Optimal Tax Progressivity with Age-Dependent Taxation

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How progressive should labor income taxation be?

- Arguments in favor of progressivity:
  - Redistribution with respect to unequal initial conditions
  - Public insurance of privately-uninsurable life-cycle shocks

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- Arguments against progressivity:
  - Labor supply distortion
  - Human capital investment distortion

HSV 2017

- Parametric tax-transfer system

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

  - $\tau > 0 \quad \Rightarrow$ progressive system: $\quad T'(y) > \frac{T(y)}{y}$
  - Function closely approximates actual US system
  - Preserves tractability $\Rightarrow$ progressivity drivers transparent

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- But is this form too restrictive?
  - Static setting: best policy in class closely replicates Mirrlees:
    - Heathcote and Tsujiyama, 2018
  - Dynamic setting: maybe welfare gains if taxes age-varying:
    - Weinzierl 2009, Farhi & Werning 2013, Golosov, Troshkin & Tsyvinski, 2016

This Paper

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4. skill investment
5. government expenditures valued by households

MODEL

Demographics and Preferences

- Perpetual youth demographics with constant survival probability δ
- Preferences over consumption (c), hours (h), publicly-provided goods (G), and skill-investment (s) effort:

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

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

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

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

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

Individual Wages and Earnings

$$\log z_{ia} = x_a + \alpha_{ia} + \varepsilon_{ia}$$

- x_a deterministic age-productivity profile
  - $\alpha_{ia} = \alpha_{i,a-1} + \omega_{ia}, \quad \omega_{ia} \sim \mathcal{N}\left(-\frac{v_\omega}{2}, v_\omega\right)$ [perm. unins.]
  - $\varepsilon_{ia} \sim \mathcal{N}\left(-\frac{v_{\varepsilon,a}}{2}, v_{\varepsilon,a}\right)$ [private insurance]
- Pre-government earnings:

$$y_{ia} = \underbrace{p(s_i)}_{\text{skill price}} \times \underbrace{\exp(x_a)}_{\text{age-productivity profile}} \times \underbrace{\exp(\alpha_{ia} + \varepsilon_{ia})}_{\text{efficiency}} \times \underbrace{h_{ia}}_{\text{hours}}$$

- Within-period insurance against ε
- No asset trade between periods (work in progress)

Technology

- Aggregate effective hours by skill type, $N(s)$
- Output a CES aggregator over continuum of skill types:

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

- Skill price: $p(s) =$ marginal product of $N(s)$

$$\log p\left(s\right)=\frac{1}{\theta}\log Y-\frac{1}{\theta}\log\left[N\left(s\right)\right]$$

- Aggregate resource constraint:

$$Y=\int_0^1(1-\delta)\sum_{a=0}^{\infty}\delta^a c_i\, di+G$$

Government

- Government budget constraint (no government debt):

$$G = (1-\delta)\sum_{a=0}^{\infty}\delta^a \int_0^1 \left[y_i - \lambda_a y_i^{1-\tau_a}\right] di$$

- Government chooses sequence $\{\lambda_a, \tau_a\}_{a=0}^{\infty}$, and G

- Equivalently, government chooses $g \equiv \frac{G}{Y}$

Equilibrium Allocations

$$\log c(\alpha, \varphi, s) \quad = \quad \log \lambda_a + \frac{\log(1-\tau_a)}{1+\hat{\sigma}_a} + (1-\tau_a)\left(\log p(s) + x_a + \alpha - \varphi\right)$$

$$\log h(\varphi, \varepsilon) \quad = \quad \frac{\log(1-\tau_a)}{(1+\hat{\sigma}_a)(1-\tau_a)} - \varphi + \frac{\varepsilon}{\widehat{\sigma}_a}$$

- $\frac{1}{\hat{\sigma}_a} = \frac{1-\tau_a}{\sigma+\tau_a}$ is the tax-modified Frisch elasticity

Skill Prices and Choices

- Skill price has Mincerian form:

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

- Optimal skill investment linear in κ;

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

where $\bar{\tau} = (1 - \beta\delta) \sum_{a=0}^{\infty} (\beta\delta)^a \tau_a$

- Equilibrium:

$$\begin{aligned} \pi_1(\bar{\tau}) &= \left(\frac{1}{\theta}\right)^{\frac{1}{1+\psi}} (1 - \bar{\tau})^{-\frac{\psi}{1+\psi}} \\ s(\kappa; \bar{\tau}) &= \left(\frac{1 - \bar{\tau}}{\theta}\right)^{\frac{\psi}{1+\psi}} \cdot \kappa \end{aligned}$$

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

SOCIAL WELFARE

Social Welfare Function

- Planner chooses policy $(g, \{\tau_a, \lambda_a\})$ once and for all, subject to balanced budget
- Planner puts equal weight on all currently alive agents, discounts U of future cohorts at rate β
- Start with policy that maximizes steady state welfare
- Then consider policy that maximizes welfare including transition
- Easy to optimize over large vector of policy choices because social welfare has a closed-form

Optimal Policy

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3. Optimal $\{\tau_a^*\}$ and $\{\lambda_a^*\}$ are age-invariant if:
   (a) $v_\omega = 0$: no uninsurable risk
   (b) flat $\{x_a\}$ efficiency profile
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4. If, in addition, $\theta = \infty$ and $v_\omega = v_\varepsilon = 0$, then optimal progressivity is

$$\tau_a = -\chi$$

Optimal Age-Varing Policy: Steady State

- Take as a baseline a specification in which the optimal $\{\tau_a^*\}$ is flat
- **RISK CHANNEL**
  Permanent uninsurable risk ($v_\omega > 0$) implies optimal profiles $\{\tau_a^*\}$ and $\{\lambda_a^*\}$ increasing in age.
- **LIFE-CYCLE PROFILE CHANNEL**
  Upward-sloping age efficiency profile $\{x_a\}$ implies decreasing optimal profiles $\{\tau_a^*\}$ and $\{\lambda_a^*\}$
- **DISCOUNTING CHANNEL**
  Lower β implies steeper optimal profiles $\{\tau_a^*\}$ and $\{\lambda_a^*\}$
- **INSURANCE CHANNEL**
  Insurable risk $\{v_{\varepsilon,a}\}$ rising with age implies declining optimal $\{\tau_a^*\}$ and $\{\lambda_a^*\}$

QUANTITATIVE IMPLICATIONS

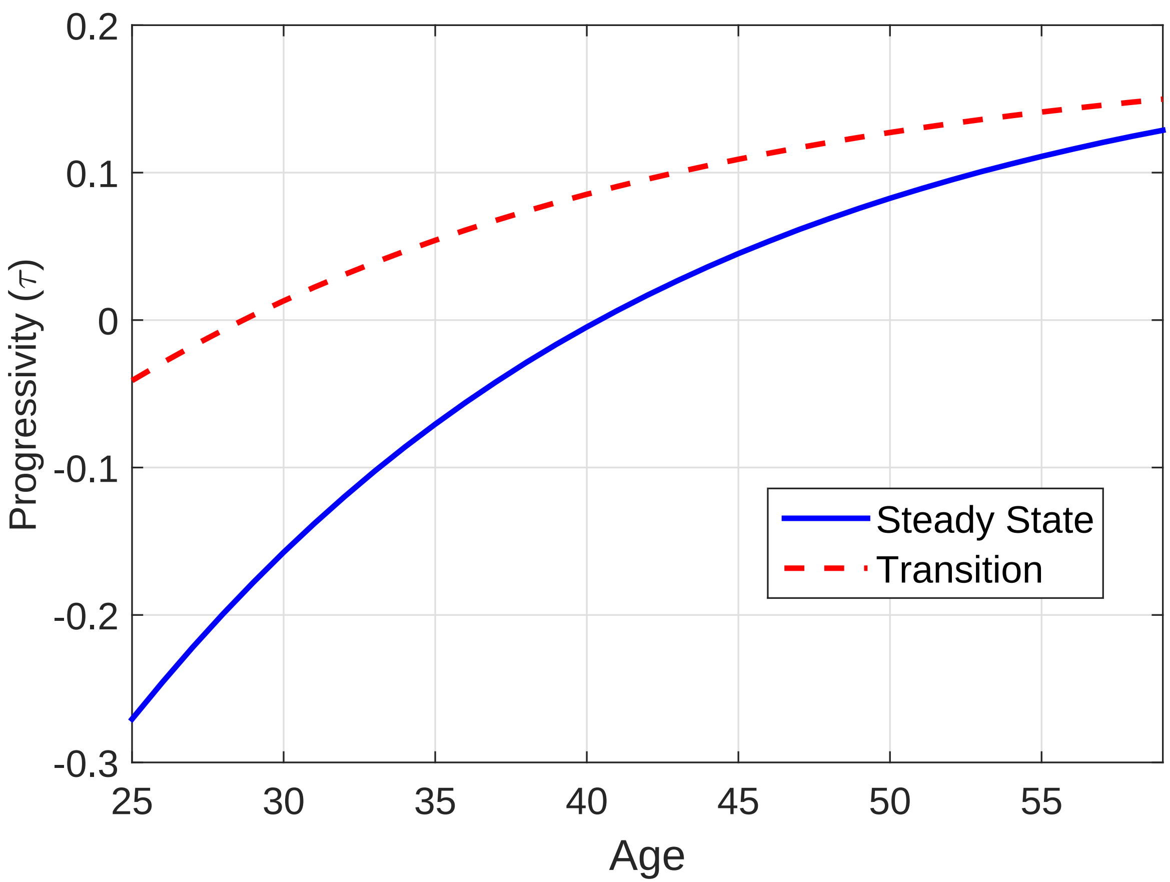
Parameterization

- Parameter vector $\{\chi, \sigma, \psi, \theta, v_\varphi, v_\omega\}$
- Assume observed $G/Y = 0.19 = g^*$ $\rightarrow \chi = 0.233$
- Frisch elasticity (micro-evidence ~ 0.5) $\rightarrow \sigma = 2$
- Price-elasticity of skill investment $\rightarrow \psi = 0.65$

$$
\begin{aligned}
var(\log h) &\rightarrow v_\varphi = 0.035 \\
var^0(\log c) &\rightarrow \theta = 3.12 \\
cov(\log w, \log c) &\rightarrow v_\omega = 0.003 \\
cov(\log w, \log h) &\rightarrow v_{\varepsilon,a} = 0 \quad \text{(for today)}
\end{aligned}
$$

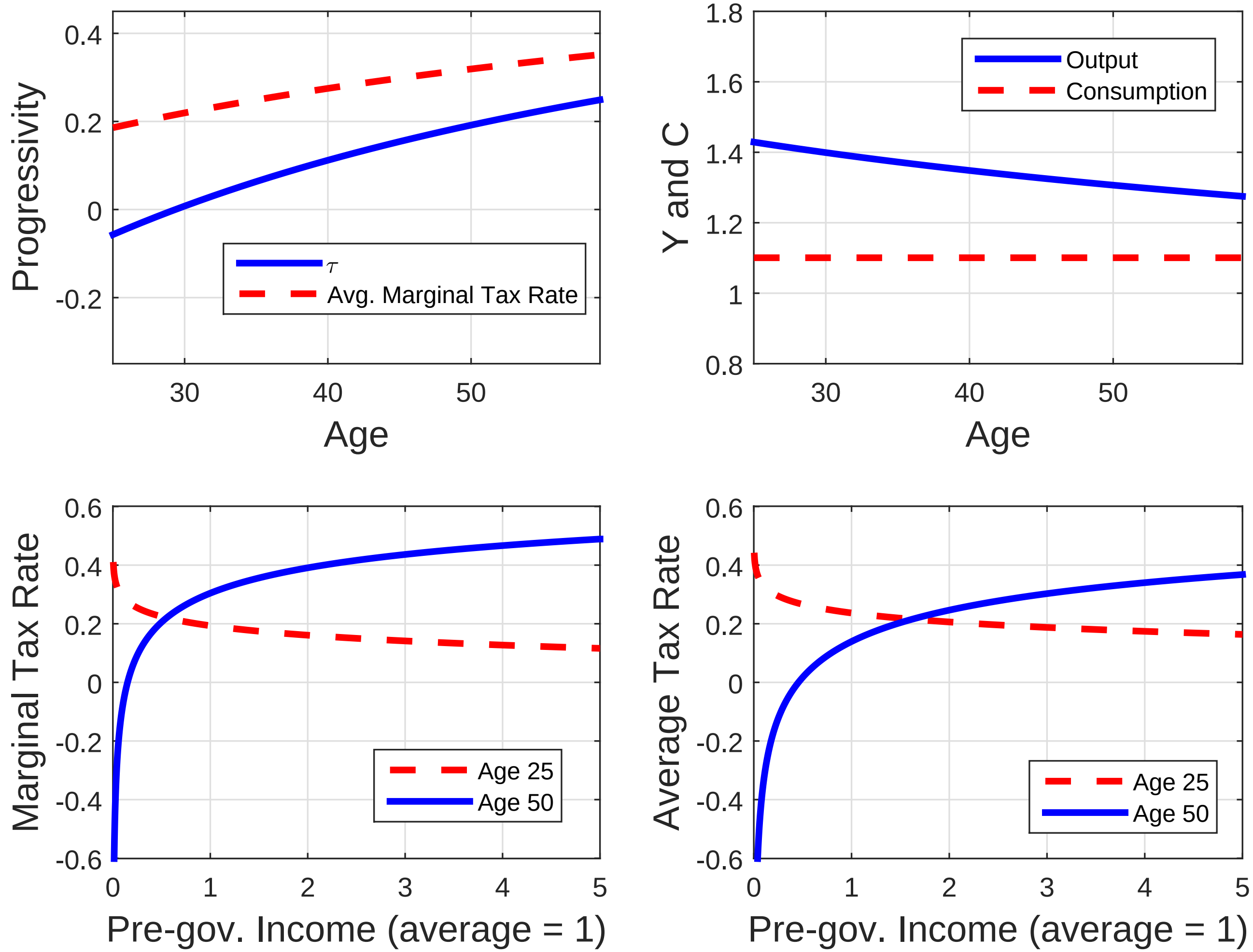
- Life-cycle profile $\{x_a\}$ estimated from PSID

Discounting Channel



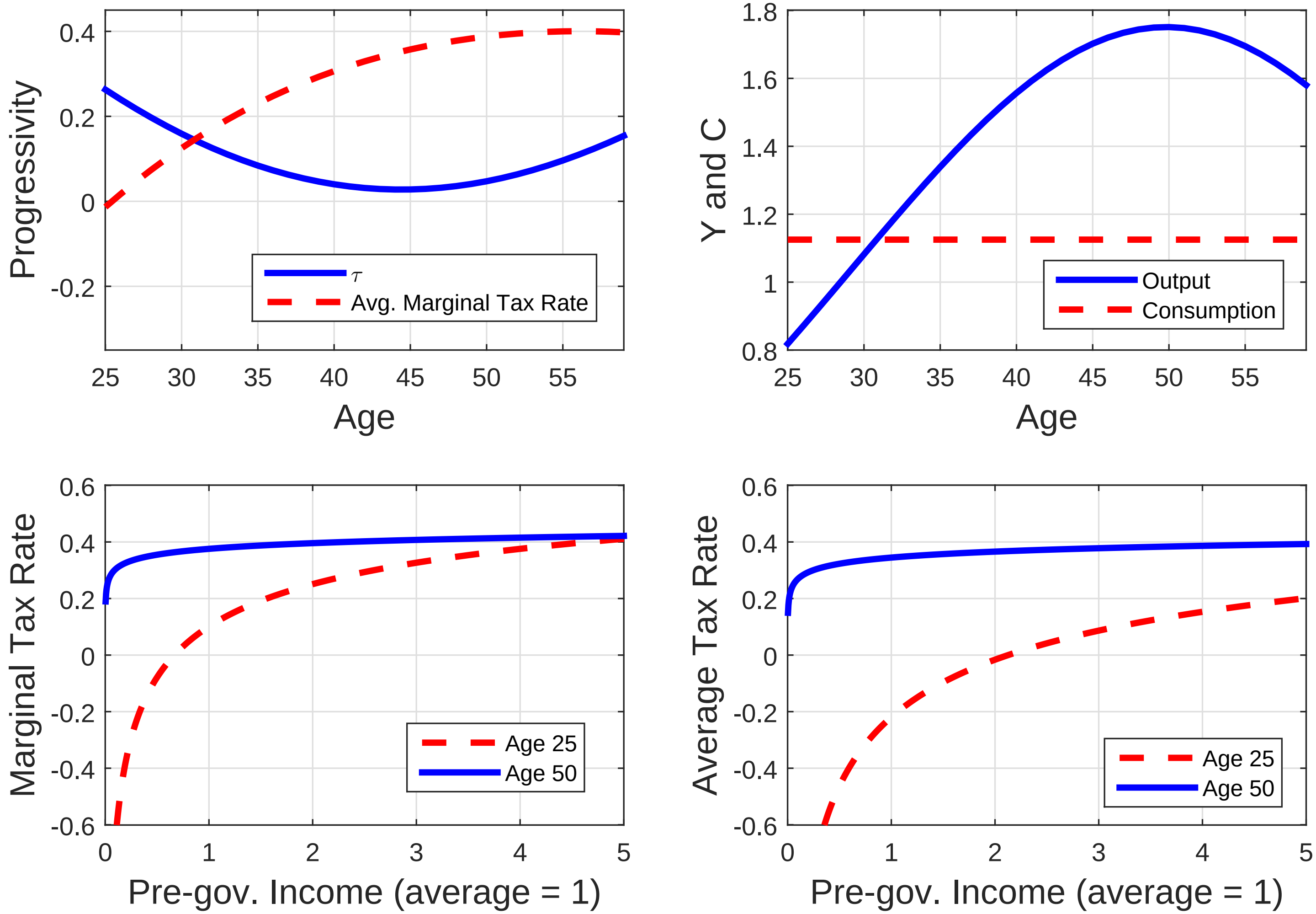
$v_\omega = 0$, $\{x_a\}$ flat, $\beta = 0.95$

Risk Channel



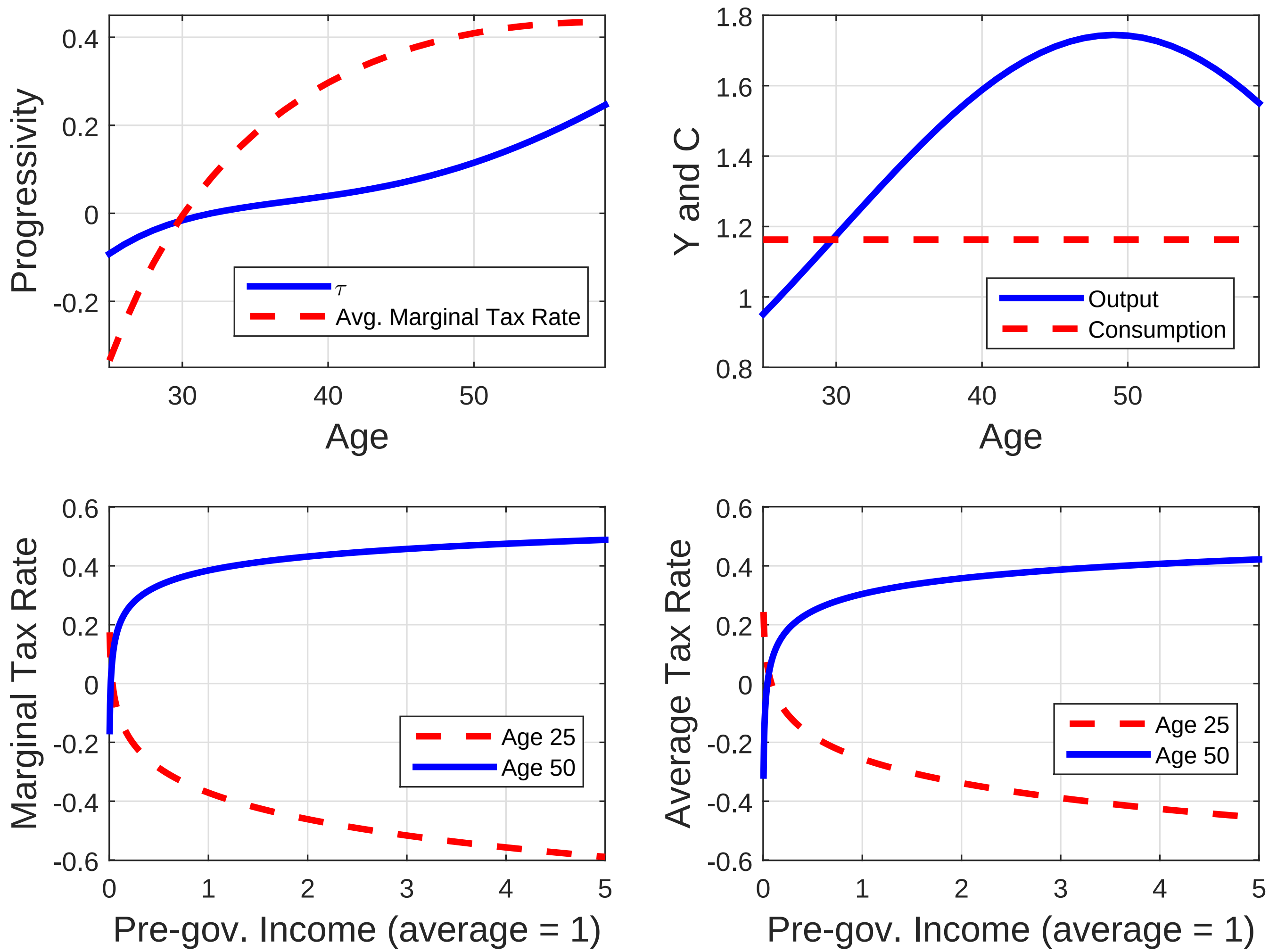
$v_\omega > 0$, $\{x_a\}$ flat, $\beta = 1.0$ (no discounting channel)

Add Life Cycle Channel



$v_\omega > 0$, $\{x_a\}$ rising, $\beta = 1$

Add Discounting Channel: Steady State Baseline



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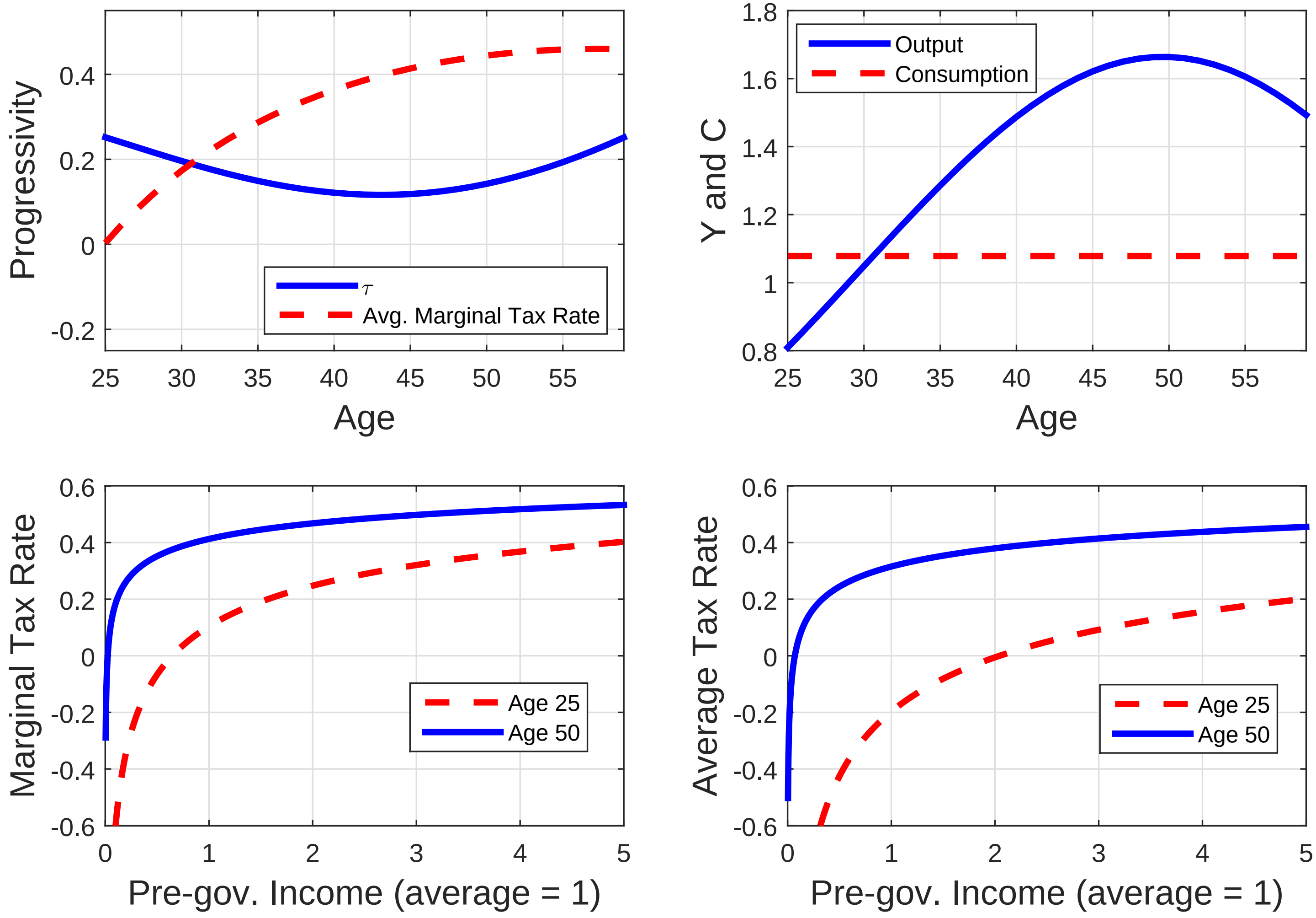
All Channels: Transition



$v_\omega > 0$, $\{x_a\}$ rising, $\beta = 0.95$, $\tau_{-1} = 0.181$

Lessons

- Distinct roles for λ_a and τ_a
  - Progressivity τ_a key for skill investment and labor supply distortions, and for redistribution / insurance within age groups
  - Tax level λ_a delivers redistribution across age groups
- Forces for and against increasing progressivity with age offset:
  - Rising labor productivity with age + rising insurable risk $\Rightarrow$ want progressivity to decline with age
  - Permanent uninsurable risk + discounting in skill investment $\Rightarrow$ want progressivity to increase with age
- Plan to explore how optimal policy changes once we introduce savings choice