Demographic Patterns and Household Saving in China

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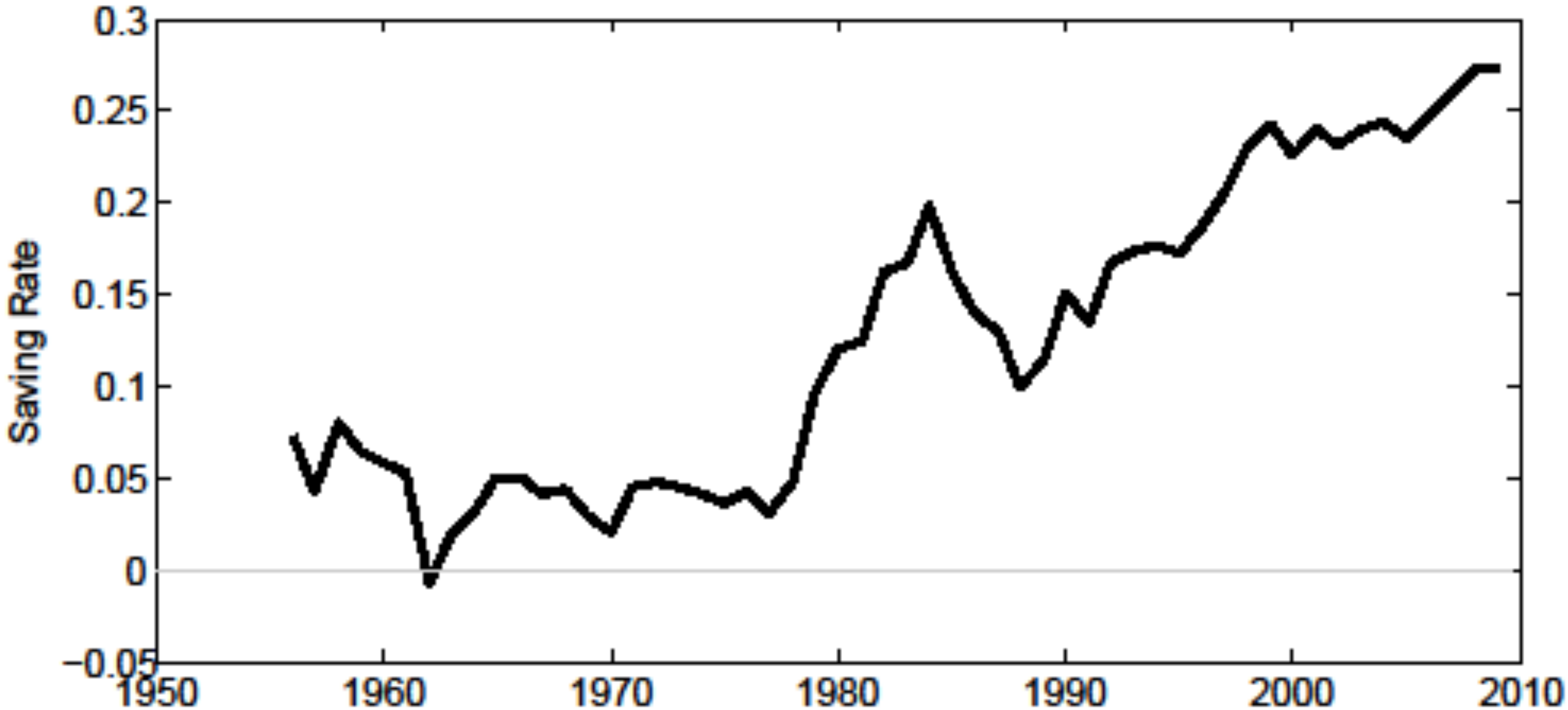
Household Saving Rate, 1955-2009



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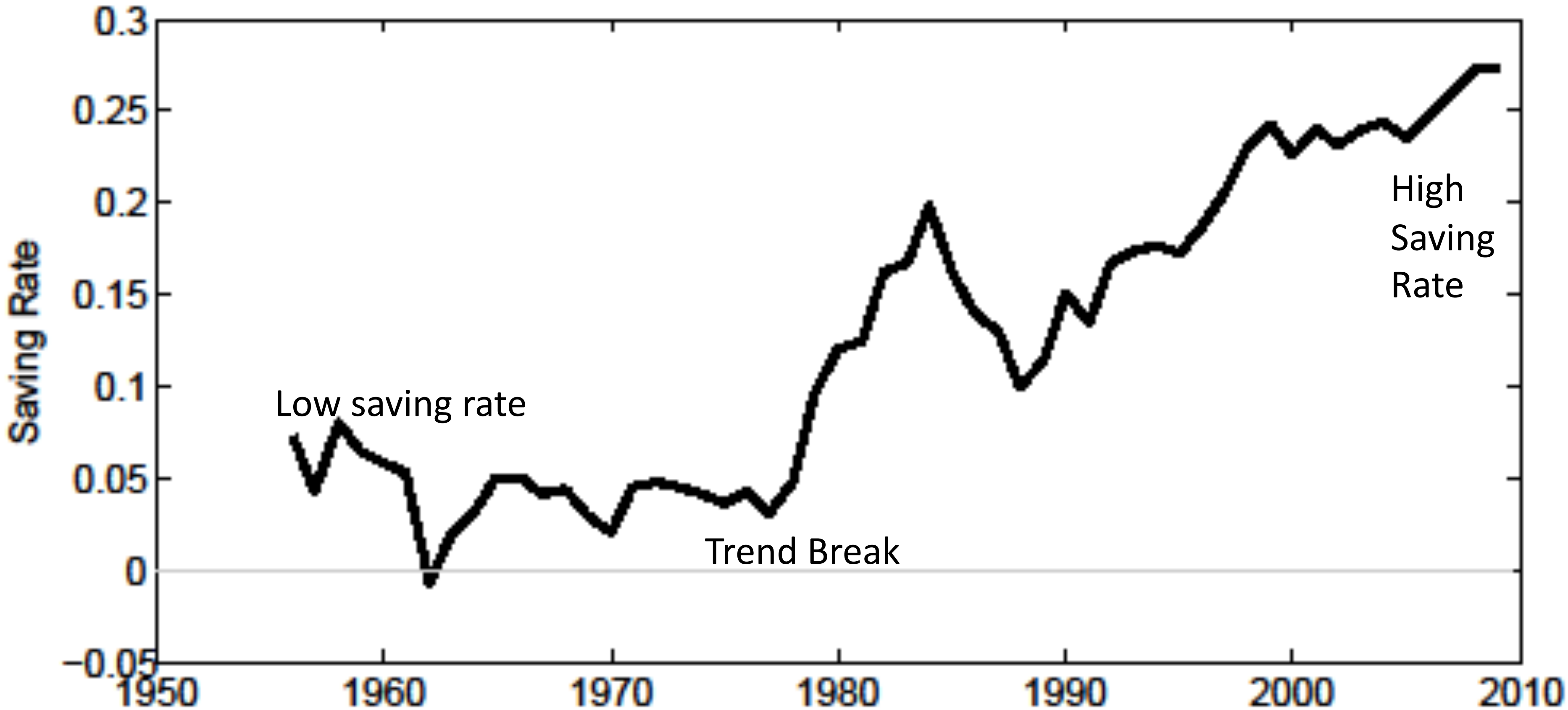
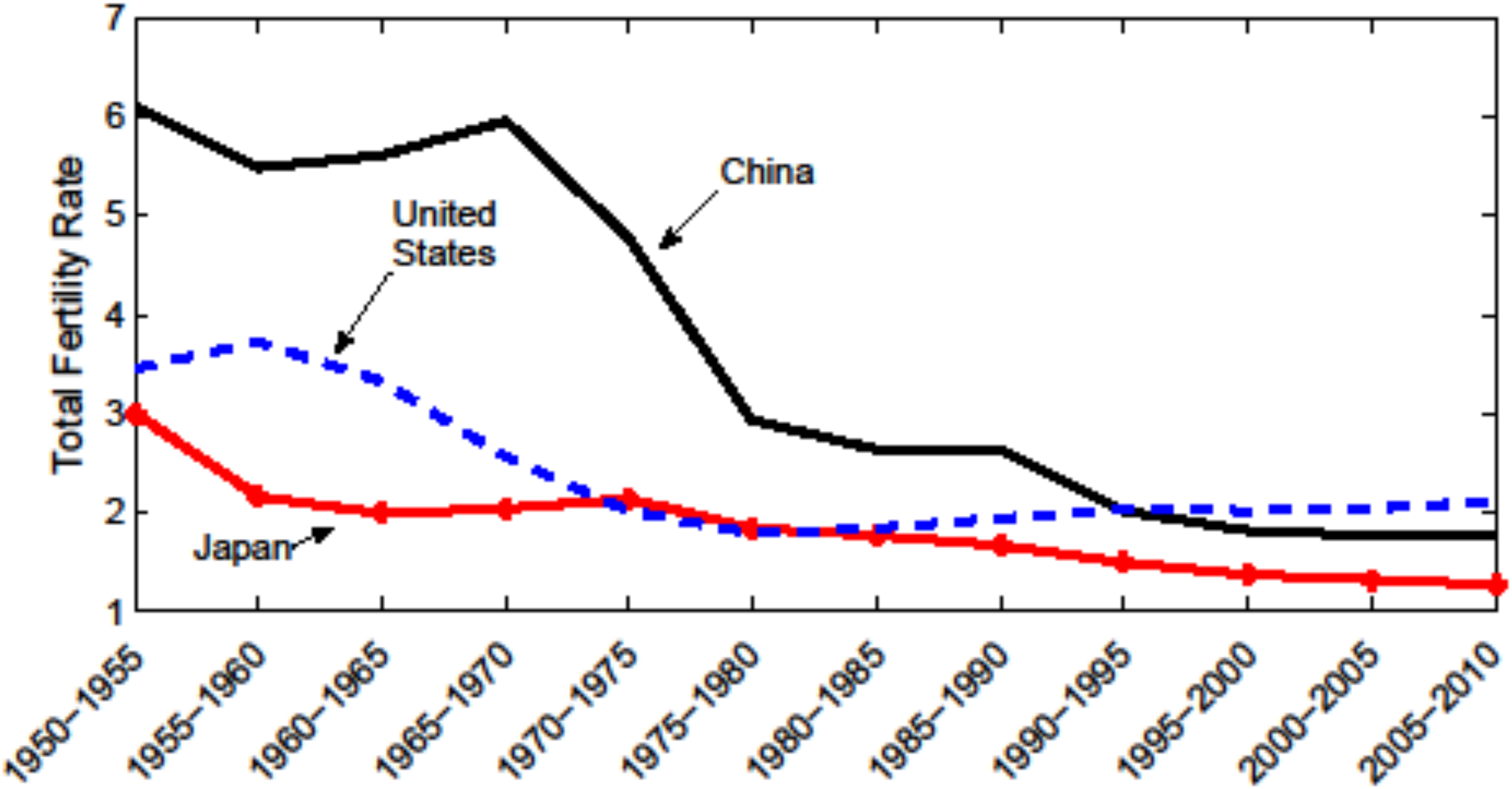


Declining Fertility Rates



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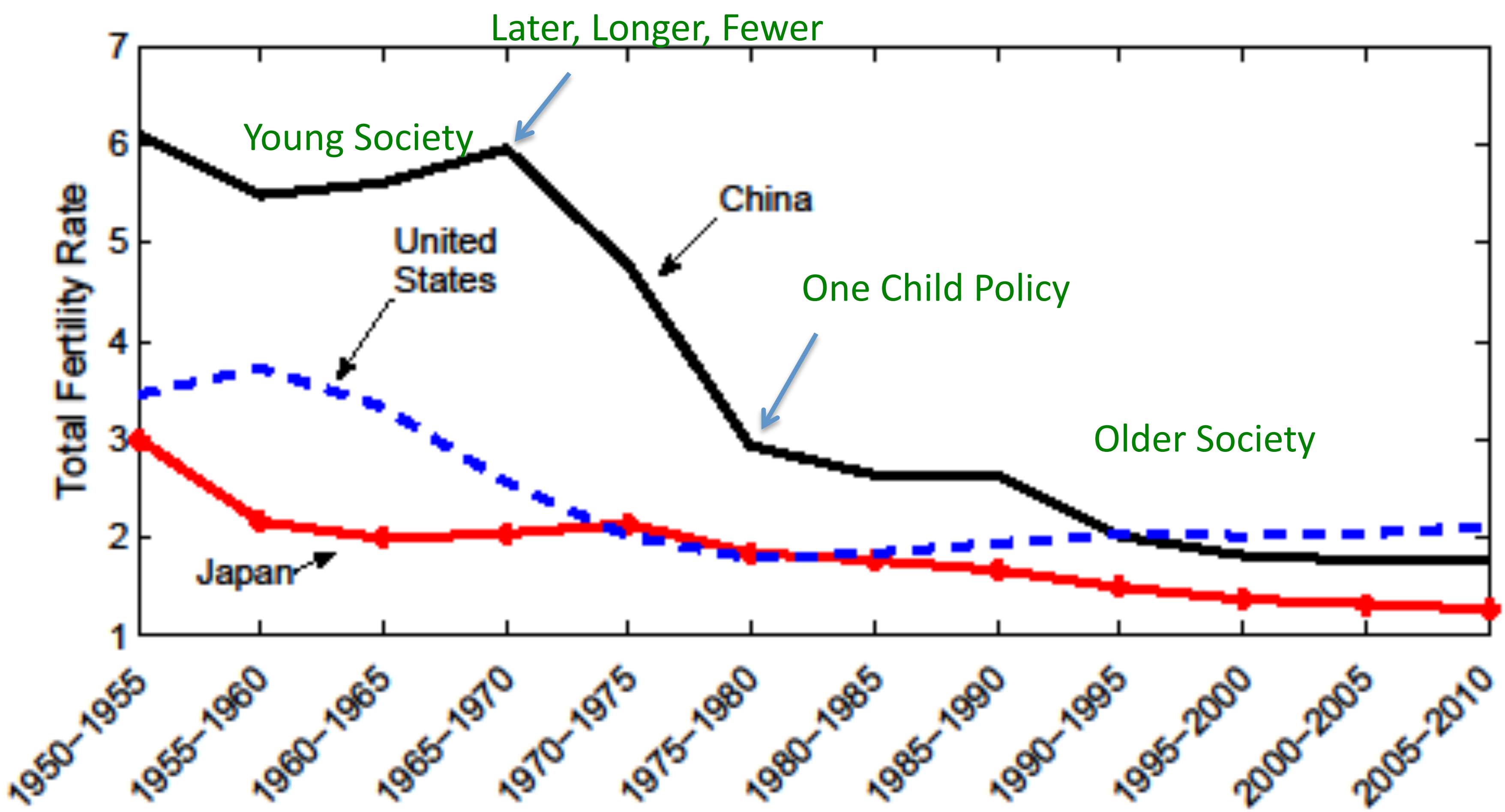


Research Issue

We think the changing age distribution explains a big part of the increase in China’s household saving rate

We investigate this idea

Methodology

- Overlapping Generations (OLG) model with saving and intergenerational transfers
  1. Care for children (family size)
  2. Workers save for retirement (composition effect)
  3. Transfers to elderly (pension)
- Parameterize to Chinese economy
- Examine how well model matches data

Related Literature

- OLG and Saving

Chen, Imrohoroglu, Imrohoroglu	2006	AER
Krueger and Ludwig	2007	JME

- China and Saving

Wei and Zhang	2011	JPE
Banerjee, Meng, Qian		
Chamon, Liu, Prasad		
Song and Yang		

Why Study China?

- It's important.
  - Largest population, Second largest economy
- Huge Saving
  - Funds (in part) massive investment
  - Funds (in part) US current account deficit

Rise in the World Economy

Share of Output (rows sum to 1)

Year	USA	Japan	Germany	**China**
1978	0.57	0.22	0.16	**0.05**
1984	0.55	0.22	0.15	0.08
1990	0.53	0.23	0.14	0.10
1995	0.51	0.21	0.13	0.15
2001	0.51	0.18	0.12	0.18
2005	0.49	0.16	0.10	0.24
2008	0.46	0.15	0.10	0.29
2009	0.44	0.14	0.09	**0.32**

Source: PWT 7.0

Investment as Share of GDP

Average of Previous 5 Years

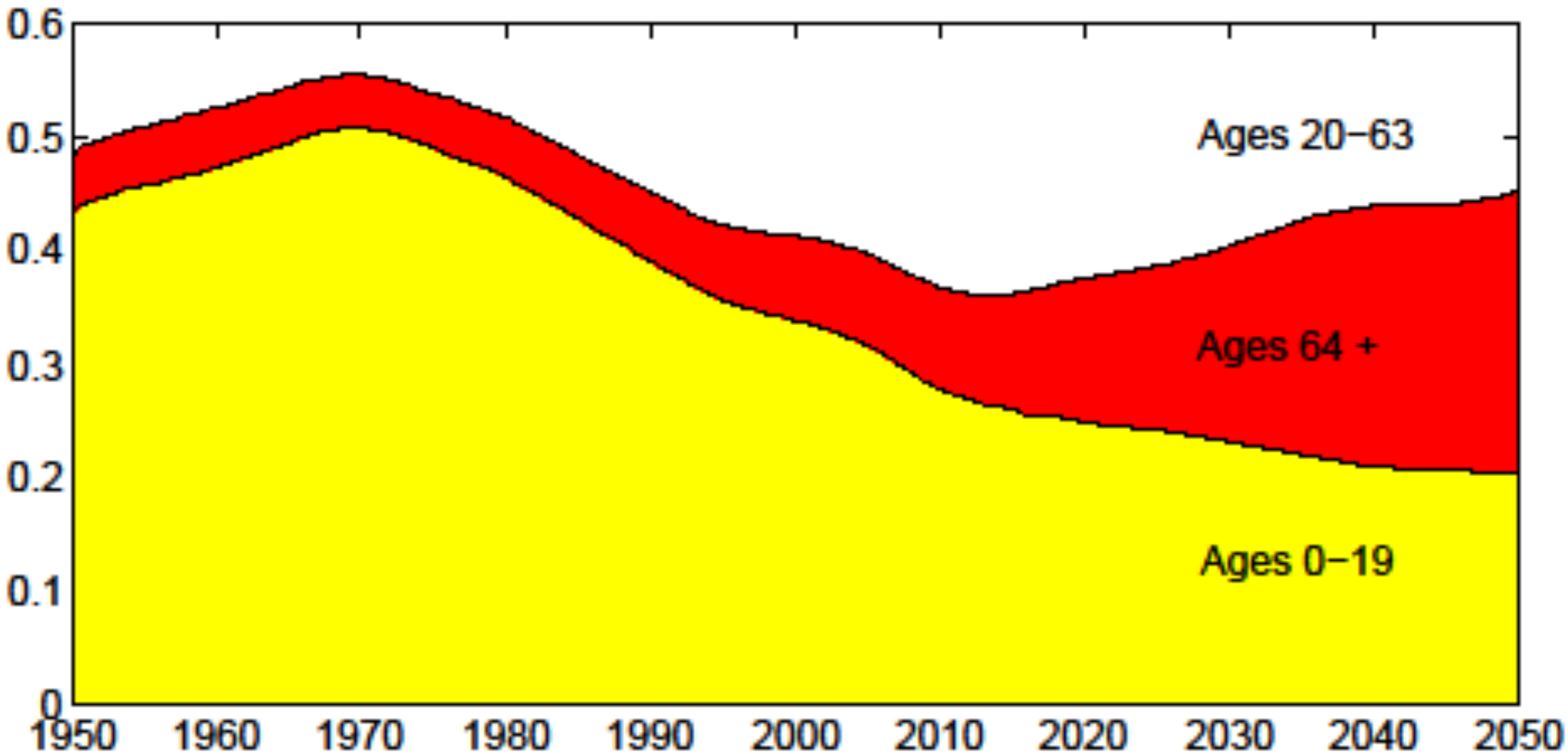
Year	USA	Japan	Germany	**China**
1985	20.8	29.1	24.4	**39.2**
1990	19.8	30.5	24.2	**37.3**
1995	17.8	29.8	22.8	**40.4**
2000	20.1	26.8	21.4	**37.4**
2005	19.3	23.5	17.6	**40.1**
2010	17.8	22.3	17.7	**45.2**

Composition of Gross National Saving

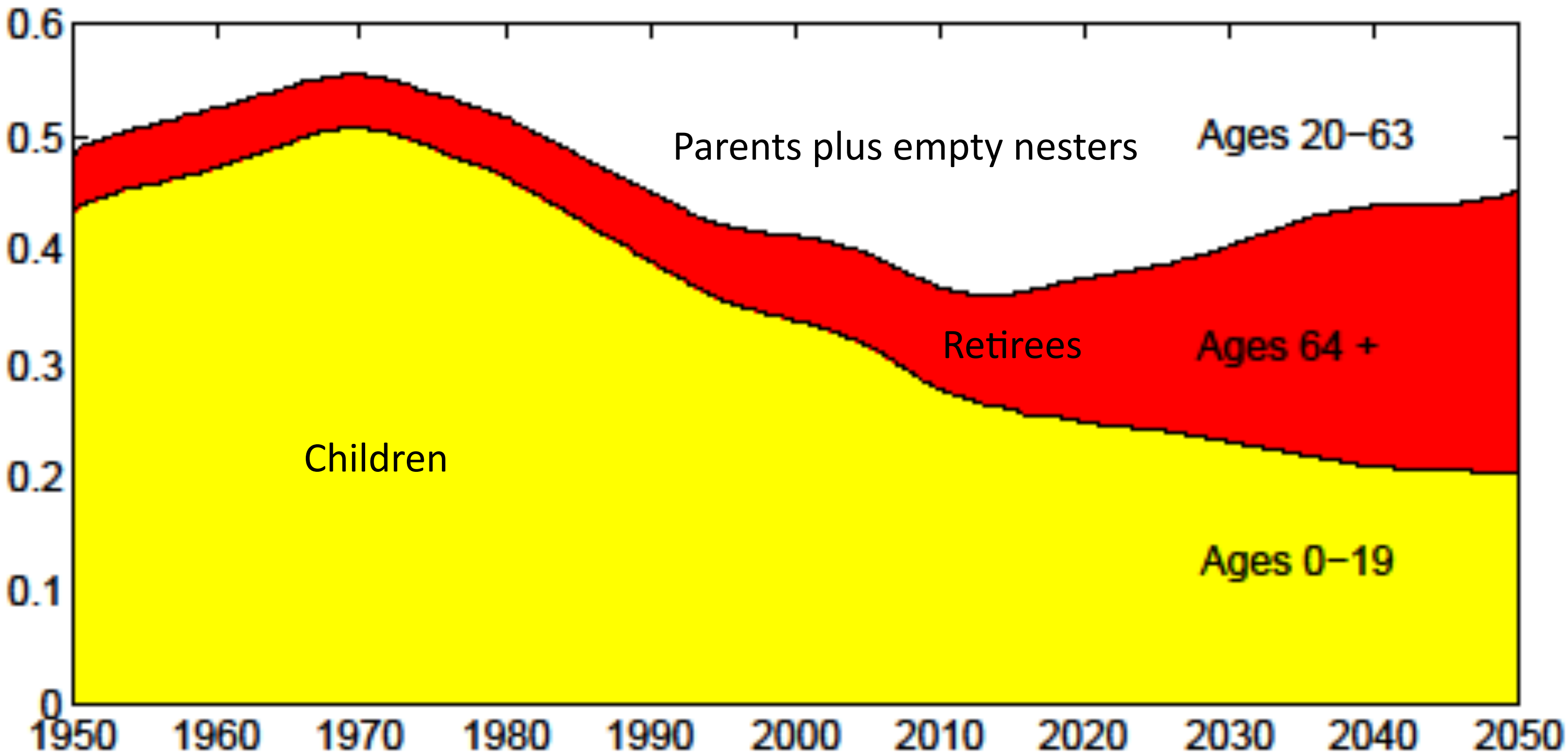
Year	Gross Saving as share of GDP	Share of National Saving: Govt	Corp	Household	Household Saving Rate
1995	38	7	42	51	**17**
2000	37	9	44	49	23
2002	40	13	45	43	23
2004	47	10	50	40	24
2006	50	18	38	44	25
2008	53	21	35	44	**27**

Source: Ma and Yang (2009)

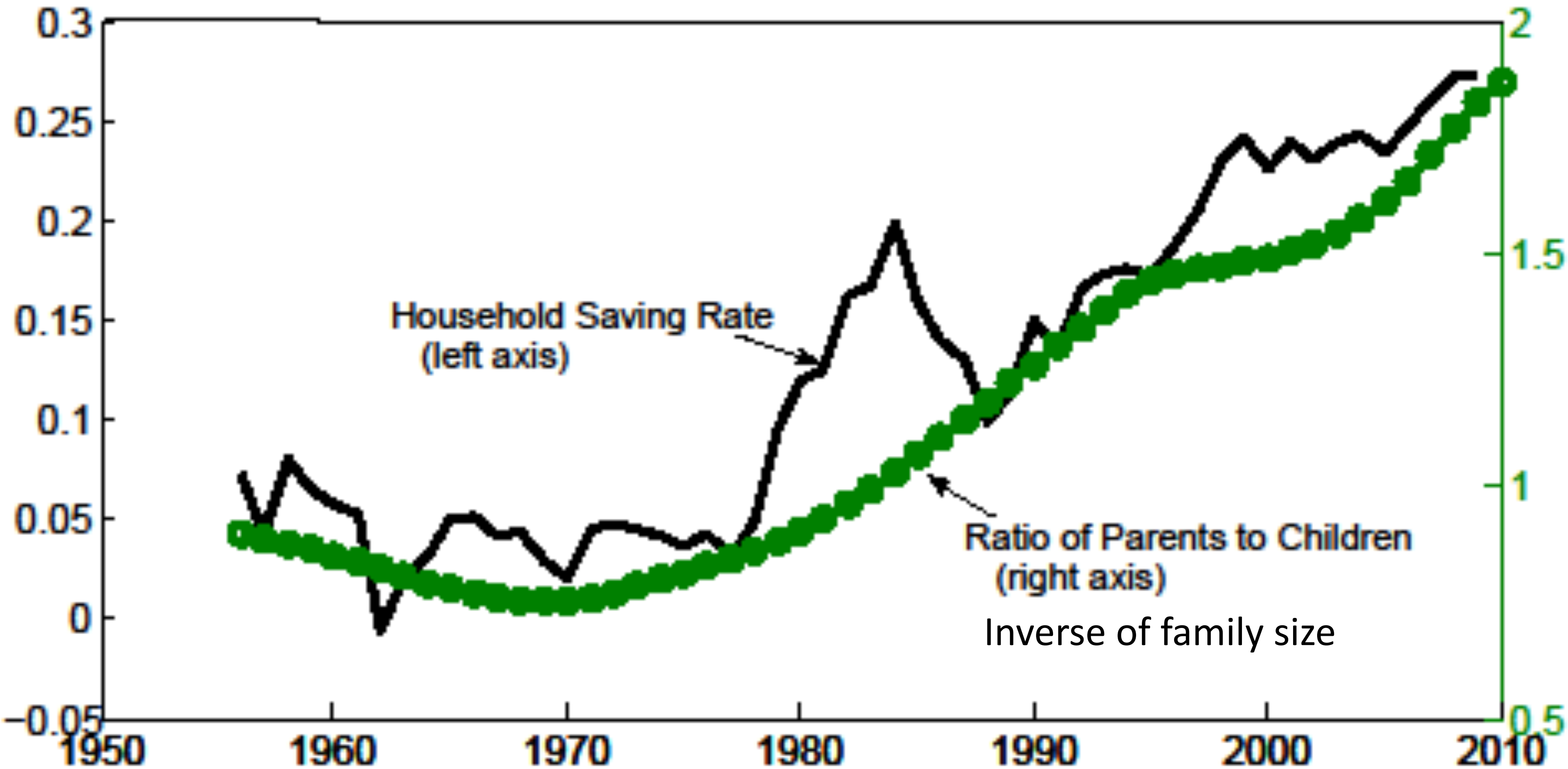
Demographic Change



Demographic Change



Saving Rate and Ratio of Parents to Children



Some Micro Data Evidence

- In micro-level survey data, household saving is negatively correlated with number of children (next slide)
  - Banerjee et al. (2010) report an even more negative relationship
  - Gruber (2012) also reports a negative correlation

Micro Evidence

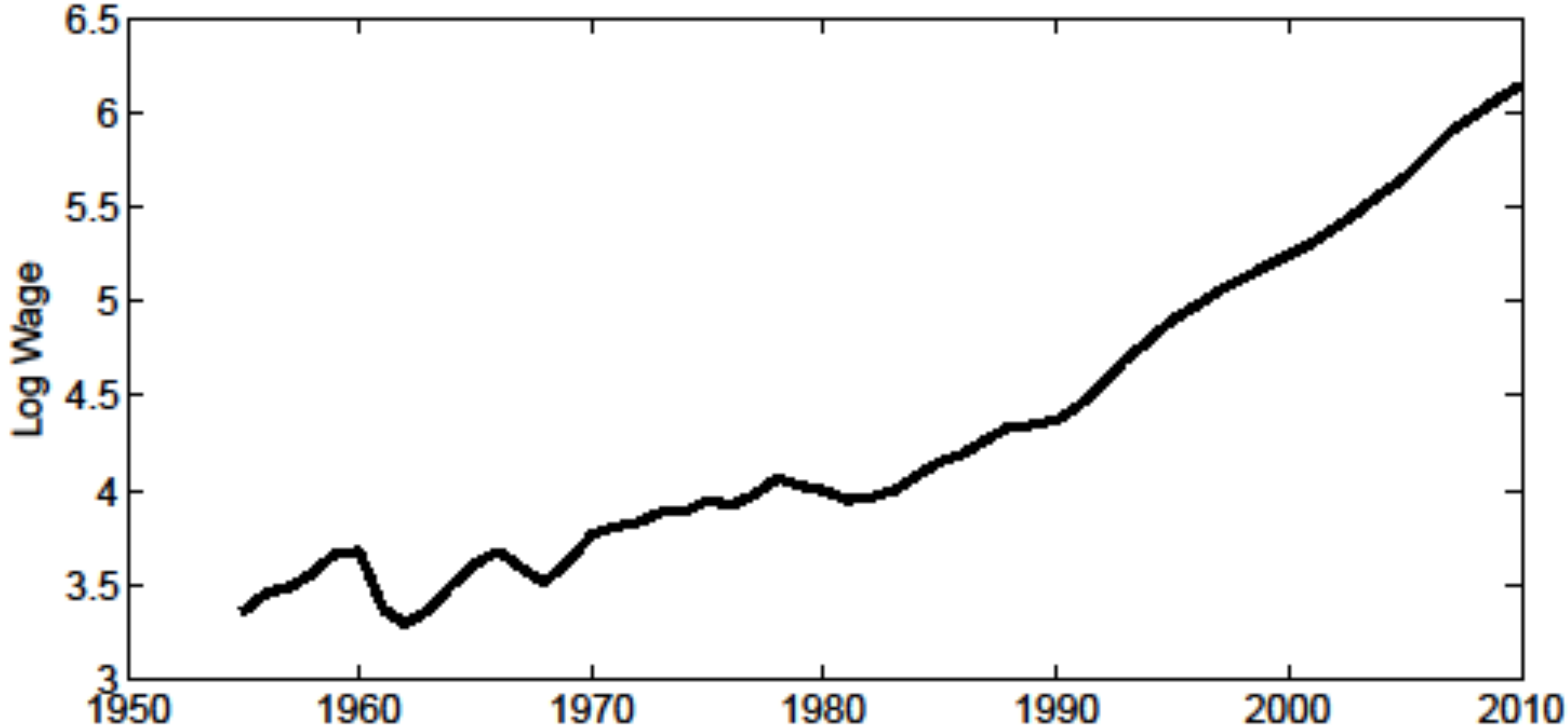
Data: 2007 Urban Household Survey

Table 1: The Effect of the Number of Children on the Household's Saving Rate, 2007

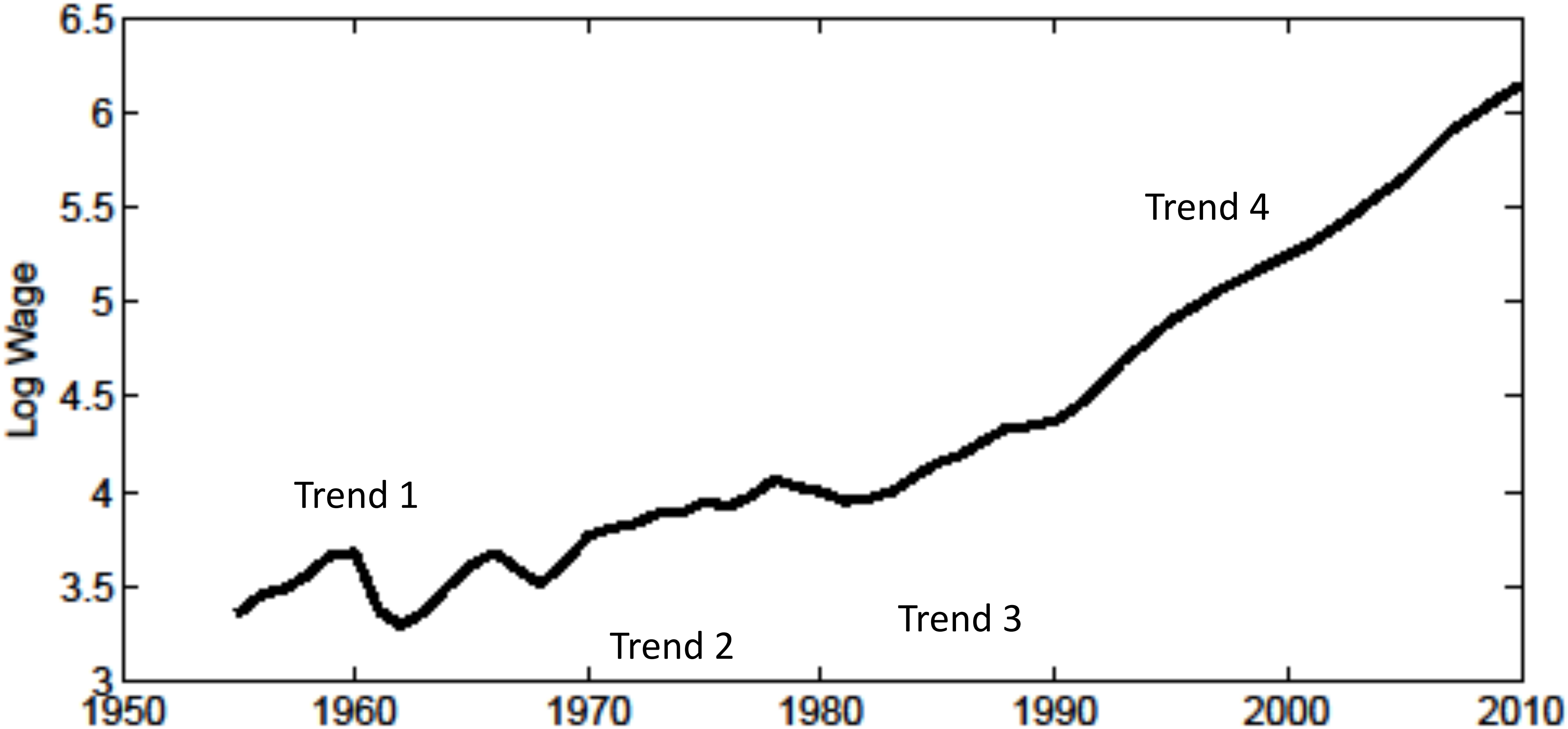
	Dependent Variable: Saving Rate	
Explanatory Variable	(1)	(2)
Number of Children	-0.052 (0.015**)	-0.046 (0.020*)
log Income	0.241 (0.011**)	0.213 (0.012**)
Sample Restrictions		
Age of Children	None	Omit HH with Children Age > 19
Observations	3234	2200
R^2	0.142	0.127

NOTES: Saving rate is defined as (Income-Consumption)/Consumption. The data is restricted to nuclear families. The regressions include controls for the head of household's age, age squared, and education level. Standard errors are reported in parentheses. Stars denote significance at the * 5 percent and ** 1 percent level.

Wage Growth



Wage Growth


6.5
6
5.5
5
4.5
4
3.5
3
Log Wage
1950
1960
1970
1980
1990
2000
2010
Trend 1
Trend 2
Trend 3
Trend 4

Impressions drawn from casual look at data

- Household Saving Rate high if
  1. Familes are small (relaxes budget constraint)
  2. Proportion of working age is high (composition effect)
  3. Proportion of future work force is low (fewer children to support in old age)
  4. Expected income growth is low

- Over the sample, demographics and income growth may work in opposite directions
- Sort out offsetting effects with a model

OLG Model Economy

- Perfect foresight consumers live 85 years
- Ages 0-19
  - Draw on family resources, contribute nothing
- Ages 20 - 49
  - Support Children – Barro and Becker (ECA 1989)
  - Support parents
  - Supply labor inelastically
  - Save for Retirement
- Ages 50 - 63
  - No Children to support, continue to work and save
- Ages 64 - Death
  - Retired: consume transfers and accumulated assets

OLG Model

- At time *t*, let

N_t^c = youth population (age 0-19)

N_t^p = parents population (age 20-49)

N_t^w = working population (age 20-63)

N_t^r = retired population (age 64-85)

- Households take demographics, interest rates, wages, and taxes as exogenously given

Budget Constraints (j indexes age)

- Parents (20-49)

$$\frac{N_t^c}{N_t^p} c_{t,j}^c + c_{t,j} + a_{t+1,j+1} = (1-\tau) w_t + (1+r_t) a_{t,j}$$

- Empty Nesters (50-63)

$$c_{t,j} + a_{t+1,j+1} = (1-\tau) w_t + (1+r_t) a_{t,j}$$

- Retirement (64-85)

$$c_{t,j} + a_{t+1,j+1} = (1+r_t) a_{t,j} + P_t$$

Where

$$P_t = \frac{N_t^w}{N_t^r} \tau w_t$$

Utility Function at Age 20

$$U_t = \sum_{j=0}^{29} \beta^j \underbrace{\frac{c_{t+j,j}^{1-\sigma} + \mu \left(\frac{N_{t+j}^c}{N_{t+j}^p} \right)^{\eta} \left(c_{t+j,j}^c \right)^{1-\sigma}}{1-\sigma}}_{\text{utility in parenting years}}$$

$$+ \sum_{j=30}^{65} \beta^j \underbrace{\frac{c_{t+j,j}^{1-\sigma}}{1-\sigma}}_{\text{utility – no kids to support}}$$

Modified Discount Rate

- Rewrite Utility function (C is total consumption)

$$U_t = \sum_{j=0}^{65} \hat{\beta}_{t+j,j} \frac{C_{t+j,j}^{1-\sigma}}{1-\sigma}$$

- The modified discount rate

$$\hat{\beta}_{t+j,j} = \beta^{j} \left[1 + \mu^{1/\sigma} \left(\frac{N_{t+j}^{c}}{N_{t+j}^{p}} \right)^{\frac{\sigma+\eta-1}{\sigma}} \right]^{\sigma}$$

Representative Firm & National Bank

- Cobb-Douglas production function

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha}$$

- National bank buys international bonds to clear the capital market

$$F_t = \underbrace{\sum_{s=0}^{65} \left(N_{t,s} a_{t,s} \right)}_{\text{Deposits}} - \underbrace{K_t}_{\text{Loans}}$$

Solution & Prices

- Factor prices set to marginal products observed in the data

$$w_t = (1-\alpha)\frac{Y_t}{N_t^w} \qquad r_t = \alpha\frac{Y_t}{K_t} - \delta$$

Solution & Prices

- To solve the model
  - Firm maximizes profits
  - Consumers maximize utility
    - Labor supply inelastic
    - Family size given
  - 65 generations of decision makers, 85 generations of people present each period.
  - Partial Equilibrium

Quantitative Exercise

- Perfect foresight households take wages, interest rates, and demographics as exogenously given.
  - Maximize lifetime utility subject to budget constraints.
  - Obtain optimal saving decision rules

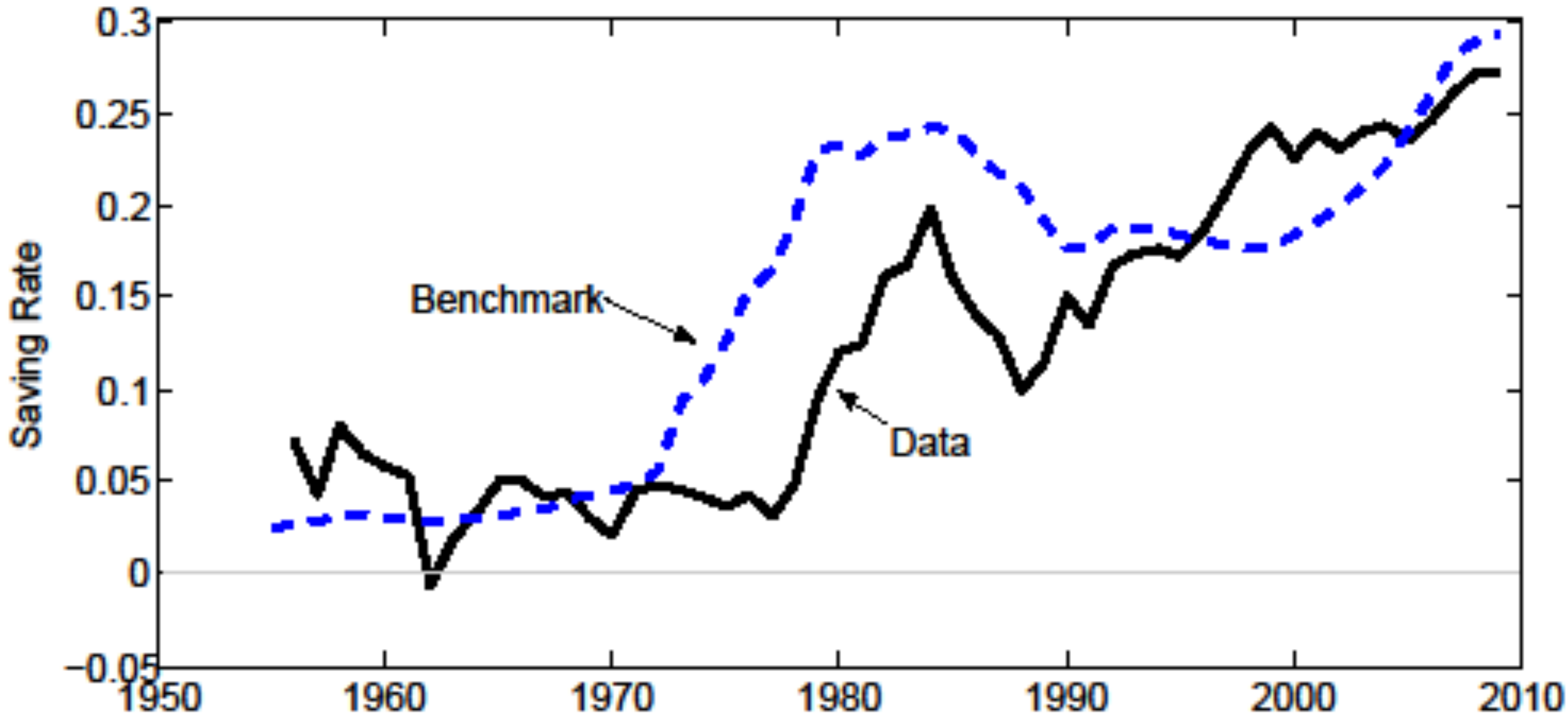
- Present model households with the data and observe implied saving rates. Compare with the household saving rate data

- Perform counterfactuals, turn on and off features of model to understand contributions of various pieces of model

Parameters

β	Discount factor	0.97
μ	Weight on children	0.65
η	Concavity for children	0.76
τ	Transfer share	0.05
σ	Coefficient of relative risk aversion	1.50
δ	Depreciation rate of capital	0.10
$1-\alpha$	Labor's share of output	0.60 – 0.40

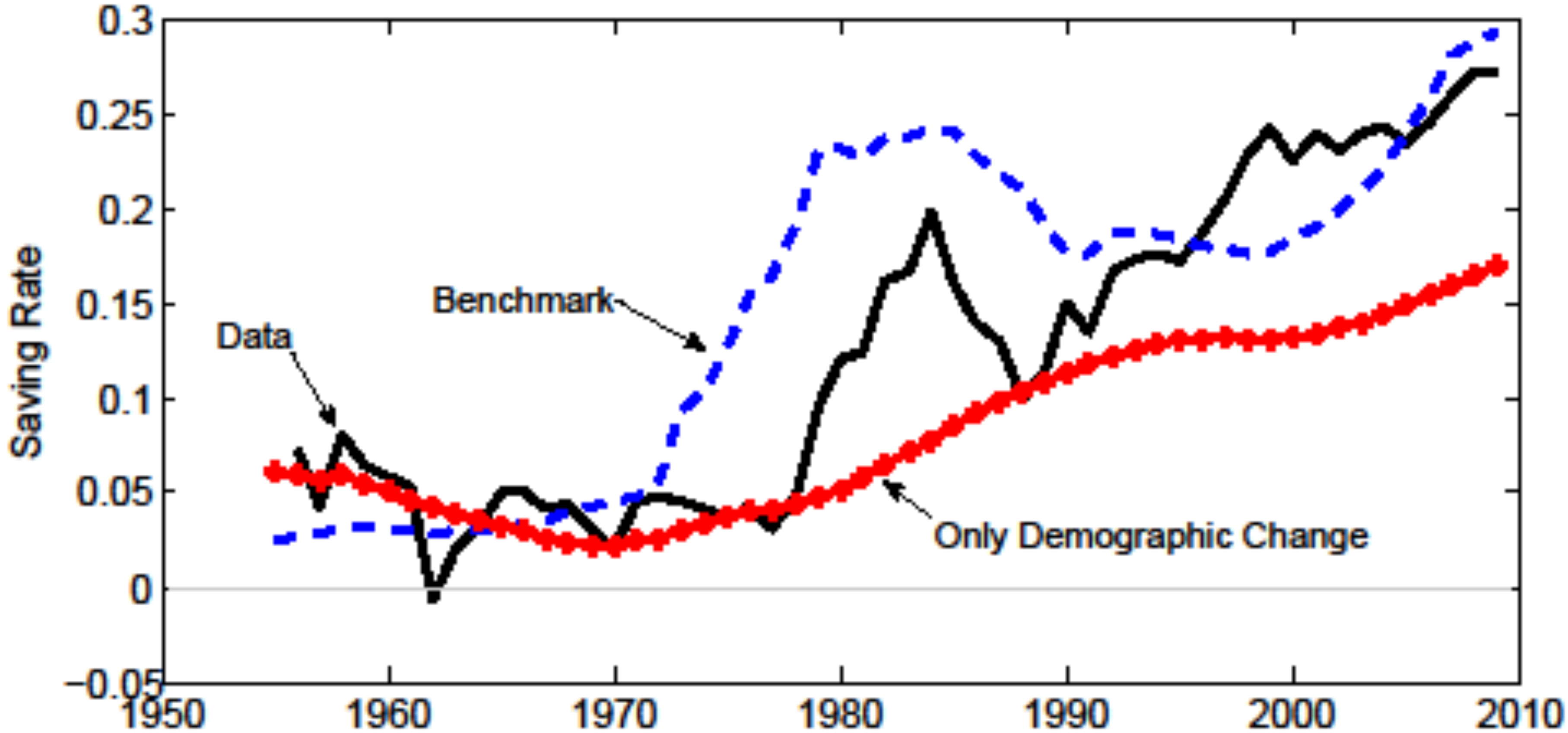
Main Result: Household Saving Rate



Turn on and off various features of model

Demographic Changes Only

(*r*, *w* constant)



Pure Composition Effect is Small

- Decompose 2009 Saving Rate (model)

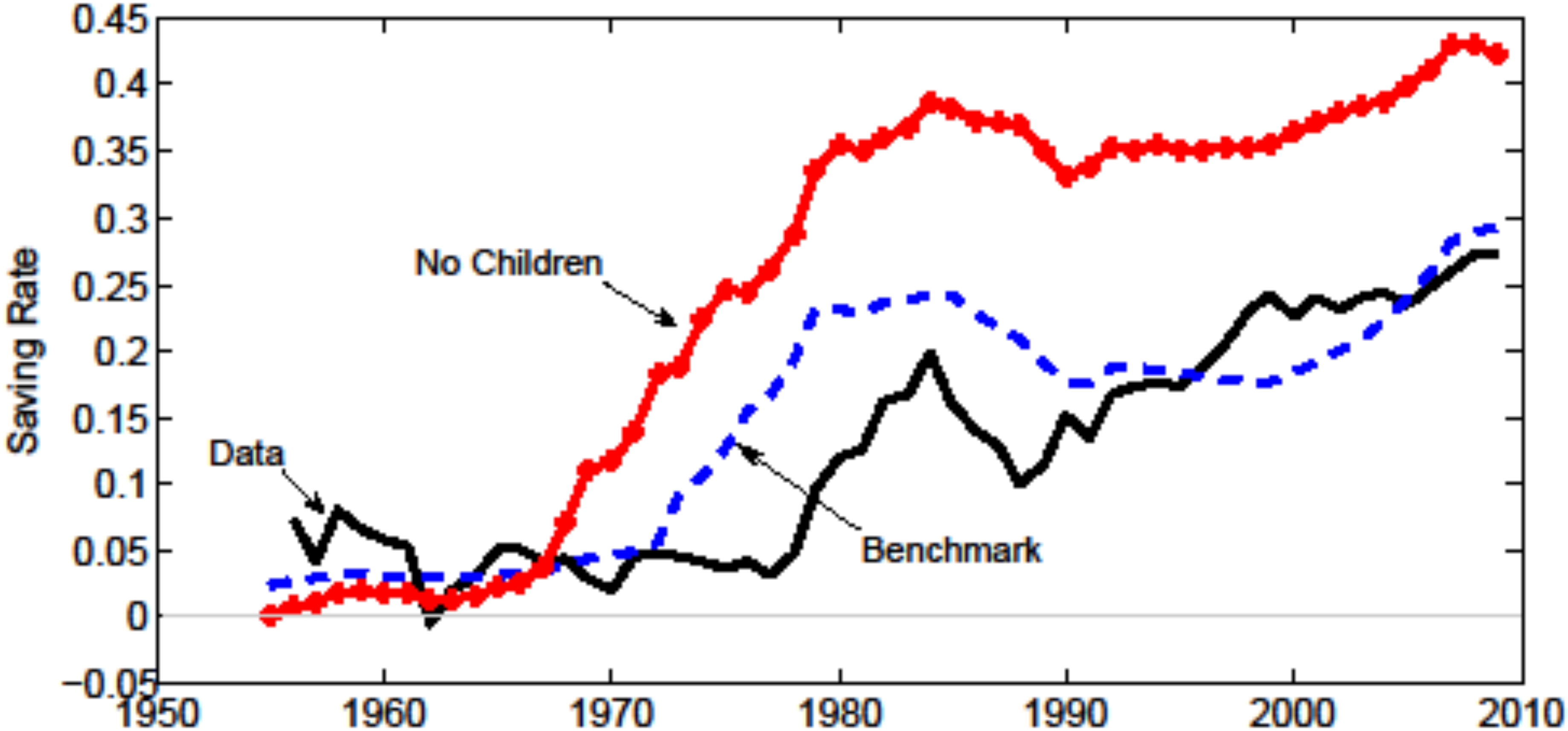
$$SR_{2009} = \sum_{s=0}^{65} N_{2009,j}\left(\varphi_{2009,j}\right) sr_{2009,j}$$

$$SR_{*2009} = \sum_{s=0}^{65} N_{1970,j}\left(\varphi_{1970,j}\right) sr_{2009,j}$$

- Hold saving by age group constant at 2009 values, then calculate ‘counterfactual’ SR
- Composition effect accounts for only 4 percentage points of increase, from 1970 to 2009

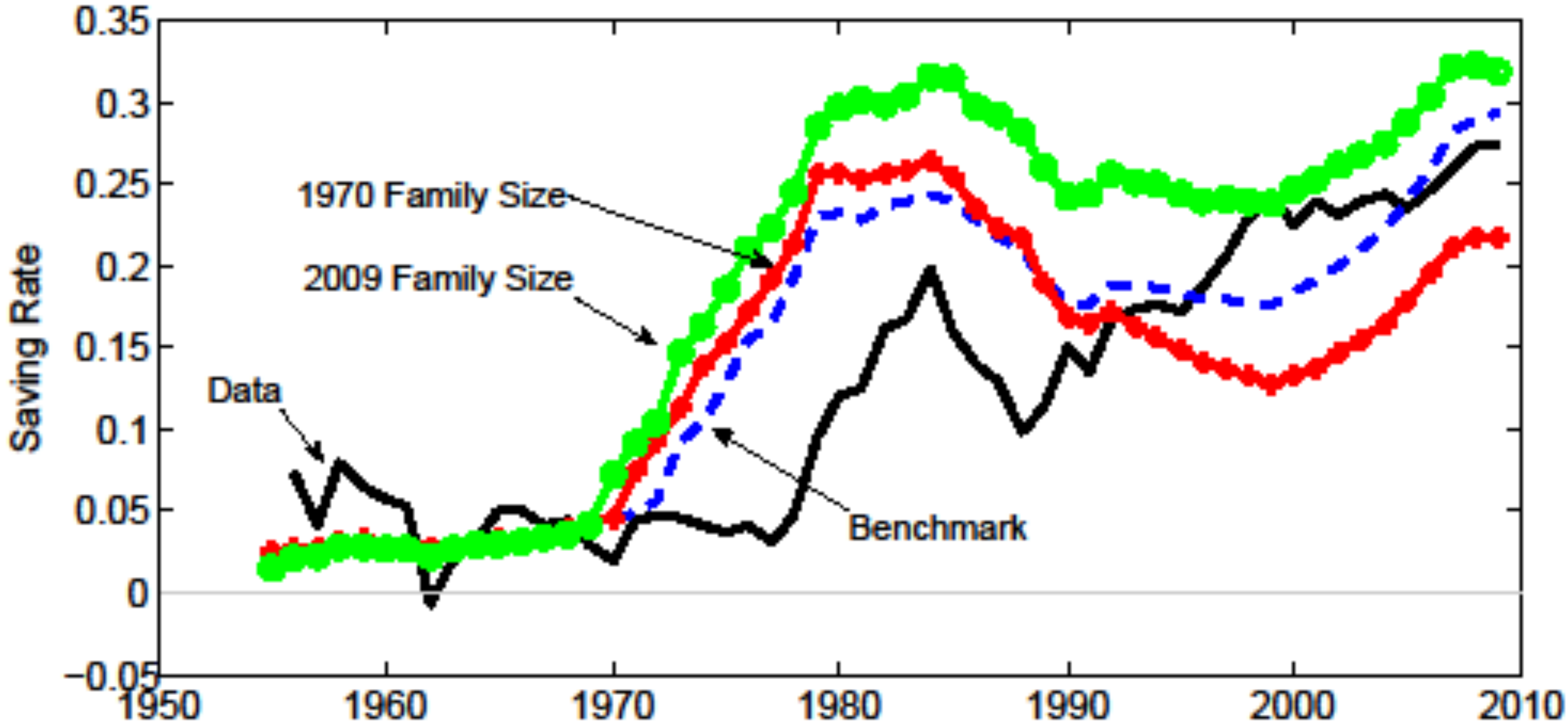
No Children in Utility

($mu = 0$)



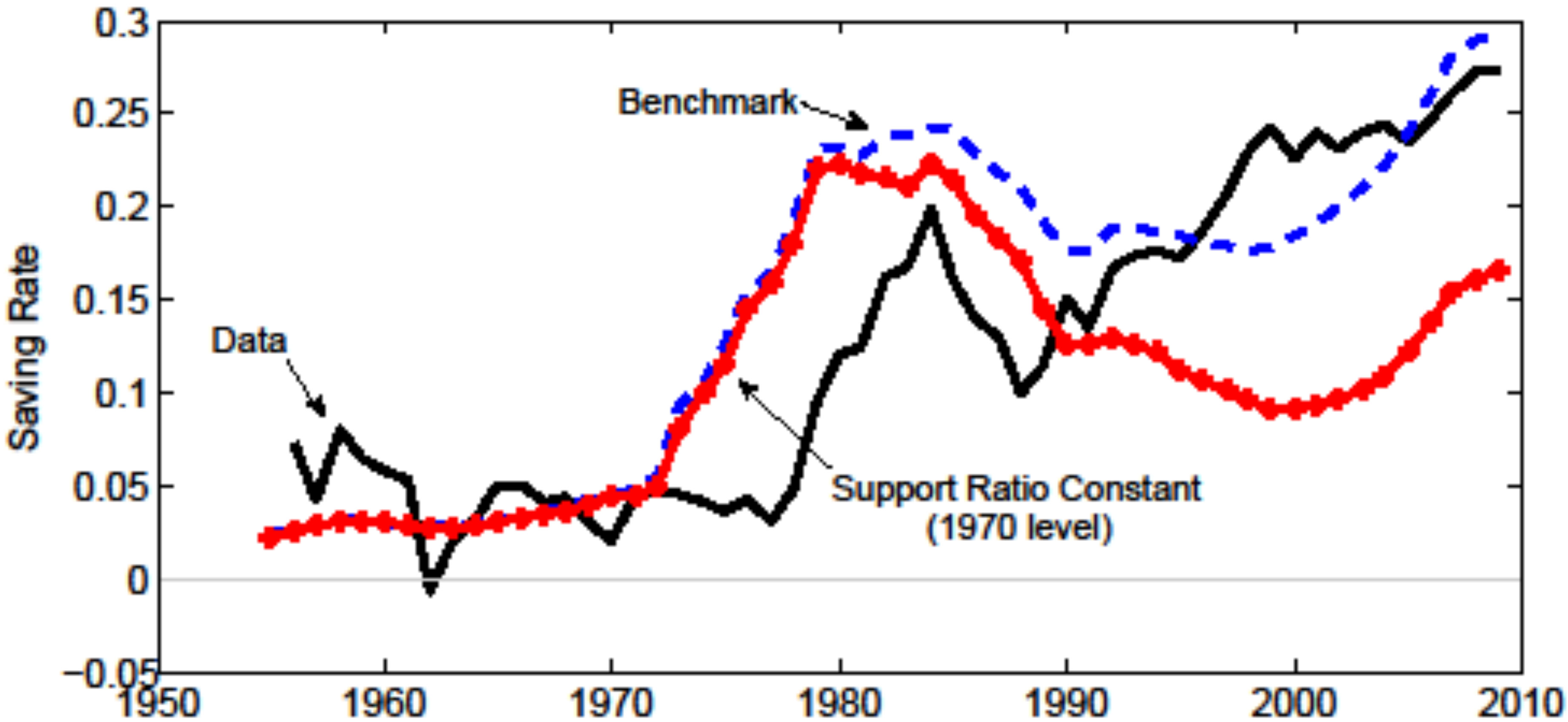
Variation in Family Size

(hold # dependents constant)



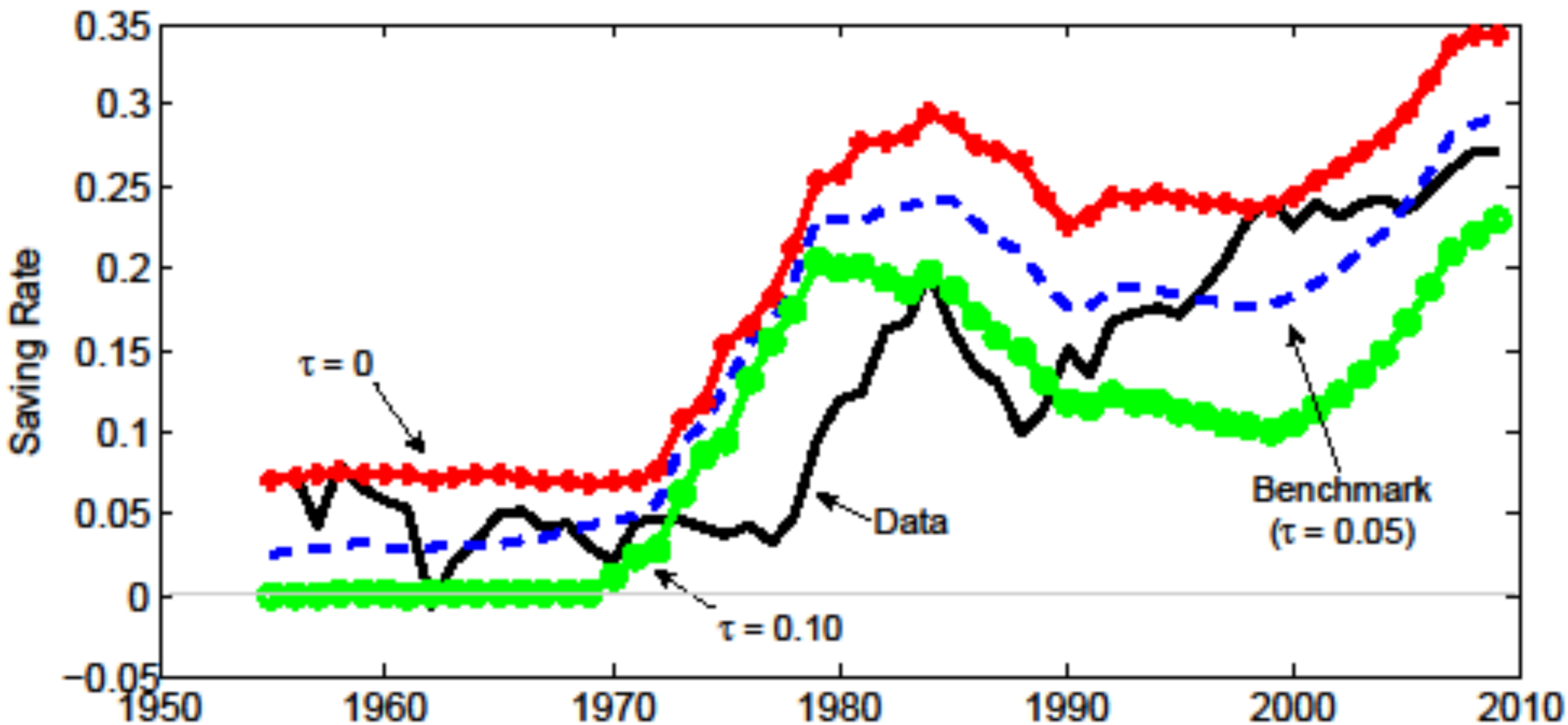
Constant Support Ratio

(9 workers per retiree)



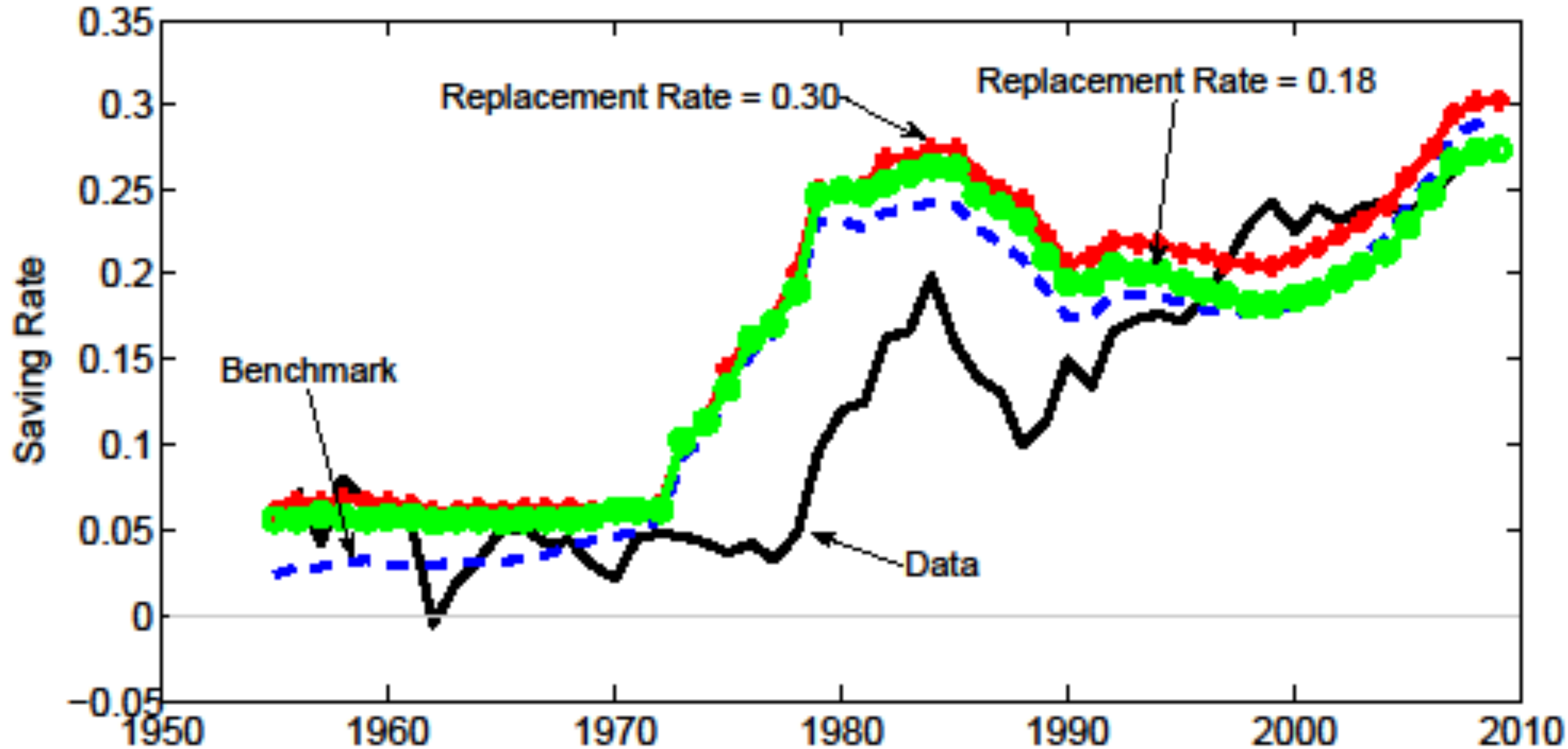
Variations in Old-Age Support

(tau = 0, tau = 0.10)



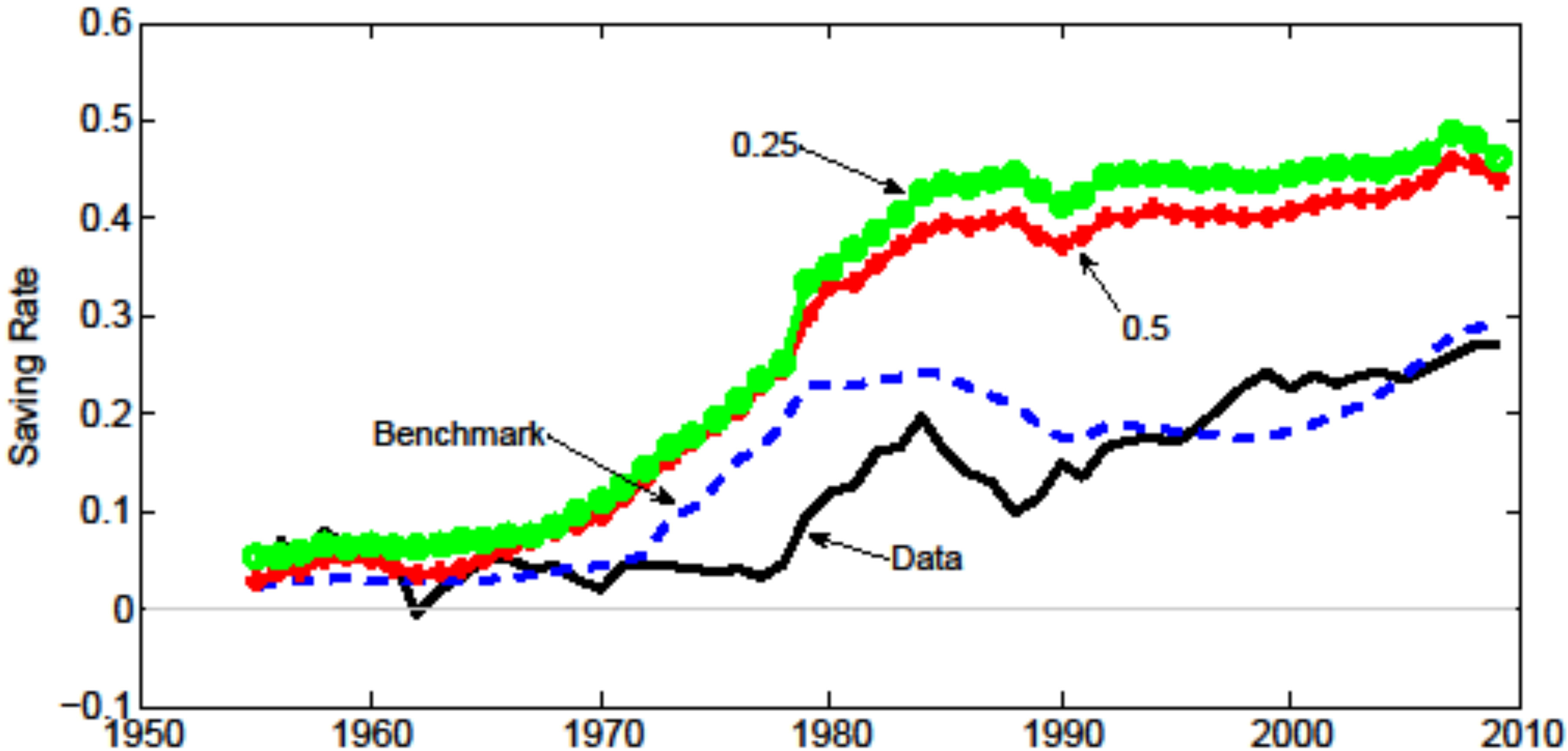
Constant Replacement Rate

(tau varies over time)

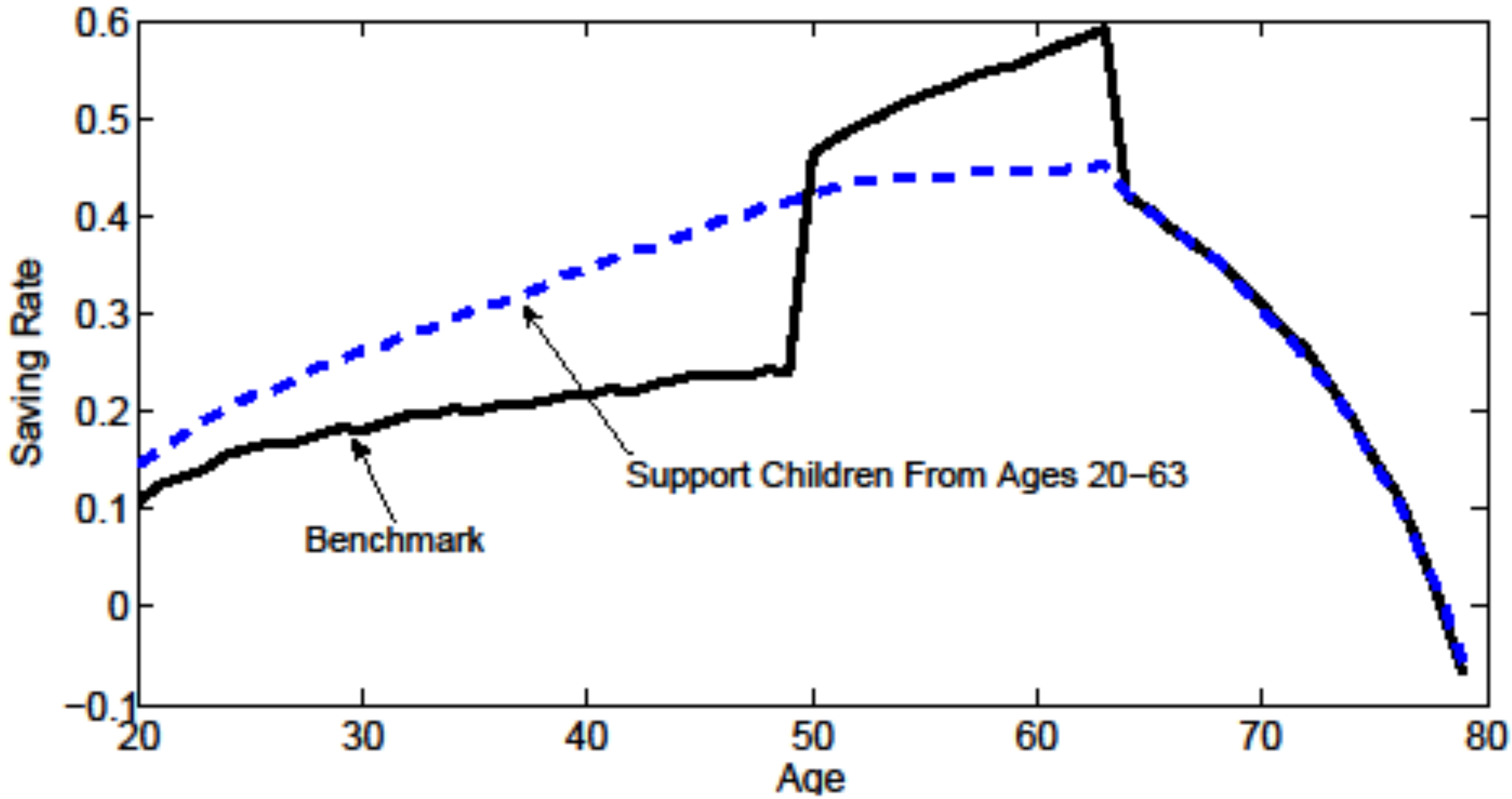


Variation in Wage Growth

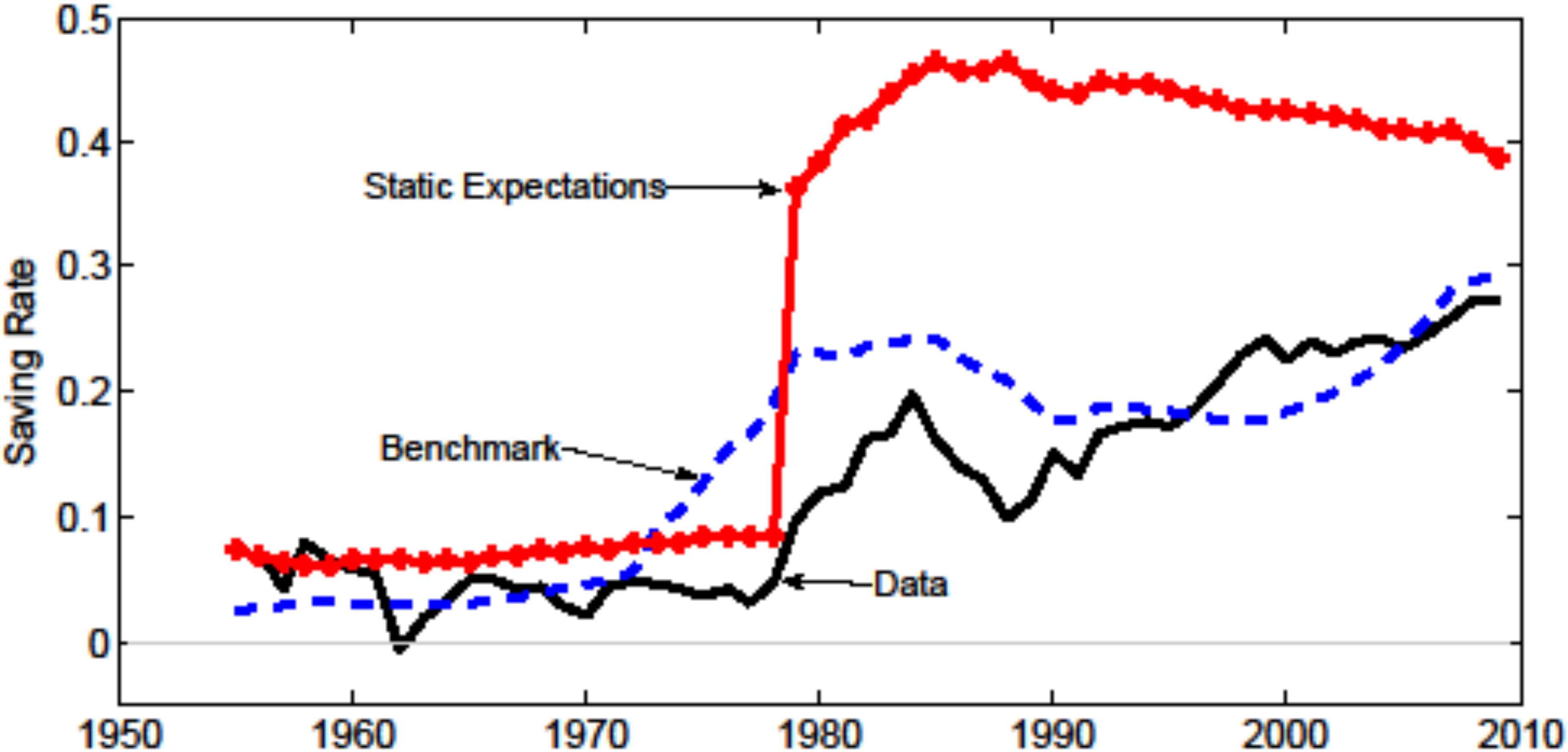
(1/2 and 1/4 observed)



Saving Rate by Age



Static Expectations



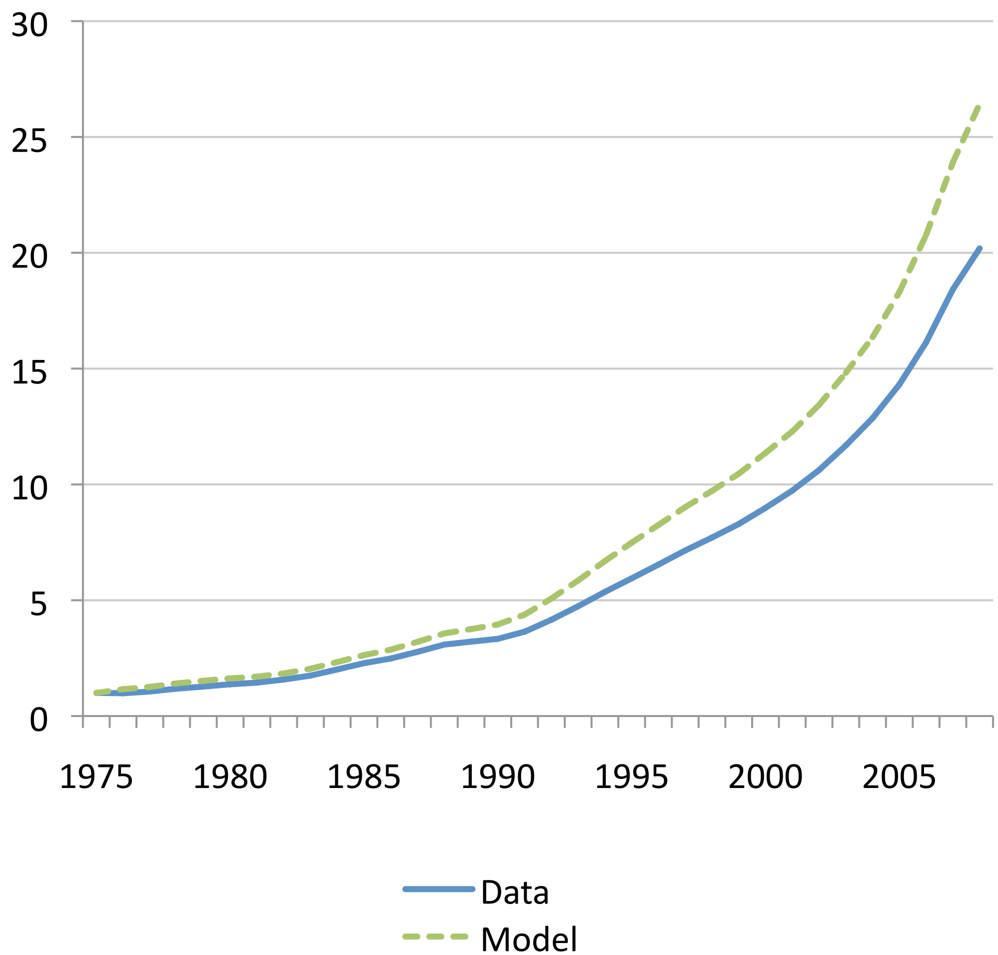
Final Remarks

- Possible to write down a model of Chinese households and get them to save a large fraction of income

- Using deterministic model, standard life-cycle considerations go a long way in explaining the evolution of household saving

- Family size, age distribution matter a great deal

Model Properties: GDP



Demographic Change

Table 2: Total Fertility Rates

Year	China	USA	Japan
1950-54	6.1	3.4	3.0
1955-59	5.5	3.7	2.2
1960-64	5.6	3.3	2.0
1965-69	5.9	2.5	2.0
1970-74	4.8	1.8	2.1
1975-79	2.9	1.8	1.8
1980-84	2.6	1.8	1.8
1985-89	2.0	1.9	1.7
1990-94	1.8	2.0	1.5
1995-99	1.8	2.0	1.4
2000-04	1.8	2.0	1.3
2005-09	1.8	2.1	1.3

Demographic Change

- With a rise in life expectancy, difficult to support elderly when there two generations affected by 1-child policy
- The 4-2-1 problem

Paternal

1. Grandfather
2. Grandmother

Maternal

3. Grandfather
4. Grandmother

1. Father
2. Mother

1. Child

Utility Function with Bequests

$$U_t = \sum_{j=0}^{39} \beta^j \underbrace{\frac{\mu\left(\theta_j \frac{N_{t+j}^y}{N_{t+j}^w}\right)^\eta \left(c_{t,j}^y\right)^{1-\sigma} + c_{t,j}^{1-\sigma}}{1-\sigma}}_{\text{utility in working years}}$$

$$+ \sum_{j=40}^{64} \beta^j \underbrace{\frac{\gamma_{t,j} c_{t,j}^{1-\sigma} + \left(1-\gamma_{t,j}\right)\left[\mu\left(\frac{N_{t+j}^w}{N_{t+j}^r}\right)^\eta \left(a_{t,j} \frac{N_{t+j}^r}{N_{t+j}^w}\right)^{1-\sigma} + c_{t,j}^{1-\sigma}\right]}{1-\sigma}}_{\text{utility in retirement}}$$

Transfers and Bequests

- Pay-as-you-Go Social Security pension

$$P_t = \frac{N_t^w}{N_t^r} \tau_t w_t$$

- In last year of life, agents leave remaining assets to current workers (their children)

$$B_t = \frac{1}{N_t^w} N_t^{67} \left(1 + r_t\right) a_{t,67}$$

No Bequests Motive