Optimal Fiscal Reform with Many Taxes

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Motivation

- Past 50 years $\longrightarrow$ rising income/wealth inequality
- Social insurance vs distortionary taxation
- Equity vs. efficiency trade-off
- Governments have many tax instruments at their disposal
  - Tax bases: consumption, capital income, labor income
  - Tax schedule: flat vs progressive
- Extensive macro literature on optimal taxation and redistribution
  - Mirrlees
  - Ramsey

This Paper

- General equilibrium with stochastic aging, heterogeneous agents, and incomplete markets:
  - uninsurable idiosyncratic labor income and mortality risk
  - exogenous borrowing limits
- Calibrate the model to US and reproduce
  - earnings/wealth inequality (including top tails)
  - social insurance embedded in the current system
- Numerical experiment: permanent fiscal policy reform
  - Allow for many candidate tax combinations
  - Transitional dynamics
  - Distributional and GE effects
  - Welfare and Voting

Preview of Results and Mechanisms

- Main results: optimal fiscal policy is highly redistributive
  - Very high tax rates on labor income, consumption, and capital income
  - Funds an enormous transfer
  - Fine tunes progressivity to reduce burden for poor workers
  - Aggregates tank but very large welfare gains
- Mechanisms and experiments:
  - Driven by large proportion of poor agents (low wealth $\sim$ high MU of consumption)
  - Optimal progressivity highly dependent on available revenues
  - Intergenerational disagreement over capital income tax

Literature Review

- Optimal progressivity: Bakiș et al. (2015), Guner et al. (2016), Heathcoate et al. (2017), Imrohoroğlu et al. (2018), Holter et al. (2019), Kindermann and Krueger (2022)
- Flexible Ramsey problem: Dyrda and Pedroni (2022), Boar and Midrigan (2022), Ferriere et. al (2023), Ackigoz et al. (2023), Guner et al. (2023b), Abraham et al. (2024), Macnamara et al. (2025)
  - Add simultaneous combination of: optimality on menu of taxes, progressivity, richer baseline environment, and voting decisions with pairwise competition
- UBI: Lopez-Daneri (2016), Ferreira et al. (2024), Conesa et al. (2023), Daruich and Fernandez (2023), Guner et al.(2023a), Jaimovich et al. (2022), Rauh and Santos (2022), Luduvice (2024);
  - In direct relation to socially optimal and politically chosen large transfers
- Pareto weights: Chang et. al (2018), Wu (2021), Heathcoate and Tsujiyama (2021)
- Political equilibria in heterogeneous agents economies: Aiyagari and Peled (1995), Krusell et. al (1997), Corbae et. al (2009), Bachmann and Bai (2013), Carroll et. al (2021)
  - Add life-cycle with social security, progressive income taxation, more dispersed earnings process, and very unequal wealth distributions

Model - Demographics, Preferences, and Technology

- Stochastic aging with age $a \in \mathcal{A} \equiv \{W, R\}$: "worker" or "young" (W) and "retiree" or "old" (R)
- Preferences:

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

- Earnings are:

$$y_j(h,\varepsilon) = w \cdot \zeta(j) \cdot \exp(\varepsilon) \cdot h$$

- Markov chain with skill-dependent transition probabilities $\pi_u(\varepsilon, \varepsilon')$ and $\pi_s(\varepsilon, \varepsilon')$
  - Regular states plus two outlier high states - "stepping" and "superstars"
- Neoclassical production sector w/ stand-in competitive firm

Government

- Adopts a tax policy: $p \equiv \{(\tau_y, \nu_y, \tau_k, \tau_c), \Upsilon_t\}_{t=1}^{\infty}$
- Fixed:
  - Capital income tax τ_k, consumption tax τ_c
  - Labor income tax $T_h(y_t) = y_t \cdot \left[1 - (1 - \tau_{y,t})\tilde{y}_t^{-\nu_{y,t}}\right]$
  - Pure govt. spending G, government debt, B
- Endogenous: lump-sum transfers, Υ (budget balanced period by period)

$$G_t + \Upsilon_t + (1 + r_t)B_t = \tau_c C_t + TN_t + \tau_k r_t A_t + B_{t+1}$$

- Social Security ▸ Details

Recursive Household Problem - Workers

- Individual state-space: $x \equiv [k, \varepsilon, j, a] \in X \equiv \{\mathcal{K} \times \mathcal{E} \times \mathcal{J} \times \mathcal{A}\}$
- Worker's recursive problem:

$$V_j^W(k,\varepsilon) = \max_{c,h,k'} u(c,h) + \beta \left[(1-\psi_a) \sum_{\varepsilon' \in \mathcal{E}} \pi_j(\varepsilon,\varepsilon') V_j^W(k',\varepsilon') + \psi_a V_j^R(k',\varepsilon) \right]$$

s.t.

$$(1+\tau_c)c + k' = (1+(1-\tau_k)r)k + y_j(h,\varepsilon) - T_h[y_j(h,\varepsilon)] - \min[\tau_{SS} \cdot y_j(h,\varepsilon), \bar{t}_{SS}] + \Upsilon$$

$$c > 0, \qquad k' \geq k_b, \qquad h \in [0,1)$$

Retirees' Problem · Def. Equilibrium

Calibration - Endogenous Parameters

	Parameter	Value	Target	Data	Model
Preferences					
Discount factor	β	0.934	K/Y	3.0	3.0
Labor disutility	θ	62.032	Average hours	0.3	0.3
Technology					
Aggregate productivity	Z	0.747	Normalize GDP	-	1.0
Labor Income					
Avg. Labor Earnings	AE	0.880	-	-	0.880
Government					
Scale parameter of labor tax	τ_y	0.224	Avg labor tax rate	21%	21%
Curvature of income taxes	ν_y	0.132	Top mg. tax rate	37.9%	37.9%
Government Debt	B/Y	0.641	Balance govt budget	63%	64.1%
Social Security					
Contribution cap	$\bar{t}_{SS}$	0.450	Balance Soc. Sec. budget	-	-
Inequality Statistics					
Prob. of staying stepping-star	$\pi_{6,6}$	0.9698	Earnings 95% - 99%	18.4	17.9
Prob. to superstar	$\pi_{6,7}$	0.0009	Earnings 99% - 100%	18.8	20.2
Prob. to star region	$\pi_{x,6}$	0.0056	Earnings Gini	0.67	0.65
Stepping-star shock	ε_6	17.2212	Wealth 95% - 99%	27.4	24.2
Superstar shock	ε_7	1090.7770	Wealth 99% - 100%	35.5	27.0
Prob of staying superstar	$\pi_{7,7}$	0.9270	Wealth Gini	0.85	0.85

▸ Calibration: Exog

Numerical Experiment

- Let $\mathcal{P}$ be a menu of fiscal policies, $p \equiv \{(\tau_y, \nu_y, \tau_k, \tau_c), \Upsilon_t\}_{t=1}^{\infty}$.
- Reforms are "once and for all", evaluated at the enacted period of the transition
- We compute 3888 equilibria with the following tax grids:

Capital income tax: $\tau_k \in \{0.0\%, 10.0\%, 18.7\%, 27.3\%, 40.0\%, 60.0\%\}$,

Consumption tax: $\tau_c \in \{0.0\%, 3.2\%, 6.4\%, 12.8\%, 25.6\%, 51.2\%\}$

Labor income tax (average): $\tau_y \in \{2.0\%, 12.0\%, 22.4\%, 32.0\%, 42.0\%, 57.0\%\}$,

Labor income tax (progressivity):
$\nu_y \in \{0.0\%, 2.7\%, 6.5\%, 10.2\%, 11.7\%, 13.2\%, 14.7\%, 17.0\%, 20.2\%, 22.2\%, 23.2\%, 24.2\%, 25.2\%, 26.2\%, 27.2\%, 28.2\%, 29.2\%, 30.2\%\}$.

- Classify as "feasible" only those with $\Upsilon_t \geq 0$ (2543 cases)

Household Policy Preferences

- $V_x(\overline{p})$ is the indirect utility from $\overline{p}$ for $x \equiv \{k, \varepsilon, j, a\}$.
- Define $p_x^\star$ as the household's *most-preferred policy*, given by

$$p_x^\star = \arg\max_{p \in \mathcal{P}} V_x(p)$$

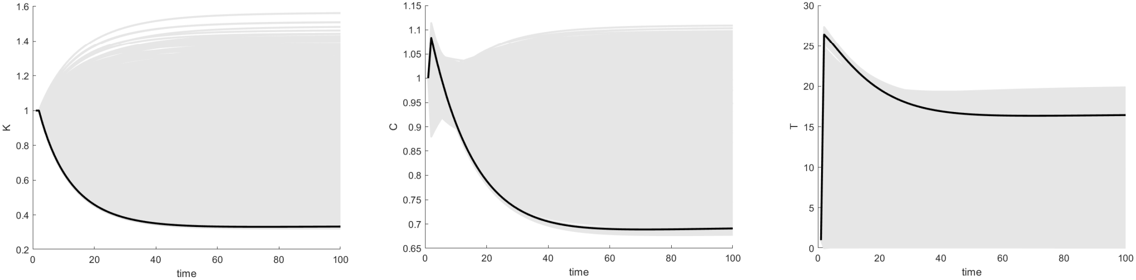
- Define p_{SP} as the policy that maximizes social welfare, given by

$$p_{SP} = \arg\max_{p \in \mathcal{P}} \int V_x(p)\, d\Gamma_0(x),$$

- p_{SP} denote the policy that maximizes the (utilitarian) welfare of HH's in period 0.

Results - Aggregates

- Optimal policy: $p_{SP} = \{(\tau_y, \nu_y, \tau_k, \tau_c), \Upsilon/Y\} = \{57.0\%, 22.2\%, 60.0\%, 51.2\%, 61.1\%\}$
- p_{SP} entails steep drop in K, Y and H
- Increases in C and w at the beginning of transition, very large final Υ



Notes: The solid black line shows the path induced by p_{SP}. The initial period represents the original steady-state quantities, which are normalized to 1.0. The duration of the transition is truncated at 100 years.

More Aggregates | Progressivity and Revenues

Results - Inequality

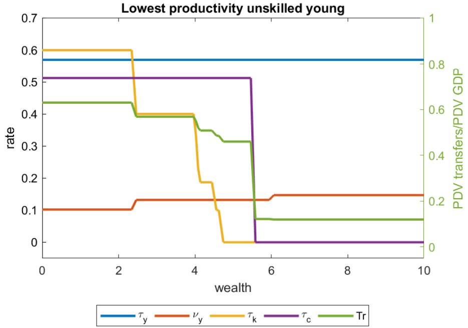
- Optimal policy permits greater pre-tax wealth and earnings dispersion
- Redistributes greatly to produce much lower consumption inequality

Gini	Initial SS	Minimum	Maximum	p_{SP}
Wealth	85	68.8	95.9	88.5
Earnings	65	62.3	77.8	76.4
Consumption	54	28.3	60.3	30.2

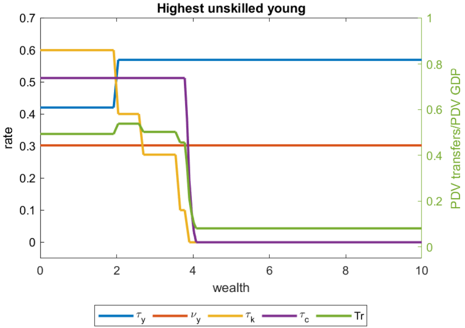
Tax Preferences by Type - Productivity/Wage

- Increased role of progressivity along the wage distribution

Lowest



Highest



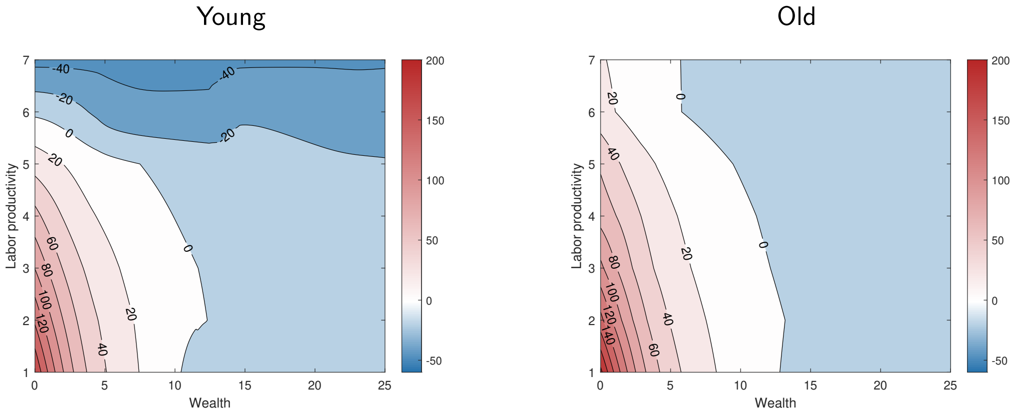
Pref. by Skill

Distribution of Tax Preferences

HH Type	τ_y	ν_y	τ_k	τ_c	Υ/Y	Population Share
Young, non-star						
unskilled	57.0	28.2	60.0	51.2	60.4	36.9
skilled	57.0	30.2	60.0	51.2	59.8	25.7
All stars	32.0	0.0	10.0	0.0	2.1	14.0
Retired						
unskilled	57.0	6.5	60.0	51.2	62.8	13.8
skilled	57.0	6.5	60.0	51.2	62.8	9.6
Wealth						
Bottom 50%	57.0	17.0	60.0	51.2	62.6	50.0
Mid $50\% - 80\%$	57.0	30.2	60.0	51.2	59.8	30.0
Top 20%	57.0	25.2	0.0	0.0	9.7	20.0

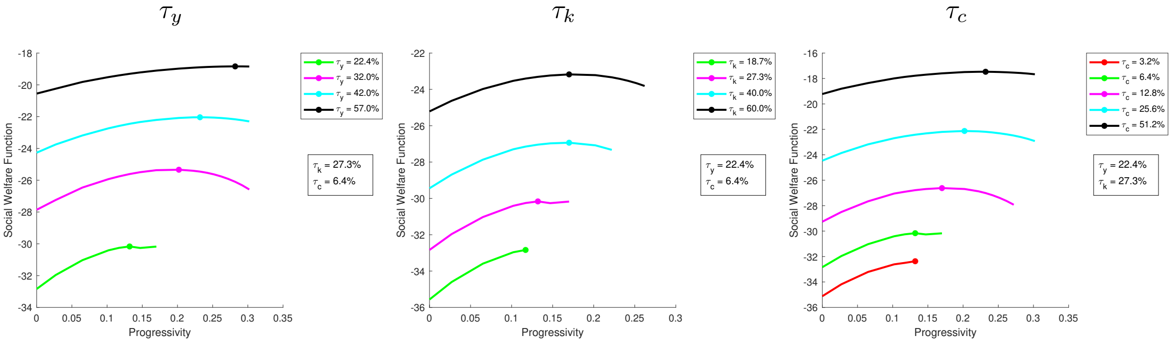
Optimal Policy - Welfare Gains

- Optimal policy: $p_{SP} = \{(\tau_y, \nu_y, \tau_k, \tau_c), \Upsilon/Y\} = \{57.0\%, 22.2\%, 60.0\%, 51.2\%, 61.1\%\}$
- Results in huge welfare gains:



Optimal Progressivity

1. Increase average rates (go to the black contour line) $\longrightarrow$ funds transfer
2. Give back some transfer to "buy progressivity"



Factors behind optimal policy

1. Thick right tail in initial wealth distribution:
   - Inelastic resources to grab ‣ Distribution ‣ Optimal Policy
2. Transition costs vs. steady-state welfare:
   - Benefits of low capital taxation enjoyed in the future ‣ SS only
3. Little altruism.
   - Favor initial living at expense of future generations ‣ Taxes across Cohorts
   - Steady-state policy dominates for older cohorts ‣ Welfare across Cohorts
4. Government budget:
   - Under p_{SP}, fiscal obligations harder to finance over time ‣ Fiscal Rules

Head-to-Head Voting - Quick Theory and Results

- We search for all possible $p_x^\star$ that could arise from a sequence of head-to-head elections $\forall\, p \in \mathcal{P}$
- If the elements of $\mathcal{P}$ are multidimensional, ordering matters (Persson and Tabelini, 2002)
- Solution: use $\{V(\boldsymbol{p}; x)\}\, \forall\, p \in \mathcal{P}$ and successively refine $\mathcal{P}$ (Carroll et. al, 2021)
  - Survives strategic voting and agenda setting. Requires finite $\mathcal{P}$
- We find:
  - $\exists!\, p_{Cond} \in \mathcal{P}$ that defeats all other policies in any arrangement of head-to-head elections
  - Nearly identical to p_{SP}, with $p_{Cond} = \{57.0\%, 26.2\%, 60.0\%, 51.2\%\}$
  - High marginal utility of consumption $\sim$ large wealth inequality
  - An utilitarian planner approximates the "one man, one vote" outcome (Aiyagari and Peled, 1995)
- Carroll et al. (2025): empirical investigation using the GSS
  - Political identity dominates preferences over taxes and redistribution

Conclusion

- A fiscal reform with many taxes leads to very high taxes and transfers
- Buying progressivity: balances progressive taxation against greater transfer
- Utilitarian planner and pairwise voting yield similar results

Discussion: Breaking the Result

- This standard model delivers counterfactual fiscal policy results
- What needs to be added/changed so that we can recover a “reasonable” policy?
  1. Add altruism: Increase weights on future generations (lower capital taxes)
  2. Increase the elasticity of transfer w.r.t. tax. E.g.: endogenous human capital
  3. Increase income/wealth mobility (or perception of it)

Thank you!

APPENDIX

Social Security Formula

- Flat SS tax rate, $\tau_{SS} = 12.4\%$; Contributions are capped
- Benefit payments are defined as:

$$b_j(\varepsilon) = \begin{cases} r_1 \bar{y_j}(\varepsilon), & \text{if } \bar{y_j}(\varepsilon) \leq b_1 \bar{y} \\ r_1 b_1 \bar{y_j}(\varepsilon) + r_2(\bar{y_j}(\varepsilon) - b_1 \bar{y_j}(\varepsilon)), & \text{if } b_1 \bar{y} < \bar{y_j}(\varepsilon) \leq b_2 \bar{y} \\ r_1 b_1 \bar{y_j}(\varepsilon) + r_2 b_2 \bar{y_j}(\varepsilon) + r_3(\bar{y_j}(\varepsilon) - b_2 \bar{y_j}(\varepsilon)), & \text{o.w.} \end{cases}$$

- Stepping/Superstar benefits equal to top normal earner.

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Recursive Household Problem - Retirees

- Retiree's recursive problem:

$$V_j^R(k,\varepsilon) = \max_{c,k'} u(c,0) + (1-\psi_d)\,\beta V_j^R(k',\varepsilon)$$

s.t.

$$(1+\tau_c)c + k' = (1+(1-\tau_k)r)k + b_j(\varepsilon) + \Upsilon$$

$$c > 0, \qquad k' \geq k_b$$

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Definition of Equilibrium I

1. Given factor prices, taxes, and transfers, $\left\{V_t\left(x\right), g_{c,t}\left(x\right), g_{k,t}\left(x\right), g_{h,t}\left(x\right)\right\}$ solve the household problems
2. Given factor prices, $\{K_t, N_t\}$ satisfy the firm's FOCs
3. Markets clear:
   3.1
   $$A_t = \int g_{k,t} d\Gamma_t\left(x\right) = K_t + B_t$$
   3.2
   $$Y_t = \int g_{c,t}\left(x\right) d\Gamma_t\left(x\right) + K_{t+1} - \left(1-\delta\right) K_t + G_t$$
   3.3
   $$N_t = \sum_{j\in\mathcal{J}} \int exp\left(\varepsilon_t\right) g_{j,h,t}\left(k,\varepsilon\right) d\Gamma^W_{j,t}\left(k,\varepsilon\right)$$

Definition of Equilibrium II

4. The government budget constraint clears

$$G_t + \Upsilon_t + (1+r_t)B_t = \sum_{j \in \mathcal{J}} \int T_t \left(y_{j,t}^W (k,\varepsilon) \right) d\Gamma_{j,t}^W (k,\varepsilon) + \tau_{k,t} r_t \int_X k d\Gamma_t (x) + \tau_{c,t} \int_X g_{c,t} (x) \, d\Gamma_t (x) + B_{t+1}$$

5. The Social Security budget balances

$$\sum_{j \in \mathcal{J}} \int b_j (\varepsilon) \, d\Gamma_{j,t}^R (k,\varepsilon) = \int \min \left[\tau_{SS} y_{j,t}^W (k,\varepsilon), \bar{t}_{SS} \right] d\Gamma_{j,t}^W (k,\varepsilon).$$

Definition of Equilibrium III

6. We can split Γ_t into the invariant distributions, $\Gamma_j^W(k,\varepsilon)$ and $\Gamma_j^R(k,\varepsilon)$. For any $\omega \in \mathcal{B}(\mathcal{K}\times\mathcal{E})$, distributions $\Gamma_j^W(k,\varepsilon)$ and $\Gamma_j^R(k,\varepsilon)$ are consistent with household decisions. Meaning that for all $j \in J$,

$$\begin{aligned}
\Gamma_{j,t}^W(\mathcal{K},\mathcal{E}) =& (1-\psi_a)\int \sum_{\varepsilon'\in\mathcal{E}} 1_{\left\{g_{j,k}^W(k,\varepsilon)\in\mathcal{K}\right\}} \pi_j\left(\varepsilon,\varepsilon'\right) d\Gamma_j^W(k,\varepsilon) \\
&+ \psi_d \int \sum_{\varepsilon\in\mathcal{E}} \overline{\pi}_j(\varepsilon) 1_{\left\{g_{j,k}^R(k,\varepsilon)\in\mathcal{K}\right\}} d\Gamma_{j,t}^R(k,\varepsilon) \\
\Gamma_{j,t}^R(\mathcal{K},\mathcal{E}) =& (1-\psi_d)\int 1_{\{\varepsilon\in\mathcal{E}\}} 1_{\left\{g_{j,k}^R(k,\varepsilon)\in\mathcal{K}\right\}} d\Gamma_{j,t}^R(k,\varepsilon) \\
&+ \psi_a \int 1_{\{\varepsilon\in\mathcal{E}\}} 1_{\left\{g_{j,k}^W(k,\varepsilon)\in\mathcal{K}\right\}} d\Gamma_{j,t}^W(k,\varepsilon)
\end{aligned}$$

where the conditional transitions $M_{j,t}^a : (\mathcal{K}\times\mathcal{E}, \mathcal{B}(\mathcal{K}\times\mathcal{E})) \rightarrow (\mathcal{K}\times\mathcal{E}, \mathcal{B}(\mathcal{K}\times\mathcal{E}))$ are explicitly written inside the sums.

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Calibration - Exogenous Parameters

	Parameter	Value	Target / Source
Demographics			
Working and retirement years	J_W, J_R	$\{40, 15\}$	Standard
Aging and death probabilities	ψ_a, ψ_d	$\{1/J_W, 1/J_R\}$	Standard
Fraction of pop. with college	μ_s	41%	Kindermann and Krueger (2022)
Preferences			
Relative risk aversion	γ	2.00	Standard
Inverse Frisch elasticity	φ	2.00	Standard
Technology			
Capital share	α	0.36	Standard
K depreciation rate	δ	0.05	Standard
Labor Income			
AR(1) non-college	$\{\rho_u, \sigma_{\varepsilon,u}\}$	0.941, 0.197	PSID (Caroll and Hur, 2022)
AR(1) college	$\{\rho_s, \sigma_{\varepsilon,s}\}$	0.914, 0.229	PSID (Caroll and Hur, 2022)
College skill premium	$\{\zeta_u, \zeta_s\}$	1.00, 1.75	Caroll and Hur (2022)
Government			
Consumption tax	τ_c	6.4%	Carey and Rabesona (2003)
Capital income tax	τ_k	27.3%	Carey and Rabesona (2003)
Payroll tax	τ_{SS}	12.4%	IRS
Government spending	G/Y	18%	Trabandt and Uhlig (2011)
Lump-sum transfer	Υ/Y	2.2%	CBO (2019); OMB (2023)
Social Security			
Replacement rates	$\{r_1, r_2, r_3\}$	$\{0.90, 0.32, 0.15\}$	Soc. Sec. data Hugett and Parra (2010)
Bend points	$\{b_1, b_2, b_3\}$	$\{0.21, 1.29, 2.42\}$	Soc. Sec. data Hugett and Parra (2010)

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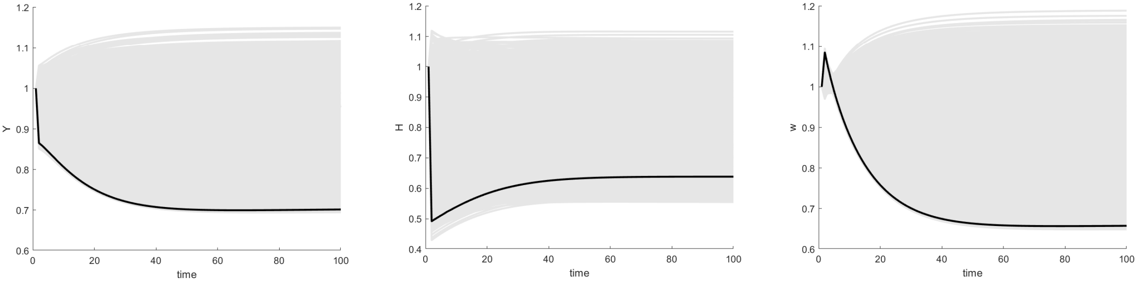
Results - Aggregates



Notes: The solid black line shows the path induced by p_{SP}. The initial period represents the original steady-state quantities, which are normalized to 1.0. The duration of the transition is truncated at 100 years.

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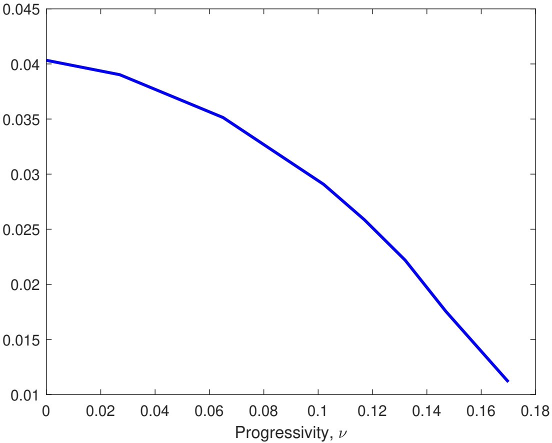
Progressivity and Revenues



Notes: The figure shows the present discounted value of equilibrium transfers as a function of the progressivity parameter, ν_y. All other tax parameters are fixed at their initial steady state values.

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Inequality across policies

- Optimal policy permits greater wealth and earnings inequality, but redistributes greatly to produce much lower consumption inequality.

Table: Range of Gini indices.

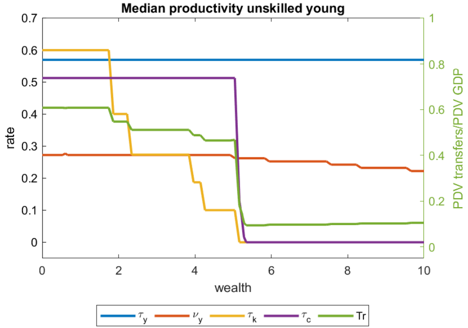
Gini	Initial SS	Minimum	Maximum	p_{SP}
Wealth	85	68.8	95.9	88.5
Earnings	65	62.3	77.8	76.4
Consumption	54	28.3	60.3	30.2

Inequality Back

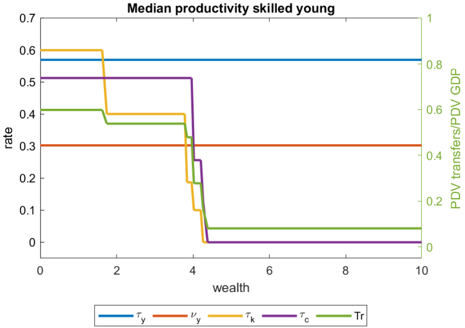
Tax Preferences by Type - Skill

- Skilled want somewhat lower average labor taxes and lower transfer than the unskilled

Unskilled



Skilled



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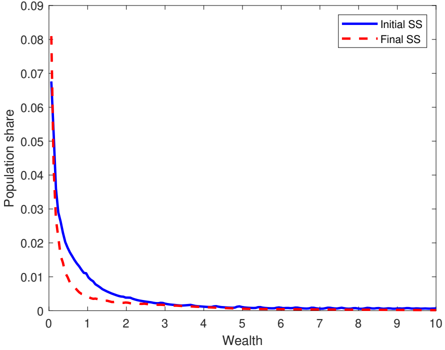
Replace initial distribution with final SS distribution

- Final SS distribution more compressed: mean wealth 54.9% lower, 55.5% of households have no wealth.
- Trade away some transfer for more progressivity



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Optimal Policy - Alternative Exercises

- Tax-transfer distribution allows more progressivity
- SS only eliminates capital taxation and increases progressivity

	τ_y	ν_y	τ_k	τ_c	Υ/Y
Baseline	57.0%	22.2%	60.0%	51.2%	61.1%
Tax-Transfer	57.0%	27.2%	60.0%	51.2%	52.4%
Steady-state only	57.0%	30.2%	0.0%	51.2%	43.0%

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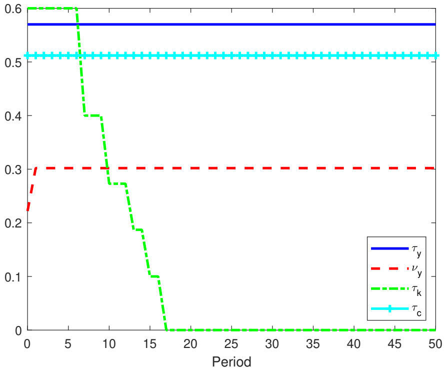
Considering Future Generations

- Experiment 3: What if period-0 households were altruistic (or SP weighted future generations welfare)
- Mostly agree with initial HH's, but optimal capital income tax diminishes quickly



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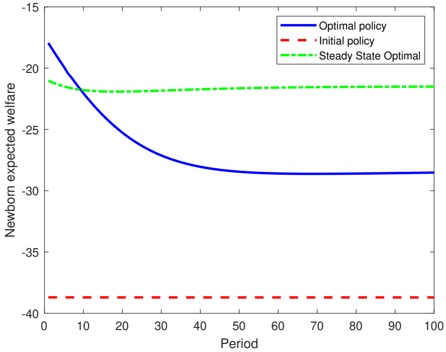
Expected Welfare Across Cohorts

- Optimal policy preferred to steady-state for the first nine cohorts.



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Relaxing the GBC and Buying Progressivity

- Baseline: G and B are fixed *in levels*
  - Under p_{SP} path, Y falls, government expenditures and debt service take up a growing share of revenues.
  - Limits how much progressivity can be increased.
- Alternative: Fix $\frac{G}{Y}$ and/or $\frac{B}{Y}$.
  - Progressivity in optimal policy rises as GBC relaxed.

Fixed (levels/ratios)	τ_y	ν_y	τ_k	τ_c	B/Y	G/Y	Υ/Y
G and B (Baseline)	57.0%	22.2%	60.0%	51.2%	81.1%	22.8%	61.1%
G and $\frac{B}{Y}$	57.0%	23.2%	60.0%	51.2%	64.1%	22.6%	61.6%
$\frac{G}{Y}$ and B	57.0%	24.2%	60.0%	51.2%	83.4%	18.0%	68.1%
$\frac{G}{Y}$ and $\frac{B}{Y}$	57.0%	26.2%	60.0%	51.2%	64.1%	18.0%	68.2%

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