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The impact of expected pensions on consumption: Evidence from China

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Abstract: We study how pension participation and expected pension benefits affect the consumption of working-age adults based on a nationally representative dataset from the China Health and Retirement Longitudinal Study during the period 2011–2015. We find that working-age adults covered by the Employees' Basic Pension, a compulsory public pension scheme for employees in the formal sector, have a consumption rate (total consumption to permanent income) that is 29.9 percentage points higher than those who do not participate in any public pension scheme. However, the Residents' Basic Pension, a low-benefit voluntary public pension scheme for other residents, only promotes the consumption of working-age adults with a low income. Focusing on pension participants, we find that if working-age adults' expected replacement rate (expected pension benefits at retirement to permanent income) increases by one percentage point, their consumption rate will increase by three percentage points. Working-age adults who are older, poorer, or live in a rural area increase their consumption more in response to the expected replacement rate. Nondurable consumption is more responsive to the expected replacement rate than durable consumption. Overall, our findings suggest that pension expectations are critical to the consumption decisions of working-age adults and can, therefore, affect total consumption.

Keywords: Pension, Replacement rate, Consumption, Retirement, Aging

JEL classification: D12, G52, H55

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1. Introduction

Consumption has become the primary driver of China's economic growth, contributing 76% to the country's GDP in 2018 (Ministry of Commerce, 2019). However, consumption growth has slowed down over the past decade: the growth rate of total retail sales of consumer goods was 4% in 2018, falling from 23% in 2008 (National Bureau of Statistics, 2009, 2019). Scholars and policymakers have proposed several suggestions to promote consumption, for example, increasing local government expenditure on health and education (Qi & Prime, 2009), expanding the market for elderly care (State Council, 2019), and improving the pension system (State Council, 2018).

Previous research confirms that the pension system and consumption are linked through several channels, including retirement decisions (Gustman & Steinmeier, 2015) and household budget constraints (Krueger & Kubler, 2006; Rojas & Urrutia, 2008). A key element in the link between the pension system and consumption is expectations: individuals' expectations of their pension benefits play an essential role in determining their level of consumption (Bottazzi et al., 2006; Chan & Stevens, 2008). However, individuals can have incorrect expectations of their future pension benefits, especially when pension policies are in flux (e.g., Bernheim, 1989; Bottazzi et al., 2006). This is relevant for China, where the pension system has undergone several major reforms during the past decades, including the introduction of the New Rural Residents' Pension in 2009 and the Urban Residents' Pension in 2011, and the merging of these two schemes in 2014. As a result, individuals might have a limited or out-of-date understanding of the rapidly changing pension policies. It is therefore important to study how individuals' expectations of their pension benefits, rather than rules-based computed pension benefits, affect individuals' current consumption.

This paper studies the impact of pension participation and the expected pension benefits on working-age adults' consumption. Our study is based on a nationally representative dataset from the China Health and Retirement Longitudinal Study (CHARLS) over the period 2011–2015. We first develop a stylized life-cycle model to guide our empirical analyses. Then, we empirically test the impact of pension participation and study how this impact differs for the two vastly different public pension schemes: the Employees' Basic Pension and the Residents' Basic Pension. After that, we investigate the impact of the expected pension replacement rate on working-age adults' consumption and study how this impact differs by age, for rural and urban residents, for different income groups, and for different consumption categories. To address endogeneity, we apply instrumental variable estimations and construct instrumental variables based on the regional variation in the introduction of the Residents' Basic Pension and use average expected replacement rates within a group of individuals in the same year, province, and job category.

Our paper is closely related to studies on the impact of the pension system on personal savings and consumption. Using macro-level data from the United States, Feldstein (1974) finds a positive effect of social security wealth on consumption and argues that social security would crowd out personal savings by 30–50%. Dicks-Mireaux and King (1984) provide early micro-level evidence from Canada that households reduce their

household net worth by 17.1 cents if they have an extra dollar of social security wealth. Most subsequent empirical studies have found that individuals with more pension wealth tend to have lower personal savings and higher consumption (Kapteyn et al., 2005; Bottazzi et al., 2006; Chetty et al., 2014). Other studies find a small effect (Zhang & Zhang, 2004) or no effect (Venti & Wise, 1990) of pension wealth on personal saving or consumption.

Several studies examine the effect of the Chinese pension system on personal savings and consumption. Based on the China Household Income Project Survey (1995, 1999), Feng et al. (2011) find for the Employees' Basic Pension that an RMB 100 (USD 15.1) decrease in pension wealth would reduce pre-retirement consumption by RMB 20–25 (USD 3.0–3.8) per year. Based on CHARLS, Zhang et al. (2014) find that New Rural Residents' Pension receivers consumed 14.1% more than those without access to this pension. Similarly, Zhao et al. (2016) report that an RMB 100 (USD 15.1) increase in annual pension benefits would increase retirees' consumption by RMB 8 (USD 1.2) per year, based on CHARLS. Chen et al. (2018) consider institutional heterogeneity and find that a 1% increase in pension wealth would increase the consumption of Employees' Basic Pension participants by 1.26% and that of Residents' Basic Pension participants by 1%. In summary, the existing empirical studies for China suggest that the pension system has a positive effect on consumption.

Our study makes two contributions to the literature. First, we improve understanding of the relationship between individuals' expectations of pension benefits and their current consumption. Taking advantage of CHARLS, we directly use expected pension benefits reported by working-age adults, while the existing literature estimates working-age adults' future pension benefits using pension policy rules and individual characteristics (e.g., Attanasio & Rohwedder, 2003; Feng et al., 2011). The validity of these estimates used in existing studies relies on a strong underlying assumption that working-age adults project their future pension benefits based on a full understanding of pension policy rules. However, as explained earlier, individuals might not fully understand the pension policy rules, and updates to their expectations may lag behind changes in the pension policies (Bottazzi et al., 2006). This is a particular concern for the rapidly changing and relatively complex pension system in China. Indeed, we find that less than 30% of working-age adults correctly predicted their replacement rate (allowing for a relative error of 10%). The fact that we use individuals' subjective expectations, which is a key driver of individuals' current consumption, is a strength of our analysis.

Second, we contribute to understanding of the heterogeneous impacts of the pension system on consumption. The existing literature finds an overall positive impact of the Chinese pension system on consumption, but little attention has been paid to the heterogeneity of this effect. We consider five dimensions of heterogeneity in the pension system: institutional; age; urban–rural; income; and different consumption types.

We find that both pension participation and the expected replacement rate impact working-age adults' consumption. Employees' Basic Pension participants have a total consumption rate (defined as the ratio of total consumption to permanent income) that is 29.9 percentage points higher than that of working-age adults who

do not participate in any public pension program. The Residents' Basic Pension only has a positive effect on those with low-income levels due to its low benefits. Furthermore, among pension participants, a one-percentage-point increase in the expected replacement rate would increase the total consumption rate of working-age adults by three percentage points. We find that working-age adults who are older, poorer, or live in rural areas respond more to the expected replacement rate, and nondurable consumption is more responsive to the expected replacement rate than durable consumption.

Our research has the following important policy implications. First, those who participate in the Residents' Basic Pension can choose to make higher voluntary contributions and receive higher benefits, but few choose to do so. Several measures can motivate individuals' voluntary contributions, including strengthening the link between general tax subsidies and individual contributions, higher interest rates of individual account, and higher fundamental pension benefits for longer-term contributions. Second, our results highlight the critical role of pension expectations in consumption decisions. The accuracy of individuals' pension expectations can be improved by providing individuals with projections of future pension benefits, for example, via an easily accessible online inquiry platform. There is an online pension calculator for the Employees' Basic Pension,[1] but it is known by very few participants and requires inputs of self-estimated future macro-economic factors, which are beyond the financial literacy of most participants. In addition, benefit projections could be provided annually to pension participants, similar to the scenario analyses provided by private insurance companies. Overall, we suggest that information about the policies and benefit levels of the Chinese public pension system should be provided in more accessible, accurate, and easy to understand ways.

The rest of the paper is organized as follows. Section 2 describes the institutional background of the Chinese pension system. Section 3 develops a stylized life-cycle model and the hypotheses to guide our empirical analyses. Section 4 describes the sample we obtained from CHARLS. Section 5 presents our empirical methodology. Section 6 reports the empirical results. Section 7 discusses the accuracy of individuals' pension expectations. Section 8 concludes the paper.

2. China's pension system

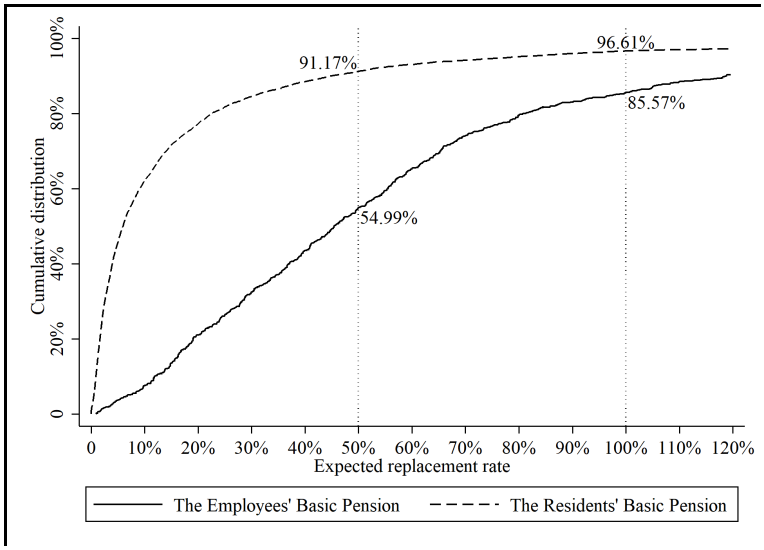
In this section, we briefly describe China's pension system and its recent reforms. China's pension system consists of three pillars: public pensions (Pillar I), employer-provided private pensions (Pillar II), and individual-arranged private pensions (Pillar III). The first pillar provides most of the pension protection for most Chinese, while the second and third pillars are very small (Zheng et al., 2019). The public pension system (Pillar I) is fragmented into two schemes: the Employees' Basic Pension and the Residents' Basic Pension. In 2018, the two public pension schemes covered 942.9 million individuals and accumulated funds of RMB 5.8 trillion (USD 0.9 trillion) (Ministry of Human Resources and Social Security, 2019). In our Sample A, more than 71% of working-age individuals were covered by Pillar I in 2015, and less than 1% were covered by Pillars II and III.

[1] The calculator can be accessed at http://si.12333.gov.cn/157569.jhtml

The Employees' Basic Pension aims to cover employees in formally established enterprises, government institutions, and state-owned enterprises. It was established in 1951 and went through major reforms in 1997 and 2005 (State Council, 1997, 2005). Currently, the Employees' Basic Pension is funded by compulsory payroll tax from both employers and employees. Employees' Basic Pension participants must meet two criteria to receive the pension benefits: (i) reach the eligible age (60 for males, 55 for female cadres, and 50 for female workers); and (ii) contribute to the program for at least 15 years.

The Residents' Basic Pension is a voluntary scheme, and aims to cover urban and rural residents who are not covered by the Employees' Basic Pension. The Residents' Basic Pension was formed in 2014 from a merger between the New Rural Residents' Pension, which was established in 2009 to secure the basic livelihood of rural residents in old age (State Council, 2009),[2] and the Urban Residents' Pension, which was established in 2011 to cover the urban residents not covered by the Employees' Basic Pension (State Council, 2011). The Residents' Basic Pension is funded by general tax (i.e., government subsidies) and voluntary individual contributions with several coverage-contribution options. Residents' Basic Pension participants need to be at least 60 years old and must have contributed for at least 15 years to receive the pension. In the following analyses, we do not distinguish the short-lived New Rural Residents' Pension and Urban Residents' Pension but analyze their impact as if there were always one scheme, the Residents' Basic Pension.

Figure 1: Cumulative distribution of expected replacement rate



Data source: CHARLS 2011, 2013, and 2015.

The main problem with China's public pension system is its inequality. The Residents' Basic Pension scheme provides very low pension benefits. In 2018, the average yearly pension benefit of the Employees' Basic Pension was 20 times that of the Residents' Basic Pension (RMB 37,841 (USD 5,718.4) vs. RMB 1,828 (USD 276.2)) (Ministry of Human Resources and Social Security, 2019). The corresponding gap in the pension

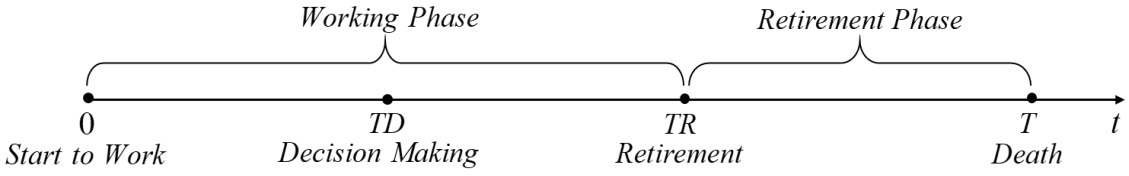
[2] From 1991–1999, a public pension program called (old) Rural Residents' Pension was implemented in China, which ceased to accept new participants and liquidated its reserves after 1999.

replacement rate (pension benefits to income) between the two schemes is also very large, given that the average wage of urban employees was only three times that of the disposal income of residents (National Bureau of Statistics, 2019). Using CHARLS data, we calculate the cumulative distribution of the expected replacement rate of working-age participants in our Sample A. Figure 1 shows that 91% of Residents' Basic Pension participants have an expected replacement rate below 50% while the same is true for only 55% of Employees' Basic Pension participants. This confirms that the Employees' Basic Pension has a higher protection level than the Residents' Basic Pension.

3. Theoretical model and hypotheses

In this section, we develop a stylized life-cycle model that characterizes the consumption decisions of working-age adults. Our model builds on existing literature (Attanasio & Brugiavini, 2003; Feng et al., 2011; Kolasa & Rubaszek, 2016). As illustrated in Figure 2, the model contains two phases: the working phase and the retirement phase. A representative agent starts to work at time 0, retires at time TR, and dies at time T. During the working phase, the agent earns an income and contributes to the pension system. After retirement, the agent lives on resources saved before retirement, expected interests, and pension benefits.

Figure 2: A representative agent's lifecycle



Specifically, we consider the agent's lifetime utility maximization problem at time *TD* before retirement, when they make a sequence of consumption decisions from *TD* onward. The agent chooses their consumption to maximize lifetime utility, subject to a lifetime budget constraint concerning their retirement assets at *TD*, future wages, and future pension benefits. In the following, we assume a constant relative risk aversion utility function.[3] The agent solves the following problem:

$$\begin{aligned} &\max_{C_{TD},\ldots,C_T} \sum_{t=TD}^{T} \beta^{t-TD} \frac{C_t^{1-\alpha}}{1-\alpha} \\ &\text{s.t.} \sum_{t=TD}^{T} \frac{C_t}{(1+r)^{t-TD}} = \sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} + \sum_{t=TR}^{T} \frac{P_{TR}(1+pr)^{t-TR}}{(1+r)^{t-TD}} + A_{TD}, \end{aligned} \tag{1}$$

where C_t denotes the agent's consumption at time $t\ (t=TD,\ldots,T)$; $\beta \in (0,1)$ is the subjective discount factor; α $(\alpha>0, \alpha \neq 1)$ is the coefficient of constant relative risk aversion; $r \in (0,1)$ is the interest rate; E_t denotes the agent's net income at time $t\ (t=TD,\ldots,T)$; P_{TR} is the pension benefit at the time of retirement TR; pr is the annual growth rate of pension benefits; and A_{TD} are the retirement assets accumulated before

[3] Our theoretical results and hypotheses do not depend on the specific form of the utility function. We present the proof for a general utility function in Appendix A.

time TD. Solving the maximization problem, we have the agent's consumption at time t $(t = TD,...,T)$:

$$C_t = \left[\beta(1+r)\right]^{\frac{t-TD}{\alpha}} \frac{1-B}{1-B^{T-TD+1}} \left[\sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} + \sum_{t=TR}^{T} \frac{P_{TR}(1+pr)^{t-TR}}{(1+r)^{t-TD}} + A_{TD} \right],$$

where $B = \beta^{\frac{1}{\alpha}}(1+r)^{\frac{1-\alpha}{\alpha}}$. The optimal consumption at time TD is thus:

$$C_{TD} = \frac{1-B}{1-B^{T-TD+1}} \left[\sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} + \sum_{t=TR}^{T} \frac{P_{TR}(1+pr)^{t-TR}}{(1+r)^{t-TD}} + A_{TD} \right]. \tag{2}$$

This result suggests that a forward-looking agent makes their consumption decisions based on the present value of future wages, future pension benefits, and retirement assets.

Next, we study how the protection level of a pension system affects the working-age agent's consumption. We focus on the replacement rate instead of absolute pension benefits because one dollar more in pension benefits yields different utility gains to individuals with different income levels. The expected replacement rate is defined as the expected pension benefits at retirement divided by the permanent income during the working phase (Zheng et al., 2019).

Assuming the agent's permanent income is $\overline{E}$, we obtain the following relationship between the current consumption rate, CR_{TD}, and the expected replacement rate at retirement, which is given by $RR_{TR} = \left(P_{TR} / \overline{E}\right)$:

$$CR_{TD} = \frac{C_{TD}}{\overline{E}} = \frac{1-B}{1-B^{T-TD+1}} \left[\sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} \frac{1}{\overline{E}} + \sum_{t=TR}^{T} \frac{(1+pr)^{t-TR}}{(1+r)^{t-TD}} RR_{TR} + \frac{A_{TD}}{\overline{E}} \right]. \tag{3}$$

Equation (3) shows that the replacement rate at retirement has a positive impact on the consumption rate in the working phase. *Ceteris paribus*, a higher expected replacement rate at retirement due to higher pension benefits relaxes the agent's lifetime budget constraint and thus motivates the agent to consume a larger fraction of permanent income. We derive our first and second hypotheses as follows:

Hypothesis 1: Individuals who participate in the pension scheme consume more during working age than those who do not.

Hypothesis 2: Individuals who have a higher expected replacement rate from the pension scheme consume more during working age than those who have a lower expected replacement rate.

In the empirical analyses, we also study how the effects on consumption of pension participation and the expected pension replacement rate differ across the two public pension schemes, for different population groups and for different consumption types.

4. Data and sample

Our empirical analyses are based on data from CHARLS over the period 2011–2015. CHARLS is designed

to be nationally representative of the Chinese middle-aged and elderly population. It collects rich information at the individual, household and community level, which provides ideal and high-quality data for our analyses. CHARLS surveys respondents aged 45 and older through face-to-face computer-assisted personal interviews. Its sample covers 450 villages or urban communities from 150 counties or urban districts in 28 provinces of mainland China. We use the national baseline survey conducted in 2011, and two follow-up surveys conducted in 2013 and 2015, respectively. We also use a supplementary CHARLS life history survey which was conducted in 2014.

To test the impact of pension participation and the expected replacement rate on working-age adults' consumption, we construct Samples A and B using the following steps.

- First, we select working-age adults with a self-reported expected retirement age between 40 and 70, which includes all possible statutory retirement ages in China. The minimum statutory retirement age is 40 for workers involved in specific unhealthy activities, and the maximum statutory retirement age is 70 for senior government officials and other senior positions (State Council, 1978).
- Second, we restrict our sample to those who have already retired or will retire before 2030. This restriction improves the accuracy and reliability of our results as we need to make income projections after 2015.
- Third, we replace missing variables values by taking full advantage of the information in CHARLS. For example, we replace missing values of time-invariant variables in one survey year with corresponding values in other survey years if possible. Otherwise, we exclude observations with missing values.
- Fourth, we truncate at the 1st and 99th percentiles of the total consumption rate, nonzero expected replacement rate, nonzero current income from work, and nonzero property value.

Through these four steps, we generate Sample A, which contains 8,239 individuals and 15,993 individual-year observations. We provide summary statistics for Sample A in Table 1 and in Appendix B. We then generate Sample B by focusing on respondents who participate in any pension scheme in Sample A. Sample B contains 4,847 individuals and 7,993 individual-year observations. We summarize Sample B in Table 2 and in Appendix B.

The variables used in our regression analyses include the consumption rates as the outcome variable, pension participation and expected replacement rate as explanatory variables of interest, and several individual and household characteristics as control variables. All variable definitions are provided in Appendix C.

In line with our theoretical model, we define the consumption rate as the ratio of an individual's current consumption expenditure to his/her permanent income from work. Our definition is consistent with the concept of the ratio of pension wealth to current income in Attanasio and Rohwedder (2003) and Feng et al. (2011).

We use per capita household consumption expenditure (total household consumption expenditure divided by family size) to capture a respondent's consumption expenditure (see, e.g., Leimer and Richardson, 1992; Chen et al., 2018). We divide total consumption expenditure into two categories: nondurable and durable

consumption expenditure. We expect that, in response to changes in expected pension benefits, durable consumption is less flexible than nondurable consumption because of its strong periodicity (Antón et al., 2014). Nondurable consumption includes work-related expenditure, and expenditure on food consumed at home, entertainment, and other nondurable goods. Durable consumption consists of expenditure on furniture, automobiles, and other durable goods. We exclude expenditure on education and medical care from consumption because they are investments in human capital rather than consumption (Aguiar & Hurst, 2005). We define family size as the number of individuals who usually eat meals together in a respondent's home.

We use binary variables to indicate pension participation in different pension schemes. We construct two binary variables *Residents' pension participation* and *Employees' pension participation* indicating whether a respondent expects to receive nonzero benefits from the Residents' Basic Pension and the Employees' Basic Pension, respectively. In case the respondent reports expecting to receive both pensions, which is not allowed according to Chinese public pension policy, we assign the respondent to the Employees' Basic Pension. We construct *Other pension participation* indicating whether a respondent expects to receive nonzero benefits from other pension schemes including employer-provided private pensions and individual-arranged private pensions. We consider *Other pension participation* as a control variable in our analyses.

We estimate the *Expected replacement rate* at the individual level to represent the protection level of the pension system. *Expected replacement rate* is defined as the expected pension benefits at retirement divided by permanent income. CHALRS captures respondents' expected pension benefits from public pensions, employer-provided private pensions, individual-arranged private pensions, and other pensions. We use the sum of all expected pension benefits to estimate the *Expected replacement rate*.

We estimate respondents' permanent income from work by their 10-year Average Indexed Annual Earnings (AIAE) before retirement. Ten-year AIAE accounts for the 10 years before retirement and calculates the average indexed earnings of these 10 years, where the index is the social average income. The 10-year period approximates an individual's long-term income history and is used in existing literature (e.g., Zheng et al., 2019). We document the process to estimate permanent income in Appendix C. The 2014 CHARLS life history survey provides detailed information on respondents' employment history, including start date, duration, and after-tax income from four types of work: employment, self-employment, own agricultural production and business activities, and military service. For respondents not included in the life history survey, we use after-tax income from all jobs during the past 12 months based on the 2011, 2013, and 2015 CHARLS surveys and assume that the respondent's income increases at the national growth rates of per capita net income of rural residents or average wage of urban employees to generate their income stream before retirement.

Individual characteristics used as control variables include *Other pension participation*, *Age*, *Retirement age*, *Male*, *Married*, *Living in an urban area*, *Non-agricultural hukou*, *Formal sector (employment sector)*, *Han (ethnic group)*, *Education level*, *Health status*, *Rely on children for old-age support*, *Current income from work*, and *Net transfers*. Household characteristics include *Family size*, *No. of children*, *% of male children*, and

Property value. *Property value* is divided by permanent income to proxy for the liquidity constraint of a household (Campbell & Cocco, 2007). We use *No. of children* and *% of male children* to proxy for bequest motives (Chen & Huang, 2013). We adjust *Current income from work*, *Permanent income*, *Consumptions*, and *Property value* to the year 2011 using the yearly nationwide inflation rate.

5. Methodology

5.1 Regression models

To test the impact of pension participation on consumption (Hypothesis 1), we estimate equation (4) below based on Sample A:

$$\begin{aligned} Consumption\ rate_{i,t} = {} & \alpha + \beta Employees'\ pension\ participation_{i,t} + \varphi Residents'\ pension\ participation_{i,t} \\ & + \gamma X_i + \delta Z_{i,t} + \chi Province_p + \phi Year_t + \varepsilon_{i,t}, \end{aligned} \quad (4)$$

where $Consumption\ rate_{i,t}$ is the total consumption rate, the nondurable consumption rate, or the durable consumption rate; X_i is a set of time-invariant control variables; $Z_{i,t}$ is a set of time-variant control variables; and $Province_p$ and $Year_t$ are province and year fixed effects, respectively.

To test the impact of expected replacement rate on consumption (Hypothesis 2), we estimate equation (5) below based on Sample B, which only includes pension plan participants:

$$\begin{aligned} Consumption\ rate_{i,t} = {} & \alpha + \beta Expected\ replacement\ rate_{i,t} + \varphi Employees'\ pension\ participation_{i,t} \\ & + \gamma X_i + \delta Z_{i,t} + \chi Province_p + \phi Year_t + \varepsilon_{i,t}. \end{aligned} \quad (5)$$

We include $Employees'\ pension\ participation_{i,t}$ in equation (5) to control for respondents' public pension arrangements, considering the significant differences between the Employees' Basic Pension and the Residents' Basic Pension.

To test the heterogeneous impact of the expected replacement rate on consumption among different population groups, we estimate equation (6) based on Sample B:

$$\begin{aligned} Consumption\ rate_{i,t} = {} & \alpha + \beta Expected\ replacement\ rate_{i,t} + \eta Expected\ replacement\ rate_{i,t} \times Moderator_{i,t} \\ & + \theta Moderator_{i,t} + \varphi Employees'\ pension\ participation_{i,t} + \gamma X_i + \delta Z_{i,t} + \chi Province_p \\ & + \phi Year_t + \varepsilon_{i,t}, \end{aligned} \quad (6)$$

where $Moderator_{i,t}$ is $Age_{i,t}$ when we test for age heterogeneity, $Living\ in\ an\ urban\ area_{i,t}$ when we test for urban–rural heterogeneity, or $Low\ income\ group_{i,t}$ when we test for income heterogeneity. That is, in equation (6), we allow the expected replacement rate to have differential effects on working-age adults with different ages, living areas, or income levels. When testing age heterogeneity, we center the expected replacement rate and age in equation (6) to avoid the multicollinearity problem. We define $Living\ in\ an\ urban\ area_{i,t}$ according to respondents' current residence. We define *Low-income group* as all

individuals whose current income from work is smaller than twice the average benefit of the Residents' Basic Pension in 2018,[4] that is, RMB 3,656 (USD 552.4) (Ministry of Human Resources and Social Security, 2019).

To further test whether the impact of the expected replacement rate on consumption differs in different consumption categories, we re-estimate equation (5) by replacing the dependent variable with seven subtypes of consumption based on Sample B. Specifically, we further divide nondurable consumption into four categories: food, work-related, entertainment, and other nondurable consumption, and divide durable consumption into three categories: furniture, automobile, and other durable consumption.

5.2 Endogeneity and instrumental variables

One could argue that the outcome variables *Residents' pension participation* and *Expected replacement rate* could be endogenous. To address this concern, we construct instrumental variables as follows.

We use a binary variable indicating whether a respondent lives in one of the pilot counties of the Residents' Basic Pension as the instrumental variable for *Residents' pension participation.* The expanded Residents' Basic Pension program was piloted in 2009 in 320 counties, and was then widely introduced to all 2,300+ counties by the end of 2012. We argue that an individual's decision to participate in the Residents' Basic Pension is partially determined by whether they live in a pilot county, which is exogenous to an individual's participation decision. The Employees' Basic Pension is a compulsory scheme for individuals in the formal sector. Thus, participation in the Employees' Basic Pension should not be endogenous.[5]

We instrument *Expected replacement rate* by the average expected replacement rate within a group of individuals in the same year, province, and job category (i.e., agriculture work, formally employed in the formal sector, and self-employment). Specifically, we categorize respondents into 252 groups based on year, province, and job category, and calculate the mean of expected replacement rate for each group. The validity of this instrumental variable relies on the assumption that unobserved variables such as the propensity for saving do not affect individuals' choice of province and job sector. This is a reasonable assumption that is in line with the existing literature (e.g., Attanasio & Brugiabini, 2003; Engelhardt & Kumar, 2011).

We assess the quality of our instrumental variables using the F-test in the first stage of the 2SLS regressions. The first-stage F-statistics in our regressions are all larger than 10, suggesting no weak instruments. With these two instrument variables, we use the 2SLS approach for total consumption, nondurable consumption regressions; and the IV-Tobit model for durable consumption regressions, because durable consumption has many zero values and thus can be considered left-censored. We apply inverse probability weight for each respondent in all regressions to correct for nonresponses. The variance inflation factors (VIF) in all regressions are less than five,

[4] By using the Residents' Basic Pension average benefit to build the threshold, we aim to investigate who is more responsive to the low pension benefits of the Residents' Basic Pension, while "twice" ensures that *Low-income group* has enough variations in our sample.

[5] Existing literature widely accepts that individuals do not choose their job sectors based on some unobserved factors that impact their consumption simultaneously (e.g., Attanasio & Brugiabini, 2003; Engelhardt & Kumar, 2011).

indicating that multicollinearity is not a problem.

6. Results

In this section, we present the main results of our two hypotheses and analyze the heterogeneous impact of the expected replacement rate. In Section 6.1, we investigate the impact of pension participation on the consumption of working-age adults and the institutional heterogeneity of this impact. We analyze the effect of the expected replacement rate on consumption in Section 6.2, and discuss the heterogeneities in this effect in Section 6.3.

6.1 The impact of pension participation on consumption

Table 3 shows how pension participation affects working-age adults' current consumption. The results are based on Sample A and equation (4). The first column shows that working-age adults covered by the Employees' Basic Pension have a total consumption rate that is 29.9 percentage points higher than those who do not participate in any public pension scheme. Columns (2) and (3) of Table 3 show that the significant effect of pension participation for the Employees' Basic Pension is significantly stronger for nondurable than for durable consumption: the estimated effect is 24.7 percentage points for the nondurable consumption rate and 4.1 percentage points for the durable consumption rate. The difference is significant based on a mean difference *t*-test with p-value<0.001. This is probably because nondurable consumption is more flexible than durable consumption, and individuals adjust nondurable consumption more actively in response to the pension system. These results support Hypothesis 1.

However, the Residents' Basic Pension has no significant impact on working-age adults' total consumption rate, nondurable consumption rate, or durable consumption. In Table 4, we examine whether the reason for the insignificant impact of the Residents' Basic Pension is its low protection level. If this is the case, we expect that the Residents' Basic Pension has an impact on the consumption of the low-income population, who are more likely to respond to a small pension benefit. We add an interaction term between *Residents' pension participation* and *Low-income group* in equation (4). The results in Table 4 show that the Residents' Basic Pension promotes the total consumption and nondurable consumption of low-income working-age adults, but not their durable consumption.

6.2 The impact of expected replacement rate on consumption

Next we analyze the effect of the expected replacement rate on working-age adults' current consumption, based on the subsample of pension plan participants (Sample B) and equation (5). Column (1) in Table 5 shows that if the expected replacement rate of pension participants increases by one percentage point, their total consumption rate increases by 3.0 percentage points. The results suggest that higher pension benefits motivate individuals to increase consumption. We also document a positive effect on nondurable and durable consumption rates in columns (2) and (3) of Table 5. We note that the estimated effect of the *Expected replacement rate* is significantly larger in the nondurable consumption regression than in the durable

consumption regression (2.7 vs. 0.2), a difference that is significant based on a mean difference *t*-test with *p*-value<0.001. Consistent with the results for pension participation, nondurable consumption is more affected by expected pension benefits than is durable consumption.

We include *Employees' pension participation* as a control variable in the models presented in Table 5 and note that the estimated coefficients for this are negative and significant. The negative coefficients in Table 5 indicate that respondents who participate in the Employees' Basic Pension have a lower consumption rate than those who participate in the Residents' Basic Pension for a given expected replacement rate. This is because, for a given expected replacement rate, Employees' Basic Pension participants have to contribute much more than Residents' Basic Pension participants due to fewer general-tax subsidies. Therefore, the Employees' Basic Pension has a weaker impact on consumption than the Residents' Basic Pension with the same expected replacement rate level.[6]

6.3 Heterogeneity of expected replacement rate's impact on consumption

We analyze how the impact of the expected replacement rate on consumption differs for different ages, rural and urban residents, different income groups, and different consumption categories. Table 6 reports the results of assessing age heterogeneity, urban–rural heterogeneity, and income heterogeneity, based on Sample B and equation (6). The first column shows that the impact of *Expected replacement rate* on *Total consumption rate* at the sample average age is 3.3 percentage points and increases by 0.2 of a percentage point per year as a working-age adult gets older. This result is explained by the fact that younger working-age adults have a longer time horizon over which to smooth consumption, and therefore respond less to an increase in the *Expected replacement rate*. Column (2) reports a similar effect for nondurable consumption. Column (3) shows that the impact on durable consumption does not differ with age.

Columns (4) to (6) of Table 6 show the results of testing urban–rural heterogeneity. Column (4) shows that a one-percentage-point increase in the expected replacement rate is linked to increases in the total consumption rate of urban and rural working-age adults by 1.7 and 5.4 percentage points, respectively. Individuals living in urban areas tend to have higher pension benefits than those living in rural areas, which leads to a weaker reaction to the expected replacement rate. The result for nondurable consumption in column (5) confirms that those who live in an urban area respond more to the expected replacement rate. Column (6) shows that the impact on durable consumption does not differ between urban and rural areas.

In columns (7) to (9) of Table 6, we test income heterogeneity by including the interaction term between *Expected replacement rate* and *Low-income group* and by replacing *Current income from work* with *Low-income group* in equation (6). The results in column (7) show that if the expected replacement rate increases by one percentage point, individuals in the low-income group increase their total consumption rate by an extra 1.7

[6] This effect cannot be compared with the results in Tables 3 and 4 as the sample and the omitted reference category for the effect are different.

percentage points compared with the high-income group. The result is consistent with the analysis of pension participation, where the low benefit scheme, the Residents' Basic Pension, only promotes the consumption of the low-income group (see Table 4). The results in columns (8) and (9) of Table 6 suggest that income heterogeneity exists for nondurable consumption but not for durable consumption.

Finally, Table 7 analyzes which category of consumption is more affected by the expected replacement rate, and we do this by replacing the dependent variable in equation (5) with seven subtypes of consumption. The results echo our previous findings that working-age adults' expected replacement rate significantly affects their nondurable consumption: we find a significant effect for food, work-related, entertainment, and other nondurable consumption, but not for durable consumption of furniture and automobiles. We note that among nondurable consumption types, entertainment is significantly less affected by the expected pension rate. These results indicate that Chinese working-age adults prioritize the consumption of goods that meet their basic needs (e.g., food and work-related goods) over goods that can improve their quality of life (e.g., entertainment, furniture, and automobiles) when they expect to have a higher replacement rate after retirement.

7. Discussion: Accuracy of pension expectations

We find that individuals' expectations of their replacement rate at retirement affect their current consumption. However, we recall that previous literature has found that individuals can have incorrect expectations of their future pension benefits, especially when pension policies are in flux (e.g., Bernheim, 1989; Bottazzi et al., 2006). China's public pension system has experienced dramatic changes during recent decades. Therefore, we discuss the accuracy of individuals' pension expectations in the following. We compare individuals' expected replacement rate and their realized replacement rate. We focus on respondents who retired during the survey period of 2011–2015 as these respondents reported their expected pension benefits in one survey and their realized pension benefits in a later follow-up survey. We calculate the relative error of individuals' expected replacement rate to measure the accuracy of individuals' expectations of their pension benefits:

$$Relative\ error_i = \left| \frac{Expected\ replacement\ rate_i - Realized\ replacement\ rate_i}{Realized\ replacement\ rate_i} \right| \times 100\%.$$

As shown in Table 8, only 27.8% of respondents predict their replacement rate within a 10% relative error, suggesting that individuals often have incorrect expectations of their pension benefits. This result suggests that Chinese working-age adults have a large chance of overestimating or underestimating the replacement rate at retirement. Given the strong positive effect of the expected replacement rate on consumption that we documented in Section 6, it is important to guide individuals toward more accurate expectations of pension benefits.

8. Conclusion

In this paper, we analyzed the impact of pension participation and expected pensions on working-age adults'

consumption. Guided by hypotheses derived in a stylized life-cycle model, we empirically tested the impact of pension participation and the expected replacement rate on current consumption rates. We used data from CHARLS over the period 2011–2015.

Our three main findings are as follows. First, both pension participation and expected replacement rate impact working-age adults' consumption. However, the impact of public pensions on working-age adults' consumption differs between the Employees' Basic Pension and the Residents' Basic Pension. The high-benefit Employees' Basic Pension effectively increases the consumption rate of working-age adults by 29.9 percentage points, while the low-benefit Residents' Basic Pension only promotes the consumption rate of working-age adults with a low income. Second, we show that working-age adults increase their consumption rate by 3.0 percentage points if their expected replacement rate increases by one percentage point. Third, we find that the consumption of working-age adults who are older, poorer, or living in rural areas is more sensitive to the expected replacement rate; and working-age adults' nondurable consumption is more responsive to the expected replacement rate than is durable consumption.

Our research has several policy implications. First, though Residents' Basic Pension participants have the option to receive higher benefits by contributing more, most participants choose to make minimum contributions. This is probably because participants can make better use of the nonproportional subsidies with minimum contribution and because the interest rate of the individual account is as low as that of the one-year bank deposit. Potential improvements include refining the government subsidy policy (e.g., strengthening the link between individuals' voluntary contributions and government subsidies), raising the interest rate of the individual account sustainably, and setting higher fundamental pension benefits for longer-term contributions. Further, the critical role of pension expectations in determining consumption underscores the importance of improving the accuracy of individuals' pension expectations. Apart from improving the existing inquiry platform, the Chinese public pension system should generate and distribute scenario-based expected pension amounts for each participant. We recommend a more accessible, accurate, and comprehensible disclosure of pension policies and pension benefits estimations.

References

Aguiar, M., & Hurst, E. (2005). Consumption versus expenditure. *Journal of Political Economy*, 113(5), 919–948.

Antón, J. I., de Bustillo, R. M., & Fernandez-Macias, E. (2014). Supplementary private pensions and saving: Evidence from Spain. *Journal of Pension Economics & Finance*, 13(4), 367–388.

Attanasio, O. P., & Brugiavini, A. (2003). Social security and households' saving. *Quarterly Journal of Economics*, 118(3), 1075–1119.

Attanasio, O. P., & Rohwedder, S. (2003). Pension wealth and household saving: Evidence from pension reforms in the United Kingdom. *American Economic Review*, 93(5), 1499–1521.

Bernheim, B. D. (1989). The timing of retirement: A comparison of expectations and realizations. In *The Economics of Aging* (pp. 335–358). Chicago: University of Chicago Press.

Bottazzi, R., Jappelli, T., & Padula, M. (2006). Retirement expectations, pension reforms, and their impact on private wealth accumulation. *Journal of Public Economics*, 90(12), 2187–2212.

Campbell, J. Y., & Cocco, J. F. (2007). How do house prices affect consumption? Evidence from micro data. *Journal of Monetary Economics*, 54(3), 591–621.

Chan, S., & Stevens, A. H. (2008). What you don't know can't help you: Pension knowledge and retirement decision-making. *Review of Economics and Statistics*, 90(2), 253–266.

Chen, D., Xiao, C., Zang, J., & Liu, Z. (2018). Old-age social insurance and household consumption: Evidence from China. *Emerging Markets Finance and Trade*, 54(13), 2948–2964.

Chen, J., & Huang, S. (2013). Trade-offs between bequest motives and wealth effects: Is housing reverse mortgaging in China feasible? *Economic Research Journal*, 9, 56–70 (in Chinese).

Chetty, R., Friedman, J. N., Leth-Petersen, S., Nielsen, T. H., & Olsen, T. (2014). Active vs. passive decisions and crowd-out in retirement savings accounts: Evidence from Denmark. *Quarterly Journal of Economics*, 129(3), 1141–1219.

Dicks-Mireaux, L., & King, M. (1984). Pension wealth and household savings: Tests of robustness. *Journal of Public Economics*, 23(1–2), 115–139.

Engelhardt, G. V., & Kumar, A. (2011). Pensions and household wealth accumulation. *Journal of Human Resources*, 46(1), 203–236.

Feldstein, M. (1974). Social security, induced retirement, and aggregate capital accumulation. *Journal of Political Economy*, 82(5), 905–926.

Feng, J., He, L., & Sato, H. (2011). Public pension and household saving: Evidence from urban China. *Journal of Comparative Economics*, 39(4), 470–485.

Gustman, A. L., & Steinmeier, T. L. (2015). Effects of social security policies on benefit claiming, retirement and saving. *Journal of Public Economics*, 129, 51–62.

Huang, Z. G., & Liu, X. H. (2014). Trends and prospects for medium and long-term growth of China's economy. *Economic Perspectives*, 08, 35–54 (in Chinese).

Kapteyn, A., Alessie, R., & Lusardi, A. (2005). Explaining the wealth holdings of different cohorts: Productivity growth and social security. *European Economic Review*, 49(5), 1361–1391.

Kolasa, A., & Rubaszek, M. (2016). The effect of ageing on the European economies in a life-cycle model. *Economic Modelling*, 52, 50–57.

Krueger, D., & Kubler, F. (2006). Pareto-improving social security reform when financial markets are incomplete!? *American Economic Review*, 96(3), 737–755.

Leimer, D. R., & Richardson, D. H. (1992). Social security, uncertainty adjustments and the consumption decision. *Economica*, 59, 311–335.

Ministry of Commerce (2019). Statistical bulletin on the development of business work in 2018. Available at: http://www.mofcom.gov.cn/article/i/jyjl/m/201902/20190202834732.shtml

Ministry of Human Resources and Social Security (2019). Statistical Bulletin on the Development of Human Resources and Social Security in 2018. Available at: http://www.mohrss.gov.cn/SYrlzyhshbzb/zwgk/szrs/tjgb/201906/t20190611_320429.html

National Bureau of Statistics (2009). China Statistical Yearbook 2008. Beijing: National Bureau of Statistics.

National Bureau of Statistics (2019). China Statistical Yearbook 2018. Beijing: National Bureau of Statistics.

Qi, L., & Prime, P. B. (2009). Market reforms and consumption puzzles in China. *China Economic Review*, 20(3), 388–401.

Rojas, J. A., & Urrutia, C. (2008). Social security reform with uninsurable income risk and endogenous borrowing constraints. *Review of Economic Dynamics*, 11(1), 83–103.

State Council (1978). Interim Measures on Retirement and Resignation of Workers. Available at: http://www.npc.gov.cn/wxzl/wxzl/2000-12/07/content_9552.htm

State Council (1997). Decision on Establishing a Unified Basic Pension System for Enterprise Employees. Available at: http://hrss.qingdao.gov.cn/n28356070/n32563353/n32563394/190125132533979605.html

State Council (2005). Decision on Improving the Employees' Basic Pension System. Available at: http://www.gov.cn/zhuanti/2015-06/13/content_2878967.htm

State Council (2009). Guidelines on Carrying out Pilot Programs for the New Rural Residents' Basic Pension. Available at: http://www.gov.cn/zwgk/2009-09/04/content_1409216.htm

State Council (2011). Guidelines on Carrying out Pilot Programs for the Urban Residents' Basic Pension. Available at: http://www.gov.cn/zhengce/content/2011-06/13/content_7241.htm

State Council (2018). Notice on Issuance of Implementation Scheme for Improving the System and Mechanism for Promoting Consumption (2018–2020). Available at: http://www.gov.cn/zhengce/content/2018-10/11/content_5329516.htm

State Council (2019). The 2019 Government Work Report. Available at: http://www.gov.cn/premier/2019-03/16/content_5374314.htm

Venti, S. F., & Wise, D. A. (1990). Have IRAs increased US saving? Evidence from consumer expenditure surveys. *Quarterly Journal of Economics*, 105(3), 661–698.

Zhang, C. C., Giles, J., & Zhao, Y. H. (2014). Policy evaluation of China's new rural pension program: Income, poverty, expenditure, subjective wellbeing and labor supply. *China Economic Quarterly*, 14(1), 203–230 (in Chinese).

Zhao, Q., Li, Z., & Chen, T. (2016). The impact of public pension on household consumption: Evidence from China's survey data. *Sustainability*, 8(9), 890–904.

Zheng, W., Liu, Z. N., & Jia, R. (2019). How private sector participation improves retirement preparation: A case from China. *Geneva Papers on Risk and Insurance: Issues and Practice*, 44(1), 123–147.

Zhang, J., & Zhang, J. (2004). How does social security affect economic growth? Evidence from cross-country data. *Journal of Population Economics*, 17(3), 473–500.

Tables

Table 1: Summary statistics of dependent variables and explanatory variables of interest for Sample A

	$Mean_w$[a]	Median	S.D.	$Mean_w$[a]	Median	S.D.	$Mean_w$[a]	Median	S.D.
	2011 wave (N=5,916)			*2013 wave (N=5,426)*			*2015 wave (N=4,651)*[b]		
Nondurable consumption	5,989.54	4,210.00	7,434.18	7,560.68	4,784.53	7,931.56	7,979.45	5,095.61	9,820.29
Food consumption	2,919.84	2,080.00	3,349.88	3,907.22	2,468.21	5,560.39	4,036.51	2,385.70	6,034.72
Work-related consumption	1,260.54	600.00	2,236.63	1,679.90	696.16	3,041.06	1,724.85	715.71	3,877.93
Entertainment consumption	297.56	0.00	862.27	234.07	0.00	805.65	233.23	0.00	1,175.74
Other nondurable consumption	1,511.61	849.60	4,317.45	1,739.49	1,082.22	2,020.02	1,984.85	1,110.88	3,735.13
Durable consumption[c]	1,586.30	0.00	5,320.25	1,471.56	38.76	6,380.21	1,632.79	24.47	6,809.14
Furniture consumption	284.54	0.00	1,070.95	396.22	0.00	2,198.27	370.39	0.00	1,852.29
Automobile consumption	479.88	0.00	4,604.88	794.72	0.00	5,834.40	1,002.39	0.00	6,321.93
Other durable consumption	821.88	0.00	2,355.40	280.62	0.00	794.86	260.01	0.00	722.40
Total consumption	7,575.85	4,909.00	9,663.54	9,032.24	5,368.36	10,792.08	9,612.24	5,674.29	12,843.45
Permanent income	24,057.83	11,489.10	31,076.12	27,916.72	13,963.17	34,288.33	29,989.13	15,610.30	40,141.70
Nondurable consumption rate	1.11	0.37	2.64	1.13	0.35	2.75	1.12	0.34	2.61
Food consumption rate	0.60	0.18	1.67	0.63	0.17	1.71	0.61	0.16	1.67
Work-related consumption rate	0.19	0.05	0.55	0.21	0.05	0.68	0.22	0.05	0.74
Entertainment consumption rate	0.04	0.00	0.27	0.01	0.00	0.13	0.01	0.00	0.10
Other nondurable consumption rate	0.27	0.07	0.83	0.28	0.07	0.82	0.28	0.07	0.77
Durable consumption rate	0.18	0.00	0.87	0.16	0.00	0.96	0.13	0.00	0.74
Furniture consumption rate	0.05	0.00	0.34	0.05	0.00	0.49	0.05	0.00	0.26
Automobile consumption rate	0.04	0.00	0.55	0.06	0.00	0.72	0.06	0.00	0.65
Other durable consumption rate	0.10	0.00	0.57	0.05	0.00	0.26	0.03	0.00	0.19
Total consumption rate	1.29	0.44	2.96	1.29	0.40	3.11	1.25	0.38	2.86
Residents' pension participation[d]	0.18	0.00	0.41	0.48	1.00	0.50	0.60	1.00	0.49
Employees' pension participation	0.05	0.00	0.20	0.08	0.00	0.25	0.11	0.00	0.28
Other pension participation	0.00	0.00	0.06	0.01	0.00	0.09	0.01	0.00	0.10
Expected replacement rate	0.07	0.00	0.28	0.13	0.01	0.37	0.20	0.03	0.50

Notes:

a. $Mean_w$ stands for weighted mean, and the weight is the inverse probability for each respondent to correct for nonresponses.

b. Sample size decreases by year because of panel attrition, respondents' retirement, and missing values.

c. The consumer electronics subsidy program which operated in rural China from 2008 to January 2013 led to higher durable consumption in 2011.

d. The introduction of the Residents' Basic Pension and the government-driven pension program expansion increased the Residents' Basic Pension coverage rate from 2011 to 2015.

Table 2: Summary statistics of dependent variables and explanatory variables of interest for Sample B

	$Mean_w$	Median	S.D.	$Mean_w$	Median	S.D.	$Mean_w$	Median	S.D.
	2011 wave (N=1,492)			*2013 wave (N=3,213)*			*2015 wave (N=3,288)*[a]		
Nondurable consumption	6,826.71	4,554.40	8,614.85	7,178.68	4,684.54	8,297.10	7,973.33	4,973.26	9,848.98
Food consumption	3,085.07	2,080.00	3,760.27	3,630.46	2,468.21	6,386.50	3,997.31	2,385.70	6,176.94
Work-related consumption	1,629.27	724.50	3,170.32	1,652.42	702.49	2,929.80	1,780.49	719.38	4,094.57
Entertainment consumption	380.44	0.00	1,263.31	207.52	0.00	633.86	270.74	0.00	1,364.38
Other nondurable consumption	1,731.92	896.00	5,444.45	1,688.28	1,053.74	1,917.49	1,924.79	1,109.35	2,927.51
Durable consumption	2,109.49	75.00	7,413.70	1,663.81	47.47	6,586.61	1,673.33	34.41	7,138.19
Furniture consumption	312.67	0.00	801.80	383.66	0.00	2,017.25	357.53	0.00	1,557.83
Automobile consumption	868.94	0.00	6,772.62	983.66	0.00	6,111.07	1,049.52	0.00	6,721.26
Other durable consumption	927.88	0.00	2,587.93	296.50	0.00	831.19	266.27	0.00	679.68
Total consumption	8,936.19	5,337.50	12,138.88	8,842.50	5,287.67	11,242.26	9,646.66	5,534.36	12,967.89
Permanent income	27,030.42	14,283.41	35,672.59	25,971.29	12,931.55	31,079.55	29,316.21	14,988.50	34,109.47
Nondurable consumption rate	1.18	0.33	2.87	1.18	0.36	2.78	1.14	0.34	2.66
Food consumption rate	0.65	0.15	1.88	0.66	0.18	1.78	0.61	0.16	1.71
Work-related consumption rate	0.21	0.06	0.58	0.23	0.05	0.73	0.22	0.05	0.74
Entertainment consumption rate	0.05	0.00	0.27	0.01	0.00	0.07	0.01	0.00	0.11
Other nondurable consumption rate	0.27	0.06	0.81	0.28	0.07	0.78	0.29	0.07	0.80
Durable consumption rate	0.18	0.00	0.83	0.18	0.00	0.92	0.14	0.00	0.77
Furniture consumption rate	0.04	0.00	0.17	0.05	0.00	0.25	0.05	0.00	0.28
Automobile consumption rate	0.04	0.00	0.60	0.08	0.00	0.82	0.06	0.00	0.66
Other durable consumption rate	0.10	0.00	0.47	0.05	0.00	0.26	0.04	0.00	0.21
Total consumption rate	1.36	0.40	3.17	1.36	0.42	3.13	1.29	0.39	2.93
Residents' pension participation	0.78	1.00	0.38	0.85	1.00	0.32	0.85	1.00	0.33
Employees' pension participation	0.21	0.00	0.38	0.14	0.00	0.31	0.15	0.00	0.32
Other pension participation	0.01	0.00	0.12	0.01	0.00	0.12	0.02	0.00	0.12
Expected replacement rate	0.30	0.09	0.51	0.24	0.07	0.46	0.28	0.08	0.57

Notes:
a. Sample size increases by year due to expansion of the public pension programs during the survey period. Sample B captures pension participants only.

Table 3: The effect of pension participation on consumption rates, Sample A

	(1)	(2)	(3)
Dependent variable	Total	Nondurable	Durable
Estimation approach	2SLS	2SLS	IV-Tobit
Employees' pension participation	0.299***	0.247***	0.041*
	(0.102)	(0.085)	(0.024)
Residents' pension participation	0.239	0.213	-0.010
	(0.176)	(0.156)	(0.041)
Age	0.007	0.009**	-0.004***
	(0.005)	(0.004)	(0.001)
Retirement age	0.016**	0.015**	-0.001
	(0.008)	(0.007)	(0.002)
Male	-0.523***	-0.443***	-0.048***
	(0.049)	(0.043)	(0.011)
Married	0.113	0.045	0.044**
	(0.102)	(0.096)	(0.021)
Living in an urban area	-0.222***	-0.219***	-0.029**
	(0.054)	(0.046)	(0.014)
Non-agricultural hukou	0.079	0.074	-0.012
	(0.072)	(0.062)	(0.021)
Formal sector	-0.206***	-0.174***	-0.014
	(0.039)	(0.030)	(0.014)
Han	-0.051	-0.003	-0.047***
	(0.093)	(0.080)	(0.018)
No formal education	0.047	0.119	-0.069***
	(0.083)	(0.075)	(0.017)
Can read or write	-0.067	-0.016	-0.030*
	(0.064)	(0.055)	(0.016)
Elementary school	-0.034	0.012	-0.032**
	(0.054)	(0.047)	(0.013)
Very poor health	0.637***	0.546***	0.067**
	(0.155)	(0.133)	(0.029)
Poor health	0.160**	0.166***	-0.024*
	(0.067)	(0.060)	(0.014)
Good health	0.003	-0.023	0.024*
	(0.050)	(0.043)	(0.014)
Excellent health	-0.019	-0.048	0.045***
	(0.063)	(0.056)	(0.014)
Other pension participation	0.195	0.037	0.107*
	(0.164)	(0.113)	(0.055)
Family size	-0.147***	-0.139***	0.009***
	(0.014)	(0.012)	(0.003)
No. of children	-0.016	-0.016	-0.003
	(0.028)	(0.025)	(0.006)
% of male children	-0.048	-0.047	0.001
	(0.059)	(0.054)	(0.012)
Rely on children for old-age support	0.029	0.003	-0.001
	(0.047)	(0.042)	(0.010)
Current income from work/10,000	-0.179***	-0.154***	-0.001
	(0.013)	(0.011)	(0.002)
Property value/Permanent income	0.013***	0.012***	0.000***
	(0.002)	(0.002)	(0.000)
Net transfers/10,000	-0.008	-0.002	-0.008***
	(0.015)	(0.013)	(0.003)
Province FE and year FE	YES	YES	YES
Observations	15,993	15,993	15,993
(Pseudo) R-squared	0.281	0.295	0.012

Notes: We report the coefficients of 2SLS estimations of equation (4) for total consumption rate and nondurable consumption rate; report the average marginal effects of IV-Tobit estimations of equation (4) for durable consumption rate; and provide robust standard errors in parentheses. Constants are included but not reported. The omitted category for education level is secondary school and above, and the omitted category for health status is fair health. * p<0.1, ** p<0.05, *** p<0.01.

Table 4: Income heterogeneity of pension participation impact, Sample A

	(1)	(2)	(3)
Dependent variable	Total	Nondurable	Durable
Estimation approach	2SLS	2SLS	IV-Tobit
Employees' pension participation	0.193**	0.148*	0.044**
	(0.097)	(0.080)	(0.020)
Residents' pension participation	-0.029	-0.064	-0.012
	(0.162)	(0.146)	(0.041)
Residents' pension participation×Low-income group	0.836***	0.826***	0.015
	(0.215)	(0.187)	(0.051)
Low-income group	0.973***	0.796***	0.054**
	(0.116)	(0.101)	(0.025)
Individual and household characteristics	YES	YES	YES
Province FE and year FE	YES	YES	YES
Observations	15,993	15,993	15,993
(Pseudo) R-squared	0.307	0.32	0.014

Notes: We report the coefficients of 2SLS estimations for regressions with total consumption rate and nondurable consumption rate; report the average marginal effects of IV-Tobit estimations for durable consumption rate; and provide robust standard errors in parentheses. Constants are included but not reported. The omitted category for education level is secondary school and above, and the omitted category for health status is fair health. * p<0.1, ** p<0.05, *** p<0.01.

Table 5: Effect of expected replacement rate on consumption rate, Sample B

	(1)	(2)	(3)
Dependent variable	Total	Nondurable	Durable
Estimation approach	2SLS	2SLS	IV-Tobit
Expected replacement rate	2.956***	2.733***	0.157***
	(0.674)	(0.623)	(0.061)
Employees' pension participation	-0.865***	-0.844***	-0.009
	(0.293)	(0.264)	(0.035)
Age	-0.009	-0.007	-0.004**
	(0.011)	(0.010)	(0.002)
Retirement age	0.062***	0.053***	0.006*
	(0.019)	(0.017)	(0.004)
Male	-0.431***	-0.334***	-0.058***
	(0.070)	(0.060)	(0.015)
Married	-0.106	-0.179	0.055**
	(0.159)	(0.154)	(0.027)
Living in an urban area	-0.352***	-0.360***	-0.013
	(0.069)	(0.059)	(0.017)
Non-agricultural hukou	-0.680***	-0.629***	-0.033
	(0.191)	(0.168)	(0.032)
Formal sector	-0.050	-0.003	-0.037**
	(0.070)	(0.062)	(0.017)
Han	-0.408***	-0.275**	-0.114***
	(0.146)	(0.122)	(0.029)
No formal education	-0.037	0.055	-0.093***
	(0.113)	(0.102)	(0.023)
Can read or write	-0.007	-0.012	-0.007
	(0.089)	(0.077)	(0.022)
Elementary school	0.085	0.104	-0.023
	(0.075)	(0.065)	(0.016)
Very poor health	0.442*	0.362**	0.050
	(0.235)	(0.183)	(0.050)
Poor health	-0.151*	-0.110	-0.056***
	(0.089)	(0.081)	(0.019)
Good health	-0.029	-0.044	0.027
	(0.078)	(0.067)	(0.017)
Excellent health	-0.071	-0.077	0.026*
	(0.074)	(0.065)	(0.015)
Family size	-0.699**	-0.795***	0.054
	(0.311)	(0.265)	(0.061)
Other pension participation	-0.124***	-0.123***	0.008*
	(0.020)	(0.017)	(0.004)
No. of children	-0.007	-0.008	0.000
	(0.040)	(0.036)	(0.009)
% of male children	-0.157	-0.166*	0.000
	(0.100)	(0.093)	(0.016)
Rely on children for old-age support	0.219***	0.192***	0.012
	(0.069)	(0.061)	(0.015)
Current income from work/10,000	-0.038	-0.025	0.006
	(0.027)	(0.025)	(0.004)
Property value/Permanent income	0.008***	0.008***	-0.000
	(0.002)	(0.002)	(0.000)
Net transfers/10,000	-0.017	-0.013	-0.008**
	(0.017)	(0.014)	(0.003)
Province FE and year FE	YES	YES	YES
Observations	7,993	7,993	7,993
(Pseudo) R-squared	0.391	0.419	0.014

Notes: We report the coefficients of 2SLS estimations of equation (5) for total consumption rate and nondurable consumption rate; report the average marginal effects of IV-Tobit estimations of equation (5) for durable consumption rate; and provide robust standard errors in parentheses. Constants are included but not reported. The omitted category for education level is secondary school and above, and the omitted category for health status is fair health. * p<0.1, ** p<0.05, *** p<0.01.

Table 6: Heterogeneity of expected replacement rate impact, Sample B

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Age heterogeneity			*Urban–rural heterogeneity*			*Income heterogeneity*		
Dependent variable	Total	Nondurable	Durable	Total	Nondurable	Durable	Total	Nondurable	Durable
Estimation approach	2SLS	2SLS	IV-Tobit	2SLS	2SLS	IV-Tobit	2SLS	2SLS	IV-Tobit
Expected replacement rate	3.346***	3.124***	0.149**	5.440***	5.310***	0.067	2.240***	2.017***	0.168
	(0.508)	(0.468)	(0.068)	(0.630)	(0.589)	(0.101)	(0.493)	(0.439)	(0.103)
Expected replacement rate×Age	0.176**	0.177**	-0.003						
	(0.086)	(0.077)	(0.008)						
Expected replacement rate×Living in an urban area				-3.742***	-3.881***	0.129			
				(0.604)	(0.553)	(0.094)			
Expected replacement rate×Low-income group							1.674**	1.782**	-0.149
							(0.743)	(0.694)	(0.104)
Age	-0.007	-0.004	-0.004**	-0.025***	-0.024***	-0.004*	-0.014*	-0.012*	-0.005***
	(0.011)	(0.009)	(0.002)	(0.009)	(0.008)	(0.002)	(0.008)	(0.007)	(0.002)
Living in an urban area	-0.309***	-0.317***	-0.014	0.544***	0.569***	-0.044*	-0.278***	-0.317***	0.010
	(0.075)	(0.065)	(0.017)	(0.142)	(0.129)	(0.025)	(0.071)	(0.058)	(0.018)
Low-income group							0.430**	0.256	0.071**
							(0.216)	(0.205)	(0.028)
Individual and household characteristics	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province FE and year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	7,993	7,993	7,993	7,993	7,993	7,993	7,993	7,993	7,993
(Pseudo) R-squared	0.375	0.401	0.014	0.393	0.41	0.014	0.414	0.437	0.013

Notes: We report the coefficients of 2SLS estimations of equation (6) for total consumption rate and nondurable consumption rate; report the average marginal effects of IV-Tobit estimations of equation (6) for durable consumption rate; and provide robust standard errors in parentheses. Constants are included but not reported. The omitted category for education level is secondary school and above, and the omitted category for health status is fair health. * p<0.1, ** p<0.05, *** p<0.01.

Table 7: Heterogeneity between durable and nondurable consumption, Sample B

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Nondurable consumption				*Durable consumption*	
	Food	Work-related	Entertainment	Others	Furniture	Automobiles	Others
Estimation approach	2SLS	2SLS	2SLS	2SLS	IV-Tobit	IV-Tobit	IV-Tobit
Expected replacement rate	1.502***	0.475***	0.049*	0.707***	0.030	-0.086	0.074***
	(0.374)	(0.122)	(0.026)	(0.162)	(0.022)	(0.066)	(0.025)
Individual and household characteristics	YES	YES	YES	YES	YES	YES	YES
Province FE and year FE	YES	YES	YES	YES	YES	YES	YES
Observations	7,993	7,993	7,993	7,993	7,993	7,993	7,993
(Pseudo) R-squared	0.368	0.201	0.098	0.234	0.026	0.055	0.019

Notes: We report the coefficients of 2SLS estimations of equation (5) for food consumption rate, work-related consumption rate, and other nondurable consumption rate; report the average marginal effects of IV-Tobit estimations of equation (5) for entertainment consumption rate, furniture consumption rate, automobile consumption rate, and other durable consumption rate; and provide robust standard errors in parentheses. Constants are included but not reported. The omitted category for education level is secondary school and above, and the omitted category for health status is fair health. * p<0.1, ** p<0.05, *** p<0.01.

Table 8: Accuracy of individuals' expectation of replacement rate at retirement

Expected replacement rate (ERR)				*N=418*
	0<ERR≤50%	50%<ERR≤70%	70%<ERR≤100%	100%<ERR
Percent (%)	85.6	5.5	2.6	6.2
Observation	358	23	11	26
Realized replacement rate (RRR)				*N=418*
	0<RRR≤50%	50%<RRR≤70%	70%<RRR≤100%	100%<RRR
Percent (%)	84.4	4.1	4.3	7.2
Observation	353	17	18	30
Relative error (RE)				*N=418*
	RE≤10%	RE≤20%	RE≤30%	RE≤40%
Percent (%)	27.8	54.5	68.4	75.1
Observation	116	228	286	314

Appendix A: Theoretical model with a general utility function

In this version of the theoretical model, we do not specify the utility function and prove that our main findings always hold as long as the utility function satisfies several properties. Specifically, we assume that the agent has a preference representable by the utility function $U(C_t)$ where $U: R_+ \to R_+$ is twice-continuously differentiable, strictly increasing, and strictly concave in its augments. The agent solves the following problem:

$$\max_{C_{TD},...,C_T} \sum_{t=TD}^{T} \beta^{t-TD} U(C_t)$$

$$\text{s.t. } \sum_{t=TD}^{T} \frac{C_t}{(1+r)^{t-TD}} = \sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} + \sum_{t=TR}^{T} \frac{P_{TR}(1+pr)^{t-TR}}{(1+r)^{t-TD}} + A_{TD}.$$

To solve this maximization problem, we rewrite it in the Lagrange form:

$$L = \sum_{t=TD}^{T} \beta^{t-TD} U(C_t) + \lambda_{TD} \left[\sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} + \sum_{t=TR}^{T} \frac{P_{TR}(1+pr)^{t-TR}}{(1+r)^{t-TD}} + A_{TD} - \sum_{t=TD}^{T} \frac{C_t}{(1+r)^{t-TD}} \right],$$

where $\lambda_{TD} (\geq 0)$ is the Lagrange multiplier. The first-order conditions are given by:

$$C_t \Rightarrow \beta^{t-TD} U'(C_t) - \frac{\lambda_{TD}}{(1+r)^{t-TD}} = 0 \ (t = TD,...,T),$$

$$\lambda_{TD} \Rightarrow \sum_{t=TD}^{T} \frac{C_t}{(1+r)^{t-TD}} - \sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} - \sum_{t=TR}^{T} \frac{P_{TR}(1+pr)^{t-TR}}{(1+r)^{t-TD}} - A_{TD} = 0.$$

The two equations above together define the strategy for the agent's consumption at time t $(t = TD,...,T)$:

$$\beta^{t-TD} U'\left[C_t(\lambda_{TD})\right] - \frac{\lambda_{TD}}{(1+r)^{t-TD}} = 0 \ ,$$

where the Lagrange multiplier λ_{TD} satisfies:

$$\sum_{t=TD}^{T} \frac{C_t(\lambda_{TD})}{(1+r)^{t-TD}} - \sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} - \sum_{t=TR}^{T} \frac{P_{TR}(1+pr)^{t-TR}}{(1+r)^{t-TD}} - A_{TD} = 0.$$

Assuming that the agent's permanent income is $\overline{E}$, we obtain the following relationship between the current consumption rate, CR_{TD}, and the expected replacement rate at retirement, RR_{TR}:

$$U'\left[CR_{TD}(\lambda_{TD}) \times \overline{E}\right] - \lambda = 0 \ .$$

where λ_{TD} is implicitly defined by:

$$\sum_{t=TD}^{T} \frac{CR_t(\lambda_{TD})}{(1+r)^{t-TD}} = \sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} \frac{1}{\overline{E}} + \sum_{t=TR}^{T} \frac{(1+pr)^{t-TR}}{(1+r)^{t-TD}} RR_{TR} + \frac{A_{TD}}{\overline{E}}.$$

Applying implicit derivation, the derivative of the current consumption rate, CR_{TD}, to the expected

replacement rate at retirement, RR_{TR}, is:

$$\frac{\partial CR_{TD}}{\partial RR_{TR}} = \frac{\partial CR_{TD}}{\partial \lambda_{TD}} \times \frac{\partial \lambda_{TD}}{\partial RR_{TR}} = \frac{1}{\overline{E}} \frac{1}{U''\left[CR_{TD}\left(\lambda_{TD}\right) \times \overline{E}\right]} \times \frac{\partial \lambda_{TD}}{\partial RR_{TR}}.$$

It is easy to show that $U''\left[CR_{TD}\left(\lambda_{TD}\right) \times \overline{E}\right] < 0$, while $\frac{\partial \lambda_{TD}}{\partial RR_{TR}}$ is obtained by differentiating the expected replacement rate at retirement, RR_{TR}, on both sides of the equation that implicitly determines λ_{TD}, which is $\sum_{t=TD}^{T} \frac{CR_t\left(\lambda_{TD}\right)}{(1+r)^{t-TD}} = \sum_{t=TD}^{TR-1} \frac{E_t}{(1+r)^{t-TD}} \frac{1}{\overline{E}} + \sum_{t=TR}^{T} \frac{(1+pr)^{t-TR}}{(1+r)^{t-TD}} RR_{TR} + \frac{A_{TD}}{\overline{E}}$, and we obtain:

$$\frac{\partial \lambda_{TD}}{\partial RR_{TR}} = \frac{\sum_{t=TR}^{T} \frac{(1+pr)^{t-TR}}{(1+r)^{t-TD}}}{\sum_{t=TD}^{T} \frac{1}{(1+r)^{t-TD}} \frac{\partial CR_t\left(\lambda_{TD}\right)}{\partial \lambda_{TD}}}.$$

It is easy to show that $\frac{\partial CR_t\left(\lambda_{TD}\right)}{\partial \lambda_{TD}} = \frac{1}{\beta^{t-TD}(1+r)^{t-TD}} \frac{1}{\overline{E}} \frac{1}{U''\left[CR_t\left(\lambda_{TD}\right) \times \overline{E}\right]} < 0$. Thus, $\frac{\partial CR_{TD}}{\partial RR_{TR}} > 0$. This completes the proof of Hypotheses 1 and 2.

Appendix B: Summary statistics of control variables

Table B1: Summary statistics of control variables for Sample A

	$Mean_w$	Median	S.D.	$Mean_w$	Median	S.D.	$Mean_w$	Median	S.D.
	2011 wave (N=5,916)			*2013 wave (N=5,426)*			*2015 wave (N=4,651)*		
Age	51.47	52.00	4.94	51.72	51.00	4.55	52.66	52.00	4.01
Retirement age	60.14	60.00	2.79	59.66	60.00	2.10	59.85	60.00	2.14
Male	0.50	0.00	0.50	0.51	0.00	0.50	0.51	0.00	0.50
Married	0.96	1.00	0.20	0.96	1.00	0.20	0.96	1.00	0.20
Living in an urban area	0.34	0.00	0.46	0.38	0.00	0.46	0.35	0.00	0.46
Non-agricultural hukou	0.12	0.00	0.29	0.16	0.00	0.33	0.14	0.00	0.31
Formal sector	0.14	0.00	0.33	0.18	0.00	0.35	0.17	0.00	0.34
Han	0.92	1.00	0.27	0.92	1.00	0.28	0.91	1.00	0.28
Education level	1.83	2.00	1.19	1.96	2.00	1.14	2.04	2.00	1.11
Health status	3.11	3.00	0.91	3.13	3.00	0.94	3.17	3.00	0.99
Family size	3.38	3.00	1.58	3.38	3.00	1.58	3.46	3.00	1.69
No. of children	2.13	2.00	0.93	2.24	2.00	0.98	2.20	2.00	0.94
% of male children	0.56	0.50	0.34	0.55	0.50	0.34	0.55	0.50	0.34
Rely on children for old-age support	0.74	1.00	0.43	0.65	1.00	0.47	0.64	1.00	0.48
Current income from work	13,736.19	6,500.00	16,206.17	16,641.92	8,666.49	19,388.80	18,355.56	9175.76	21,200.36
Low-income group	0.36	0.00	0.49	0.32	0.00	0.48	0.33	0	0.47
House value	10,8192.30	60,000.00	116,846.70	143,578.40	85,438.09	154,946.10	144,111.60	77,128.48	168,868.60
Net transfers	342.83	0.00	5,808.79	-128.41	0.00	14,190.28	-1,136.35	183.52	16,820.17
Property value/Permanent income	22.88	4.63	81.78	24.56	4.99	115.58	22.83	4.28	87.10

Notes: All variables are defined in Appendix C.

Table B2: Summary statistics of control variables for Sample B

	$Mean_w$	Median	S.D.	$Mean_w$	Median	S.D.	$Mean_w$	Median	S.D.
	2011 wave (N=1,492)			*2013 wave (N=3,213)*			*2015 wave (N=3,288)*		
Age	51.27	51.00	4.61	52.24	52.00	4.45	52.94	53.00	3.98
Retirement age	59.72	60.00	2.53	59.67	60.00	1.83	59.87	60.00	2.07
Male	0.52	1.00	0.50	0.50	0.00	0.50	0.51	1.00	0.50
Married	0.97	1.00	0.18	0.96	1.00	0.20	0.96	1.00	0.19
Living in an urban area	0.33	0.00	0.45	0.31	0.00	0.44	0.33	0.00	0.45
Non-agricultural hukou	0.16	0.00	0.32	0.13	0.00	0.30	0.13	0.00	0.30
Formal sector	0.20	0.00	0.38	0.18	0.00	0.35	0.18	0.00	0.35
Han	0.93	1.00	0.24	0.92	1.00	0.27	0.92	1.00	0.26
Education level	2.00	2.00	1.18	1.98	2.00	1.16	2.06	2.00	1.12
Health status	3.16	3.00	0.94	3.13	3.00	0.94	3.19	3.00	1.01
Family size	3.36	3.00	1.56	3.41	3.00	1.58	3.47	3.00	1.69
No. of children	1.98	2.00	0.87	2.24	2.00	0.96	2.18	2.00	0.93
% of male children	0.55	0.50	0.35	0.55	0.50	0.33	0.54	0.50	0.34
Rely on children for old-age support	0.65	1.00	0.47	0.66	1.00	0.47	0.63	1.00	0.48
Current income from work	16,481.11	10,000.00	18,070.22	16,032.40	8,211.55	18,880.99	18,894.48	9,175.76	21,579.23
Low-income group	0.31	0.00	0.47	0.33	0.00	0.48	0.32	0.00	0.47
House value	122,205.80	75,000.00	122,569.20	138,652.60	75,944.97	151,474.00	142,370.80	82,471.56	163,132.90
Net transfers	316.96	0.00	6,520.63	-80.46	0.00	15,626.07	-1,211.98	275.27	17,743.66
Property value/Permanent income	26.56	4.62	95.59	25.56	4.96	99.58	23.13	4.59	84.15

Notes: All variables are defined in Appendix C.

Appendix C: Definitions of variables

Outcome variables:

Total consumption: The sum of durable consumption and nondurable consumption; excludes expenditure on education and medical care.

Nondurable consumption: Includes work-related expenditure, expenditure on food consumed at home, expenditure on entertainment, and expenditure on other nondurable goods. Work-related expenditure includes expenditure on eating out, transportation, clothing, and communication. Expenditure on entertainment includes expenditure on tour and other entertainment activities. The remaining nondurable expenditure includes expenditure on property management, daily chemicals, water and electricity, fuel, beauty, centralized heat supply, alcohol, donations to society, and other services. The Consumer Price Index obtained from the National Bureau of Statistics is used to deflate nondurable consumption at the 2011 price level.

Durable consumption: Includes expenditure on furniture, automobiles, and other durable goods. Other durable goods include transportation vehicles, appliances, communication products, etc. The Consumer Price Index obtained from the National Bureau of Statistics is used to deflate durable consumption at the 2011 price level.

Permanent income: The AIAE in the 10 years before the respondent's retirement:

$$
\begin{aligned}
Permanent\ income\ &= AIAE \\
&= \frac{1}{10} \times \sum_{All\ income\ types} \sum_{t=retirement\ year-10}^{retirement\ year-1} \left(\frac{Social\ average\ income_{retirement\ year-1}}{Social\ average\ income_t} \times Net\ Income_t \right) \\
&= \frac{1}{10} \times \sum_{All\ income\ types} \sum_{t=retirement\ year-10}^{retirement\ year-1} \left\{ \left[\prod_{i=t}^{retirement\ year-1} \left(1 + income\ growth\ rate_i\right) \right] \times Net\ Income_t \right\},
\end{aligned}
$$

where $Social\ average\ income_t$ is the per capita net income of rural residents or the average wage of urban employees in period t; $Net\ Income_t$ is the respondent's income from work in period t minus contributions to the Residents' Basic Pension or other pension schemes; and $income\ growth\ rate_t$ is the nominal growth rate of agricultural income, which is used to adjust net agricultural income for respondents participating in farming, and the nominal growth rate of employees' wages, which is used to adjust the other three income types, as shown in Table C1. Those three income types are employment wage for employees, business income for self-employed respondents, and income from military service.

Since the 2014 CHARLS life history survey only contains income information in the first year, middle year (if job tenure is longer than 20 years), and last year of a job, we estimate the income for each year using linear interpolation to simulate respondents' income stream in the 10 years prior to their retirement. For respondents still working in 2014, we assume that they will retain their current job until retirement. We also use the income information collected in the other CHARLS waves (2011, 2013, and 2015) to calculate permanent income if the life history survey fails to collect respondents' income history. In this situation, we first calculate the average income of the three waves at the 2011 price level. Then, we assume that the respondent's income increases with the growth rate in Table C1 to simulate the respondents' income stream 10 years before retirement.

To ensure that the incomes of respondents covered by different pension schemes are comparable, we subtract the contribution to the Residents' Basic Pension and other pension schemes, for example, employer-provided private pensions and individual-arranged private pensions, from income from working activities to obtain respondents' net income from work, since Employees' Basic Pension participants only report their net cash earnings after contributing to the Employees' Basic Pension. We cannot capture the respondent's actual contribution to pension schemes beyond the survey period. Thus, we use the contribution information collected in the 2011, 2013, and 2015 CHARLS waves to generate the average contribution to each pension scheme at the 2011 price level and further simulate the contribution stream by assuming that respondents' contributions will be adjusted according to the inflation rate in Table C1. Specifically, we use the nominal growth rate of employees' wages to adjust contributions so that they are in line with contributions to the Employees' Basic Pension and employer-provided private pensions.

Independent variables:

Residents' pension participation: A binary variable indicating whether the respondent expects to receive pension benefits from the Rural Residents' Pension, the New Rural Residents' Pension, the Urban Residents' Pension, or the Residents' Basic Pension.

Employees' pension participation: A binary variable indicating whether the respondent expects to receive pension benefits from the Employees' Basic Pension.

Expected replacement rate: The expected pension benefits at retirement divided by the permanent income from work activities, which is the AIAE in the 10 years before the respondent's retirement. Both expected pension benefits and permanent income are deflated to the 2011 price level.

Calculation of the expected pension benefits consists of six steps.

1. First, we calculate the respondents' expected pension benefits from the Residents' Basic Pension. Generally, respondents are supposed to have only one type of pension for residents. However, during the transition process of the public pension system, respondents may have more than one type of pension for residents or misunderstand the complex composition of their pension benefits after retirement. Thus, for those who report participating in the New Rural Residents' Pension, the Urban Residents' Pension, and the Residents' Basic Pension, or a combination thereof, we choose the largest expected pension benefits from the above three residents' pensions to represent their expected pension benefits from the Residents' Basic Pension. If respondents are participating in the Rural Residents' Pension and any of the above-mentioned three schemes, we add the expected pension benefit from the Rural Residents' Pension to the previous basis to obtain the final expected pension benefits from the Residents' Basic Pension according to the guidance on developing a new type of rural social endowment insurance pilot (State Council, 2009).
2. Second, we calculate the respondents' expected pension benefits from the Employees' Basic Pension. There are two categories of working-age adults participating in the Employees' Basic Pension. The first category includes those who have experienced internal retirement but not formal retirement. Internal retirement describes the situation in which respondents are not old enough to retire, but can sign contracts with firms

to stop work early and retire formally when they reach retirement age. The second category includes those who have not experienced either internal retirement or formal retirement. An individual should only be in one of the above two categories. For those who misreported being in the above two categories simultaneously, we chose the larger expected pension benefit of the above categories to represent their expected pension benefit from the Employees' Basic Pension.

3. Third, we calculate respondents' expected pension benefits from other pension schemes by adding up their expected pension benefits from supplementary pension insurance of the firm, commercial pension endowment insurance for farmers losing land, old-age pension allowance, and other pension programs.

4. Fourth, we fill the missing values of respondents' expected pension benefits from the Residents' Basic Pension and the Employees' Basic Pension. If CHARLS fails to collect information on participants' expected pension benefits for these two types of pensions, we supplement missing values in one year with corresponding nonzero values in other years.

5. Fifth, we correct the incorrect values of respondents' expected pension benefits from the Residents' Basic Pension. Some individuals report receiving nonzero pension benefits from both the Residents' Basic Pension and the Employees' Basic Pension, which is not allowed under current Chinese pension policies. For these individuals, we correct their expected pension benefits from the Residents' Basic Pension to zero.

6. Sixth, we add up respondents' expected pension benefits from the Residents' Basic Pension, the Employees' Basic Pension, and other pension schemes to obtain respondents' total expected pension benefits at retirement.

Control variables:

Other pension participation: A binary variable indicating whether the respondent will receive nonzero pension benefits from pension schemes other than the Residents' Basic Pension and the Employees' Basic Pension, including employer-provided private pensions, individual-arranged private pensions, and pensions from other schemes, such as pensions for farmers losing land.

Birth year, Age: Respondents' self-reported birth year and age. If the respondent does not report their birth year, we substitute the birth year reported in the ID card for missing values. If the values of the birth year are different among different waves, we substitute the first wave's value for the following two waves' values. After that, if the respondents' birth year is still missing, we supplement missing values of this variable in one year with corresponding values in other years. Finally, we generate respondents' age when surveyed using their birth year and the surveyed year.

Retirement age: For respondents participating in pension schemes, the retirement age is defined as the expected age when the respondent will receive their first pension. For respondents not participating in pension schemes, the retirement age is defined as the expected age when they will stop working. If the respondent's retirement age is still missing, we assume the retirement age to be the statutory retirement age.

Male: A binary variable indicating whether the respondent is male. We supplement missing values of this variable in one year with corresponding values in other years. If the values of this variable are different among

different waves, we substitute the first wave's value for the following two waves' values.

Married: A binary variable indicating whether the respondent is married. If the respondent's marital status is missing, we supplement the missing values according to the internal logical relationship of the questionnaire. According to the CHARLS questionnaire, the respondent should report the number of their children based on their marital status.

Living in an urban area: A binary variable indicating whether the respondent lives in an urban area.

Non-agricultural hukou: A binary variable indicating whether the respondent has non-agricultural hukou.

Formal sector: A binary variable indicating whether the respondent is currently employed in the formal sector. The formal sector consists of the public sector and the private sector, where public sector includes government agencies, public institutions, state-owned enterprises, and nonprofit organizations.

Han: A binary variable indicating whether the respondent is of Han ethnicity. If the value of this variable is missing, we assume that the value of this variable is zero if at least one of the respondent's parents and children belongs to an ethnic minority. After this step, we supplement missing values of this variable in one year with corresponding values in other years.

Education level: The highest education level completed by the respondent, with 0 = no formal education, 1 = can read and write, 2 = elementary school, and 3 = secondary school or above. We supplement missing values of this variable in one year with the values reported in another year. That is, we assume that the CHARLS respondents have not obtained further education.

Health status: Self-reported health status of the respondent, where 1 = very poor health, 2 = poor health, 3 = fair health, 4 = good health, and 5 = excellent health.

Family size: The number of individuals who usually eat meals together in the respondent's home. If the value of this variable is missing, we use the number of individuals living together in the dwelling as collected in the household roster to make up the missing values.

No. of children: The respondent's number of living children.

% of male children: The proportion of male children of the respondent's living children. For childless respondents, we assume that this proportion is 0.5.

Rely on children for old-age support: A binary variable indicating whether the respondent mainly relies on his/her children for old-age support.

Current income from work: This consists of employment wage for employees, business income for self-employed respondents, net agricultural income for respondents participating in farming, income from side jobs, and fringe benefits in the past year. The Consumer Price Index obtained from the National Bureau of Statistics is used to deflate income from work to the 2011 price level.

Low-income group: A binary variable indicating whether the respondent's current income from work is smaller than twice the average benefit of the Residents' Basic Pension in 2018, that is, RMB 3,656 (USD 552.4)

(Ministry of Human Resources and Social Security, 2019).

Property value: The total value of the respondent's property. If the respondent has no property, the value of this variable is zero. If the value of this variable is missing, we use the product of the house price and the area of the house to fill the missing value. If the value of the house price is missing, we use the average community house price to fill the missing value. The Consumer Price Index obtained from the National Bureau of Statistics is used to deflate the property value to the 2011 price level.

Net transfers: The net value of financial transfers respondents received from their child(ren) in the previous year, which is given by subtracting the total economic transfer the respondent gave to their child(ren) in the previous year from the total economic transfer the respondent received from their child(ren) in the previous year. The Consumer Price Index obtained from the National Bureau of Statistics is used to deflate net transfers to the 2011 price level.

Table C1: Macroeconomic variables

Macroeconomic factors	Basis of historical rate[a] (2002–2018)	Future rate[b] (2019–2030)	Usage
Inflation rate	Consumer Price Index	2.57%	To deflate all variables in the RMB value (e.g., total consumption and property value) to 2011 price level
Nominal growth rate of agricultural income	Per capita net income of rural residents	9.60%	To adjust net agricultural income
Nominal growth rate of wage of employees	Average wage of urban employees	7.10%	To adjust employment wage for employment individuals and business income for self-employed individuals

Notes:

a. The Consumer Price Index, per capita net income of rural residents, and average wage of urban employees for the period 2002–2018 are obtained from the National Bureau of Statistics.

b. We generate future rates of inflation by calculating the geometric average value over the past 17 years (2002–2018). We use values predicted by Huang and Liu (2014) as the future rates of real growth rate of agricultural income and real growth rate of wage of employees, which are 7.03% and 4.53% respectively, and we get the nominal growth rates by adding up the future inflation rate (2.57%) and the real growth rates.