Redistributive Taxation in a Partial-Insurance Economy

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ESSIM, May 28, 2010

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Redistributive taxation

Two classic roles for government:

1. Redistribution / social insurance
2. Provision of public goods

At the same time, the design of public taxation must be sensitive to private incentives

In light of these objectives, how progressive should the tax system be?

More specifically

- How does the optimal rate of progressivity for earnings taxation vary with ...

  1. the level of inequality / risk in the economy
  2. the elasticity of labor supply
  3. the amount of privately-provided insurance
  4. the desire for public goods

- Our contribution: Tractable framework that delivers insights on the trade-offs

Ramsey taxation with incomplete markets

- Take tax instruments and market structure as given

  1. specific functional form for nonlinear tax/transfer system

  2. non-contingent bond plus insurance against certain shocks

The Model (H-S-V, 2009)

- Equilibrium heterogeneous-agents model featuring:

  1. differential labor productivity + idiosyncratic productivity risk
  2. flexible labor supply and risk-free bond (*self-insurance*)
  3. additional risk-sharing (financial markets, family etc.)
  4. nonlinear tax/transfer system
  5. valued government expenditures

Technology

- Aggregate output linear in effective labor:

$$Y = \int w_i h_i di \equiv \int y_i di$$

- Resource constraint:

$$Y = \int c_i di + G$$

Demographics and preferences

- Perpetual youth demographics with constant survival probability δ

- Preferences over sequences of consumption, hours, and publicly-provided good:

$$U(\mathbf{c}_i, \mathbf{h}_i, \mathbf{G}) = \mathbb{E}_0 \sum_{t=0}^{\infty} (\beta\delta)^t u(c_{it}, h_{it}, G_t)$$

  - with period-utility:

$$u(c_{it}, h_{it}, G_t) = \frac{c_{it}^{1-\gamma} - 1}{1-\gamma} - \widetilde{\varphi}\, \frac{h_{it}^{1+\sigma}}{1+\sigma} + \chi \frac{G_t^{1-\gamma} - 1}{1-\gamma}$$

Wages

- Log individual wage is the sum of two components:

$$\ln w_{it} = \alpha_{it} + \varepsilon_{it}$$

  - α_{it} component follows unit root process

    $\alpha_{it} = \alpha_{i,t-1} + \omega_t$ with $\omega_{it} \sim F_\omega$ and $\alpha_{i0} \sim F_{\alpha_0}$

  - ε_{it} component is transitory

    ε_{it} i.i.d. with $\varepsilon_{it} \sim F_\varepsilon$

Financial and insurance markets

- Assets traded competitively (all in zero net supply)
  - Perfect annuity against survival risk
  - Non-contingent bond
  - Complete markets for ε shocks

- Market structure
  - $v_\alpha = v_\varepsilon = 0 \Rightarrow$ representative agent economy
  - $v_\alpha > 0, v_\varepsilon = 0 \Rightarrow$ bond economy
  - $v_\alpha = 0, v_\varepsilon > 0 \Rightarrow$ complete markets
  - $v_\alpha > 0, v_\varepsilon > 0 \Rightarrow$ "partial insurance"

Government

- Two parameter tax/transfer function to redistribute and finance publicly-provided goods G

- Disposable post-government earnings:

$$\tilde{y}_i = \lambda y_i^{1-\tau}$$

- Government budget constraint (no public debt):

$$G = \int \left[y_i - \lambda y_i^{1-\tau} \right] di$$

Our model of fiscal redistribution

- The parameter τ measures the rate of progressivity:

$$\ln(\tilde{y}_i) = \ln(\lambda) + (1-\tau)\ln(y_i)$$

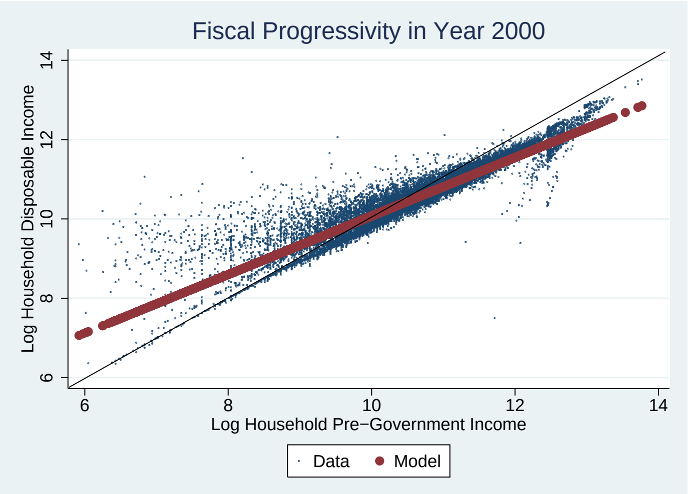
1. $\tau = 0 \rightarrow \tilde{y}_i = \lambda y_i$: flat tax rate $(1-\lambda)$
2. $\tau = 1 \rightarrow \tilde{y}_i = \lambda$: full redistribution

- If $\tau > 0$ the system is progressive:

$$\frac{T'(y)}{T(y)/y} = \frac{1-\lambda(1-\tau)y^{-\tau}}{1-\lambda y^{-\tau}} > 1 \;\; \forall y$$

Fit

- Estimated slope by OLS: $\tau = 0.26$ ($R^2 = 0.88$)



Agent's Problem

$$V(\alpha, b) = \max_{c,h,b',B(\cdot)} \int_{\mathcal{E}} \left(u(c, h, G) + \delta\beta \int_{\Omega} V(\alpha + \omega, b')\, dF_\omega \right) dF_\varepsilon$$

subject to

$$\int_{\mathcal{E}} Q(\cdot)\, B(\cdot)\, d\varepsilon = b$$

$$c + q\delta b' = B(\varepsilon) + \lambda \cdot (\exp(\alpha + \varepsilon)\, h)^{1-\tau} \qquad \forall \varepsilon$$

$$c \geq 0, \qquad h \geq 0, \qquad b' \geq \underline{B}$$

$$b_0 = 0$$

A stationary equilibrium is a set of prices $(q, Q(\cdot))$ and a policy (G, τ, λ) s.t. when agents take these as given and maximize utility, markets clear and the government budget is balanced

“No bond trade” equilibrium

- There exists an equilibrium in which the wealth distribution is always degenerate at zero

  $\Rightarrow$ individual allocations only depend on (α, ε)

- Micro-foundations for Constantinides and Duffie (1996)
  - CRRA prefs, unit root shocks to log disposable income

- We start from richer process for individual wages:
  1. Labor supply: exogenous wages $\rightarrow$ endogenous earnings
  2. Private risk sharing: earnings $\rightarrow$ gross income
  3. Non-linear taxation: gross income $\rightarrow$ disposable income

- No bond trade: disposable income = consumption

Equilibrium risk-free rate r^*

- Under log-normality of the shocks, closed form for r^*
- With inelastic labor $(\sigma = \infty)$ and linear taxes $(\tau = 0)$:

$$\frac{\rho - r^*}{\gamma} = (\gamma + 1)\,\frac{v_\omega}{2}$$

where $(\gamma + 1)$ is the coefficient of relative prudence

- With non-linear taxes $(\tau \neq 0)$:

$$\frac{\rho - r^*}{\gamma} = (1 - \tau)\,(\gamma\,(1 - \tau) + 1)\,\frac{v_\omega}{2}$$

Equilibrium allocations: hours worked

$$\ln h^*(\alpha, \varepsilon) = \underbrace{\frac{1}{(1-\tau)(\widehat{\sigma}+\gamma)}\left[(1-\gamma)\ln \lambda^* + \ln(1-\tau) - \varphi\right]}_{\text{Representative agent}}$$

$$- \underbrace{M_h(v_\varepsilon)}_{\text{Wealth effect}} + \underbrace{\frac{1-\gamma}{\widehat{\sigma}+\gamma}\alpha}_{\text{Unins. shock}} + \underbrace{\frac{1}{\widehat{\sigma}}\varepsilon}_{\text{Insurable shock}}$$

- Tax-modified Frisch elasticity (decreasing in τ):

$$\frac{1}{\widehat{\sigma}} \equiv \frac{1-\tau}{\sigma+\tau}$$

Equilibrium allocations: consumption

$$\ln c^*(\alpha) = \underbrace{\frac{1}{\widehat{\sigma}+\gamma}\left[(1+\widehat{\sigma})\ln\lambda^* + \ln(1-\tau) - \varphi\right]}_{\text{Representative agent}}$$

$$+ \underbrace{M_c(v_\varepsilon)}_{\text{Wealth effect}} + \underbrace{\pi(\gamma,\sigma,\tau)\alpha}_{\text{Uninsurable shocks}}$$

- The transmission coefficient of a permanent uninsured shock:

$$\pi(\gamma,\sigma,\tau) = \underbrace{(1-\tau)\left[\frac{\sigma+\gamma}{\sigma+\gamma+\tau(1-\gamma)}\right]}_{\text{TAX PROGRESSIVITY}} \quad \underbrace{\frac{\sigma+1}{\sigma+\gamma}}_{\text{LABOR SUPPLY}}$$

Government's problem

- Government chooses (τ, G) to maximize social welfare
- Government puts weight β^t on the welfare of all agents born at dates $t = -\infty, ..., \infty$
- The Social Welfare Function becomes:

$$\mathcal{W}(\tau, G) \equiv \frac{1}{1-\beta} \int \int u\left(c^*(\alpha; \tau, G), h^*(\alpha, \varepsilon; \tau, G), G\right) dF_\varepsilon dF_\alpha$$

Roadmap for welfare analysis

- Assumptions:
  a) log-normal shocks
  b) log-utility over private and public consumption $(\gamma = 1)$

1. No utility from public goods $(\chi = 0)$
   - Instrument chosen: τ

2. Valued G $(\chi > 0)$
   - Instruments chosen: (τ, G)

Social welfare function $(\chi = 0)$

- Representative agent $(v_\alpha = 0, v_\varepsilon = 0)$:

$$\mathcal{W}^{RA}(\tau) = -\varphi + \frac{\ln(1-\tau) - (1-\tau)}{1+\sigma}$$

  - Welfare maximizing $\tau = 0$

- Heterogeneous agents $(v_\alpha > 0, v_\varepsilon > 0)$:

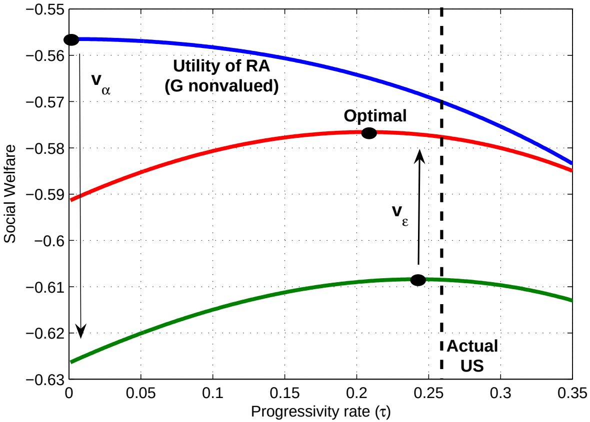
$$\mathcal{W}(\tau) = \underbrace{-\varphi + \frac{\ln(1-\tau) - (1-\tau)}{1+\sigma}}_{\mathcal{W}^{RA}(\tau)}$$

$$+ \underbrace{\frac{1}{\hat{\sigma}} v_\varepsilon}_{\ln(Y/H)} - \underbrace{(1-\tau)^2 \frac{v_\alpha}{2}}_{var(\ln c)} - \sigma \underbrace{\left(\frac{1}{\hat{\sigma}^2}\right) \frac{v_\varepsilon}{2}}_{var(\ln h)}$$

Comparative statics

- $\mathcal{W}(\tau)$ is globally concave in τ if $\sigma \geq 2$
- $\frac{\partial \tau^*}{\partial v_\alpha} > 0$: more uninsurable risk $\Rightarrow$ more public insurance
- $\frac{\partial \mathcal{W}(\tau)}{\partial \tau}|_{\tau=0} > 0$ iff $v_\alpha > 0 \Rightarrow$ strictly positive solution for τ^*
- $\frac{\partial \tau^*}{\partial \sigma} > 0$: less elastic labor supply $\Rightarrow$ less severe distortions
- $\frac{\partial \tau^*}{\partial v_\varepsilon} < 0$: more insurable risk $\Rightarrow$ more distortion of labor effort

Welfare Functions, $\chi = 0$



Parameterization: $\sigma = 2, v_\alpha = v_\varepsilon = 0.14 \Rightarrow \tau^*(\sigma, v_\alpha, v_\varepsilon) = 0.21$

Valued government consumption: $\chi > 0$

- Representative agent $(v_\alpha = v_\varepsilon = 0)$
- Define $g \equiv G/Y$
- Welfare-maximizing fiscal policy given by:

$$g^* = \frac{\chi}{1+\chi} \quad \textit{Samuelson's condition}$$

$$\tau^* = -\chi \quad \textit{Regressive taxation}$$

- Allocations (C^*, H^*, G^*) induced by (g^*, τ^*) are first best

Intuition

- Optimal regressivity $(\tau^* = -\chi)$ achieves both:
  - desired average tax rate (to finance G)
  - zero marginal tax rate at H^* (as with a lump-sum tax)
- Note that H^* is larger than it would be absent taxes: taxation is used to increase hours worked to socially efficient level

Heterogeneity and public goods

- Optimal public good provision g^* is unchanged: $g^* = \frac{\chi}{1+\chi}$
- Trade-off in determining optimal rate of progressivity:
  - Stronger taste for G (higher χ) $\Rightarrow$ more regressive taxation
  - More uninsurable risk (higher v_α) $\Rightarrow$ more progressive taxation

Progressive or regressive taxation?

- Parameter space can be divided into two regions:

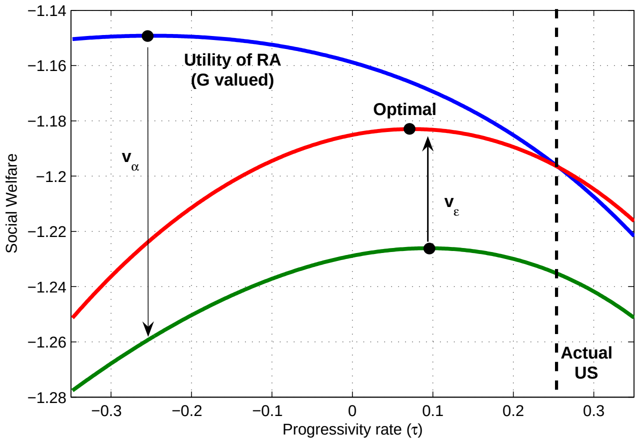
$$\begin{array}{lcl} \chi > v_\alpha(1+\sigma) & \Rightarrow & \tau^* < 0 \\ \chi = v_\alpha(1+\sigma) & \Rightarrow & \tau^* = 0 \\ \chi < v_\alpha(1+\sigma) & \Rightarrow & \tau^* > 0 \end{array}$$

- Insurable risk v_ε irrelevant because at $\tau^* = 0$ labor supply response to insurable shocks is undistorted

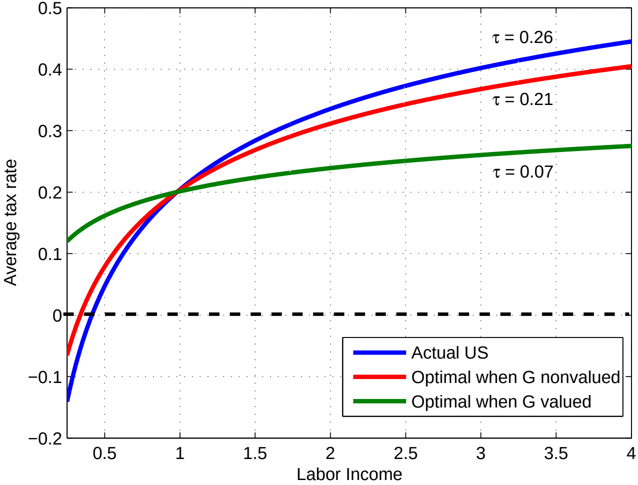
- With $v_\alpha = v_\varepsilon = 0.14$, and $\chi = 0.25$ $(g^* = 0.2)$

$$\begin{array}{lcll} \sigma = 0.8 & \Rightarrow & \tau^* = 0.00 & \textit{(flat)} \\ \sigma = 2.0 & \Rightarrow & \tau^* = 0.07 & \textit{(optimal)} \\ \sigma = 6.3 & \Rightarrow & \tau^* = 0.26 & \textit{(actual US)} \end{array}$$

Welfare Functions, $\chi = 0.25$

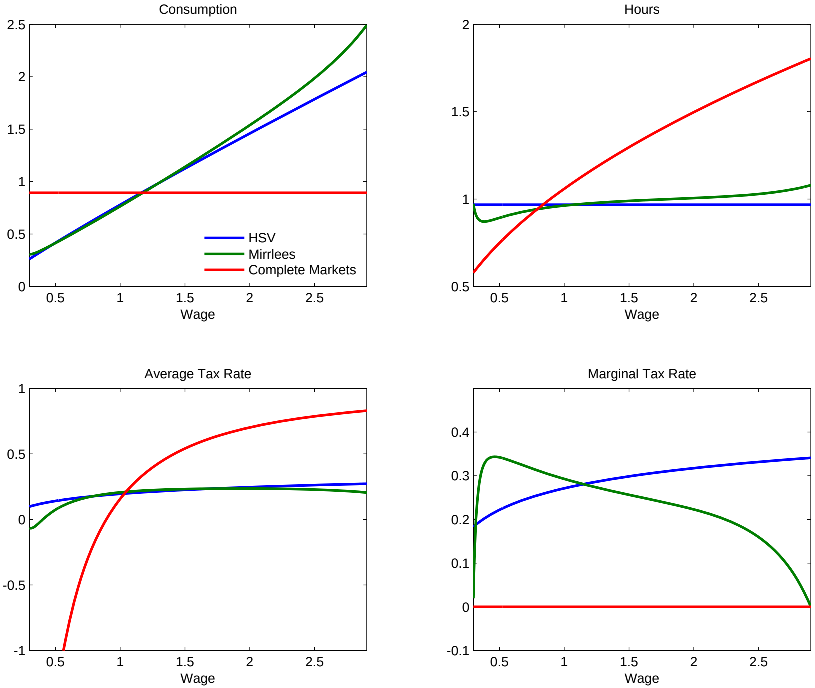


Average tax rate: actual US vs optimal



Relationship to Mirlees approach ($v_\varepsilon = 0$)

- Our Ramsey-style approach
  - specific functional form for earnings tax schedule
- Mirlees approach
  - $ln(w) = \alpha$ unobservable, constrained-efficient allocations implementable via unrestricted earnings tax schedule
- Complete markets
  - $ln(w) = \alpha$ observable, efficient allocations implementable via unrestricted wage tax schedule
- Result 1: In all three economies: $g^* = \frac{G}{Y} = \frac{\chi}{1-\chi}$


Consumption
Hours
Average Tax Rate
Marginal Tax Rate
Wage
HSV
Mirrlees
Complete Markets
2.5
2
1.5
1
0.5
0
-0.5
-1
0.4
0.3
0.2
0.1
-0.1

Concluding remarks

- We have also studied consumption taxation, and politico-economic equilibrium with policies chosen by a median voter

- What's next?

    - Solve model for general CRRA preferences $(\gamma \neq 1)$

    - Introduce wealth heterogeneity and time-varying taxation