Redistributive Taxation in a Partial Insurance Economy

Jonathan Heathcote
Federal Reserve Bank of Minneapolis

Kjetil Storesletten
Federal Reserve Bank of Minneapolis, and Oslo University

Gianluca Violante
New York University

University of Delaware, November 26th, 2012
Redistributive Taxation

- How progressive should earnings taxation be?
Redistributive Taxation

• How progressive should earnings taxation be?

• Arguments in favor of progressivity:
  1. Social insurance of privately-uninsurable shocks
  2. Redistribution from high to low innate ability
Redistributive Taxation

- How progressive should earnings taxation be?

- Arguments in favor of progressivity:
  1. Social insurance of privately-uninsurable shocks
  2. Redistribution from high to low innate ability

- Arguments against progressivity:
  1. Distortion to distribution of labor supply
  2. Distortion to human capital investment
  3. Redistribution from low to high taste for leisure
  4. Inefficient financing of G expenditures
Ramsey Approach

Government/Planner takes policy instruments and market structure as given, and chooses the CE that yields the largest social welfare

- CE of an heterogeneous-agent, incomplete-market economy
- Nonlinear tax/transfer system
- Valued public expenditures also chosen by the government
- Various social welfare functions

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Ramsey Approach

Government/Planner takes policy instruments and market structure as given, and chooses the CE that yields the largest social welfare

- CE of an heterogeneous-agent, incomplete-market economy
- Nonlinear tax/transfer system
- Valued public expenditures also chosen by the government
- Various social welfare functions

*Tractable equilibrium framework* clarifies economic forces shaping the optimal degree of progressivity
Overview of the model

- **Huggett (1994) economy**: \( \infty \)-lived agents, idiosyncratic productivity risk, and a risk-free bond in zero net-supply, **plus**:
Overview of the model

- **Huggett (1994) economy**: ∞-lived agents, idiosyncratic productivity risk, and a risk-free bond in zero net-supply, plus:

  1. differential “innate” (learning) ability

  2. endogenous skill investment + multiple-skill technology
Overview of the model

- **Huggett (1994) economy**: $\infty$-lived agents, idiosyncratic productivity risk, and a risk-free bond in zero net-supply, plus:
  
  1. differential “innate” (learning) ability
  2. endogenous skill investment + multiple-skill technology
  3. endogenous labor supply
  4. heterogeneity in preferences for leisure
  5. valued government expenditures

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Overview of the model

- **Huggett (1994) economy**: ∞-lived agents, idiosyncratic productivity risk, and a risk-free bond in zero net-supply, plus:
  
  1. differential “innate” (learning) ability
  2. endogenous skill investment + multiple-skill technology
  3. endogenous labor supply
  4. heterogeneity in preferences for leisure
  5. valued government expenditures
  6. additional partial private insurance (other assets, family, etc)
Overview of the model

- **Huggett (1994) economy**: $\infty$-lived agents, idiosyncratic productivity risk, and a risk-free bond in zero net-supply, **plus**:
  
  1. differential “innate” (learning) ability
  2. endogenous skill investment + multiple-skill technology
  3. endogenous labor supply
  4. heterogeneity in preferences for leisure
  5. valued government expenditures
  6. additional partial private insurance (other assets, family, etc)

- **Steady-state analysis**

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Demographics and preferences

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

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

  \[
  U_i = v_i(s_i) + \mathbb{E}_0 \sum_{t=0}^\infty (\beta \delta)^t u_i(c_{it}, h_{it}, G)
  \]

  \[
  v_i(s_i) = -\frac{1}{\kappa_i} \frac{s_i^2}{2\mu}
  \]

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

  \[
  \kappa_i \sim \text{Exp}(\eta)
  \]

  \[
  \varphi_i \sim N\left(\frac{v_\varphi}{2}, v_\varphi\right)
  \]

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Technology

- **Output** is CES aggregator over continuum of skill types:

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

- Aggregate **effective hours** by skill type:

  \[ N(s) = \int_0^1 I_{\{s_i = s\}} z_i h_i \, di \]

- Aggregate **resource constraint**:

  \[ Y = \int_0^1 c_i \, di + G \]
Individual efficiency units of labor

\[ \log z_{it} = \alpha_{it} + \varepsilon_{it} \]

• \( \alpha_{it} = \alpha_{i,t-1} + \omega_{it} \) with \( \omega_{it} \sim N \left( -\frac{v_\omega}{2}, v_\omega \right) \)
  \( \alpha_{i0} = 0 \) \( \forall i \)

• \( \varepsilon_{it} \) i.i.d. over time with \( \varepsilon_{it} \sim N \left( -\frac{v_\varepsilon}{2}, v_\varepsilon \right) \)

• \( \varphi \perp \kappa \perp \omega \perp \varepsilon \) cross-sectionally and longitudinally

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Individual efficiency units of labor

\[ \log z_{it} = \alpha_{it} + \varepsilon_{it} \]

- \( \alpha_{it} = \alpha_{i,t-1} + \omega_{it} \) with \( \omega_{it} \sim N \left( -\frac{v_\omega}{2}, v_\omega \right) \)
  \( \alpha_{i0} = 0 \) \( \forall i \)

- \( \varepsilon_{it} \) i.i.d. over time with \( \varepsilon_{it} \sim N \left( -\frac{v_\varepsilon}{2}, v_\varepsilon \right) \)

- \( \varphi \perp \kappa \perp \omega \perp \varepsilon \) cross-sectionally and longitudinally

- Pre-government earnings:

\[ y_{it} = p(s_i) \times \exp(\alpha_{it} + \varepsilon_{it}) \times h_{it} \]

determined by skill, fortune, and diligence

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Government

• Runs a 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 government debt):

$$G = \int_0^1 [y_i - \lambda y_i^{1-\tau}] \, di$$

Government chooses $(G, \tau)$, and $\lambda$ balances the budget residually
Our model of fiscal redistribution

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

- The parameter \( \tau \) measures the rate of progressivity:
  - \( \tau = 1 \): full redistribution \( \rightarrow \tilde{y}_i = \lambda \)
  - \( 0 < \tau < 1 \): progressivity \( \rightarrow \frac{T'(y)}{T(y)/y} > 1 \)
  - \( \tau = 0 \): no redistribution \( \rightarrow \) flat tax \( 1 - \lambda \)
  - \( \tau < 0 \): regressivity \( \rightarrow \frac{T'(y)}{T(y)/y} < 1 \)
Our model of fiscal redistribution

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

- The parameter \( \tau \) measures the rate of progressivity:
  - \( \tau = 1 \): full redistribution \( \rightarrow \tilde{y}_i = \lambda \)
  - \( 0 < \tau < 1 \): progressivity \( \rightarrow \frac{T'(y)}{T(y)/y} > 1 \)
  - \( \tau = 0 \): no redistribution \( \rightarrow \) flat tax \( 1 - \lambda \)
  - \( \tau < 0 \): regressivity \( \rightarrow \frac{T'(y)}{T(y)/y} < 1 \)

- Marginal tax rate \textit{monotone} in earnings

- Negative average tax rates below \( y^0 = \lambda^{\frac{1}{\tau}} \)
Our model of fiscal redistribution

- CPS 2005, $N_{obs} = 52,539$: $R^2 = 0.92$ and $\tau = 0.18$
Our model of fiscal redistribution

Heathcote-Storestten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Representative Agent Warm Up

\[
\max_{C,H} \quad U = \log C - \frac{H^{1+\sigma}}{1 + \sigma} + \chi \log G
\]

\text{s.t.}

\[
C + G = Y = H
\]

\[
G = Y - \lambda Y^{1-\tau}
\]

Equilibrium allocations:

\[
\log C^{RA}(G, \tau) = \log \lambda^*(G, \tau) + \frac{(1 - \tau)}{(1 + \sigma)} \log(1 - \tau)
\]

\[
\log H^{RA}(G, \tau) = \frac{1}{(1 + \sigma)} \log(1 - \tau)
\]
Representative Agent Optimal Policy

• Welfare:

\[ \mathcal{W}^RA(g, \tau) = \log(1 + g) + \chi \log g + (1 + \chi) \frac{\log(1 - \tau)}{(1 + \sigma)} - \frac{1 - \tau}{(1 + \sigma)} \]

• Welfare maximizing \((g, \tau)\) pair:

\[ g^* = \frac{\chi}{1 + \chi} \]
\[ \tau^* = -\chi \]

• Allocations are first best

\[ \mathcal{W}^RA(\tau) = \chi \log \chi - (1 + \chi) \log(1 + \chi) + (1 + \chi) \frac{\log(1 - \tau)}{(1 + \sigma)} - \frac{1 - \tau}{(1 + \sigma)} \]

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Markets

- Competitive good and labor markets

- Competitive asset markets (all assets in zero net supply)
  
  - Non state-contingent bond
Markets

- Competitive good and labor markets

- Competitive asset markets (all assets in zero net supply)
  
  ▶ Non state-contingent bond
  
  ▶ Full set of insurance claims against $\varepsilon$ shocks
    
    ■ If $v_\varepsilon = 0$, it is a bond economy
    
    ■ If $v_\omega = 0$, it is a full insurance economy
    
    ■ If $v_\omega = v_\varepsilon = v_\phi = 0 \quad \& \quad \theta = \infty$, it is a RA economy
Markets

- Competitive good and labor markets
- Competitive asset markets (all assets in zero net supply)
  - Non state-contingent bond
  - Full set of insurance claims against $\varepsilon$ shocks
    - If $v_\varepsilon = 0$, it is a bond economy
    - If $v_\omega = 0$, it is a full insurance economy
    - If $v_\omega = v_\varepsilon = v_\phi = 0$ \& $\theta = \infty$, it is a RA economy
- Perfect annuity against survival risk

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Budget constraints

1. **Beginning of period**: innovation $\omega$ to $\alpha$ shock is realized

2. **Middle of period**: buy insurance against $\varepsilon$:

   \[ b = \int_E Q(\varepsilon)B(\varepsilon) d\varepsilon, \]

   where $Q(\cdot)$ is the price of insurance and $B(\cdot)$ is the quantity

3. **End of period**: $\varepsilon$ realized, consumption and hours chosen:

   \[ c + \delta qb' = \lambda [p(s) \exp(\alpha + \varepsilon)h]^{1-\tau} + B(\varepsilon) \]
Recursive stationary equilibrium

- **Given** \((G, \tau)\), a stationary RCE is a value \(\lambda^*\), asset prices \(\{Q(\cdot), q\}\), skill prices \(p(s)\), decision rules \(s(\varphi, \kappa, 0)\), \(c(\alpha, \varepsilon, \varphi, s, b)\), \(h(\alpha, \varepsilon, \varphi, s, b)\), and aggregate quantities \(N(s)\) such that:

  - households optimize
  - markets clear
  - the government budget constraint is balanced
Recursive stationary equilibrium

• Given \((G, \tau)\), a stationary RCE is a value \(\lambda^*\), asset prices \(\{Q(\cdot), q\}\), skill prices \(p(s)\), decision rules \(s(\varphi, \kappa, 0)\), \(c(\alpha, \varepsilon, \varphi, s, b)\), \(h(\alpha, \varepsilon, \varphi, s, b)\), and aggregate quantities \(N(s)\) such that:

  ▶ households optimize
  ▶ markets clear
  ▶ the government budget constraint is balanced

• The equilibrium features no bond-trading
  ▶ \(b = 0 \rightarrow\) allocations depend only on exogenous states
  ▶ \(\alpha\) shocks remain uninsured, \(\varepsilon\) shocks fully insured

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
No bond-trade equilibrium

- Micro-foundations for Constantinides and Duffie (1996)
  - CRRA, unit root shocks to log disposable income
  - In equilibrium, no bond-trade $c_t = \tilde{y}_t$
No bond-trade equilibrium

• Micro-foundations for Constantinides and Duffie (1996)
  ▶ CRRA, unit root shocks to log disposable income
  ▶ In equilibrium, no bond-trade \( \Rightarrow c_t = \tilde{y}_t \)

• Unit root disposable income micro-founded in our model:
  1. \textbf{Skill investment+shocks:} \( \rightarrow \) wages
  2. \textbf{Labor supply choice:} wages \( \rightarrow \) pre-tax earnings
  3. \textbf{Non-linear taxation:} pre-tax earnings \( \rightarrow \) after-tax earnings
  4. \textbf{Private risk sharing:} after-tax earnings \( \rightarrow \) disp. income
  5. \textbf{No bond trade:} disposable income = consumption
Equilibrium risk-free rate $r^*$

$$
\rho - r^* = (1 - \tau) \left((1 - \tau) + 1\right) \frac{\nu_\omega}{2}
$$

- Intertemporal dis-saving motive = precautionary saving motive

- Key: precautionary saving motive common across all agents

- $\frac{\partial r^*}{\partial \tau} > 0$: more progressivity $\Rightarrow$ less precautionary saving $\Rightarrow$ higher risk-free rate

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Equilibrium skill choice and skill price

• FOC \[ \frac{s}{\kappa \mu} = \frac{(1 - \beta \delta) \partial U_0(\phi, s)}{\partial s} = (1 - \tau) \frac{\partial \log p(s)}{\partial s} \]
Equilibrium skill choice and skill price

• **FOC** \[ \frac{s}{\kappa \mu} = (1 - \beta \delta) \frac{\partial U_0(\varphi, s)}{\partial s} = (1 - \tau) \frac{\partial \log p(s)}{\partial s} \]

• Skill price has **Mincerian shape**: \( \log p(s) = \pi_0 + \pi_1 s \)

\[ \pi_1 = \sqrt{\frac{\eta}{\theta \mu (1 - \tau)}} \] (return to skill)
Equilibrium skill choice and skill price

- **FOC** → \[ \frac{s}{\kappa \mu} = (1 - \beta \delta) \frac{\partial U_0(\varphi, s)}{\partial s} = (1 - \tau) \frac{\partial \log p(s)}{\partial s} \]

- Skill price has **Mincerian shape**: \( \log p(s) = \pi_0 + \pi_1 s \)

\[ \pi_1 = \sqrt{\frac{\eta}{\theta \mu (1 - \tau)}} \quad \text{(return to skill)} \]

\[ \text{var}(\log p(s)) = \frac{1}{\theta^2} \]

Offsetting effects of \( \tau \) on \( s \) and \( p(s) \) leave pre-tax inequality unchanged
Equilibrium skill choice and skill price

- **FOC** → \( \frac{s}{\kappa \mu} = (1 - \beta \delta) \frac{\partial U_0(\varphi, s)}{\partial s} = (1 - \tau) \frac{\partial \log p(s)}{\partial s} \)

- Skill price has **Mincerian shape**: \( \log p(s) = \pi_0 + \pi_1 s \)

\[
\pi_1 = \sqrt{\frac{\eta}{\theta \mu (1 - \tau)}} \quad \text{(return to skill)}
\]

\[
\text{var}(\log p(s)) = \frac{1}{\theta^2}
\]

Offsetting effects of \( \tau \) on \( s \) and \( p(s) \) leave pre-tax inequality unchanged

- Distribution of skill prices (in level) is **Pareto with parameter** \( \theta \)
Upper tail of wage distribution

Top 1pct of the Wage Distribution

Wage (average=1)

Density

Model Wage Distribution
Lognormal Wage Distribution

Heathcote-Storelsletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Equilibrium consumption allocation

\[ \log c^*(\alpha, \varphi, s; G, \tau) = \log C^{RA}(G, \tau) + \underbrace{\mathcal{M}(v_\varepsilon)}_{\text{level effect from ins. variation}} + (1 - \tau) \log p(s; \tau) - (1 - \tau) \varphi + (1 - \tau) \alpha \]

- Response to variation in \((p(s), \varphi, \alpha)\) mediated by progressivity
- Invariant to insurable shock \(\varepsilon\)

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Equilibrium hours allocation

\[
\log h^*(\varepsilon, \varphi; G, \tau) = \log H^{RA}(G, \tau) - \frac{1}{\hat{\sigma}(1 - \tau)} M(v_\varepsilon)
\]

level effect from ins. variation

\[
- \varphi + \frac{1}{\hat{\sigma}} \varepsilon
\]

pref. het. ins. shock

- Response to \(\varepsilon\) mediated by tax-modified Frisch elasticity \(\frac{1}{\hat{\sigma}} = \frac{1 - \tau}{\sigma + \tau}\)

- Invariant to skill price \(p(s)\) and uninsurable shock \(\alpha\)

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Utilitarian Social Welfare Function

- Steady states with constant \((G, \tau)\)

\[
\mathcal{W}(G, \tau) \propto \sum_{k=-\infty}^{\infty} \mu_k \int_0^1 U_{i,k}(\cdot; G, \tau) di
\]

- Government sets weights: \(\mu_k = \beta^k \times \text{cohort size}\)
  
  ▶ SWF becomes average period utility in the cross-section
  
  ▶ Skill acquisition cost for those currently alive imputed to SWF proportionally to their remaining lifetime

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Utilitarian Social Welfare Function

- Steady states with constant \((G, \tau)\)

\[
W(G, \tau) \propto \sum_{k=-\infty}^{\infty} \mu_k \int_{0}^{1} U_{i,k}(\cdot; G, \tau) \, di
\]

- Government sets weights: \(\mu_k = \beta^k \times \text{cohort size}\)

  - SWF becomes average period utility in the cross-section
  - Skill acquisition cost for those currently alive imputed to SWF proportionally to their remaining lifetime

- WLOG, government chooses \(g = G/Y\)
Exact expression for SWF

\[ \mathcal{W}(g, \tau) = \log(1 + g) + \chi \log g + (1 + \chi) \frac{\log(1 - \tau)}{(1 + \hat{\sigma})(1 - \tau)} - \frac{1}{(1 + \hat{\sigma})} \]

\[ + (1 + \chi) \left[ \frac{-1}{\theta - 1} \log \left( \sqrt{\frac{\eta \theta}{\mu (1 - \tau)}} \right) + \frac{\theta}{\theta - 1} \log \left( \frac{\theta}{\theta - 1} \right) \right] \]

\[ - \frac{1}{2\theta}(1 - \tau) - \left[ - \log \left( 1 - \left( \frac{1 - \tau}{\theta} \right) \right) - \left( \frac{1 - \tau}{\theta} \right) \right] \]

\[ - (1 - \tau)^2 \frac{v_\varphi}{2} \]

\[ - \left[ (1 - \tau) \frac{\delta}{1 - \delta} \frac{v_\omega}{2} - \log \left( \frac{1 - \delta \exp \left( \frac{-\tau(1-\tau)}{2} v_\omega \right)}{1 - \delta} \right) \right] \]

\[ - (1 + \chi) \sigma \frac{1}{\hat{\sigma}^2} \frac{v_\varepsilon}{2} + (1 + \chi) \frac{1}{\hat{\sigma}} v_\varepsilon \]
Representative Agent component

\[
\mathcal{W}(g, \tau) = \log(1 + g) + \chi \log g + (1 + \chi) \frac{\log(1 - \tau)}{(1 + \hat{\sigma})(1 - \tau)} - \frac{1}{(1 + \hat{\sigma})}
\]

\[
\text{Representative Agent Welfare} = \mathcal{W}^{RA}(g, \tau)
\]

\[
+(1 + \chi) \left[ \frac{-1}{\theta - 1} \log \left( \sqrt{\frac{\eta\theta}{\mu(1 - \tau)}} \right) + \frac{\theta}{\theta - 1} \log \left( \frac{\theta}{\theta - 1} \right) \right]
\]

\[-\frac{1}{2\theta}(1 - \tau) - \left[ -\log \left( 1 - \left( \frac{1 - \tau}{\theta} \right) \right) - \left( \frac{1 - \tau}{\theta} \right) \right]
\]

\[-(1 - \tau)^2 \frac{v_\phi}{2}
\]

\[-\left[ (1 - \tau) \frac{\delta}{1 - \delta} \frac{v_\omega}{2} - \log \left( \frac{1 - \delta \exp \left( \frac{-\tau(1 - \tau)}{2} v_\omega \right)}{1 - \delta} \right) \right]
\]

\[-(1 + \chi)\sigma \frac{1}{\hat{\sigma}^2} \frac{v_\epsilon}{2} + (1 + \chi) \frac{1}{\hat{\sigma}} v_\epsilon
\]

Heathcote-Storelets-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Skill investment component

\[ \mathcal{W}(\tau) = \mathcal{W}^{RA}(\tau) \]

\[ + (1 + \chi) \left[ -\frac{1}{\theta - 1} \log \left( \sqrt{\frac{\eta \theta}{\mu (1 - \tau)}} \right) + \frac{\theta}{\theta - 1} \log \left( \frac{\theta}{\theta - 1} \right) \right] \]

productivity gain = \( \log E[(p(s))] = \log \frac{Y}{N} \)

\[ - \frac{1}{2\theta} (1 - \tau) \]

avg. education cost

\[ - (1 - \tau)^2 \frac{v_\varphi}{2} \]

\[ - \left[ (1 - \tau) \frac{\delta}{1 - \delta} \frac{v_\omega}{2} - \log \left( 1 - \delta \exp \left( \frac{-\tau (1 - \tau)}{2} v_\omega \right) \right) \right] \]

consumption dispersion across skills

\[ - (1 + \chi) \sigma \frac{1}{\hat{\sigma}^2} \frac{v_\varepsilon}{2} + (1 + \chi) \frac{1}{\hat{\sigma}} v_\varepsilon \]
Skill investment component

Skill Investment Component

(A) Prod Gain – Edu Cost
(B) Btw–Skill Cons Ineq
(A)+(B) Net Effect

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Uninsurable component

\[ \mathcal{W}(\tau) = \mathcal{W}^{RA}(\tau) \]

\[ +(1 + \chi) \left[ \frac{-1}{\theta - 1} \log \left( \sqrt{\frac{\eta \theta}{\mu (1 - \tau)}} \right) + \frac{\theta}{\theta - 1} \log \left( \frac{\theta}{\theta - 1} \right) \right] \]

\[ - \frac{1}{2\theta} (1 - \tau) - \left[ - \log \left( 1 - \left( \frac{1 - \tau}{\theta} \right) \right) - \left( \frac{1 - \tau}{\theta} \right) \right] \]

\[ - \left( 1 - \tau \right)^2 \frac{v_\varphi}{2} \]

cons. disp. due to prefs

\[ - \left[ (1 - \tau) \frac{\delta}{1 - \delta} \frac{v_\omega}{2} - \log \left( \frac{1 - \delta \exp \left( \frac{-\tau(1 - \tau)}{2} v_\omega \right)}{1 - \delta} \right) \right] \]

consumption dispersion due to uninsurable shocks \( \approx \) \( (1 - \tau)^2 \frac{v_\alpha}{2} \)

\[ -(1 + \chi) \sigma \frac{1}{\hat{\sigma}^2} \frac{v_\varepsilon}{2} + (1 + \chi) \frac{1}{\hat{\sigma}} v_\varepsilon \]

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
\[ W(\tau) = W^{RA}(\tau) \]

\[ + (1 + \chi) \left[ \frac{-1}{\theta - 1} \log \left( \sqrt{\frac{\eta\theta}{\mu(1-\tau)}} \right) + \frac{\theta}{\theta - 1} \log \left( \frac{\theta}{\theta - 1} \right) \right] \]

\[ - \frac{1}{2\theta}(1-\tau) - \left[ - \log \left( 1 - \left( \frac{1-\tau}{\theta} \right) \right) - \left( \frac{1-\tau}{\theta} \right) \right] \]

\[ -(1-\tau)^2 \frac{v_\varphi}{2} \]

\[ - \left[ (1-\tau) \frac{\delta}{1-\delta} \frac{v_\omega}{2} - \log \left( \frac{1 - \delta \exp \left( \frac{-\tau(1-\tau)}{2} v_\omega \right)}{1 - \delta} \right) \right] \]

\[ -(1 + \chi) \sigma \left( \frac{1}{\hat{\sigma}^2} \frac{v_\epsilon}{2} \right) \left( \frac{1}{\hat{\sigma}} \right) v_\epsilon \]

hours dispersion prod. gain from ins. shock = \log(N/H)
Parameterization

- Parameter vector \( \{\chi, \sigma, \delta, \theta, v_\varphi, v_\omega, v_\epsilon, \} \)
Parameterization

• Parameter vector $\{\chi, \sigma, \delta, \theta, v\phi, v\omega, v\epsilon, \}$

• To match $G/Y = 0.20$:  $\rightarrow \chi = 0.25$
Parameterization

- Parameter vector \( \{\chi, \sigma, \delta, \theta, v_\phi, v_\omega, v_\varepsilon, \} \)

- To match \( G/Y = 0.20 \): \( \rightarrow \chi = 0.25 \)

- Frisch elasticity (micro-evidence): \( \rightarrow \sigma = 2 \)
Parameterization

- Parameter vector \( \{ \chi, \sigma, \delta, \theta, v_\varphi, v_\omega, v_\varepsilon, \} \)

- To match \( G/Y = 0.20 \): \( \rightarrow \chi = 0.25 \)

- Frisch elasticity (micro-evidence): \( \rightarrow \sigma = 2 \)

\[
\begin{align*}
\text{cov}(\log h, \log w) & = \frac{1}{\sigma} v_\varepsilon \\
\text{var}(\log h) & = v_\varphi + \frac{1}{\sigma^2} v_\varepsilon \\
\text{var}^0(\log c) & = (1 - \tau)^2 \left( v_\varphi + \frac{1}{\theta^2} \right) \\
\Delta \text{var}(\log w) & = v_\omega 
\end{align*}
\]
Parameterization

• Parameter vector $\{\chi, \sigma, \delta, \theta, v_\varphi, v_\omega, v_\varepsilon, \}$

• To match $G/Y = 0.20$: $\Rightarrow \chi = 0.25$

• Frisch elasticity (micro-evidence): $\Rightarrow \sigma = 2$

\[
\begin{align*}
cov(\log h, \log w) &= \frac{1}{\hat{\sigma}} v_\varepsilon \Rightarrow v_\varepsilon = 0.18 \\
var(\log h) &= v_\varphi + \frac{1}{\hat{\sigma}^2} v_\varepsilon \Rightarrow v_\varphi = 0.06 \\
var^0(\log c) &= (1 - \tau)^2 \left( v_\varphi + \frac{1}{\theta^2} \right) \Rightarrow \theta = 3 \\
\Delta var(\log w) &= v_\omega \Rightarrow v_\omega = 0.005, \delta = 0.963
\end{align*}
\]
Optimal progressivity

Social Welfare Function

Welfare gain = 0.82 pct

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Optimal progressivity: decomposition

Social Welfare Function

welf change rel. to baseline optimum (% of cons.)

Progressivity rate ($\tau$)

(1) Rep. Agent $\tau = -0.25$

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Optimal progressivity: decomposition

Social Welfare Function

(1) Rep. Agent $\tau = -0.25$

(2) + Skill Inv. $\tau = -0.066$

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Optimal progressivity: decomposition

Social Welfare Function

(1) Rep. Agent $\tau = -0.25$

(2) + Skill Inv. $\tau = -0.066$

(3) + Pref. Het. $\tau = 0.00$

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Optimal progressivity: decomposition

Social Welfare Function

- (1) Rep. Agent $\tau = -0.25$
- (2) + Skill Inv. $\tau = -0.066$
- (3) + Pref. Het. $\tau = 0.00$
- (4) + Unins. Shocks $\tau = 0.102$

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Optimal progressivity: decomposition

Social Welfare Function

- (1) Rep. Agent $\tau = -0.25$
- (2) + Skill Inv. $\tau = -0.066$
- (3) + Pref. Het. $\tau = 0.00$
- (4) + Unins. Shocks $\tau = 0.102$
- (5) + Ins. Shocks $\tau = 0.087$

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Actual and optimal progressivity

Heathcote-Storesletten-Violante, "Redistributive Taxation in a Partial Insurance Economy"
Alternative SWF

Utilitarian SWF embeds desire to insure and to redistribute wrt \((\kappa, \varphi)\)

Turn off desire to redistribute
Alternative SWF

Utilitarian SWF embeds desire to insure and to redistribute wrt $(\kappa, \varphi)$

Turn off desire to redistribute

- Economy with heterogeneity in $(\kappa, \varphi)$, and $\chi = v_\omega = \tau = 0$
  
- Compute CE allocations

- Compute Negishi weights s.t. planner’s allocation $= CE$

- Use these weights in the SWF

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
### Alternative SWF

<table>
<thead>
<tr>
<th></th>
<th>Utilitarian</th>
<th>$\kappa$-neutral</th>
<th>$\varphi$-neutral</th>
<th>Insurance-only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redist. wrt $\kappa$</td>
<td>$Y$</td>
<td>$N$</td>
<td>$Y$</td>
<td>$N$</td>
</tr>
<tr>
<td>Redist. wrt $\varphi$</td>
<td>$Y$</td>
<td>$Y$</td>
<td>$N$</td>
<td>$N$</td>
</tr>
<tr>
<td>Insurance wrt $\omega$</td>
<td>$Y$</td>
<td>$Y$</td>
<td>$Y$</td>
<td>$Y$</td>
</tr>
<tr>
<td>$\tau^*$</td>
<td>0.087</td>
<td>0.046</td>
<td>0.030</td>
<td>-0.012</td>
</tr>
<tr>
<td>Welf. gain (pct of $c$)</td>
<td>0.82</td>
<td>1.33</td>
<td>1.66</td>
<td>2.67</td>
</tr>
</tbody>
</table>

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Optimal progressivity: alternative SWF

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Progressive consumption taxation

\[ c = \lambda \tilde{c}^{1-\tau} \]

where \( c \) are expenditures and \( \tilde{c} \) are units of final good

- Implement as a tax on total (labor plus asset) income less saving

- Consumption depends on \( \alpha \) but not on \( \varepsilon \)

- Can redistribute wrt. uninsurable shocks without distorting the efficient response of hours to insurable shocks

- Higher progressivity and higher welfare
Alternative assumptions on $G$

1. $G$ endogenous and valued: $\chi = 0.25, \ G^* = \chi/(1 + \chi) = 0.2$
Alternative assumptions on $G$

1. G endogenous and valued: $\chi = 0.25$, $G^* = \chi/(1 + \chi) = 0.2$

2. G endogenous but non valued: $\chi = 0$, $G^* = 0$

3. G exogenous and proportional to $Y$: $G/Y = \bar{g} = 0.2$

4. G exogenous and fixed in level: $G = \bar{G} = 0.2 \times Y^{US}$
Alternative assumptions on $G$

1. G endogenous and valued: $\chi = 0.25$, $G^* = \chi/(1 + \chi) = 0.2$

2. G endogenous but non valued: $\chi = 0$, $G^* = 0$

3. G exogenous and proportional to $Y$: $G/Y = \bar{g} = 0.2$

4. G exogenous and fixed in level: $G = \bar{G} = 0.2 \times Y^{US}$

<table>
<thead>
<tr>
<th></th>
<th>Utilitarian SWF</th>
<th>Insurance-only SWF</th>
</tr>
</thead>
<tbody>
<tr>
<td>$G$ endogenous</td>
<td>$\chi = 0.25$</td>
<td>$G_{Y(\tau^*)}$</td>
</tr>
<tr>
<td></td>
<td>0.200</td>
<td>0.087</td>
</tr>
<tr>
<td>$G$ endogenous</td>
<td>$\chi = 0$</td>
<td>$\tau^*$</td>
</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.209</td>
</tr>
<tr>
<td>$g$ exogenous</td>
<td>$\bar{g} = 0.2$</td>
<td>$\tau^*$</td>
</tr>
<tr>
<td></td>
<td>0.200</td>
<td>0.209</td>
</tr>
<tr>
<td>$G$ exogenous</td>
<td>$\bar{G} = 0.2 \times Y^{US}$</td>
<td>$\tau^*$</td>
</tr>
<tr>
<td></td>
<td>0.188</td>
<td>0.095</td>
</tr>
</tbody>
</table>

Heathcote-Storesletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Going forward

- Part of $G$ wasted
- Median voter choosing $(g, \tau)$ once and for all
- Skill-biased technical change
- Comparison with Mirlees solution
- Rent-extraction by top earners? (Piketty-Saez view)
- Endogenous growth?

Heathcote-Storelletten-Violante, “Redistributive Taxation in a Partial Insurance Economy”
Going forward

• Part of $G$ wasted

• Median voter choosing $(g, \tau)$ once and for all

• Skill-biased technical change

• Comparison with Mirlees solution

• Rent-extraction by top earners? (Piketty-Saez view)

• Endogenous growth?