Efficiency and Redistributive Effects of Progressive Housing Taxation

Bohdan Kalinichenko
Anastasis Koufakis

Universidad Carlos III de Madrid

24th CRETE Conference
Ios, Greece
July 7–11, 2026

Income and Housing Taxation: A Joint Approach

Housing: large tax base, but neglected for redistribution by researchers & policymakers
(50% of capital stock, 2–3 times GDP) Jordà et al. (2019)

Dual Role of housing

- Savings vehicle
- Consumption good
  $\rightarrow$ indivisible + financial frictions
  Housing-Age Profile $\neq$ Income-Age Profile
  Young: high Income, low Housing / Retirees: low Income, high housing

Main instrument for redistribution: **progressive Income tax**
Distortive: especially for entrepreneurs $\rightarrow$ High Income, less Housing

$\Rightarrow$ **What is the jointly optimal Income & Housing Tax-Transfer schedule?**

Overview & Tax Setup

Quantitative Heterogeneous Agent model with **housing** and **entrepreneurs**

Calibrated to Spanish household-level data

Spain: housing's median portfolio share $\sim 80\%$

Tax Setup

nonlinear functional form for both Income & Housing Heathcote et al. (2017)

$\rightarrow$ allows for negative tax rates (subsidies)

Income tax: on labor and entrepreneurial income

Housing Tax: on **housing consumption**

- paid by owners on houses they consume
- paid by **renters** on houses they consume **(not landlords!)**

$\rightarrow$ calculated on the **total** market value of houses used by household

Rel. Literature

Relevant Literature

- **Progressive Income Taxation** İmrohoroğlu et al. (2023), Brüggemann (2021), Heathcote et al. (2017)

  ⇒ **Contribution:** Income and housing taxation should be jointly studied.

- **Wealth Taxation** Guvenen et al. (2023), Boar and Midrigan (2023)
  - *"Use-it-or-lose-it": wealth tax reallocates capital to productive agents.*

  ⇒ **But:** Housing $\neq$ business equity

- **Housing Taxation** Balke et al. (2025),Chiocchio (2024), Rotberg (2022),Borri and Reichlin (2021),Juan (2018)
  - *Literature focuses on* **flat** *housing tax vs. capital income tax.*

  ⇒ We study non-linear **progressive** housing tax;
  find optimal to shift progressivity from **income** to housing.

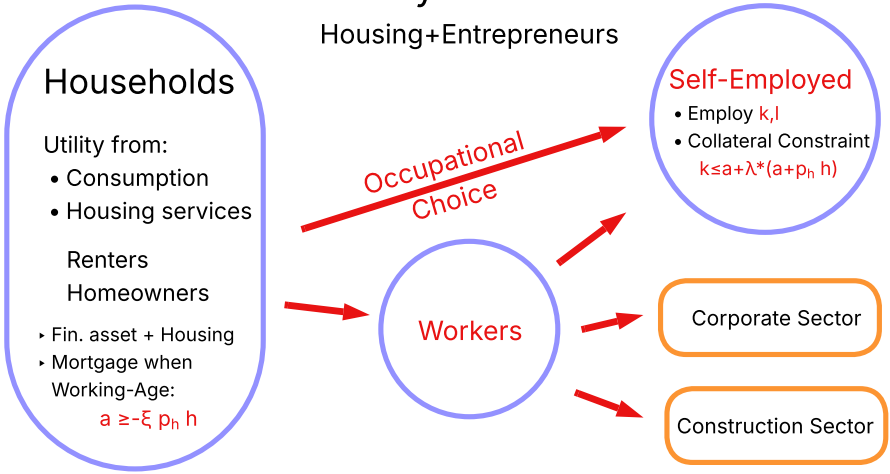
- **Progressive Consumption Taxation** da Costa and Santos (2023), Conesa et al. (2020)
  - *Theoretically good properties, but difficult implementation.*

  ⇒ **Link:** Housing is large & observable component of consumption.

Back

Lifecycle Model

Housing+Entrepreneurs



‣ Model Details

Calibration

- Set of parameters fixed from data or previous studies.
- Internally calibrate 16 parameters to match 16 moments:
  - h_1, χ, ξ match housing moments; β matches wealth-to-income ratio
  - 3 Superstar State parameters $\rightarrow$ income distr. + entrepreneurs' share at top Details
  - 6 parameters for entrepreneurial ability process Details
- Benchmark replicates wealth, income, and housing distributions

Moment	Data	Model
Renters' share	26.0	26.2
Avg. housing portfolio share (%)	50.1	51.9
wealth Gini	63.8	62.5
Share entrepreneurs (%)	7.3	7.4
Share E among top 1% income (%)	31.5	31.6

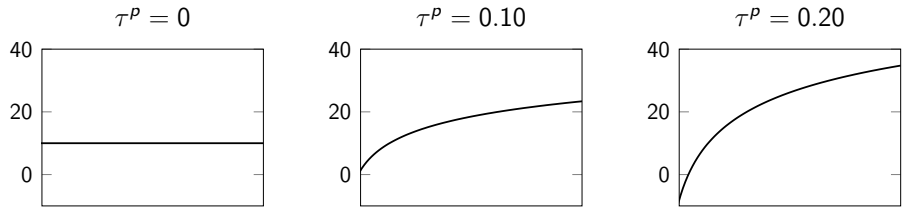
All calibrated parameters | All targeted moments | Distributions

Main Experiment

- Income Tax-Transfer Schedule $(1 - \tau_y^l(\tilde{I})^{-\tau_y^p})y$ (Heathcote et al., 2017)
- Housing Tax-Transfer Schedule $p_h t_h(h)$, with

$$t_h(h) = (1 - \tau_h^l(\frac{h}{\bar{h}})^{-\tau_h^p})h$$

→ parameters τ_y^l, τ_h^l: affect tax level
→ parameters τ_y^p, τ_h^p: affect tax progressivity (e.g. $\tau_h^p = 0$: flat tax)



Main Experiment: Jointly Optimal Housing+Income Tax-Transfer Schedules

Exp. Utility of Newborn, Budget Neutral Reforms

Computation

Involved maximization problem:

- over 4 arguments, s.t. 1 constraint
- Objective function
  - Non-convex, Noise
  - Costly to evaluate (2 assets, equilibrium)

State-of-the-art techniques

1. Solving the model:
   extend Bakota and Kredler (2022) (Markov Chain Approximation Method for discrete time)
   - OLG model, high saving rates
   - Tackle non-convexities
2. Maximization algorithm
   - Reduce dimensionality: use τ_l^y to balance budget
   - DIviding RECTangles algorithm (Jones & Martins, 2021)
   - Warm start on prices

Jointly Optimal Tax Schedules

		Baseline	*Joint*
Tax Parameters			
τ_h^l	Housing tax level	0.99	1.10
τ_h^p	Housing progressivity	0.00	0.15
τ_y^l	Income tax level	0.88	0.41
τ_y^p	Income progressivity	0.10	0.00
Tax Structure			
Effective income tax rate (%)		12.80	59.00
Share of hhs paying income Tax		72.16	100.00
Effective housing tax rate (%)		0.62	-11.38
Share of hhs paying housing Tax		100.00	0.09

Income tax:

- Flat at **59%** — everyone pays

Housing tax:

- Very progressive ($\tau_h^p = 0.15$)
- Only **0.09%** pay a tax
- $\sim$**100%** receive housing subsidies (effective subsidy rate: 11%)

▸ vs Opt Income

Jointly Optimal Tax Schedules

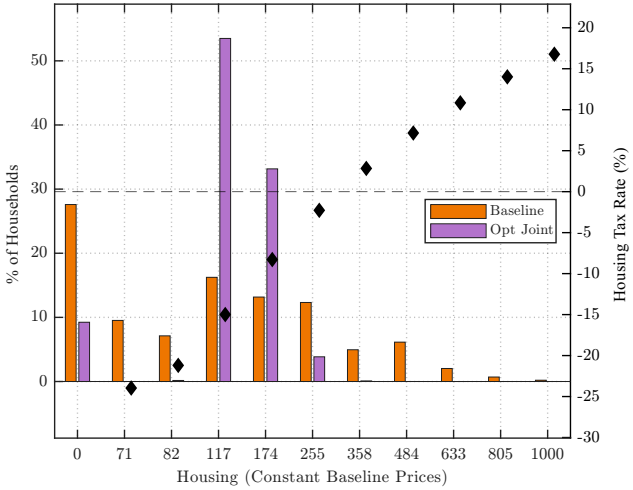
		Baseline	*Joint*
Prices			
p_h	Housing price	1.00	0.73
r	Interest rate (%)	4.09	5.14
w	Wage	1.00	0.95
Aggregate Variables			
Production		100	96.00
Aggregate capital		100	85.00
Real housing stock		100	75.00
Share of homeowners		72.40	90.76
Welfare (Δ%)		–	20.43

High flat income tax (59%), yet:

- $Y \downarrow$ only **4%**, $w \downarrow$ only **5%**
  (vs $Y \downarrow 11\%$, $w \downarrow 9\%$ in Opt Y)
- $p_h \downarrow 27\%$ + *housing subsidies*
- Homeownership
  $\uparrow$ 72.4% $\rightarrow$ **90.8%**

Welfare: +20.4%

Housing Distribution

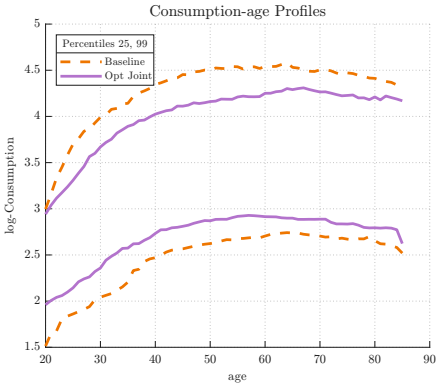


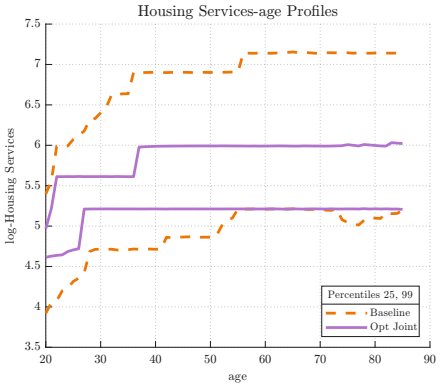
Prohibitively expensive to live in large houses

(only 0.09% pay tax)

Under Baseline distribution:
top 17% would pay the Jointly Optimal Tax

Optimal Joint: Consumption and Housing

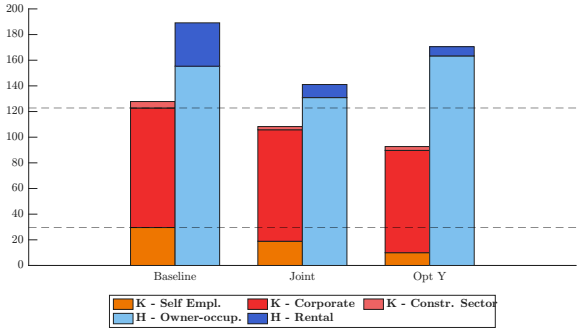




- 99th percentile: Collapse of Rich Retiree's Housing holdings
  high taxes, lower value of inheritance ($p_h \downarrow$)
- 25th percentile: Redistribution in favor of poor and young
  $\uparrow\sim 60\%$ in both Consumption and Housing services for 20s,30s

▸ Tax Burden by Age

Resource Allocation: Capital and Housing

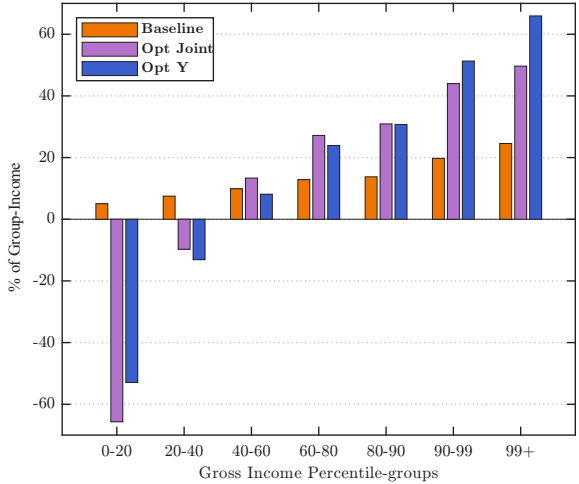


- Limited fall in capital stock (15%) and Self-Employed capital (35%)

(vs ↓ 28%, 66% in Opt Y)

- Higher overall Redistribution + collateral constraint($\downarrow p_h$) ▸ Collateral Constr. ▸ Overall Progr.

Total Tax Burden By Income Groups



Opt Income: Higher Tax Rates at top

▸ Tax Burden by Age

Understanding the Mechanisms

Results of Jointly optimal tax schedules

	τ_h^{lev}	τ_h^{prog}	τ_y^{lev}	τ_y^{prog}
Baseline	1.1	0.15	0.41	0
Only S.E	1.11	0.12	0.43	0
Only H.O.	0.92	**0**	0.52	**0.87**
Baseline, high h_{min}	1.14	0.24	0.25	0.03
Baseline, high χ	1.1	0.22	0.38	0

- Entrepreneurship: both flat income & progressive housing tax
- Homeownership: motive for more progressive housing taxation

▸ Housing Supply Elasticity

Redistribution-Neutral Optimal Taxation, No Subsidies

		Baseline	*Gini C_{tot} constrained*
Tax Parameters			
τ_y^p	Income progressivity	0.100	0.037
τ_h^p	Housing progressivity	0.000	0.008
Tax Structure			
Effective income tax rate (%)		12.803	9.943
Effective housing tax rate (%)		0.620	1.391
Gini of C_{tot}		0.385	0.385
p_h	Housing price	1.000	0.973
r	Interest rate (%)	4.090	3.475
w	Wage	1.000	1.032
Production		100	103.5
Capital		100	110.8
Housing stock		100	91.8
Homeowners		73.2	72.4
Welfare (Δ%)		–	**1.98**

- Income tax ↓ progressive, ↓ eff. tax rate
- Housing tax becomes (mildly) progressive
- Homeownership *roughly unchanged*
- Efficiency gain: **+1.98%** welfare, with equal consumption inequality

▸ Housing Distribution & Tax Rates

Conclusion

Contributions:

- **Large Welfare Gains** from Introducing a Progressive Housing Tax
  - Capital deepening/ Equilibrium Effects
  - Inter-generational Redistribution
  - Less distortive to entrepreneurs
- **Jointly Optimal Tax Schedule:** flat income tax, progressive housing tax
  - Income and Housing Taxation Should be studied jointly
  - Entrepreneurship drives Results
  - Homeownership,Inelastic Housing Supply: $\uparrow$ optimal progressivity of housing tax
- Redistribution Neutral Optimal policy: Welfare Gains 1.98%

Future Research

- Segmented housing markets, spatial dimension, holiday homes
- Uncertainty (house prices, business income)

References I

Bakota, I., & Kredler, M. (2022). Continuous-time speed for discrete-time models: A markov-chain approximation method.

Balke, K. K., Karlman, M., & Kinnerud, K. (2025). Winners and losers from property taxation. *Quantitative Economics*. (Forthcoming)

Blanco, M. A., Bauluz, L., & Martínez-Toledano, C. (2021). Wealth in spain 1900–2017 a country of two lands. *The Economic Journal*, *131*(633), 129–155.

Boar, C., & Midrigan, V. (2023). Should we tax capital income or wealth? *American Economic Review: Insights*, *5*(2), 259–274.

Borri, N., & Reichlin, P. (2021). Optimal taxation with home ownership and wealth inequality. *Review of Economic Dynamics*, *40*, 64–84.

Brüggemann, B. (2021). Higher taxes at the top: The role of entrepreneurs. *American Economic Journal: Macroeconomics*, *13*(3), 1–36.

References II

Chiocchio, F. (2024). Why not tax it? the effects of property taxes on house price and homeownership. *The Effects of Property Taxes on House Price and Homeownership*.

Conesa, J. C., Li, B., & Li, Q. (2020). Welfare implications of switching to consumption taxation. *Journal of Economic Dynamics and Control*, *120*, 103991.

da Costa, C. E., & Santos, M. R. (2023). Progressive consumption taxes. *Journal of Public Economics*, *220*, 104854.

De Nardi, M. (2004). Wealth inequality and intergenerational links. *The Review of Economic Studies*, *71*(3), 743–768.

Favilukis, J., Ludvigson, S. C., & Van Nieuwerburgh, S. (2017). The macroeconomic effects of housing wealth, housing finance, and limited risk sharing in general equilibrium. *Journal of Political Economy*, *125*(1), 140–223.

References III

Guvenen, F., Kambourov, G., Kuruscu, B., Ocampo, S., & Chen, D. (2023). Use it or lose it: Efficiency and redistributional effects of wealth taxation. *The Quarterly Journal of Economics*, *138*(2), 835–894.

Heathcote, J., Storesletten, K., & Violante, G. L. (2017). Optimal tax progressivity: An analytical framework. *The Quarterly Journal of Economics*, *132*(4), 1693–1754.

İmrohoroğlu, A., Kumru, Ç. S., Lian, J., & Nakornthab, A. (2023). Revisiting taxes on high incomes. *Review of Economic Dynamics*, *51*, 1159–1184.

Jones, D. R., & Martins, J. R. (2021). The DIRECT algorithm: 25 years later. *Journal of global optimization*, *79*(3), 521–566.

Jordà, Ò., Knoll, K., Kuvshinov, D., Schularick, M., & Taylor, A. M. (2019). The rate of return on everything, 1870–2015. *The Quarterly Journal of Economics*, *134*(3), 1225–1298.

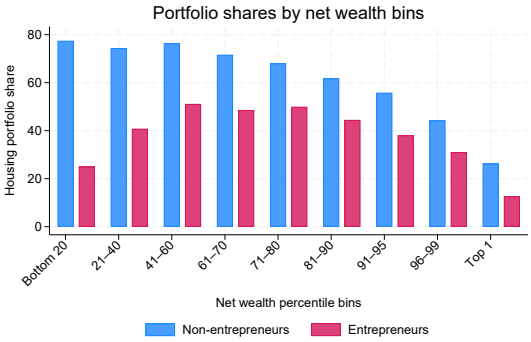
Juan, L.-P. (2018). *Wealth taxation in a life-cycle model with entrepreneurship and housing* (Unpublished doctoral dissertation). University of Minnesota.

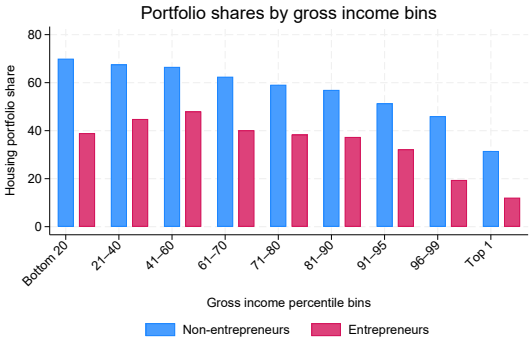
References IV

Kaplan, G., Mitman, K., & Violante, G. L. (2020). The housing boom and bust: Model meets evidence. *Journal of Political Economy*, *128*(9), 3285–3345.

Rotberg, S. (2022). The implications of housing for the design of wealth taxes. *International Economic Review*, *63*(1), 125–159.

Portfolio Shares: Workers vs Entrepreneurs





Entrepreneurs own less housing along Income and Wealth distribution

Back

Demographics & Utility

Demographics

- Live up to J periods
- Survival Probability ζ_j

Utility

- Consumption c & housing services d, eq. scale e_j

$$u_j(c,d) = e_j \frac{\left(\frac{c^{\xi} d^{(1-\xi)}}{e_j}\right)^{1-\gamma}}{1-\gamma}$$

- Warm Glow Bequests: $\Phi(b) = \phi_1 \frac{(\phi_2+b)^{1-\gamma}}{1-\gamma}$ De Nardi (2004)

Back to Main

Earnings

Workers/Retirees

- Labour productivity $n_j(z) = q(j)z$:
  - Age-Deterministic component $q(j)$
  - Idiosyncratic component z, Markov Chain while $j < J_{ret}$

Entrepreneurs

Details

- Entrepreneurial ability θ, Markov Chain
- Hire Capital and Labor, Decreasing Returns to Scale
  $y_j^e(z, \theta, k, l) = \theta \left(k^\alpha (n_j(z) + l)^{1-\alpha}\right)^\nu$
- Can use their own financial assets a into their business
- Collateral Constraint: can borrow up to $\lambda(a + p_h h)$ i.e. $k \leq a + \lambda(a + p_h h)$
- Option only for $j < J_{ret}$

Back to Main

Financial Assets & Housing

Financial Assets

- Interest rate r
- Borrowers: pay intermediation cost ι (wedge)
- Retirees: Cannot Borrow

Housing

- Rental option (continuous) at price p_r
- Preference for homeownership χh (discrete)
- Depreciation costs $\delta_h p_h h$

When Moving:

- Can take mortgage up to ψ of new house value $p_h h'$ if $j < J_{ret}$
- Adjustment costs, transaction tax: $\psi_s p_h h + (\psi_b + \tau_h^t) p_h h'$

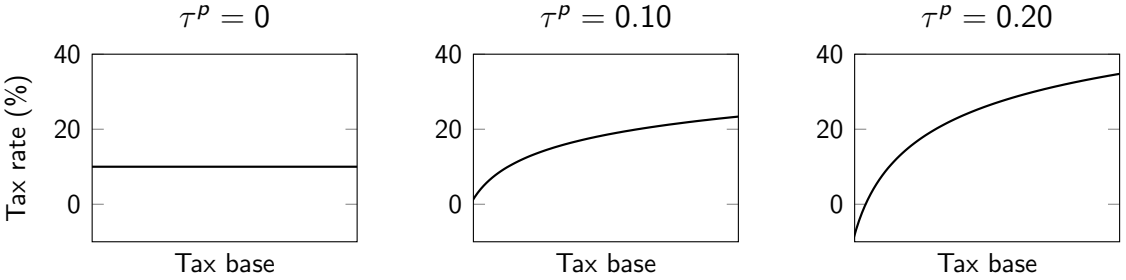
Back to Main

Taxation

- Income Tax-Transfer Schedule $(1 - \tau_y^l (\frac{y}{\bar{y}})^{-\tau_y^p})y$ (Heathcote et al., 2017)
- Housing Tax-Transfer Schedule $p_h t_h(h)$, with

$$t_h(h) = (1 - \tau_h^l (\frac{h}{\bar{h}})^{-\tau_h^p})h$$

→ parameters τ_y^l, τ_h^l: affect tax level
→ parameters τ_y^p, τ_h^p: affect tax progressivity (e.g. $\tau_h^p = 0$: flat tax)



Taxation

- Income Tax-Transfer Schedule $(1 - \tau_y^l (\frac{y}{\bar{y}})^{-\tau_y^p})y$ (Heathcote et al., 2017)
- Housing Tax-Transfer Schedule $p_h t_h(h)$, with

$$t_h(h) = (1 - \tau_h^l (\frac{h}{\bar{h}})^{-\tau_h^p})h$$

  → parameters τ_y^l, τ_h^l: affect tax level
  → parameters τ_y^p, τ_h^p: affect tax progressivity (e.g. $\tau_h^p = 0$: flat tax)

Allows for Subsidies

tax on Housing Consumption

- Other Taxes: Social Security, Capital Income,
  Housing Transaction tax, Inheritance tax, COnsumption tax,
  Corporate taxation

Back to Main

Other Sectors and Bequests

- **Corporate Sector** employs Capital and Labor $K_c^{\alpha} L_c^{1-\alpha}$

  → *Big firms not facing Collateral Constraint*

- **Construction Sector** employs Capital, Labor, and Land $K_h^{\alpha_K^h} L_h^{\alpha_L^h} (\delta_h \bar{L})^{1-\alpha_K^h-\alpha_L^h}$

  → *Realistic Housing Supply Elasticity* Details

- **Government:** Funds pensions and exogenous spending G
- **Financial Intermediary** Details
  - Allocates Deposits to Capital, Mortgages & Rental Stock
  - Zero-profit condition:
    - $p_r = p_h(\delta_h + r) + \eta$

Bequests

- Houses sold at death, inheritance tax paid
- Agent of age j, labor productivity z receives $B_j(z)$

  → Most bequests flow to old & rich

Bellman Equations | Market Clearing | Equilibrium | Back to Main

Entrepreneurs' problem

An entrepreneur at state (a, h, z, θ, j) faces the problem

$$
\begin{aligned}
\Pi_j^e(a,h,z,\theta) = \max_{k,l} & \{\pi_j^e - t_y(\pi_j^e) + (a-k)r(1-\tau_k)1_{k<a}\} \\
\text{s.t.} \quad & \pi_j^e = y_j^e(z,\theta,k,l) - \delta_k k - (r+\iota)(k-a)1_{k\geq a} + m - wl \\
& y_j^e(z,\theta,k,l) = \theta\left(k^\alpha (n_j(z)+l)^{1-\alpha}\right)^\nu \\
& m = -a(r+\iota)1_{a<0} \\
& 0 \leq k \leq a + \lambda(p_h h + a) \\
& l \geq 0
\end{aligned} \tag{1}
$$

Back to Main Back to B.E.

Financial Intermediary

- Lives 2 periods, discounts profits at r (Balke et al., 2025)
- Collects deposits from households
- Buys Rental Stock $\mathcal{H}_{f,r}$, lends mortgage and capital
- Period 2: receives interest and rental income
- Pays housing depreciation costs $p_h \delta_h \mathcal{H}_{f,r}$, intermediation cost $\eta \mathcal{H}_{f,r}$
- Resells Rental Stock, returns deposits to households
- Zero-profit condition:
  - $p_r = p_h(\delta_h + r) + \eta$

Back to Main | Fin Intermediary's Problem

Financial Intermediary's Problem

$$
\begin{aligned}
V_f = \max_{\mathcal{K}'_f, \mathcal{H}'_{f,r}, \mathcal{M}'_f, \mathcal{D}'_f} \Bigg\{ & - p_h \mathcal{H}'_{f,r} - \mathcal{K}'_f - \mathcal{M}'_f \\
& + \frac{\left(p_r \mathcal{H}'_{f,r} - \delta_h p_h \mathcal{H}'_{f,r} - \eta \mathcal{H}'_{f,r}\right)}{1+r} \\
& + \frac{p_h \mathcal{H}'_f}{1+r} + \frac{(1+r)\mathcal{K}'_f}{1+r} + \frac{(1+r)\mathcal{M}'_f}{1+r} \Bigg\} \\
s.t. \quad & \mathcal{K}'_f + p_h \mathcal{H}_{f,r} + \mathcal{M}'_f = \mathcal{D}'_f,
\end{aligned}
\tag{2}
$$

Stationary Equilibrium: 0-profits

$$
p_r = p_h(\delta_h + r) + \eta \tag{3}
$$

Back

Construction firm

$$\Pi^H(p_h, r, w) = \max_{K_H, L_H} \{p_h K_h^{\alpha} L_h^{\beta} (\delta_h \bar{L})^{1-\alpha-\beta} - (r + \delta_k) K_h - w L_h\}$$

where $\bar{L}$ is the total stock of land.

This problem yields the following housing supply:

$$I_H = p_h^{\frac{\alpha+\beta}{1-\alpha-\beta}} \left(\frac{\alpha}{r+\delta_k}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}} (\delta_h \bar{L})$$

- Land in fixed supply $\delta_h \bar{L}$
- Profits collected by the government (Favilukis et al. (2017), Kaplan et al. (2020))

Back

Household's Bellman Equation: First Stage

$$\mathcal{V}_j(a,h,z,\theta) = \max_{c,s,h^r,i} \quad u_j(c,d) + \tilde{\mathcal{V}}_j(s,h,z,\theta)$$

s.t. $(1+t_c)c + s + (p_r + p_h t_h(h^r))h^r 1_{h=0} + m \leq a + y_j^i - p_h h \delta_h - p_h t_h(h)$

$$d = h^r 1_{h=0} + \chi h 1_{h>0} \qquad m = -(r+\iota)a 1_{a<0}$$

$$y_j^i = \begin{cases} wn(j,z) + r(1-\tau_k)a1_{a\geq 0} - t_y(wn) - t_{ss}(wn), & \text{if} \quad i = \text{w} \\ \Pi_j^e(a,h,z,\theta) & \text{if} \quad i = \text{e} \end{cases}$$

$$s \geq \min\{a, 0\} \qquad h^r \geq 0$$

$i \in \{\text{w}, \text{e}\}$ Entrepreneurial problem

Back to Main

Household's Bellman Equation: Second Stage

$$\tilde{\mathcal{V}}_j(s,h,z,\theta) = \max_{h',a'} \left\{ \beta\zeta_j \, \mathbb{E}_{z',\theta'}[\mathcal{V}_{j+1}(a' + B_{j+1}(z'), h', z', \theta')] + \beta(1-\zeta_j)\Phi(b) \right\}$$

$$\text{s.t.} \quad p_h h' + p_h C_{adj}(h,h') + a' \leq s + p_h h$$

$$C_{adj}(h,h') = 1_{h \neq h'}(\psi_s h + (\psi_b + \tau_h^t)h')$$

$$b = p_h h' + a' - \psi_s p_h h' - t_{inh}(p_h h' + a')$$

$$a' \geq -\psi p_h h' 1_{h \neq h'}$$

$$h' \in \hat{\mathcal{H}} = \{0, h_1, h_2, ..., h_N\}$$

Numerical Solution: extend (Bakota & Kredler, 2022) Back to Main

Entrepreneurial ability process

as in Brüggemann (2021):

- 4 values for entrepreneurial ability $\theta = \{0, \bar{\theta}(1-\hat{\theta}), \bar{\theta}, \bar{\theta}(1+\hat{\theta})\}$
- Transition Matrix:

$$\Lambda = \begin{pmatrix} \pi_1^\theta & 1-\pi_1^\theta & 0 & 0 \\ \pi_2^\theta & \pi_3^\theta & 1-\pi_2^\theta-\pi_3^\theta & 0 \\ 0 & \pi_2^\theta & \pi_3^\theta & 1-\pi_4^\theta \\ 0 & 0 & \pi_4^\theta & \pi_4^\theta \end{pmatrix}$$

Back

Market Clearing Conditions

$$L_{se,net} + L_c + L_h = \int \mathcal{I}_w(\mathbf{x}) n(j,z)\, d\Gamma(\mathbf{x}) \qquad \text{(Labor Market)}$$

$$\delta_h \mathcal{H}_{ho} + \delta_h \mathcal{H}_{f,r} = H^s \qquad \text{(Housing, Construction)}$$

$$\int a(x)\, \mathcal{I}_{a(x)>0}\, d\Gamma(x) = \mathcal{D}_f = K_f + \mathcal{M}_f + \mathcal{H}_{f,r} \qquad \text{(Deposits)}$$

$$K_{se,net} + K_c + K_h = K_f \qquad \text{(Capital)}$$

$$-\int a(x)\, \mathcal{I}_{a(x)<0}\, d\Gamma(x) = \mathcal{M}_f \qquad \text{(Mortgage)}$$

$$\int h_r(x)\, d\Gamma(x) = \mathcal{H}_{f,r} \qquad \text{(Rental Market)}$$

Equilibrium definition Back

Equilibrium definition

Equilibrium is defined by:

1. Prices: $\{r, w, p_h, p_r\}$
2. Policy functions for the firms and intermediary: $\{K_c, L_c, K_h, L_h, \mathcal{D}_f, \mathcal{M}_f, \mathcal{H}_{f,r}\}$
3. Value and policy functions of the households: $\{c(\mathbf{x}), d(\mathbf{x}), k(\mathbf{x}), l(\mathbf{x}), h'(\mathbf{x}), a'(\mathbf{x})\}$
4. A stationary distribution over households' state: $\Gamma(\mathbf{x})$

Given a government tax schedule, equilibrium satisfies:

1. Households value and policy functions solve the household maximization problem
2. Corporate and construction firms optimize
3. Zero-profit condition for the financial intermediary: $p_r = p_h(\tau_h + \delta_h) + \eta$
4. Government budget is satisfied. Inheritances left = inheritances distributed.
5. Markets (labor, capital, housing and consumption good) clear. ▸ Market Clearing ▸ Back

Entrepreneurial ability process

as in Brüggemann (2021):

- 4 values for entrepreneurial ability $\theta = \{0, \bar{\theta}(1-\hat{\theta}), \bar{\theta}, \bar{\theta}(1+\hat{\theta})\}$
- Transition Matrix:

$$\Lambda = \begin{pmatrix} \pi_1^\theta & 1-\pi_1^\theta & 0 & 0 \\ \pi_2^\theta & \pi_3^\theta & 1-\pi_2^\theta-\pi_3^\theta & 0 \\ 0 & \pi_2^\theta & \pi_3^\theta & 1-\pi_4^\theta \\ 0 & 0 & \pi_4^\theta & \pi_4^\theta \end{pmatrix}$$

Back

Labor Productivity Process

$n_j(z) = q(j)z$

- Deterministic component $q(j)$: estimated from data (EFF)
- Idiosyncratic component z: İmrohoroğlu et al. (2023), Brüggemann (2021)
  - First 5 gridpoints: log AR(1) process
    - persistence ρ_z: from literature (0.96)
    - std. dev. σ_z: endogenously estimated
  - 6th gridpoint: Superstar state

$$\Lambda_z(z' \mid z) = \begin{pmatrix} \pi_{11}^z & \pi_{12}^z & \pi_{13}^z & \pi_{14}^z & \pi_{15}^z & \pi_6^{z+} \\ \pi_{21}^z & \pi_{22}^z & \pi_{23}^z & \pi_{24}^z & \pi_{25}^z & \pi_6^{z+} \\ \pi_{31}^z & \pi_{32}^z & \pi_{33}^z & \pi_{34}^z & \pi_{35}^z & \pi_6^{z+} \\ \pi_{41}^z & \pi_{42}^z & \pi_{43}^z & \pi_{44}^z & \pi_{45}^z & \pi_6^{z+} \\ \pi_{51}^z & \pi_{52}^z & \pi_{53}^z & \pi_{54}^z & \pi_{55}^z & \pi_6^{z+} \\ 0 & 0 & \pi_6^{z-} & 0 & 0 & 1 - \pi_6^{z+} \end{pmatrix}$$

4 free parameters $(\sigma_z, z_6, \pi_6^{z-}, \pi_6^{z+})$

Back

Internally calibrated parameters

		Value
Housing		
χ	Homeownership utility premium	1.57
h_1	Minimum housing size for homeowners	71
Preferences		
ϕ_1	Luxury good parameter of bequests	266.3
ϕ_2	Bequest intensity parameter	1426
β	Discount factor	0.9705
ξ	Consumption utility share	0.6509
Entrepreneurial ability process Details		
$\hat{\theta}$	Dispersion of ent. ability	0.3501
$\bar{\theta}$	Average of ent. ability	4.341
$(\pi_1, \pi_2, \pi_3, \pi_4)$	Transition probabilities	(0.9441, 0.4734, 0.4786, 0.9889)
Labor productivity process s Details		
σ_z	St. dev. labor productivity	0.6981
z_6	Highest labor prod. level	$2.42 z_5$
$\pi_6^{z^+}$	Probability of reaching z_6	0.8011
$\pi_6^{z^-}$	Probability of leaving z_6	0.0021

Back

Targeted moments. Data vs Baseline values.

	Data	Model
Housing		
Homeownership rate	72.3	72.4
Avg. housing portfolio share	50.0	48.0
Housing holdings Gini	44.1	37.0
Overall economy		
Wealth-to-Income Ratio*	6.7	7.2
Net wealth Gini	68.5	64.2
Top 10% income share	30.6	35.9
Top 1% income share	6.85	6.89

	Data	Model
Entrepreneurs		
Share entrepreneurs	7.73	7.81
Share of hiring entrepreneurs	55.2	51.9
Entrepreneur's earnings Gini	49.1	47.3
Share of E among top 1% of income	29.6	30.9
Ratio of median income of E/W	1.33	1.39
Share ent. top 10% wealth	20.1	17.6
Workers and retirees		
Worker's earnings Gini	40.8	40.6
Homeownership rate 65+	83.8	83.7
Net wealth Gini of retirees	61.3	60.8

Data source: EFF (2022), except * which we take from Blanco et al. (2021).

Back

Wealth, income and housing distributions

	Gini	0–20	20–40	40–60	60–80	80–90	90–99	Top 1%
Wealth								
Data	63.8	-0.11	3.69	9.12	17.57	16.18	32.58	20.98
Model	62.5	0.84	4.48	8.89	18.21	17.94	37.66	11.98
Income								
Data	41.6	5.05	9.90	15.14	22.66	16.78	23.67	6.79
Model	45.3	4.83	8.50	13.28	21.68	15.53	29.31	6.87

Housing	Gini	0-50	50-90	90-99	Top 1%
Data	44.09[t]	21.36	45.21	25.35	8.08
Model	36.98	20.55	46.83	27.66	4.95

Model replicates concentration of Wealth, Income and Housing

Back

Housing Portfolio Share by Occupation and Wealth Bin

	0–20	21–40	41–60	61–80	81–90	91–99	Top 1%
Workers							
Data	73.1	73.1	75.1	68.8	54.4	51.2	35.4
Model	13.4	77.3	74.7	66.6	57.0	37.4	23.0
Entrepreneurs							
Data	–	41.8	56.6	45.2	44.7	33.5	10.3
Model	–	56.8	63.6	45.1	27.5	40.6	24.5

Data source: EFF (2022). *Note*: for entrepreneurs, the 0–20 wealth bin is omitted because it contains too few observations in the EFF; the corresponding model moment is also omitted for comparability.

Jointly Optimal Tax Schedules

		Baseline	*Joint*	Opt Income
Tax Parameters				
τ_h^l	Housing tax level	0.99	1.10	0.99
τ_h^p	Housing progressivity	0.00	0.15	0.00
τ_y^l	Income tax level	0.88	0.41	0.68
τ_y^p	Income progressivity	0.10	0.00	0.57
Tax Structure				
Effective income tax rate (%)		12.80	59.00	19.37
Share of hhs paying income Tax		72.16	100.00	35.33
Effective housing tax rate (%)		0.62	-11.38	0.62
Share of hhs paying housing Tax		100.00	0.09	100.00

- Flat Income tax at 59%
- Very progressive Housing Tax
- $\sim$100% of households receive housing Subsidies
- Effective Housing Subsidy Rate: 11%

▸ Back to Joint vs Income Aggr. ▸ Opt Inc Tax Fct
▸ Back to Main

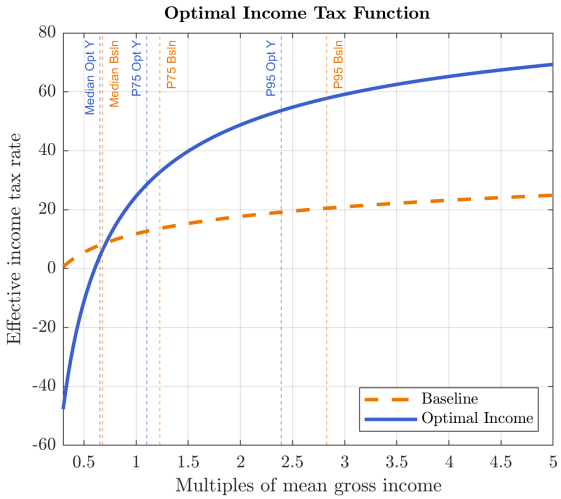
Jointly Optimal Tax Schedules Aggregates & Prices

		Baseline	*Joint*	Opt Income
Prices				
p_h	Housing price	1.00	0.73	0.81
r	Interest rate (%)	4.09	5.14	6.23
w	Wage	1.00	0.95	0.91
Aggregate Variables				
Production		100	96.0	89.0
Aggregate capital		100	85.0	73.0
Real housing stock		100	75.0	90.0
Share of homeowners		72.4	90.76	92.07
Welfare (Δ%)		–	20.43	11.90

- Limited drop in w, Production (vs $\sim$10% in *Opt Income*)
- Large drop in Housing Stock, house prices
- Share of homeowners $\uparrow$ to 90.8%

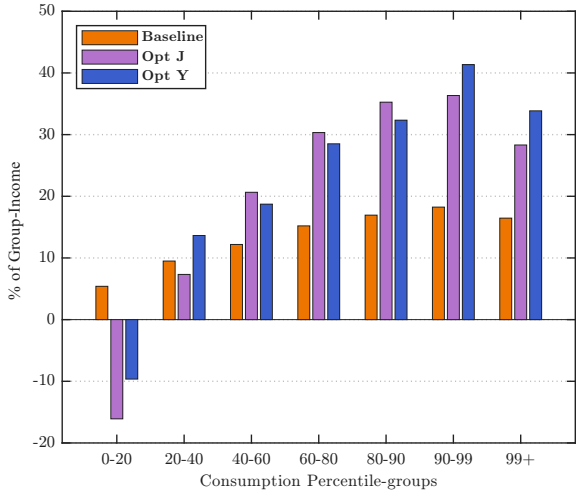
▸ Opt Income Tax Schedule ▸ Back to Main

Opt Y, Income tax function



Back to Main

Total Tax Burden By Consumption-Groups $C_{tot} = c^{\xi} d^{1-\xi}$



Opt Income: Higher Tax Rates at top

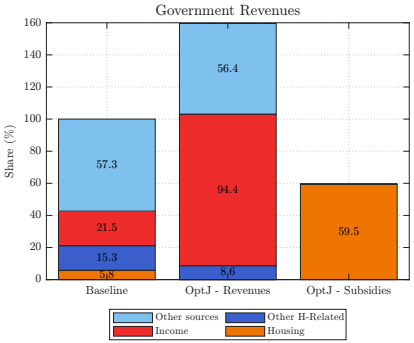
Back

Self Employed: The role of Collateral

	Baseline	Opt Y	Opt J
Mean k^*	100	33.5	70.4
Unconstrained mean k^*	100	79.2	94.3
Average collateral	100	43.3	60.2
Share of S.E.	7.9	7.9	7.2
Share of Constrained S.E.	58.2	64.9	70
S.E., Wealth Share	12.4	7.4	10.2

Back

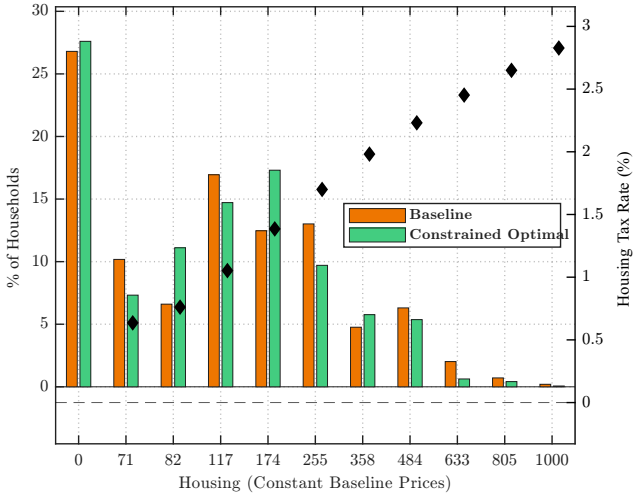
Government Revenues (Opt Joint)



- Flat Income Tax: Revenue collecting
- Sizable Redistribution through housing tax

Back

Redistribution Neutral Optimal, H-distribution



Understanding the Mechanisms: Housing Supply Elasticity

Results of Jointly optimal tax schedules (with Subsidies)

		Baseline Economy	Low elasticity $\epsilon_h = \mathbf{0.1}$	Main estimate $\epsilon_h = \mathbf{1.17}$	High elasticity $\epsilon_h = \mathbf{10}$
Tax Parameters					
τ_h^l	Housing tax level	0.994	1.357	1.103	1.083
τ_h^p	**Housing progressivity**	0.000	**0.522**	**0.151**	**0.100**
τ_y^l	Income tax level	0.882	0.423	0.410	0.441
τ_y^p	Income progressivity	0.100	0.001	0.000	0.001

Optimal Housing Progressivity: decreasing in ϵ_h

Prices and Aggregates Back To Main

Understanding the Mechanisms: Housing Supply Elasticity

		Low ϵ_h $\epsilon_h = 0.1$	Main estimate $\epsilon_h = 1.17$	High ϵ_h $\epsilon_h = 10$
Prices				
p_h	Housing price	0.190	0.730	0.930
r	Interest rate (%)	4.470	5.140	5.280
w	Wage	0.980	0.950	0.950
Aggregate Variables				
Production		100.1	95.6	93.0
Aggregate Capital		72.6	74.0	79.4
Real housing stock		85.2	74.7	75.8
Share of homeowners		97.5	90.8	85.8
Welfare (Δ%)		38.49	19.94	14.34

- Much Higher Response under $\epsilon_h = 0.1$
- Welfare gains decreasing in ϵ_h

▸ Back

No Subsidies

	Baseline	*Opt Y*	*Opt H*	*Opt Joint*
Tax Parameters				
τ_h^p Housing progressivity	0.000	0.000	0.084	0.061
τ_y^p Income progressivity	0.100	0.159	0.100	0.122
Tax Structure				
Effective Y tax rate	9.297	9.632	9.789	9.017
% hhs paying Y Tax	**72.127**	45.124	72.002	67.386
Effective H tax rate	0.620	0.620	2.544	2.442
% hhs paying H Tax	100	100	63.840	67.476
p_h Housing price	1.000	0.980	0.760	0.800
r Interest rate	4.090	4.220	3.160	3.290
w Wage	1	0.990	1.050	1.040
Production	100	99.2	105.9	105.0
Real housing stock	100	99.0	67.3	72.0
Homeowners	72.4	73.9	79.0	77.5
Welfare (Δ%)	–	**0.41**	6.20	6.35

- *OptY* barely effective
- *OptH* similar but ↓ homeownership
- *Joint* H,Y both more progressive

Back