Never Too Old to Save - Explaining the High Saving Rates of the Chinese Elderly

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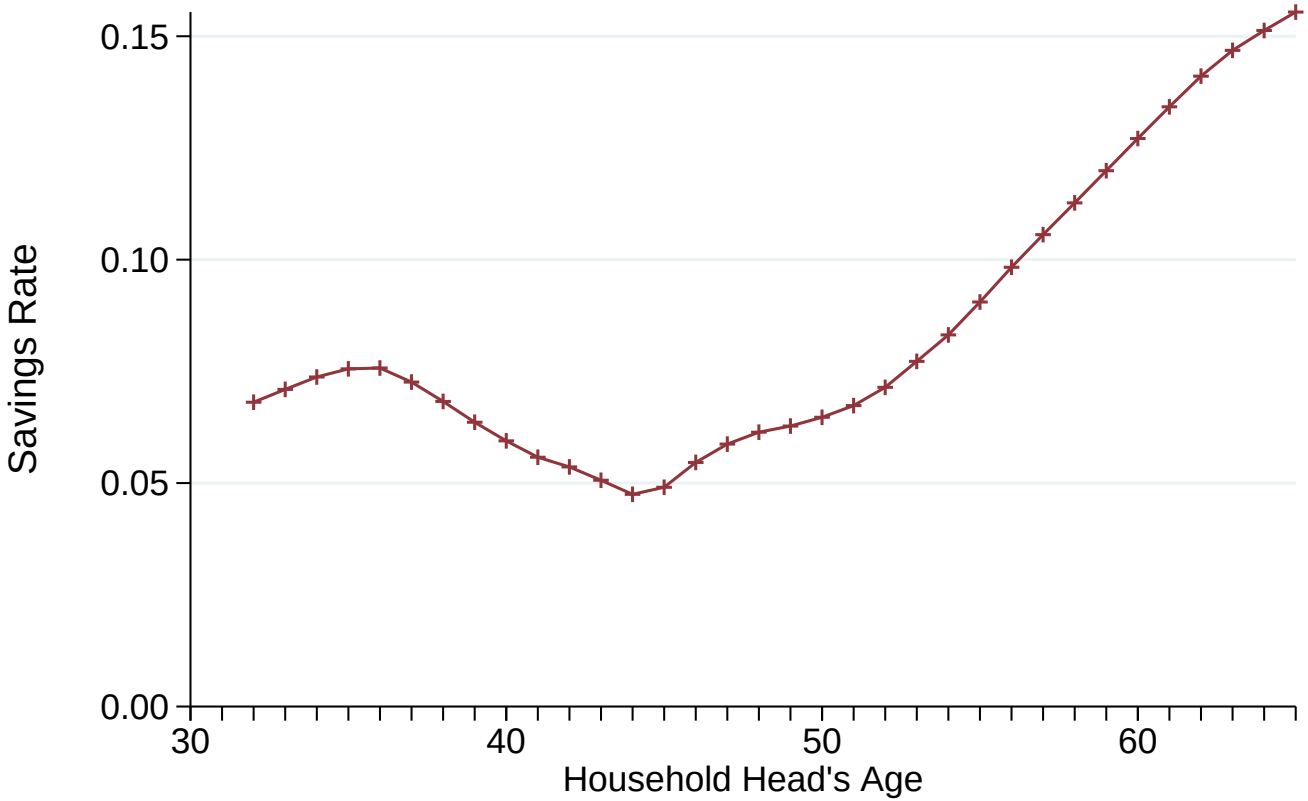
- National saving is composed of household saving, government saving and corporate saving.
  - Household saving is on average the most important component in the past twenty years.
    - Savings from the elderly account for an important share of household saving.
    - The saving rates of the elderly are found to be higher than the middle-aged (Chamon and Prasad, 2010; Yang et al., 2011).

Figure 1: Age Pattern of Chinese Saving Rate in 2002



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- Empirically - Why do the elderly in China save so much (in absolute&relative terms)?
- Theoretically - Can the counter intuitive fact be consistent with the life-cycle model? How to apply LCM in the set-up of a fast developing economy?

Previous Work Explaining the High Chinese Saving Rate

- Educational and medical expenses - Chamon and Prasad (2010)
- Flattened income profile - Song and Yang (2010)
- Pension reform - Feng et al. (2011)
- Coresidence - Rosenzweig and Zhang (2014)
- Migration and habit formation - Brugiavini et al. (2013)
- One-child policy - Wei and Zhang (2010); Banerjee et al. (2010)

Previous research is more successful in explaining why young people keep high saving. However, they cannot explain the high saving of the elderly.

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Preview of Results

- High and increasing pension income in China is the major contributor of the high saving rates of the Chinese elderly.
- When life cycle profile of pension income is taken into account, and together with medical expenditures and bequest motives, I can replicate the high and increasing saving rates after retirement.
- The counter-intuitive empirical facts in China can be well-explained under the framework of life-cycle model.

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  - The pension reform reduce the *de jure* replacement rate, but not *de facto*
  - From a life cycle point of view, lower pension would increase saving BEFORE retirement and reduce saving AFTER retirement.

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- (Structural model) A dynamic life-cycle model
  - Set-up
  - Identification & estimation
  - Simulation

Outline

Background

- The female labor force participation rate is among highest in the world.
- Retirement age: male - 60, female officer - 55, female worker - 50
- Exceptions include early retirement because of work injuries or disability and late retirement as requested by employers because of special skills (professors and experienced doctors, for example). In both cases, individual decisions are not important.
- Pension payment starts right at the time of retirement.
- Amount of pension is indexed to the average of current workers' wage.

Data

Urban sample of following data sets,

- China Household Income Project (1995, 2002)
  - Advantage: information for each family member, detailed employment information, asset information. People are asked to recall their past income for the past 5 years, providing partial "panel" natural.
- China Health and Nutrition Survey (1997, 2000, 2004, and 2006)
- China Health and Retirement Longitudinal Study (2011)

Sample

- **Sample:** nuclear family (exclude couples living with their children), both husband and wife are in labor force or retired, exclude negative income/expenditure, exclude top and bottom 1% of income/expenditure.

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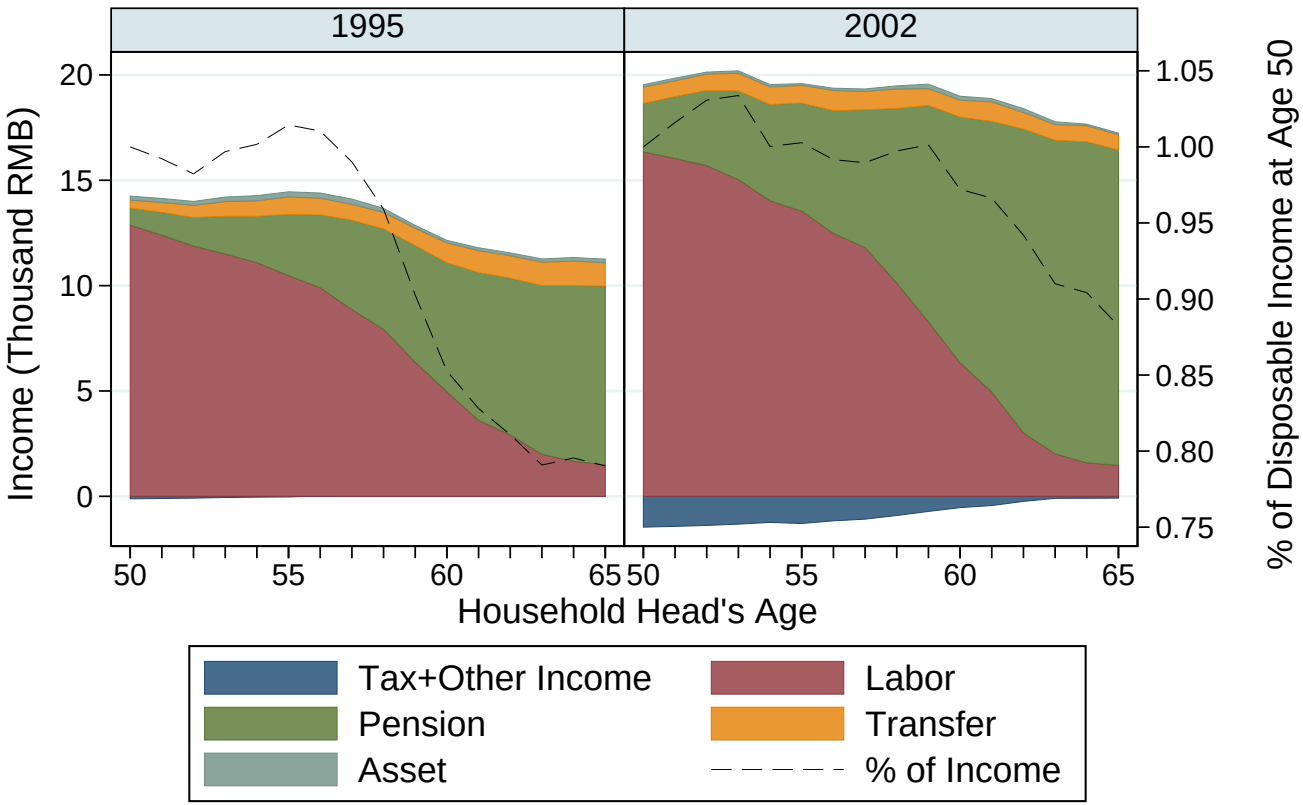
- Cross sectional variation
- Pension reform as exogenous shock

Across Time

Figure 2: Composition of Disposable Income by Survey Years



Source: Chinese Household Income Project, 1995, 2002.

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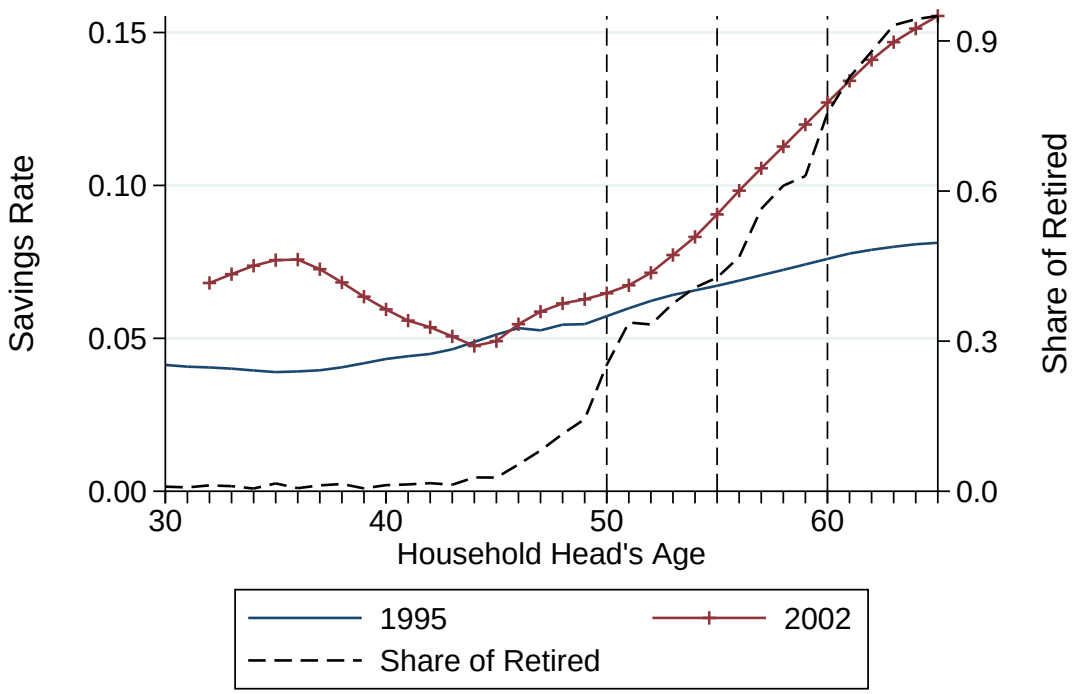
Figure 3: Age Pattern of Chinese Saving Rate by Survey Years



Source: Chinese Household Income Project, 1995, 2002.

▸ robustness

Across Group

Figure 4: Composition of Disposable Income by Employment Types

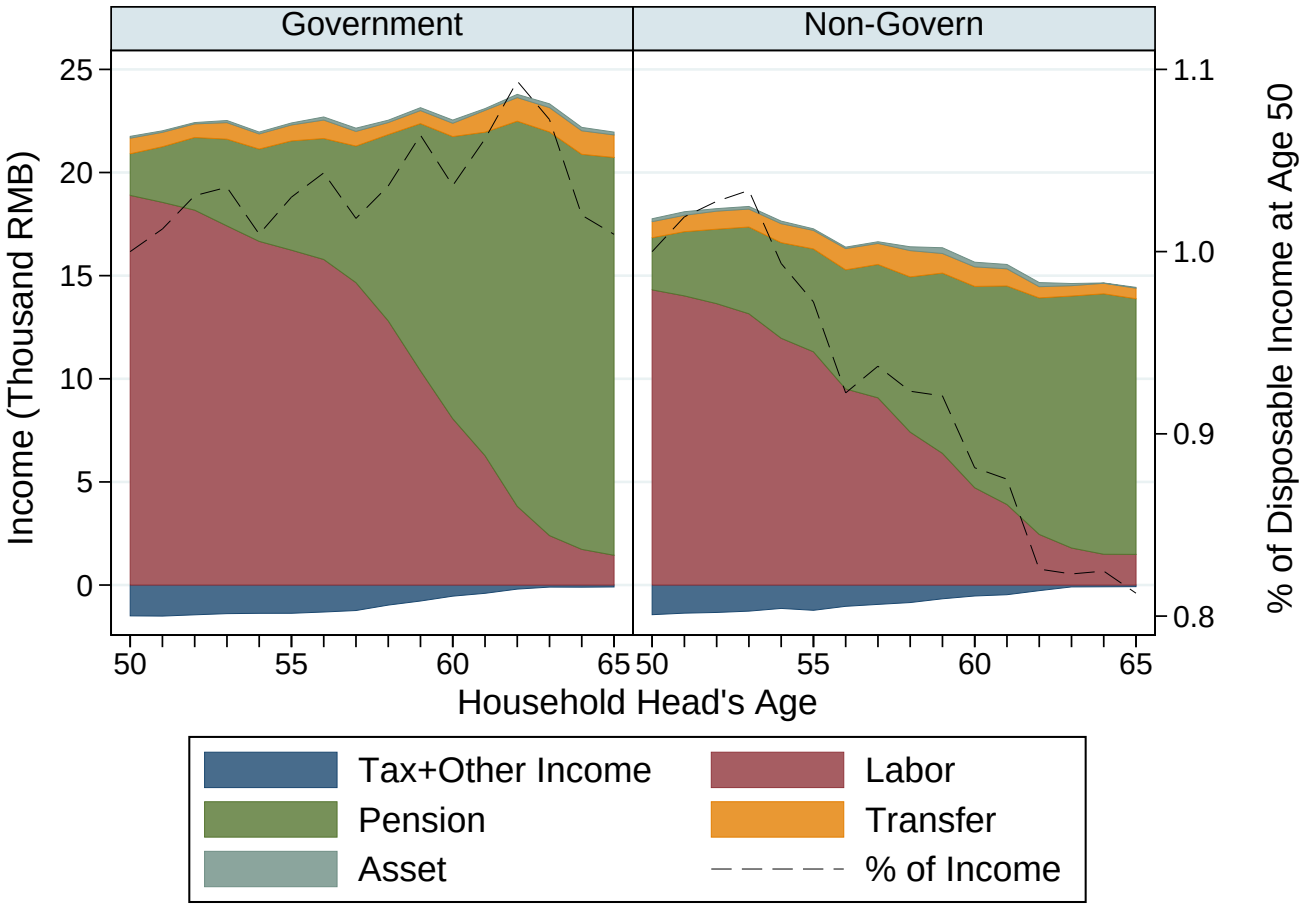


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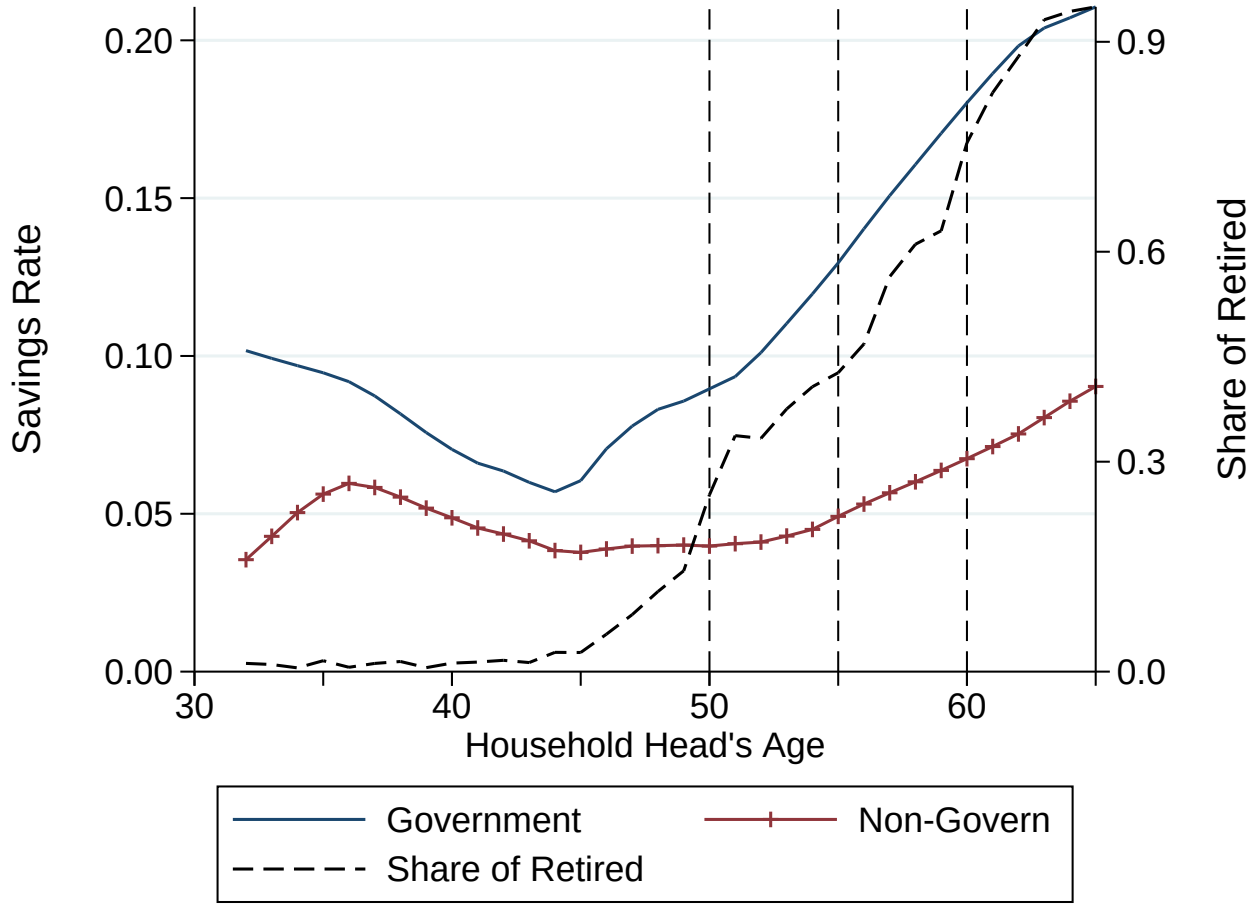
Figure 5: Age Pattern of Chinese Saving Rate by Employer Types



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- People who are more risk averse are more likely to choose firms with higher pensions to secure elderly life.

To address the possible concerns of endogeneity, I use the pension reform since 1990's as exogenous shock.

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  - Before 1978 - Planned economy, government provide cradle-to-grave social security through state-owned-enterprise.
  - 1978 - early 1990s - Firms are assumed responsibility of their retirees.
    - The *de facto* rate is much lower than the *de jure* rate because unprofitable firms delay or cancel the pension payment to their retirees.
    - Meng (2003) estimated that in 1995 and 1996, around 50% of the SOEs reported losses.
- A new three-tier pension scheme is established - public + occupational + voluntary

Pension Reform as Exogenous Variable

- Since the start of 1990, the Chinese pension system gradually switched from a PAYG system to a three-tier system.
- Before 1995, some provinces started their own experiment first and have different target replacement rates.
- In 1997, a formal national level reform occurred, resulting in the same target replacement rate across the country.
- As a result, provinces with lower replacement rates before the reform benefited more from the reform.

Province	Target Replacement Before Reform
Beijing	75
Shanxi	95
Jiangsu	65
Henan	75
Hubei	85
Guangdong	70
Chongqing	95
Sichuan	95
Yunnan	71

Where Does the Exogenous Variation Comes From?

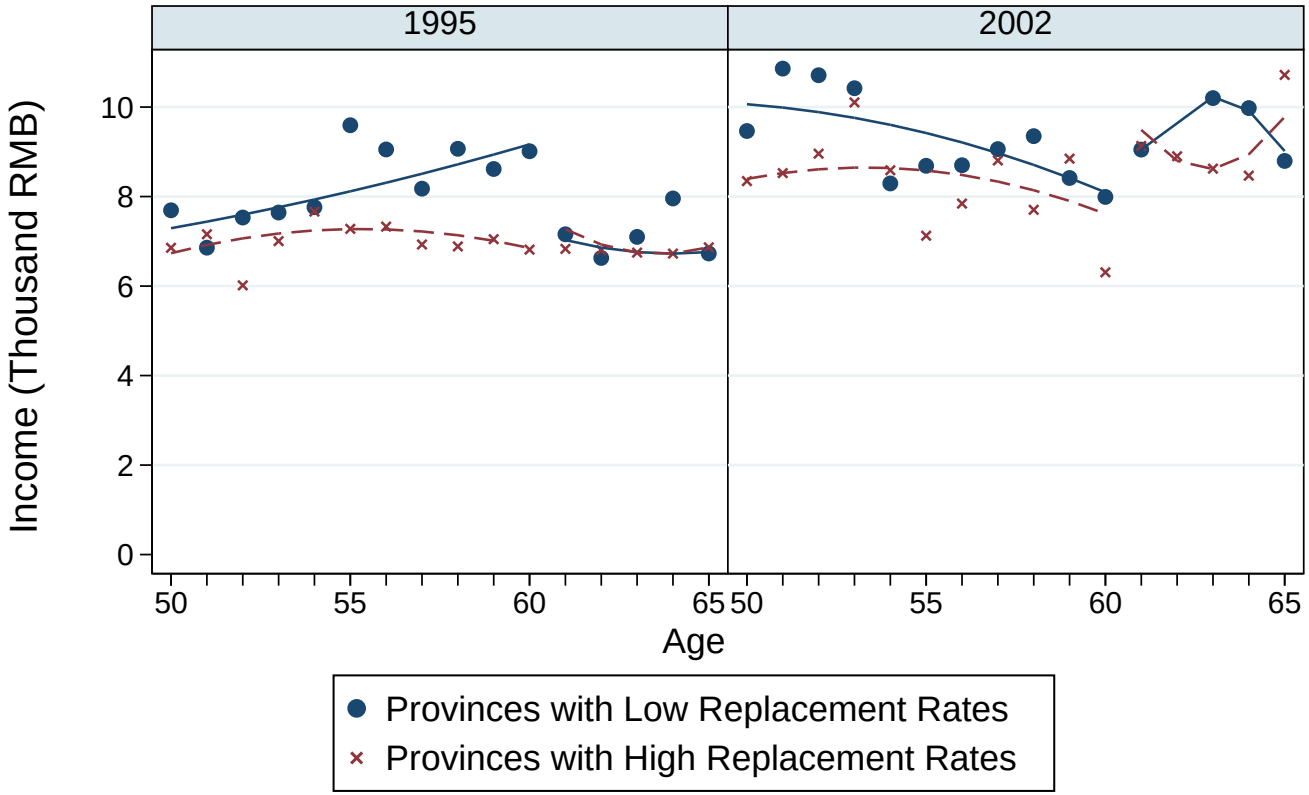
	Before Reform		After Reform	
Province	Jiangsu (Rate=0.65)	Hubei (Rate=0.85)	Jiangsu (Rate=0.75)	Hubei (Rate=0.75)
Working	6,300	5,700	7,700	7,500
Retired	4,095	4,845	5,775	5,625
DID	-1,350		-50	
DDD	1,300			

Identification Strategy - DDD

$$\begin{aligned}\log(Income_{i,p,t}) = \; & \beta_1 After_t + \beta_2 Retire_{i,p,t} + \beta_3 \Delta Rate\_Rp_p \times Retire_{i,p,t} \\ & + \beta_4 \Delta Rate\_Rp_p \times After_t + \beta_5 Retire_{i,p,t} \times After_t \\ & + \beta_6 \Delta Rate\_Rp_p \times Retire_{i,p,t} \times After_t + \beta_7 X_{i,t} \\ & + \sum \beta_{8,p} Prov_p + \sum \beta_{9,p} Prov_p \times After_t + \beta_0 + \varepsilon_{i,p,t}\end{aligned}$$

- 1st difference - retire - exogeneity of the reform comes from replacement rate, and the difference before and after retirement captures the retirement rate.
- 2nd difference - after - before the reform the target replacement rates are the different and after reform they become the same.
- 3rd difference - $\Delta Rate\_Rp$ - replacement rates go up more for provinces with lower initial rates.

Figure 6: Replacement Rates and Pension Reform



Source: Chinese Household Income Project, 1995, 2002.

Table 3: Estimation of the Effect of Pension on Saving Rate

Dependent Variables	log(Income)	log(Expenditure)	Saving Rate
	(1)	(2)	(3)
Δ Replacement Rate	-0.417***	-0.167	-0.605**
*Retired	(0.147)	(0.153)	(0.276)
Δ Replacement Rate	0.247*	0.234*	0.00774
*After	(0.139)	(0.139)	(0.232)
Retired*After	0.416***	0.113	0.615**
	(0.150)	(0.148)	(0.274)
Δ Replacement Rate	0.383**	0.0760	0.685**
*Retired*After	(0.186)	(0.194)	(0.347)
Observations	11,380	11,499	11,380

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- However, retirees experiencing greater increase in pensions do not increase their expenditures accordingly. Instead, the extra pensions mostly transit into saving.
- Why?

Outline

Some Possibilities

- Concerns for high future medical expenditures.
- Bequest motive.

Other Possibilities

Of course, there maybe other possibilities including

- Prepare for the cost of children's education, housing and marriage.
- Deteriating health status.
- Longer life expectancy.

However, I provide evidence these explanation fails to match some important empirical facts in China. ▸ Why?

The Role of Medical Expenditures

- Medical expenditures are believed to be an important variable to explain the saving of the elderly. (for example, DeNardi et al. (2010) argues this is the main reason why the old people in the United States keep a high amount saving.)

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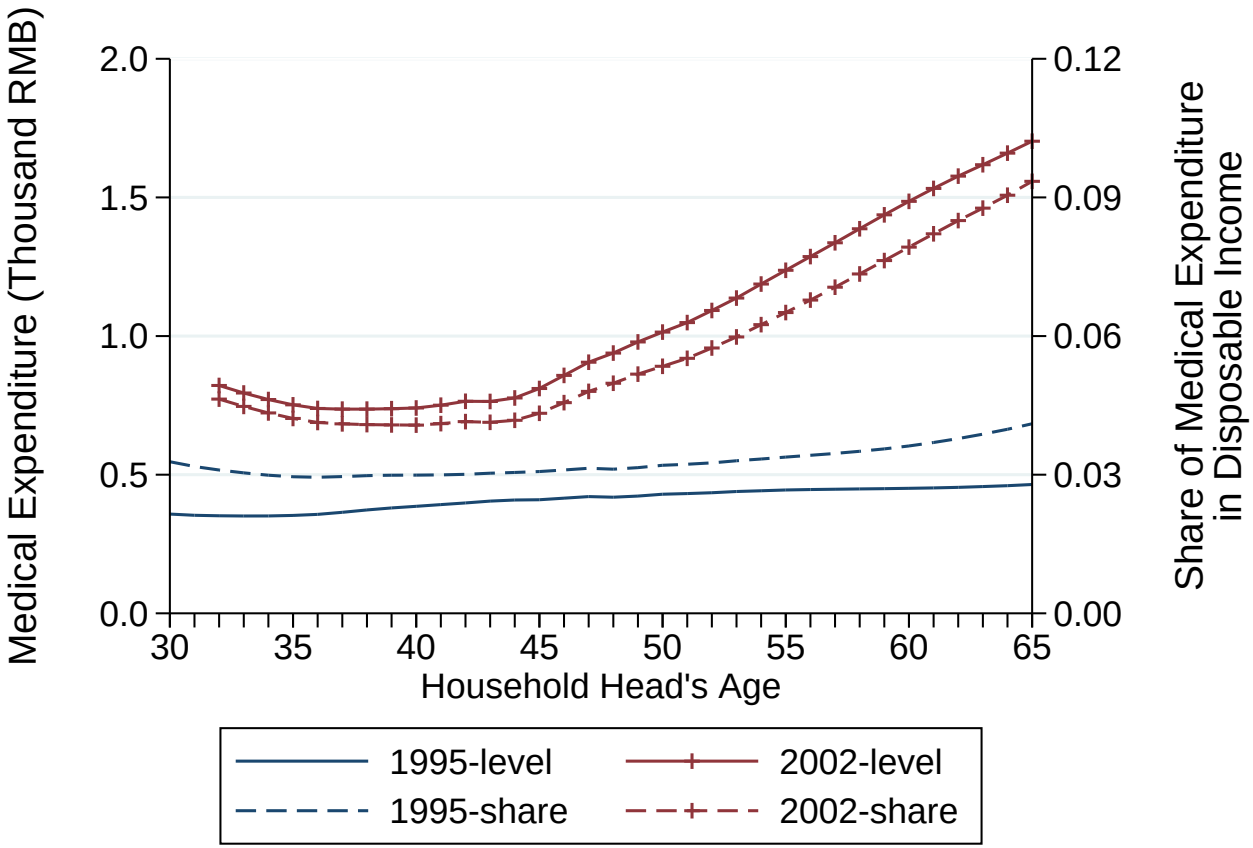
- In 2002, medical expenditures are significantly higher, especially for the old people. This happens as a result of a decline public medical insurance during the period.

Figure 7: Out of Pocket Medical Expenditure by Years



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- Mechanical effect - saving is defined as income minus expenditures, therefore medical expenditures are subtracted from saving.
- Precautionary effect - high current medical expenditures are usually accompanied with even higher future medical expenditures. Household may save more to prepare for the future needs.

Bequest Motives

- Identifying bequest motives is difficult.
- Even if a positive amount of assets are observed when the elderly pass away, we cannot guarantee whether they are intentional bequests or accidental bequests.

Suggestive Evidence 1: Direct Objective Questions

Table 5: Distribution of the Objective Question "*I want to leave as large a bequest as possible to my children*"

	Urban Households	
	Observations	Percentage
I think so	81	17.69%
I tend to think so	205	44.76%
I can't say one way or the other	127	27.73%
I tend not to think so	38	8.3%
I do not think so	7	1.53%
Total	458	100%

Source: Yin (2010)

Suggestive Evidence 2: Saving for Old-Age Support?

Table 6: Who can Rely on for Old-Age Support

Sample	Below 50	50~60	Above 60
Children	36.07%	31.71%	28.68%
Saving	8.00%	3.36%	2.65%
Pension or retirement salary	50.15%	59.34%	63.51%
Commercial pension insurance	1.82%	0.93%	0.31%
Other	3.95%	4.65%	4.86%
Observations	987	1,397	1,625

Note: Source, CHARLS 2011.

Suggestive Evidence 3: Saving Rate and Number of Children

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- A natural assumption is if the household does not have children, then the saving is more likely to be accidental.
- From CHARLS 2011, for old households (older than 60) without any child, conditional on education and income level, they save 11.1% less when compared to households with at least one child.

Outline

Why I Need a Model

- To quantify the importance of pension income when joint with bequest motives and medical expenditures.
- To carry out counterfactual simulations.

Outline of the Model

- Preference
- Heterogeneity of household
- Income process
- Medical expenditure process
- Constraints

Preference

A household i in a specific cohort in his age t has a CRRA utility function

$$u^i\left(C_t^i\right) = \delta(h_t^i, l_t^i)\frac{\left(C_t^i\right)^{1-\nu}}{1-\nu}$$

where $\delta(h_t^i, l_t^i) = 1 + \delta_1 h_t^i + \delta_2 l_t^i + \delta_3 h_t^i l_t^i$. Here C_t^i is consumption, h_t^i is health status and l_t^i is leisure.

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The reason to include health and leisure into the model is that previous research has found they are important determinants of consumption after retirement.

- At the end of each year, there is a mortality shock. Household dies with probability m_t. There is a utility from bequests.

$$b^i\left(A_t^i\right) = \left(\theta_0 + \theta_1 Child^i\right) \frac{\left(A_t^i + \kappa\right)^{1-\nu}}{1-\nu}$$

where $Child^i$ is an indicator variable whether the household has child or not.

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  where $Child^i$ is an indicator variable whether the household has child or not.

- The reason to include child is empirical evidence shows strength of bequest is closely related to whether the household has child or not.

Household Heterogeneity

- Education - fixed through out life cycle.
- Health - transition probability estimated using CHNS.
- Cohort - multiple cohorts in the model.

Heterogeneity affects household through income, medical expenditure, utility function and initial conditions.

Income Process

- There is income uncertainty, and for a given cohort, income is assumed to be

$$\ln(Y_t^i) = \ln(\overline{Y}_t^i) + e_t^i$$

Here $\overline{Y}_t^i = f\left(t, E^i, h_t^i\right)$

That is, the average cohort income will be estimated as a function of age, education and health (also their interaction term). Income profile for different cohort will be estimated separately.

- There is a transitory part and permanent part, ε_t and ϵ_t, which are normally distributed white noise

$$\begin{aligned} e_t^i &= u_t^i + \varepsilon_t^i \\ u_t^i &= \rho u_{t-1}^i + \epsilon_t^i \end{aligned}$$

- Income process is estimated outside the model. Because people are asked about income in previous years, it is possible to identify transitory income and permanent income using Meghir and Pistaferri (2004)'s approach.

- Parameter estimate

$$\widehat{\sigma}_\varepsilon = 0.045, \widehat{\sigma}_\epsilon = 0.0039, \rho = 0.87$$

Modeling Life-Cycle Income Profile

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Modeling Life-Cycle Income Profile

- It is important to take into account the fact the in China is income is growing quickly for all cohorts.
- In the model I estimate the life cycle profiles separately for each cohort. Therefore I make a clear distinction between "life cycle profile" and "cross-sectional profile."

- In developed countries, the economy is stationary. "Cross-sectional profile" serves as a good proxy for "life cycle profile."

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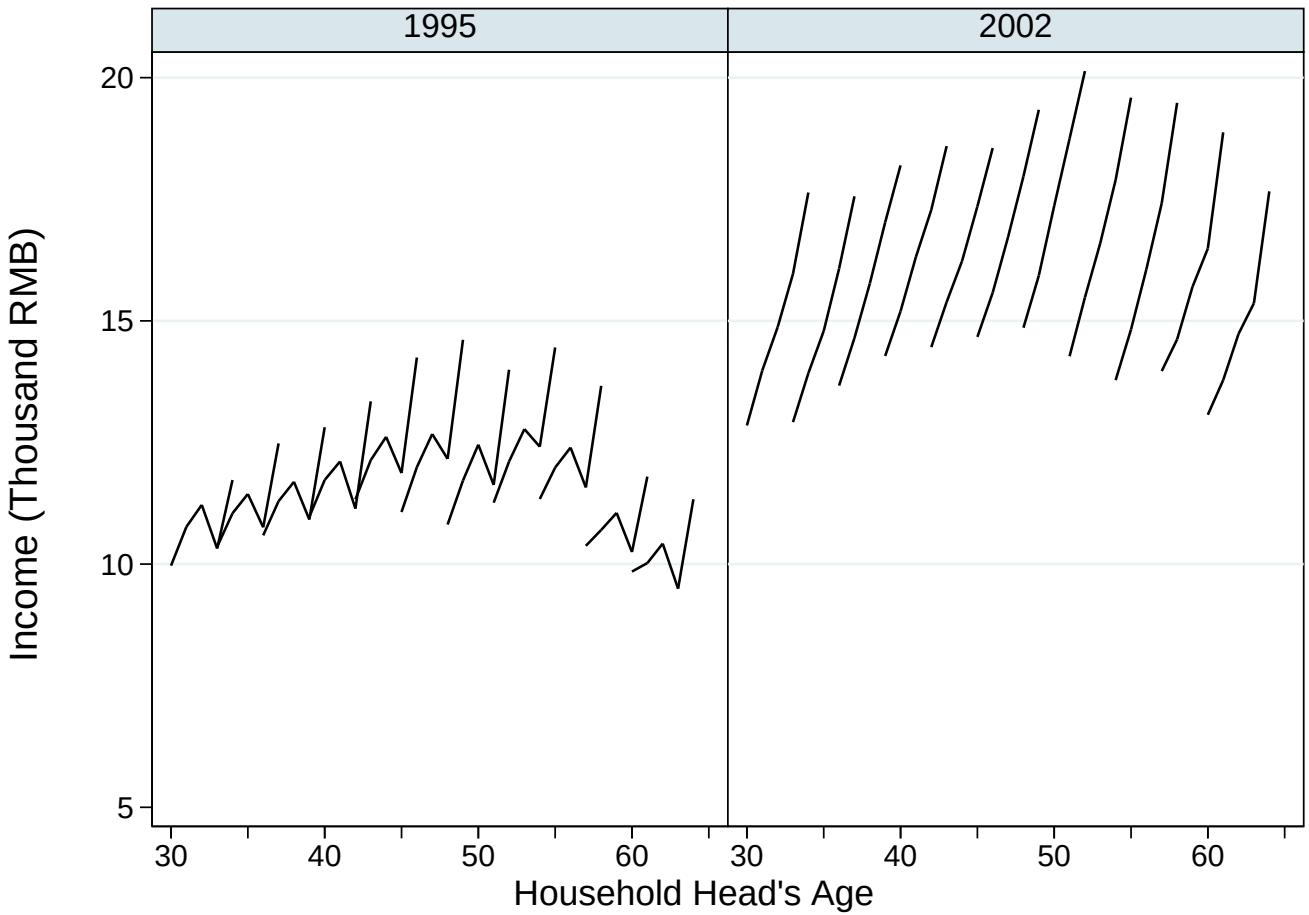
- In China, the pension income is indexed to current worker's average wage. The economy is growing fast. Household's income keeps increasing even after retirement, creating a sharp difference between "cross-sectional profile" and "life cycle profile."

Figure 8: Life Cycle Profile of Income



Source: Chinese Household Income Project, 1995, 2002.

▸ Expectation?

Medical Expenditure Process

- Medical expenditure process is also estimated outside the model.
- Medical expenditures are determined by two elements - health status (estimated using CHNS) and medical expenditure conditional on health status (estimated using CHIP).

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- Allow the possibility of catastrophic shock - conditional on a "shock" happening, there is a probability of ϕ for this shock to be catastrophic
  - $M_t^{i,1}$ if no shock happens (with probability $1-\pi$)
  - $M_t^{i,2}$ if small shock happens (with probability $\pi(1-\phi)$)
  - $M_t^{i,3}$ if catastrophic shock happens (with probability $\pi\phi$)
  - for simplicity I assume $M_t^{i,3} = \gamma M_t^{i,2}$.

Constraints

- Budget constraint

$$A^i_{t+1} = (1+r)A^i_t + Y^i_t + T^i_t - C^i_t - M^i_t$$

T^i_t is the cash transfer from the government to guarantee consumption floor $\underline{C}$ (estimated by the average consumption of bottom 1%).

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- Liquidity constraint (only 1.5% of households in China has negative assets)

$$A^i_t \geq 0, \forall t$$

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- At the beginning of each period, random income shock and medical shock are realized. Together with household's types, these shocks determine the level of income and medical expenditures.
- Household makes consumption and saving decision. Government guarantee a minimum consumption level.

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- Representative household with initial assets, initial health status, initial type (education level, employment type). May live up to a certain amount of periods.
- At the beginning of each period, random income shock and medical shock are realized. Together with household's types, these shocks determine the level of income and medical expenditures.
- Household makes consumption and saving decision. Government guarantee a minimum consumption level.
- At the end of a period, a mortality shock and health transition shock is realized.

Optimization Problem

The recursive problem is given by,

$$\begin{aligned} V_t(A_t, h_t, l_t, u_t; E) &= \max_{C_t}\{u(C_t) \\ &\quad +\beta E_t V_{t+1}(A_{t+1}, h_{t+1}, l_{t+1}, u_{t+1}; E)\} \end{aligned}$$

subject to

$$\begin{aligned} A_{t+1} &= (1+r)A_t + Y_t + T_t - C_t - M_t \\ T_t &= \max\{\underline{C} + M_t - Y_t - (1+r)A_t, 0\} \\ A_t &\geq 0 \end{aligned}$$

Estimation of Parameters

The parameters in the model can be estimated from three sources,

- Fix discount factor $\beta = 0.98$ and obtain interest rate r from macro data
- Estimated outside the model (income process, medical expenditure process)
- Estimated within the model (risk aversion, bequest motives, utility shifters)

What is new about the model?

- Allow for income uncertainty along with medical expenses uncertainty.
- Emphasize the difference between "life-cycle profile" and "cross-sectional" profile.
- Model is built to overcome data limitation (e.g., lack of panel data about medical expenses).
- "Partially" identifies bequest motives from "residual claimer."

Parameters to Be Identified Within the Model

- Strength of bequest motive - $\theta_0,\ \theta_1$
- Curvature of bequest motive - κ
- Relative risk aversion - ν
- Preference shifter - $\delta_1,\ \delta_2,\ \delta_3$

Match of Moments

- The model is estimated using Method of Simulated Moments (MSM).

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- Moments are chosen to identify all the parameters. ▸ Identification

Estimate of Parameters in the Model

Parameters	Estimate (Standard Error)
θ_0	97.24 (14.7648)
θ_1	126.8 (19.4594)
κ	18.91 (3.1710)
ν	1.989 (0.1934)
δ_1	-1.332 (1.5503)
δ_2	0.0996 (0.0864)
δ_3	0.1948 (0.1450)

Parameter Estimation

- Relative risk aversion ν is estimated to be around 2, which is actually lower compared to the estimates in U.S.

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Parameter Estimation

- Relative risk aversion ν is estimated to be around 2, which is actually lower compared to the estimates in U.S.
  - There is no evidence suggesting the Chinese elderly are more risk averse.
- The strength of the bequest motive for households without child is only 43% of those with children.
  - Suggesting strong bequest motives.

Outline

Questions to Be Answered

- Does the model match empirical patterns well?

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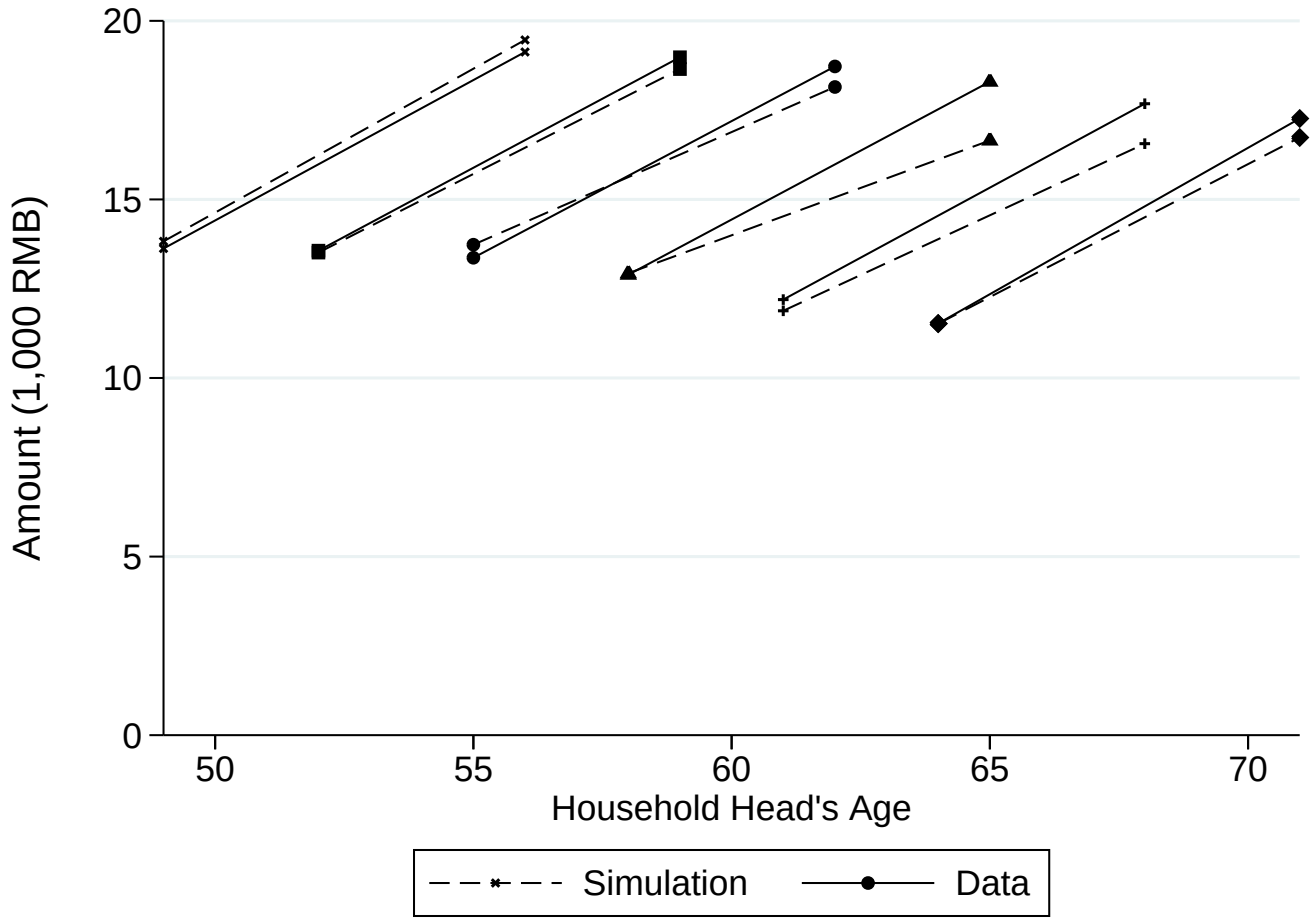
- Can pension explain the high saving rate for the Chinese elderly?
- How important is Chinese economy growth upon the elderly saving?

Match of Income

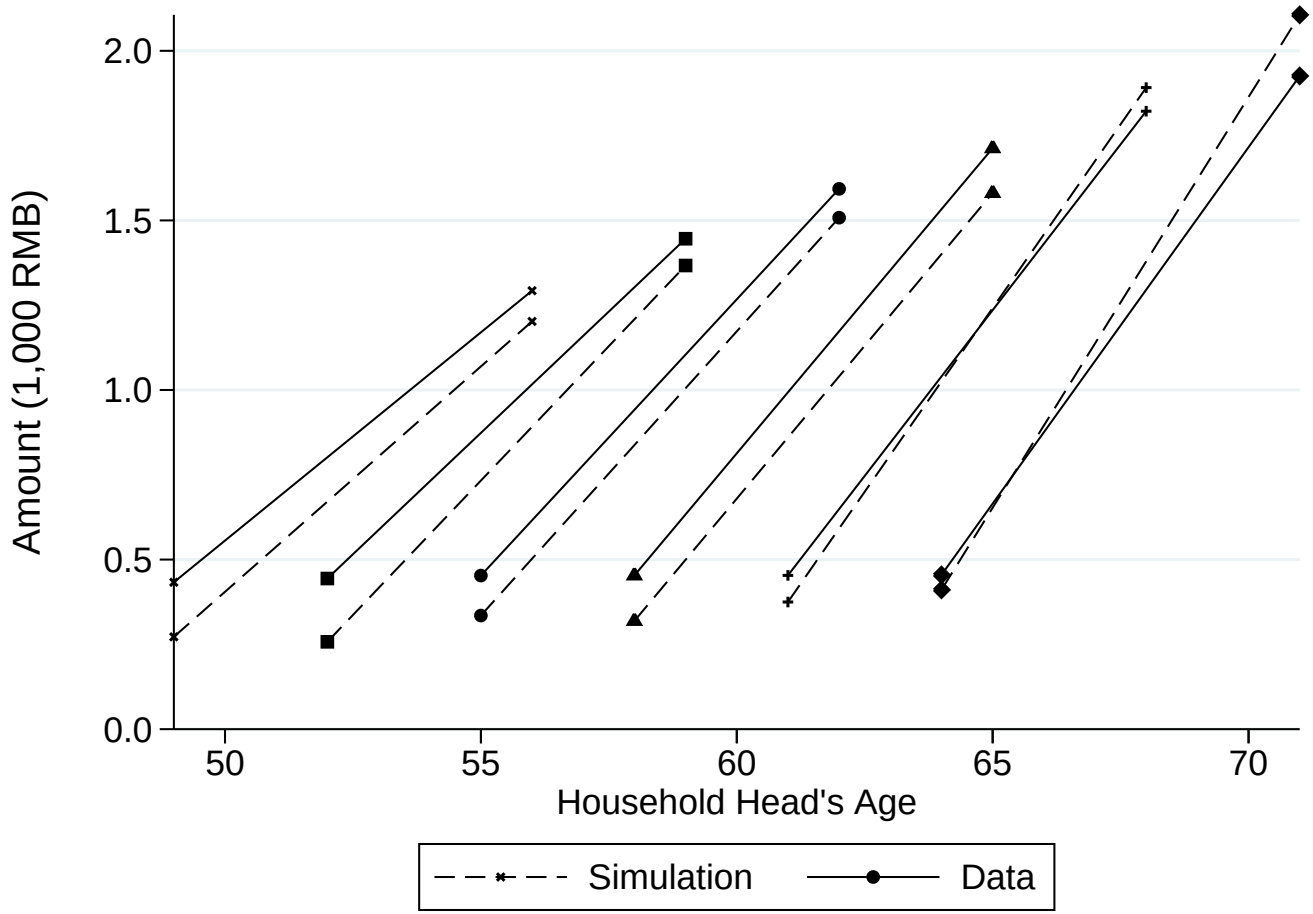
Figure 9: Match of Income



Source: Chinese Household Income Project, 1995, 2002.

Match of Medical Expenditure

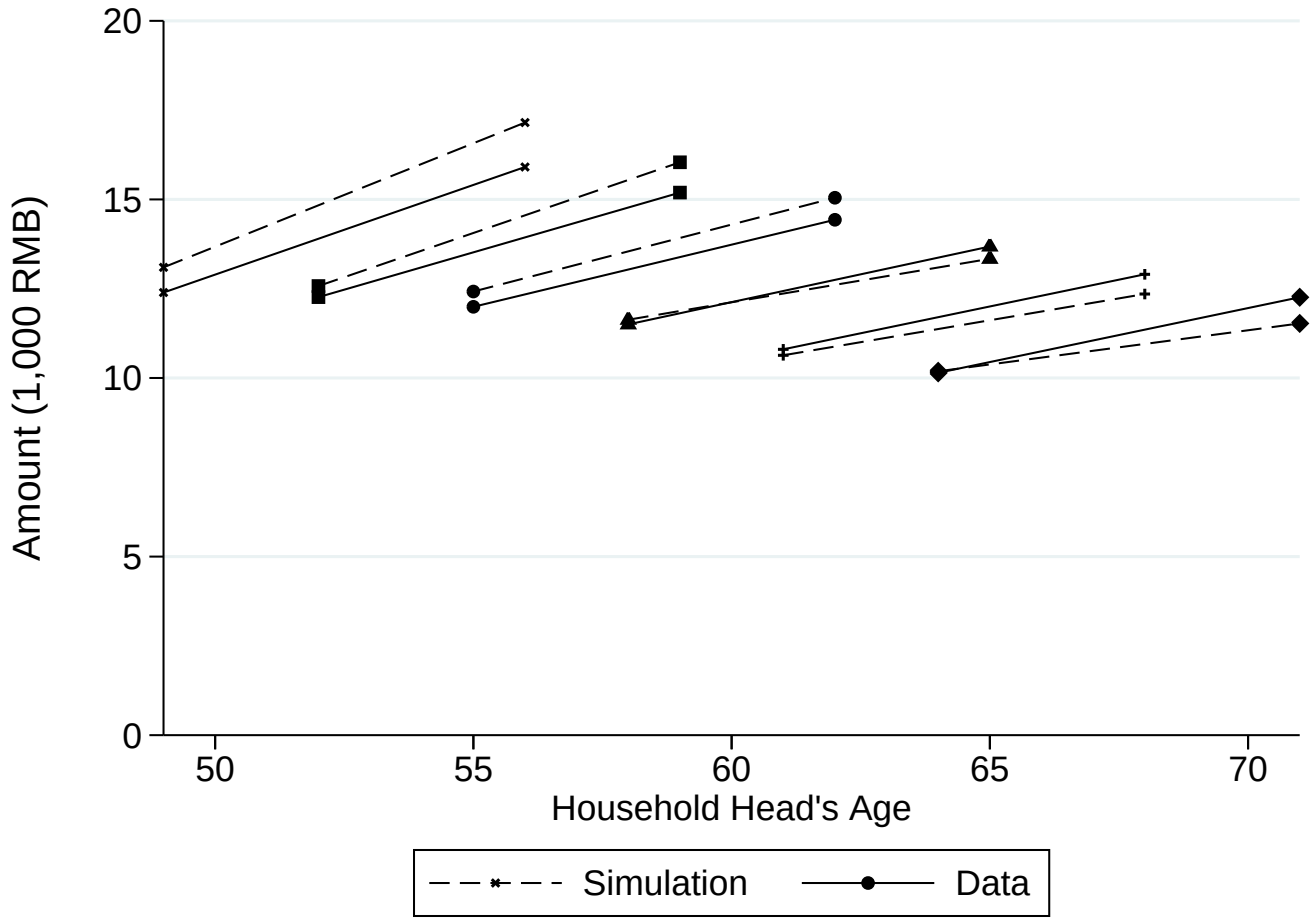
Figure 10: Match of Medical Expenditure



Source: Chinese Household Income Project, 1995, 2002.

Match of Consumption

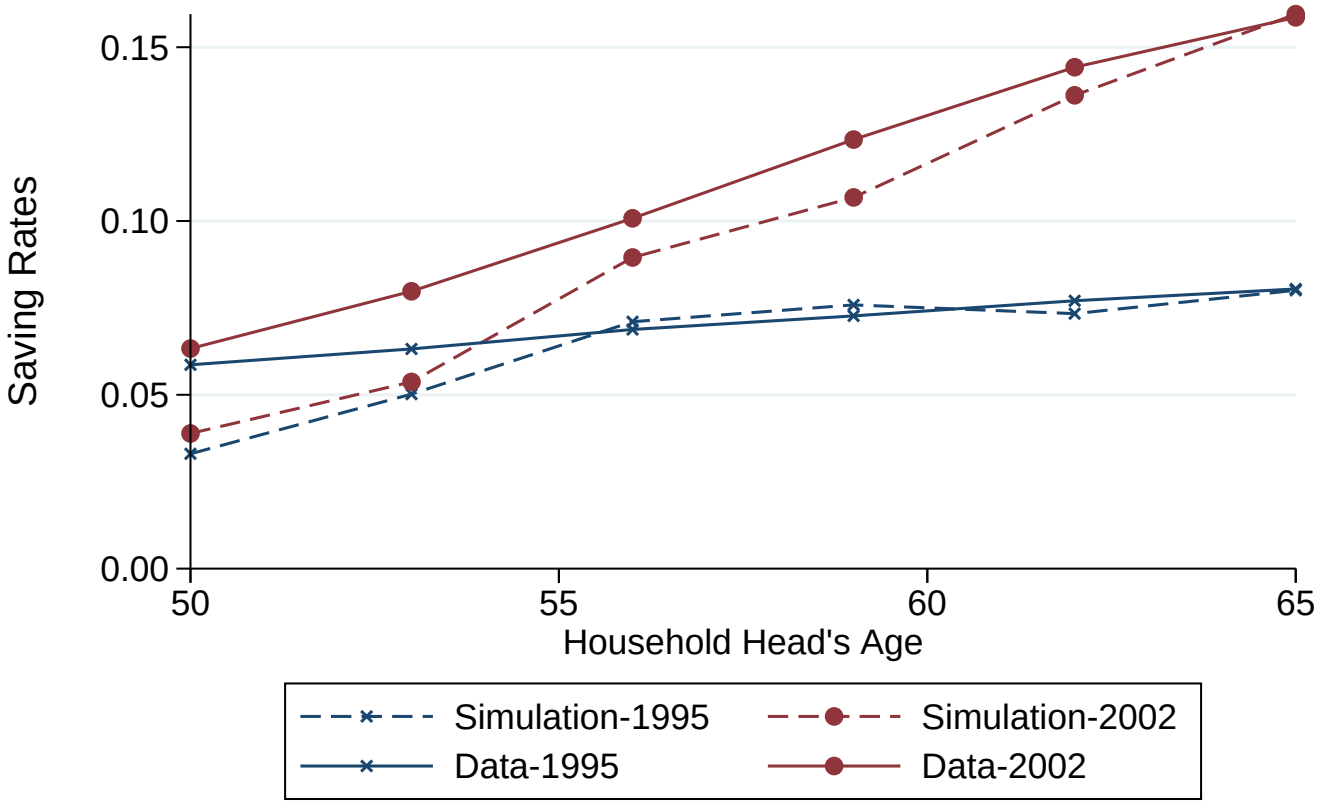
Figure 11: Match of Consumption



Source: Chinese Household Income Project, 1995, 2002.

Match of Saving Rate Across Time

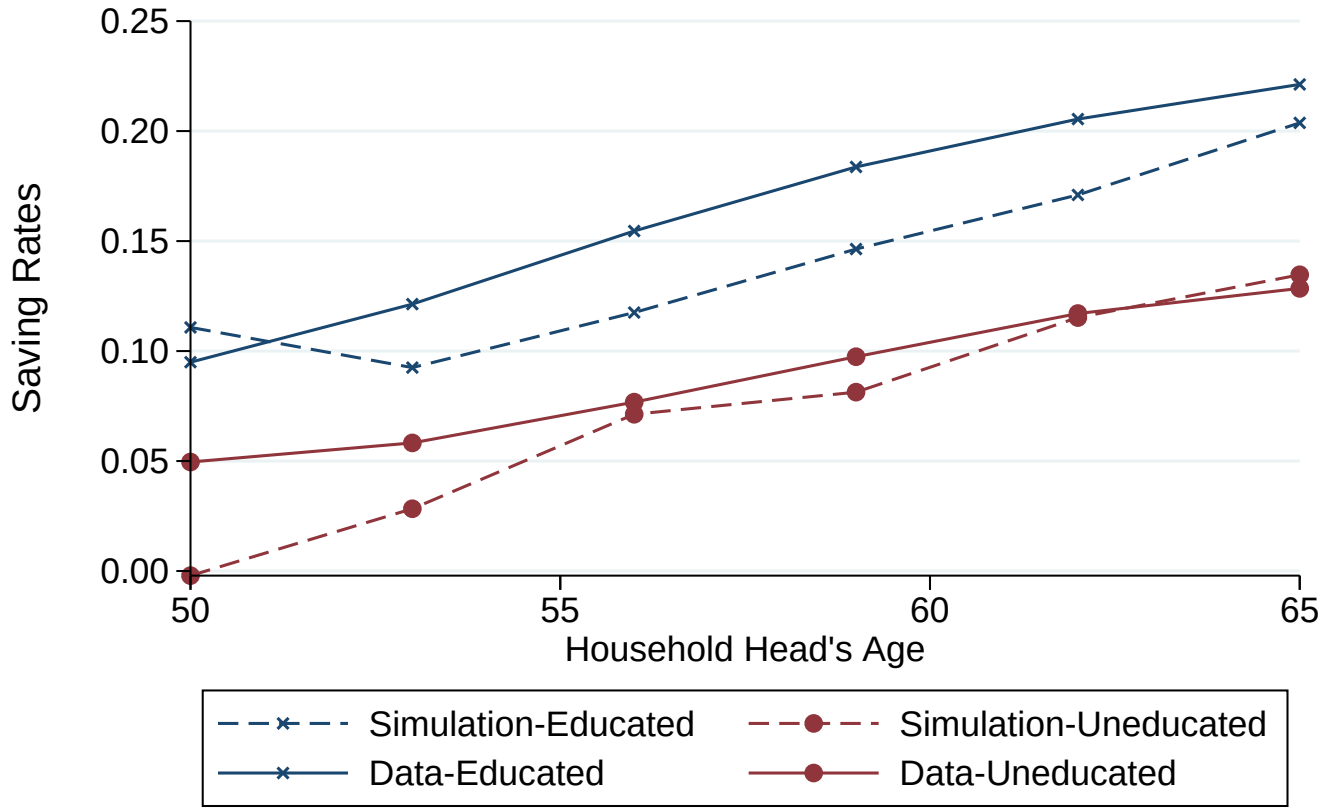
Figure 12: Match of Saving Rates for Different Waves



Source: Chinese Household Income Project, 1995, 2002.

Match of Saving Rate Across Education

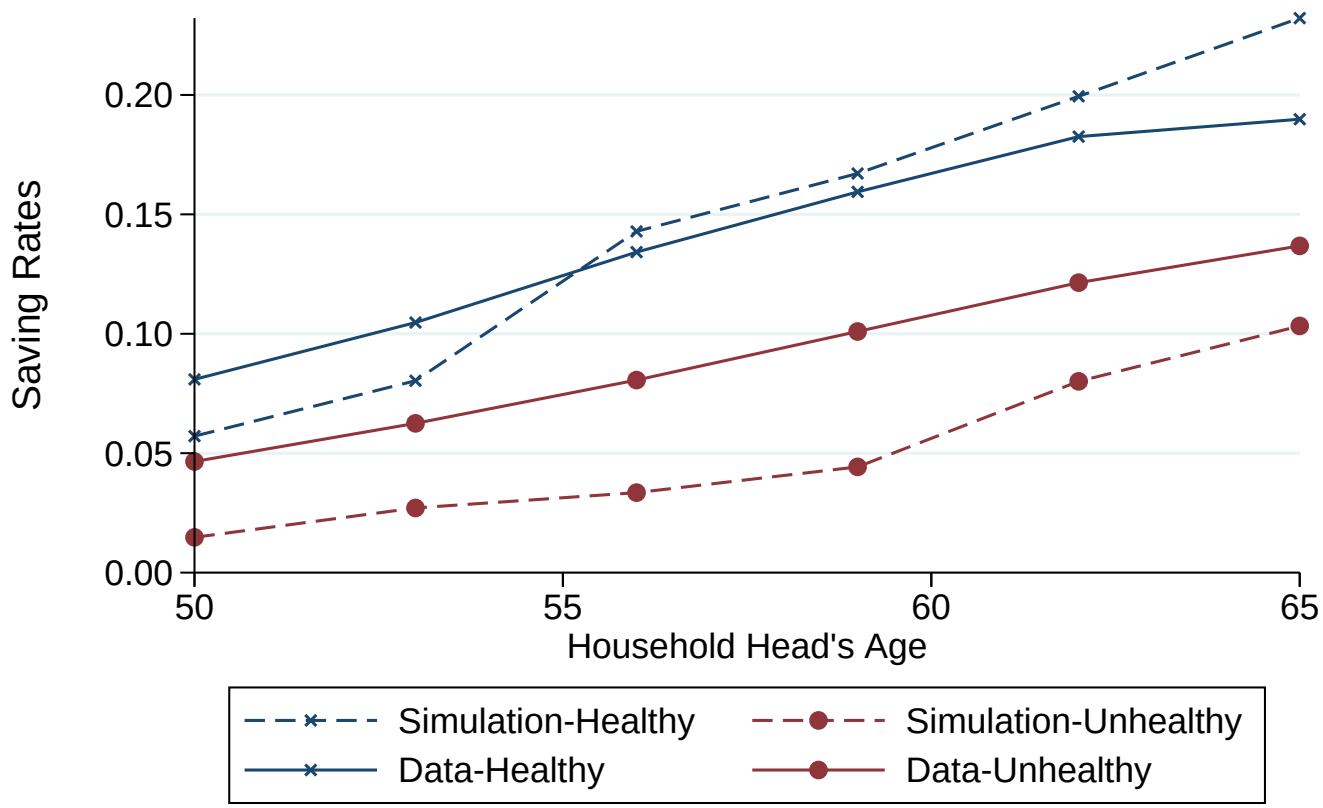
Figure 13: Match of Saving Rates for Different Education Level



Source: Chinese Household Income Project, 1995, 2002.

Match of Saving Rate Across Health

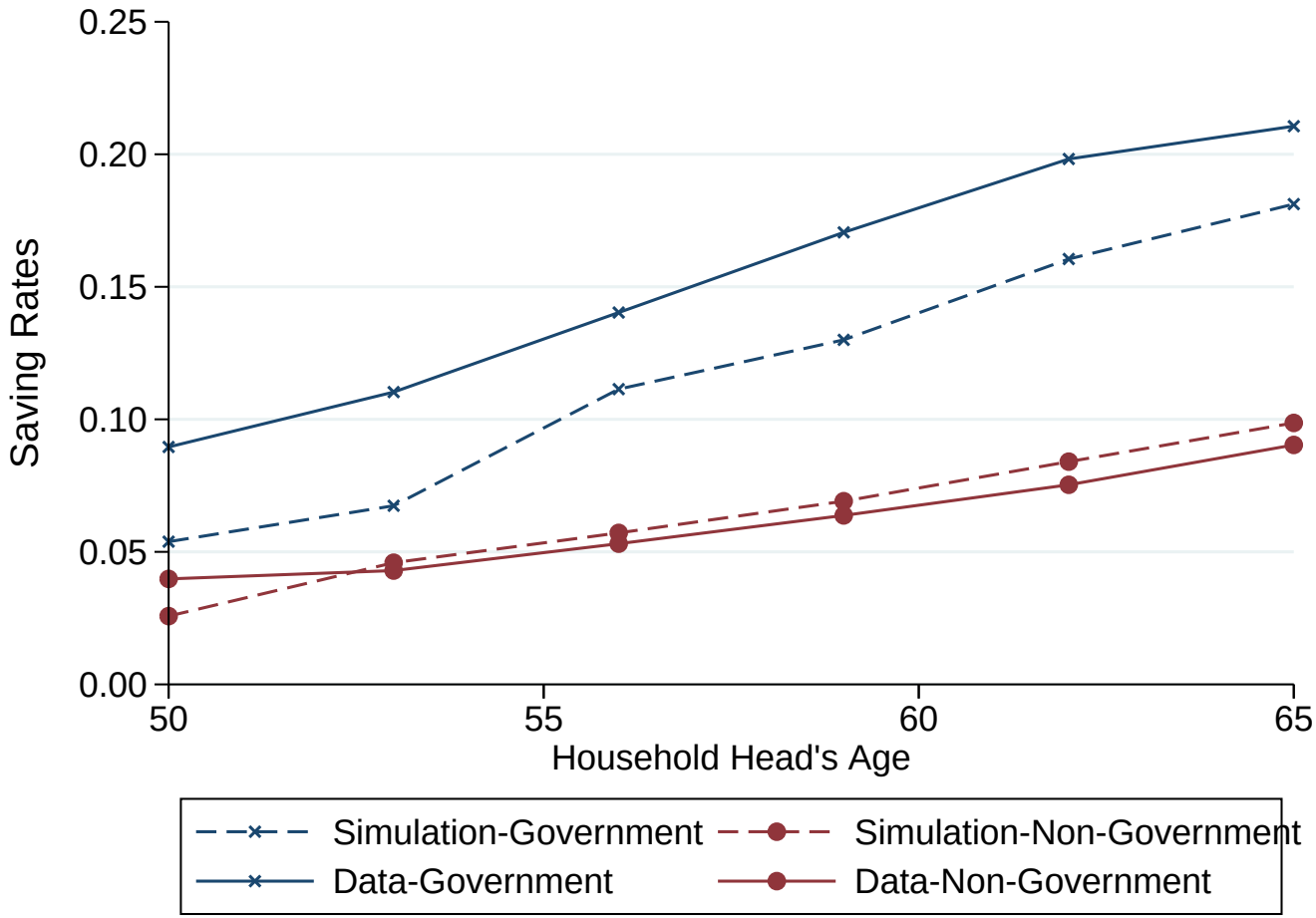
Figure 14: Match of Saving Rates for Different Health Status



Source: Chinese Household Income Project, 1995, 2002.

Out of Sample Test - Across Employment Type

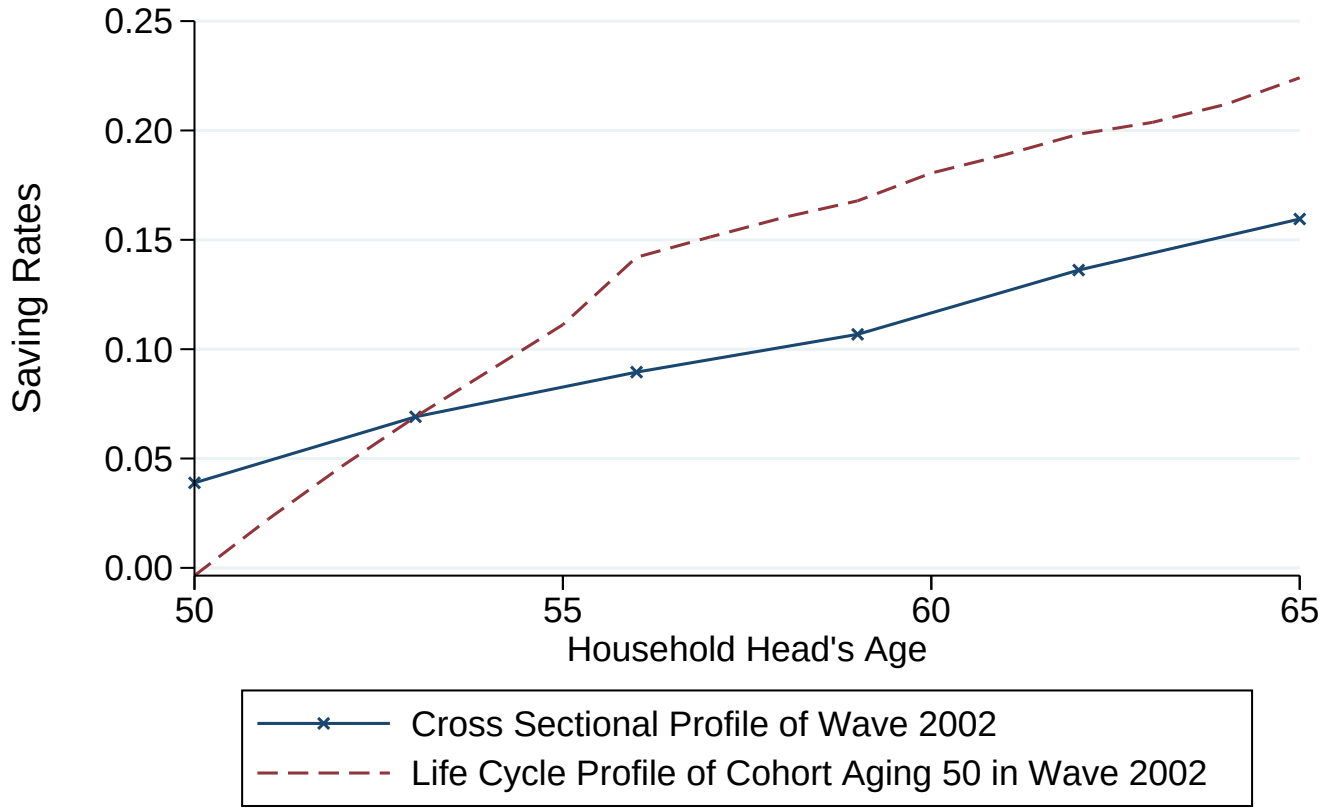
Figure 15: Match of Saving Rates for Different Employment Types



Source: Chinese Household Income Project, 1995, 2002.

Life Cycle versus Cross Sectional

Figure 16: Comparing Life Cycle Profile and Cross Sectional Profile



Source: Chinese Household Income Project, 1995, 2002.

Sum Up

- The model successful explain the variation of saving rate over age 50 across
  - Time (81.8%)
  - Education (61.8%)
  - Health (36.9%)
  - Employment type (55.9%)
- It is life cycle effect instead of cohort effect driving the results.

Simulation 1 - Can pension explain the high saving rates for the Chinese elderly?

To test the important of pension,

- Replace the life cycle pension profile with alternative cross-sectional profile.
- Pension index to CPI instead of wage.

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To test the important of pension,

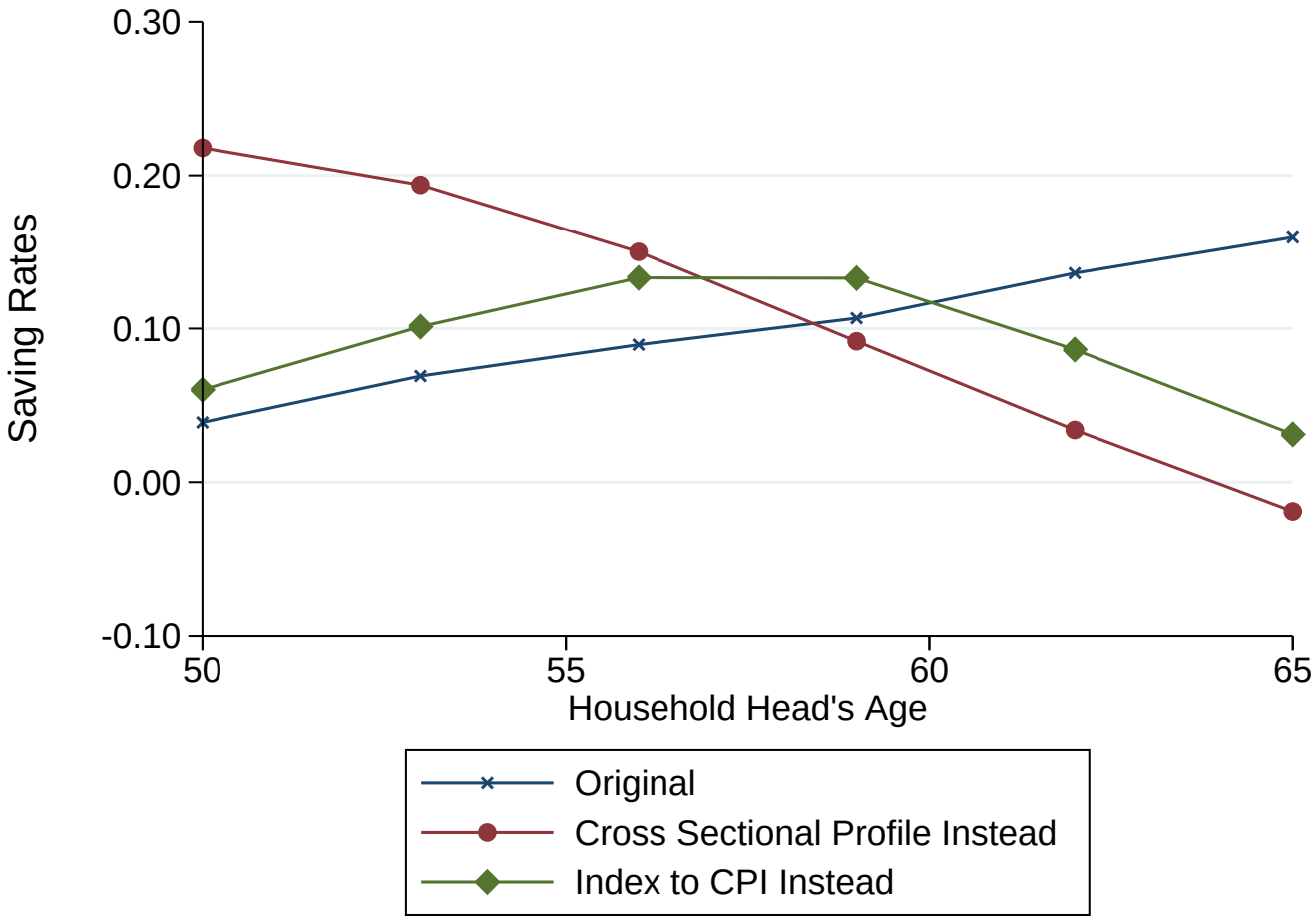
- Replace the life cycle pension profile with alternative cross-sectional profile.
- Pension index to CPI instead of wage.

To test how pension works jointly with bequest motive and medical expenditure

- Bequest motive - $\theta_0 = 0,\ \theta_1 = 0$
- Medical expenditure - $M_t = 0$

Importance of Pension Income

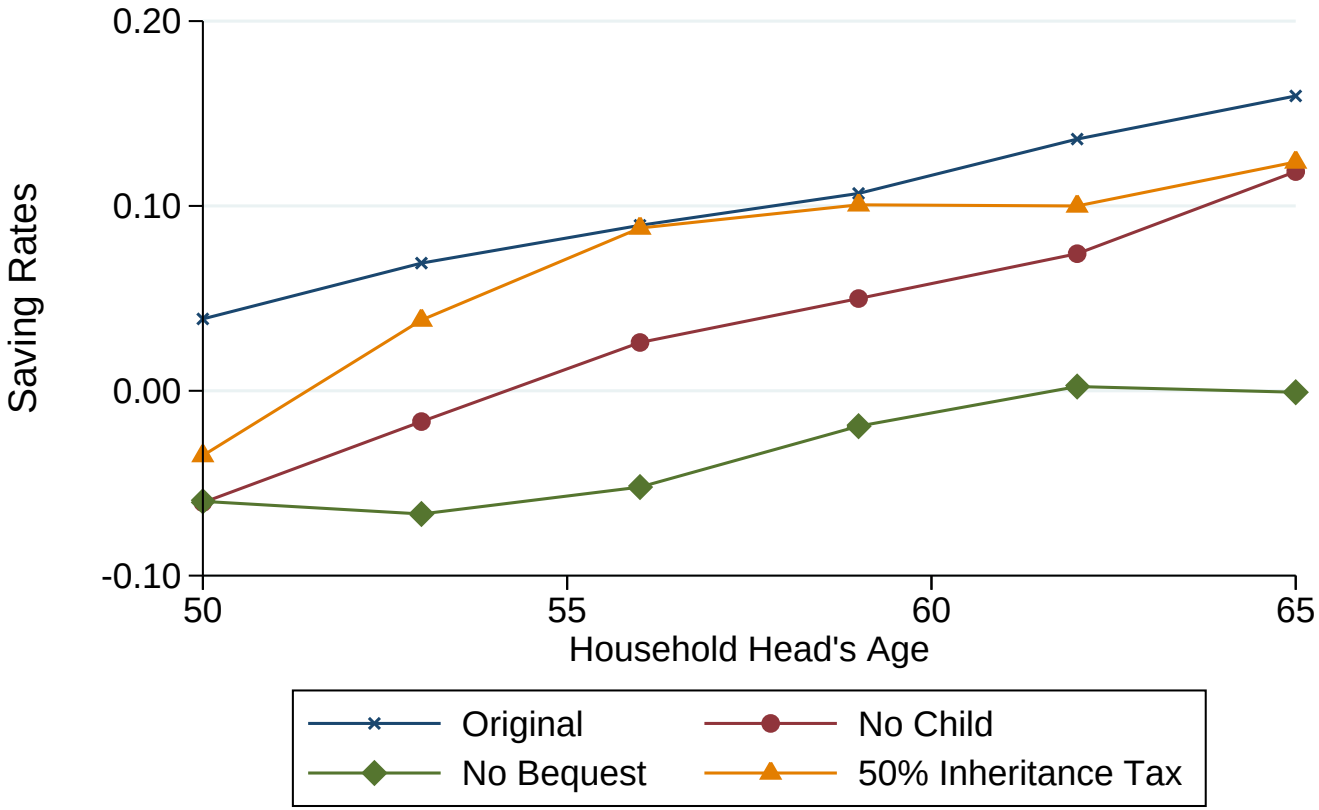
Figure 17: Experiment 1 - Effect of Pension



Source: Chinese Household Income Project, 1995, 2002.

Importance of Bequest Motive

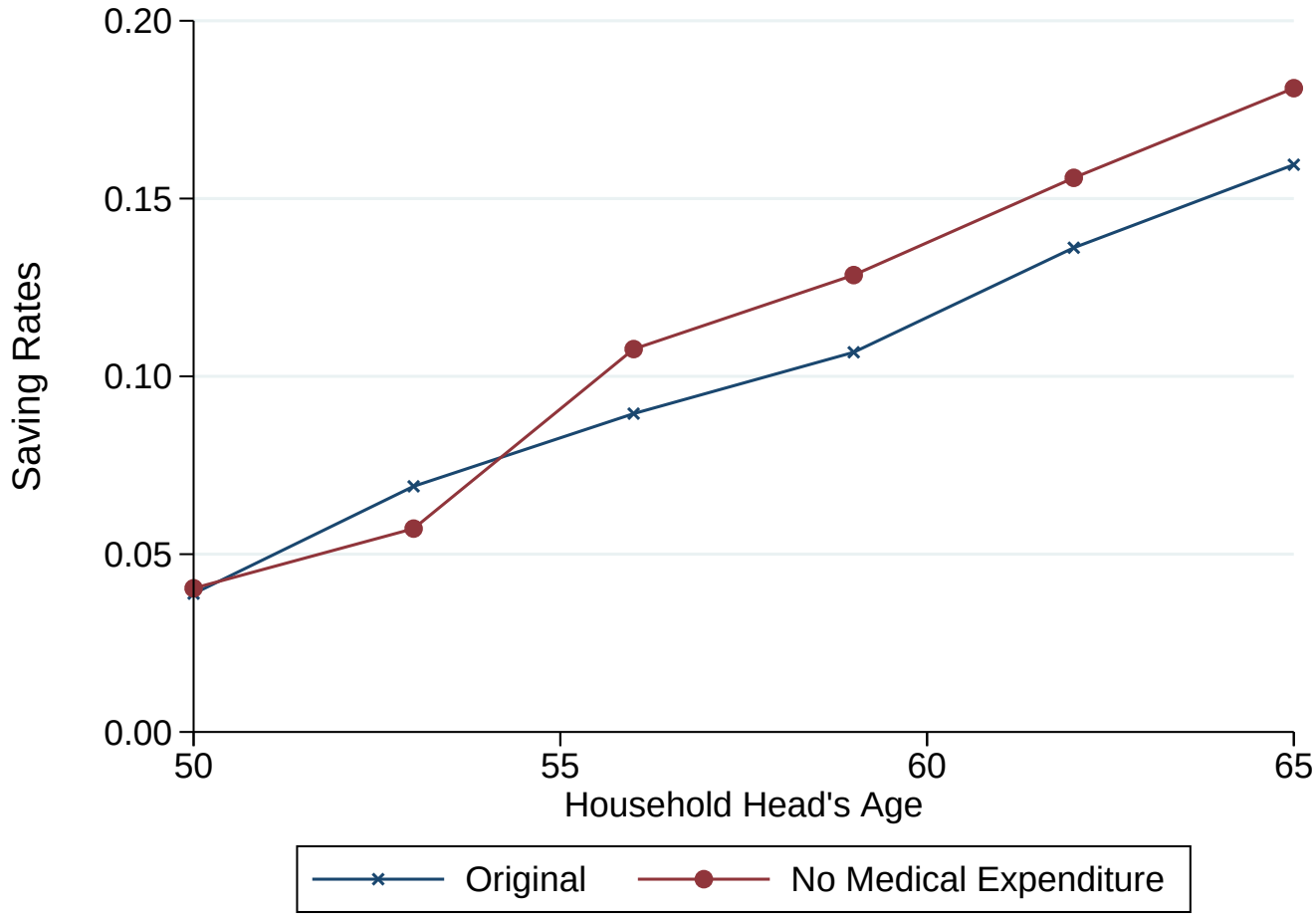
Figure 18: Experiment 2 - Effect of Bequest Motives



Source: Chinese Household Income Project, 1995, 2002.

Importance of Medical Expenditure

Figure 19: Experiment 3 - Effect of Medical Expenditures



Source: Chinese Household Income Project, 1995, 2002.

Policy Implication

- Medical expenditure has little effect on elderly's saving
  - Policy on medical insurance will not change saving behavior a lot.

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- Pension income and bequest motive are the main determinants
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  - Policy on bequest (inheritance tax for example) will affect saving rate.

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  - Policy on medical insurance will not change saving behavior a lot.
- Pension income and bequest motive are the main determinants
  - Policy on pension scheme will affect saving rate.
  - Policy on bequest (inheritance tax for example) will affect saving rate.
- The counter-intuitive fact that the elderly save more than the middle-aged is mostly because of institutional reason
  - In China pension is indexed to wage
  - In China there is no inheritance tax

Simulation 2 - Growth Rate and Saving Rate

Economic growth affects elderly saving directly through increase in pension income.

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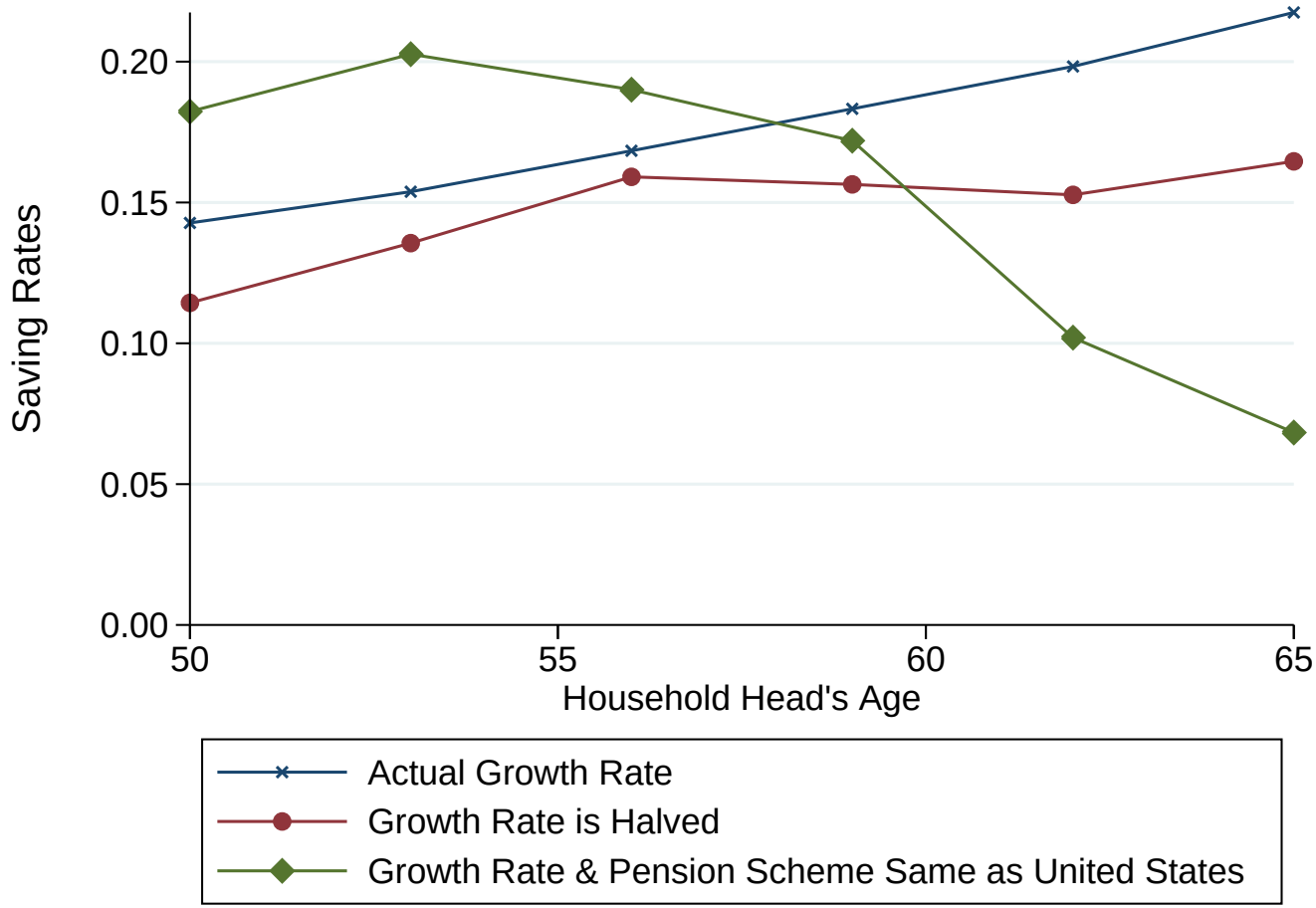
- If the Chinese economy starts to slow down, how will the saving rate looks like? Will it still be U-shaped?

Simulation 2 - Growth Rate and Saving Rate

Economic growth affects elderly saving directly through increase in pension income.

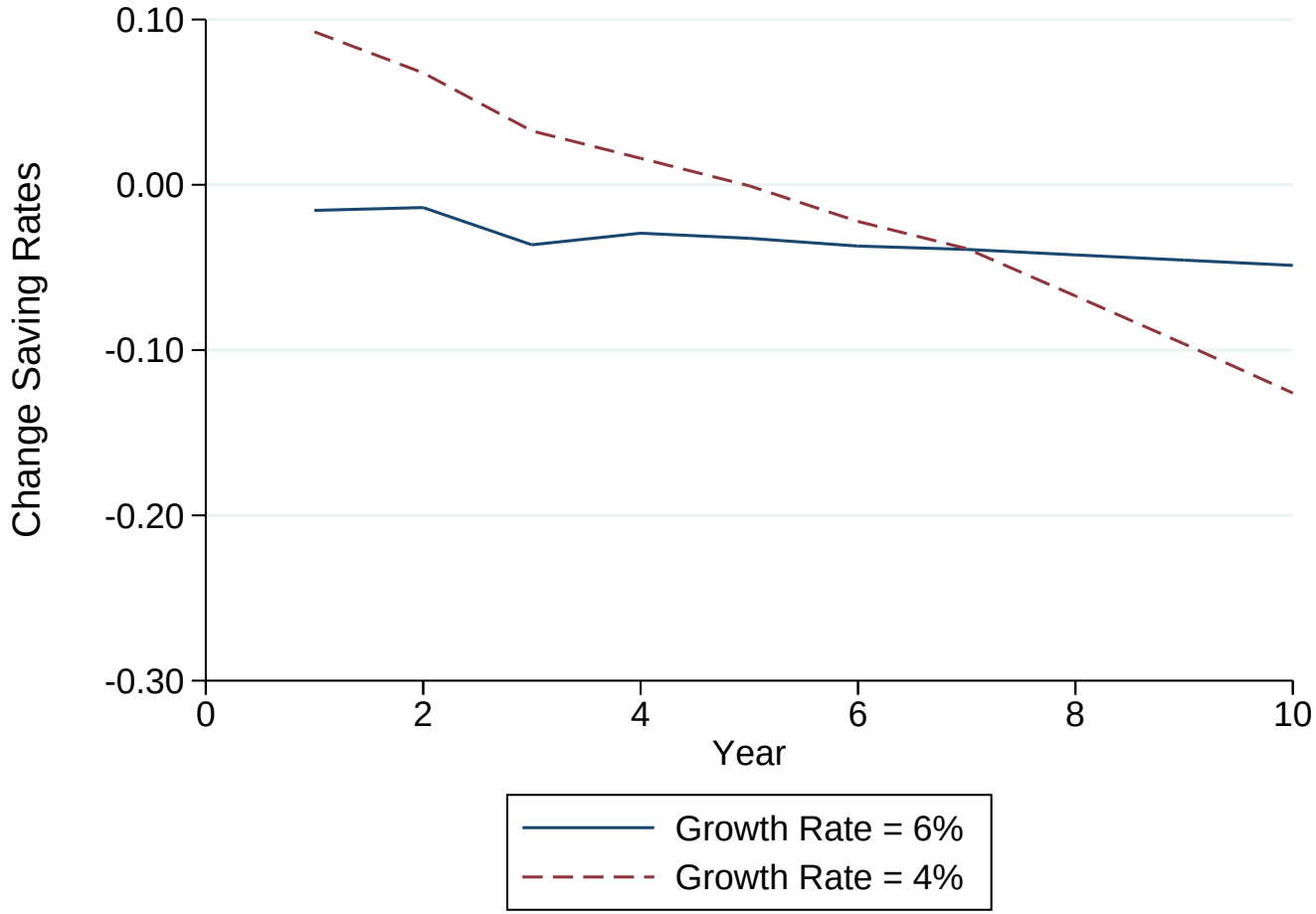
- If the Chinese economy starts to slow down, how will the saving rate looks like? Will it still be U-shaped?
- Will people respond differently?

Figure 20: Simulation of Cross Sectional Saving Rate with Different Growth Rate



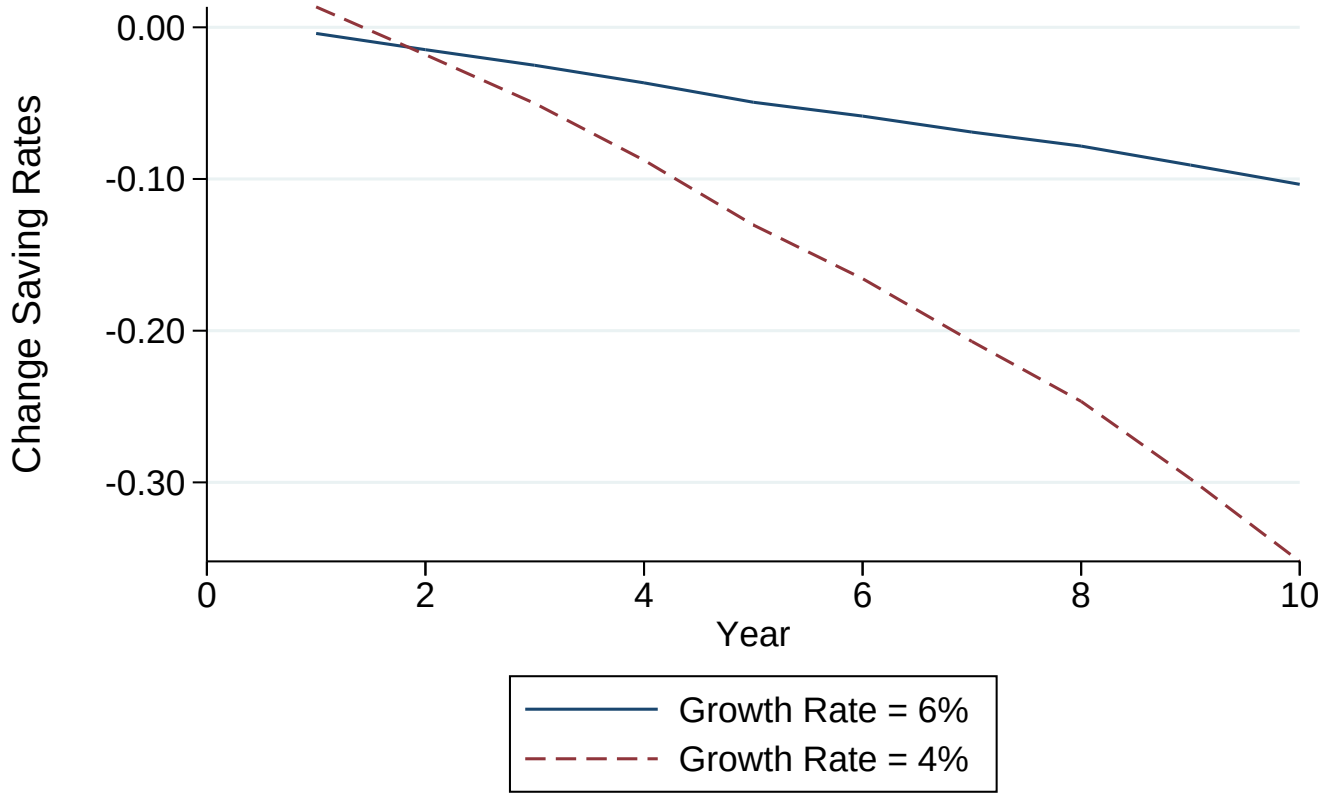
Source: Chinese Household Income Project, 1995, 2002.

Figure 21: Response of a Slowdown in Economic Growth (Age = 50)



Source: Chinese Household Income Project, 1995, 2002.

Figure 22: Response of a Slowdown in Economic Growth (Age = 60)



Source: Chinese Household Income Project, 1995, 2002.

Policy Implication

- If the growth rate is not that high, elderly people will save lower than middle aged, which is observed in developed countries like United States.

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- In case of economic slow down, the old people will react to a greater extent than to the middle aged.

Outline

Conclusion

- Pension plays an important role in understanding the high saving rates for the Chinese elderly.

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- Using pension reform as a natural experiment, I observe that when there is an increase in pension, there is no corresponding increase in consumption, resulting in higher saving.

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- Model shows the increasing pension after retirement together with bequest motive is the key determinant of high saving for the Chinese elderly.

Conclusion

- Pension plays an important role in understanding the high saving rates for the Chinese elderly.
- Using pension reform as a natural experiment, I observe that when there is an increase in pension, there is no corresponding increase in consumption, resulting in higher saving.
- Model shows the increasing pension after retirement together with bequest motive is the key determinant of high saving for the Chinese elderly.
- The pattern of saving rates in China is highly related to its economic growth. If there is a slowdown, the saving rate will drop quickly.

Thank You!

Robustness of the Empirical Fact

- Cohort effect?

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- Cohort effect?
  - Track the saving rates of different cohorts

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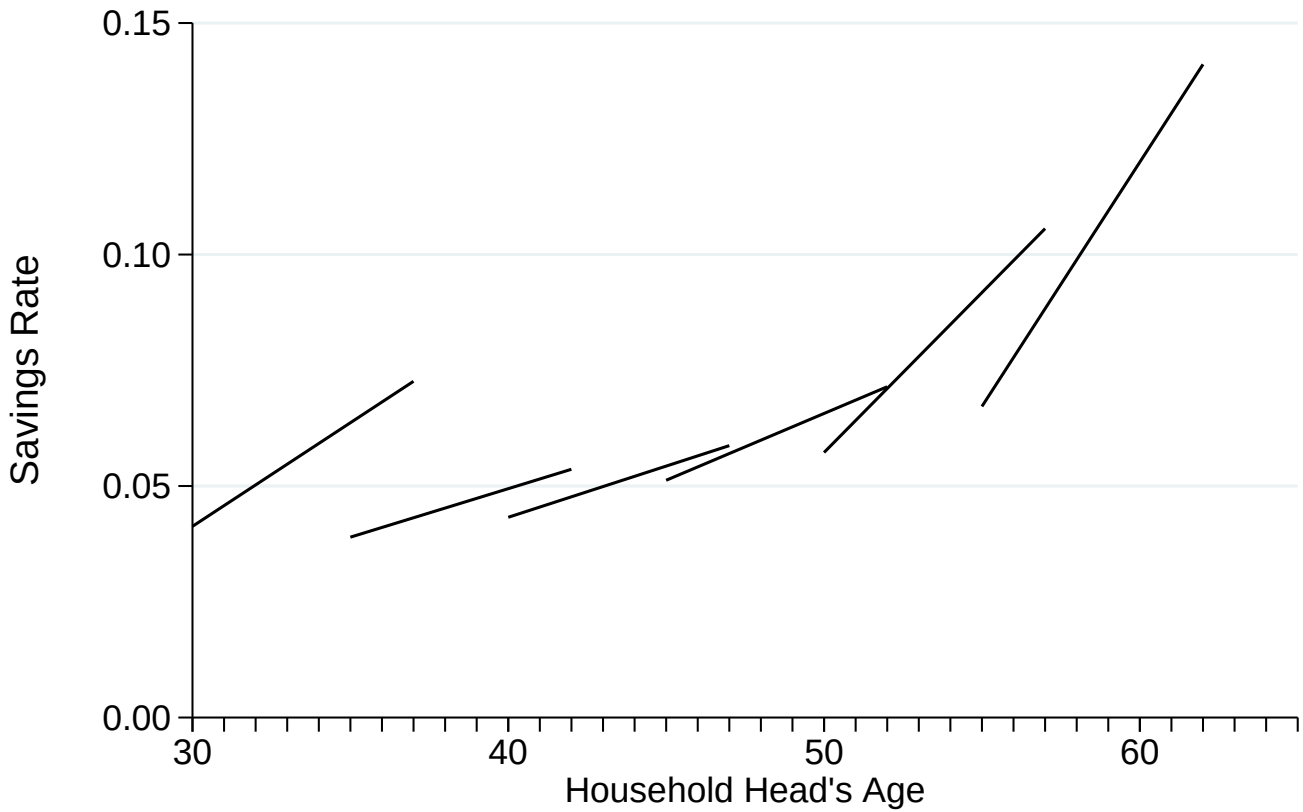
- Selection?

Robustness of the Empirical Fact

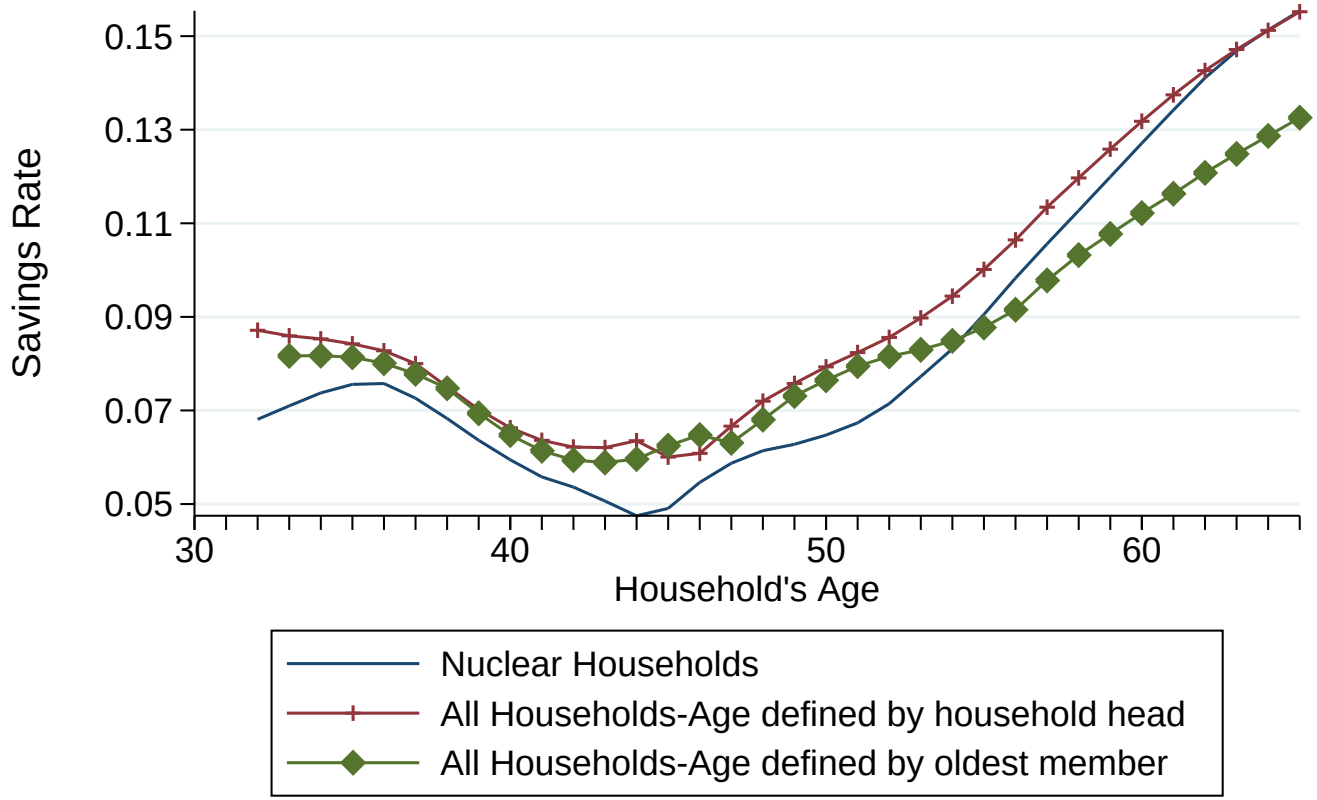
- Cohort effect?
  - Track the saving rates of different cohorts
- Selection?
  - Plot the age profile of saving rates not restricted to nuclear household

Figure 23: Age Pattern of Chinese Saving Rate by Cohorts



Source: Chinese Household Income Project, 1995, 2002.

Figure 24: Robustness of Age Profile of Saving Rate against Selection



Source: Chinese Household Income Project, 2002.

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Test Validity of the Reform

$$\begin{aligned} Income_{i,p,t} &= \beta_1 After_t + \beta_2 Retire_{i,p,t} + \beta_3 Rate\_Before_p \times Retire_{i,p,t} \\ &\quad + \beta_4 X_{i,t} + \sum \beta_{5,p} Prov_p + \varepsilon_{i,p,t} \end{aligned}$$

- If the reform is valid, I expect,
  - $\beta_3 > 0$ before the reform
  - $\beta_3 = 0$ after the reform (placebo test)

- If the replacement rate is associated with some unobserved factors that may also affect income directly, β_3 should not be greater than zero even after the reform.

Table 4: Test the Validity of Reform

Wave	1995	2002
	(1)	(2)
Retired	-0.535***	-0.0793
	(0.117)	(0.0903)
Retired*Original Replacement Rate	0.432***	0.0309
	(0.149)	(0.111)
Observations	5,714	5,666

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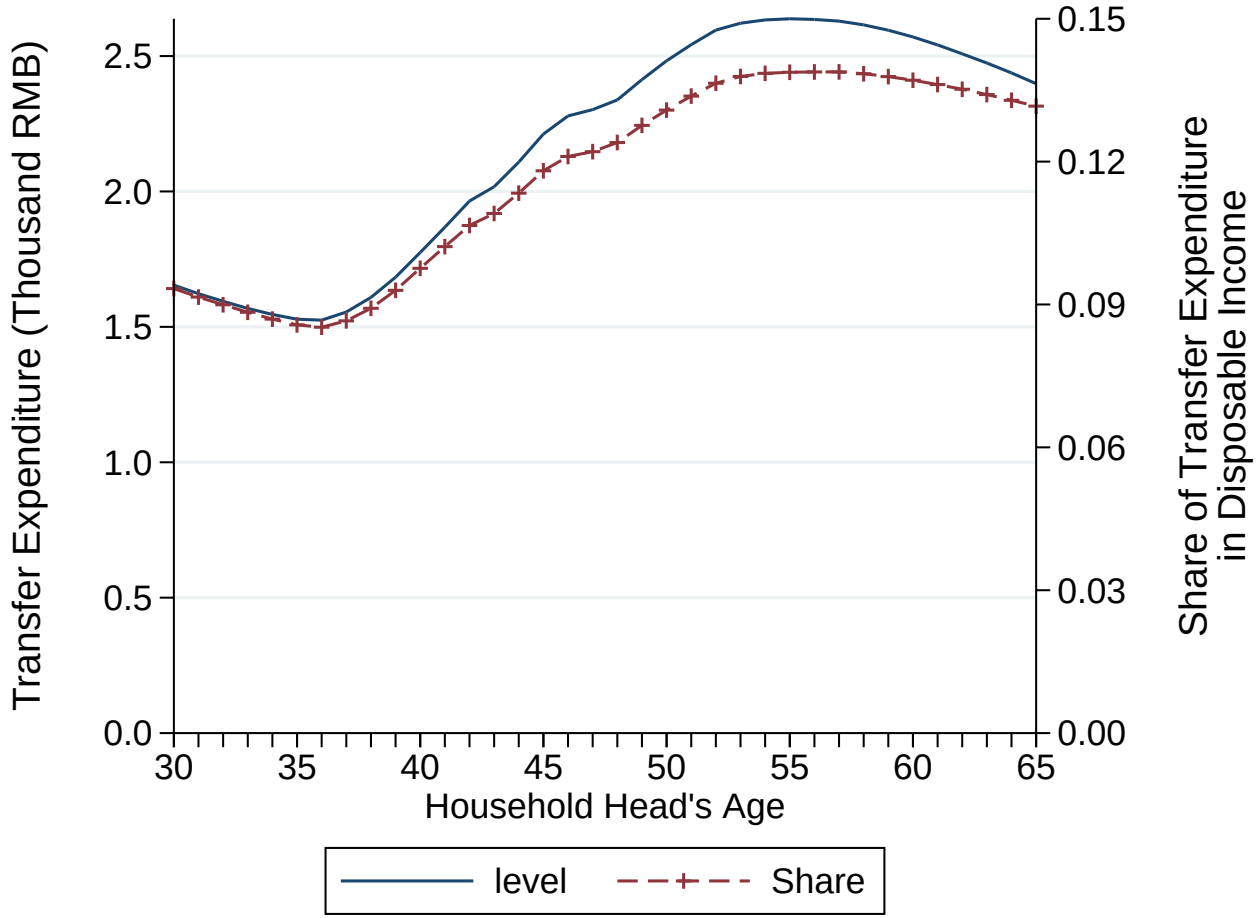
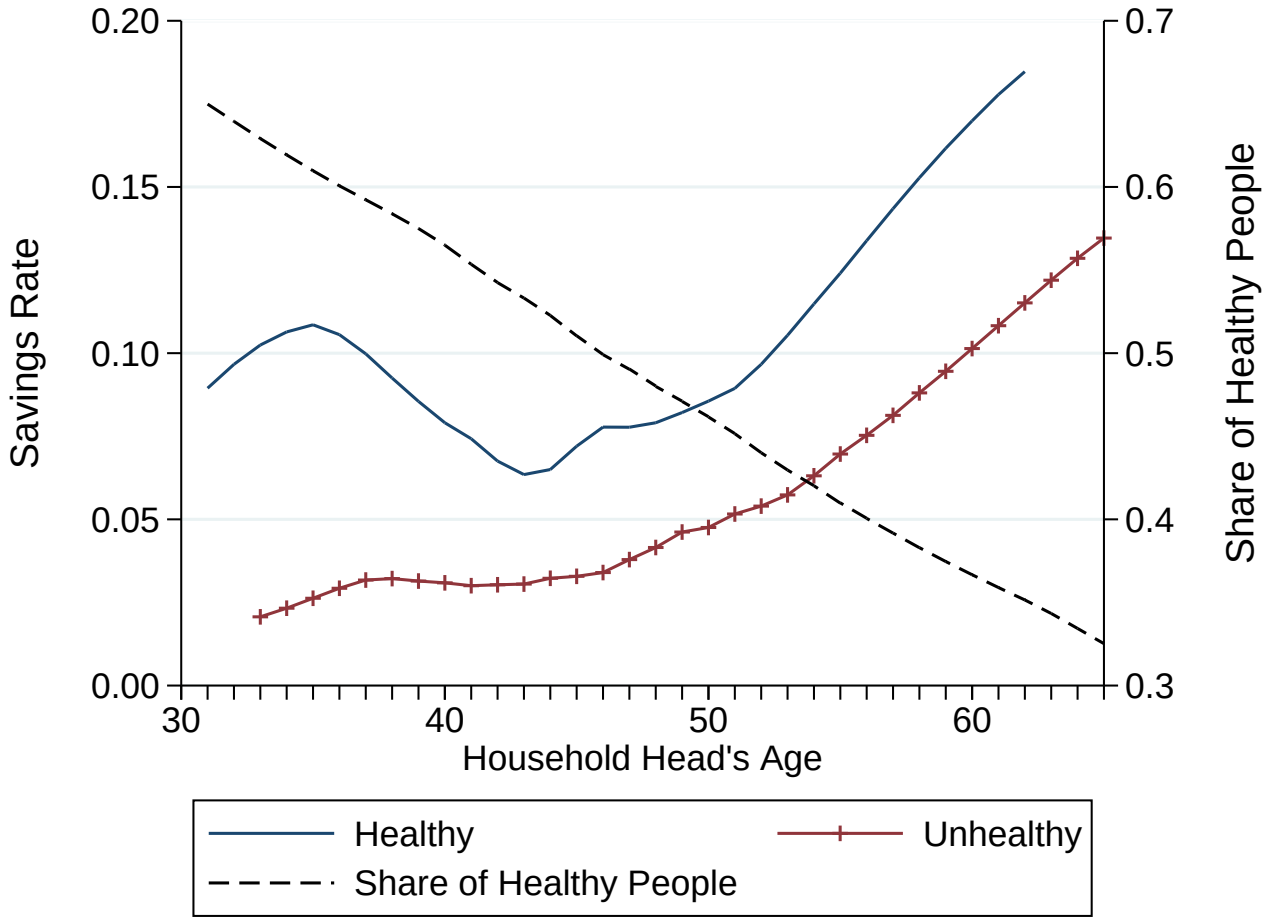
Figure 25: Age Pattern of Transfer Expenditure in 2002



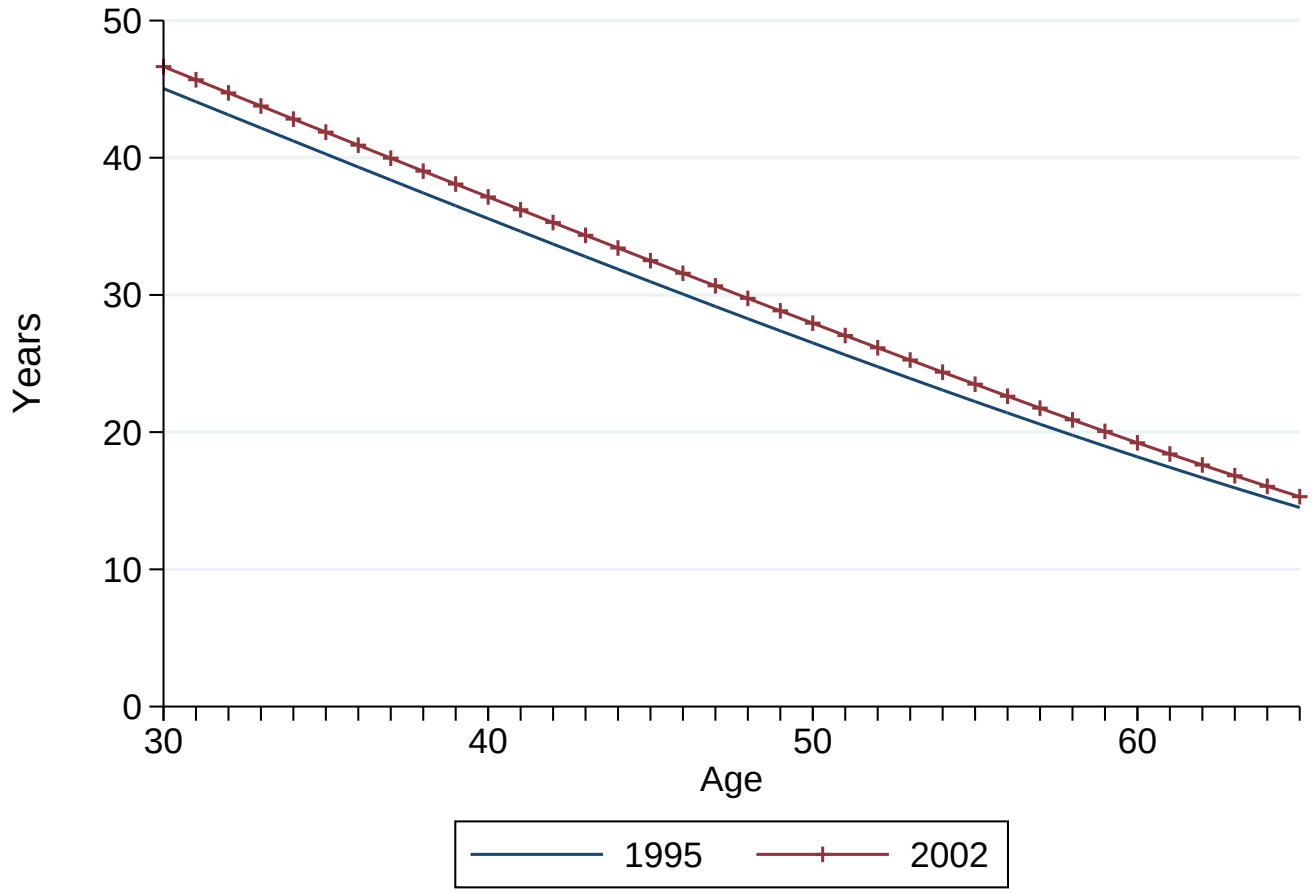
Source: Chinese Household Income Project, 2002.

Figure 26: Age Pattern of Chinese Saving Rate by Health Status



Source: Chinese Household Income Project, 2002.

Figure 27: Age Pattern of Remaining Life Expectancy



Source: Author's calculation based on mortality rate provided by China Insurance Regulatory Commission.

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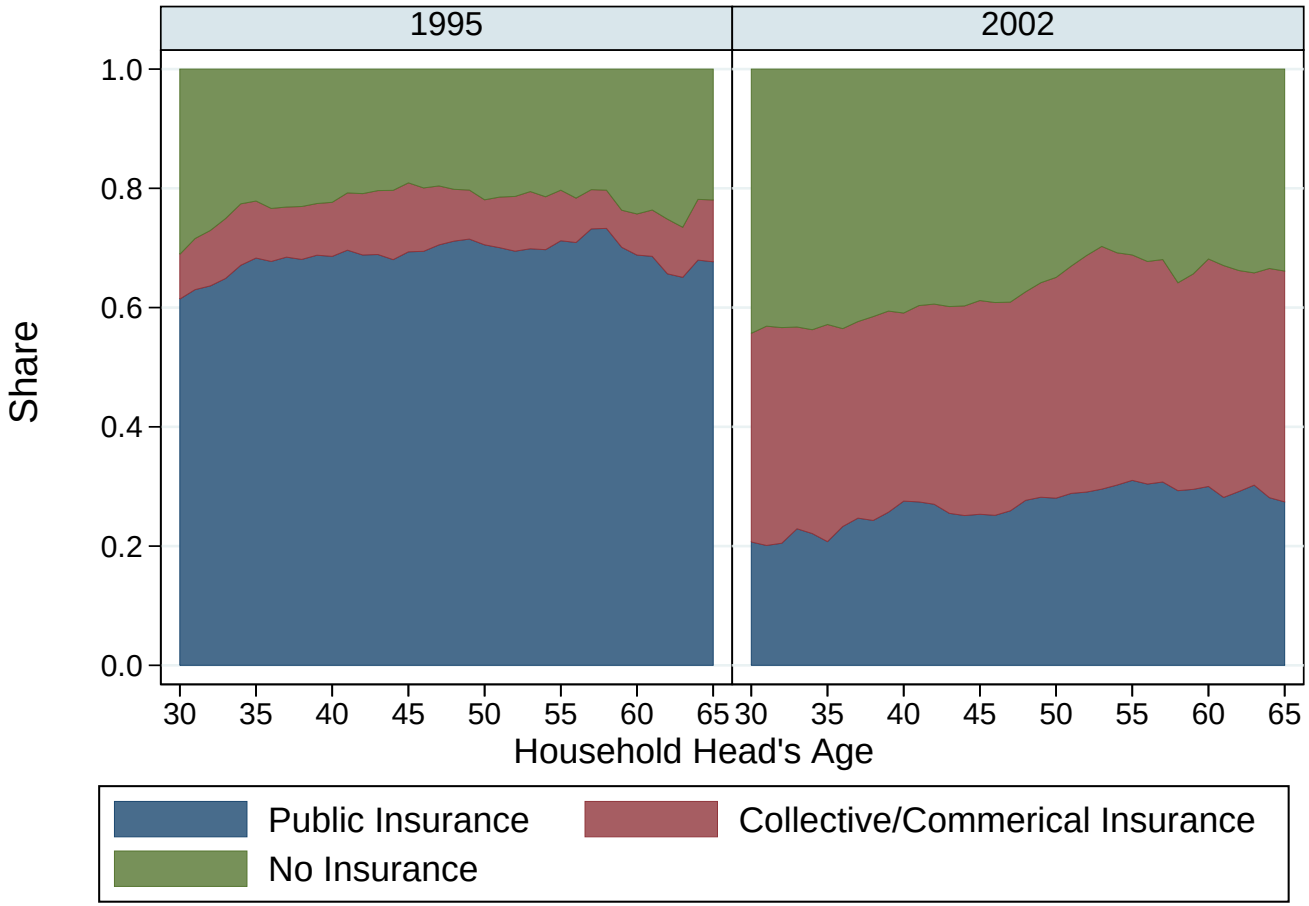
Figure 28: Type of Medical Insurance by Survey Years



Source: Chinese Household Income Project, 1995, 2002.

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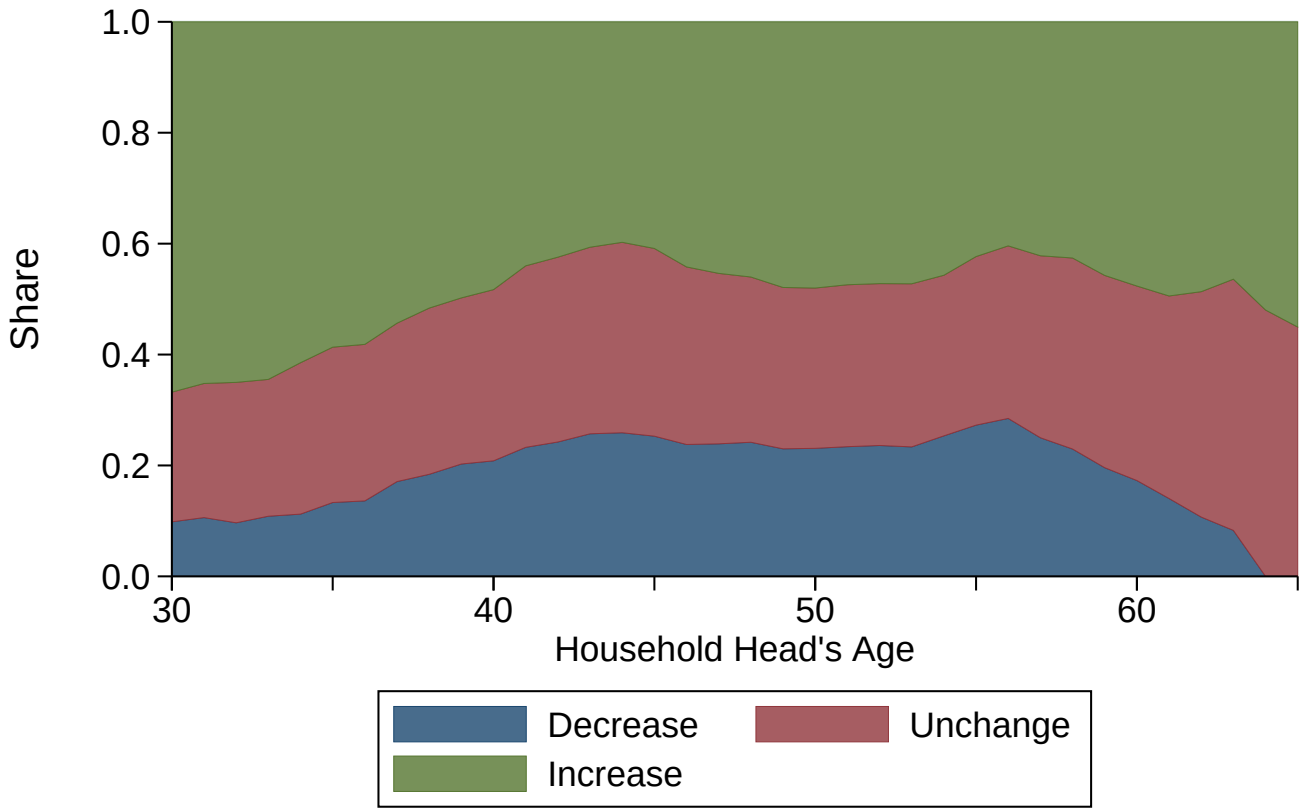
Figure 29: Expectation of Future Income Change (2002)



Source: Chinese Household Income Project, 2002.

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Identification Strategy

- Relative risk aversion (ν) - ν can be identified by how people value current consumption compared to future consumption. If people are highly risk averse, they will tend to have higher current consumption since future has uncertainty.

- Strength of bequest motive (θ_1) - θ_1 can be identified by the difference in saving rates between families with children and families without child.

- Strength of bequest motive (θ_0) - θ_0 can be identified by the amount of assets at the end of life cycle, which is equivalent to total amount of saving through out life cycle conditional on initial assets.

- Preference shifter ($\delta_1,\ \delta_2,\ \delta_3$) - these parameters can be identified by the correlation between consumption and corresponding factors (leisure, health) and their interaction. back