Optimal Income Redistribution

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Motivation

- Two major elements of the modern welfare state:
  - Income tax-and-transfer system
  - Pay-as-you-go pension system

- Considerable heterogeneity across countries:
  - US: moderately progressive income tax system, not generous and strongly progressive pension system
  - Europe: progressive income tax system and generous, fairly linear pension system

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- Two major elements of the modern welfare state:
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  - Pay-as-you-go pension system
- Considerable heterogeneity across countries:
  - US: moderately progressive income tax system, not generous and strongly progressive pension system
  - Europe: progressive income tax system and generous, fairly linear pension system
- Should both systems operate in tandem to achieve the desired levels of redistribution and insurance?
- Or would it be more efficient to streamline Social Security, as in many European countries?
- What can rationalize these differences? (future research)

What do we do?

- Set-up a state-of-the-art life-cycle model with realistic pension and tax-transfer systems.

- Compute the optimal com bination of the pension system (in terms generosity and progressivity) and income tax progressivity under different welfare criteria.

- Key trade-offs:
  - Pension progressivity distorts labor supply (and hence human capital accumulation) of the high productivity agents more.
  - Pension generosity reduces labor supply distortions but financed by distortionary payroll taxes.
  - Both distort life-cycle savings and retirement decisions.
  - Redistribution within generations through progressivity (of pensions and taxes).
  - Redistribution across current and future generations comes through the time path of distortions.
  - Intergenerational links, welfare objectives, and transitions are key.

Literature

1. Optimal Pension Generosity and Progressivity Nishiyama and Smetters (2007 JPE), Huggett and Parra (2010 JPE), Fehr, Kallweit & Kindermann (2013 JEEA), Brendler (2022 RED), Nam (2023)
2. Optimal Income Tax Progressivity Heathcote, Storesletten & Violante (2017 QJE), Conesa and Krueger (2007, JME), Conesa, Kitao, & Krueger (2009, AER), Guner, Kaygusuz & Ventura (2023 ECMA), Carroll, Luduvice & Young (2023), MacNamara & Rossi (2023)

- **We find significant welfare gains from joint reforms, however results and to the welfare objective.**
- Some recent work on the joint income tax and pension systems:
  Ludwig et al. (2023) → aging & solvency; Brendler (2023 JME) → inverse-optimum approach;
  Makarski et al (2023) → complementing pension privatization with a tax reform;
  Kindermann and Puschel (2023) → design pension progressivity like EITC
  Tran and Zakariya (2023) → Pension progressivity through means testing

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- Pension generosity and progressivity are substitutes with income tax progressivity:
  - Providing less insurance through the pension system requires more insurance through the income tax system.
  - Intergenerational preferences determine the balance between overall insurance vs. distortions.

$\rightarrow$ For any intergenerational preferences, we find joint reforms that make all current and future cohorts, on average, better off.

Model

Overview

- Overlapping generations with agents live up to max. age J but may die earlier ($\psi_j^{z,v}$ – education-, type- and age-specific survival rates).
- Agents enter at age $j=1$ with permanent component of productivity v, no assets (a_0=0), and with an education level $z \in \{H, L\}$.
- Each education level comes with initial skill $h_{1,z}$ and (permanent) learning ability θ_z
- Agents accumulate skills through learning-by-doing (l – hours worked):

$$h_{j+1,z} = (1-\delta^h) \cdot h_{j,z} + \theta_z \cdot (h_{j,z} \cdot l)^{\gamma^h}$$

- Retirement is endogenous with penalty for retiring early.
- Agents leave bequests due "joy of giving" preferences.

Worker's budget

- Pre-tax earnings ($w_{z,t}$ – skill price, v – fixed effect, y_j – idios. shock):

$$e = w_{z,t} \cdot h_{j,z} \cdot v \cdot y_j \cdot l$$

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- Budget constraint ($\lambda_{I,t}$ – income tax policy):

$$a' + (1+\tau_c)c = (1+r_t)a + e - \underbrace{\tau_{SS,t} \times \min(cap, e)}_{\text{Soc. Sec. taxes}} - \underbrace{\Psi_t(\iota; \lambda_{I,t})}_{\text{income taxes}}$$

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- Taxable income: $\iota = r_t a + e - 0.5 \underbrace{\tau_{SS,t} \times \min(cap, e)}_{\text{Soc.Sec. deduction}}$

Retiree's budget

- Budget constraint ($\lambda_{\mathbf{SS,t}}$ – Social Security policy):

$$a' + (1+\tau_c)c = (1+r_t)a + \underbrace{b(\bar{b}_t(\bar{e};\lambda_{\mathbf{SS,t}}), j^R)}_{\text{pension net of penalty}} - \underbrace{\max\{0, \Psi_t(\iota;\lambda_{I,t})\}}_{\text{income taxes}}$$

$\bar{b}_t$ – normal pension benefit, j^R – retirement age, $\bar{e}$ – average lifetime earnings

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$\bar{b}_t$ – normal pension benefit, j^R – retirement age, $\bar{e}$ – average lifetime earnings

- Taxable income:

$$\iota = \underbrace{r_t a}_{\text{asset income}} + \underbrace{b}_{\text{pension}}$$

Household's problem

- Individual state space: $\boldsymbol{x} = (j, v, z, y, h, \bar{e}, a, j^R)$

  j – age, v – fixed effect, z – education, y – idios. shock,
  h – human capital, a – assets, j^R – retirement age,
  $\bar{e}_{j+1} = \left[(j-1)\bar{e}_j + \min(e_j, cap)\right]/j$ – average lifetime earnings

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- Worker's problem (no decision to retire):

$$V_t(\boldsymbol{x}) = \max_{\substack{c,a' \geq 0,\\ l \in [0,1]}} \Big\{ u(c, 1-l) + \beta \psi_j^{z,v} \mathbb{E}_{y'|y} \Big[\Gamma_{j+1,t+1}^{z,v} \int V_{t+1}(\boldsymbol{x}'_b) \Phi_{t+1}^{z,v}(b) db + (1 - \Gamma_{j+1,t+1}^{z,v}) V_{t+1}(\boldsymbol{x}') \Big] + (1 - \psi_j^{z,v}) q(a') \Big\}.$$

$\Gamma_{j+1,t+1}^{z,v}$: age and type dependent probability of receiving bequests; $\Phi_{t+1}^{z,v}(b)$: the distribution bequests left to type (z, v) $\Rightarrow$ Intergenerational links of types.

Government: Social Security

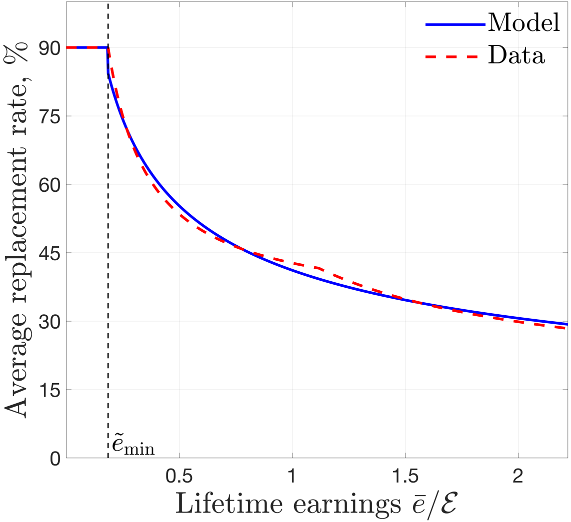
- Normal pension $\bar{b}_t$ is determined by replacement rate schedule: $\bar{b}_t = R_t(\bar{e}; \lambda_{\mathbf{SS,t}}) \cdot \bar{e}$
- Empirical schedule is approximated using:

$$R_t(\bar{e}; \lambda_{\mathbf{SS,t}}) = \begin{cases} \bar{\lambda}_{SS,t} \times \tilde{e}^{\,1-\lambda_{SS,t}} & \text{if } \tilde{e} \geq \tilde{e}_{\min} \\ \\ \bar{\lambda}_{SS,t} \times \tilde{e}_{\text{min}}^{1-\lambda_{SS,t}} & \text{otherwise} \end{cases}$$

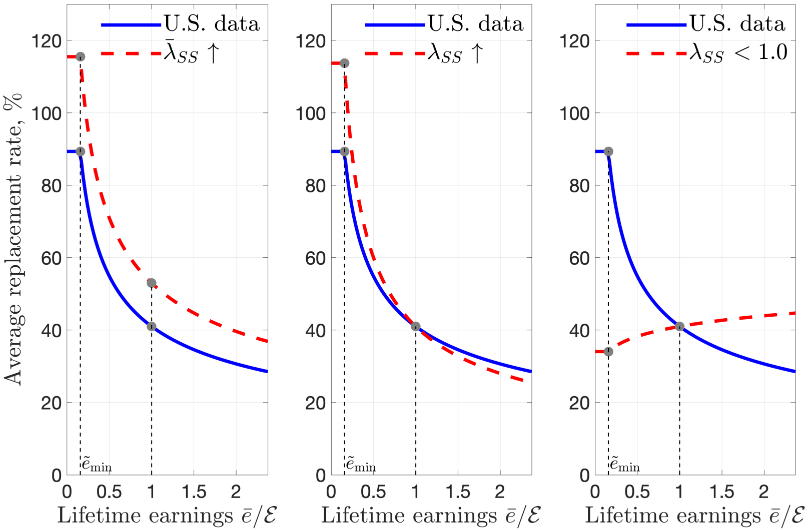
$\bar{\lambda}_{SS,t}$ – level (generosity), $\lambda_{SS,t}$ – curvature (progressivity), $\tilde{e} = \bar{e}/\mathcal{E}_{t-j+j^R}$ with $\mathcal{E}_{t-j+j^R}$ – economy-wide average lifetime earnings at retirement

- Penalty: $b(\bar{b}, j^R) = (1 - \delta^p) \cdot \bar{b} + \left(\frac{j^R - J^E}{J^R - J^E}\right) \cdot \delta^p \cdot \bar{b}$
- Given $(\bar{\lambda}_{SS,t}, \lambda_{SS,t})$, Social Security tax $\tau_{SS,t}$ adjusts each period to balance pay-as-you-go budget

Statutory replacement rate schedule



Government: Social Security



Government: Income taxation

- Net tax liability (HSV function):

$$\Psi_t(\iota; \bar{\lambda}_{I,t}, \lambda_{I,t}) = \iota - \mathcal{I}_t \cdot (1 - \bar{\lambda}_{I,t}) \cdot (\iota/\mathcal{I}_t)^{1-\lambda_{I,t}}$$

$\bar{\lambda}_{I,t}$ – income tax level, $\lambda_{I,t}$ – income tax progressivity, $\mathcal{I}_t$ – aggregate taxable income

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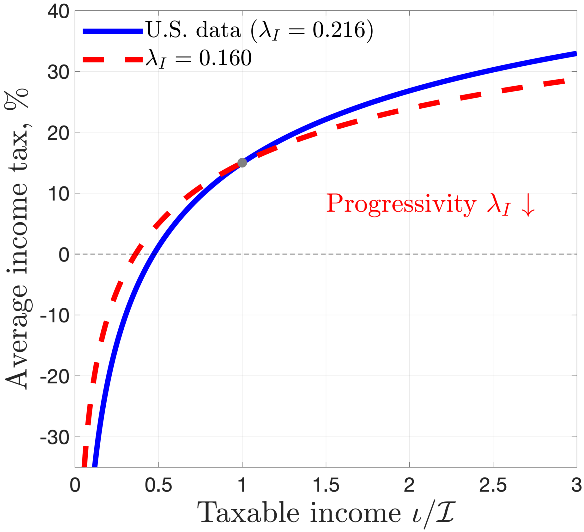
- Income tax program runs a separate budget

- Given $\lambda_{I,t}$, income tax level $\bar{\lambda}_{I,t}$ balances the general government budget:

$$\text{Income taxes} + \text{Consumption taxes} + \text{Debt issuance}$$
$$= \text{Wasted spending} + \text{Debt service}$$

Government: Income taxation



Firms and Equilibrium

- Standard production function allowing imperfect substitutability between skilled and unskilled workers

$$Y_t = ZK_t^{\varpi}\left[\left(N_{L,t}^{\rho} + N_{H,t}^{\rho}\right)^{\frac{1}{\rho}}\right]^{1-\varpi}$$

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- General Equilibrium
  - Labor markets and capital market clear.
  - Budget constraints for Social Security and general government clear.
  - Bequest distributions are internally consistent.
  - Any change in the tax system will trigger a transitional dynamics for the interest rate, wages, the average income tax rates and social security contribution rates.
  - They are key for welfare evaluations.

Calibration and Model Fit

Calibration

- We calibrate the model to the recent US data
- Agents enter the model at age 25
- Tax parameters are set to approximate current US income tax and social security system
- Earnings process is calibrated inside the model to match earnings and income distribution
- Learning by-doing technology is calibrated inside the model to match life-cycle profiles of hourly wages
- "Joy of giving"parameters are set to match the distribution of bequests.

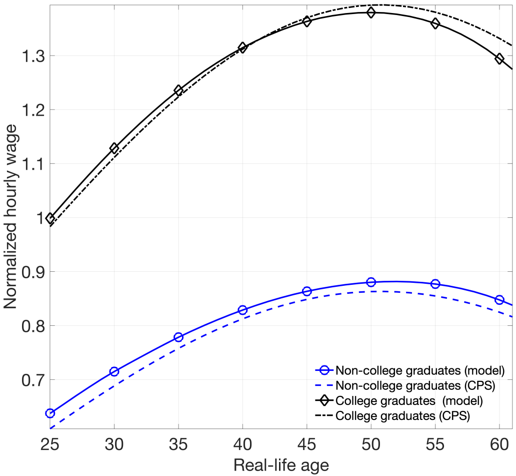
Externally calibrated parameters

Parameter	Description	Value
Demographics and preferences		
(J, J^E, J^R)	Maximum age, early and normal retirement age	$(76, 38, 42)$
$\{\psi_j^{z,v}\}$	Education and income specific age profile of survival probabilities	Appendix
n	Population growth rate, %	1.3
σ	Coefficient of relative risk aversion	2.0
Labor productivity		
γ^h	Elasticity of human capital production	0.7
$(\rho_y, \sigma_\epsilon^2)$	Persistence and variance of AR(1) shock	$(0.979, 0.015)$
(π_z, π_v)	Inter-generational transmission of labor productivity	See text
Production		
(ϖ, δ)	Capital share and capital depreciation, %	$(46.0, 6.0)$
ρ	Elasticity of substitution is $1/(1-\rho)$	0.285
Government policies		
λ_I	Income tax progressivity	0.216
λ_{SS}	Pension system progressivity	1.420
τ_c	Consumption tax, %	4.1
(dy, gy)	Debt-to-GDP and wasted spending-to-GDP ratio, %	$(100.0, 7.8)$

Internally calibrated parameters

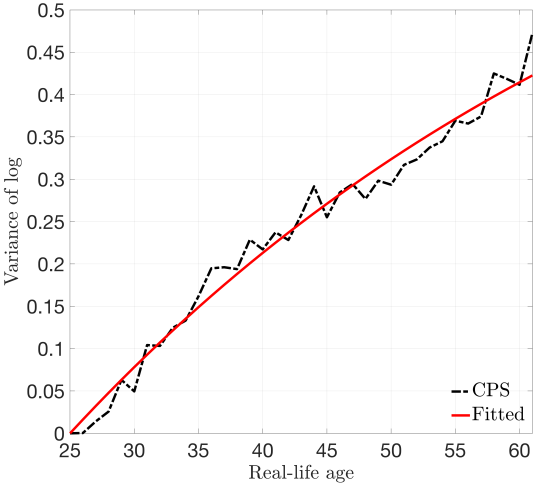
Parameter	Description and target	Value
Preferences		
β	Discount factor (Capital/GDP $= 3.0$)	0.99
γ	Weight on consumption (average hours $= 0.40$)	0.318
(ϕ_1, ϕ_2, η)	"Joy of giving"' (Bequest distribution)	$(8.0, 4.0, 2.3)$
Labor productivity		
$(h_{1,H}, h_{1,L})$	Initial skill levels (hourly wage profiles)	$(1.59, 0.45)$
δ^h	Skill depreciation, % (hourly wage profiles)	5.9
σ_v^2	Var. of fixed effect (Gini for pre-gov. earnings = 0.40)	0.021
Production		
Z	TFP (average wage = 1.0)	0.263
Government policies		
$\bar{\lambda}_{SS}$	Replacement rate level ($\tau_{SS} = 10.6\%$)	0.413
$\tilde{e}_{\min}$	Lowest bend point	0.05
cap	Max. taxable earnings (taxable earnings > cap = 8%)	1.11
δ^p	Penalty for early retirement (retired at age 62 = 26%)	0.167 Details

Model fit: Life-cycle wage profiles



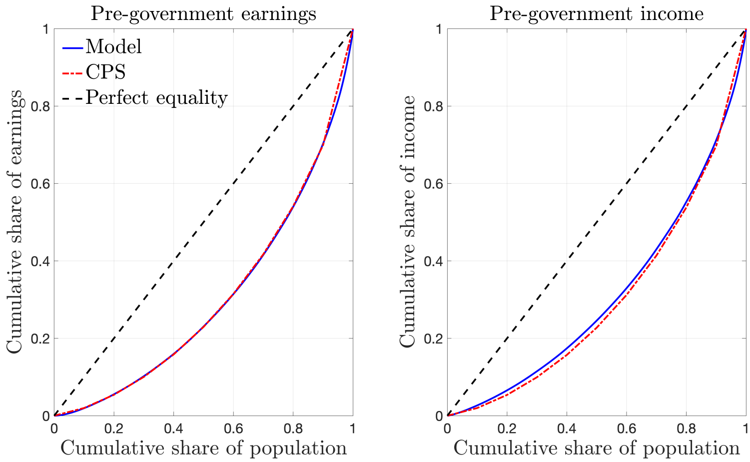
- Human capital accumulation in the model achieves a good fit of age-earnings profiles

Model fit: Residual variation in earnings



- Idios. shocks match well the increase of earnings heterogeneity over the life-cycle

Model fit: Inequality (Lorenz curves)



- Model achieves a good fit of pre-government earnings and income distributions
- We calibrate altruism (ϕ_1, ϕ_2, η) to match the distribution of bequests ▸ Bequest distribution

Quantitative Experiments

Quantitative experiments

- Unanticipated, permanent, an potentially joint social security and income tax reforms:
  - New pension system is only applied to agents that are currently working
  - New pension system is phased in linearly during forty years. $\Rightarrow$ Only a new labor market entrant takes full advantage.
  - New income tax system applies to everyone immediately
  - Average income tax rate adjusts every period to satisfy the government budget
  - Payroll taxes adjust every period to make sure the Social Security budget is satisfied
- We compute the full transition to the new steady state for all reforms

Social Welfare Function

- The initial (calibrated) policy is $\mathbf{\Lambda}^0$
- At time t, government chooses constant future policy $\mathbf{\Lambda}^\star = (\bar{\lambda}_{SS}, \lambda_{SS}, \lambda_I)$ given by:

$$\mathbf{\Lambda}^\star = \arg\max_{\mathbf{\Lambda}} W(\mathbf{\Lambda}^0, \mathbf{\Lambda})$$

- Two Social Welfare Functions:
  - Current Cohorts:

$$CG : W = \underbrace{\sum_j \int V_t(\boldsymbol{x}; \mathbf{\Lambda}^0, \mathbf{\Lambda}) dF_{t,j}}_{\text{welfare of current generations}}$$

  - Newborn in a Final Steady State

$$FG : W = \underbrace{\int V_\infty(\boldsymbol{x^{nb}}; \mathbf{\Lambda}^0, \mathbf{\Lambda}) dF_{\infty,j=1}}_{\text{welfare of long run newborn}}$$

Constraints

- Given the initial conditions, the new policy triggers a new equilibrium (transition to a new steady state).
- The government may face some "Pareto Constraints" when setting the policies:
  - No current cohort is worse off:

$$\int V_t(\boldsymbol{x}; \boldsymbol{\Lambda}^0, \boldsymbol{\Lambda}) dF_{t,j} \geq \int V_t(\boldsymbol{x}; \boldsymbol{\Lambda}^0, \boldsymbol{\Lambda^0}) dF_{t,j} \ \forall j$$

  - No future cohort is worse off:

$$\int V_t(\boldsymbol{x^{nb}}; \boldsymbol{\Lambda}^0, \boldsymbol{\Lambda}) dF_{t,j=1} \geq \int V_t(\boldsymbol{x^{nb}}; \boldsymbol{\Lambda}^0, \boldsymbol{\Lambda^0}) dF_{t,j=1} \ \forall t > 1$$

Findings

Optimal policy

	Joint policy			CEV, %	
	$\bar{\lambda}_{SS}$	λ_{SS}	λ_I	Alive	Future
Status Quo	0.413	1.420	0.216	–	–

Optimal policy

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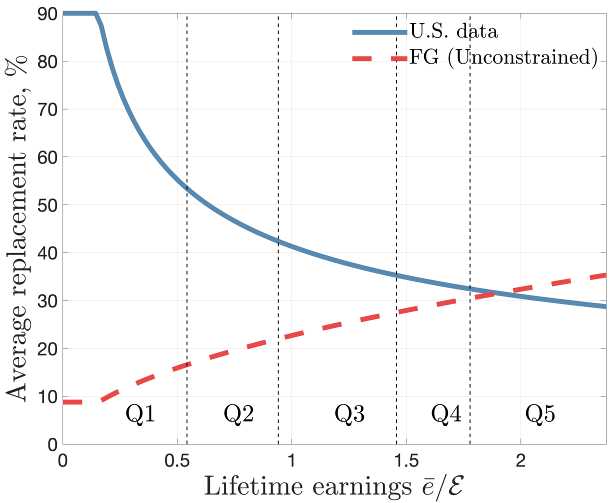
Status Quo	0.413	1.420	0.216	–	–
Objective: Long Run Welfare (**FG**)					
– Unconstrained	0.227	0.488	0.221	-3.519	2.314

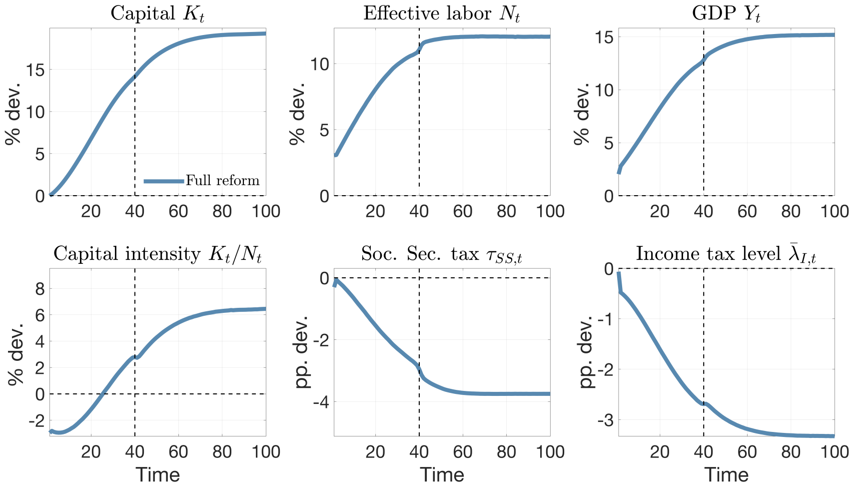
- Redistribution/Insurance has declined (slightly increased) through the pension system (tax system).
- Welfare gains are much higher than those that can be achieved by income tax reforms.

Average replacement rates



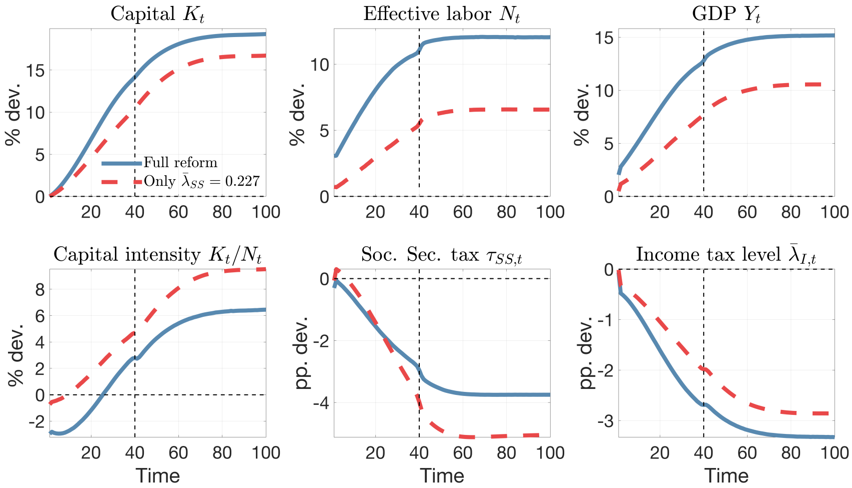
- Not generous and regressive pension system

Aggregate variables and prices



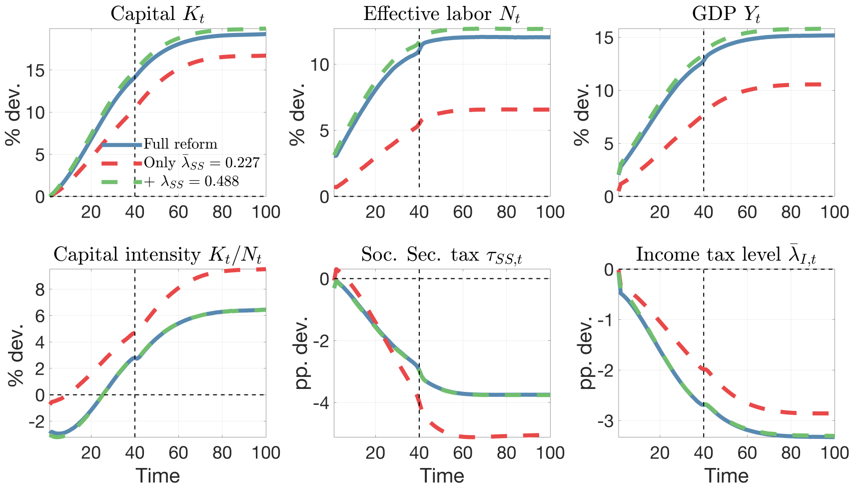
- Reform reduces distortions and hence increases output/consumption in the long run.

Aggregate variables and prices



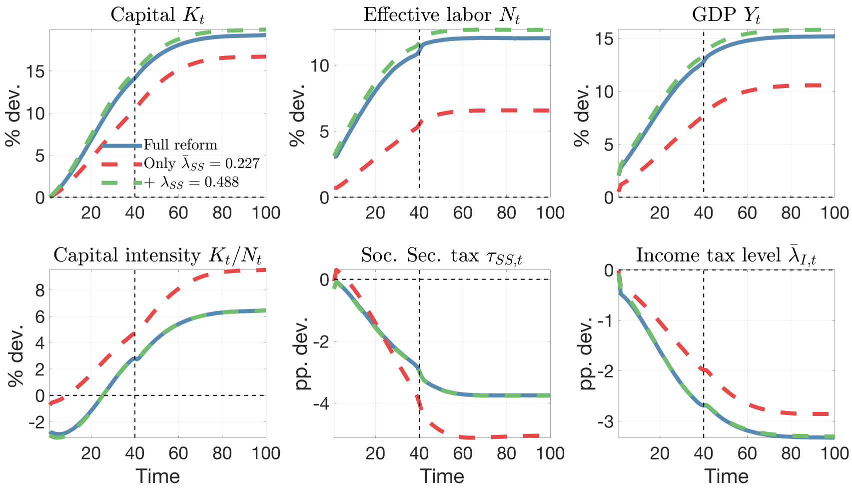
- Reduced level of pensions lowers distortions on savings and on labor supply.

Aggregate variables and prices



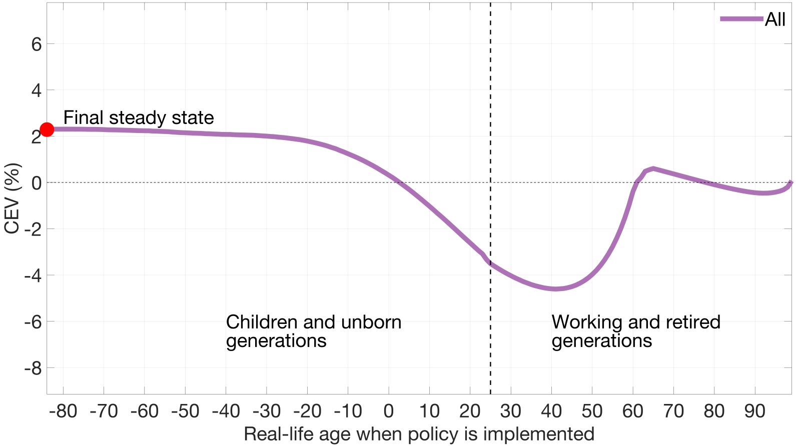
- Regressive pension system boosts labor supply further.

Aggregate variables and prices



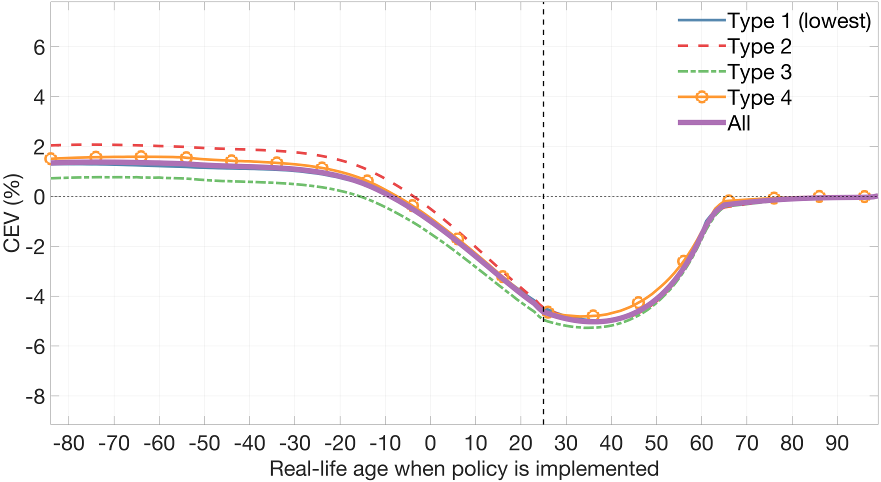
- Less redistribution through the pension system requires slightly more redistribution through the income tax system.

Welfare effects by cohort (CEV, %)

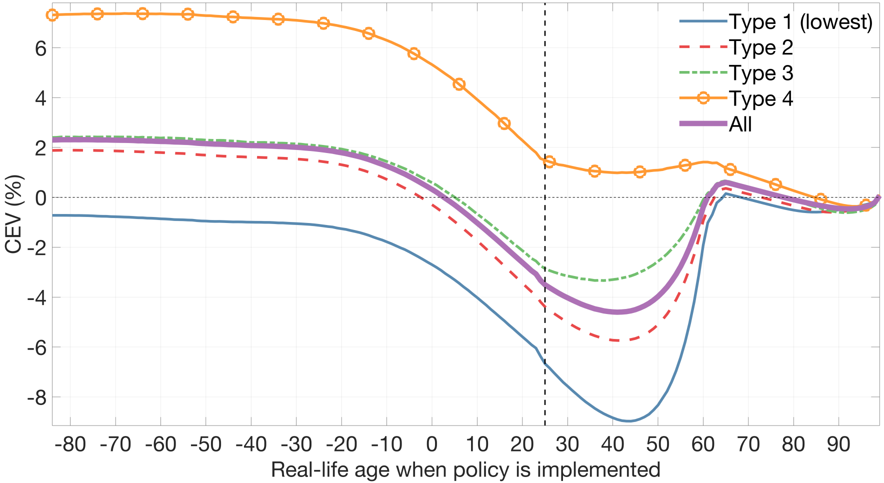


- Reform benefits future cohorts at the welfare cost of current generations

Only pension generosity $\bar{\lambda}_{SS} = 0.227$



Full reform



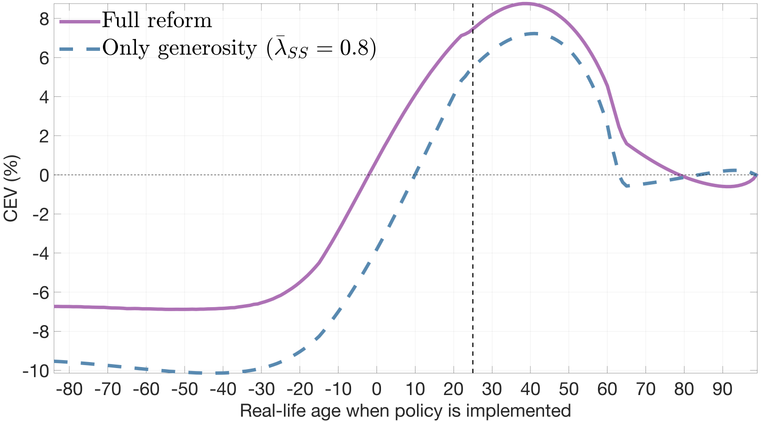
Type 1 (lowest)
Type 2
Type 3
Type 4
All
CEV (%)
6
4
2
0
-2
-4
-6
-8
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Real-life age when policy is implemented

Optimal policy

	Joint policy			CEV, %	
	$\bar{\lambda}_{SS}$	λ_{SS}	λ_I	Alive	Future
Status Quo	0.413	1.420	0.216	–	–
Objective: Long Run Welfare (**FG**)					
– Unconstrained	0.227	0.488	0.221	-3.519	2.314
Objective: Current Generations (**CG**)					
– Unconstrained	**0.800**	0.40	0.184	7.426	-6.730

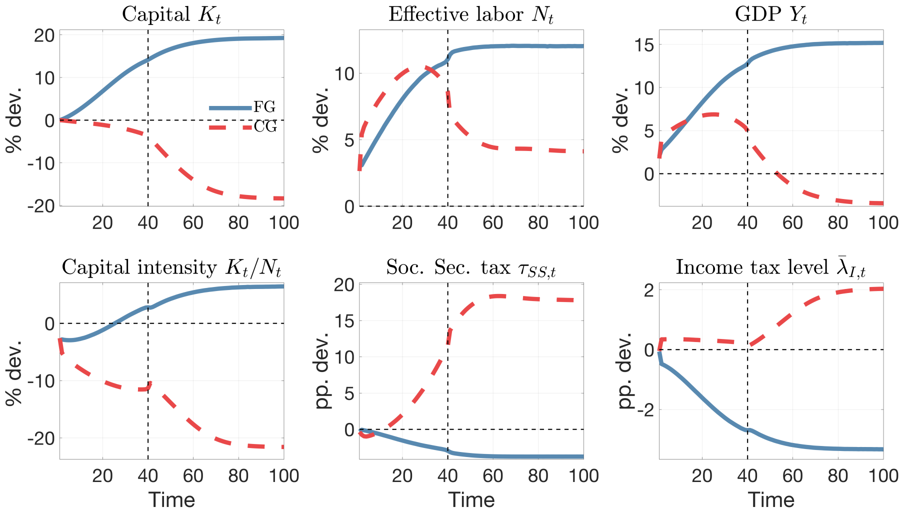
- Pension generosity Doubles.

Inter-generational redistribution



- Pension generosity $\bar{\lambda}_{SS}$ achieves most welfare gains for alive cohorts .

Aggregate variables and prices



- Current generations transfer resources from the (distant) future.

Optimal policy

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	$\bar{\lambda}_{SS}$	λ_{SS}	λ_I	Alive	Future
Status Quo	0.413	1.420	0.216	–	–
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Objective: Current Generations (**CG**)					
– Unconstrained	0.800	0.40	0.184	**7.426**	**-6.730**

- Is it feasible to design reform that maximizes the welfare of alive and does not make **any** cohort, on average, worse off?

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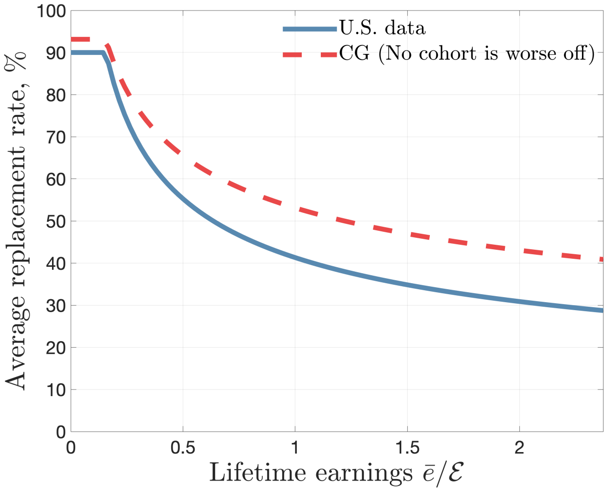
Objective: Long Run Welfare (**FG**)					
– Unconstrained	**0.227**	0.488	0.221	-3.519	2.314
Objective: Current Generations (**CG**)					
– Unconstrained	0.800	0.40	0.184	7.426	-6.730
– No cohort is worse off	**0.531**	**1.303**	**0.140**	2.558	0.106

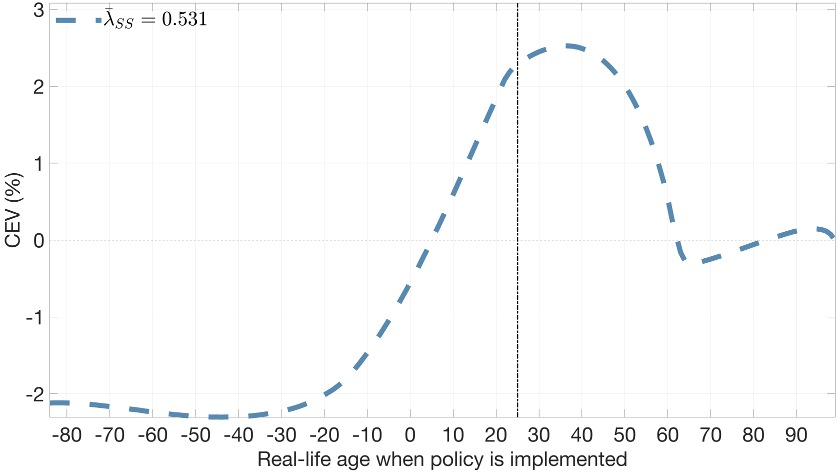
- Is it feasible to design reform that maximizes the welfare of alive and does not make **any** cohort, on average, worse off? **YES**

Average replacement rates



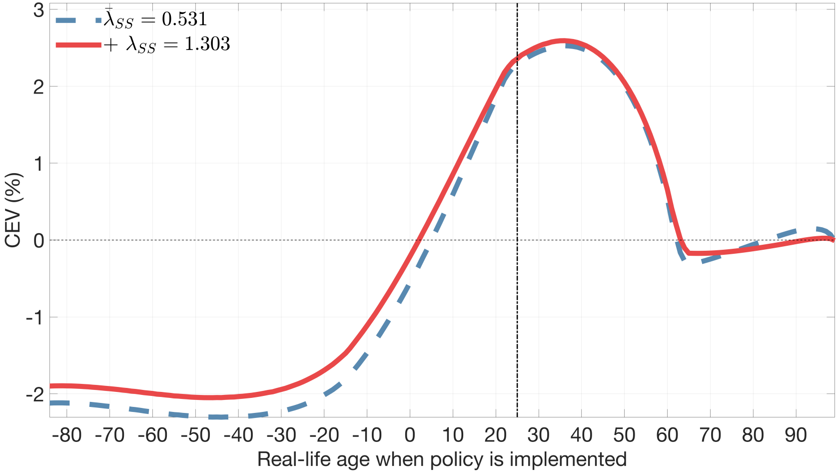
- Slightly more generous and less progressive pension system

Welfare effects: Decomposition



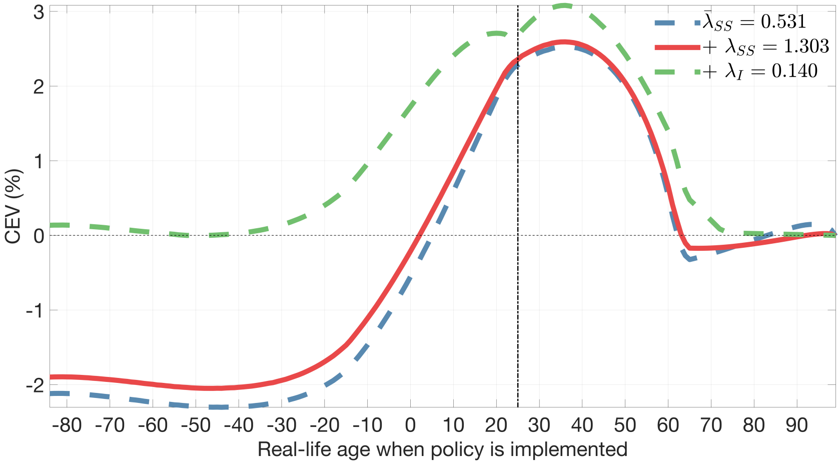
- Generosity is distortionary and cannot achieve Pareto-improvement across all cohorts

Welfare effects: Decomposition



- Less progressive pension system boosts economy in the long run

Welfare effects: Decomposition



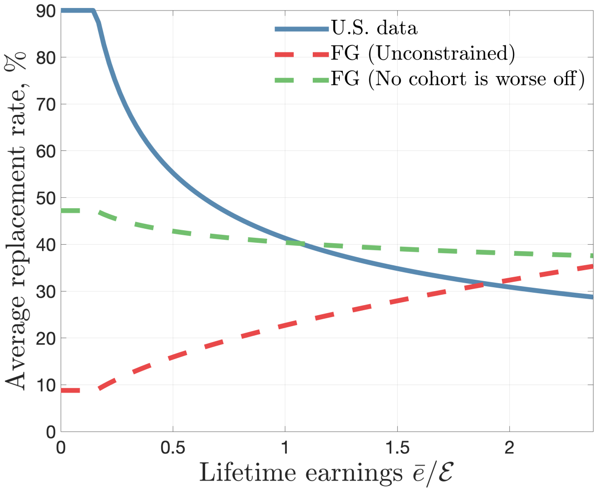
- Providing more insurance/redistribution through the pension system allows to provide less insurance/redistribution in the income tax system

Optimal policy

	Joint policy			CEV, %	
	$\bar{\lambda}_{SS}$	λ_{SS}	λ_I	Alive	Future
Status Quo	0.413	1.420	0.216	–	–
Objective: Long Run Welfare (**FG**)					
– Unconstrained	0.227	0.488	0.221	-3.519	2.314
– **No cohort is worse off**	0.404	1.084	0.169	0.203	1.111
Objective: Current Generations (**CG**)					
– Unconstrained	0.800	0.40	0.184	7.426	-6.730
– **No cohort is worse off**	0.531	1.303	0.140	2.558	0.106

- There exist reforms of the pension system that make all current and future cohorts, on average, better off (regardless of the SWF)

Average replacement rates



- Reducing distortion through all channels brings all current cohorts on board.

Optimal joint policy

	Joint policy			CEV, %	
	$\bar{\lambda}_{SS}$	λ_{SS}	λ_I	Alive	Future
Status Quo	0.413	1.420	0.216	–	–
Objective: Long Run Welfare (**FG**)					
– Unconstrained	0.227	0.488	0.221	-3.519	2.314
– No cohort is worse off	0.404	1.084	0.169	0.203	1.111
– No Type 1 is worse off	0.285	2.100	0.159	-2.285	1.362
– No current type is worse off	0.448	1.535	0.185	0.887	0.272
Objective: Current Generations (**CG**)					
– Unconstrained	0.800	0.400	0.184	7.426	-6.730
– No cohort is worse off	0.531	1.303	0.140	2.558	0.106
– No Type 1 is worse off	0.603	2.026	0.175	3.156	-3.839
– No future type is worse off	0.427	1.643	0.181	0.442	0.426

Takeaways

- Unconstrained reforms make extreme changes in generosity, causing large intergenerational redistribution; distortions reduce by lowering pension progressivity.
- When redistribution across generations is limited, the direction of pension system redesign is the same, but less redistribution through the tax system is needed.
- When redistribution “in the wrong direction” needs to be avoided, pension progressivity becomes the desirable instrument.
- When both intergenerational and cross-sectional redistribution is limited, pension progressivity increases, compensated by a significant decline in tax progressivity.
- In all cases, the joint redesign of the pension and the tax system brings much larger welfare gains than only reoptimising the tax system.

Political support

Reform	Support, %
Objective: Long Run Welfare (**FG**)	
– Unconstrained	34.3
– No cohort is worse off	57.5
– No Type 1 is worse off	21.4
– No future type is worse off	16.4
– No current type is worse off	82.9
Objective: Current Generations (**CG**)	
– Unconstrained	81.5
– No cohort is worse off	73.4
– No Type 1 is worse off	62.2
– No future type is worse off	73.3
– No current type is worse off	88.2

Optimal pension redesign

	Pension redesign			CEV, %	
	$\bar{\lambda}_{SS}$	λ_{SS}	λ_I	Alive	Future
Status Quo	0.413	1.420	0.216	–	–
Objective: Long Run Welfare (**FG**)					
– Unconstrained	0.210	0.499	0.216	-4.049	2.250
– No cohort is worse off	0.405	0.492	0.216	0.455	0.523
– No Type 1 is worse off	0.263	2.300	0.216	-3.519	-0.740
– No future type is worse off	0.232	1.029	0.216	-3.895	1.869
– No current type is worse off	0.485	1.408	0.216	1.309	-1.159
Objective: Current Generations (**CG**)					
– Unconstrained	0.800	0.400	0.216	7.293	-7.551
– No cohort is worse off	0.435	0.423	0.216	1.101	0.059
– No Type 1 is worse off	0.571	1.863	0.216	2.189	-4.960
– No future type is worse off	0.416	1.419	0.216	0.052	0.062
– No current type is worse off	0.800	0.400	0.216	7.293	-7.551

Conclusions

- The optimal joint pension and tax policy critically depends on the social welfare criterion.
- When both intergenerational and within generation redistribution is limited, the optimal policy increases pension progressivity and reduces income tax progressivity.
- The welfare gains from only adjusting the tax or the pension system are significantly smaller compared to the joint design.

Next Steps

- Examine how particular elements of the tax/pension system (cap, tax credit for SS contributions, taxation of pensions, early retirement) affect our optimal policies.
- Analyse more where the distortions are coming from: labor supply/human capital vs. life-cycle savings and how they interact with redistribution needs.
- Is there a chance for a fully Pareto optimal reform?
- Why pension progressivity is more distortionary than income tax progressivity?

Optimal Income Redistribution

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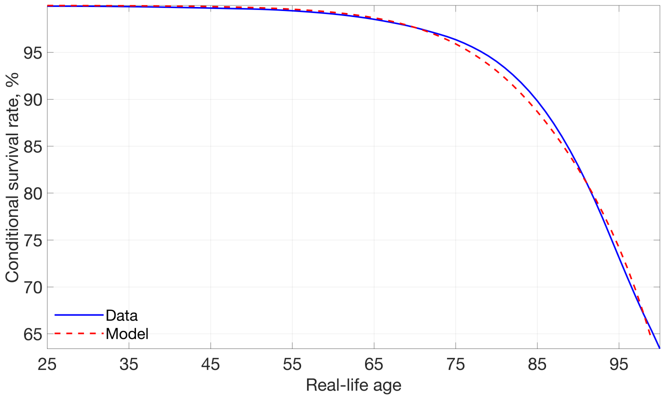
HANK Prague, May 17, 2024

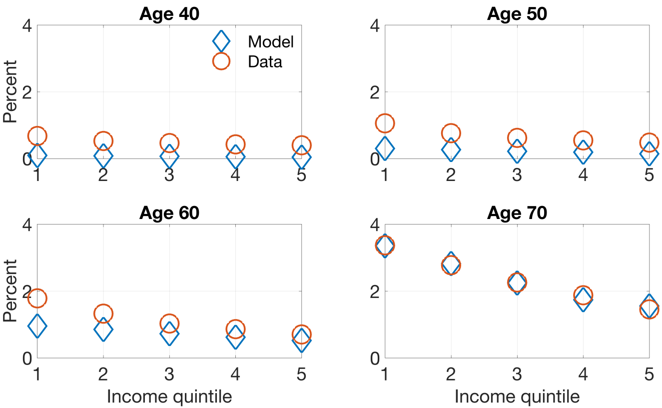
Appendix

Survival probability rates



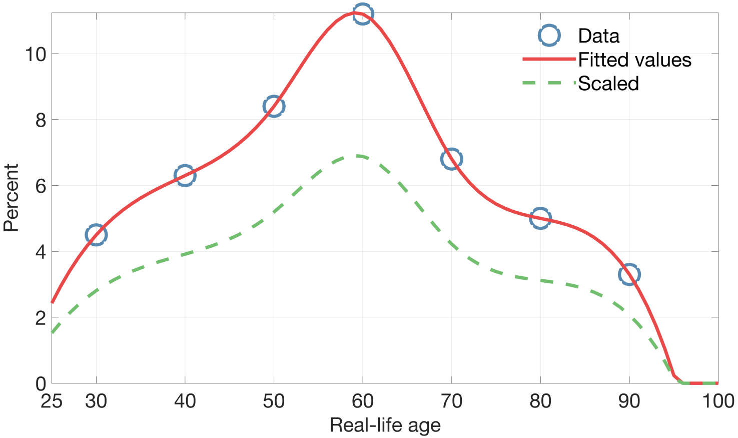
Conditional survival probability rates in the model and data ▸ Back

Mortality rates



Conditional mortality rates by income in the model and data ▸ Back

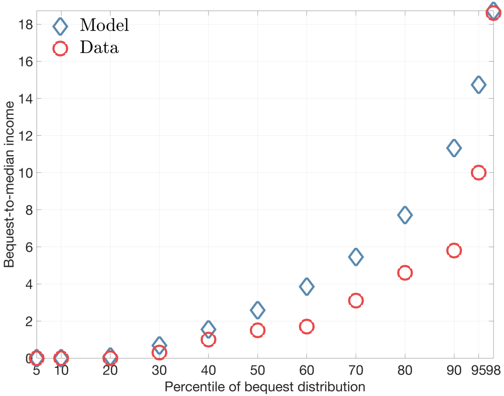
Bequest distribution



Age profile of probabilities to receive a bequest in the model and data ▸ Back

Notes: Empirical data comes from SCF (2001–2019).

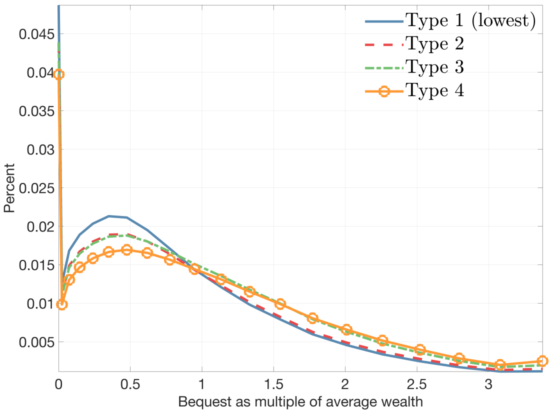
Bequest distribution



Bequest distribution in the model and data ▸ Back

Notes: Bequests are normalized by the economy-wide median pre-government income. Empirical data comes from Hurd and Smith (2001).

Bequest distribution



Bequest distribution by type in the model ▸ Back

Notes: Bequests are normalized by the economy-wide average wealth.