No Retirement Consumption Puzzle–the Effect of Labour Supply on Disaggregated Life Cycle Expenditure in the Later Life

Yiyang Luo*

30 May, 2016

*PhD student. Department of Economics, University of Essex.

Abstract

This paper examines the life cycle profile of disaggregated nondurable expenditures for Chinese urban households. The result shows that aggregated expenditure conceals substantial heterogeneity in the life-cycle pattern of expenditure subcomponents and underestimates the uninsurable permanent income risk that households face. Based on the observed empirical pattern, I test how much of the adjustment of consumption across time and categories can be attributed to the labour supply status. A regression discontinuity approach shows that elderly households adjust expenditure at retirement across subaggregated categories even though there is no significant change in total nondurable spending. In particular, households are not only able to smooth food expenditure but also food consumption upon retirement. Furthermore, by using subjective retirement expectations as an instrument for actual retirement, I find that the adjustments in sub-aggregated expenditure categories are resulting from unexpected retirement. This study has important implications for using disaggregated data to test the existence of retirement consumption puzzle and for testing consumption theories.

1 Introduction

The Chinese economy experienced rapid growth since the 1978 economic reform, which achieved an average of 8.6 percent in GDP annual growth over the period 1978-2007. The significant growth is mainly driven by the expansion of international trade. China has overtaken the US, becoming the world's biggest goods exporter in 2009, but this export-led pattern has been proved to be unsustainable. The growth of the economy has decelerated recently especially signalled by the stock market crash in July 2015. Despite remarkable economic growth, household consumption, decreasing from 50% in 1980 to 36% in 2014, accounted for a gradually smaller proportion of the GDP. It raises the importance of analysing and understanding the consumption behaviour of Chinese households.

In addition, Chinese population has been ageing rapidly over the past three decades resulting from the family planning policy and longer life expectancy. The amount of elderly population was around 2 billion by 2014, which accounted for 15.5 percent of the whole population, and it has been projected to surpass one thirds of the whole population by 2050. Given the fact that the working population is shrinking over time, the topic on delaying mandatory retirement age is widely debated. It is certainly a public policy that not only concerns the economic growth, but more importantly the welfare of elderly people. Modigliani and Brumberg (1954) suggests that households should smooth consumption over the life cycle to maintain a stable marginal utility, thus a failure to smooth the consumption upon retirement would arise considerable concerns for the well-being of elderly people and adjustments of public policies. Hence, studying consumption behaviour of elderly individuals and how their consumption responds to retirement is of great policy implication.

Studies of retirement consumption are mainly focus on the western world, and significant drops in consumption upon retirement are repeatedly documented. China provides a comparable context for investigating this issue due to different retirement policies and social norms. The mandatory retirement policy provides a quasi-experimental framework for identifying a causal relationship between labour supply status and consumption. Moreover, the high saving rates of elderly households provides a unique opportunity to understand the potential mechanism through which households smooth their consumption.

This paper begins by exploring the mean and cross-sectional variance of nondurable expenditure life cycle profile. In particular, it reports the evolution of household consumption at disaggregated categories over the life cycle. The importance of analysing subcomponents of consumption goods is raised by Aguiar and Hurst (2013) who claim that the total nondurable consumption pattern is mainly driven by inputs that are complementary to work status and that are amendable to home production. This study confirms that total nondurable expenditure masks heterogeneity in the life cycle profile of disaggregated individual consumption. Specifically, the food expenditures present a hump-shaped profile in general but remains relatively stable at later stage of the life cycle. The core nondurable expenditure shows a typical hump-shaped life cycle profile, while the work-related expenditure displays a significant drop since age 45. The total nondurable expenditure presents a typical hump-shaped pattern. It seems that the pattern of total nondurable expenditure is mainly driven by the drop in work-related spending in the later stage of life cycle. Additionally, all three categories show an increasing pattern of cross-sectional variance, while the work-related expenditure displays the most dramatic increase in inequality. These evidence gives rise to the importance of the roles of subaggregated expenditures for explaining the life cycle profile of total nondurable goods. Furthermore, this paper explicitly tests how retirement affects the consumption behaviour of households.

This study adds to prior literature in several aspects. First, it provides the first empirical evidence of the disaggregated Chinese household consumption life cycle profile with respect to both mean and cross-sectional variance. The hump-shaped age-consumption profiles is consistent with the life cycle hypothesis with uncertainty. Second, it presents new evidence on testing the existence of retirement consumption puzzle in China. A regression discontinuity approach fails to find any impact of retirement on total nondurable expenditure, while retirement affects the allocation of disaggregated categories. In particular, there is no drop in food consumption taking into account food production. Third, possible mechanisms through which the retirement affects disaggregated expenditures are provided. Supported by a change in family composition, stable household food production time and an improvement in food quality, households are not only able to smooth food expenditure but also food consumption upon retirement; work related expenditure drops upon retirement due to the complementary effects of labour supply; total nondurable expenditures stay stable leaving out sub-expenditures that are inputs into market work and amendable to home production. Fourth, this paper provides an implicit test of the consumption theory that the life cycle profile of consumption goods that are complementary to working status should be different from those goods that are substitution or amendable to home production. The results confirm the complementary mechanism, and the home production theory finds support in adjustments of intra-household food shopping time. Fifth, the main analysis is based on a repeated cross sectional data that has the advantage over panel data in its longer span of coverage. Existing research in Chinese retirement consumption use panel structure with short time span which are insufficient to fully capture the welfare changes of elderly households. Sixth, I use an additional dataset (CHARLS) which allows me to distinguish between the effects of anticipated and unanticipated changes in consumption upon retirement.

The remainder of this paper is organized as follows: section 2 presents the institutional background and literature review on the analysis of household life cycle consumption behaviour. Section 3 states the empirical framework that the current paper focuses on. Section 4 describes the data source and descriptive statistics. Section 5 provides empirical results, including robustness check. Finally, Section 6 draws conclusion.

2 Background information

2.1 Institutional background

This mandatory retirement law has been officially implemented in formal sectors including governments and public sectors, state-owned enterprises, and collectively-owned enterprises since May 1978, and then gradually applies to private sectors. The retirement law requires male worker to retire at age 60, female white-collar worker to retire at age 55 and female blue-collar worker to retire at age 50, with few exceptions applying to certain occupations and physical situations. These age thresholds have not changed since the initial establishment in 1950s, while there are heated debates regarding postponing the retirement age given the fact that China is among those countries with earliest retirement age and experiences a rapid change in demographic structure. The ageing population puts heavy pressure on pension reforms that it has been projected that one pensioner will be sponsored by two tax payers in 2035.

The compliance of the mandatory retirement age law is not perfect, there are cases that people retire earlier than the mandatory age due to inner retirement and other issues, and cases that people get re-hired by the previous employer after official retirement or get a new job.

Although the mandated retirement age has been fixed for about 60 years, the replacement rate–the percentage of a worker's pre-retirement wage–varies across time and work-unit types. China adopts a double standards pension scheme which treats the retirees of government and public sectors differently from the retirees of private sectors, in the aspects of contribution and replacement rate. Government and institution workers can obtain a replacement rate up to 90%, while the private sector workers receives around 60% of the pre-retirement income.

The pension system has gone through several reforms in changing the way providing funds and replacement rates, a major reform took place in 1997 that required the retirement fund to be provided by combining individual accounts and social pooling instead of providing entirely by the employers before 1997. This reform interferes with my sample period 1995-2007, but it should not affect the size of compliers and consumption behaviour right upon the retirement age given the nature of the RDD design. Additionally, results are robust to drop 1995 wave.

2.2 Literature Review

Aguiar and Hurst (2013) firstly document that the life cycle profile of total nondurable consumptions masks surprising heterogeneity across expenditure subcomponents. The well-known hump-shaped nondurable expenditure profile is mostly driven by sub-expenditures that are inputs into market work or are amendable to home production. Consumption categories that are complements to labour supply would decline as the labour supply declines at the later life cycle, while those categories that are substitutes to labour supply which are cost opportunity of the working status would not decline significantly with the change in labour supply.

Their paper gives insight to a new understanding of the so-called retirement consumption puzzle–that household consumption drops significantly at retirement–which contradicts the life cycle hypothesis by Modigliani and Brumberg (1954). A key implication of the life cycle model is that individuals are able to smooth their consumption over the life cycle against expected income shocks. While retirement is probably the most predictable change in the income, Banks et al. (1998) firstly document the retirement consumption puzzle in UK, they claim that unexpected adverse information around retirement would affect the consumption behaviour, Smith (2006) and Barrett and Brzozowski (2012) show that it is the involuntary retirement that cause a drop in the consumption while the voluntary retirement actually shows no change. Bernheim et al. (2001) find a pronounced discontinuity in consumption at retirement by using PSID in US, in particular, they claim that work-related expenses or leisure substitutes donot contribute to explain the reduction in consumption based on Consumer Expenditure Survey. However, based on the longitudinal component of Consumption Expenditure Survey (CEX), Aguila et al. (2011) find no evidence of discontinuity of retirement consumption measured by total nondurable expenditure, while food expenditure declines by 6 percent at retirement.

Hurst(2008) surveys the retirement consumption puzzle literature and concludes that the standard lifecycle consumption model augmented with home production and health shocks mostly accounts for the retirement consumption patterns of households. The fact that work-related declines at retirement has been consistently documented but what really puzzling is that the well documented significant drop in food expenditure at retirement. Given food is necessity in daily life thus have relatively lower income elasticity, a promising explanation is the relative lower opportunity cost of home production after retirement.

Empirical challenges to identify a causal effect of retirement on consumption come from several aspects. The first concern is that retirement is an endogenous choice, but often times older studies have no good ways to deal with the endogenous issue, therefore, it is most likely for them to present a correlation instead of a causal effect. There are few exceptions that exploit variation in retirement due to retirement benefit eligibility((Battistin and Weber, 2009)) or subjective retirement expectations ((Haider and Stephens, 2007)).

Battistin and Weber (2009) identify the causal effect of retirement on consumption in Italy by using the exogenous variation in pension eligibility. They find that a 9.8 percent of the nondurable consumption drop is due to eligibility induced retirement, and the drop is explained by reduction in work-related expenses or leisure substitutes. However, most of the retirement consumption drop is attributed to a significant reduction in the number of adult children living with their parents. The paper most closely related to this study in the context of China is provided by Li et al. (2015). They exploit a causal relationship between retirement and consumption within a regression discontinuity framework. The identification comes from China's mandatory retirement policy and they report a 21 percent drop in nondurable consumption at retirement, but the drop is mainly driven by work-related expenditures and food at home expenditures. Their work is in support of the finding of Hurst (2008) that the retirement consumption puzzle is not exist when take into account home production in the life-cycle model. Dong and Yang (2016) find a significant decline in food expenditure that is mostly accounted for by drop in average food prices rather than quantities, but find not change in work-related expenses.

The second challenge is that most of the literature donot have detailed information on consumption or they provide evidence based only on food expenditure or total nondurable expenditure. While food is a relatively easy accessed measurement of expenditure in most of the database and assumed to have low income elasticity, it cannot represent a composite measurement of expenditure especially in the presence of heterogeneity in the subcomponent consumption.

3 Empirical Methodology

To provide the life cycle profile of mean expenditures, this analysis adopts the specification by Aguiar and Hurst(2013),

$$lnC_{it}^{k} = \alpha_0^k + \alpha_1^k Age_{it} + \alpha_2^k Cohort_{it} + \alpha_3^k Family_{it} + \epsilon_{it}^{k} \tag{1}$$

where C_{it}^{k} represents nondurable expenditure of household i in year t on category k, Age_{it} contains a set of age dummies that cover household head age range from 26 to 75, α_1^k shows the effect of age at each life stage relative to age 25 on expenditure category k. $Cohort_{it}$ is a vector of cohort dummies, ranging from 1927 to 1974. $Family_{it}$ is a set of family composiiton dummies, including dummies indicating number of household members, dummies representing number of children in age categories 0-2, 3-5, 6-13, 14-17 and 18-21 and a dummy for marital status. The measure of expenditure is at household level instead of the individual level, I use the cross-sectional differences in family structure to identify family composition effects. One common alternative approach is to deflate expenditure by a measure of common equivalence scales, as this study looks at sub-aggregated expenditure categories, the major limitation in applying a common equivalence scale is that it cannot account for the different returns to scale across expenditure categories(Aguiar and Hurst, 2013).

Since this analysis is based on repeated cross section surveys, the age effects would actually capture a mixture of life cycle and cohort effects. Hall(1968) states that age effects are not identified due to the collinearity among age, cohort and year effects. The standard practice is to normalize year dummies so that the year effects are capturing cyclical fluctuations or business cycle effects that average to zero over the long run (Deaton, 1997). Thus the year effects would be orthogonal to a time trend. This study deals with few waves that it is insufficient to isolate time trends from transitory shocks. Moreover, if the true time effects contains a linear trend, the orthogonal assumption will create bias by forcing that trend into estimated age and cohort effects (Browning et al., 2014). An alternative to put restriction on the time effects is to model time effects with observable variables. To account for the relative change in the price of goods over time, the expenditures are deflated based on category, region and year.

In order to understand the cross-sectional expenditure dispersion across households, the dispersion $(\sigma^2)_{it}^{k}$ is computed from the square of the residuals of equation (1) for each age and cohort, then the life cycle profile of the expenditure dispersion is estimated by the following specification:

$$(\sigma^2)_{it}^k = \beta_0^k + \beta_1^k Age_{it} + \beta_2^k Cohort_{it} + \eta_{it}^k \tag{2}$$

The vector β_1^k shows the cross-sectional variance in expenditures at each life stage relative to age 25 on expenditure category k.

To test how the consumption behaviour of elderly people changes with working status, specifically to assess the impact of retirement on sub-aggregated expenditures, this paper exploits the discontinuity at the mandatory retirement age. Under the assumption that the cutoff is not related to any family characteristics or predetermined variable, any significant change in consumption at the age cutoff can be attributed to the retirement.

The fact that retirement is mandatory at a certain threshold in China provides a unique quasi-experiment to capture the causal effect of retirement on consumption. The RD design was firstly introduced by Thistlethwaite and Campbell (1960) and become gradually popular in relatively recent studies(Angrist and Lavy (1999), Hahn et al. (2001), Imbens and Lemieux (2008), Lee and Lemieux (2010)). There are few studies employing the RD design to test the existence of a retirement consumption puzzle(Battistin and Weber (2009), Stancanelli and Van Soest (2012), Li et al. (2015), Dong and Yang (2016)). Essentially, I would like to estimate the treatment effect at a range as close as possible to the threshold of assignment variable while donot lose too much precision at around the cutoff.

Ideally this paper is interested in estimating the following specification:

$$lnC_{it}^k = \gamma_0^k + f(age_{it}) + \rho Retire_{it} + \nu_{it}^k \tag{3}$$

where $f(age_{it})$ represents a nonlinear relationship between outcome and the forcing variable age_{it} for allowing a reasonable smooth at both sides of the cutoff. In practice, there are two ways to approximate $f(age_{it})$, one is to use a pth order polynomial specification i.e.

$$lnC_{it}^k = \gamma_0^k + \gamma_1^k \tilde{age}_{it} + \gamma_2^k \tilde{age}_{it}{}^2 + ... + \gamma_p^k \tilde{age}_{it}{}^p + \rho Retire_{it} + \nu_{it}^k \tag{4}$$

where $\tilde{age}_{it} = age_{it} - 60$, centering the running variable at cutoff age 60 to ensure that the treatment effect at $age_{it} = 60$ is the coefficient on $Retire_{it}$ in a regression with interaction terms. The choice of polynomial order is based on the Akaike information criterion (AIC) as suggested by Van der Klaauw (2002) and Lee and

Lemieux (2010). In the regression context, the AIC is given by

$$AIC = Nln(\sigma^2) + 2k \tag{5}$$

where σ is the root mean squared error, and k represents the number of parameters in the regression.

$Retire_{it}$ is a dummy for retirement status of the household head in household i at time t. This specification implicitly assumes that the only factor affecting the outcome at a range very close to age 60 is the retirement status which is independent of the error term. Figure 3 shows that there is a jump of around 40 percent of individual transiting into retirement from employment. However, there are noncompliers who got early retirement or postponed retirement. Hence the endogeneity of retirement would bias the result estimated from equation (4). Following Li et al.(2015), I use an age indicator D_{it} that equals to one if age above 60 and 0 if below 60 to instrument the retirement status. D_{it} is a strong predictor for retirement and is very unlikely to suffer from any manipulation and selection bias.

The first stage specification can be estimated from

$$\begin{aligned} Retire_{it} =& \delta_0 + \delta_{l1}\tilde{age}_{it} + \delta_{l2}\tilde{age}_{it}^2 + ... + \delta_{lp}\tilde{age}_{it}^p + \lambda D_{it} + \\ & \delta_{r1}\tilde{age}_{it}D_{it} + \delta_{r2}\tilde{age}_{it}^2 D_{it} + ... + \delta_{rp}\tilde{age}_{it}^p D_{it} + \nu_{1it} \end{aligned} \tag{6}$$

where both D_{it} and the interaction terms are used as instruments for $Retire_{it}$.

The second stage model with the interaction terms can be specified as the following:

$$\begin{aligned} lnC_{it}^k =& \gamma_0^k + \gamma_{l1}^k\tilde{age}_{it} + \gamma_{l2}^k\tilde{age}_{it}^2 + ... + \gamma_{lp}^k\tilde{age}_{it}^p + \rho Retire_{it} + \\ & \gamma_{r1}^k\tilde{age}_{it}Retire_{it} + \gamma_{r2}^k\tilde{age}_{it}^2 Retire_{it} + ... + \gamma_{rp}^k\tilde{age}_{it}^p Retire_{it} + \nu_{it}^k \end{aligned} \tag{7}$$

A natural alternative way to approximate $f(age_{it})$ is to use a nonparametric kernel method to show a local linear fit. By applying kernel weights and conditioning on the age, the idea is to eliminate residual differences between individual who are close to get retired and are just retired. The first-stage and reduced-form local linear kernel regressions are specified as following,

$$\min_{\alpha,\delta} \Sigma_{it} K(\frac{\tilde{age}_{it}}{h})(Retire_{it} - \alpha D_{it} - \delta_0 - \delta_1\tilde{age}_{it} - \delta_2\tilde{age}_{it}D_{it})^2 \tag{8}$$

$$\min_{\beta,\gamma} \Sigma_{it} K(\frac{\tilde{age}_{it}}{h})(lnC_{it}^k - \beta D_{it} - \gamma_0 - \gamma_1\tilde{age}_{it} - \gamma_2\tilde{age}_{it}D_{it})^2 \tag{9}$$

where $K(\frac{\tilde{age}_{it}}{h})$ is a triangular kernel that puts more weight on observations that closer to the cutoff point, h is a positive bandwidth sequence. Here the running variable comes with discrete nature so that it simplifies the problem of bandwidth choice, as the graphic fit will be shown using the mean of the outcome variable for each value of the discrete running variable.

The estimated effects should be interpreted as a local average treatment effect since fuzzy RD by construction is a 2SLS estimation with treatment-covariate interactions, the estimated causal effect captures the average treatment effect for those compliers who only retire at the point when they reach the mandatory retirement age.

4 Data

Our empirical analysis is based on data from the urban Chinese Household Income Project (CHIP), which was conducted by the Institute of Economics at the Chinese Academy of Social Sciences with assistance from the National Bureau of Statistics(NBS). The survey adopts a national probability sample of households approach, selecting provinces from four distinct regions varies in economic development and geography for constructing a nationally representative sample. The four regions of China are defined as coastal, central, western and large municipalities with provincial status. Ideally, the sampling should ensure that the sample size of each province is proportional to the population size of each province, but if the provincial sample sizes are deliberately choose to be representative of the region, then the sample weights need not to be consistent with the provincial population share. In fact, the provinces selected into the sample have different population size, while the CHIP survey shows quite similar provincial sample sizes(Song et al.2015). Unfortunately, the author is not aware of the exact selection process of the households within each province since the documentation of this dataset is not really informative in this sense. The main result of this study is based on the raw dataset, but the robustness check chooses to construct sample weight for two reasons: the unclear design of sampling process and the variation in sample provinces across waves.

I use four waves out of the available five from this project, which covers year 1995, 1999, 2002 and 2007. The purpose of 1999 survey differs from the other waves in the sense that it is not representative of the whole population and it contains relatively smaller sample size. I tested that the exclusion of this wave do not alter the results. Hence I decided to include this wave in the main sample since it contributes to additional birth cohorts and efficiency improvement. The initial 1988 survey differs from the rest in terms of purchasing pattern, in order to meet people's need of necessities against a terrible shortage of supply since 1950s, the government implemented a central controlled food supply policy that urban people were issued with food ration which was the only way to purchase food. This policy was abolished nationwide in 1992. One may suspect that the cease of this policy would induce a change in people's expenditure pattern, thus the 1988 wave is excluded. All surveys document individual and household characteristics, sources of income and categories of expenditure. All expenditure and income data are deflated on urban and category basis, and are in 2007 constant Chinese Yuan[1].

The expenditure data are recorded on a diary basis across the survey years in the CHIP dataset. There are three main disaggregated expenditure to be exploited in this study. The first category is food expenditure, the second category is work-related expenditure which includes clothing, transportation and communication and cigarette and alcohol spending[2]. The third category is the core nondurable expenditure which includes rent or rent equivalent, utility, property management and daily use goods spending. This study only focuses on nondurable expenditure since it is difficult to obtain annual service flow measures from durables. For the same reason, education and health expenditure are excluded.

There is no information to distinguish food at home from food away in our sample, except for 2002 urban survey. Hence, food expenditure consists of both food at home and food away from home. It is also difficult to distinguish work-related transportation from travel-based transportation spending in the sample. Given the fact that for most of the working age people, travelling transportation should account for a relatively smaller fraction of total transportation cost in China, I assume that most of the transportation cost occurred during working age is driven by work-related transportation cost. The drop in transportation cost at later stage of life potentially confirms this statement. In addition, the robustness check section uses a demand system analysis to test the relationship between work-related spending and work status by directly controlling for labour supply. Utilities costs include electricity and fuel expenditures. Entertainment expenditure is included in a broader category education, culture and entertainment services. For most of the survey waves, it is difficult to isolate the entertainment expenditure from the rest. Thus entertainment expenditure is not included in our analysis. Rents are computed as annual actual rent paid of renters and self-reported estimation of rental equivalent of the house owners.

The sample is restricted to households who report a non-missing expenditure on five

[1]the results are robust to CPI index by province and category

[2]In China, alcohol and cigarette are an important work-related social spending especially for men

key subcomponents of the consumption: food, transportation and communication, clothing, utilities and rent or equivalent. The sample only includes households with household heads age over 25 and below 75 to ensure that household head have completed education. The sample left with 21900 observations.

Table 1 shows the share and mean change of three main nondurable goods over the life cycle. Specifically, it shows the pattern for individual ages around 25, 45 and 65. The share of food spending over total nondurable expenditure increases across these age groups, while work-related expenditure share decreases and the core nondurable share remains fairly constant. Column (4) and (5) show the log change in mean expenditure between age 25 and 45, 45 and 65, respectively. The log change is given by the change in corresponding age dummy coefficient as shown in figure 1 and figure 2. Table 2 summarizes the life cycle profile for the variance of the three composite consumption spending. Food spending presents the lowest unconditional variance among these three composite consumption goods, while the work-related goods reports the highest inequality since middle age.

In this analysis, retirement is defined based on current labour force status, i.e. individual is retired if self-reported labour supply status is retired. For testing the existence of retirement consumption puzzle, the RD sample restricts households to those with male household head and age between 50 to 70(60 is excluded[3]).The RD sample contains 5305 observations. This analysis focus only on households with male household heads due to the fact that the mandatory retirement law is more complicated for women, depending on the occupation and type of work unit. In addition, there are few cases that female are the household heads. In fact, the average age difference between husband and wife is around three years old, 71.5(95.4) percent of the households in our sample have less than 5(10) years age-gap between husband and wife, which suggests that most of the spouse are already retired upon husband's retirement. Thus, this analysis does not take into account wife's retirement decision[4] and attributes the change of household consumption at husband age 60 mainly to the retirement of husband.

Table 3 shows the summary statistics for both outcome variables and some predetermined variables of the RD sample. The mean age of household head is around 58, 4 percent of which are ethnic minorities, with 41 percent obtained high school or above education. On average, there are 3.05 individuals in the household among which includes 0.79 child. Around 97 percent of the male are married or cohab-

[3]Individuals age 60 are likely to be in a situation of a mixture of pre-retirement and post-retirement status, therefore the expenditure data of age 60 people are excluded.

[4]the balance test in the section 5 confirms that the retirement status of wife is stable at the cutoff.

ited, with 55 percent of the spouse are also retired. Table 3 also reports the mean expenditures in Chinese currency[5].

5 Result

This section starts with showing an empirical life cycle pattern of the evolution of mean and variance of expenditures. Based on the graphic evidence, I test the association between labour supply status and consumption goods. To be specific, the RD approach is employed to test how much of the drop in total nondurables and changes in the three sub-aggregated expenditures in later stage of the life can be attributed to transiting into retirement.

5.1 Empirical Patterns

Figure 1 shows the life cycle consumption pattern in the aspects of both mean and variance. Clearly, the mean consumption displays a hump-shaped pattern but with two peaks, it rises over the early stage of life cycle, peaking at around age 40 at roughly 28 log points higher than the baseline 25-year-old spending, the second peak comes at age 55 with 26 log points higher than the baseline age effects[6]. The cross sectional consumption dispersion increases relative to the variance observed for 25-year-olds over the life cycle, in particular, the cross-sectional inequality of nondurable consumption rises by roughly 36 log points[7].

The typical consumption patterns documented in figure 1 conceals substantial heterogeneity among subcomponent consumption goods as depicted in figure 2. It shows that different expenditure categories present quite heterogeneous life cycle patterns for both mean and variance of spending. In general, the food and core nondurables spending show a hump-shaped profile. Food expenditure rises by 30 log points at around age 40 and then stays relatively stable until age 54, followed by some fluctuations within the range between 20 and 40 log points. The core nondurable expenditure presents a increasing pattern before age 35 and relatively stable spending between age 35 and age 50, then it slightly declines. The work-related consumption displays a dramatically different life cycle profile from the previous two

[5]Here the expenditures are measured in Yuan for the ease of understanding the composition of spending, but the main results are reported based on log value of expenditure.

[6]Note that Aguiar and Hurst (2013) show a peak at age 45.

[7]The increase in variance over the life cycle is larger than that reported in Aguiar and Hurst (2013) where they find an increase of 0.15 points. It is likely due to the fact the developing country experience much higher inequality than developed country.

consumption goods. It drops substantially after around age 45 which is below the baseline age effect at age 25, followed by a decline of 60 log points until age 75[8]. Figure 2(b) presents a life cycle inequality pattern in term of these three components of nondurable consumption. All of these three consumption categories reflect an increasing inequality over the life cycle, while most of the increase in the variance of total nondurable expenditure comes from work-related spending.

In summary, there is substantial heterogeneity across life cycle profiles of expenditure categories both in terms of mean expenditures and cross-sectional variance, which is in general consistent with the finding of Aguiar and Hurst(2013), but in particular, I do not observe a fall in mean food expenditure at retirement as mostly documented in the literature. It is natural to incorporate the home production theory since the opportunity cost of time is lower after retirement. If this also applies to this study, then the actual food consumption might increase after retirement. As the observed pattern has shown that work-related spending drives down the total nondurable expenditure and drives up the total cross-sectional variance at later stage of the life. A potential explanation for the heterogeneous pattern can be derived from the relationship between different expenditure categories and employment status, those categories which are complementary to work should fall while those substitutes should increase.

5.2 Main result

Given the potential importance of the work-related expenditures in accounting for the evolution of the life cycle profile, this paper is interested in assessing the relationship between labour supply and adjustment of expenditures across life cycle and expenditure categories. Specifically in order to understand how much of the decline in spending of the older households(age between 50 and 70) can be attributed to transition into retirement, a RD design has been employed to test the existence of retirement consumption pattern in China. The share of work-related spending accounts for around 20 percent of the total expenditure at age range 50-70, clearly not a negligible amount. It is natural to question how much of the total nondurable drop at around retirement age can be attributed to a change in work status. Here, the real consumption puzzle would present if the total nondurable consumption drops at retirement even after taking out the work-related spending.

Figure 3 shows a significant jump of the retiree fraction at the mandatory retirement age 60, with the share of retirees increasing from around 40 percent at age

[8]Aguiar and Hurst (2013) show a roughly 60 log points fall after middle age.

59 to around 80 percent at age 61. Table 4 confirms a significant first stage effect that age above 60 increases the likelihood to retire by about 34.4% to 45.6%, depending on the different specifications used. As stated in equation(6), this study incorporates flexible age controls, allowing for interactions between age dummies and D_{it} and asymmetric polynomial orders on either side of the age 60 cutoff. A valid RD design would imply that the inclusion of other covariates does not affect the consistency but the efficiency of estimators. Table 4 shows that province and year dummies attributes to explain the variation in the outcome variable retirement, and the standard errors of augmented regressions are smaller while the significance and magnitude of the estimators stay quite similar.

The validity of the RD design is presented in table 5, additionally in figure 4 and 5. In order for the RD design to be valid, one would expect that individuals have imprecise control over the assignment variable. Since it is not possible to test this directly, an alternative approach is to test the continuity of the density of assignment variable at age 60 (McCrary, 2008). If individuals near the compulsory retirement age were able to select on either side of it, and if they did so in a monotonic way, then one would expect to observe a discontinuity of the density of running variable at age 60. Figure 4 provides evidence that retirement status is as good as random assigned near the cutoff.

Ideally, one would like the discontinuity in the outcome of interest comes from only the treatment effects while there is no correlation between predetermined variables and the treatment. The variables that are taking into consideration are household size, number of children, education level, ethnic minority, whether the household head is married or cohabited, the retirement status of his spouse. Figure 5 tests the validity of the assumption that the cutoff is not correlated with any predetermined background variables. Table 5 shows that there is no correlation between the treatment and household background characteristics, which provides additional support on the fundamental assumption that retirement status is as good as randomly assigned to either side of the cutoff controlling for a smooth polynomial in age. Here the polynomial order are choose by the AIC criterion. Since the AIC is a generalized cross validation procedure that minimizes a loss function, it puts more weight on model fitting rather than a significance testing of the null hypothesis that the estimator is zero. It explains why the AIC procedure selects specification with polynomial orders that lack of significance or nearly zero in magnitude.

The main result of the regression discontinuity design is given by figure 6 and table 6. Figure 6 shows a discontinuity in work-related expenditure, while there is no clear evidence of a drop in total nondurable expenditure, food and core nondurable expenditure. Table 6 confirms the graphic finding that there is no impact of retirement on total nondurable expenditure; food and core nondurable expenditures stay stable, while work-related spending shows a significant decline of 27.3%. It implies that households are able to adjust expenditure across categories even though there is no significant change in total nondurable spending. Hence, households remain the same level of utilities though reallocating sub-expenditures.

Note that my treatment-determining covariate is a discrete variable, since it is impossible to get observations within arbitrarily small neighbourhoods of the cutoff, the identification relies on choosing a particular functional form for relating the covariate to outcomes. The specification error occurs whenever there is a deviation of the expected value of outcome from the predicted outcome of a given functional form. This study assumes that the specification error is random and identical (Lee and Card, 2008), to be specific, I assume that the sources of specification error is independent of treatment status. This orthogonal assumption of the specification error may seem restrictive, but to an extent it relaxes the assumption of no specification error that conventional inference relies on. The randomness assumption induces a within-group correlation (at age level) in the error, therefore consistent estimators are provided by clustering at age and province level.

5.3 Robustness check

Several robustness checks have been applied to this analysis, mainly focusing on testing the robustness of the regression discontinuity method and the sensitivity of the expenditure measurements.

5.3.1 Bandwidth choice

The discrete nature of the running variable simplifies the problem of bandwidth choice, each observation in the graphic presentation displays an average over each age. The main analysis focus on observations with ten-year bands on each side of the mandatory retirement age, for achieving a bias-efficiency balance.

Table 7 experiments with different selection criteria on the bandwidth, ranging from five-year bands to fifteen-year bands. The results are robust using the eight-year up to fifteen-year bands that a significant decline in work-related expenditure is observed upon retirement, while seven-year bands and smaller show no effects. Figure 2(a) shows that work-related expenditure starts to drop at around age 45, wider bandwidth captures a bigger work-related spending drop and composition effects due to mortality. Although conventionally small bandwidth reduce the bias, in our case smaller bands suffer from the effect of outliers in the age profile. Thus it provides less credibility on the estimated effects upon retirement.

5.3.2 Alternative Specifications

Figure 3, figure 5 and figure 6 in this paper are based on local linear fit estimations, which provide a robustness check on the AIC-selected polynomial specifications as shown in table 4, table 5 and table 6. Both the local linear and AIC polynomial specifications reach the same conclusion.

The main analysis draws conclusion based on specification chosen by the AIC criterion, which incorporates third order polynomial in some cases. However, higher older specification achieves more flexible control and reduces bias at the cost of greater asymptotic variance. Gelman and Imbens (2014) argue that regression discontinuity analysis should not control for higher order (third, fourth, or higher) polynomials of the running variable. The estimators that rely on such methods have poor properties and are often misleading, therefore instead they suggest to use quadratic polynomials or other smooth functions. Figure 7, figure 8 and figure 9 show graphic results that are based on quadratic polynomial regression, and confirm the robustness of the previous findings. One exception is that work-related expenditure shows no discontinuity under this specification, although the coefficient gives similar magnitude as the AIC selected model. The standard error doubled compares to the AIC selected model [9].

5.3.3 Placebo test

Essentially, the placebo test in this context is to estimate whether there are discontinuities at points where there should be no jumps. This analysis implements this idea by splitting the sample into two subsamples on each side of the cutoff value and then take the median of the running variable as a “fake” cutoff in each subsample(Imbens and Lemieux, 2008). If the RD design is valid, one would expect no discontinuity exists in either subsample. Picking the “fake” cutoff at the median on either side increases the power of the test to detect jumps. Moreover, this idea avoids including the true cutoff point in the subsamples, therefore excludes the possibility that the known discontinuity contaminates the estimation.

Placebo estimates are implemented with age 54 and age 64 as the “fake” cutoff

[9] Tables of quadratic polynomial analysis are provided on request.

points on either side of the true cutoff. Table 8 is in favour of the null hypothesis of no effect of retirement. Notice that the standard error in both subsamples are relatively bigger due to smaller sample size.

5.3.4 Heterogeneity

Households with different pre-retirement wealth are likely to respond in a different way to retirement even if the shock is expected. The socially disadvantaged households maybe less prepared for the reduction in income, such as a shortage of saving or less organised financial behaviour or bounded by credit constraint. Due to a lack of wealth measurement across all waves, education is used as a proxy for wealth. Table 9 shows that there are no significant differences in the consumption response to retirement between low and high educated groups. One exception is in the aspect of work-related expenditure, high educated households show a significant 28 percent of a decline while low educated households show no effect. Potential explanations could be that high educated households are more likely to concentrate in big cities where requires higher transportation expenses and more formal outfits, and are tend to be employed in certain occupations or work-units that stress more importance on outfits, in contrast, low educated households incline to rely on cheap transportation, i.e. public transportation or bicycle, and pay less attention on the outfits.

Chinese pension system is renowned for its double standard treatments, workers in government, institutions and state-owned enterprise enjoy much higher replacement rates than those work for private enterprises. One would expect that workers in former sector are less affected by retirement than the latter. The results[10] surprisingly show that there are no significant differences between those two groups of people. This may reflect the fact that people who experiences the transition in economy have high precautionary motives in general.

5.3.5 Measurement of expenditure

Given the fact that clothing, transportation and communication are categorized as work-related expenditure, it is natural to question that they pick up some expenditures that are not related to work. For example, transportation expenditure includes not only commuting to work but also travelling and visiting family members and friends. Since the author doesn't have sources of data to tease out that part of expenditure, a potential approach is to directly measure the effect of work status in the life cycle equations, a demand system analysis((Deaton and Muellbauer, 1980;

[10] Tables are provided on request

Aguiar and Hurst, 2013)) has been employed to assess how much of the evolution of subaggregated expenditures can be attributed to the labour supply status.

A main concern with this regression is that the labour supply is closely related to permanent income which makes the specification suffer from omitted variable bias. For example, if labour supply is measured by employment status dummy, then those individuals who are working are likely to earn more than those who are unemployed. By conditional on total expenditure which is a proxy for permanent income, it is able to separate the effect of labour supply from income effect. There are some other issues with this specification: first, total spending appears as both a right hand side variable and part of the left hand side dependent variable, which makes it subjects to measurement error. The standard practice is to instrument total nondurable expenditure with income and education. Second, labour supply is potentially endogenous if it is correlated with some shocks that affecting the expenditure share. For example, if there is a shock on transportation industry that makes transportation more expensive and therefore tends to be a larger share of total spending(assume most part of the transportation cost is unavoidable), in the meanwhile this shock affects the employment status of people working in transportation industry, then failing to instrument labour supply would lead to a bias. Moreover, the instruments used for controlling measurement error would be vulnerable to endogeneity issues as to labour supply.

$$Cshare_{it}^{k} = \theta_0^k + \theta_1^k Age_{it} + \theta_2^k Cohort_{it} + \theta_3^k Family_{it} + \theta_4 lnX_{it} + \theta_5 L_{it} + \epsilon_{it}^k \tag{10}$$

where X_{it} represents the total nondurable expenditure including food, work-related and core nondurables; $Cshare_{it}^{k}$ measures the share of expenditure category k out of total nondurable spending X_{it}; L_{it} is our measurement of household labour supply. Note that the changes in relative price of each expenditure category across time are controlled for by the deflating process. Table 10 confirms that work-related expenditures are positively correlated with employment status, while food expenditure remains stable with the transition into retirement.

5.4 Mechanism

5.4.1 Family structure and valuation of health

The literature overwhelmingly shows a drop in food expenditure upon retirement, this paper presents a surprisingly increase yet not significant in food expenditure. Moreover, food expenditure includes food eat away from home since eating at home and away from home cannot be distinguished in this paper. If the spending of food eating away drops at retirement, then spending on food eating at home would have a bigger increase than the documented increase in total food spending. There are two possible explanations: an increase number of grandchildren in the households and higher valuation of own health.

In the Chinese tradition, grandchildren are often took care of by their grandparents especially when grandparents are retired. They have more time and energy to care about and cook for their grandchildren while their children are busy with work. Figure 10(a) shows no evidence of a significant change in the number of grandchildren upon retirement but the increasing trend of grandchildren and decreasing trend of children in the household may indicate that the incorporating of grandchildren in the households contribute to a relatively stable food consumption.

In addition, as individual retired, they have more time to take care of their own health and switch to higher quality food. Dong and Yang (2016) find that the households age 50-70 experience a decline in food price over their sample period 1997-2006, if this finding can be extrapolate to this analysis (my sample period covers 1995-2007), then the stable food consumption implies that the retirees seek for higher quality food assuming the price of food signals the quality.

5.4.2 Time use

A complementary indicator for testing retirement consumption puzzle is the time use. Aguiar and Hurst (2005) highlight the difference between consumption and expenditure, as stated by Becker (1965), consumption is the output of market expenditure and time. Assuming individual's opportunity cost of time declines upon retirement, individuals will substitute market expenditure with time used for food production. For the purpose of understanding the real change in food consumption, this study provides suggestive evidence on food shopping time based on the time use data is from the China Health and Nutrition Survey (CHNS).

The CHNS is an ongoing open cohort, which covers a span of 22 years in 15 provinces and municipal cities that varies in economic development and geography. The survey is consists of about 7200 households with over 30000 individuals drawing from a multistage, random cluster process. The survey provides information on food shopping and food preparation frequency and time use. For example, it asks two types of questions related to food shopping, one type is whether the individual did food shopping in the past week, the other type is the amount of time spent per day on food shopping. The sample is restricted to urban households with male household heads age between 50 and 70.

To provide a comparison of the CHNS and CHIP data, panel (b) of figure 10 presents a jump of the fraction of retirees at age cutoff 60 of 30 percent. This is slightly lower than the CHIP sample, probably due to different sample coverage. Results are provided on both household head and household level. Table 11 shows no clear change in food production time upon retirement both at household head level and household level. Figure 11 presents a jump in individual food shopping time for the low educated but no jump for the high educated household heads. However, there is no clear change in food shopping time at household level for both groups of households. Thus retirees adjust their time use to maintain a stable household food shopping time. This provides evidence that households not only able to smooth food expenditure but also food consumption.

5.4.3 Unexpected Retirement

The life cycle hypothesis implies that consumption should not fall with expected retirement, therefore a drop in consumption at an unexpected retirement would not contradict the LCH. However, most of the literature provides evidence on retirement consumption puzzle without distinguishing between expected and unexpected retirement, it is very likely that the conclusion drawn from those analysis are biased upwards. Haider and Stephens (2007) show that consumption drop estimated from expected retirement are roughly a third less than those from other instrument variables such as age.

This study adopts an instrument variable method as a complementary approach to confirm the non-existence of the retirement consumption puzzle in China. In specific, I use subjective retirement expectations as an instrument for actual retirement (Haider and Stephens, 2007). Subjective expectation has been proved to be a strong predictor of the subsequent outcomes(Dominitz1998, Stephens2004). Implicitly I assume that household expectation error is not correlated with any past information possessed by the household. The nature of this instrument provides potential mechanism of retirement consumption smoothing of elderly households. Hence, this section tests whether consumption falls at expected retirement.

In order to exploit the information on retirement expectation, I use the China Health and Retirement Longitudinal Study (CHARLS). This dataset collects a nationally representative sample of Chinese ages 45 and older, covering a wide range of information on demographic background, health status, household income, wealth and consumption. It resembles the American Health and Retirement Study(HRS) and the English Longitudinal Study of Ageing(ELSA) in terms of sampling and questionnaire.

Table 12 shows a strong first stage effect that an expectation to retire next year increase the actual retirement at next year by 10 percent. The 2SLS estimator shows no evidence of a fall in any subcomponent of consumption at an expected retirement. While it is consistent with the RD finding with respect to total nondurable spending, it contradicts the results on sub-aggregated categories. This could be due to the fact that the RD setting captures the effects on unexpected retirement in addition to the expected effects estimated from the CHARLS data. If the change in expenditure is caused by unexpected event, then the evidence does not refute the life cycle hypotheses. Another possibility is that the repeated cross-sectional data fails to control for some unobserved family traits that would bias the results.

5.4.4 Saving

Accompany with China's high economic growth rate, the national saving rate is persistently high and accounts for 34% to 53% of the GDP in the past three decades, higher than other Asian countries with similar GDP per capita. In addition, household saving experiences the highest growth among the three sectors(government saving, corporate saving and household saving) since the economy reform in 1978.

Chamon and Prasad (2010) shows a 7 percentage points rise in Chinese urban household savings rate from 1995 to 2005, accounting for one-quarter of disposable income. While the saving rates rise across all demographic groups, the age profile of saving gradually turns into a U-shaped pattern with the younger and the older households saving relatively more. The households in my sample are those age from 50-70, who are in their 20s and 30s as China transiting into a market economy where they bore the most of the increase in uncertainty during the transition but also benefited from the rapid income growth. The mean saving rate is 37 percent in my sample, if the high saving rates prepare households to future adverse shocks, one would expect that households with higher saving rates to bear less of the retirement shock. Surprisingly, table 13 shows no significant differences in the total expenditure, food and core nondurable expenditure between high and low saving groups. Given the saving rates of elderly households are high in general, even the relatively lower saving rate group are able to smooth out the shock.

6 Conclusion

This study firstly documents that there is a substantial heterogeneity across sub-components of nondurable goods in the life cycle pattern of mean and variance of expenditures in the context of China. Specifically, the food expenditure presents a hump-shaped profile but the decline after around age 60 is minor, in other words, the food expenditure at older stage of life cycle remains relatively stable. The core nondurable expenditure shows a typical hump-shaped life cycle profile, while the work-related expenditure displays a significant drop at age 45 and older. This provides insight into the fact that the fall of total nondurable expenditure at age 55 is most likely to be driven by the change in the work-related spending. Additionally, all three categories show an increasing pattern of cross-sectional variance, but the work-related expenditure displays the most dramatic increase in inequality. This finding differs from the work of Aguiar and Hurst (2013) in that they find only significant increase in the variance of work-related expenditure.

Based on the empirical pattern observed above, I tested how much of the adjustments of consumption across time and categories can be attributed to the labour supply status. In particular, a regression discontinuity approach is used to test for the existence of the retirement consumption puzzle for the elderly households (age above 50 but below 70). There is a significant positive effect of labour supply on work-related expenditures, but no evidence of a retirement consumption puzzle. In particular, this analysis provide new evidence that elderly households are able to smooth food consumption upon retirement by testing food production theory using time use data from CHNS.

I explore several potential explanations for the differences in the profiles across expenditure categories. Supported by a trend of change in family composition, stable household food production time and improvement in food quality, food consumption smooths upon retirement; work related expenditure drops upon retirement due to the complementary effects of labour supply; total nondurable expenditures stay stable leaving out sub-expenditures that are inputs into market work and amendable to home production. There is no evidence of heterogeneity between households with different education, work units and saving rates. One exception comes from that households of higher education/saving rates show larger discontinuity in work related expenditure.

Furthermore, by using subjective retirement expectations as instrument for actual retirement, I find no evidence of a fall in any subcomponent of consumption at an expected retirement. It implies that the adjustments in sub-aggregated expenditure categories are resulting from unexpected retirement. It is worth testing further to what extent that the unexpected retirement is due to health conditions.

This paper also provides an implicit test of the consumption theory that the life cycle profile of consumption goods that are substitution to working status should be different from those goods that are complementary or amendable to home production. The results confirm the complementary mechanism, and the home production theory finds support in adjustments of intra-household food shopping time.

As with any study, there are some limitations of this paper. First, this study use repeated cross section data that may fail to control for some unobserved household characteristics that would bias the results. Moreover, while the data covers a relatively long time span ranging from 1995 to 2007, there is only four waves of cross section data, the analysis is likely to suffer from some transitory shocks that is difficult to separate from time trends.

Nonetheless, the estimates and their magnitude are important for understanding the life cycle profile of Chinese households' consumption behaviour. The results demonstrate that disaggregated expenditures exhibit substantial heterogeneity with respect to both mean and variance. In particular, work status is closely associated with total nondurable expenditure life cycle profile. The finding has important implications for using disaggregated data to test the existence of retirement consumption puzzle, for testing consumption theories and for providing evidence on the widely debated topic of postponing the mandatory retirement age given the economic deceleration and rapid ageing problems in China.

References

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

Aguiar, M. and E. Hurst (2013). Deconstructing lifecycle expenditure. *Journal of Political Economy 121*(3), 437–492.

Aguila, E., O. Attanasio, and C. Meghir (2011). Changes in consumption at retirement: evidence from panel data. *Review of Economics and Statistics 93*(3), 1094–1099.

Angrist, J. D. and V. Lavy (1999). Using maimonides' rule to estimate the effect of class size on student achievement. *Quarterly Journal of Economics 114*(2), 533–75.

Banks, J., R. Blundell, and S. Tanner (1998). Is there a retirement-savings puzzle? *American Economic Review 88*(4), 769–788.

Barrett, G. F. and M. Brzozowski (2012). Food expenditure and involuntary retirement: Resolving the retirement-consumption puzzle. *American Journal of Agricultural Economics 94*(4), 945–955.

Battistin, Erich, A. B. E. R. and G. Weber (2009). The retirement consumption puzzle: Evidence from a regression discontinuity approach. *American Economic Review*, 2209–2226.

Becker, G. S. (1965). A theory of the allocation of time. *The economic journal 75*(299), 493–517.

Bernheim, B. D., J. Skinner, and S. Weinberg (2001). What accounts for the variation in retirement wealth among us households? *American Economic Review*, 832–857.

Browning, M., T. F. Crossley, and M. Lührmann (2014). Durable purchases over the later life cycle. *Oxford Bulletin of Economics and Statistics*.

Chamon, M. D. and E. S. Prasad (2010). Why are saving rates of urban households in china rising? *American Economic Journal: Macroeconomics*, 93–130.

Deaton, A. (1997). *The analysis of household surveys: a microeconometric approach to development policy.* World Bank Publications.

Deaton, A. and J. Muellbauer (1980). An almost ideal demand system. *The American economic review*, 312–326.

Dong, Y. and D. Yang (2016). Mandatory retirement and the consumption puzzle: Prices decline or quantities decline? *working paper*.

Gelman, A. and G. Imbens (2014). Why high-order polynomials should not be used in regression discontinuity designs. Technical report, National Bureau of Economic Research.

Hahn, J., P. Todd, and W. Van der Klaauw (2001). Identification and estimation of treatment effects with a regression-discontinuity design. *Econometrica 69*(1), 201–209.

Haider, S. J. and M. Stephens (2007). Is there a retirement-consumption puzzle? evidence using subjective retirement expectations. *The review of economics and statistics 89*(2), 247–264.

Hurst, E. (2008). The retirement of a consumption puzzle. Technical report, National Bureau of Economic Research.

Imbens, G. W. and T. Lemieux (2008). Regression discontinuity designs: A guide to practice. *Journal of econometrics 142*(2), 615–635.

Lee, D. S. and D. Card (2008). Regression discontinuity inference with specification error. *Journal of Econometrics 142*(2), 655–674.

Lee, D. S. and T. Lemieux (2010). Regression discontinuity designs in economics. *Journal of Economic Literature 48*, 281–355.

Li, H., X. Shi, B. Wu, et al. (2015). The retirement consumption puzzle in china. *American Economic Review papers and proceedings 105*(5), 437–41.

McCrary, J. (2008). Manipulation of the running variable in the regression discontinuity design: A density test. *Journal of Econometrics 142*(2), 698–714.

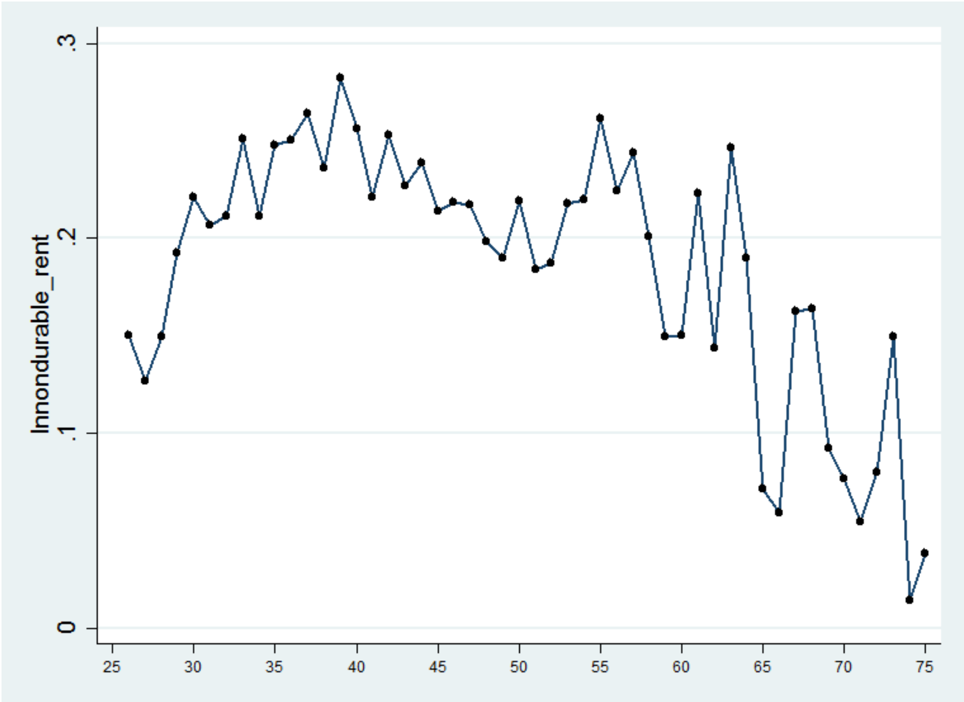
Modigliani, F. and R. Brumberg (1954). Utility analysis and the consumption function: An interpretation of cross-section data. *Franco Modigliani 1*.

Smith, S. (2006). The retirement-consumption puzzle and involuntary early retirement: Evidence from the british household panel survey. *The Economic Journal 116*(510), C130–C148.

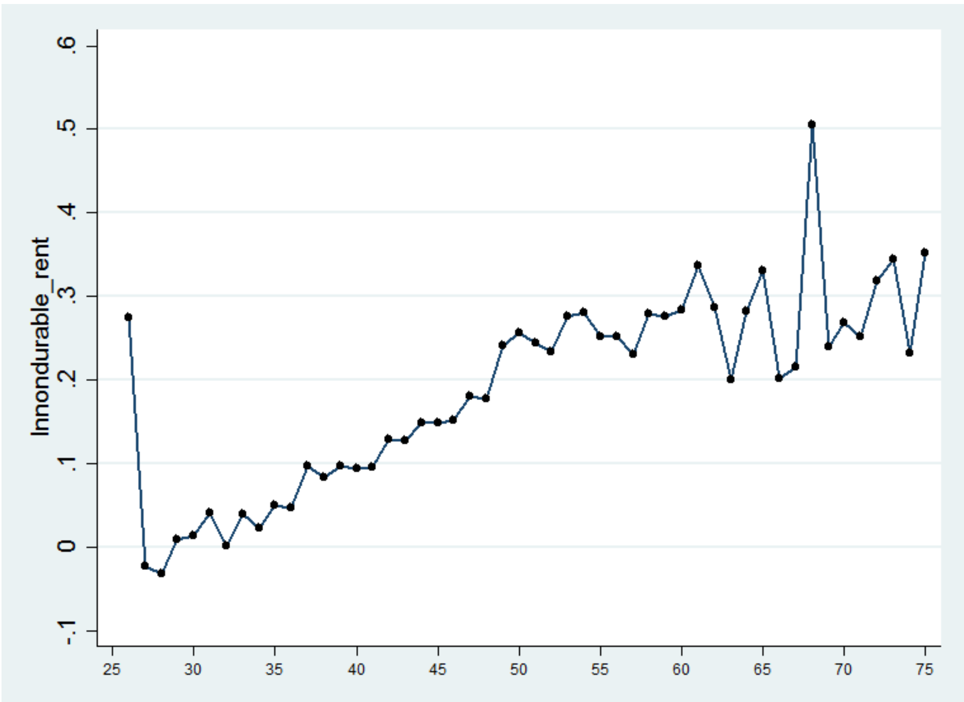
Stancanelli, E. G. and A. Van Soest (2012). Retirement and home production: A regression discontinuity approach. *American Economic Review papers and proceedings 102*(3), 600–605.

Thistlethwaite, D. L. and D. T. Campbell (1960). Regression-discontinuity analysis: An alternative to the ex post facto experiment. *Journal of Educational psychology 51*(6), 309.

Van der Klaauw, W. (2002). Estimating the effect of financial aid offers on college enrollment: A regression–discontinuity approach*. *International Economic Review 43*(4), 1249–1287.



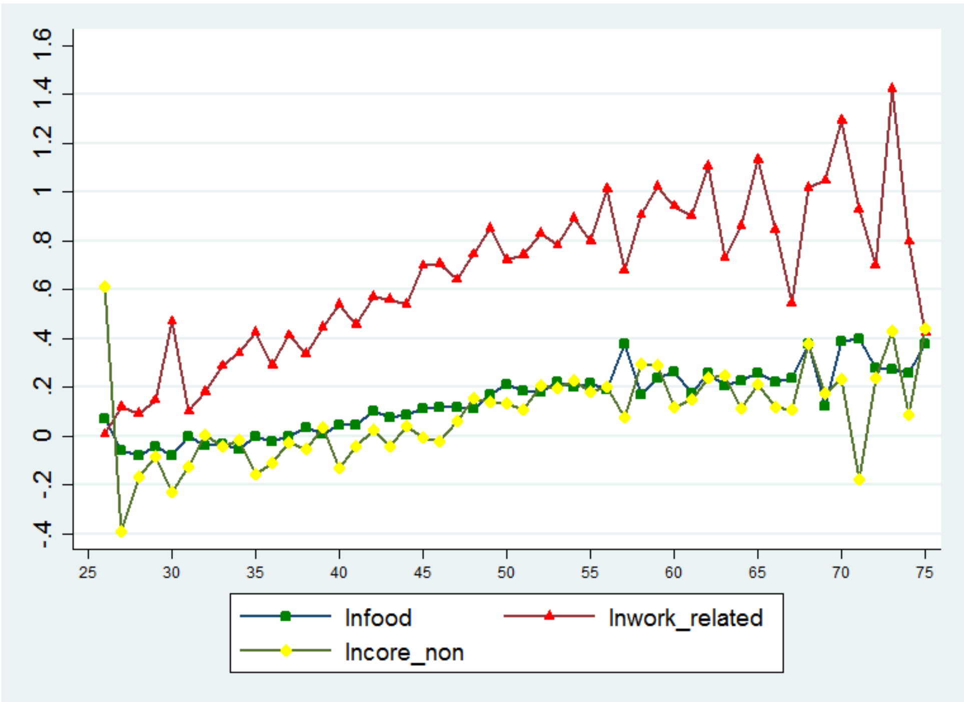
(a) Mean Profile



(b) Variance Profile

Figure 1: Life cycle pattern of total nondurable expenditure. The regression based mean and variance of total nondurable expenditures have been shown in graph (a) and (b), respectively. The age effects are given by controlling for year and family composition controls, with age 25 as the baseline group. Due to few extreme values at age 26, the coefficient plot at age 26 exhibits a big variation.

(a) Mean Profile



(b) Variance Profile

Figure 2: Life cycle pattern of main expenditure categories. Graph (a) and (b) are identical to graph (a) and (b) of figure 1, except that the total nondurable expenditure are disaggregated to three main categories.

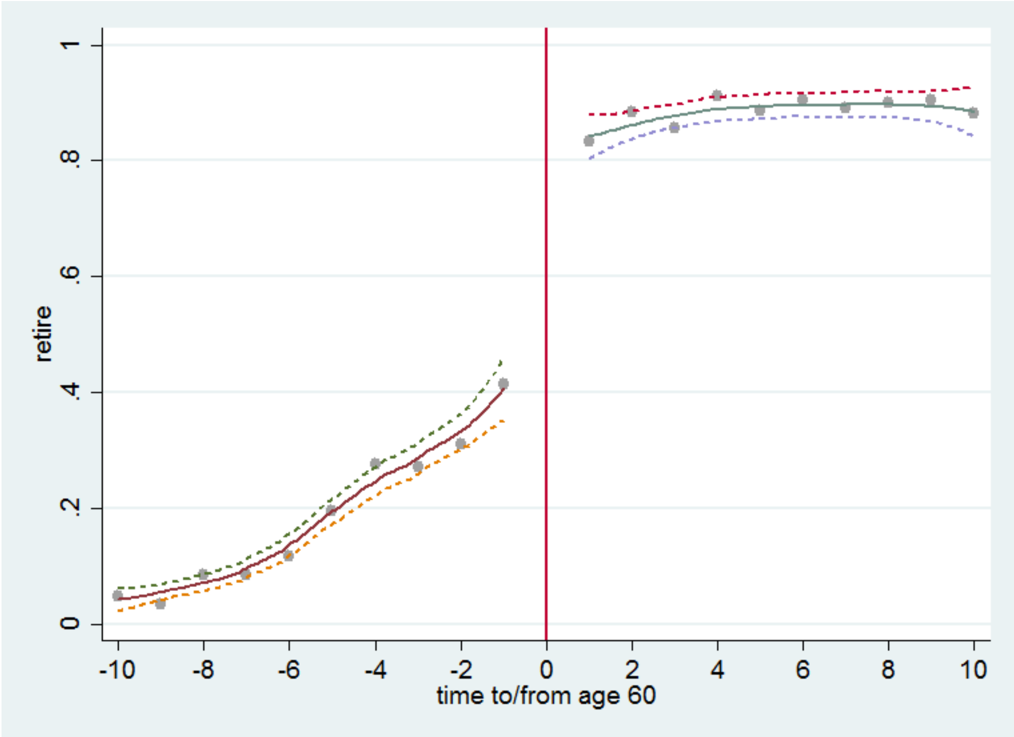


Figure 3: Fraction of retirees. Cells are the proportion of people in each age from age 50 to 70. The solid lines and dashed lines are local linear fitted outcomes and associated confidence intervals, respectively, on either side of the age 60 cutoff.

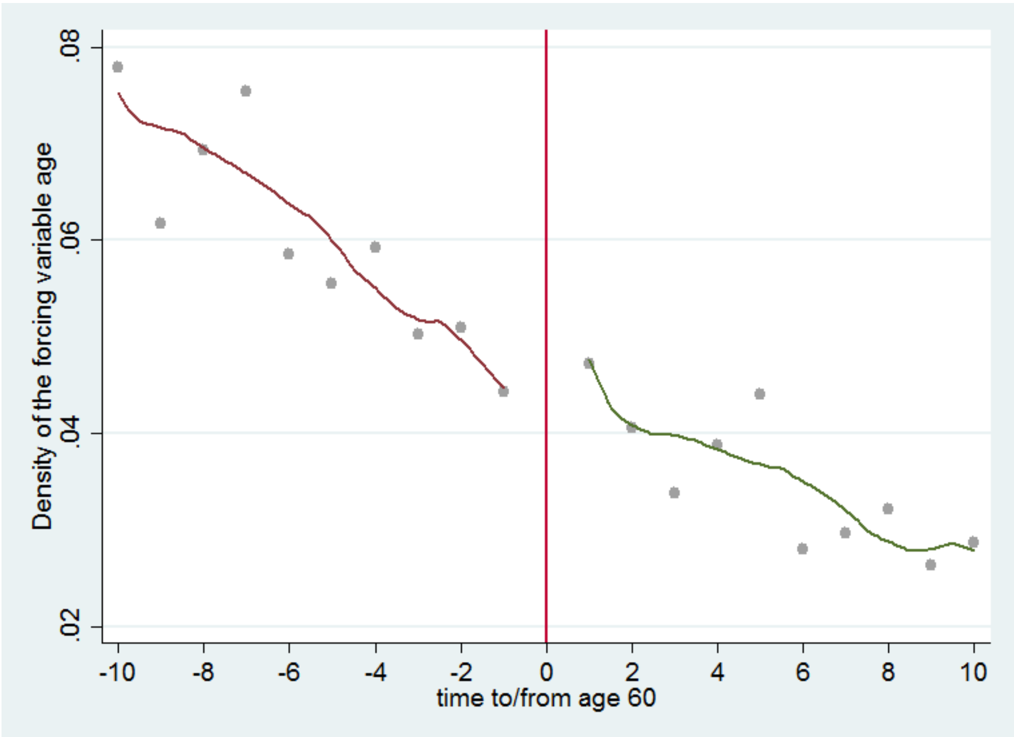
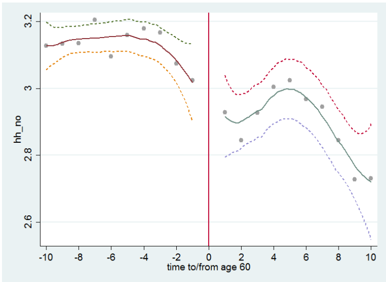
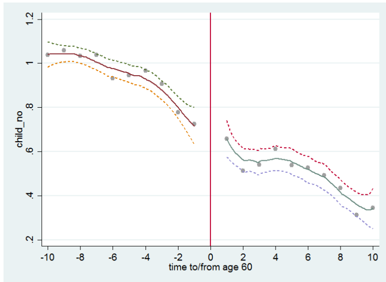


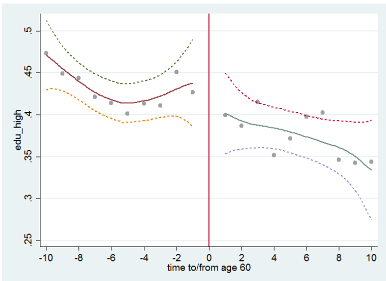
Figure 4: the density of the running variable. It plots the density of households at each age over the total number of households with household age between 50 and 70.



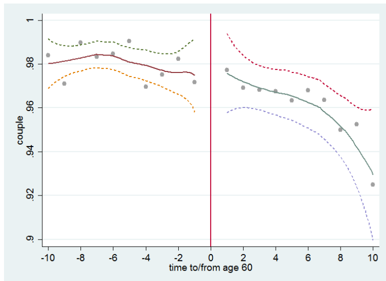
(a) Household Size



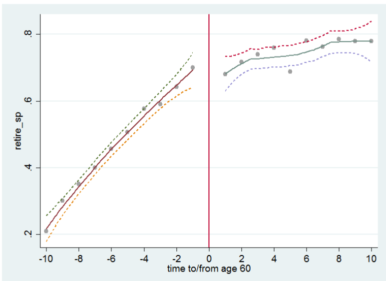
(b) Number of Children



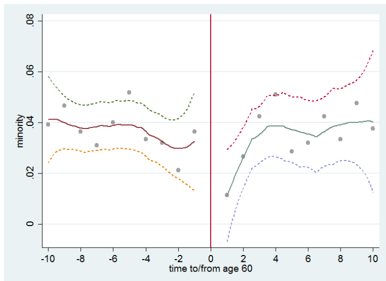
(c) Above high school education



(d) couple

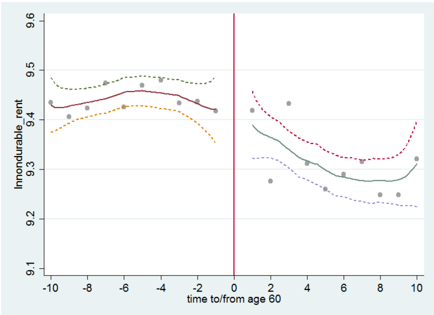


(e) Retirement Status of the Spouse

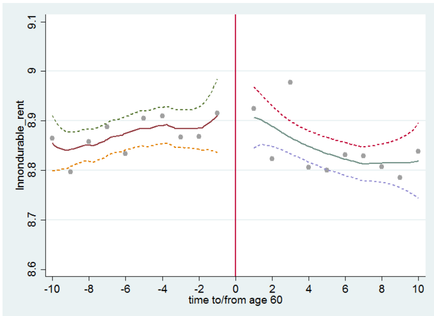


(f) Minority

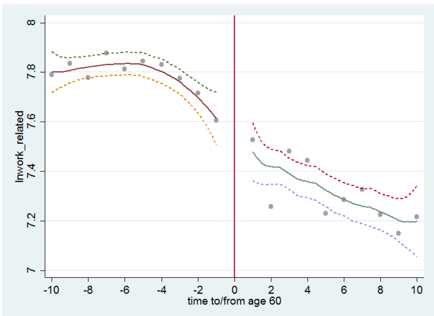
Figure 5: Balance test – effect of retirement on predetermined variables. Cells are the household head in each age from age 50 to 70. The solid lines and dashed lines are local linear fitted outcomes and associated confidence intervals, respectively, on either side of the age 60 cutoff.



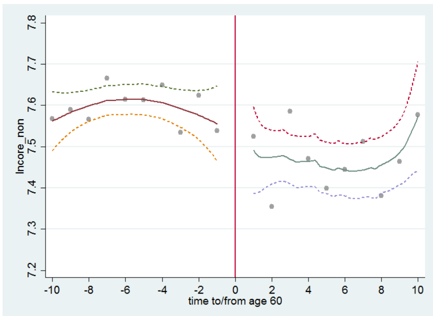
(a) Total nondurable expenditures



(b) food expenditures



(c) work related expenditures



(d) Core-nondurable expenditures

Figure 6: Reduced form effects. Cells are the household head in each age from age 50 to 70. The solid lines and dashed lines are local linear fitted outcomes and associated confidence intervals, respectively, on either side of the age 60 cutoff.

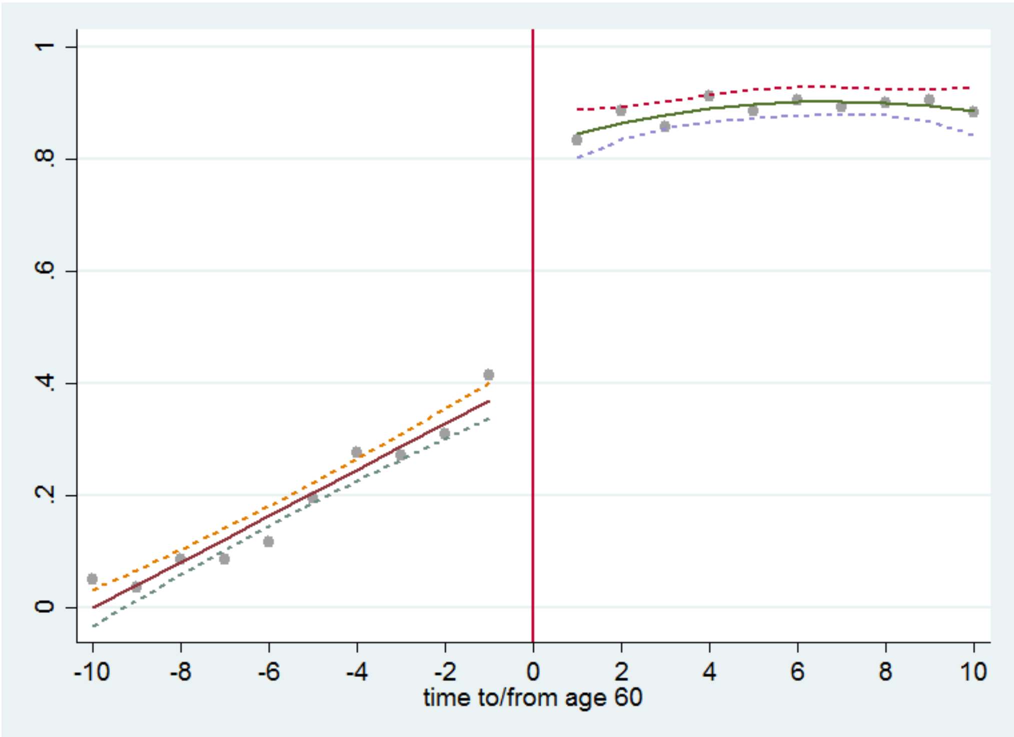
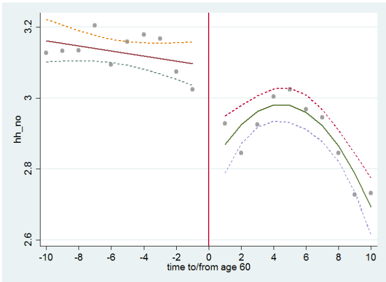
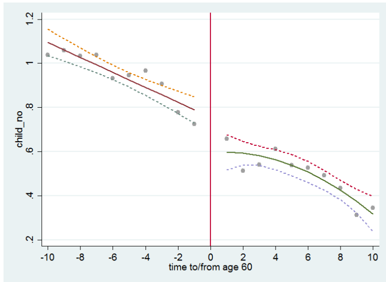


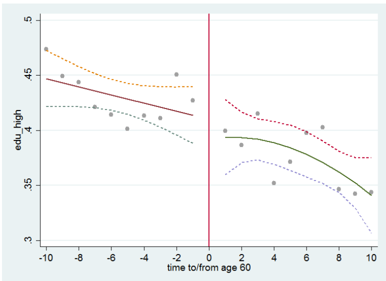
Figure 7: Robustness Check based on quadratic polynomial regressions – fraction of retirees. Cells are the proportion of people in each age from age 50 to 70. The solid lines and dashed lines are the predicted outcomes and associated confidence intervals, respectively



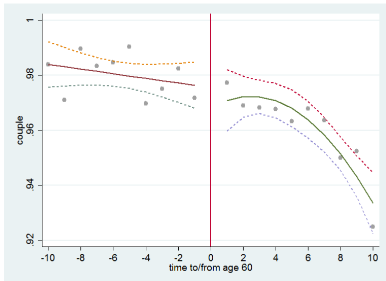
(a) Household Size



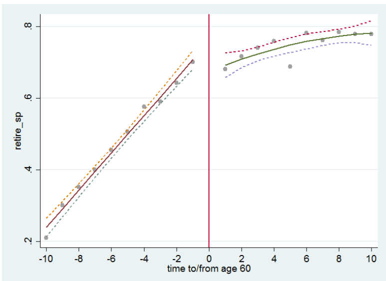
(b) Number of Children



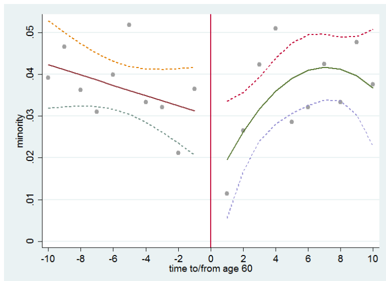
(c) Above high school education



(d) couple

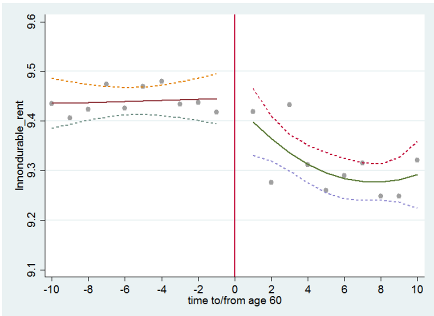


(e) Retirement Status of the Spouse

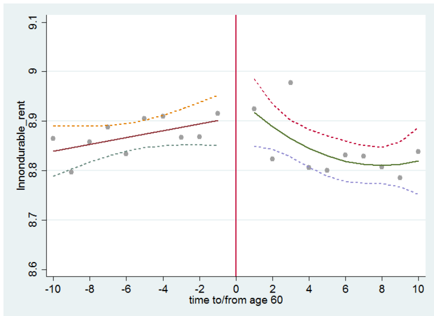


(f) Minority

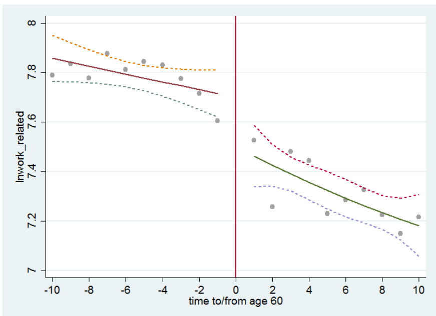
Figure 8: Robustness Check based on quadratic polynomial regressions – balance test. Cells are the household head in each age from age 50 to 70. The solid lines and dashed lines are the predicted outcomes and associated confidence intervals, respectively



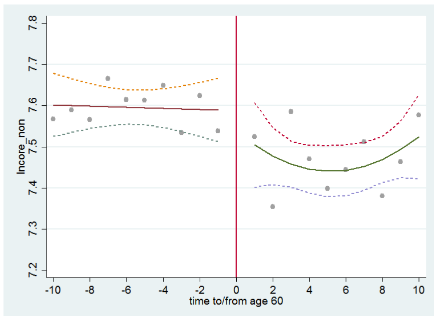
(a) Total nondurable expenditures



(b) food expenditures

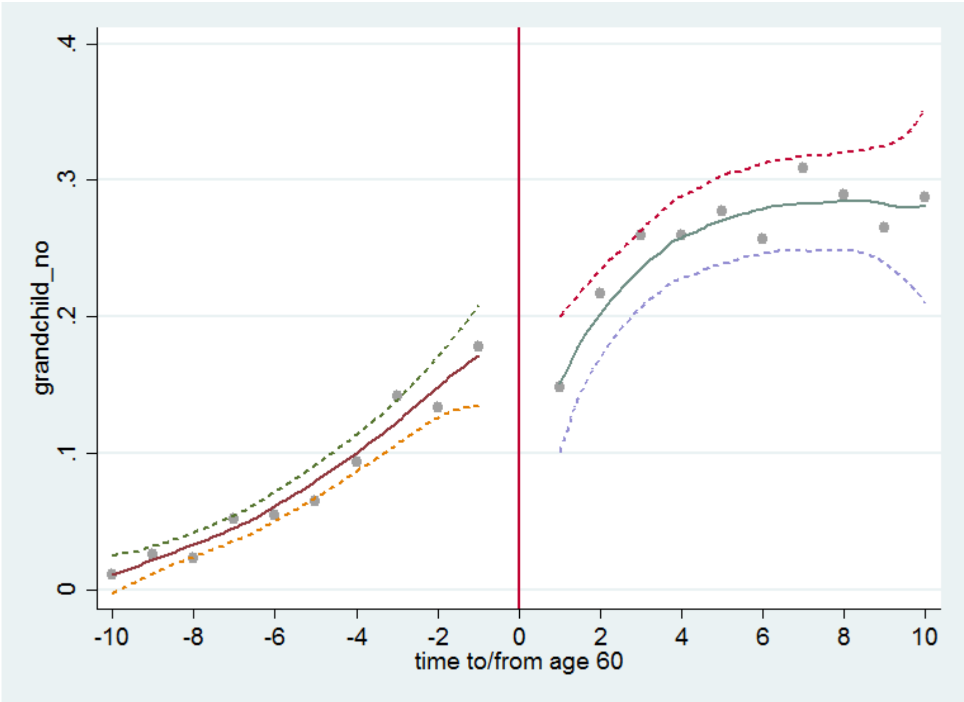


(c) work related expenditures

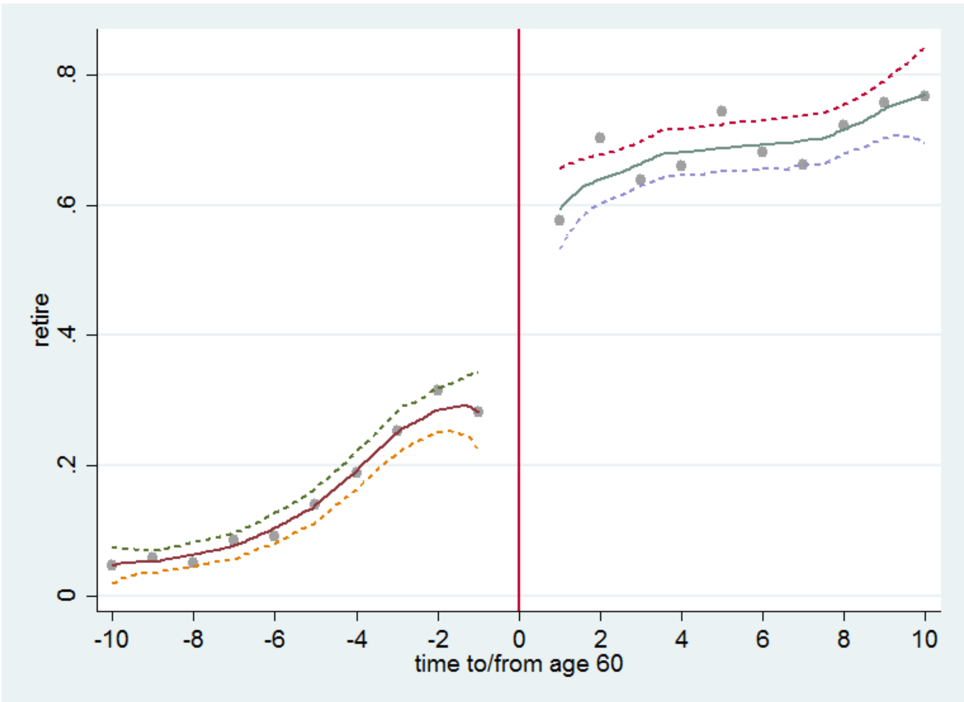


(d) Core-nondurable expenditures

Figure 9: Robustness Check based on quadratic polynomial regressions – reduced form estimation. Cells are the household head in each age from age 50 to 70. The solid lines and dashed lines are the predicted outcomes and associated confidence intervals, respectively

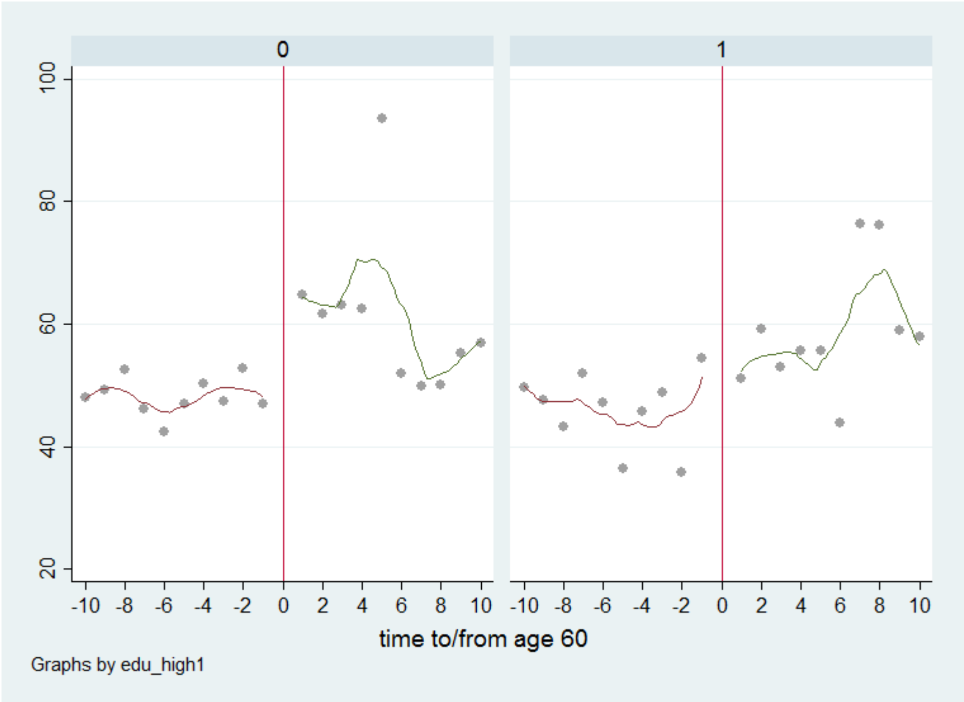


(a) the number of grandchildren living with household head

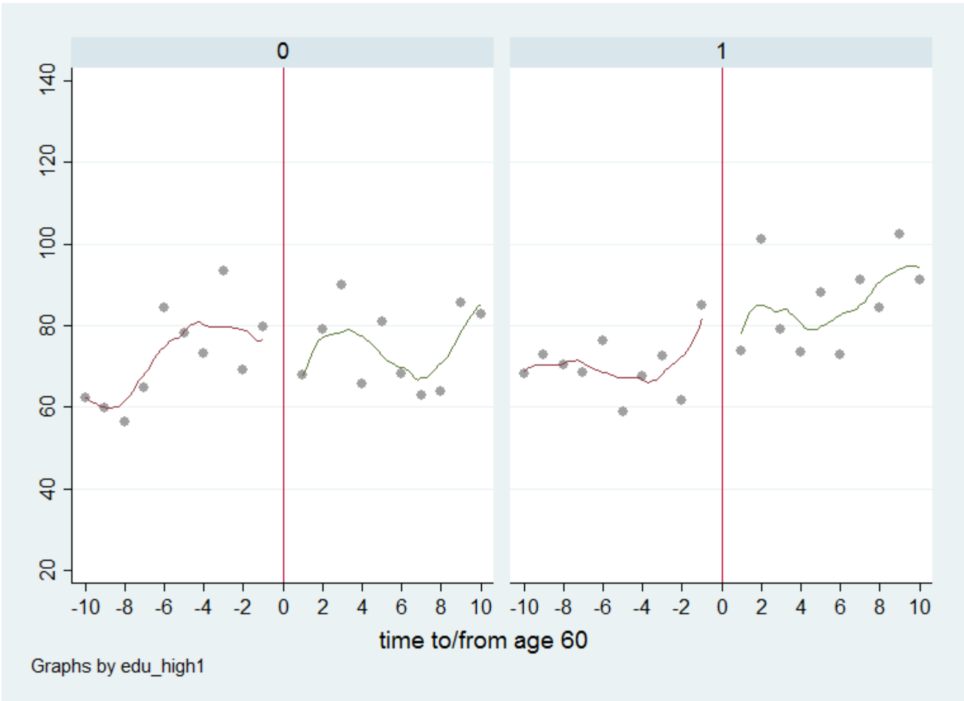


(b) the fraction of retiree in the CHNS sample

Figure 10: Panel (a) shows local linear estimation of the number of grandchildren living with household heads. Panel (b) shows local linear estimation of fraction of retirees in the CHNS sample.



(a) Food shopping time of the individual



(b) Food shopping time of the household

Figure 11: Food shopping time. This graph is analysed based on the CHNS dataset. Cells are the household head in each age from age 50 to 70. Panel (a) shows the food shopping time pattern of the household head only for low educated group (left) and high educated group (right). Panel (b) shows the household food shopping time pattern for low educated group (left) and high educated group (right).

Table 1: Summary of mean change in expenditure over the life cycle by consumption category

Disaggregated consumption group	(1) Share of expenditures at age 25-27	(2) Share of expenditures at age 43-45	(3) Share of expenditures at age 64-66	(4) Log change in expenditure b/t age 25-45	(5) Log change in expenditure b/t age45-65
Food	0.56	0.60	0.64	0.28	0.00
Work	0.26	0.23	0.17	0.05	-0.60
Core	0.18	0.17	0.19	0.25	-0.12
Total	1.00	1.00	1.00	0.21	-0.14

Note: This table summarizes the life cycle mean expenditure profiles for total nondurable good and three main consumption categories: food, work-related and the core nondurables, as shown in figure 1(a) and figure 2(a). Column 1-3 report the share of expenditures at ages 25-27, 43-45 and 64-66, respectively. I use three year age average to smooth out some of the age-to-age variability. Column 4 and 5 report the log change in mean expenditure between ages 25 and 45, 45 and 65, which is the difference in coefficient on the age dummies from the regression of log expenditure on age dummies and demographic controls (equation 1).

Table 2: Summary of change in cross-sectional variance over the life cycle by consumption category

Disaggregated consumption group	(1) Unconditional Cross-section variance at age 25-27	(2) Unconditional Cross-section variance at age 43-45	(3) Unconditional Cross-section variance at age 64-66	(4) Change in cross-section variance between age 25 and 45	(5) Change in cross-section variance between age 45 and 65
Food	0.64	0.34	0.35	0.11	0.15
Work	1.04	0.79	0.93	0.70	0.43
Core	1.61	0.77	0.81	-0.01	0.22
Total	0.74	0.35	0.33	0.15	0.18

Note: This table summarizes the life cycle profile of the cross-sectional expenditure for total nondurable good and three main consumption categories: food, work-related and the core nondurables, as shown in figure 1(b) and figure 2(b). Column 1-3 report the unconditional cross-sectional variance at ages 25-27, 43-45 and 64-66, respectively. I use three year age average to smooth out some of the age-to-age variability. Column 4 and 5 report the log change in cross-sectional variance of expenditure between ages 25 and 45, 45 and 65, which is the difference in coefficient on the age dummies from the regression (equation 2).

Table 3: Summary statistics for the RD sample

	Observations	Mean	s.d.
Demographic Characteristics			
age	5308	58.09	6.01
retire	5305	0.43	0.49
high school or above	5291	0.41	0.49
number of household memebers	5308	3.05	1.03
number of children	5308	0.79	0.73
couple	5308	0.97	0.16
minority	5308	0.04	0.19
spouse retired	5136	0.56	0.50
housing area	4091	52.97	27.82
Expenditures			
food	5308	8654.62	7737.11
work_related	5308	3263.05	4757.98
core_non	5308	2945.53	5497.00
total nondurable	5308	14863.20	13039.37

Note: This table summarizes demographic characteristics and main expenditure categories for the RD sample, which restricts the sample to households that age between 50 and 70 with age 60 excluded. The expenditures reported here are measured in Chinese currency Yuan(1 Yuan=0.10 Pound) for the purpose of understanding the scale of spending, while log value of expenditures is used in the regression-based analysis.

Table 4: First stage effects of age above 60 on retirement

	(1) Retire	(2) Retire	(3) Retire	(4) Retire	(5) Retire	(6) Retire
D(age>60)	0.454***	0.456***	0.344***	0.347***	0.371***	0.375***
	(0.028)	(0.025)	(0.043)	(0.037)	(0.073)	(0.062)
age*D	-0.035***	-0.035***	-0.050***	-0.051***	-0.001	-0.009
	(0.004)	(0.004)	(0.016)	(0.015)	(0.054)	(0.049)
age^2*D			-0.005***	-0.005***	-0.000	-0.000
			(0.001)	(0.001)	(0.011)	(0.010)
age^3*D					0.001	0.001
					(0.001)	(0.001)
age	0.040***	0.040***	0.075***	0.074***	0.039	0.042
	(0.003)	(0.003)	(0.011)	(0.010)	(0.039)	(0.034)
age^2			0.003***	0.003***	-0.004	-0.004
			(0.001)	(0.001)	(0.008)	(0.007)
age^3					-0.000	-0.000
					(0.000)	(0.000)
Province dummies	No	YES	No	YES	No	YES
Year dummies	No	YES	No	YES	No	YES
Polynomial order	1st order	1st order	2nd order	2nd order	3rd order	3rd order
N	5305	5305	5305	5305	5305	5305
R-sq	0.521	0.525	0.522	0.527	0.522	0.527
F statistics for joint significance	178.100	223.610	113.130	135.720	26.650	35.360

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. Variable D is an indicator for whether age of household head is above 60, variable age is the difference between real age and age 60.

Table 5: the effect of retirement on predetermined variables

	(1) edu_high	(2) hh_no	(3) child_no	(4) couple	(5) minority	(6) retire_sp
Retire	-0.137	-0.209	-0.084	0.018	-0.022	0.045
	(0.102)	(0.156)	(0.182)	(0.029)	(0.020)	(0.079)
age*Retire					0.002	
					(0.002)	
age^2*Retire						
age^2*(1-Retire)						-0.003***
						(0.000)
age^3*(1-Retire)	-0.000*	0.000**	0.000*	0.000		
	(0.000)	(0.000)	(0.000)	(0.000)		
age	0.009	-0.013	-0.043***	-0.003	0.000	0.013***
	(0.009)	(0.010)	(0.015)	(0.002)	(0.002)	(0.005)
age^2	-0.001		0.001	-0.000		
	(0.001)		(0.001)	(0.000)		
Province dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES
Polynomial order	left3right2	left3right1	left3right2	left3right2	linear	left2right1
N	5288	5305	5305	5305	5305	5135
R-sq	0.025	0.040	0.142	0.007	0.050	0.198

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. All the regressions control for year dummies and province dummies. The polynomial orders are chosen by AIC. The AIC criteria chooses among symmetric and asymmetric polynomial order(up to the fifth order) for the balance test, for example, left3right2 in the fourth row means that third order and second order polynomial specification is choosen by the AIC criteria for variable education.

Table 6: the effect of retirement on expenditure categories

	(1) Total	(2) Food	(3) Work	(4) Core
Retire	-0.011	0.092	-0.273**	-0.126
	(0.106)	(0.105)	(0.132)	(0.099)
age2*(1-Retire)			-0.003***	-0.002***
			(0.001)	(0.000)
age3*(1-Retire)	0.000	0.000		
	(0.000)	(0.000)		
age	-0.009	-0.006	-0.031***	-0.002
	(0.009)	(0.009)	(0.009)	(0.006)
age2	-0.000	-0.000		
	(0.001)	(0.001)		
Province dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Polynomial order	left3right2	left3right2	left2right1	left2right1
N	5305	5305	5288	5246
R-sq	0.397	0.423	0.238	0.248

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. All the regressions control for year dummies and province dummies. The polynomial orders are chosen by AIC. The AIC criteria chooses among symmetric and asymmetric polynomial order(up to the fifth order) , for example, left3right2 in the fourth row means that third order and second order polynomial specification is choosen by the AIC criteria for variable total nondurable log expenditure.

Table 7: Robustness check: Retirement effects of different age band

	(1) Total	(2) Food	(3) Work	(4) Core
45-75	-0.152*	-0.005	-0.326***	-0.200*
	(0.078)	(0.075)	(0.101)	(0.117)
N	8078	8078	8052	7983
46-74	-0.124	-0.006	-0.321***	-0.157
	(0.084)	(0.083)	(0.103)	(0.170)
N	7506	7506	7484	7417
47-73	-0.117	0.008	-0.304***	-0.165
	(0.091)	(0.088)	(0.112)	(0.172)
N	7017	7017	6996	6933
48-72	-0.069	0.055	-0.280	-0.171
	(0.097)	(0.094)	(0.206)	(0.173)
N	6449	6449	6428	6374
49-71	-0.035	0.097	-0.231*	-0.178
	(0.102)	(0.100)	(0.124)	(0.192)
N	5855	5855	5836	5786
51-69	-0.069	0.060	-0.273*	-0.094
	(0.141)	(0.064)	(0.140)	(0.109)
N	4711	4711	4697	4662
52-68	-0.042	0.066	-0.244*	-0.095
	(0.344)	(0.070)	(0.146)	(0.117)
N	4220	4220	4207	4175
53-67	-0.019	0.111	-0.266	-0.121
	(0.085)	(0.077)	(0.168)	(0.137)
N	3655	3655	3645	3622
54-66	0.033	-0.016	-0.216	-0.109
	(0.094)	(0.171)	(0.173)	(0.207)
N	3070	3070	3062	3046
55-65	0.054	0.064	-0.192	-0.036
	(0.101)	(0.167)	(0.194)	(0.261)
N	2588	2588	2582	2568

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. All the regressions control for year dummies and province dummies. The polynomial orders are chosen by AIC.

Table 8: Robustness check: Placebo test

	Left-side subsample–age 54				Right-side subsample–age 64			
	Total	Food	Work	Core	Total	Food	Work	Core
Retire	0.218	0.785	-0.003	-0.736	0.003	0.118	-0.392	-0.214
	(0.704)	(0.506)	(1.467)	(1.190)	(0.250)	(0.235)	(0.567)	(0.406)
age*Retire		-0.103**	0.016					
		(0.047)	(0.514)					
age^2*Retire			-0.031					
			(0.063)					
age^2*(1-Retire)				-0.001				
				(0.005)				
age^3*(1-Retire)	-0.001				0.004	0.003	0.007	0.007
	(0.001)				(0.004)	(0.004)	(0.009)	(0.006)
age	0.009	-0.000	0.013	0.040	-0.022**	-0.016*	-0.045**	-0.021
	(0.034)	(0.014)	(0.025)	(0.047)	(0.009)	(0.009)	(0.020)	(0.015)
age^2	-0.003							
	(0.002)							
N	3360	3360	3350	3320	2211	2211	2202	2192
R-sq	0.358	0.259	0.210	0.170	0.365	0.412	0.151	0.239

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. All the regressions control for year dummies and province dummies. The polynomial orders are chosen by AIC. The AIC criteria chooses among symmetric and asymmetric polynomial order(up to the fifth order) , for example, left3right2 in the fourth row means that third order and second order polynomial specification is choosen by the AIC criteria for variable total nondurable log expenditure.

Table 9: Robustness check: Retirement effects of different education group

	Non-high school group				High_school group			
	Total	Food	Work	Core	Total	Food	Work	Core
Retire	-0.015	0.083	-0.170	-0.064	-0.024	0.116	-0.280**	-0.161
	(0.091)	(0.189)	(0.218)	(0.146)	(0.128)	(0.117)	(0.135)	(0.120)
age^2*(1-Retire)	-0.002***			-0.003***			-0.003***	-0.001
	(0.000)			(0.001)			(0.001)	(0.001)
age^3*(1-Retire)		0.000	0.000***		0.000	0.000		
		(0.000)	(0.000)		(0.000)	(0.000)		
age	-0.013**	-0.009	-0.040***	-0.007	-0.003	-0.003	-0.020**	0.004
	(0.005)	(0.015)	(0.014)	(0.008)	(0.012)	(0.011)	(0.009)	(0.009)
age^2		-0.000			-0.000	-0.000		
		(0.001)			(0.001)	(0.001)		
N	3109	3109	3096	3084	2179	2179	2175	2146
R-sq	0.393	0.406	0.220	0.264	0.400	0.447	0.256	0.230

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. All the regressions control for year dummies and province dummies. The polynomial orders are chosen by AIC. The AIC criteria chooses among symmetric and asymmetric polynomial order(up to the fifth order) , for example, left3right2 in the fourth row means that third order and second order polynomial specification is choosen by the AIC criteria for variable total nondurable log expenditure.

Table 10: The relationship between work status and spending by consumption category

	(1) Share of food	(2) Share of food	(3) Share of work_related	(4) Share of work_related	(5) Share of core_non	(6) Share of core_non
Employ	-0.017***	-0.014***	0.020***	0.013***	-0.003	0.001
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
model	OLS	2SLS	OLS	2SLS	OLS	2SLS
N	5305	5261	5305	5261	5305	5261
R-sq	0.204	0.198	0.196	0.141	0.101	0.091

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. This table provides estimation from demand system analysis, where total expenditure is instrumented with income and education.

Table 11: the effect of retirement on food production

	(1) Individual time spend on buying food	(2) Individual time spend on preparing food	(3) Household time spend on buying food	(4) Household time spend on preparing food
Retire	13.097	-1.968	-24.542	1.375
	(12.853)	(14.055)	(19.870)	(11.370)
age*Retire		-0.182		-0.089
		(2.267)		(0.684)
age^2*Retire		0.150		
		(0.256)		
age^3*(1-Retire)	-0.010		0.010	
	(0.007)		(0.007)	
age	0.529	0.205	1.119	0.189
	(0.645)	(0.491)	(0.947)	(0.621)
Province dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
N	1657	1566	3425	3425
R-sq	0.240	0.573	0.129	0.622

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. All the regressions control for year dummies and province dummies. The polynomial orders are chosen by AIC. The time use data are based on the CHNS.

Table 12: the effect of expected retirement on expenditure categories

	(1) change in food expenditure	(2) change in work_related	(3) change in core nondurable	(4) change in total nondurable
OLS				
retire_wave2	-0.048	-0.097*	-0.024	-0.107**
	(0.050)	(0.058)	(0.050)	(0.047)
N	6045	5647	6100	5091
R-sq	0.018	0.044	0.036	0.037
2SLS				
retire_wave2	0.244	-0.798	1.649	0.316
	(0.980)	(0.906)	(1.088)	(0.795)
N	4153	3956	4243	3585
	retired in year t+1			
First Stage				
expected year t+1	0.102***			
retirement at year t	(0.022)			

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. This analysis is based on the China Health and Retirement Longitudinal Study (CHARLS). Subjective retirement expectations are used as an instrument for actual retirement. Each column shows the effect of retirement on the change of main subaggregated categories and total nondurable expenditure, respectively.

Table 13: Robustness check: Retirement effects of different saving rate group

	Low saving rate group				High saving rate group			
	Total	Food	Work	Core	Total	Food	Work	Core
Retire	-0.015	0.083	-0.170	-0.064	-0.024	0.116	-0.280**	-0.161
	(0.091)	(0.189)	(0.218)	(0.146)	(0.128)	(0.117)	(0.135)	(0.120)
age2*(1-Retire)	-0.002***			-0.003***			-0.003***	-0.001
	(0.000)			(0.001)			(0.001)	(0.001)
age3*(1-Retire)		0.000	0.000***		0.000	0.000		
		(0.000)	(0.000)		(0.000)	(0.000)		
age*Retire		-0.021						
		(0.022)						
age2*Retire		-0.000						
		(0.003)						
age	0.002	0.008	-0.033***	0.004	-0.015***	0.008	-0.026**	-0.008
	(0.015)	(0.014)	(0.011)	(0.009)	(0.005)	(0.007)	(0.011)	(0.009)
age2	-0.001	-0.001						
	(0.001)	(0.001)						
N	2639	2639	2635	2614	2638	2638	2625	2605
R-sq	0.399	0.486	0.228	0.241	0.420	0.392	0.256	0.271

Note: Standard errors are clustered at province-age level. $***$ significant at 1 %; $**$ significant at 5 %; $*$ significant at 10 %. All the regressions control for year dummies and province dummies. The polynomial orders are chosen by AIC. The AIC criteria chooses among symmetric and asymmetric polynomial order(up to the fifth order) , for example, left3right2 in the fourth row means that third order and second order polynomial specification is choosen by the AIC criteria for variable total nondurable log expenditure.