Journal of Health Economics 62 (2018) 165–177

Contents lists available at ScienceDirect

Journal of Health Economics

journal homepage: www.elsevier.com/locate/econbase

The effect of retirement on healthcare utilization: Evidence from China☆

Yi Zhang[a], Martin Salm[a,*], Arthur van Soest[b]

[a] CentER, Tilburg University, the Netherlands
[b] Netspar, Tilburg University, the Netherlands

ARTICLE INFO

Article history:
Received 15 December 2017
Received in revised form
20 September 2018
Accepted 27 September 2018
Available online 9 October 2018

JEL classifications:
I10
J14
J26

Keywords:
Retirement
Healthcare utilization
Fuzzy regression discontinuity design
China

ABSTRACT

We examine the effect of retirement on healthcare utilization in China using longitudinal data. We use a nonparametric fuzzy regression discontinuity design, exploiting the statutory retirement age in urban China as a source of exogenous variation in retirement. In contrast to previous results for developed countries, we find that in China retirement increases healthcare utilization. This increase can be attributed to deteriorating health and in particular to the reduced opportunity cost of time after retirement. For the sample as a whole, income is not a dominating mechanism. People with low education, however, are more likely to forego recommended inpatient care after retirement.

1. Introduction

China is aging rapidly. The number of persons above age 65 grew from 100 million in 2005 to 143 million in 2015 (National Bureau of Statistics of China, 2016). At the same time, the Chinese statutory retirement ages (SRAs) of 60 years for men and 50 or 55 years for women are among the lowest in the world. The increasing number of retired people imposes large costs on public and private budgets. This has led to an ongoing debate about increasing retirement ages. In order to understand the full consequences of retirement policies, we have to take into account the effect of retirement on healthcare utilization. For example, if retirement increases healthcare utilization then this further adds to the costs of retirement.

In this study, we investigate the effect of retirement on healthcare utilization in urban China. The direction of this effect is far from obvious. Economic theory makes ambiguous predictions (Galama et al., 2013; Kuhn et al., 2015). On the one hand, retirement might increase healthcare utilization because of reduced time cost of using healthcare services or a negative effect of retirement on health (e.g. cognitive decline, obesity). On the other hand, retirement might decrease healthcare utilization because of lower income after retirement in the presence of high co-payments, or because people switch to a healthier lifestyle.[1]

☆ The authors thank the China Health and Retirement Longitudinal Study (CHARLS) team for providing the data. We are very grateful for many helpful comments of the editor and two anonymous referees. We also thank Vellore Arthi, Bart Bronnenberg, Meltem Daysal, Max Groneck, Jan Kabátek, Peter Eibich, Tunga Kantarci, Tobias Klein, Lei Lei, Carol Propper, Renata Rabovič, Hans Henrik Sievertsen, Moritz Suppliet, Agne Suziedelyte, Yan Xu, seminar participants at Tilburg University, and conference participants at the 4th SDU Workshop on Applied Microeconomics, the 31 st Annual Conference of ESPE, Netspar Pension Day 2017, and the 12th European Conference on Health Economics (EuHEA) for their helpful comments and suggestions. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. There are no conflicts of interest.

* Corresponding author at: Department of Econometrics and Operations Research, Tilburg University, PO Box 90153, 5000, LE, Tilburg, the Netherlands.

E-mail addresses: y.zhang_3@uvt.nl (Y. Zhang), m.salm@uvt.nl (M. Salm), avas@uvt.nl (A. van Soest).

[1] A growing literature discusses the causal effect of retirement on physical and mental health (e.g. Mein et al., 2003; Neuman, 2008; Lei et al., 2011; Coe and Zamarro, 2011; Behncke, 2012; Bonsang et al., 2012; Coe et al., 2012; Hernaes et al., 2013; van der Heide et al., 2013; Atalay and Barrett, 2014; Insler, 2014; Iparraguirre et al., 2014; Eibich, 2015; Che and Li, 2018; Hagen, 2018; Shai, 2018), as well as the effect of retirement on health behaviors (e.g. Lang et al., 2007; Zantinge et al., 2014; Bertoni et al., 2018; Coe and Zamarro, 2015b; Kim et al., 2016; Godard, 2016). Retire-

https://doi.org/10.1016/j.jhealeco.2018.09.009

The empirical evidence for the effect of retirement on healthcare utilization is also mixed. Previous studies based on data from developed countries find either negative effects (Bejarano et al., 2014; Eibich, 2015; Coe and Zamarro, 2015a; Grøtting and Lillebø, 2017; Shai, 2018), or no significant effects (Laaksonen et al., 2012; Fé and Hollingsworth, 2011; Hagen, 2018).

A fundamental challenge in estimating the causal effect of retirement on healthcare utilization is that retirement can be endogenous to health, and therefore also to healthcare utilization. People in poor health might be more likely to retire early. One approach to address this endogeneity problem is to use SRAs as a source of exogenous variation in retirement (Neuman, 2008; Lei et al., 2011; Bonsang et al., 2012; Insler, 2014; Eibich, 2015; Coe and Zamarro, 2015b; Godard, 2016). This approach can be implemented with a fuzzy regression discontinuity design, comparing individuals of ages just below and just above their SRA.

We employ this method to examine the effect of retirement on healthcare utilization based on the 2011 and 2013 waves of the "China Health and Retirement Longitudinal Study" (CHARLS). We exploit the discontinuity in retirement rates at the SRA in urban China. At the SRA, the probability of being retired increases by around 30 percentage points. We can exclude the possibility that changes in healthcare utilization at the SRA are due to factors other than retirement, such as changes in health insurance. Therefore, the assumptions of a fuzzy regression discontinuity approach are met allowing us to estimate the causal effect of retirement on healthcare utilization.

We find that retirement increases healthcare utilization. Specifically, retirement significantly increases the number of doctor visits, the number of hospital stays, yearly out of pocket expenditures for inpatient care, and monthly out of pocket expenditures for self-treatment. This finding is robust to alternative specifications such as different parametric functional forms of age or different age bandwidths for choosing the sample. For men, we also find a marginally significant positive effect of retirement on the incidence of outpatient care and a strong and significant positive effect on out-of-pocket inpatient cost.

To better understand our findings, we explore three possible mechanisms. The first possible explanation is deteriorating health after retirement. We find negative effects on objective measures of physical functioning and an increase in self-reported incidence of chronic diseases. A second explanation could be the reduced opportunity cost of time after retirement. We find that the increase in inpatient care use is mainly driven by retirees who previously worked in the private sector, where it might be more difficult to take time off for medical care. This relates to China's institutional feature that employment protection practices are much less generous compared to developed countries, leading to higher opportunity costs of time. A third potential mechanism relates to income, but we do not find a significant income drop at retirement.

For the low educated, there is no income drop at retirement either, but we do find that retirement leads to a significant increase in the likelihood of foregoing inpatient care of 20%-points, even though it was suggested by a physician. Our interpretation is that for this group, retirement releases the time constraint but financial barriers, in particular the high copayments that form another institutional feature typical for China, still prevents many people from using care. This finding implies that policymakers should pay attention to keeping medical care affordable for retirees with lower socio-economic status.

Our study contributes to the growing literature on the effects of retirement on health and healthcare utilization. To the best of our knowledge, it provides the first evidence of an effect of retirement on healthcare utilization from a developing country.[2] Our results strongly differ from existing evidence for developed countries. The analysis of the mechanisms underlying the effect of retirement on healthcare utilization in relation to institutional characteristics will also be informative for other developing countries with low employment protection and high co-payments.

The remainder of the paper is organized as follows: Section 2 introduces the institutional background. Section 3 describes the data. Section 4 presents the empirical strategy. Section 5 shows our main results, and Section 6 explores the possible mechanisms. Section 7 provides sensitivity analyses, while Section 8 discusses the role of institutions and policy implications.

2. Institutional background and international comparison

2.1. Statutory retirement ages in urban China

The statutory (full) retirement age in China is 60 years for men, 55 years for female civil servants, and 50 years for other female employees. China has the lowest retirement ages in the world, even though its population is aging fast as a result of birth control policies and increasing life expectancy. For historical reasons, SRAs only apply to urban China.[3] Retirement arrangements were introduced to protect urban employees in the 1950s when the only employers were either the government or state-owned companies and institutions. Private sector and self-employment entered after the economic reforms in the 1980s. Retirement arrangements were adapted to cover urban workers in these "new" sectors, but still do not apply to rural China. Farmers usually continue working as long as their health permits. In this study, we therefore restrict our analysis to urban residents.

In principle, employees are required to retire at their SRA, but deviations are possible: (1) Employees are allowed to retire five years earlier than the full retirement age if their jobs are dangerous or harmful to health, or if a medical exam proves that they are too ill to continue working.[4] (2) Retirement at the SRA is not as strictly enforced in the private sector, self-employment, and temporary employment as in the public sector and state-owned companies. Therefore, "compliance" with the SRA is not perfect: a substantial number of people still works for pay after reaching the SRA. However, as we show later in this study, we do observe a discontinuity in the retirement rate at this age.

2.2. Pension and "processed retirement"

Urban employees are required to participate in pension programs. This policy is strictly enforced in the public sector, state-owned enterprises, and big companies in the private sector. Deviations exist in small private companies and in informal employment.

Employees are eligible to claim a pension when they reach their SRA and "process" retirement. The pension income varies in amount and composition, depending on pension program, years of contribution, and occupation. The actual pension income can be lower or higher than the pre-retirement wage.

"Processed retirement" means that an employee reaching the SRA leaves the current job after going through all the formalities with employer and local government. A difference from many other countries is that people can still continue working after "processing

ment can have health-preserving and health-damaging effects and the evidence on which effect dominates is inconclusive.

[2] Lei et al. (2011) examine the effect of retirement on health in China.

[3] In 2011 the labor force in China included 359 million people in urban areas and 405 million people in rural areas (National Bureau of Statistics of China, 2016).

[4] In our sample, around 22% of retirees took early retirement.

Table 1
International Comparison on Labor Market Characteristics.

	Employment in sectors of mining, manufacturing, utilities, and construction	Hours of work	Monthly earnings	Share of out-of-pocket expenditure	Share of out-of-pocket health expenditure per capita
	%	Weekly	Constant 2011 PPP $	% of total health expenditure	% of monthly earnings
Urban China	52.75	46	1106	55.3	6.4
The United Sates	18.50	36	4417 (in 2010)	11.7	1.8 (in 2010)
Germany	30.20	36	4762	11.9	1.1
Malaysia	28.57	46	1317	32.7	1.9
Brazil	23.01	39	907	30.6 (in 2009)	3.3
Year	2012	2012	2012	2010	2012

Notes: Years are chosen as close as possible to 2012, given data availability. Figures are from International Labour Organization (2018) unless mentioned otherwise. In column (4), "Share of out-of-pocket expenditure" refers to out-of-pocket expenditure as a percentage of total health expenditure. Monthly earnings in US dollars are converted using 2011 purchasing power parities (PPPs). For urban China, employment in sectors of mining, manufacturing, utilities, and construction is computed using figures of "Number of Employed Persons in Urban Units" and "Number of Engaged Persons in Urban Private Enterprises and Self-employed Individuals" in 2012 from National Bureau of Statistics of China (2016). In column (5), "share of out-of-pocket health expenditure per capita" refers to out-of-pocket health expenditure per capita as a percentage of monthly earnings. For urban China, this figure is computed using figures of monthly "per capita health expenditure in urban areas (yuan)" in 2012 from National Bureau of Statistics of China (2016), divided by "monthly earning in urban China (yuan)" in 2012 from International Labour Organization (2018). For the other countries, "share of out-of-pocket health expenditure per capita" is computed using "out-of-pocket expenditure as percentage of current health expenditure (CHE)" and monthly "current health expenditure (CHE) per capita in US$" from World Health Organization (2018), together with "monthly earnings in US$" from International Labour Organization (2018).

retirement". They can work for a new employer or even for the former employer with a temporary contract, while at the same time claiming pension (and health insurance) benefits from the former employer. This fact complicates the definition of retirement, which we will further discuss in Section 3.

2.3. Health insurance system

Health insurance in urban China is organized independently from retirement arrangements: Eligibility for public health insurance does not depend on retirement status or pension claiming. Public health insurance programs cover more than 95% of the overall population. Private health insurance programs are much less prevalent.[5] There are different types of public health insurance programs, as seen in Figure B.1.[6] An individual's type depends on occupation and residential status, and it is not easy to switch types.

Health insurance programs differ in generosity, but generally require high patient copayments. The two major urban insurance programs, covering 75% of our sample, are the Urban Employee's Basic Medical Insurance (UEBMI) for urban employees and the Urban Resident Basic Medical Insurance (URBMI) for urban residents without formal employment. These plans have copayments of at least 35% and at least 45% for inpatient care, respectively.

Despite differences across insurance programs, the covered benefits and the copayment rates within the same health insurance program remain the same before and after retirement. Moreover, individuals do not change program when they retire.

2.4. International comparison

Table 1 compares labor market characteristics in urban China with selected developed countries (US, Germany) and less developed countries (Malaysia and Brazil). In urban China, sometimes referred to as "the world's factory", the share of employment in mining, manufacturing, utilities and construction sectors was above 50% in 2012, higher than in any of the other countries. Compared to the US and Germany, working hours in urban China are substantially longer, indicating that visiting a clinic or hospital will be difficult without absence from work, creating a potential impediment to seeking healthcare before retirement.

Wages in urban China are similar to those in Malaysia and Brazil, but much lower than in the US or Germany. After adjusting for purchasing power differences, monthly earnings are around one fourth of those in the US and Germany. Due to high copayments, the share of healthcare expenditures that patients pay out of pocket is high, about 5 times larger than in the US and Germany and almost twice that in Malaysia or Brazil. Accordingly, the share of out-of-pocket expenditure as a percentage of monthly earnings in urban China is also much higher than in the other countries. This may be another reason for not seeking health care, both before and after retirement.

3. Data

The data we use come from "The China Health and Retirement Longitudinal Study" (CHARLS).[7] This dataset is ideal for our study because it collects rich information about retirement, healthcare utilization, health, income and expenditures, health insurance status, and demographic characteristics, from a nationally representative sample of 17,500 individuals aged 45 or older and their spouses. Interviews are repeated every two years. We use information from the first two waves of the survey in 2011 and 2013.

We restrict the sample to urban residents aged between 40 and 75.[8] This reduces the sample size from 36,338 to 7286 individual-year observations. We further exclude the self-employed since they do not process retirement, and we exclude those who neither work nor report "processed retirement".[9,10] This reduces the sample size to 5438 observations. Finally, we exclude observations with missing information on retirement status, age, or gender, leaving us with

[5] In our sample, coverage by private health insurance programs is about 5%. Such programs usually provide supplementary insurance to public health insurance plans. Eligibility and benefits are independent of retirement status.

[6] Figures B.1 – B.10 are in the Online Appendix.

[7] CHARLS is harmonized with the Health and Retirement Study (HRS), the English Longitudinal Study of Aging (ELSA), and the Survey of Health, Aging and Retirement in Europe (SHARE). For more details, see http://charls.ccer.edu.cn/en/page/about/CHARLS.

[8] We define urban and rural using "Hukou", a household registration system that distinguishes "Urban Hukou" and "Rural Hukou".

[9] "Working" refers to either engaging in agricultural work (including farming, forestry, fishing, and husbandry for one's own family or others) for more than 10 days per year, or performing any of the following activities for at least one hour per week: earning a wage, running one's own business or helping in a family business, etc. "Working" does not include activities without pay, such as housework or voluntary work.

[10] Those who neither work nor report "processed retirement" account for around 1/6 of the sample.

Table 2
Panel Structure.

Years of observation	Individual records	
	Frequencies	Percentage
2011 and 2013	1667	47.48
2011	825	23.50
2013	1019	29.02
Total	N=3511	100

a sample of 5178 individual-year observations for 3511 individuals. Around half of the individuals in our sample are observed in both waves (see Table 2). In Section 7 we test whether the results are sensitive to sample attrition by excluding those who only appear in the first wave.

3.1. Retirement

There are three common ways to define retirement: (1) self-reported “processed retirement”. This is not ideal because many people still work for pay after processing retirement from their “career jobs” (20% of individuals in our sample continue working after processing retirement). (2) Neither working for pay nor searching for a paid job. This is not ideal either, because some people have never had a paid job at all and did not “retire” from work. (3) Both “processed retirement” and not working for a paid job anymore. We adopt this third definition because we consider “retirement” as a change from working to non-working. In additional analyses, we show how alternative definitions of retirement influence the results.

3.2. Normalized age

Fig. 1 shows the “retirement rate” (the sample fraction of individuals in retirement) by age and gender. It shows a clear discontinuity at age 50 for women and at age 60 for men, the SRAs. There are also substantial increases in retirement rates at other ages (e.g. 51 for women and 56 for men), but these are not related to formal retirement rules.

For female civil servants, the SRA is 55. In Fig. 1 we do not see a clear discontinuity in retirement rates for women at age 55, since civil servants are a relatively small group, and the distinction between civil servants and other public sector employees is poorly measured in our data. We therefore proxy the SRA to age 50 for all women.

Workers can retire (at most) 5 years before the SRA if their jobs are dangerous, health-damaging, or extremely onerous. Therefore early retirement starts at age 45 for female workers and 55 for male workers. While we do not use early retirement ages in our main analysis, we add a dummy for having reached the early retirement age as an additional instrument as a sensitivity check. This also allows us to test the validity of our instruments.

We define the normalized age a as the actual age minus the corresponding SRA for each gender: a = age – 60 for men, and a = age – 50 for women. This is the assignment variable for the fuzzy regression discontinuity design in our main analysis.

3.3. Outcome variables

We consider the following outcome variables in our main analysis: (1) *Outpatient incidence*: a dummy indicating whether the respondent used outpatient care in the past month or not.[11] (2) *# Doctor visits*: number of doctor visits in the past month.[12] (3) *Outpatient cost*: the out-of-pocket expenditure for outpatient care in the past month. The expenditures in tables and graphs are in RMB or CNY (both mean Chinese Yuan). In the text, we translate them into US dollars using the exchange rate: 1 USD = 6.5 CNY. (4) *Inpatient incidence*: a dummy indicating whether the respondent received inpatient care in the past year or not. (5) *# Hospital stays*: the number of times the respondent received inpatient care during the past year. (6) *Inpatient cost*: the out-of-pocket expenditure for inpatient care in the past year.[13] (7) *Self-treatment incidence*: a dummy indicating whether the respondent treated herself in the past month or not.[14] (8) *Self-treatment cost*: the out-of-pocket expenditure for self-treatment in the past month. (9) *Health check incidence*: a dummy indicating whether the respondent did any health check in the past 2 years or not. (10) *Forgone outpatient incidence*: a dummy indicating whether the respondent was sick but did not seek outpatient care in the past month or not. (11) *Forgone inpatient incidence*: a dummy indicating whether or not a doctor had suggested that the respondent needed inpatient care but the respondent was not hospitalized in the past year. (12) *Self-reported health*: self-reported health status on a scale from 1 to 5, with 1: excellent; 2: very good; 3: good; 4: fair; 5: poor.[15]

3.4. Control variables

We control for predetermined variables such as individual's gender, a third-degree age polynomial, living with or without a partner,[16] and education level. Age is constructed from information about birth year and month. Education level is categorized as low (at most elementary education),[17] middle (finished middle school, high school, or vocational school), or high (“two-/three-year college/associate degree”, “four-year college/bachelor degree”, master degree, or doctoral degree). In additional analysis and sensitivity analysis, we also study mechanisms related to variables like BMI, chronic disease, etc.

3.5. Summary statistics

Table 3 presents summary statistics. The sample consists of 5178 observations. About 55% of them are men. The average age is 59 years old. 52.8% have both processed retirement and stopped working. The vast majority (86.6%) have a partner. The middle education group is the largest (61.1%), while 28.1% of the sample belongs to

[11] There are no general practitioners in China. To see a doctor, one usually needs to go to a hospital or clinic. According to the survey question, outpatient care refers to visiting a public hospital, private hospital, public health center, clinic, or health worker's or doctor's practice, or to home visits by a health worker or doctor.

[12] More precisely: the total number of visits to general hospitals, specialized hospitals, Chinese medicine hospitals (“Zhongyi”), community healthcare centers, township hospitals, healthcare posts, private clinics, and other healthcare organizations.

[13] Inpatient expenditures include fees paid to the hospital, including ward fees but excluding wages paid to a hired nurse, transportation costs, and accommodation costs for the respondent herself or for family members.

[14] Self-treatment refers to treatment without resorting to professional medical care, such as over-the-counter drugs, traditional herbs or medication, tonic/health supplement, and the use of healthcare equipment.

[15] We do not look at dentist visits as outcome variable in our main analysis. Summary statistics and estimation results of dentist visits are available in Tables A.12 and A.14. We do not find a significant effect of retirement on dentist visits. Questions about dentist visits are only included in the second wave. Dentists work in outpatient care departments in hospitals. As for other outpatient care, patients do not have to make an appointment, and waiting times tend to be short.

[16] In our sample, 95.62% of respondents have no further household members other than their spouse. Results are essentially unchanged if we add the number of household members other than the spouse as additional control.

[17] The low education group includes illiterates, those who did not finish primary school but are capable of reading and/or writing, those who have been to home school, and those who finished elementary school.

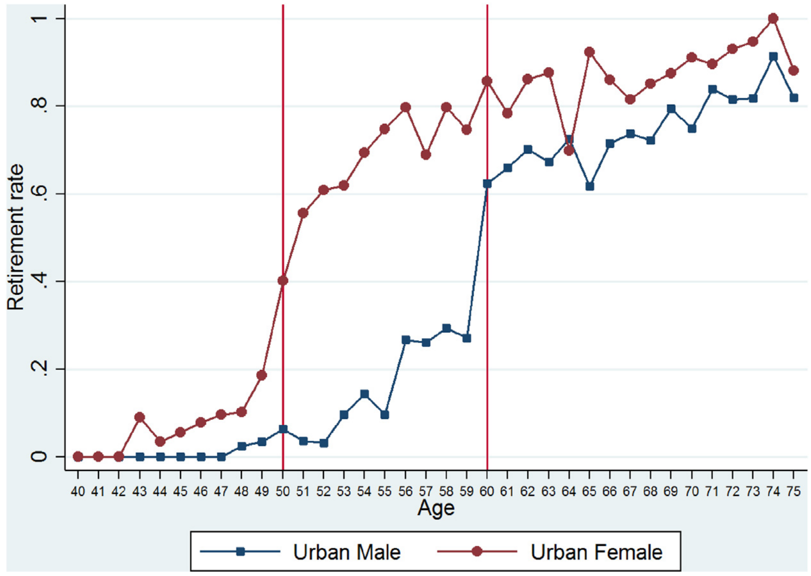

Fig. 1. Retirement Rate by Age. Note: The vertical lines at ages 50 and 60 are the SRAs for female and male workers.

Table 3
Summary Statistics.

Variable	Obs.	Mean	Std. dev.	Variable	Obs.	Mean	Std. dev.
Outcome Variables				*Other Variables*			
Outpatient incidence	5162	0.193	0.395	Enrolled in pension plan	5151	0.616	0.486
# Doctor visits	5162	0.431	1.61	Medical Insurance	5178	0.949	0.219
Outpatient cost	5178	51.882	434.556	*Mechanism Variables*			
Inpatient incidence	5176	0.128	0.334	Mental health	4616	11.951	4.032
# Hospital stays	5173	0.184	0.622	Life Satisfaction	4572	2.861	0.645
Inpatient cost	5178	266.37	2655.498	Individual income	4293	25444.61	17857.99
Self-treatment incidence	5163	0.58	0.494	Chronic disease	5178	0.657	0.475
Self-treatment cost	5178	114.524	342.017	Smoking	4650	0.25	0.433
Health check incidence	5178	0.62	0.485				
Forgone outpatient incidence	5178	0.073	0.26	*Physical Functioning Variables*			
Forgone inpatient incidence	5178	0.043	0.203	BMI	3314	24.692	3.980
Self-reported health	4454	3.674	0.891	Systolic blood pressure	3340	131.055	20.926
Treatment Variable				Diastolic blood pressure	3339	77.272	13.016
Retirement	5178	0.528	0.499	Diabetes	4972	0.109	0.311
Control Variables				Cancer	4982	0.012	0.108
Male	5178	0.551	0.497	Stomach disease	4993	0.169	0.375
Age in years	5178	58.871	8.438				
Has a partner	5178	0.866	0.341	*Instrumental Variable*			
Low education	5178	0.281	0.449	Age $\geq$ 60 (or 50)	5178	0.651	0.477
Middle education	5178	0.611	0.488				
High education	5178	0.107	0.309				

Notes: Mental health: index for mental health problems, ranging from 8 to 32. Life satisfaction: scale from 1 (completely satisfied) to 5 (not at all satisfied). See text and Online Appendix C for detailed variable definitions.

the low education group and only a small minority are highly educated. The average individual yearly income is about $4000 with a standard deviation of $2700; 94.9% of individuals in our sample are covered by health insurance, and 61.6% are enrolled in a pension plan.[18]

The probability of having used outpatient care last month is close to 20%, while the probability for having used inpatient care last year is only 12.8%. On average, people visit a doctor once every two months and stay in hospital once every five years. Average out-of-pocket expenditures on outpatient care (monthly) and inpatient care (yearly) are $8 and $41, respectively.[19] Self-treatment is very common: Almost 60% of respondents report that they have used it last month. The average monthly out-of-pocket cost of self-treatment is about $18. Approximately 62% had a health check in the last two years. During the past year, 7.3% of respondents have foregone outpatient care and 4.3% have foregone inpatient care even though such care was recommended by a physician.

In Table A.1[20] we show additional summary statistics for individuals who are just below and just above the SRAs. Retired

[18] The survey question in 2011 asks respondents whether they are claiming a pension. In 2013, the question changed to "whether they are either claiming or accumulating a pension". We try to use other questions in 2011 to retrieve the information about whether the respondent is accumulating a pension in government/institution/new rural/other pension programs. However, we cannot exclude the possibility of some measurement error if contributors to some pension programs are left out. Adding pension claiming as a control variable does not influence the estimation results.

[19] These average amounts are unconditional. The averages conditional on being positive are: out-of-pocket expenditure on outpatient care (monthly) $117; inpatient care (yearly) $1405; monthly out-of-pocket cost of self-treatment $40.

[20] Tables A.1 – A.16 are in the Online Appendix.

individuals just above the SRA use substantially more health care than people just below SRA or those just above SRA who have not yet retired. For example, they have substantially more hospital stays and inpatient care incidences and much higher outpatient and inpatient costs. Whether these differences reflect causal effects of retirement on healthcare use is what we will analyze in the next section, but the data already suggest that some mechanisms are more likely than others. For example, individual income is slightly higher among the non-retirees above the age cut-off than among retirees, while health expenditures are much higher for the retirees, suggesting that income is not a major channel. On the other hand, non-retirees above the age cut-off more often forego outpatient and inpatient care than retirees, suggesting that, controlling for diagnosis, current workers less often use (or postpone) health care, possibly because of their higher opportunity cost of time.[21]

Table A.1 also shows summary statistics for individuals who were below the SRA and working in the first wave and above SRA and retired in the second wave (columns 5 and 6). For this (small) sample of compliers, socio-economic characteristics such as education level do not differ markedly from the general population in the full sample, and their healthcare utilization before retirement is generally not higher than for others of the same age. This suggests that compliers did not already use more medical treatment before they retired.

4. Empirical strategy

Our aim is to estimate the causal effect of retirement on healthcare utilization. We start with a linear model:

$$H_{it} = \tau R_{it} + X_{it}^{'}\beta + \varepsilon_{it} \tag{1}$$

H_{it} is one of the 12 outcome variables measuring healthcare utilization (or health) of individual i in wave t. R_{it} is the binary variable for retirement and τ is the causal effect of retirement on the outcome, the main parameter of interest. X_{it} is a vector of predetermined variables including gender, age, age^2, age^3, living with a partner, education level, and a constant.

If we assume that ε_{it} is an idiosyncratic shock that is uncorrelated with R_{it} and X_{it}, then OLS gives a consistent estimate of τ. But this assumption may not be valid, since retirement might be endogenous to healthcare use. For example, both retirement decisions and healthcare utilization might be influenced by an unobserved component of health or another unobserved factor.

To correct for potential endogeneity of retirement, instrumental variables estimation (Coe and Zamarro, 2015a) and a fuzzy regression discontinuity design (Fé and Hollingsworth, 2011; Eibich, 2015) are two frequently used methods in the existing literature. We use a nonparametric fuzzy regression discontinuity (RD) design for our main analysis, avoiding restrictive assumptions on functional form. As a robustness check, we present results with linear IV regressions (Section 7), using a binary variable Z_{it} for being at or above the SRA (60 for men and 50 for women) as an instrument for retirement.

4.1. Fuzzy regression discontinuity design

The regression discontinuity design exploits the SRA as a source of exogenous variation in retirement status. Since not all individuals retire exactly at their SRA, this RD framework is fuzzy (Lee and Lemieux, 2010). The treatment effect can be estimated as the

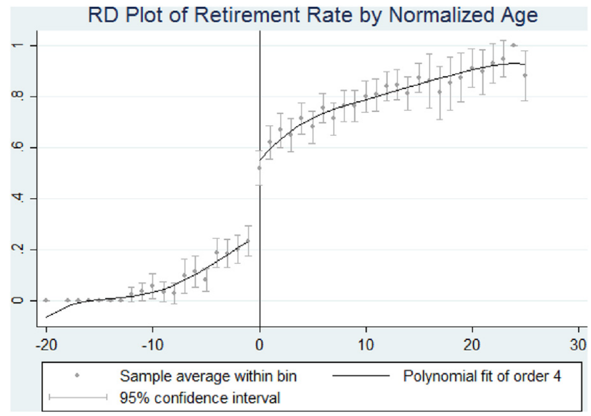

Fig. 2. Retirement Rate by Normalized Age.

ratio of the jump in the outcome variable H and the jump in the probability of being retired at the SRA, as shown in Eq. (2):

$$\tau_{FRD} = \frac{\lim\limits_{\varepsilon\downarrow 0} E\left[H|a=0+\varepsilon\right] - \lim\limits_{\varepsilon\uparrow 0} E\left[H|a=0+\varepsilon\right]}{\lim\limits_{\varepsilon\downarrow 0} E\left[R|a=0+\varepsilon\right] - \lim\limits_{\varepsilon\uparrow 0} E\left[R|a=0+\varepsilon\right]} \tag{2}$$

Here a is the normalized age (as defined in Section 3) which is zero at the cutoff point. τ_{FRD} is the local average treatment effect (LATE), the effect on compliers at the cutoff point. In our context, it is the average change in healthcare utilization for those who retire exactly at the SRA.

A valid fuzzy RD design relies on two main assumptions (Imbens and Lemieux, 2008). The first assumption requires a discontinuity in the probability of treatment at the cutoff point:

$$\lim_{\varepsilon\downarrow 0} Pr\left(R=1|a=0+\varepsilon\right) \neq \lim_{\varepsilon\uparrow 0} Pr\left(R=1|a=0+\varepsilon\right)$$

This assumption is verified in Fig. 2, which shows how retirement rates vary with age. We can see a discontinuity at the SRA (a = 0) where the probability of being retired increases by around 30 percentage points.

The second assumption requires continuity in potential outcomes as a function of the assignment variable around the cutoff point. This implies that in the absence of retirement, healthcare utilization should not change at the cutoff point. In other words, “all other factors” driving healthcare utilization must be continuous at the cutoff point (see, e.g., Hahn et al., 2001). Though we cannot test this assumption directly, we check in Section 7 whether relevant variables change significantly at the age cutoff, considering, e.g. participation in pension and health insurance programs and switches between health insurance programs. The untreated group in our study includes individuals who process retirement, but continue working. We test whether income, working hours, and healthcare utilizations change significantly at the full retirement age for those who continue working, and find no effect. We also examine whether healthcare utilization changes at the SRAs in rural areas. This is a falsification test since the SRAs do not apply to rural China. In addition, in a sensitivity analysis we employ a different definition of retirement which includes all people who have processed retirement. We find that results are similar compared to the baseline estimates.

4.2. Nonparametric estimation

The LATE parameter τ_{FRD} can be estimated parametrically or non-parametrically. In our main analysis, we choose nonparametric estimation to avoid assuming a particular functional form of the

[21] Note that the age difference between columns (2) and (3) is substantial. This is due to the large difference between SRA for men and women and the difference in the fractions of retirees just above the age cut-off among men and women.

Table 4
Main Results.

Dependent variable	OLS	RD		Male		Female	
		Conventional	Robust	Conventional	Robust	Conventional	Robust
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outpatient incidence	0.032**	0.104	0.103	0.380*	0.392*	−0.298	−0.526
	(0.014)	(0.149)	(0.183)	(0.201)	(0.227)	(0.506)	(0.712)
# Doctor visits	0.059	0.816*	0.887*	1.162**	1.140*	0.829***	0.900***
	(0.066)	(0.433)	(0.508)	(0.532)	(0.592)	(0.176)	(0.207)
Outpatient cost	48.688***	0.289	−19.655	529.88*	578.11	−1523	−2469.7
	(17.365)	(231.81)	(292.76)	(299.13)	(358.5)	(1410.3)	(1834)
Inpatient incidence	0.065***	0.163	0.208	0.103	0.142	0.204*	0.158
	(0.012)	(0.131)	(0.159)	(0.174)	(0.214)	(0.111)	(0.120)
# Hospital stays	0.112***	0.409*	0.491*	0.411	0.437	0.416	0.493
	(0.020)	(0.225)	(0.261)	(0.283)	(0.330)	(0.485)	(0.659)
Inpatient cost	277.027***	1517.6**	1660.4**	1925.7**	1741.9*	824.61	1227.7
	(90.850)	(610.66)	(690.43)	(805.45)	(897.69)	(709.59)	(838.04)
Self-treatment incidence	0.052***	0.096	0.102	0.048	−0.035	1.531	2.562
	(0.018)	(0.198)	(0.241)	(0.303)	(0.353)	(1.650)	(2.213)
Self-treatment cost	59.403***	177.29**	170.06	75.08	68.069	481.8	607.12
	(11.383)	(90.01)	(107.36)	(92.86)	(108.09)	(399.95)	(480.68)
Health check incidence	0.030*	−0.051	−0.040	0.150	0.093	−0.167	−0.126
	(0.018)	(0.187)	(0.229)	(0.253)	(0.317)	(0.127)	(0.139)
Forgone outpatient incidence	−0.011	0.004	0.010	0.022	0.011	0.049	0.049
	(0.009)	(0.110)	(0.135)	(0.115)	(0.145)	(0.075)	(0.075)
Forgone inpatient incidence	0.001	0.079	0.068	0.028	0.045	0.192	0.292
	(0.008)	(0.068)	(0.083)	(0.071)	(0.082)	(0.195)	(0.238)
Self-reported health	0.143***	0.069	0.060	0.104	0.087	0.245	0.448**
	(0.035)	(0.395)	(0.491)	(0.499)	(0.623)	(0.237)	(0.227)
Covariates	Yes	Residualized		Residualized		Residualized	
Observations	5178	5178		2851		2327	

Notes:*Significant at 10%; ** at 5%; *** at 1%. In column (1), numbers in parentheses show robust standard errors clustered at the person level. Table A.2 shows full results. In columns (2) and (3), numbers in parentheses show robust standard errors clustered at the person level. "Conventional" refers to estimates using conventional coefficient and variance estimators, and "Robust" refers to estimates using bias-corrected coefficient estimators and robust variance estimators. Full results with first stage results and information on bandwidth are shown in Table A.3. The number of observations varies slightly across outcome variables due to missing values. Numbers of observations for each outcome variable are reported in Tables A.2 and A.3. Columns (4) to (7) are the same nonparametric RD estimates but separately for men and women. For details and full table, see Table A.7. Covariates refer to age polynomials (age, age^2, and age^3), binary variables for male, having a partner, having mid-education, and having high education. For "residualized" outcome variables, we regress outcome variables on the covariates, and then conduct the nonparametric RD analysis described above based on the residuals.

assignment variable. We present parametric estimates as a robustness check in Section 7.

The nonparametric estimation uses local linear regressions (Fan, 1992) to estimate the elements of Eq. (2). The estimate of τ_{FRD} is then computed as in Eq. (3):

$$\hat{\tau}_{FRD}(b) = \frac{\hat{\mu}_{H+}(b) - \hat{\mu}_{H-}(b)}{\hat{\mu}_{R+}(b) - \hat{\mu}_{R-}(b)} \tag{3}$$

Here $\hat{\mu}_{H+}(b)$ is the estimate of $\lim_{\varepsilon \downarrow 0} E[H|a = 0 + \varepsilon]$, the healthcare utilization just above the cutoff point. Similarly, $\hat{\mu}_{H-}(b)$, $\hat{\mu}_{R+}(b)$, and $\hat{\mu}_{R-}(b)$ are estimates of the corresponding terms in Eq. (2). For a given bandwidth b, $\hat{\mu}_{H+}(b)$ is computed using a triangular kernel-weighted linear regression of H using observations to the right of the age cutoff. The intercept of this local linear regression is $\hat{\mu}_{H+}(b)$. The other three terms in Eq. (3) are computed similarly.

Following Lee and Lemieux (2010) we "residualize" the outcome variables. We regress outcome variables on age polynomials (age, age^2, and age^3) and other control variables, and then conduct the nonparametric RD analysis described above based on the residuals.[22] Residualizing is not necessary for consistency, but reduces the variance. In Section 7 we show that estimation results are very similar without residualizing. Figure B.2 displays how the "residualized" outcome variables change with normalized age. It suggests that several types of healthcare use increase abruptly at retirement.

In order to choose the bandwidth b of the kernel function, we use a data driven method suggested by Calonico et al. (2014, 2016). We select b based on two separate MSE-optimal bandwidth selectors (below and above the cutoff). We use a robust variance estimator clustered at the individual level in order to account for the correlation of error terms across waves for the same individual.[23]

We report two types of estimates: "conventional" estimates using conventional coefficient and variance estimators, and "bias-corrected" estimates using a bias-corrected coefficient estimator and a robust variance estimator. According to Calonico et al. (2014, 2016), the latter corrects for the possible bias of $\hat{\tau}_{FRD}(b)$ caused by potential misspecification of the local linear regression with a limited sample size.

5. Main results

The OLS estimates for τ (Table 4 Column 1) indicate that retirement is associated with a deterioration of self-reported health (a positive effect means a health decline) and an increase in the utilization of most types of healthcare.

Columns (2) and (3) of Table 4 report conventional and bias-corrected RD estimates, respectively. These estimates are close to each other. The remaining columns show the RD results by gender, which are sometimes very imprecise, due to limited sample sizes.[24] Furthermore, coefficients for men and women are not significantly

[22] We also tried age and age^2. The results are very similar.

[23] We use a cluster-robust nearest neighbor variance estimator with three nearest neighbors. We also tried alternative variance estimators like heteroskedasticity-robust nearest neighbor variance estimator; the results are very similar.

[24] Figure B.7 shows plots of retirement rates for men and women separately. In both plots, there is a clear discontinuity in the probability of being retired at the cutoff point.

different from each other (see test statistics in Table A.7). We will therefore mainly focus on columns (2) and (3).

The overall conclusion is that almost all RD estimates imply a positive effect of healthcare utilization at retirement. The point estimates are typically larger than with OLS, but also much less precise. This applies in particular to the estimated effects on costs (for inpatient, outpatient, and self-treatment). The most robust finding is the significant positive effect on the number of doctor visits, for men as well as women. Retirement increases the number of doctor visits by almost one per month for women and more than one per month for men. Since the mean number of doctor visits in the sample is only 0.43, these are quite large effects. Retirement raises the number of hospital stays per year by around 0.4 (60% of one standard deviation). Retirement also leads to an increase in the out-of-pocket amount spent on self-treatment (informal healthcare use) by about 177 RMB/month ($27/month) - 52% of a standard deviation and around 8% of annual income. These two effects are marginally significant in the pooled sample.

For men, we find a marginally significant positive effect of retirement on the incidence of outpatient care, while this effect is insignificant and even negative for women. Perhaps this is because men tend to work more hours than women, raising their opportunity cost of time when still working. For men, we also find a strong and significant effect on out-of-pocket inpatient cost, which amounts to about 6.8% of average individual annual income. This effect is smaller and insignificant for women. The other effects are less robust or insignificant. In spite of this, the fact that almost all point estimates are positive suggests that there is a general pattern that health care use increases at retirement.

In China, visiting a doctor by itself is not expensive, with a “regular outpatient registration fee” of only about 7–15 RMB ($1 to $2). This again suggests that particularly for the number of doctor visits the main mechanism may not relate to the monetary costs of health care; it is more likely that the large opportunity cost of time before retirement plays a decisive role. On the other hand, we find essentially no effect of retirement on the probability of a health check. Although retirees should have more time to invest in preventive care, health checks are rather costly for retirees as they are usually not covered by health insurance.

Table 5
The Effect of Retirement on Mechanism Variables: RD estimates.

Dependent variable	Mechanisms	
	Conventional	Robust
log(1+annual income)	−0.044	−0.126
	(0.341)	(0.411)
Mental health	−1.220	−1.637
	(1.535)	(1.885)
Life satisfaction	0.152	0.119
	(0.319)	(0.402)
Smoking	−0.096	−0.163
	(0.256)	(0.306)
Chronic disease	0.184	0.139
	(0.198)	(0.241)
BMI	4.346**	5.637**
	(1.884)	(2.384)
Systolic blood pressure	21.021**	24.963*
	(10.446)	(13.157)
Diastolic blood pressure	7.556	8.560
	(6.618)	(8.144)
Diabetes	0.229**	0.263**
	(0.099)	(0.117)
Cancer	0.062	0.083*
	(0.039)	(0.046)
Stomach disease	0.391**	0.461**
	(0.167)	(0.199)
Residualized	No	
Observations	5178	

Notes: See Table 3, Section 3 and Appendix C for variable definitions. *Significant at 10%; ** at 5%; *** at 1%. Numbers in parentheses are robust standard errors clustered at the person level. “Conventional” estimates using conventional coefficient and variance estimators; “Robust” estimates using bias-corrected coefficient estimators and robust variance estimators.

6. Mechanisms

We consider three mechanisms that may explain how retirement affects healthcare utilization: health, time, and income. We also look at possible longer term effects of retirement.

6.1. Health and health behavior

It is not clear a priori how retirement influences health. On the one hand, retirement can have a negative effect on health if retirees are more often physically inactive, or if retirement comes with the loss of valuable social contacts, identity, and self-esteem. On the other hand, the effect can be positive if retirees use their additional time for health enhancing activities or if retirement ends strenuous or dangerous working conditions. Our data concern several measures of health, including self-reported overall health. Since self-reported health may systematically differ before and after retirement due to, e.g., justification bias (Currie and Madrian, 1999; McGarry, 2004), we also use objective health measures (e.g. biomarkers for BMI and blood pressure).

Table 5 shows RD estimates of the effect of retirement on several measures of health, health behavior, and well-being. We find significant negative effects of retirement on several measures of health: a significant increase in systolic blood pressure, which can be associated with hypertension among the elderly; significant increases in self-reported incidence of diabetes and stomach disease, and even a marginally significant positive effect on the incidence of cancer. These effects could reflect causal effects of retirement on genuine health, but it could also be that retirement makes it more likely that health problems are diagnosed, since, as we saw before, retirement increases the probability of visiting a doctor or hospital. The increase in the incidence of self-reported chronic diseases could be explained by bad health conditions and habits already developed before retirement but without being diagnosed, and not so much by retirement per se changing the disease occurrence. Furthermore, we find that retirement significantly increases mortality (defined as the probability of death between the two waves) by 2% (see Table A.14), even though this is driven by a small number of deaths.

The effects on other health variables are insignificant. Retirement has an insignificant effect on an indicator whether patients have any of a broader range of chronic diseases (e.g. arthritis, stroke, chronic lung diseases etc.). We also find an insignificant deterioration of self-reported health (Table 4) and life satisfaction (Table 5). Based on a larger sample, Lei et al. (2011) found that retirement leads to significantly worse self-reported health and subjective well-being; perhaps our insignificant findings are due to the smaller sample and less precise estimates.

We find that retirement does not improve health behaviors: it has no significant effect on the incidence of smoking, and BMI even increases with retirement (Table 5). This could be the result of the sudden cessation of intensive work while keeping the same eating habits. As shown in Figure B.10, with a very stable level of food consumption and physical activities, retirees did not substitute work with more calorie-burning exercising. Physical inactivity after retirement could lead to health deterioration and hence more healthcare use.

In summary, our results on the effect of retirement on health should be interpreted with caution. While we find an effect of retirement on high blood pressure and on BMI, it is not clear whether this would immediately translate into higher health care

Table 6
The Effect of Retirement on Healthcare Use by Groups.

	Public sector		Private sector		Low education		Mid & high education	
Dependent variable	Convent. (1)	Robust (2)	Convent. (3)	Robust (4)	Convent. (5)	Robust (6)	Convent. (7)	Robust (8)
Outpatient incidence	0.115	0.109	0.052	0.064	0.317	0.296	0.046	0.034
	(0.144)	(0.180)	(0.213)	(0.257)	(0.310)	(0.398)	(0.157)	(0.190)
# Doctor visits	0.626*	0.611	0.325	0.456	1.264	1.408	0.267	0.294
	(0.346)	(0.405)	(0.536)	(0.637)	(0.844)	(1.016)	(0.377)	(0.435)
Outpatient cost	−77.545	−112.56	75.733	108.22	530.77	732.37	−233.54	−342.43
	(126.33)	(154.17)	(411.43)	(516.87)	(411.88)	(583.32)	(283.94)	(352.58)
Inpatient incidence	0.042	0.075	0.315*	0.356*	0.379	0.434	0.099	0.144
	(0.136)	(0.171)	(0.175)	(0.211)	(0.291)	(0.369)	(0.149)	(0.183)
# Hospital stays	0.063	0.099	0.836**	0.973**	0.908*	1.042*	0.275	0.339
	(0.166)	(0.208)	(0.368)	(0.429)	(0.501)	(0.621)	(0.203)	(0.238)
Inpatient cost	495.33	527.51	2492.2*	2965*	4510.4*	4962.1*	1084**	1297.1**
	(347.96)	(371.45)	(1398.8)	(1562.2)	(2622.9)	(2785.6)	(506.63)	(543.05)
Self-treatment incidence	0.051	0.063	0.158	0.154	0.483	0.575	0.030	0.004
	(0.226)	(0.281)	(0.303)	(0.374)	(0.470)	(0.594)	(0.216)	(0.257)
Self-treatment cost	87.616	102.92	234.65	232.48	180.15	197.82	169.37*	155.38
	(93.067)	(112.36)	(142.93)	(163.08)	(149.54)	(179.02)	(98.453)	(117.21)
Health check incidence	−0.132	−0.157	0.220	0.319	−0.038	−0.187	0.016	0.084
	(0.205)	(0.257)	(0.330)	(0.394)	(0.484)	(0.591)	(0.199)	(0.235)
Forgone outpatient incidence	0.033	0.053	0.034	0.040	0.0323	−0.012	−0.009	0.003
	(0.109)	(0.133)	(0.145)	(0.178)	(0.227)	(0.307)	(0.098)	(0.119)
Forgone inpatient incidence	0.074	0.072	0.066	0.073	0.168	0.209*	0.050	0.062
	(0.062)	(0.077)	(0.115)	(0.138)	(0.103)	(0.123)	(0.066)	(0.079)
Self-reported health	−0.294	−0.425	0.580	0.640	0.013	−0.001	0.134	0.118
	(0.340)	(0.411)	(0.758)	(0.917)	(0.829)	(1.062)	(0.422)	(0.510)
Residualized	Yes		Yes		Yes		Yes	
Observations	2020		3158		1454		3718	

Notes:*Significant at 10%; ** at 5%; *** at 1%. Numbers in parentheses are robust standard errors clustered at the person level. "Convent." refers to estimates using conventional coefficient and variance estimators, and "Robust" refers to estimates using bias-corrected coefficient estimators and robust variance estimators. We choose separate bandwidths for the region to the left and to the right of the cutoff point for all outcome variables except for "Inpatient cost" for the low education group. For the latter, due to a small number of observations to the left of the cutoff point, we use a common bandwidth on both sides of the cutoff point. For "residualized" outcome variables, we regress outcome variables on age polynomials (age, age^2, and age^3), binary variables for male, having a partner, having mid-education, and having high education, and then conduct the nonparametric RD analysis described above based on the residuals.

expenditures. Also, the effect of retirement on self-reported chronic diseases could potentially be explained by more physician visits rather than by an effect of retirement per se on chronic diseases.

6.2. Time

A second mechanism could be time. The opportunity cost of the time spent on medical care is reduced after retirement, which provides incentives to increase healthcare utilization. Before retirement, taking sick leave could imply a loss of income or even a risk of job loss. According to the Labor Law of the People's Republic of China, a worker with a non-work-related disease is entitled to sick leave for a period between 3 to 24 months, depending on years of employment. A longer sick leave gives the employer the right to terminate the contract. Even within the sick leave period, the salary can be reduced substantially, to 80% of the local minimum wage (Mayer Brown, 2008).[25] Taking sick leave can also have a negative impact on variable wage components such as an end-of-month bonus. This is different from the European context, where income and job loss are less of a concern when taking sick leave.

The opportunity cost of sick leave can be especially high in small private companies and for temporary employment, where the law is less strictly enforced and employers are less cooperative with respect to sick leave. This gives workers incentives to postpone medical care, especially time-consuming inpatient care. After retirement, when workers no longer have to worry about income and job loss, they can spend more time on queuing for an available ward and staying in hospital.

This mechanism is not directly testable, but we provide some indirect evidence. We would expect that opportunity costs of sick leave are higher for retirees from small private companies or temporary jobs than for those who work for government, public institutions or state-owned companies. If the time mechanism is relevant, we expect a larger increase in inpatient care use at retirement for employees outside the public sector and in less protected jobs. Separate estimates in Table 6 indeed show that this is the case.[26]

The reduced opportunity cost of time after retirement can potentially also explain the increase in self-reported incidence of diabetes and stomach disease: It is possible that a worker's health has deteriorated already before retirement, but a formal diagnosis is only given after retirement when the worker has time to seek treatment. However, this explanation does not apply to our results for biomarkers which are not self-reported.

6.3. Income

A third possible mechanism relates to income. If income falls at retirement, this may have a negative effect on healthcare utilization due to high co-payments. However, we do not find a significant change in income at retirement (Table 5 and Figure B.3), and retirees actually use more instead of less healthcare after retirement. This suggests that income is not the main mechanism.

[25] 80% of the local minimum wage varied across provinces from about \$100 to \$200 per month in the year 2013.

[26] We have 2020 observations for workers who currently work for or are retired from government, public institutions or state-owned enterprises ("public") and 3158 other observations ("private"). The first stage plots in Figure B.4 show that the discontinuity in the public sector is larger than in the private sector, in line with the fact that retirement at the SRA is more common in the public than in the private sector.

Income does matter, however, to individuals with lower socioeconomic status for whom the income constraint can be binding. We split the sample into groups with a low level of education and a middle or high level of education.[27] People born before the 1970s with a middle education would be able to get a skilled job and earn an average wage. In contrast, the low educated usually earn a lower income in a strenuous unskilled job.[28] Table 6 presents the estimation results for the two education groups, showing that the effect of retirement on healthcare utilization, especially hospital stays and out-of-pocket inpatient expenditure is larger for people with low education than for people with high or middle education. At the same time, the incidence of forgoing inpatient care increases by more than 20%-points at retirement for the low education group, and by only about 6 or 7%-points for the middle and high education group.

6.4. Longer term effects

Our regression discontinuity estimates measure the immediate effect of retirement on health care utilization at the SRA. To analyze the effect of retirement on health care costs in the longer run, we examine the effects on health investment behavior and consider the possibility that individuals postpone healthcare use from (shortly) before until after retirement ("demand-shifting").

Higher health care utilization after retirement can reduce health care expenditures in the long term if it is aimed at preventive care. This is not what we find: Only 10% of outpatient care is preventive care (Table A.12), and there is no significant effect of retirement on preventive outpatient care. Furthermore, higher self-treatment expenditures after retirement are largely explained by a higher consumption of "over the counter medicines" which commonly does not aim at health prevention (Table A.13, Table A.14, and Figure B.11). In addition, the incidence of health checks does not significantly increase at retirement (Table 4), and health behaviors such as BMI or smoking do not improve at retirement (Table 5).

The increase in health care utilization after retirement can be short lived if it is explained by pent-up demand or by shifting treatment from before to after retirement, due to the high opportunity cost of time while still working. In Figure B.2 we show health care utilization at different ages around the SRA. For inpatient care costs, we see that expenditures decrease for ages just below the SRA, increase at the SRA, and then decrease again, suggesting that there could indeed be demand shifting. Yet, we do not see such a pattern for other health care utilization variables.

As a formal test for demand shifting we apply a donut-hole regression discontinuity design (see Shigeoka, 2014), which boils down to not using the years just before and after SRA. Table A.11 shows how parametric and nonparametric estimates change. For inpatient care costs, the positive effect of retirement disappears, but for other variables, the results remain qualitatively unchanged. Especially for self-treatment cost and incidence of forgone inpatient care, the effects are very stable as we drop more years of observations around the SRA cutoff point. This suggests that while we do find some evidence of demand shifting for inpatient care costs, the increased health care use after retirement cannot be attributed solely to demand shifting or pent-up demand.

7. Sensitivity analysis and specification checks

7.1. Functional form assumptions

In addition to the nonparametric fuzzy RD estimation approach presented above we also used alternative parametric estimation approaches. These methods use Z_{it}, the indicator of individual i being at or above the SRA at time t, as instrumental variable for retirement R_{it}. We restrict the sample to 10 years below and above the SRAs to reduce the impact of observations far away from the age cutoff.[29]

In our first robustness check we control for a cubic function of age that is the same function on both sides of the cutoff point as shown in Eq. (1). Column (1) of Table 7 presents the results. They are similar to the nonparametric RD estimates in Table 4.

In column (2) of Table 7, we present IV estimates for the alternative specification in equation (4):

$$H_{it} = \delta_1 a_{it} + \delta_2 a_{it}^2 + \gamma_1 a_{it} \cdot R_{it} + \gamma_2 a_{it}^2 \cdot R_{it} + \tau R_{it} + X_{it}^{'} \beta + \varepsilon_{it} \quad (4)$$

Here $a_{it} \cdot R_{it}$, $a_{it}^2 \cdot R_{it}$, and R_{it} are instrumented by $a_{it} \cdot Z_{it}$, $a_{it}^2 \cdot Z_{it}$, and Z_{it} respectively. This model assumes a quadratic form of normalized age a_{it} and allows for different age trends below and above the age cutoff, in contrast to the specification in column (1). Column (2) shows that estimation results are similar to the main results.

Column (3) shows non-parametric RD estimation results without residualizing the covariates. These results are very close to the main estimates in column (2) of Table 4.

7.2. Alternative estimation methods

We estimated a specification with fixed effects instrumental variables estimation (see columns 1 and 2 in appendix Table A.15). The coefficients point in the same direction as in the baseline specification and are even larger in absolute size. But the standard errors are also very large. This is not surprising because the identification of this model relies on a small number of individuals who are below the SRA and working in the first wave and above the SRA and retired in the second wave.

In addition, we estimated a model which includes additional instrumental variables for being above the early retirement age (45 years for females and 55 years for males). Results shown in column (3) of Table A.15 are almost identical to the baseline estimates in column (1) of Table 7. Adding additional instrumental variables allows us to test the joint validity of the instruments using overidentifying restrictions. The null hypothesis that the instruments are valid is never rejected.

Columns (4) and (5) of Table A.15 show separate estimates for men and women. They are qualitative similar to the non-parametric RD estimates, but much less precise due to the smaller number of observations.

7.3. Attrition

We examine to what extent our estimation results are affected by sample attrition. It is possible that some individuals left the sample in the second wave for reasons that are related to health or healthcare use. This motivates two robustness checks: 1) excluding individuals who are only observed in the first wave, keeping those observed in both waves or in the second wave only. 2) using the balanced sample of individuals observed in both waves. We use

[27] Figure B.4 shows the first stage plot by education groups. We observe clear discontinuities in all three groups. There are 1454 observations in the low education group, 3165 in middle education group and 553 observations in the high education group. Because most sample respondents are born before the Cultural Revolution, high education is rare. We therefore merge middle and high levels of education.

[28] The correlation between the level of education and individual income is around 0.4.

[29] For the parametric estimations in Section 7, we also estimated specifications which restricted the sample to 5 years below and above the age cutoff. The qualitative results do not change.

Table 7
Alternative Estimation Approaches and Sub-Samples.

Dependent variable	ParametricRD 1	Parametric RD 2	Nonparametric RD		Both-wavers + only in the second wave		Only both-wavers	
	±10 years (1)	±10 years (2)	Convent. (3)	Robust (4)	Convent. (5)	Robust (6)	Convent. (7)	Robust (8)
Outpatient incidence	0.095	0.036	0.104	0.109	0.158	0.195	0.114	0.173
	(0.081)	(0.121)	(0.148)	(0.183)	(0.182)	(0.224)	(0.213)	(0.265)
# Doctor visits	0.341	0.242	0.767*	0.839*	1.221**	1.412**	1.867*	2.387**
	(0.287)	(0.372)	(0.411)	(0.486)	(0.591)	(0.676)	(0.992)	(1.138)
Outpatient cost	153.283	122.235	−1.005	−20.508	35.312	28.911	251.67	343.58
	(111.622)	(220.788)	(234.18)	(294.64)	(242.6)	(303.3)	(384.9)	(484.77)
Inpatient incidence	0.127*	0.119	0.165	0.195	0.167	0.206	0.376*	0.507**
	(0.066)	(0.099)	(0.124)	(0.152)	(0.157)	(0.194)	(0.218)	(0.258)
# Hospital stays	0.238**	0.346**	0.398*	0.460*	0.445**	0.539**	0.778**	1.011**
	(0.105)	(0.157)	(0.223)	(0.257)	(0.226)	(0.266)	(0.387)	(0.445)
Inpatient cost	556.356	1,425.696**	1513**	1592.4**	1557.7**	1699.9**	2515**	3172.1***
	(451.243)	(693.242)	(598.34)	(677.91)	(613.19)	(687.01)	(1092.3)	(1201.3)
Self-treatment incidence	0.254**	0.119	0.098	0.093	0.121	0.130	−0.002	−0.027
	(0.110)	(0.174)	(0.200)	(0.243)	(0.183)	(0.222)	(0.263)	(0.318)
Self-treatment cost	178.762***	214.480***	175.55**	166.5	161.1	165.92	192.13	195.6
	(62.585)	(79.955)	(84.241)	(102.67)	(108.83)	(134.22)	(131.78)	(156.57)
Health check incidence	−0.026	−0.028	−0.049	−0.017	−0.070	−0.158	0.323	0.438
	(0.105)	(0.160)	(0.198)	(0.241)	(0.247)	(0.301)	(0.265)	(0.313)
Forgone outpatient incidence	−0.007	0.017	0.005	0.011	0.026	0.046	−0.027	−0.029
	(0.056)	(0.087)	(0.111)	(0.136)	(0.112)	(0.140)	(0.150)	(0.183)
Forgone inpatient incidence	0.084**	0.083	0.081	0.070	0.093	0.099	0.108	0.120
	(0.044)	(0.067)	(0.069)	(0.084)	(0.079)	(0.093)	(0.119)	(0.142)
Self-reported health	0.380*	0.166	0.054	0.002	−0.154	−0.168	−0.488	−0.663
	(0.205)	(0.305)	(0.398)	(0.507)	(0.408)	(0.513)	(0.437)	(0.524)
Covariates	Yes	Yes	No		Residualized		Residualized	
Age polynomial	3	2	No		3 (residualized)		3 (residualized)	
Observations	3542	3542	5178		4353		3334	

Notes: *Significant at 10%; ** at 5%; *** at 1%. In columns (1) and (2) numbers in parentheses show robust standard errors clustered at the person level. First stage results are shown in Table A.4; full results for Column (1) are shown in Table A.5 and for Column (2) in Table A.6. In columns (3) to (8) numbers in parentheses show robust standard errors clustered at the person level. “Convent.” estimates using conventional coefficient and variance estimator; “Robust” estimates using bias-corrected coefficient estimators and robust variance estimators. Covariates refer to age polynomials (age, age^2, and age^3), binary variables for male, having a partner, having mid-education, and having high education. For “residualized” outcome variables, we regress outcome variables on the covariates, and then conduct the nonparametric RD analysis described above based on the residuals.

the same nonparametric estimation approach as in our main specification. The results in columns (5) to (8) of Table 7 are very similar to those in the main estimation in Table 4. The main finding that retirement increases inpatient care utilization remains.

7.4. Alternative definitions of retirement

In order to check whether estimation results are sensitive to the definition of retirement, we use two alternative definitions of retirement. Firstly, following Coe and Zamarro (2015a) we define a person as retired if she no longer works in a paid job. This definition is less restrictive than before since it does not require that the respondent has “processed” retirement. It adds the self-employed and those who neither work nor report “processed retirement” to the estimation sample and excludes those who report that they never worked for at least three months during their lifetime.[30] The resulting sample size is 7021 observations. Figure B.5 (A) shows the first stage plot for the new definition of retirement. The discontinuity at the age cutoff is still noticeable although its magnitude is reduced to around 0.2. Columns (1) and (2) of Table 8 display results using the new retirement variable. The magnitude of the effect of retirement is even larger than in Table 4. This could be explained by the composition of the new sample which includes a higher share of lower educated people for whom the effect of retirement on health care utilization is larger (cf. Section 6).

Secondly, we define retirement based on “processed retirement” only, regardless whether an individual continues working or not. Figure B.5 (B) plots the first stage for this definition. The discontinuity in retirement rates at the age cutoff is around 0.4. Columns (3) and (4) of Table 8 show that the estimated effects are slightly smaller, but similar to the results in the main analysis.

7.5. Specifications checks

We check the requirement that other variables do not change discontinuously at the cutoff point. Table A.8 and Figure B.6 confirm that participation rates in pension or health insurance plans do not change significantly at the age cutoff, and the number of switches between different types of health insurance programs does not increase either. Table A.9 shows that for individuals who continue working after their SRA, there are no discontinuities in income, working hours, or healthcare utilizations at the SRA. These results also address the concern that reaching certain ages may have a direct psychological impact, which may lead to an increase in healthcare utilization irrespective of employment status (Behncke, 2012). Reaching such milestones is unlikely to explain our results since there is no change in healthcare utilization at the SRA for individuals who do not retire. Columns (5) to (8) of Table 8 show placebo tests at other nearby cutoff points, -1, +1, -5 and +5. As expected, there is no effect at other cutoff points. We also performed a falsification test based on a sample of rural residents (20,657 observations). Figures B.8 and B.9 show retirement rates

[30] Work includes agricultural work, paid employment, self-employment, and unpaid work in family businesses.

Table 8
Alternative Retirement Definitions and Placebo Tests.

Dependent variable	Retirement definition 1 (Stop working)		Retirement definition 2 (Processed retirement)		Placebo tests for different age cutoffs (Nonparametric RD-Conventional)			
	Conventional (1)	Robust (2)	Conventional (3)	Robust (4)	Cutoff: -1 (5)	+1 (6)	−5 (7)	+5 (8)
Outpatient incidence	−0.031	−0.088	0.136	0.142	−0.367	−0.069	−0.754	−0.584
	(0.192)	(0.231)	(0.153)	(0.185)	(0.461)	(0.337)	(1.092)	(1.467)
# Doctor visits	0.735	0.721	0.852*	0.953*	−3.768	−0.053	−1.496	−4.099
	(0.667)	(0.806)	(0.466)	(0.561)	(3.476)	(0.967)	(3.113)	(4.422)
Outpatient cost	29.756	21.968	−7.159	−29.312	778.55	4619.7	1501.8	−2486.3
	(314.75)	(404.04)	(180.72)	(233.12)	(632.97)	(8052.4)	(3103.3)	(3762.9)
Inpatient incidence	0.407	0.496*	0.125	0.146	0.256	0.224	−1.640	−0.902
	(0.248)	(0.291)	(0.085)	(0.101)	(0.364)	(0.257)	(2.669)	(1.633)
# Hospital stays	1.091**	1.335**	0.309**	0.366**	0.541	0.977	−1.459	−1.646
	(0.513)	(0.592)	(0.139)	(0.163)	(0.504)	(1.166)	(3.566)	(1.794)
Inpatient cost	3903.8**	4706.9**	1064.9**	1182.7**	996.72	−1250.5	18596	−9123.6
	(1835.8)	(2036.6)	(418.38)	(504.95)	(2458.4)	(1664.9)	(42,007)	(11,549)
Self-treatment incidence	0.254	0.297	0.109	0.138	−0.426	0.438	−2.107	−2.442
	(0.292)	(0.354)	(0.160)	(0.201)	(0.744)	(0.541)	(2.971)	(3.524)
Self-treatment cost	66.514	52.949	141.64*	145.02	−64.284	−35.004	1223.7	−1055.9
	(182.28)	(229.32)	(80.455)	(95.385)	(423.35)	(225.2)	(3553.9)	(1496.9)
Health check incidence	−0.098	−0.105	−0.021	−0.002	0.207	0.327	−2.368	1.809
	(0.241)	(0.296)	(0.122)	(0.148)	(0.429)	(0.839)	(2.875)	(2.478)
Forgone outpatient incidence	0.077	0.093	0.003	0.008	0.084	−0.362	0.504	0.414
	(0.150)	(0.185)	(0.081)	(0.101)	(0.390)	(1.069)	(1.582)	(0.895)
Forgone inpatient incidence	0.080	0.065	0.070	0.058	0.069	0.389	1.853	−0.134
	(0.094)	(0.114)	(0.060)	(0.073)	(0.260)	(0.464)	(5.419)	(0.498)
Self-reported health	0.633	0.713	0.063	0.052	1.360	−10.472	2.087	1.202
	(0.532)	(0.634)	(0.301)	(0.371)	(1.137)	(50.922)	(5.820)	(1.304)
Residualized	Yes		Yes		Yes			
Observations	7021		5178		5178			

Notes:*Significant at 10%; ** at 5%; *** at 1%. Numbers in parentheses show robust standard errors clustered at the person level. "Conventional" estimates using conventional coefficient and variance estimators; "Robust" estimates using bias-corrected coefficient estimators and robust variance estimators. For "residualized" outcome variables, we regress outcome variables on age polynomials (age, age^2, and age^3), binary variables for male, having a partner, having mid-education, and having high education, and then conduct the nonparametric RD analysis described above based on the residuals.

and healthcare utilization by normalized age.[31] As expected, in the absence of a statutory retirement age, we observe no discontinuity in either the probability of being retired or the outcome variables.

As a final check we examine how estimates change if we perform the same nonparametric estimation as in our main analysis but use alternative bandwidths (assuming the same bandwidth for observations below and above the cutoff). The results are robust to bandwidth choice (Table A.10).

8. Discussion

This paper studies the causal effect of retirement on healthcare utilization in China. We find that retirement increases healthcare utilization. The size of this effect is substantial. For example, the effect of retirement on inpatient care costs for men is equivalent to around 6.8% of average individual annual income. One possible mechanism is deteriorating health. We find evidence of this in objective measures of physical functioning such as high blood pressure and BMI. Moreover, we find a higher incidence of self-reported diseases after retirement, possibly because retirement makes it more likely that health problems are diagnosed. Arguably, the main mechanism explaining our findings is more time available for medical care after retirement. For the sample as a whole, income is not the dominating channel, yet people with low education are more likely to forego inpatient care recommended by a physician after retirement.

Our findings contrast with previous studies using data from developed countries. They tend to find that retirement reduces the use of outpatient care and has no significant effect on the use of inpatient care. The difference can be explained by differences in institutional characteristics. Labor market institutions and economic conditions can influence healthcare utilization. In a labor market where employment protection is weaker, the opportunity cost of healthcare utilization can be high. Moreover, in a developing country, a larger proportion of people tends to be engaged in arduous or unskilled jobs where their employers are often less cooperative with medical leave because they can easily find a substitute if a worker stays away from his work for a considerable time. These institutional characteristics may well translate into underinvestment in health before retirement, and an increase in healthcare utilization after retirement when time constraints are relaxed.

The characteristics of the Chinese healthcare system also contribute to the different results. One possible explanation is the absence of primary care physicians as gatekeepers. Coe and Zamarro (2015a) point out that healthcare systems with primary care physicians as gatekeepers can be effective at decreasing healthcare utilization after retirement. In China, the main constraint on healthcare utilization are high copayments. They push up out-of-pocket healthcare expenditure and constrain inpatient care use of individuals with low socio-economic status.

Our results relate to the policy debate on whether and when to raise the retirement age in China. With an increasing life expectancy and the one-child policy, China is quickly depleting its demographic dividend and facing overwhelming pressure on the social security and medical care systems. In spite of that, China still has the world's youngest retirement ages. Our findings imply that retirement increases healthcare use. At least in the short run, this would mean that raising the SRAs would reduce expenditures on the public health insurance in urban China. On the other hand, raising retirement ages might have negative effects on health if workers

[31] Retirement is now defined as having stopped with work, since "processed retirement" only applies to urban areas.

postpone necessary treatment due to time constraints. An increase in retirement ages should therefore go along with more facilitation of preventive care and more efforts to reduce employees' opportunity costs of seeking medical treatment. Moreover, policy makers should not ignore that high co-payments can imply financial barriers to medical care and lead to more forgone inpatient care for the low socioeconomic status group. Last but not least, our findings on the incidence of outpatient care and the cost of inpatient care stem mainly from men. One has to be careful when interpreting the results and making policy suggestions for outpatient care for women.

Our findings may be relevant for other developing countries with a rapidly increasing urban population engaged in arduous jobs in industrial sectors, where employment protection are relatively weak and health insurance is not generous.

For future research, one interesting next step would be to examine the long-run impact of retirement on healthcare utilization in more depth. Another direction of future research could be to investigate how the effect of retirement on healthcare utilization changes as the working population becomes more educated and better paid in the future.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jhealeco.2018.09.009.

References

Atalay, Kadir, Barrett, Garry F., 2014. The causal effect of retirement on health: new evidence from Australian pension reform. Econ. Lett. 125.3, 392–395.

Behncke, Stefanie, 2012. Does retirement trigger ill health? Health Econ. 21.3, 282–300.

Bejarano, Hernán, Kaplan, Hillard, Rassenti, Stephen, 2014. Effects of retirement and lifetime earnings profile on health investment. In: ESI Working Paper No. 14-21.

Bertoni, Marco, Brunello, Giorgio, Mazzarella, Gianluca, 2018. Does postponing minimum retirement age improve healthy behaviours before retirement? Evidence from Middle-aged Italian workers. J. Health Econ. 58 (1), 215–227.

Bonsang, Eric, Adam, Stéphane, Perelman, Sergio, 2012. Does retirement affect cognitive functioning? J. Health Econ. 31.3, 490–501.

Calonico, Sebastian, Cattaneo, Matias D., Titiunik, Rocio, 2014. Robust nonparametric confidence intervals for regression-discontinuity designs. Econometrica 82.6, 2295–2326.

Calonico, Sebastian, Cattaneo, Matias D., Farrell, Max H., Titiunik, Rocio, 2017. rdrobust: software for regression discontinuity designs. Stata J 17 (2), 372–404.

Che, Yi, Li, Xin, 2018. Retirement and health: evidence from China. China Econ. Rev. 49, 84–95.

Coe, Norma B., von Gaudecker, Hans-Martin, Lindeboom, Maarten, Maurer, Jürgen, 2012. The effect of retirement on cognitive functioning. Health Econ. 21.8, 913–927.

Coe, Norma B., Zamarro, Gema, 2011. Retirement effects on health in Europe. J. Health Econ. 30.1, 77–86.

Coe, Norma B., Zamarro, Gema, 2015a. Does retirement impact healthcare utilization? In: CESR-Schaeffer Working Paper 2015-2032.

Coe, Norma B., Zamarro, Gema, 2015b. How does retirement impact health behaviors? An international comparison. In:. CESR-Schaeffer Working Paper 2015-2033.

Currie, Janet, Madrian, Brigitte C., 1999. Health, health insurance and the labor market. Handb. Labor Econ. 3, 3309–3416.

Eibich, Peter, 2015. Understanding the effect of retirement on health: mechanisms and heterogeneity. J. Health Econ. 43, 1–12.

Fan, Jianqing, 1992. Design-adaptive non-parametric regression. J. Am. Stat. Assoc. 87.420, 998–1004.

Fé, Eduardo, Hollingsworth, Bruce, 2011. Estimating the effect of retirement on health via panel discontinuity designs. Unpublished manuscript, University of Manchester / University of Lancaster.

Galama, Titus, Kapteyn, Arie, Fonseca, Raquel, Michaud, Pierre-Carl, 2013. A health production model with endogenous retirement. Health Econ. 22.8, 883–902.

Godard, Mathilde, 2016. Gaining weight through retirement? Results from the SHARE survey. J. Health Econ. 45, 27–46.

Grøtting, Maja Weemes, Lillebø, Otto Sevaldson, 2017. Health effects of retirement. Evidence from Norwegian survey and register data. In: UiB Working Papers in Economics No. 02/17.

Hagen, Johannes, 2018. The effects of increasing the normal retirement age on health care utilization and mortality. J. Popul. Econ. 31.1, 193–234.

Hahn, Jinyong, Todd, Petra, van der Klaauw, Wilbert, 2001. Identification and estimation of treatment effects with a regression-discontinuity design. Econometrica 69.1, 201–209.

Hernaes, Erik, Markussen, Simen, Piggott, John, Vestad, Ola L., 2013. Does retirement age impact mortality? J. Health Econ. 32.3, 586–598.

Imbens, Guido W., Lemieux, Thomas, 2008. Regression discontinuity designs: a guide to practice. J. Econ. 142.2, 615–635.

Insler, Michael, 2014. The health consequences of retirement. J. Hum. Resour. 49.1, 195–233.

International Labour Organization, 2018. Key Indicators of the Labour Market. International Labour Organization, Genève, 1 June. 2018 http://www.ilo.org/ilostat.

Iparraguirre, José, 2014. Physical functioning in work and retirement: commentary on age-related trajectories of physical functioning in work and retirement–the role of sociodemographic factors, lifestyle and disease by Stenholm et al. J. Epidemiol. Community Health 68, 493–499.

Kim, Jinhee, Cha, Seung-Eun, Kawachi, Ichiro, Lee, Sunmin, 2016. Does retirement promote healthy behaviors in young elderly Korean people? J. Behav. Health 5.2, 45–54.

Kuhn, Michael, Wrzaczek, Stefan, Prskawetz, Alexia, Feichtinger, Gustav, 2015. Optimal choice of health and retirement in a life-cycle model. J. Econ. Theory 158, 186–212.

Laaksonen, Mikko, Metsä-Simola, Niina, Martikainen, Pekka, Pietiläinen, Olli, Rahkonen, Ossi, Gould, Raija, Partonen, Timo, Lahelma, Eero, **38.5**, 2012. Trajectories of mental health before and after old-age and disability retirement: a register-based study on purchases of psychotropic drugs. Scand. J. Work, Environ. Health, 409–417.

Lang, Iain A., Rice, Neil E., Wallace, Robert B., Guralnik, Jack M., Melzer, David, 2007. Smoking cessation and transition into retirement: analyses from the English Longitudinal Study of Ageing. Age Ageing 36.6, 638–643.

Lee, David S., Lemieux, Thomas, 2010. Regression discontinuity designs in economics. J. Econ. Lit. 48.2, 281–355.

Lei, Xiaoyan, Tan, Li, Zhao, Yaohui, 2011. The impact of retirement on health: Evidence from China. Unpublished Manuscript, China Center for Economic Research, Peking University, Peking.

Mayer Brown, J.S.M., 2008. Guide to Employment Laws in the PRC. Mayer Brown JSM, Hong Kong, https://www.mayerbrown.com/files/Publication/8cc25b33-7ada-49da-b444-cf697e1bc63f/Presentation/PublicationAttachment/79dcf986-2913-492b-97b3-ecb41a5f91b1/JSM_PRC_Employment_May2008.PDF. Feb. 2017.

McGarry, Kathleen, 2004. Health and retirement do changes in health affect retirement expectations? J. Hum. Resour. 39.3, 624–648.

Mein, Gill, Martikainen, P., Hemingway, Harry, Marmot, Michael G., 2003. Is retirement good or bad for mental and physical health functioning? Whitehall II longitudinal study of civil servants. J. Epidemiol. Community Health 57.1, 46–49.

National Bureau of Statistics of China, 2016. National Data. National Bureau of Statistics of China, Beijing, 25 May. 2018 http://data.stats.gov.cn/english/easyquery.htm?cn=C01.

Neuman, Kevin, 2008. Quit your job and get healthier? The effect of retirement on health. J. Labor Res. 29.2, 177–201.

Shai, Ori, 2018. Is retirement good for men's health? Evidence using a change in the retirement age in Israel. J. Health Econ. 57, 15–30.

Shigeoka, Hitoshi., 2014. The effect of patient cost sharing on utilization, health, and risk protection. Am. Econ. Rev. 104.7, 2152–2184.

van der Heide, Iris, van Rijn, Rogier, Robroek, Suzan, Burdorf, Alex, Proper, Karin, 2013. Is retirement good for your health? A systematic review of longitudinal studies. BMC Public Health 13.1, 1180.

World Health Organization, 2018. Global Health Observatory Data Repository. World Health Organization, Genève, 21 August. 2018 http://apps.who.int/gho/data.

Zantinge, Else M., van den Berg, Matthijs, Smit, Henriëtte A., Picavet, H.Susan J., 2014. Retirement and a healthy lifestyle: opportunity or pitfall? A narrative review of the literature. Eur. J. Public Health 24.3, 433–439.