MACROECONOMICS

PSE Summer School, 2024

On the Optimal Design of Fiscal Policy

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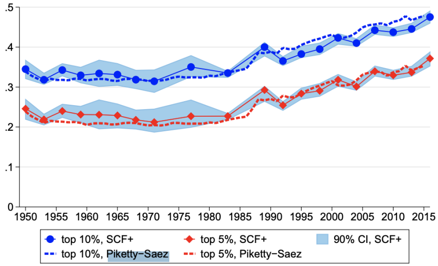
Summer School PSE

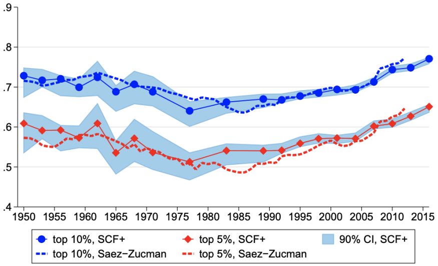
June 25, 2024

Income and wealth inequality have increased since 1950

Figure 5: Top 5% and top 10% income and wealth shares



(a) Income



(b) Wealth

- Top-income and -wealth shares have increased (SCF+, United States)
  Kuhn, Schularick and Stein (2020)

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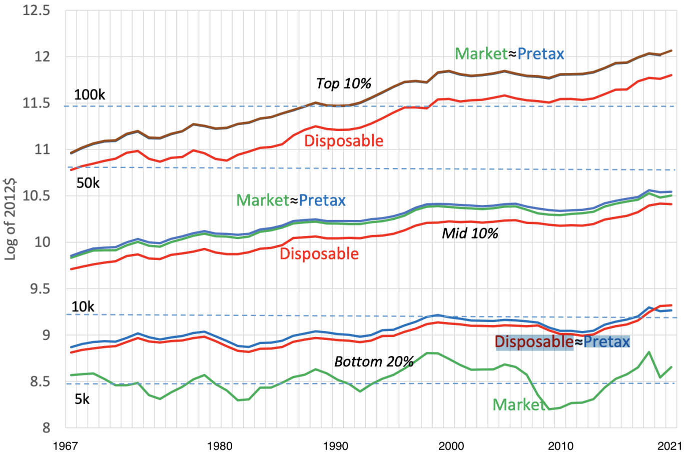

- Household income has been flat for 5 decades at the bottom (CPS, United States)
  Heathcote, Violante, Perri and Zhang (2023)

Rethinking fiscal policy

- High levels of inequality

  Piketty Saez (2003), Heathcote Perri Violante (2010), Kuhn, Schularick and Stein (2020), Saez and Zucman (2020, 2022), Heathcote, Violante, Perri and Zhang (2022), ...

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- New questions in the policy debate, on the role of the welfare state
  - Should we tax wealth?
  - Should we implement a Universal Basic Income? Should we increase income tax progressivity?

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- This class: rethinking fiscal policy
  - Optimal taxes at the household level
  - Old classical theoretical literature, new quantitative macro literature

Lecture 1

Capital and Wealth Taxes

On capital taxes

Should we tax capital?

- A classic question in macro...
  - ... which came back in recent policy debate

On capital taxes

Should we tax capital?

- A classic question in macro...
  - ... which came back in recent policy debate
- Methodology
  - Ramsey plans
  - Quantitative heterogeneous-agent models
- Deterministic, long-run, steady-state

Should we tax capital?

1. Optimal fiscal policy in representative-agent models

    - Define **Ramsey plans** to compute optimal taxes

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    - Insurance, redistribution, and life-cycle dynamics

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   - Capital taxes should be 34%
3. Optimal fiscal policy with heterogeneous capital returns
   - New facts on capital returns

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   - Define **Ramsey plans** to compute optimal taxes
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3. Optimal fiscal policy with heterogeneous capital returns
   - New facts on capital returns
   - Capital taxes should be negative, wealth taxes should be positive

Literature **Main references (many more at the end)**

- On optimal fiscal policy in RA models and the latest controversies
  - **Chamley (1986)**, Judd (1985), Straub and Werning (2020)
  - Chari, Christiano, and Kehoe (1994), Farhi (2010), ...

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  - Bach, Calvet, and Sodini (2020), Smith et al. (2019), Becker and Hvide (2022), ...
- On models with entrepreneurs and heterogeneous capital returns
  - **Guvenen et al. (2023)**
  - Kitao (2008), Bhandari and McGrattan (2020), Boar and Knowles (2020), Gaillard and Wangner (2022), ...

1. Optimal Taxes in a Deterministic Growth Model

General motivation

- Optimal taxes in a **competitive equilibrium**

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  - Households' behaviors and prices

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General motivation

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  - Households' behaviors and prices
- Taxes: functional forms
- Commitment in time-zero
- Outline: environment; equilibrium; Ramsey plan

Environment Preferences and resources

- Preferences of the representative household:

$$\sum_{t=0}^{\infty} \beta^t u(c_t, l_t), \tag{1}$$

where c_t: consumption, l_t: leisure.

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- The two resource constraints are given by

$$l_t + n_t = 1$$

  where n_t: labor, and

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$$l_t + n_t = 1$$

where n_t: labor, and

$$g_t + c_t + k_{t+1} = A_t F(k_t, n_t) + (1-\delta)k_t, \tag{2}$$

where g_t: government expenditure, A_t: TFP, k_t: capital with k_0 is given.

Environment First-Best

- Planner problem

Environment First-Best

- Planner problem

- Two efficiency conditions

$$u_{c,t} A_t F_{n,t} = u_{l,t} \tag{3}$$

$$u_{c,t} = \beta u_{c,t+1} \left[A_{t+1} F_{k,t+1} + 1 - \delta \right] \tag{4}$$

Competitive Equilibrium with Taxes **Three agents**

- Representative household
- Representative firm
- Government

Competitive Equilibrium with Taxes **Government**

- Government
  - Spending g_t
  - Public debt b_t, labor tax τ_t^n, capital tax τ_t^k, lump-sum taxes T_t
  - b_0 given

Competitive Equilibrium with Taxes

- Government
  - Spending g_t
  - Public debt b_t, labor tax τ_t^n, capital tax τ_t^k, lump-sum taxes T_t
  - b_0 given

- Budget constraint:

$$g_t + b_t = \tau_t^k r_t k_t + \tau_t^n w_t n_t + b_{t+1}/R_t + T_t \tag{5}$$

where r_t: renting price of capital, w_t: price of labor, R_t: gross rate of return on one-period bonds from t to $t+1$.

Competitive Equilibrium with Taxes **Households**

- Household
  - Save in b_t and k_t
  - b_0 and k_0 given

Competitive Equilibrium with Taxes Households

- Household
  - Save in b_t and k_t
  - b_0 and k_0 given

- Maximizes utility given budget constraint:

$$c_t + k_{t+1} + b_{t+1}/R_t = (1 - \tau_t^n) w_t n_t + (1 - \tau_t^k) r_t k_t - T_t + (1 - \delta) k_t + b_t \tag{6}$$

Competitive Equilibrium with Taxes Households

- Household's maximization problem

Competitive Equilibrium with Taxes Households

- Household's maximization problem

- Three first-order conditions

$$u_{l,t} = u_{c,t} w_t (1 - \tau_t^n) \tag{7}$$

$$u_{c,t} = \beta u_{c,t+1} [(1 - \tau_{t+1}^k) r_{t+1} + 1 - \delta] \tag{8}$$

$$R_t = (1 - \tau_{t+1}^k) r_{t+1} + 1 - \delta \tag{9}$$

Competitive Equilibrium with Taxes Firms

The representative firm is standard and maximizes its profit every period:

$$r_t = A_t F_{k,t} \tag{10}$$

$$w_t = A_t F_{n,t} \tag{11}$$

Competitive Equilibrium with Taxes Definition

Let $x \equiv \{x_t\}_{t=0}^{\infty}$.

Definition

A **feasible allocation** is a sequence (k, c, n, g) such that the resource constraint (2) holds $\forall t \geq 0$.

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Definition

A **price system** is a non-negative bounded sequence (w, r, R).

Definition

A **government policy system** is a sequence $(g, \tau_k, \tau_n, T, b)$.

Competitive Equilibrium with Taxes Definition

Definition

A **competitive equilibrium** is a feasible allocation, a price system, and a government policy, such that:

a. Given the price system and the government policy, the allocation solves the firm's problem and the household's problem

b. Given the allocation and the price system, the government policy satisfies the sequence of government budget constraints (5).

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- An infinity of CE! Why?

Competitive Equilibrium with Taxes Distortions

Claim

The first-best allocation requires capital and labor taxes to be zero.

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- Labor and capital taxes are said to be distortionary.
- What about τ_0^k? What about lump-sum taxes?

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The first-best can be implemented by lump-sum taxes and balanced budget.

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The first-best can be implemented by lump-sum taxes and balanced budget.

Claim

Ricardian equivalence: the first-best allocation can be implemented by any path $\{b_t\}$ for debt, and $T_t = g_t + b_t - b_{t+1}/R_t$.

Ramsey Plan Definition

Government

- Choose sequences of tax rates at time-0
- Anticipate households' responses to tax plans
- Benevolent

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A Ramey problem is to choose a competitive equilibrium which maximizes (ex ante) consumer welfare.

Ramsey Plan Definition

Government

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- Anticipate households' responses to tax plans
- Benevolent

Definition

A Ramey problem is to choose a competitive equilibrium which maximizes (ex ante) consumer welfare.

- Rule-out lump-sum taxes and assume τ_0^k is given. Why?

Ramsey Plan Definition

- A Ramsey plan is a complicated problem
  - Choose allocations, price system, and government policy
  - To maximize utility (1)
  - S.T. all equations holds: resource (2), gov BC (5), HH BC (6) & FOC (7), (8), (9), Firm FOC (10), (11)

Ramsey Plan **Definition**

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  - Choose allocations, price system, and government policy
  - To maximize utility (1)
  - S.T. all equations holds: resource (2), gov BC (5), HH BC (6) & FOC (7), (8), (9), Firm FOC (10), (11)

$\Rightarrow$ Goal: to simplify the Ramsey plan

Ramsey Plan **Simplify the problem**

- First, we can ignore the household budget constraint

Ramsey Plan Simplify the problem

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  - Euler theorem: $F(k, n) = F_k k + F_n n$

Ramsey Plan **Simplify the problem**

- First, we can ignore the household budget constraint
  - Euler theorem: $F(k, n) = F_k k + F_n n$
  - Resource constraint (2) + govt budget constraint

$$g_t + c_t + k_{t+1} = A_t F(k_t, n_t) + (1 - \delta) k_t \tag{2}$$

$$g_t + b_t = \tau_t^k r_t k_t + \tau_t^n w_t n_t + b_{t+1}/R_t \tag{5}$$

Ramsey Plan **Simplify the problem**

- Dual approach: use **after-tax prices**
  - $\tilde{r}_t \equiv (1-\tau_{kt})F_{k,t}$ and $\tilde{w}_t \equiv (1-\tau_{nt})F_{n,t}$
  - Solve for $\tilde{r}_t$ and $\tilde{w}_t$ instead of r_t and w_t

Ramsey Plan Simplify the problem

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  - Get rid of two controls: τ_t^k and τ_t^n, and two FOC (firm)

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  - Solve for $\tilde{r}_t$ and $\tilde{w}_t$ instead of r_t and w_t
  - Get rid of two controls: τ_t^k and τ_t^n, and two FOC (firm)
- Rewrite government's budget constraint

Ramsey Plan Lagrangian

$$L = \sum_{t=0}^{\infty} \beta^t \left\{ \begin{array}{c} u(c_t, 1 - n_t) + \\ \\ \\ \\ \end{array} \right.$$

Ramsey Plan Lagrangian

$$L = \sum_{t=0}^{\infty} \beta^t \left\{ \begin{array}{c} u(c_t, 1-n_t) + \\ + \Phi_t \left[A_t F(k_t, n_t) - \tilde{r}_t k_t - \tilde{w}_t n_t - g_t + b_{t+1}/R_t - b_t \right] + \\ \\ \\ \end{array} \right.$$

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Ramsey Plan Lagrangian

$$L = \sum_{t=0}^{\infty} \beta^t \left\{ \begin{array}{c} u(c_t, 1-n_t)+ \\ +\,\Phi_t\left[A_t F(k_t, n_t) - \tilde{r}_t k_t - \tilde{w}_t n_t - g_t + b_{t+1}/R_t - b_t\right]+ \\ +\,\lambda_t\left[A_t F(k_t, n_t) + (1-\delta)k_t - k_{t+1} - c_t - g_t\right]+ \\ +\,\mu_{1t}\left[u_l(c_t, 1-n_t) - u_c(c_t, 1-n_t)\tilde{w}_t\right]+ \\ +\mu_{2t}\left[u_c(c_t, 1-n_t) - \beta u_c(c_{t+1}, 1-n_{t+1})\left(\tilde{r}_{t+1} + 1 - \delta\right)\right] \\ +\mu_{3t}\left[R_t - \tilde{r}_{t+1} + 1 - \delta\right] \end{array} \right\}$$

- No more taxes!
- What do I chose?
  - Allocations $\{c_t, k_{t+1}, n_t\}$ and after-tax prices $\{\tilde{w}_t, \tilde{r}_t, R_t\}$

Ramsey Plan Lagrangian

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- No more taxes!
- What do I chose?
  - Allocations $\{c_t, k_{t+1}, n_t\}$ and after-tax prices $\{\tilde{w}_t, \tilde{r}_t, R_t\}$
- Then I can compute taxes:

$$\tilde{r}_t = (1-\tau_t^k)r_t = (1-\tau_t^k)F_k(n_t,k_t)$$
$$\tilde{w}_t = (1-\tau_t^n)w_t = (1-\tau_t^n)F_n(n_t,k_t)$$

Ramsey Plan Lagrangian

$$L=\sum_{t=0}^{\infty}\beta^t\left\{\begin{array}{c}u(c_t,1-n_t)+\\ +\Phi_t\left[A_tF(k_t,n_t)-\tilde{r}_tk_t-\tilde{w}_tn_t-g_t+b_{t+1}/R_t-b_t\right]+\\ +\lambda_t\left[A_tF(k_t,n_t)+(1-\delta)k_t-k_{t+1}-c_t-g_t\right]+\\ +\mu_{1t}\left[u_l(c_t,1-n_t)-u_c(c_t,1-n_t)\tilde{w}_t\right]+\\ +\mu_{2t}\left[u_c(c_t,1-n_t)-\beta u_c(c_{t+1},1-n_{t+1})\left(\tilde{r}_{t+1}+1-\delta\right)\right]\\ +\mu_{3t}\left[R_t-\tilde{r}_{t+1}+1-\delta\right]\end{array}\right\}$$

Ramsey Plan Capital taxes in the long-run

- FOC w.r.t. k_{t+1}

$$\lambda_t = \beta \left[\Phi_{t+1} \left(A_{t+1} F_k(k_{t+1}, n_{t+1}) - \tilde{r}_{t+1} \right) + \lambda_{t+1} (A_{t+1} F_k(k_{t+1}, n_{t+1}) + 1 - \delta) \right]$$

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- Long-run non-stochastic steady-state: $g_t = g$, $A_t = A$, assuming the steady-state converges

$$\lambda = \beta \left[\Phi \left(r - \tilde{r} \right) + \lambda (r + 1 - \delta) \right]$$

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- Long-run non-stochastic steady-state: $g_t = g$, $A_t = A$, assuming the steady-state converges
$$\lambda = \beta \left[\Phi \left(r - \tilde{r} \right) + \lambda (r + 1 - \delta) \right]$$

- Households' Euler equation (8) in steady-state
$$1 = \beta \left((1 - \delta) + \tilde{r} \right)$$

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- Combining these equations

$$(\lambda + \Phi)(r - \tilde{r}) = 0$$

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- Long-run non-stochastic steady-state: $g_t = g$, $A_t = A$, assuming the steady-state converges

$$\lambda = \beta \left[\Phi \left(r - \tilde{r} \right) + \lambda (r + 1 - \delta) \right]$$

- Households' Euler equation (8) in steady-state

$$1 = \beta \left((1 - \delta) + \tilde{r} \right)$$

- Combining these equations

$$(\lambda + \Phi)(r - \tilde{r}) = 0$$

- Under some conditions, $\lambda + \Phi > 0 => r = \tilde{r} => \tau_k = 0$

Ramsey Plan **Capital taxes should be zero...**

- Capital should not be taxed in the long run!

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- Capital should not be taxed in the long run!
  - How to finance g in the long-run? With labor taxes! (or assets?)

Ramsey Plan Capital taxes should be zero...

- Capital should not be taxed in the long run!
  - How to finance g in the long-run? With labor taxes! (or assets?)
  - An **efficiency** argument

Ramsey Plan **Capital taxes should be zero... or one!**

- Capital should not be taxed in the long run!
  - How to finance g in the long-run? With labor taxes! (or assets?)
  - An **efficiency** argument
- But in the short run... $\tau_0^k = \bar{\tau}$!
  - Terrible time-consistency problem

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$\Rightarrow$ Not as general as we thought it was...

Optimal Fiscal Policy in RBC Model Taking stock

- Capital taxes should be zero. . .
- . . . in the long-run, and under some conditions

2. Optimal Fiscal Policy in Standard Aiyagari Models

Fiscal policy in standard Aiyagari models Capital taxes

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- Environment; equilibrium; optimal policy

Environment Demography

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- Value consumption and labor:

$$\mathbb{E} \sum_{j=1}^{J} \beta^{j-1} u(c_j, n_j)$$

Environment Demography

- Idiosyncratic productivity of agent with type i and age j: $\varepsilon_j \alpha_i \eta$
- Heterogeneity in several dimensions
  - Age j: ε_j captures the age-profile productivity, with $\varepsilon_j = 0 \; \forall \; j > J_r$
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- Household state: (a, η, i, j)

- Technology

$$G_t + C_t + K_{t+1} - (1-\delta)K_t = K_t^{\alpha} N_t^{1-\alpha} \tag{12}$$

- Aggregate stationary steady-state
  - Aggregates are constant... but not idiosyncratic variables!

Environment Government

- Social Security
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- Exogenous spending G_t financed by
  - A linear tax τ_k on capital income $r_t(A_t + Tr_t)$
  - A linear tax τ_c on consumption c
  - A progressive tax $T(.)$ on taxable labor income $y_L - \tau_{ss} min\{y_L, \overline{y}\}$ where $y_L = w\varepsilon_j\alpha_i\eta$

Competitive Equilibrium **Definition**

A stationary recursive competitive equilibrium (RCE) is:

- a policy $\{G, \tau_c, \tau_k, T, \tau_{ss}, \overline{y}, SS\}$
- a policy for the firm $\{N, K\}$
- value and policy functions for the household $\{\nu(a,\eta,i,j), c(a,\eta,i,j), a'(a,\eta,i,j), n(a,\eta,i,j)\}$ and bequests (Tr)
- prices $\{w, r\}$ and a distribution $\Phi(a,\eta,i,j)$

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s.t.:

1. Given prices and policies, the household behaves optimally:

$$\nu(a,\eta,i,j) = \max_{c,a',n} u(c,n) + \beta\psi_j \int_{\eta'|\eta} \nu(a',\eta',i,j+1)\pi(\eta'|\eta) \text{ s.t.}$$

$$(1+\tau_c)c + a' = y_L - \tau_{ss} min\{y_L, \overline{y}\} - T(y_L^T) + [1 + r(1-\tau_k)](a + Tr) \text{ if } j < J_r, \text{ where } y_L = w\varepsilon_j\alpha_i\eta n$$

$$(1+\tau_c)c + a' = ss + [1 + r(1-\tau_k)](a + \text{Tr}) \text{ if } j \geq J_r$$

$$a' \geq \underline{a}$$

Competitive Equilibrium Definition

2. Firms behave optimally:

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$$\tau_{ss} \int \min\{w \alpha_i \varepsilon_j \eta n(a,\eta,i,j), \overline{y}\} \Phi(a,\eta,i,j) = SS \int \Phi(a,\eta,i,j \geq J_r)$$

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5. The government's budget constraint holds:

$$G = \int \tau_k r(a + Tr) \Phi(a,\eta,i,j) + \int T(y_L^T(\eta,i,j)) \Phi(a,\eta,i,j) \cdots$$
$$+ \int \tau_c c(a,\eta,i,j) \Phi(a,\eta,i,j)$$

Competitive Equilibrium Definition

6. Markets clear:

$$K = \int a\Phi(a, \eta, i, j)$$

$$N = \int \varepsilon_j \alpha_i \eta n(a, \eta, i, j)\Phi(a, \eta, i, j)$$

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$$K = \int a\Phi(a,\eta,i,j)$$

$$N = \int \varepsilon_j \alpha_i \eta n(a,\eta,i,j)\Phi(a,\eta,i,j)$$

7. The measure is stationary: $\forall \mathcal{J}$ s.t. 1 non in $\mathcal{J}$,

$$\Phi(A \times E \times \mathcal{I} \times \mathcal{J}) = \int Q((a,\eta,i,j); A \times E \times \mathcal{I} \times \mathcal{J})\Phi(a,\varepsilon,i,j)$$

where

$$Q(a,\eta,i,j; A \times E \times \mathcal{I} \times \mathcal{J}) = \cdots$$

$$\psi_j \int 1_{(a'(a,\eta,i,j)\in A)\times(i\in\mathcal{I})\times(j+1)\in\mathcal{J})} \sum_{\eta'} P(\eta' \in E|\eta)\Phi(a,\eta,i,j)$$

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- Technology: $\alpha = 0.36$, δ s.t. $\frac{I}{Y} = 25\%$
- Heterogeneity
  - Age-profile productivities $\{\epsilon_j\}$ follow Hansen (93)
  - Two types $\{\alpha_i\}$
  - Productivity $\{\eta\}$ follows Storesletten, Telmer, Yaron (04)

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- Government
  - G s.t. $G/Y = 0.17$
  - $\tau_c = 5\%$
  - Total income (including capital) taxed a la Gouveia and Strauss (94)

$$T(y) = \kappa_0 \left(y - \left(y^{-\kappa_1} + \kappa_2\right)^{-\frac{1}{\kappa_1}} \right)$$

  where κ_0 captures the average tax rate (26%), κ_1 level of progressivity (0.76), κ_2 solves the budget constraint

Calibration A comment on tax functions

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  - Short-run capital gains are taxed differently in the U.S.
  - Real estate is taxed linearly
  - Corporate profits are taxed linearly
  - Measurement issues...

Results Optimal plan

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  - Tax capital to lower labor taxes

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- Evaluate life-cycle components
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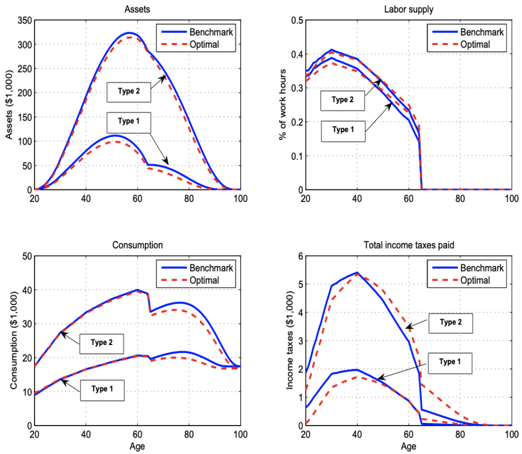

Figure 1: Life Cycle Profiles of Assets, Labor Supply, Consumption and Taxes

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- Extensive robustness checks
  - Less elastic labor supply decreases τ_k
  - Robustness w.r.t.: IES, D/GDP, social welfare function, U, ...
  - No transitions (!!!)

3. Heterogeneous Capital Returns

Taxing capital? An ongoing debate

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- Policy: Taxing capital to redistribute?

Understanding capital? Mechanisms of accumulation

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  - Standard log-AR(1) process (Floden and Lindé 2001) & preferences

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    - + Entrepreneurship, and more generally, **heterogeneous capital returns**

Heterogeneous returns Theory

- Heterogeneous capital returns: most promising theoretical avenue
  - Can generate fat tails in wealth distribution
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- Norwegian administrative data
  - Individual tax records 2004-2015
  - + Labor and capital income
  - + **Asset holdings and liabilities**

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    - **Asset holdings and liabilities**
  - Private business balance sheet
  - Housing transactions registry
  - Data on deposits and loans

- Compute individual returns to wealth

Heterogeneous capital returns Data

- Very heterogeneous returns on wealth
  - Large heterogeneity: standard deviation 22.1%
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$\Rightarrow$ Implications for taxation?

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- What if returns are heterogeneous?

$$(1 + r_i(1 - \tau_k))a_i \text{ vs. } (1 - \tau_a)(1 + r_i)a_i$$

· Guvenen et al. (2023)

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- Assume two agents, a and b
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“Use it or lose it!” Three channels

In a dynamic general-equilibrium model

1. “Use-it-or-lose-it” channel

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1. “Use-it-or-lose-it” channel
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2. “Behavior response” channel
   - More productive entrepreneurs will save more
3. “Price” channel
   - Wages and interest rates will adjust

Environment Demographics

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  - Age h, live up to H years
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  - Portfolio choice
    - Choose how much to invest in own technology ("entrepreneurship")

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  - Stochastic transition downwards

Environment Production

- Final good: $Y = Q^{\alpha} L^{1-\alpha}$
  - Aggregate labor L, with $\alpha = 0.4$
  - Intermediates: $Q = \left(\int x_{ih}^{\mu}\right)^{\frac{1}{\mu}}$, with $\mu = 0.9$
  - Competitive sector
- Intermediate goods: $x_{ih} = z_{ih} k_{ih}$
  - Price $p_{ih} = \alpha x_{ih}^{\mu-1} Q^{\alpha-\mu} L^{1-\alpha}$

Environment Household problem and equilibrium

1. Choose capital to max profits

$$\pi(a,z) = \max_{k \leq \nu(z)a} p(zk)zk - (r+\delta)k$$

   - Financial friction which generates misallocation
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$$a' \ge \underline{a}$$

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- Equilibrium: $\int a = \int k$

Calibration

- Dynamics of entrepreneurship to match fast wealth growth of super wealthy (Forbes 400)
- Standard earnings risk
- Taxes: $\tau_k = 25\%$, $\tau_\ell = 22.4\%$, $\tau_c = 7.5\%$

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⇒ Generates high wealth inequality!

	top-50	top-10	top-1	top-0.5	top-0.1
Data	0.99	0.75	0.36	0.27	0.14
Model	0.97	0.66	0.36	0.31	0.23

- Data: SCF+Forbes 2010

Main experiment **A wealth tax**

Tax reform

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    - Wealth tax $\tau_a = 1.13\%$

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  - Larger Y and C: $+10\%$
  - Higher wages, smaller net interest rates on the risk-free rate
  - Large welfare gains: $+7.4\%$!

Main experiment **A wealth tax**

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Main experiment A wealth tax

- Who wins from the reform? Welfare gains by age and entrepreneurial ability

TABLE IX – Welfare Gain/Loss by Age Group and Entrepreneurial Ability

Age groups:	*Entrepreneurial Ability Groups ($\bar{z}_i$ Percentiles)* 0–40	40–80	80–90	90–99	99–99.9	99.9+
	RN Reform					
20	7.0	7.3	7.9	8.9	10.6	11.7
21–34	6.5	6.3	6.3	6.6	7.0	6.8
35–49	5.1	4.4	3.9	3.3	1.7	0.1
50–64	2.3	1.8	1.4	0.8	–0.6	–1.8
65+	–0.2	–0.3	–0.4	–0.6	–1.2	–1.8

- The high-wealth/low-z (= the old) **lose**
- The young **benefit**...
  + From $\tau_k = 0$ (high z)
  + From higher w (low a)

Optimal taxation

Optimize steady-state fiscal system

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  - Gaillard and Wangner (2023), Ferey, Lockwood, Taubinsky (2023), Guvenen et al. (2023b), etc.!

Taxing capital? Gaillard and Wangner (2023)

- On taxation and heterogeneous returns
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- A follow up: Gaillard, Hellwig, Wangner, and Werquin (2024)
  - Non-homothetic utility

Lecture 2

Labor Taxes and Transfers

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   - Going further: **Progressive** taxes?

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  - Welfare costs
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  - General equilibrium effects
- Hard to analyze?
  - A highly multi-dimensional object
  - Computational?

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  - Progressive taxes (brackets) on labor and capital income taxes

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- Non-monetary transfers: spending on education, etc.

Optimal progressivity Two approaches

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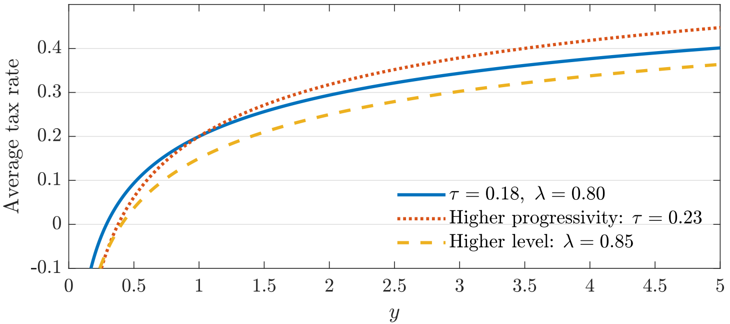
  - Quantitatively realistic model
  - But simple tax functions?
- "New" approach: a rich Ramsey approach
  - Heathcote, Storesletten, and Violante (2014), Heathcote, Storesletten, and Violante (2017)
  - Heathcote and Tsujiyama (2021a, 2021b)
  - Ferriere, Grübener, Navarro, and Vardishvili (2023a)

1. Optimal Progressivity With Loglinear Income Taxes

Loglinear tax function

- A loglinear tax scheme: $\mathcal{T}(y) = y - \lambda y^{1-\tau}$
- Tax progressivity is captured by τ
    - If $\tau = 0$: flat average (and marginal) tax rate $\mathcal{T}(y) = (1-\lambda)y$
    - If $\tau > 0$: progressive tax
    - If $\tau = 1$: full redistribution $y - \mathcal{T}(y) = \lambda \ \ \forall y$



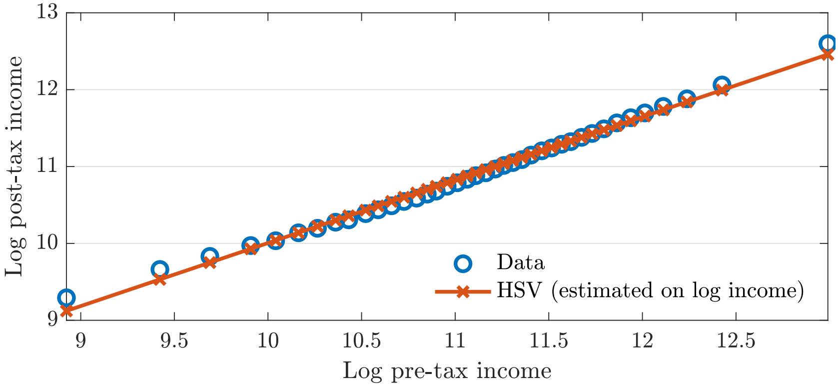
Data Taxes and transfers FGNV (2023)

- CPS 2013, working-age population
  - Total pre-tax income
  - Minus personal federal and state income taxes; payroll taxes
  - Minus payroll taxes (including employer share)
  - Plus tax credits
  - Plus SNAP and Housing Assistance (CBO imputation); Welfare

    IPUMS CPS

    Imputation of transfers following CBO Habib (2018)

Log-linear tax function



- Linear estimate on log income: $\log(y^{at}) = \log(\lambda) + (1-\tau)\log(y)$
- Estimated progressivity $\tau = 0.18$

Log-linear tax function

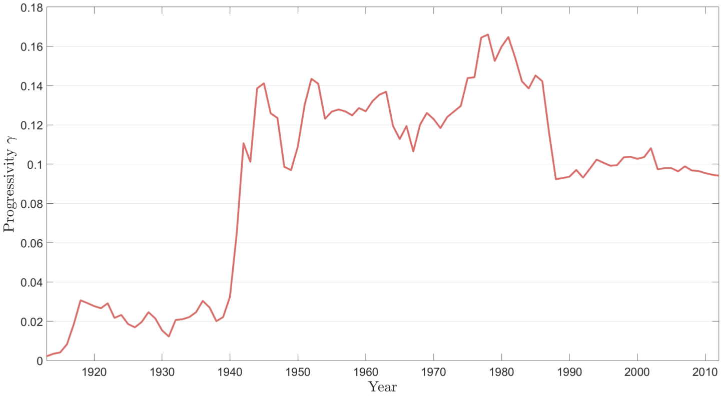


Figure 12: U.S. Federal Income Tax Progressivity

- A crude estimate over time Ferriere and Navarro (2023)

A tractable environment HSV (2017), FGNV (2023)

- No capital, representative **firm** with linear production function

A tractable environment HSV (2017), FGNV (2023)

- No capital, representative **firm** with linear production function
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  - Budget: $G = \int y_{it} di - \lambda \int y_{it}^{1-\tau} di$

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- No capital, representative **firm** with linear production function
- Utilitarian **government**
  - Budget: $G = \int y_{it} di - \lambda \int y_{it}^{1-\tau} di$
- A continuum of **workers**
  - Heterogenous wages: log-normal distribution with variance v_ω
  - Separable utility function: $\log c_{it} - B \frac{n_{it}^{1+\varphi}}{1+\varphi}$
  - Hand-to-mouth workers: $c_{it} = \lambda (z_{it} n_{it})^{1-\tau}$

Welfare **Heterogeneous agents**

- Policy function for labor is $n_{it} = [(1-\tau)/B]^{\frac{1}{1+\varphi}} \equiv n_0(\tau)$

Welfare Heterogeneous agents

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- Compute Y, λ and c_{it} and obtain welfare in closed-form

$$\mathcal{W}(\tau) = \underbrace{\underbrace{\log\left(n_0(\tau) - G\right)}_{\text{Size}} \underbrace{-\frac{1-\tau}{1+\varphi}}_{\text{Labor disutility}}}_{\text{Efficiency}} \overbrace{-(1-\tau)^2 \frac{v_\omega}{2}}^{\text{Redistribution}}$$

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  - Size term $\downarrow$ with τ; Labor disutility term $\uparrow$ with τ

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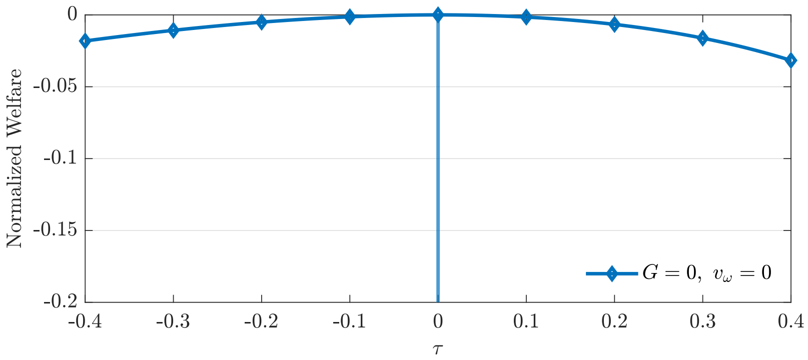
  - Size term $\downarrow$ with τ; Labor disutility term $\uparrow$ with τ
- **Redistribution** term $\uparrow$ with τ
- Calibration: $\tau = 0.18$, $\varphi = 2.5$, $G/Y = 0.223$, v_ω to match $\mathbb{V}[\log c] = 0.18$

Welfare **Optimal τ**



- Optimal income-tax progressivity:
  - No spending, no heterogeneity: $\tau = 0$

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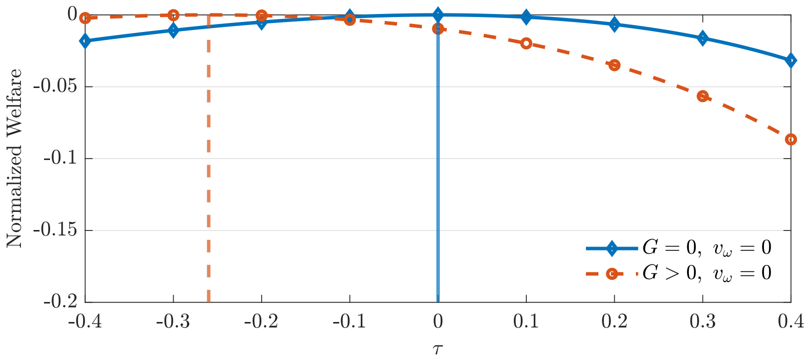

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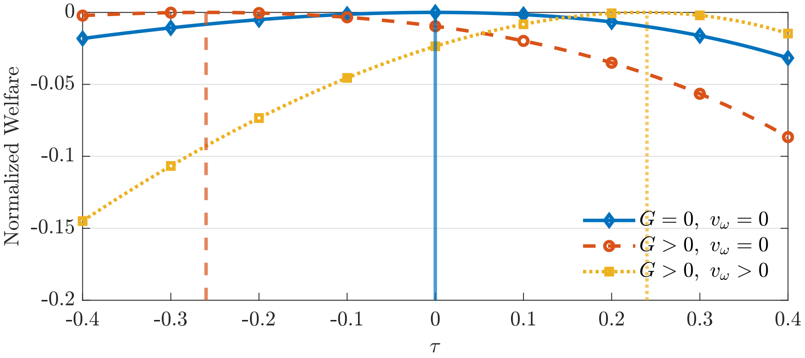

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Adding savings HSV (2014)

- A richer model with hand-to-mouth households *in equilibrium*
  - Richer structure of stochastic process

$$\log w_t = \alpha_t + \varepsilon_t$$

    where

$$\alpha_t = \alpha_{t-1} + w_t, \ \varepsilon_t = \theta_t$$

    with w_t and θ_t normally i.i.d. (+ stochastic death)

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$\Rightarrow$ "Partial-insurance" framework

- $v_\omega + v_\theta$ to capture variance of log income
- v_ω to capture variance of log consumption

Optimal income-tax progressivity HSV (2017)

- A richer model with many more features

1. Endogenous spending

2. Distribution over preference parameters

$$u_i(c_{it}, h_{it}, G) = \log c_{it} - B_i \frac{n_{it}^{1+\varphi}}{1+\varphi} + \chi \log G$$

where $\log B_i \sim \mathcal{N}(\frac{v_B}{2}, v_B)$

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3. Investment in education

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

   where $v_i(s_i) = \frac{1}{\kappa_i^{1/\psi}} \frac{s_i^{1+1/\psi}}{1+1/\psi}$, where $\kappa_i \sim exp(1)$

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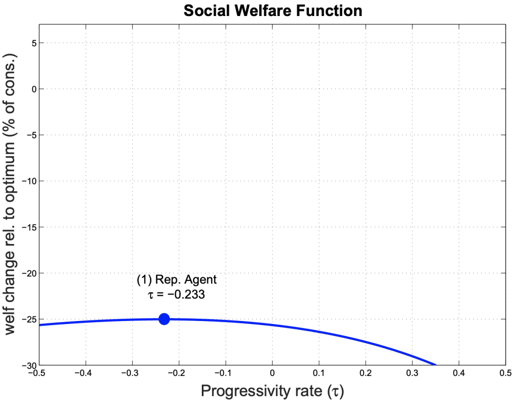
4. [Insurable shocks] ε

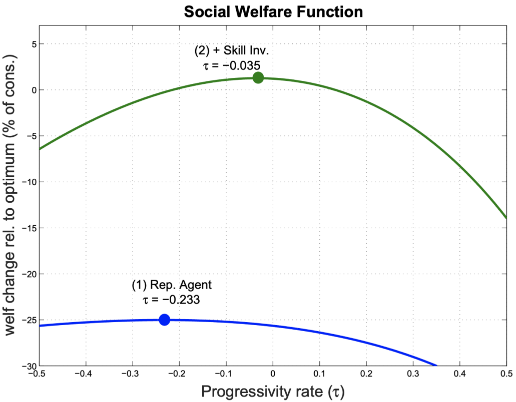
Welfare HSV (2017)

- Representative-agent, $\chi > 0$



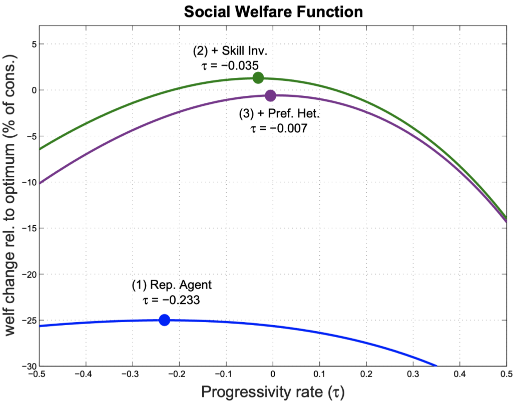
Welfare HSV (2017)

- With heterogeneity in skills



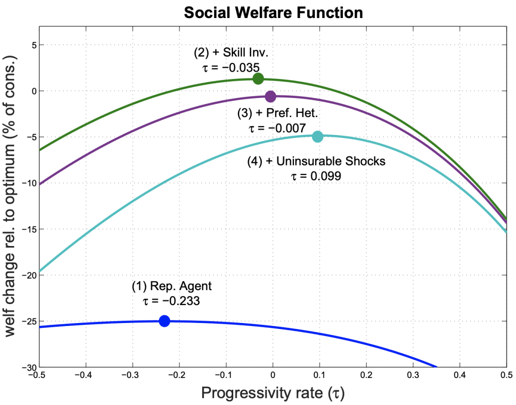
Welfare HSV (2017)

- With heterogeneity in labor disutility



Welfare HSV (2017)

- With uninsurable shocks



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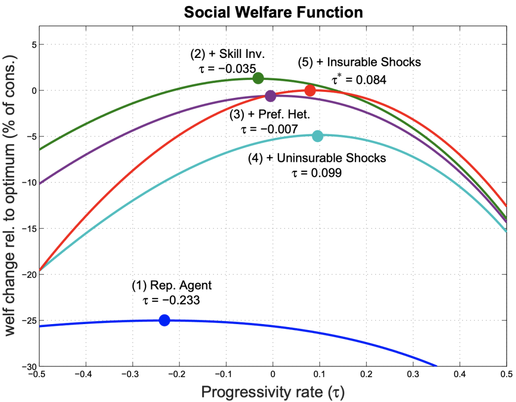

Taking stock HSV (2017)

- Taxes should be progressive
  - Optimal progressivity should be lower than in the U.S. ...

Taking stock HSV (2017)

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  - Optimal progressivity should be lower than in the U.S. . . .

- A great framework to think about optimal progressivity!

- Going further: adding an intercept?
  - Mirrlees typical findings: a quick overview
  - Revisiting the data

Adding Transfers

- Tax and transfer functions
  - Progressive income taxes: $\mathcal{T}(y) = y - \lambda y^{1-\tau}$
  - A lump-sum transfer T

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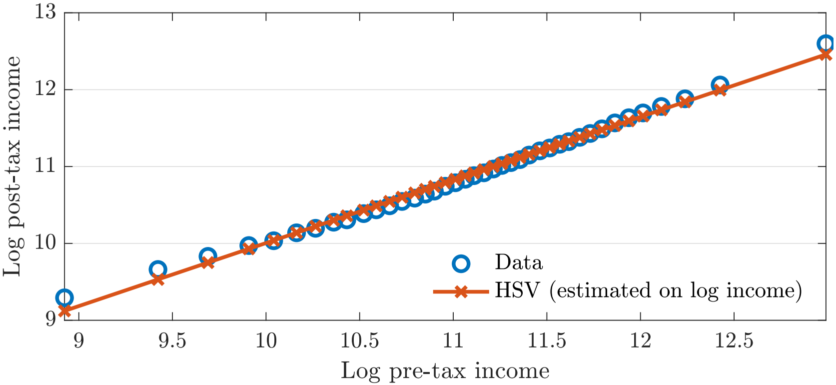
Loglinear tax function **No transfer (HSV)**



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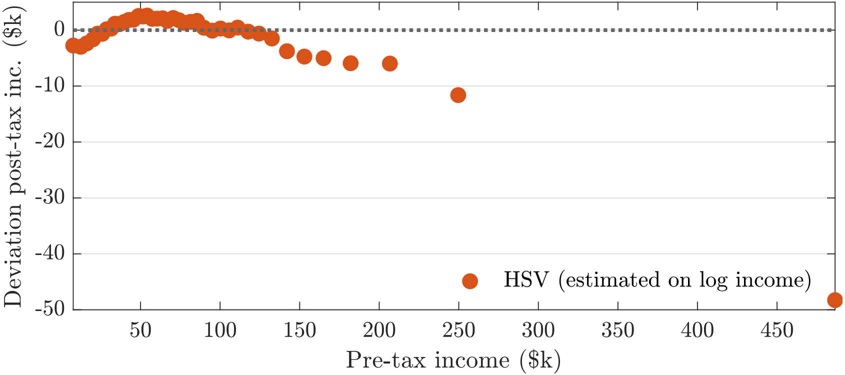

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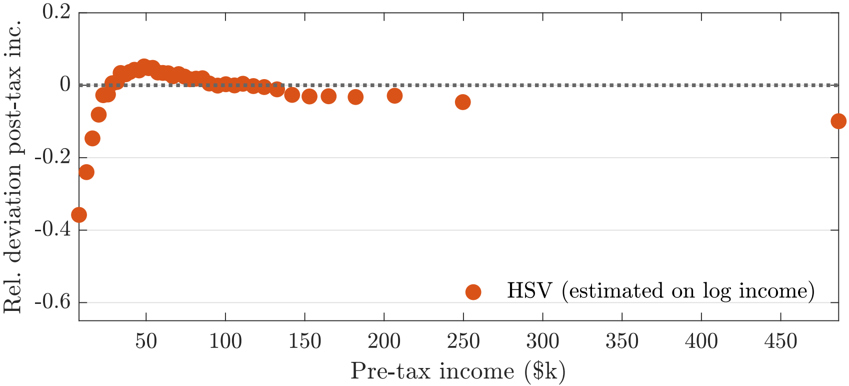

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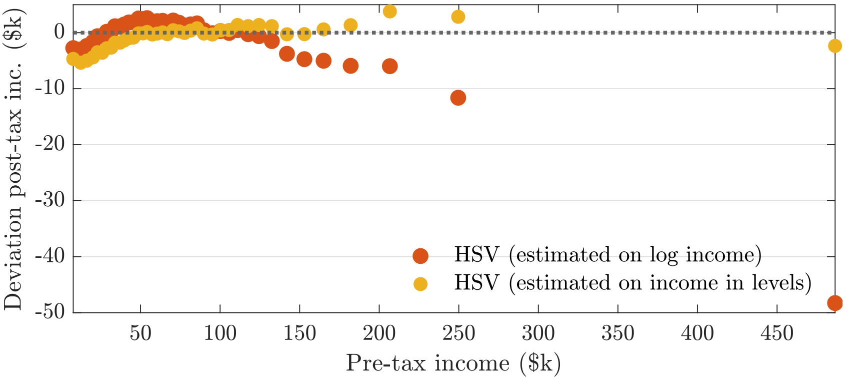
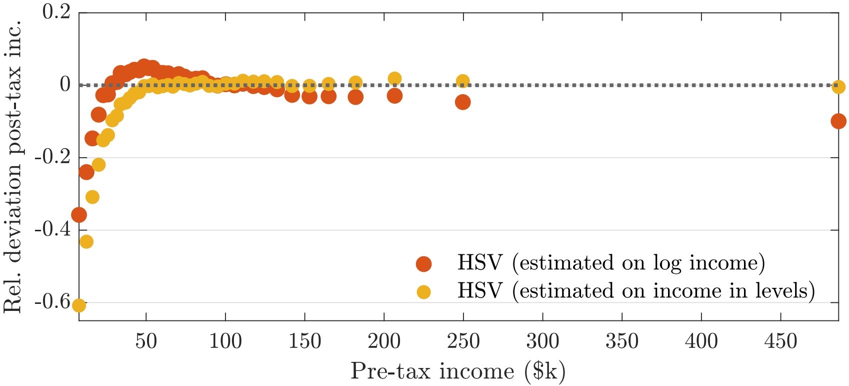


- Non-linear estimate on income in levels: $y^{at} = \lambda y^{1-\tau}$
- Estimated progressivity: $\tau = 0.09$

Loglinear tax function No transfer



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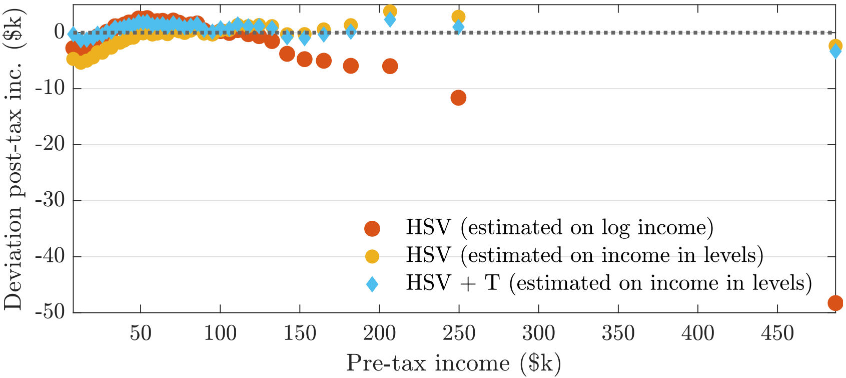
Empirical fit **Loglinear tax function with a transfer**



- Non-linear estimate on income in levels: $y^{at} = \lambda y^{1-\tau} + T$
- Estimated progressivity $\tau = 0.06$, transfer $T \approx \$5,400$

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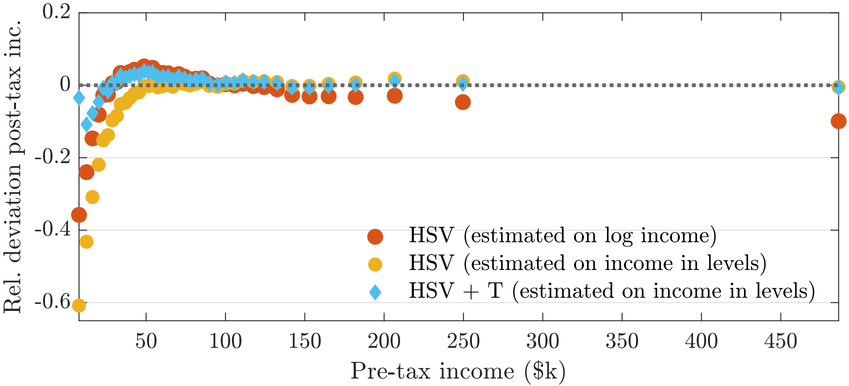

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Transfers **Heterogeneous agents**

- Implicit function theorem: approximation of the FOC around $T = 0$:

$$\hat{n}_{it} \approx n_0(\tau) - \frac{T}{1+\varphi}\frac{n_0(\tau)}{n_0(\tau)-G}\exp\left(-\tau(1-\tau)v_\omega\right) z_{it}^{-(1-\tau)}$$

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- Approximated formula with heterogeneity $v_\omega > 0$

$$W(\tau, T) = W(\tau, 0) + T\left[\Omega_e(\tau, v_\omega) + \Omega_r(\tau, v_\omega)\right],$$

where the two terms capture

- Efficiency concerns
- Redistribution concerns ($\Omega_r(\tau, v_\omega) = 0$ when $v_\omega = 0$)

Transfers Welfare: Efficiency

- **Efficiency** with a representative agent ($v_\omega = 0$):

$$\Omega_e(\tau,0) \equiv \underbrace{U_c(C_0(\tau)) \left.\frac{\partial Y^{ra}(\tau,T)}{\partial T}\right|_{T=0}}_{\text{Size } <\mathbf{0}} \underbrace{+U_n(n_0(\tau)) \left.\frac{\partial n^{ra}(\tau,T)}{\partial T}\right|_{T=0}}_{\text{Labor disutility } >\mathbf{0}}$$

  - Claim: Ω_e **decreases with** τ
    + Offset the effects of progressivity on labor supply incentives

- With heterogeneity, efficiency Ω_e numerically decreases with τ

$\Rightarrow$ **Efficiency** gains of T are **decreasing** in τ

Transfers Welfare: Redistribution

- Redistribution $\Omega_r(\tau, v_\omega)$

$$\Omega_r(\tau, v_\omega) \equiv \mathbb{E}\left[U_c(c_0(\tau))\right] - U_c(C_0(\tau)) = (1-\tau)^2 \frac{1}{n_0(\tau) - G} v_\omega$$

  - Positive as long as $v_\omega > 0$ and **decreases** with τ

$\Rightarrow$ **Redistribution** gains of T are **decreasing** in τ

$\Rightarrow$ Overall **negative** optimal relationship between T and τ

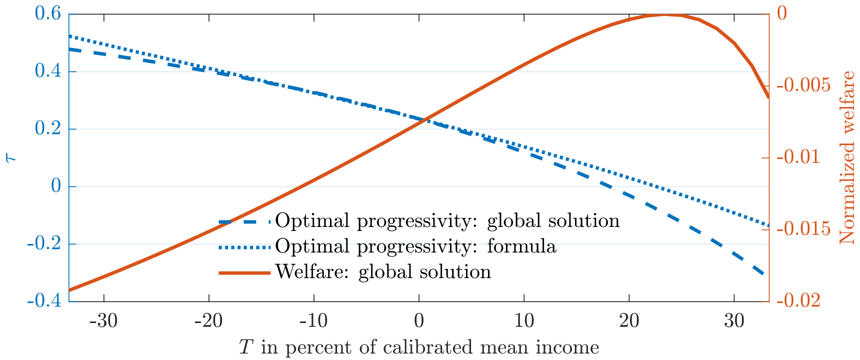
- Use formula to evaluate local welfare gains of transfers:

$$W(\tau, T) = W(\tau, 0) + T\left[\Omega^e(\tau, v_\omega) + \Omega^r(\tau, v_\omega)\right]$$

  - At calibrated v_ω and τ: -0.54 + 0.78 > 0

Transfers Heterogeneous agents

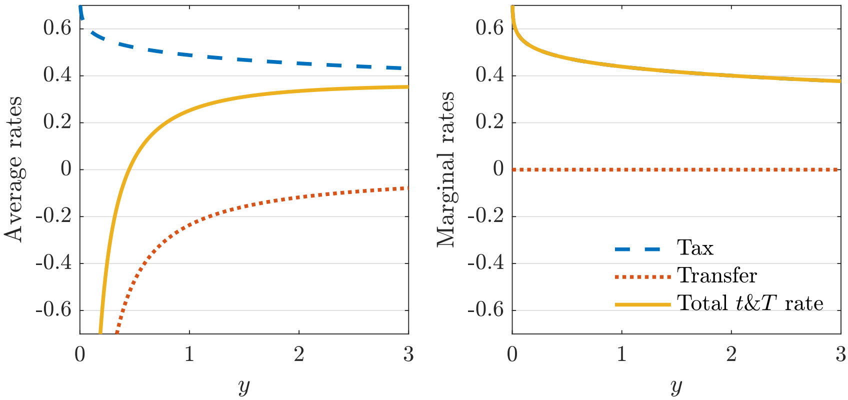
- A **negative** relationship between τ and T



- Formula: a good approximation
- Optimal transfers are large, with regressive income taxes

Optimal plan with transfers **Global static solution**

- Generous transfers: $T/Y = 23\%$, regressive income taxes: $\tau = -0.09$



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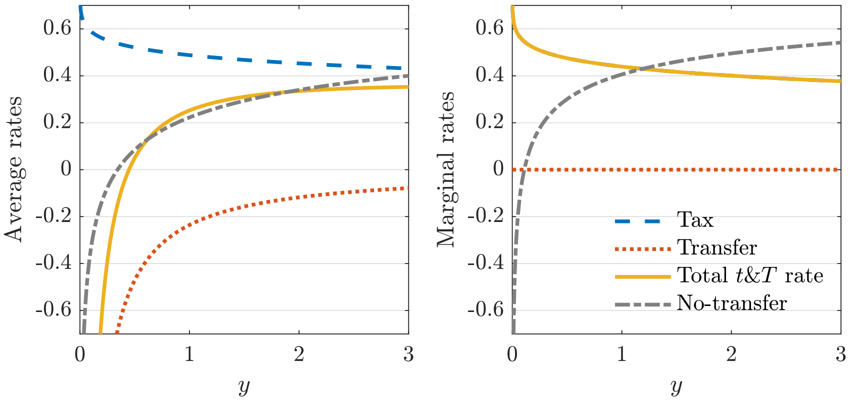

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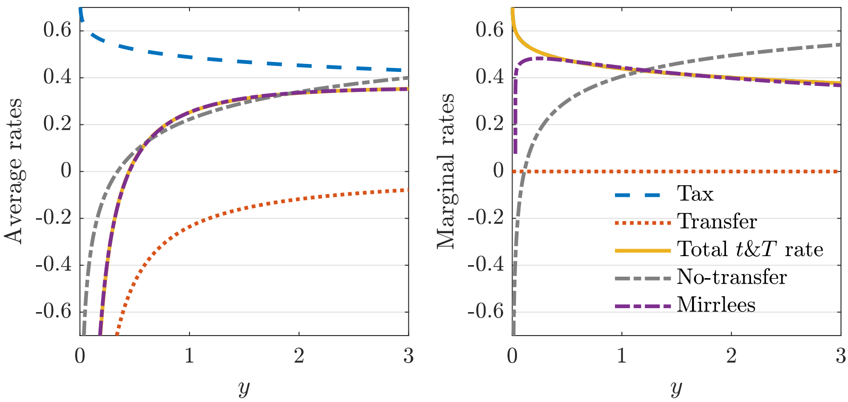
Optimal plan with transfers Comparison to second-best

- Welfare in CE terms: HSV: +0.14%, HSV+T: +0.90%



- Close to welfare gains of the Mirrlees/second-best allocation: +0.93%

Taking stock

- Loglinear taxes plus a transfer
  - Is still simple and tractable
  - Fits the data better
- Welfare gains from allowing for transfers
  - Break the link between average and marginal $t\&T$ rates
  - Systematically close to the second-best!

2. Revisiting the Welfare State

A Quantitative Approach

The Welfare State in the US **A complex safety net**

- Complex design
  - Means-tested (on labor and capital income), phasing-in, phasing-out in time, etc.
  - Partly refundable, partly not...
  - Federal and state level
  - Very heterogeneous take-up rates (and difficult to align in the data)
- It's big: 2.5% of GDP
- It depends a lot on the number of children, on the structure of the household, etc.

The Welfare State in the US Is it optimal?

- Effects of **both**:
  - Transfers themselves, and associated taxes to finance them. . .

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- On multiple margins
  - Labor supply: intensive margin, extensive margin, search
  - Human capital accumulation: college decision, over the working life
  - Savings, self-insurance, physical capital accumulation

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  - The gender gap?
  - Household status? Number of children?
  - . . .

Reforms: Typical proposals

- Universal Basic Income
  - Guaranteed unconditional (lump-sum) transfer
  - At the individual or hh level? Children?

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  - Nothing else but a lump-sum tax with a flat rate
- Can we disentangle the optimal transfers from the optimal tax?

Roadmap

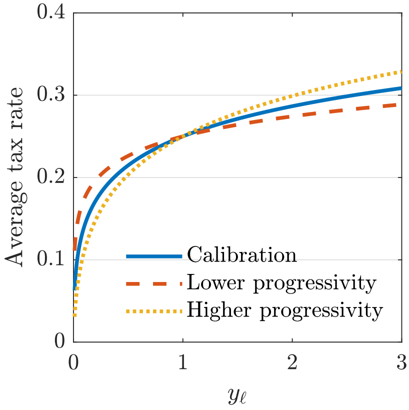
- Separating taxes and transfers in the data: new functional forms
- Optimizing on transfers
    - Ferriere et al. (2023)
    - Guner et al. (2023)
    - Jaimovich, Saporta-Eksten, Setty and Yedid-Levi (2022)
    - Daruich and Fernandez (2023)
    - Holter, Krueger and Stepanchuk (2024)
    - ...

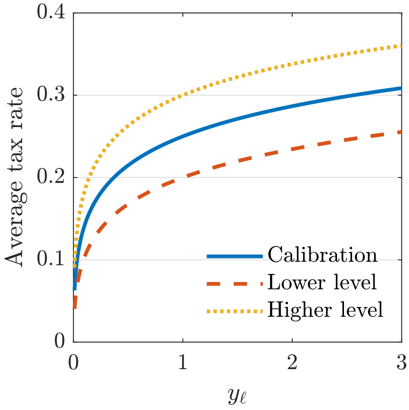
Taxes and transfers in the data

- Ferriere et al (2023)
- New functional forms for taxes and transfers
- Fit to the data
- Optimized fiscal instruments

Fiscal system Income taxes

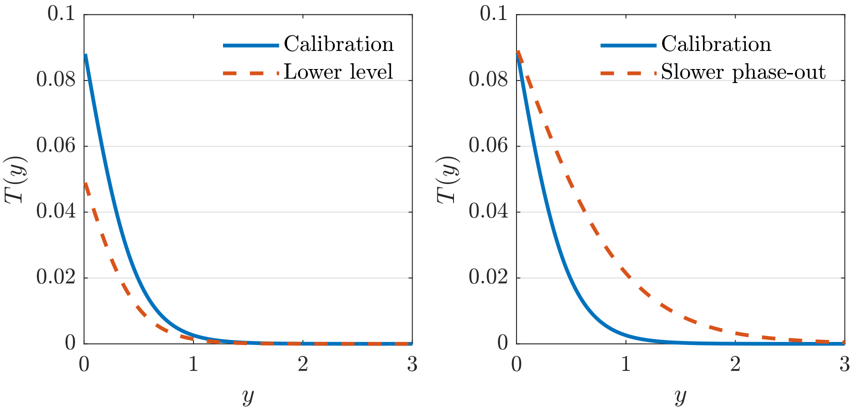
- Flat capital tax τ_k
- Progressive labor tax: $\exp\left(\log(\lambda)\left(\frac{y_\ell}{\bar{y}}\right)^{-2\theta}\right) y_\ell$, with level λ and progressivity θ



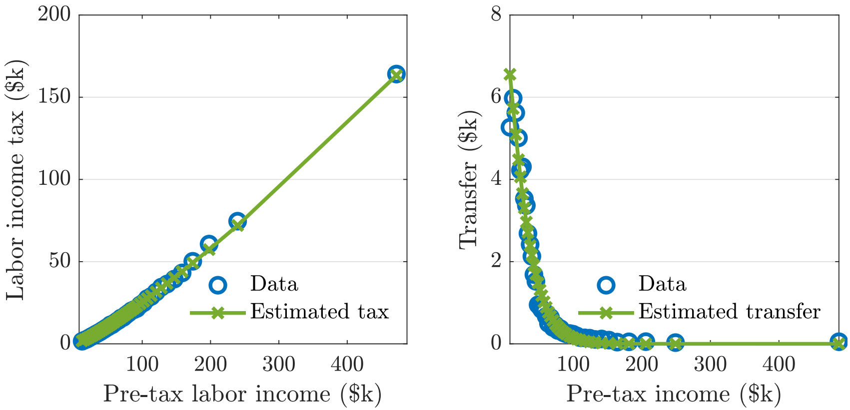


Fiscal system Transfers

- New targeted-transfers function: $m\bar{y}\frac{2\exp\left\{-\xi\left(\frac{y}{\bar{y}}\right)\right\}}{1+\exp\left\{-\xi\left(\frac{y}{\bar{y}}\right)\right\}}$
  - m is the level at $y=0$, ξ is the speed of phasing-out

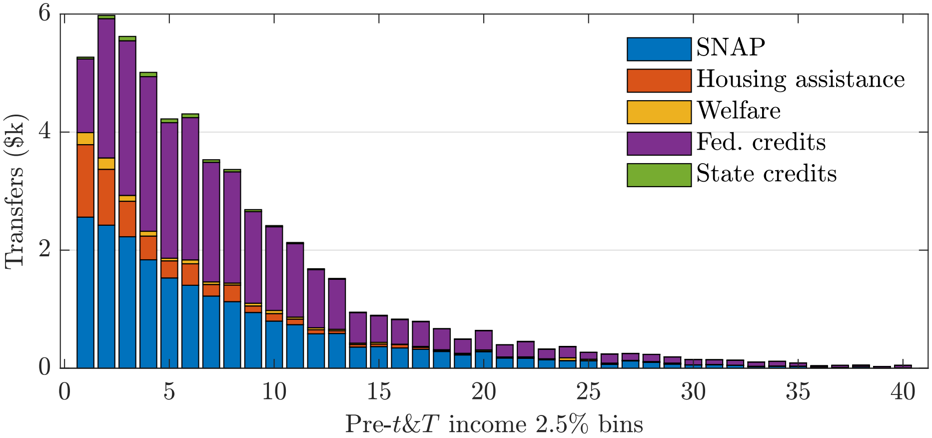


Calibration Fiscal system: Micro estimates

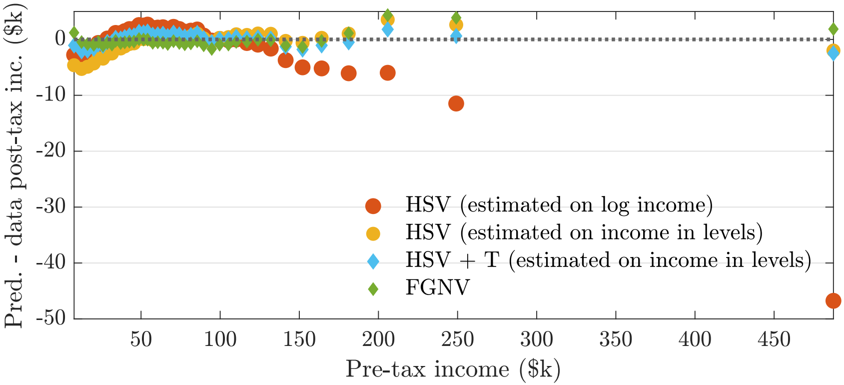


- Estimated on taxes and transfers: $\theta = 0.08$, $m = 0.09$, $\xi = 4.22$

Transfers Components across the distribution



Fiscal system After-tax-and-transfer income fit



- Predicted after-tax-and-transfer income

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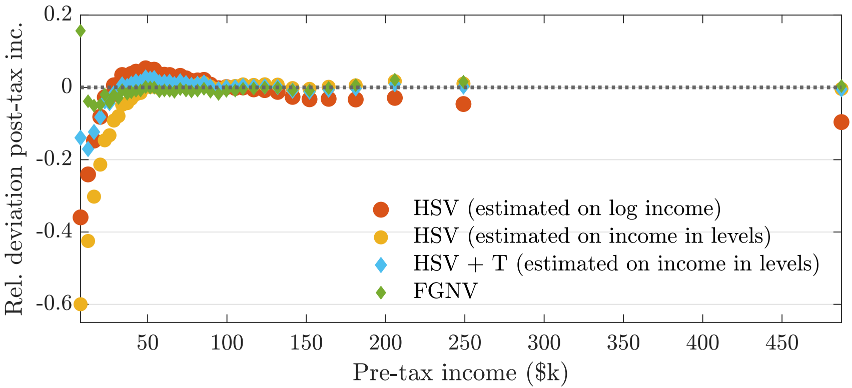

- Predicted after-tax-and-transfer income
  - Relative to pre-tax income

Calibration

- Income process to match household income risk
  - Annual earnings growth distribution from PSID (1978-1992)
    Guvenen, Karahan, Ozkan, and Song (2021)
  + Std deviation: 0.33, Skewness: -0.33, Kurtosis: 12, P9010: 0.60
  - And top-10 labor income share: 41% (Aoki and Nirei, 2017)

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  - Debt: $D/Y = 100\%$, residual $G/Y \approx 21\%$

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  - Debt: $D/Y = 100\%$, residual $G/Y \approx 21\%$
- Production: labor share $\alpha = 0.64$, depreciation $\delta = 0.06$
- Preferences: $\sigma = 2$, $\varphi^{-1} = 0.4$; β to match $r = 2\%$
- Borrowing constraint: $\underline{a}$ a quarter of mean income

Calibration Income and tax distribution, wealth effects and elasticities

- Income distribution, including at the bottom
- Distribution of taxes and transfers

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- Income distribution, including at the bottom

- Distribution of taxes and transfers

- Compare model implied wealth effects to evidence

  Golosov, Graber, Mogstad, and Novgorodsky (2023)

  - Five-year average change in labor income for every $\$100$ won:

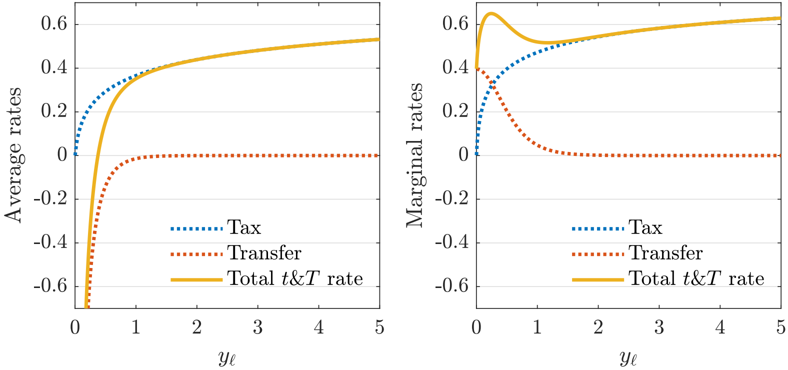
    Data: 2.3, model: 2.4

- Labor elasticity of the top-1%

  - A 1% increase in marginal rates: 0.12-0.33 depending on persistence

Optimal tax-and-transfer plan

- The **optimal plan** features
  - Large transfers $m = 0.23$, i.e. $\$20k$, with phase-out $\xi = 3.41$
  - Moderate tax progressivity $\theta = 0.14$



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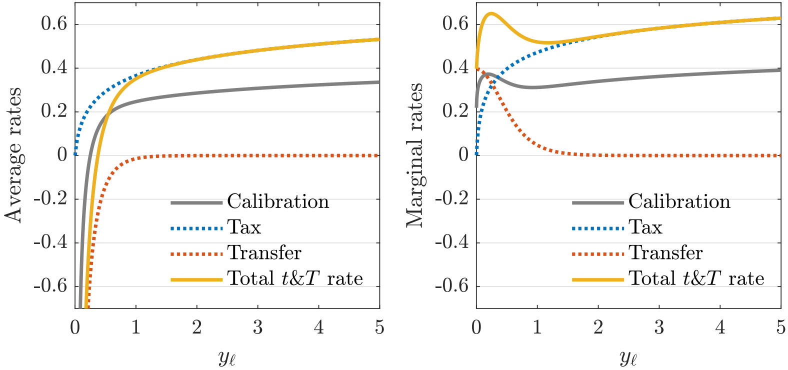

Optimal plan Average and marginal rates

Data	Q1	Q2	Q3	Q4	Q5
Tax rate	16%	19%	22%	24%	29%
Transfer rate	23%	4%	1%	0%	0%

Optimal (long-run)	Q1	Q2	Q3	Q4	Q5
Tax rate	19%	23%	26%	26%	36%
Transfer rate	85%	24%	8%	2%	0%

Optimal plan Average and marginal rates

Data	Q1	Q2	Q3	Q4	Q5
Tax rate	16%	19%	22%	24%	30%
Transfer rate	23%	4%	0%	0%	0%
Average $t\&T$ rate	-7%	16%	21%	24%	29%
Optimal (long-run)	Q1	Q2	Q3	Q4	Q5
Tax rate	19%	23%	26%	26%	36%
Transfer rate	85%	24%	8%	2%	%
Average $t\&T$ rate	-66%	-1%	19%	24%	36%

- Average $t\&T$ rates are strongly increasing...

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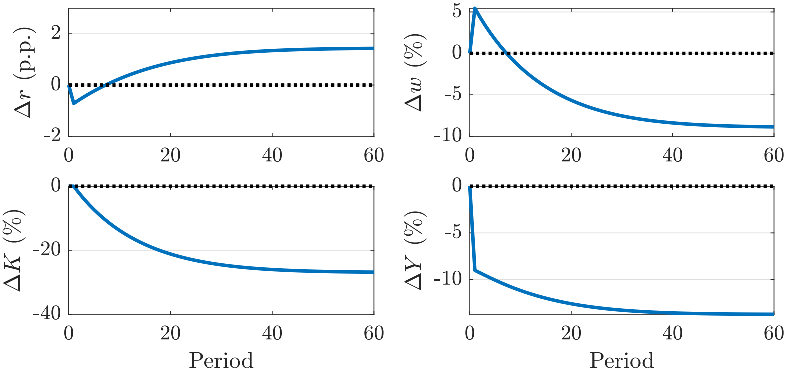
Average $t\&T$ rate	-66%	-1%	19%	24%	36%
Marginal $t\&T$ rate	63%	61%	55%	48%	50%

- Average $t\&T$ rates are strongly increasing...but not marginal $t\&T$ rates

Optimal tax-and-transfer plan **Transitions and welfare**



- The economy (output, capital, wages) shrinks

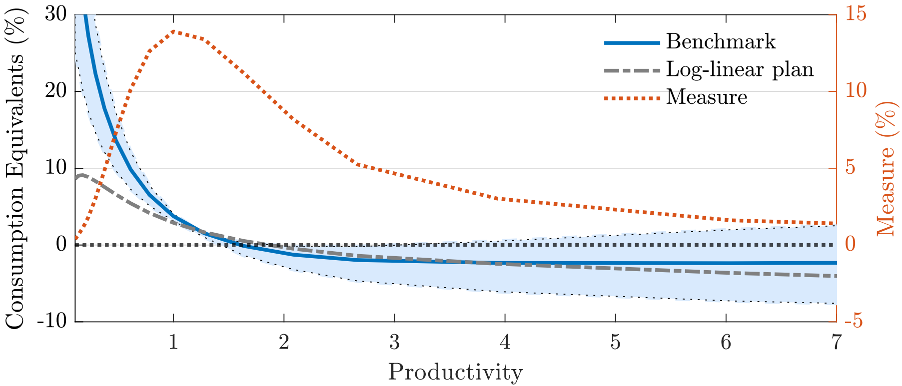
Optimal tax-and-transfer plan **Transitions and welfare**

Mean hours	Hours worked quintile				
Calibration	0.20	0.28	0.32	0.35	0.38
Optimal	0.18	0.25	0.28	0.31	0.34

Log hours deviation	Wage quintile				
Calibration	-0.03	0.00	-0.04	0.05	0.01
Optimal	-0.18	-0.07	-0.01	0.12	0.13

- The economy (output, capital, wages) shrinks, but better allocation of hours worked

Optimal tax-and-transfer plan Transitions and welfare



- The economy (output, capital, wages) shrinks, but better allocation of hours worked
- Large welfare gains (6%); 76% of households benefit

Non-monotonic marginal rates UBI and log-linear plans

- Optimal plan with **lump-sum** transfers ($\xi = 0$)
  - Large transfer: $\$19k$ financed with flatter taxes $\theta = 0.04$

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    - Large transfer: $\$19k$ financed with flatter taxes $\theta = 0.04$
- **Welfare gains** are 5.36% vs. 6.00% with phase-out
- Optimal **affine**: transfer of $\$20k$, tax 60%, CE 5.26%

Optimal UBI Average and marginal rates

With phase-out	Q1	Q2	Q3	Q4	Q5
Tax rate	19%	23%	26%	26%	36%
Transfer rate	85%	24%	8%	2%	0%
Average $t\&T$ rate	-66%	-1%	19%	24%	36%
Marginal $t\&T$ rate	63%	61%	55%	48%	50%

Lump-sum	Q1	Q2	Q3	Q4	Q5
Tax rate	48%	46%	47%	41%	48%
Transfer rate	97%	49%	33%	22%	9%
Average $t\&T$ rate	-48%	-3%	15%	19%	40%
Marginal $t\&T$ rate	56%	58%	59%	59%	61%

- Different tax rates and transfer rates, not so different overall rates

Taking stock

- With a Utilitarian planner, transfers should be more generous, but taxes should not be much more progressive
- Monotonic marginal rates deliver large welfare gains
  - UBI delivers large gains

A focus on the household structure

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- Depart from the typical household structure
  - Heterogeneity in gender x hh structure x education
  - \+ Income risk
  - \+ Number of kids and cost of labor force participation
  - \+ Tax-and-transfer system

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- Detailed modeling of the existing tax-and-transfer system
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- Control: consumption, savings, extensive and intensive labor decision
- Capture accurately income risk by hh structure, gender, education
  - Increasing of the wage-gender gap over the life-cycle
  - Smaller increase in variance of log earnings for female
  - U-shape female labor force participation

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Very simple exploration of the welfare state in PE and steady-state

- Replacing the welfare state with... nothing
  - Aggregate welfare losses, especially for single females
  - Majority support
- Implementing a UBI: optimal $\$12{,}500$
  - Keeping the progressivity fixed, adjusting λ
  - Aggregate welfare losses, especially from unskilled single females
  - Welfare gains from married households, and majority support

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  - Still, unskilled single females loose
- Important to think of transfers with taxes!

Quantitative Macro Public Finance

- Very active field to bridge the gap between Mirrlees and Ramsey
  - Quantify redistribution needs and efficiency concerns
  - Flexible modeling yet serious calibration
  - Policy!

3. Revisiting the Welfare State

Fighting the Recession

Motivation

- Design of counter-cyclical policies
  - Monetary policy: short-term nominal interest rate
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    Mertens and Ravn (2013), Zidar (2019)
- "Fiscal Management of Aggregate Demand" Ferriere Navarro (2024)
  - Quantitative HANK model
  - Effectiveness of various fiscal stabilization packages after a negative demand shock

Framework

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  - Heterogeneous stochastic discount factors $\rightarrow$ heterogeneous mpc

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$\Rightarrow$ Relevant framework to quantify fiscal stabilization packages

- Demand-driven recession
  - Negative shock to marginal utility: unexpected, deterministic, transitory

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- Robustness: Alternative calibrations, other standard fiscal packages
- Discussion: Implementability and limits

A HANK model with some twists

- Households
  - Bond economy with borrowing constraint
  - Stochastic discount factors
  - Indivisible labor choice
  - Idiosyncratic labor productivity shocks + unemployment shocks
- NK block with sticky prices
  - Linear technology in labor
  - Monetary authority implements a standard Taylor rule
- Government
  - Finances spending, transfers, UI benefits and debt with labor and capital taxes

Households Working households

- Individual state: asset a, discount factor β, productivity x, and employment $\eta \in \{e, u\}$

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$$V_t(a, x, e, \beta) = \max_{c,h,a'} \{\log c - Bh + \beta \mathbb{E}_t [V_{t+1}(a', x', \eta', \beta')|x, \beta, e)]\} \quad \text{s.t.}$$

$$c + a' = a + y^\ell + y^k - \mathcal{T}_t(y^\ell, y^k) + T_t + d_t^h(x),$$

$$y^\ell = w_t x h, \quad y^k = r_t a, \quad h \in \{0, \bar{h}\}, \quad a' \geq 0.$$

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  - Preference shock on discrete labor choice, distributed Gumbel with variance ρ_h
    - $+\ \rho_h \geq 0$ calibrated to discipline labor elasticities
  - AR(1) process for discount factor, productivity and employment status
  - Flat capital tax τ^k, progressive loglinear labor tax (λ_t, τ^ℓ)
    Heathcote, Storesletten, and Violante (2017)

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  - Unemployment benefits function of hourly wage $\mathcal{B}_t(w_t x) = \zeta \max\left(\mathcal{R} w_t x \bar{h}, \overline{ui}\right)$
    Kekre (2022)
    - ζ to match fraction of recipients, $\mathcal{R}$ the replacement rate, $\overline{ui}$ the UI cap
  - χ to capture household labor income received while in unemployment
    Kekre (2022)
    - Calibrated to match the consumption ratio of unemployed to employed
  - AR(1) process for discount factors, productivity and employment status

Firms

- Standard two-layer structure with a final-good producer and intermediate good producers
  - Sticky prices a la Rotemberg

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- Fiscal rule with parameter Φ_D for public debt, λ_t clears the budget constraint
  Uhlig (2010)
  - $\Phi_D = 0$ for constant debt, $\Phi_D = 1$ for constant λ
  - $\Phi_D > 0$ implies larger debt in case of lower tax base and higher expenditures

Steady State Households

- Quarterly model calibrated to liquid wealth
- Stochastic β with average duration of 50 years
  - Mean s.t. $r \equiv 3\%$ annually
  - Variance s.t. top-quintile liquid wealth $\approx 90\%$ (SCF)

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    Jang, Sunakawa, and Yum (2023)
  - ρ_h to match annual labor elasticity of ≈ 0.5 for the bottom quartile
    Ferriere and Navarro (2024)
    Triest (1990), Eissa and Liebman (1996), Kleven and Kreiner (2006), Meghir and Phillips (2010)

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- Productivity $(\rho_x, \sigma_x) = (0.989, 0.287)$
  Chang and Kim (2007)

Steady State Unemployment

- Job finding rates and separation rates across hourly wage distribution

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- Job finding rates are constant in the distribution distribution
  Mueller (2017)

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Steady State **Unemployment**

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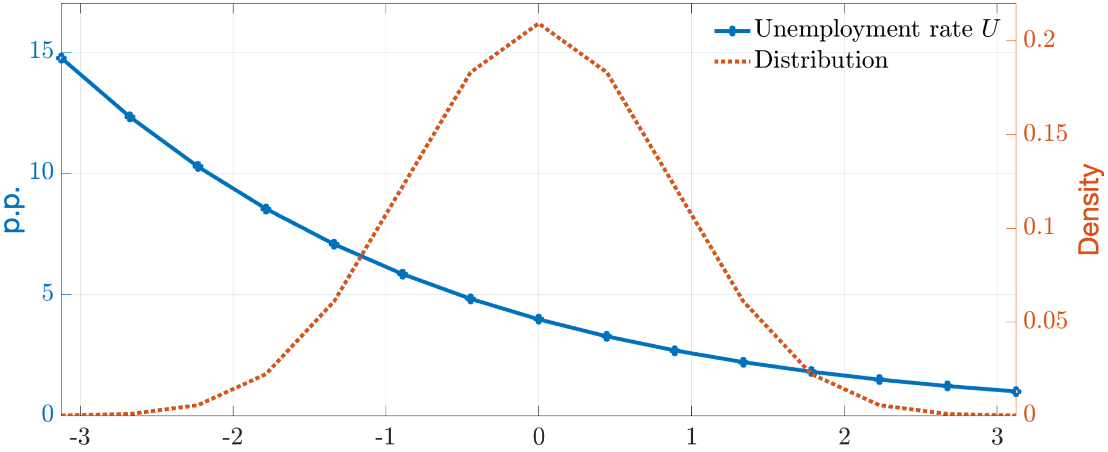
  $\Rightarrow$ $\pi_\eta(u|e,x) = \phi_0 x^{\phi_1}$, with $\phi_0 = 0.029$ and $\phi_1 = -0.446$
- Average unemployment rate at 4.3% with unequal incidence in the distribution
- Fraction of labor income when unemployed $\chi = 0.21$ to match $C_u/C_e \approx 75\%$
  Gorn and Trigari (2024)

Steady State Unemployment in the Distribution



Steady State **Firm and government**

- Technology: $\varepsilon = 7$, $\Theta = 200$
  Galí and Gertler (1999)

- Dividends redistributed linearly in x
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- Government
  - Capital tax $\tau_k = 35\%$

    Chen, Imrohoroglu, and Imrohoroglu (2007)
  - Labor income tax progressivity $\tau_\ell = 0.1$

    Heathcote, Storesletten, and Violante (2017), Ferriere, Grübener, Navarro, and Vardishvili (2023b)
  - Spending $G/Y = 10\%$, transfers $T/Y = 8\%$, debt $D/Y = 100\%$
  - Unemployment benefits: $\zeta = 0.4$, $\mathcal{R} = 0.5$, $\overline{ui} = 60\%\bar{y}$

    Kekre (2022)
  - Automatic responses: $\Phi_\Pi = 1.5$, $\Phi_D = 0.75$

Unemployment and the Business Cycle **Okun's law**

- Okun's law type of relation between output and unemployment
  - Okun coefficient $c_{OK} = 0.5$: $U_t = U - 0.5 \log(Y_t/Y) = U - 0.5\Delta Y_t$

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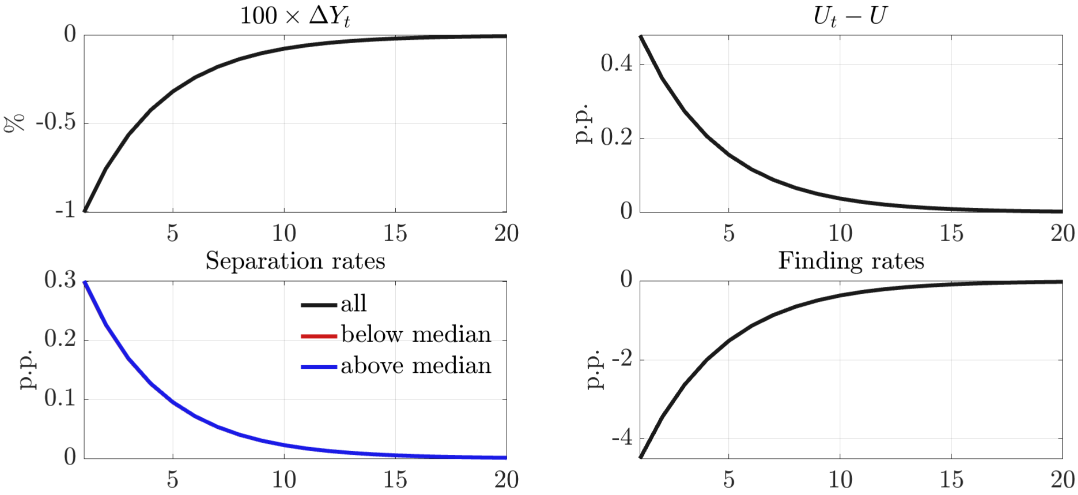
- Job separation rates? A flexible formulation

$$\pi_{\eta,t}(u|x,e) = \pi_\eta(u|x,e) - \phi^a_{eu}\Delta Y_t x^{-\phi^b_{eu}}$$

Unemployment and the Business Cycle **Okun's law**



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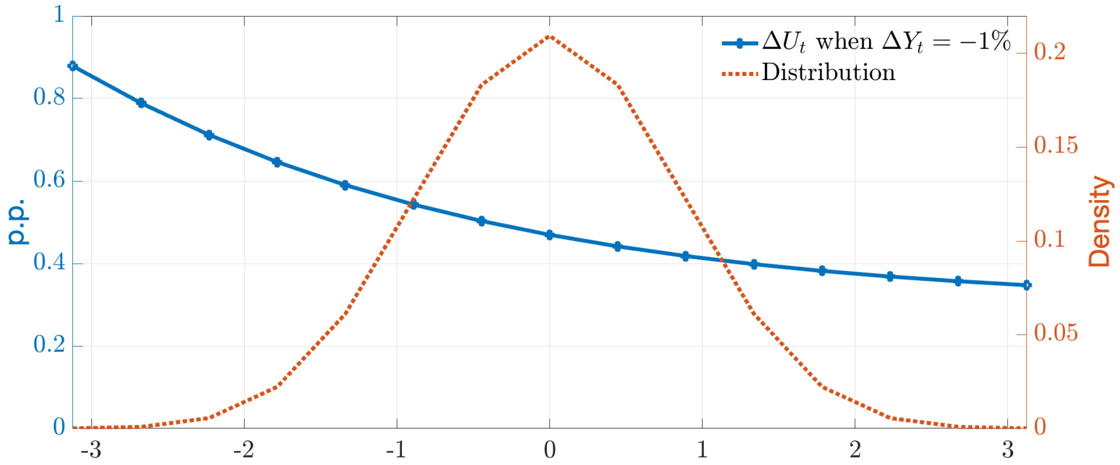

Investigating the Calibration mpc

- Marginal propensities to consume (mpc) out of a $\$500$ rebate quarterly
  Parker, Souleles, Johnson, and McClelland (2013), Kaplan and Violante (2014), ...
  - Average quarterly mpc of 0.13, declining with wealth

Wealth quartile	1	2	3	4
mpc	0.19	0.15	0.07	0.03

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  - Larger for unemployed at 0.32
    + Unemployment drop when falling into unemployment: -10%
      Ganong Noel (2017)

Investigating the Calibration Labor elasticities

- Labor elasticities decline with income
  - Simulate steady-state model annually and run applied-micro regression
    Rogerson and Wallenius (2009), Chang and Kim (2006)
    - Estimate b_1 in $\log h_{in} = b_0 + b_1 \log \tilde{w}_{in} - b_2 \log c_{in} + \varepsilon_{in}$
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  - Compute labor responses to a temporary tax shock
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Income quartile	1	2	3	4
Labor elasticities (regression)	0.54	0.32	0.13	0.11
Labor elasticities (tax shock)	0.43	0.33	0.25	0.22

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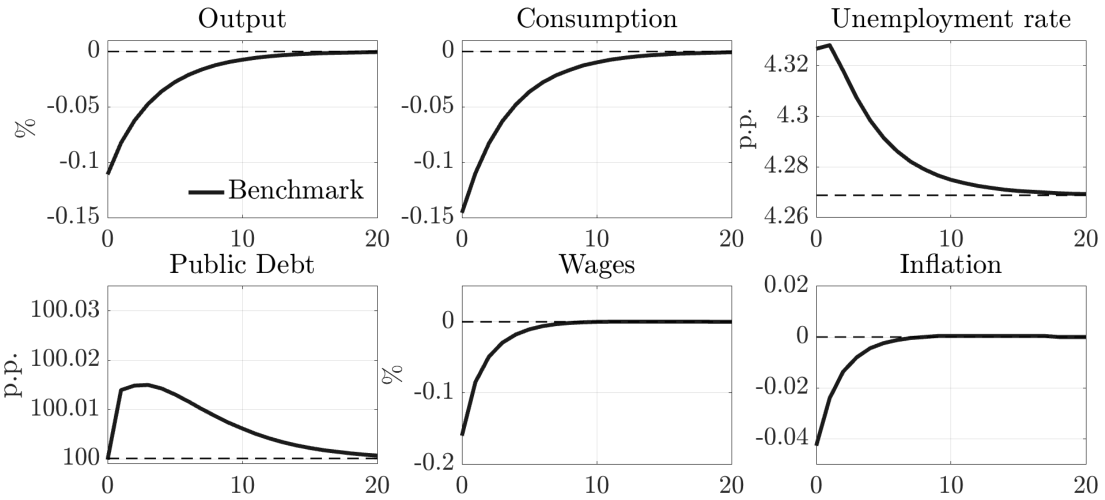
⇒ Conservative calibration regarding tax responses

Benchmark **No Fiscal Stabilization**

- Recession induced by a negative demand shock: $(1 - \omega_t)u(c_t, n_t)$
  - ω_0 such that $\Delta Y_t = -0.10\%$ on impact
  - Reverts to $\omega = 0$ with persistence $\rho_\omega = 0.75$ at the quarterly level
- Unexpected, transitory, perfect foresight: a ‘MIT’ shock

Benchmark No Fiscal Stabilization



Three Fiscal Stabilization Packages **TT Package**

- A Targeted Transfer **(TT)** Package
  - Design to mimic checks sent in 2008: For all low-income households, based on last-year income
  - An "automatic stabilizer" flavor: Phase out over time with persistence ρ_ω

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$$\hat{T}_t(y) = m_t \frac{2\exp(-\chi y/\bar{y})}{1+\exp(-\chi y/\bar{y})}, \quad m_t \text{ the transfer at } y = 0,\ \chi \text{ the phasing-out speed}$$

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    + "Based on no-recession income": $\tilde{y}(x, \eta, \beta)$
  - Calibration such that $\sum_t \int \hat{T}_t(y) d\mu_t$ equals a one-time check of $\$200$ to all households
    + Initial check at $y = 0$ is $m_0 = \$900$
    + Quick phase-out at $\chi = 12$: 20% households receive more than $\$50$ at $t = 0$

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Three Fiscal Stabilization Packages **UI Package & TC Package**

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    - $+$ Phase out with current labor income $w_t x \bar{h}$
    - $+$ Eligible **only if** $\eta = e$ and $h = \bar{h}$

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- A Tax Credit **(TC)** Package
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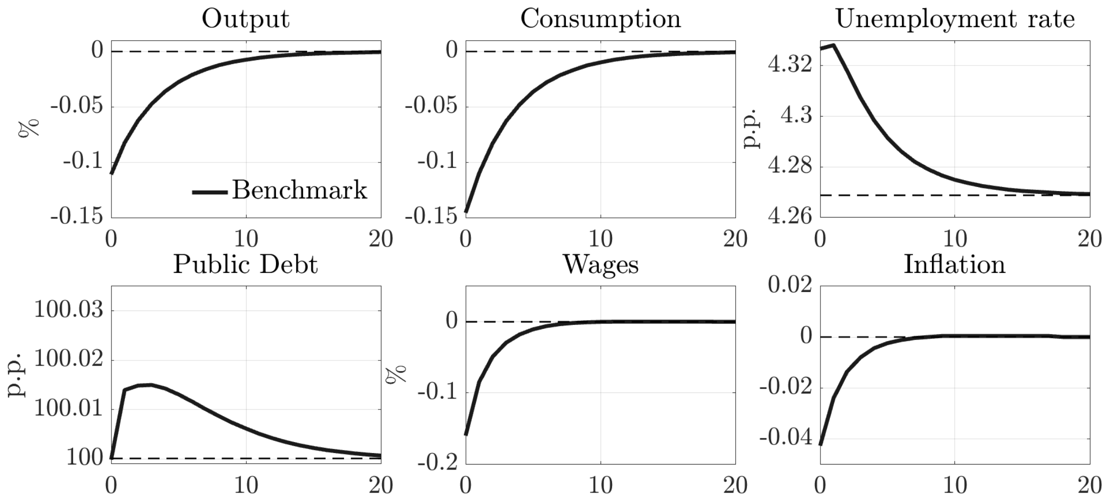
    - + Phase out with current labor income $w_t x \bar{h}$
    - + Eligible **only if** $\eta = e$ and $h = \bar{h}$
  - Calibration such that equals a one-time lump-sum check of $\$200$
    - + Initial maximum check of $\$800$, slower phase-out at $\chi = 6$

Three Fiscal Stabilization Packages Impulse Response Functions



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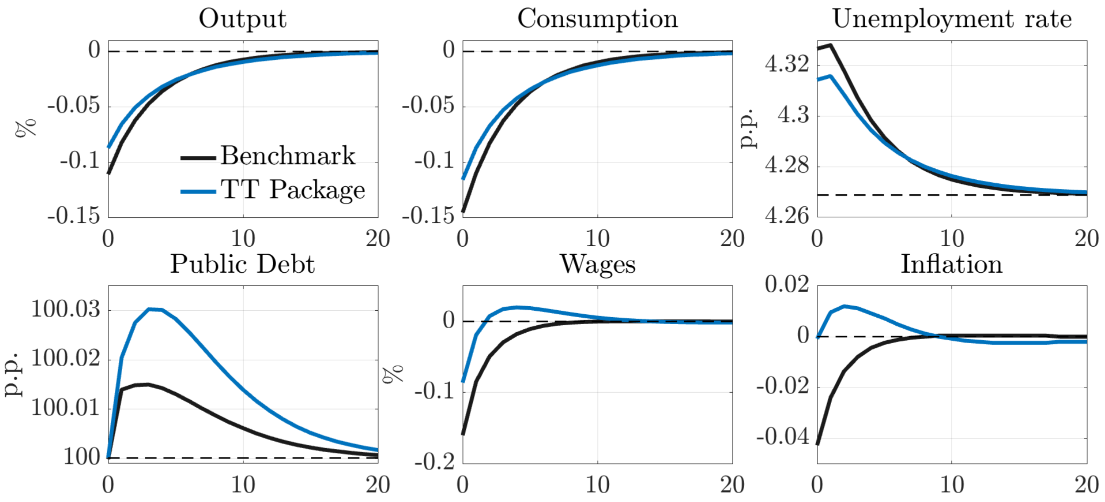

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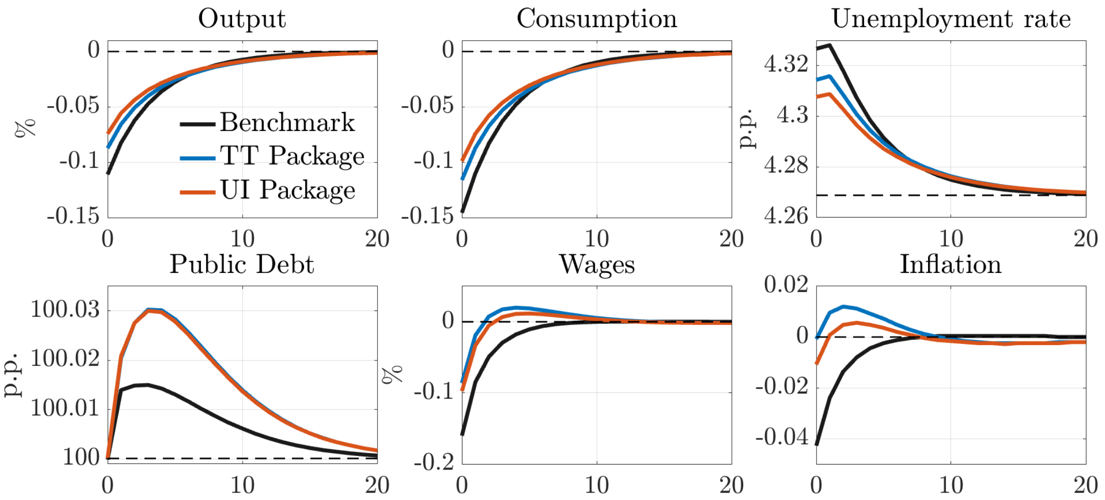
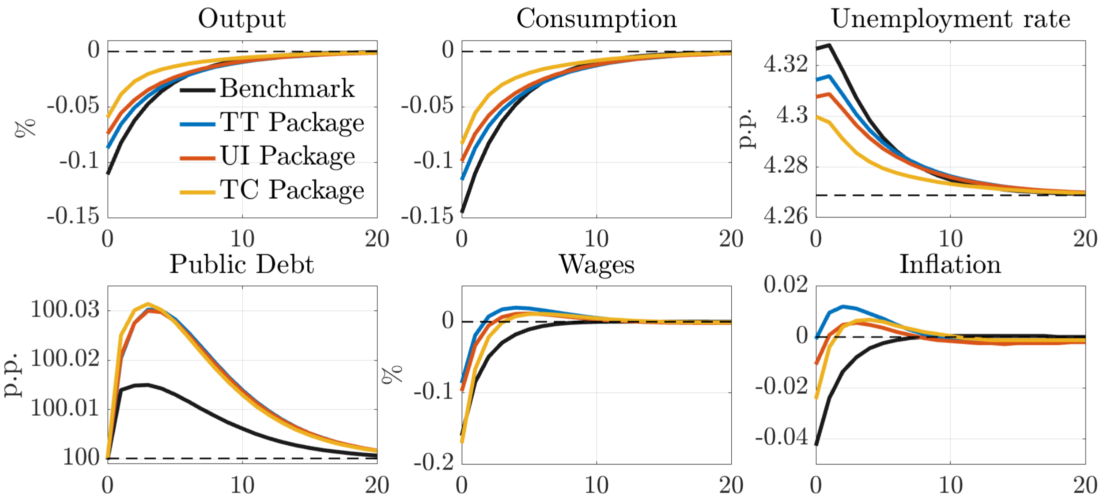
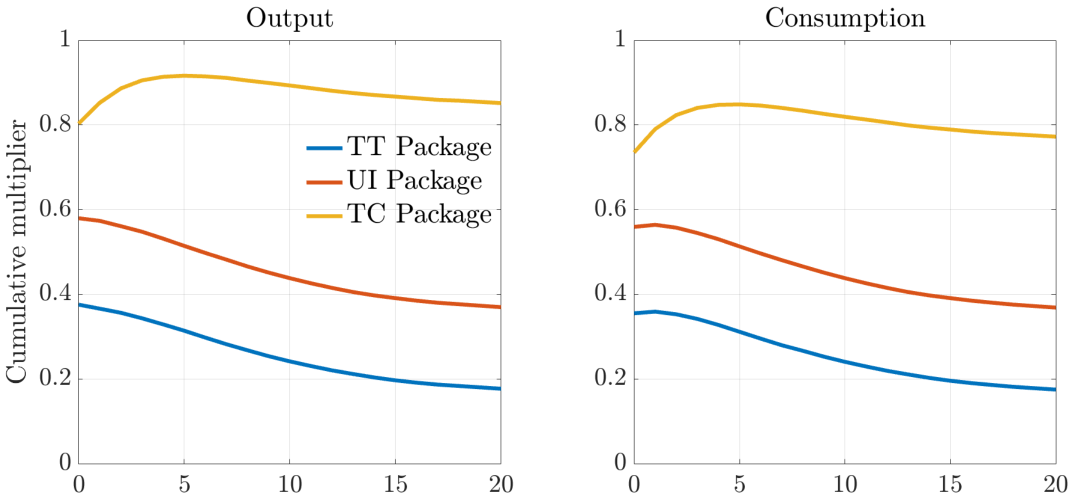


Three Fiscal Stabilization Packages **Impulse Response Functions**



Three Fiscal Stabilization Packages Multipliers



Conclusion

- A temporary increase in labor income tax progressivity can stabilize the economy
  - Labor income tax cuts to low-income households
  - Operates also through consumption responses

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Thank you!

Appendix

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