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Essays on Household Saving Rates

A dissertation submitted in partial satisfaction
of the requirements for the degree
Doctor of Philosophy in Economics

by

Yi Chen

2015

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Abstract of the Dissertation

Essays on Household Saving Rates

by

Yi Chen

Doctor of Philosophy in Economics

University of California, Los Angeles, 2015

Professor Maurizio Mazzocco, Chair

This dissertation is devoted to understanding household saving rates of the two largest countries in the world - China and the United States. The first two chapters explain why the Chinese elderly save at extraordinarily high rates and the third chapter explains why the U.S. personal saving rate has been falling since 1980's.

Chapter 1 explores the potential explanation of the high saving rates of the Chinese elderly. The high saving rate of China has attracted global attention. Furthermore, the saving rates of the Chinese elderly are especially high. Understanding why the elderly in China save at high rates is important for two reasons: (1) it partially explains the high aggregate saving rate in China, and (2) the fact that the elderly save more than the middle-aged contradicts the predictions of the life-cycle model. In this chapter, I present evidence that pension income is the primary explanation for the high saving rates of elderly Chinese households. I provide this evidence in two steps. First, I document three stylized facts that are consistent with this hypothesis: (1) saving rates are higher in years with higher pensions, (2) saving rates are higher for those with more generous pension plans, and (3) policy reforms that exogenously increase pensions also increase saving rates. However, a higher pension income on its own cannot explain the entire pattern because a household can simultaneously adjust its consumption. Therefore, in the second step, I demonstrate that concerns regarding future medical

expenditures and bequest motives can explain why households do not increase their consumption commensurate with increases in pension income.

In Chapter 2, I build and estimate a dynamic life cycle model for two purposes. The first is to quantify the effect of pension income. The second purpose is to carry out counterfactual policy simulations. The model is a standard life-cycle model with three main components. First, pension income is properly modeled to capture the increase observed in the data. The second part of the model is about uncertainty. In the model, I cover income uncertainty, health status and medical expenditures as the main source of uncertainty for the elderly. Finally, individuals have bequest motives. I estimate the model using the method of simulated moments. The estimation results show that it is possible to match the data with reasonable parameters. It is noteworthy that the estimated degree of relative risk aversion for the Chinese elderly is similar to that of U.S. population in other studies. This implies when factors including pension income, medical expenditures and bequest motives are properly taken into account, it is not necessary to assume Chinese elderly to be highly risk averse to explain their high saving rates. With the model, I am able to carry out various policy simulations. The most interesting simulation is if the Chinese pension and economy growth rate becomes similar to those in the United States, the saving rates of the Chinese elderly will fall to the level of the U.S.

Chapter 3 is a joint work with Maurizio Mazzocco and Béla Személy. In this chapter we provide evidence that most of the decline in the U.S. personal saving rate from 9 percent in the early eighties to 2 percent in 2007 can be explained by the steep increase in health expenditure experienced by the U.S. economy during the same period. The most convincing evidence is provided using the FDA approval of new drugs as a source of exogenous variation in medical expenses. Employing this source of variation, we find that a 1 percentage point increase in health expenditure generates a decline in the U.S. saving rate that is between 0.58

and 0.67 percentage points. Using this result, we calculate that the rise in health expenditure explains about 83 percent of the drop in the U.S. saving rate. To evaluate whether households changed their consumption decisions to mitigate the effect of higher medical expenses, we develop a stylized model of household's and government's decisions. Using the model jointly with our empirical results, we find that the households' response to the rise in health expenses was negligible. This is why the saving rate dropped by a significant amount. Finally, with the objective of better understanding why households did not respond, we provide evidence on how the increase in medical expenditure was funded. We find that it was paid almost exclusively by an increase in government debt, a reduction in other government expenses, and an increase in employer contributions to health funds. The main implication of these findings is that the households were barely affected by the rise in health expenditure. The households' negligible response was, therefore, rational.

The dissertation of Yi Chen is approved.

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2015

To my mom and dad

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CHAPTER 1

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

1.1 Introduction

The Chinese saving rate is currently one of the highest in the world (World Bank, 2010), and the high saving rate in China has important global impacts. Because Chinese savings are not invested solely in China's own expenditures, Chinese saving has also become an important financial resource for many developed countries. For example, since 2008, China has been the largest holder of US treasury bonds. In February 2014, China held 21.6% of all US treasury bonds (National Bureau of Statistics of China, 2014). Chen et al. (2014) show that the rise in the Chinese saving rate partially helps to fund the decline in the household saving rate in the United States (Parker, 1999). Greenspan (2009) and Obstfeld and Rogoff (2009) argue that China's high saving has contributed to a global imbalance since 2000, which was directly related to the 2008 global financial crisis.

Among the three components of national saving - household saving, corporate saving and government saving - household saving has been the most important component of Chinese saving over the past two decades (Yang et al., 2011). This paper focuses on household saving. Despite the importance of the high household saving rate in China, no clear explanation for this high saving rate has been proposed, and it remains a puzzle (Modigliani and Cao, 2004).

To understand the high household saving rate, it is important to understand

the answer to the following question: what groups of people maintain the highest saving rates? Figure 1.1 plots the age profile of saving rates in 2002 based on Chinese Household Income Project (CHIP) data. Surprisingly, elderly households maintain the highest saving rates. For households aged 40-50,[1] households maintain an average saving rate of approximately 6%. From that point, saving rates grow quickly as households age, reaching 15% at age 65. Chamon and Prasad (2010) and Yang et al. (2011) have also plotted the age profile of the saving rates in China using data from the Urban Household Survey (UHS), and they obtained similar results.[2] These authors have also noted that this pattern is especially strong after 2000. Therefore, understanding why the elderly save so much is of crucial importance. First of all, understanding why the elderly save so much will contribute to the understanding of the high household saving rate in China and will therefore help to explain the high aggregate saving rate. Second, the life-cycle model predicts that individuals should save the most during middle age, when they have the highest income, and begin to dissave after retirement. The empirical pattern in China is the opposite of this prediction. The standard life-cycle model was constructed to apply to developed countries whose economies are stationary. Understanding the counterintuitive pattern observed in China will help to apply the life-cycle model to countries with rapidly developing economies, such as China.

The major contribution of this paper is to provide an explanation for the high saving rates of the Chinese elderly. I provide evidence that pension income

[1]Household age is defined by the age of the household head.

[2]Compared with the saving rates obtained by Chamon and Prasad (2010) and Yang et al. (2011), the saving rates presented in this paper are lower. The primary reason for this difference is that in the aforementioned papers, transfers to relatives outside the household are treated as saving. In this paper, such transactions are treated as expenditures instead. If the data presented here were to be treated using the same definition used in these previous papers, the numbers would be of similar magnitude. However, I argue that transfers to relatives outside the household should be defined as expenditures. Transfers from relatives outside the household are treated as household income; therefore, if transfers to those outside the household were to be treated as saving, it would result in double counting and an overestimation of the saving rate.

in China, in combination with bequest motives and medical expenditures, can explain the high saving rates of the Chinese elderly. I provide evidence not only using descriptive analysis but pension reform as exogenous variable as well.

I provide this evidence in two stages. First, I provide descriptive evidence that the high saving rates of the Chinese elderly are closely related to the pension scheme in China. I present three pieces of evidence that is consistent with the hypothesis. The first such piece of evidence is the time variation of saving rates. I demonstrate that during periods when pension incomes are higher, saving rates are also higher. Compared with the year 1995, the average pension income in 2002 was higher, both in absolute value and relative to disposable income. At the same time, in 2002, the elderly maintained higher saving rates, and the increase in saving rates after retirement was greater. Moreover, the starting point of this increase in saving rates coincided with the age at which Chinese workers gradually begin to retire.

The second piece of evidence is cross-sectional variation. I find that those who enjoy more generous pension payments also save more and that this difference becomes more prominent as retirees age. Employees of the Chinese governmen-t enjoy more generous pension plans than their non-government counterparts. Saving rates are correspondingly higher for government employees. More interest-ingly, before the age of retirement, there is no significant difference between these two groups. The saving rates only begin to diverge after workers begin to retire.

To provide better causal inference, as the third piece of evidence, I investigate the effect of pension on saving using pension reform as a natural experiment, as time series and cross-sectional variations may be subject to endogeneity problems. The reform I use for this purpose is China's transition from a PAYG (pay-as-you-go) pension system to a mixed three-tier pension system. This reform has been implemented in different provinces with different policies since the early 1990s. As a result, prior to 1997, difference provinces implemented pension systems with

different replacement rates.[3] In 1997, China defined a new unified national pension system. As a result, there was an exogenous convergence in replacement rates. Retirees in provinces with originally low replacement rates experienced a greater increase in pensions during the reform. I find that households who received higher pensions as a result of the reform did not increase their consumption to a commensurate degree,resulting in higher saving rates.

The aforementioned evidence, however, presents another puzzle: why do higher pensions lead to higher saving instead of higher consumption? If households were to increase their consumption by a sufficient amount in the case of an increase in income, there would be no increase in saving rates. Therefore, as the second step, I investigate the factors that prevent households from further increasing expenditures. First, I find evidence that concerns regarding future medical expenditures and bequest motives may be potential explanations for why the elderly do not increase their consumption in such a scenario. I find that during the process of Chinese market reform, the government slowly scaled back its provision of national free public medical insurance. As a result, it became necessary for households to be able to afford a larger share of their medical expenditures. Elderly households are more strongly affected by such changes because their medical expenditures will rise by a greater extent. Therefore, they may need to maintain higher saving rates until the end of their life cycles to prepare for potential medical expenditures. Secondly, I provide two pieces of suggestive evidence that bequest motives may be pertinent in China. First of all, 62% of the elderly explicitly claim in a survey question that they have bequest motives. Moreover, most elderly individuals claim that they rely on an annual flow of pension income instead of accumulated assets for their old-age support, which suggests that the annual flow of pension income is typically sufficient to cover their expenditures of elderly life and that the wealth they save is more likely to be intended for their children than for them-

[3]Replacement rate can be defined as pension income received after retirement divided by the wage received before retirement.

selves. Second, I find evidence that households with no children save significantly less compared to households with children. Therefore, the elderly may save for bequest purposes.

The remainder of the paper is organized as follows. In Section 1.2, I introduce background information regarding the Chinese retirement system and pension system. I also introduce previous literature concerning the Chinese saving rate. The datasets used throughout this paper are introduced in Section 1.3. Section 1.4 presents empirical evidence that pension income is related to saving. Section 1.5 explains why more pension income leads to more saving instead of more consumption. Section 1.6 presents the conclusions of the study.

1.2 Background and Existing Literature

1.2.1 Background of the Pension Scheme in China

The retirement age in China has remained stable since the early 1950s. Males are expected to retire at age 60. Female workers are expected to retire at age 50, and female officers are expected to retire at age 55. 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. Thus, in China, retirement is mostly assumed to be exogenous (Banerjee et al., 2010). Pension payments begin when the worker retires, and they are indexed to the average worker's wage. As a result, it is possible for pension income in China to continuously increase after retirement because of economic growth.

The retirement age has remained constant since the early 1950s. However, the pension system has changed considerably in the past 50 years. Before the implementation of *Reform and Opening-Up* policies in 1978, when China was a

planned economy, the pension system was simple and straightforward. State-owned enterprises provided cradle-to-grave social security, which guaranteed life-time employment, along with housing, health care, and pensions after retirement. If an enterprise did not have sufficient funds, the state budget would cover the necessary payments. Therefore, during this period, the pension system was considered to be an "iron bowl," although the average wage and pension were low because of low levels of economic development.

With the 1978 reforms, China began to transition from a planned economy into a market economy. With the approach of market reforms, firms themselves began to assume increasing responsibility for the welfare of their employees. Meanwhile, unprofitable enterprises were no longer supported by the government. As a result, unprofitable firms canceled or delayed pension payments to their retirees. Therefore, during that time, despite the high *de jure* replacement rate that retirees were supposed to receive (85%), the *de facto* rate that retirees actually received was much lower, and millions of retired workers were thrown into poverty.

To resolve this issue, China began to experiment with a new pension scheme beginning in the early 1990s. The new plan replaced the existing PAYG system with a three-tier system. The first tier consists of public pensions for all retirees that are jointly financed by the government, enterprises and workers. The second tier consists of occupational pensions funded by enterprises. The third tier consists of voluntary pension savings originating from individual accounts. It is estimated that the *de jure* replacement rate under the new scheme is lower than that under the old system (approximately 75%). However, the new system is supported by the state budget in the first tier, pension payments are more effectively guaranteed, and the *de facto* replacement rate can be higher than that under the old system, and, indeed, the data suggest that this is the case. Figure 1.2 plots the total pension payments from the government and the pension pool relative to total fiscal expenditures and GDP. Both shares have approximately tripled in 15 years,

suggesting that the government is spending more to ensure the pension payments of retirees. In the following sections, I will present a household survey that also suggests that pensions increased during this period.

The experiment of the new pension scheme first began as State-Owned Enterprises (SOEs) in certain provinces. Initially, different provinces implemented different pension policies and different target replacement rates. In 1997, a national reform was undertaken. There were two major features of this reform. First, it expanded the coverage of the new scheme into the private sector. Second, it unified the previous pension systems of different provinces with different target replacement rates. As a result, there are two possible exogenous variations that can be used to describe this reform. First is the comparison of SOE workers and private-sector workers. This approach, however, is problematic because most elderly retirees work in SOEs before retirement. [4] Retirees from the private sectors alone represent a small sample size, and that sample is likely to be highly selective. In this paper, I exploit the second possible approach - the convergence of replacement rates after the national reform for workers in SOEs. Further details about the identification strategy using the reform will be discussed in later sections.

1.2.2 Existing Literature

Recent literature has documented the high saving rates of Chinese households (Modigliani and Cao, 2004; Chamon and Prasad, 2010; Wei and Zhang, 2010; Yang et al., 2011), and this phenomenon cannot be explained simply in terms of culture because in the years before 1978, the Chinese saving rate was only approximately five percent (Modigliani and Cao, 2004). Carroll et al. (1994) have examined data concerning migrants in Canada from various source countries and have found no evidence of cultural effects on saving. The high saving rate in China is therefore known as "the Chinese saving puzzle."

[4] In 1995, 78.28% of retirees worked in SOEs. The number is 75.3% in 2002.

More recently, economists have attempted to exploit household survey data in addition to aggregate data to gain further insight into this puzzle. Instead of providing an explanation, however, this research has identified a more interesting pattern. In contrast to the hump-shaped age profile of saving rates that is predicted by the standard life-cycle model, the Chinese profile turns out to be U-shaped: young households and elderly households maintain higher saving rates than the middle-aged (Chamon and Prasad, 2010; Yang et al., 2011). More interestingly, this shape only appears after the year 2000. Yang et al. (2011) have plotted two separate profiles of saving rates: for 1988-1990 and 2005-2007. The 1988-1990 profile still appears hump-shaped, but that corresponding to 2005-2007 becomes U-shaped.

Therefore, the Chinese saving puzzle can be summarized into two categories. The time-series puzzle can be summarized as follows: why is the current saving rate so high, and why has the saving rate risen so tremendously since 1978? The cross-sectional puzzle can be summarized as follows: why is the current age profile U-shaped? Although the time-series puzzle has already been widely discussed in the literature,[5] and several plausible explanations have been proposed (for example, family programming (Banerjee et al., 2010), the biased sex ratio (Wei and Zhang, 2011), demographic transitions (Modigliani and Cao, 2004) and greater uncertainty (Chamon and Prasad, 2010)), the cross-sectional puzzle is far from being as well-addressed. This paper contributes to one aspect of this puzzle: why the saving rates are so high for the Chinese elderly.

The existing explanations for the U-shaped pattern focus on two factors: the expenditure burden and income pattern. Chamon and Prasad (2010) have proposed that the U-shaped pattern can be explained by the influence of high educational and medical expenditures. They have observed that the increase in saving

[5]This puzzle has been addressed using aggregate data (Modiglianai and Cao, 2004), provincial data (Horioka and Wan, 2007) and household data (Chamon and Prasad, 2010).

rates has been accompanied by a drastic increase in educational expenditures and medical expenditures. Educational expenditures for children create a saving motivation for young households, and medical expenditures create a saving motivation for elderly households.

Song and Yang (2010) attribute the recent change toward the U-shaped profile to a flatter income profile. Using an overlapping-generation model, they have demonstrated that a flatter income profile predicts higher saving rates for both young and elderly individuals. Blanchard and Giavazzi (2005) have noted the importance of income uncertainty in explaining the high saving rate in China. Chamon et al. (2013) have proposed that this greater uncertainty and the decreased pension ratio constitute the primary explanation for the U-shaped profile. Feng et al. (2011) have also argued that the pension reform resulted in lower replacement rates for the elderly, further motivating them to save more.

However, although these explanations of the U-shaped pattern are successful in explaining the high saving rates of the youth, they are not as successful for the elderly. For example, educational expenditures are highest in middle age for parents of children who are attending college. To prepare for these high expenditures, young families will save in advance before these expenditures arise. However, medical expenditures increase quickly as individuals age. By definition, high expenditures will suppress saving instead of increasing it because saving is defined as income minus expenditures. Similarly, greater uncertainty explains why young people save more because they need to build higher buffer-stock savings. However, as individuals age after retirement, there are fewer uncertainties remaining in their life cycles, and the need for buffer-stock savings shrinks. Gourinchas and Parker (2002) have demonstrated that buffer-stock saving occurs mostly at the beginning of the life cycle; therefore, it is unlikely to be a major explanation for the saving of the elderly.

Although the pension program has previously been considered as an explana-

tion for the high saving rates of the elderly (Chamon et al., 2013; Feng et al., 2011), who proposed lower replacement rates raises precautionary saving of the elderly to prepare for their elderly life, my focus on pensions exhibits a crucial difference from previous research. First of all, lower replacement rates for the retired are unlikely to provide an explanation for the high saving rates of the elderly because pension payments are a component of income, and saving is defined as income minus expenditure. A lower pension implies lower saving unless consumption decreases by a greater amount, which is generally not the case as households attempt to smooth consumption. Secondly, in China, the *de facto* rate and the *de jure* rate can be different because of delayed and canceled payments. As discussed in the previous subsection, although it is true that the reform has reduced the *de jure* replacement rate, this does not necessarily imply that the *de facto* rate will fall as well. Indeed, the data suggest that if there is any change in the *de facto* rate, it is more likely to increase than to decrease. Therefore, Chamon et al. (2013) and Feng et al. (2011) have only been able to predict the increase in the saving rate before age 60, prior to the time when male workers have retired. These authors do not explain why the saving rate continues to increase after retirement, as shown in the data.

Other explanations, such as the one-child policy (Banerjee et al., 2010), migration and housing tenure (Brugiavini et al., 2013), and co-residence selection (Rosenzweig and Zhang, 2014), also cannot explain the high saving rates of the elderly. Banerjee et al. (2010) have noted that children and savings are important substitutes for parents' old-age support. A decrease in the fertility rate will imply an increase in saving rates. However, according to the one-child policy, the younger cohort is more strongly affected because older cohort may already give birth to more than one child before the implementation of the policy. This implies that the one-child policy should suggest that older households will maintain lower saving rates because, on average, they have more children; however, this trend is

opposite to that observed in the data. Brugiavini et al. (2013) have argued that China is experiencing massive rural-to-urban migration. Rural migrants immediately receive higher income, but they cannot quickly adjust their consumption because of habit formation. Therefore, their income has been increased to the urban level, but their consumption remains at the rural level, resulting in high saving. However, most migrants are young people, and if they are elderly, it is likely that they have already lived in an urban environment for a long time, meaning that their consumption habits should have already become adapted to the urban level. Housing may also be a potential explanation for the high saving rates of the youth, but not for the elderly, as the elderly have generally already acquired their houses. One alternative argument is that elderly households save for their children's housing after marriage. However, the timing of such saving does not match the data. In China, parents typically have children before age 25, implying that if they are preparing for their children's housing, they should be prepared for this expenditure before age 50. However, the data indicate that saving rates continue to rise after this age. Rosenzweig and Zhang (2014) have noted there is selection bias in the plotting of the age profile of saving rates. Young people with higher income are more likely to leave their parents and form new households. Therefore, households with young heads of household are selectively richer, resulting in higher saving rates. Later in this paper, I will present evidence that similar arguments do not hold for the elderly.

1.3 Data

This paper uses three different datasets: the Chinese Household Income Project (CHIP), and the China Health and Retirement Longitudinal Study (CHARLS). I use only urban samples from all three datasets. In rural China, it is common to have large families with multiple generations living in the same household. There-

fore, the decisions of the household can be complicated, and it can be difficult to assign an "age" to a household in rural China that contains multiple generations.

The primary data used in this paper are from the CHIP, which is conducted by the Institute of Economics of the Chinese Academy of Sciences. Three waves are currently publicly available: 1988, 1995, and 2002. I focus on the latter two waves because consumption information is incomplete for 1988. The CHIP collects detailed information on both the income and expenditures of each household.

I collapse the dataset at the household level to compute the age profiles of saving rates, household income and expenditures. To maximize the comparability among households of the same age, I focus only on "nuclear families" - families composed only of a husband, a wife and children under age 25. The sample is further restricted to households with positive income and expenditures with heads of household aged between 25 and 80. I also eliminate households in the top or bottom 1% in terms of income, expenditures or assets to mitigate the possible effects of measurement error and extreme values. I assume that there are two types of families - high and low - defined by whether either the husband or the wife holds a degree equivalent to or above the senior high school level. These requirements restrict the dataset to $5,111$ observations for the 1995 wave and $4,727$ observations for the 2002 wave. For the 1995 wave, $2,072$ of the observations are of the high type and $3,039$ are of the low type. For the 2002 wave, the number of high-type observations is $2,280$, and the number of low-type observations is $2,447$.

The income consists of individual-level income and household-level income. Individual-level income includes wages, bonus pension payments and subsidies. Household-level income includes property income (interest, dividends, rent, et al.) and transfer income (pension payments, payments from the government, and payment from other family members). For the 1995 data, the mean household income is $12,766$ RMB (Chinese yuan),[6] with a standard deviation of $5,497$ and a medi-

[6]Currently, 1 USD $\approx$ 6.1 RMB. All income, expenditures and assets are adjusted to the price

an of 11,733. For the 2002 data, the real average household income increases by nearly 50% to 18,538 yuan, with a standard deviation of 9,394 and a median of 16,668. Moreover, although the CHIP does not collect panel data, information about income history for the past five years is available. Therefore, it is possible to estimate income shocks based on this income history information. Expenditures include food, clothing, communication, medication, education, appliance purchases, transfers and other miscellaneous items (such as interest payments). Assets include housing, financial assets (cash, savings, stock, etc.) and durable goods (cars, pianos, etc.). Appendix A provides definitions of the variables and summary statistics of the CHIP.

However, there is an important limitation of the CHIP. It does not contain fertility history information. The number of children in the household is an important factor in understanding saving behavior in China (Banerjee et al., 2010). Without fertility information, the CHIP can capture only children who live together with their parents. To overcome this issue, I use the CHARLS, which contains both fertility history and information related to income and expenditures. The CHARLS (2011) is the most recently released dataset that focuses on aging and retirement study in China. The design of the CHARLS is very similar to that of the Health and Retirement Survey (HRS) in the United States. Currently, however, only one wave is available. Moreover, the CHARLS spans a broad range of subjective questions, thereby informing a detailed understanding of the saving motivations of the Chinese elderly.

level in 1995.

1.4 Empirical Relationships Between Pension Income and Saving

In this section, I will provide empirical evidence that higher pension income is related to higher saving. I provide three pieces of evidence. First of all, I compare the patterns between the 1995 and 2002 waves. I note that in 2002, the pension income was higher, and the saving rate of the elderly was also higher. Second, I compare two different types of employees: government workers and non-government workers. Government workers enjoy more generous pension plans compared to non-government workers. They also maintain higher saving rates, and this discrepancy becomes larger after retirement. Finally, to overcome the potential endogeneity problem, I treat the pension reform that occurred during this period as an exogenous change in pension income to verify the causal relationship between pension income and saving. The reform exogenously induced a convergence of replacement rates among different provinces; therefore, retirees in provinces with originally lower replacement rates became relatively better off. I provide evidence that these retirees correspondingly increased their saving.

1.4.1 Changes in Saving Rates Over Time

Figure 1.3 plots the compositions of disposable income in 1995 and 2002. Labor income and pension income are the two most important components of income for Chinese households. On average, these two components accounted for approximately 91.7% of disposable income in 1995 and 95.5% in 2002. Figure 1.3 also shows that in 2002, as the population aged, the increase in pension income better compensated for the decrease in labor income. As indicated by the dashed line in Figure 1.3, in 1995, a household of age 60 earned an average of 84.4% of the income of a household of age 50. This value drops to 78.2% for a household of age 65. For 2002, these two values increase to 97.1% and 88.4%, respectively. This

finding implies that in 2002, an elderly household did not earn considerably less than a middle-aged household. This empirical fact is consistent with Song and Yang (2010)'s observation of a "flattening income profile." The difference between two waves can be primarily attributed to the fact that the new pension scheme better guarantees pension payments, meaning that there are fewer delayed and canceled payments, as introduced in the background section.

Another important fact that can be inferred from this graph is that in urban China, older households are mostly financially dependent. Over 90% of their income originates from either wages or pensions. Transfers from children account for only a small proportion of household income, which implies that the role of children in old-age support is not as important as expected.

There is also a sharp difference in the patterns of saving rates between 1995 and 2002, as seen in Figure 1.4. The U-shaped pattern observed in Figure 1.4 for the 2002 data has also been observed by Chamon and Prasad (2010) and by Yang et al. (2011), although I use a different dataset (they used the Urban Household Survey (UHS)) and a slightly different definition of the average saving rate for a specific age.[7] As demonstrated by Chamon and Prasad (2010) and by Yang et al. (2011), Figure 1.4 illustrates that the age profile of saving rates in 2002 exhibits a much stronger U-shaped pattern, with older households and younger households saving more compared to the middle-aged. In both the 1995 and 2002 waves, households maintained an average saving rate of approximately 5% at age 45. In 1995, the rate rose only modestly to 7.5% for households of

[7]There are two ways to define the average saving rate for a specific age. The first is the average of all saving rates corresponding to that age:

$$\Sigma_{i=1}^{n} rate_i/n$$

The second is the difference between the average income and the average expenditure divided by the average income:

$$(\overline{income_i} - \overline{expenditure_i})/\overline{income_i}$$

In this paper, I use the second definition because it matches the definition of the national saving rate, whereas the other two papers use the first definition.

age 65, whereas in 2002, it rose sharply to 15% at the same age. Figure 1.4 also plots the percentage of retirement as individuals age, as indicated by the dashed line.[8] More interestingly, the start of the increase in saving rates occurs right near the point at which individuals begin to retire. The discrepancy becomes larger as more workers retire. The trend in the percentage of retirees corresponds well to the rise in saving rates. To test whether the difference is statistically significant, I performed the following regression for each year separately:

$$rate_i = \alpha + \sum_s \beta_s Age_Group_{i,s} + \gamma X_i + \varepsilon_i \tag{1.1}$$

where the outcome variable $rate_i$ is the household saving rate of the ith household. I ran this regression for households aged over 45 and grouped them into five-year increments. The coefficient β_s can be used to test whether the increase in saving rates is statistically significant. X_i includes control variables such as education, employer type and province dummies. Columns (1) and (2) in Table 1.1 report the regression results for the 1995 and 2002 waves, respectively. The regression results reveal that the change in saving rates with household age in 1995 was not significant. Compared with ages 45-49, the other age groups varied little in saving rates (from -0.1% to 2.5%, and all coefficients in front of age are statistically insignificant) after controlling for certain key variables. However, the age gradient became significant in 2002. Starting at age 50, on average, saving rates rose by 3.9% for every five years of age.

Might this pattern be simply the result of a cohort effect? Is it merely because these particular older cohorts happened to save at high rates? To address this concern, Figure 1.5 plots the changes in saving rates between the two waves for certain select cohorts. Figure 1.5 shows that the younger cohorts increased their

[8]It is possible to draw two different lines for the two years individually. However, the patterns of retirement for both years were similar. Therefore, for simplicity, I combine both years and draw only a single line.

saving rates by approximately $2-3\%$ between the two waves, whereas the older cohorts increased their saving rates by nearly 10%. There is clear evidence that all cohorts increased their saving rates; therefore, the cohort effect alone is not sufficient to explain why older households maintain a high saving rate.

Might selection bias have contributed to this pattern? For example, to properly define the age of a household, I restricted the samples to nuclear households. This implies that older couples living with their children are excluded from this analysis. If richer parents have a higher tendency to live on their own and richer households typically maintain higher saving rates (Friedman, 1957; Gustman and Steinmeier, 1999; Venti and Wise, 1999), then the selection of nuclear households will necessarily lead to higher saving rates as households age. This is also the reason given by Rosenzweig and Zhang (2014) for the high saving rates of young Chinese households. To address this issue, in Figure 1.6, I plot age profiles calculated for 2002 without any sampling restrictions. To address the possibility of multiple generations living together in the same household, I tested two definitions of household age: the age of the head of household and the age of the oldest household member. The first definition is intuitive because the head of household is expected to be the most influential household member in decision-making. The second definition attempts to capture families that include older individuals living with younger relatives. The graph indicates that even when no selection is applied, the saving rates still increase quickly for older households. Through a comparison of the two plots corresponding to data restricted and not restricted to nuclear households, I conclude that selection bias alone cannot explain why older households save so much.

1.4.2 Changes in Saving Rates Across Groups

In addition to variation over time, there is also variation in pension income across groups. In China, government employees enjoy better welfare treatment, including

more generous pension plans. Unlike non-government employees, whose pension payments were not secured in the old region-based regime and are only partially secured by province budgets in the new regime, government employees receive fully secured pension payments. In the old regime, the pension plans of non-government workers were financed solely from the profits of the enterprises for which they worked before retirement. In the new regime, although the first tier is financed from the pension pool at the province level, the second tier is still financed by enterprises. Government employees, by contrast, enjoy fully secured, generous pension plans that are supported by the budget of the central government.

Figure 1.7 plots the difference in income between government employees and non-government employees in the 2002 wave. The results were similar for the 1995 wave. On average, at age 60, non-government workers earned 87.7% of the amount earned by those who were age 50 at that time, and at age 65 , they earned 81.3% of that amount. This finding implies that the income of non-government workers suffered a drop because the increase in pension was insufficient to cover the loss of labor income. By contrast, for government workers, the increase in pension was so rapid that it even exceeded the rate of decrease in labor income. At age 60, government employees actually earned 4% more than those who were age 50 at that time.

Figure 1.8 plots the difference in saving rates for the two groups. Similar to the results over time, government employees who receive more generous pension plans also save more. Interestingly, the difference between the two groups again begins to diverge at exactly the same age at which the divergence is seen in Figure 1.4: age 45, the age at which Chinese workers gradually begin to retire. The two lines are nearly parallel to each other between age 35 and age 45, with a gap of only $2\% - 3\%$. However, starting at age 45, the gap quickly increases. At age 65, the gap reaches 15%. The regression equation (1.1) can also be used to assess the difference between the groups. Columns (3) and (4) in Table 1.1 illustrate

the difference between government workers and non-government workers. The results indicate that the saving rate increases quickly as retirees age in the case of government employees. Their saving rates increase by 5.1% for every five years of age. No such pattern is observed for non-government workers.

In summary, both time variation and group variation are consistent with the fact that higher pensions lead to higher saving. During the time period when pensions are higher, the saving rates are higher. For the group with higher pension income, the saving rates are correspondingly higher as well. More importantly, the difference only begins to manifest at the point at which workers begin to retire. Both pieces of evidence support the hypothesis that pension income may be a major motivator of the high saving rates of the elderly in China.

1.4.3 Pension Reform as a Natural Experiment

Previous subsections have presented suggestive evidence that the saving rates of the Chinese elderly are closely related to pension income. However, these two empirical facts may be subject to endogeneity problems. For example, if a positive economic shock occurred in 2002, this would temporarily increase pension income. Meanwhile, as households have a tendency to save a larger percentage of income from a temporary positive economic shock to smooth their lifetime consumption, saving rates would also be higher. In addition, individuals who are more risk-averse will have a greater tendency to work for the government because government jobs are typically more secure. More risk-averse individuals would have saved more even if they did not work for the government. To provide better estimation of the causal effect of pension income on saving, I make use of the 1997 pension reform as an exogenous shock.

In 1997, a national reform was implemented to convert the Chinese pension system from a PAYG system to a defined contribution system. However, before

this national reform, beginning in the early 1990s, certain provinces had initiated their own experimental reform in SOEs,[9] each adopting their own target replacement rates ahead of the national reform. Table 1.2 summarizes the target replacement rates for various provinces ahead of the national reform (World Bank, 1997). The data were obtained from the provincial statistical yearbook. Among the 12 provinces surveyed in the CHIP, nine provided information regarding replacement rates. Either the remaining three did not implement a reform, or the pertinent information regarding their replacement rates is missing; therefore, these three provinces are excluded from the sample in the following analysis.[10] Figure 1.9 visualizes the intuition of the identification strategy of the reform. The graph only uses a male sample, so the retirement age is 60. I divide provinces with information regarding replacement rates into three groups according to initial replacement rates in 1995. I compare the group with the highest replacement rates and the group with the lowest replacement rates. The provinces with the top three replacement rates are Shanxi (95%), Hubei (85%) and Sichuan (95%).[11] The provinces with the bottom three replacement rates are Jiangsu (65%), Guangdong (70%) and Yunnan (71%). Figure 1.9 shows that in 1995, before the reform, workers in provinces with low replacement rates suffered from a substantial drop of approximately 28% in disposable income at the time of retirement, while the income of workers in provinces with high replacement rates barely changed. In 2002, with the convergence of replacement rates after the pension reform, the change in disposable income barely differed across those provinces at age 60. In summary, the identification comes from a triple difference: retired and non-retired, before and after the reform, and provinces with high and low replacement rates.

[9]The analysis in this section uses a sample of SOEs only.

[10]The average household income of the provinces with missing information was 14.34% lower than that of the rest of the country. This implies that the analysis presented in this subsection may not be fully representative of the national population; instead, it is likely to be biased toward richer provinces.

[11]Chongqing was a city in the Sichuan province and became a municipality directly under the central government in 1997. For consistency, I treat Chongqing as a city in the Sichuan province in both waves.

I constructed a triple-difference model as follows:

$$\begin{aligned}\log(Income_{i,p,t}) &= \beta_0 + \beta_1 After_t + \beta_2 Retire_{i,p,t} + \beta_3 \Delta Rate_Rp_p \times Retire_{i,p,t} \\ &+ \beta_4 \Delta Rate_Rp_p \times After_t + \beta_5 Retire_{i,p,t} \times After_t \\ &+ \beta_6 \Delta Rate_Rp_p \times Retire_{i,p,t} \times After_t + \beta_7 X_{i,t} \\ &+ \sum \beta_{8,p} Prov_p + \sum \beta_{9,p} Prov_p \times After_t + \varepsilon_{i,p,t} \qquad (1.2)\end{aligned}$$

where the subscript i represents the household, p represents the province, and t represents time. $Retire_{i,p,t}$ is an indicator variable representing whether an individual is retired. $\Delta Rate_Rp_p$ represents the change in the target replacement rates in each province after the reform. $Prov_p$ is the province dummy variable. $\Delta Rate_Rp_p$ does not enter the equation as a separate variable because it is perfectly colinear with the province dummy variable. The control variables $X_{i,t}$ include age, education and gender. Notably, it is important to control the province dummy variables as well as their interactions with the time dummy. As suggested in Figure 1.9, workers in provinces with lower replacement rates tend to have higher income on average in 1995. One possible explanation for this difference is that if the replacement rate were the same for all provinces, it would be more difficult for local governments in rich provinces to cover pension payments. Therefore, they tend to set their replacement rates lower to relieve their fiscal burden. Moreover, the gap in income shrinks in the year 2002, suggesting possibilities of different trends among different provinces. Controlling province dummies and their interaction with the time dummy helps to alleviate the problem.

In this model, the parameter β_6 in front of the triple-difference term $\Delta Rate_Rp_p \times Retire_{i,p,t} \times After_t$ is of key interest. I expect this parameter to be positive. Assuming that two provinces had the same average wage of workers before and after the reform but different replacement rates before the reform, the retirees in the province with the lower initial replacement rate experienced a greater increase in

the replacement rate and therefore benefited more as a result of the convergence of the target replacement rates after the reform. A similar model can be used to investigate the responses in consumption and saving by changing the dependent variable.

Notably, this econometric model makes three implicit assumptions. The first assumption is the similarity of life-cycle income profiles across different provinces. The replacement rate is defined as income after retirement as a percentage of income before retirement for the same individual. However, this estimation uses cross-sectional data and compares the income of individuals immediately after retirement with the income of other individuals immediately before retirement. The assumption of the similarity of life-cycle income profiles is necessary to ensure that the difference between these two groups of individuals is a good proxy for the replacement rate.[12] The second assumption is that people of the same age in different provinces are at the same stage in their life cycles. The reason that this assumption is required is because according to the life-cycle model, even if the level of income is the same, consumption is not necessarily the same for individuals at different stages of their life cycles. This assumption is likely to be true because the retirement age is the same across China. Therefore, individuals in different provinces should be near the same age when they are in the near-retirement stage of their life cycles. The final assumption is that the order in the *de facto* replacement rate is positively correlated with the trend in the *de jure* replacement rate, which means if a province has higher *de jure* rate, it should maintain a higher *de facto* rate as well. This assumption is necessary because the

[12]In China, not all retirees enjoy the same policies. A retiree's pension income is determined by the policy that was in place during his working life. When a new pension policy is implemented, workers who have already retired (called "old people") remain in their original plan, workers (called "new people") who have not joined the labor force use the new plan, and workers who have already started working but have not yet retired (called "middle men") use a mixture of the new and old plans. However, because the econometric setup controls for age and relies on the discontinuity at retirement age for identification, the newest pension plan in effect is always captured.

replacement rates used in the econometric model refer to the *de jure* rate, but the pension income is determined by the *de facto* rate. The identification between the two is not valid unless the order in the *de facto* rate follows that in the *de jure* rate. This assumption will be tested later in this subsection.

Table 1.3, Column (1), presents the results of the analysis. As expected, the estimated coefficient $\widehat{\beta}_6$ is positive and statistically significant. A coefficient value of 0.383 implies that for a retiree in a province where the replacement rate was increased by 10 percentage points with respect to another province, after the reform, his income increased by 3.83 percentage points more with respect to a retiree in the other province. The next question to address is the following: how do households respond to such a change in pension income? Table 1.3, Column (2) reports the corresponding change in consumption.[13] This coefficient is also positive, implying that consumption moves in the same direction as income. However, this change is statistically insignificant, implying that the response in consumption is not commensurate with the increase in income. A strong increase in income accompanied by an insufficiently strong response in consumption implies an increase in saving, as indicated in Table 1.3, Column (3).

However, there are still two potential threats to the identification strategy. First of all, in China, the *de jure* replacement rate may be different from the *de facto* replacement rate, as mentioned above. Moreover, pensions are pooled at the province level and the pools are managed by each province separately; therefore, despite the implementation of the same target *de jure* rate across the country, the *de facto* rates may differ across provinces. Ultimately, it is the *de facto* rate that determines pension incomes and, therefore, consumption patterns. However, policy variations are based on the *de jure* rate. Will the difference between these two rates affect the identification strategy? For example, the identification strategy

[13]Because the regression model requires exact timing of retirement, the model can only be run at individual level. Therefore here consumption at individual level is defined as household consumption divided by two.

requires the replacement rate to be the same across provinces after the reform. According to policy, the *de jure* rate will be the same across provinces; will the *de facto* rate be the same as well? To investigate this question, I performed separate difference-in-differences estimations corresponding to before and after the reform using following equation.

$$\begin{aligned} \log(Income_{i,p,t}) &= \beta_1 + \beta_2 Retire_{i,p,t} + \beta_3 Rate_Before_p \times Retire_{i,p,t} \\ &\quad + \beta_4 X_{i,t} + \sum \beta_{5,p} Prov_p + \varepsilon_{i,p,t} \end{aligned} \tag{1.3}$$

The results are presented in Table 1.4. Table 1.4 indicates that the original target replacement rates exerted a strong effect before the reform but not after the reform. This result confirms the validity of the reform. It also indicates that the difference between the *de jure* and *de facto* rates may be not a major concern in the new scheme because pensions in the new scheme are better secured by the government's support. Another threat to the validity of the analysis is that the pension reform period coincided with another important event in China: the massive layoffs of workers in 1997. However, this event is unlikely to have affected the estimation because the source of identification comes from workers near retirement, whereas the massive layoffs affected mostly young workers. Moreover, the original replacement rate was set ahead of this event and is therefore exogenous. To confirm this hypothesis, I ran a probit model to test whether the replacement rate could predict whether workers aged 50-60 in 2002 had ever lost their jobs in the preceding seven years. The regression results indicate that the correlation is statistically insignificant.

1.5 Why Higher Pension Income Leads to Higher Saving Rates

In the previous section, I presented evidence that suggests the high saving rates of the Chinese elderly are closely related to their pension income and that an increase in pension income over the preceding decade can result in an increase in saving. However, the puzzle remains unsolved. Mechanically, higher income results in a higher saving rate because the saving rate is defined as follows:

$$\text{Saving Rate} = \frac{\text{Income - Expenditure}}{\text{Income}}$$

However, in the above definition, expenditure is endogenous to income; therefore, it is not necessarily true that a higher pension income leads to a higher saving rate. Households can freely decide what to do with their additional pension income: they can either save this income or consume it. According to the results presented in Table 1.3, households modify their consumption in the same direction as their income, but only very modestly, thus resulting in higher saving. Why do households not increase their consumption by a sufficient amount such that their saving rates will not increase? This section will address this question.

If households maintain positive saving rates, there can be only two possibilities: either they are saving for themselves or they are saving for others. For older couples, the most important potential concerns for future expenditures are related to medical expenditures. If couples are not saving for themselves, they are most likely saving for their children. Therefore, I propose two possible explanations for why older households do not increase their consumption by a sufficient amount to compensate for increased income: medical expenditures and bequest motives. At the end of this section, I will discuss other possibilities, including transfer payments to children, deteriorating health status and longer life expectancy.

1.5.1 Concern for Future Medical Expenditures

Future medical expenditures are a common concern in the saving decisions of the elderly. In the analysis by De Nardi et al. (2010), medical expenditures, especially the massive medical expenditures that occur shortly before the end of the life cycle, are the primary reason why the elderly continue saving in the United States. Chamon and Prasad (2010) have also observed that medical expenditures are related to high saving rates among the elderly in China. To discuss this possibility, I present the following empirical evidence.

First, out-of-pocket medical expenditures in China have been increasing rapidly over the past decade, especially for the elderly. Figure 1.10 plots the age profiles for average medical expenditures for the 1995 and 2002 waves. I also plot the share of medical expenditures as a percentage of disposable income. A sharp difference is observed between the two years. For the year 1995, there is little variation in medical expenditures across all age groups. The average medical expenditures fluctuate between 400 yuan and 500 yuan between age 30 and age 65, which accounts for only approximately 3-4% of disposable income. There is no evidence of increasing medical expenditures with age. For 2002, however, the pattern is different. Before age 50, medical expenditures remain stable at approximately 750 yuan. For more advanced ages, however, the level of medical expenditures begins to rise quickly, more than doubling by the time an individual reaches age 60. A similar pattern is observed in the share of medical expenditures with respect to disposable income. In summary, the Chinese elderly face increasing medical expenditures.[14] Moreover, these medical expenditures are expected to further increase in the future.

[14]However, despite the increasing medical expenditures in China, it is important to note that these expenditures are still far from the level of such expenditures incurred in the United States. In the United States, the out-of-pocket medical expenditures for the elderly may be multiple times their annual income, especially for rich households (De Nardi et al., 2010). In China, however, although medical expenditures have increased considerably, they still account for only approximately 10% of the annual income of an average elderly household.

Second, the decrease in medical insurance explains the observed increase in out-of-pocket medical expenditures. Figure A1.1 plots the best type of medical insurance owned by the household. In China, public medical insurance is considered to be the best type of medical insurance, followed by collective and commercial medical insurance. Because medical insurance can be used by all family members, in most cases, it is typically the best type of medical insurance owned by any household member that will be most commonly used. One noticeable difference observed in Figure A1.1 is that the percentage of households owning public medical insurance fell from over 60% in 1995 to approximately 20% in 2002. Some households acquired collective or commercial medical insurance as a replacement, but others lost their medical insurance entirely. The reason for this change is China's marketing reform. Initially, the government provided full cradle-to-grave insurance and medical service nearly free of charge for workers. However, with the market reform, free public medical insurance has been gradually replaced with commercial and collective medical insurance.

What is a possible effect of medical expenditures on saving rates? If current medical expenditures increase further, how will household saving behavior respond? An increase in medical expenditures has two potential effects. First, increased medical expenditures at present imply that there may be even higher expenditures in the future, which is especially true for older individuals. In this case, precautionary motives may cause households to increase their present saving rates to prepare for future medical expenditures. On the other hand, in the definition of the saving rate, medical expenditures are subtracted from saving. This implies that mechanically, medical expenditures suppress saving in the current period. The direction in which medical expenditures will alter saving rates depends on the relative strength of these two effects. A model is required to answer this question.

1.5.2 Bequest Motives

Bequest motives are another important factor suggested in the literature to explain the saving rates of the elderly (Hurd, 1987, 1989; Bernheim, 1991; Kopczuk and Lupton, 2007). However, identifying bequest motives is notoriously difficult because even if a bequest is observed when parents pass away, the bequest may be either purposeful (left for the children) or accidental (intended to prepare for the parents themselves in case they were to live longer). Do bequest motives exist in China? The rigorous identification and estimation of bequest motives are beyond the scope of this paper. However, I will provide some evidence that suggests that bequest motives do exist in China.

First, most Chinese elderly state that they want to leave bequests to their children and that they do not need to save for their old-age support. Yin (2010) studies the strength of bequest motives in China. He used a dataset called the "Survey of Living Preferences and Satisfaction," which was conducted as part of the 21st Century Center of Excellence Program of Osaka University. In the survey, there is a question asking the elderly whether they agree with the statement, "I want to leave as large a bequest as possible to my children." Table 1.5 shows the distributions of their responses: 62.45% of the surveyed people stated either, "I think so" or "I tend to think so." A mere 9.83% stated, "I tend not to think so" or "I do not think so." In addition to direct questions asking about bequest motives, there is also indirect evidence. In CHARLS 2011, a question was included that asked the elderly, "Who can you rely on for old-age support?" Table 1.6 reports the distribution of the answers to this question. Although it is widely believed that children are the most important source of old-age support in China (Banerjee et al., 2010), the data indicate that this is not the case in urban China. Table 1.6 shows that only approximately 30% of the elderly rely on their children for support. More than double that amount rely on pension income. This observation further confirms that in urban China, pension income is the most important source

of old-age support. In Figure 1.3, I illustrate that pension income accounts for over 80% of income after retirement, whereas transfer income from children accounts for less than 10%.

Interestingly, very few elderly people state that they rely on savings for their old-age support (8% of households below age 50 and 2.65% of households above age 60). This finding has important theoretical implications. Savings refer to the stock of wealth that a household has accumulated, and pension income is the annual flow of income. The fact that most of the elderly rely on pension income instead of savings implies that for most Chinese elderly, the annual flow of pension income is sufficient to cover their old-age expenditures. In this case, if they maintain a significant level of saving (which is the case, according to the data),[15] it is likely that they are not saving for themselves. This implies a strong motive to save for bequests.

A second piece of evidence is the relationship between the number of children and the saving rate. If a bequest motive exists, a natural conjecture is that saving rates will be lower for households without children. Although the CHIP cannot be used for this purpose because it captures only children living in the household, CHARLS 2011 is suitable for this purpose because it contains information concerning all children regardless of whether they live in the household. The CHARLS 2011 data indicate that for households above age 60, the saving rates are 16.7% for households without children and 27.8% for households with children. The difference of 11.1% between these values is statistically significant after controlling for factors such as age, education, and household income.

Might there be other possible factors that may prevent household expenditures from increasing by amounts commensurate with increases in pension income? Although it is not possible to discuss all such possibilities, I would like to discuss

[15]In 2002, the average wealth of households aged 60 or above is 908.55 thousand yuan, which is about fives times the average disposable income.

three possible channels.

The first possibility is that their children may seek help in purchasing a house or paying for their own children's educational expenditures. To consider this possibility, in Figure 1.11, I plot the transfer expenditures to family members outside the household. The figure demonstrates that transfer expenditures cannot explain the pattern in saving rates because transfer expenditures peak at age 55, which implies that if these expenditures serve as a motive for saving, households should save in advance of age 55, at which time this motive should start to diminish. The saving rate, however, continues to increase after age 55.

Another possibility it is not that households choose not to increase consumption but rather that their deteriorating health conditions prevent them from increasing expenditures. To evaluate this possibility, I plot the percentage of healthy households and the saving rates of households of different health statuses. Figure 1.12 indicates that the deterioration in health status is constant from age 30 onward and is therefore unlikely to match the increasing trend in saving rates beginning at age 45. Moreover, even when the data are separated by health status, a strong increase in saving rates after retirement is still observed when comparing households with similar health status but at different ages. Another important observation is that healthy households maintain higher saving rates. If a deteriorating health status prevented households from increasing their consumption, then unhealthy households would be expected to save more because of their lower consumption. The data, however, indicate the opposite. Therefore, I conclude that changing health status alone cannot explain the high saving rates of the Chinese elderly.

Finally, can increasing longevity as a result of the economic development in China explain higher saving rates because the elderly need to prepare for a longer life? This hypothesis contradicts some empirical observations. First of all, there is no evidence that the life expectancy of the elderly increase tremendously in

China during the investigated period. World Bank (2010) shows that from 1990 to 2008. China experienced a surprisingly small increase in life expectancy at birth (5 years), which is smaller compared to other developing countries including Brazil (6 years), Egypt (6 years), India (8 years) and Indonesia (7 years), even though these countries have experienced much slower economic growth than China. Moreover, the increase in life expectancy at birth in developing countries is mostly attributable to the drop in infant mortality. The increase is much smaller for the elderly. Figure A1.2 shows that the expected years of life increased by less than one year for individuals aged 60 from 1995 to 2002. Liu et al. (2008) obtained even smaller estimates. They estimated that the remaining life expectancy of adults aged 60 and above only increased by 0.9 years from 1987 to 2006. Moreover, an important share of this increase came from a cohort effect. Younger cohorts are born with better economic conditions, have better nutrition intakes and are generally healthier. As a result, the increase in life expectancy would appear to be even smaller if we followed a specific older cohort. Secondly, even if the life expectancy increases, it does not necessarily imply that the saving rate would increase. In Table 1.6, the elderly indicate that pension income is the most important resource they rely on for old-age support. Pension income persists until the end of the life cycle, which implies that the elderly do not have to maintain higher saving.

In summary, previous sections have provided evidence that high pension income may be an explanation for why the Chinese elderly save at such high rates. Upon the receipt of additional income, households increase their saving instead of increasing consumption, possibly as a result of concerns related to future medical expenditures as well as bequest motives. However, without a model, it is difficult to understand whether these factors are quantitatively important. I turn to this in the following section.

1.6 Conclusion

The Chinese elderly maintain a high saving rate. Their saving rates not only remain positive but also continue to grow after retirement. In this paper, I demonstrated that this pattern can be explained by the pension system in China. The evidence includes: (1) saving rates are higher in years with higher pensions, (2) saving rates are higher for those with more generous pension plans, and (3) policy reforms that exogenously increase pensions also increase saving rates. These empirical observations raise another question of why households do not increase their consumption sufficiently. I provided evidence medical expenditures and bequest motives can be the potential explanations.

The paper also sheds light on areas of future research. The paper presents the importance of bequest motives in understanding the saving behavior of the Chinese elderly. However, in this paper, bequest motives are exogenous; therefore, it would be interesting to investigate how bequest motives are formed and what the determinants of bequest motives are. Moreover, the paper only investigates part of the household saving in China: the saving of the elderly. The saving behavior of the middle-aged and the young remain unexplored. Modeling their saving behaviors can be more challenging because many factors can be subtracted away from the saving decisions of the elderly (education, marriage, fertility, job seeking, household purchases, etc.).

Appendix A - Definitions of Variables and Summary Statistics

Appendix A defines certain key variables that are used throughout the paper.

Age of household - defined as the age of the head of household.

Educated household - defined as a household in which at least one member of the couple has received a high school diploma or better.

Household employed by the government - defined as a household in which at least one member of the couple is employed by the government sector.[16]

Healthy household - defined as a household in which both members of the couple rated their health status as "very good" or "good."[17]

Disposable household income - defined as the total net household income, including taxes and social security payments. Total household income includes labor income (wages if employed, net profits if self-employed), pension income, asset income (rent, interest) and transfer income from the government.

Lagged household income - in each wave, households were asked to recall their disposable income over the previous four years. However, unlike the current wave, no detailed information is available regarding household income for this recalled income, only an aggregate value.

Total household expenditures - total household expenditures include food, clothing, utility, rent, communication, medication, education, transfers, purchases of non-durable goods and financial expenses (interest payments).

Total household assets - total household assets include the value of the house, financial assets (cash in hand, savings accounts, value of stocks owned, etc.) and

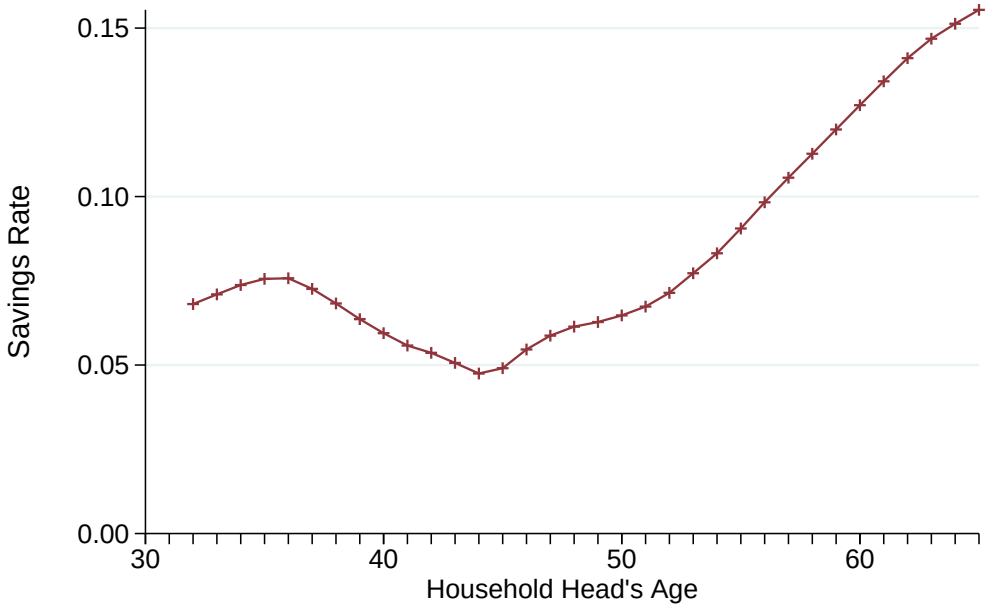
[16]The reason for this definition is that as long as one family member works for the government, the entire family will receive some benefits with regard to education and medical treatment.

[17]The reason for this definition is that as long as one member of a household is in poor health, medical expenditures are expected to increase considerably.

durable goods (motorcycles, cars, computers, etc.).

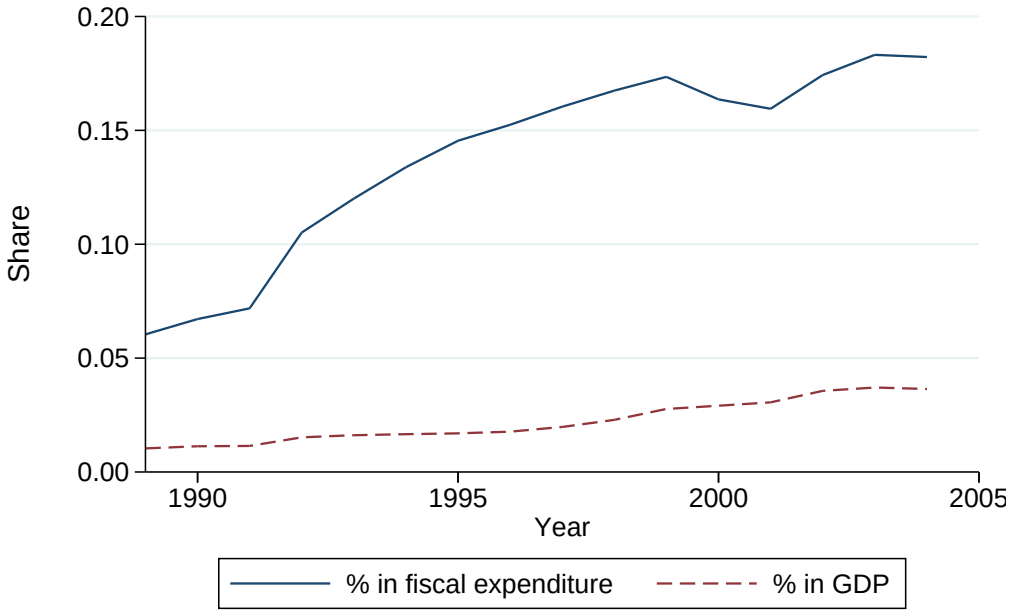
Table A1.1 reports the summary statistics of the data.

Figure 1.1: Age Pattern of Chinese Saving Rate in 2002



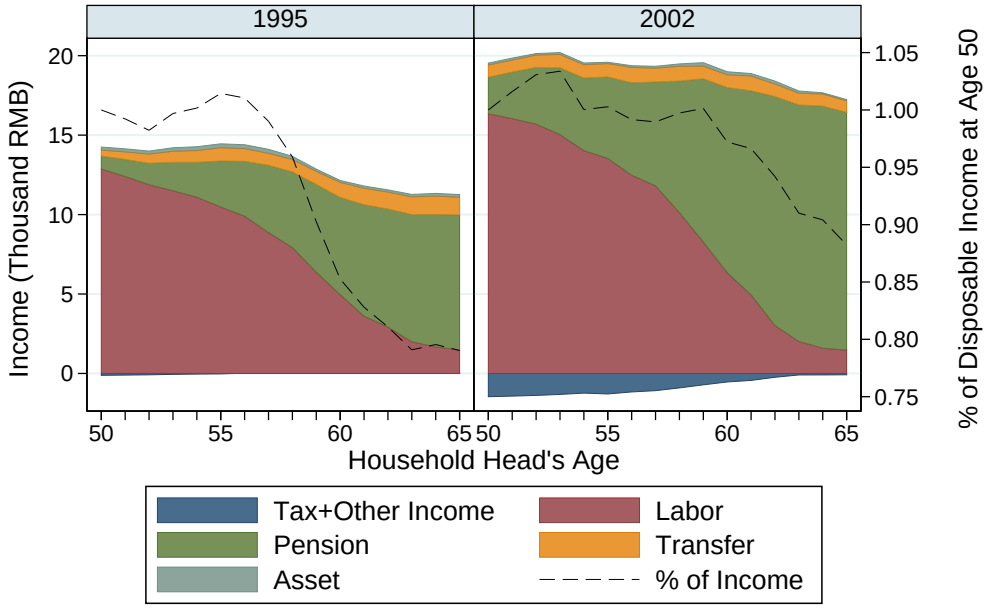
Source: Chinese Household Income Project, 2002.

Figure 1.2: Total Pension Payment as Share of Fiscal Expenditure and GDP



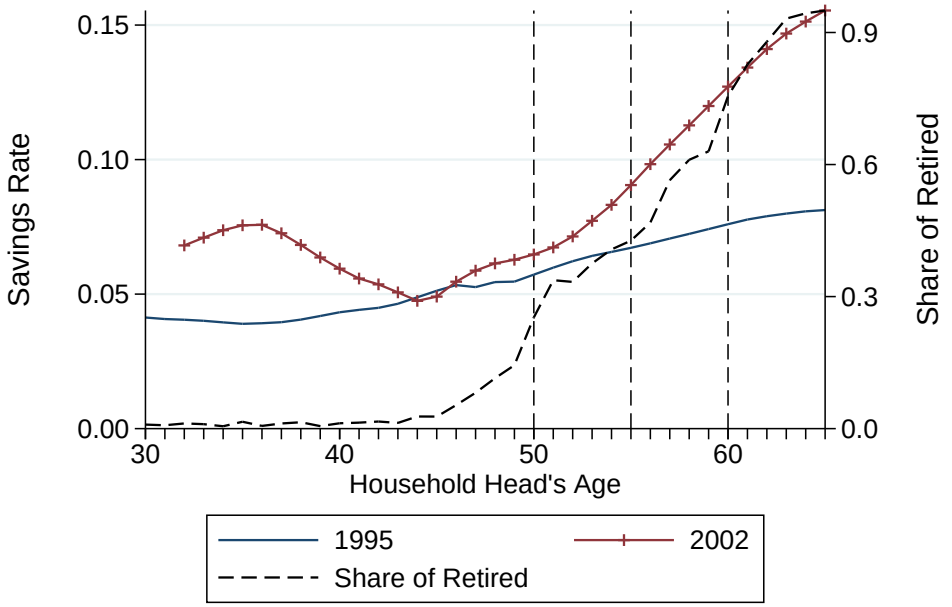
Source: National Bureau of Statistics of China.

Figure 1.3: Composition of Disposable Income by Survey Years



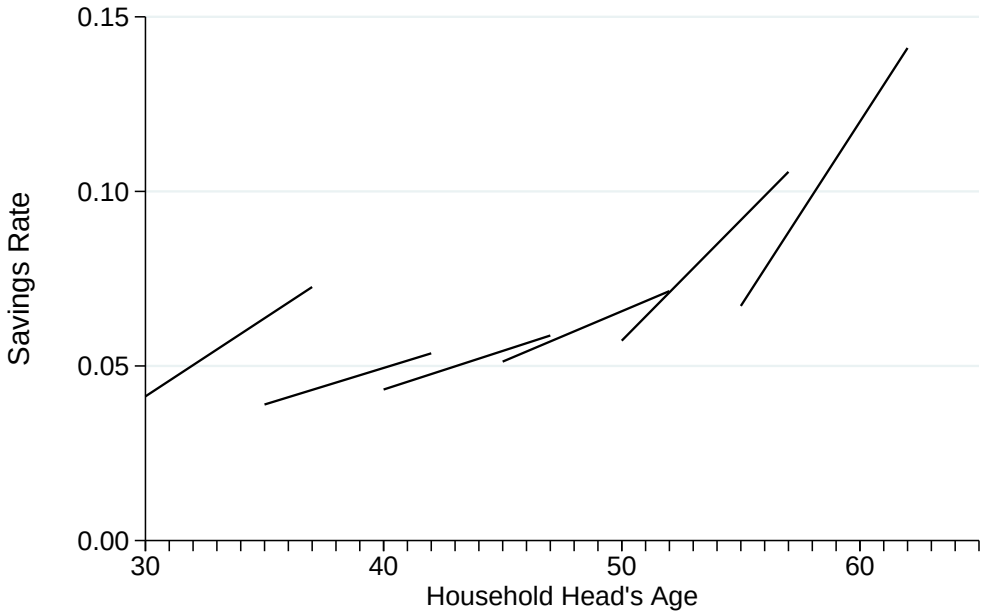
Source: Chinese Household Income Project, 1995, 2002.

Figure 1.4: Age Pattern of Chinese Saving Rate by Survey Years



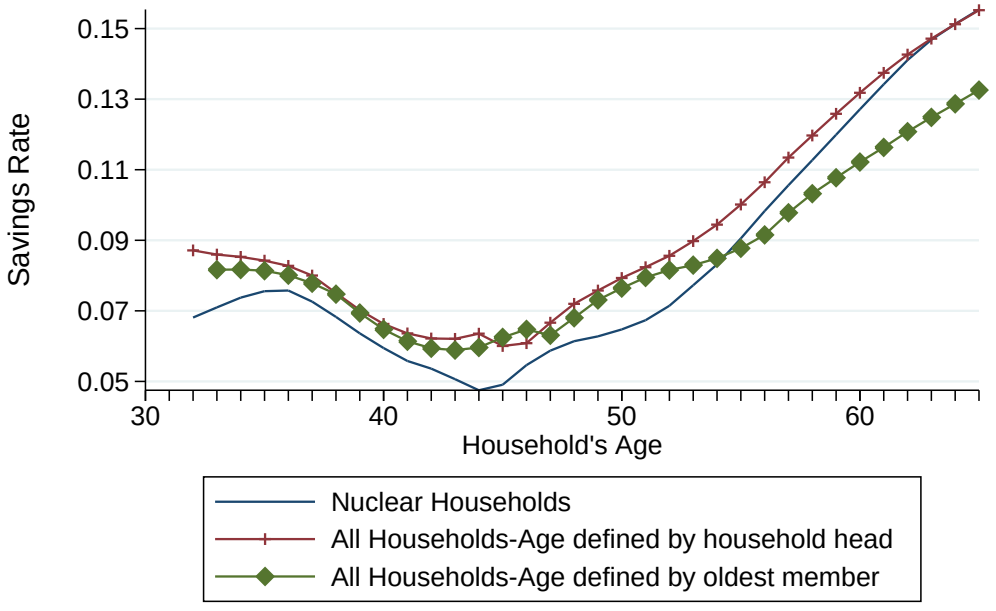
Source: Chinese Household Income Project, 1995, 2002.

Figure 1.5: Age Pattern of Chinese Saving Rate by Cohorts



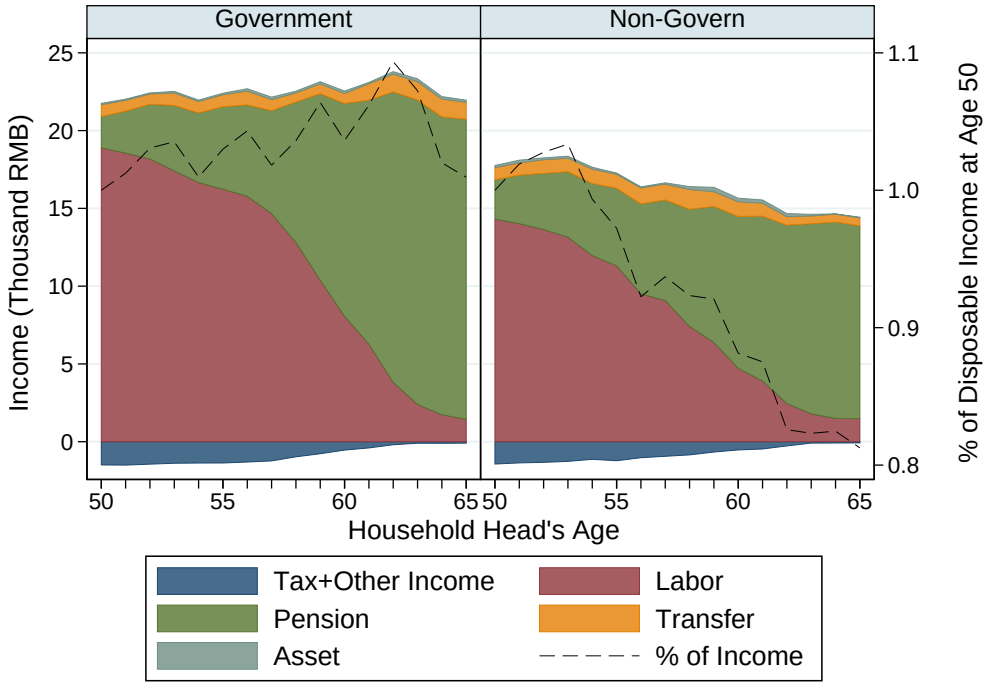
Source: Chinese Household Income Project, 1995, 2002.

Figure 1.6: Robustness of Age Profile of Saving Rate against Selection



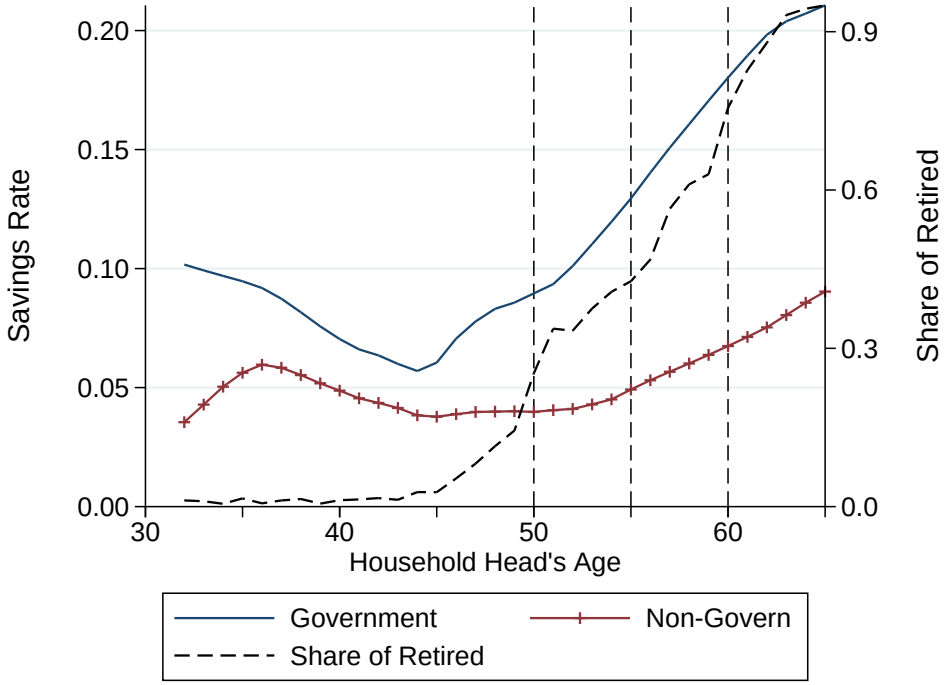
Source: Chinese Household Income Project, 2002.

Figure 1.7: Composition of Disposable Income by Employment Types



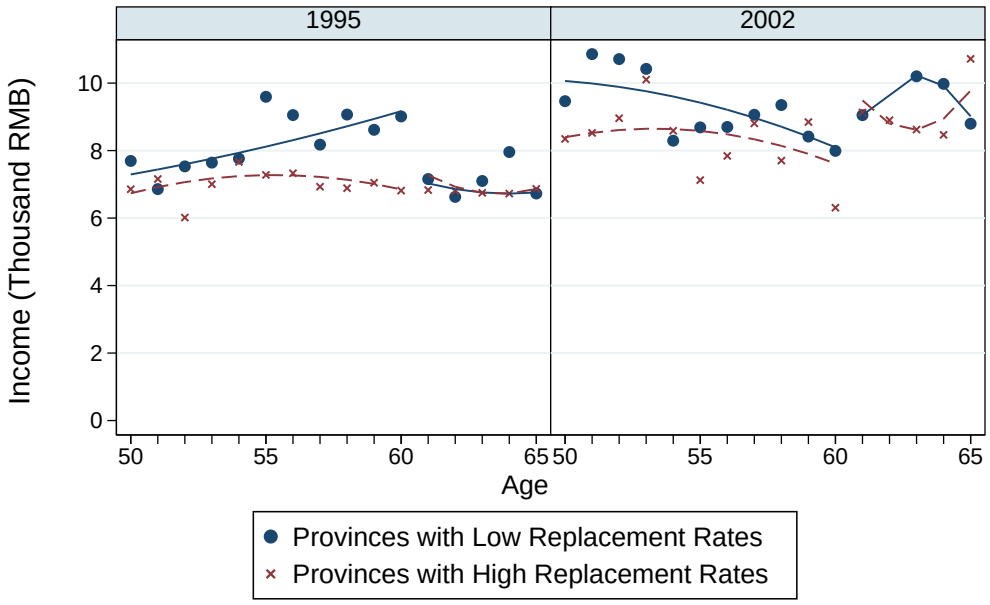
Source: Chinese Household Income Project, 2002.

Figure 1.8: Age Pattern of Chinese Saving Rate by Employer Types



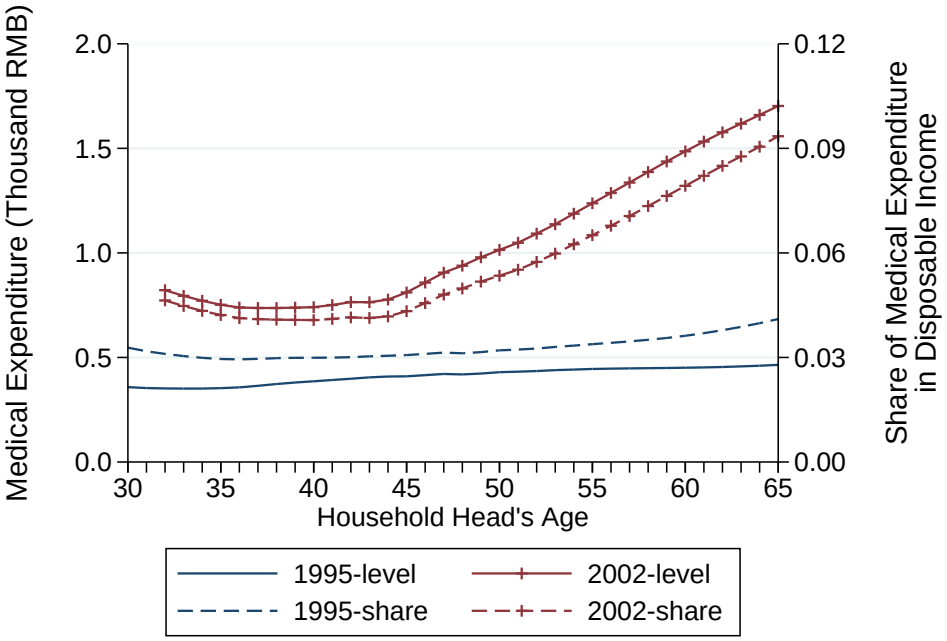
Source: Chinese Household Income Project, 2002.

Figure 1.9: Profile of Disposable Income by Provinces with Different Initial Replacement Rates



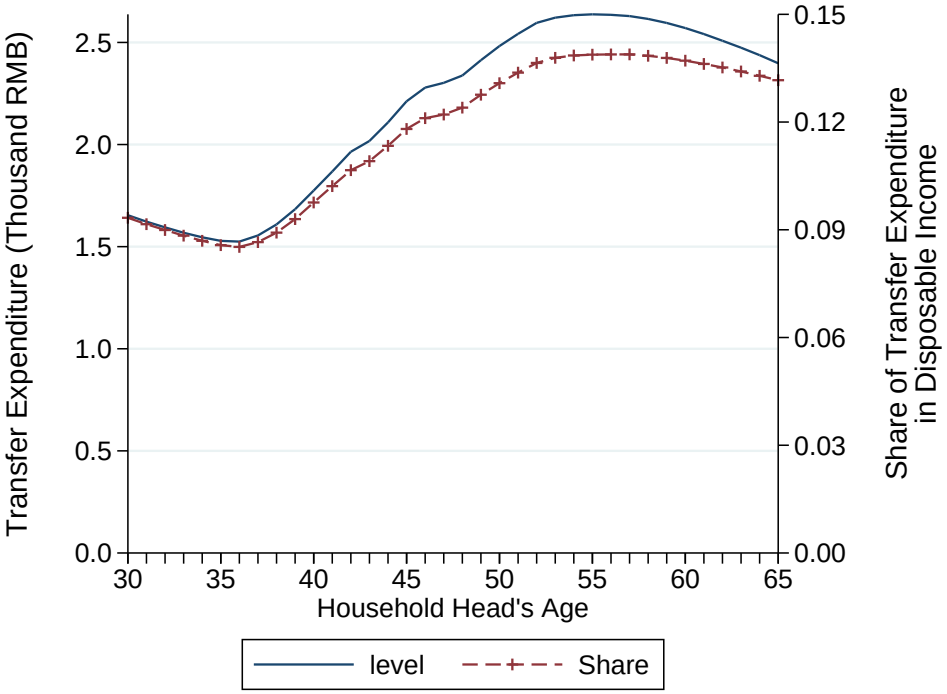
Source: Chinese Household Income Project, 1995, 2002.

Figure 1.10: Out of Pocket Medical Expenditure by Years



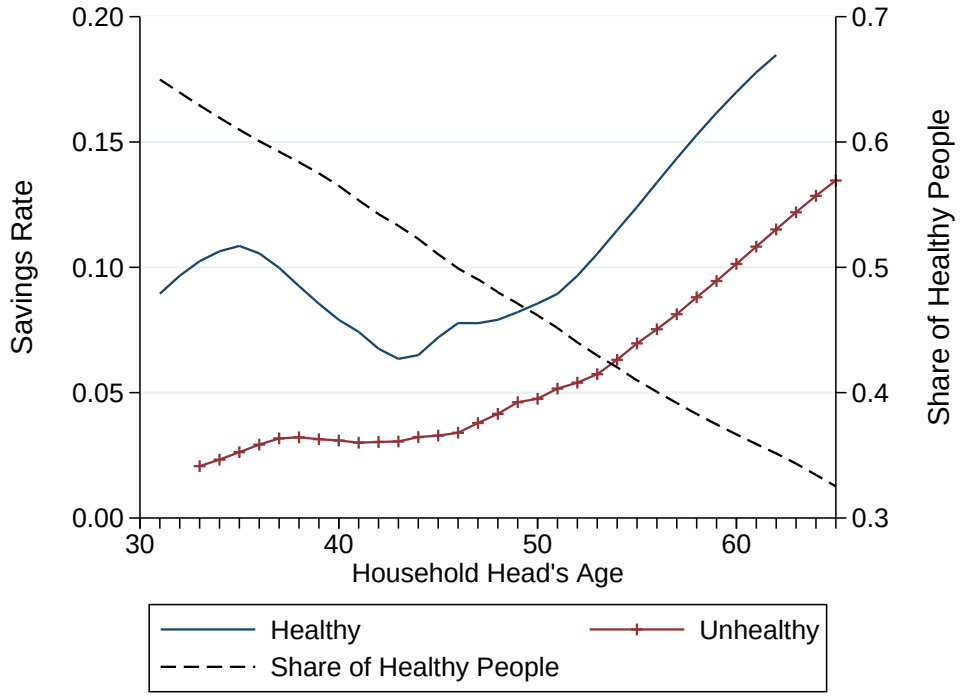
Source: Chinese Household Income Project, 1995, 2002.

Figure 1.11: Age Pattern of Transfer Expenditure in 2002



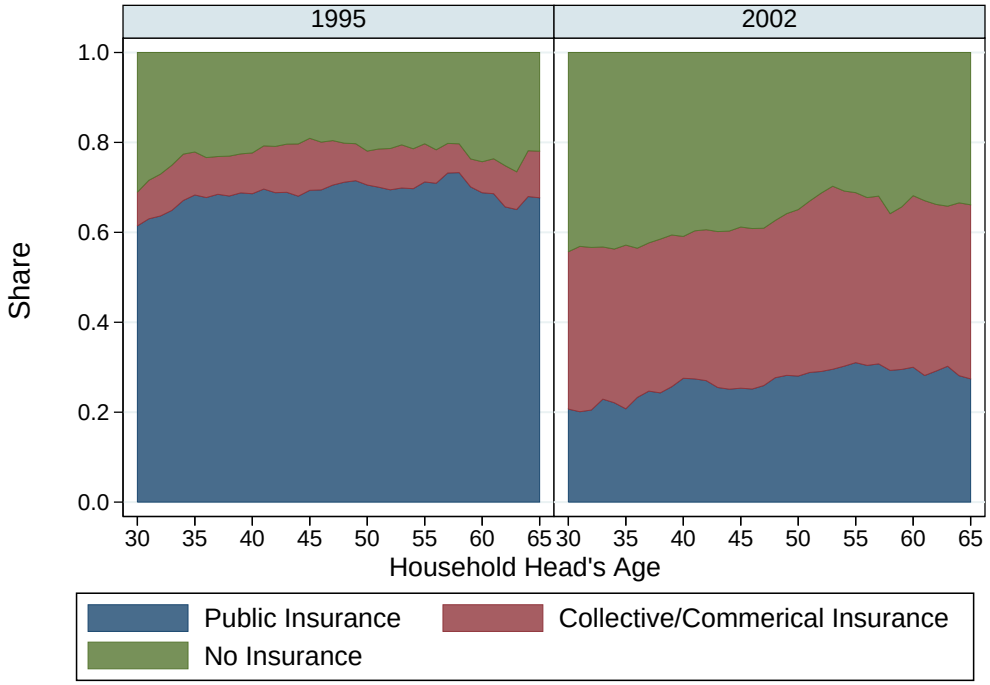
Source: Chinese Household Income Project, 2002.

Figure 1.12: Age Pattern of Chinese Saving Rate by Health Status



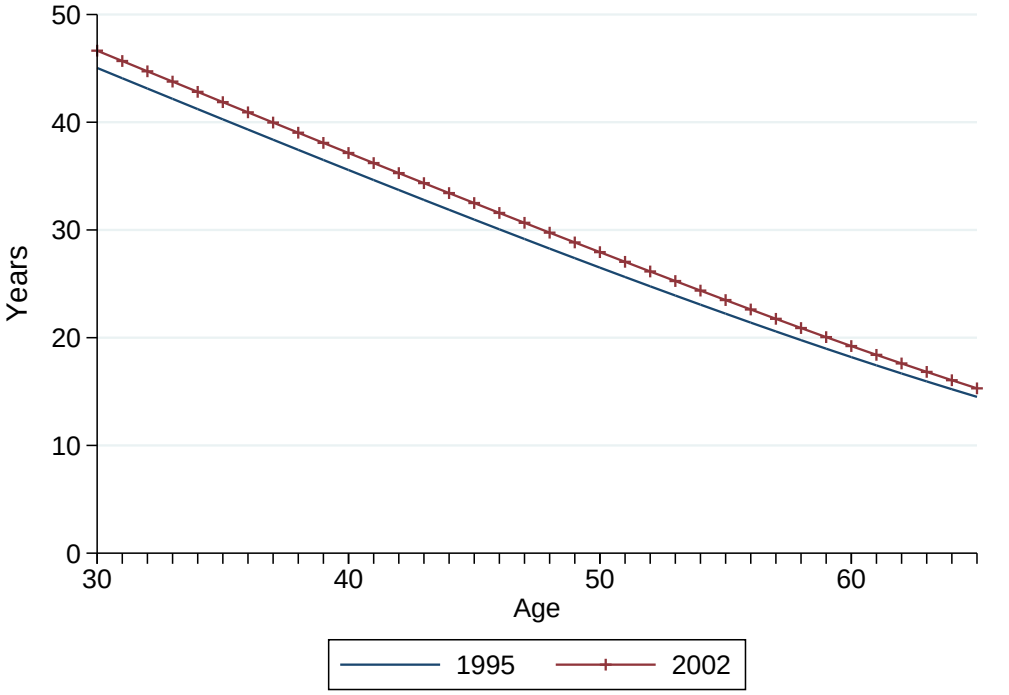
Source: Chinese Household Income Project, 2002.

Figure A1.1: Type of Medical Insurance by Survey Years



Source: Chinese Household Income Project, 1995, 2002.

Figure A1.2: Expected Life Remaining



Source: author's calculation based on mortality rate provided by China Insurance Regulatory Co

Table 1.1: Test of the Increase in Saving Rates as Households Age

Wave	1995	2002		
Group	All	All	Non-Government	Government
	(1)	(2)	(3)	(4)
Age 50-54	-0.0010	0.0457**	0.0614**	0.0281
	(0.0182)	(0.0218)	(0.0276)	(0.0318)
Age 55-59	0.0245	0.0735***	0.0380	0.119***
	(0.0194)	(0.0276)	(0.0382)	(0.0402)
Age 60-64	0.0258	0.0892**	0.0129	0.186***
	(0.0207)	(0.0357)	(0.0541)	(0.0352)
Age 65-69	0.0143	0.155***	0.108***	0.205***
	(0.0259)	(0.0304)	(0.0407)	(0.0454)
Educated	0.0446***	0.0305	-0.0005	0.0674***
	(0.0148)	(0.0209)	(0.0350)	(0.0241)
Government	0.0154	0.0431**		
	(0.0141)	(0.0197)		
Observations	2,069	2,338	1,297	1,041

Source: Based on data from the Chinese Household Income Project, 1995 and 2002.
Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors are provided in parentheses. Province dummies are controlled but not reported.

Table 1.2: Difference in Replacement Rates Across Provinces Before National Reform

Province	Replacement Rate (%)
Beijing	75
Shanxi	95
Jiangsu	65
Henan	75
Hubei	85
Guangdong	70
Chongqing	95
Sichuan	95
Yunnan	71

Source: World Bank (1997)

Table 1.3: Estimation of the Effect of Increased Pension Income on Saving Rates Treating the Pension Reform as an Exogenous Shock

Dependent Variables	log(Income)	log(Expenditure)	Saving Rate
	(1)	(2)	(3)
Junior High	0.136***	0.135***	0.0420
	(0.0144)	(0.0157)	(0.0265)
Senior High	0.250***	0.227***	0.0888***
	(0.0148)	(0.0158)	(0.0268)
College or Above	0.440***	0.416***	0.106***
	(0.0169)	(0.0177)	(0.0305)
Female	-0.136***	0.0254***	-0.302***
	(0.00822)	(0.00825)	(0.0146)
Age	0.0281***	0.0258***	0.00692
	(0.00256)	(0.00280)	(0.00484)
Age Squared/100	-0.0219***	-0.0231***	-0.000749
	(0.00274)	(0.00307)	(0.00522)
Retired	-0.520***	-0.183	-0.701***
	(0.118)	(0.117)	(0.219)
After Reform	0.420***	0.384***	0.0270
	(0.116)	(0.116)	(0.198)
ΔReplacement Rate*Retired	-0.417***	-0.167	-0.605**
	(0.147)	(0.153)	(0.276)
ΔReplacement Rate*After	0.247*	0.234*	0.00774
	(0.139)	(0.139)	(0.232)
Retired*After	0.416***	0.113	0.615**
	(0.150)	(0.148)	(0.274)
ΔReplacement Rate	0.383**	0.0760	0.685**
*Retired*After	(0.186)	(0.194)	(0.347)
Observations	11,380	11,499	11,380

Source: Based on data from the Chinese Household Income Project, 1995 and 2002.
Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors are provided in parentheses. Province dummies and industry dummies are controlled but not reported.

Table 1.4: Placebo Test of Pension Reform

Wave	1995	2002
	(1)	(2)
Junior High	0.157***	0.114***
	(0.0194)	(0.0213)
Senior High	0.238***	0.265***
	(0.0198)	(0.0221)
College or Above	0.380***	0.481***
	(0.0227)	(0.0252)
Female	-0.134***	-0.139***
	(0.0108)	(0.0123)
Age	0.0417***	0.0172***
	(0.00379)	(0.00365)
Age Squared/100	-0.0357***	-0.0115***
	(0.00426)	(0.00372)
Retired	-0.535***	-0.0793
	(0.117)	(0.0903)
Retired*Original Replacement Rate	0.432***	0.0309
	(0.149)	(0.111)
Observation	5,714	5,666

Source: Based on data from the Chinese Household Income Project, 1995 and 2002.
Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors are provided in parentheses. Province dummies and industry dummies are controlled but not reported.

Table 1.5: 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)

Table 1.6: 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)

Table A1.1: Summary Statistics of Data

Year	1995		2002	
Education	High	Low	High	Low
Age	40.51	47.03	42.83	48.69
	(9.72)	(10.48)	(8.78)	(10.34)
Government	0.57	0.28	0.56	0.34
	(0.49)	(0.45)	(0.50)	(0.47)
Healthy			0.57	0.44
			(0.49)	(0.50)
Disposable Income	13.94	11.94	21.39	15.84
	(5.62)	(5.21)	(9.78)	(8.07)
Income Lagged 1 Year	11.78	10.26	19.72	14.49
	(5.92)	(5.36)	(9.23)	(7.79)
Income Lagged 2 Year	12.58	10.97	18.23	13.62
	(5.86)	(5.44)	(8.55)	(7.30)
Income Lagged 3 Year	11.97	10.65	16.87	12.85
	(5.81)	(5.36)	(8.06)	(6.98)
Income Lagged 4 Year	11.13	10.00	15.64	12.11
	(5.61)	(5.15)	(7.62)	(6.70)
Total Expenditures	12.94	11.51	19.64	14.95
	(5.33)	(5.05)	(9.79)	(8.12)
Total Assets	23.88	22.10	110.10	83.83
	(26.95)	(26.73)	(83.30)	(74.85)
Observations	2,072	3,039	2,280	2,447

Source: Based on data from the Chinese Household Income Project, 1995 and 2002.
Note: Standard errors are provided in parentheses.

CHAPTER 2

Life Cycle Model in a Fast Developing Economy

2.1 Introduction

In the previous chapter, the documented empirical evidence suggests that pension income, in combination with medical expenditures and bequest motives, may be important drivers of the high saving rates of the Chinese elderly. However, based on a descriptive analysis alone, it is difficult to quantify the importance of pension income in determining their saving behavior.

To address this concern, in this chapter, I build and estimate a dynamic life-cycle model that accounts for all related factors identified in the previous two steps. In this model, a representative household will face four types of shock: income shock, health shock, medical expenditure shock and mortality shock. Other factors that may contribute to saving-consumption decisions are also included, such as leisure, education and bequests. In the process of estimating income and medical expenditure profiles, one key feature of this paper is that I carefully distinguish between the "life-cycle profile" and the "cross-sectional profile." In a developed country whose economy is relatively stable, the cross-sectional profile serves as a good proxy for the life-cycle profile. However, in a country such as China whose economy is growing quickly, these two profiles may differ tremendously, which may lead to contradictory theoretical implications. This difference is also one the major differences between my study and previous studies of Chinese saving rates using the life-cycle model.

The model is estimated by using the Method of Simulated Moments (MSM) to match the key features of the empirical patterns. The model achieves good matching to the following features: (1) elderly households maintain positive saving rates, (2) saving rates continue to increase after retirement, (3) households saved more in 2002, (4) educated households save more, and (5) healthy households save more. The model also successfully predicts the difference in saving rates between government and non-government employees, which is intentionally left unmatched in the MSM to perform an out-of-sample test. Moreover, the estimated degree of risk aversion for China is similar to the estimated number for the number for the United States. This result implies that the patterns of saving in China can be explained well in the framework of a life-cycle model. It is not necessary that the Chinese elderly be highly risk-averse in order for us to explain their high saving rates.

After the estimation, I run simulations to test whether the influence of pension income is sufficiently strong to explain the high saving rates of the Chinese elderly when combined with bequest motives and medical expenditures. I individually close one of the following three channels at a time: pension income, bequest motives and medical expenditures. I find that pension income, in combination with bequest motives, best explains the high saving rates of the Chinese elderly. Medical expenditures, however, have only a modest effect. The simulation results also indicate that the current saving pattern in China is related to the country's rapid economic growth. As the pension income in China is indexed to the current average wage of workers, economic growth directly affects the increase in pension income. I find that in cases of economic slowdown, elderly households will decrease their saving rates to a larger extent. If the economic growth rate is sufficiently low, then elderly households will save less than middle-aged households.

With the model, I can also run interesting counterfactual simulations. For example, at the moment, pensions in China are indexed to the current average

wage of workers. What would happen if the pension income is instead indexed to CPI, similar to many other countries around the world? Moreover, there is no inheritance tax in China. What would happen if China imposes a 50% inheritance tax, similar to the United States? The simulation results suggest that the saving rates of the elderly would drop by $5\% - 10\%$ and the rates are lower than those of the middle-aged if pensions are indexed to CPI. In the case that inheritance taxes are imposed, the elderly would reduce their saving rates by 4%.

This main contribution of this paper is that it builds and estimates a dynamic life-cycle model that takes relevant factors into account. Using this model, I am able to test the importance of pension income in determining saving behavior and to understand how economic growth in China is related to the saving rates of the elderly.

The data used in this chapter is the same as previous chapter with one addition. Because Chinese Household Income Project (CHIP) lacks longitudinal health information, which prevents the estimation of important factors, such as health transition probability. To overcome this issue, I use another dataset: the Chinese Health and Nutrition Survey (CHNS). The CHNS (1997, 2000, 2004, and 2006) is mainly used to estimate health transition shock. The CHNS is a household panel survey that offers a rich cross-section of information concerning individual health status; therefore, it can be used to estimate the probability of transition in health status. However, the CHNS contains no detailed information regarding expenditures and therefore cannot be used as the main dataset.

The remainder of the paper is organized as follows. In Section 2.2, I build a stylized life-cycle model based on the observed empirical facts. In Section 2.3, I describe the estimation method and discuss the estimation results. Various counterfactual simulations are performed in Section 2.4. Section 2.5 concludes.

2.2 Life Cycle Model

In this section, I develop and estimate a dynamic life cycle model of household saving decisions that captures the key empirical features described in the previous sections. Such a model will prove useful for two reasons. First, the previous sections have highlighted several possible drivers that may explain the high saving rates of the Chinese elderly. Using such a model, it will be possible to analyze the relative importance of all of these drivers. Second, it will be possible to perform various simulation exercises. For example, the potential global impact of a potential slowdown in the Chinese economy is of worldwide concern. Because one direct effect of the economic slowdown is on pension income, as it is indexed to average wages, which are captured in such a model, this model will enable an analysis of how the Chinese saving rate will evolve during an economic slowdown. Chinese saving has a global impact, as it is one of the major financing resources of many developed countries (the U.S., for example).

I first provide an overview of the model. Then, I provide details regarding each component of the model. Afterward, I introduce the estimation method and discuss how each parameter in the model is identified.

2.2.1 Overview of the Model

The outline of the model follows DeNardi et al. (2010), Hubbard et al. (1995), Gourinchas and Parker (2002) and Palumbo (1999). In this model, I assume representative households that make joint decisions. These households earn income [1] together and make consumption decisions together. Many cohorts are included in the model. Different cohorts enter in the year 1995 with different starting ages.

[1] Ideally, I should estimate the income processes of a husband and wife separately and then aggregate them. However, there is a limitation in the dataset that prevents such an approach. To estimate the dynamic features of income (for example, permanent shock or temporary shock), information on past income is necessary. However, information on past income is available only at the household level.

Each household begins with a given education level, health status and amount of initial assets. Each household may live up to a maximum age of T.

Households face four types of shock in the model: health shock, medical expense shock, income shock and mortality shock. Households will experience three stages per year. The first stage is the realization of shocks. Health shock is realized first. Conditional on current age and health status, each household may change to a different health status. After this stage, health status remains fixed throughout the year. Conditional on health status, a household may experience (1) no medical expenditures, (2) modest medical expenditures, or (3) high medical expenditures. The probability of each level of expenditure varies depending on health status. At the same time, household income will be determined by health status, age, education, income shocks and cohort effects.

The second stage consists of consumption decisions. After all shocks are realized, the household will know its income and medical expenditures for the year. The government guarantees a minimum consumption level. The household decides how much to consume and how much to save. Utility will be derived from consumption and will be affected by other variables, such as health status. The final stage is the realization of mortality shock. Each household has some probability of dying and of deriving utility through bequest motives. If a household survives, it will move to the next period.

2.2.2 Utility

A representative household[2] i born in cohort c at age t derives utility from consumption $C^i_{t,c}$. The utility function is assumed to be the CRRA (Constant Relative

[2]China maintains the highest female labor force participation rate within major countries in the world (U.S. Bureau of Labor Statistics, 2012), which is 7% higher than the second highest country (Canada). The rate is even higher in urban areas. Therefore, in the model, I assume that the wife in a household always joins the labor force in China. In countries with a low female labor force participation rate, the female labor supply may partially substitute for the role of saving in buffering negative economic shock (Attanasio et al., 2005, 2008).

Risk Aversion) function with utility shifter $\delta(h_t^i, l_t^i)$, where h_t^i is the current health status and l_t^i is leisure.[3] Previous research (Attanasio and Weber, 1994; Palumbo, 1999; Banks et al., 1998) has demonstrated that both health and leisure are important in understanding consumption patterns near retirement.

The utility function takes the following form:

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

where $\delta(h_t^i, l_t^i) = 1 + \delta_1 h_t^i + \delta_2 l_t^i + \delta_3 h_t^i l_t^i$.

At the end of each year, there is a mortality shock. Each household may die with a probability of m_t. In the case of death, there is some utility derived through bequests:

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

where $Child^i$ is a variable that indicates whether the couple has any children, and A_t^i represents the assets remaining after death. θ_1 is introduced to capture the sharp difference in saving rates between households with children and households without children.

2.2.3 Education and Health Status

In the model, each household begins with a given education level E^i. I assume that no further education can be received, meaning that E^i remains fixed throughout the life cycle. There are two types of education: high and low.

There are also two possible health statuses: good health and poor health. Unlike education, health can evolve over time depending on the household's current

[3]If a variable contains no subscript c, it implies that I assume that there is no difference in that variable among different cohorts. For example, there is no subscript c for leisure, which implies that I assume that households will engage in the same amount of leisure at age t regardless of the cohort. For income, a subscript c is present, implying that in this model, different cohorts will have different incomes when they reach the same age.

age and health status.

2.2.4 Income Process

Household income in the model[4] depends on education, health, age and birth cohort. Income consists of a deterministic component and a stochastic component. More specifically, income takes the following form:

$$\log(Y_{t,c}^i) = \log(\overline{Y}_{t,c}^i) + e_t^i$$

where $\overline{Y}_{t,c}^i$ is the deterministic component, which is assumed to be $\overline{Y}_{t,c}^i = f_c\left(t, E^i, h_t^i\right)$. The function f_c can differ for different cohorts. In practice, the income process is estimated using the following equation:

$$\begin{aligned} \log(Y_i) &= \alpha + \beta_1 Age_i + \beta_2 Age_i^2 + \beta_3 Edu_i + \beta_4 Edu_i \cdot Age_i \\ &\quad \beta_5 Edu_i^2 \cdot Age_i + \gamma X_i + e_i \end{aligned}$$

Here, the control variables X_i include health, employer type, province of residence and whether the income information is recalled.

The stochastic component e_t^i includes permanent income shock and temporary income shock:

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

where ε_t^i and ϵ_t^i are independent and identically distributed, and they are also independent of each other. Both types of shock satisfy the normal distribution:

[4]Because interest income and transfer income will be separately added to the model in a later stage, in the estimation of the income process presented here, I take away these two components of income.

$\varepsilon_t^i \sim N(0, \sigma_\varepsilon^2)$ and $\epsilon_t^i \sim N(0, \sigma_\epsilon^2)$.

One possible caveat for the modeling of the income process is the potential endogeneity in the timing of retirement. Treating retirement as exogenous when it is actually endogenous will lead to an overestimation of shocks (Low et al., 2010). However, in China, although there is some difference in the timing of retirement depending on gender and work type, retirement is typically mandated instead of being a personal choice. Early retirement usually occurs because of disability or work-related injury, and late retirement is usually requested by employers because of special skills possessed by the worker (experienced doctors, for example). This scenario is also the scenario most commonly considered in the previous literature (Banerjee et al., 2010).

The identification of temporary and transitory shock is similar to the approaches adopted by Meghir and Pistaferri (2004) and Chamon et al. (2013) for application to China. Table 2.1 reports the estimation of the parameters and standard errors. Appendix B provides more technical details regarding this estimation.

It should be noted that the deterministic component of the income process is estimated for each cohort separately.[5] It is crucial to distinguish between the life cycle profile for a specific cohort and the cross-sectional profile in a specific wave. In a stationary economy, these two profiles are equivalent to each other. Those who are currently 60 will receive the same amount of income five years in the future as the amount that those who are currently 65 receive in the present year. In a growing economy, especially one that is growing as rapidly as that of China, these two profiles can differ tremendously from each other because of economic development. Younger cohorts usually receive higher incomes when they reach a given age compared with older cohorts. In such a case, the income of individuals who are currently 65 will no longer serve as a valid proxy for the income of

[5]For simplicity, the structure of the stochastic component is assumed to be the same for all cohorts.

individuals who are currently 60 five years in the future. Previous literature on the Chinese saving rate has not made this distinction (e.g., Chamon and Prasad, 2010; Song and Yang, 2010).

Figure 2.1 plots the income of each cohort in the past five years. Unlike the hump-shaped income profile of a standard life cycle model, in China, income continues to increase for all cohorts because of economic growth.[6] Even after retirement, household income continues to increase at a rate no slower than that of a working household. The reason for this pension growth after retirement in China is that the level of pension income is indexed to the average worker's wage in China, which is rising quickly as the Chinese economy grows. Notably, in this paper, all income and expenditures are adjusted according to the price level in year 1995; therefore, the results are robust to inflation.

Individuals have not experienced decreases in income in the past, and they do not expect their income to decrease in the future. In CHIP 2002, a question was asked regarding the expectations of changes in future income. Figure 2.2 presents the results. Fewer than 20% of Chinese households reported an expectation that their household income would decrease in the future. More interestingly, as workers retire, a smaller percentage of them expect their income to decrease, implying that retirees mostly expect their pension income after retirement to readily increase. No individuals at age 65 in the sample expected their income to drop in the future.

In short, whereas cross-sectional profiles predict that household income will decrease after retirement, life cycle profiles predict that income will continue to rise. When households make consumption-saving decisions, they take into account their life cycle profiles instead of cross-sectional profiles. The two different profiles will generate vastly different predictions. Figure 2.3 plots the cross-sectional

[6]In the 1995 wave, there is a small dip for all cohorts. This is because during the 1992-1993 period, China experienced high inflation. The data have been adjusted to the consumer-pricing index; therefore, this inflation induces a temporary drop in the true income for that year.

profile for 2002 and various predicted life cycle profiles for different cohorts in the model. It is clearly apparent that in the cross-sectional profile, income begins to decrease slowly after age 55. The life cycle profiles, however, indicate that income continues to grow for all cohorts, even for cohorts who have already retired.

2.2.5 Medical Expenditure Process

In principle, medical expenditures should be estimated in a similar fashion as the income process. However, there is a limitation of the available datasets that prevents this approach. To date, there are no available panel data for China that contain information regarding medical expenditures.[7] This limitation will result in two difficulties in the estimation of the medical expenditure process. The first difficulty lies in distinguishing between permanent shock and temporary shock. The second difficulty lies in estimating the medical expenditure profiles for each cohort.

To address the first difficulty, I estimate the permanent component and transitory component of medical expenditure shocks separately using different datasets.

I assume that health status captures the permanent features of medical expenditures because health is the most important determinant of medical expenditures. Health status also captures the evolution of medical expenditures because a household's level of medical expenditures typically decreases when its health status improves. More importantly, the China Health and Nutrition Survey, which is a panel survey, contains information regarding health status. Therefore, it is possible to estimate the transition probability for health status, which can be used to represent the permanent shock of medical expenditures. For simplification, I

[7]The CHNS is a panel survey; however, it does not contain information regarding medical expenditures. The CHIP contains information regarding medical expenditures, but it is not a panel survey. The income process can be estimated using the CHIP because the CHIP records the income history for each household over the preceding five years. No similar history information is available for medical expenditures.

assume

$$\Pr(h_t^i = j | h_{t-1}^i = k) = \frac{N(h_t = j, h_{t-1} = k)}{N(h_{t-1} = k)}$$

which means that the health transition probability is a function only of age and previous health status. In the model, I define two possible health statuses: healthy and unhealthy.[8] Figure A2.1 plots the probability that a household will maintain its health status. As expected, as a household ages, it becomes more difficult for it to remain in a healthy status and less likely for it to leave unhealthy status.

The transitory shock of medical expenditures is captured by medical expenditures that are conditional on health status. Households of the same health status can incur different levels of medical expenditures. In the model, I consider three possibilities: no shock, low shock and catastrophic shock. In each case, the associated medical expenditures are $M_{t,c}^{i,1}$, $M_{t,c}^{i,2}$, and $M_{t,c}^{i,3}$, respectively. Specifically, a household of education level E^i and health status h_t^i will have a probability $\pi(h_t^i, E^i)$ of experiencing some sort of medical shock. Conditional on experiencing such a shock, there is a probability ϕ that the shock will be a catastrophic one. In summary, medical expenditures are modeled as follows:

1. $M_{t,c}^{i,1}$ if no shock occurs (with probability $1 - \pi$)
2. $M_{t,c}^{i,2}$ if a low shock occurs (with probability $\pi\,(1 - \phi)$)
3. $M_{t,c}^{i,3}$ if a catastrophic shock occurs (with probability $\pi\phi$)

To estimate the medical expenditure process, I further assume that $M_{t,c}^{i,3} = \gamma M_{t,c}^{i,2}$ and $\phi = 0.05$.[9]

[8] In the survey, each household member was asked individually for his or her self-evaluated health status. One's health could be reported to be "very good," "good," "fair" or "poor." A healthy household is defined as one in which both members of the couple rate their health statuses as "very good" or "good."

[9] ϕ and γ cannot be independently identified. Because medical expenditures are continuously distributed, the smaller ϕ is, the larger γ will be. I have also tested other values of ϕ and have found the estimation results yielded by the rest of the model to be similar.

A second difficulty is to determine the profile of medical expenditures for each cohort. Similar to income, the process of medical expenditures in China is unlikely to be stationary. The cost of medical services changes every year. The change in out-of-pocket medical expenditures experienced by a household is determined by two factors: the total medical expenditure and the percentage of the total that the household itself must pay. Assume

$$M_{t,c}^{i,j} = s_{t,c} \cdot \overline{M}_{t,c}^{i,j}$$

where $\overline{M}_{t,c}^{i,j}$ represents the total medical expenditure and $s_{t,c}$ represents the share of out-of-pocket payment. Because the survey included a question regarding the proportion of its medical expenditures for which each household was obliged to pay, $s_{t,c}$ is known, and $\overline{M}_{t,c}^{i,j}$ can be recovered from $M_{t,c}^{i,j}$ using the two available data points. To estimate future medical expenditures, I make two additional assumptions. First, $\overline{M}_{t,c}^{i,j}$ is assumed to increase smoothly each year at the given age, specifically,

$$\overline{M}_{t,c+k}^{i,j} = \overline{M}_{t,c}^{i,j} + k \cdot \Delta_t$$

where Δ_t can be estimated using the data from the 1995 and 2002 waves for each age. This specification assumes that a cohort that is younger by k years will need to pay $k \cdot \Delta_t$ more in total medical expenditures. For $s_{t,c}$, I assume

$$\begin{aligned}
s_{t,c} &= s_{t,1995-t} \text{ if } t+c \leq 1995 \\
s_{t,c} &= \frac{2002-t-c}{7} s_{t,1995-t} + \frac{t+c-1995}{7} s_{t,2002-t} \text{ if } 1995 < t+c < 2002 \\
s_{t,c} &= s_{t,2002-t} \text{ if } t+c \geq 2002
\end{aligned}$$

Note that the current year can be recovered from $t+c$. This specification assumes that prior to 1995, the rate is fixed to the level of 1995, and that after 2002, the rate is fixed to the level of 2002. Between these two years, the rate changes at a

constant rate. The reason for this specification is that no further data are available to describe the variation in the rate in greater detail. Despite the many limitations of this specification, it is the most reasonable option given the availability of the data.

2.2.6 Constraints

There are two major constraints in the model. The first is the liquidity constraint. Because the financial system in China is not highly developed, borrowing typically requires collateral, meaning that it is rare for a household to be able to borrow an amount greater than that corresponding to the assets it owns. According to the data, fewer than 1% of households possess negative assets. Specifically, I assume

$$A^i_{t,c} \geq 0, \forall t, c$$

The second restriction is the guarantee of a minimum standard of living. This is a program that is intended to ensure that poor households maintain a minimum standard of living. Although this standard is defined differently for different provinces in China, for simplicity, I assume a single country-wide standard. Following Hubbard et al. (1995), I assume the rules governing this constraint to be that the government will guarantee a minimum consumption of

$$T^i_{t,c} = \max\left\{\underline{C} + M^i_{t,c} - Y^i_{t,c} - (1+r)\, A^i_{t,c}, 0\right\}$$

and that there is a budget constraint of

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

Here, $\underline{C}$ is the minimum consumption, which is estimated from the average consumption of the bottom 1%. If the family receives government transfers, I impose

$C^i_{t,c} = \underline{C}$, and $A^i_{t+1,c} = 0$.

2.2.7 Optimization Problem

The timing of the model can be summarized as follows:

1. A household that belongs to a specific cohort c at an age of t begins with assets $A^i_{t-1,c}$, health status h^i_{t-1}, education level E^i, and permanent income shock u^i_{t-1}.

2. Health shock is realized, determining whether the household will experience a change in health status h^i_t.

3. Income shock and medical expenditure shock are realized, determining the household's income $Y^i_{t,c}$ and medical expenditures $M^i_{t,c}$.

4. The government determines whether to provide a transfer to the household in accordance with the minimum consumption rules.

5. Each household is left with cash in hand equal to $(1+r)A^i_{t-1,c}+Y^i_{t,c}+T^i_{t,c}-M^i_{t,c}$ and determines how much to consume ($C^i_{t,c}$) and how much to leave for the next period $A^i_{t,c}$. The saving rate in this period is determined as follows:

$$rate^i_{t,c} = \frac{rA^i_{t-1,c} + Y^i_{t,c} + T^i_{t,c} - M^i_{t,c} - C^i_{t,c}}{rA^i_{t-1,c} + Y^i_{t,c} + T^i_{t,c}}$$

6. A mortality shock is realized at the end of the year. Each household will move into the next year with a probability of $1 - m_t$.

The maximization problem can be written as follows:

$$\begin{aligned} V_t(A_{t-1}, h_{t-1}, u_{t-1}; E) &= \max_{C_t}\{\delta(h_t, l_t)\frac{(C_t)^{1-v}}{1-\nu} \\ &\quad +\beta E_t V_{t+1}(A_t, h_t, u_t; E)\} \end{aligned}$$

subject to

$$\begin{aligned}
A_t &= (1+r)A_{t-1} + Y_t + T_t - C_t - M_t \\
T_t &= \max\left\{\underline{C} + M_t - Y_t - (1+r)\,A_{t-1}, 0\right\} \\
A_t &\geq 0 \\
\log(Y_{t,c}) &= \log(\overline{Y}_{t,c}) + e_t \\
e_t &= u_t + \varepsilon_t \\
u_t &= \rho u_{t-1} + \epsilon_t \\
M^j_{t,c} &= s_{t,c} \cdot \overline{M}^j_{t,c} \quad (j = 1, 2, 3)
\end{aligned}$$

The solution will yield a policy function:

$$C_t\left(l_t, M_t, \varepsilon_t, A_{t-1}, h_t, u_t; E\right)$$

and this function will be different for different cohorts.

2.3 Estimation of the Parameters

2.3.1 Method of Simulated Moments

The parameters in the model are estimated in three different ways: taken from the literature, estimated externally and estimated within the model. The first category includes the discount factor, which is assumed to be 0.98. The second category includes the interest rate, the income process and the medical expenditure process. The methods for estimating the income process and the medical expenditure process have been introduced in previous subsections. The interest rate is estimated as the average one-year interest rate for savings accounts since 1995. Parameters in the final category are estimated using the Method of Simulated Moments (McFadden, 1989). This category includes (1) the CRRA risk-aversion parameter (ν),

(2) the utility shifters ($\delta_1,\ \delta_2,\ \delta_3$) and (3) the bequest motives ($\theta_0,\ \theta_1,\ \kappa$).

The major moments used in the estimation are the amounts of saving separated by cohort, health and education at the two available data points. More specifically, I choose six cohorts:[10] two health levels, two education levels and two years of data. Because health information is available only for the 2002 wave of the CHIP, in practice, these data total 36 moments. Additionally, I consider the difference in saving rates between families with and without children for a single cohort.

The simulated moments are obtained using the following procedure. First, I estimate the income process and the medical expenditure process for the six selected cohorts as well as other necessary information, such as health transition probability and leisure for each age. Second, I use the 1995 data to determine the distributions of the number of children,[11] health, education and starting assets for use as the initial conditions. For each cohort, I perform a certain number of simulations with different incidences of shocks. The number of simulations is proportional to the cohort size. Third, I aggregate the simulations into four groups for each cohort (education by health). Then, I determine the saving in the first year of the simulation (matched to the year 1995) and the saving seven years later (matched to the year 2002). Finally, I compute the difference in saving rates for one chosen cohort sixteen years later (matched to the year 2011, the CHARLS survey year) between households with children and households without children.

I will now discuss how the chosen moments can be used to intuitively identify the parameters. The relative degree of risk aversion ν can be identified by considering how individuals value current consumption relative to the future. If individuals are highly risk-averse, they will tend to engage in higher current consumption because the future is uncertain. That is to say, CRRA risk aversion can be identified from changes in consumption between the two waves. Preference

[10]Household head born in 1929-1931, 1932-1934, 1935-1937, 1938-1940,1941-1943, 1944-1946.

[11]The distribution of the number of children is estimated from the CHARLS because the CHIP does not capture children not living in the household.

shifters (δ_1, δ_2, δ_3) can be identified as the correlations between consumption and corresponding factors (leisure, health) and their interactions. The difference in consumption between households with different health statuses will identify δ_1. Because the leisure variable changes rapidly during the process of retirement (ages 50 to 60), the corresponding change in consumption will identify δ_2. Because δ_3 represents the interaction between health and leisure, the different changes in consumption during the retirement process for healthy and unhealthy households will help to identify δ_3. Finally, θ_1 is identified as the difference in saving rates between households with and without children. $\theta_0 + \theta_1$ (and therefore θ_0) can be identified from the amount of assets a household leaves behind upon death, which is equivalent to the average saving throughout the life cycle. κ is the curvature of bequests; if this quantity is positive, it indicates that bequests are a luxury good. Therefore, the different rates of saving among households of different income levels (for example, households with different education level) will help to identify the parameter κ. In the data, both health and education inform the income process; therefore, differences in consumption between the healthy and unhealthy and between the educated and uneducated will help to identify this parameter.

More technical details about obtaining the standard error from the Method of Simulated Moments are provided in Appendix C.

2.3.2 Estimation Results

Table 2.2 presents the estimated coefficients of the model. The model yields several interesting results. First of all, the estimated CRRA degree of risk aversion equals 1.989, which is very similar to estimates for the United States (De Nardi et al., 2010). This implies that the Chinese saving pattern can be explained by a reasonable parameter value. It is not required that Chinese households be highly risk-averse to explain their high saving rates. My finding also reinforces the finding of Carroll et al. (1994) that culture does not play an important role

in saving behavior. Second, children are the most important source of bequest motives. In my estimate, I find that $\widehat{\theta}_1 > \widehat{\theta}_0$, implying that more than half of the bequest motives are explained by children. Note that in the identification, $\widehat{\theta}_0$ serves as a residual claimer in the model[12] meaning that if there is any other factor that affects saving decisions but that is not captured by the model, it will be incorporated into the estimate of θ_0. The fact that $\widehat{\theta}_0$ is not especially high implies that the model captures most important factors that may affect the saving rate.[13] Moreover, the estimated bequest curvature $\widehat{\kappa}$ is positive and statistically significant, implying that bequests are a luxury good in China. This finding is also consistent with the fact that richer households maintain higher saving rates on average (Dynan et al., 2004). Finally, the coefficients of the utility shifters are statistically insignificant. δ_1 is identified as the difference in consumption between healthy and unhealthy households, conditional on income and expenditures. The fact that $\widehat{\delta_1}$ is insignificant implies that the differences in income and expenditures between healthy and unhealthy households capture most of the difference in saving. The estimation of $\widehat{\delta_1}$ also verifies that deteriorating health status, which requires δ_1 to be negative, cannot explain the high saving rates of the elderly, as discussed in previous sections. δ_2 is identified as the change in consumption during the retirement period. The insignificance of $\widehat{\delta_2}$ implies that work-related expenditures and substitutions between leisure and consumption cannot explain the rise in saving rates on their own. [14]

[12]In the previous section, I argued that θ_0 is identified as the average saving rate across the life cycle.

[13]The ratio $\frac{\widehat{\theta}_1}{\widehat{\theta}_0+\widehat{\theta}_1}$ gives the estimate of the lower bound of the share that bequests account for. The lower bound assumes that the household has no bequest motives other than bequests for children. In reality, bequest motives can also exist for spouses, other relatives or charitable donations.

[14]In the United States, previous research has documented a puzzle known as the "retirement-savings puzzle" (Hammermesh, 1984; Hausman and Paquette, 1987; Bernheim, 1991). The life-cycle model predicts that there should be little change in consumption in the case of expected retirement. However, the data indicate that in the United States, consumption falls considerably during retirement. If this is also the case in China, then this drop in consumption can be mapped as an increase in saving. The explanation for the puzzle includes substitutions between leisure and consumption and work-related expenditures (Banks et al., 1998; Aguiar and Hurst, 2005).

Figure 2.4 - 2.6 presents the matching qualities for income, medical expenditures and consumption.[15] The model best matches the income profile. This result is expected because the income process is estimated separately and all information is drawn from the same dataset. Although medical expenditures are also estimated outside the model, the matching quality is not as good as that for income because some component of the medical expenditures is estimated based on another dataset: the CHNS instead of the CHIP. The simulated consumption also tracks the data well, although the model slightly overestimates the consumption of younger cohorts and underestimates the consumption of older cohorts.

Figure 2.7 presents the matching of saving rates in the 1995 and 2002 waves.[16] Because the data are cross-sectional, I also create a simulated cross-section, although the simulation model is based on the life cycle approach. Each point in the graph corresponds to the saving rate of a specific cohort at a specific age in the life cycle. The cross-sectional profile from the simulation is composed of the life-cycle profiles of six selected cohorts. The model successfully matches several important empirical facts. First of all, the simulation reproduces the trends in saving rates observed in 1995 and 2002. In 1995, the increase in saving rates after retirement was not prominent, whereas in 2002, saving rates increased quickly among older retirees. Second, the simulation captures the fact that in 2002, the saving rate was generally higher compared to that in 1995. However, although the model fits the saving rates for the older cohorts very well, the model also predicts that households should save at a lower rate compared with the data for households in their early 50s. This implies that some mechanisms that are not captured in the

In the model, this requires $\delta_2 < 0$.

[15] In practice, the moments match consumption patterns distinguished by education and health status separately. For presentation purposes, I collapse all information for a single cohort together. Because the cohort size is drawn directly from the data, there is no aggregation bias.

[16] According to the definition of the saving rate, the estimation bias predominantly originates from income, medical expenditures and consumption. Although interest income and asset income also affect saving rates, the effects of these types of income are limited because of their relatively small magnitude.

model may be important motives for saving by the middle-aged but not by the elderly.

Figures 2.8 and 2.9 plot the matching of moments for different types of households in the year 2002.[17] Overall, the matching results are similar to those for time-series variations. The model successfully reproduces the fact that better-educated households and healthy households maintain higher saving rates. However, the simulated difference between different education levels is smaller than that observed in the data and the simulated difference between different health status is larger. The remainder of the time-series variations and cross-sectional variations can be attributed to heterogeneous preferences, different expectations about the future and unobserved heterogenous shocks.

A final question is that of why older people save at a higher rate. The difference in saving rates between older households and younger households can be decomposed into the following effects: (1) older households are at a later stage of the life cycle (life cycle effect) and (2) older households belong to older cohorts (cohort effect). Therefore, is the cross-sectional pattern explained predominantly by the life cycle effect or the cohort effect? Figure 2.10 plots the life cycle saving rate of a selected cohort and compares it to the cross-sectional pattern. The graph indicates that older households save more predominantly because of the life cycle effect. The cohort effect, if anything, lowers the saving rates of the elderly. Because the estimated value of the bequest curvature κ is positive, the saving rate will be higher for richer households. In China, younger cohorts are richer in life cycle resources, meaning that they will maintain higher saving rates at a given stage of the life cycle if all else remains constant.

Previous graphs presented the quality of the matching of the moments used in the estimation procedures of the model. To test the power of the model, in Figure 2.11, I compare two groups that were not matched during estimation: government

[17]The results of the simulation for 1995 are similar.

and non-government employees. I generated the income profile, medical expenditure profile and initial conditions for government employees and non-government employees separately and performed the model simulation using the parameters estimated in Table 2.2. The model successfully predicts that government employees maintain higher saving rates compared with their non-government counterparts, although the discrepancy between the two groups indicated by the simulation underestimates that observed in the data. There are two reasons why government employees maintain higher saving rates. First, as suggested in Figure 1.8, government employees enjoy more generous pension plans, and higher pension income leads to higher saving. Second, government employees are better educated and healthier, which are characteristics associated with higher saving.

2.4 Counterfactual Simulations

In this section, I will first discuss the estimation results and the quality of the matching of the moments. Two sets of simulations are then presented. The first set of simulations tests the importance of factors that may affect saving rates. I also carry out policy simulations that change these factors. In previous sections, I introduce pension income, which, when combined with bequest motives and medical expenditures, may contribute to the high saving rates of the Chinese elderly. In the simulation, I hold other factors constant and alter the channels of interest one by one. The second set of simulations tests the importance of economic growth. The most important impact of economic growth in the model is that it will affect the income profile $f_c\left(t, E^i, h_t^i\right)$. I can estimate the importance of economic growth by modifying the income profile for each cohort.

2.4.1 Simulation 1 - Factors that Determine Saving Rates

The previous subsection demonstrated that the model can reproduce important empirical features of the data. The next task is to identify the driving force of the high observed saving rates. In the empirical sections, I presented evidence that high saving rates are related to pension income. However, even if there is an increase in pension income, saving will not increase if the household consumption also increases by a sufficient amount. I demonstrated that bequest motives and concerns for future medical expenditures may be potential explanations for why consumption does not increase commensurately with income. In this subsection, I use the model to run simulations that can help to understand the relative importance of these three factors.

Figure 2.1 and Figure 2.3 illustrate that in China, there is a sharp difference between life cycle profiles and cross-sectional profiles. Because of China's economic development and the fact that pensions are indexed to the average wage of current workers, pension income will continue to increase even after retirement. The cross-sectional profiles, however, predict lower incomes for the elderly because of the cohort effect. In the framework of the life cycle model, a household relies on the life cycle profile instead of cross-sectional profile to make current consumption decisions.

The predictions of the life cycle model differ greatly for increasing and decreasing income profiles. For a hump-shaped income profile, household income will decrease after retirement. Because households attempt to smooth consumption throughout the life cycle and wish consumption to remain relatively constant, consumption will tend to remain constant or decrease at a slower rate than income. Therefore, the saving rate will decrease or even become negative after retirement. By contrast, if income is increasing after retirement and the household still wishes to maintain a constant level of consumption, this will result in a positive and

increasing saving rate after retirement.

Figure 2.12 compares the original simulated cross-sectional profile with a case in which the cross-sectional profile is used instead of the life cycle profile to drive saving decisions. More specifically, instead of using $\left\{\overline{Y}^i_{t,c}\right\}_{t,c}$ for each cohort separately, I use $\left\{\overline{Y}^i_{t,1995-t}\right\}_t$, which means that the cross-sectional profile corresponding to 1995 is used for all cohorts. As discussed above, when the cohort effect is neglected and income is wrongly believed to decrease after retirement, the saving rate also tends to decrease and becomes close to zero after age 60.

Given the fact that pensions continue to grow after retirement contributes to the high saving rates of the Chinese elderly, a related policy question follows: what if pensions are indexed differently? Pension income in China grows quickly even after retirement because it is indexed to current workers' wages. What would happen if pensions are indexed to CPI instead, similar to many other countries around the world? Figure 2.12 also simulates an alternative policy that pension income is indexed to CPI instead of average worker's wages. Because all of the numbers used in this paper are in real terms, it is equivalent to simulate the case that household income ceases to increase after retirement. The simulation results show that in this case, the saving rates peak at the 55-60 age range and will begin to decrease afterward. The saving rates of the retirees would be lowered by $5\% - 10\%$ if pensions are indexed to CPI instead. Moreover, when pensions are indexed to CPI, the Chinese elderly would maintain a low saving rate compared to the middle-aged. The simulation results indicate that increasing pension income after retirement is crucial to explain the observations of positive and increasing saving rates after retirement.

However, pension income alone is not sufficient to guarantee a positive and increasing income profile after retirement, as confirmed by Figure 2.13. Figure 2.13 compares the original case with the case in which there are no children ($\theta_1 = 0$) and the case in which there is no bequest motive ($\theta_0 = \theta_1 = 0$). Figure 2.13 shows

that if there is no bequest motive, the saving rate will be negative, and there will be no strong increase in saving rates after retirement. The intuitive explanation for this result is that if there is no bequest motive, then the only reason to save is precautionary saving to prevent consumption from dropping. In China, however, because of the strong annual growth in income, even when income uncertainty and growth in medical expenditures are taken into account, the probability of net income (income minus medical expenditures) is unlikely to decrease. As a result, if there is no bequest motive, then households will simply consume their annual income. However, if a bequest motive exists, a household will tend to increase its consumption less rapidly than its income increases, thereby leaving a "triangle"[18] as a bequest. As expected, if there are no children in the household, saving will be significantly lower; in this case, the simulated difference is very similar to what is observed in the empirical data.

A related policy question with respect to bequest motives is the effect of the inheritance tax. At the moment, there is no inheritance tax in China. What would happen if China imposes a 50% inheritance tax, similar to the United States? Figure 2.13 presents the simulation results. As expected, the saving rates are lower with the existence of inheritance taxes. Old households aged above 60 lower their saving rates by approximately 4%. This magnitude, however, is not as large as expected. One explanation is that inheritance taxes have two effects on saving. The first is the substitution effect because with inheritance taxes, saving is also implicitly taxed, which discourage households from saving. The second is the income effect because children would receive smaller bequests in the case of the same amount saving because part of the inheritance is taxed away when parents die.

Finally, Figure 2.14 compares the original saving rate to a case with zero med-

[18]Figure A2.2 plots the life cycle income and expenditure of a specific cohort. It is observed that the growth in consumption falls short of the growth in income.

ical expenditures. Surprisingly, I find little effect of medical expenditures. If anything, medical expenditures suppress the saving of the elderly. This finding is contradictory to the results of studies conducted in the United States (DeNardi et al., 2010) and other studies conducted in China (Chamon and Prasad, 2010). In their paper, Chamon and Prasad (2010) have predominantly observed correlation instead of causality. They have noted that in recent years, the Chinese elderly have both incurred high medical expenditures and engaged in high saving. After performing a regression, they found a strong correlation between the two phenomena. However, as discussed in previous sections, there are two causal effects of medical expenditures on saving behavior. The first effect is the mechanical effect. Saving is defined as income minus expenditures; therefore, higher medical expenditures will mechanically reduce saving rates. Second is the precautionary effect. The current saving rate typically accounts for possibly high medical expenditures in the future, and such future medical expenditures have no mechanical effect on current saving and will therefore unambiguously increase current saving. The net causal effect depends on which effect is stronger. My results suggest that the mechanical effect dominates the precautionary effect.

Compared with the United States, there are several major empirical differences. First, although medical expenditures in China have grown considerably, they remain far below the corresponding level in the United States. In China, out-of-pocket medical expenditures account for only approximately 10% of disposable income for the elderly. In the United States, this value is greater than 100% (DeNardi et al., 2010). A second difference is that in China, the growth of medical expenditures is not very rapid for the extremely elderly. The CHNS is not a survey that is designed for the extremely elderly; therefore, the medical expenditure information it provides for those older than 65 is very noisy. However, the CHARLS data offer a broader coverage of older individuals. Based on CHARLS data, Figure A2.3 plots the medical expenditures of very elderly people in China.

Notably, medical expenditures exhibit the largest growth from approximately age 50 to age 65 and then remain fairly stable beyond that point. The share of medical expenditures with respect to disposable income increases only modestly after age 65. This observation is in sharp contrast with the empirical observations in the United States, where the growth in medical expenditures continues to increase with age. Differences in income levels and culture may help to explain this difference in medical expenditures.[19]

2.4.2 Simulation 2 - Economic Growth and Saving Rates

Numerous research studies have documented a positive correlation between economic growth and saving rates (Carroll and Weil, 1994; Paxson, 1996). Habit formation is one of the primary explanations for this correlation - income continues increasing, but consumption does not catch up with the growth in income. This paper reaches a similar conclusion. In the case of the Chinese elderly, their income continues to increase, but their consumption rises only modestly, resulting in higher saving rates as they age. This paper contributes to the previous literature in two respects. First, this paper demonstrates that bequest motives can contribute to habit formation and can help illustrate why the change in consumption is smaller than the change in income. Second, using a model, I can simulate saving rates for different growth rates. However, this model has limited power to predict the aggregate saving rate because the behavior of the youth is not sufficiently well-modeled.[20]

In this paper, I simulate two scenarios of economic slowdown: expected and

[19]According to CHARLS 2011, among individuals older than 60 who were sick in the previous month, only 13.49% visited the hospital. Among those who were sick and did not visit the hospital, 55.65% believed that the "illness was not serious" and that they did "not need treatment," and 6.09% claimed to be "poor."

[20]There are many factors that do not affect the saving decisions of the elderly but will strongly affect the saving behavior of the youth, such as housing, fertility and children's education. Further investigation is necessary to extend the model to younger households.

unexpected. In the first case, I investigate what the saving rate would have been if the Chinese economy had grown more slowly. Instead of the original income profile $\left\{\overline{Y}^{i}_{t,c}\right\}_{t,c}$ for all cohorts, I use a new income profile $\left\{\widetilde{Y}^{i}_{t,c}\right\}_{t,c}$, which satisfies

$$\begin{aligned}\widetilde{Y}^{i}_{1995-c,c} &= \overline{Y}^{i}_{1995-c,c} \\ \widetilde{Y}^{i}_{y-c,c} &= \frac{\Pi^{y}_{k=1995}\left(1+g^{k}_{new}\right)}{\Pi^{y}_{k=1995}\left(1+g^{k}_{old}\right)}\overline{Y}^{i}_{y-c,c} \text{ if } y > 1995\end{aligned}$$

In the second case, I test the household response in the case of an unexpected economic shock. Each household behaves as if it will maintain its life cycle income profile $\left\{\overline{Y}^{i}_{t,c}\right\}_{t,c}$. However, in year y, a permanent economic shock hits China, and future economic growth is reduced. Then, each household must solve a new optimization problem, given the initial conditions in year y and the new income profile.

Figure 2.15 plots the simulated profile for 2002 if the economic growth rate had been slower. An interesting observation is that as the economy slows down, the saving rate will begin to decrease instead of increase as retirees age. When the Chinese economic growth is halved (to approximately 5%), the saving rate remains constant from age 50 to age 65, and if the growth rate is further reduced to 1/4 of the original rate (to approximately 2.5%), the saving rates for the elderly begin to decrease. The simulation results suggest that Chinese economy growth is an important determinant of the level of elderly saving as well as the observation that the elderly save more than the middle-aged.

Figures 2.16 and 2.17 test the response of household saving rates in the case of an unexpected economic slowdown for households aged 50 and 60, respectively. There are several interesting observations. First of all, the decrease in saving rates is stronger in the long run. For a household aged 50, the saving rate actually increases by 10% compared with the original saving rate when the economic growth rate is decreased to 4%. Ten years later, the saving rate drops to 10%

less than the original rate. Second, the change in saving rates is very sensitive to the change in economic growth. Between the 6% scenario and the 4% scenario, although there is a difference in economic growth of only 2 percentage points, the difference in saving rates can be as high as 20 percentage points 15 years later. Finally, older households respond more strongly to changes in economic growth. When economic growth slows to 6%, households of age 50 exhibit only a modest response. The saving rate is only 5% lower 10 years later. However, that value is almost doubled for households of age 60. The intuition behind the simulation results is older households have less time to respond to a shock. They need to rapidly adjust their level of wealth within a short window of time.

The results presented above suggest that strong growth in pension income after retirement is necessary to maintain the high saving rates of the elderly. Therefore, policies that slow economic growth or directly reduce pension income (for example, causing pension income to no longer be indexed to the current wage) will immediately reduce the saving rates of the elderly.

2.5 Conclusion

The paper builds and estimates a dynamic life cycle that takes into account all relevant factors in order to quantitatively evaluate the effect of pensions on saving in China. With the model I am able to carry out various counterfactual analysis.

The counterfactual simulations of model have important policy implications. First of all, the pension mechanism that indexes the level of pensions to the average wage of current workers greatly contributes to the high saving rates of the elderly. Because the Chinese economy is growing quickly, indexing pensions to average wages results in a quick increase in pension income even after retirement for the elderly. The rise in pensions finally leads to an increase in saving rates. I simulated that if pensions are indexed to CPI instead of wages, the saving rates of the retirees

would decrease by $5\% - 10\%$, and saving rates would be lower after retirement. Secondly, bequest motives play an important role in China. Medical expenditures, in contrast, play a limited role because the level of medical expenditures in China is still quite low compared to that in the United States. These results suggest that policies related to inheritance (e.g., imposing an inheritance tax in China) will affect saving rates. Finally, the economic growth rate in China directly affects the saving rates of the elderly, as it alters the profile of pensions of the elderly. In the case of a slowdown of economic growth, the elderly will respond by decreasing their saving. Older households respond more strongly.

The paper has important theoretical implications as well. The paper shows the counter-intuitive observation that the elderly keep extremely high saving rates can be well explained with the life cycle framework with reasonable estimates of parameters. It is not necessary to assume Chinese have high degree of risk aversion in order to explain their high saving rates. Moreover, when applying the life cycle model in a fast-developing economy, it is important to distinguish between the life cycle profile and the cross-sectional profile, as these two profiles lead to vastly different predictions.

Appendix B - Estimation of the Income Process

The income process is assumed to be described as follows:

$$\log(Y^i_{t,c}) = \log(\overline{Y}^i_{t,c}) + e^i_t \tag{2.1}$$

The stochastic component e^i_t includes both permanent shock and temporary shock:

$$\begin{aligned} e^i_t &= u^i_t + \varepsilon^i_t \\ u^i_t &= \rho u^i_{t-1} + \epsilon^i_t \end{aligned}$$

where $\varepsilon^i_t \sim N(0, \sigma^2_\varepsilon)$ and $\epsilon^i_t \sim N(0, \sigma^2_\epsilon)$, and the two components are independent of each other.

To estimate σ^2_ε, σ^2_ϵ and ρ, I made two further assumptions: that the time-series process is stationary and that the stochastic process is the same for all processes. Under these assumptions, I can write the following equations:

$$var(e^i_t) = \sigma^2_\varepsilon + \frac{\sigma^2_\epsilon}{1-\rho^2} \tag{2.2}$$

$$cov(e^i_t, e^i_{t-1}) = \rho\frac{\sigma^2_\epsilon}{1-\rho^2} \tag{2.3}$$

$$cov(e^i_t, e^i_{t-2}) = \rho^2\frac{\sigma^2_\epsilon}{1-\rho^2} \tag{2.4}$$

First of all, I estimate equation (2.1) for each cohort; I then combine all residuals $\widehat{e}^i_t$ together. Using equation (2.3) and equation (2.4), I can estimate parameter ρ as follows:

$$\widehat{\rho} = \frac{\widehat{cov}(e^i_t, e^i_{t-2})}{\widehat{cov}(e^i_t, e^i_{t-1})}$$

Inserting $\widehat{\rho}$ into equation (2.3) yields

$$\widehat{\sigma}^2_\epsilon = \frac{1-\widehat{\rho}^2}{\widehat{\rho}}\widehat{cov}(e^i_t, e^i_{t-1})$$

Finally, insertion into equation (2.2) yields

$$\widehat{\sigma}_{\varepsilon}^{2} = \widehat{var}(e_t^i) - \frac{\widehat{\sigma}_{\epsilon}^{2}}{1 - \widehat{\rho}^{2}}$$

The standard errors of the estimated parameters can be obtained through bootstrapping.

Appendix C - Standard Errors of the Method of Simulated Moments

Assume that in the model, there are M parameters to be estimated. $\mathbf{\Theta}$ is an $M \times 1$ vector containing all parameters. There are J moments to be matched, and $\widetilde{\mathbf{\Phi}}(\mathbf{\Theta}_0) and \mathbf{\Phi}$ represent the moments simulated using parameters $\mathbf{\Theta}_0$ and the true moments, respectively. The moment condition is

$$E(\widetilde{\mathbf{\Phi}}(\mathbf{\Theta}_0) - \mathbf{\Phi}) = 0$$

Because $J > M$, this condition cannot be exactly identified; the MSM estimator can be defined as

$$\widehat{\mathbf{\Theta}}_{MSM} = \arg\min_{\mathbf{\Theta}}(\widetilde{\mathbf{\Phi}}(\mathbf{\Theta}) - \widehat{\mathbf{\Phi}})'\widehat{\mathbf{W}}(\widetilde{\mathbf{\Phi}}(\mathbf{\Theta}) - \widehat{\mathbf{\Phi}})$$

where $\widehat{\mathbf{\Phi}}$ is the sample analogue of the true moments and $\widehat{\mathbf{W}}$ is the estimated weighting matrix.

Obtaining the variance of $\widehat{\mathbf{\Phi}}$ is more complicated. Because not all parameters are estimated within the model, the above process will treat parameters that are estimated outside the model as known instead of unknown, resulting in the underestimation of the variance. Pakes and Pollard (1989) have stated that under certain regularity conditions, the asymptotic distribution of MSM estimators can be written as follows:

$$\sqrt{N}\left(\widehat{\mathbf{\Theta}}_{MSM} - \mathbf{\Theta}_0\right) \rightarrow N(0, \mathbf{\Omega})$$

where

$$\mathbf{\Omega} = \left(1 + \frac{N}{I}\right)(\mathbf{D'WD})^{-1}\mathbf{D'WSWD}(\mathbf{D'WD})^{-1}$$

N is the number of observations included in the data, and I is the number of

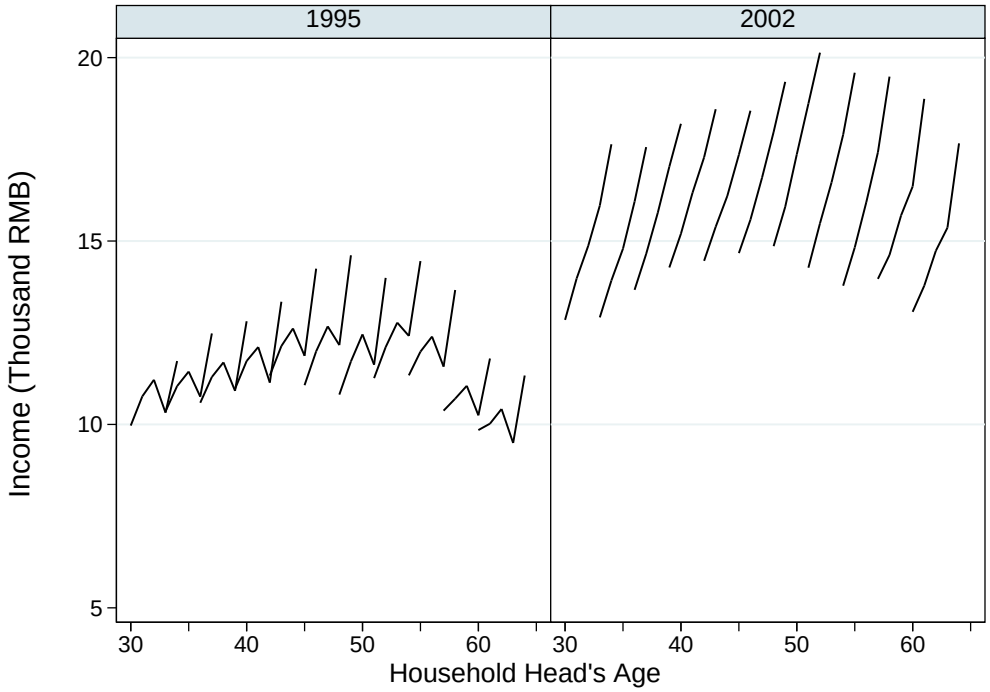
simulations. $\mathbf{S}$ is the $J \times J$ variance-covariance matrix of sample moment $\widehat{\Phi}$. $\mathbf{D}$ is the first-order derivative of the simulated moments with respect to the parameters,

$$\mathbf{D} = \frac{\partial \widetilde{\mathbf{\Phi}}\left(\mathbf{\Theta}_0\right)}{\partial \mathbf{\Theta}'}$$

An efficient estimator can be obtained by setting $\mathbf{W} = \mathbf{S}^{-1}$; $\mathbf{\Omega}$ will be simplified to $\left(1 + \frac{N}{I}\right)\left(\mathbf{D}'\mathbf{S}^{-1}\mathbf{D}\right)^{-1}$.

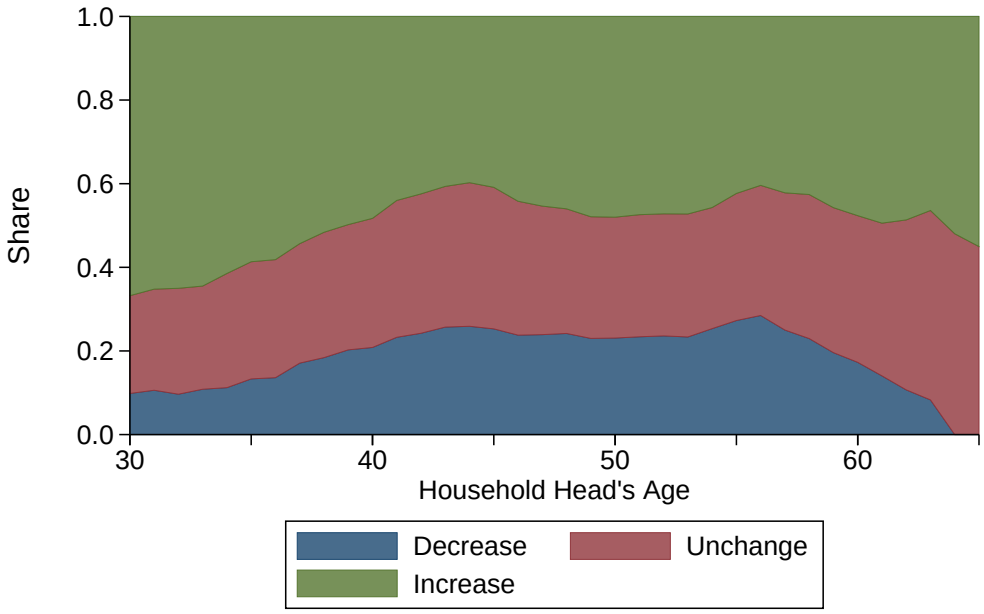
In practice, I set $\widehat{\mathbf{W}} = \mathbf{\Sigma}$, where the elements of $\mathbf{\Sigma}$ are equal to those of $\mathbf{S}^{-1}$ on the diagonal and equal to zero on the off-diagonal to overcome the potential small-sample bias, as suggested by Pischke (1995).

Figure 2.1: Life Cycle Profile of Income



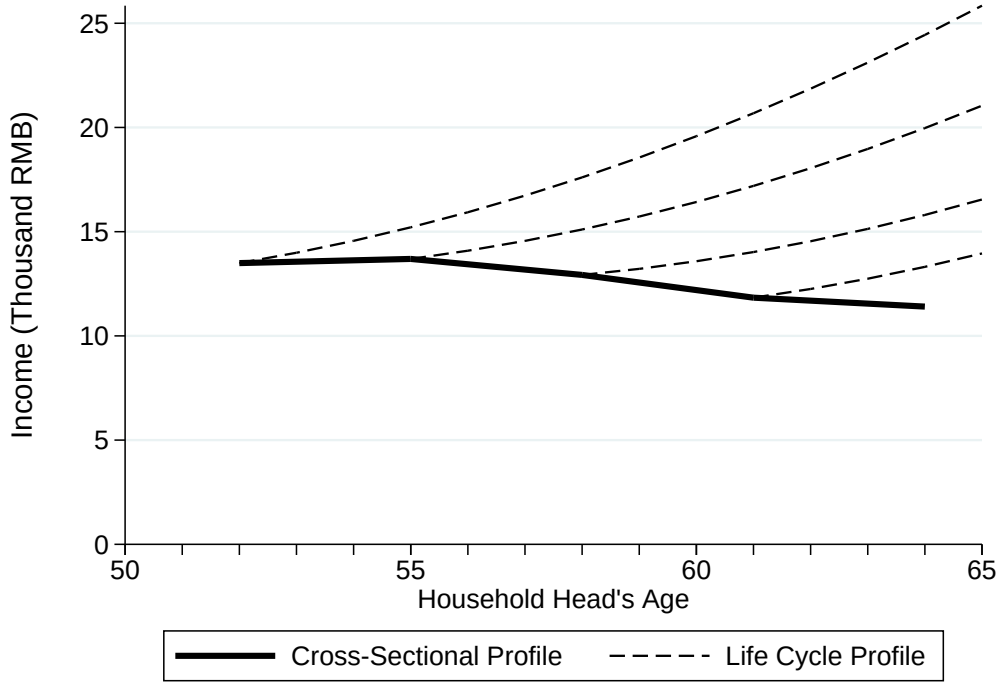
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.2: Expectation of Future Income Change (2002)



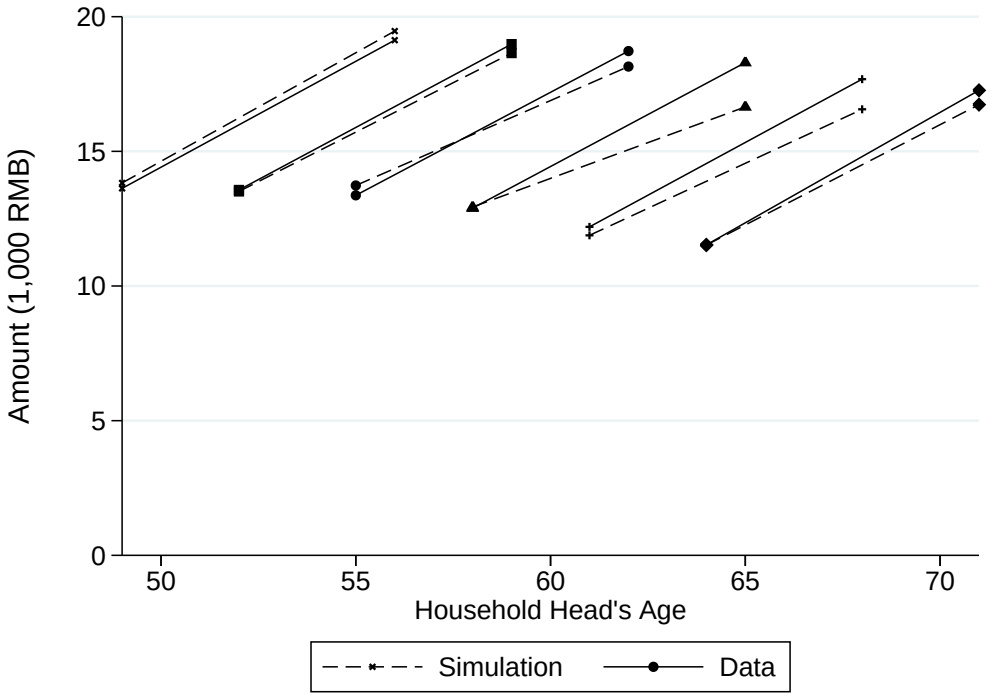
Source: Chinese Household Income Project, 2002.

Figure 2.3: Cross-Sectional Profile versus Predicted Life Cycle Profile of Income in Year 2002



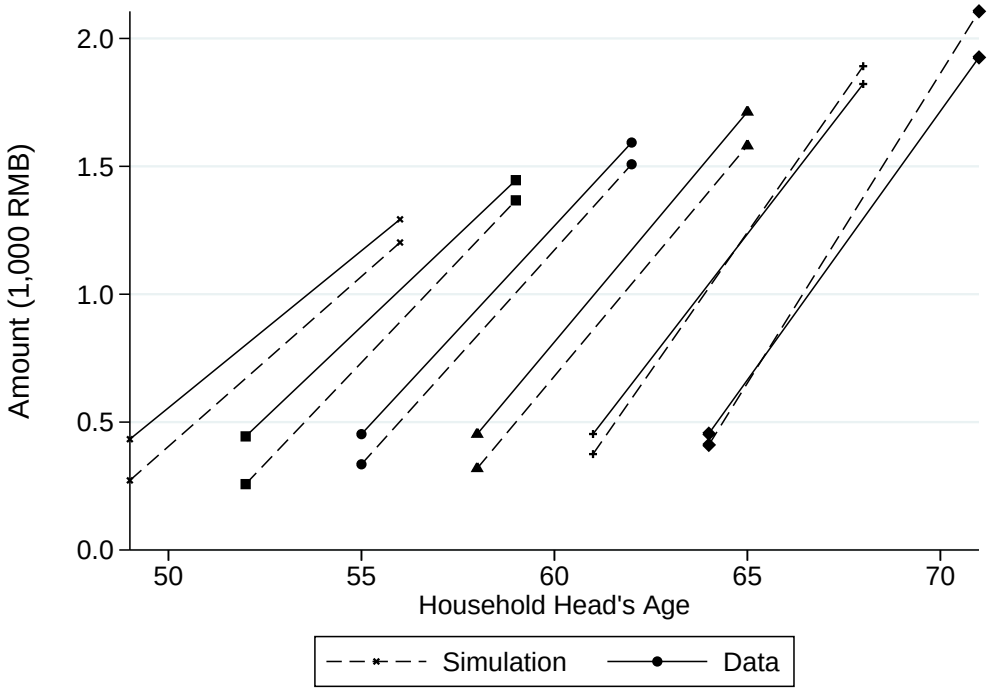
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.4: Match of Income



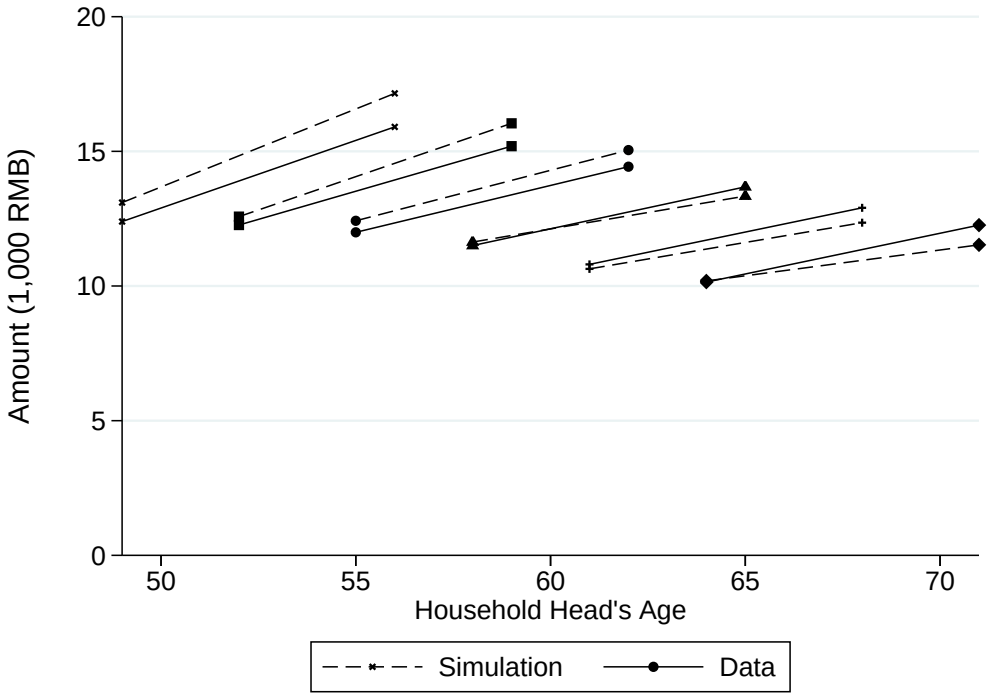
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.5: Match of Medical Expenditure



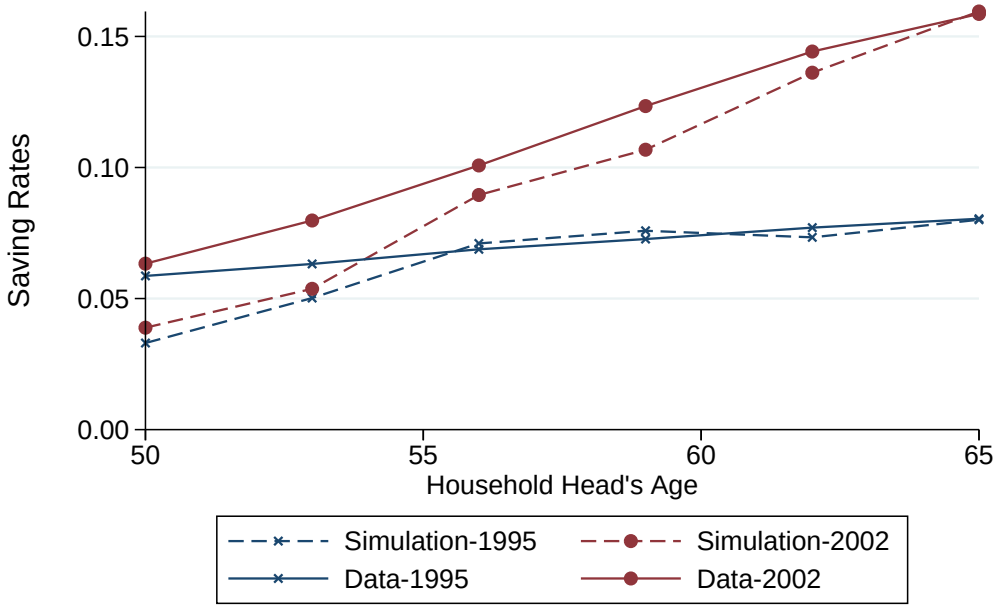
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.6: Match of Consumption



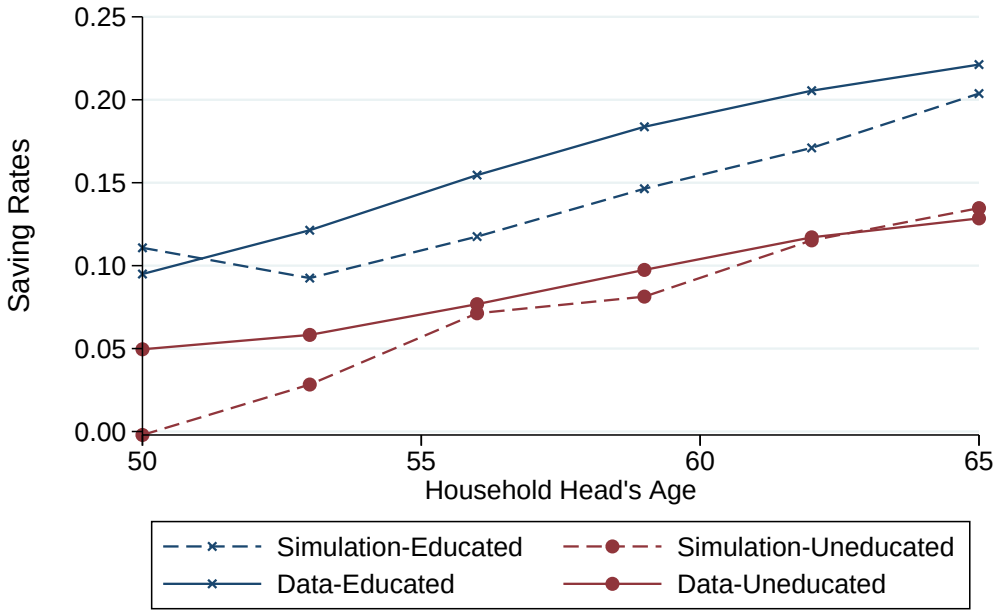
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.7: Match of Saving Rates for Different Waves



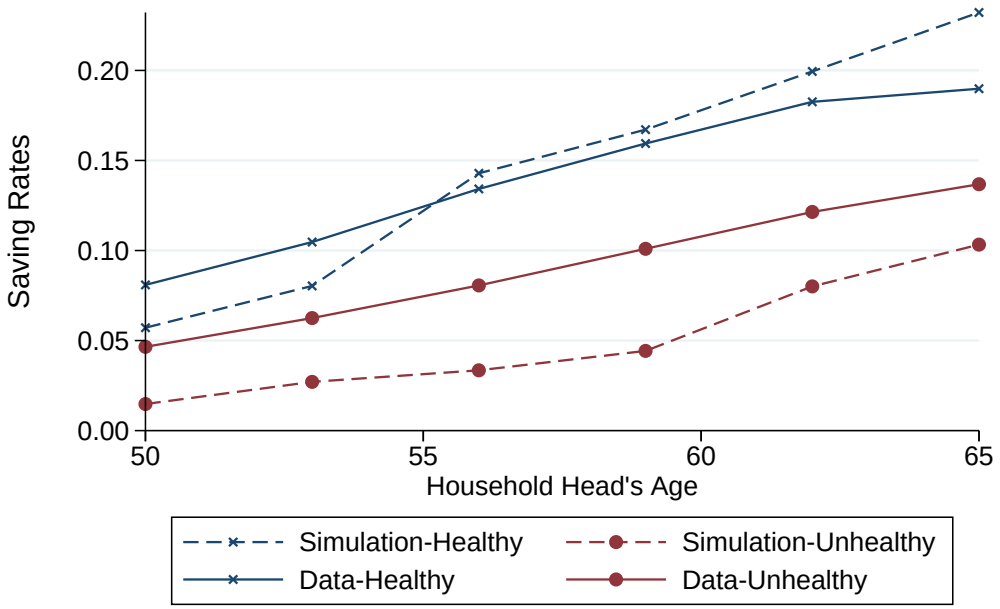
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.8: Match of Saving Rates for Different Education Level



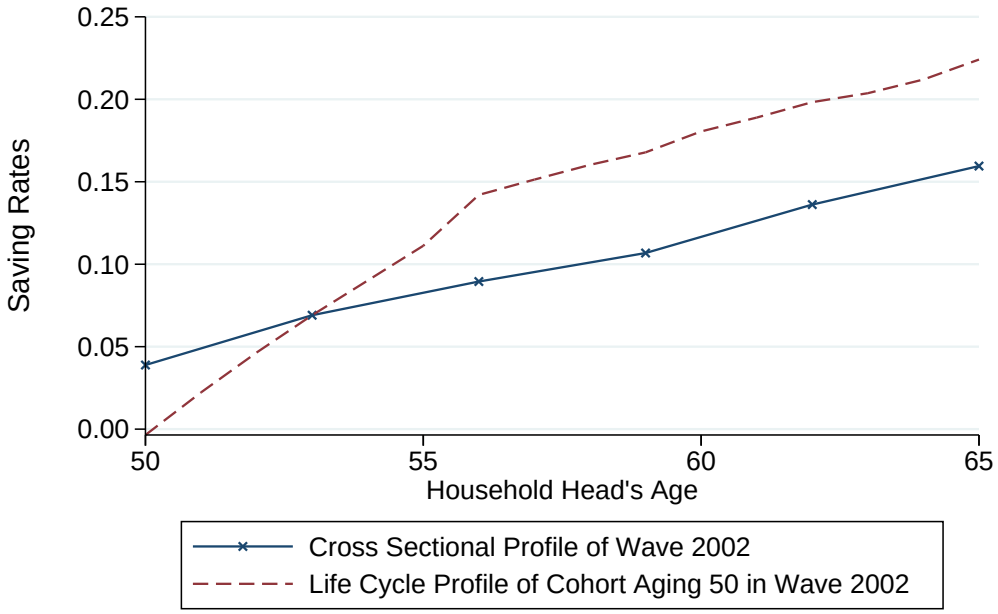
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.9: Match of Saving Rates for Different Health Status



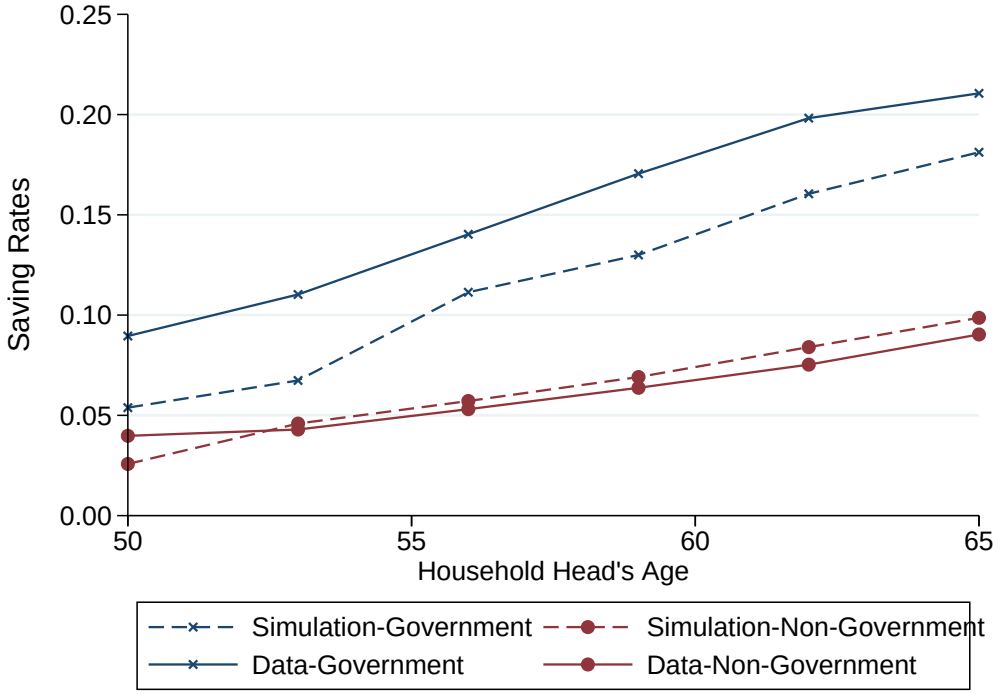
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.10: Comparing Life Cycle Profile and Cross Sectional Profile



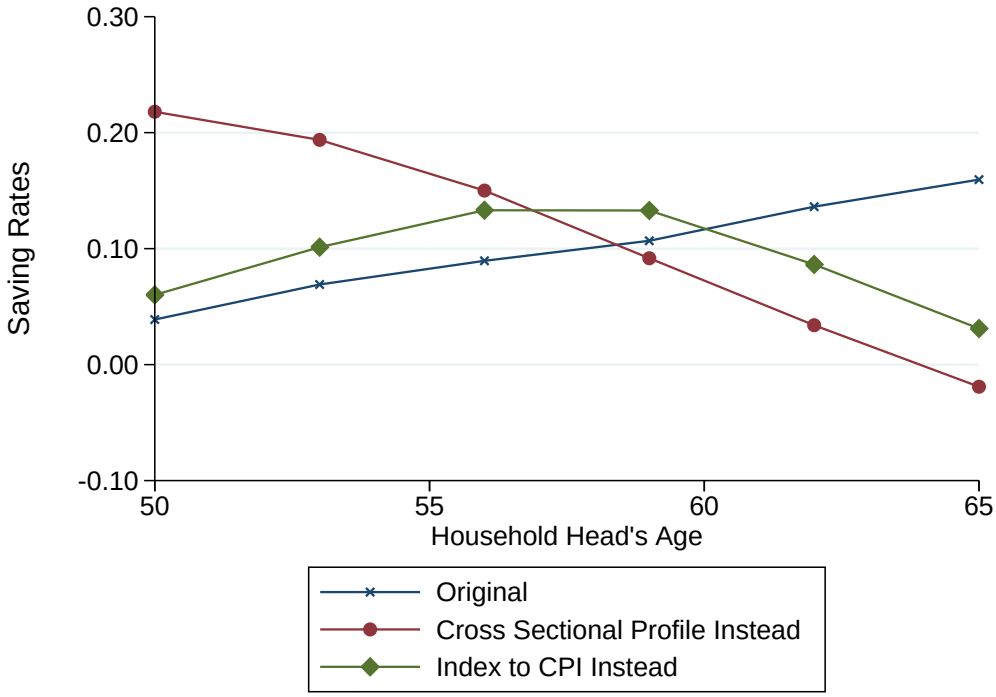
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.11: Match of Saving Rates for Different Employment Types



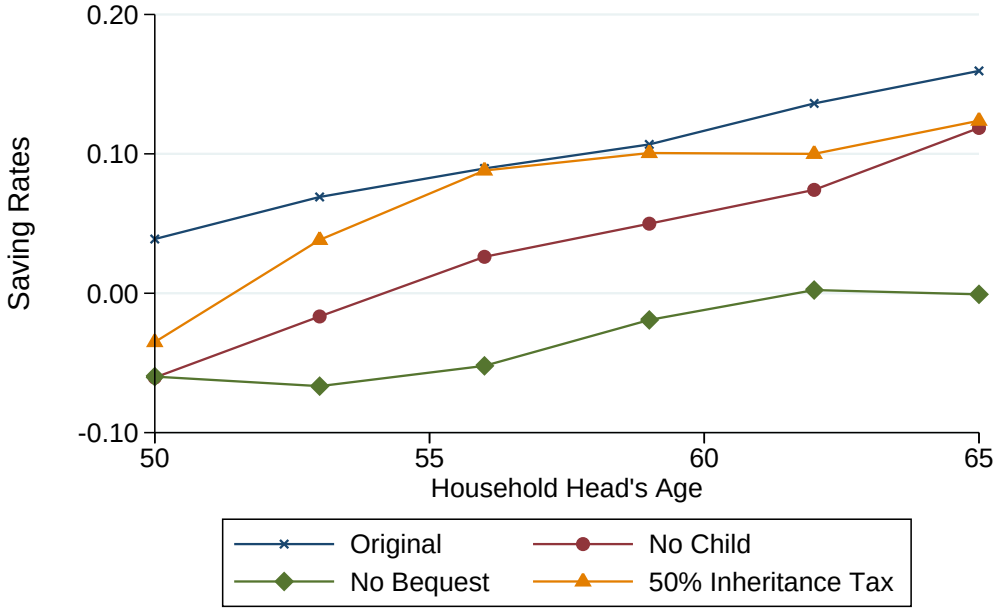
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.12: Experiment 1 - Effect of Pension



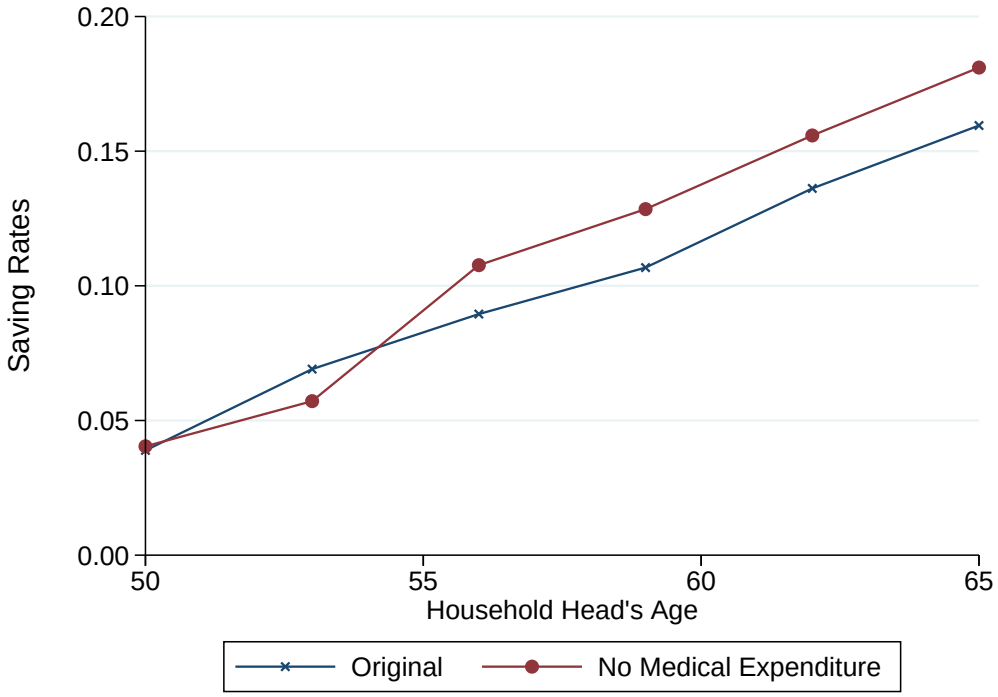
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.13: Experiment 2 - Effect of Bequest Motives



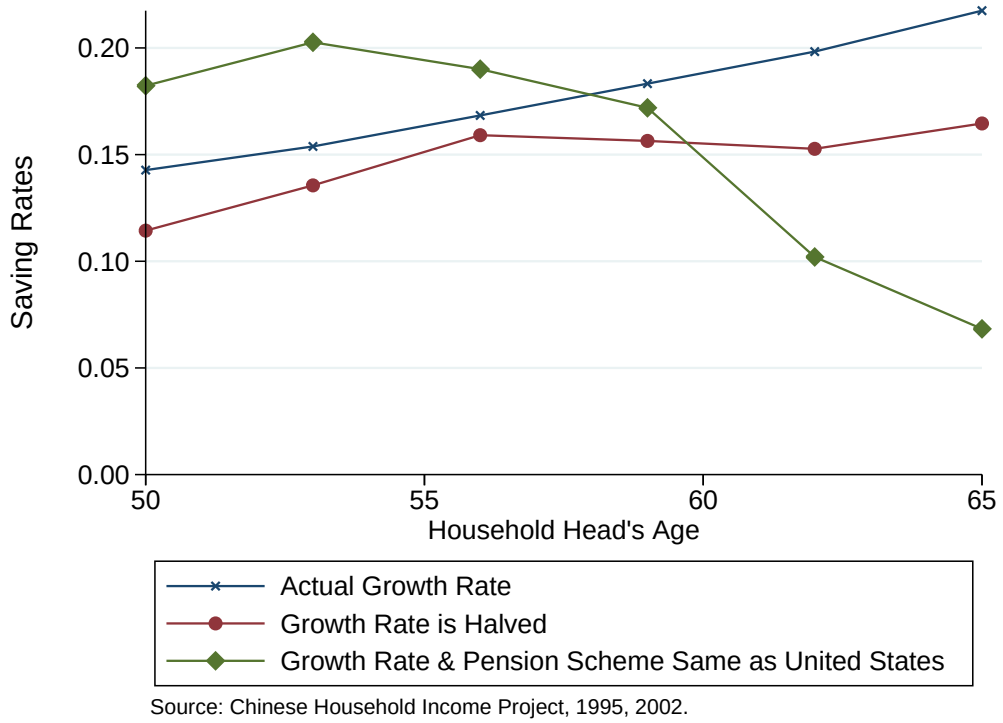
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.14: Experiment 3 - Effect of Medical Expenditures



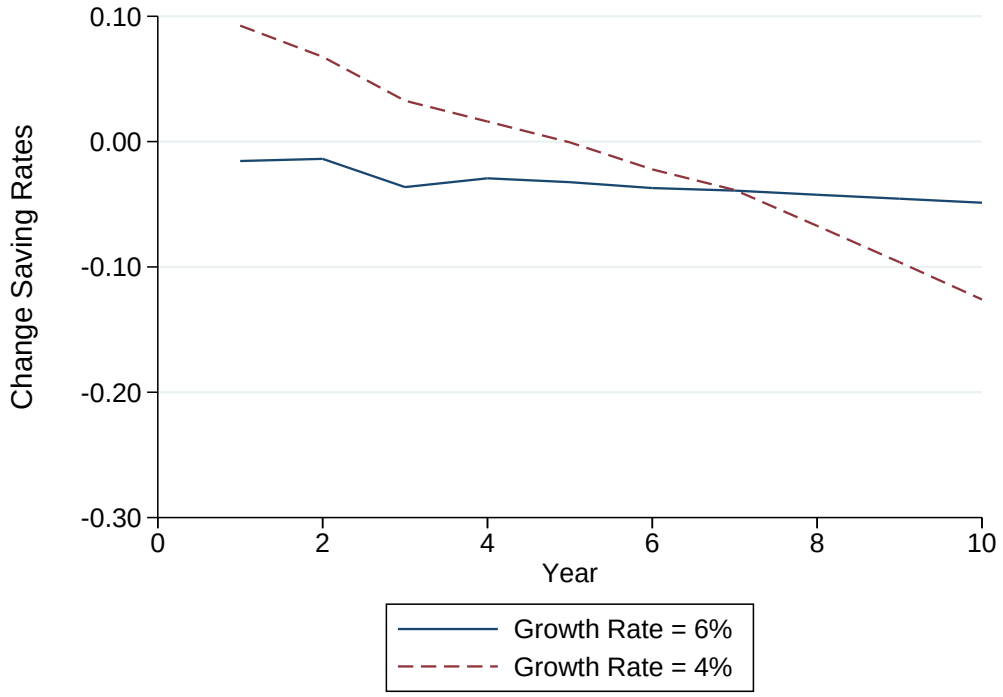
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.15: Simulation of Cross Sectional Saving Rate with Different Growth Rate



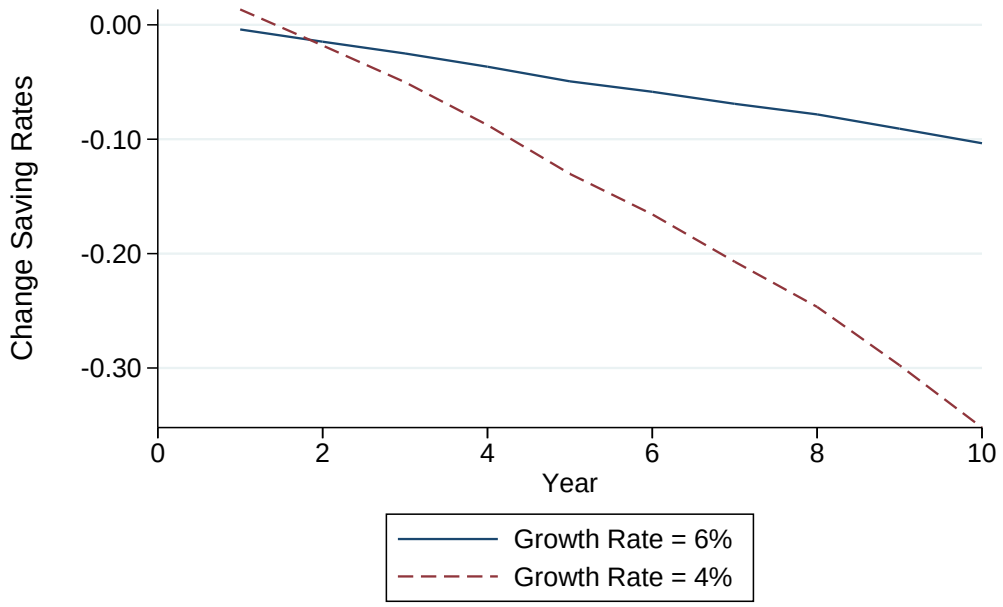
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.16: Response of a Slowdown in Economic Growth (Age = 50)



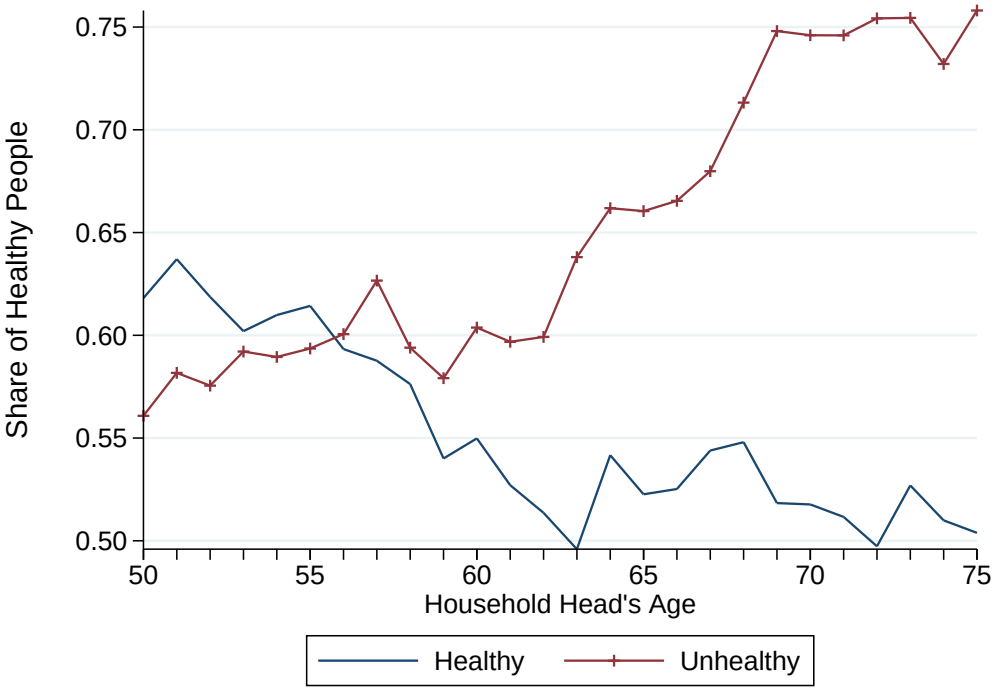
Source: Chinese Household Income Project, 1995, 2002.

Figure 2.17: Response of a Slowdown in Economic Growth (Age = 60)



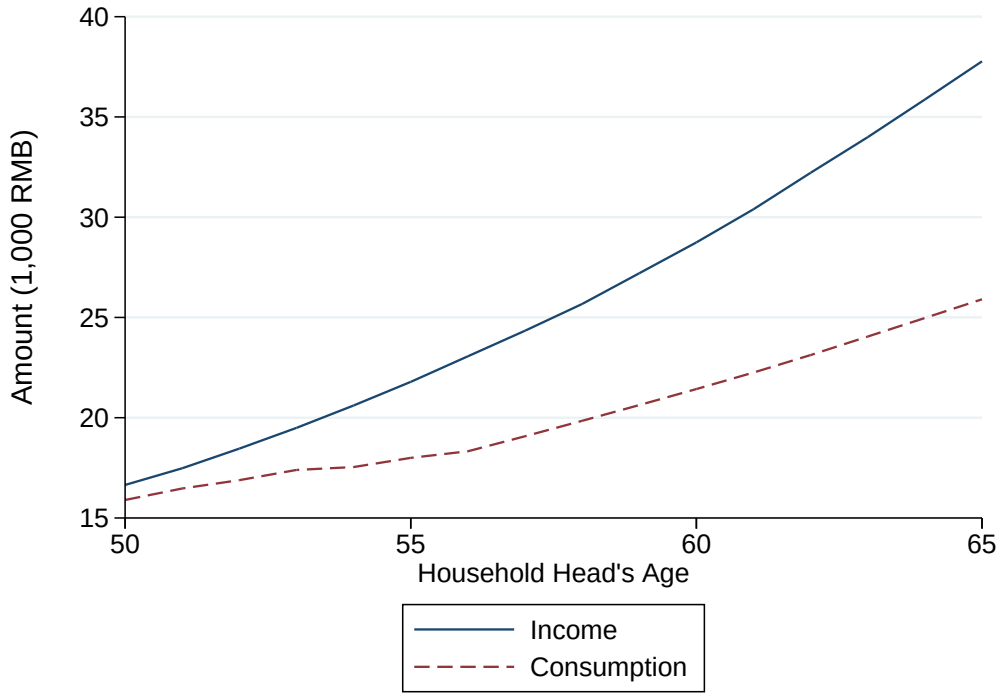
Source: Chinese Household Income Project, 1995, 2002.

Figure A2.1: The Probability Staying in the Same Health Condition



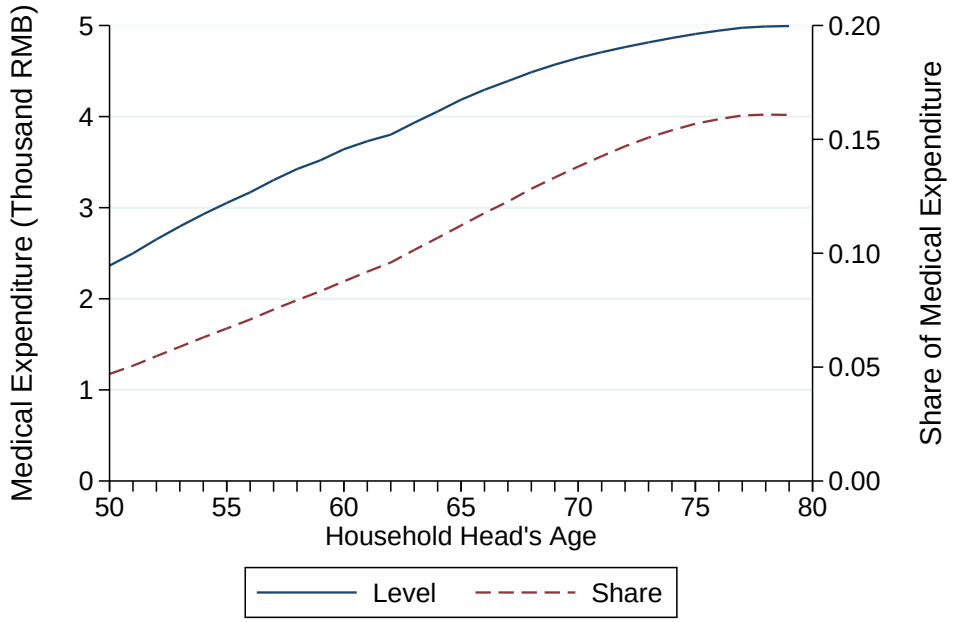
Source: Chinese Health and Nutrition Survey, 1997, 2000, 2004, 2006.

Figure A2.2: Comparing Life Cycle Profile of Income and Expenditure



Source: Chinese Household Income Project, 1995, 2002.

Figure A2.3: Medical Expenditure of the Very Elderly



Source: CHARLS, 2011.

Table 2.1: Estimation of Parameters in the Income Process

Parameters	Variable	Estimate (S.E.)
ρ	auto correlation, persistent component	0.8667 (0.0074)
σ_{ϵ}^2	innovation variance, persistent component	0.0451 (0.0028)
σ_{ε}^2	innovation variance, transitory component	0.0039 (0.0022)

Table 2.2: Estimation of Parameters in the Model Using the Method of Simulated Moments

Parameters	Variable	Estimate (S.E.)
θ_0	base bequest motive	97.24 (14.7648)
θ_1	additional bequest motive with children	126.8 (19.4594)
κ	bequest curvature	18.91 (3.1710)
ν	CRRA degree of risk aversion	1.989 (0.1934)
δ_1	preference shifter of health	-1.332 (1.5503)
δ_2	preference shifter of leisure	0.0996 (0.0864)
δ_3	preference shifter of interaction between health and leisure	0.1948 (0.1450)

CHAPTER 3

Explaining the Decline of the U.S. Saving Rate: the Role of Health Expenditure

3.1 Introduction

It is well-known that the U.S. personal saving rate declined from 9 percent in the early eighties to about 2 percent in 2007. Economists and policy-makers are concerned with this drop because it may signal an increased dependence on foreign investment and a future reduction in capital stock with negative consequences for labor productivity, wages, and national output. In the past twenty years economists have attempted to explain this sharp drop. An examination of the related literature indicates that the decline is still a puzzle. Parker (1999) states that "Each of the major current theories of the decline in the U.S. saving rate fails on its own to match significant aspects of the macroeconomic or household data". Guidolin and Jeunesse (2007) review a number of arguments and theories that have been proposed and conclude that "The recent decline of the U.S. private saving rate remains a puzzle".

The main contribution of this paper is to provide evidence that the increase in medical expenditure as a share of disposable income explains about 83 percent of the decline in the U.S. personal saving rate. We provide this evidence in three steps.

In the first step, we use a simple accounting exercise to provide evidence that the share of health expenditure on its own can explain most of the drop in the U.S.

saving rate that started at the beginning of the eighties. Papers in the literature have discarded health expenditure as a possible explanation for the decline in the U.S. saving rate because this variable has been growing since the early sixties. They therefore concluded that, if this variable was the main determinant of the drop, the saving rate should have started its decline in the sixties. In the paper we confirm the finding that health expenditure has been rising since the sixties. But we provide evidence that, in spite of this, medical expenses can be the main driver of the drop in the saving rate because of the following remarkable coincidence. From the early sixties to the end of the seventies, the employer contributions to pension and health funds increased as a fraction of income at the same rate as the share of health expenditure, therefore offsetting the negative effect of health expenditure on the saving rate. Starting from the early eighties, however, the share of employer contributions stopped increasing, whereas medical expenses continued to rise at the same rate. As a result, the saving rate began to decline at approximately the rate health expenditure was increasing.

To test whether medical expenses can explain on its own the decline in the saving rate, in the accounting exercise we consider a hypothetical situation in which health expenditure net of employer contributions remains constant as a fraction of disposable income for the entire period and compute the corresponding saving rate. If our variable is the main factor behind the drop in the saving rate, in this hypothetical exercise we should observe that the saving rate fluctuates around a constant rate from the sixties to today. When we plot the hypothetical saving rate, this is the pattern we observe therefore confirming our hypothesis. The main limitation of the accounting exercise is that it does not allow us to make the causal statement that the increase in medical expenditure has generated the drop in the U.S. saving rate. It only delivers a variable that has the potential of explaining this decline.

To address this issue, as a second step, we use cross-state variation in household

saving rates and health expenditure to provide a first set of results in support of a causal relationship between changes in medical expenses and saving rates. The state-level saving rates are constructed using as our main source of data a measure of retail sales, whereas state-level medical expenses are calculated employing the National Health Expenditure Accounts (NHEA). To evaluate the relationship between these two variables, we run a standard fixed-effect regression in which the state-level saving rate is our dependent variable and the state-level share of health expenditure is our main explanatory variable. This specification enables us to test whether states that experienced larger increases in medical expenses had more significant drops in their saving rate. If this is not the case, we can reject the hypothesis that changes in health expenditure caused the drop in the U.S. saving rate. We find that a 1 percentage point increase in the share of medical expenses is associated with a 0.64 percentage point decline in the saving rate. The main concern with our cross-state analysis is that there may be omitted variables that are correlated with both the saving rate and medical expenditure. In that case, our estimated coefficient will be affected by an omitted-variable bias that invalidates our causal interpretation.

To overcome this problem, in the third part of the paper we use as an arguably exogenous source of variation in medical expenditure the approval of new drugs by the Food and Drug Administration (FDA). The idea behind the choice of this instrument is straightforward. When a new drug is approved and made available to users, medical expenses will generally increase since consumers have a new product that can help treat medical conditions. The main limitation of this variable is that, in each time period, it is constant for the entire U.S., whereas in our analysis we need changes across states. To generate the required cross-state variation, we interact the FDA approval of new drugs with the demographic characteristics of a state. The constructed variables provide the needed variation, since the approval of a new drug produces larger increases in health expenditure in states with a

larger fraction of families that make extensive use of medical products. Using these variables as our instruments, we find that a 1 percentage point increase in health expenses generates a reduction in the saving rate of between 0.58 and 0.67 percentage points. Our instrumental variable results are therefore similar to our fixed-effect estimates, which suggest that the omitted-variable bias in our first set of results was negligible. Using these results and back of the envelope calculations, we conclude that about 83 percent of the drop in the U.S. saving rate is explained by the rise in health expenditure.

Our empirical results clearly indicate that the rise in medical expenses had a negative and significant effect on the the U.S. saving rate. However, from them it is difficult to establish whether households responded optimally to the rise in health expenditure by reducing the consumption of other goods. To address this issue, we develop a model of households' and government's decisions that enables us to evaluate the households' response. The model is characterized by the following features. First, the economy is populated by two overlapping generations. The young generation is composed of working-age households, whereas the old generation includes only retired households. Second, the altruism of the old generation toward the young one is sufficiently low. Third, only the young generation pays taxes. Fourth, the health technology evolves over time, with the newer technology being able to guarantee a higher level of health status but at a higher cost. Fifth, the government chooses which technology to adopt and how to fund it by maximizing a weighted average of the welfare of the two generations, where the weights represent their political power. Finally, preferences depend on non-durable consumption and health status and there is a limited degree of complementarity between these two goods. As a first result, we show that the government always selects the newer technology and chooses to fund the corresponding health costs by issuing debt. Using this result and our estimated coefficients, we then show that the households' response was negligible. We also find that, according to our

model, it was optimal for households not to respond to the rise in medical expenses because the increase had only minor effects on variables relevant for their consumption decisions.

With the objective of evaluating the main predictions of our model, in the last part of the paper we provide evidence on how the increase in medical expenses was funded. Our results indicate that it was financed almost exclusively by (i) an increase in government debt, (ii) a reduction in government expenditure on other items, and by (iii) a rise in employer contributions to health insurance funds. In particular, the increase in health costs was not paid by raising taxes. This findings are consistent with the main predictions of our model and suggests that it was optimal for households to respond to the increase in medical expenses with a negligible reduction in the consumption of other goods.

Our findings have important implications for policy analysis. They imply that there are two sets of policies that can be effective at reducing health expenditure and therefore at increasing the saving rate. The first set includes policies that attempt to raise the amount voters pay for health care. There are several ways this objective can be achieved. For instance, out-of-pocket expenses can be increased or the government can raise the taxes levied on the young generation. The second set is composed of policies designed to reduce the cost of health care. The most obvious one is a policy that requires health institutions to be more selective in the adoption of newer technologies. Both kinds of policies, however, are difficult to implement since voters will oppose them. As a consequence, politicians will have no incentive to put them into effect. These policies are problematic for an additional reason. The constant adoption of new health technologies that was responsible for a significant fraction of the increase in health expenditure had the positive effect of fostering a large number of discoveries and innovations in the health sector. An increase in the fraction of the health costs that are passed on to voters and the more frequent use of older technologies will most likely slow this

progress.

The rest of the paper proceeds as follows. The next section provides a brief discussion of related papers. In section 3, we describe the data sets and define the variables used in this paper. Section 4 uses an accounting exercise to show that most of the decline in the U.S. household saving rate can be explained by the rise in health expenditure. In section 5, we use cross-state variation to provide evidence on a causal relationship between health expenditure and saving rates. Section 6 develops a model to provide an economic interpretation of the estimation results. In section 7, we provide evidence on how the increase in health costs was funded. Section 8 concludes.

3.2 Related Papers

A large number of studies have analyzed the decline in the U.S. saving rate. In this section, we will discuss the papers with findings that are related to ours. For a thorough review of the literature see Browning and Lusardi (1996), Parker (1999), and Guidolin and Jeunesse (2007).

One of the first papers to address the decline in the U.S. saving rate is the work by Summers and Carroll (1987), where they study the change in the national and household saving rate from the fifties to 1986. Their main conclusion is that the decline in the private sector U.S. saving rate is real and not a result of measurement issue and that the most likely cause of the decline is the increase in expected income after retirement that has induces the younger cohorts to reduce the rate at which they save. In our paper, we only focus on the household saving rate which experienced most of its decline after 1986, the last year considered by Summers and Carroll.

The paper by Gokhale, Kotlikoff, and Sabelhaus (1996) is the first one to discuss the steep increase in health expenditure in the past 50 years and to suggest

a possible relationship with the drop in the saving rate. They report that medical consumption as a percentage of disposable income was 3.9 in the fifties, 5.2 in the sixties, 7.3 in the seventies, 10.1 in the eighties, and 12.8 in the early nineties. This pattern suggests that it is difficult for medical expenditure to explain the decline in the saving rate. Health expenses were already growing in the sixties and seventies, whereas the saving rate started its decline in the eighties. Probably for this reason, Gokhale, Kotlikoff, and Sabelhaus (1996) do not directly explore the effect of the increase in medical consumption on household saving. Instead, they use it mainly as a motivation for decomposing the changes in the saving rate in four components: the changes generated by variations in the intergenerational distribution of resources; the effects produced by changes in the cohort-specific consumption propensities; the changes produced by modifications in the rate of government spending; the effects of changes in demographics. The decomposition of the changes in the saving rate is based on a simple life-cycle model and relies on the assumptions implicit in it. Their results suggest that the decline in the saving rate is mainly a consequence of government redistribution of resources from the young generation with low propensities to consume to the old generation with higher propensities. Our results differ from theirs in several respects. First, we show that the sharp increase in health expenditure can explain on its own the decline in the U.S. saving rate if considered jointly with the evolution of employer contributions to pension and health funds. Second, we use exogenous variation in medical expenditure to provide evidence on the existence of a causal relationship between health expenses and saving rates. Third, we show that the expansion in health expenditure paid by some form of private health insurance is of the same order of magnitude as the increase experienced by Medicare. Our results therefore suggest that all generations are responsible for the drop in the saving rate.

Attanasio (1998) uses the Consumer Expenditure Survey (CEX) and synthetic cohorts to study the reduction in the U.S. saving rate for the period 1981-1991.

His main conclusion is that the decline was mostly generated by cohorts born between 1925 and 1939. In this paper we study a longer sample period and provide evidence that the U.S. saving rate continued to decline for another two decades. This suggests that many more cohorts are responsible for the observed pattern in saving rates.

In a related paper, Parker (1999) considers the main explanations given in the literature for the decline in the saving rate, namely the effect of asset value appreciations, durable goods, changes in the intergenerational distribution of resources, financial innovations, and changes in discount factors. He then evaluates whether these hypotheses are consistent with patterns observed in micro and macro data. He concludes that each of the main theories fails on its own to explain the decline in the saving rate since it cannot match significant aspects of aggregate and household data. In particular, he rejects the hypothesis that changes in the intergenerational distribution of resources, which include the increase in medical expenditure, can explain the decline for two reasons. First, the trends in the government redistribution of resources and the increase in health expenditure predate the drop in the saving rate. Second, the ratio of consumption to income increases for all generations and not only the old ones. Both conclusions are correct. Without considering the growth in the share of employer contributions during the sixties and seventies, health expenditure cannot explain the decline in the saving rate. Moreover, as argued above, health expenses increased for all generations.

In a paper that is contemporaneous to Parker's, Gale and Sabelhaus (1999) start from the observation that one may require different measures of aggregate savings to answer different economic questions. They then study the evolution of the U.S. saving rate using several measures of this aggregate variable. They first use the measure employed by the National Income and Product Accounts (NIPA). In this case, the pattern displayed by the saving rate is consistent with the findings of previous papers, which document a steep decline that starts in the

early eighties. They then consider an alternative measure that modifies the NIPA definition of the saving rate in a way that enables them to take into account the evolution of durable goods, retirement accounts, inflation, and tax accruals. Using this measure, the authors still report a decline in the saving rate but of a smaller magnitude. Gale and Sabelhaus consider also a third measure that adds capital gains. In this case, as one may expect, the saving rate at the end of the nineties was at the highest level in the last forty years. In our paper, we only consider the standard measure of aggregate savings provided by NIPA and we have nothing to say about the evolution of alternative measures.

The most recent survey we could find is the paper by Guidolin and Jeunesse (2007). The first part of the paper examines whether the decline in the U.S. saving rate is real or a simple statistical artifact generated by measurement issues. Since the decline is evident in all the standard measures considered in their paper, they conclude that it cannot be easily explained by measurement issues. In the second part of the paper, Guidolin and La Jeunesse review many of the theories that have been proposed and conclude that the drop in the saving rate is still a puzzle.

We conclude this section with one remark. In this paper, we do not make statements about the optimal saving rate for the U.S. economy. We do not argue that a saving rate of 2 percent is low or that a saving rate of 9 percent is optimal. We only provide an explanation for its decline in the past thirty years. For a discussion on the optimality of the current saving rate, one can read Scholz, Seshadri, and Khitatrakun (2006) and Lusardi, Skinner, and Venti (2001).

3.3 Data Description and Variable Definition

In this section we describe the main data sets used in the paper, which are the NIPA, the NHEA, the retail sale data prepared by the private company Claritas, the Current Population Survey (CPS), and the Survey of Epidemiology and End

Table 3.1: NIPA Data

Components of Personal Health Expenditures	
Item	Line in NIPA Table 2.4.5
Therapeutic appliances and equipment	line 21
Pharmaceutical and other medical products	line 40
Health care	line 60
Net health insurance	line 93
Other Variables	
Item	Line in NIPA Tables
Personal saving rate	line 34 in NIPA Table 2.1
Employer contributions for employee pension and health plans	line 7 in NIPA 2.1
Employer contributions for health plans	line 16 in NIPA Table 7.8
Personal taxes	line 25 in NIPA Table 2.1
Government current expenditures by function	various lines in NIPA Table 3.6

Results (SEER).

The NIPA are published by the Bureau of Economic Analysis and constitute the major source of aggregate data for the U.S. economy. We use annual data for the years 1960-2009, which is the period for which the second data set employed in the paper, the NHEA, has data available. All files were downloaded on 1/20/2012 from the BEA website (http://bea.gov/national/index.htm).

We construct our expenditure, income, and savings variables using data from Table 2.1, Personal Income and Its Disposition, and Table 2.4.5, Personal Consumption Expenditures by Function. Specifically, we compute health expenditure as the sum of the items in the NIPA Table 2.4.5, which are listed in the first part of Table 3.1. Other variables used in the analysis are defined in the second part of Table 3.1.

The NHEA have been published since 1964 by the Department of Health and Human Services. The NHEA provide not only a comprehensive measure of total spending on health care goods and services, but also a breakdown of the sources of funds that finance these expenditures. This level of detail is important because it allows us to determine how health expenses were funded and hence

Table 3.2: Definitions of Variables from NHEA

Item	Line in NHEA Data
Personal Health Care	line 104
Out of pocket expenditure	line 107
Health Institutions	line 104 minus line 107
Private Funds	line 106
Private Health Insurance	line 108
Public Funds	line 113
Gov't programs	line 146
Medicare	line 115
Medicare Part A	line 159 + 335 + 476
Medicare Part B, C, D	line 115 minus line above
Medicaid	line 118 and 135
Health insurance premiums paid by employers	NIPA Table 7.8, line 16
Health insurance premiums paid by households	NIPA Table 4.2.5, line 93

what was their effect on households' decisions. All NHEA files were downloaded on 1/20/2012 from the Centers for Medicare and Medicaid Services website (http://www.cms.hhs.gov). To make the NHEA data as comparable as possible to the NIPA health data, we use the Personal Health Care data from the NHEA which tracks the personal health expenditure measures in the NIPA remarkably well. Throughout the period 1960-2009, the ratio of the two health expenditure measures obtained using the NIPA and NHEA is between 0.94 - 1.06.[1] The variables that we use from the NHEA are defined in Table 3.2. The measure of total health expenditure reported by the NHEA is available yearly for the entire U.S. and also for each state separately.

Retail sales are one of the main inputs in the construction of the saving rate at the state level. We employ the most commonly used retail sale data which are prepared by the private company Claritas and can be found in the Survey of Buying Power published by the Sales & Marketing Management magazine. These data were first used by Asdrubali, Sorensen, and Yosha (1996) and subsequently in several other studies.

[1]The reconciliation project discussed in Sensenig and Wilcox (2001) shows that the NHEA data are generally compatible with the NIPA data.

Finally, we use the CPS to construct income at the state level for some industries and some ages to perform robustness checks and the SEER to compute population estimates.

3.4 Health Expenditure and the Evolution of the U.S. Saving Rate: an Accounting Exercise

In this section we provide evidence that the drop in the private saving rate that occurred over the past three decades can be explained by the evolution over this period of health expenditure. We document this finding in three steps. We first show that medical expenses grew as a share of disposable income at an approximately constant rate starting from the early sixties. We then provide evidence that, in spite of this, health expenditure can explain the decline in the saving rate because of the following coincidence. From the early sixties to the end of the seventies, the employer contributions to pension and health plans, which enter the saving rate through disposable income, increased as a fraction of income at the same rate as the share of medical expenses. As a result, during the sixties and seventies the rise in health expenditure had no effect on the saving rate since it was matched by a corresponding increase in employer contributions. Beginning from the early eighties, however, the employer contributions stopped growing. The rise in health expenditure was therefore transformed into a corresponding decline in the U.S. saving rate. Finally, we show that health expenditure can explain on its own the drop in the saving rate by considering a hypothetical situation in which health expenses and employer contributions are set equal to a constant fraction of household disposable income for the entire period.

We start by introducing the definition of the saving rate that is commonly

used in the savings literature:

$$r_t = \frac{\text{disposable income - total expenditure}}{\text{disposable income}}. \tag{3.1}$$

Using this measure, Figure 3.1 illustrates the evolution of the U.S. personal saving rate in the last fifty years. As many other papers have documented, during the sixties and seventies the saving rate in the household sector was approximately constant at around 9%. But in the early eighties it started to decline at a fast pace until in the second half of the last decade it reached the unusually low level of 2-3%. It is noteworthy the upward trend displayed by the U.S. saving rate during the recent recession. This increasing pattern is common to most economic downturns. It can be observed during the recessions that took place in the early eighties, during the downturn of the early nineties, and also during the recession that characterized the beginning of the new century. It is remarkable, however, that from the end of the recent recession the U.S. saving rate resumed its downward trend.

We will now document the evolution of health expenditure from the early sixties to the present. Gokhale, Kotlikoff, and Sabelhaus (1996) have provided evidence that health expenditure has increased at a steep rate during the period under consideration. Figure 3.2 confirms their finding by reporting the evolution of health expenditure as a fraction of income using data from NIPA and NHEA. It shows that health expenditure has been growing as a percentage of income at a steady rate since 1960.

As mentioned above, during the sixties and seventies the growth in the share of medical expenses was matched by a similar increase in the share of employer contributions to pension and health funds, therefore offsetting its effect on the saving rate. But starting in the eighties the share of employer contributions stopped growing. Figure 3.3 documents this pattern jointly with the evolution of the share

of health expenditure and of a new variable obtained by subtracting the share of employer contributions from medical expenses. The share of employer contributions clearly grew at the same rate as the share of medical costs until the end of the seventies. They then remain constant at around 9 percent of disposable income. As a consequence, the new variable we have constructed displays the pattern required to explain the decline in the saving rate. It was constant until the end of the seventies and grew at a steep rate since then.

To confirm this hypothesis, we perform a simple empirical exercise. We consider the evolution of the saving rate for a hypothetical situation in which health expenditure net of employer contributions is set equal to a constant fraction of income throughout the period. Without loss of generality, we consider the case in which the constant fraction is zero. If the increase in medical expenditure net of employer contributions is the main driver of the drop in the saving rate, in this hypothetical exercise we should observe that the saving rate fluctuates around a constant rate throughout the period. Figure 3.4, in which we report the share of health expenditure net of employer contribution, the actual saving rate, and the hypothetical saving rate, shows that this is the case. The hypothetical saving rate fluctuates around 12% for the entire period. This result confirms the hypothesis that the increase in health expenditure net of employer contributions can explain on its own the decline in the U.S. saving rate.

Before concluding this section it is important to make one remark about the hypothetical exercise just discussed. In the computation of the U.S. saving rate, NIPA includes Medicaid and Medicare expenses in total household expenditure as well as in disposable income. They are included in total expenditure as a measure of the consumption value derived by households from those expenses. They are included in disposable income because they represent government's social benefits to individuals. In addition, NIPA subtract from disposable income the following transfers from the private sector to the government used to pay for Medicaid and

Medicare expenses: the Medicare payroll tax paid by employees and the part of personal taxes that is used to pay for Medicare and Medicaid. NIPA treat differently the part of Medicare payroll tax that is paid by employers. Since it is considered a source of wage income, it is added to disposable income. Given the way NIPA construct the saving rate, the hypothetical exercise can be performed in two different ways. One alternative is to first subtract twice from disposable income the part of the Medicare payroll tax paid by employers: once to compensate for the fact that NIPA considers this part of the tax a source of disposable income, which disappears if health expenses are set to zero; and a second time to account for the fact that it is used as a source of funding for Medicaid and Medicare. Then, after all measurable sources of personal funding for Medicaid and Medicare have been accounted for in disposable income, one can perform the hypothetical exercise by setting the share of health expenditure in household expenditure equal to zero without changing the variable disposable income. Using this approach, one makes the implicit assumption that, if there is any source of funding that is not accounted for in disposable income, such as an increase in debt or a reduction of other public expenses, this part of funding will be returned to the household sector using tax credits or alternative forms of government subsidies.[2] An alternative way of implementing the hypothetical exercise is to first set equal to some constant the share of health expenses in household expenditure. Then, to set equal to the same constant the share of Medicaid and Medicare in household disposable income as well as the observed transfers from the private sector that the government uses to pay for Medicaid and Medicare expenses. This alternative is problematic because only a small fraction of the private sector's transfers allocated to Medicaid and Medicare payments is observed. Specifically, as we will describe in details in Section 3.7, the private sector transfers used to

[2]Since the Medicare payroll tax is a small fraction of disposable income (see Figure 3.17), the graph obtained using this approach but without subtracting twice the part of the Medicare payroll tax paid by employers is similar to the one presented in this section. That graph is reported in the Appendix as Figure A3.1.

pay for Medicare and Medicaid are composed of two parts: the Medicare payroll tax and personal taxes. The Medicare payroll tax is observed, but it is only a small percentage of the Medicaid and Medicare expenditure. For instance, in 2009 the Medicare payroll tax covered about one fifth of those expenses. The rest is paid using general personal taxes, reductions in other public expenses, and budget deficits, for which it is not observed the part that is allocated to funding Medicare and Medicaid. As a consequence, if one uses this alternative approach, only the share of the Medicare payroll tax can be set equal to the desired constant. In this case, the implicit assumption is that the personal taxes used to pay for Medicare and Medicaid are employed in alternative ways that do not benefit the household sector. The choice of one approach over the other depends on which assumption is believed to be more realistic. Since we have a slight preference for the first assumption, in this section we have use the first approach. For completeness, we have reported the main graph obtained using the alternative method in the Appendix in Figure A3.2. The results are similar. With the alternative approach, the increase in health expenditure can explain around 90 percent of the decline in the U.S. saving rate. In this case, the decline is explained only by the increase in health expenses paid by some form of private insurance and by the reduction in disposable income generated by setting the share of Medicaid and Medicare expenses equal to the desired constant .

In this section, we have provided evidence that the increase in health expenditure can explain on its own the decline in the personal saving rate that began in the eighties. The main limitation of the analysis performed here is that our findings are based on a simple accounting exercise. We believe that the accounting exercise is informative because it suggests a potential simple explanation for the puzzling decline in the U.S. saving rate. However, on its own it cannot be used to establish whether there is a causal relationship between the growth in health expenditure and the saving rate decline, i.e. whether a percentage increase in

health expenditure generates a drop in the saving rate. The reason for this is that we cannot rule out the existence of one or more variables that are correlated with both the saving rate and health expenditure and are the real drivers of the decline. To address this issue, in the next section we use cross-state variation to provide evidence on a possible causal relationship between our two main variables.

3.5 Health Expenditure and the Evolution of the U.S. Saving Rate: Cross-state Variation

The objective of this section is to understand whether there is a causal relationship between changes in health expenditure and changes in the saving rate. We will proceed in two steps. In the next subsection, we use variation across states in our two main variables to test whether the relationship is causal. Results obtained using cross-state variation may be affected by an omitted-variable bias. To address this potential problem, in the second subsection, we instrument the changes in health expenditure using as an arguably exogenous source of variation the FDA approval of new drugs interacted with demographic characteristics of a particular state.

An important point we want to stress is that, for reasons that will be clear in the next subsection, we can only perform the cross-state analysis for the sample period 1980-2009. The previous section made clear that from around 1980 the employer contributions to pension and health plans remained approximately constant as a fraction of disposable income. They had therefore at most a limited effect on the decline of the saving rate. For this reason in the rest of the paper we will only focus on the rise in the share of medical expenditure.

3.5.1 Changes in Health Expenditure Across States

The idea behind using cross-state variation to determine whether there is a causal relationship between health expenditure and the saving rate is straightforward. If there is a causal relationship, states that experience larger increases in health expenditure should display larger declines in their saving rate. If this is not the case, we can reject that the relationship is causal.

The implementation of this strategy requires the construction of saving rates at the state level. The computation of state-level saving rates requires knowledge of disposable income and total expenditure for each state. State-level disposable income can be easily measured, since data on this variable have been regularly published by NIPA since 1948. The computation of state-level total expenditure is more complicated since there is no readily available measure for this variable. To overcome this problem, we experimented with two different approaches. We first attempted to construct this variable by using micro-level data on household expenditure. Since the most reliable source of household-level expenditure in the U.S. is the Consumer Expenditure Survey (CEX), we employed this data set. There are two main issues with using the CEX to construct state-level expenditure. First, the sample size for most states is small, which makes this measure of expenditure imprecise and volatile. Second, a well-known fact in the savings literature is that changes in the aggregate U.S. saving rate obtained using the CEX differ in a significant way from the changes constructed using NIPA data.[3] Our analysis confirms this result and therefore disqualifies this first approach as a possible way of understanding the reasons behind the recent decline in the U.S. saving rate.

A second possible method for constructing state-level expenditure is to use retail sale data. Evidence has been provided that retail sale data approximate well

[3]See for instance Slesnick (2001), Garner et al. (2006), and Heathcote, Perri, and Violante (2010).

household expenditure at the aggregate level if one is interested in changes and not in levels.[4] Since in this section we exploit changes over time in savings rates, all we need is a state-level variable that, divided by disposable income, can replicate well the changes in the share of household expenditure. The retail sale data are, therefore, well suited for the construction of our variable. As mentioned in the data section, the retail sale data used in this paper are prepared by the private company Claritas and can be found in the Survey of Buying Power published by the Sales & Marketing Management magazine.

There are four main expenditure components that are missing from retail sale data: health expenditure, expenses related to renting a house, the rental value associated with owning a house, and expenditure on services. Unfortunately, there is no state-level measure of household expenditure on services. There exist, however, state-level measures for the other three components. We add them to retail sales to improve the ability of our measure to approximate household expenditure. Health expenditure at the state level can be constructed using data from the NHEA. The NHEA publishes two measures at the state level: by state of the provider of the health service and by residence of the consumer buying the health service. Since the data by residence are only available starting in 1991, we use as our main variable state-level health expenses by provider. The second expenditure component that is missing from retail sale data - expenses related to renting or buying a house - can be approximated using the state-level NIPA measure of housing services which is available as part of disposable income. For renters, it corresponds to the rent paid to the owner minus expenses related to housing services such as depreciation, maintenance and repairs, property taxes, and mortgage interest. For owners, it is constructed as the imputed rental value of the house minus the housing expenses described above. This state-level measure of expenditure of housing services is only an approximation of the true measure

[4]See for instance the detailed and careful discussion in Zhou (2010).

because depreciation, property taxes, and mortgage interest should be included in this measure. Notice that expenses from maintenance and repairs are correctly subtracted from our measure of housing expenses since they are already included in the retail sale data.

In Figures 3.5 and 3.6, we provide evidence on the ability of our measure of the share of household expenditure to approximate the variable constructed by NIPA for the U.S.. Since the NHEA started publishing health expenditure data in 1980 and the last year for which we have retail sale data is 2009, our expenditure measure covers the period 1980-2009. In Figure 3.5, we describe the ratio between the aggregate household expenditure obtained using our measure and using NIPA data. As expected, our measure is always below the variable constructed by NIPA. But, remarkably, the difference between the two measures is approximately constant during our sample period with a ratio that stays around 65% from 1980 to 2009. This result suggests that our measure should be able to approximate the changes in the share of household expenditure as measured by NIPA. To confirm this, in Figure 3.6 we plot the changes between t and $t+1$ for the NIPA saving rate and the corresponding changes computed using our measure. The graph indicates that our measure matches remarkably well the changes constructed using the NIPA data.[5]

We can now use cross-state variation to estimate the effect of a change in the share of health expenditure on the saving rate. In Figure 3.7, we report preliminary evidence on the relationship between state-level health expenditure and state-level saving rates by plotting these two variables for each state and time period. The first panel reports our two main variables in levels, whereas the second panel describes them using changes. In both panels, we also report a line obtained

[5]During our sample period, one data point is missing from the retail sale data. The reason for this is that until 2000 the survey recorded retail sale data for the previous calendar year. But starting from 2000, it began reporting retail sale data for the current year. The retail sale number for 1999 is therefore missing. As a consequence, when we use changes in the saving rate, two data points are missing.

by regressing the state-level saving rates on state-level health expenditure. The two scatter plots indicate that there is a negative relationship between saving rates and medical expenses both in levels and changes: states with higher levels of expenditure have lower saving rates; and states that experience larger increases in health expenditure display larger declines in their saving rate.

To provide more evidence, let s_t and $\bar{c}_t^h$ be, respectively, the saving rate and the share of health expenditure. Denote with f_t and f_s time and state fixed effects, and with $X_{t,s}$ a set of control variables that vary with time and state. We can then estimate the effect of changes in the share of health expenditure on changes in saving rates for the sample period 1980-2009 by using the following linear equation:

$$s_{t,s} = \alpha_0 + \alpha_1 \bar{c}_{t,s}^h + \alpha_2 X_{t,s} + f_t + f_s + \epsilon_{t,s}. \tag{3.2}$$

Standard theories indicate that saving decisions and therefore the saving rate depend on risk preferences, permanent income, and the degree of uncertainty faced by the individual. Variables that are constant over time such as risk preferences are already captured in equation (3.2) by the state fixed effects. To account for the time-varying variables that may affect the saving rate independently of health expenditure, we include in $X_{t,s}$ the following state-level variables. As proxies for the degree of uncertainty, we include the unemployment rate and the fraction of individuals with college or higher degree. As proxies for permanent income, we include the fraction of individuals with college or higher degree, the fraction of individuals between the ages of 30 and 60, the fraction older than 60, the fraction of African-americans, and the fraction of Hispanics.

Before presenting the results it is important to make two remarks. First, the fixed effect regression described by equation (3.2) uses the data variation described at the beginning of this subsection: it considers changes over time in health ex-

penses for different states and it relates them to the corresponding changes in saving rates. The coefficient of interest is given by α_1, which measures the percentage point change in the saving rate that corresponds to a one percentage point change in the share of health expenditure. We have also experimented with the following specification that uses changes in saving rates and health expenditure:

$$s_{t,s} - s_{t-1,s} = \alpha_1 \left(\bar{c}^h_{t,s} - \bar{c}^h_{t-1,s}\right) + \alpha_2 \left(X_{t,s} - X_{t-1,s}\right) + d_t + \epsilon_{t,s} - \epsilon_{t-1,s},$$

A known result is that the two specifications produce identical estimates if only two periods are considered. If the data set contains more than two periods, the results should be similar. We report the estimated coefficients of the regression that uses first differences in the Appendix.

As a second remark, notice that the share of health expenditure enters the right hand side of equation (3.2) as our main independent variable. At the same time, it also affects our dependent variable. To make this clear, let $\bar{c}_t$ be the share of household expenditure net of health expenses and observe that the saving rate can be written as follows:

$$s_t = 1 - \bar{c}_t - \bar{c}^h_t.$$

In spite of this, regression (3.2) does not simply captures a mechanical relationship between $\bar{c}^h_t$ on the right hand side and $\bar{c}^h_t$ inside the saving rate. To see this, observe that when there is an increase in the share of health expenses, consumers can choose to reduce the consumption of other goods if it is optimal for their saving rate to stay at a higher level. If this is the case in the data, the coefficient α_1 will be estimated to be lower than without a household response. Consumers may also choose to increase the consumption of goods that have some degree of complementarity with health expenses. If the increase is large enough, the coefficient α_1 will be estimated to be greater than with no reaction by households.

The results of the OLS regression are presented in Table 3.3. The parameter of

interest, α_1, is estimated to be equal to -0.643. This number implies that a 1 percentage point increase in the share of medical expenditure reduces the saving rate by 0.643 percentage points. The estimated coefficients on the control variables have the expected sign. An increase in the share of middle-aged individuals by a 1 percentage point increases the state saving rate by 0.93 percentage points. The same change in the share of Hispanics increases the saving rate by 0.40 percentage points. The unemployment rate has a positive effect at 0.41, which confirms our insight that it captures the degree of uncertainty in a given state and is consistent with the observation that saving rates increase during recessions. Finally, the share of individuals older than 60, the share of individuals with college or higher degree, and the share of African-americans have no significant effect on the dependent variable. The estimated coefficients obtained using first differences, which are reported in the Appendix, are slightly larger in magnitude, but have similar economic interpretation.

It is important to remark that it is difficult to infer directly from the size of the estimated coefficient α_1 whether households responded to the rise in health expenditure by reducing the consumption of other goods, since the NIPA definition of the saving rate includes several components that are affected differently by the increase in the share of health expenditure. For this reason, we postpone the discussion of this crucial issue to section 3.6, where we develop a model that enables us to understand which size the coefficient α_1 should have if there is no household's response and under what conditions households should react to the increase in medical expenses.

The results presented in this subsection confirm the negative relationship between saving rates and health expenditure suggested by our accounting exercise. There are, however, at least two reasons that prevent a causal interpretation of our OLS results, which are related to omitted variables. First, households tend to migrate to states where there are more employment opportunities and, con-

sequently, to state that have higher disposable income. In addition, most of the migration flows are driven by individuals with high education, who generally have lower medical expenses. If the propensity to save increases with income, these two patterns generate a negative correlation between saving rates and health expenses that could bias our OLS estimate of α_1 and make it more negative. If the propensity to save decreases with income, the correlation between our two main variables will be positive and the estimated α_1 could be biased toward zero. A second potential problem is related to adverse economic shocks that are state specific. Generally, negative shocks affect at the same time saving and health expenditure decisions. If these shocks create a negative correlation between our two main variables, the estimated OLS coefficient on medical expenses will be characterized by a negative bias. If they generate a positive correlation, our estimated coefficient will be biased toward zero. In the OLS regressions, we control for education and unemployment. The effect of migration and economic shocks should therefore be at least partially captured by those variables. However, there is always a possibility that those controls are not sufficient to completely eliminate the possible bias generated by migration decisions and economic shocks. To address this potential threat to a causal interpretation of the OLS estimates, in the next subsection we instrument state-level health expenditure using as an arguably exogenous source of variation the FDA approval of new drugs interacted with the demographic structure of the corresponding state.

3.5.2 Instrumental Variables Strategy

To overcome the endogeneity problem discussed in the previous subsection, we need a variable that is correlated with state-level health expenditure, but uncorrelated with the error term of equation (3.2). A good candidate for a variable that affects the state-level saving rate only through state-level health expenditure is the FDA approval of new drugs. This variable clearly affects health expenses,

since the approval of new drugs has generally a positive effect on them. In addition, it is arguably exogenous to changes in the saving rate after the variation in medical expenditure is taken into account.

We construct the variable FDA approval of new drugs using data that are publicly available from the FDA website.[6] There are two kinds of approvals: (i) approvals of new molecular entities and (ii) approvals of new drugs composed of old molecular entities.[7] Since new molecular entities are the most likely to increase medical expenditure, we first construct our approval variable using only the first category. We then check whether our results are robust to the inclusion of new drugs in the second group. Even when we include new products from the second group, we do not make use of drugs with a new manufacturer and new indications because they have insignificant effects on health spending. Our state-level health expenditure variable covers the period 1980-2009. We therefore construct our instrumental variable for the same sample period.

Figure 3.8 illustrates the number of new molecular entities approved each year during the period 1980-2009, which is the variation used in our analysis. For completeness, we also include in the figure the cumulative number approved up to a given year. Figure 3.9 displays the same two variables when we use the alternative definition of FDA approvals which includes all new drugs. The two figures show that there was a significant number of drugs that entered the market each year. If one focuses on new molecular entities, the lowest number was approved in 1980 when 9 new products entered the market, whereas the highest number was recorded in 1997 with 58 new molecular entities. For new drugs, the

[6]The data on drug approvals can be downloaded at http://www.fda.gov/Drugs/InformationOnDrugs/ucm079750.htm. These data were first used by Lichtenberg and Virabhak (2007) as one of the inputs to estimate the effect of drugs approved in different years on post-treatment health. Acemoglu and Linn (2004) also employ those data as one of the variables used to construct market size.

[7]The second category includes drugs having as ingredients new ester, new salt, or other noncovalent derivative, drugs with a new formulation, drugs with a new combination of old molecular entities, drugs with a new manufacturer, and drugs with new indications.

minimum was recorded in 1983 at 33 and the maximum in 1997 at 137.

The main limitation of our instrumental variable is that it does not vary across states. Notice, however, that the federal approval of new drugs has different effects on local economies depending on their demographic structure. Everything else equal, states with a larger fraction of older individuals should see a steeper increase in medical expenditure after the approval of a particular drug, since older people tend to have higher demand for medical products. Similarly, states with a higher fraction of college graduates should experience a smaller increase in health expenses if more educated individuals are healthier and, hence, spend less on medical consumption. Using this insight, we construct four state-level instruments by interacting the FDA cumulative approval of new drugs with the following state-level variables: the fraction of individuals that are older than 60; the fraction of individuals with college or higher degree; the fraction of African-americans; and the fraction of Hispanics. Since those four variables are included in the vector of controls $X_{t,s}$, it is straightforward to show that, if the variable FDA approval is uncorrelated with the error term of equation (3.2) conditional on $X_{t,s}$, the four variables we propose as instruments are also uncorrelated with the error term.[8]

The set of instruments we have described is simple to construct and makes intuitive sense. Its explanatory power, however, could be improved by using the following idea. New drugs are generally targeted to individuals of particular ages. Some new drugs are mostly sold to older individuals, whereas other new drugs are designed for younger populations. As a consequence, if we can isolate the new

[8]To see this, denote with Z the variable FDA approval and with W_j, $j = 1, ..., 4$, the four state-level variables mentioned above. Then, by the law of iterated expectations and $W^j \in X$, $j = 1, ..., 4$, if $E[\epsilon Z | X] = 0$ we have,

$$E\left[\epsilon Z W^j\right] = E\left[W^j E\left[\epsilon Z | X\right]\right] = 0.$$

Hence, if this condition is satisfied, our instruments ZW^j, $j = 1, ..., 4$, fulfill the exclusion restriction.

drugs that are developed for a particular age group, we may be able to increase the explanatory power of our age-based instrument by interacting new drugs approved for a particular age group with the corresponding fraction of individuals in that age bracket. To identify the new drugs for individuals in different age groups, we first construct three age groups: individuals older than 60, individuals between the ages of 30 and 60, and individuals younger than 30. We then use the Medical Expenditure Panel Survey (MEPS) to determine the amount spent by a particular age group on a new drug. Finally, we assign a newly approved drug to a particular age group if the expenditure of this age group on the drug is at least 20% higher than for the other groups. A new set of instruments can then be constructed by replacing the FDA approvals interacted with the fraction of individuals older than 60 with the following two new instruments: the approval of a new drug designed for individuals older than 60 interacted with the fraction of the population in a state in that age group; the same interaction for individuals between the ages of 30 to 60.[9] We will present the results obtained using both sets of instruments.

To obtain the instrumental variable estimates we use a standard approach. In the first stage, we estimate the equation that relates the share of health expenditure to FDA approvals interacted with state-level variables:

$$\bar{c}^h_{t,s} = \delta_0 + \sum_j \delta_j Z_t W^j_{t,s} + \beta X_{t,s} + g_t + g_s + \eta_{t,s},$$

where g_t and g_s are time and state fixed effects. In the second stage, we estimate equation (3.2) with the share of health expenditure, $\bar{c}^h_{t,s}$, instrumented using the estimates from the first stage. As for the OLS regressions, we have also estimated the parameters using first differences. The estimates obtained using this specification are reported in the Appendix.

The results of the first stage regressions are reported in Table 3.6. As men-

[9]We do not include the approval of new drugs for individuals younger than 30 interacted with their fraction in a state because there are too few approvals for this age group.

tioned above, we consider four different specifications. In the first column, we report the results obtained using only approvals of new molecular entities interacted with the state-level variables. The coefficient estimates, which are for 100 approvals, have the expected sign. The cumulative number of approvals interacted with the fraction of old people has a strong and positive effect on the share of medical expenditure in that state. The approval of 100 new molecular entities increases the share of health expenditure in a given state by 0.043 percentage points relative to a state with a one percentage point lower fraction of older individuals. As expected, the effect of education is negative and statistically significant at -0.027. This means that the approval of new molecular entities in states with a larger fraction of individuals with college or higher degree has a smaller effect than in other states. The fraction of African-americans and Hispanics have a positive and statistically significant effect on the share of medical consumption. The approval of 100 new molecular entities increases the share of health expenditure in a state with a given fraction of Blacks by 0.004 percentage points relative to a state that has a fraction of African-americans that is 1 percentage point lower. For Hispanics, this percentage is 0.005. In the second column, we present the results generated by the second set of instruments which uses approvals for specific age groups for the age-based instruments. The sign of the coefficients and their statistical significance remains the same. But their size increases for the age-based instruments. In this case, the approval of 100 new drugs for older individuals increases the share of health expenditure by 0.13 percentage points in a state with a 1 percentage point higher fraction of older individuals. The coefficient for the middle-aged population is 0.04 percentage points but not statistically significant. In the third and fourth columns, we report the results when we use the approvals of all drugs. The coefficients are generally smaller, but their sign and statistical significance does not change. The F-test to evaluate the strength of the instruments is large in all our specifications, with the smallest statistic at 76.74 and the

highest at 98.92.

The second stage results for our four specifications are reported in Table 3.7. The effect of the share of health expenditure on the saving rate is similar in our four specifications and also similar to the effect estimated using OLS. The coefficient α_1 is estimated to be between -0.674 in the first specification and -0.580 in the last specification. These results suggest that, after controlling for demographic differences, the bias in our OLS estimates is small. The estimated coefficients obtained using the first difference specification are similar and reported in the Appendix. As mentioned for the OLS estimates, we postpone the discussion on the economic signficance of the coefficient estimates for α_1 to the model section.

There exists a potential threat to our IV strategy. If pharmaceutical companies have their headquarters and manufacturing plants in some states but not in others, the approval of new drugs may have a direct effect on state-level saving rates, even after controlling for health expenditure, through the following channel. The approval of new drugs may increase employment and income relatively more in states where the headquarter and factories of the pharmaceutical company with the new drug are located. If the propensity to save depends on income, the rise in employment and income will change the saving rate of that state relative to others introducing a bias in our analysis. To address this issue we proceed in two steps. First, we evaluate how serious such a threat can be by documenting the share of workers in the pharmaceutical industry in the US and the share of US GDP generated by that industry. The idea behind the first step is that, if those shares are small, it is unlikely that our IV results are affected by the changes in employment and income generated by the pharmaceutical industry. According to the CPS, from 1980 to 2010, the share of workers employed in that industry fluctuated between 0.15% to 0.34%. In 2010, the share of GDP generated by the pharmaceutical industry was 0.63%. In previous years, it was of similar magnitude. These numbers suggest that the impact of this industry on state level

employment and income should be small. As a consequence, it is unlikely that it generates significant biases in our IV estimates. However, even if unlikely, it is still possible that the shares are small at the national level, but the differences across states are sufficiently large to introduce a significant bias in our estimates. To evaluate this possibility, in the second step we use the CPS to measure the share of workers employed by the pharmaceutical industry in each state. We then re-estimate the IV coefficients after having added this variable to the set of controls. If the approval of a new drug has a direct effect on the state-level saving rate through an increase in employment and income generated by the pharmaceutical industry, the state-level share of workers in that industry is an omitted variable and should therefore have a significant effect on the state-level saving rate. The results for the IV regressions are presented in Tables 3.6 and 3.7. As expected, the coefficient on the state-level share of workers in the pharmaceutical industry is small and statistically insignificant and the coefficient on the share of medical expenditure has barely changed.

We can now use the estimated coefficient on health expenditure and back of the envelope calculations to compute the fraction of the decline in U.S. saving rate that can be explained by the rise in health expenditure. From the beginning of the eighties, the share of medical expenses has increased by about 9 percentage points. If we use the coefficient on health expenses estimated by OLS, which is between the highest and lowest estimates obtained with IV, a 9 percentage point increase in medical costs translates in a decline in the saving rate of about 5.8 percentage points (0.643×9). From the eighties, the personal saving rate dropped from around 9 percent to around 2 percent, a 7 percentage point decline. The rise in health expenditure is therefore able to explain about 82.9 percent of the decline in the U.S. saving rate ($100 \times 5.8\,/7$).

The main finding of the last two sections is that the steep rise in medical expenses had a negative and strong effect on the U.S. saving rate. It is difficult,

however, to provide an economic interpretation of this finding without a well-defined model of households decisions. The next section develops such a model and uses it to understand our empirical results.

3.6 A Model of Savings and Health Expenditure

The main objective of this section is to develop a simple model that, jointly with the empirical results of the previous section, can help us understand whether households changed their consumption decisions in response to the rise in medical expenditure and whether their reaction was rational.

Consider an economy populated by two overlapping generations, a young and an old one, which are governed by an infinitely-lived government. The young generation is composed of working-age individuals, whereas the old generation includes retired individuals. Each generation lives for two periods, has a discount factor β, and preferences over a standard non-durable consumption good c and the current health status h. The corresponding utility function takes the form $u(c,h)$. We make the assumption that preferences are strongly separable between consumption and health status, i.e. $u(c,h) = v_1(c) + v_2(h)$. The objective of each generation is to maximize its life-time utility. We assume that there is no altruism toward future generations. The significance of this and of the strong separability assumption will be discussed at the end of the section.

In each period t, the health status of a generation is a function of three variables: the technology used to maintain and improve its health θ_t, the amount of resources spent on health care c_t^h, and a health shock ϵ_t. If we allow the effect of the three variables to vary across generations, the health status can be written as follows:

$$h_t = \bar{f}^j\left(\theta_t, c_t^h, \epsilon_t\right) \qquad j = y, o.$$

We will assume that the amount of resources spent on health is a deterministic

function of the adopted technology, i.e. $c_t^h = g(\theta_t)$. As a consequence, the health status becomes simply a function of the health shock and of the technology, i.e.

$$h_t = f^j(\theta_t, \epsilon_t) \qquad j = y, o.$$

The technology is allowed to evolve over time. Specifically, in each period t the economy is characterized by two technologies that can be used to affect the level of health: a modern technology θ_t^m and an outdated technology θ_t^{ou}. In each period, a third and newer technology becomes available with a probability P_θ. If it does, the outdated one can no longer be used, whereas the modern technology becomes outdated. At each point in time only one technology can be used. We will assume that, conditional on the health shock, the newer technology guarantees higher levels of health, but it also requires larger health expenses c_t^h.[10]

The health expenses of the old generation are paid using a public health insurance which is provided by the government and funded by a combination of taxes on the young τ_t and government debt d_t. The health expenses of the young generation are covered by a private health insurance which is paid partly by the young generation at a premium P_t^h and partly by their employers through employer contributions to health plans E_t^h. Since our focus is on households' choices, we will not model firms' decisions and assume that E_t^h is exogenously given. To simplify the notation we will include out-of-pocket health expenses in the premium P_t^h.

In each period, the young generation is endowed with an amount of income y_t which is assumed to evolve deterministically. In addition, it receives employer contributions to pension plans, which will be denoted by E_t^p. The young generation can save an amount b_t using a risk-free asset with a gross interest rate R_t. The only source of income for the old generation is the amount of savings they possess when old. The consumption of the non-durable good is the numeraire.

[10]For a discussion of the relationship between health care costs and technology adoption see Newhouse (1992) and Fuchs (1996).

Finally, we will denote with $\omega \in \Omega$ one of the possible states of nature.

We can now describe the decisions of the two generations and of the government. In period t, the young generation chooses how much to consume of the non-durable good and how much to save as the solution of the following problem:

$$\max_{c_t, c_{t+1}, b_t} v_1(c_t) + v_2(h_t) + \sum_{\omega=1}^{\Omega} P\left(\epsilon_{t+1}^{\omega}, \theta_{t+1}^{\omega} \middle| \epsilon_t, \theta_t\right) \beta \left(v_1\left(c_{t+1}^{\omega}\right) + v_2\left(h_{t+1}^{\omega}\right)\right)$$

$$s.t. \quad c_t + P_t^h + b_t = y_t - \tau_t$$

$$c_{t+1}^{\omega} = R_t\left(b_t + E_t^p\right) \quad \text{for each } \omega \in \Omega$$

$$h_t = f^y(\theta_t, \epsilon_t) \quad \text{and} \quad h_{t+1} = f^o\left(\theta_{t+1}^{\omega}, \epsilon_{t+1}^{\omega}\right) \quad \text{for each } \omega \in \Omega.$$

Notice that the employer contributions to health plans do not affect the budget constraint because they enter its left hand side as part of the payment for health insurance as well as its right hand side as a transfer from employers. In spite of this, they will affect our analysis becaue NIPA adds them to household's income in the computation of the saving rate. The solution of this problem as a function of taxes will be denoted with $c^y(\tau_t)$, $b(\tau_t)$, and $c^{\omega,o}(\tau_t)$.

The old generation only chooses consumption of the non-durable good which must equate the available resources, i.e. $c_t = R_t b_{t-1}$. Its health status can be easily computed to be $h_t = f^o(\theta_t, \epsilon_t)$. We will denote with $c^o(\tau_{t-1})$ the optimal consumption of the old generation as a function of taxes.

The role of the infinitely-lived government is to choose which health technology to adopt and how to finance health expenditure of the old generation. Specifically, in period t the government chooses taxes, the amount of outstanding debt, and the health technology by maximizing a weighted sum of the welfare of the two generations, where the weights describe the political power of the two generations,

i.e.

$$\max_{\tau_t, d_t, \theta_t} \mu^y \left[u\left(c^y\left(\tau_t\right), h_t^y\right) + \beta \sum_{\omega=1}^{\Omega} P\left(\epsilon_{t+1}^{\omega}, \theta_{t+1}^{\omega} \middle| \epsilon_t, \theta_t\right) u\left(c^{\omega,o}\left(\tau_t\right), h_{t+1}^{\omega,o}\right) \right] + \mu^o u\left(c^o\left(\tau_{t-1}\right), h_t^o\right)$$

$$s.t. \;\; \tau_t + d_t = R_t^I d_{t-1} + c_t^h$$

$$h_t^y = f^y\left(\theta_t, \epsilon_t\right), \quad h_t^o = f^o\left(\theta_t, \epsilon_t\right), \text{ and } \quad h_{t+1}^{\omega,o} = f^o\left(\theta_{t+1}^{\omega}, \epsilon_{t+1}^{\omega}\right) \quad \text{for each } \omega \in \Omega.$$

We will assume that the government has access to a supply of capital d_t which is infinitely elastic.

In this model it is straightforward to show that, for any health technology, if $\mu^y > 0$ the government will set taxes to zero and will fund the entire cost of health care by issuing debt. To understand why observe that, for any technology, issuing debt has no effect on the old generation. It also has no impact on the welfare of the young generation since the government cannot tax them when they are old. It is also straightforward to show that the government will always choose to adopt the newest technology. To see this notice that the welfare of the old generation increases if the government adopts the new technology since this generation is not affected by the corresponding rise in health expenditure. In addition, remember that for any technology it is optimal for the government to choose $\tau_t = 0$ and $d_t = R_t^I d_{t-1} + c_t^h$. As a consequence, the young generation is also better off if the latest technology is adopted since it is paid by issuing debt.

Now that we know the government's decisions, we can analyze the decisions of the young generation. Since the new technology is funded exclusively by debt, its adoption has no effect on the household budget constraint. Under the assumption that preferences are strongly separable, the expected improvement in health status generated by the adoption of the modern technology has no effect on the consumption and saving decisions of the young generation. Specifically,

consumption is determined by the following standard Euler equation:

$$v_1^{'}\left(c_t\right) = \beta R_t v_1^{'}\left(c_{t+1}^{\omega}\right).$$

In the Euler equation, there is no expectation on the right hand side because the only uncertainty in the model is about health status and this variable is strongly separable from non-durable consumption.

To simplify the notation we will consider the case in which $\beta R_t = 1$.[11] The Euler equation and the budget constraint of the young generation can be solved for non-durable consumption and savings to obtain:

$$c_t = \frac{R_t\left(y_t + E_t^p - P_t^h\right)}{1 + R_t} \qquad \text{and} \qquad b_t = \frac{y_t + E_t^p - P_t^h}{1 + R_t}.$$

These equations establish that the young generation consumes about half of the income left after paying the health insurance premiums and out-of-pocket expenses and saves approximately the other half for when they are old.

In our empirical analysis, we have used the total saving rate of the household sector as measured by NIPA. It is defined as income of the young minus their expenditure, plus income of the old minus their expenditure, everything divided by income of the young plus income of the old. In our model, the NIPA definition of income for the young generation is given by the exogenous income y_t plus the employer contributions to health plans E_t^h and pension plans E_t^p, whereas the NIPA definition for the old generation is given by their asset income $\left(R_t - 1\right) b_t$ plus the transfers received from the government as payment for health treatments (Medicare and Medicaid). The previous discussion indicates that in each period those transfers are equal to the increase in debt $d_t - R_t^I d_{t-1}$. The NIPA definition of the saving rate takes therefore the following form:

[11] For standard utility functions, such as Constant and Relative Risk Aversion utilities, similar results hold if $\beta R_t \neq 1$. The only difference is that in this case consumption, and hence the saving rate, are also a functions of the discount factor β.

$$s_t^{NIPA} = \frac{y_t + E_t^h + E_t^p - c_t^y - c_t^{h,y} + (R_t - 1)\, b_{t-1} + d_t - R_t^I d_{t-1} - c_t^o - c_t^{h,o}}{y_t + E_t^h + E_t^p + (R_t - 1)\, b_{t-1} + d_t - R_t^I d_{t-1}}.$$

As argued earlier, in our model we have $c_t^o = R_t b_{t-1}$ and $c_t^{h,o} = d_t - R_t^I d_{t-1}$. Hence, if one defines $Y_t = y_t + E_t^h + E_t^p + (R_t - 1)\, b_{t-1} + d_t - R_t^I d_{t-1}$, the NIPA saving rate can be written as follows:

$$s_t^{NIPA} = \frac{y_t + E_t^h + E_t^p - c_t^y - c_t^{h,y} - b_{t-1}}{Y_t}. \tag{3.3}$$

This alternative way of writing the NIPA saving rate shows that an increase in health expenditure in period t has two effects on the saving rate at t. The first one is the direct effect of increasing health expenses, which is measured by $-\frac{c_t^{h,y}}{Y_t}$. The second effect is the indirect effect, which is generated by households changing their consumption of other goods in response to the increase in health expenditure, $\frac{y_t + E_t^h + E_t^p - c_t^y}{Y_t}$. It is important to remark that, in our decomposition of the effect of an increase in health expenses, we have assumed that the increase has no influence on the share of financial wealth accumulated by the old generation when young, $\frac{b_{t-1}}{Y_t}$. In the model, this is a good assumption since the old generation does not pay for health expenditure. In reality, this assumption is consistent with the current discussion in news outlets on the state of health expenditure, which suggests that the steep rise in health-related payments was not expected.

Equation (3.3) highlights an important feature of the direct effect. Since NIPA includes Medicaid and Medicare payments in both disposable income and household expenditure, the direct effect is mainly generate by changes in private health expenditure. Medicare and Medicaid can only affect the denominator of the saving rate. In the data, during the sample period 1980-2009, private health expenditure was on average 66 percent of total health expenditure. This implies that a 1 percentage point rise in total health expenditure increases the share of private health

expenditure by 0.66 percentage points, as long as the increase is spread evenly across health expenses. As a consequence, if there is no household's response, a 1 percentage point increase in total medical expenditure should generate a 0.66 percentage points reduction in the NIPA saving rate.

We can now interpret the coefficient on health expenditure in the saving rate regression estimated in the previous section, α_1. If families did not change their consumption choices, α_1 should be approximately equal to -0.66. However, if households chose to respond to the increase in health expenses by reducing the consumption of other goods, α_1 should be estimated to be lower than 0.66 in absolute value. For similar reasons, if consumers decided to increase the consumption of goods that have some degree of complementarity with health expenses and the increase was large enough, the coefficient α_1 should be estimated to be greater than 0.66 in absolute value. The empirical results presented in the previous section indicate that α_1 is between 0.58 and 0.67. We can therefore conclude that the households' response to the increase in the share of health expenditure was small or absent.

Using our model, we can determine whether households should have responded to the rise in health expenditure. By substituting for the optimal level of consumption c_t^y, our model predicts that the household's response should take the following form:

$$\begin{aligned}\frac{y_t + E_t^h + E_t^p - c_t^y}{Y_t} &= \frac{y_t + E_t^h + E_t^p - \dfrac{R_t\left(y_t + E_t^p - P_t^h\right)}{1+R_t}}{Y_t} \\ &= \frac{1}{1+R_t}\frac{y_t + E_t^p + (1+R_t)\,E_t^h}{Y_t} + \frac{R_t}{1+R_t}\frac{P_t^h}{Y_t}.\end{aligned}$$

This equation indicates that, since in our model taxes are optimally set to zero, households should have responded to the rise in health expenditure only if the increase had the effect of raising the share of disposable income earned by the

young generation, $\frac{y_t + E_t^p + (1 + R_t) E_t^h}{Y_t}$, or of raising the share of premiums paid for private health insurance plus out-of-pocket expenses, $\frac{P_t^h}{Y_t}$.

The evolution over our sample period of the variable $\frac{y_t + E_t^p + (1 + R_t) E_t^h}{Y_t}$ can be documented using data from the CPS on income, jointly with data from NIPA on employer contributions to health plans and data from SEER on population counts by age groups. Specifically, employing information available in the CPS, we construct per-capita income for individuals younger than 65, y_t, from 1980 to 2009. Then, using SEER data we compute the number of individuals younger than 65 for each year and multiply per-capita income times this number. Finally, using NIPA data, we calculate the employer contributions to health plans E_t^h and total disposable income for the household sector Y_t and compute the variable we are interested in $\frac{y_t + E_t^p + (1 + R_t) E_t^h}{Y_t}$. As interest rate, we used the 1-year rate on treasury bills. Its evolution from 1980 to 2009 is documented in Figure 3.10. This variable was remarkably constant during the period we are considering at around 79% of disposable income. In the next section, we will provide evidence that the share of employer contributions to health plans grew during the period 1980-2009. The reason the variable $\frac{y_t + E_t^p + (1 + R_t) E_t^h}{Y_t}$ stayed approximately constant is that the share of income of the working generation declined at a similar rate. This first piece of evidence suggests that it was optimal for households to barely change their consumption choices in response to the increase in health expenditure.

We will now describe the evolution of the share of health insurance premiums plus out of pocket health expenses to verify whether it was characterized by an increase sufficiently large to induce households to respond to the steep rise in medical expenditure. Figure 3.11 shows that, during the period considered in our cross-state analysis, 1980-2009, this variable remained approximately constant around 4 percent of disposable income. Once again, this suggests that it was optimal for households to hardly react to the rise in medical costs.

To summarize, using the model developed in this section we can assign an economic meaning to the estimated coefficient on health expenditure in the saving rate regression. Since the coefficient is estimated to be between 0.58 and 0.67, we can conclude that the households' response to the rise in the share of health expenditure was negligible. The increase in medical expenses was therefore transformed in almost its entirety in a reduction in the U.S. saving rate. In addition, using the model one can understand why households barely responded. According to our model, households should have responded only if the increase in medical expenditure had generated an increase in the income of the young generation or a rise in the premiums paid for private health insurance. The data suggests that this was not the case. It was therefore optimal for households to hardly change their consumption choices.

We conclude this section by discussing the main assumptions that characterize our model. We start by considering the assumption that the old generation does not pay taxes. Without this assumption, a rise in current debt will translate into an increase in the probability that the young generation will pay higher taxes when old. As a consequence, the consumption decisions of the young individuals will be directly affected by the rise in health costs. To evaluate whether this assumption is realistic one can use generational accounts, which compute the present value of the per-capita net taxes that a generation will pay for the rest of its life under a particular fiscal policy. Gokhale, Page, and Sturrock (1999) compute the generational accounts for a number of U.S. generations and find that net tax payments are negative for men that are 60 or older and for women that are 55 or older. Our assumption is therefore consistent with the findings in the generational accounting literature.

A second assumption that is worth discussing is the strong separability between non-durable goods and health status. We are not aware of any paper that has tested this separability hypothesis. Without empirical evidence, the most

plausible effect of a non-separability between those two goods is that, everything else equal, healthier individuals derive higher levels of utility from non-durable consumption. If this is the case, the adoption of a newer technology and the subsequent improvement in the health status of old individuals would make it optimal for the new generation to increase their savings to pay for the higher level of non-durable consumption they will demand when old. Our empirical results suggest that this is not the case, since households hardly responded to the increase in the share of health expenditure.

The last assumption that we consider is the lack of altruism. This assumption has no effect on our results provided that the supply of capital is not perfectly inelastic for any level of debt. In this case, the government will choose to postpone the payment of the debt indefinitely, which implies that the welfare of future generations will not be affected. This is clearly a strong assumption. Without it, with some degree of altruism households will take into account the effect of an increasing debt on future generations and react to it by increasing savings. Our findings indicate that either the current generation is not very altruistic toward future generations or it is unaware that the rise in health expenditure is paid by increasing the level of debt, since it did not reduce the consumption of other goods in response to the increase in medical consumption.

In the next section, we provide evidence on how the rise in private and public medical consumption was funded. That evidence will enable us to evaluate the model we have developed in this section by answering the following two questions. First, was the rise in public health expenditure financed mainly through debt? Second, who paid for the increase in private health expenditure?

3.7 How Was the Increase In Health Expenditure Paid For?

The main objective of this section is to describe how the rise in health expenditure was financed. We will first provide evidence that the increase in private health expenses was financed almost entirely through a rise in employer contributions to health plans. We will then provide evidence that public health expenditure was funded almost exclusively by (i) an increase in government debt and by (ii) a reduction in expenditure on other public goods. Taxes were not raised during the period under investigation.

To determine how health expenses were funded, it helps to divide them in private health expenses, which are defined as expenses paid by consumers or health insurance companies, and public health expenses, which are composed of all the expenses that are paid using public funds. Public health expenditure will be further divided in its two main components: Medicare, which covers people older than 65 and disables, and Medicaid, which assists low-income families. Figure 3.12 documents the evolution of total, private, and public health expenditure as a percentage of household disposable income. It shows that public as well as private health expenses grew during the period under consideration. Private health expenditure more than doubled as a fraction of income, experiencing an increase from 4.9% in 1960 to 10.5% in 2009. Public health expenditure grew at a faster rate, increasing from 1.3% in 1960 to 9.2% in 2009. In Figure 3.13 we report the changes in public health expenditure, and separately, in Medicare and Medicaid expenses.[12] According to the data, from their inception in 1966 both programs increased at a similar rate, with Medicare and Medicaid reaching, respectively, 4.6% and 3.5% of disposable income in 2009.

We will start by describing how the rise in private health expenses was fi-

[12]Medicare and Medicaid account for a large fraction of public health expenditure. For instance, in 2009 they added up to 88.4% of public health expenses.

nanced. There are three possible groups of individuals and companies that may have funded it. First, health insurance companies may have paid for the increase through a reduction in their underwriting gains which are defined as the difference between the premiums received and the benefits paid. Second, employers may have funded a portion of the rise by way of an increase in the health insurance premiums they pay as a contribution for their employees. Finally, consumers may have financed part of the rise through an increase in their health insurance premiums and out-of-pocket expenses.

With regard to health insurance companies, it has been documented that in the past several decades private insurers have generally experienced a health insurance underwriting cycle, which is defined as three consecutive years of underwriting gains followed by three consecutive years of losses.[13] As a consequence, a reduction in underwriting gains could not have financed the increase in private health expenditure observed in the past 50 years. Figure 3.14 reports the amount of private health expenditure that was paid by consumers and employers. As a fraction of disposable income, the insurance premiums paid by employers increased at a steep rate, going from 0.9% in 1960 to 5.2% in 2009. In contrast, as documented in the previous section, the contributions of consumers remained approximately constant at around 4 percent of disposable income for the entire period. In Figure 3.15 we decompose consumers' payments in out-of-pocket expenses and premiums. The premiums paid by consumers grew at a steady rate throughout the period. During the same period, however, consumers enjoyed a reduction in out-of-pocket expenses that offset the increase in premiums. These results suggest that the rise in private health expenditure was financed almost entirely by employers and that consumers were not affected by its increase.

We will now discuss the financing of the health expenses related to Medicare.

[13]This cycle has been documented, for instance, in Reed, Robert, and Maule (1989), Gabel et al. (1991), and in the executive report prepared in 2003 by the consulting firm Milliman USA (www.aha.org/aha/content/2003/pdf/MillimanReport030410.pdf).

To that end, it is useful to divide Medicare in its four components, Part A, B, C, and D, since they are funded in different ways. The original Medicare program consisted only of Part A and Part B. Part A covers only inpatient hospital stays. Part B helps pay for some of the services and products administered on an outpatient basis and not covered by Part A. In 1997, with the passage of the Balanced Budget Act, Medicare beneficiaries were given the option to receive their Medicare benefits through private health insurance plans, instead of through the original Medicare plans A and B. These plans are known as Part C. Medicare Part D was enacted as part of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA) and went into effect on January 1, 2006. The objective of this program is to subsidize the costs of prescription drugs for Medicare beneficiaries. Figure 3.16 shows that Part A is the component of Medicare that grew at the fastest rate, increasing from 0.24% of disposable income in 1966, when it was introduced, to 2.6% in 2009. The rest of Medicare expenses increased at a more moderate rate, going from 0.1% in 1966 to 1.2% in 2005. In 2006 the introduction of Part D generated a jump to 1.5%. In 2009, Part B, C, and D amounted to 2.1% of disposable income.

Given the sharp increase in Part A expenditure, we will start by documenting how this component of Medicare was funded. These health expenses are paid using the Hospital Insurance (HI) trust fund, which is financed for the most part by a Medicare payroll tax. For instance, in 2006 86% of the funds came from it. The second source of funds in order of importance was interest payments on the trust fund, which in 2006 accounted for just 7% of the total.[14] The evolution of the Medicare payroll tax, which is paid half by the employee and half by the employer, is displayed in Figure 3.17. One can see that most of the expansion of Medicare Part A was funded with an increase in the corresponding payroll tax.

[14]The percentages for 2006 have been computed using data from the 2007 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds.

The tax receipts increased from 0.4% of disposable income in 1966 to 1.8% in 2009. To understand the effect of the change in payroll taxes on household decisions, however, one has to analyze the evolution of the total amount of taxes paid by households. The dynamics of this variable, which is documented in Figure 3.17, indicates that throughout this period total taxes paid by the household sector as a fraction of income fluctuated around a constant rate of 14%. This result suggests that the increase in Medicare payroll tax was compensated by a reduction in other personal taxes. This evidence is consistence with one of the predictions of our model according to which the rise in medical consumption should not be funded by raising taxes.

Medicare expenses related to Parts B, C, and D are paid using the Supplementary Medical Insurance (SMI) Trust Fund. This fund is financed primarily through the monthly premiums that all beneficiaries of Parts B, C, and D must pay and general government revenues. For instance, in 2006 general revenues accounted for 76% of the SMI Trust Fund inflow, while beneficiary premiums accounted for 21% of the Trust Fund inflow. Figure 3.18 describes the evolution of the general revenues allocated to the SMI Trust Fund and of the monthly premiums, both as a fraction of income. At the beginning of the program, general revenues and premiums represented an identical and small fraction of disposable income. They were both equal to 0.12%. With time, however, the two series started to diverge with general revenues accounting for a larger fraction of the inflow to the Trust Fund. In 2009, general revenues amounted to 1.96% of income, while beneficiary premiums were one third of revenues and only 0.58% of income. These results suggest that the majority of Parts B, C, and D expenses are paid with general government revenues, even if personal taxes have not increased in this period, as documented in Figure 3.17. The beneficiary premiums are the only variables we have found whose small increase had a direct effect on the within-period budget constraint of families.

We will now turn our attention to Medicaid. Financing of the Medicaid program is shared by the federal government and the states. Unlike Medicare, federal funding for Medicaid comes entirely from general revenues. Funding for the state share of Medicaid costs comes from a variety of sources, but at least 40% must be financed by the state, and up to 60% may come from local governments. The main sources of funds are personal income, sales, and corporate income taxes. For instance, the National Association of State Budget Officers reports that in 2006 about 80% of the state share of their Medicaid costs was financed by state general funds, most of which are raised from personal income, sales, and corporate income taxes. The remaining 20% was financed by other state funds. Since, as suggested above, personal taxes did not increase during this period, one can conclude that the households were not affected by the increase in Medicaid expenditure.

We can now summarize the findings documented up to this point for public health expenditure. The evidence suggests that, with the exception of the small increase in the premiums charged to the beneficiaries of Parts B, C, and D, households did not pay for the rise in public health costs. There are, therefore, three possible ways in which the government could have funded public health expenditure. One possibility is that the government chose to reduce the expenditure on other public goods. The second possibility is that the government decided to raise taxes on production and imports, taxes on corporate income, and/or taxes from the rest of the world. Finally, the government might have selected to increase its debt.

Figure 3.19 shows that, at the time public health expenses increased from 1.5% to 9.8% of disposable income, the share of military outlays declined from 12.1% to 5.7%.[15] One can therefore conclude that part of the increase in health

[15]Observe that during the second half of the sixties and the first half of the seventies part of the decrease in military expenditure was used to fund the rise in income security expenditure. Notice also that we left out the items of government expenditure that are either too small to have a significant effect on our analysis or that remained approximately constant during the period considered.

costs was financed by a reduction in expenditure on other government items. In Figure 3.20, we describe the evolution of total government revenues and total government expenditure. There are three patterns that are worth discussing. First, total government revenues as a fraction of disposable income fluctuated around a constant rate of 40%. As a consequence the rise in health expenditure was not funded by an increase in other taxes. Second, during the period considered, government expenditure as a fraction of income increased by 12 percentage points to 48.6%. Lastly, from 1970 government expenditure has been above government revenues in all years except for the period 1997-2001. These last two patterns suggest that part of the rise in medical costs was financed by issuing debt.

The evidence provided in this section is consistent with the conclusions reached at the end of the model section: households chose to hardly reduced the consumption of other goods in response to the rise in medical consumption because they did not pay for that increase. The evidence is also consistent with the two main predictions of our model, according to which the increase in medical expenditure should have been paid by increasing the level of debt without increasing taxes. One pattern in the data that our model cannot explain is that part of the health costs were funded by reducing the consumption of other public goods. Adding those public goods to our model is beyond the scope of our paper. But studying substitution patterns across different types of public goods is an interesting topic that we hope to study in future research.

3.8 Conclusions

In this paper, we study the relationship between the evolution of the U.S. personal saving rate and changes in health expenditure. We find that a 1 percentage point increase in health expenditure is associated with a decline in the saving rate of between 0.57 and 0.67 percentage points. This finding combined with back of the

envelope calculations imply that the increase in health expenditure can explain about 83% of the decline in the saving rate. We provide this evidence using first an accounting exercise and then cross-state variation in saving rates and health expenditure combined with FDA approvals of new drugs.

To understand the economic meaning of the empirical results, we develop a model that enables us to evaluate whether households responded to the increase in medical expenses and whether the response was rational. Our results indicate that households barely changed their consumption of other goods and that their response was rational.

Finally, we provide evidence on the way the rise in health expenditure was funded. We find that the increase in medical expenses was financed almost exclusively by a rise in employer contributions to health plans, by a reduction in government expenditure on other items, and by an increase in government debt. This evidence support the main predictions of our model.

The results presented in this paper have important policy implications. They indicate that there are two sorts of policies that can effectively increase the saving rate. The first one is composed of policies that are aimed at reducing the rate of growth in health expenditure. Such policies should require health institutions to be more selective in the adoption of newer and costlier technologies and at encouraging innovations that result in the development of more cost efficient health technologies. The second group includes policies designed to raise the amount voters pay for health care so that they will internalize its cost and save more.

Figure 3.1: Personal Saving Rate from NIPA

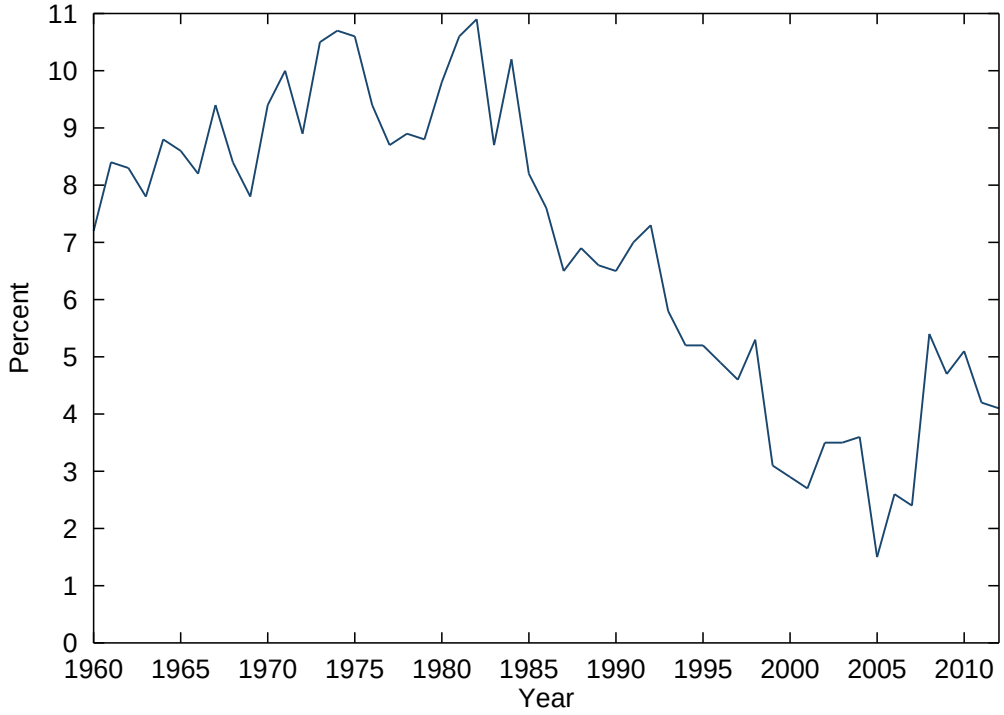


Figure 3.2: Total Health Expenditure as a Percentage of Disposable Income from NIPA and NHEA

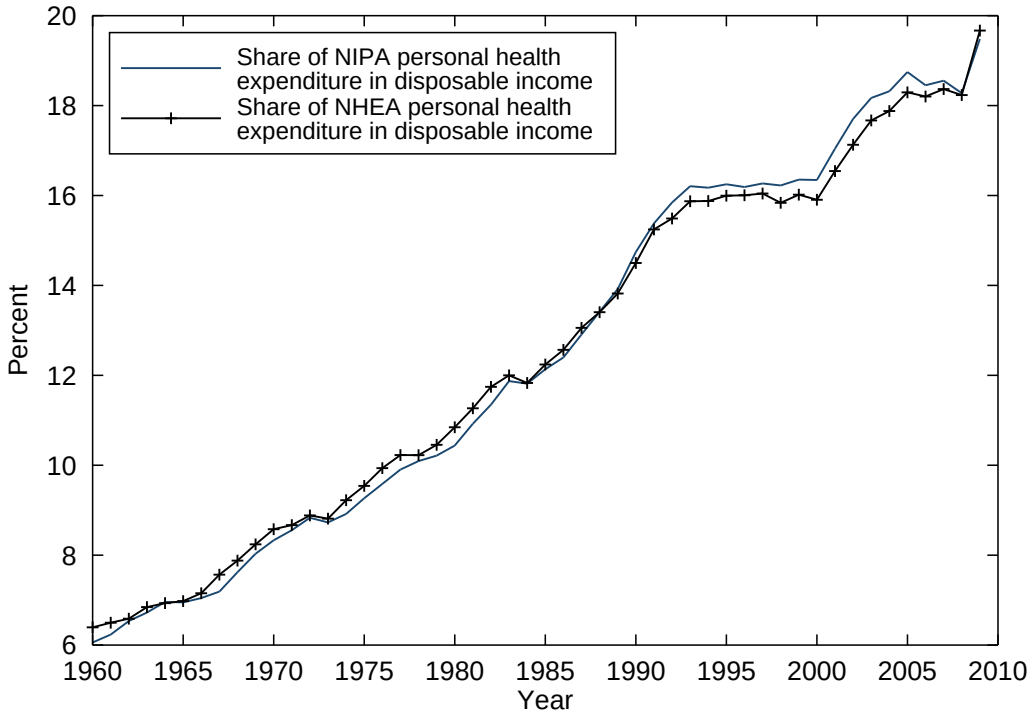


Figure 3.3: Health Expenditure and Employer Contributions as a Percentage of Income, NIPA

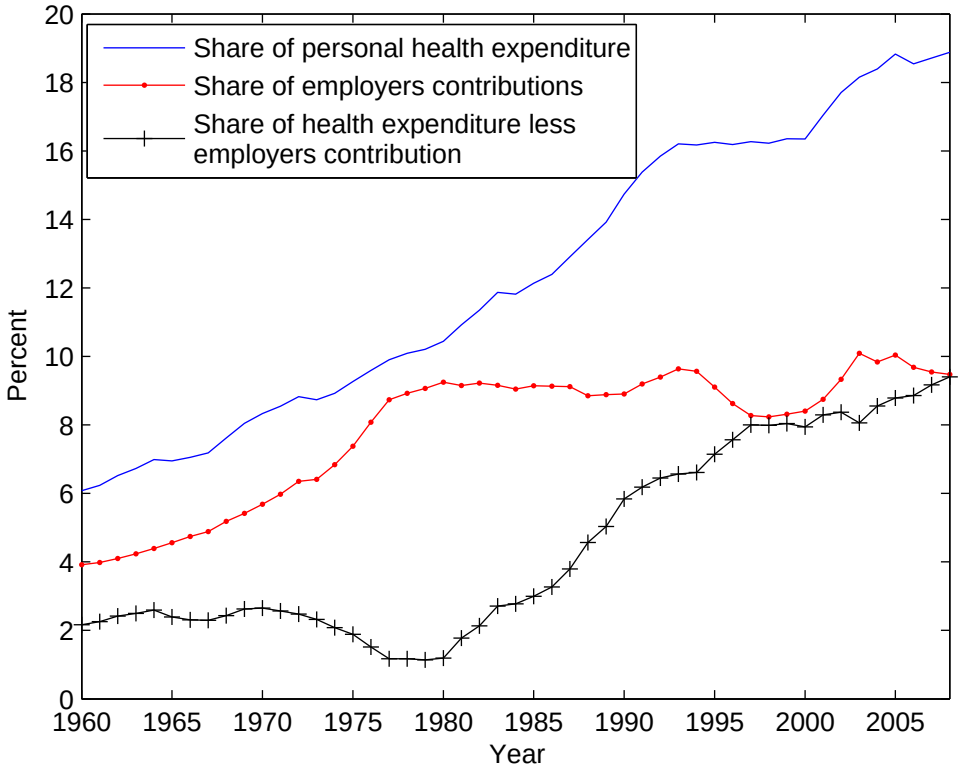


Figure 3.4: Saving Rates and Health Expenditure Net of Employers' Contributions, NIPA

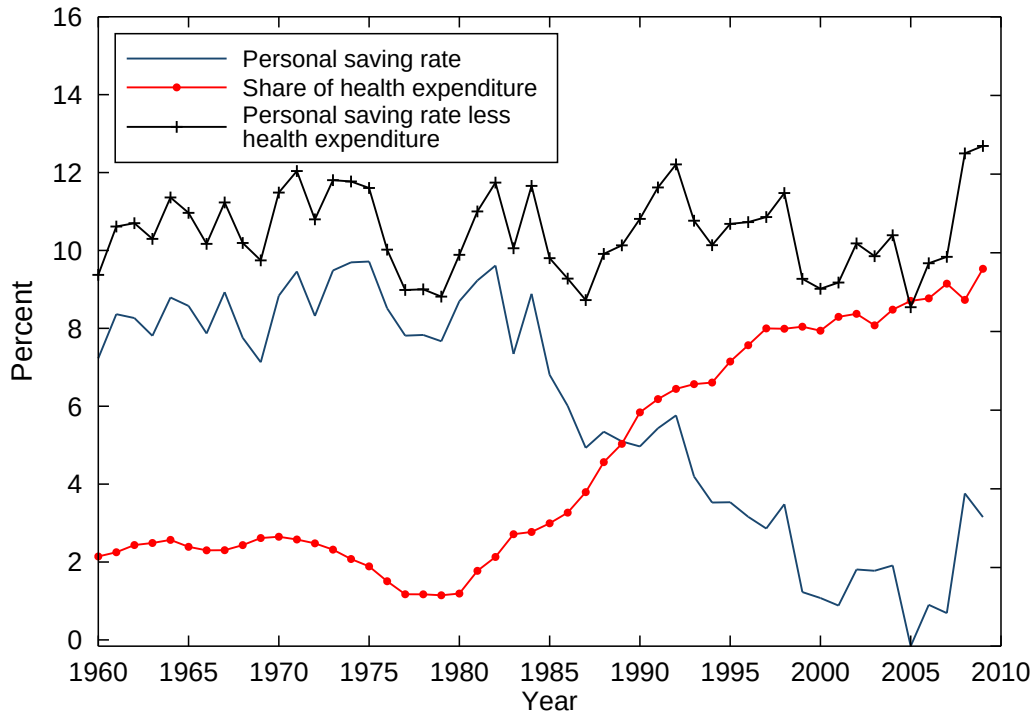


Figure 3.5: Ratio Between Constructed and NIPA Household Expenditure

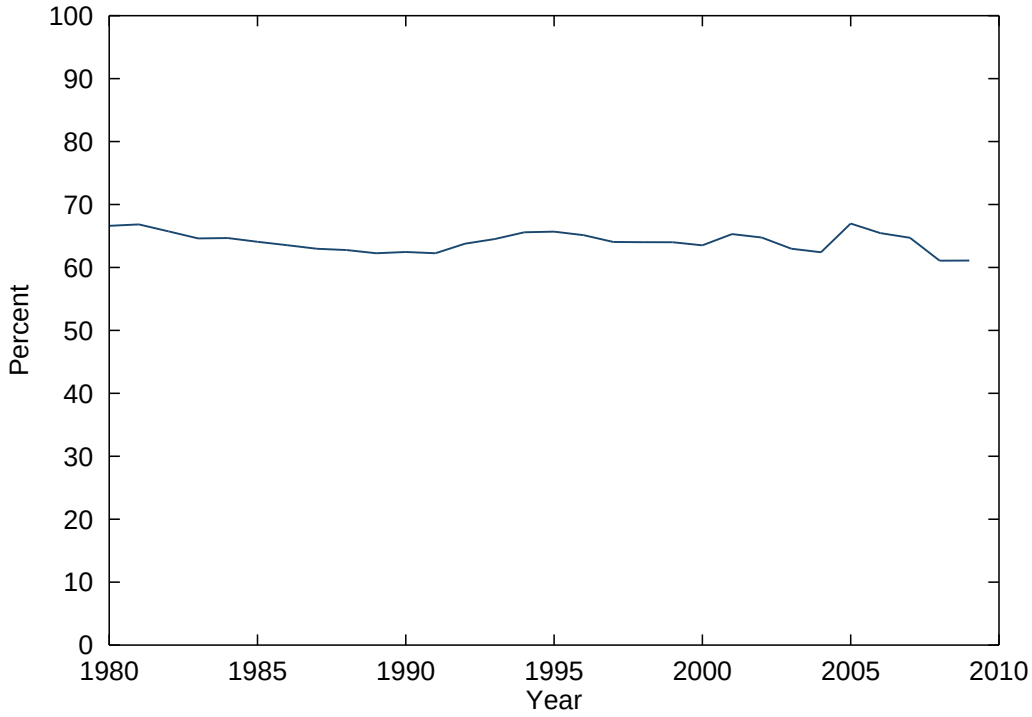


Figure 3.6: Changes for Constructed and NIPA Aggregate Saving Rates

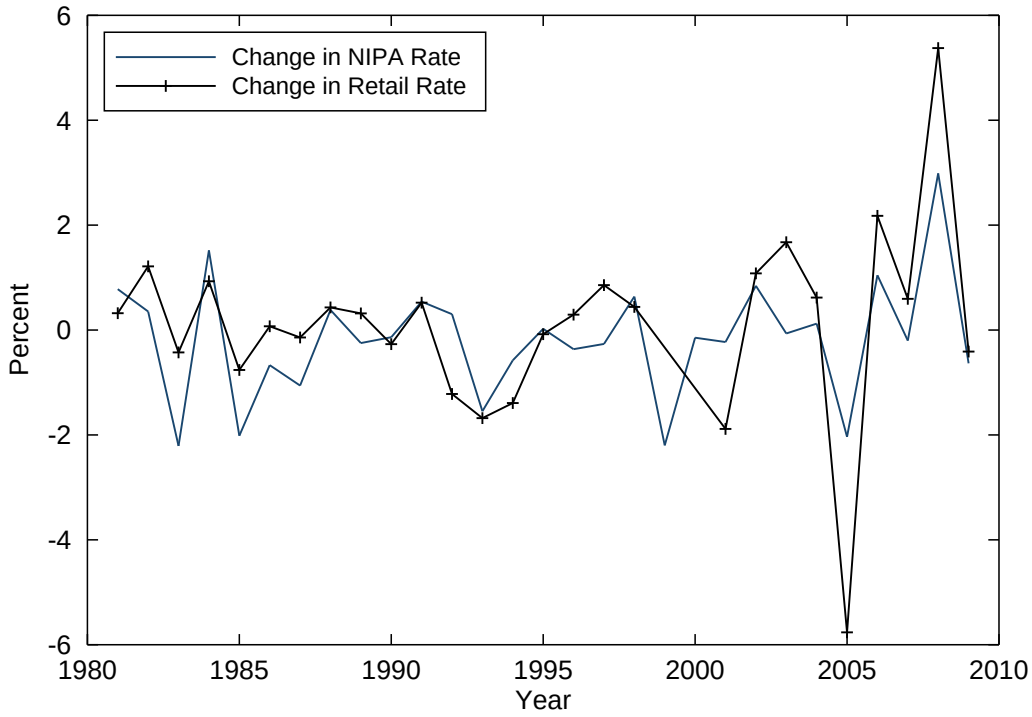
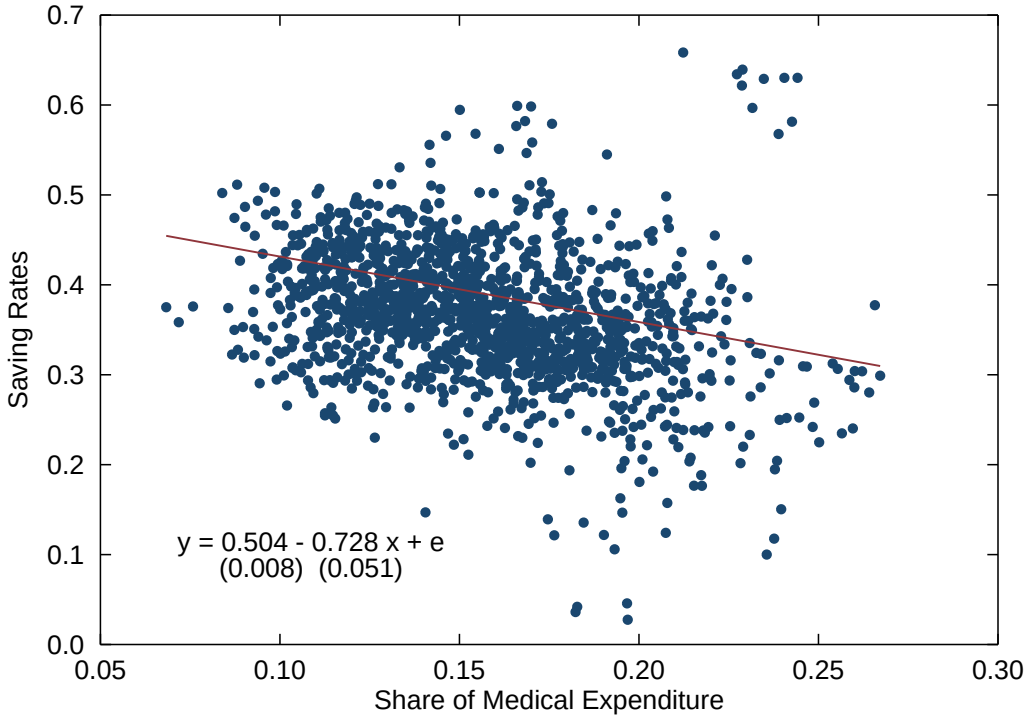
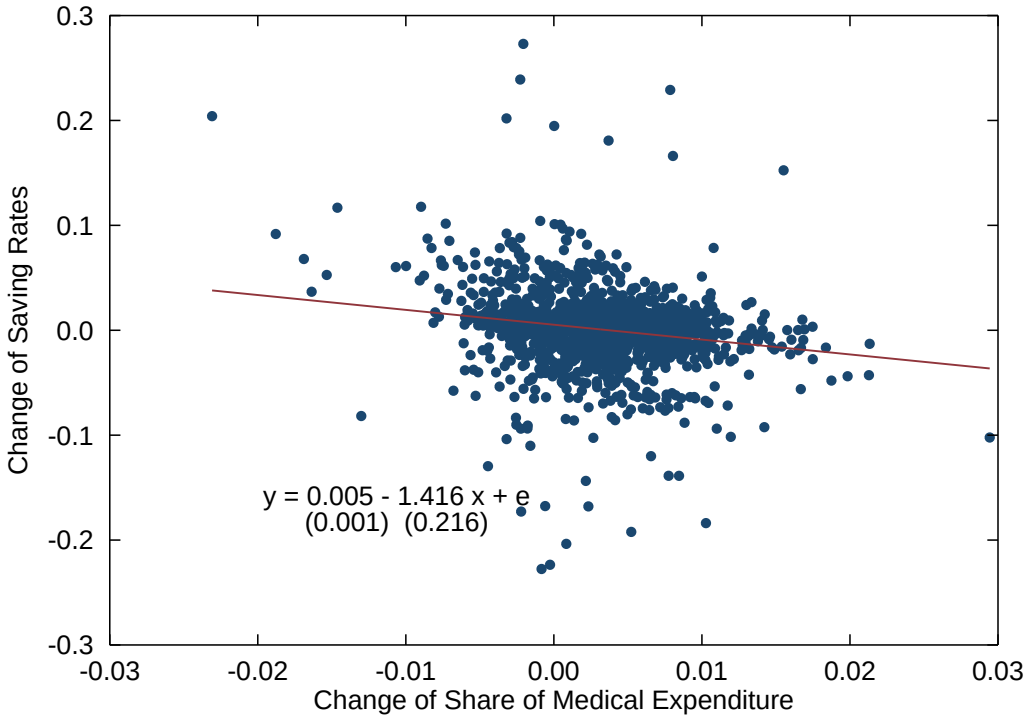


Figure 3.7: State-level Saving Rates and Health Expenditure



(a) Levels



(b) Changes

Figure 3.8: FDA Aprovals and Cumulative Aprovals of New Molecular Entities

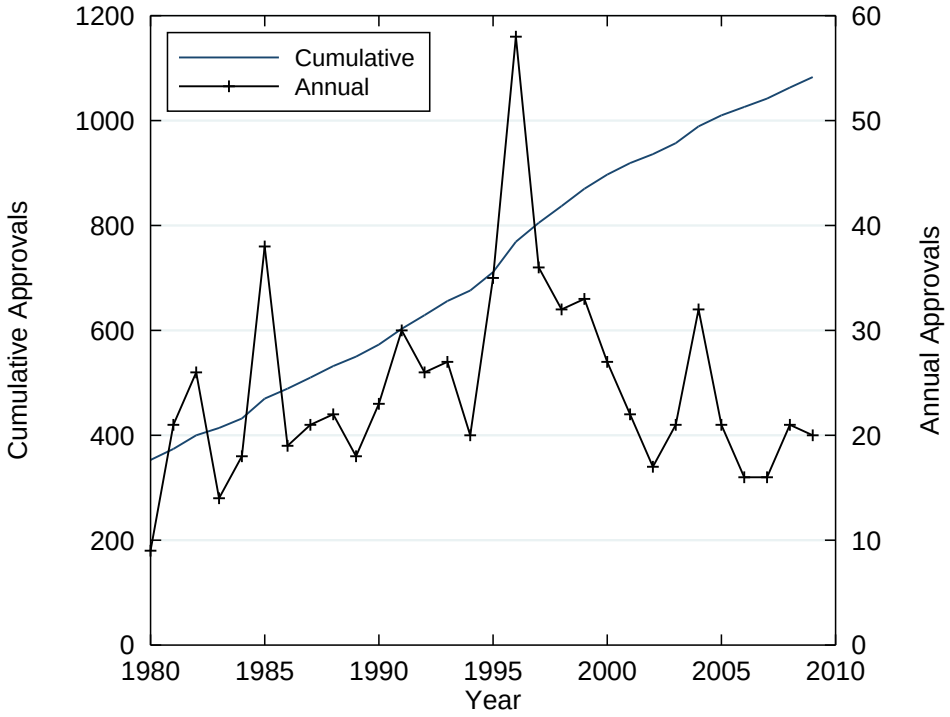


Figure 3.9: FDA Aprovals and Cumulative Aprovals of New Drugs

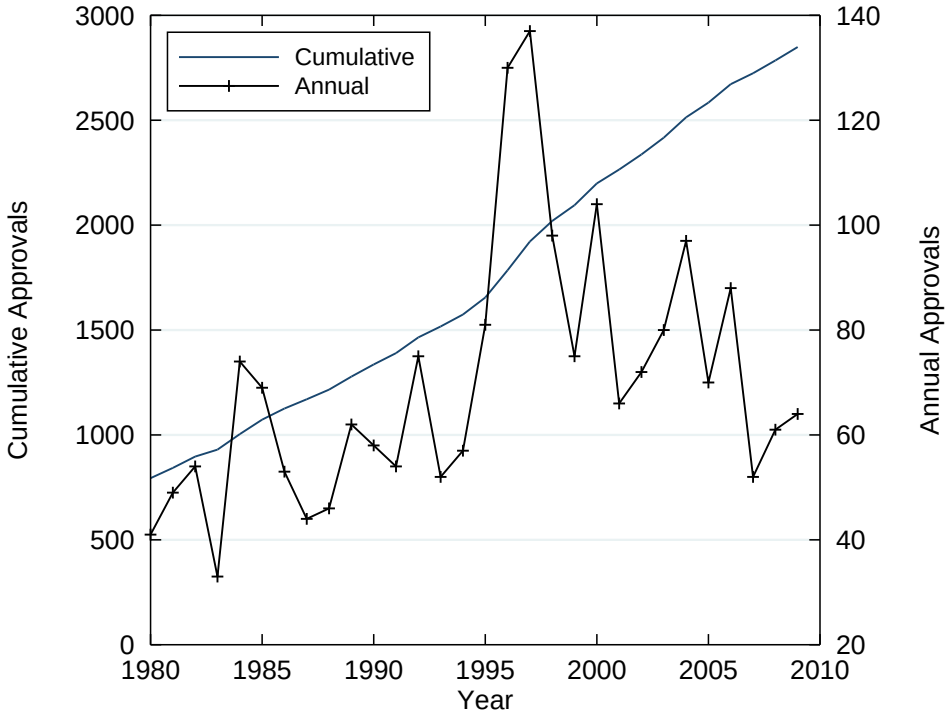


Figure 3.10: Share of Working Generation Income Plus Employer Health Contributions

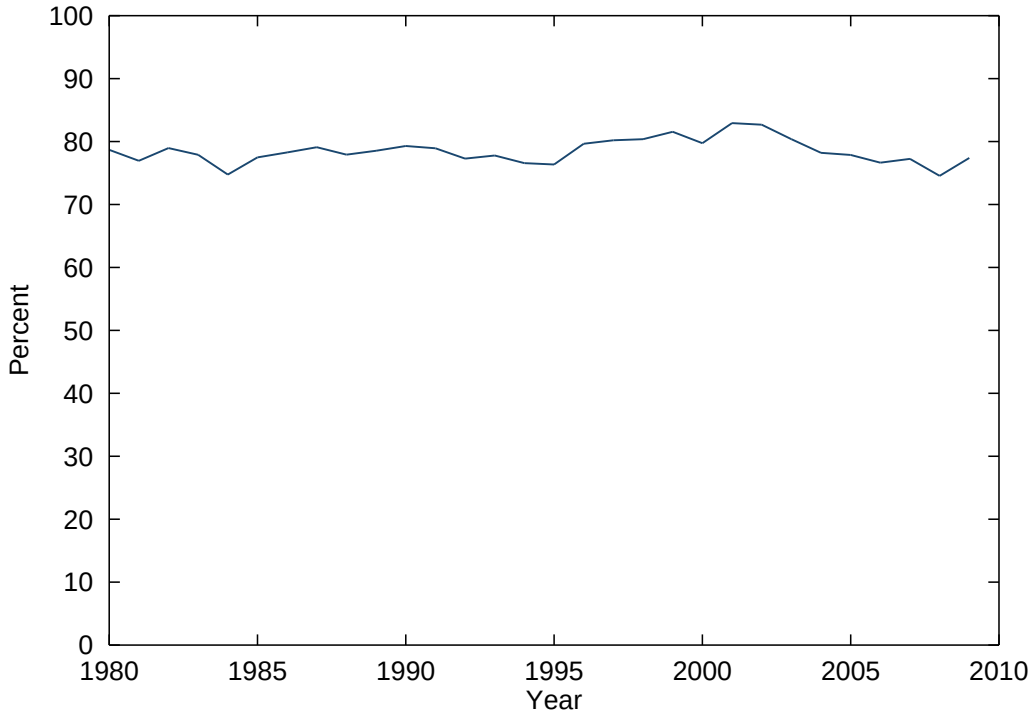


Figure 3.11: Share of Health Insurance Premiums and Out-of-Pocket Expenses

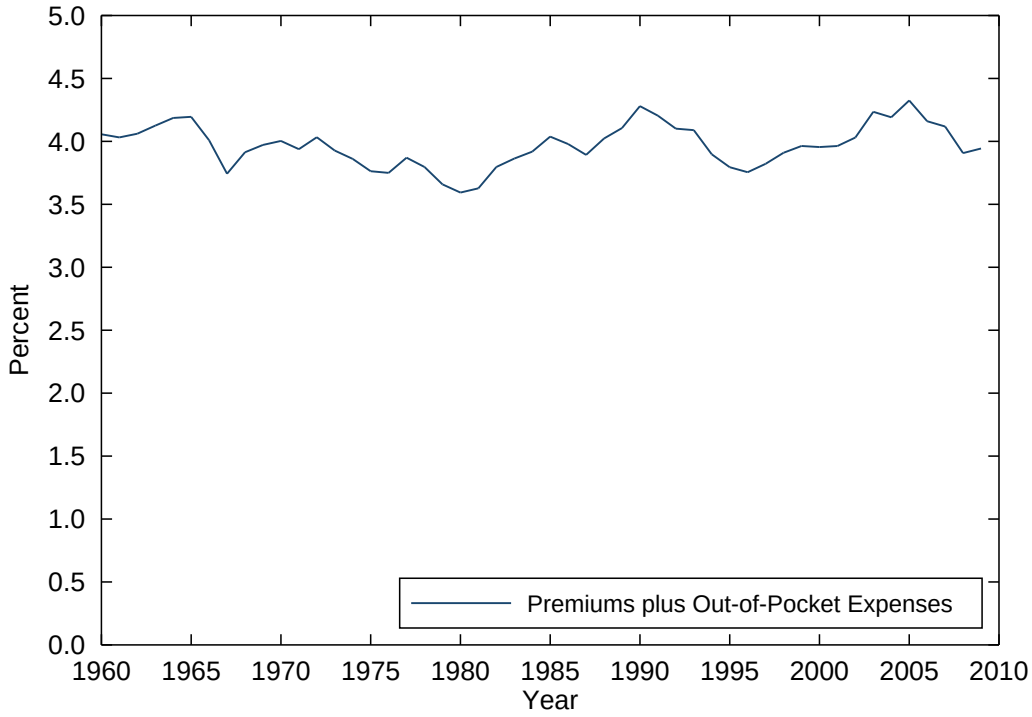


Figure 3.12: Components Of Health Expenditure As Percentage Of Disposable Income

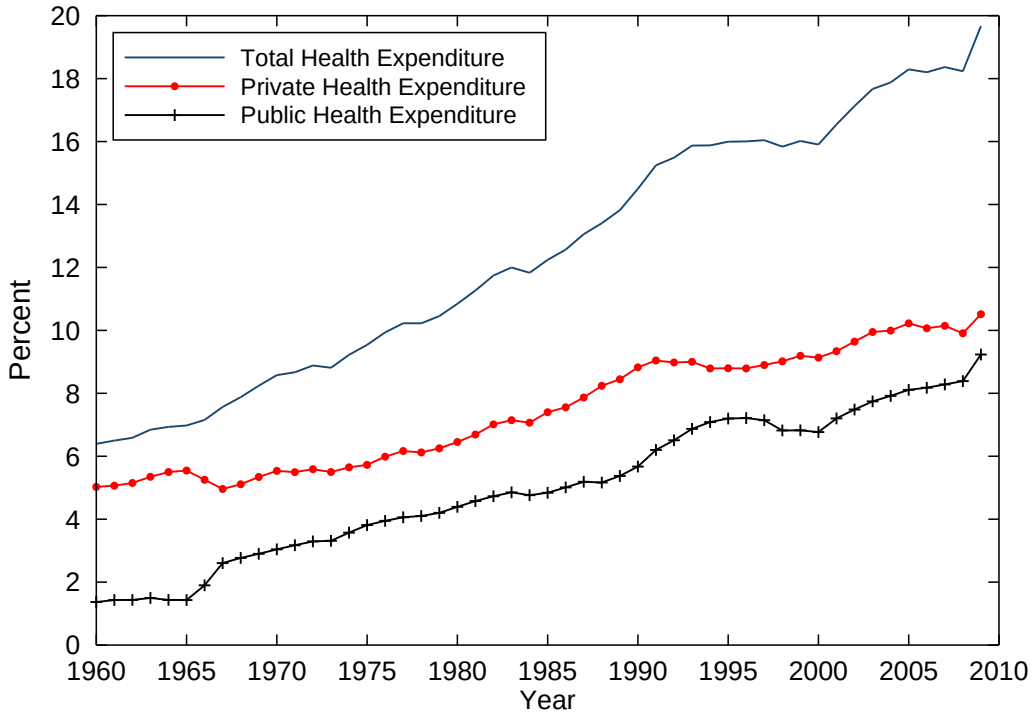


Figure 3.13: Components Of Public Health Expenditures As Percentage Of Disposable Income

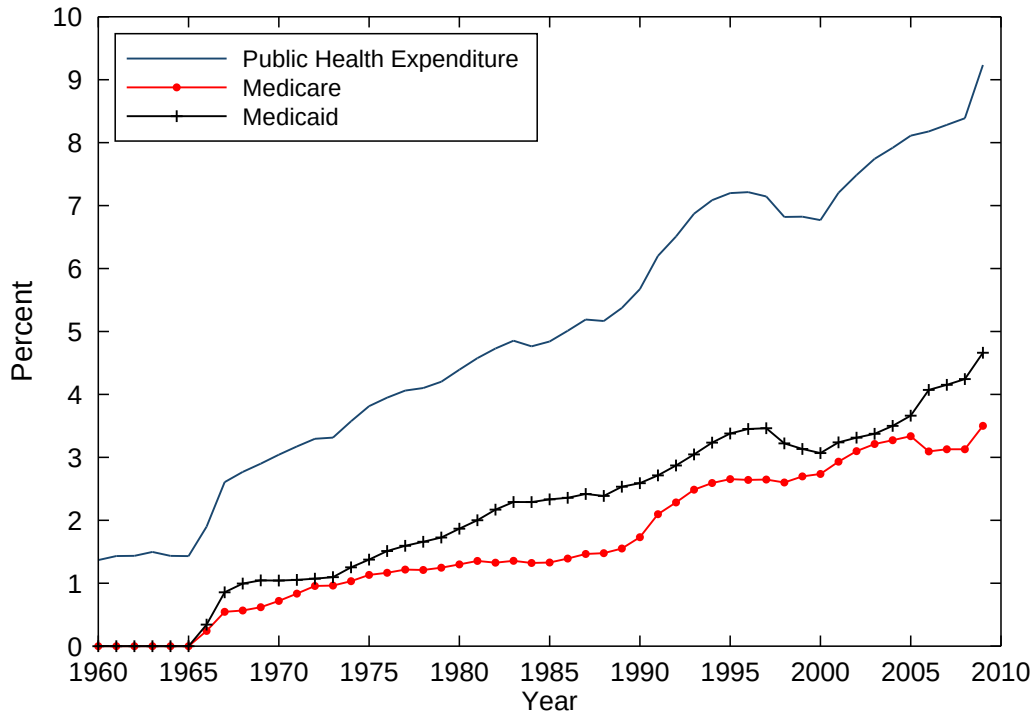


Figure 3.14: Contributions By Consumers And Employers To Health Expenditure As Percentage Of Disposable Income

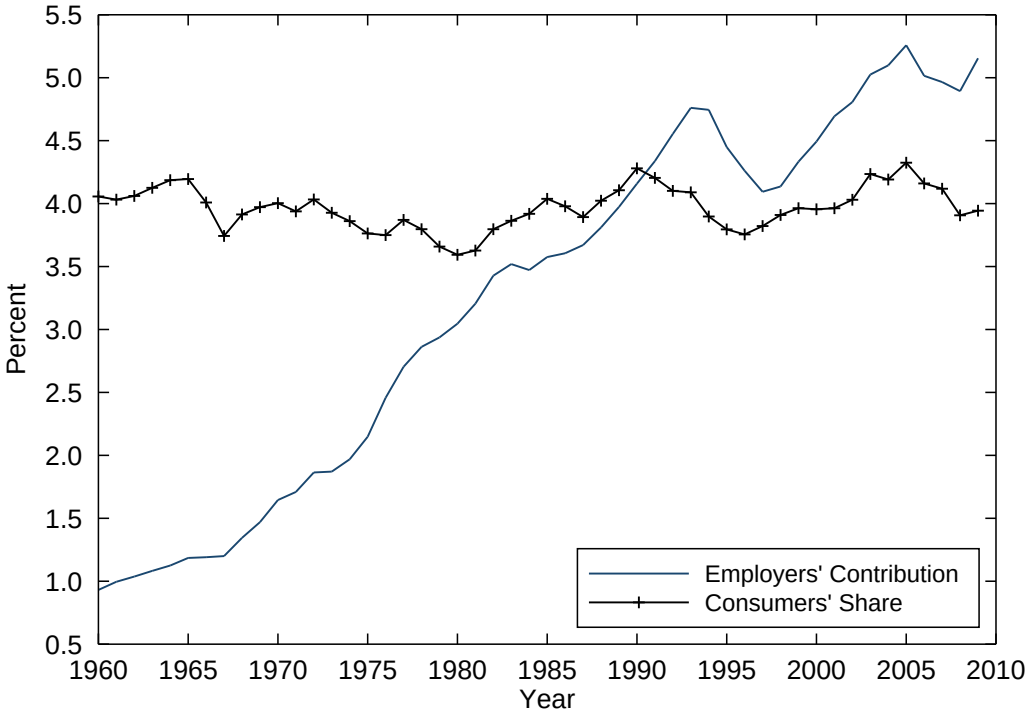


Figure 3.15: Decomposing Consumer Health Expenditure As Percentage Of Disposable Income

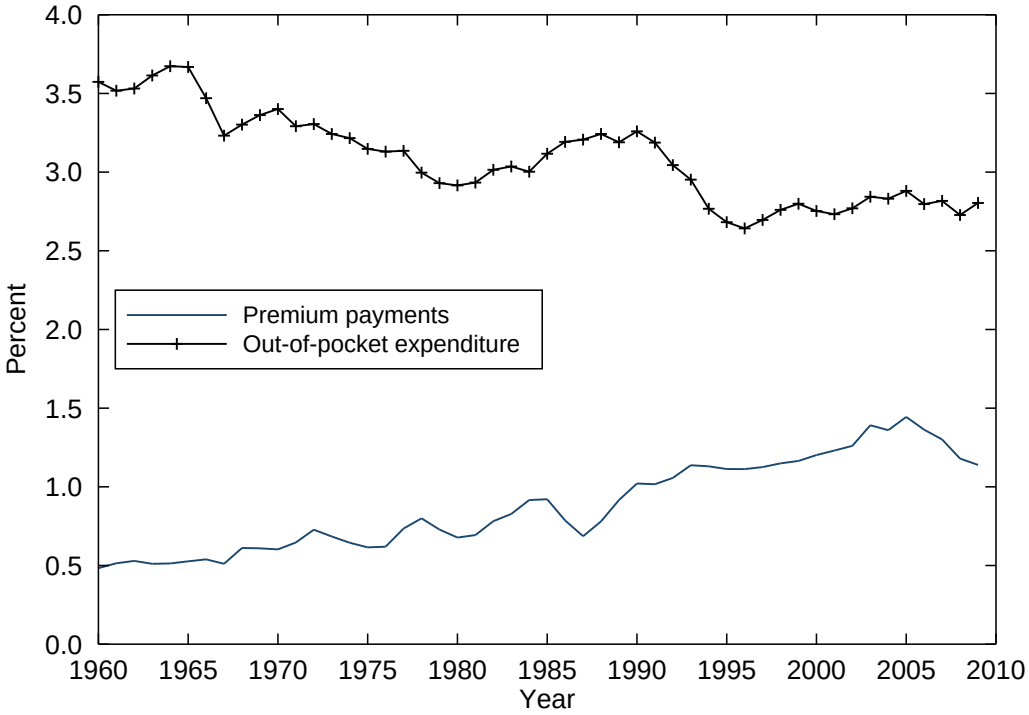


Figure 3.16: Medicare Components As Percentage Of Disposable Income

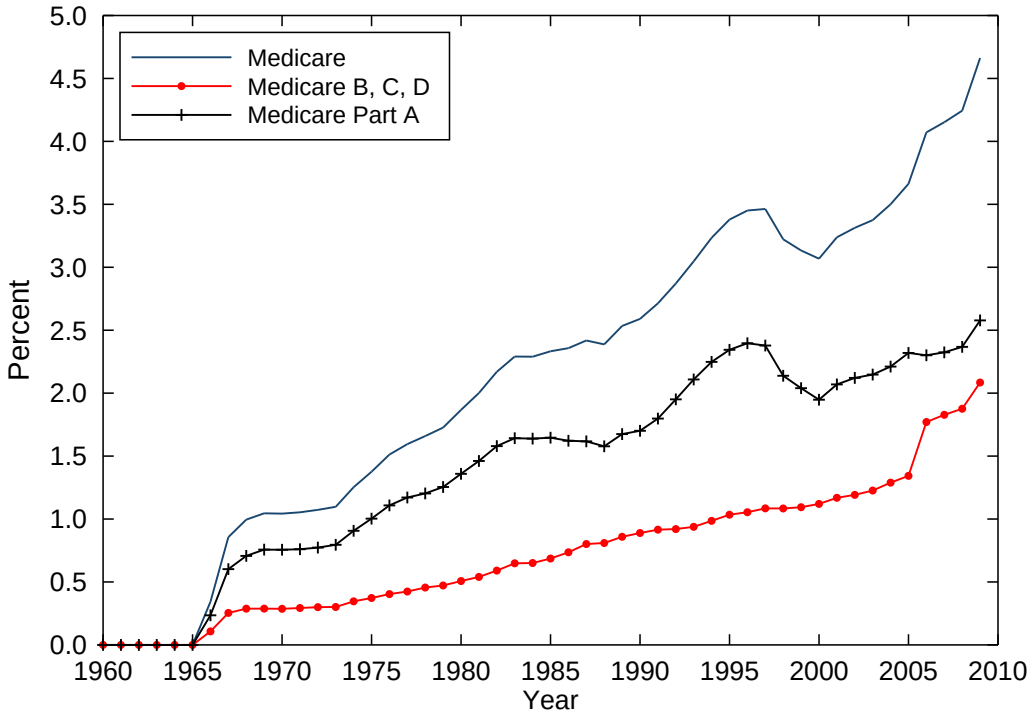


Figure 3.17: Personal Taxes and Medicare Payroll Tax As Percentage Of Disposable Income

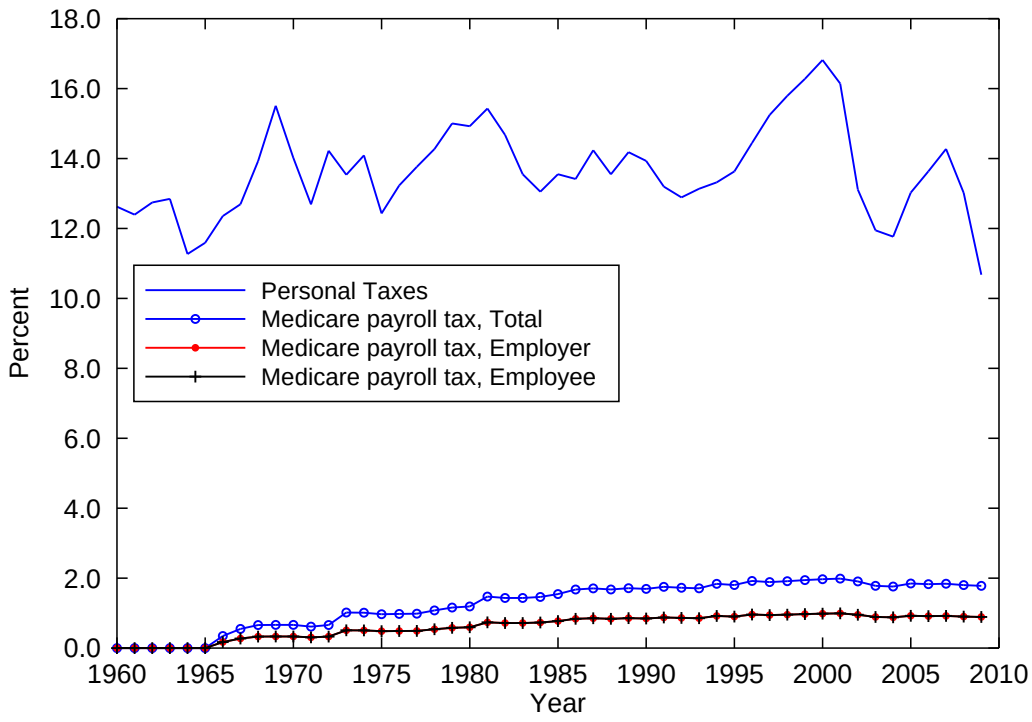


Figure 3.18: Revenue Allocated to SMI Trust Funds and Premiums As Percentage Of Disposable Income

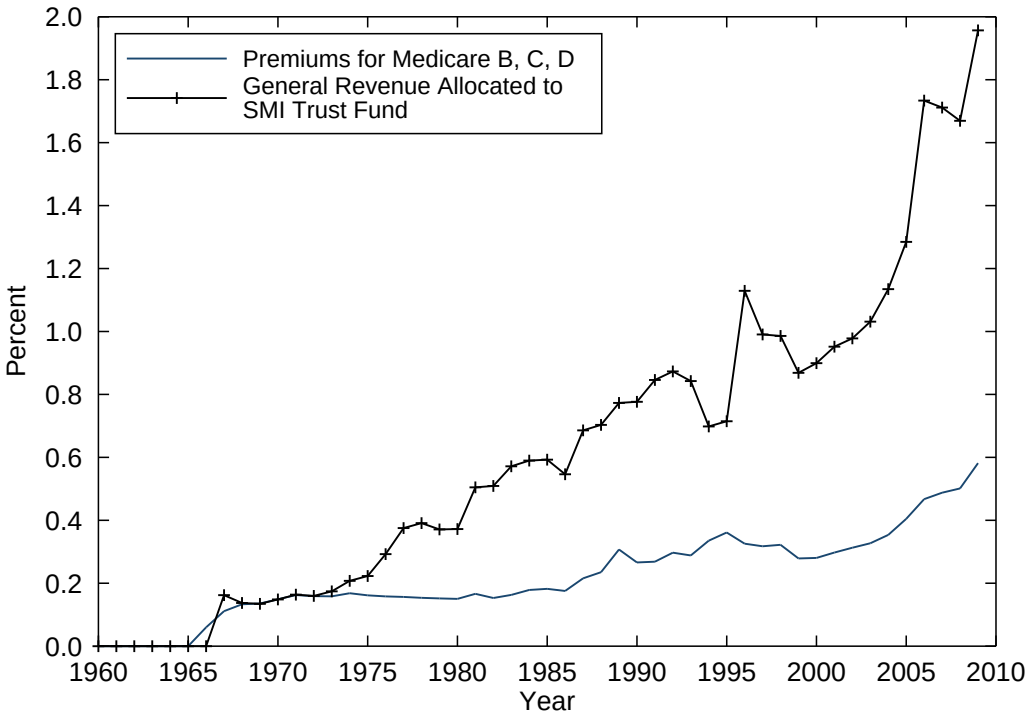


Figure 3.19: Public Expenditure Components As a Share of Disposable Income

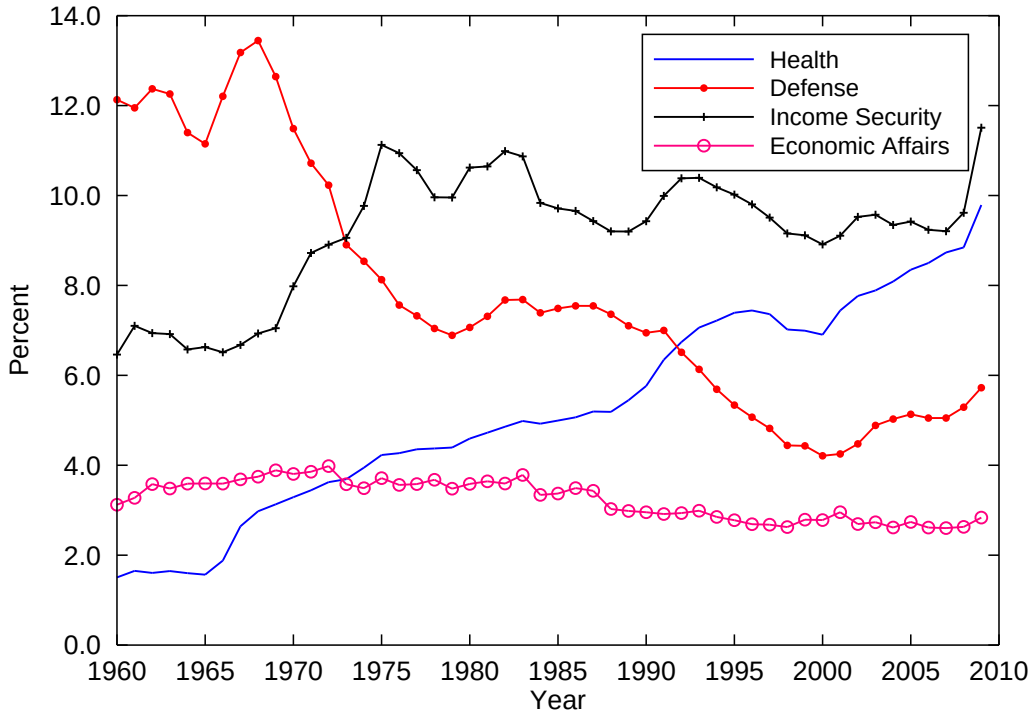


Figure 3.20: Share Of Government Income And Expenditure In Disposable Income

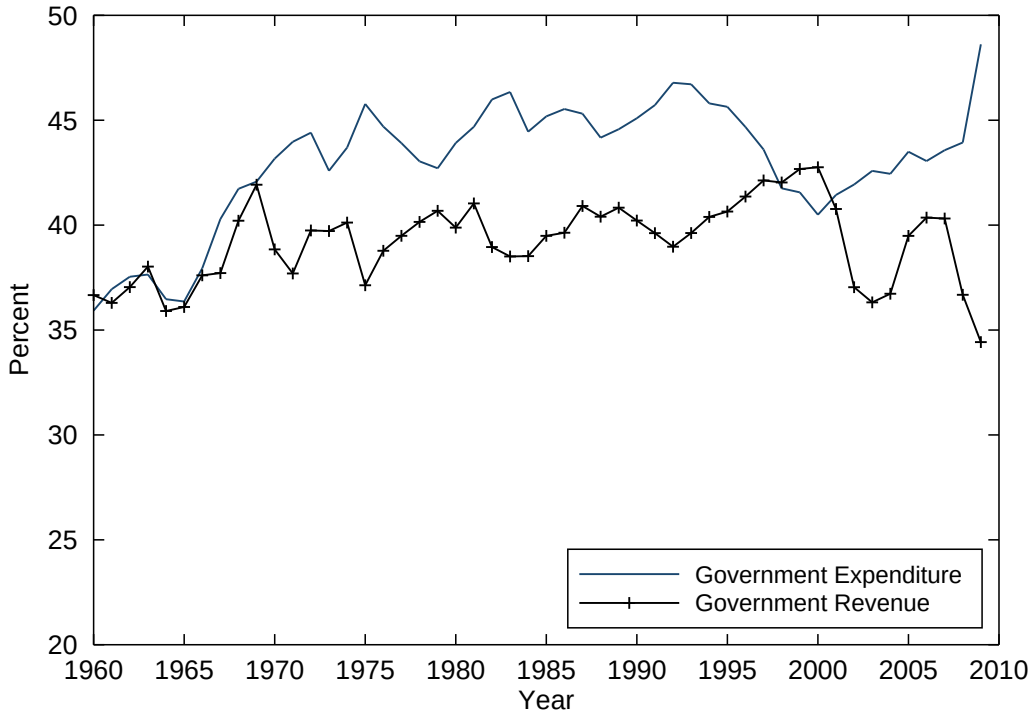


Table 3.3: Cross-state Regression

Dependent Variable: State-level Saving Rate	
Share of Medical Expenditure	**-0.643*****
	(0.135)
Share of Old Individuals	0.220
	(0.222)
Share of Middle-aged Individuals	0.933***
	(0.241)
Share with College or Higher Degree	0.062
	(0.056)
Share of Black Individuals	0.182
	(0.194)
Share of Hispanic Individuals	0.404***
	(0.093)
State Unemployment Rate	0.410***
	(0.085)
N	1275
R-squared	0.845

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time and state fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3.4: Instrumental Variable Regressions

First Stage Regressions. Dependent Variable: Share of Medical Expenditure				
	NME I	NME II	ND I	ND II
Total Approval * Share Old	0.0429***		0.0165***	
	(0.0045)		(0.0018)	
Total Approval For Old * Share Old		0.1298***		0.0412***
		(0.0137)		(0.0043)
Total Approval For Middle Age * Share Middle Age		0.0403		0.0155
		(0.0290)		(0.0103)
Total Approval * Share with College or Higher Degree	-0.0272***	-0.0295***	-0.0099***	-0.0110***
	(0.0030)	(0.0033)	(0.0011)	(0.0012)
Total Approval * Share Blacks	0.0044***	0.0043***	0.0016***	0.0015***
	(0.0012)	(0.0012)	(0.0005)	(0.0004)
Total Approval * Share Hispanic	0.0054**	0.0062**	0.0018*	0.0020**
	(0.0027)	(0.0029)	(0.0010)	(0.0010)
N	1275	1275	1275	1275
F-test	98.92	78.12	93.82	76.74

All regressions include as control variables the fraction of individuals between the ages of 30 and 60, the fraction older than 60, the fraction with college or higher degree, the fraction of Blacks and Hispanics, and the unemployment rate, time and state fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3.5: Instrumental Variable Regressions

Second Stage Regressions. Dependent Variable: State-level Saving Rates				
	NME I	NME II	ND I	ND II
Share of Medical Expenditure	**-0.674****	**-0.615****	**-0.606****	**-0.580****
	(0.277)	**(0.272)**	**(0.282)**	**(0.275)**
Share Old	0.222	0.217	0.216	0.213
	(0.220)	(0.220)	(0.221)	(0.220)
Share Middle Age	0.931***	0.935***	0.935***	0.937***
	(0.236)	(0.236)	(0.236)	(0.235)
Share with College or Higher Degree	0.062	0.063	0.063	0.063
	(0.054)	(0.054)	(0.054)	(0.054)
Share Blacks	0.185	0.179	0.178	0.176
	(0.185)	(0.186)	(0.186)	(0.186)
Share Hispanics	0.395***	0.412***	0.414***	0.422***
	(0.122)	(0.121)	(0.122)	(0.121)
State Unemployment Rate	0.416***	0.404***	0.402***	0.397***
	(0.102)	(0.101)	(0.103)	(0.101)
N	1275	1275	1275	1275

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time and state fixed effects are included as regressors.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3.6: Instrumental Variable Regressions With Share of Workers in Pharmaceutical Industry

First Stage Regressions. Dependent Variable: Share of Medical Expenditure				
	NME I	NME II	ND I	ND II
Total Approval * Share Old	0.0426***		0.0164***	
	(0.0045)		(0.0018)	
Total Approval For Old * Share Old		0.1292***		0.0410***
		(0.0138)		(0.0043)
Total Approval For Middle Age * Share Middle Age		0.0403		0.0155
		(0.0290)		(0.0103)
Total Approval * Share with College or Higher Degree	-0.0273***	-0.0296***	-0.0100***	-0.0110***
	(0.0030)	(0.0033)	(0.0011)	(0.0012)
Total Approval * Share Blacks	0.0044***	0.0043***	0.0016***	0.0016***
	(0.0012)	(0.0012)	(0.0005)	(0.0004)
Total Approval * Share Hispanic	0.0055**	0.0062**	0.0018*	0.0021**
	(0.0027)	(0.0029)	(0.0010)	(0.0010)
N	1275	1275	1275	1275
F-test	99.23	78.34	94.19	77.00

All regressions include as control variables the fraction of individuals between the ages of 30 and 60, the fraction older than 60, the fraction with college or higher degree, the fraction of Blacks and Hispanics, the unemployment rate, the share of workers in the pharmaceutical industry, time and state fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix

Figure A3.1: Saving Rates and Health Expenditure Net of Employers' Contributions Without Subtracting Employers' Payroll Tax, NIPA

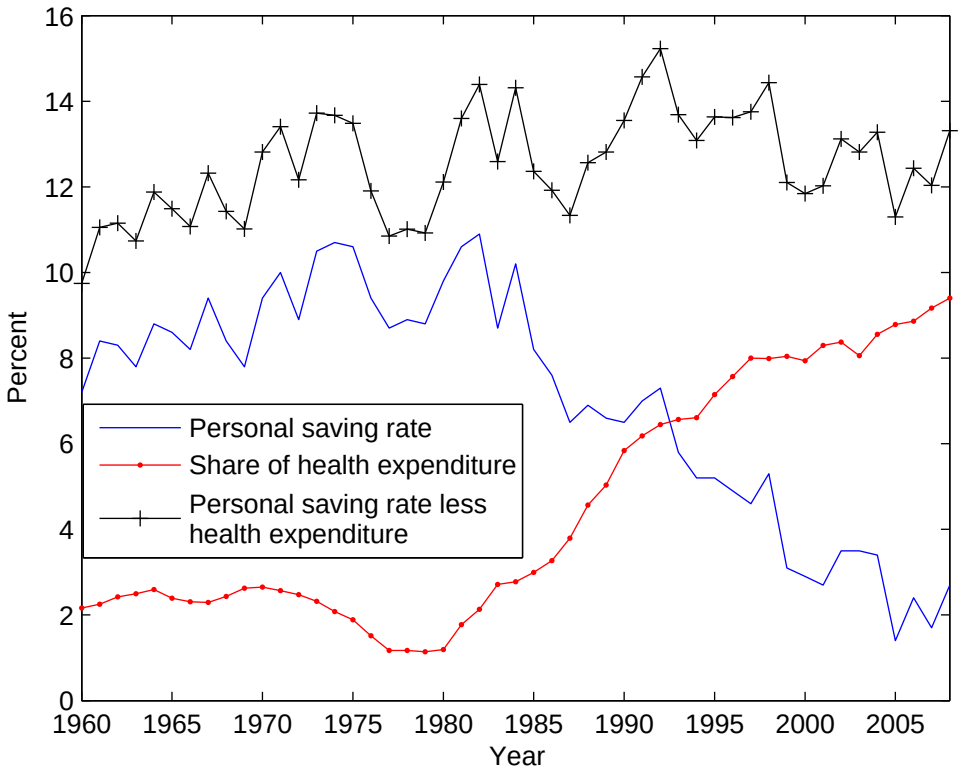


Figure A3.2: Saving Rates and Net Health Expenditure When The Share of Medicare and Medicaid Is Set to a Constant In Disposable Income, NIPA

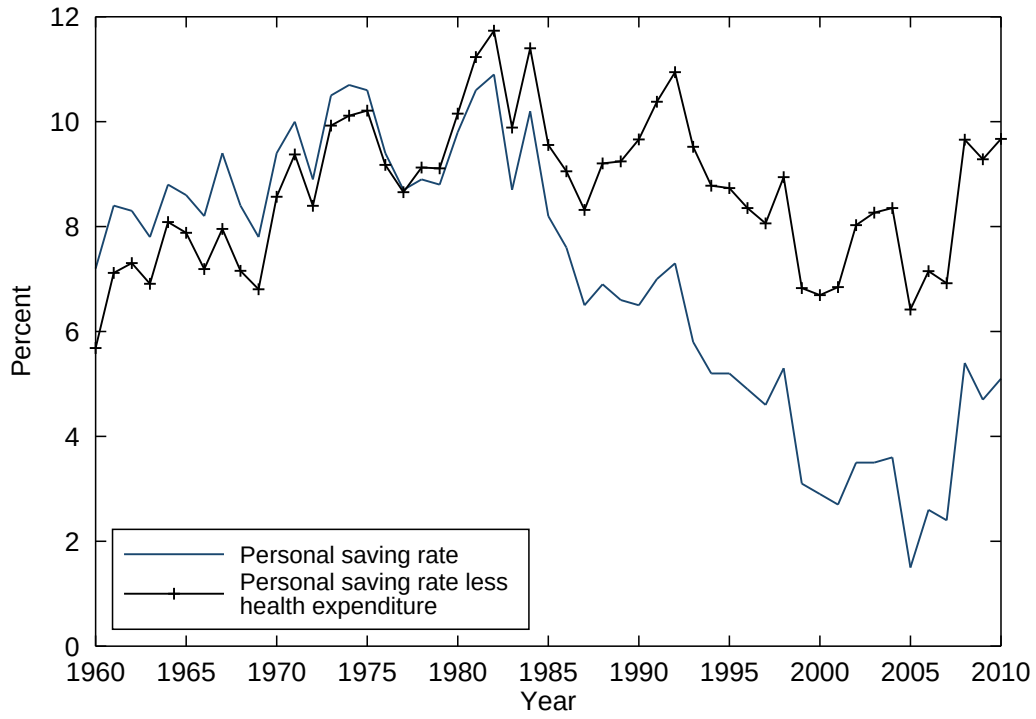


Table 3.7: Instrumental Variable Regressions With Share of Workers in Pharmaceutical Industry

Second Stage Regressions. Dependent Variable: State-level Saving Rates				
	NME I	NME II	ND I	ND II
Share of Medical Expenditure	**-0.671****	**-0.611****	**-0.603****	**-0.577****
	(0.277)	**(0.273)**	**(0.283)**	**(0.276)**
Share Old	0.223	0.217	0.217	0.214
	(0.220)	(0.220)	(0.221)	(0.221)
Share Middle Age	0.915***	0.920***	0.920***	0.922***
	(0.237)	(0.237)	(0.237)	(0.237)
Share with College or Higher Degree	0.057	0.057	0.057	0.057
	(0.054)	(0.054)	(0.054)	(0.054)
Share Blacks	0.189	0.183	0.182	0.179
	(0.186)	(0.187)	(0.187)	(0.187)
Share Hispanics	0.397***	0.414***	0.416***	0.424***
	(0.122)	(0.121)	(0.123)	(0.121)
State Unemployment Rate	0.408***	0.396***	0.394***	0.389***
	(0.102)	(0.101)	(0.103)	(0.102)
State Share of Workers in Pharma. Ind.	0.0073	0.0073	0.0073	0.0072
	(0.0058)	(0.0058)	(0.0058)	(0.0058)
N	1275	1275	1275	1275

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time and state fixed effects are included as regressors.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3.1: Cross-state Regression

Dependent Variable: First Difference in State-level Saving Rate	
Changes in Share of Medical Expenditure	**-0.727*** **
	(0.120)
Changes in Share of Old Individuals	0.137
	(0.243)
Changes in Share of Middle-aged Individuals	0.530***
	(0.138)
Changes in Share with College or Higher Degree	0.025
	(0.058)
Changes in Share of Black Individuals	0.157
	(0.191)
Changes in Share of Hispanic Individuals	0.304***
	(0.062)
Changes in State Unemployment Rate	0.410***
	(0.084)
N	1224
R-squared	0.367

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3.2: Instrumental Variable Regressions

First Stage Regressions. Dependent Variable: Changes in Share of Medical Expenditure				
	NME I	NME II	ND I	ND II
Δ (Total Approval * Share Old)	0.0636***		0.0237***	
	(0.0042)		(0.0017)	
Δ (Total Approval For Old * Share Old)		0.1408***		0.0451***
		(0.0137)		(0.0043)
Δ (Total Approval For Middle Age * Share Middle Age)		0.0872***		0.0311***
		(0.0133)		(0.0052)
Δ (Total Approval * Share with College or Higher Degree)	-0.0272***	-0.0309***	-0.0078***	-0.0114***
	(0.0030)	(0.0033)	(0.0012)	(0.0012)
Δ (Total Approval * Share Blacks)	0.0044***	0.0045***	0.0019***	0.0016***
	(0.0012)	(0.0012)	(0.0005)	(0.0005)
Δ (Total Approval * Share Hispanic)	0.0054**	0.0069**	0.0012	0.0023**
	(0.0027)	(0.0029)	(0.0010)	(0.0011)
N	1224	1224	1224	1224
F-test	93.68	109.6	87.24	106.8

All regressions include as control variables first differences in the fraction of individuals between the ages of 30 and 60, in the fraction older than 60, in the fraction with college or higher degree, in the fraction of Blacks and Hispanics, and in the unemployment rate. Time fixed effects are included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3.3: Instrumental Variable Regressions

Second Stage Regressions. Dependent Variable: Changes in State-level Saving Rates				
	NME I	NME II	ND I	ND II
Changes in of Medical Expenditure	**-0.798****	**-0.741****	**-0.710****	**-0.691****
	(0.301)	**(0.298)**	**(0.308)**	**(0.302)**
Changes in Share Old	0.308	0.303	0.300	0.298
	(0.239)	(0.239)	(0.239)	(0.239)
Changes in Share Middle Age	0.930***	0.931***	0.932***	0.932***
	(0.247)	(0.247)	(0.247)	(0.247)
Changes in Share with College or Higher Degree	0.052	0.052	0.053	0.053
	(0.055)	(0.055)	(0.055)	(0.055)
Changes in Share Blacks	0.203	0.197	0.193	0.191
	(0.189)	(0.190)	(0.190)	(0.190)
Changes in Hispanics	0.372***	0.389***	0.397***	0.403***
	(0.130)	(0.129)	(0.131)	(0.129)
Changes in State Unemployment Rate	0.423***	0.411***	0.405***	0.401***
	(0.109)	(0.108)	(0.109)	(0.108)
N	1224	1224	1224	1224

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.

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