL	Natural BL
(λ^*, τ^*) constant	0.04		
λ^* age-varying, τ^* constant	3.00		
(λ^*, τ^*) age-varying	3.70		

Intertemporal Trade

Introducing Borrowing and Lending

- Modification to baseline model:
  - Non-contingent bonds in zero net supply s.t. credit limit

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- Modification to baseline model:
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- Numerical solution:
  - Skill investment decision rules unchanged
  - Solve numerically for hours worked, savings, interest rate
  - Search for optimal $\{\tau_a\}$ as 3rd order polynomial of age

Estimation of Consumer Credit Limit

- SCF 2013 data, households 25-60. We sum four components:

  (a) Limit on credit cards

  (b) Limit on HELOCs

  (c) Installment loans for durables

  (d) Other debt (e.g., short-term loans from IRA)

- We set it to 2 $\times$ annual income (95th pct conditional on borrowing)

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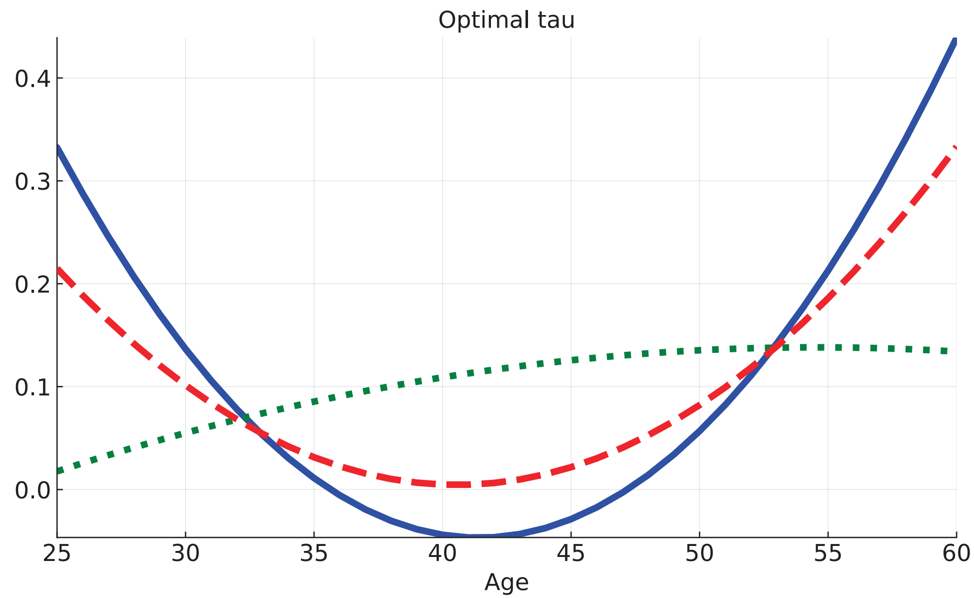
- Zero BL (tightest) $\Rightarrow$ autarky

- Natural BL (loosest): max 30 times annual income

Optimal Progressivity with Borrowing/Saving



- Zero BL: $\{\tau_a^*\}$ identical to benchmark model
- Natural BL: $\{\tau_a^*\}$ close to model with flat profile for $\{x_a - \bar{\varphi}_a\}$
- U.S. BL: $\{\tau_a^*\}$ closer to autarky/benchmark case

Welfare Gains

- Equivalent variation: % of lifetime consumption
- Computed relative to the US tax/transfer system

	Benchmark	U.S. BL	Natural BL
(λ^*, τ^*) constant	0.04	0.15	0.15
λ^* age-varying, τ^* constant	3.00	1.88	1.43
(λ^*, τ^*) age-varying	3.70	2.12	1.47

THANKS!