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

• Arguments against progressivity:
  ▶ Labor supply distortion
  ▶ Human capital investment distortion
HSV 2017

- Parametric tax-transfer system

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

- \( \tau > 0 \) \( \Rightarrow \) progressive system: \( T'(y) > \frac{T(y)}{y} \)

- Function closely approximates actual US system

- Preserves tractability \( \Rightarrow \) progressivity drivers transparent
• Parametric tax-transfer system

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- Preserves tractability \implies \text{progressivity drivers transparent}

• 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

- Generalize HSV 2017 to allow age variation in tax system:

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• Model ingredients:

1. differential diligence & learning ability \[\text{[ex-ante heter.]}\]

2. life-cycle labor productivity shocks: some uninsurable, some privately insurable \[\text{[ex-post heter.]}\]
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3. flexible labor supply

4. skill investment

5. government expenditures valued by households
MODEL
Demographics and Preferences

- **Perpetual youth** demographics with constant survival probability $\delta$.

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

  $$\kappa_i \sim \text{Exp}(1)$$

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

  $$\varphi_i \sim \mathcal{N} \left( \frac{\nu_\varphi}{2}, \nu_\varphi \right)$$
Individual Wages and Earnings

\[
\log z_{ia} = x_a + \alpha_{ia} + \varepsilon_{ia}
\]

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

• Pre-government earnings:
  
  \[y_{ia} = p(s_i) \times \exp(x_a) \times \exp(\alpha_{ia} + \varepsilon_{ia}) \times h_{ia}\]

  - skill price
  - age-productivity profile
  - efficiency
  - hours

• Within-period insurance against \(\varepsilon\)

• 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:

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

• Skill price: \( p(s) = \text{marginal product of } N(s) \)

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

• Aggregate resource constraint:

\[
Y = \int_0^1 (1 - \delta) \sum_{a=0}^{\infty} \delta^a c_i d + G
\]
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

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

\[
\log h(\varphi, \varepsilon) = \frac{\log(1 - \tau_a)}{(1 + \hat{\sigma}_a)(1 - \tau_a)} - \varphi + \frac{\varepsilon}{\hat{\sigma}_a}
\]

- \(\frac{1}{\hat{\sigma}_a} = \frac{1 - \tau_a}{\sigma + \tau_a}\) 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 $\kappa$;

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

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

• Equilibrium:

$$\pi_1(\bar{\tau}) = \left( \frac{1}{\theta} \right)^{\frac{1}{1+\psi}} (1 - \bar{\tau})^{-\frac{\psi}{1+\psi}}$$

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

• Distribution of $p(s)$ is Pareto with parameter $\theta$
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 utility \( U \) of future cohorts at rate \( \beta \).

- 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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\[ g^* = \frac{\chi}{1 + \chi} \]
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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
   (c) \( \beta \to 1 \), and
   (d) \( v_{\varepsilon,a} \) age-invariant
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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-Varging 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 $\beta$ implies steeper optimal profiles $\{\tau^*_a\}$ and $\{\lambda^*_a\}$

- **INSURANCE CHANNEL**
  Insurable risk $\{v_{\in\varepsilon,a}\}$ 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 \( \sim 0.5 \)) \( \rightarrow \sigma = 2 \)

- Price-elasticity of skill investment \( \rightarrow \psi = 0.65 \)

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

- Life-cycle profile \( \{ x_a \} \) estimated from PSID
Discounting Channel

\[ v_\omega = 0, \{x_a\} \text{ flat, } \beta = 0.95 \]
Risk Channel

\[ \nu_w > 0, \ \{x_a\} \text{ flat, } \beta = 1.0 \text{ (no discounting channel)} \]
Add Life Cycle Channel

$v_\omega > 0$, \( \{x_\omega\} \) rising, \( \beta = 1 \)
$v_\omega > 0$, $\{x_a\}$ rising, $\beta = 0.95$
$v_\omega > 0, \{x_\alpha\} \text{ rising}, \beta = 0.95, \tau_{-1} = 0.181$
Lessons

• Distinct roles for $\lambda_a$ and $\tau_a$
  ▶ Progressivity $\tau_a$ key for skill investment and labor supply distortions, and for redistribution / insurance within age groups
  ▶ Tax level $\lambda_a$ 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