Sustainable Social Security : Four Options

Sagiri Kitao

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Introduction

- Ongoing demographic shift
  - Life-expectancy: 68 years in 1950, 77 in 2000, 85 in 2100.
  - Total fertility rate: 3.0 in 1950, 2.0 in 2000.
  - Old-age dependency ratio: 22% in 2010, 38% in 2050, 45% in 2100.
- Social security is unsustainable (as it is)
  - OASI Trust Fund will start to decline in 2017 and be exhausted by 2038.
  - Unfunded liabilities of social security today: $17.9 trillion.
- Some legislative action will be needed rather urgently.

Introduction

- What policy can make the social security sustainable under the coming demographic shift?

- Build an economic model to answer the question.
  - Simple accounting exercise is not enough.

- Consider an example in which "dependency ratio" doubles.

	Age 20-65	Age > 65		
Now	100	20		
Future	100	40		

- Consider an example in which "dependency ratio" doubles.

	Age 20-65	Age > 65	Dependency ratio	
Now	100	20	20%	
Future	100	40	40%	

- Consider an example in which "dependency ratio" doubles.

	Age 20-65	Age > 65	Dependency ratio	Payroll tax rate
Now	100	20	20%	10%
Future	100	40	40%	20%

- Suppose each worker 20-65 makes $1.0 (tax base) and every retiree above 65 (not working) receives $0.5 pension benefit.
- Payroll tax needs to rise by 10 percentage points from 10% to 20% to sustain the budget.

1. Tax increase to finance the demographic change

- What if more elderly participate, people work longer, and wage increases?

Number of workers	Earning	Tax base	Change in tax rate
100	$1.00	$100	+10.0%

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More elderly (1/3) participate

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113	$1.05	$119	+6.9%

Wage rate increases

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113	$1.10	$124	+6.1%

Work hours increase

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- Suppose benefits are reduced by 50%.

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- Again, what if individuals respond by working even more, and saving aggressively (pushing up the wage rate).

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More elderly participate

Work hours & wage increase

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120	$1.20	$144	$10	-3.1%

This paper

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II. Present policy options to make the social security sustainable under the coming demographic shift and quantify the magnitude of adjustment.

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2. Reduce the benefit replacement rates
3. Raise the retirement age
4. Means-test the benefits

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I. Build a general-equilibrium life-cycle model of individuals with endogenous labor supply (hours and participation), saving and consumption.

II. Present policy options to make the social security sustainable under the coming demographic shift and quantify the magnitude of adjustment.

1. Increase the payroll taxes **by 6 percentage points**
2. Reduce the benefit replacement rates **by about one-third**
3. Raise the retirement age **from 66 to 73**
4. Means-test the benefits **and reduce them one-to-one with income**

Literature

1. General-equilibrium life-cycle models to study social security reforms
   - Auerbach and Kotlikoff (1987), Hubbard and Judd (1987), Imrohoroglu, Imrohoroglu, and Joines (1995), Rios-Rull (1996), Conesa and Krueger (1999), De Nardi, Imrohoroglu and Sargent (1999), Huggett and Ventura (1999), Kotlikoff, Smetters and Walliser (2007), Nishiyama and Smetters (2007), Attanasio, Kitao and Violante (2007), etc.
   - Simulations with ad hoc reforms (full privatization, 50% benefit cut, etc)
   - Exogenous labor supply or participation

2. Models with endogenous participation and hours
   - Imrohoroglu and Kitao (2011), Diaz-Gimenez and Diaz-Saavedra (2009)
   - Rogerson and Wallenius (2009), Prescott, Rogerson, and Wallenius (2009)

MODEL

Model: demographics

- Overlapping generations of individuals of age $j = 1, 2, \ldots, J$
- Conditional survival rates of s_j
- The size of new cohort grows at rate n

Model: endowments

- One unit of time each period → leisure or market work
- Earnings: $y_L = \widetilde{\omega} h$
  - Work hours h
  - Wage rate per hour $\widetilde{\omega}$

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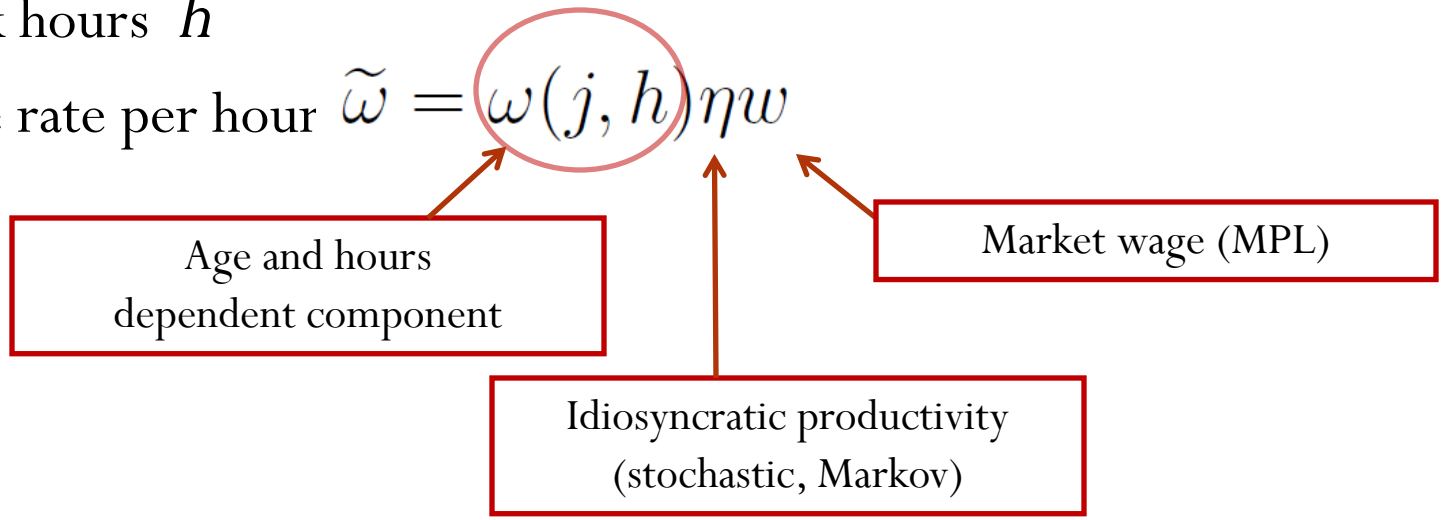

Model: preferences

- $u(c, h)$: period utility function
- $u_B(b)$: warm-glow bequests
- β : subjective discount factor

Model: technology

- Single good is produced according to neoclassical aggregate production function:

$$Y = F(K, L) = AK^{\alpha}L^{1-\alpha}$$

- Capital depreciates at $\delta \in (0, 1)$

Model: social security

- Pay-as-you-go social security system
  - Benefit is a concave function of career-average earnings
  - Payroll tax imposed on earnings up to the maximum y^s
- Normal retirement age (NRA) 66

Government budget

$$G + (1+r)D + \sum_x ss(x)\mu(x) =$$

$$\sum_x \left[\tau^l \tilde{\omega} h(x) + \tau^s \min\{\tilde{\omega} h(x), y^s\} + \tau^k r(a(x)+b) + \tau^c c(x)\right] \mu(x) + D'$$

where $\mu(x)$ denotes the measure of individuals in state x.

Government budget

Government expenditures

Public debt plus interest

Social security benefit

$$G + (1+r)D + \sum_x ss(x)\mu(x) =$$

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Labor income tax

Social security tax

Capital income tax

Consumption tax

Debt issue

Government budget

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Labor income tax rate

Household problem

- States: $x = \{j, a, \eta, e\}$
  - j : age
  - a : assets
  - η : idiosyncratic labor productivity
  - e : average life-time earnings (represents social security wealth)

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- States: $x = \{j, a, \eta, e\}$
  - j : age
  - a : assets
  - η : idiosyncratic labor productivity
  - e : average life-time earnings (represents social security wealth)
- Controls: $\{c, h, a'\}$
  - c : consumption
  - h : work hours / labor supply
  - a' : assets (for next period)

Household problem

$$V(j,a,\eta,e) = \max_{c,h,a'} \{u(c,h) + \beta s_j E\left[V(j+1,a',\eta',e')\right] + (1-s_j)u_B(a')\}$$

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subject to

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$$a' \geq 0,$$

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subject to

$$\begin{aligned} c + a' &= (1+r)(a+b) + \tilde{\omega}h + ss(x) - T(x), \\ a' &\geq 0, \end{aligned}$$

where $T(x)$ denotes the taxes paid by an individual in state x.

$$T(x) = \tau^c c + \tau^k r(a+b) + \tau^l \tilde{\omega}h + \tau^s \min\{\tilde{\omega}h, y^s\}$$

Calibration

Calibration

- Model period : one year
- Sample unit : individuals (male and female)

Demographics

- Survival rates : life-tables of Bell and Miller(2005)
- Population growth : 1.2%

Endowments

- Wage per hour: $\widetilde{\omega} = \omega(j,h)\eta w$

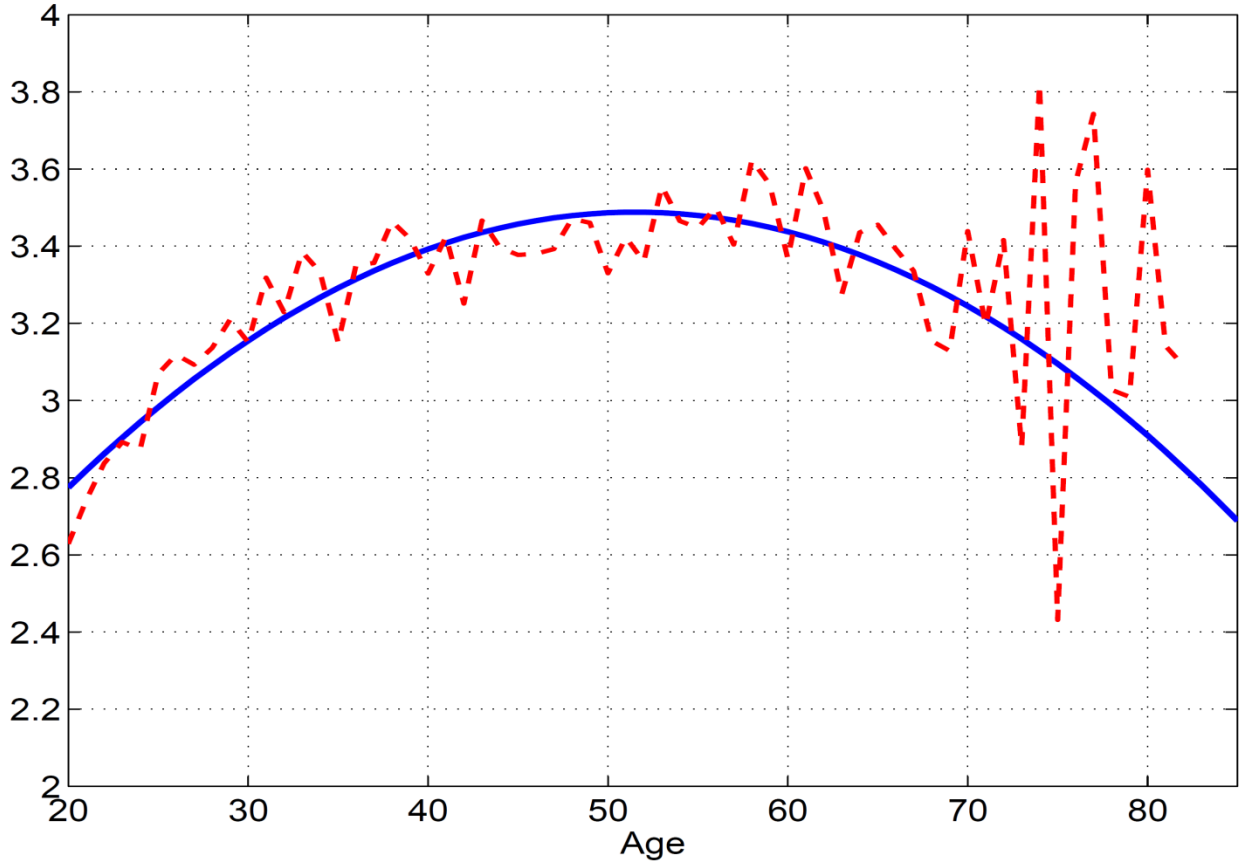
- η : AR(1) in log with a persistent parameter 0.97 and variance of the white noise 0.02 (Heathcote, et al. 2010)

- Age and hours dependent component:

$$\ln \omega(j,h) = \xi \ln h + \psi_j \ ; \qquad h \in [0,1]$$

  - ξ : part-time wage penalty set at 0.415 (Aaronson and French, 2004), which implies 25% lower wage if working 1000 hours rather than 2000 hours.
  - ψ_j : age-specific productivity, computed residuals net of hours effect from the PSID.

Age-dependent productivity ψ_j



Preferences

$$u(c,h) = \frac{c^{1-\sigma}}{1-\sigma} + \chi \frac{(1-h-\theta_j \cdot i_p)^{1-\gamma}}{1-\gamma}$$

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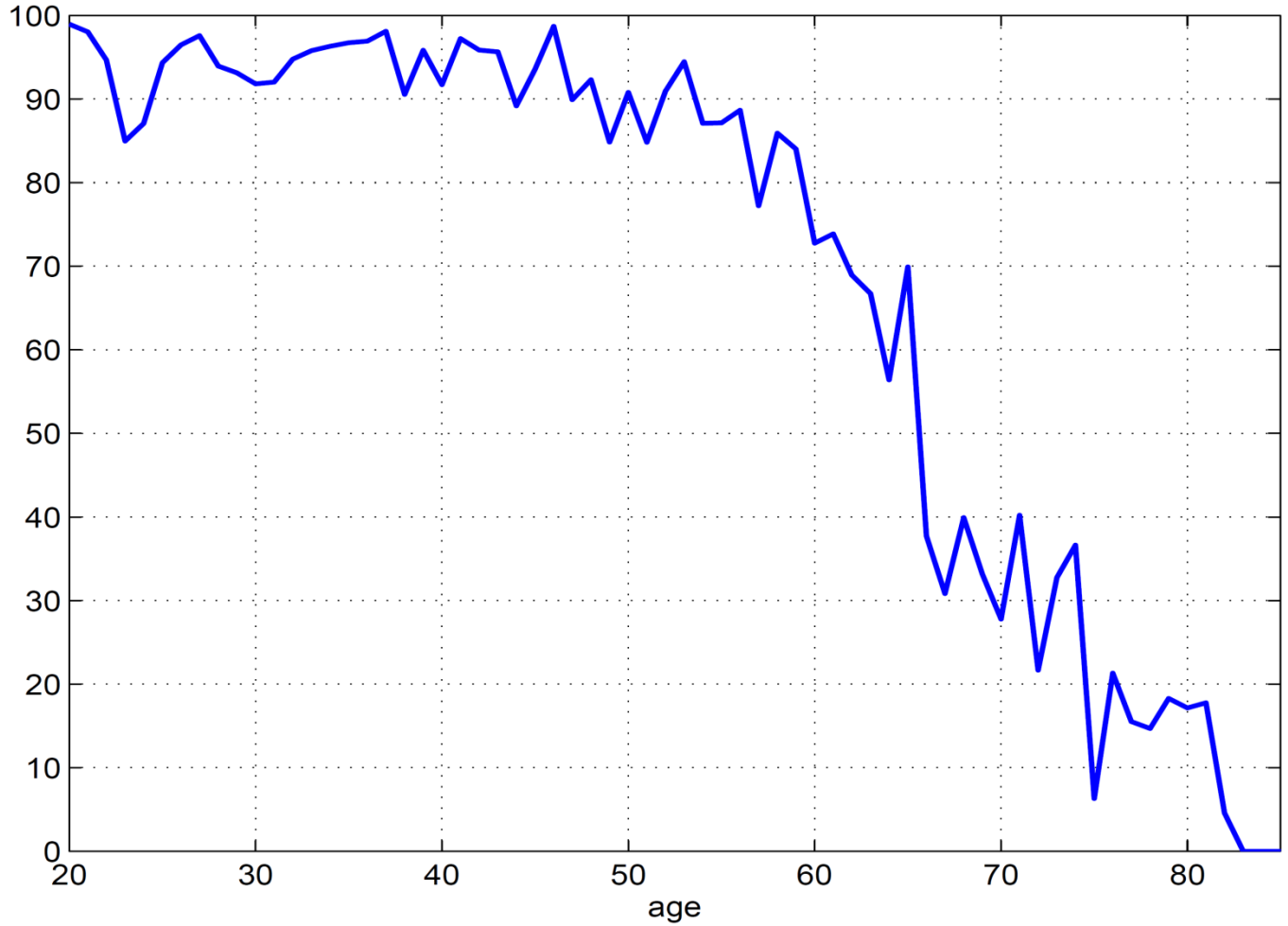
- σ : CRRA set at 2.0
- χ : relative weight between consumption and leisure utility, set so that market work accounts for 38% of disposable time
- γ : set at 4.0, implying the average Frisch elasticity of 0.32
- θ_j : disutility of participation, measured in terms of lost leisure time

Labor force participation (PSID)



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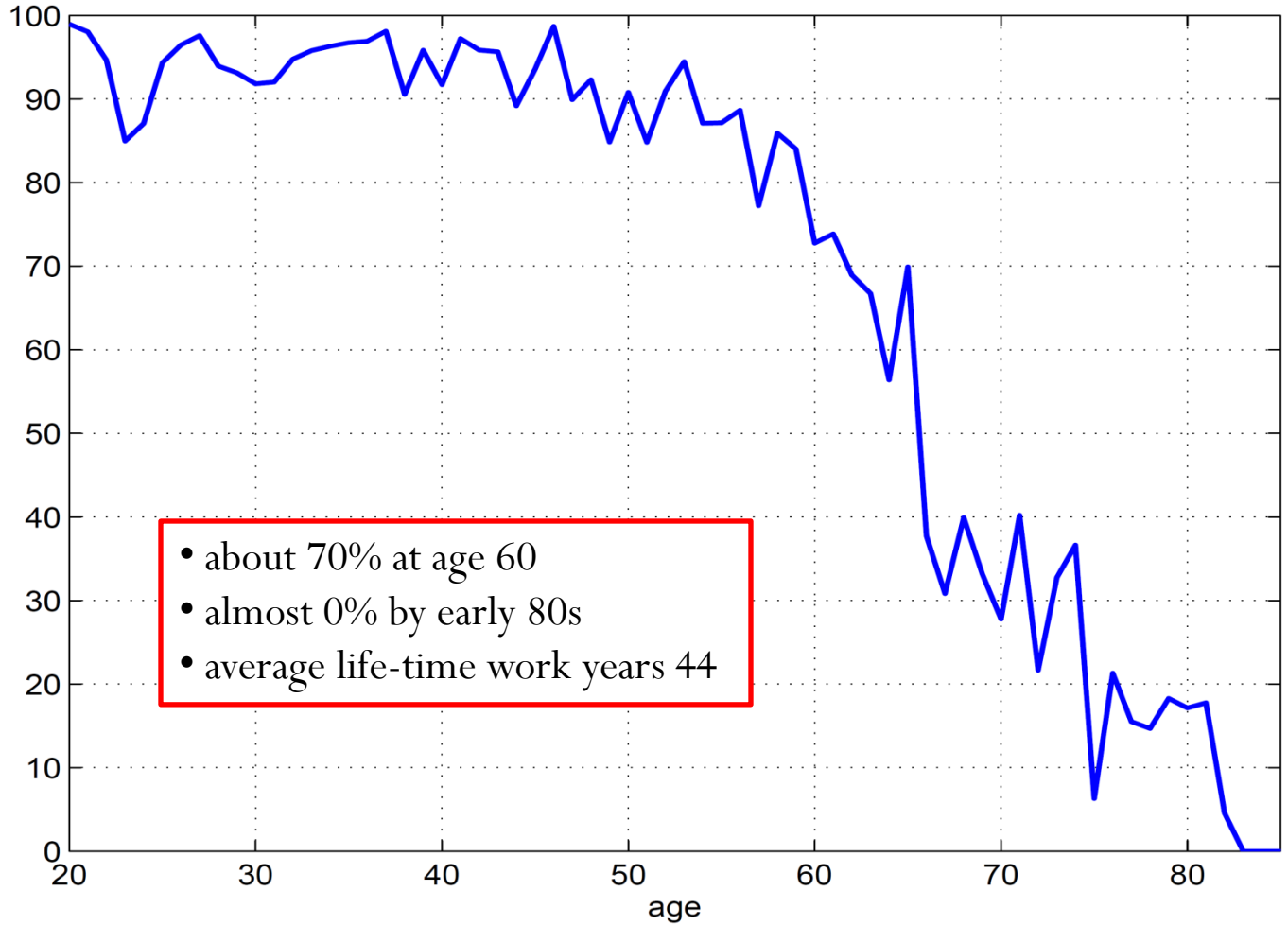

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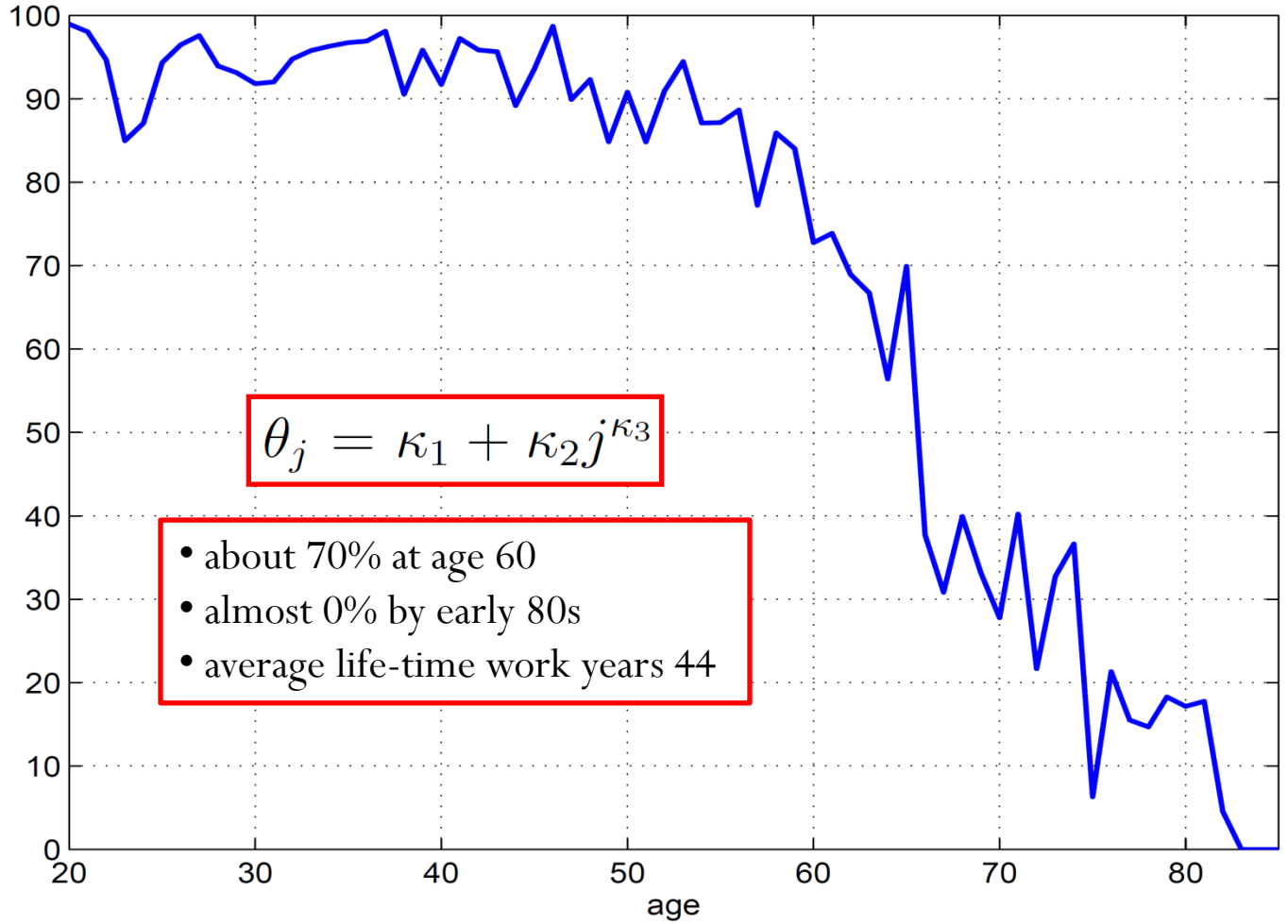
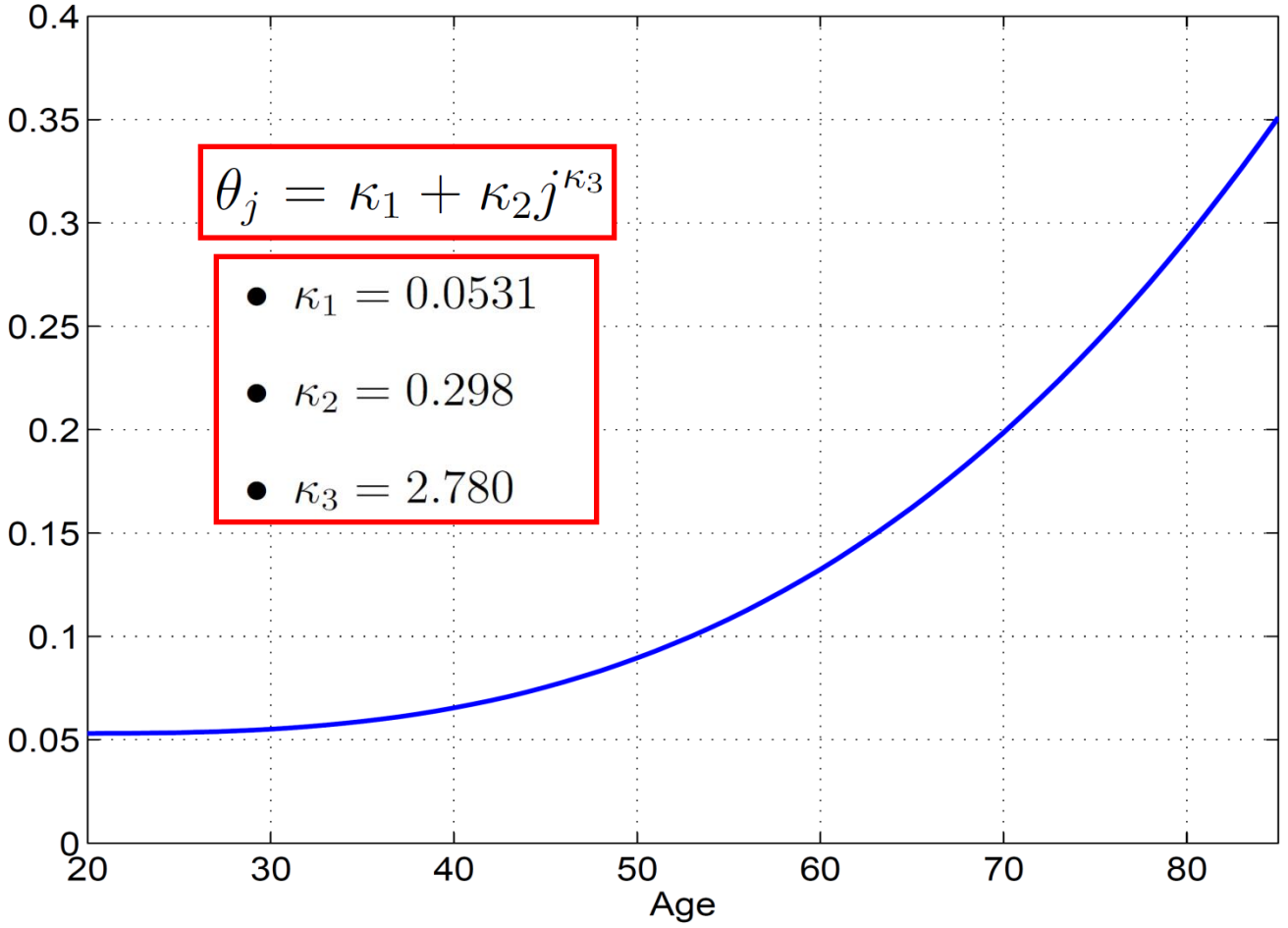


Participation cost θ_j



Preferences: utility from bequest

$$u_B(b) = \phi_B b$$

- ϕ_B : 0.44 so that the average wealth of the elderly is 50% above that of the young (20-64) as in the Survey of Consumer Finance (SCF).

Calibration: social security

- Payroll tax 10.6% up to $106,800
- Benefits ("PIA": *ss*) are determined as a concave function of the career-average earnings ("AIME": *e*)

$$PIA_t = \begin{cases} 0.9 \times AIME_t & \text{if} \quad AIME_t \leq \$9,132 \\ \$8,219 + 0.32 \times (AIME_t - \$9,132) & \text{if} \quad \$9,132 < AIME_t \leq \$55,032 \\ \$22,907 + 0.15 \times (AIME_t - \$55,032) & \text{if} \quad AIME_t > \$55,032 \end{cases}$$

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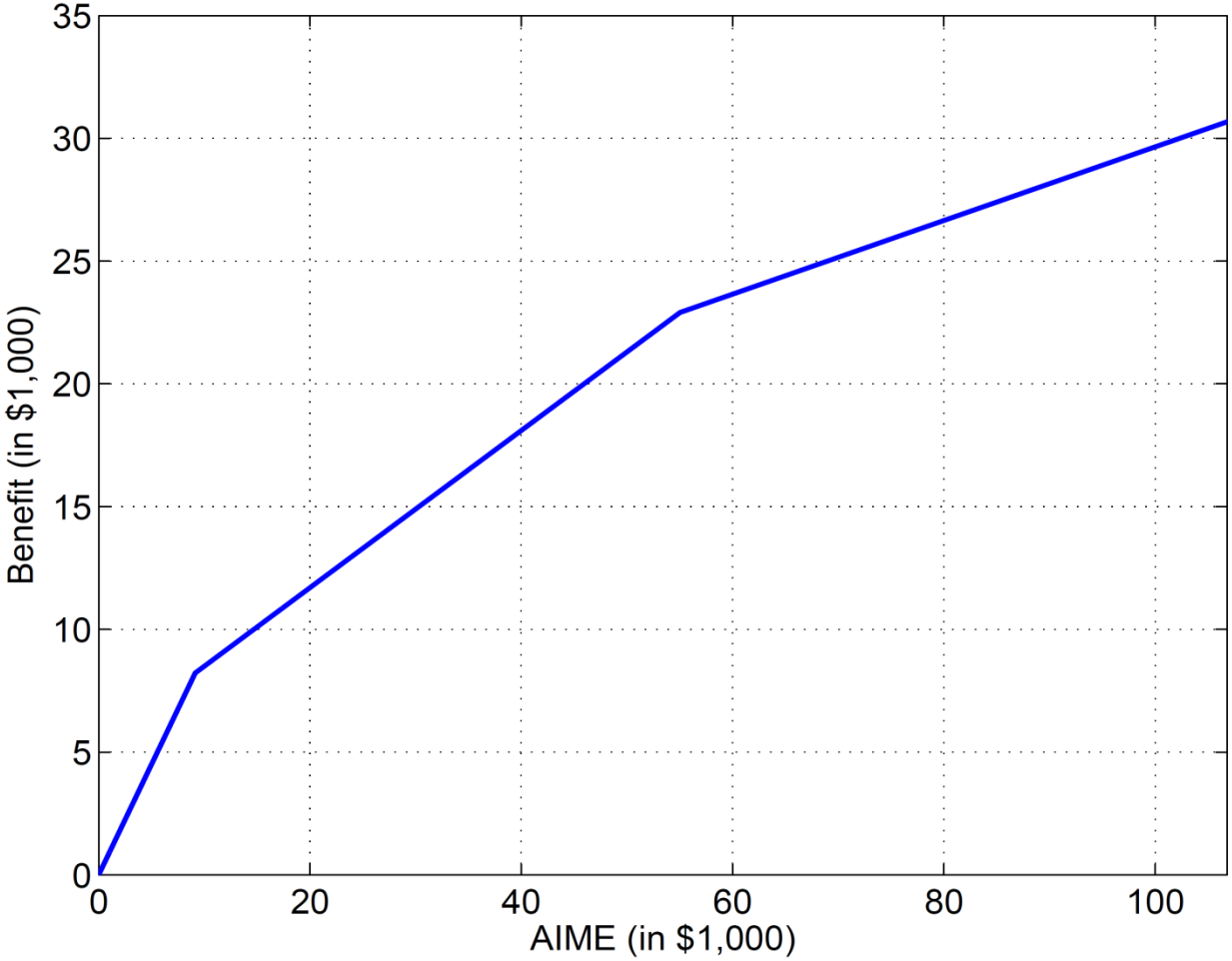

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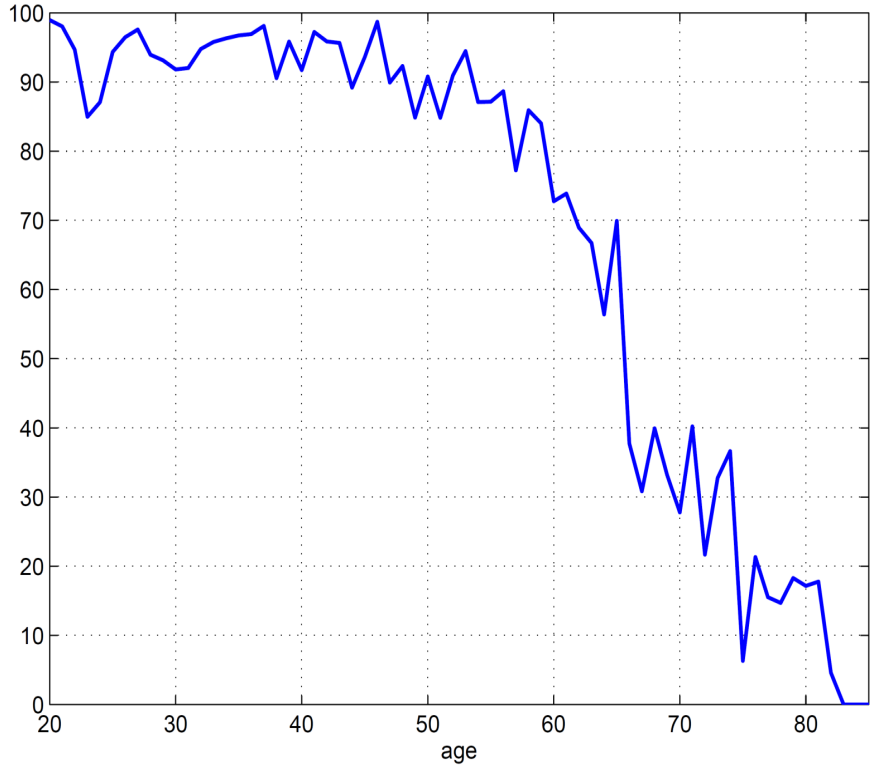
- The average replacement rate is about 40% in the benchmark economy.

Calibration: government

- Taxes
  - Consumption 5%
  - Capital income 30%
  - Labor income 22.1% (endogenous)
- Governemnt spending G : 20% of GDP
- Government debt D : 40% of GDP

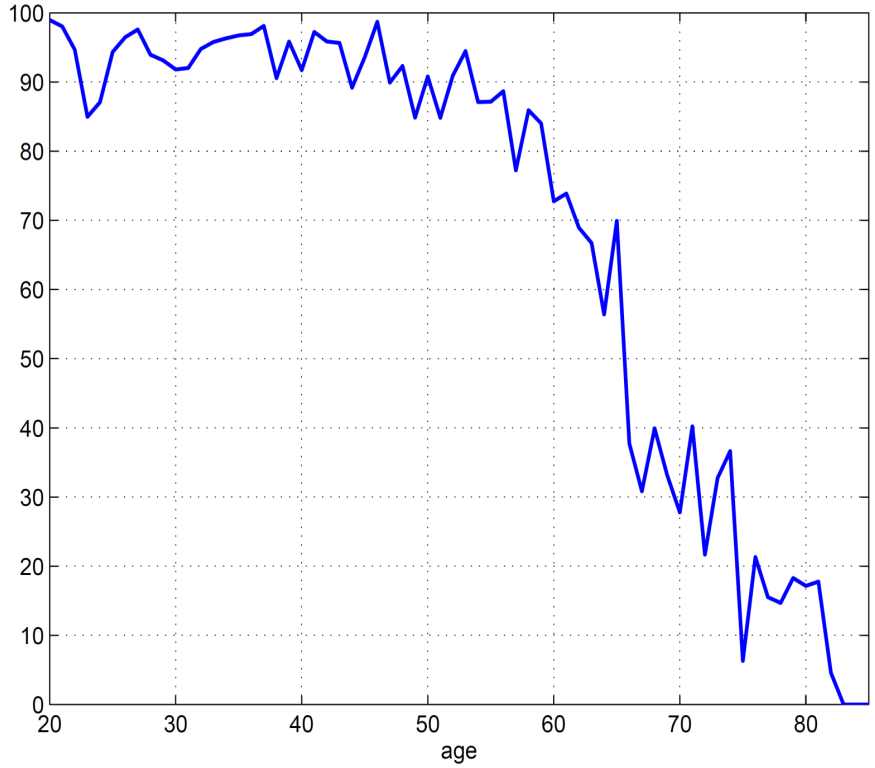
Numerical Results

Labor force participation



Data (PSID)

Labor force participation



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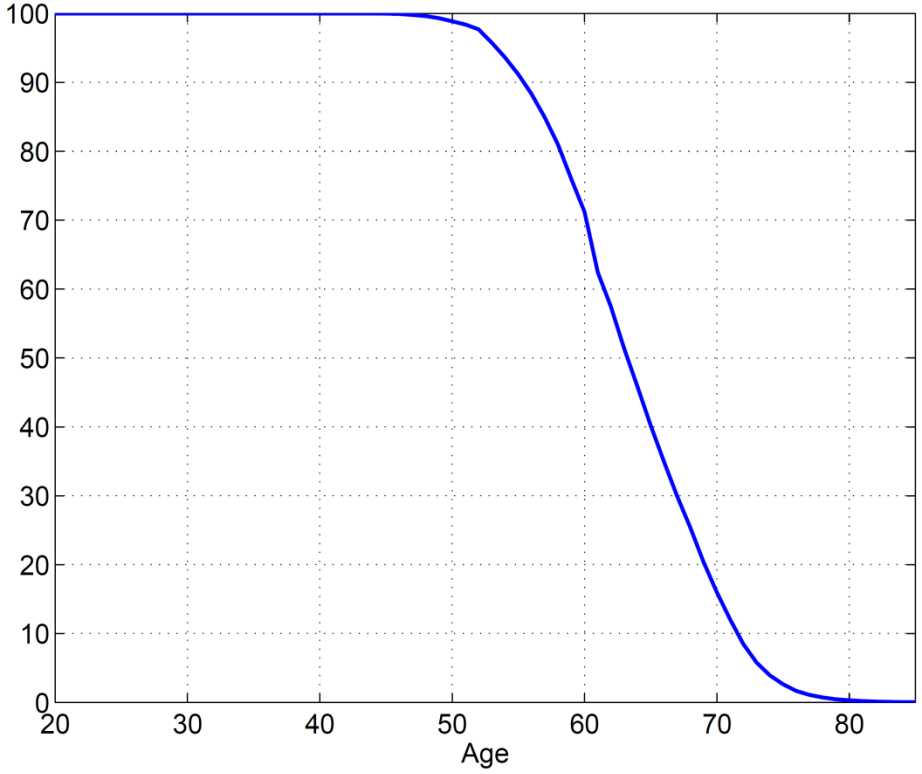
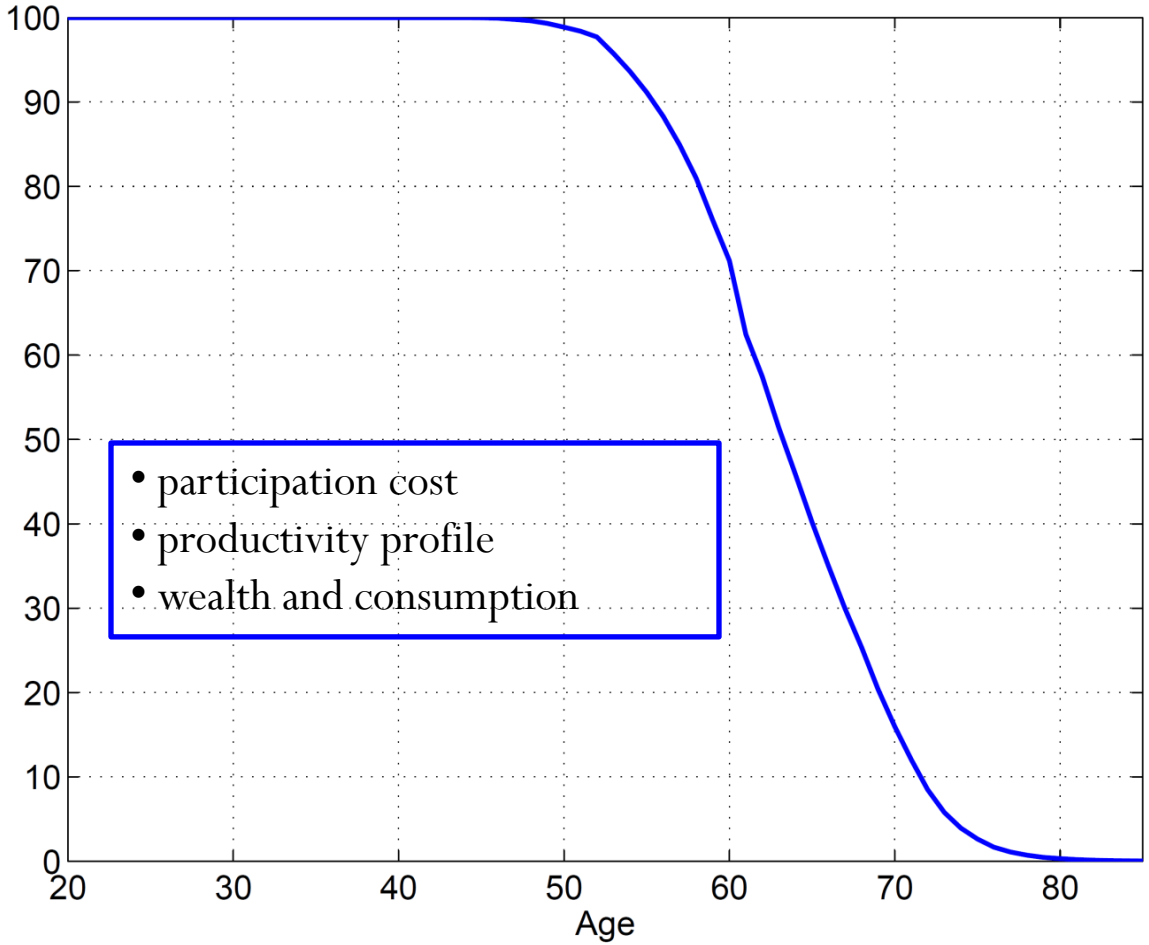


Benchmark model

Labor force participation



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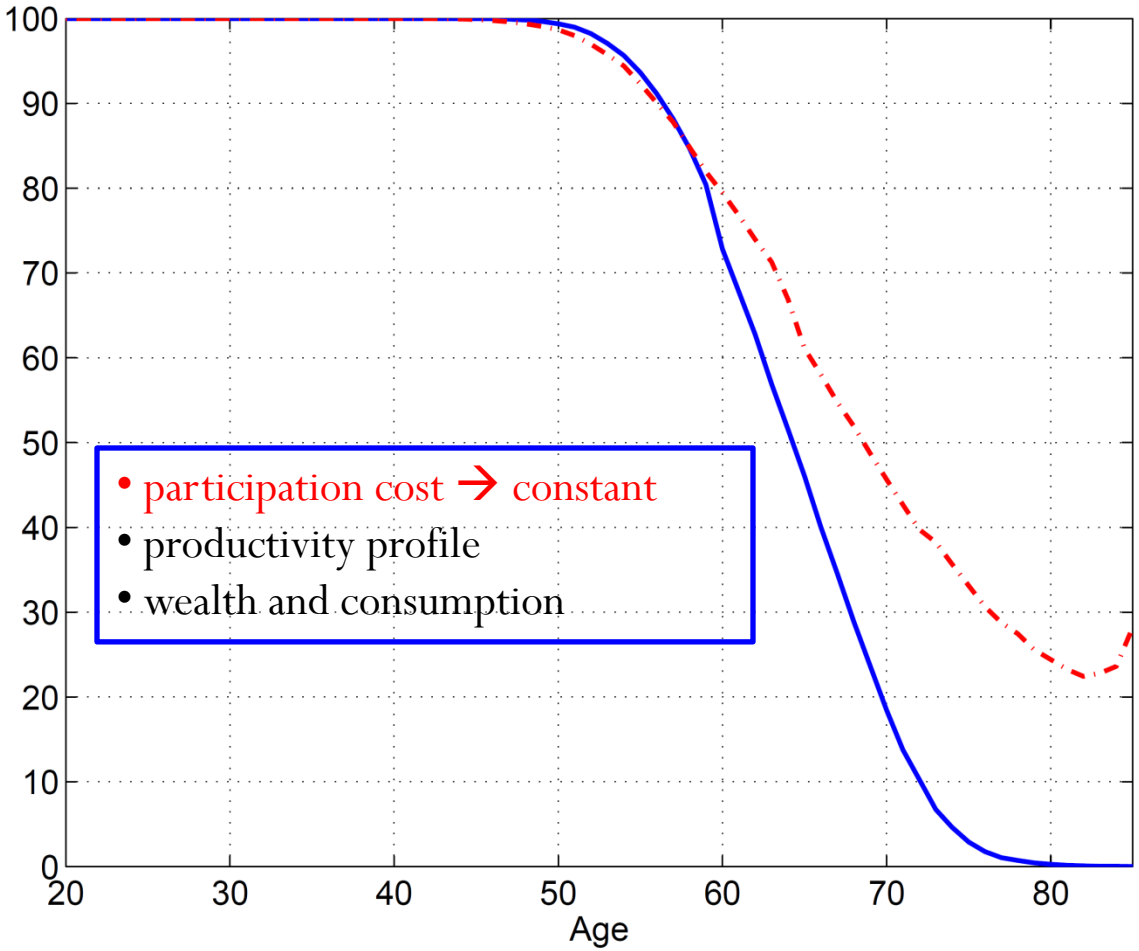

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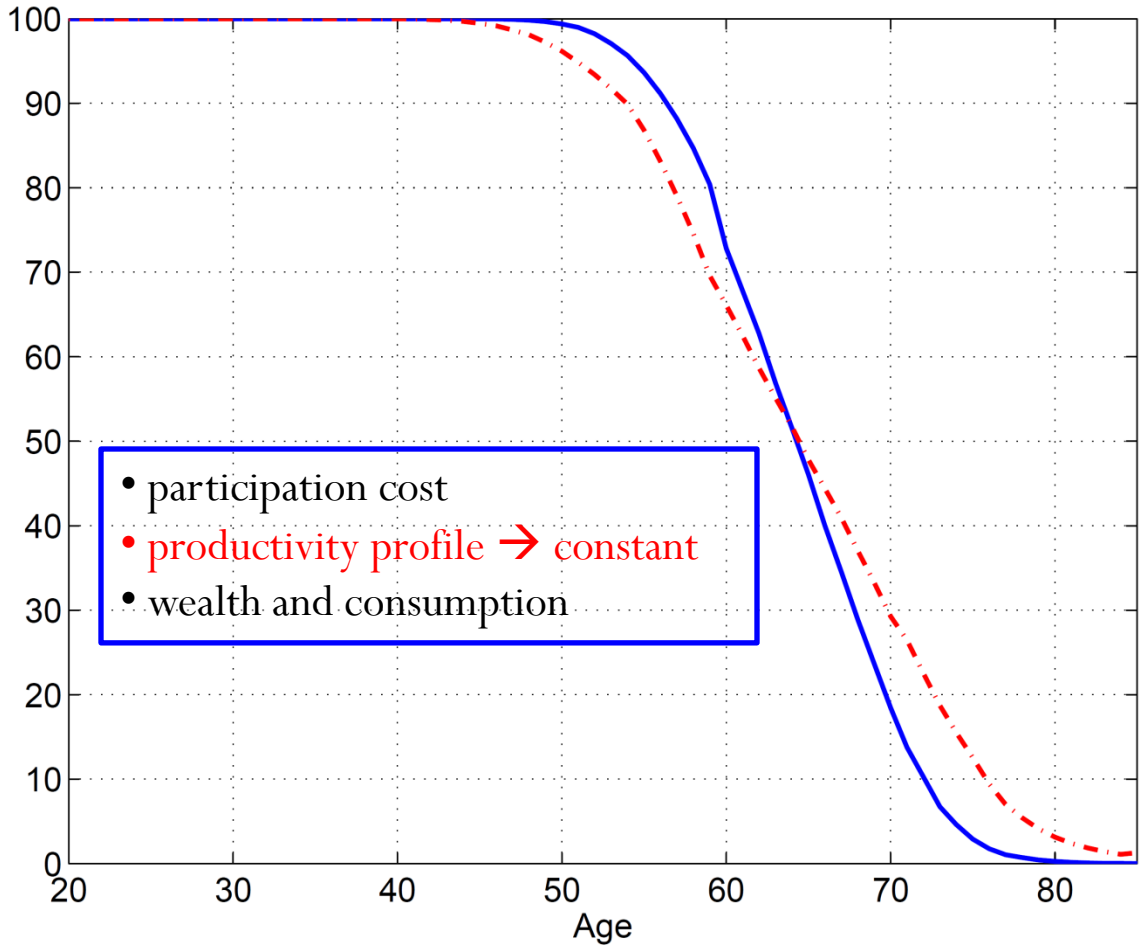
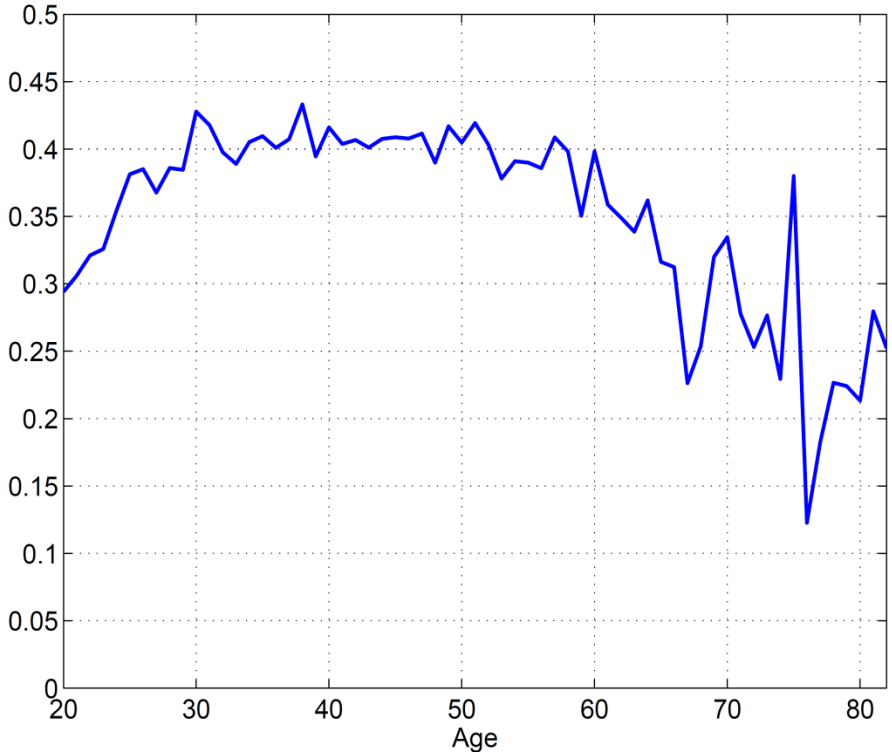


Work hours



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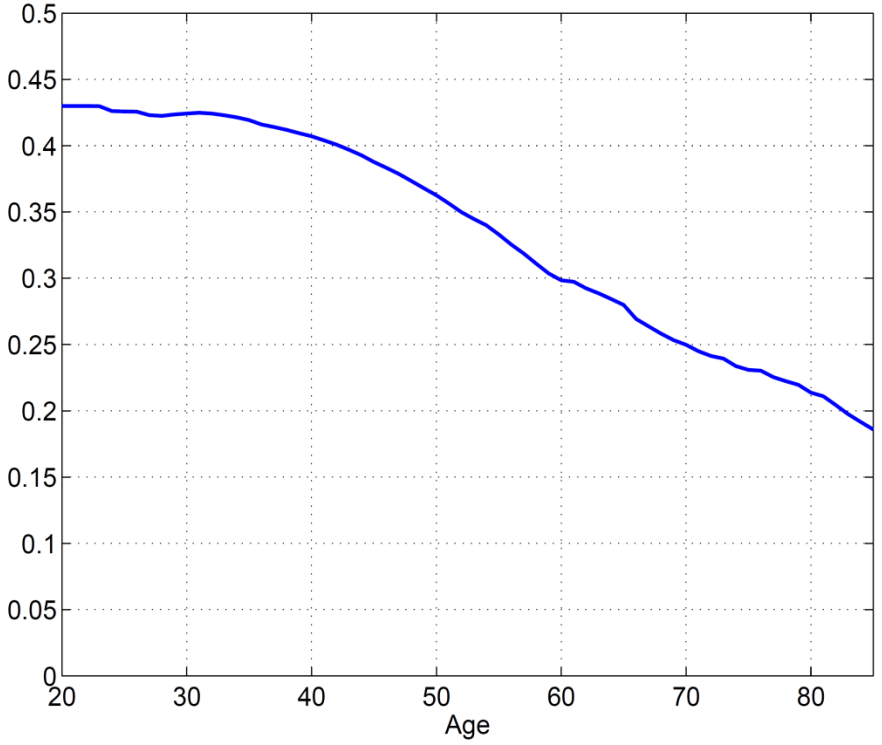
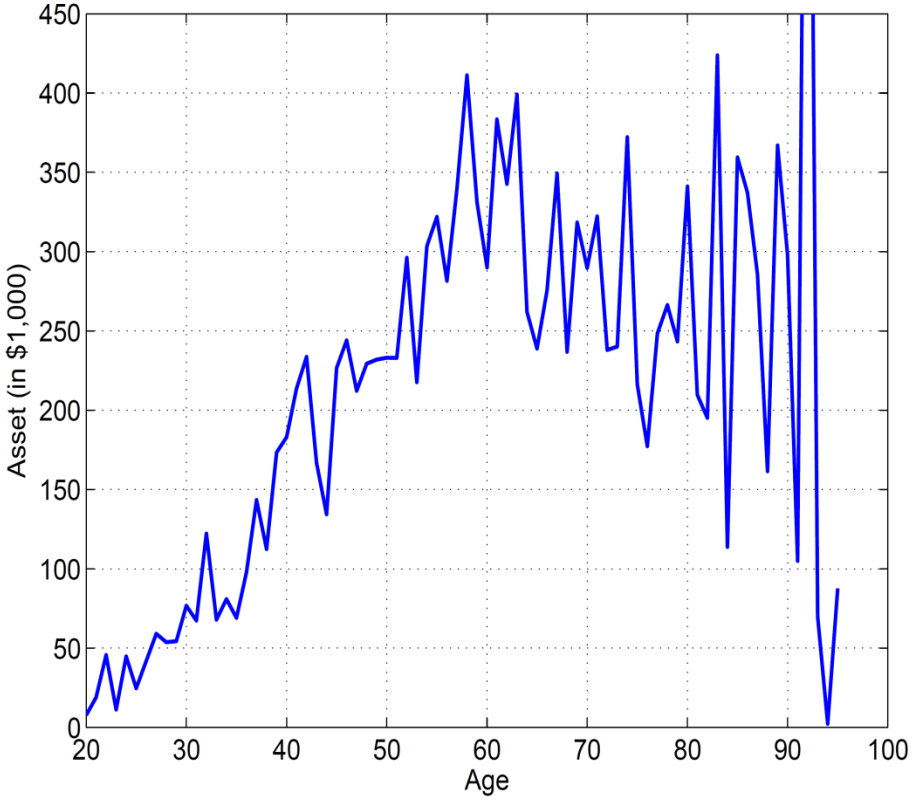
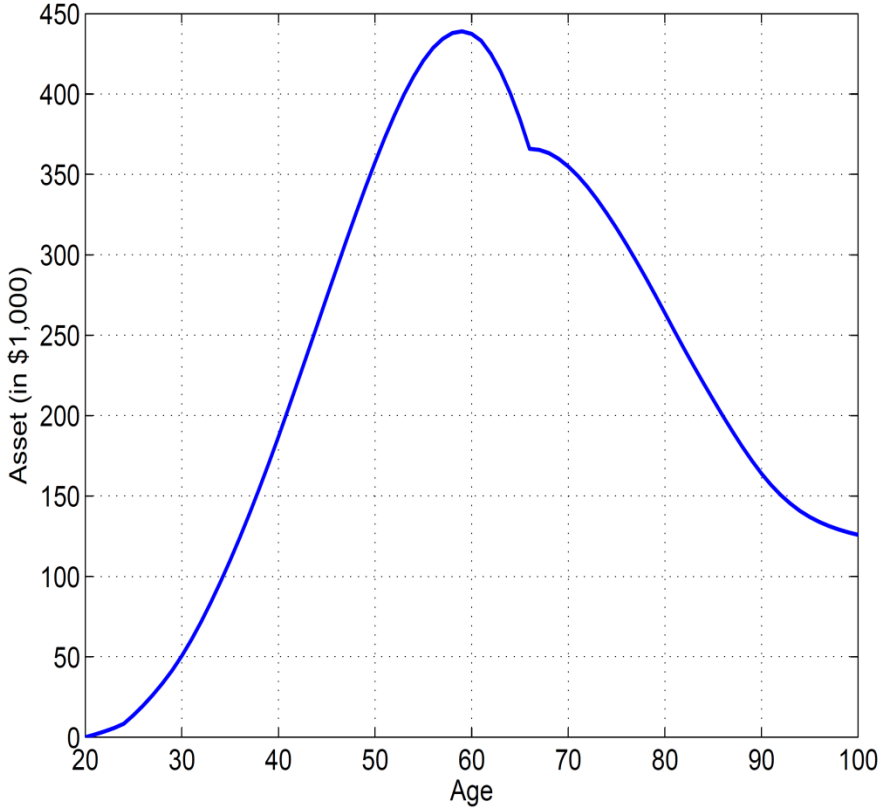


Benchmark model

Assets



Data (SCF)



Benchmark model

Social security

- Average replacement rate of 40%
- Social security runs a surplus of 0.44% of GDP

→ Changing the demographics (2010→2100) : "economy with aging"

- survival rates of 2100 (Bell and Miller, 2005)
- cohort growth rate of 0.5% (Census projection)
- dependency ratio rises from 25.2% to 41.9%

- Under "do-nothing policy", labor tax rises from 22.1% to 28.8%
- Social security runs a deficit of 3.3% of GDP

→ Now run policy experiments to balance the social security budget
Keep the government expenditures at the level of "do-nothing policy" (revenue neutral)

Policy options

- Consolidated budget (benchmark)

$$G + (1+r)D + \sum_x ss(x)\mu(x) =$$

$$\sum_x \left[\tau^l \tilde{\omega} h(x) + \tau^s \min\{\tilde{\omega} h(x), y^s\} + \tau^k r(a(x)+b) + \tau^c c(x)\right] \mu(x) + D'$$

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Policy options

Separate budgets

- Social security budget

$$\sum_x ss(x)\mu(x) = \sum_x \tau^s \min\{\tilde{\omega}h(x), y^s\}\mu(x)$$

- General government budget

$$G + (1+r)D = \sum_x \left[\tau^l \tilde{\omega}h(x) + \tau^k r(a(x)+b) + \tau^c c(x)\right]\mu(x) + D'$$

Policy options

- Benchmark economy

- Policy options (economy with aging)

1. Raise the social security tax
2. Reduce the benefit replacement rates
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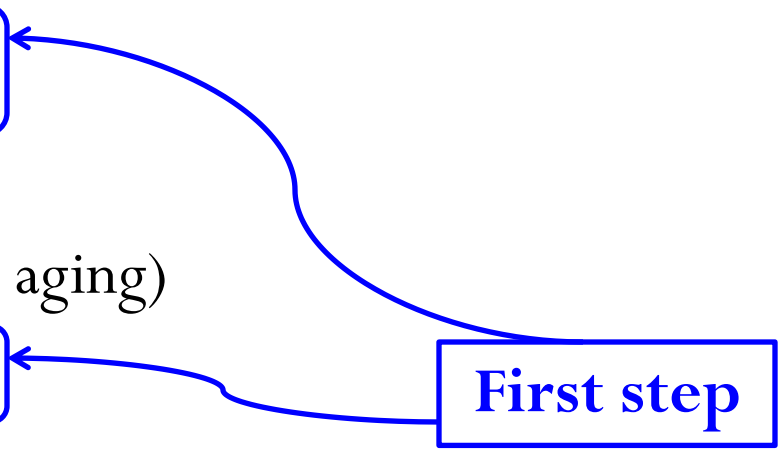

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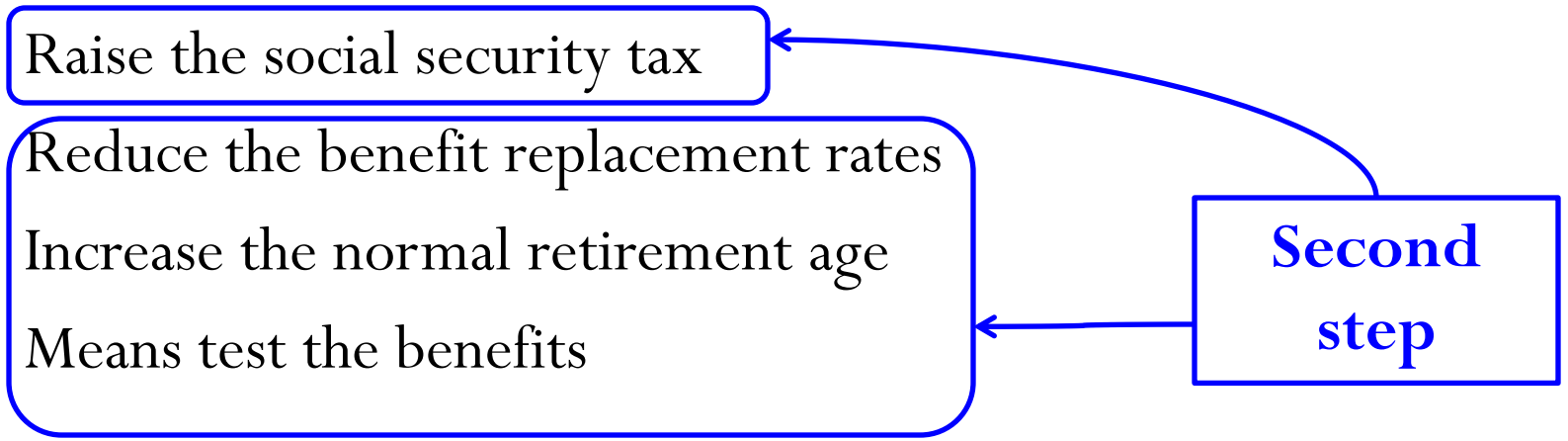

Benchmark vs economy with aging (Option 1)

	Benchmark	Economy w/ aging Option 1
Social security spending (per capita)	–	+54.1%
Total labor taxes	32.7%	39.4%
– labor income tax	22.1%	23.2%
– social security tax	10.6%	16.3%

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– social security tax	10.6%	16.3%
Avg work hours	–	+1.3%
Labor force participation		
– age 20-49	100.0%	100.0%
– age 50-64	81.0%	83.2%
– age 65-85	12.9%	13.0%
Avg work years	44.0	44.7

Benchmark vs economy with aging (Option 1)

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Social security spending (per capita)	–	+54.1%
Total labor taxes – labor income tax – social security tax	32.7% 22.1% 10.6%	39.4% 23.2% 16.3%
Avg work hours	–	+1.3%
Labor force participation – age 20-49 – age 50-64 – age 65-85 Avg work years	 100.0% 81.0% 12.9% 44.0	 100.0% 83.2% 13.0% 44.7
Capital (per capita)	–	−2.6%
Labor (per capita)	–	−7.5%
Consumption (per capita)	–	−3.0%
Wage	–	+2.1%

Policy options

1. Raise the social security tax
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Policy options

1. Raise the social security tax → **increase by 5.7%**
2. Reduce the benefit replacement rates
3. Increase the normal retirement age
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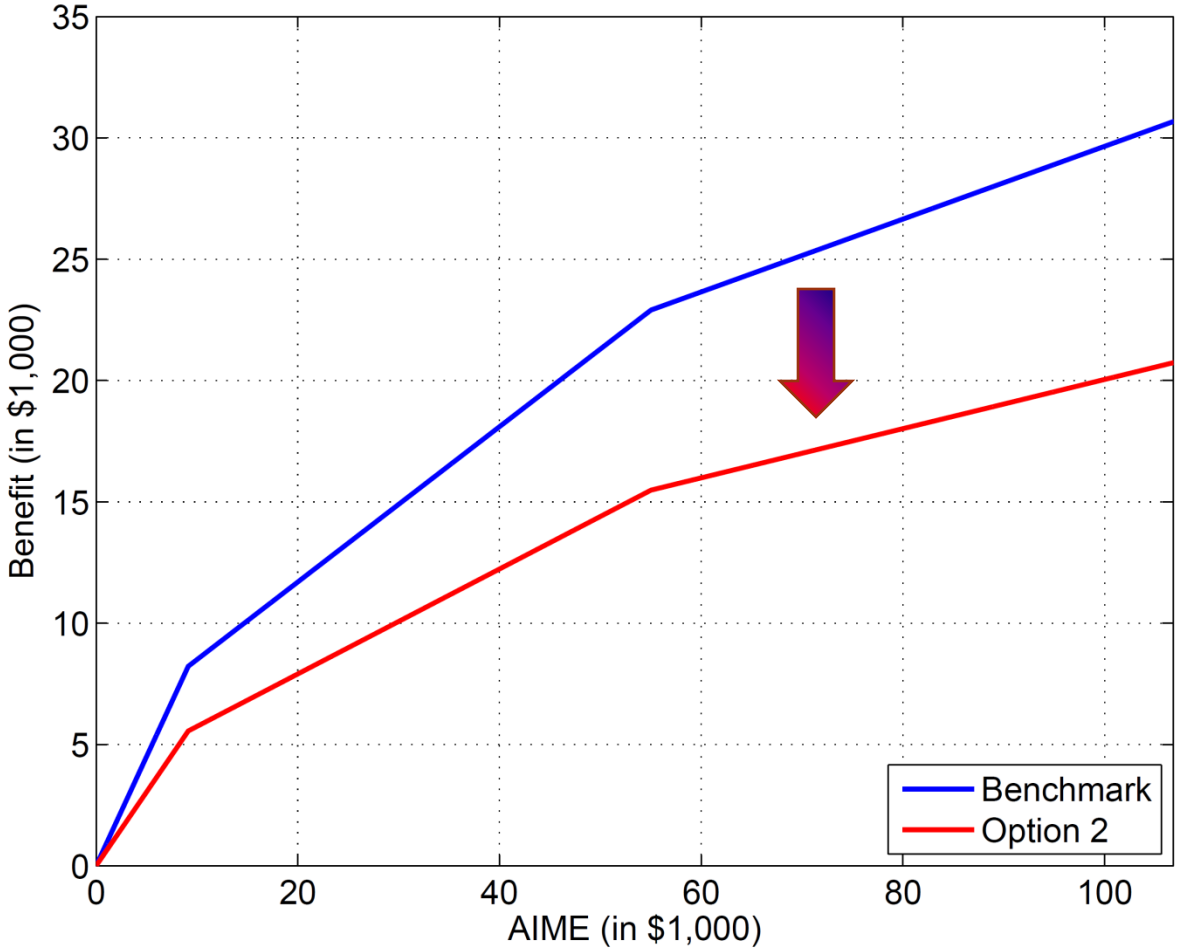
Four options

	Option 1 Tax increase
Capital	–
Labor	–
Avg work hours	–
Wage	–
Total labor tax – labor income tax – social security tax	**39.4%** **23.2%** **16.3%**
SS benefit spending SS replacement rate	– **38.8%**
Labor force participation – age 20-49 – age 50-64 – age 65-85 Avg work years	 **100.0%** **83.2%** **13.2%** **44.7**

Policy options

1. Raise the social security tax → **increase by 5.7%**
2. Reduce the benefit replacement rates → **reduce by 32.4%**
3. Increase the normal retirement age
4. Means test the benefits

Social security benefit : Option 2



Four options

	Option 1 Tax increase	Option 2 Benefit cut
Capital	–	**+14.4%**
Labor	–	**+0.6%**
Avg work hours	–	**−2.4%**
Wage	–	**+5.3%**
Total labor tax – labor income tax – social security tax	39.4% 23.2% 16.3%	**32.5%** **21.9%** **10.6%**
SS benefit spending SS replacement rate	– 38.8%	**−31.1%** **26.3%**
Labor force participation – age 20-49 – age 50-64 – age 65-85 Avg work years	 100.0% 83.2% 13.2% 44.7	 **100.0%** **88.2%** **19.3%** **46.8**

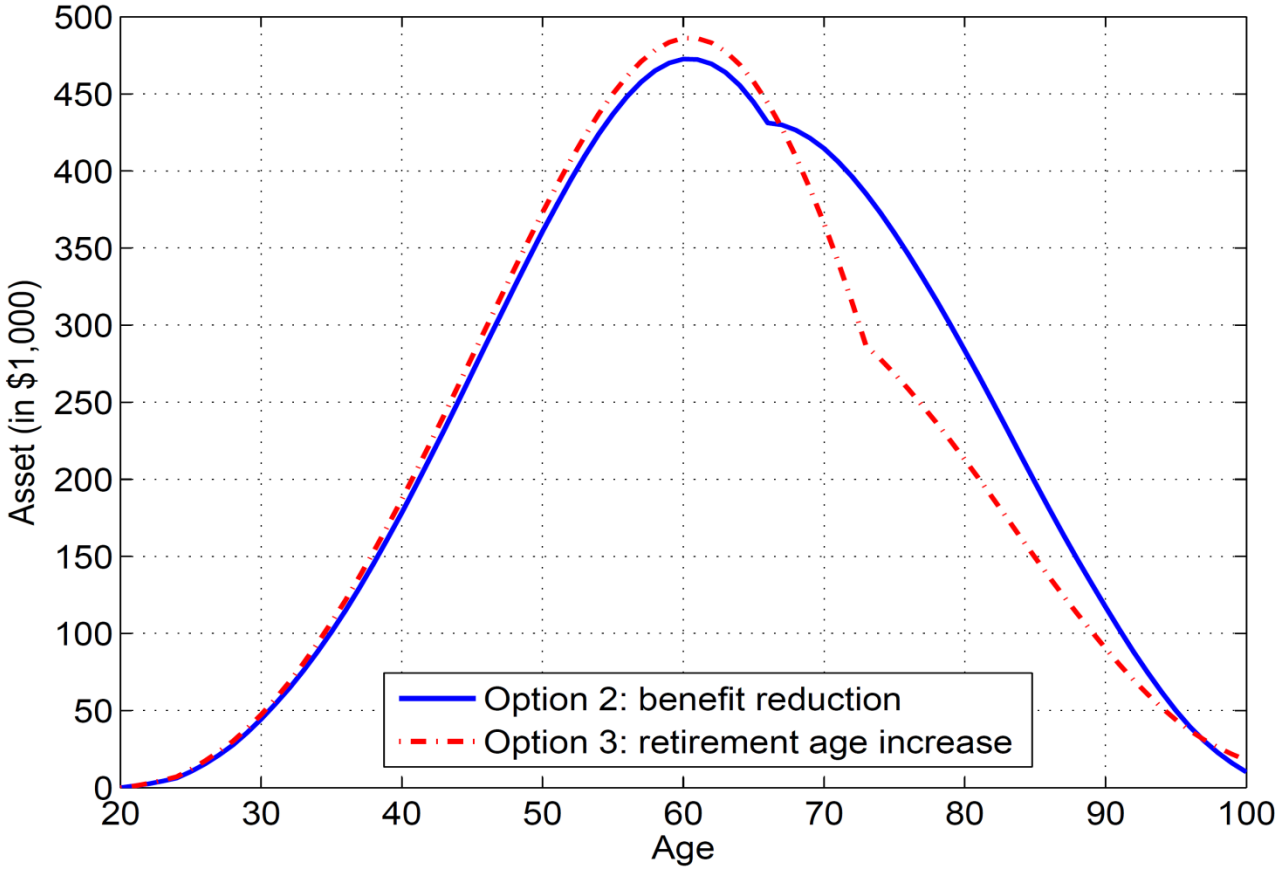
Policy options

1. Raise the social security tax → **increase by 5.7%**
2. Reduce the benefit replacement rates → **reduce by 32.4%**
3. Increase the normal retirement age → **from 66 to 73**
4. Means test the benefits

Four options

	Option 1 Tax increase	Option 2 Benefit cut	Option 3 Retire. age
Capital	–	+14.4%	**+10.1%**
Labor	–	+0.6%	**+0.8%**
Avg work hours	–	−2.4%	**−1.5%**
Wage	–	+5.3%	**+3.6%**
Total labor tax – labor income tax – social security tax	39.4% 23.2% 16.3%	32.5% 21.9% 10.6%	**32.9%** **22.3%** **10.6%**
SS benefit spending SS replacement rate	– 38.8%	−31.1% 26.3%	**−31.3%** **38.9%**
Labor force participation – age 20-49 – age 50-64 – age 65-85 Avg work years	 100.0% 83.2% 13.2% 44.7	 100.0% 88.2% 19.3% 46.8	 **100.0%** **87.3%** **18.1%** **46.3**

Asset profile: options 2 and 3



Policy options

1. Raise the social security tax → **increase by 5.7%**
2. Reduce the benefit replacement rates → **reduce by 32.4%**
3. Increase the normal retirement age → **from 66 to 73**
4. Means test the benefits → **reduce benefits 1-to-1 with income**

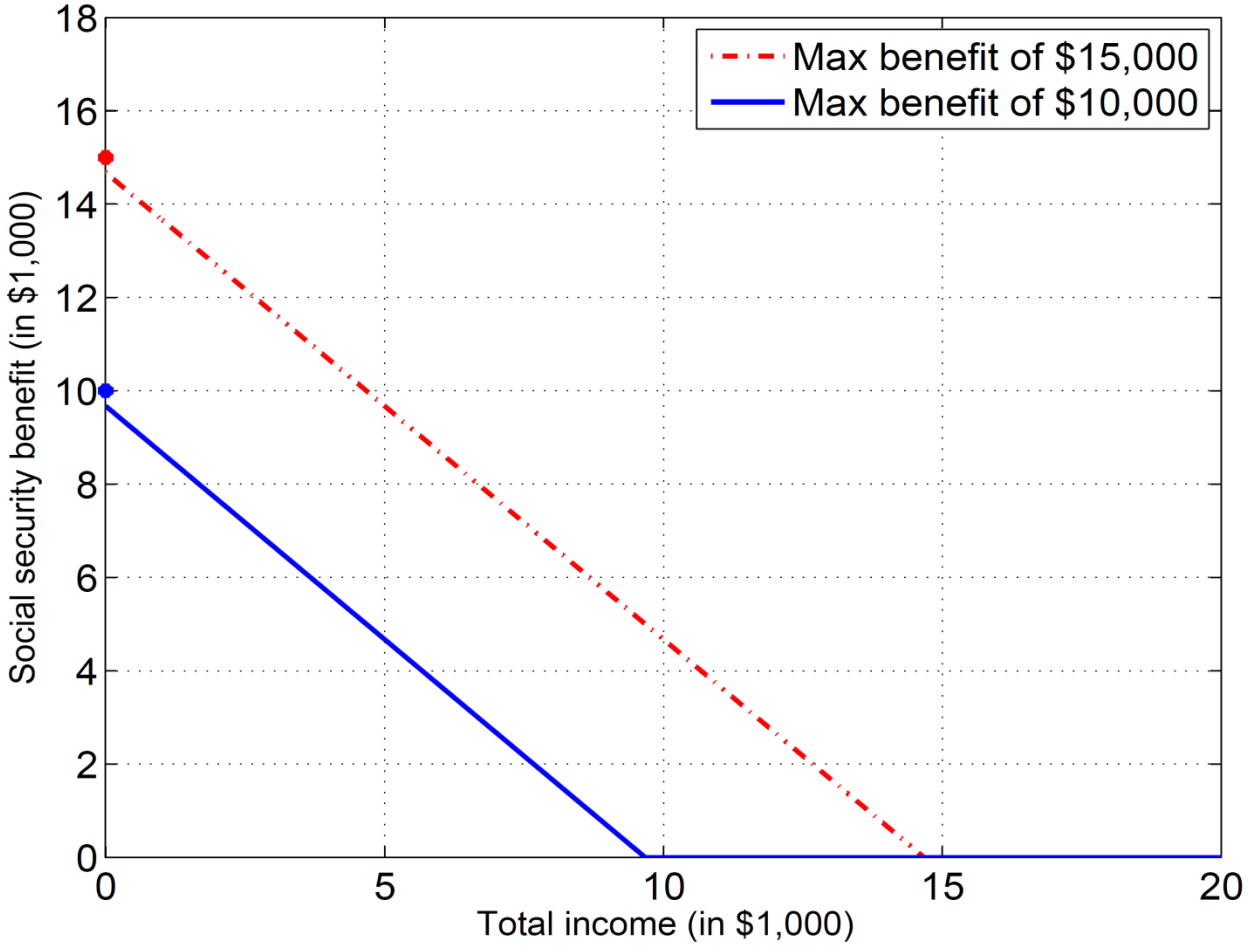
Option 4: means tested benefits

- Benefit:

$$ss = \max\{\overline{ss} - \max(y - \overline{y}, 0), 0\}$$

  - $\overline{ss}$: benefits without means test
  - $\overline{y} = -0.0063$ (or $-\$330$)

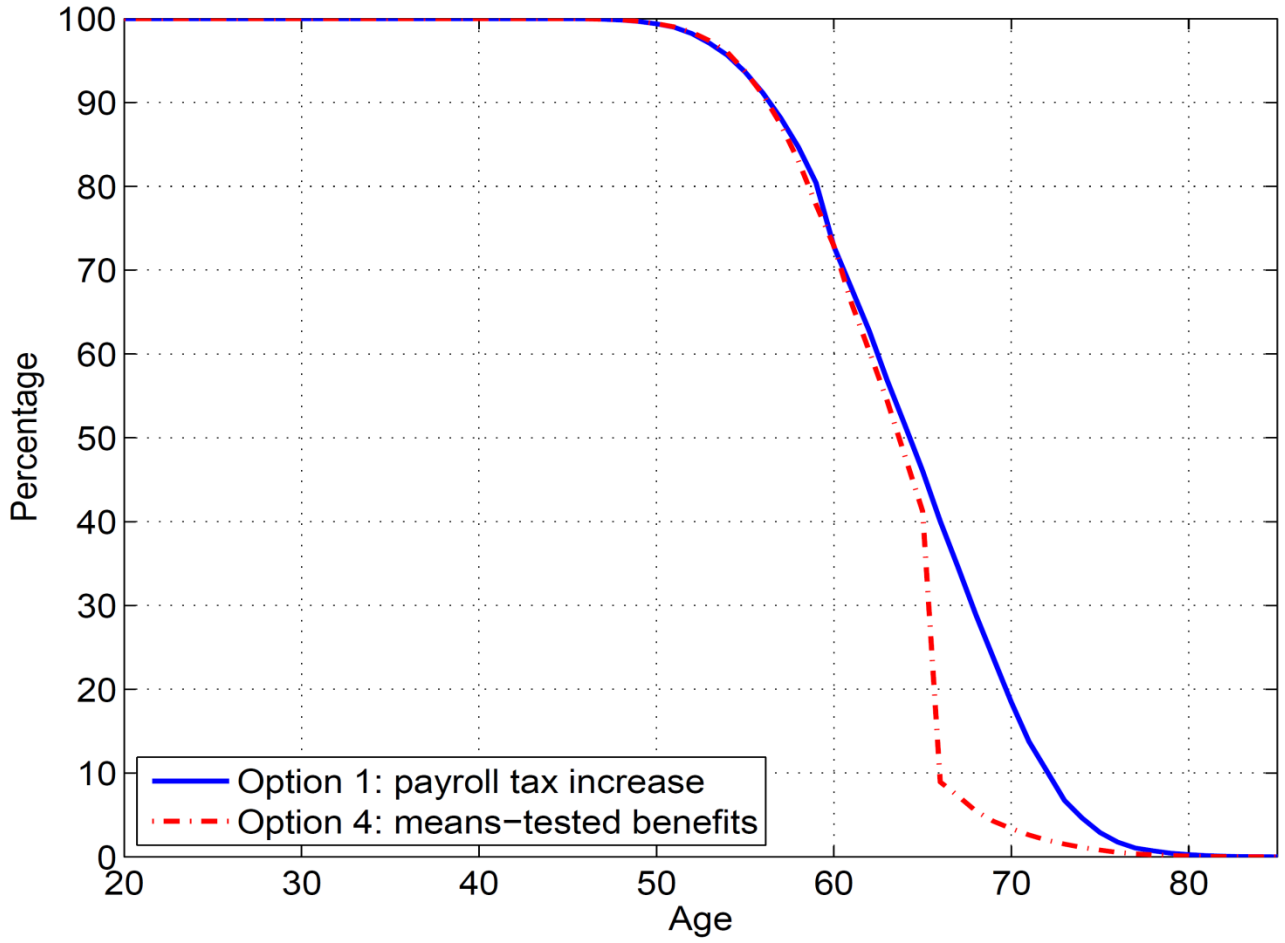
Option 4: means tested benefits



Four options

	Option 1 Tax increase	Option 2 Benefit cut	Option 3 Retire. age	Option 4 Means test
Capital	–	+14.4%	+10.1%	**−2.5%**
Labor	–	+0.6%	+0.8%	**−0.9%**
Avg work hours	–	−2.4%	−1.5%	**+1.7%**
Wage	–	+5.3%	+3.6%	**−0.7%**
Total labor tax – labor income tax – social security tax	39.4% 23.2% 16.3%	32.5% 21.9% 10.6%	32.9% 22.3% 10.6%	**34.2%** **23.6%** **10.6%**
SS benefit spending SS replacement rate	– 38.8%	−31.1% 26.3%	−31.3% 38.9%	**−35.6%** **24.6%**
Labor force participation – age 20-49 – age 50-64 – age 65-85 Avg work years	 100.0% 83.2% 13.2% 44.7	 100.0% 88.2% 19.3% 46.8	 100.0% 87.3% 18.1% 46.3	 **100.0%** **82.2%** **4.5%** **43.0**

Labor force participation in option 4



Concluding remarks

1. Raise the social security tax
2. Reduce the benefit replacement rates
3. Increase the normal retirement age
4. Means test the benefits

Concluding remarks

1. Raise the social security tax
   → high labor taxes, low participation
2. Reduce the benefit replacement rates
   → highest capital, highest participation and longest work years
3. Increase the normal retirement age
   → higher capital, more participation of the elderly
4. Means test the benefits
   → lowest labor supply, shortest work years, significant drop in participation at and above age 66

Concluding remarks

- Some change in the pension system is unavoidable. Options can have significantly different effects on the individuals' lifecycle behavior (consumption, saving and labor supply) and the level of aggregate economic activities.
- Other public programs that can be affected by the demographic shift:
  - Medicare and Medicaid, disability and unemployment insurance
  - Need augment the model with health status, expenditures and unemployment

BACK-UPS

Four options: wealth inequality

	Option 1 Tax increase	Option 2 Benefit cut	Option 3 Retire. age	Option 4 Means test
Wealth gini	0.628	0.600	0.613	0.666

Concentration of wealth

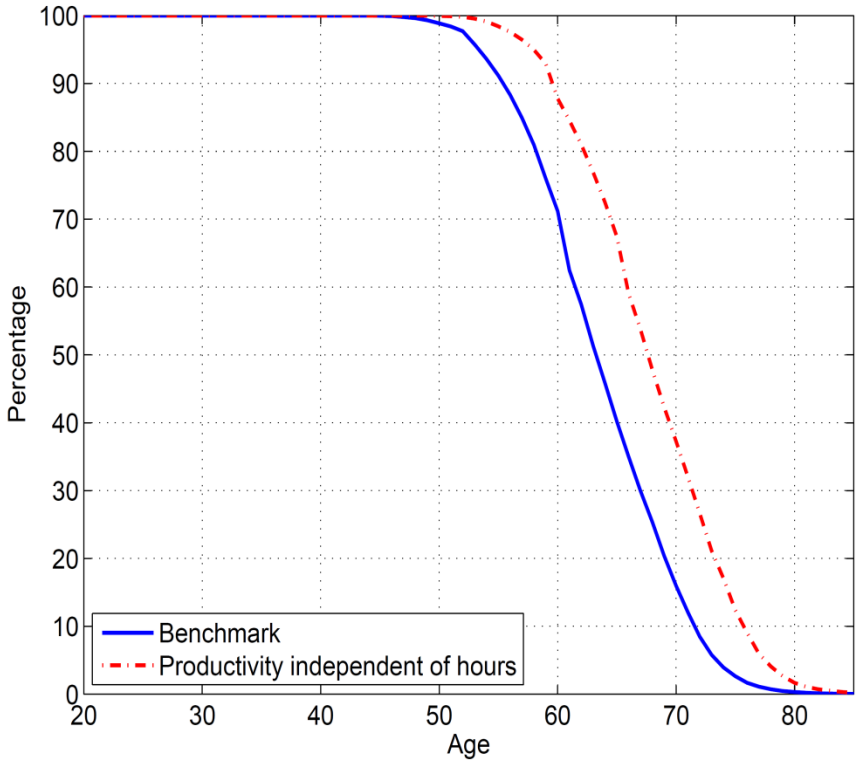
Fraction of wealth held by top	Model	Data
1%	9.07%	34.7%
5%	28.52%	57.8%
10%	45.88%	68.9%
20%	67.45%	81.7%
40%	89.06%	93.9%
60%	97.83%	98.9%

Data: Budria-Rodriguez, et al (2002), Survey of Consumer Finance

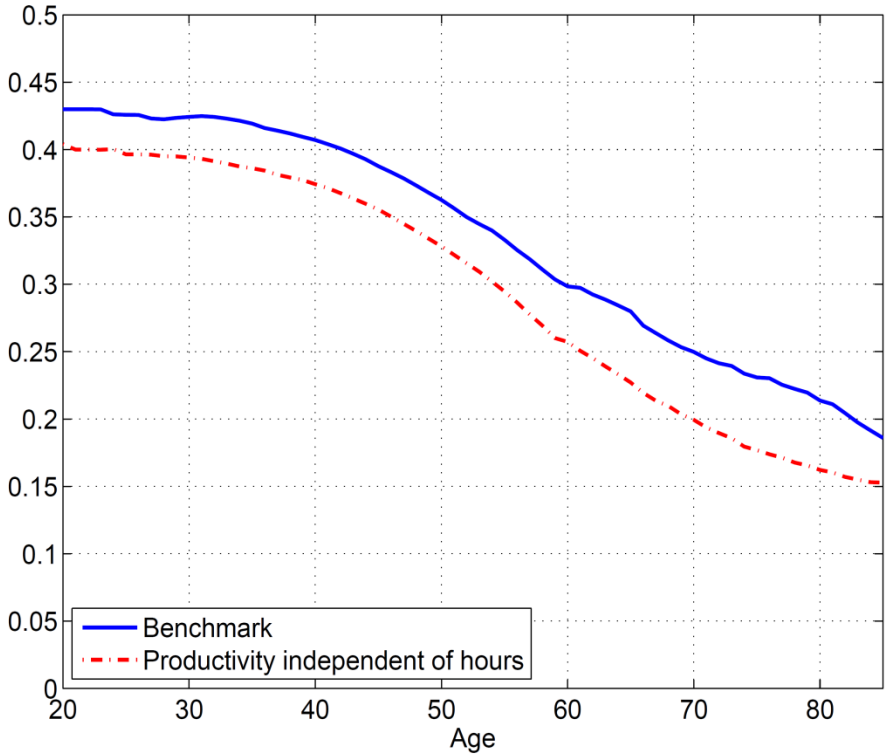
Long-run welfare

4	Raise the social security tax
1	Reduce the benefit replacement rates
2	Increase the normal retirement age
3	Means test the benefits

Hours-dependence of productivity



Labor force participation



Work hours

More on earnings and wealth distribution

- Workers making more than the cutoff level of social security maximum taxable earnings $106,000
  - 7.52% in the data, PSID samples
  - 7.76% in the model.

Sensitivity: option 1 without max tax base

	Option 1 Tax increase	Option 1 No max base
Capital	–	−3.7%
Labor	–	−0.5%
Avg work hours	–	+0.1%
Wage	–	−1.3%
Total labor tax – labor income tax – social security tax	39.4% 23.2% 16.3%	39.7% 23.6% 16.1%
Labor force participation – age 20-49 – age 50-64 – age 65-85 Avg work years	 100.0% 83.2% 13.2% 44.7	 100.0% 83.5% 12.5% 44.7
Wealth gini	0.628	0.601