The Pension Option in Labor Insurance and Precautionary Savings: Evidence from Taiwan

Hua Chen, Wenyen Hsu and Mary A. Weiss

Hua Chen
Department of Risk, Insurance and Healthcare Management
Temple University
1801 Liacouras Walk, 625 Alter Hall
Philadelphia, PA 19122
Phone: (215) 204-5905
Fax: (215) 204-4712
Email: hchen@temple.edu

Wenyen Hsu (Corresponding Author)
Department of Risk Management and Insurance
Feng Chia University
100 Wen Hwa Road
Taichung City, 407, Taiwan
Phone: +886-6-24517250x4107
E-mail: wyhsu@fcu.edu.tw

Mary A. Weiss
Department of Risk, Insurance and Healthcare Management
Temple University
1801 Liacouras Walk, 624 Alter Hall
Philadelphia, PA 19122
Phone: (215) 204-1916
Fax: (215) 204-4712
Email: mweiss@temple.edu

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Abstract

Starting in 2009, the Labor Insurance (LI) program in Taiwan has allowed workers to choose between pension old-age benefits and one-time old-age benefits. The introduction of the pension option not only mitigates longevity risk for workers but also provides a higher expected present value of old-age benefits to workers than the one-time benefit option (on average). Based on a lifecycle model with uncertain lifespan, we expect that workers will increase current consumption and reduce savings in response to this policy intervention. We use data from the Survey of Family Income and Expenditure (SFIE) in Taiwan to empirically test this prediction. In order to isolate other systematic structural changes or economic shocks from the true impact of the pension option on savings and consumption, we adopt a difference-in-differences (DID) approach in this study. Our results demonstrate that the implementation of pension benefits in LI lowers households' savings by 9.25% (NT$ 50,798) and raises consumption by 5.27% (NT$ 42,663) for LI workers. In addition, younger households tend to be more responsive to this policy in terms of increasing consumption, while some older households experience a significant decrease in savings.

Key Words: Pension Benefits, Precautionary Savings, Difference-in-Differences Estimator

1. Introduction

Precautionary savings occurs in response to future income uncertainty. Leland (1968) proves that for prudent individuals, the precautionary demand for savings exists even for small variations in future income.[1] Skinner (1988) points out that such precautionary savings could be substantial, accounting for as much as 56 percent of total lifecycle savings. Social insurance programs may lessen uncertainty arising from various sources and reduce the need for precautionary savings. Social insurance programs such as disability insurance (Kantor and Fishback 1996), unemployment insurance (Engen and Gruber 2001), Medicaid (Gruber and Yelowitz 1999) and health insurance (Chou et al. 2003) have been studied for their effects on precautionary savings. In this paper we examine the impact on precautionary savings and consumption of longevity risk reduction resulting from the Labor Insurance (LI) program in Taiwan providing old-age pension benefits.

More specifically, we use a natural experiment associated with a change in Taiwan's LI law to examine the effect on household savings and consumption of the introduction of a pension annuity for workers. Government employees have been offered annuitized pension benefits since 1959, and were not affected by the policy change in LI. Starting in 2009, workers

[1] Some researchers have focused on the effects of earning uncertainty on savings (e.g., Cantor 1985, Skinner 1988, Zeldes 1989, Kimball 1990, and Caballero 1991); other researchers have analyzed the effect on savings of uncertain medical expenses (e.g., Farley and Wilensky 1985, Kotlikoff 1989, Feenberg and Skinner 1994, Palumbo 1999, and Chou et al. 2003) or lifetime uncertainty (e.g., Yaari 1965, Davies 1981, Skinner 1985, Abel 1986, Hubbard and Judd 1987, Hurd 1989, and Engen 1992).

covered under LI can receive annuitized pension benefits as well.[2] The difference in timing of providing old-age pension benefits between these two programs enables us to identify its effect on precautionary savings and consumption for workers under LI. We adopt a 'difference in differences' (DID) approach in order to compare the change in precautionary savings or consumption of a treatment group (workers under LI) with the change of a control group (government employees). The change in savings or consumption for the government employee control group accounts for any systematic structural change while the LI worker treatment group's change reflects both the systematic structural change and the impact of the policy intervention.

The research most closely related to our study is that of Chou et al. (2003). The latter used the DID methodology to empirically test how National Health Insurance (NHI) in Taiwan affected precautionary savings and consumption. Chou et al. (2003) hypothesize that a reduction in uncertainty about future health expenses (the *risk effect*) discourages savings if households are prudent and that the risk effect would dominate an *income effect* in their case.[3] They find that the introduction of NHI in Taiwan reduced savings by an average of 8.6 to 13.7 percent and raised average consumption expenditure by 2.9 to 3.6 percent, with the largest impact on households with the lowest savings.

[2] The terms "annuitization option" and "pension option" are used interchangeably in this paper.

[3] Implementation of the NHI increases expected income net of medical expenses for households because they only need to pay 30 to 40 percent of the premium, resulting in an increase in both saving and consumption – the income effect. The income effect was hypothesized to be trivial because the partial contribution of premiums by employees only accounted for a small percentage of households' expenditures.

In this paper, we present a lifecycle model to demonstrate that the provision of pension benefits in LI can affect households' consumption/saving profile in two ways. The model setup is similar to Cantor (1985), Caballero (1991) and Santen (2011). First, annuitizing old-age benefits obviously reduces longevity risk of workers.[4] So we expect households to respond by raising current consumption and cutting savings due to the *risk effect*.[5] Second, we conduct a simple actuarial analysis which indicates that the pension option significantly increases households' expected old-age benefits on average.[6] An increase in future retirement income will boost permanent income; accordingly workers are encouraged to spend more and save less in the current period. Thus, unlike Chou et al. (2003), risk reduction and income-augmentation resulting from the pension option may actually reinforce the effects of each other, leading to a decrease in savings and an increase in consumption.

Our data is from the Survey of Family Income and Expenditure (SFIE) in Taiwan, a nationally representative survey that collects detailed information on income and consumption expenditures, demographics, and employment status for each member of the households that are surveyed. We use a large data sample (19,802 households) to ensure the applicability of our

[4] The literature investigating the role of uncertain lifespan on consumption/saving profiles can be traced back to Yaari (1965) and has grown extensively in recent years. Hubbard and Judd (1987) argue that substantial precautionary savings are likely to accompany longevity risk in the absence of annuities. Therefore, access to a fair annuity market could remove the influence of lifespan uncertainty on savings and consumption.

[5] Actually, workers may use all of part of the one-time benefit to purchase a private annuity. However, the annuity rate would not be known prior to retirement. In addition, private annuity rates are associated with loadings for underwriting and acquisition expenses. Also, due to longevity risk and investment risk, private annuity issuers would also include a loading for profit. These expenses/loadings are not incurred when the government provides the pension benefit.

[6] Our model does not involve the projection of future pension wealth (e.g., Guiso et al. 1992; Santen 2011) since assumptions in calculating potential pension benefits could introduce noise into the model.

results and the statistical power of our tests. The sample period is 2006 to 2010.[7] Over this sample period, no additional payroll tax for the pension option was levied. Thus, our estimates are free from potential depression of payroll tax on savings and consumption as shown in Hubbard and Judd (1987).[8]

Ordinary-least-squares (OLS) is used in conjunction with the DID methodology to determine the overall effect of the pension option on consumption and savings. Quantile regressions are performed as well to determine the welfare implication across the household-saving (or household-consumption) distribution. Following Kuan and Chen (2011), we also partition the sample into several age groups and investigate the effect of the pension option over the lifecycle.

The results indicate that offering old-age pension benefits through LI lowers overall households' savings by 9.25 percent (NT$ 50,798) and raises overall consumption by 5.27 percent (NT$ 42,663) for workers. The quantile regressions imply that the impact of annuitized pension benefits is larger on households that save less or consume less. We also find that younger households respond significantly in terms of the increase in consumption; and older households react by saving less. This result is intuitive as the motive for savings is not very important at the initial life stage, but it matters more for elder people.

[7] We exclude 2008 for reasons explained later.

[8] Hubbard and Judd (1987) point out that when Social Security is financed through a proportional payroll tax on current earnings the payroll taxes could depress consumption dollar for dollar when the individual faces a liquidity constraint and cannot borrow from the capital market. Thus the increase in individual welfare by introducing Social Security could be reduced or eliminated in the presence of the constraint.

This research has several important advantages over existing empirical work on the effect of pension plans on consumption and precautionary saving. First, we test the impact of offering the pension option in LI on precautionary savings and consumption for workers, not the decision to annuitize or not. Second the provision of pension benefits in LI is not means-tested. Therefore, we can directly test its effect on precautionary savings or consumption without any additional negative impact arising from means-testing. Third, this policy change and other unobservable events may occur simultaneously but independently, changing precautionary savings or consumption and thus leading to potentially biased regression estimates. The difference in timing of annuitizing the old-age benefit in Governmental Employment Insurance (GEI) and LI enables us to use the DID approach to modify the conventional pre-post comparison and provides for a more accurate assessment of the annuitization benefit under LI.

This research contributes to the existing literature as being the first paper to test the effect of LI pension reform in Taiwan on precautionary savings and consumption. Unlike most other papers investigating pension wealth uncertainty (see, e.g., Guiso et al. 2009), we focus on longevity risk reduction.[9] Our results support the theory that a precautionary saving motive from longevity risk is an important determinant of household saving/consumption behavior. This research can provide important insights to many other countries that have aging populations

[9] Pension risk may exist because the pension benefit is designed as a defined contribution plan. Estimating pension risk may also involve subjective beliefs of respondents about future benefits. Thus, large uncertainty and substantial heterogeneity in expected benefits may exist in these studies (Guiso et al. 2009).

like Taiwan and can provide guidance in making new policies in pension programs. Particularly, our findings across the household-saving (or consumption) distribution and across age groups have significant implications to policymakers and can help them target policy intervention to specific groups.

The remainder of this paper is organized as follows. In Section 2, we provide background information on labor insurance in Taiwan. We conduct an actuarial analysis and consider a lifecycle model to illustrate the effect of the pension option in LI in Section 3. We describe the data and discuss our empirical methodology based on the DID approach in Sections 4 and 5, respectively. Empirical results are presented in Section 6. Section 7 concludes.

2. Background of Labor Insurance in Taiwan

Taiwan established its labor insurance program in March 1950, which was the first compulsory social insurance program in Taiwan. Subsequently, the Craft Workers' Insurance Program was initiated in 1951, and the Fishermen's Insurance Program was initiated in 1953. The Government promulgated the Labor Insurance Act in 1958 and it was made effective in 1960. When this program went into effect, the three previous, separate programs were nullified. The Act was amended many times for the purposes of expanding its coverage to more workers, offering better protection, and providing more generous benefits.[10]

[10] Since 1995, medical care for common accidents has been provided by the NHI Program.

In recent years, Taiwan's population and employment structure have experienced great changes with the result that Taiwan is becoming an increasingly aging society. In order to offer the insured person or insured person's dependents long-term living expenses, the government began to plan an old-age labor insurance pension system. After years of effort by the government and discussions among labor, ownership, and academic circles, a bill was passed on July 17, 2008, and the system went into effect on January 1, 2009. At the end of year 2010, approximately 9.4 million people were covered by LI, giving LI the widest coverage of all payment systems in Taiwan and making it the type of social insurance with the greatest number of insureds (General Condition of Labor Insurance from 1950, Bureau of Labor Insurance).

Under the old system, eligible workers could receive a one-time old-age benefit only.[11] In particular, for every full year of insurance coverage, workers could receive one month of the "average monthly insurance salary".[12] After fifteen years, two months of the "average monthly insurance salary" would accumulate for each additional year of insurance. The maximum amount is set at forty-five months of the "average monthly insurance salary". For those who continue to work over the age of sixty, a maximum of five years of insurance coverage can be granted for these years. The combined old-age payment was therefore limited to a maximum of fifty months.

[11] By "one time old age benefit" we mean a lump sum payment at retirement.

[12] The monthly insurance salary is determined by categorizing the worker's actual monthly salary into twenty-two levels, ranging from NT$ 17,280 to NT$ 43,900 in 2008. For example, if actual monthly salary is below NT$ 17,280, the monthly insurance salary is NT$ 17,280. If the actual monthly salary is between NT$ 17,281 to NT$ 17,400, the monthly insurance salary is NT$ 17,400. Likewise, if actual monthly salary is above NT$ 42,001, the monthly insurance salary is NT$ 43,900.

After the Labor Pension Act went into effect on January 1, 2009, workers who have LI insurance coverage before December 31, 2008 could select to have the one time old-age benefit or an old-age pension benefit.[13,14] A claim for the old-age pension benefit can be made by the following: (1) An insured person whose insurance coverage exceeds fifteen years, and who is at least sixty years of age and has resigned from work and withdrawn from insurance coverage; or (2) An insured person who has worked in dangerous, physical hard labor, or work of special character for more than fifteen years, and who is at least fifty-five years of age and has resigned from work and withdrawn from insurance coverage. The monthly payment of pension benefits is the maximum of two amounts: (1) Average Monthly Insurance Salary × Coverage Years × 0.775% + 3,000; (2) Average Monthly Insurance Salary × Coverage Years × 1.55%.[15]

3. Theoretic Framework

Providing pension benefits in LI can obviously reduce the risk that workers outlive their

[13] A one time old-age benefit is available only to the persons who have labor insurance coverage before December 31, 2008. Those who participate in LI for the first time after January 1, 2009 cannot select the one time old-age benefit.

[14] There is another old-age benefit option under the new system called the old-age lump sum benefit. It is clearly different from the pension benefit since it is provided to an insured person whose insurance coverage years are less than fifteen years and is at least sixty years of age and has resigned from work and withdrawn from insurance coverage. For every one full year of insurance coverage, one month of average monthly insurance salary would be paid. For insurance coverage after 60 years of age, five years would be the maximum to be included in the insurance coverage. Therefore, the lump sum benefit is also different from the one-time benefit, in the sense that the former does not set an upper limit while the latter has a maximum of 45 months or 50 months if the insured continues to work over age 60. To avoid complexity, we do not include the discussion of this lump sum benefit in this paper since we mainly focus on the effect of the old-age pension benefit on precautionary savings or consumption of workers.

[15] In the actuarial analysis in Section 3.1, we assume that laborers prefer amount (2) to amount (1) in order to normalize the "average monthly insurance salary" and compare the present value of old-age pension benefits with the value of the one-time old-age benefits. Note when the monthly insurance salary is NT$ 26,400 (the 11th among 22 levels), a minimum coverage year of 14.67 is required to satisfy this assumption. We also know laborers need at least 15 years coverage to qualify for the pension benefits. So qualified laborers whose monthly insurance salary is greater than NT$ 26,400 will automatically choose amount (2), and other qualified laborers may or may not choose amount (2) depending on their coverage year seniority. However, even for the lowest monthly insurance salary level (NT$ 17,280), the insured will choose amount (2) as long as the coverage year is greater than 22.4.

resources, i.e., longevity risk. Furthermore, it may affect the present value of old-age benefits that workers expect to receive upon retirement. Comparing the risk and retirement income between the one-time benefit option and the pension benefit option can shed light on how this policy change in LI affects precautionary savings and consumption behavior. In this section, we first calculate the actuarial present value of old-age benefits for these two options. We then use a lifecycle model to analyze the policy implications of offering pension benefits to workers.

3.1. Actuarial Analysis

Driven by improving human health and prolonged life expectancy, the average retirement age in Taiwan has risen from 54.9 years in 2005 to 56.3 years in 2009, according to statistics compiled by the Directorate General of Budget, Accounting and Statistics (DGBAS).[16] Suppose a representative individual started working at the age of twenty-five and retired at the age of fifty-six.[17] Let n denote the number of complete months from the individual's retirement until his/her death. Before 2009, the insured could only receive a one-time old-age benefit (PV^{OT}) from LI, which is equal to forty-five months of the "average monthly insurance salary". Normalizing the average monthly insurance salary to one, we have $PV^{OT} = 45$. Since 2009, eligible workers can choose between the one-time benefit and pension benefit with monthly payments (MP) that are equal to Average Monthly Insurance Salary × Coverage Years × 1.55%.

[16] The rising retirement age in Taiwan is also due to the revision of the Labor Standards Act in April 2008, delaying mandatory retirement to 65 from the former 60.

[17] The insured can wait until he/she reaches age 60 to claim the old-age benefit. If he/she wants to claim earlier than age 60, a deduction ratio will apply to the monthly payment. Considering this deduction does not change the conclusions of our analysis.

Normalizing the average monthly insurance salary to be one and assuming the worker has LI coverage for thirty-one years, we have

$$MP = 1.55\% \times 31 = 0.4805. \tag{1}$$

Suppose the level benefits are paid at the beginning of each month while the laborer survives. The present value of pension benefits (PV^{PB}) at the time of retirement can be calculated as

$$PV^{PB} = MP \times \ddot{a}_{\overline{n}|\frac{i^{(m)}}{m}}, \tag{2}$$

where $\ddot{a}_{\overline{n}|i^{(m)}/m}$ is the present value of an annuity-due, payable \$1 at the beginning of each period for n periods, with the interest rate $i^{(m)}/m$. Here $i^{(m)}$ is the nominal interest rate compounded m-thly per year and $m = 12$.

In Figure 1, we plot the present value of pension benefits (PV^{PB}) against the number of months until death (n) using several nominal interest rate scenarios ($i^{(m)} = 2\%$, 4% or 6%). Once the individual aged 56 at retirement survives another 126 months (10 years and 6 months), he /she receives more old-age benefits under the annuity option than he/she does under the one time option, when the nominal interest rate compounded monthly is 6%. As the interest rate gets lower, he/she needs less time to accumulate the equivalent benefits under the one time option. Living for another 10.5 years is not a dream for most Taiwanese: the life expectancy for an individual aged 56 in year 2009 is 26.46 years.[18] So clearly most insureds will prefer the pension benefit to

[18] Source: Department of Statistics in Taiwan http://sowf.moi.gov.tw/stat/english/elife/te98210.htm

the one-time benefit.[19]

[Insert Figure 1 Here]

Now we calculate the actuarial present value of pension benefits (APV^{PB}),

$$APV^{PB} = m \times MP \times \ddot{a}_{56}^{(m)}, \tag{3}$$

where $\ddot{a}_x^{(m)}$ is the actuarial present value of a whole life annuity-due of \$1 per year, payable in installments of $\$1/m$ at the beginning of each *m*-th of the year, issued to an individual aged x. The calculation of $\ddot{a}_x^{(m)}$ can be found in any actuarial textbook. We include the formula in Appendix A for completeness. Based on the mortality table in Taiwan[20], $APV^{PB} = 71.97$ when $i^{(m)} = 6\%$; $APV^{PB} = 89.27$ when $i^{(m)} = 4\%$; and $APV^{PB} = 114.35$ when $i^{(m)} = 2\%$. In each interest rate scenario, the expected present value of old-age benefits under the pension option is greater than that under the one-time benefit option. (Recall that $PV^{OT} = 45$.)

3.2. A Lifecycle Model

In this subsection, we consider a simplified version of the lifecycle model presented by Santen (2011) to illustrate the effect of the pension option on precautionary savings and consumption. Santen (2011) takes into account both lifespan uncertainty and income uncertainty while we focus on lifetime uncertainty and the difference in the actuarial present value of old-age benefits between the two options in LI. We also assume a zero interest rate and zero discount rate

[19] Alternatively, the pension annuity benefit can be viewed as an additional retirement option for workers. If this option has no value, then we would expect to see no difference in savings or consumption for workers before and after the implementation of pension benefits in LI. Changes in savings and/or consumption, then, can provide evidence that the pension option, overall, has value to LI workers.

[20] Source: Human Mortality Database http://www.mortality.org/

for illustration purposes.

Assume a representative individual aged x in the current period is endowed with some wealth, A_{x-1}, from the previous period.[21] His/her remaining lifetime is divided between the working stage and the retirement stage. The retirement age, K, is exogenous. The individual receives an exogenous income stream, y_s $(x \le s \le K-1)$, before retirement. His/her retirement income is constant per period until death, i.e., $y_s = y_K$ for $s \ge K$. Survival until retirement is guaranteed; after retirement, the survival probability up to age s is denoted by ${}_{s-K}p_K$ with ${}_0p_K = 1$. The maximum attainable age is denoted by T. We assume a constant-absolute-risk-aversion (CARA) utility function for each period, i.e.,

$$u(c) = -\frac{1}{\alpha}\exp(-\alpha c), \tag{4}$$

where c is the consumption expenditure and α measures the degree of absolute risk aversion.

Under this model setup, the lifetime utility maximization problem can be written as

$$\begin{aligned} &\max_{c_s} -\frac{1}{\alpha}\sum_{s=x}^{K-1}\exp(-\alpha c_s) - \frac{1}{\alpha}E_x\sum_{s=K}^{T}{}_{s-K}p_K\exp(-\alpha c_s) \\ &\text{s.t. } \sum_{s=x}^{K-1}c_s + \sum_{s=K}^{T}c_s = A_{x-1} + \sum_{s=x}^{K-1}y_s + \sum_{s=K}^{T}y_K \end{aligned}, \tag{5}$$

where c_s is consumption at age s and E_x is the expectation operator conditional on information up to age x.

The current period consumption, c_x, can be solved as[22]

[21] We use age instead of time as the subscript to avoid complexity of notation. It does not change the results.

[22] We refer interested readers to Santen (2011) for the complete derivation of the model. Basically, it can be solved in three steps. First, we focus on the retirement period and calculate the value of future utility streams given the

$$c_x = \frac{A_{x-1} + \sum_{s=x}^{K-1} y_s + (T-K+1)y_K}{T-x+1} - \frac{\sum_{s=K}^{T} \frac{1}{\alpha} \ln({}_{s-K}p_K)}{T-x+1}. \quad (6)$$

Equation (6) is economically intuitive. The first term is permanent income and the second term measures precautionary savings due to lifetime uncertainty. If the individual lives up to T for certain, i.e., ${}_{s-K}p_K = 1$ for $K \le s \le T$, the second term goes to zero, which implies that the individual maximizes the lifetime utility by smoothing out his/her consumption path. With lifetime uncertainty, however, the second term does not go to zero. In this case, the individual consumes less and saves more in order to reduce risk, compared with the case of a certain lifetime horizon. The lower longevity risk the individual faces (i.e., smaller survival probabilities), the more current consumption and the less savings take place. In addition, an increase in income after retirement leads to an increase in current consumption and a decrease in savings.

Providing pension benefits in LI significantly reduces longevity risk for workers, thus discouraging precautionary savings and increasing current consumption from the risk effect. Pension benefits also bring more expected cash flows for the representative individual than the one-time benefit option, which increases current consumption and decreases savings further.[23] In the remaining parts of this paper, we will empirically test the impact of the pension option in LI

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wealth available right before retirement, A_{K-1}. Second, we solve the problem for the working stage, and compute the value of utility streams as a function of A_{K-1} as well. Third, we choose A_{K-1} to maximize the lifetime utility.

[23] Some may argue the pension option can increase savings and consumption based on an income effect. However, the extra income from the pension benefit is only realized after retirement, so the increased retirement income raises consumption and cuts savings for the current period provided that the current period income remains unchanged.

on individuals' saving/consumption behavior to see if it is consistent with our prediction.

4. Data and Sample

We employ data from the Survey of Family Income and Expenditure (SFIE) conducted each year by the Directorate-General of Budget, Accounting and Statistics, Taiwan. The SFIE is conducted on a household basis. It includes information on demographic characteristics, income, educational background, social insurance status (GEI, LI, or others) and industrial sector of employment for each member in the sampled households.

Though the LI pension system was formally implemented in 2009, the passage of the bill on July 17, 2008 could have affected individuals' expectations and incentives for precautionary savings. To avoid potential biases, data for 2008 are excluded. We therefore use the 2006-2007, 2009-2010 data to compare the changes in precautionary savings and consumption between the pre- and post-annuitization periods. Since all samples are randomly drawn each year, we cannot track individual households longitudinally.[24]

Since GEI has provided the pension option in old-age benefits to insureds since 1959,

[24] The Directorate-General of Budget, Accounting and Statistics uses two methods to enhance the accuracy of the survey. In particular, "Both interviews and account-keeping are used to collect data in the survey. Households for interview are drawn from the population by the stratified random sampling method, and parts of the sampled households for interview are also selected to do account-keeping regularly. The sampled households are interviewed once a year for major items of income and expenditure of the year. Detailed categories are estimated on the basis of data recorded by account-keeping households. For households assigned to do account-keeping, they are required not only to receive an interview but to record actual income and expenditure every day. The enumerator shall review the account books and provide necessary advice in order to avoid mistakes, duplication, and omission. Data obtained in this way are more accurate than those derived from interviews." (Directorate-General of Budget, Accounting and Statistics Executive Yuan, 1994, p. 2). These data are used in many research studies, such as Deaton and Paxson (1994), Liu and Chen (2002), and Chou et al. (2003).

government employees are not affected by the policy change in LI. Hence we use government employees as a control group in this paper. Households without members insured in either GEI or LI are excluded. Households with members working in different sectors (one works for the public sector and is thus insured by GEI, and the other one works in the private sector and is insured by LI) are also excluded. Our control group includes households with at least one member covered by GEI (one with GEI and the other is not in the labor force or both covered by GEI). The treatment group includes households with at least one member covered by LI (one with LI and the other one is not in the labor force, or both are covered by LI).[25]

We restrict our sample to households whose head is married and between 20-65 years old. Since agricultural families and households with members serving in the army are insured in different annuity programs, they are excluded from the sample. Households reporting negative net saving or incomplete information are also excluded.[26] The final sample contains 19,802 households, among which 1,380 household heads are government employees and 18,422 are non-government employees.

[25] Since 2009 and 2010, the SFIE doesn't report individual income and consumption. We therefore cannot differentiate whether both the head and the spouse of the household head are in the same insurance program. However, we still can identify whether the household pays GEI premiums or LI premiums. Therefore, we exclude households reporting no GEI nor LI premiums, and those paying both GEI premiums and LI premiums. We cannot identify unemployment by premium.

[26] Chou et al. (2003, 2004) exclude households with negative savings in their empirical studies. Focusing on the same dataset, Kuan and Chen (2011) find that households with negative savings account for 18.9% of the entire sample. They argue that deleting such a large proportion of the sample causes a sample selection problem and may lead to biased results. In our data, the proportion of households with negative savings is 4.6% only. We obtain very similar empirical results when including them in our sample.

5. Empirical Methodology

A naïve approach for evaluating the effect of a treatment event on the treatment group is to simply compare the outcomes of the treatment group before and after the policy intervention, the so-called pre-post estimator. However, several other systematic structural changes might occur during the same time period as the treatment event. To separate the true effect of the treatment from other structural changes, we use the DID estimator in this paper through the use of a control group.

5.1. The DID Estimator: An Overview

Suppose that we wish to evaluate the impact of a program or treatment on an outcome y_i over a population of individuals. There are two groups indexed by treatment status $T = 0$ or 1, where 0 indicates the group that does not receive treatment, i.e., the control group, and 1 indicates the group that receives treatment, i.e., the treatment group. We observe data in two periods, denoted by $t = 0$ or 1, where 0 indicates a time period before the treatment group receives treatment, and 1 indicates the time period after that. In order to evaluate the effect of treatment on the treatment group, a simple pre-post estimator or a treatment-control estimator can be constructed. However, both the pre-post estimator and the treatment-control estimator are biased, given a time trend or a permanent difference between the two groups. Therefore, we adopt the DID estimator to measure the true effect of treatment.

The outcome y_i can be modeled as follows:

$$y = \alpha + \beta T + \gamma t + \delta(t * T) + \varepsilon\,, \tag{7}$$

where α is a constant term, β measures the treatment group specific effect (to account for average permanent differences between treatment and control groups in the pre-treatment period), γ controls for a time trend common to the control and treatment groups, δ measures the true effect of treatment, and ε is a random error term.

Let $\overline{y}_0^T$ and $\overline{y}_1^T$ be the average outcomes for the treatment group before and after treatment, respectively, and $\overline{y}_0^C$ and $\overline{y}_1^C$ be the corresponding average outcomes for the control group. Under these assumptions we can obtain expected values of these variables easily.

$$E\left[\overline{y}_0^T\right] = \alpha + \beta\,,\;\; E\left[\overline{y}_1^T\right] = \alpha + \beta + \gamma + \delta\,,\;\; E\left[\overline{y}_0^C\right] = \alpha\,,\;\; E\left[\overline{y}_1^C\right] = \alpha + \gamma\,. \tag{8}$$

The DID estimator is defined as the difference in average outcome in the treatment group before and after treatment minus the difference in average outcome in the control group before and after treatment, i.e.,

$$\hat{\delta}_{DD} = \overline{y}_1^T - \overline{y}_0^T - \left(\overline{y}_1^C - \overline{y}_0^C\right). \tag{9}$$

Note that the DID estimator is unbiased as

$$\begin{aligned} E[\hat{\delta}_{DD}] &= E[\overline{y}_1^T] - E[\overline{y}_0^T] - \left(E[\overline{y}_1^C] - E[\overline{y}_0^C]\right) \\ &= \alpha + \beta + \gamma + \delta - \left(\alpha + \beta\right) - \left(\alpha + \gamma - \alpha\right) \\ &= \delta \end{aligned} \tag{10}$$

5.2.1. The OLS Regression with DID

In this paper, we investigate the effect of providing pension old-age benefits to households with LI on their consumption/savings profile. Recall that households with LI

comprise the treatment group, while GEI households are the control group. We pool the samples of the control and treatment groups and estimate the following equation,

$$y_i = \alpha + \beta \times LI_i + \gamma \times Annuitization_i + \delta \times (LI_i \times Annuitization_i) + \lambda \times Z_i + \varepsilon_i \qquad (11)$$

where y denotes the log of precautionary savings (or consumption) for the households in our sample; LI=1 for households with LI and 0 for those with GEI; Annuitization=1 if the data is from the post-annuitization period and 0 if it is from the pre-annuitization period; and Z is a set of control variables described below plus a trend variable. This trend variable, Trend, is defined as the difference between the current year and 2006. Using the trend variable can control for time effects other than pre- and post-annuitization (Chou et al. 2004, Cohen et al. 2008). If δ is statistically significant, there exists a significant relationship between the change in precautionary savings (or consumption) and the provision of the pension option.

5.2.2. Dependent and Independent Variables

We use two dependent variables: household savings and household consumption expenditures. Household saving is defined as the difference between disposable income and consumption expenditure. All money figures are converted to 2006 NT dollars by using the all items Consumer Price Index.[27]

Since the demographic characteristics of household members affect saving and

[27] Let the CPI in 2006 be equal to 1. The CPI for each year in Taiwan was 1.0180 (1.0483, 1.0461) in 2007 (2009, 2010). The average exchange rate in 2006 was NT$32.53 (31.52, 33.05, 31.62) for an US dollar in 2006 (2007, 2009, 2010).

consumption behavior, we include the household head's gender, age, age squared, education dummies (6 category dummy variables), spousal education dummies (6 category dummy variables), the number of children under the age of 18 years, the number of elderly parents or grandparents, and the logged value of household permanent income.

According to the permanent income hypothesis, individuals' consumption in a given period is determined by his/her permanent income instead of income in that period (Friedman 1957). It is a common practice to control for permanent income in the saving/consumption functions; see, e.g., Guiso et al. (1992), Starr-McCluer (1996), Kazarosian (1997) and Chou et al. (2004). Thus, permanent income is included as an independent variable in our models. In this paper, we follow Guiso et al. (1992) to construct household permanent income. It is based on the observable characteristics of households. The details can be found in Appendix B.

A complete list of variable definitions is reported in Table 1.

[Insert Table 1 Here]

Table 2 presents summary statistics for the explanatory variables. The average savings of the sample is NT$ 516,898 and the average consumption is NT$ 826,585. The logged household permanent income is 14.2134.

[Insert Table 2 Here]

5.3. Transformation Bias and Marginal Effects

Recall that the dependent variable (savings or consumption) is transformed to log values

in the OLS regression (11). However, the "real" marginal effect of annuitization should be assessed on the untransformed scale. So we are confronted with the problem of a retransformation effect, i.e., the logged dependent variable is unbiased but the marginal effect on the untransformed dependent variable might be biased. Duan (1983) proposes a nonparametric method, the smearing estimate, to measure an individual's expected response on the untransformed scale. Basically, we need to first estimate the error distribution by the empirical cumulative distribution function of the estimated regression residuals, and then take the desired expectation with respect to the estimated error distribution. This approach can be viewed as an application of the bootstrap principle in a broader context (Efron 1979).

Specifically, the marginal effect can be expressed either in the dollar amount change

$$E(y \mid t=1) - E(y \mid t=0), \tag{12}$$

or the percentage change

$$\frac{E(y \mid t=1) - E(y \mid t=0)}{E(y \mid t=0)}. \tag{13}$$

The general form of the retransformation for a log-linear model is given by

$$E(y) = \phi \exp(X\beta), \tag{14}$$

where $\phi = E[\exp(\varepsilon)]$ is the smearing factor.

5.4. Quantile Regressions

While the OLS regression can answer the question "does the provision of pension

benefits in LI significantly affect savings (or consumption) for households with LI?", it cannot address another important question: "does it affect savings (or consumption) differently for households with low savings (or consumption) than for those with high savings (or consumption)?" A more comprehensive picture of the impact on households' savings (or consumption) of the provision of pension benefits in LI can be obtained by using quantile regression. Quantile regression was introduced by Koenker and Bassett (1978) as a statistical technique intended to estimate, and conduct inference about, conditional quantile functions. The classical linear regression methods based on minimizing sums of squared residuals enable one to estimate models for conditional mean functions, while quantile regression methods offer a mechanism for estimating models for the full range of conditional quantile functions. Quantile regressions are estimated in this study.

5.5. Age-varying Effects

So far, we have assumed the effect of providing pension benefits in LI is constant over the life cycle. However, it is possible that the effect varies across age groups. Kimball (1990) argues that like risk aversion, prudence also declines with wealth. Given the fact that a household's wealth path is usually hump-shaped and peaks before the retirement age, decreasing absolute prudence implies that younger households are usually more sensitive to risk reduction and thus inclined to demonstrate a larger response than older households. In addition, households with a liquidity constraint might have a stronger precautionary saving incentive (Carroll, 1997).

Younger households are more likely to have a liquidity constraint and thus be more responsive to this policy change. On the other hand, older groups that are close to the retirement age usually face more urgent needs to plan retirement life, so they can be more sensitive to risk reduction resulting from the provision of the pension option in LI as well. Putting all this together, the response of different age groups to the provision of pension benefits in LI is not likely to be uniform. Caution has to be used to identify the welfare implication of this policy change.

In order to estimate the effect of annuitization on precautionary savings or consumption over the life cycle, we partition the data into eight age groups (age group 20-30, then 5-year age groups such as 30-35, 35-40, up to 60-65).[28] We estimate the groupwise treatment effects based on the following regression,

$$\begin{aligned} y_i = \alpha + \sum_{j=1}^{8} \beta_j \left(LI_i \times K_i(j) \right) + \sum_{j=1}^{8} \gamma_j \left(Annuitizat\ ion \times K_i(j) \right) \\ + \sum_{j=1}^{8} \delta_j \left(LI_i \times Annuitizat\ ion_i \times K_i(j) \right) + \lambda \times Z_i + \varepsilon_i \end{aligned} \tag{15}$$

where $K(j)$, $j = 1,2,...,8$, are the indicators of the eight age groups.

6. Empirical Results

6.1. Preliminary Results

Table 3 compares the changes in household savings and consumption in the pre- versus post-annuitization periods according to insurance status. Savings and consumption in GEI

[28] There is no government employee aged 20-25 in our sample. So we have to pool the individuals aged 20-30.

households are higher than those in LI households. Both savings and consumption in LI households drop substantially after the year 2008: the average savings decreases by 0.0934 and the average consumption decreases by 0.0402. In contrast, savings in GEI households change in the opposite direction: their average savings increase by 0.0398. The average consumption in GEI households decreases by 0.0621. The DID indicator between LI households and GEI households is -0.1332 for savings and 0.0219 for consumption at the mean.[29] Other percentile statistics show a similar pattern. In other words, we observe clear evidence that the introduction of the pension option in LI discourages savings and raises consumption for LI workers, using the change in the savings/consumption profile of government employees as a benchmark.

[Insert Table 3 Here]

6.2. OLS Regression Results

The OLS regression results with heteroscedasticity-consistent standard errors are reported in Table 4.

[Insert Table 4 Here]

The adjusted R^2 is 25.86% for the savings regression and 41.30% for the consumption regression, which indicates that the models fit the data well. Most explanatory variables have coefficients significant at the 1% level. They are also jointly significant as suggested by the F-statistics. In particular, the coefficient of the interaction term between Annuitization and LI is

[29] The change in savings or consumption is measured in log values in this paragraph.

statistically significant at the 1% level in both models. It is negative in the saving model and positive in the consumption model, which confirms our prediction that the implementation of the pension scheme decreases savings and increases consumption for households with LI.

6.3. Marginal Effect of Annuitization

We now estimate the impact of annuitization on workers' saving and consumption levels. Since we use the logged value of savings or consumptions as the dependent variable in the OLS regression, but the true effect of the pension option needs to be evaluated on the untransformed variable scale, we have to take into account the potential transformation bias. Following Duan (1983) and Chou et al. (2003), we apply the "smearing" method to retransform the dependent variable to calculate the "real" marginal effect of the pension option on precautionary savings. We estimate the smearing factor as the sample average of the exponentiated least-squares residuals in the OLS regression (11). The smearing factor is 1.3066 for the saving model and 1.0492 for the consumption model. We then calculate the marginal effect of the pension option in LI based on equations (12), (13) and (14). Our results show that providing pension benefits decreases savings by 9.25% (NT$ 50,798) and increases consumption by 5.27% (NT$ 42,663) for households with LI.

6.4. Quantile Regression Results

We are also interested in the effect of annuitization across households with different levels of savings (or consumption). A natural and relatively simple way to explore this difference

is through the use of quantile regressions. To focus on the impact of annuitization on the treatment group, we only report δ, the coefficient of the DID estimator, for the 10th, 25th, 50th, 75th and 90th percentiles in Table 5.

[Insert Table 5 Here]

All the DID coefficients are negative in the savings regression and positive in the consumption regressions, indicating a consistent pattern regarding the influence of annuitization on households with LI across varying levels of savings or consumption. Our empirical results show that its effect is insignificant for households at the top of the saving distribution (above 50th percentile) or at the top of the consumption distribution (above 75th percentile). At lower percentiles, the DID coefficients are statistically significant at the 5% level or better, indicating that the impact of annuitization is significant only for households that save less or consume less. We use the Wald F-statistics to test if the difference in the DID estimator is significant across the household-saving (or consumption) distribution. The test results reject the null hypothesis that the DID coefficients are equivalent in the saving and consumption models, which implies that its effect on savings and consumption for households with LI is significantly different across percentiles. From Table 5, the impact of annuitization on savings monotonically decreases at all percentiles levels. In addition, the Wald test indicates that the impact on the 10th percentile is significantly greater than that on the 25th percentile for savings. For households' consumption, the largest positive effect on consumption appears at the 25th percentile. However, the difference

between the 10th and 25th percentiles is insignificant. Its impact on the 25th percentile is significantly greater than at the 50th percentile. Our empirical evidence suggests that the provision of pension benefits has significantly greater impact on households that save less or consume less.

6.5. Age-Varying Effects of Annuitization

To compare the treatment effects across age groups, we create eight dummy variables indicating different age groups and estimate model (15). To conserve space, we only report the DID estimators and their standard errors in Table 6; complete estimation results are available upon request.

[Insert Table 6 Here]

With respect to savings, the treatment effect is negative for all age groups except for the age group 30-35. The treatment effect on household consumption is almost always positive except for age groups 50-55 and 60-65. It is noteworthy that though the DID estimators in these age groups have an opposite sign to our prediction, they are not significant. The implementation of annuitized pension benefits in LI has a significantly negative impact on household savings for senior age groups (40-45 and 50-55) and it has a significantly positive impact on household consumption for younger age groups (20-30, 35-40, and 40-45).

Our results are consistent with the findings in Chou et al. (2004) and indicate a clear lifecycle pattern. On the one hand, younger households usually possess less wealth and thus are

more prudent due to decreasing absolute prudence; this implies they would be more sensitive to risk reduction associated with the provision of pension benefits. Considering that they are at the initial life stage and the motive of saving for retirement is not very important, they react with a substantial increase in their consumption expenditures. On the other hand, elderly groups have retirement on the horizon, which presumably they have been saving for. So their reaction to risk reduction is mainly on the saving side. They would save less after the implementation of pension benefits in LI.

7. Conclusions

In this paper, we use the provision of pension benefits in the Labor Insurance program in Taiwan as a natural experiment to test its impact on households' precautionary savings and consumption. We choose households with at least one member covered by GEI as the control group since GEI has provided the pension option since 1959. Our treatment groups include households with at least one member covered by LI. We employ a DID approach to isolate "nuisance" factors from the true impact of annuitzation in LI.

Our OLS regression results indicate that the reduction of longevity risk/or the provision of the pension option have a significantly negative effect on precautionary savings and a significantly positive influence on consumption: it decreases savings by 9.25% (NT$ 50,798) and increases consumption by 5.27% (NT$ 42,663) for households with LI. These results are

consistent with findings in Chou et al. (2003) and other papers that reducing future income uncertainty may discourage precautionary savings. In addition, the magnitude of its impact on savings (or consumption) is the largest at the bottom percentile in the household-saving (or household-consumption) distribution. We also investigate how its effect varies across age groups. Our empirical results show that younger households respond to the provision of the pension benefit by significantly increasing their consumption and older ones respond by significantly reducing their savings.

This research indicates that government policy can have a significant influence on consumption and savings patterns of the population. These effects vary by demographic characteristics (e.g., age distribution) in ways that are predictable given the life cycle hypothesis. Thus this research indicates that factors such as the age distribution must be taken into account when making governmental policy. Many countries besides Taiwan have an aging population, so these results could provide some useful guidance for other countries in making new policy, especially with respect to pension programs. Finally, this work is useful because it complements the work of previous studies concerning the impact of social security type programs on precautionary savings.

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Appendix A: Calculate the APV of Pension Benefits

Notations:

$i^{(m)}$: nominal interest rate compounded m-th ly per year.

$i = \left(1 + \frac{i^{(m)}}{m}\right)^m - 1$: annual effective interest rate,.

$v = \frac{1}{1+i}$: one year discount factor

$d = 1 - v$: annual effective discount rate

$d^{(m)} = \frac{m i^{(m)}}{m + i^{(m)}}$: nominal discount rate compounded m-th ly,

$\ddot{a}_x = \sum_{k=0}^{\infty} v^k \, {}_k p_x$: APV of a whole life annuity-due of \$1 per year.

$\ddot{a}_x^{(m)} = \frac{1}{m} \sum_{k=0}^{\infty} v^{k/m} \, {}_{k/m} p_x$: APV of a whole life annuity-due of \$1 per year, payable in installments of $\$1/m$ at the beginning of each m-th of the year while (x) survives.

With these notations in mind, the actuarial present value of old-age pension benefits can be calculated as

$$APV^{PB} = m \times MP \times \ddot{a}_x^{(m)} = m \times MP \times \left(\alpha(m)\ddot{a}_x - \beta(m)\right), \tag{A.1}$$

where $\alpha(m) = \frac{i \times d}{i^{(m)} d^{(m)}}$ and $\beta(m) = \frac{i - i^{(m)}}{i^{(m)} d^{(m)}}$.

Appendix B: Estimation of Permanent Income

We follow Guiso et al. (1992) to construct the permanent household income. The permanent household income at age τ can be expressed as

$$Y(\tau) = Z\beta + \Phi(\tau), \tag{B.1}$$

where Z is a vector of characteristics for the household head and Φ is a quadratic function of age for household heads. Assuming 65 years is the maximum age at which people work, the estimated permanent income at age τ_0 is

$$Y_p(\tau_0) = (65 - \tau_0 + 1)^{-1} \sum_{\tau=\tau_0}^{65} [Zb + f(\tau)] \left(\frac{1+n}{1+r}\right)^{\tau-\tau_0}, \tag{B.2}$$

where b and f are the estimated coefficients of β and Φ, r and n are interest rate and the rate of growth of productivity. For simplicity, let r equal n. The estimated permanent income can be calculated as

$$Y_p(\tau_0) = Zb + (65 - \tau_0 + 1)^{-1} \sum_{\tau=\tau_0}^{65} f(\tau). \tag{B.3}$$

Variables used to estimate β and Φ include demographic characteristics, occupation for heads of a household and their spouses, family size, and the year trend. The estimation results are satisfactory. Most explanatory variables are significant at 1% level and adjusted R^2 is 42.14%. The estimated permanent household income is then used as a control variable in the saving/consumption equation.

Table 1: Variable Descriptions

Variables	Definition
Log(Saving)	Log of the difference between total disposable household income and expenditures
Log(Consumption)	Log of consumption expenditure including food, beverage, tobacoo, closing, fuel, water, rent, future and family facilities, medical care and sanitation, transport and communication, recreation, education, culture, and other miscellaneous expenditures.
LI	Dummy variable = 1 if the household is insured by labor insurance
Annuitization	Dummy variable = 1 if the year is post-annuitization
Characteristics of Household Head	
Head Educational Dummies: Junior/Senior/College/University/ Graduate	Dummy variable = 1 if household head finished junior high school/ senior high school/ community college/ university/ gradual school (illiterate individuals are in the reference group)
Male	Dummy variable = 1 if household head is male
Age	Age of the household head in years
Age^2	Squared age/100
Characteristics of Family Members	
Spouse Educational Dummies: Junior/Senior/College/University/ Graduate	Dummy variable = 1 if spouse of household head finished junior high school/ senior high school/ community college/ university/ gradual school (Illiterate individuals are in the reference group)
# of children	# of children under age 18
# of parents or grandparents	# of parents or grandparents
Log(Permanent Income)	Log of household permanent income

Table 2: Summary Statistics

Variable	Mean	Std Dev	25th percentile	50th percentile	75th percentile
Log (Saving)	12.7836	0.9282	12.2561	12.8416	13.3913
Log (Consumption)	13.5462	0.3980	13.2979	13.5519	13.8031
LI	0.9303	0.2546	1.0000	1.0000	1.0000
Annunitization	0.4968	0.5000	0.0000	0.0000	1.0000
Junior	0.1673	0.3732	0.0000	0.0000	0.0000
Senior	0.3393	0.4735	0.0000	0.0000	1.0000
College	0.1663	0.3724	0.0000	0.0000	0.0000
University	0.1428	0.3499	0.0000	0.0000	0.0000
Graduate	0.0482	0.2143	0.0000	0.0000	0.0000
Male	0.8797	0.3254	1.0000	1.0000	1.0000
Age	46.2093	8.7731	39.0000	47.0000	53.0000
Spouse Junior	0.1695	0.3752	0.0000	0.0000	0.0000
Spouse Senior	0.3693	0.4826	0.0000	0.0000	1.0000
Spouse College	0.1479	0.3550	0.0000	0.0000	0.0000
Spouse University	0.1277	0.3338	0.0000	0.0000	0.0000
Spouse Graduate	0.0212	0.1441	0.0000	0.0000	0.0000
# of children	1.0214	1.0034	0.0000	1.0000	2.0000
# of grandparents	0.2244	0.5597	0.0000	0.0000	0.0000
Log (Permanent Income)	14.2134	0.3044	14.0177	14.1914	14.3962
Trend	1.9962	1.5907	0.0000	1.0000	4.0000

Note: The final sample contained 19,802 households of which 1,380 household heads are government employees and 18,422 are non-government employees. Log(Saving) is the logged difference between total disposable household income and expenditures. Log(Consumption) is the logged sum of consumption expenditures. LI is 1 if the household head is insured by labor insurance and 0 otherwise. Annuitization is 1 if the year is post-annuitization and 0 otherwise. Junior/Senior/College/University/Graduate are education dummy variables. Male is 1 if the household head is male, and 0 otherwise. Age is the age of the household head. # of children is the number of children under age 18. # of grandparents is the number of parents or grandparents. Log (Permanent Income) is the log of household permanent income. Trend is 0 (1, 2, 3, 4) for year 2006 (2007, 2008, 2009, 2010).

Table 3: Comparison of saving/consumption for both groups in pre- versus post-annuitization

		Log (Saving)					Log (Consumption)			
		N	Mean	25th percentile	50th percentile	75th percentile	Mean	25th percentile	50th percentile	75th percentile
Households with LI	Pre	9,219	12.7685	12.2611	12.8142	13.3523	13.5490	13.3053	13.5549	13.8043
	Post	9,203	12.6751	12.1679	12.7470	13.2737	13.5088	13.2542	13.5156	13.7631
	Pre - post		*-0.0934*	*-0.0932*	*-0.0672*	*-0.0786*	*-0.0402*	*-0.0511*	*-0.0393*	*-0.0412*
Households with GEI	Pre	746	13.5898	13.1450	13.7016	14.0559	13.8045	13.5810	13.7968	14.0193
	Post	634	13.6296	13.2637	13.7348	14.0588	13.7424	13.4977	13.7128	13.9750
	Pre - Post		*0.0398*	*0.1187*	*0.0332*	*0.0029*	*-0.0621*	*-0.0833*	*-0.084*	*-0.0443*
DID: LI versus GEI			*-0.1332*	*-0.2119*	*-0.1004*	*-0.0815*	*0.0219*	*0.0322*	*0.0447*	*0.0031*

Note: The final sample contained 19,802 households of which 1,380 household heads are government employees and 18,422 are non-government employees. Saving is the difference between total disposable household income and expenditures. Consumption is the sum of consumption expenditures.

Table 4: The Effect of the Annuitization Option on Saving and Consumption

Dependent variable	Log (Saving)	Log (Consumption)
Intercept	-7.1970***	-1.9633***
	(0.584)	(0.203)
LI	-0.3649***	-0.0182
	(0.026)	(0.012)
Annunitization	0.0150	-0.0724***
	(0.048)	(0.021)
Annunitization * LI	-0.0971***	0.0514***
	(0.035)	(0.018)
Junior	-0.0562**	0.0040
	(0.024)	(0.009)
Senior	-0.0836***	-0.0112
	(0.024)	(0.009)
College	-0.0903***	-0.0570***
	(0.029)	(0.011)
University	-0.0715**	-0.1294***
	(0.033)	(0.013)
Graduate	-0.0669	-0.1924***
	(0.041)	(0.017)
Male	0.0934***	-0.0244***
	(0.020)	(0.007)
Age	-0.0444***	0.0156***
	(0.007)	(0.003)
Age^2	0.0481***	-0.0176***
	(0.007)	(0.003)
Spouse Junior	-0.1099***	0.0421***
	(0.023)	(0.009)
Spouse Senior	-0.0888***	0.0313***
	(0.023)	(0.009)
Spouse College	-0.0633**	-0.0242**
	(0.030)	(0.011)
Spouse University	-0.1025***	-0.1001***
	(0.034)	(0.013)
Spouse Graduate	-0.1653***	-0.1892***
	(0.051)	(0.023)
# of children	-0.2178***	-0.0305***
	(0.008)	(0.003)
# of grandparents	-0.0694***	-0.0065
	(0.011)	(0.004)
Log(Permanent Income)	1.5205***	1.0749***
	(0.043)	(0.015)
Trend	0.0167	0.0134***
	(0.011)	(0.004)
F Statistics	346.39	697.71
Adjusted R^2	25.86%	41.30%
N	19,802	19,802

Note: The final sample contained 19,802 households of which 1,380 household heads are government employees and 18,422 are non-government employees. Log (Saving) is the logged difference between total disposable household income and expenditures. Log (Consumption) is the logged sum of consumption expenditures. LI is 1 if the household head is insured by labor insurance and 0 otherwise. Annuitization is 1 if the year is post-annuitization and 0 otherwise. Junior/Senior/College/University/Graduate are education dummy variables. Male is 1 if the household head is male, and 0 otherwise. Age is the age of the household head. # of children is the number of children under age 18. # of grandparents is the number of parents or grandparents. Log(Permanent Income) is the log of household permanent income. Trend is 0 (1, 2, 3, 4) for year 2006 (2007, 2008, 2009, 2010). *** (**, *) indicates statistical significance at the 1% (5%, 10%) level. Heteroscedasticity-consistent standard errors are in parentheses.

Table 5: Results of the Quantile Regression

Percentile	Quantile Regression					Wald Test F Statistics				
	10^{th}	25^{th}	50^{th}	75^{th}	90^{th}	All equal	10^{th} =25^{th}	25^{th} =50^{th}	50^{th} =75^{th}	75^{th} =90^{th}
Log (Saving)	-0.2197*** (0.066)	-0.1022** (0.052)	-0.0462 (0.044)	-0.0391 (0.043)	-0.0316 (0.055)	2.42**	4.67**	1.62	0.04	0.03
Log (Consumption)	0.0944*** (0.029)	0.0986*** (0.021)	0.0489** (0.022)	0.0342 (0.024)	0.0080 (0.037)	2.33*	0.03	6.67***	0.55	0.74

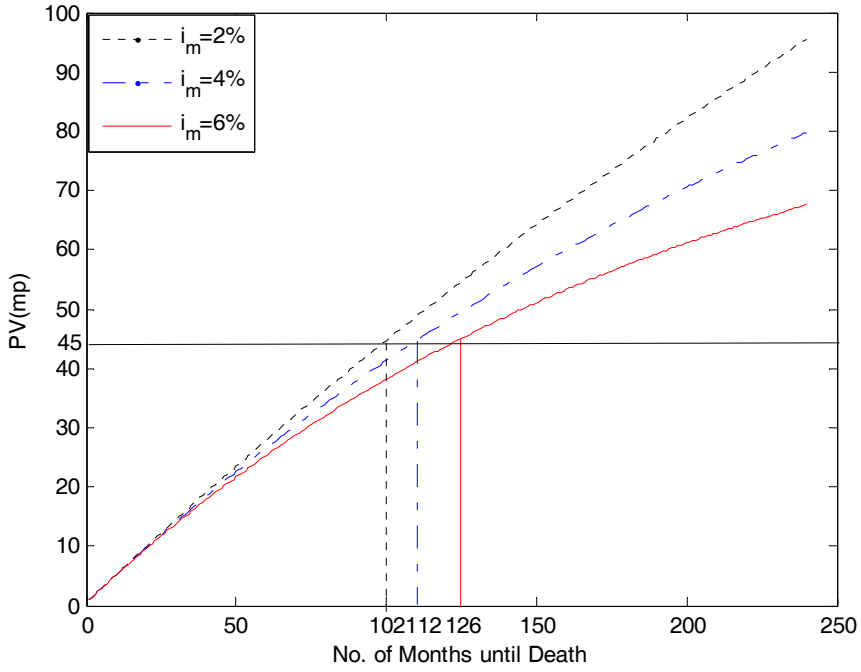
Note: The final sample contained 19,802 households of which 1,380 household heads are government employees and 18,422 are non-government employees. Log (Saving) is the logged difference between total disposable household income and expenditures. Log (Consumption) is the logged sum of consumption expenditures. *** (**, *) indicates statistically significance at the 1% (5%, 10%) level. Bootstrap standard errors are shown in parentheses. The model specification is the same as that in Table 4. The above reports the DID estimates only. All other control variables are not reported.

Table 6: Results of the Groupwise Treatment Effects

Age Group	20-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65
Log (Saving)	-0.2660 (0.3305)	0.1555 (0.1130)	-0.0415 (0.0750)	-0.1240* (0.0645)	-0.1068 (0.0728)	-0.1987* (0.1040)	-0.0857 (0.1218)	-0.1859 (0.2337)
Log (Consumption)	0.3662* (0.1919)	0.0872 (0.0574)	0.1378*** (0.0387)	0.0692** (0.0347)	0.0185 (0.0337)	-0.0052 (0.0491)	0.0206 (0.0669)	-0.0814 (0.0956)

Note: The final sample contained 19,802 households of which 1,380 household heads are government employees and 18,422 are non-government employees. We partition the sample into eight age groups and estimate the groupwise treatment effect. We report the DID estimators only. All other control variables are not reported. Log (Saving) is the logged difference between total disposable household income and expenditures. Log (Consumption) is the logged sum of consumption expenditures. *** (**, *) indicates statistically significance at the 1% (5%, 10%) level. Heteroscedasticity-consistent standard errors are in parentheses.

Figure 1: The present value of monthly benefits against the number of months until death



Note: The illustration is based on a representative individual covered by Labor Insurance who starts to work at the age of 25 and retires at the age of 56. Under the one-time benefit option, he will receive retirement benefits equal to 45 months of the "average monthly insurance salary". Under the pension benefit option, he will receive a monthly benefit until death that is the product of the "average monthly insurance salary", coverage years (31 in this example), and 1.55 percent. The horizontal line represents the present value of retirement benefits under the lump sum option. We also depict the present value of monthly benefits under the annuitization option against the number of months until death when the nominal interest rate is equal to 2%, 4% and 6%, respectively.