

MACROECONOMICS

PSE Summer School, 2024

On the Optimal Design of Fiscal Policy

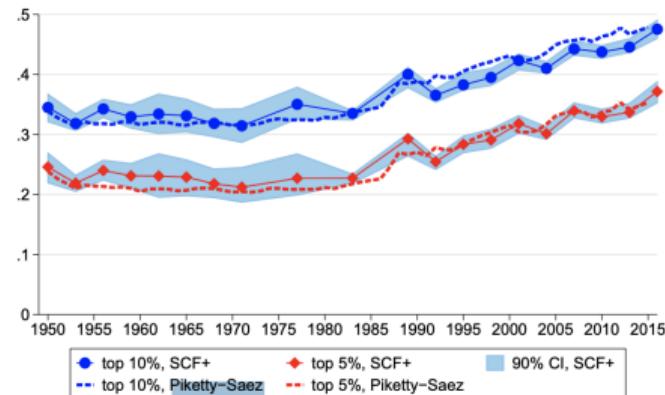
Axelle Ferriere

Summer School PSE

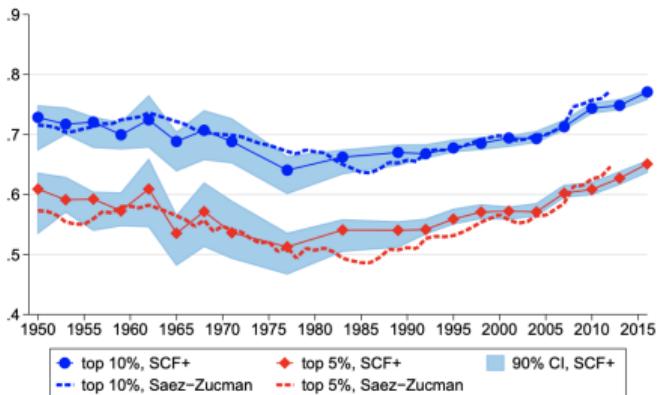
June 25, 2024

Income and wealth inequality have increased since 1950

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



(a) Income

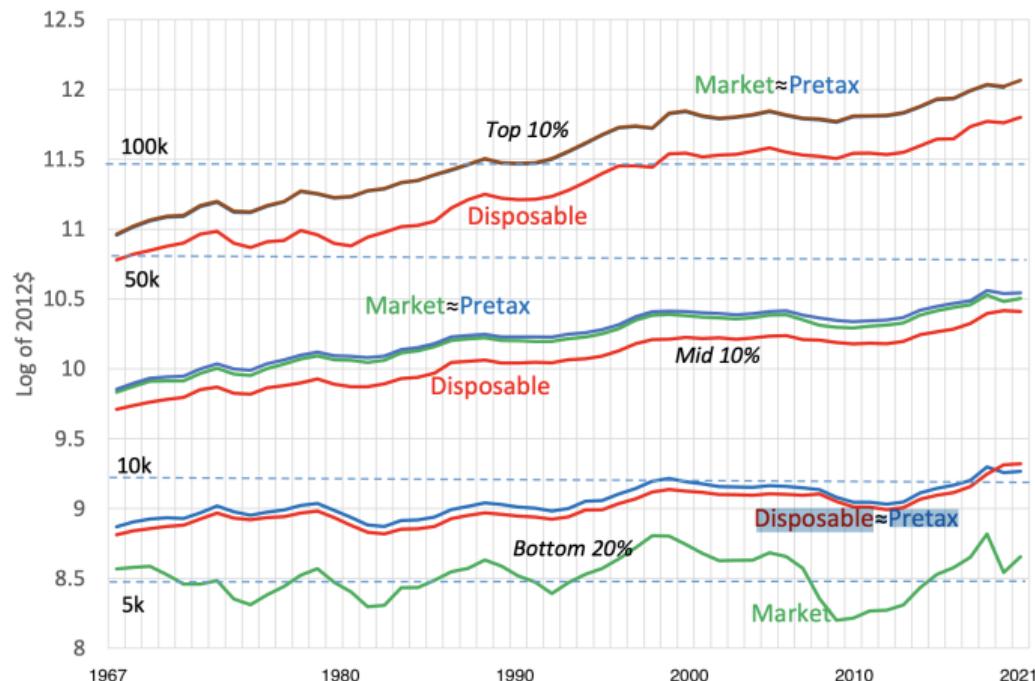


(b) Wealth

- Top-income and -wealth shares have increased (SCF+, United States)

Kuhn, Schularick and Stein (2020)

Income and wealth inequality have increased since 1950



- 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), ...

- New questions in the policy debate, **on the role of the welfare state**

- Should we implement a **Universal Basic Income**?
- Should we tax **wealth**?

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- Should we implement a **Universal Basic Income**?
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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?

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- A classic question in macro...

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 - ... which came back in recent policy debate

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- A classic question in macro...
 - ... which came back in recent policy debate
- Methodology
 - Ramsey plans
 - Quantitative heterogeneous-agent models

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- 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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3. Optimal fiscal policy with heterogeneous capital returns

- New facts on capital returns

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- 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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 - Conesa, Kitao, and Krueger (2009)
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 - Fagereng, Guiso, Malacrino, and Pistaferri (2020)
 - Bach, Calvet, and Sodini (2020), Smith et al. (2019), Becker and Hvide (2022), ...

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- 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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- Taxes: **functional** forms

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- **Commitment** in time-zero

General motivation

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- **Commitment** in time-zero
- Outline: environment; equilibrium; Ramsey plan

Environment Preferences and resources

- Preferences of the representative household:

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

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

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

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

$$u_{c,t} A_t F_{n,t} = u_{l,t} \quad (3)$$

$$u_{c,t} = \beta u_{c,t+1} [A_{t+1} F_{k,t+1} + 1 - \delta] \quad (4)$$

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

■ 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:

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

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:

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

Competitive Equilibrium with Taxes

Households

- Household's maximization problem

Competitive Equilibrium with Taxes

Households

- Household's maximization problem

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

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

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

Competitive Equilibrium with Taxes Firms

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

$$r_t = A_t F_{k,t} \quad (10)$$

$$w_t = A_t F_{n,t} \quad (11)$$

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 $\forall t \geq 0$.

Competitive Equilibrium with Taxes

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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).

Competitive Equilibrium with Taxes

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 - b. Given the allocation and the price system, the government policy satisfies the sequence of government budget constraints (5).
-
- An infinity of CE! Why?

Competitive Equilibrium with Taxes

Distortions

Claim

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

Competitive Equilibrium with Taxes

Distortions

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

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

Ramsey Plan Definition

Government

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

Definition

A Ramsey 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)

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⇒ Goal: to **simplify** the Ramsey plan

Ramsey Plan Simplify the problem

- First, we can ignore the household budget constraint

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

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- Resource constraint (2) + govt budget constraint

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

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

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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- 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)

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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

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

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

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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:

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

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

Ramsey Plan Capital taxes in the long-run

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

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

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

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

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

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

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

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

- Combining these equations

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

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

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

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

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

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

- Combining these equations

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

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

Ramsey Plan Capital taxes should be zero...

- Capital should not be taxed in the long run!

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?)

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

Ramsey Plan Should capital taxes really be zero??

- Straub and Werning (2020)

Ramsey Plan Should capital taxes really be zero??

- Straub and Werning (2020)
- Key argument: $\tau_k < \bar{\tau}$ in the long-run and an **interior steady-state** exists

Ramsey Plan Should capital taxes really be zero??

- Straub and Werning (2020)
- Key argument: $\tau_k < \bar{\tau}$ in the long-run and an **interior steady-state** exists
- Writing the constraint explicitly...
 - One more constraint in the Lagrangian:

$$\tilde{r}_t = (1 - \tau_t^k) F_k(k_t, n_t) \geq (1 - \bar{\tau}) F_k(k_t, n_t)$$

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⇒ 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

- Optimal taxes with heterogeneity
 - Redistribution/insurance concerns

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- Environment; equilibrium; optimal policy

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 - Work until age J_r , then retired
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- Value consumption and labor:

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

- 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

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

- Aggregate stationary steady-state

- Aggregates are constant... but not idiosyncratic variables!

■ 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 $T(\cdot)$ on taxable **labor** income $y_L - \tau_{ss}\min\{y_L, \bar{y}\}$ where $y_L = w\varepsilon_j\alpha_i\eta$

Competitive Equilibrium

Definition

A stationary recursive competitive equilibrium (RCE) is:

- a policy $\{G, \tau_c, \tau_k, T, \tau_{ss}, \bar{y}, SS\}$
- 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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- Given prices and policies, the **household** behaves optimally:

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

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

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

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

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

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5. The government's budget constraint holds:

$$\begin{aligned} G &= \int \tau_k r(a + Tr) \Phi(a, \eta, i, j) + \int T(y_L^T(\eta, i, j)) \Phi(a, \eta, i, j) \cdots \\ &\quad + \int \tau_c c(a, \eta, i, j) \Phi(a, \eta, i, j) \end{aligned}$$

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

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

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

Calibration

■ Demographics

- Agents born at age 20, retire at age 65, die w.p.1 at age 100
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■ 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)

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

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...

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■ Redistribution motives

- Tax capital to lower labor taxes

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- Evaluate **life-cycle** components
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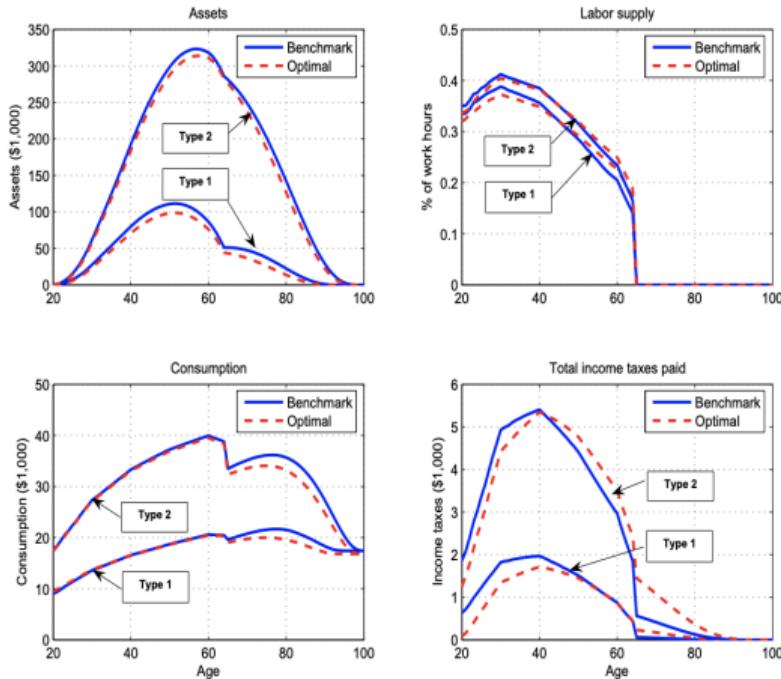


Figure 1: Life Cycle Profiles of Assets, Labor Supply, Consumption and Taxes

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- It's all about **life-cycle** motives!

- 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

- Wealth inequality is very large in the data
 - Top-10% owns 65% of wealth, top-1% owns 34% (SCF 2004)

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■ Policy: Taxing capital to redistribute?

Understanding capital? Mechanisms of accumulation

- Basic Aiyagari model **fails** to generate realistic wealth distributions
 - 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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 - **Correlation** of wealth and returns
 - + “*Scale dependence*”

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 - Gabaix, Lasry, Lions, and Moll (2016)
- Needed ingredients
 - **Persistent** idiosyncratic returns (even across generations)
 - + “*Type dependence*”
 - **Correlation** of wealth and returns
 - + “*Scale dependence*”
- Plausible in the data?

Heterogeneous capital returns Data

Fagereng, Guiso, Malacrino, and Pistaferri (2020)

- Norwegian administrative data
 - Individual tax records 2004-2015
 - + Labor and capital **income**
 - + **Asset holdings and liabilities**

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- 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%
- Large **scale dependence**: from net worth-10th to 90th, returns +18pp
- Strong **persistence** across generations

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⇒ Implications for taxation?

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- Under **homogenous returns**, **taxing capital = taxing wealth**

$$(1 + r(1 - \tau_k))a_i = (1 - \tau_a)(1 + r)a_i$$

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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)

“Use it or lose it!” A simple idea

- Assume two agents, a and b

- Same wealth $k = \$1000$; but **different returns**: $r^a = 0 < r^b = 0.2$

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Three channels

In a dynamic general-equilibrium model

1. “Use-it-or-lose-it” channel
 - Capital reallocates toward more productive entrepreneurs

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In a dynamic general-equilibrium model

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

Environment Demographics

- Overlapping generations (OLG) model
 - Age h , live up to H years
 - Wealth inheritance (no bequests motives)

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- Endogenous **labor** until retirement R
 - **Consumption**-savings decision
 - **Portfolio** choice
 - + Choose how much to invest in own technology ("entrepreneurship")

Environment Households

- Labor productivity w_{ih} s.t. $\log w_{ih} = \kappa_i + g(h) + e_{ih}$

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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: $Q = (\int x_{ih}^\mu)^{\frac{1}{\mu}}$, 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

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

- Financial friction which generates misallocation
- Invests more if z is higher and if a is higher

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2. Choose how much to work (when $h \leq R$), consume, and save in assets

$$V_h(a, \bar{z}, \mathcal{I}, e, \kappa) = \max_{c, n, a'} u(c, n) + \beta s_{h+1} \mathbb{E} [V_{h+1}(a', \bar{z}, \mathcal{I}', e', \kappa)]$$

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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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 - Standard earnings risk
 - Taxes: $\tau_k = 25\%$, $\tau_\ell = 22.4\%$, $\tau_c = 7.5\%$
- ⇒ 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

- Set $\tau_k = 0$, balance budget with a **wealth tax**
 - Wealth tax $\tau_a = 1.13\%$

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 - Larger K : +20% → agents save more
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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

- Why does capital increase? Three channels

Main experiment A wealth tax

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 - “Use-it-or-lose-it” [fixing prices & decision rules to benchmark] $K \uparrow$

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- GE effects [with prices of new equilibrium] $K \downarrow$
- Behavioral responses [with new decision rules] $K \uparrow$

Main experiment A wealth tax

- Who wins from the reform?

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:	<i>Entrepreneurial Ability Groups (\bar{z}_i Percentiles)</i>					
	0–40	40–80	80–90	90–99	99–99.9	99.9+
	<i>RN Reform</i>					
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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- Transitions

Taxing capital? Heterogeneous returns

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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

- Productivity or rents?
 - Scale or type dependency?

⇒ Capital income or wealth taxation?

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- On taxation and heterogeneous returns
 - Productivity or rents?
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- ⇒ Capital income or wealth taxation?
- A follow up: Gaillard, Hellwig, Wangner, and Werquin (2024)
 - Non-homothetic utility

Lecture 2

Labor Taxes and Transfers

Should we tax labor? Yes! But how?

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1. Optimal fiscal policy in **representative-agent** models

- Linear labor taxes to finance **spending** $G \dots$

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 . . . but not to absorb shocks: “smooth distortions!”
- Lucas Jr. and Stokey (1983), Aiyagari, Marcet, Sargent, and Seppälä (2002)

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 - Floden and Lindé (2001)

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- Going further: **Progressive** taxes?

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- Hard to analyze?

- A highly multi-dimensional object
- Computational?

The U.S. tax-and-transfer system

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

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- Tax credits: EITC, CTC, . . . partially refundable
- Transfers: SNAP, TANF, . . . means-tested

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

Optimal progressivity

Two approaches

Optimal progressivity Two approaches

■ Public finance: Mirrlees

- Fully flexible tax-and-transfer function
- Difficult to bring into rich quantitative models?

Optimal progressivity

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- Quantitatively realistic model
- But simple tax functions?

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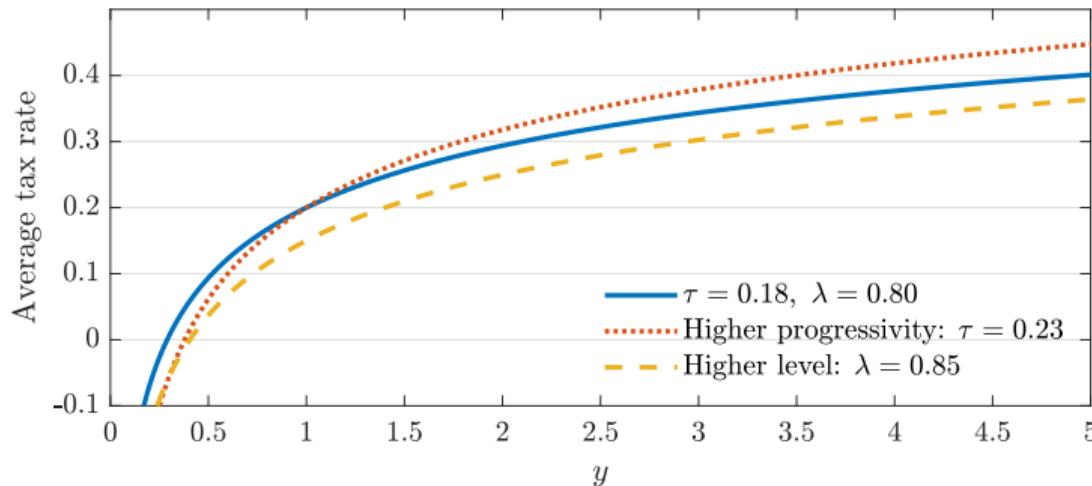
■ “New” approach: a rich Ramsey approach

- Heathcote, Storesletten, and Violante (2014), Heathcote, Storesletten, and Violante (2017)
- Heathcote and Tsuijiyama (2021a, 2021b)
- Ferriere, Grübener, Navarro, and Vardishvili (2023a)

1. Optimal Progressivity With Loglinear Income Taxes

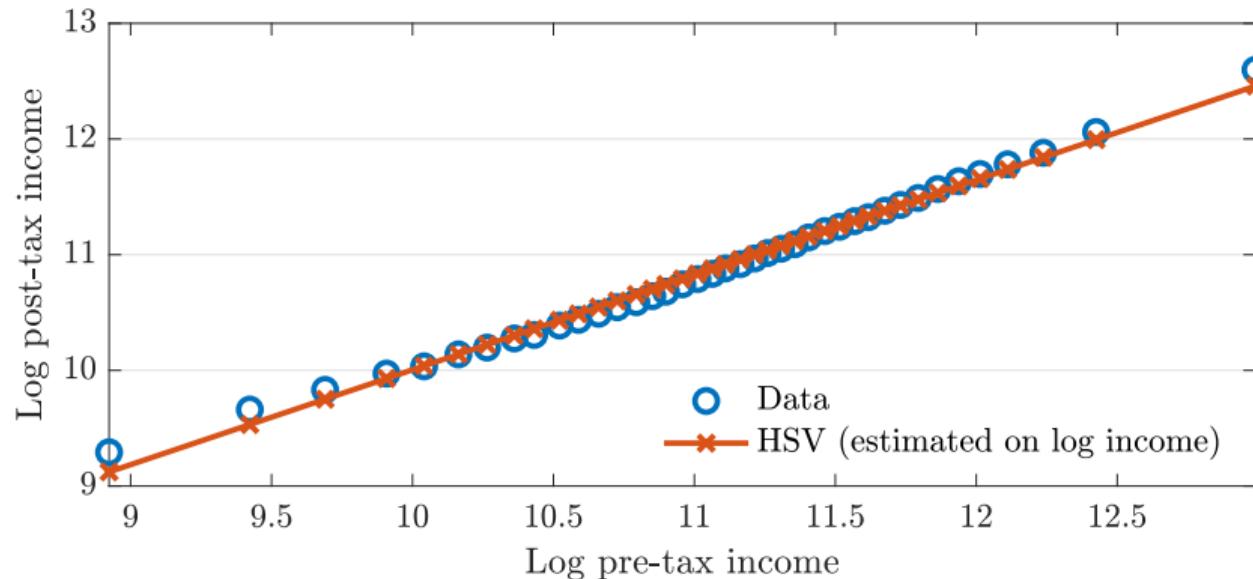
Loglinear tax function

- 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 $y - \mathcal{T}(y) = \lambda \quad \forall y$



- 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

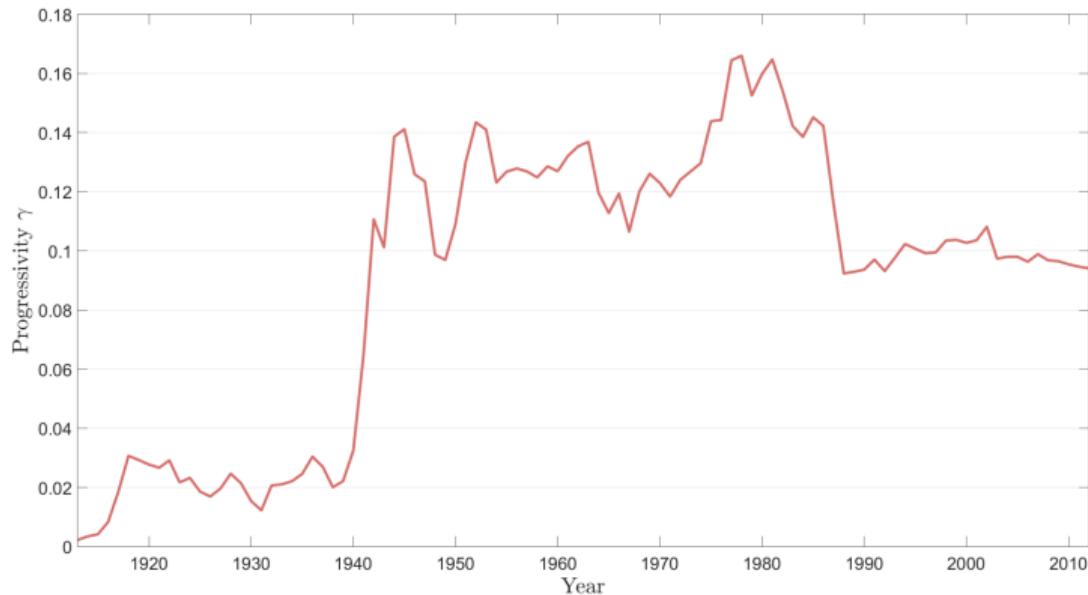


Figure 12: U.S. Federal Income Tax Progressivity

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

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

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

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

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

Efficiency

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Efficiency

- Two **efficiency** terms
 - Size term \downarrow with τ ; Labor disutility term \uparrow with τ

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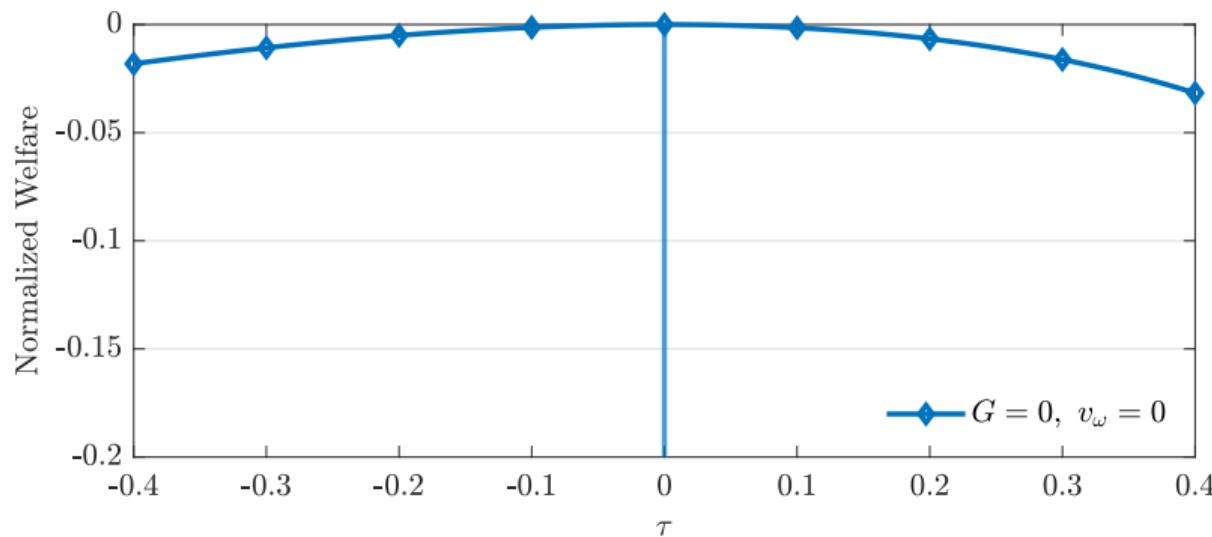
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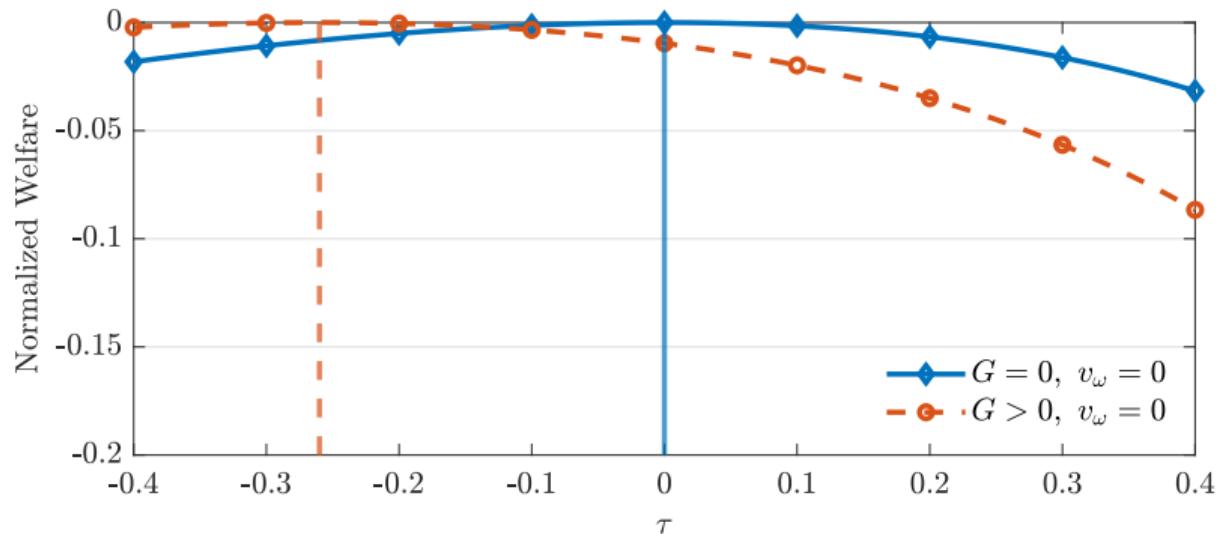
- Two **efficiency** terms
 - Size term \downarrow with τ ; Labor disutility term \uparrow with τ
- **Redistribution** term \uparrow with τ
- Calibration: $\tau = 0.18$, $\varphi = 2.5$, $G/Y = 0.223$, v_ω to match $\mathbb{V}[\log c] = 0.18$

Welfare Optimal τ



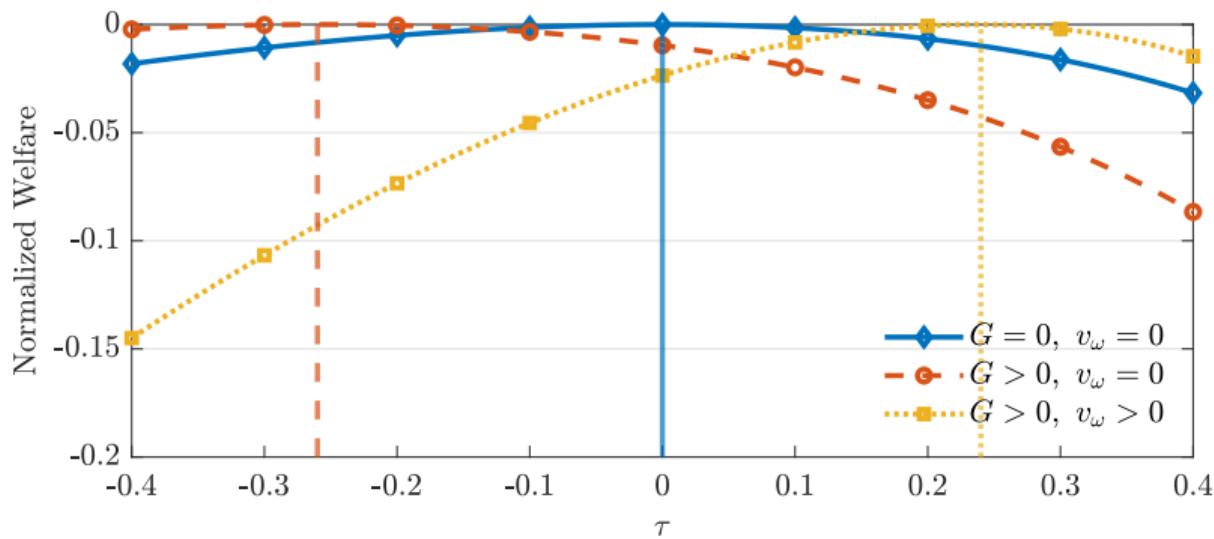
- Optimal income-tax progressivity:
 - No spending, no heterogeneity: $\tau = 0$

Welfare Optimal τ



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

Welfare Optimal τ



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

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

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

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

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⇒ “**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 $\log B_i \sim \mathcal{N}\left(\frac{v_B}{2}, v_B\right)$

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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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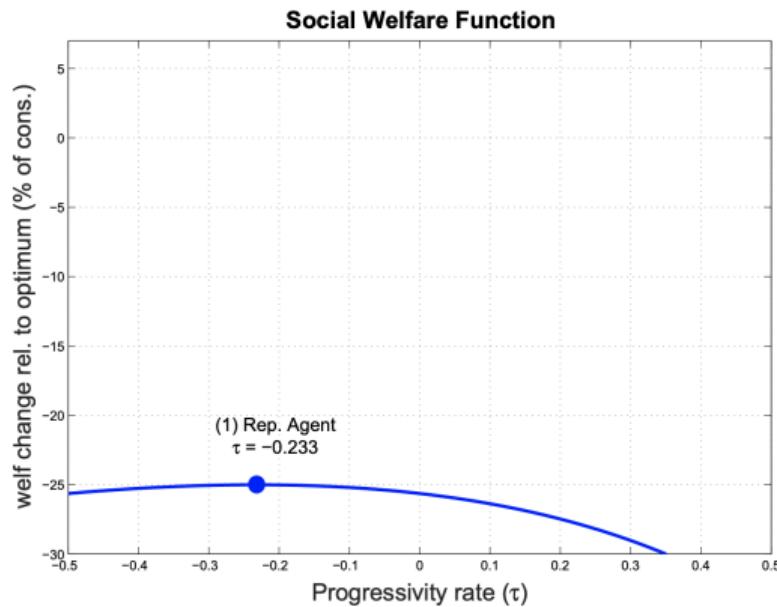
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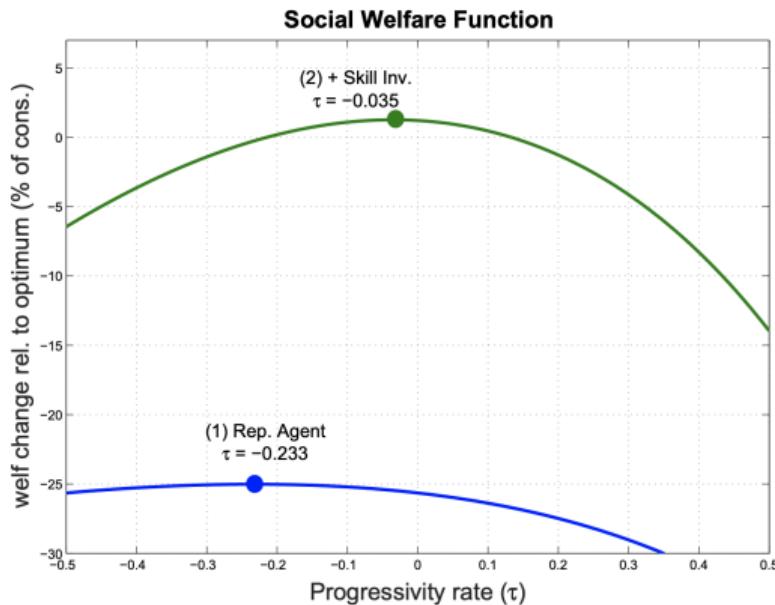
Welfare HSV (2017)

- Representative-agent, $\chi > 0$



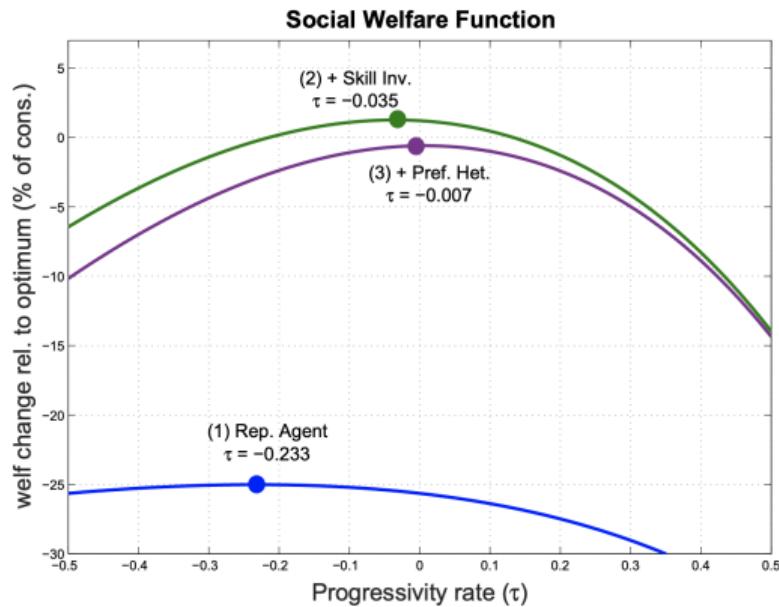
Welfare HSV (2017)

- With heterogeneity in skills



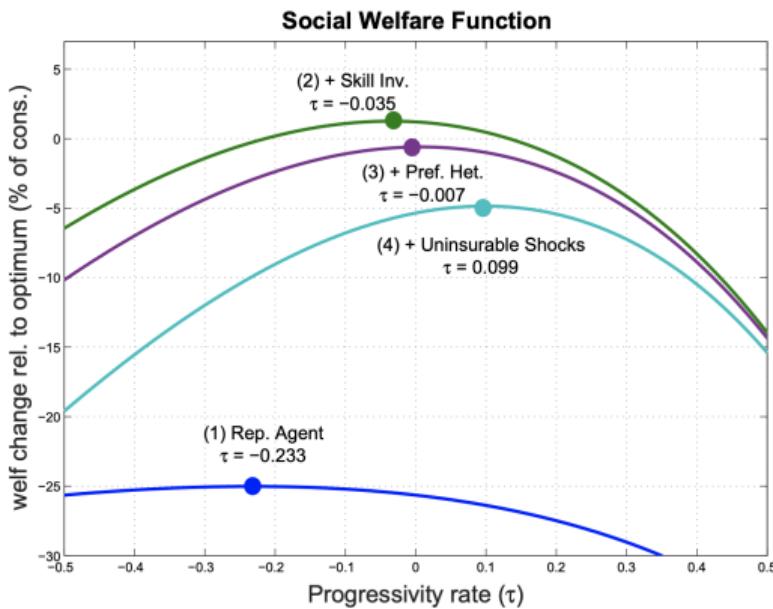
Welfare HSV (2017)

- With heterogeneity in labor disutility



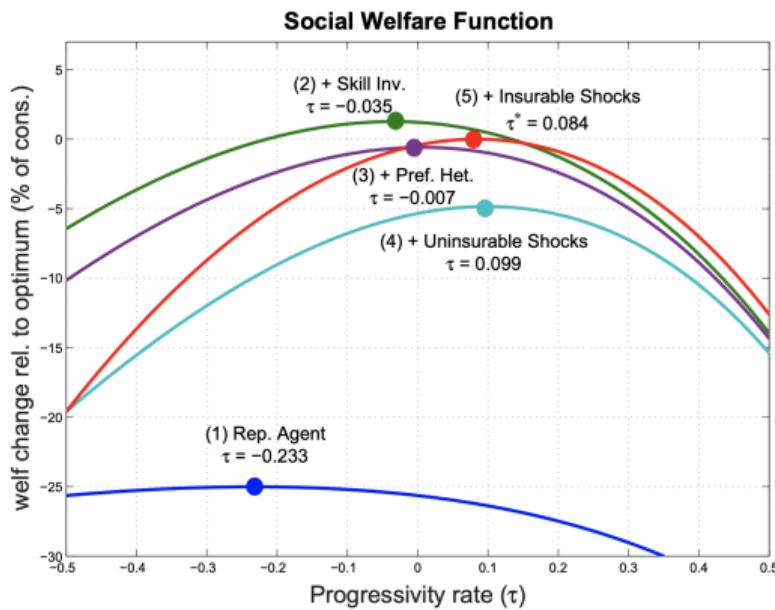
Welfare HSV (2017)

■ With uninsurable shocks



Welfare HSV (2017)

■ With insurable shocks



Taking stock HSV (2017)

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

Taking stock HSV (2017)

- Taxes should be progressive
 - 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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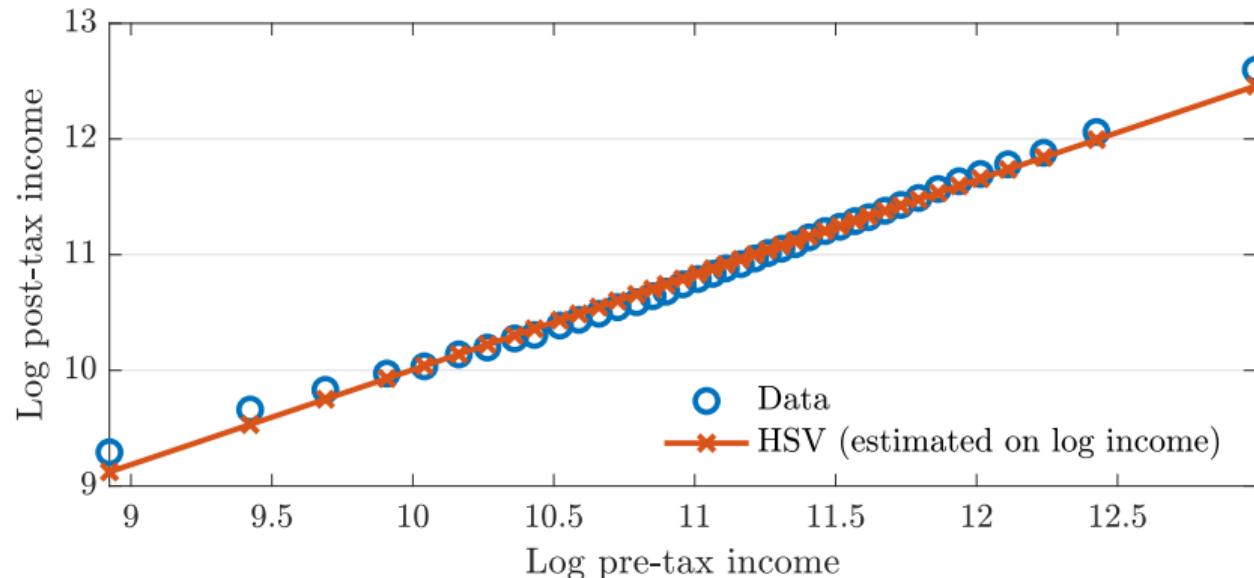
■ Utilitarian government

- Budget: $G + T = \int y_{it} di - \lambda \int y_{it}^{1-\tau} di$

■ A continuum of workers

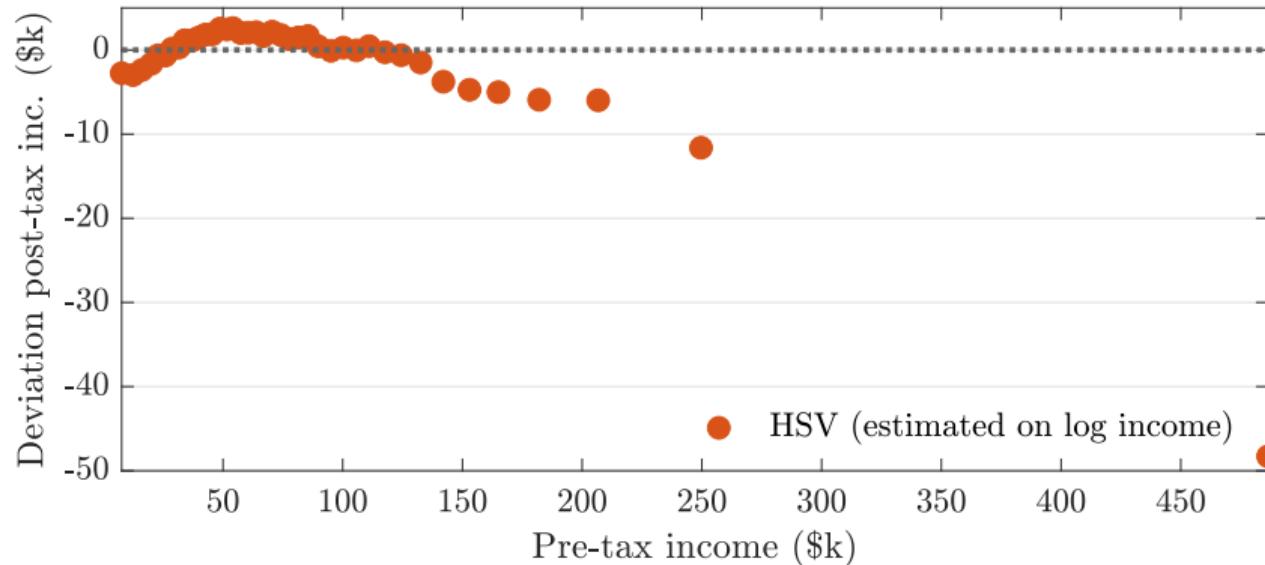
- Hand-to-mouth workers: $c_{it} = \lambda(z_{it} n_{it})^{1-\tau} + T$

Loglinear tax function No transfer (HSV)



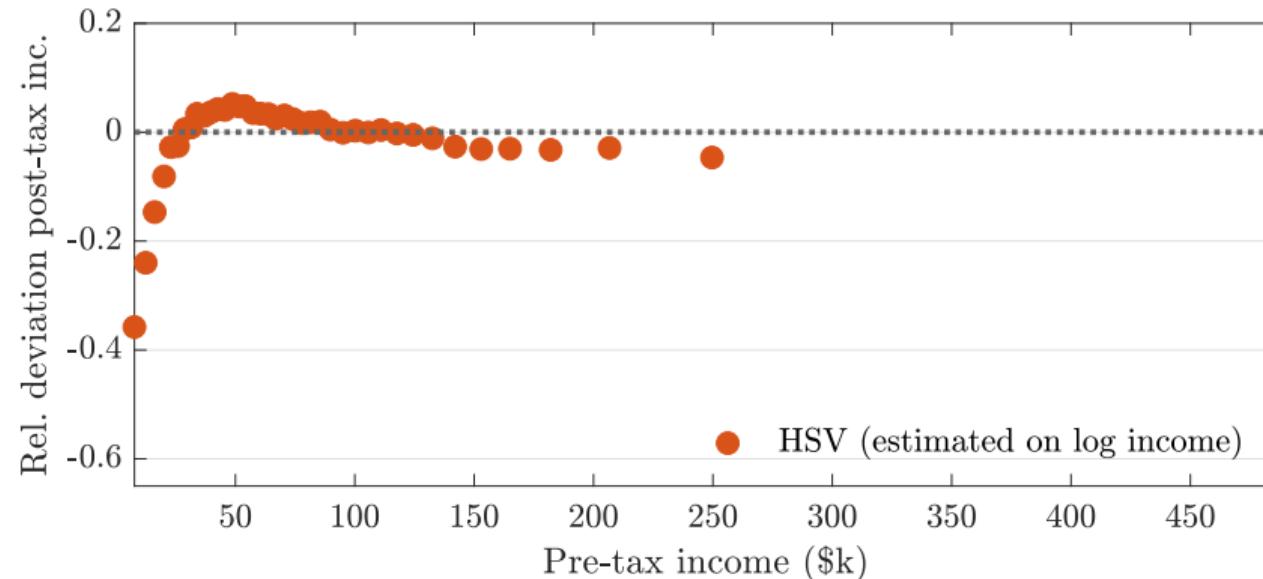
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- Estimated progressivity $\tau = 0.18$

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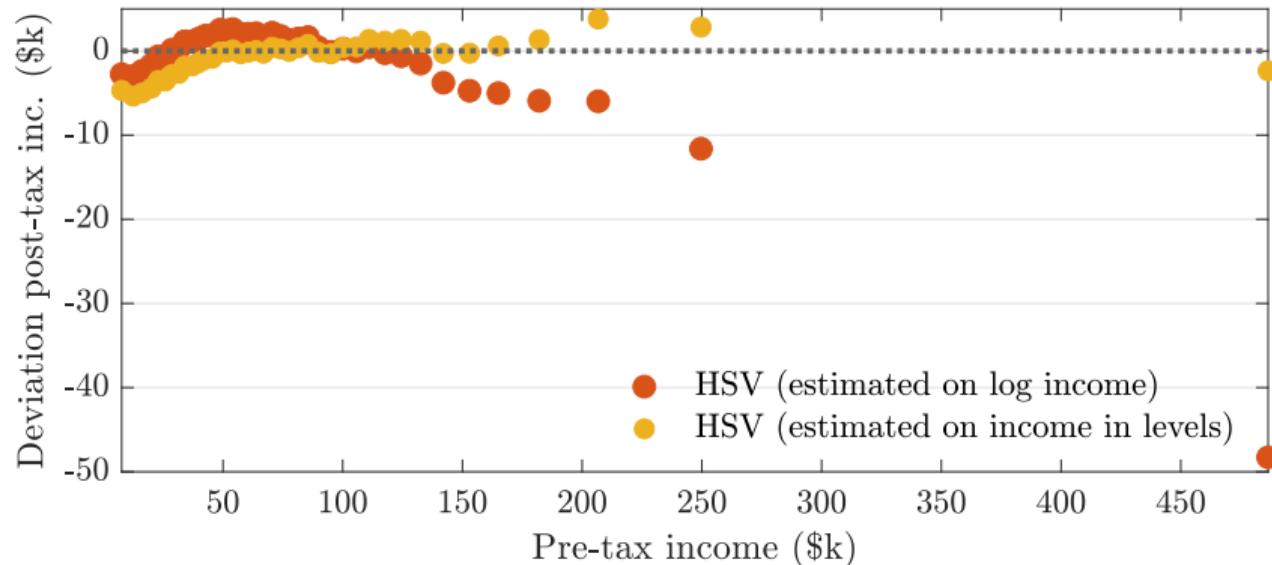
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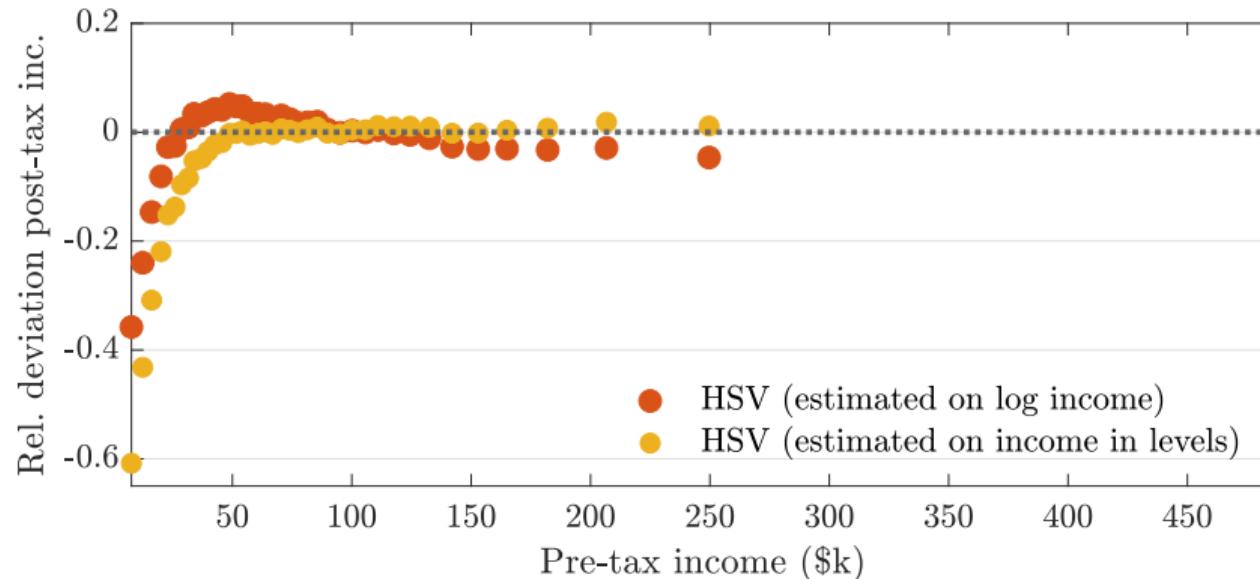
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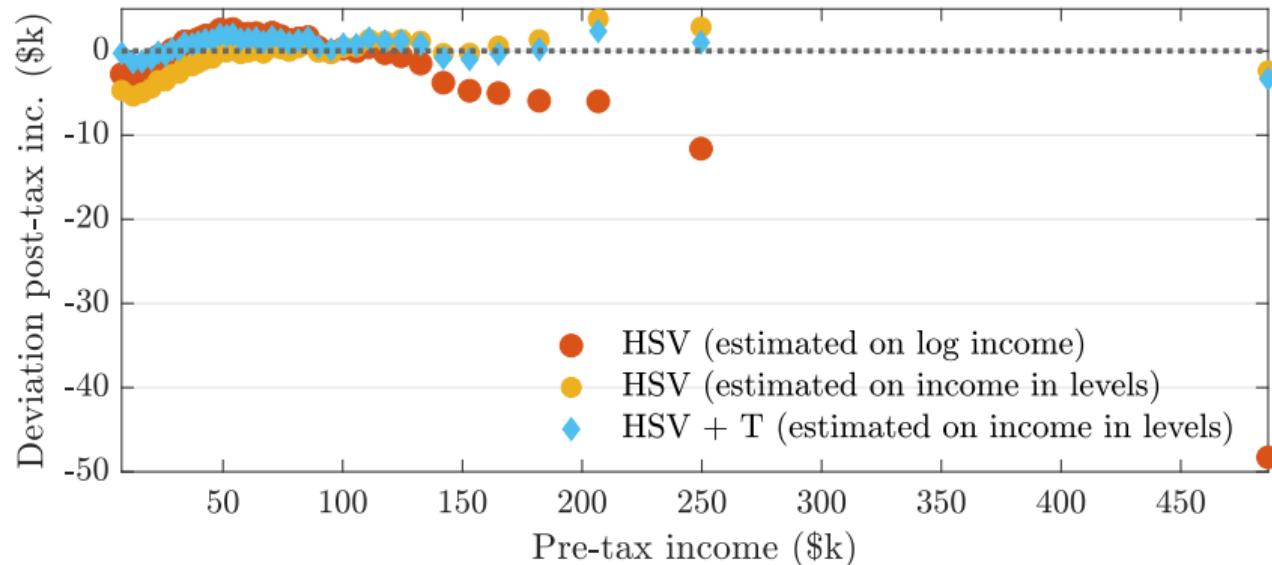
- Non-linear estimate on income in **levels**: $y^{at} = \lambda y^{1-\tau}$
- Estimated progressivity: $\tau = 0.09$

Loglinear tax function No transfer



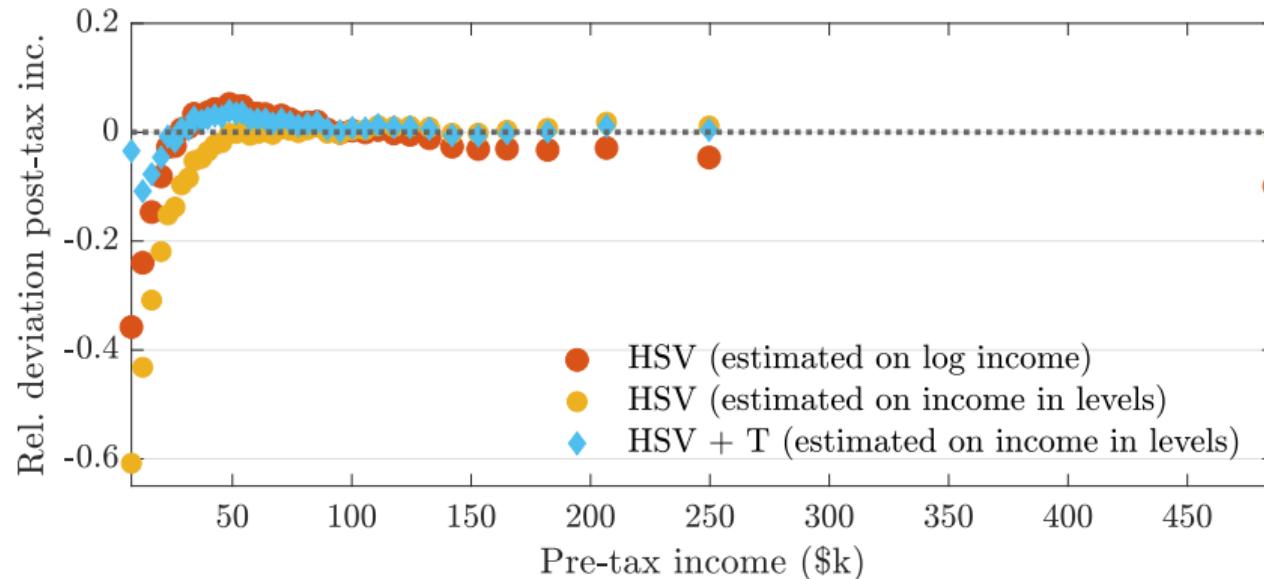
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Empirical fit Loglinear tax function with a transfer



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- Estimated progressivity $\tau = 0.06$, transfer $T \approx \$5,400$

Empirical fit Loglinear tax function with a transfer



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- Estimated progressivity $\tau = 0.06$, transfer $T \approx \$5,400$

Transfers Heterogeneous agents

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

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

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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 ($v_\omega = 0$):

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

- Claim: Ω_e decreases with τ
 - + Offset the effects of progressivity on labor supply incentives
 - With heterogeneity, efficiency Ω_e numerically decreases with τ
- ⇒ Efficiency gains of T are decreasing in τ

Transfers

Welfare: Redistribution

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

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

- 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

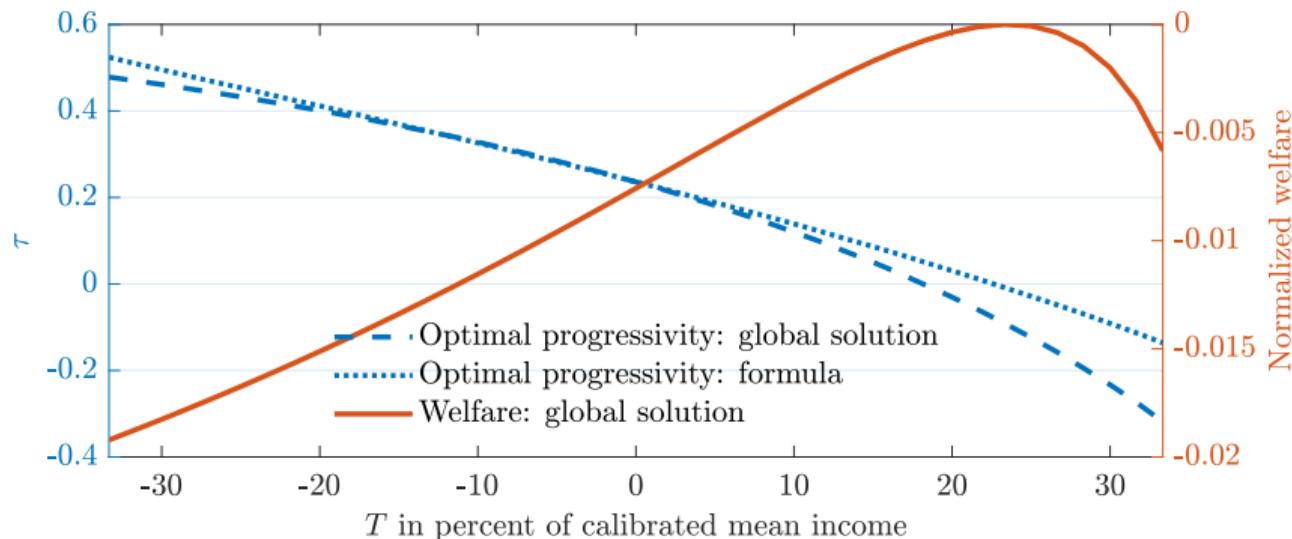
- Use formula to evaluate local welfare gains of transfers:

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

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

Transfers Heterogeneous agents

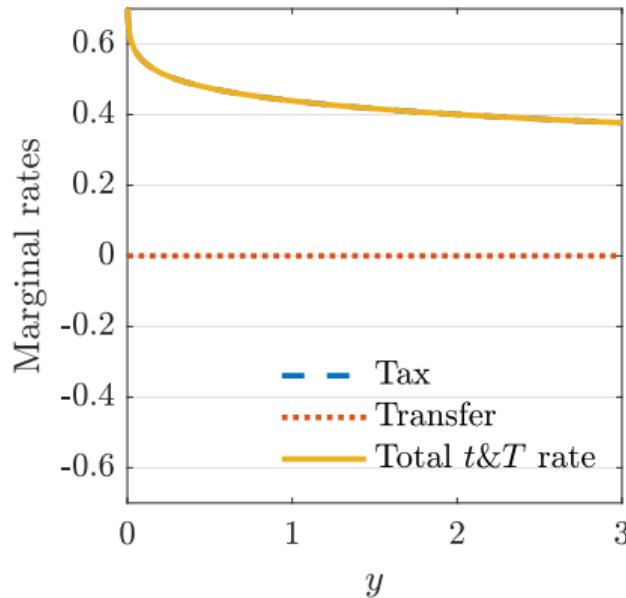
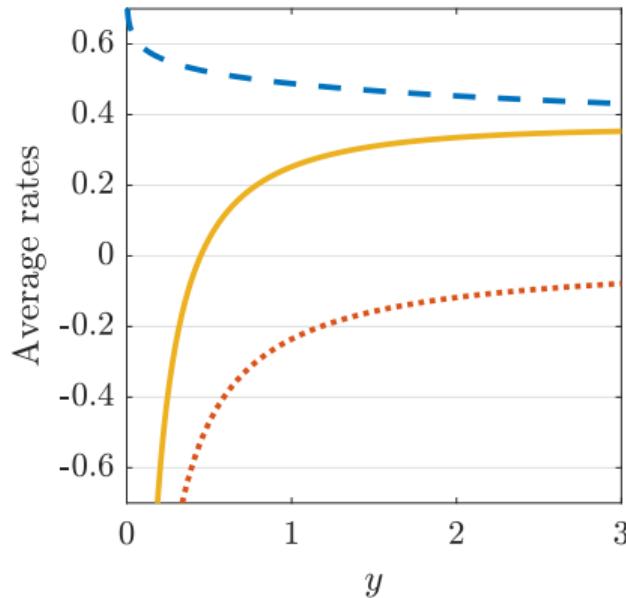
- A **negative** relationship between τ and T



- 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: $\tau = -0.09$

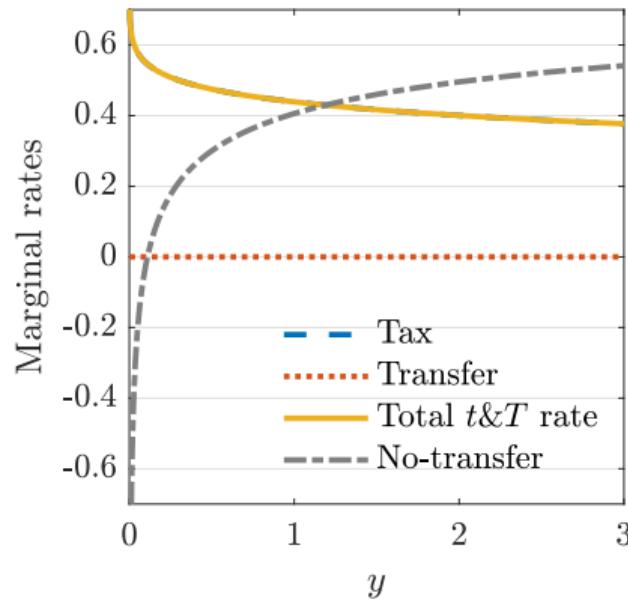
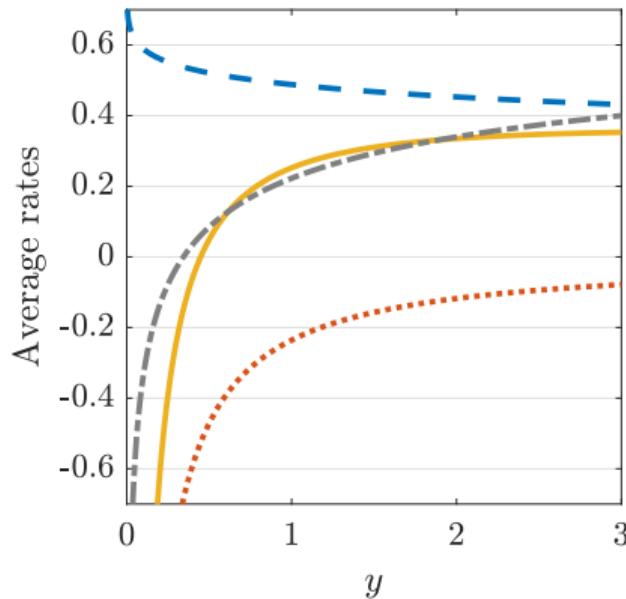


- Average taxes are increasing, marginal taxes are decreasing

- Transfers to disentangle average from marginal $t\&T$ rates

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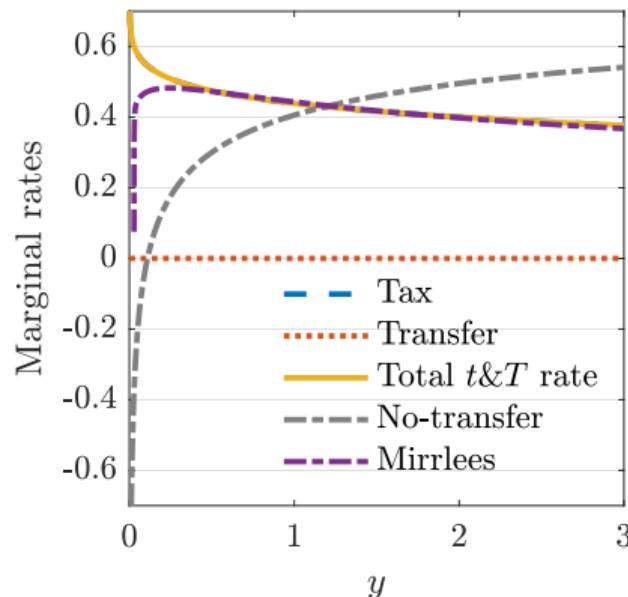
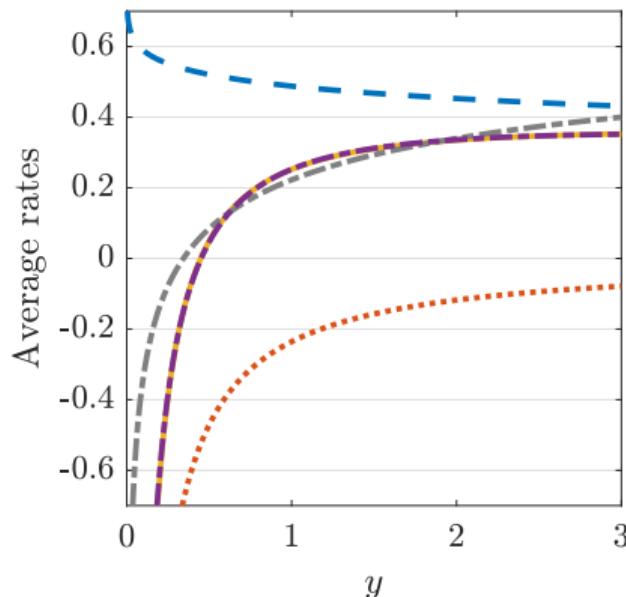
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Optimal plan with transfers

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...

The Welfare State in the US

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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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 - Investment in early childhood?
 - 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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- 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)
 - ...

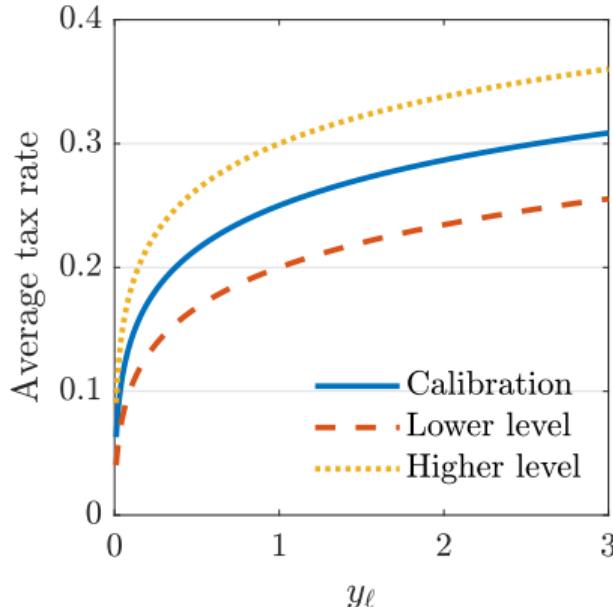
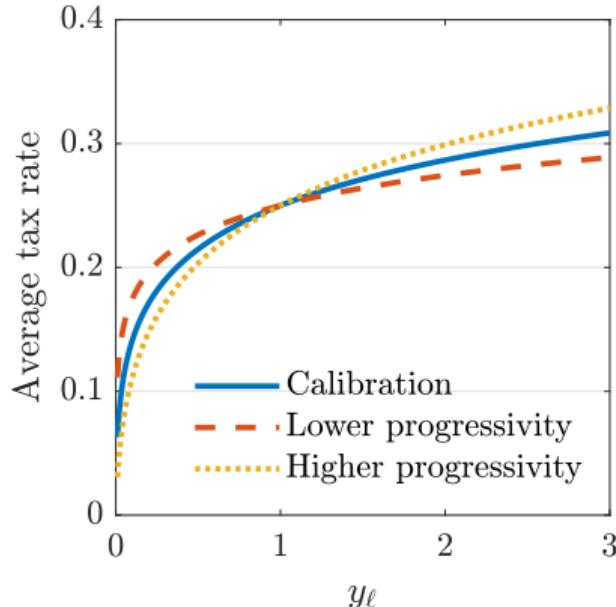
Taxes and transfers in the data

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

Fiscal system

Income taxes

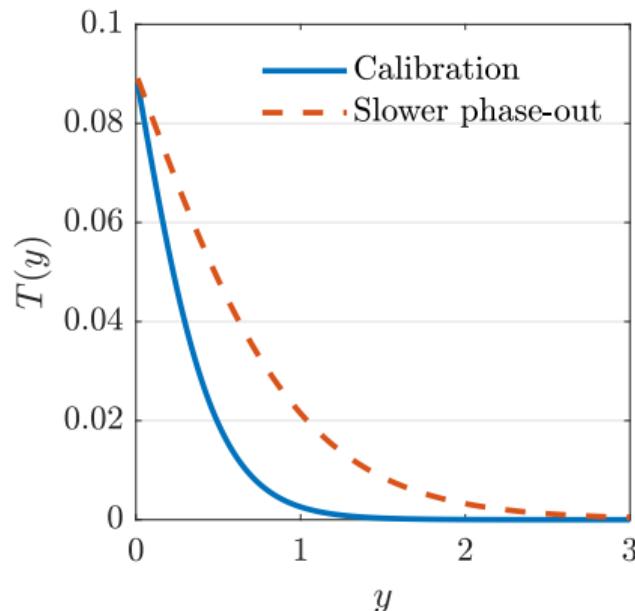
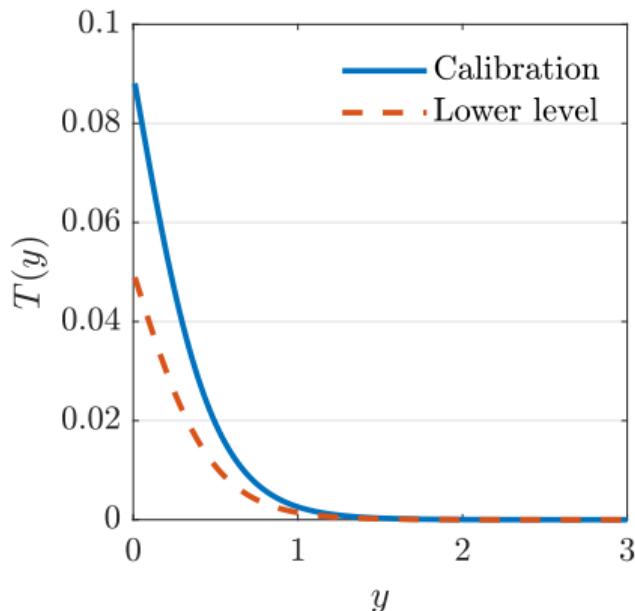
- Flat capital tax τ_k
- Progressive labor tax: $\exp\left(\log(\lambda)\left(\frac{y_\ell}{\bar{y}}\right)^{-2\theta}\right)y_\ell$, with level λ and progressivity θ



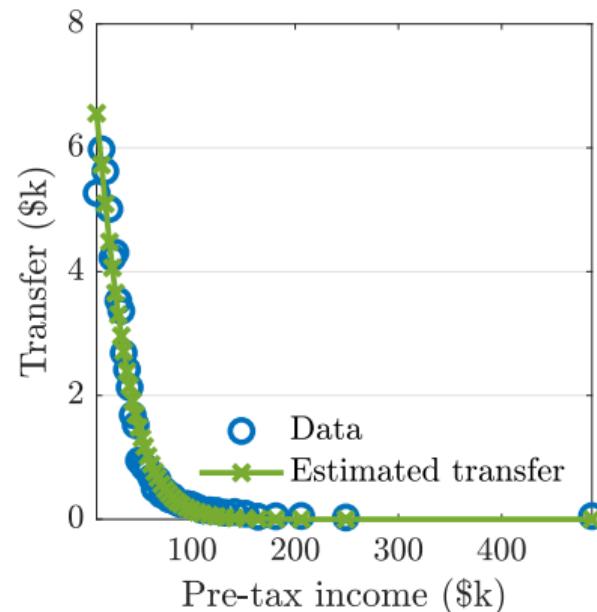
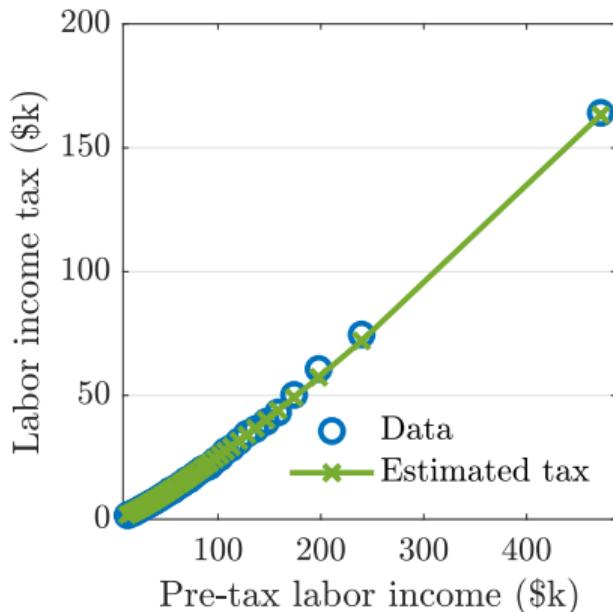
Fiscal system Transfers

■ 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



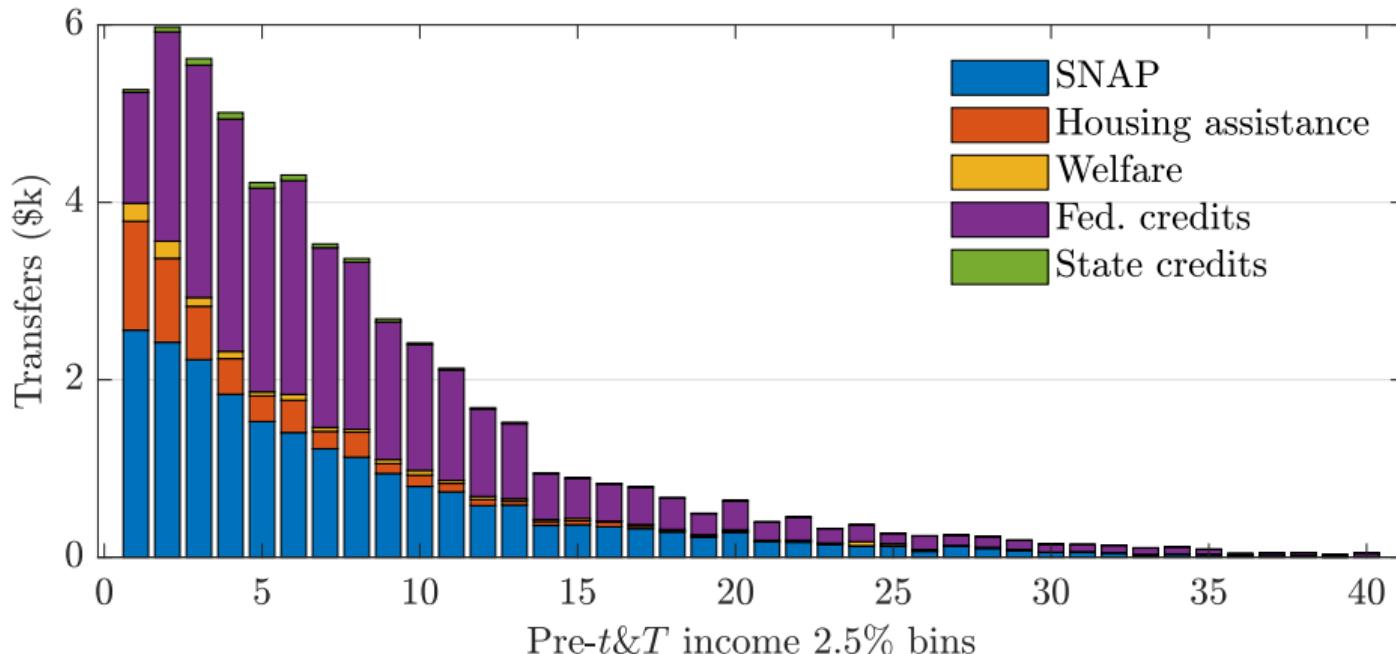
Calibration Fiscal system: Micro estimates



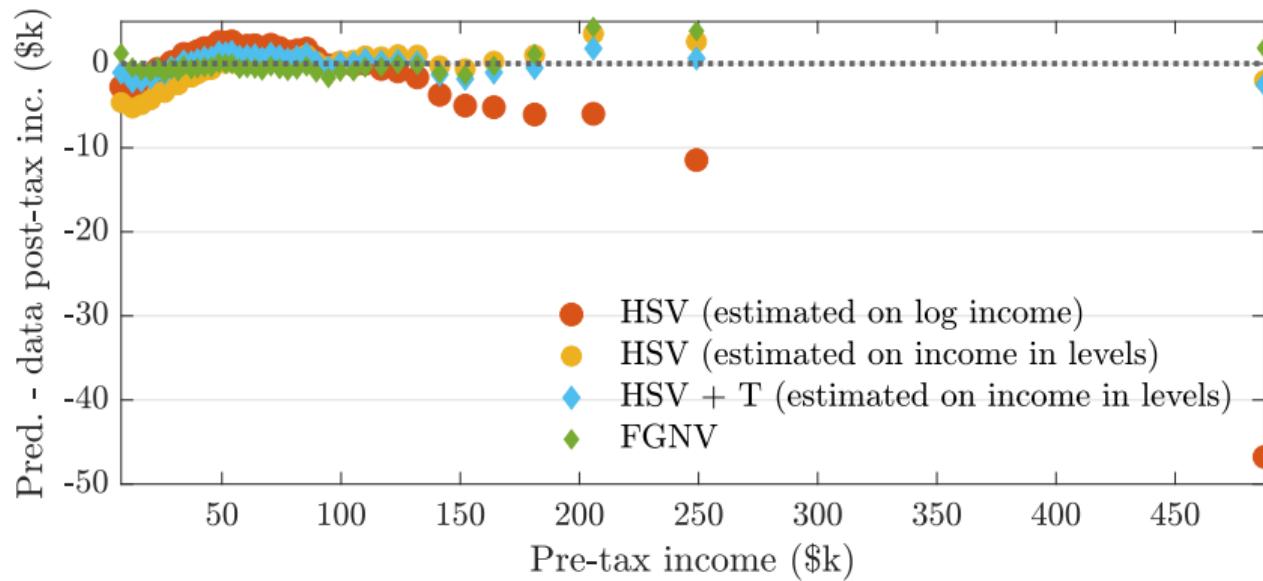
- Estimated on taxes and transfers: $\theta = 0.08$, $m = 0.09$, $\xi = 4.22$

Transfers

Components across the distribution

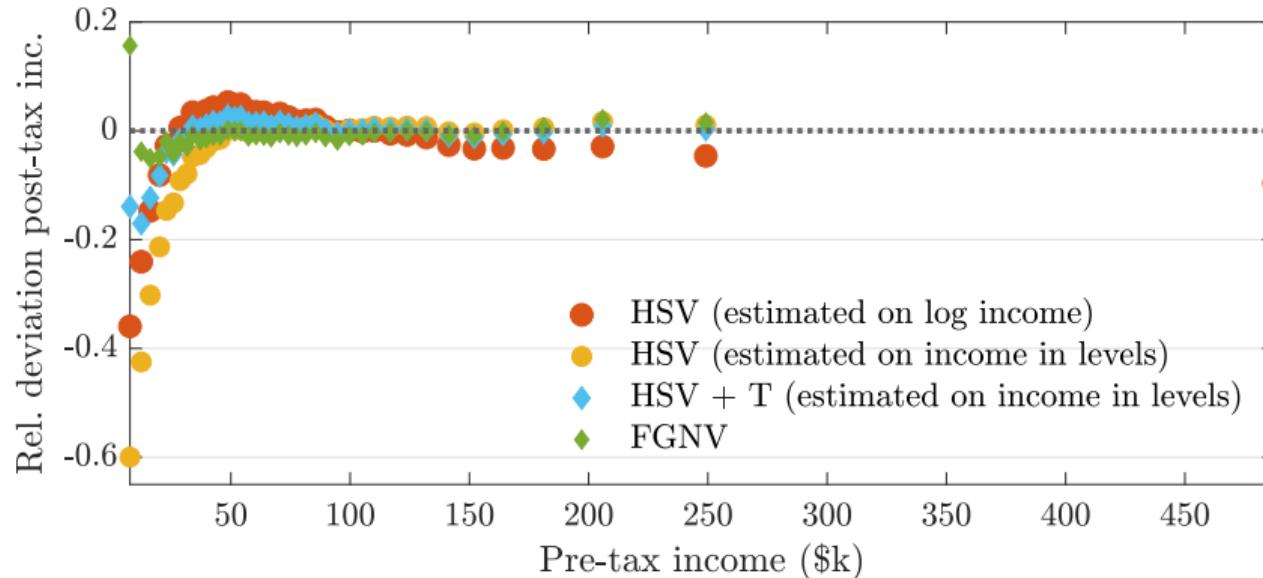


Fiscal system After-tax-and-transfer income fit



■ Predicted after-tax-and-transfer income

Fiscal system After-tax-and-transfer income fit



- 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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- Fiscal parameters
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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: 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

Calibration Income and tax distribution, wealth effects and elasticities

- Income distribution, including at the bottom

- Distribution of taxes and transfers

- Compare model implied **wealth effects** to evidence

Golosov, Gruber, Mogstad, and Novgorodsky (2023)

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

Data: 2.3, model: **2.4**

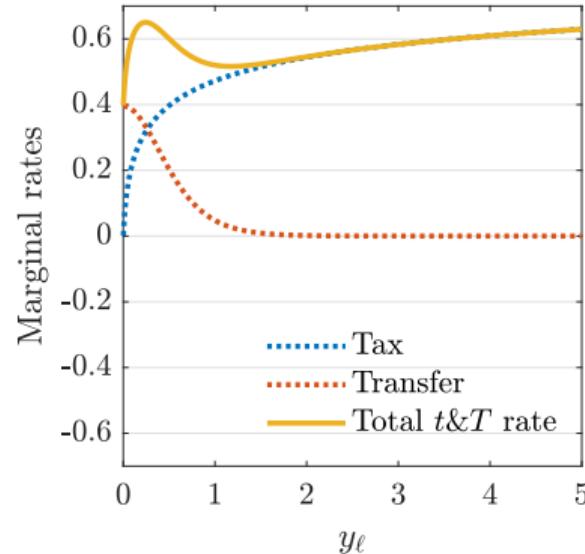
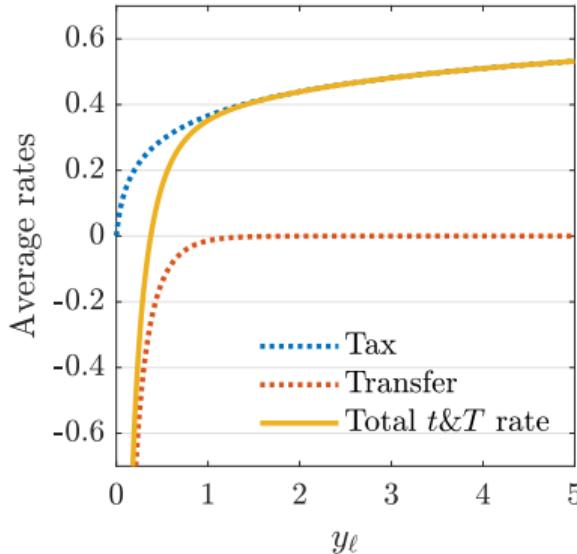
- Labor **elasticity** of the top-1%

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

Optimal tax-and-transfer plan

■ The **optimal plan** features

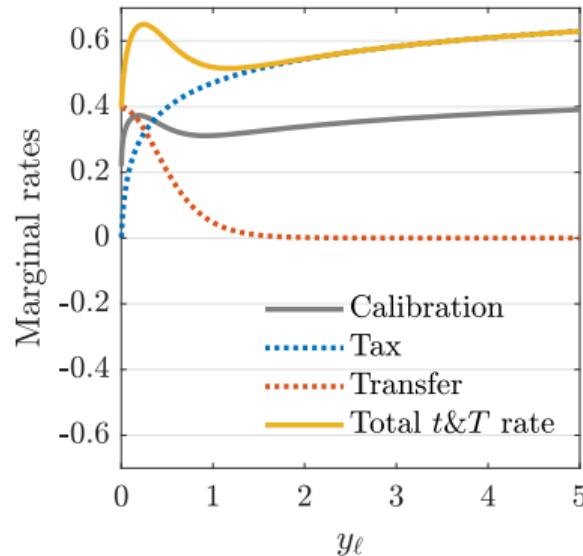
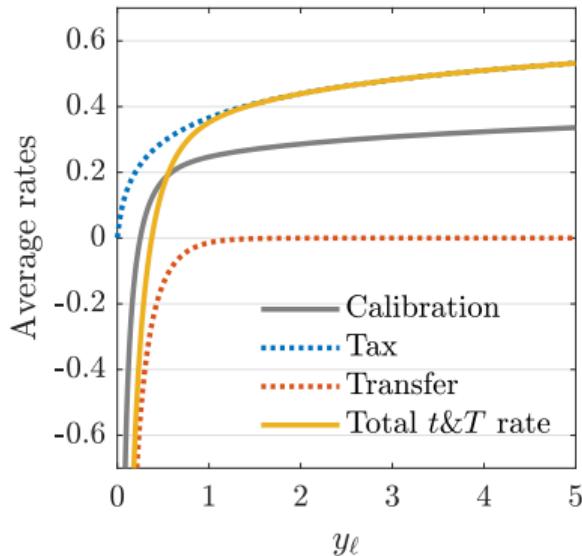
- Large transfers $m = 0.23$, i.e. \$20k, with phase-out $\xi = 3.41$
- Moderate tax progressivity $\theta = 0.14$



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- Large transfers $m = 0.23$, i.e. \$20k, with phase-out $\xi = 3.41$
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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...

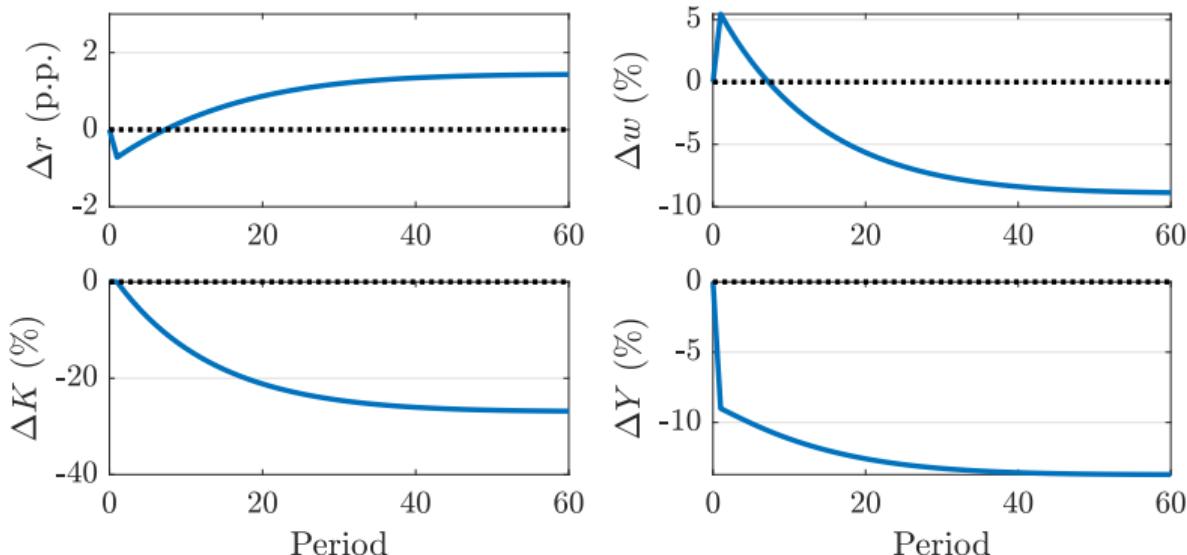
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Average $t\&T$ rate	-66%	-1%	19%	24%	36%
Marginal $t\&T$ rate	63%	61%	55%	48%	50%

- 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

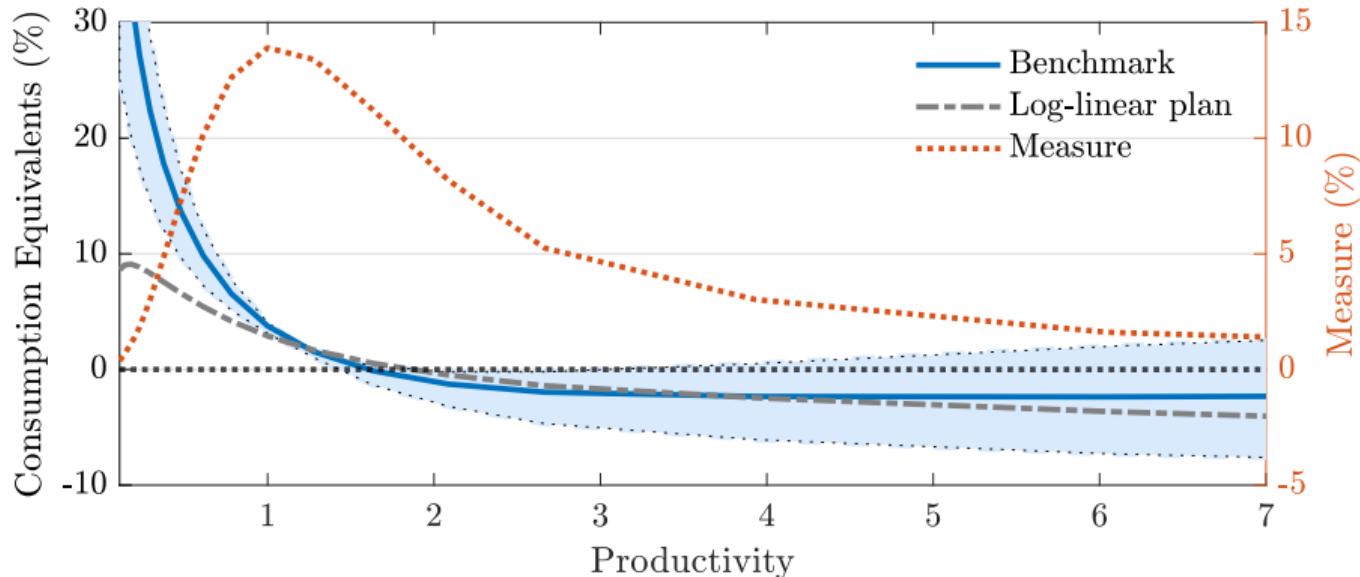
Transitions and welfare

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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 - A very rich modeling of the current US system
 - Simple exploration of the optimal welfare state
- 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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- Progressive taxes by hh structure: τ^M , τ^F
- Tax credits as in the data
- Childcare subsidies as a function of hh structure and children age
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 - Other transfers
- 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**

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 - Aggregate welfare losses, especially for single females
 - Majority support

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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**

A focus on the household structure

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■ Implementing a Negative Income Tax

- Income tax progressivity at $\tau = 0$, adjust λ
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■ 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
 - Fiscal policy: spending, unemployment benefits, lump-sum checks

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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

- Standard HANK model with three additional components

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 - **Heterogeneous** stochastic discount factors → heterogeneous mpc

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- Standard HANK model with three additional components
 - Heterogeneous stochastic discount factors → heterogeneous mpc
 - An extensive labor supply margin → heterogeneous labor elasticities
 - Unemployment risk of heterogeneous incidence & varying with the cycle
- ⇒ Relevant framework to quantify fiscal stabilization packages
- Demand-driven recession
 - Negative shock to marginal utility: unexpected, deterministic, transitory

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- Three fiscal stabilization packages

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 - Operates through both labor supply and consumption
 - Despite the larger unemployment risk
- **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)

Households

Unemployed households

- Value function when unemployed $\eta = u$

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- Unemployment benefits function of hourly wage $\mathcal{B}_t(w_t x) = \zeta \max (\mathcal{R} w_t x \bar{h}, \overline{ui})$
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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$$G_t + (1 + r_t)D_t + T_t + \int \mathcal{B}_t(w_t x) d\mu_t = D_{t+1} + \int \mathcal{T}_t(y_t^\ell, y_k^t) d\mu_t$$

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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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 - B to match employment $\approx 78\%$
Jang, Sunakawa, and Yum (2023)
 - ρ_h to match annual labor elasticity of ≈ 0.5 for the bottom quartile
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Triest (1990), Eissa and Liebman (1996), Kleven and Kreiner (2006), Meghir and Phillips (2010)

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Triest (1990), Eissa and Liebman (1996), Kleven and Kreiner (2006), Meghir and Phillips (2010)
- 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

Steady State Unemployment

- Job finding rates and separation rates across hourly wage distribution
- Job finding rates are constant in the distribution distribution
Mueller (2017)
 - Monthly finding rate of 0.32 $\Rightarrow \pi_\eta(e|u) = 0.691$

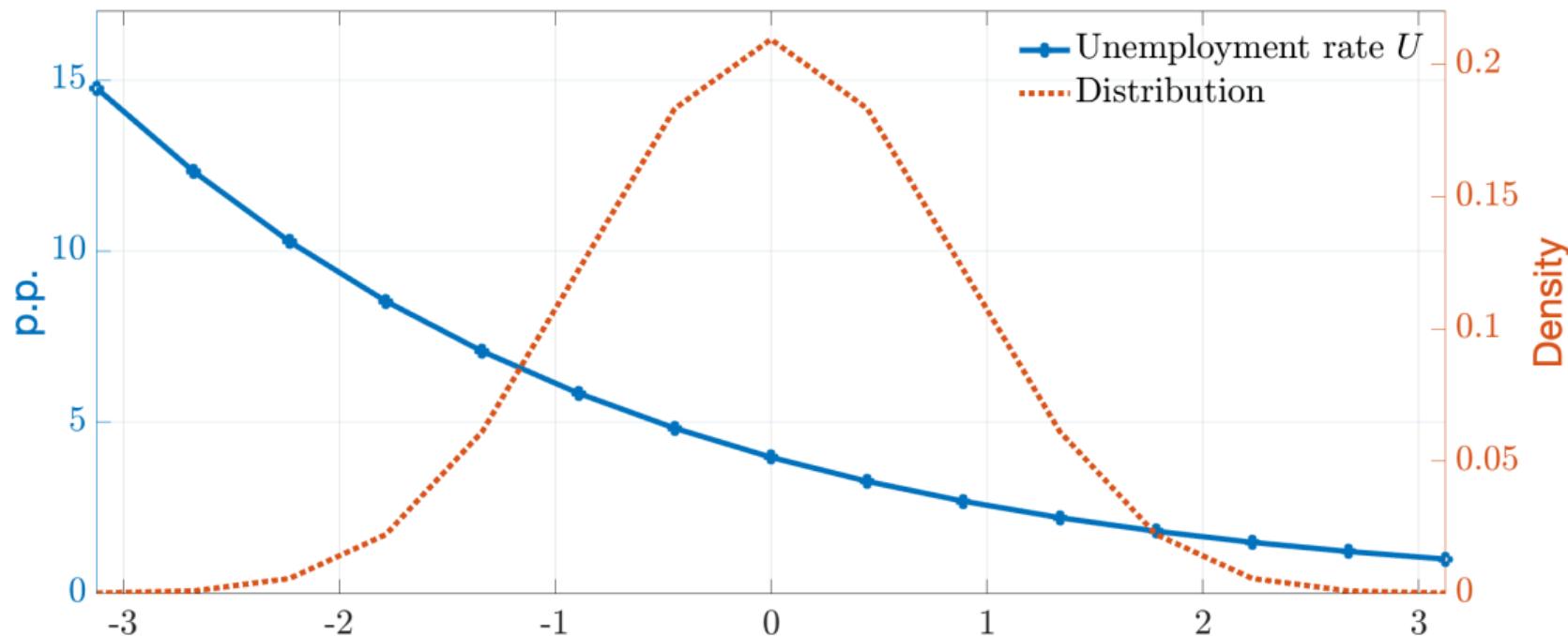
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 - Monthly finding rate of 0.32 $\Rightarrow \pi_\eta(e|u) = 0.691$
- Separation rates falling in hourly wage/productivity x
Mueller (2017)
 - Monthly separation rates of $\approx 1.4\%$ and 0.7% below and above median, respectively
 - $\Rightarrow \pi_\eta(u|e, x) = \phi_0 x^{\phi_1}$, with $\phi_0 = 0.029$ and $\phi_1 = -0.446$

Steady State Unemployment

- Job finding rates and separation rates across hourly wage distribution
- Job finding rates are constant in the distribution distribution
Mueller (2017)
 - Monthly finding rate of 0.32 $\Rightarrow \pi_\eta(e|u) = 0.691$
- Separation rates falling in hourly wage/productivity x
Mueller (2017)
 - Monthly separation rates of $\approx 1.4\%$ and 0.7% below and above median, respectively
 - $\Rightarrow \pi_\eta(u|e, x) = \phi_0 x^{\phi_1}$, 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

Farhi and Werning (2019)

Steady State

Firm and government

- Technology: $\varepsilon = 7$, $\Theta = 200$

Galí and Gertler (1999)

- Dividends redistributed linearly in x

Farhi and Werning (2019)

- 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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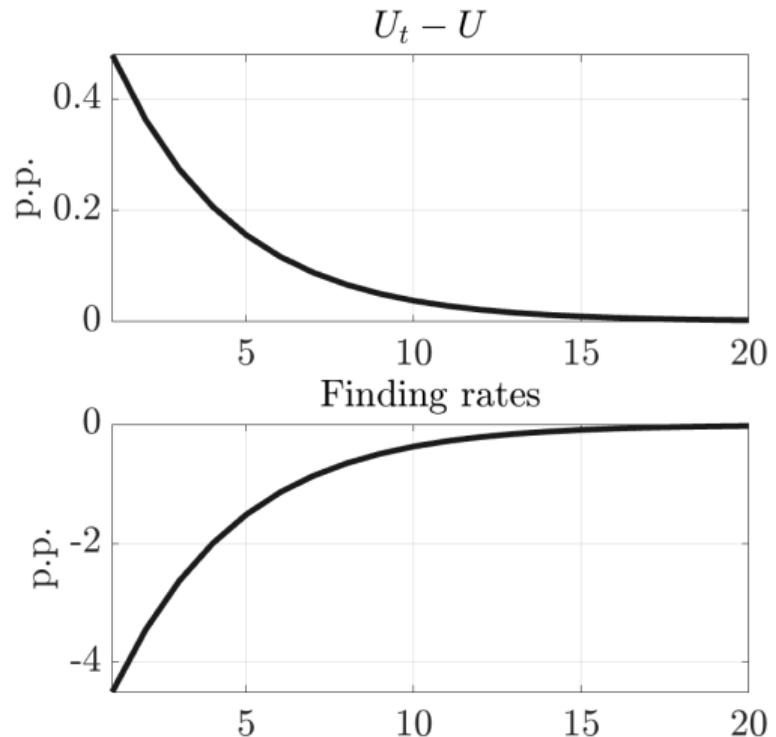
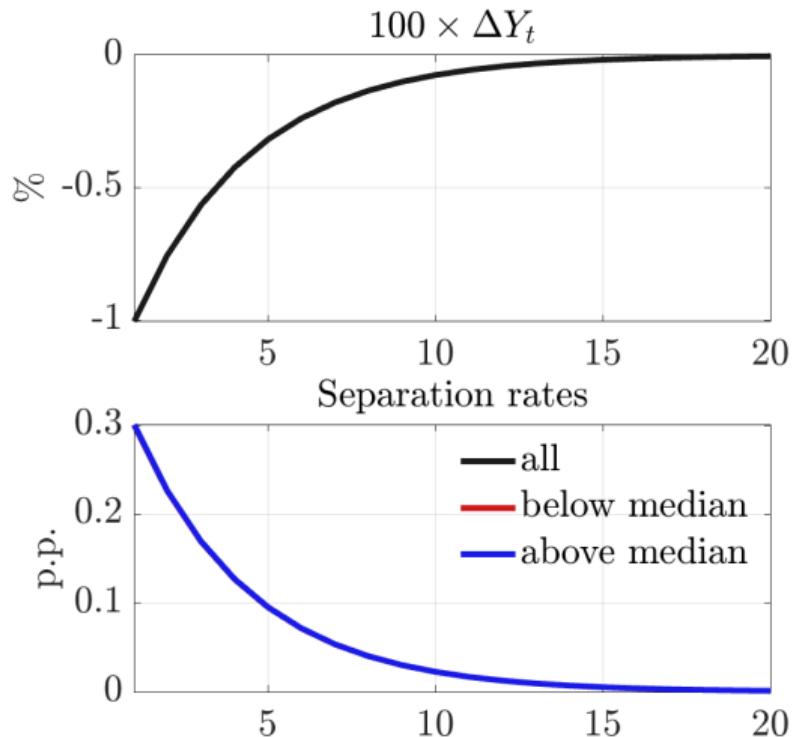
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- Job separation rates? A flexible formulation

$$\pi_{\eta,t}(u|x, e) = \pi_\eta(u|x, e) - \phi_{eu}^a \Delta Y_t x^{-\phi_{eu}^b}$$

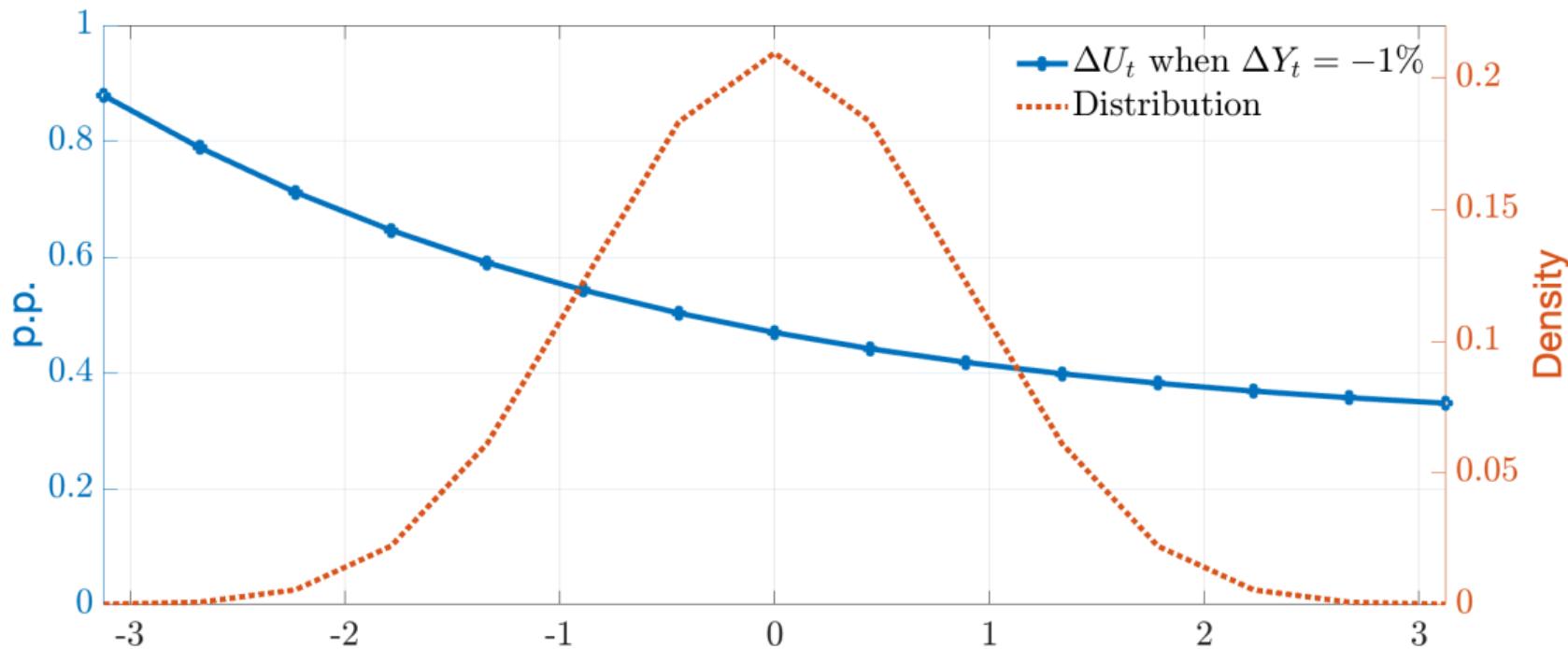
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Unemployment and the Business Cycle

Okun's law



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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mpc	0.19	0.15	0.07	0.03

- 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 $\log h_{in} = b_0 + \textcolor{red}{b}_1 \log \tilde{w}_{in} - b_2 \log c_{in} + \varepsilon_{in}$

- + Aggregate labor elasticity is **0.28**, declining with income

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- Compute labor responses to a temporary tax shock
Erosa, Fuster, and Kambourov (2016)
 - + Annual hours response to a 1% change in after-tax rate for one year
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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

Investigating the calibration Tax shocks

- Further investigate aggregate effects of tax shocks

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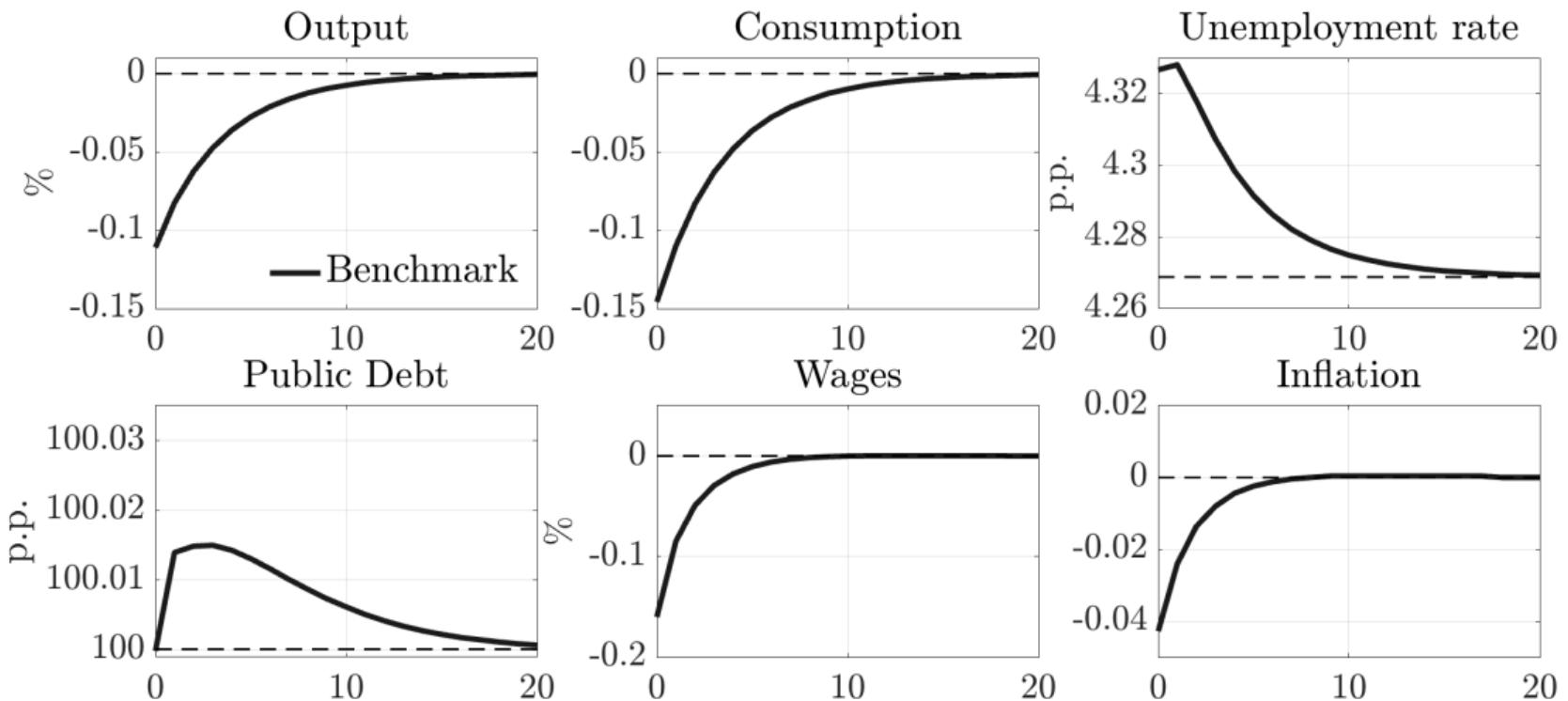
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 - Peaks on impact in the model, at 2 years in the model
- ⇒ Conservative calibration regarding tax responses

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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- Temporary transfer modeled as a **logistic** function

Ferriere, Grübener, Navarro, and Vardishvili (2023b)

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

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+ “Based on **no-recession** income”: $\tilde{y}(x, \eta, \beta)$

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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 $t = 0$

Three Fiscal Stabilization Packages

UI Package

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 - A check to **all** unemployed households, phase out with persistence ρ_ω

Three Fiscal Stabilization Packages

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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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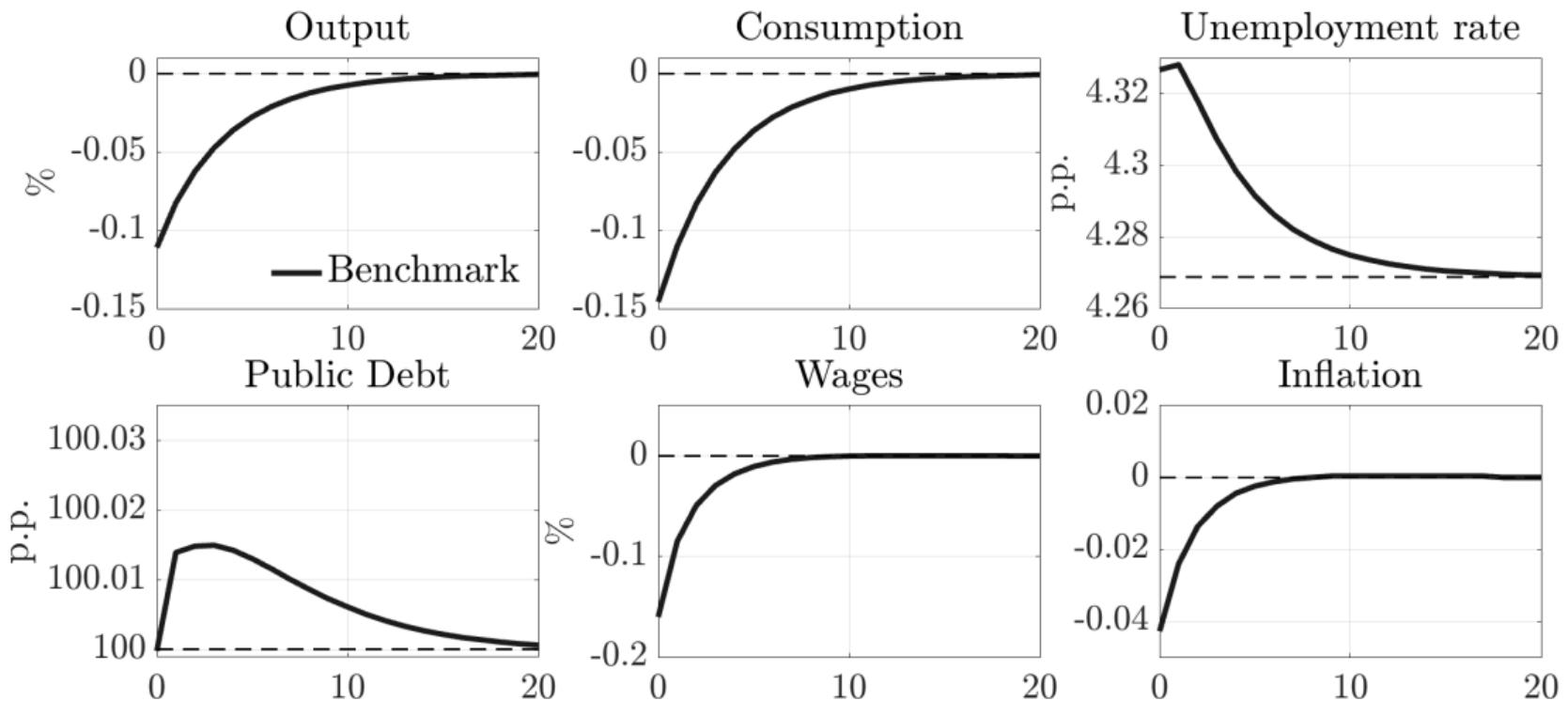
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■ A Tax Credit (TC) Package

- A check to **working low-income** households
 - + **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 $\chi = 6$

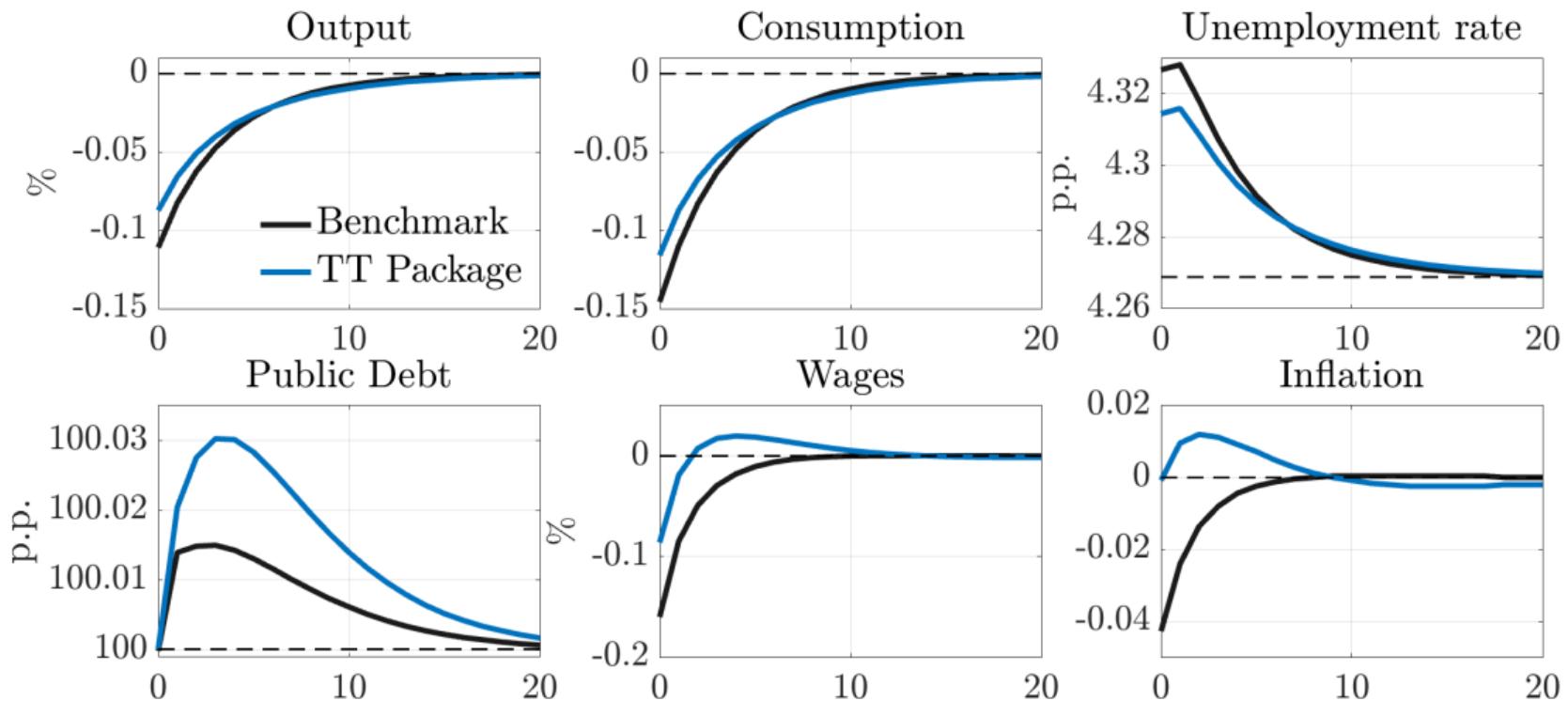
Three Fiscal Stabilization Packages

Impulse Response Functions



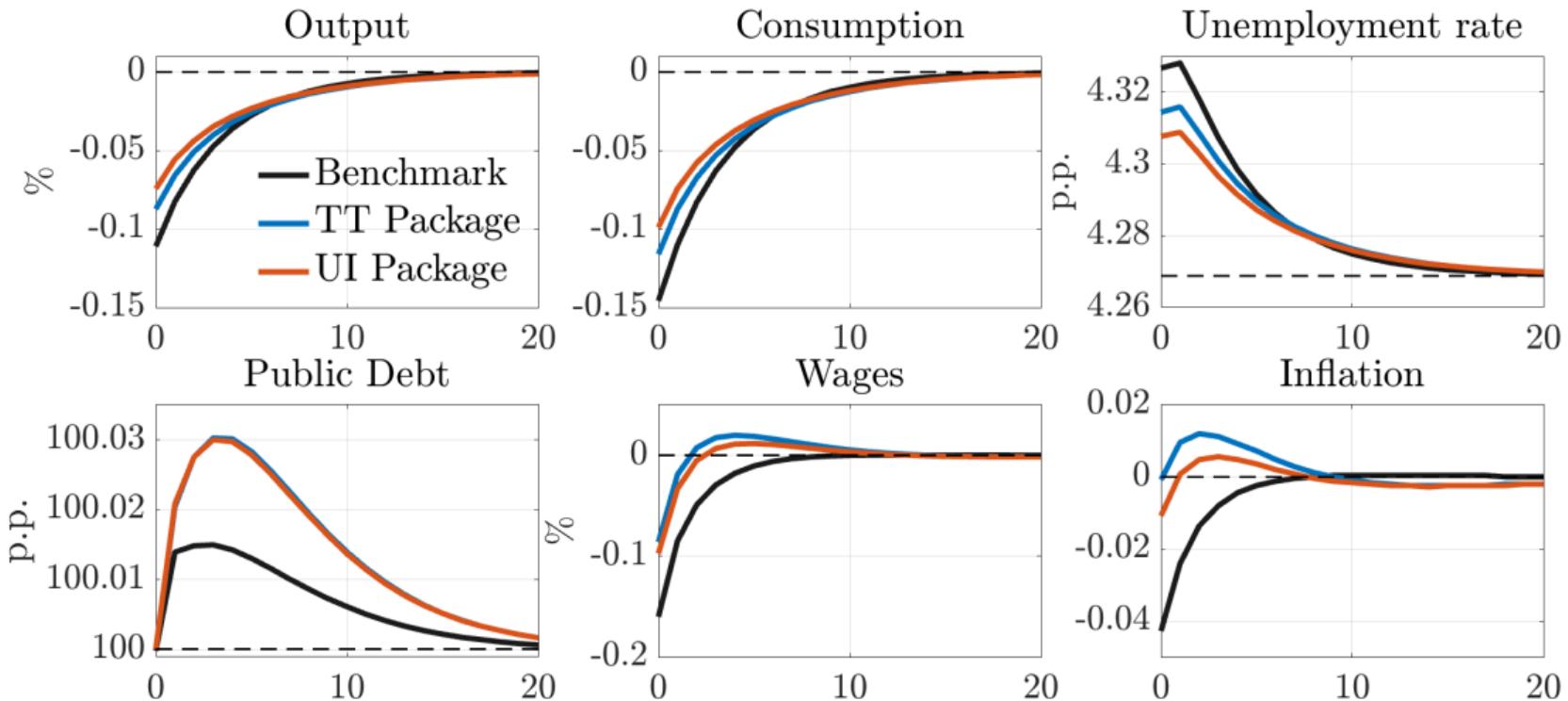
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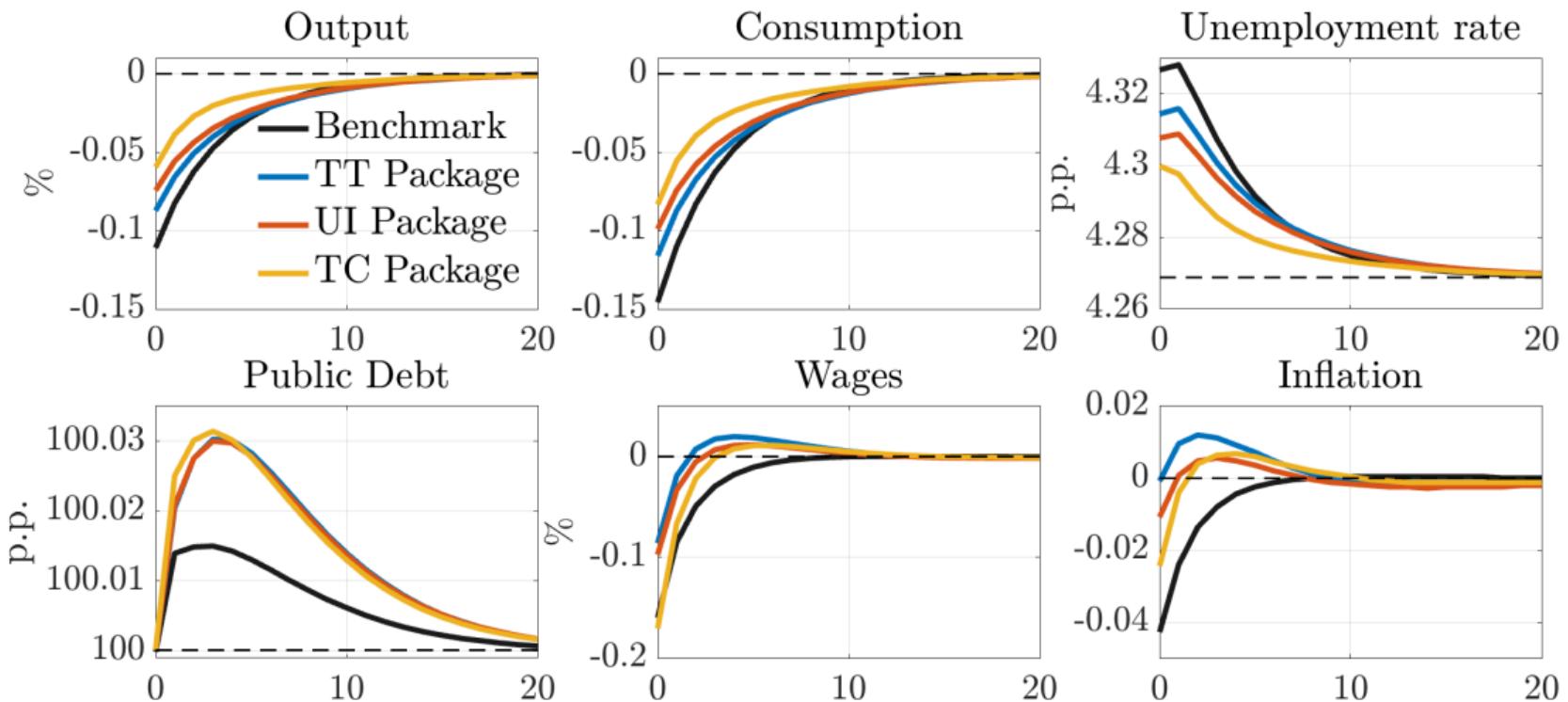
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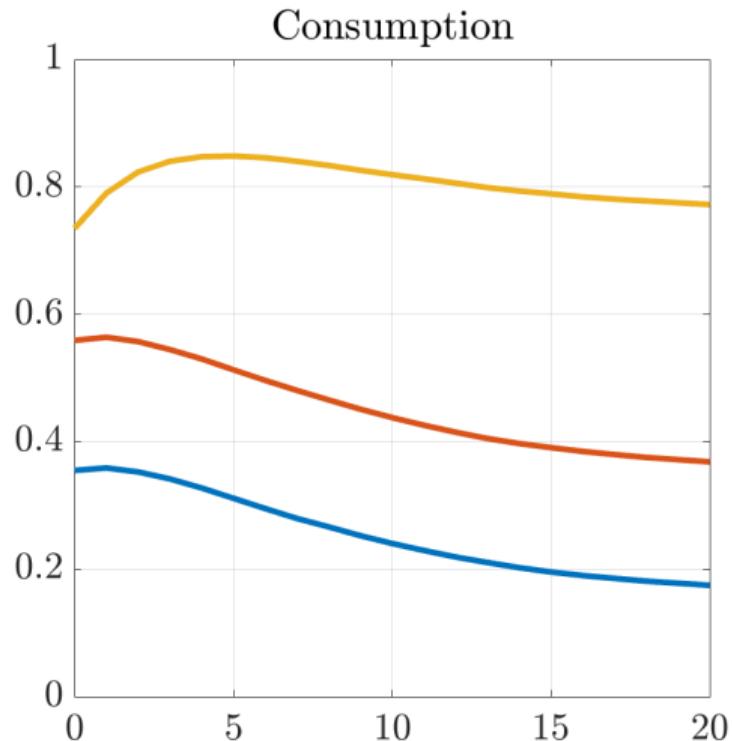
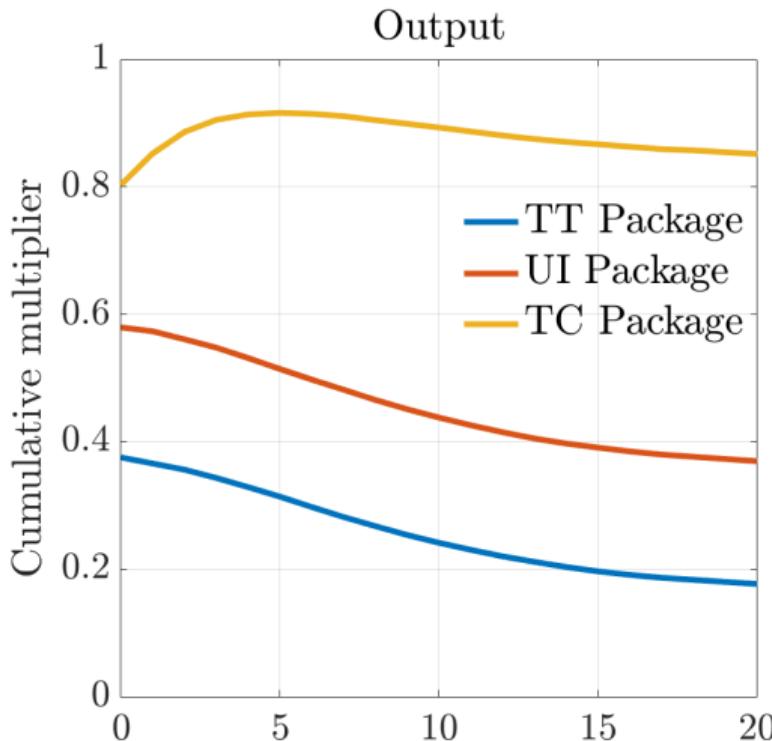
Three Fiscal Stabilization Packages

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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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