Optimal Income Taxation: Mirrlees Meets Ramsey

Jonathan Heathcote
FRB Minneapolis and CEPR

Hitoshi Tsujiyama
Goethe University Frankfurt

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Introduction

- Roles of government:
  - Provide public goods
  - Redistribute to the poor
- Labor income taxation is main source of revenue
- Important question: How should taxes vary with income?
- Want to maximize redistribution, minimize distortions

Disagreement in the Literature

- Proposals for a flat tax system with transfers
  - Friedman (1962)
  - Mirrlees (1971)
  - Flavor of Universal Basic Income

- Others have argued for U-shaped marginal tax schedule
  - Diamond (1998)
  - Saez (2001)
  - Flavor of means-tested transfers

- Or should marginal tax rates be increasing with income, as in the U.S.?

Approaches to Studying Optimal Taxation

- Mirrleesian approach
  - No restrictions on shape of tax / transfer schedule
  - Compute best possible tax scheme subject to constraint that taxes must be a function of market earnings y
    - $y = w \times h$ but planner cannot see productivity w or hours h
- Ramsey approach
  - Impose a parametric form for tax function
  - Less flexible, but easier to embed into richer models

This Paper

We compare 3 tax and transfer systems:

1. Mirrleesian tax system: Main focus
   - fully non-linear
2. Ramsey 1: Affine system: $T(y) = \tau_0 + \tau_1 y$
   - constant marginal rates with lump-sum transfers
3. Ramsey 2: HSV system: $T(y) = y - \lambda y^{1-\tau}$
   - function introduced by Feldstein (1969), Persson (1983), Benabou (2000)
   - increasing marginal rates without transfers
   - τ indexes progressivity: $1 - \tau = \frac{1-T'(y)}{1-T(y)/y}$

Novel Elements

1. Key innovation: partial private insurance $\Rightarrow$ reduced role for redistribution through tax system
2. Explore how fiscal pressure to raise revenue shapes optimal tax system $\Rightarrow$ reconcile disparate results in the literature
3. Emphasize role of planner's taste for redistribution in shaping optimal tax schedule and welfare gains
4. Characterize Pareto-improving tax reforms

Main Findings

- Marginal tax rates in the United States should be increasing in income, NOT flat or U-shaped
- Increasing fiscal pressure $\rightarrow$ flatter, then U-shaped optimal tax schedule
- Current tax system close to optimal, given modest taste for redistribution
- Pareto-improving tax reforms imply no changes in taxes for most households

Environment

- Static model, labor supply only margin distorted by taxes
- Heterogeneous individual labor productivity with two stochastic components

$$\log w = \alpha + \varepsilon$$

- ε is privately-insurable, α is not
- One interpretation:
  - Individuals belong to large families
  - ε idiosyncratic shock that can be insured within family
  - α common across family members $\Rightarrow$ no private insurance
  - Planner sees neither component of productivity

Environment 2

- Common preferences

$$u(c,h) = \frac{c^{1-\gamma}}{1-\gamma} - \frac{h^{1+\sigma}}{1+\sigma}$$

- Production linear in aggregate effective hours

$$\int\int \exp(\alpha+\varepsilon)h(\alpha,\varepsilon)dF_\alpha dF_\varepsilon = \int\int c(\alpha,\varepsilon)dF_\alpha dF_\varepsilon + G$$

Planner's Problem

- Seeks to maximize SWF denoted $W(\alpha)$
- Only sees total family income $y(\alpha) = \int \exp(\alpha + \varepsilon) h(\alpha, \varepsilon) dF_\varepsilon$
- First Stage
  - Planner offers menu of contracts $\{c(\widetilde{\alpha}), y(\widetilde{\alpha})\}$
  - Family heads draw idiosyncratic α and report $\widetilde{\alpha}$
- Second Stage
  - Family members draw idiosyncratic ε
  - Family head tells each member how much to work
  - Total earnings must deliver $y(\widetilde{\alpha})$ to the planner
  - Must divide consumption $c(\widetilde{\alpha})$ between family members

Nature of the Solution

- Planner cannot condition individual allocations on ε, given free within-family transfers
- Thus, planner cannot take over private insurance

  $\Rightarrow$ Distinct roles for public and private insurance

- Note: Extent of private risk-sharing is exogenous with respect the tax system

Planner's Problem

$$\max_{c(\alpha),y(\alpha)} \quad \int W(\alpha)U(\alpha,\alpha)dF_\alpha$$

$$\text{s.t.} \quad \int y(\alpha)dF_\alpha \geq \int c(\alpha)dF_\alpha + G$$

$$U(\alpha,\alpha) \geq U(\alpha,\widetilde{\alpha}) \qquad \forall\alpha, \forall\widetilde{\alpha}$$

where $U(\alpha,\widetilde{\alpha}) \equiv$

$$\left\{ \begin{array}{ll} & \max_{\{c(\alpha,\tilde{\alpha},\varepsilon),h(\alpha,\tilde{\alpha},\varepsilon)\}} \int \left\{ \frac{c(\alpha,\tilde{\alpha},\varepsilon)^{1-\gamma}}{1-\gamma} - \frac{h(\alpha,\tilde{\alpha},\varepsilon)^{1+\sigma}}{1+\sigma} \right\} dF_\varepsilon \\ \text{s.t.} & \int c(\alpha,\tilde{\alpha},\varepsilon)dF_\varepsilon = c(\tilde{\alpha}) \\ & \int \exp(\alpha+\varepsilon)h(\alpha,\tilde{\alpha},\varepsilon)dF_\varepsilon = y(\tilde{\alpha}) \end{array} \right.$$

$$U(\alpha,\widetilde{\alpha}) = \frac{c(\widetilde{\alpha})^{1-\gamma}}{1-\gamma} - \frac{\Omega}{1+\sigma}\left(\frac{y(\widetilde{\alpha})}{\exp(\alpha)}\right)^{1+\sigma}$$

$$\text{where} \quad \Omega = \left(\int \exp(\varepsilon)^{\frac{1+\sigma}{\sigma}} dF_\varepsilon(\varepsilon)\right)^{-\sigma}$$

Planner's Problem: Ramsey

$$\max_{\tau} \quad \int W(\alpha)\left\{\int u(c(\alpha,\varepsilon),h(\alpha,\varepsilon))dF_\varepsilon\right\}dF_\alpha$$

$$\text{s.t.} \quad \int\int c(\alpha,\varepsilon)dF_\alpha dF_\varepsilon + G = \int\int \exp(\alpha+\varepsilon)h(\alpha,\varepsilon)dF_\alpha dF_\varepsilon$$

where $c(\alpha,\varepsilon)$ and $h(\alpha,\varepsilon)$ are the solutions to

$$\begin{cases} \max_{\{c(\alpha,\varepsilon),h(\alpha,\varepsilon)\}} & \int\left\{\log c(\alpha,\varepsilon) - \frac{h(\alpha,\varepsilon)^{1+\sigma}}{1+\sigma}\right\}dF_\varepsilon \\ \text{s.t.} & \int c(\alpha,\varepsilon)dF_\varepsilon = y(\alpha) - T(y(\alpha);\tau) \\ & y(\alpha) = \int \exp(\alpha+\varepsilon)h(\alpha,\varepsilon)dF_\varepsilon \end{cases}$$

Decomposing Welfare Effects of Tax Reform

- Contemplate raising $T'(y)$ at $y = \hat{y}$, using revenue to raise transfers

- "Distributional gain:" assuming no behavioral response (utilitarian planner)

$$D(\hat{y}) = [1 - F(\hat{y})] - \frac{\int_{\hat{y}}^{\infty} u_c(y)dF(y)}{\int_0^{\infty} u_c(y)dF(y)}$$

- "Efficiency cost:" amount of hypothetical revenue from reform that leaks away due to behavioral responses

$$E(\hat{y}) = [1 - F(\hat{y})] - \Delta Tr(\hat{y})$$

  - Depends on substitution and income effects
  - Increases in $T'(y)$

- When tax system is optimal distributional gain equals efficiency cost at every y

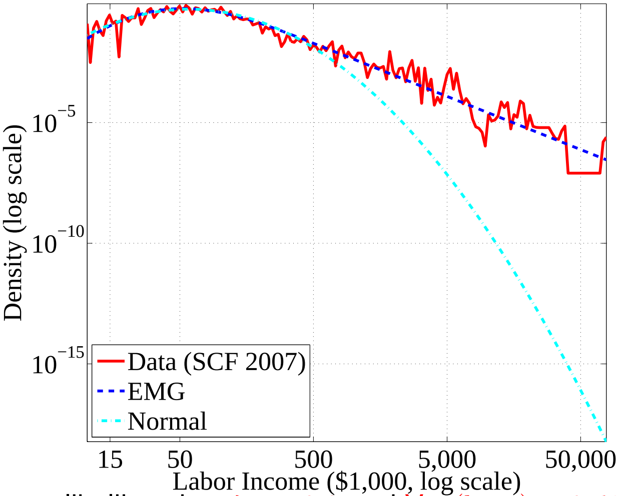
Calibration: Wage Distribution

- F_α : Exponentially Modified Gaussian $EMG(\mu_\alpha, \sigma_\alpha^2, \lambda_\alpha)$
- F_ε : Normal $N(\frac{-\sigma_\varepsilon^2}{2}, \sigma_\varepsilon^2)$
- $\log(wh)$ and $\log(c)$ also EMG, given our utility function, private insurance model, and HSV tax system
- Estimate earnings distribution parameters using cross-sectional income data from SCF
- Decompose σ_α^2 versus σ_ε^2 to match cross-sectional dispersion in consumption

$$\text{Var}(\log y) = \left(\frac{1+\sigma}{\sigma}\right)^2 \sigma_\varepsilon^2 + \sigma_\alpha^2 + \frac{1}{\lambda_\alpha^2}, \tag{1}$$

$$\text{Var}(\log c) = (1-\tau)^2\sigma_\alpha^2 + \frac{(1-\tau)^2}{\lambda_\alpha^2}. \tag{2}$$

Distribution for Labor Income



Maximum likelihood $\Rightarrow$ $\lambda_\alpha = 2.2$ and $\text{Var}\left(\log y\right) = 0.618$

Calibration

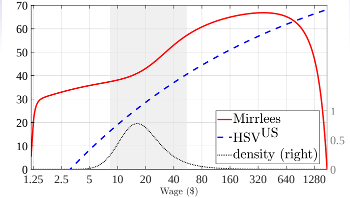
- Log utility from consumption, $\gamma = 1$
- Frisch elasticity $= 0.5 \Rightarrow \sigma = 2$
- Progressivity parameter $\tau = 0.181$ (HSV 2016)
- Govt spending G s.t. $G/Y = 0.188$ (US, 2005)
- Extent of insurance: $\sigma_{\alpha}^{2} = 0.142$ and $\sigma_{\varepsilon}^{2} = 0.120$ to hit Var $(\log y) = 0.618$ and Var$(\log c) = 0.234$
- Utilitarian social welfare function: $W(\alpha) = 1 \ \forall \alpha$
- Numerical implementation: 10,000 grid points for α

Bottom of Wage Distribution

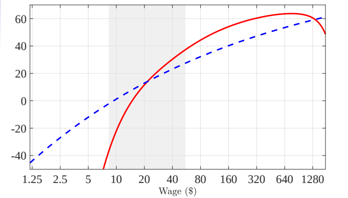
- Difficult to measure distribution of offered wages at the bottom, given selection into participation
- Low and Pistaferri (2015) estimate distribution of latent offered wages within a structural model in which workers face disability risk and choose participation

Percentile Ratios	Model	LP
P5/P1	1.46	1.48
P10/P5	1.23	1.20
P25/P10	1.42	1.40

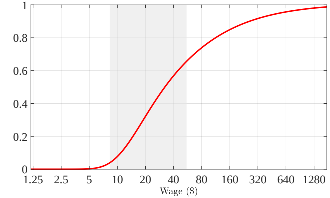
(a) Marginal Tax Rate (%)



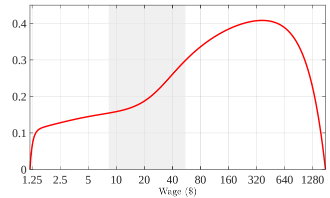
(b) Average Tax Rate (%)



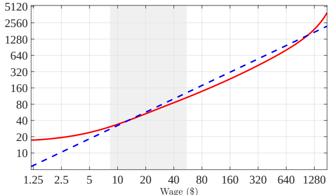
(c) Distributional Gain $D(\alpha)$



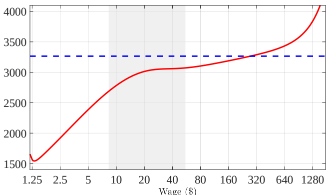
(d) $D(a) \times [1 - F_\alpha(\alpha)]/f_\alpha(\alpha)$



(e) Consumption ($1,000)



(f) Hours Worked



Main Takeaways

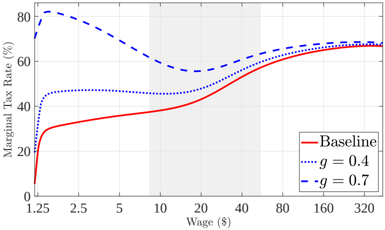
- Optimal marginal rate monotone increasing in income
- Optimum much more redistributive than current system
- Efficiency / distributional gains rise with income
  - At 3 times average productivity, 71% of each hypothetical tax dollar leaks away
  - At 1/3 average productivity, only 3% does
- Why are things this way?
- Why did Diamond and Saez argue for a U-shaped marginal rate schedule?

Insurance and Distributional Gains

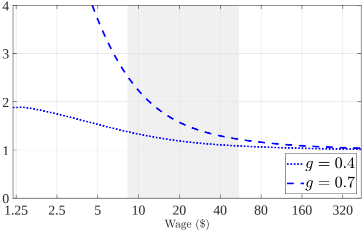
- Always want high taxes at the top
  - Want to redistribute away from this group
  - $\Rightarrow$ Set taxes to maximize revenue extracted from rich
- At low income levels, small distributional gains from raising rates
  - Private insurance + public transfers from taxing the rich
  - $\Rightarrow$ Modest consumption inequality at the bottom
- $\Rightarrow$ Hence no desire for high taxes on the moderately poor to benefit the very poor

Increasing Fiscal Pressure

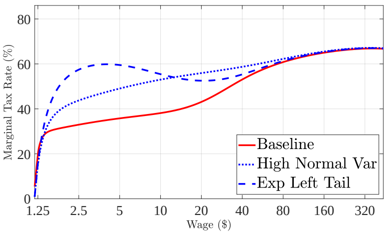
(a) High Government Expenditure



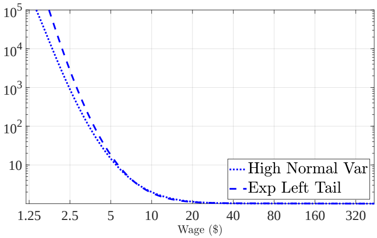
(b) D/D_{baseline}



(c) No Insurable Shock



(d) D/D_{baseline}



Interpretation

- $\uparrow G$ reduces revenue for transfers $\Rightarrow \uparrow$ inequality at the bottom $\Rightarrow \uparrow$ distributional gains $\Rightarrow$ high marginal tax rates
- $\downarrow$ private insurance $\Rightarrow \uparrow$ consumption inequality at the bottom $\Rightarrow$ higher marginal tax rates
- In both scenarios, planner faces more revenue pressure
- Low marginal rates in middle where productivity density largest
- Note Saez (2001) economy features high fiscal pressure:
    - total govt. spending at his optimum: 56% of GDP
    - c.f. 42% in our economy, 33.4% in the U.S.

Summary Statistics

Model	**Outcomes**					
	$\overline{T'}$	Tr	$\frac{Tr}{Y}$	$\frac{Tr+G}{Y}$	ω	ΔY
HSV^{US}	33.5	$1,753$	2.3	21.1	—	—
Baseline	49.1	$15,400$	21.5	41.8	2.07	-7.32
High Risk Aversion: $\gamma = 2$	59.8	$22,722$	32.1	52.9	5.12	-9.63
High Labor Elasticity: $\sigma = 1$	42.6	$12,638$	17.4	37.4	0.87	-5.85
High G: $g = 0.4$	52.9	$5,633$	7.3	47.8	0.19	-1.07
No Private Insurance	58.6	$21,586$	32.5	53.8	8.63	-11.57

Diamond's (1998) U-shaped Example

- Assume

$$u(c,h) = \log\left(c - \frac{h^{1+\sigma}}{1+\sigma}\right)$$

- Efficiency cost:

$$E(\alpha) = \frac{1}{1+\sigma}\frac{T'(\alpha)}{1-T'(\alpha)} f_\alpha(\alpha)$$

- Let α_m denote argmax of $f_\alpha(\alpha)$
- At optimum $D(\alpha) = E(\alpha)$ so

$$\frac{T'(\alpha)}{1-T'(\alpha)} = (1+\sigma)\frac{D(\alpha)}{f_\alpha(\alpha)}$$

Declining Marginal Rates?

$$\frac{T'(\alpha)}{1-T'(\alpha)} = (1+\sigma)\frac{D(\alpha)}{f_\alpha(\alpha)}$$

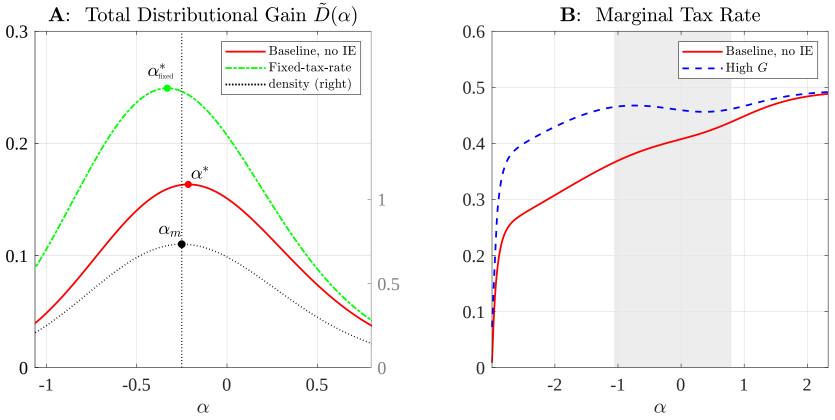
$$D(\alpha) = \int_\alpha^\infty \left\{1 - \frac{u_c(s)}{E\left[u_c(\alpha)\right]}\right\} dF_\alpha(s)$$

- $u_c(\alpha)$ decreasing
  $\Rightarrow \exists \alpha^*$ s.t. $u_c(\alpha^*) = E\left[u_c(\alpha)\right]$ & $D(\alpha)$ maxed
- Does $T'(\alpha)$ have a downward-sloping portion?
  - Yes, if $\alpha^* < \alpha_m$
  - Diamond (1998): "*This seems like the more interesting case, assuming the government would like to redistribute toward a fraction of the labor force well below one half*"
- But in our calibration, $\alpha^* > \alpha_m$!
  - $\Rightarrow$ govt. wants to redistribute to middle class as well as poor
  - $\Rightarrow$ no downward-sloping portion for $T'(\alpha)$

Increasing $\rightarrow$ U-Shaped Rates

- Consider increase in G paid for by reducing lump-sum transfers
- Proposition: This reform (i) has no effect on $E(\alpha)$, (ii) increases $D(\alpha)$ for all α, and (iii) reduces α^*
- Thus, higher fiscal pressure $\Rightarrow$ higher marginal rates, especially at low income levels
- Intuition: planner gives up on redistribution to middle class in order to focus on poorest
- Result: U-shaped system with flavor of means-tested transfers

Fiscal Pressure with GHH Preferences



Alternative Social Preferences

- Welfare gain for utilitarian planner moving to optimum sizable 2.1% of consumption
- But optimum is much more redistributive than current system $\Rightarrow$ reform creates winners and losers
- Do welfare gains mostly reflect greater efficiency, or desire for less inequality?
- Are Pareto-improving reforms possible?

Empirically Motivated SWF

- Progressivity built into current tax system informative about taste for redistribution
- Assume planner (political system) choosing tax system in HSV class: $T(y) = y - \lambda y^{1-\tau}$
- Assume planner has SWF in class $W(\alpha; \theta) = \exp(-\theta\alpha)$
- What value for θ gives observed τ as solution to Ramsey problem?
- Empirically Motivated SWF $W(\alpha; \theta^*)$ s.t. $\tau^*(\theta^*) = \tau^{US}$

Alternative SWFs

- Closed form expression for θ^*!

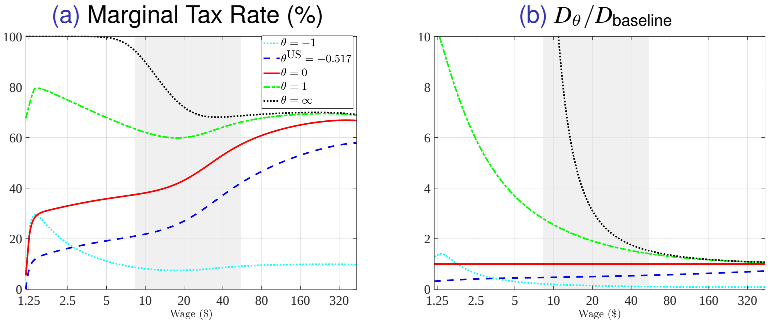
$$\sigma_\alpha^2\theta^* - \frac{1}{\lambda_\alpha+\theta^*} = -\frac{1}{\lambda_\alpha-1+\tau} - \sigma_\alpha^2(1-\tau) + \frac{1}{1+\sigma}\left\{\frac{1}{(1-g)(1-\tau)} - 1\right\}$$

- Simple in Normal case ($\lambda_\alpha \to \infty$)

$$\theta^* = -(1-\tau) + \frac{1}{\sigma_\alpha^2}\frac{1}{1+\sigma}\left\{\frac{1}{(1-g)(1-\tau)} - 1\right\}$$

  - θ^* increasing in τ and g
  - θ^* declining in σ and σ_α^2
  - θ^* increasing in λ_α (holding fixed $var(\alpha) = \sigma_\alpha^2 + \frac{1}{\lambda_\alpha^2}$)
- Also consider $\theta \to \infty$: Rawlsian
- And $\theta = -1$: Laissez-Faire Planner

Optimal Policy with Alternative Pareto Weights



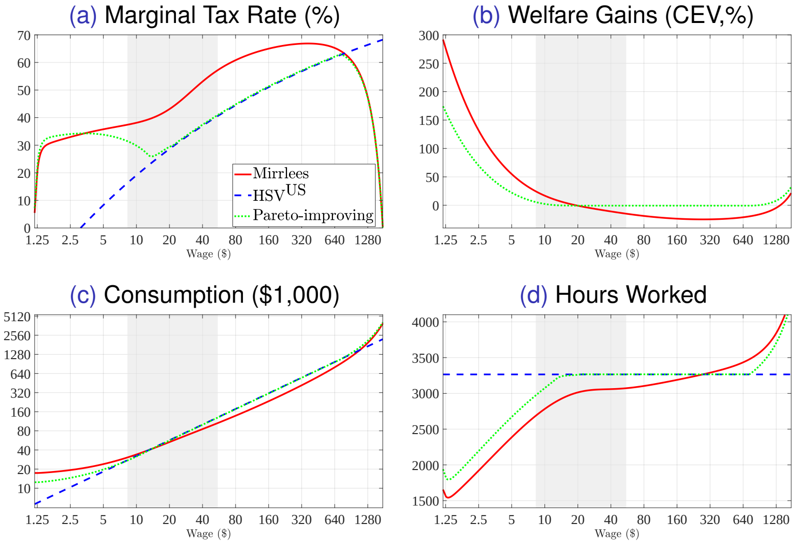
Remarks

- Optimal marginal rates still increase in income given empirically-motivated SWF
- Optimal policy is sensitive to SWF (no surprise)
- With a strong desire to redistribute get downward-sloping / U-shaped marginal rates
    - Rawlsian case is the extreme – goal is simply to max revenue that can be used for transfers
- Welfare gains of tax reform vary enormously:
    - 662% of consumption for Rawlsian planner
    - 0.05% for planner with empirically-motivated SWF

Pareto-Improving Tax Reform

- Let's insist tax reform cannot make anyone worse off
- Partially sidesteps question of what social welfare function to use
- Revisit original problem, with new constraints to ensure that each α type is weakly better off

Pareto Improving Tax Reform



Takeaways

- Pareto-improving constraints bind in the middle of the distribution
- Those in the tails gain
  - Lower marginal rates at the top
  - Larger transfers at the bottom
- Surprising theorem we stumbled across numerically:
- Allocations and marginal / average tax rates unchanged where Pareto-improving constraints bind

Mirrlees versus Ramsey

- Some advantages to simple parameter tax / transfer schedules
- But which form is best? Is it more important to have lump-sum transfers or increasing marginal rates?
- Compare Mirrlees to best-in-class affine and HSV schedules
- Focus here on utilitarian social welfare function

Mirrlees vs. Ramsey

Comparison Summary

System	Parameters		Outcomes					
			$\overline{T'}$	Tr (\$)	$\frac{Tr}{Y}$	$\frac{Tr+G}{Y}$	ω (%)	ΔY
HSV^{US}	$\lambda : 0.840$	$\tau : 0.181$	33.5	1,753	2.3	21.1	—	—
HSV	$\lambda : 0.817$	$\tau : 0.331$	46.6	4,632	6.4	26.5	1.65	−6.53
Affine	$\tau_0 : -20,747$	$\tau_1 : 49.2\%$	47.7	20,111	28.1	48.3	1.36	−7.31
Mirrlees			49.1	15,400	21.5	41.8	2.07	−7.32

Conclusions

- Optimal tax schedule likely features increasing marginal rates
- HSV approximation to current U.S. system might be close to optimal
- Optimal tax system less redistributive when there is private insurance
- Optimal system highly sensitive to desire for redistribution
- Pareto-improving tax systems likely similar to current one