Addressing Low Annuity Demand with Capital Taxes

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Motivation

- People live much longer than before:
  - More complicated saving decisions to insure themselves against longevity risk.
- One way: buy annuities:
  - Offer higher returns than risk-free assets but pay nothing when agents die.
- Real world: low annuity demand. Due to bequest (individual are altruistic to children).
- Government: may want to increase annuity demand to reduce stress on social safety net. How?

Capital taxation:

- Estate (Bequest) Tax, Wealth Tax, Capital Income Tax
- May alter annuity ownership.

Question

- Quantify the effect of different capital taxes on annuity demand.
- What are the welfare impacts of such tax reforms?

What We Do

- Apply a two-period analytical model to discuss the direction of the effect and uncover the mechanism;
- Construct a full-fledged life-cycle model with heterogeneous agents to match the data;
- Policy experiments:
  - How an estate tax affects annuity demand;
  - How a wealth tax affects annuity demand;
  - How a capital income tax affects annuity demand.

What We Find

- Low annuity ownership can increase from around 5% in the real economy to over 10% with reasonable capital tax rates.
  - Annuity ownership exhibits a hump-shaped relationship with the estate tax rate;
  - Annuity demand peaks at 22.61% when the estate tax rate is 38%.

Capital Taxation

- Government impose the estate tax, τ^{b}, if the bequest exceeds the exemption level, ex;
- Pays pension.
- Government budget balances,

$$\tau^{b}\left[\pi\left(b^{s}-ex\right)+(1-\pi)\left(b^{d}-ex\right)\right]=p.$$

Mechanism (Estate Tax)

Higher estate taxation

- Substitution effect:
  - Increase the opportunity cost of bequests;
  - Encourage individuals to consume more and buy more annuities.
- Income effect:
  - Larger transfers;
  - Reduce the demand for annuities.
- Interest rate effect:
  - More eligibility to buy annuities.

$\Rightarrow$ The net effect depends on the relative strength of three forces.

Demographics and Preferences

- Young or old: Remain young with a constant probability π_y;
- Alive or dead: The old continue to live with a constant probability π_o;
- Only the old leave bequests;
- No population growth;
- Care about the welfare of offspring.
- The instantaneous utility function is given by:

$$u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}.$$

Technology

- Two abilities:
  - Entrepreneurial ability: capacity to employ capital and labor effectively by running own firms;
  - Working ability: labor efficiency.
  - Both abilities: stochastic, positively correlated over time, and uncorrelated with each other.
- Two production sectors:
  - Entrepreneurial sector (decreasing returns to scale):

$$f(k_t, n_t) = \theta_t (k_t^{\gamma} (1 + n_t)^{1-\gamma})^{\nu};$$

  - Corporate sector (constant returns to scale):

$$F(K_t^c, L_t^c) = Z(K_t^c)^{\alpha} (L_t^c)^{1-\alpha}.$$

Who are entrepreneurs? Why entrepreneurs?

Government

- Collect income, consumption, and estate/wealth/capital income taxes;
- Finance government consumption, pension payments, and transfers and pay back debt.

$$\int_{\mathbf{s}_t} \left(T_t^{\mathbf{s}}(Y_t^{\mathbf{s}}) + \tau^c c_t(\mathbf{s}_t) + \tau^b \mathbf{1_o}(\mathbf{s}_t)(1-\pi_o)\max\{0, a_{t+1}(\mathbf{s}_t) - ex\} \right) d\Phi_t + \tau^a a_t(\mathbf{s}_t) +$$

$$+ \tau^k r_t k_t(\mathbf{s}_t) + D_{t+1} = g_t + p_t \pi_r + \int_{s_t} TR_t^s(Y_t^s) d\Phi_t + (1+r_t)D_t.$$

Government (Cont.)

- Income tax:

$$T_t^i(Y_t) = b^i \left[Y_t - \left(Y_t^{-p^i} + s^i \right)^{-\frac{1}{p^i}} \right] + \tau^p Y_t,$$

where $i = e, w$ denotes entrepreneurs and workers, respectively;

- Mean-tested transfers:

$$TR(Y_t) = e^{\omega_1} e^{\omega_2 Y_t} Y_t^{\omega_3} - \tau_{ls},$$

τ_{ls}: a lump sum tax/transfer.

Annuity Contract

- The young turn old: an option to buy annuities.
- Annuity Contract:

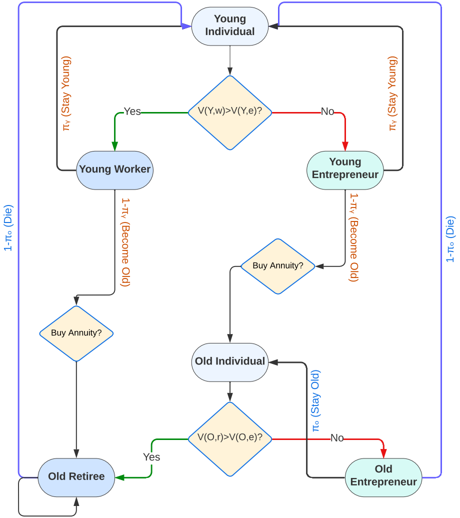
$$A(\Delta_t) = \frac{\sum_{t=1}^{\infty} \Delta_t \left(\frac{\pi_o}{1 + r_t} \right)^t}{1 - \lambda}$$

  - $A(\Delta_t)$: annuity premium;
  - λ: annuity load.

- Profits: "thrown away into the ocean" and not appear in equilibrium.
- Purchase annuities only if $a_t \geq A(\Delta_t)$.

Value Functions

Individual Decision Problem



Calibration

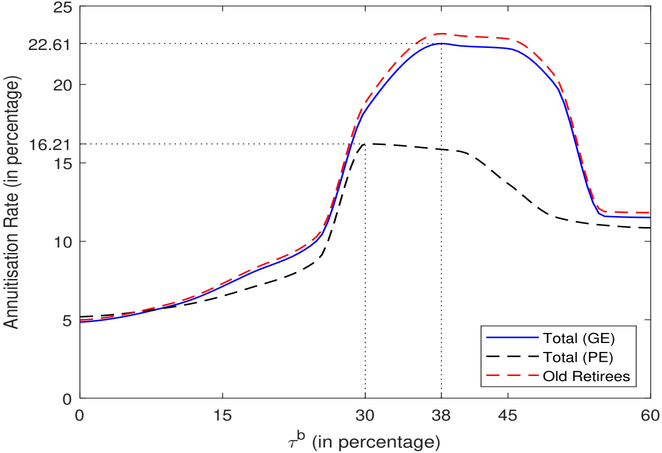
- Parameters taken from external sources (such as previous literature):
  - External Parameters
- Parameters calibrated to match certain targets:
  - Targeted Parameters
- Targeted data moments:
  - Targeted Moments

The Benchmark Economy

Quantiles	Model	Data	Sources
Income Distribution			
0-20%	3.1	2.9	SCF(2022)
20-40%	4.2	5.5	SCF(2022)
40-60%	7.3	10.7	SCF(2022)
60-80%	15.7	16.4	SCF(2022)
80-100%	69.7	64.5	SCF(2022)
95-99%	21.2	18.2	SCF(2022)
99-100%	30.9	22.1	SCF(2022)
Wealth Distribution			
0-20%	0.1	-0.2	SCF(2022)
20-40%	1.0	1.0	SCF(2022)
40-60%	3.4	3.7	SCF(2022)
60-80%	8.2	10.1	SCF(2022)
80-100%	87.3	85.4	SCF(2022)
95-99%	30.6	25.9	SCF(2022)
99-100%	33.4	35.1	SCF(2022)
Estate Tax Revenue to GDP	0.14	0.1-0.2	IRS

Adjusting the Estate Tax

- Adjusting the Estate Tax Rate:

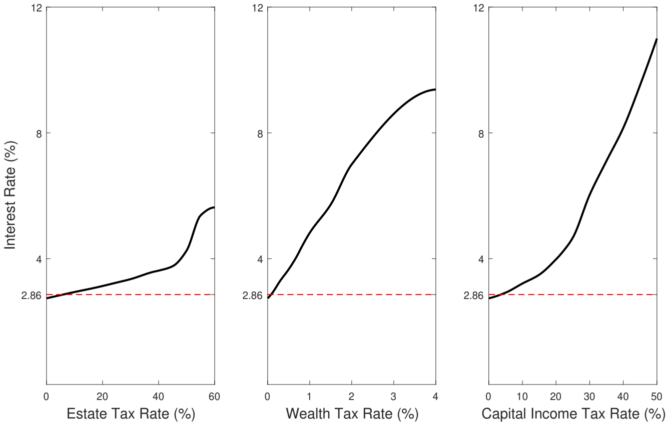


Adjusting the Estate Tax (Cont.)

- Mechanism:
    - At lower tax rates, the substitution effect dominates;
    - Beyond the 38% threshold, the income and bequest effects outweigh the substitution effect;
    - The interest rate rises monotonically with the estate tax rate in general equilibrium.
        - Allow more individuals to meet the purchase threshold, $a_t \geq A(\Delta_t)$.

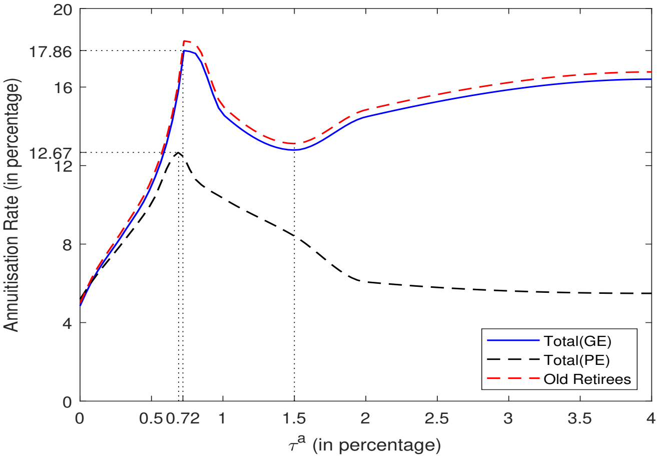
Adjusting the Estate Tax (Cont.)

- Mechanism (Cont.):



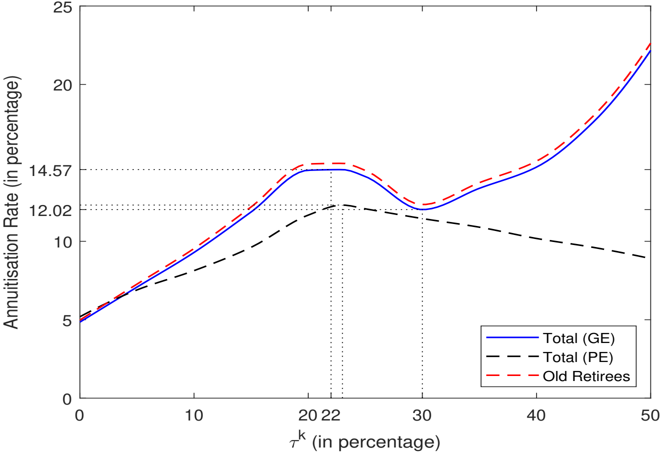
Introducing a Wealth Tax

- Adjusting the Wealth Tax Rate:



Capital Income Tax

- Adjusting the Capital Income Tax Rate:



Aggregate Effects of Capital Taxes

Table: Comparing Capital Taxes

Indicator	**Baseline**	τ^b**=24.5%**	τ^a**=0.37%**	τ^b**=28.6%**	τ^a**=0.66%**
Annuity (%)	4.85	10	10	15	15
Output (% of baseline)	100	96.36	95.15	95.68	96.23
Capital Stock(% of baseline)	100	93.88	91.97	92.78	85.79
Wealth Gini	0.8429	0.8389	0.8454	0.8393	0.8448
Consumption Gini	0.572	0.560	0.561	0.557	0.520
Capital tax revenue (% GDP)	0	0.81	1.36	1.00	3.16
Wage (% of baseline)	100	97.51	96.61	97.04	93.88
Interest rate (%)	2.74	3.23	3.41	3.32	4.01
CEV: Overall (%)	0	0.67	2.69	1.03	14.95

Conclusion

1. Study the interaction between capital taxes and annuity demand;
2. The relationship between annuity demand and the estate tax rate is hump-shaped, with a peak ownership rate of 22.61% at a tax rate of 38%;
3. Introducing a wealth tax produces a non-monotonic relationship with annuity demand;
4. Similar results for different demographic condition (higher life expectancy).

Thank You

Motivation: Entrepreneurs in the Economy

- Entrepreneurs represent 7% of the population.
- Entrepreneurs earn 18.2% of total income.
- 41.7% of top 1% income earners are entrepreneurs.
- Entrepreneurs are sensitive towards higher marginal tax.

Who are entrepreneurs? Back to Research Question

Survey Questions

1. Do you (and your family living here) own or share ownership in any privately-held businesses, including farms, professional practices, limited partnerships, private equity, or any other business investments that are not publicly traded? Yes
2. Do you (or anyone in your family living here) have an active management role in any of these businesses? Yes
3. Do you(/Does he/Does she/Does he or she) work for someone else,(are you/is he/is she/is he or she) self-employed, or something else? Self Employed

PEU: Primary Economic Unit.

▸ Back to Research Question ◂ Back to Calibration

Optimality in Period 2

- Let $V(x)$ be the utility in the old age as a function of wealth in the old age, x,

$$V(x) = \max_{c_2, b^s} \left\{ u(c_2) + \eta v\left(b^{s,net}\right) \right\},$$

$u(\cdot)$ and $v(\cdot)$ are strictly increasing, strictly concave, and two times continuously differentiable in their arguments.

- The optimal allocation in the old age:

$$u'(c_2) = \eta(1 - \tau^b) v'\left(b^{s,net}\right).$$

Back to Model

Optimality in Period 1

- Individual maximizes expected utility,

$$\max_{c_1, s, \pi} \left\{ u(c_1) + \beta \left[pV(x) + (1-p)\eta v \left(b^{d,net} \right) \right] \right\},$$

subject to (**??**), (**??**), and (3),
where $V(x)$ and $b^{d,net}$ are expressed by (3) and (**??**), respectively.

◂ Back to Model

Simplify Analysis

- (**??**) and (3) solve for c_2 and b^s given x.
- Define the marginal propensity to consume out of the total wealth, θ, such that $c_2 = \theta x$ satisfying $u'(\theta x) = \eta v'\left((1-\tau^b)(1-\theta)x + \tau^b \cdot ex\right)$.

$\Rightarrow \theta \in [0,1]$ is determined by the optimal allocation in Period 2.

Back to Model

Optimal Choice

- Euler Equations:

$$u'(w - s - \pi) = \beta p(1 + r)u'(\theta x) + \beta\eta(1 - p)(1 + r)\left(1 - \tau^{b}\right) v'\left(b^{d,net}\right),$$

$$u'(w - s - \pi) = \beta(1 + r)u'(\theta x),$$

where x is a function of s and π.

$\Rightarrow$ These two equations solve for s and π.

Back to Model

Optimal Choice (Cont.)

- Define $H(\cdot)$ as the inverse function of $u'(\cdot)$.
  - $H(\cdot) > 0$ and is strictly decreasing.

$$s = \frac{p}{1-p}\left(-\frac{H\left(\eta\left(1-\tau^{b}\right)\right)}{\theta(1+r)} - \frac{H\left(\beta\eta(1+r)\left(1-\tau^{b}\right)\right)}{p} + \frac{Tr}{1+r} + \frac{w}{p}\right),$$

$$\pi = \frac{p}{1-p}\left(\frac{H\left(\eta\left(1-\tau^{b}\right)\right)}{\theta(1+r)} + H\left(\beta\eta(1+r)\left(1-\tau^{b}\right)\right) - \frac{Tr}{1+r} - w\right).$$

Back to Model

Calibration (External)

Table: External Parameters

Parameters	Values	Sources/Targets
Demographics & Preferences		
Probability of staying young: π_y	0.978	Average Working life: 45 years
Probability of staying old: π_o	0.909	Average Retirement: life 11 years
Risk aversion: σ	1.5	Standard in literature
Technology		
Capital share: α	0.33	Guvenen et. al. (2024)
Total Factor Productivity: Z	1	Normalisation
Entrepreneur's return to scale: ν	0.88	Imrohorgulu et. al (2023)
Annuity Load: λ	0.18	Aranjelovic et. al (2023)
Persistence: ρ	0.95	Guvenen et. al. (2023)
Government		
Wealth tax rate: τ_a	0.0	IRS
Estate tax rate: τ_b	0.18	IRS
Consumption tax rate: τ_c	0.11	Altig et. al. (2001)
Government spending to output: g	0.187	Economic Report of the president
Government debt to capital ratio: D	0.27	US Treasury
Income Tax		
b_0 b_1	0.32 0.26	?

Calibration (Target)

Table: Calibrated Parameters

Parameters	Values	Targets
Discount factor: β	0.905	$\frac{K}{Y} = 3.00$
Level of altruism: η	0.79	Annuity Ownership
Depreciation rate: δ	6.5%	Interest rate $= 2.86\%$
Entrepreneurial ability: θ	$\{0, 1.09\}$	Entrepreneurs in the Economy
Entrepreneurial capital share: γ	0.84	Hiring Entrepreneurs
Entrepreneur's borrowing constraint: d	1.10	Median Net worth Entrp. to Worker
Productivity shock standard deviation: σ_y	0.18	Income and wealth distribution
Estate tax exemption level: ex (Normalised)	100	% Estates paying taxes
State/local tax rate: τ_p	0.033	Balance Budget

Back to Calibration

Calibration (Targeted Moments)

Table: Targeted Moments

Targeted Moments	Model	Data	Sources
Entrepreneurship			
Entrepreneurs (%)	7.73	7.12	SCF(2022)
Exiting entrepreneurs (%)	22.19	22-24	Bassetto et al. (2015)
Workers entering entrepreneurship (%)	2.34	2-3	Bassetto et al. (2015)
Hiring entrepreneurs (%)	50.18	56.98	SCF(2022)
Median net worth: entrepreneurs/workers	6.7	6.0	SCF(2022)
Inequality			
Worker income Gini	0.54	0.51	SCF(2022)
Wealth Gini	0.84	0.85	SCF(2022)
Households with zero wealth (%)	14.93	11.71	SCF(2022)
Annuities and Estate Tax			
Estates paying taxes (%)	1.91	1.5-2.0	IRS
Annuity ownership rate (%)	5.01	5.0	Pashchenko (2013)

Back to Calibration

Data

- 2022 Survey of Consumer Finances (SCF 2022).
- A triennial cross-sectional survey of US families.
- Includes results of 4602 households.
- Calculated moments for income and wealth distributions, entrepreneurial shares.

Who are entrepreneurs?

Back to Calibration

Individual Decision Problem: Young

$$V_t^{Y}(a_t, y_t, \theta_t) = \max\left\{V_t^{Y,e}(a_t, y_t, \theta_t), V_t^{Y,w}(a_t, y_t, \theta_t)\right\},$$

$$\begin{aligned} V_t^{Y,e}(a_t, y_t, \theta_t) = \max_{c_t, a_{t+1}, k_t, n_t} & \Big\{u(c_t) + \beta\pi_y E_t\left[V_{t+1}^{Y}(a_{t+1}, y_{t+1}, \theta_{t+1})\right] \\ & + \beta(1-\pi_y)E_t\left[W_{t+1}^{O,e}(a_{t+1}, \theta_{t+1})\right]\Big\}, \end{aligned}$$

$$\begin{aligned} V_t^{Y,w}(a_t, y_t, \theta_t) = \max_{c_t, a_{t+1}, k_t, n_t} & \Big\{u(c_t) + \beta\pi_y E_t\left[V_{t+1}^{Y}(a_{t+1}, y_{t+1}, \theta_{t+1})\right] \\ & + \beta(1-\pi_y)\left[W_{t+1}^{O,r}(a_{t+1})\right]\Big\}, \end{aligned}$$

Back to Model

Individual Decision Problem: Old

$$V_t^{O}(a_t, \Delta_t, \theta_t) = \max\left\{V_t^{O,e}(a_t, \Delta_t, \theta_t), V_t^{O,r}(a_t, \Delta_t)\right\},$$

$$\begin{aligned} V_t^{O,e}(a_t, \Delta_t, \theta_t) = \max_{c_t, a_{t+1}, k_t, n_t} & \Big\{u(c_t) + \beta\pi_o E_t\left[V_{t+1}^{O}(a_{t+1}, \Delta_t, \theta_{t+1})\right] \\ & + \beta(1-\pi_o)E_t\left[V_{t+1}^{Y}(a_{t+1}^{net}, y_{t+1}, \theta_{t+1})\right]\Big\}, \end{aligned}$$

$$V_t^{O,r}(a_t, \Delta_t) = \max_{c_t, a_{t+1}} \Big\{u(c_t) + \beta\pi_o E_t\left[V_{t+1}^{O,r}(a_{t+1}, \Delta_t)\right] + \beta(1-\pi_o)E_t\Big[V_{t+1}^{Y}(a_{t+1}^{net}, y_{t+1}, \theta$$

Back to Model