SHARE WORKING PAPER SERIES

Retirement and Health Investment Behaviors: An International Comparison

Hiroyuki Motegi, Yoshinori Nishimura, Masato Oikawa

Working Paper Series 46-2020
Published January 13, 2020

DOI:10.17617/2.3231796

SHARE-ERIC | Amalienstr. 33 | 80799 Munich | Germany | share-eric.eu

MAX PLANCK INSTITUTE FOR SOCIAL LAW AND SOCIAL POLICY
Munich Center for the Economics of Aging

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 676536.

SPONSORED BY THE Federal Ministry of Education and Research

Supported by the National Institute on Aging

Retirement and Health Investment Behaviors: An International Comparison

Hiroyuki Motegi [*] Yoshinori Nishimura [†] Masato Oikawa [‡]

Current version: November 29, 2019

Abstract

This study aims to better understand the effects of retirement on health outcomes through a large-scale cross-country study of the changes in health investment behaviors after retirement among the populations of seven developed countries. Much of the literature on retirement health consists of single-country studies which generally find that health investment behaviors are effective predictors of health outcomes. However, using Global Aging Data normalized to facilitate cross-country comparison, and exploiting differences in the financial incentives in the pension systems across countries as our identification strategy, we find that, even with a careful accounting of the differences in baseline retirement ages, the elderly do not uniformly change their health investment behaviors in retirement. Therefore, in a cross-country framework, health investment behaviors are not necessarily good predictors of health in retirement.

JEL Classification Numbers: I00, I100, I120
Keywords: aging population, health investment behaviors, health outcomes, retirement, heterogeneity, global aging data

[*] Recruit Works Institute, and the University of Tokyo, Japan. Email: motegihiro@gmail.com
[†] Global Institute of Financial Research, Chiba Institute of Technology, Japan. Email: nishimura.yy@gmail.com
[‡] Faculty of Political Science and Economics, Waseda University, Japan, and Japan Society of the Promotion of Science (JSPS Postdoctoral Research Fellow). Email: masato.oikawa1991@gmail.com

1 Introduction

Over the past decade, pension system reform and other retirement-related policies have become increasingly important in developed countries for sustaining their social security systems. In evaluating the effects of these reforms, possible health externalities should be explicitly taken into account. If, for instance, an active work life is beneficial for the health of the elderly, policies aiming at delaying retirement could potentially improve health and reduce medical expenses. In order to inform the policy debate of such possible health externalities, knowledge of how retirement causally affects health is critical.

Investigations of the relationship between retirement and health have increased in the two decades since the seminal study of Kerkhofs and Lindeboom (1997) along with a growing interest in the effects of policies that delay retirement.[1] However, there remains no unified view of the impact of retirement on various health outcomes, with some studies concluding that retirement has a positive influence on health (both mental and physical) and others stating that retirement has a negative or null effect. Investigating the reasons for these differing results can help us to better understand the relationship between retirement and health. A survey of the literature on this topic by Nishimura et al. (2018) finds that differences in estimation methods and country-specific contexts are the main drivers of heterogeneous results across studies.

Another key aspect to understanding these differences is a better grasp of the mechanisms through which retirement influences health outcomes and health investment behaviors (i.e., health lifestyle). This research question has been first tackled by Eibich (2015) using German data, and subsequently by Motegi et al. (2016); Kämpfen and Maurer (2016); Ayyagari (2016); Zhu (2016); Celidoni and Rebba (2017); Zhao et al. (2017); Bertoni et al. (2018); Kesavayuth et al. (2018) and Binh Tran and Zikos (2019).[2] [3] However, since most studies consider a specific country and estimation methods are often different, findings are difficult to compare and/or to generalize, and sometimes lead to opposite conclusions. Insler (2014) finds that retirees decrease smoking after retirement, while Ayyagari (2016) estimates that retirement increases the probability of smoking

[1] Representative papers include Charles (2004), Lee and Smith (2009), Johnston and Lee (2009), Rohwedder and Willis (2010), Fonseca et al. (2014), Godard (2016), and Shai (2018).
[2] Insler (2014) suggested the mechanism as well in a supplement.
[3] This literature is also expanding, with Müller and Shaikh (2018) analyzing the effects of spouse retirement on health investment behaviors.

among ever smokers even though they both used the same U.S. Health and Retirement Study data. In view of the existing literature, cross-country studies using harmonized data and identical estimation methods may offer a valuable contribution to better assess the effect of retirement on health.

In this study, we take on this task and examine the effect of retirement on health behaviors in seven major developed countries. To avoid confounding heterogeneity in cross-country findings with differences in data and estimation methods, we use harmonized data, and adopt identical variable definitions, sample restrictions, and methodology for each country. Specifically, we estimate the effect of retirement on health investment behaviors such as alcohol consumption and smoking by exploiting rich and harmonized longitudinal data on older adults from the U.S., England, Europe, and Japan. Our empirical strategy relies on fixed-effects instrumental variables estimation to deal with the endogeneity of retirement decisions. We use pension eligibility age as an instrumental variable, assuming that financial incentives associated with pension eligibility age affect the retirement decision, but are not directly related to an individual's health investment behaviors.

In contrast to the literature, most of which consists of single-country studies, we find that the elderly do not uniformly change their health investment behaviors in retirement. Changes in behavior differ across countries not only in magnitude but also in the direction of change, and are also heterogeneous by gender and age. Consequently, we cannot present a single unified view of the effects of retirement on health investment behaviors across countries. It is possible that these differences in behavior may be due to differences in the retirement age across countries, and so we have paid particular attention to the control of age in this study and have adopted a flexible functional form in our estimations. We have been able to replicate the results from previous studies by adjusting the way in which we control for age. An additional finding of this study is a verification of the results of Nishimura et al. (2018), which finds that health outcomes can be improved after retirement in most cases. However, although we find that health outcomes may improve, the heterogeneity of health investment behaviors means that the behaviors themselves are not necessarily good predictors of health in retirement.

The remainder of the paper is organized as follows. Section 2 describes the data used in the analysis, and section 3 explains the estimation methods and identification strategies. Section 4 presents the results and our interpretation, and section 5 summarizes, draws conclusions, and provides ideas for future research.

2 Data

2.1 Global Aging Data

This study utilizes Global Aging Data from the U.S. Health and Retirement Study (HRS)[4] and other related datasets, including the English Longitudinal Study on Aging (ELSA), the Survey of Health, Ageing, and Retirement in Europe (SHARE), and the Japanese Study of Aging and Retirement (JSTAR).[5] These datasets constitute panel surveys of elderly individuals, and have been designed collaboratively by the researchers responsible for each study to be as comparable as possible. Furthermore, this family of datasets is constructed so that the questions on the HRS are reproduced in the other surveys as much as possible. They thus include a rich variety of variables to capture living conditions related to family background and economic, health, social and work status. In order to ensure global comparability, for this study, we mainly utilize the harmonized datasets compiled by the Gateway to Global Aging Data (http://gateway.usc.edu) from the individual studies mentioned above. Because each individual study aims to include the same variables and follow the same naming conventions, the harmonized datasets enable researchers to conduct cross-national comparative studies.[6] However, when relevant variables are not available in the harmonized datasets, we obtain the information from the original datasets. Table 1 shows the information used to compare each dataset, representing the data from different studies through the years, how many waves of data are available, and initial sample sizes.

2.2 Choice of Countries for Main Analysis

This section explains how the countries are chosen for the main analysis, beginning with all waves of data for Western countries (HRS, ELSA and SHARE) and East Asia (CHARLS, JSTAR and KLoSA) as of 2016 and then restricting the analysis sample step by step according to the following criteria. First, as pensionable age is the identification strategy in this paper, we restrict

[4] See http://hrsonline.isr.umich.edu for detailed information on the HRS.

[5] See also the China Health and Retirement Longitudinal Study (CHARLS) and Korean Longitudinal Study of Aging (KLoSA).

[6] The program code to generate the harmonized datasets from the original ones is provided by the Center for Global Ageing Research, USC Davis School of Gerontology, and the Center for Economic and Social Research (CESR). Some variables, such as measures of assets and income, are input by this code.

our sample to only those countries whose pensionable age information is available by cohort levels, [7] leaving at this stage the USA, England, Germany, France, Denmark, Switzerland, the Czech Republic, Estonia, Japan, China, and Korea. Second, because we utilize a dynamic definition of retirement, we analyze only countries that had been surveyed more than four times by 2013, which causes us to drop the Czech Republic, Estonia and China from the analysis. Finally, as we are reporting results only when coefficients of instrumental variables are significant in the first stage regression, we drop Korea at this stage, leaving the final seven countries reported in our main analysis: the USA, England, Germany, France, Denmark, Switzerland and Japan.[8]

2.3 Definition of Retirement

Many studies in the literature (e.g., Coe and Zamarro (2011), Bonsang et al. (2012)) define retirement either as "not working for pay" or "self-reported retired", but there are drawbacks to both definitions. "Not working for pay" may include those who are unemployed or working as volunteers, and "self-reported retired" could include those who have retired from their career job but who remain in the labor force. This paper aims to address these drawbacks by considering three different retirement definitions. For our main analysis, in order to exclude those who are either unemployed or still working after retiring from their career job, we use the variable "Retirement 1 (Ret.1)", consisting of those who are both "not working for pay" and who are "self-reported retired'.[9] Then, for our robustness check, we consider two other possible definitions of retirement: "Retirement 2 (Ret.2)", which includes a respondent who is both "not working for pay" and who self-reported as either "retired", "partly retired", or "not in the labor force"; and "not working for pay (NW)", which includes those "not working for pay".

The inclusion relationship is that $Ret.1 \subset Ret.2 \subset NW$. Table 2 presents the summary statistics of each definition of retirement, showing the inclusion relationship along with demographic variables

[7] In appendix A, we explain how to get the pensionable ages in this analysis.

[8] For the United States, we use waves 3-11 for the HRS because waves 1 and 2 are from the Study of Assets and Health Dynamics (AHEAD), which is technically distinct from the HRS and could not be combined due to differences in the question content. We do not use wave 3 for the SHARE survey because the data is not current but retrospective.

[9] The question for "not working for pay" is "Are you doing any work for pay at the present time?", which takes one if the respondent replies "No." "Self-reported retired" is derived from the "r@lbrf" variable in the harmonized datasets that is constructed based on RAND HRS data. In the HRS, "r@lbrf" takes seven self-reported labor force status values (working full time, working part time, unemployed, partly retired, retired, disabled, and not in the labor force). We define a respondent as "self-reported retired" if "r@lbrf" indicated "retired." Page 1033 of the Rand HRS data codebook (http://hrson- line.isr.umich.edu/modules/meta/rand/randhrsm/randhrsM.pdf) provides details on the construction of "r@lbrf". In this study, we use the variable "r@lbrf" in all harmonized datasets.

such as age and gender. Section 4.2 reports the results of a robustness check, showing how the estimates differ from the narrowest defined Ret.1 used in our main analysis to other less restrictive definitions.

2.4 Health Investment Behaviors

Although the literature includes a range of other health investment behaviors such as health conscious diet and sleep duration (Eibich, 2015), in this study, we follow Bertoni et al. (2018) and investigate alcohol consumption, smoking and physical activity because these three behaviors are included in all datasets and thus can be compared internationally.[10] The measurement scale for health investment behaviors is adjusted to enable an international comparison because each individual dataset uses different measures. Table 3 shows the summary statistics for retirees and non-retirees, with all waves for each country pooled. Below is an explanation of the behavior variables and their relationship to health outcomes according to the medical literature.

- Alcohol consumption: Four measures of alcohol consumption are used in this study. "Alcohol consumption: yes/no" indicates whether a respondent consumed alcohol or not in each survey year, taking 1 if the respondent had drunk alcohol. "Alcohol consumption: Freq. >3d/w" is a binary variable that measures the alcohol consumption frequency each week, taking 1 if the respondent drank alcohol more than three days in a week. "Alcohol consumption: Freq. >5d/w" is another binary variable measuring alcohol consumption frequency each week, taking 1 if the respondent drank alcohol more than five days in a week.[11] "Alcohol consumption: Amount" measures the number of drinks per day in HRS, SHARE and JSTAR.[12]

  Alcohol drinking customs differ by country. Table 3 shows that the ratio of non-retirees who drink alcohol in England, Germany, France, Denmark, and Switzerland when measured by "yes/no" (and elderly drinkers measured by "frequency" or "amount") is larger than that of those in the US and Japan.

[10] For example, the information about sleep duration is included in only HRS and JSTAR.
[11] We construct the above two variables from raw data taking values from 0 to 4; "0" if not drinking in a week, "1" if drinking once or twice a week, "2" if three or four times, "3" if five or six times; and "4" if every day.
[12] We define the number of drinks per day as the sum of three types of alcohol consumption variables (beer, wine, and liquor). ELSA includes information about the number of drinks per week, so we divide this number by seven.

The main concern with drinking is that it causes circulatory system diseases. Rehm et al. (2003) find that the average volume of alcohol consumption increases the risk for the following major chronic diseases: liver cancer, unipolar major depression, epilepsy, alcohol use disorders, hypertensive disease, hemorrhagic stroke, and cirrhosis of the liver. Sabia et al. (2014) shows that alcohol consumption decreases cognitive ability early in old age. Lin et al. (2005) finds that middle-aged and elderly men and women who drink excessive amounts of alcohol per day have a 30% higher mortality risk from all causes compared to non-drinkers. Based on the literature, decreasing alcohol consumption after retirement can improve some health indices such as "ADLs (activities of daily livings)".

- Smoking: One measure of smoking is used in this study. "Smoking: yes/no" takes 1 if a respondent smokes at the interview date. From Table 3, there are no significant differences between countries regarding smoking measures for non-retirees.

  Many papers have shown that smoking has negative effects on elderly health. For example, Benowitz (2010) finds that cigarette smoking remains a leading cause of preventable diseases and premature death in the United States and other countries. Tobacco use is also a main cause of death from cancer, cardiovascular disease, and pulmonary disease (Barik and Wonnacott (2009)). Cessation of smoking after retirement may thus improve health outcomes.

- Physical activities: We use two measures of physical activity: "Vigorous Physical Activity: yes/no", which takes 1 if respondents replied that they engaged in vigorous physical activity at least once a week, and "Moderate Physical Activity: yes/no", which takes 1 if respondents indicated moderate physical activity at least once a week. As the frequency of physical activity is measured categorically in the HRS, ELSA, SHARE, and JSTAR, and the measurement scales and questions asked in each survey vary slightly, changes in physical activity is not strictly comparable among the four data sets.[13] Nonetheless, from the raw data, the two physical activity variables are constructed for this study.

  Table 3 shows the summary statistics. For moderate activities, the elderly in continental

[13] For example, while SHARE asks "How often do you engage in vigorous physical activity, such as sports, heavy housework, or a job that involves physical labour?", HRS asks "How often do you take part in sports or activities that are vigorous, such as running or jogging, swimming, cycling, aerobics or gym workout, tennis, or digging with a spade or shovel"

Europe exercise more, and those in the U.S. exercise less. This may be because Europeans often commute by train or on foot, while Americans often commute by car, and moderate exercise includes walking at moderate pace. Japanese elderly do vigorous physical activities less than those in other countries.

According to Penedo and Dahn (2005), daily moderate exercise improves physical functions, including lower-extremity functions and balance. Stathopoulou et al. (2006) also finds that individuals who exercise at least two or three times per week experience significantly lower depression levels. Our findings support the literature, as when elderly Japanese people walk more and increase vigorous exercise after retirement, their health improves. We assume that the main reason for this increase in exercise after retirement is due to an increase in spare time.

Although there are other lifestyle habits that may be relevant, which include in some studies preventive care (disease screening, wellness visits, dental/vision), medication adherence, and gym membership, this study restricts the analysis to the above three lifestyle variables in order to conduct an international comparison. All of them have been identified in the literature as influencing health.

One notable point among the three behavior variables chosen is that physical activity differs from drinking and smoking in the nature of health investment behaviors. While physical exercise consumes time and is thus closely related to leisure time after retirement, drinking and smoking do not involve the exclusive consumption of time and are instead a matter of preference, social custom, and culture. Consequently, the reason why people change their lifestyles after retirement depends on the specific behavior at issue.

2.5 Sample Restrictions

This section describes sample restrictions related to age and working status. First, regarding working status, those who had not worked during the survey period are excluded, leaving the analysis sample consisting of retired civil servants and self-employed individuals as well as those who had not been employed prior to retirement. While the pension systems for civil servants and self-employed differ slightly, we set the pensionable age the same for simplicity.

Previous research used various age ranges for analysis.[14] For example, Eibich (2015) restricts the sample to those aged 55-70 because he finds that the probability of retirement increases sharply at 60 to 65 years of age in Germany. It is better to narrow the age range for precise estimation. However, this German phenomenon does not exist in other countries which have a different pensionable age, and other studies such as Shai (2018) and Kesavayuth et al. (2018) choose a broader age range of 50-75.

Figure 1 shows that the fraction of retired individuals after age 75 remains rather stable across countries, which justifies using 75 as the upper bound on age. However, for robustness checks, we also limited our sample to the age range 50-70 as well as to a 5-year window around the pension eligibility age in each country.

3 Estimation Method and Identification Strategy

This paper follows similar estimation procedures as Nishimura et al. (2018), using either the fixed effects instrumental variables method (FE-IV) to estimate the effects of retirement on health investment behaviors by using pension eligibility age as the IV.

We estimate the equation as follows:

$$health\_invest_{it} = \beta_0 + \beta_1 retire_{it} + \beta_2 age_{it} + \beta_3 {age^2}_{it} + \beta_4 {age^3}_{it} + x'_{it}\gamma + a_{1i} + \lambda_{1t} + \varepsilon_{1it} \quad (1)$$

$$retire_{it} = \alpha_0 + \alpha_1 1\{age_{it} \geq {A^{eb}}_i\}$$
$$+\alpha_1 1\{age_{it} \geq {A^{fb}}_i\} + \alpha_3 age_{it} + \alpha_4 {age^2}_{it} + \alpha_5 {age^3}_{it} + x'_{it}\eta + a_{2i} + \lambda_{2t} + \varepsilon_{2it}$$

${A^{eb}}_i$*: early retirement benefit eligibility age*

${A^{fb}}_i$*: full retirement benefit eligibility age*

where i represents an individual and t time. x_{it} represents a set of exogenous control variables that include marital status, number of children, income quartile, wealth quartile, house ownership, residence variables, and wave variables. The dependent variable $health\_invest_{it}$ represents health investment behaviors. The binary variable $retire_{it}$ equals 1 if the elderly person is retired, according

[14] [14]The previous literature is summarized in Table 10.

to the detailed definitions provided in Section 2. ε_{1it} and ε_{2it} are unobserved error terms. a_{1i} and a_{2i} represent unobserved individual fixed effects and λ_{1t}, λ_{2t} denote unobserved time effects. The coefficient of interest is β_1. Standard OLS estimates for the equation above cannot generate consistent results due to the endogeneity of $retire_{it}$. There are unobserved third factors at the individual level such as individual preferences and subjective life expectancy which can affect both retirement and health investments.

Our identification strategy utilizes the fact that the proportion of retired elderly in many developed countries increases after the pension eligibility age.[15] While pension eligibility age correlates very strongly with individual retirement decisions, it is not under the individual's control and is unlikely to influence health investment behaviors. For this reason, pension eligibility age has been used as an IV in many studies, including Rohwedder and Willis (2010), Bonsang et al. (2012), Insler (2014), Godard (2016), Nishimura et al. (2018), and Shai (2018), among others. We follow a similar identification strategy in this study, using cohort-specific pension age eligibility (both early and full retirement ages) as an instrument for observed individual retirement decisions.

While other estimation methods such as regression discontinuity design (RDD) around the pension eligibility age have been applied in the literature (Eibich (2015) and Johnston and Lee (2009)), the sample size in some datasets such as JSTAR is not sufficiently large, and the pension eligibility age also differs across the countries studied. Because RDD estimates show the effects on discontinuity points, this makes it difficult to compare results across countries, Accordingly, we instead choose a wide age range (50-75) to capture the pension eligibility ages of all countries and apply FE-IV methods, controlling for age effects flexibly by including linear, squared and cubic age terms.

Figure 1 shows the proportion of retired elderly by age after pooling all samples. Early and normal pension eligibility ages are represented by the vertical dashed lines. In the U.S., Denmark, France, and Germany, there is a sharp proportional increase in retired elderly around the early pension eligibility age, whereas this occurs around the normal pension eligibility age in England and Japan (males).

[15] While other institutions such as the U.S. medicare system and Japan's severance pay may also affect the decision to retire, research suitable for international comparison shows that pension affects the decision in a wider range of countries.

4 Results

In this paper, we report only the coefficients of the retirement variables for each country, which represent the marginal effects. The results are shown in Table 4. The full set of estimated coefficients in the second stage for the probability of drinking, smoking and moderate physical activity are provided in Appendix B, and other results can be made available upon request. Although the results for both FE-IV and FE estimations are shown in Table 4, here we interpret the results only for FE-IV. A comparison of the results from FE and FE-IV is provided at the end of subsection 4.1.[16]

For brevity, the results are not discussed when the coefficients of the pensionable age dummy variables for the first stage are not significant. Also, in order to test for weak instruments, we have calculated the Kleibergen-Paap Wald rk F-statistic, which deals with clustered standard errors. The F-values are meaningful when the results of the first stage are significant, and these are shown in Table 16 of Appendix C. As suggested by Stock and Yogo (2005), it is desirable for all F-statistics to exceed the critical value for the desired maximal size 0.1 of a 5% Wald test, and we follow the rule-of-thumb value of 10, which is a standard commonly used in empirical analysis. Although Japan falls below this critical value of 10, the estimates are unbiased at the median value when there is one endogenous variable and one IV and so we have retained them.[17] Nonetheless, care must be taken in interpreting the results from Japan.

4.1 Effects of Retirement on Lifestyle Habits

In this section, we report cross-country changes after retirement in three common health investment behaviors (alcohol consumption, smoking, and physical activity). The main results are shown in Table 4.

- Alcohol Consumption:

  We analyze alcohol consumption through three variables (frequency, amount, and probability of consumption) and find that the elderly changed their drinking habits slightly in terms of

[16] We have also conducted estimations either by FE or FE-IV depending on the results of a DWH test. For the results of this approach, see Motegi et al. (2019).
[17] See Angrist and Pischke (2008) p. 213.

frequency and amount in two of the seven countries studied, but the probability of alcohol consumption (Y/N) did not change after retirement in any country. We speculate that this may be due to alcohol being highly addictive and also because consumption of alcohol depends on preferences: elderly who do not usually drink alcohol do not begin to drink after retirement and vice versa.

However, the frequency of alcohol consumption did change considerably after retirement in Germany (>3d/w = 0.274). This large change is consistent with Eibich (2015), and suggests that being non-retired and elderly in Germany increases the probability of drinking 3 days a week by 51.6% from a baseline probability of 53.1% (see Table 3).[18] The results for other countries are not significant, and the coefficients are small except for those from Denmark. We can therefore say that the elderly in most countries do not change the frequency of their consumption of alcohol after retirement.

As with frequency, changes in the amount of alcohol consumption differs by country as well. We find that elderly in Denmark substantially increased the amount of alcohol consumed per day after retirement, by 1.705, or 70.6% (=1.705/2.414) from baseline. Taken together with the apparent decrease in the frequency of drinking in retirement in Denmark (though the signs are not significant), this suggests that at least some elderly in Denmark increase the amount they drink per day even while drinking less frequently

To sum up, although no statistically significant change in the probability of drinking has been found in any of the countries analyzed, changes in the frequency and/or daily intake has been found in two of the seven countries studied: Denmark and Germany. We therefore conclude that elderly in most countries do not change their consumption of alcohol after retirement, probably because drinking alcohol depends more on preferences, and is less related to working conditions.

- Smoking:

We find that the elderly changed their smoking habits in only one of seven countries, decreasing after retirement in Denmark (-0.279). Our finding that in no country do retirees

[18] This is calculated by 0.274/0.531, and the following numbers are calculated in the same way.

increase smoking significantly is consistent with previous research, including Insler (2014), Eibich (2015), Motegi et al. (2016) and Zhao et al. (2017). We note that the decrease in smoking in Denmark is very large, at 106.5% at mean level (=0.279/0.262). Although it is a conjecture, the large magnitudes could indicate a sociocultural or medical reason unique to the country.

Other possible reasons why the elderly in Denmark might reduce smoking could be reduced job stress and removal from a work environment that encourages smoking, as suggested by Motegi et al. (2016). In other words, if many people smoke to relieve job stress and while interacting socially with co-workers, these smokers might typically stop smoking after retirement. However, we find this pattern only in Denmark, with the elderly in other countries not changing their smoking habits uniformly or significantly. We thus conclude that the elderly do not change their smoking habits after retirement in most cases.

- Physical Activity:
  In this study, we analyze physical activity as moderate or vigorous, and our investigation finds that the elderly changed their participation in either moderate or vigorous physical activity after retirement in two of the seven countries studied. In Denmark, the probability of vigorous physical activity each week after retirement increased 68.8% (=0.454/0.660) from the baseline level of non-retirees, and in England, the probability of moderate physical activity increased 16.5% (=0.133/0.806) from baseline. Consequently, we can conclude that the elderly in England and Denmark increased physical activity after retirement. However, as we find with smoking habits, behavioral changes in physical activity do not occur in many countries. Looking at the results for England and Denmark, the changes in behavior are consistent with economic theory, which predicts that an increase in physical activity might accrue from a reduction in the opportunity cost for physical activity after retirement. The opportunity cost, measured as the wage per hour, becomes 0 when an individual stops working. Grossman (1972) also suggests this explanation and presents a health production model that can explain the effects of relaxing time constraints on health investment behavior due to retirement.

According to our results at this point, we have found that elderly do not change their health investment behaviors after retirement in many countries (US, France, Switzerland and Japan).

Furthermore, even in those countries in which behaviors do change, the change is not necessarily in a healthy direction. Further, when we take non-significant results into consideration, the direction of change varies from country to country for each health investment behavior. Thus, from the analysis of the age 50-75 sample, we cannot report a unified result about health investment behavior after retirement. The behavior of the elderly varies from country to country and the magnitude of the change is minimal in most cases. In the next subsection, we check the robustness of these results. We then investigate the cause of these different results across countries by separating the sample and analyzing heterogeneity of the retirement effects.

Before moving to the robustness check, here we provide a comparison of the results for FE and FE-IV (Table 4 and Table 13 ~ 15 in Appendix B), two alternative specifications considered for this study. We can see that FE has a greater number of significant results than FE-IV from Table 4 because the standard errors for FE-IV are large from Table 13 ~ 15. This is expected, for when the retirement variable is exogenous, FE-IV estimates are consistent but inefficient, having a large standard error.

Because of the consistency of the FE-IV estimates, we have chosen to report them in the main results, even at the cost of efficiency when the retirement variable is exogenous. In comparing the FE and FE-IV results, in some cases the signs are different (for example, the probability of smoking in the U.S. is -0.012 for FE, but 0.023 for FE-IV), but in no case are both coefficients different and significant. As a sufficient number of samples and surveys have been used even in the U.S. analysis, we cannot say for certain the cause of the difference in direction of the coefficients, but one possibility is an identification problem when using the FE model. For example, while FE estimates can control time invariant factors such as preferences, they cannot control time variant factors such as a health shock. Thus, FE cannot deal with endogeneity of retirement while FE-IV can.

We also note that FE-IV estimates can be larger than FE estimates if such time variant shocks are not adequately controlled for. As McGarry (2004) finds that elderly are inclined to retire when they are affected by negative health shocks, and we might also consider a positive health shock to be correlated with health investment behaviors such as an increase in physical activities, it is likely that time variant shocks might affect our retirement variable. In most cases the magnitude of the coefficients are larger for FE-IV than FE (for example, the coefficient for moderate physical activities in England is 0.133 for FE-IV and 0.017 for FE). Due to the consistency of the FE-IV estimates and correction of bias, we have chosen to report these in the main analysis.

4.2 Robustness Check by Different Definitions of Retirement

This section considers an alternative definition of retirement as a robustness check due to the varying definitions of retirement in the literature, which may impact the conclusions reached if elderly perceive retirement differently according to the country in which they live. For example, Figure 2 shows that retirement after age 75 is very low for Japanese women, possibly because in Japan, women do much more housework than men and so they may regard it as a type of work from which they do not retire. Furthermore, when partial retirement is considered, the elderly may change their lifestyle habits gradually, depending on their level of retirement. For these reasons, we consider two other definitions of retirement: “Ret.2”, which is “Ret.1”+ partly retired +not in the labor force, and “NW” (not working for pay). The results are shown in Table 5, with only the FE-IV coefficients of each retirement definition reported.[19]

The results for “Ret.2” are similar to those of “Ret.1”, with the few differences being the frequency of alcohol consumption and vigorous physical activities in Germany. Germany aside, elderly who are “partly retired” and “not in the labor force” change their lifestyle habits similarly to those who are “retired’. Elderly in many countries appear to not change their lifestyle rapidly after retirement, and so it appears that our main analysis of retirement affects on health behaviors is relatively robust against varying recognitions of retirement, as captured by “Ret.2”.

The second alternative definition for retirement considered is “NW” (not working for pay), which is commonly used in the literature (e.g. Coe and Zamarro (2011) and Bonsang et al. (2012)). “NW” includes those who are unemployed as well as those who are not paid for their work, such as volunteers and homemakers. There are potentially some different behaviors associated with this retirement definition than “Ret.1” of the main analysis. For example, unemployed elderly may decrease alcohol consumption in preparation for job interviews compared to elderly who are retired. Additionally, volunteers might not increase physical activity after completing that work in the same way as retirees do because the opportunity cost has not changed. In Table 5, we see that while most results are insignificant, they are similar to those of “Ret.1” of the main analysis except for one

[19] As the Kleibergen-Paap Wald rk F-statistic is below 10 for some countries for some behaviors depending on definitions of retirement, care should be taken with those interpretations.

notable point, which is that the magnitude of the coefficients for “NW” is larger than that of “Ret.1”. This may be because elderly who are “not working for pay” may change their lifestyle more than those who are “retired” because while they are not subject to the same inflexible work environment and thus have more time compared to those working for pay, they still must remain active and invest their health (e.g. moderate physical activities in England). We can also conjecture that unemployed elderly in these countries may change some behaviors in a different manner than those who self-reported that they had retired. Therefore, we can conclude that health investment behaviors of the unemployed are likely to change again once they consider themselves to be fully retired.

4.3 Heterogeneity by Gender

In this subsection, we investigate heterogeneous effects in elderly males and females, focusing on the U.S., England and France (columns (3) and (6) in Tables 6 ~ 8), as we would like to rule out any spurious gender differences caused only by inaccurate estimates and the results of the first stage estimation for these countries satisfy the critical value. We report the results only for FE-IV. We find that while there is evidence of heterogeneity in the changes in health investment behaviors of elderly males and females after retirement, the changes are not uniform across behaviors or across countries. While in France there is no significant change in behavior for either gender, in England, both elderly males and females increase physical activity but do not change other behaviors. In the United States, different tendencies are observed for alcohol consumption by gender, with consumption decreasing for males and increasing for females.

Taking insignificant results into consideration, both the signs and magnitudes of the coefficients are different for males and females for some behaviors. While these patterns may possibly be due to differences in the ways that men and women work as they age, they are not always consistent with economic predictions. For example, although Grossman (1972) does not specifically consider gendered differences in preference for exercise, it is plausible to consider that if the wage of males is higher than that of females prior to retirement, the greater decline in the opportunity cost of exercise after retirement might cause elderly males to increase exercise more after retirement than elderly females. However, in England, we find that the opposite is true: females increased exercise more than men post retirement, and the impacts are larger. Summing up these results, it appears clear that while there is heterogeneity in the health investment behaviors of males and females after retirement, it does not occur in a uniform manner across behaviors or countries.[20]

4.4 Heterogeneity by Age

In this section, we analyze any heterogeneity due to age and also perform a robustness check by considering a different age range than in the main analysis. As lifestyles vary with age, it is conceivable that a change in the age range under study could alter the results, and a number of studies in the literature that have adopted different age ranges have found different results. Further, as we use pension eligibility age as the instrumental variable in this study, it is important to clarify whether a change in the age range may influence the results, as a more restricted age range increases identification power. It is thus necessary to compare elderly people with similar attributes by narrowing their age.

From the 50-75 age range of the main analysis, we first restrict it to age 50-70. Then, as we use $1\{age_{it} \geq A^{eb}{}_i\}$ and $1\{age_{it} \geq A^{fb}{}_i\}$ as the IV in this paper, we further restrict the age range from $(A^{eb} - 5)$ to $(A^{fb} + 5)$ and call this range "+-5". As the pension eligibility age differs for males and females, we report here the results by gender. Results for age range "+-5" are shown in columns (5) and (8) of Tables 6, 7 and 8 and results for age range "50-70" are shown in columns (2), (4) and (7) of Tables 6, 7 and 8. All results for only FE-IV are shown.

We have found from the beginning of this analysis that the IVs do not work for many countries with the age range "+-5", as the source of the variation of these IVs is age difference. There is a trade-off between an increase in the flexibility of the estimation by controlling the cubic term for age and a reduction in the identification power of the IVs. Because of this reduced power of the instrumental variables, we find significant results for the first stage estimation only for the United States, England and France. In these three countries, we find that the elderly may retire immediately when they become of pensionable age, either because they do not have a strong preference for work or because they have a good pension system.

By comparing columns (1) and (2) of Tables 6, 7 and 8, we can see that our main results are robust to a change in the age range from 50-75 to 50-70. One exception is the frequency of alcohol

[20] For the countries in which first stage F values do not exceed critical values, we observe similar tendencies in Denmark but different results for Germany and Switzerland from Table 17 ~ 19 in Appendix D.

consumption in France, where elderly aged 50-70 increase $>3d/w$ but those aged 50-75 do not. We also notice that, while they are not significant, the magnitude of the coefficients is larger for the 50-70 age range in most cases for all three countries, which means that those aged 50-70 change their behavior to a greater extent than those aged 70-75.

For more detail, we also compare the results for columns (3), (4) and (5) (male), and (6), (7) and (8) (female) of Tables 6, 7 and 8. In all three countries, results are generally robust to age specification because the elderly do not change their health investment behaviors in most cases in each age range. However, there is certainly heterogeneity in age. In particular, columns (5) and (8), which are estimated the most strictly, do not show significant signs, although some columns (3), (4), (6) and (7) show significant signs (alcohol consumption in the U.S.). For the other countries analyzed, in which the IVs do not work perfectly, robustness to different age specifications seems less clear from Tables 17 ~ 20 of Appendix D.

To sum up, our analysis of two other possible age ranges obtains robust results only for some behaviors in some of the countries analyzed. Due to heterogeneity in health investment behaviors by age and gender, this is an inherent limitation of an international comparative study. While the same age range should be set for all countries for comparative purposes, doing so limits the power of the IVs and causes some IVs to not work for certain age ranges in some countries. This tradeoff between comparative precision and IV power is a limitation of this and any other study using a cross-country comparative methodology.

4.5 Comparison with Previous Studies and Control of Age

We find that elderly do not change their health investment behaviors after retirement in many countries (Table 4), which contrasts with most of the previous literature that shows that elderly increase their consumption of alcohol, decrease smoking and increase physical activities after retirement. In this subsection, we consider what may be the cause of the difference.

One consideration is the way in which age is controlled. Although we control for age, age^2 and age^3 in main analysis, here we control instead for only age and age^2, and the results are presented in Table 9. We focus on the results for FE-IV. We see that the change in age control specification changes post-retirement health investment behaviors in many countries, with a tendency for elderly to increase drinking, decrease smoking and increase physical activities. These results suggest that this type of estimation depends heavily on the functional form of age.

Table 10 provides a summary of the results of previous studies in the economics literature. While our results when controlling for age, age^2 and age^3 show that the elderly do not change their lifestyle habits in most cases, we can broadly replicate the results of the literature when we include only age and age^2. The greatest cause of the difference between our results and the literature thus appears to be our controlling the cubic term of the age variable.[21] However, as we consider the baseline of age is important for the health investment behaviors of post-retirement elderly, we should control for age effects as flexibly as possible.

4.6 Discussion of The Mechanism

In this section, for simplicity, we discuss the effects of retirement on health investment behaviors as the mechanism for the impact of retirement on health outcomes, drawing on the results from Nishimura et al. (2018) and the medical literature discussed in section 2.[22]

The results from Nishimura et al. (2018) are summarized in Table 21 of Appendix E. Nishimura et al. (2018) shows that self-reported health improved after retirement in many countries (the U.S., England, France, and Germany), and depression improved in the U.S., England, and Denmark. They also find that activities of daily living (ADLs), which is a term used in the healthcare literature to refer to peoples' daily self-care activities, improved in the U.S., England, and Germany while body mass index (BMI) deteriorated after retirement in the U.S., England and Switzerland. They do not obtain contradictory results on the impacts of self-reported health, depression, BMI and ADLs. Thus, as elderly see an improvement in their self-reported health, depression and ADLs, but a deterioration in BMI,[23] we can say that the health of the elderly generally improves after retirement.

To sum up, despite our attempt to enable international comparisons by using harmonized methodologies (Table 4), we find that the elderly in most countries studied do not change their

[21] Other candidates include different definitions of retirement, covariate variables, and units of measure for each behavior. However, we find that the results for other definitions of retirement are similar to the almost same as to the definition of retirement from Table 5. Further, we have included important covariates such as family conditions, income and assets in our analysis.

[22] Nishimura et al. (2018) confirm the robustness of their results by changing either the control variables or the definition of retirement, but this paper differs from Nishimura et al. (2018) in these parameters, as Nishimura et al. (2018) restricts age to those over 50 and uses only the linear term for age_{it}. The impact of these differences requires further attention.

[23] Cognition also deteriorates after retirement in the U.S.

health investment behaviors in a uniform manner. While we do find that the elderly increase drinking in England and Germany, decrease smoking in Denmark and increase physical activities in England and Denmark, and we also note that many health outcomes for the elderly change after retirement in the U.S. even when health investment behaviors do not change, it is clear that there is no universal interpretation from our results. This suggests that health investment behaviors, at least the ones studied, cannot work as a mechanism of the effects of retirement on health outcomes.

Looking at each of the health investment behaviors individually, alcohol consumption increased post-retirement in both Germany and Denmark. Although the medical literature suggests that reduced alcohol can lead to improvement in cognition, Nishimura et al. (2018) finds no impact on cognition in Germany and Denmark. Furthermore, while the medical literature finds alcohol consumption to be generally associated with increased depression, we find an increase in alcohol consumption in Denmark concurrent with lower depression. Thus we cannot find a definitive relationship between retirement, alcohol and health outcomes from the above results.

Similar tendencies are observed for smoking. While elderly in Denmark decrease smoking significantly after retirement, and Nishimura et al. (2018) finds improvements in depression indicators, we find that in the U.S. and England, depression improves while smoking does not change. There- fore, we cannot assert a uniform cross-country relationship between smoking and depression after retirement.

Finally, as for physical activity, Penedo and Dahn (2005), and Stathopoulou et al. (2006) find that increasing exercise time may lead to reduced depression and improved ADLs while also helping to reduce BMI. Although we find that the elderly in England increase physical activity after retirement, results which are robust to age range and retirement definition, and Nishimura et al. (2018) find reduced levels of depression and improved ADLs among the elderly of England, they also find an increase in BMI. Moreover, we find an improvement in ADLs among retirees in the United States even with no change in physical activity. Thus we can conjecture that changes in physical activity do not directly lead to specific health outcomes.

To summarize, in none of the countries analyzed is there a consistent impact of all health investment behaviors on health outcomes, so we are not able to assert a strong relationship between health investment behaviors and health outcomes after retirement. One possible reason for this is that mental improvement may be not a consequence of health investment, but simply a consequence of leaving the workplace and experiencing relief from work-related stress.

5 Conclusions

This study examines the effects of retirement on health investment behaviors in seven developed countries. We generalize the findings of Eibich (2015) and other studies by providing a framework for international comparison, and we contribute new empirical evidence to the literature. Moreover, we examine other literature including medical research findings to determine if changes in health investment behaviors can explain the observed heterogeneities in changes in post-retirement health outcomes.

We find that the elderly do not uniformly change their health investment behaviors after retirement. While we do observe some changes in behaviors, the patterns vary across countries and they are also heterogeneous by age and gender. Accordingly, we cannot provide a unified view of the effects of retirement on health investment behaviors in this short-term analysis which compares behaviors immediately before and after retirement. Our results differ from the literature, most of which consists of single country studies that do find a relationship between health behaviors and outcomes in retirement. Through robustness checks, we find that one of the main differences from that of previous studies is our flexible controlling for age across countries to account for the difference in baseline retirement ages. By setting similar age conditions, we can replicate the results of previous studies. While our results verify those of Nishimura et al. (2018), which finds that health outcomes can be improved after retirement, the heterogeneity that we find in health investment behaviors means that the behaviors themselves are not necessarily good predictors of health in retirement.

Limitations of the study center around the choice of age range in a cross-country study in which pensionable age differs by country, the need for further investigation of cultural-historical factors which may impact health investment behaviors differently across countries, the tradeoff of consistent modeling versus limitations in the power of IVs in a cross-country framework, and the specific empirical approach chosen. Taking the last point first, the approach adopted in this study has been to check the consistency of our results from an international comparative framework with Nishimura et al. (2018) and other economic studies as well as the medical literature of the relationship between retirement, health investment behaviors, and health outcomes. An alternative approach such as causal mediation analysis could be used to investigate the mechanism more comprehensively. In addition, further analysis is required to determine to what extent health investment behaviors can explain the heterogeneity of the effects of retirement on health.

A second area for further study is why health investment behaviors after retirement differ among countries. Some possible candidates include differences in health care access and life expectancy, and other social and environmental factors in the workplace may also be important and provide more clarity as to the specific mechanism. Cultural and historical factors may also come into play. A more comprehensive study of the observed heterogeneity among individuals may also be insightful. For instance, is there a difference in the effect of retirement on physical activity for individuals currently working or who are working in physically demanding jobs? Heterogeneity in education is important to consider as well.

Finally, the choice of age range is a fundamental challenge for international comparative studies in which the pensionable age differs among the countries analyzed. In this study, a wider age range of 50-75 is chosen for the main analysis in order to accommodate all the countries sampled, but this limits IV power. An alternative methodology would be to narrow the age range to one appropriate for each country and then perform an RDD analysis. However, this approach is not optimal for international comparison, as RDD estimates a local point in the age range. The crux of the challenge is that all conditions should be essentially the same in order to make an international comparison of the coefficients but, at the same time, if they are identical, a source of variation in the IVs may not be available in certain countries.

To sum up, a challenge of an international comparative study of this type is the existence of a trade-off between the precision of estimates and compatibility of measures across countries. In this study, we have prioritized the latter. Future research should attempt to find approaches that take both into consideration.

Table 1: The Datasets Used in This Paper

	HRS	ELSA	SHARE	JSTAR
Country	United States	England	20+ European Countries and Israel	Japan
First Year of Survey	1992-93	2002-03	2004-05	2006-2007
Latest released Year[2]	2016-17	2016-17	2016-17	2012-13
Sample size at baseline	12600	12000	30700	3700
Frequency of Survey	Biennial	Biennial	Biennial	Biennial
Number of the wave available[2]	13	8	7	4
Waves Used in This Paper	w3-w12	w1-w6	w1-w2, w4-w5	w1-w4

[1] This graph uses data from the Gateway to Global Aging Data (g2aging.org). The Gateway to Global Aging Data is funded by the National Institute on Aging (R01 AG030153). Gateway to Global Aging Data, Produced by the Program on Global Aging, Health & Policy, University of Southern California with funding from the National Institute on Aging (R01 AG030153).

[2] As of May 14, 2019.

Table 2: Summary Statistics (Age 50-75)

	US			England			Germany			France			Denmark			Switzerland			Japan		
	mean	s.d.	N	mean	s.d.	N	mean	s.d.	N	mean	s.d.	N	mean	s.d.	N	mean	s.d.	N	mean	s.d.	N
Retirement variavbles																					
Complete Retirement (CR)	0.41	0.49	140344	0.42	0.49	49130	0.41	0.49	10432	0.49	0.50	12113	0.34	0.47	8435	0.32	0.47	7209	0.14	0.35	16255
Partial Retirement (PR)	0.48	0.50	140344	0.49	0.50	49130	0.44	0.50	9700	0.52	0.50	11328	0.35	0.48	8371	0.34	0.47	6655	0.39	0.49	16255
Not Working for Pay (NW)	0.54	0.50	140344	0.56	0.50	49130	0.55	0.50	10432	0.61	0.49	12113	0.43	0.49	8435	0.43	0.49	7209	0.45	0.50	16255
Demographics																					
Female	0.57	0.50	140727	0.54	0.50	49306	0.52	0.50	10594	0.55	0.50	12449	0.52	0.50	8584	0.54	0.50	7294	0.51	0.50	19456
Age	62.98	6.92	140727	62.29	6.92	49306	61.97	7.17	10594	61.56	7.08	12449	61.10	7.11	8584	61.92	7.06	7294	64.33	6.57	19456

Table 3: Summary Statistics of Behaviors by Retirement1 (Age 50-75)

	Alcohol consumption										**Physical activity**			
	Y/N		**> 3 d/w**		**> 5 d/w**		**Amount**		**Smoking**		**Vigorous**		**Moderate**	
	Not Retired	Retired	Not Retired	Retired	Not Retired	Retired	Not Retired	Retired	Not Retired	Retired	Not Retired	Retired	Not Retired	Retired
US														
Mean	0.561	0.483	0.173	0.162	0.096	0.099	0.834	0.673	0.178	0.170	0.401	0.310	0.744	0.641
(s.d.)	(0.496)	(0.500)	(0.379)	(0.368)	(0.294)	(0.299)	(1.545)	(1.403)	(0.383)	(0.376)	(0.490)	(0.462)	(0.437)	(0.480)
Obs.	83426	56871	83282	56732	83282	56732	83195	56698	83002	56460	48781	34874	48821	34889
England														
Mean	0.908	0.882	0.420	0.413	0.225	0.237	0.892	0.813	0.187	0.133	0.345	0.291	0.806	0.769
(s.d.)	(0.289)	(0.322)	(0.494)	(0.492)	(0.418)	(0.425)	(1.293)	(1.141)	(0.390)	(0.340)	(0.475)	(0.454)	(0.395)	(0.421)
Obs.	24904	18713	19107	14852	19107	14852	11686	9791	28185	20469	28390	20555	28391	20554
Germany														
Mean	0.889	0.849	0.531	0.527	0.170	0.229	2.038	1.767	0.242	0.144	0.674	0.532	0.910	0.880
(s.d.)	(0.315)	(0.358)	(0.499)	(0.499)	(0.376)	(0.420)	(3.822)	(3.252)	(0.428)	(0.351)	(0.469)	(0.499)	(0.286)	(0.325)
Obs.	6129	4300	6128	4299	6128	4299	4516	3127	6130	4301	6129	4302	6130	4301
France														
Mean	0.857	0.853	0.567	0.607	0.269	0.372	1.916	1.903	0.215	0.137	0.529	0.406	0.859	0.855
(s.d.)	(0.350)	(0.354)	(0.495)	(0.488)	(0.444)	(0.483)	(3.583)	(3.633)	(0.411)	(0.344)	(0.499)	(0.491)	(0.348)	(0.352)
Obs.	6208	5901	6207	5901	6207	5901	4917	4746	6207	5901	6207	5898	6209	5901
Denmark														
Mean	0.959	0.948	0.729	0.690	0.237	0.342	2.414	2.070	0.262	0.240	0.660	0.557	0.938	0.912
(s.d.)	(0.197)	(0.221)	(0.445)	(0.463)	(0.425)	(0.474)	(2.006)	(1.614)	(0.440)	(0.427)	(0.474)	(0.497)	(0.242)	(0.284)
Obs.	5542	2892	5542	2892	5542	2892	4658	2337	5542	2892	5541	2892	5541	2892
Switzerland														
Mean	0.902	0.881	0.666	0.668	0.230	0.307	2.551	2.427	0.247	0.184	0.662	0.574	0.901	0.881
(s.d.)	(0.298)	(0.324)	(0.472)	(0.471)	(0.421)	(0.461)	(6.175)	(6.429)	(0.431)	(0.388)	(0.473)	(0.495)	(0.299)	(0.324)
Obs.	4924	2283	4923	2283	4923	2283	4340	2004	4925	2283	4925	2280	4926	2282
Japan														
Mean	0.425	0.579	0.354	0.513	0.280	0.429	0.811	1.086	0.191	0.211	0.105	0.122		
(s.d.)	(0.494)	(0.494)	(0.478)	(0.500)	(0.449)	(0.495)	(1.361)	(1.329)	(0.393)	(0.408)	(0.307)	(0.328)		
Obs.	10756	1778	10756	1778	10756	1778	10248	1683	12892	2166	7310	1333		

Figure 1: The Proportion of Retired Elderly By Age and Country (US, England, Denmark, France, Germany, and Switzerland)

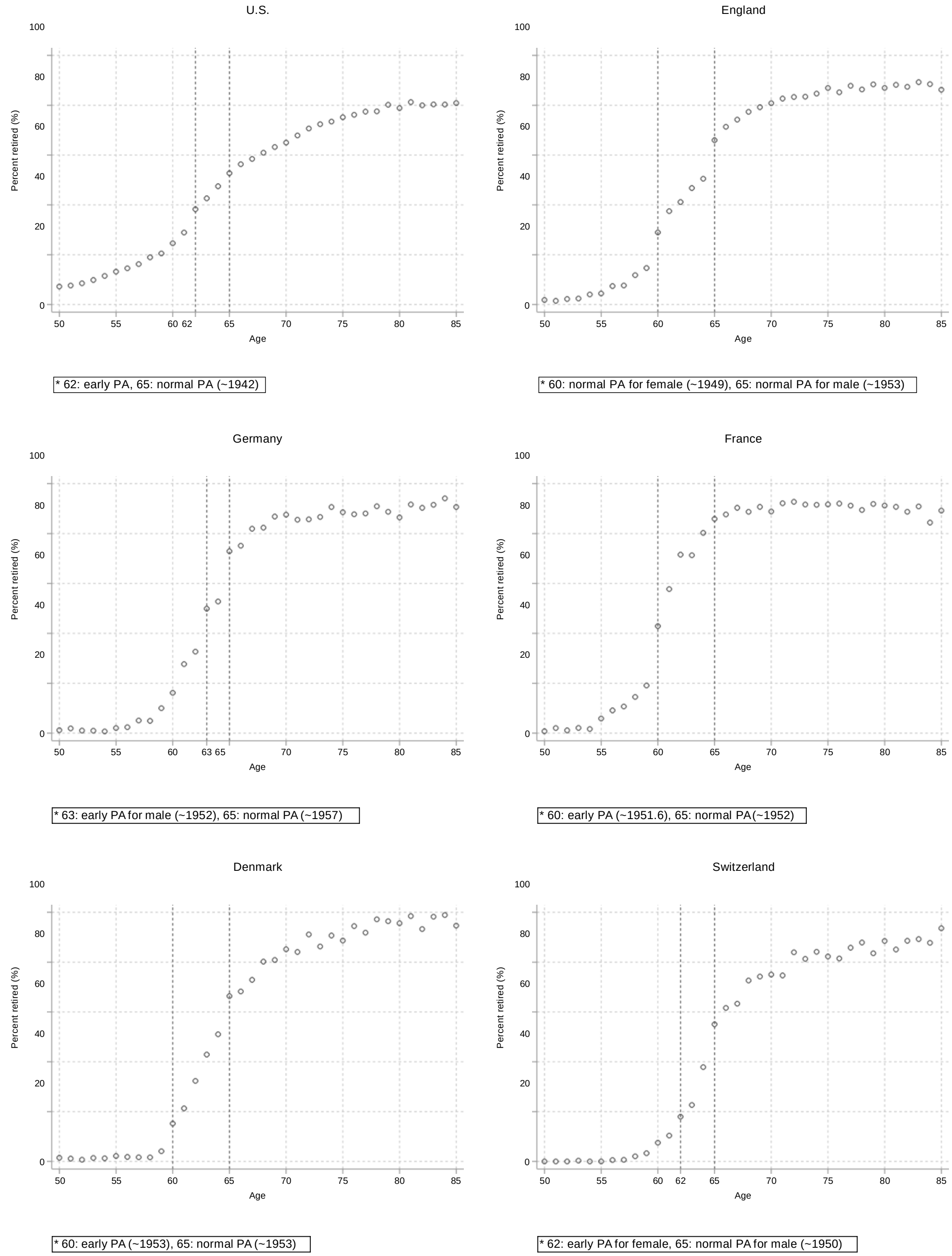

Figure 2: The Proportion of Retired Elderly By Age and Country (Japan)

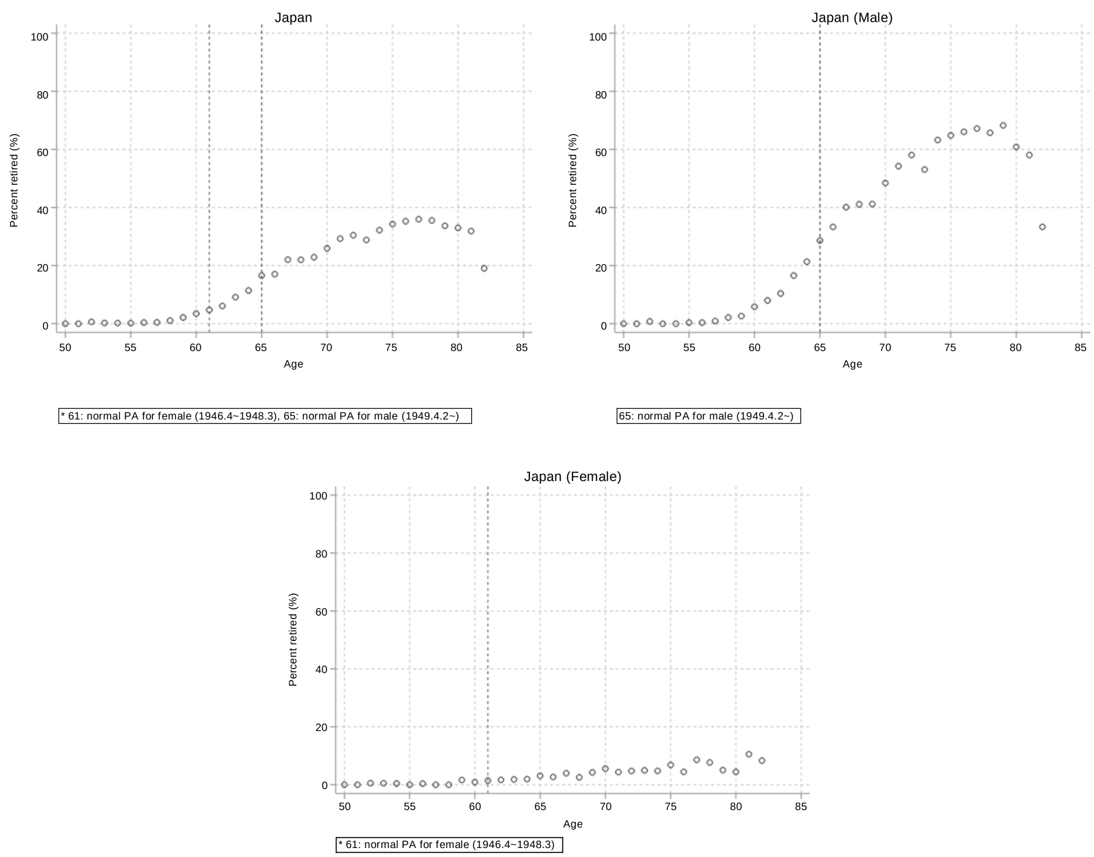

Table 4: Effects of Retirement on Health Investments in 7 Countries

	Alcohol consumption					Physical activity	
	Y/N	**> 3 d/w**	**> 5 d/w**	**Amount**	**Smoking**	**Vigorous**	**Moderate**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
U.S.							
FE	-0.005	-0.005**	-0.004*	-0.022**	-0.012***	0.022***	-0.004
FE-IV	0.009	-0.034	-0.041	-0.017	0.023	-0.006	-0.033
Obs.	134352	134064	134064	133942	133542	79320	79372
Kleibergen-Paap Wald rk F statistic	161.0	160.6	160.6	159.5	159.6	66.0	65.5
England							
FE	0.001	0.016**	0.004	0.029	-0.002	0.014**	0.017***
FE-IV	-0.018	0.025	0.015	0.031	-0.002	0.019	0.133***
Obs.	38681	29964	29964	18326	43623	43946	43946
Kleibergen-Paap Wald rk F statistic	525.6	345.3	345.3	137.6	585.0	591.1	592.1
Germany							
FE	-0.029	0.049**	0.026	0.141	0.006	-0.054*	0.026
FE-IV	0.037	0.274*	0.110	1.034	0.096	-0.240	0.041
Obs.	4415	4415	4415	2636	4417	4417	4417
Kleibergen-Paap Wald rk F statistic	22.7	22.7	22.7	19.6	22.7	22.7	22.7
France							
FE	0.016	0.019	-0.003	0.043	0.005	-0.015	0.001
FE-IV	-0.032	0.091	0.006	-0.804	0.009	0.058	0.074
Obs.	8424	8424	8424	6151	8422	8421	8424
Kleibergen-Paap Wald rk F statistic	75.2	75.2	75.2	51.6	75.2	75.2	75.2
Denmark							
FE	-0.013	-0.012	0.022	-0.017	0.001	0.023	-0.017
FE-IV	-0.030	-0.242	-0.214	1.705*	-0.279**	0.454*	-0.020
Obs.	5353	5353	5353	4000	5353	5352	5351
Kleibergen-Paap Wald rk F statistic	15.1	15.1	15.1	12.3	15.1	15.1	15.1
Switzerland							
FE	-0.004	-0.008	0.018	-0.946*	0.026	-0.036	-0.049**
FE-IV	0.160	0.121	-0.089	2.823	0.145	0.199	-0.208
Obs.	3993	3993	3993	3227	3995	3994	3995
Kleibergen-Paap Wald rk F statistic	22.8	22.8	22.8	23.2	22.8	22.8	22.8
Japan							
FE	-0.001	-0.006	0.010	0.013	-0.026**	0.024	
FE-IV	0.189	0.036	0.124	-0.824	0.267	0.183	
Obs.	7704	7704	7704	7150	10489	5215	
Kleibergen-Paap Wald rk F statistic	4.7	4.7	4.7	5.4	5.7	3.3	

[1] * * $p < .1$, ** ** $p < .05$, *** *** $p < .01$, Kleibergen-Paap Wald rk F statistic ≥ 10.

[2] All specifications include *age* , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 5: Robustness Check of Retirement Definition

	Alcohol consumption								Smoking		Physical activity			
	Y/N (1)		**> 3 d/w** (2)		**> 5 d/w** (3)		**Amount** (4)		**Smoking** (5)		**Vigorous** (6)		**Moderate** (7)	
U.S.														
Ret.1 : Coef./1st Stage F	0.009	C	-0.034	C	-0.041	C	-0.017	C	0.023	C	-0.006	C	-0.033	C
Ret.2 : Coef./1st Stage F	0.014	C	-0.039	C	-0.049	C	-0.016	C	0.027	C	0.003	C	-0.027	C
N.W. : Coef./1st Stage F	0.011	C	-0.047	C	-0.056	C	-0.024	C	0.033	C	0.005	C	-0.030	C
England														
Ret.1 : Coef./1st Stage F	-0.018	C	0.025	C	0.015	C	0.031	C	-0.002	C	0.019	C	0.133	C
Ret.2 : Coef./1st Stage F	-0.019	C	0.026	C	0.015	C	0.032	C	-0.002	C	0.020	C	0.140	C
N.W. : Coef./1st Stage F	-0.031	C	0.041	C	0.025	C	0.050	C	-0.003	C	0.034	C	0.238	C
Germany														
Ret.1 : Coef./1st Stage F	0.037	C	0.274	C	0.110	C	1.034	C	0.096	C	-0.240	C	0.041	C
Ret.2 : Coef./1st Stage F	-0.070	C	0.107	C	0.111	C	0.744	C	0.088	C	-0.350	C	0.086	C
N.W. : Coef./1st Stage F	-0.215		0.130		0.272		-1.650		0.056		-0.567		0.253	
France														
Ret.1 : Coef./1st Stage F	-0.032	C	0.091	C	0.006	C	-0.804	C	0.009	C	0.058	C	0.074	C
Ret.2 : Coef./1st Stage F	-0.030	C	0.058	C	0.010	C	-0.794	C	-0.003	C	0.051	C	0.064	C
N.W. : Coef./1st Stage F	-0.088	C	0.097	C	0.022	C	-1.296	C	0.045	C	0.142	C	0.089	C
Denmark														
Ret.1 : Coef./1st Stage F	-0.030	C	-0.242	C	-0.214	C	1.705	C	-0.279	C	0.454	C	-0.020	C
Ret.2 : Coef./1st Stage F	-0.025	C	-0.219	C	-0.191	C	1.691	C	-0.275	C	0.492	C	-0.030	C
N.W. : Coef./1st Stage F	-0.069		-0.778		-0.298		3.011		-0.573		1.055		0.043	
Switzerland														
Ret.1 : Coef./1st Stage F	0.160	C	0.121	C	-0.089	C	2.823	C	0.145	C	0.199	C	-0.208	C
Ret.2 : Coef./1st Stage F	0.236	C	0.102	C	-0.098	C	3.722	C	0.120	C	0.286	C	-0.194	C
N.W. : Coef./1st Stage F	0.367		0.268		-0.224		8.588		0.346		0.449		-0.484	
Japan														
Ret.1 : Coef./1st Stage F	0.189		0.036		0.124		-0.824		0.267		0.183			
Ret.2 : Coef./1st Stage F	0.142		0.027		0.094		-0.570		0.223		†			
N.W. : Coef./1st Stage F	0.192		0.037		0.126		-0.683		0.228		†			

[1] $p < .1$, $p < .05$, ¿ $p < .01$, C Kleibergen-Paap Wald rk F statistic $\geq$ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include *age* , *age*^{2} , *age*^{3}, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 6: Effects of Retirement by Age Range and Gender (The U.S.)

	Full Sample		Male			Female		
	50-75 (1)	50-70 (2)	50-75 (3)	50-70 (4)	57-71 (5)	50-75 (6)	50-70 (7)	57-71 (8)
Alcohol consumption: Y/N								
Coefficient	0.009	0.047	-0.117	-0.129	-0.129	0.119	0.193	0.120
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: > 3 d/w								
Coefficient	-0.034	-0.034	-0.076	-0.092	-0.154	-0.002	0.010	0.022
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: > 5 d/w								
Coefficient	-0.041	-0.046	-0.044	-0.079	-0.073	-0.036	-0.017	-0.040
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: Amount								
Coefficient	-0.017	-0.076	-0.233	-0.441	-0.562	0.141	0.161	0.323
1st stage F-statistics	C	C	C	C	C	C	C	C
Smoking								
Coefficient	0.023	0.026	0.055	0.063	0.068	-0.008	-0.013	0.000
1st stage F-statistics	C	C	C	C	C	C	C	C
Physical activity: Vigorous								
Coefficient	-0.006	-0.025	-0.108	-0.184	-0.313	0.083	0.114	0.066
1st stage F-statistics	C	C	C	C	C	C	C	
Physical activity: Moderate								
Coefficient	-0.033	0.001	0.111	0.082	0.054	-0.161	-0.084	-0.611
1st stage F-statistics	C	C	C	C	C	C	C	

[1] $p < .1$, $p < .05$, ¿ $p < .01$, C Kleibergen-Paap Wald rk F statistic ≥ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include age , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 7: Effects of Retirement by Age Range and Gender (England)

	Full Sample		Male			Female		
	50-75 (1)	50-70 (2)	50-75 (3)	50-70 (4)	60-70 (5)	50-75 (6)	50-70 (7)	55-67 (8)
Alcohol consumption: Y/N								
Coefficient	-0.018	-0.026	-0.004	-0.031	-0.025	-0.032	-0.030	-0.068
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: > 3 d/w								
Coefficient	0.025	0.006	0.090	0.089	-0.041	-0.034	-0.028	0.079
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: > 5 d/w								
Coefficient	0.015	0.011	0.036	0.034	0.115	-0.021	-0.034	0.004
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: Amount								
Coefficient	0.031	0.008	-0.020	-0.030	-0.231	0.175	0.097	0.236
1st stage F-statistics	C	C	C	C	C	C	C	C
Smoking								
Coefficient	-0.002	-0.008	-0.032	-0.040	-0.056	0.015	-0.013	-0.030
1st stage F-statistics	C	C	C	C	C	C	C	C
Physical activity: Vigorous								
Coefficient	0.019	0.025	0.054	0.068	0.035	-0.046	-0.016	-0.069
1st stage F-statistics	C	C	C	C	C	C	C	C
Physical activity: Moderate								
Coefficient	0.133	0.122	0.097	0.082	0.038	0.146	0.103	0.061
1st stage F-statistics	C	C	C	C	C	C	C	C

[1] $p < .1$, $p < .05$, ¿ $p < .01$, C Kleibergen-Paap Wald rk F statistic ≥ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include age , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 8: Effects of Retirement by Age Range and Gender (France)

	Full Sample		Male			Female		
	50-75	50-70	50-75	50-70	55-70	50-75	50-70	55-70
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alcohol consumption: Y/N								
Coefficient	-0.032	-0.049	0.025	-0.053	-0.025	-0.057	-0.032	-0.015
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: > 3 d/w								
Coefficient	0.091	0.225	0.109	0.190	0.181	0.075	0.191	0.243
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: > 5 d/w								
Coefficient	0.006	-0.002	0.034	-0.031	-0.262	0.020	0.027	0.094
1st stage F-statistics	C	C	C	C	C	C	C	C
Alcohol consumption: Amount								
Coefficient	-0.804	-1.315	1.112	2.432	3.602	-1.729	-2.665	-2.614
1st stage F-statistics	C	C	C	C	C	C	C	C
Smoking								
Coefficient	0.009	0.019	-0.028	-0.019	0.005	0.061	0.078	0.071
1st stage F-statistics	C	C	C	C	C	C	C	C
Physical activity: Vigorous								
Coefficient	0.058	0.146	0.100	0.263	0.265	0.013	0.066	0.142
1st stage F-statistics	C	C	C	C	C	C	C	C
Physical activity: Moderate								
Coefficient	0.074	0.095	-0.025	-0.142	-0.191	0.125	0.215	0.179
1st stage F-statistics	C	C	C	C	C	C	C	C

[1] $p < .1$, $p < .05$, ¿ $p < .01$, C Kleibergen-Paap Wald rk F statistic ≥ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include age , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 9: Effects of Retirement on Health Investments in 7 Countries (Controlling up to *age*²)

	Alcohol consumption					Physical activity	
	Y/N	> 3 d/w	> 5 d/w	Amount	Smoking	Vigorous	Moderate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
U.S.							
FE	-0.002	-0.005**	-0.003*	-0.020**	-0.013***	0.023***	-0.002
FE-IV	0.135***	-0.005	0.003	0.106	-0.003	0.071	0.088*
Obs.	134352	134064	134064	133942	133542	79320	79372
Kleibergen-Paap Wald rk F statistic	499.2	497.2	497.2	495.5	498.3	240.0	240.0
England							
FE	0.003	0.019***	0.004	0.027	-0.005	0.019***	0.020***
FE-IV	0.006	0.051*	0.017	0.008	-0.026*	0.063**	0.117***
Obs.	38681	29964	29964	18326	43623	43946	43946
Kleibergen-Paap Wald rk F statistic	1042.3	668.4	668.4	233.5	1162.8	1170.2	1171.5
Germany							
FE	-0.031	0.033	0.032	-0.018	-0.003	-0.059**	0.033**
FE-IV	-0.022	-0.015	0.103	-0.834	-0.041	-0.166*	0.099*
Obs.	4415	4415	4415	2636	4417	4417	4417
Kleibergen-Paap Wald rk F statistic	84.0	84.0	84.0	58.5	84.0	84.0	84.0
France							
FE	0.019	0.024	0.016	0.129	-0.001	-0.013	0.010
FE-IV	0.016	0.097*	0.120**	0.191	-0.036	0.024	0.102**
Obs.	8424	8424	8424	6151	8422	8421	8424
Kleibergen-Paap Wald rk F statistic	177.3	177.3	177.3	126.0	177.3	177.3	177.3
Denmark							
FE	-0.005	-0.007	0.028	0.008	-0.006	0.030	-0.013
FE-IV	0.085*	-0.032	0.035	0.733	-0.185***	0.261**	0.052
Obs.	5353	5353	5353	4000	5353	5352	5351
Kleibergen-Paap Wald rk F statistic	70.1	70.1	70.1	52.2	70.1	70.1	70.1
Switzerland							
FE	0.001	0.000	0.017	-0.866*	0.016	-0.034	-0.045**
FE-IV	0.161**	0.186*	-0.044	2.056	-0.042	0.139	-0.086
Obs.	3993	3993	3993	3227	3995	3994	3995
Kleibergen-Paap Wald rk F statistic	39.3	39.3	39.3	38.4	39.4	39.4	39.4
Japan							
FE	-0.001	-0.005	0.010	0.011	-0.026**	0.025	
FE-IV	0.191	0.262	0.048	-1.281	0.213	0.207	
Obs.	7704	7704	7704	7150	10489	5215	
Kleibergen-Paap Wald rk F statistic	8.5	8.5	8.5	8.7	10.6	5.4	

1 * * $p < .1$, ** ** $p < .05$, *** *** $p < .01$, Kleibergen-Paap Wald rk F statistic ≥ 10.

2 All specifications include *age*, *age*², married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 10: Comparison with Previous Studies

	Country (Data)	Drinking	Smoking	Exercise		Method	Age range	Age control
				Light	Heavy			
Our Paper main results (including up to *age*^{3})	US(HRS)	no	no	no	no	FE-IV	50-75	*age*, *age*^{2} , *age*^{3}
	England (ELSA)	no	no	no	up			
	France(SHARE)	no	no	no	no			
	Germany(SHARE)	up	no	no	no			
	Denmark(SHARE)	up	down	up	no			
	Switzerland (SHARE)	no	no	no	no			
	Japan(JSTAR)	no	no	no	no			
Our Paper another results (including up to *age*^{2})	US(HRS)	up	no	up	no	FE-IV	50-75	*age*, *age*^{2}
	England (ELSA)	up	down	up	up			
	France(SHARE)	up	no	up	down			
	Germany(SHARE)	no	no	up	no			
	Denmark(SHARE)	up	down	no	up			
	Switzerland (SHARE)	up	no	no	no			
	Japan(JSTAR)	no	no	no	no			
Insler(2014)	US(HRS)	-	down	-	up	FE-logit	over 50	*age*, *age*^{2}
Eibich(2015)	Germany(SOEP)	up	down	up	-	RDD	55-70	nonparametric
Motegi et al. (2016)	Japan(JSTAR)	down	no	-	up	FE-IV	over 50	*age*, *age*^{2}
Ayyagari (2016)	US(HRS)	-	up	-	-	bivariate probit	60-80	*age*, *age*^{2}
Zhu (2016)	Australia(HILDA)	no	down	up	no	FE-IV	50-75 (only women)	*age*, *age*^{2}
Zhao et al. (2017)	Japan(original data)	up	down	up	-	IV	50-70	*age*
Celidoni and Rebba (2017)	Europe(SHARE)	up	no	up	up	FE-IV	45-85	*age*
Kesavayuth et al. (2018)	Europe(SHARE)	up	down	up	up	FE-IV	50-75	*age*
Tran and Zikos (2019)	Australia(HILDA)	no	no	up	-	FE-IV	50-80	*age*, *age*^{2}

[1] All papers use the pension eligibility ages as instrumental variables.
[2] The unit measure for each behavior is different across each study.

Appendix A: Pension Eligibility Age

In this section, we describe how pensionable age is calculated. First, we used the information from the Bureau of Labor Statistics of each country. In countries for which information about the pension eligibility age is not publicly available, we contacted the Bureau of Labor Statistics or Bureau of Statistics directly in an attempt to retrieve the information. When the data is still unavailable by these means, we referred to the OECD's Pension at a Glance: Social Security Programs throughout the World (Europe, Asia and the Pacific, and The Americas), and The EUs Mutual Information System in Social Protection (MISSOC) as data sources. Even after these methods, detailed data on pensionable age remained unavailable for many countries. The countries in which pensionable age data is successfully accessed are the U.S., England, Germany, France, Denmark, Switzerland, Czech, Estonia, Japan, China[24] , and Korea. For these countries, we could directly obtain the table of correspondence between birth cohort and pensionable age. For Sweden, Spain, Poland, and Slovenia, we constructed the table based on the OECD and EU documents mentioned above, as well as information from governmental institutions in those countries. We do not analyze the countries where detailed information about the pension eligibility age is not available. Finally, we included some countries for our analysis following the rule explained in section 2.2, using the pension eligibility age for each country in this analysis.

[24] Pension eligibility age depends on hukou status and the type of employer according to the China Labour Bulletin. When generating IVs for China, we used the hukou status variable "r@hukou" in the harmonized CHARLS, and the type of employer (current job:"fd002", last job: "fl014") and civil servant status (current job:"fd006", last job: "fl015") in the original CHARLS.

Table 11: Pension Eligibility Age (the U.S., England, Germany and France)

Panel A: the US

Birth cohort	PEA
Early PEA	
	62y0m
Normal PEA	
˜ 1937.12	65y0m
1938.1 ˜ 1938.12	65y2m
1939.1 ˜ 1939.12	65y4m
1940.1 ˜ 1940.12	65y6m
1941.1 ˜ 1941.12	65y8m
1942.1 ˜ 1942.12	65y10m
1943.1 ˜ 1943.12	66y0m
1944.1 ˜ 1944.12	66y0m
1945.1 ˜ 1945.12	66y0m
1946.1 ˜ 1946.12	66y0m
1947.1 ˜ 1947.12	66y0m
1948.1 ˜ 1948.12	66y0m
1949.1 ˜ 1949.12	66y0m
1950.1 ˜ 1950.12	66y0m
1951.1 ˜ 1951.12	66y0m
1952.1 ˜ 1952.12	66y0m
1953.1 ˜ 1953.12	66y0m
1954.1 ˜ 1954.12	66y0m
1955.1 ˜ 1955.12	66y2m
1956.1 ˜ 1956.12	66y4m
1957.1 ˜ 1957.12	66y6m
1958.1 ˜ 1958.12	66y8m
1959.1 ˜ 1959.12	66y10m
1960.1 ˜ 1960.12	67y0m

Panel B: England

Birth cohort	PEA
Normal PEA: Male	
˜ 1953.12	65y0m
1954.1 ˜ 1954.12	66y0m
1955.1 ˜ 1959.12	66y0m
1960.1 ˜ 1960.12	67y0m
1961.1 ˜	67y0m
Normal PEA: Female	
˜ 1949.12	60y0m
1950.1 ˜ 1950.12	61y0m
1951.1 ˜ 1951.12	62y0m
1952.1 ˜ 1952.12	63y0m
1953.1 ˜	65y0m

Panel C: Germany

Birth cohort	PEA
Early PEA: Male	
˜ 1952.12	63y0m
1953.1 ˜ 1953.12	63y2m
1954.1 ˜ 1954.12	63y4m
1955.1 ˜ 1955.12	63y6m
1956.1 ˜ 1956.12	63y8m
1957.1 ˜ 1957.12	63y10m
1958.1 ˜ 1958.12	64y0m
1959.1 ˜ 1959.12	64y2m
1960.1 ˜ 1960.12	64y4m
1961.1 ˜ 1961.12	64y6m
1962.1 ˜ 1962.12	64y8m
1963.1 ˜ 1963.12	64y10m
1964.1 ˜ 1964.12	65y0m
Early PEA: Female	
˜ 1951.12	60y0m
Normal PEA	
˜ 1946.12	65y0m
1947.1 ˜ 1947.12	65y1m
1948.1 ˜ 1948.12	65y2m
1949.1 ˜ 1949.12	65y3m
1950.1 ˜ 1950.12	65y4m
1951.1 ˜ 1951.12	65y5m
1952.1 ˜ 1952.12	65y6m
1953.1 ˜ 1953.12	65y7m
1954.1 ˜ 1954.12	65y8m
1955.1 ˜ 1955.12	65y9m
1956.1 ˜ 1956.12	65y10m
1957.1 ˜ 1957.12	65y11m
1958.1 ˜ 1958.12	66y0m
1959.1 ˜ 1959.12	66y2m
1960.1 ˜ 1960.12	66y4m
1961.1 ˜ 1961.12	66y6m
1962.1 ˜ 1962.12	66y8m
1963.1 ˜ 1963.12	66y10m
1964.1 ˜ 1964.12	67y0m

Panel D: France

Birth cohort	PEA
Early PEA	
˜ 1951.6	60y0m
1951.7 ˜ 1951.12	60y4m
1952.1 ˜ 1952.12	60y9m
1953.1 ˜ 1953.12	61y2m
1954.1 ˜ 1954.12	61y7m
1955.1 ˜ 1955.12	62y0m
1956.1 ˜ .	62y0m
Normal PEA	
˜ 1951.6	65y0m
1951.7 ˜ 1951.12	65y4m
1952.1 ˜ 1952.12	65y9m
1953.1 ˜ 1953.12	66y2m
1954.1 ˜ 1954.12	66y7m
1955.1 ˜ 1955.12	67y0m
1956.1 ˜ .	67y0m

Table 12: Pension Eligibility Age (Denmark, Switzerland and Japan)

Panel A: Denmark

Birth cohort	PEA
Early PEA	
˜ 1953.12	60y0m
1954.1 ˜ 1954.6	60y6m
1954.7 ˜ 1954.12	61y0m
1955.1 ˜ 1955.6	61y6m
1955.7 ˜ 1955.12	62y0m
1956.1 ˜ 1956.6	62y6m
1956.7 ˜ 1958.12	63y0m
1959.1 ˜ 1959.6	63y6m
1959.7 ˜ 1964.6	64y0m
1964.7 ˜	64y0m
Normal PEA	
˜ 1953.12	65y0m
1954.1 ˜ 1954.6	65y6m
1954.7 ˜ 1954.12	66y0m
1955.1 ˜ 1955.6	66y6m
1955.7 ˜ 1955.12	67y0m
1956.1 ˜ 1956.6	67y0m
1956.7 ˜ 1958.12	67y0m
1959.1 ˜ 1959.6	67y0m
1959.7 ˜ 1964.6	67y0m
1964.7 ˜	67y0m

Panel B: Switzerland

Birth cohort	PEA
Early PEA: Male	
˜ 1924.12	63y0m
1925.1 ˜ 1950.12	63y0m
Early PEA: Female	
˜ 1937.12	60y0m
1938.1 ˜ 1940.12	61y0m
1941.1 ˜	62y0m
Normal PEA: Male	
˜ 1924.12	65y0m
1925.1 ˜ 1950.12	65y0m
Normal PEA: Female	
˜ 1937.12	62y0m
1938.1 ˜ 1940.12	63y0m
1941.1 ˜	64y0m

Panel C: Japan

Birth cohort	PEA
Normal PEA: Male	
˜1941.4.1	60y0m
1941.4.2˜1943.4.1	61y0m
1943.4.2˜1945.4.1	62y0m
1945.4.2˜1947.4.1	63y0m
1947.4.2˜1949.4.1	64y0m
1949.4.2˜1953.4.1	65y0m
1953.4.2˜1955.4.1	65y0m
1955.4.2˜1957.4.1	65y0m
1957.4.2˜1959.4.1	65y0m
1959.4.2˜1961.4.1	65y0m
1961.4.2˜	65y0m
Normal PEA: Female	
˜1932.4.1	55y0m
1932.4.2˜1934.4.1	56y0m
1934.4.2˜1936.4.1	57y0m
1936.4.2˜1937.4.1	58y0m
1937.4.2˜1938.4.1	58y0m
1938.4.2˜1940.4.1	59y0m
1940.4.2˜1946.4.1	60y0m
1946.4.2˜1948.4.1	61y0m
1948.4.2˜1950.4.1	62y0m
1950.4.2˜1952.4.1	63y0m
1952.4.2˜1954.4.1	64y0m
1954.4.2˜1958.4.1	65y0m
1958.4.2˜1960.4.1	65y0m
1960.4.2˜1962.4.1	65y0m
1962.4.2˜1964.4.1	65y0m
1964.4.2˜1965.4.1	65y0m
1965.4.2˜	65y0m

Appendix B: Full Sets of Results of Each Behavior

In this Appendix, the full sets of results about probability of drinking, smoking and moderate physical activity are reported. Tables 13 ~ 15 show not only the retirement variables, but also the covariates of the 2nd stage estimates. We compare standard errors of FE-IV with those of FE in section 4.1.

Table 13: Effects of Retirement on Drinking Probability (Age50-75)

	US		England		Germany		France		Denmark		Swizterland		Japan	
	(1) FE	(2) FE-IV	(3) FE	(4) FE-IV	(5) FE	(6) FE-IV	(7) FE	(8) FE-IV	(9) FE	(10) FE-IV	(11) FE	(12) FE-IV	(13) FE	(14) FE-IV
= 1 if Retired	-0.005	0.009	0.001	-0.018	-0.029	0.037	0.016	-0.032	-0.013	-0.030	-0.004	0.160	-0.001	0.189
	(0.003)	(0.046)	(0.004)	(0.019)	(0.020)	(0.135)	(0.015)	(0.061)	(0.013)	(0.099)	(0.018)	(0.112)	(0.018)	(0.483)
Age	-0.282***	-0.263***	-0.102**	-0.152**	0.082	0.292	-0.100	-0.237	-0.352***	-0.394	-0.345	0.054	-0.043	0.029
	(0.041)	(0.075)	(0.050)	(0.070)	(0.242)	(0.484)	(0.159)	(0.232)	(0.130)	(0.274)	(0.247)	(0.366)	(0.169)	(0.251)
Age^2	0.447***	0.416***	0.179**	0.259**	-0.125	-0.467	0.176	0.399	0.563***	0.630	0.571	-0.073	0.081	-0.020
	(0.066)	(0.120)	(0.081)	(0.113)	(0.388)	(0.783)	(0.260)	(0.380)	(0.211)	(0.437)	(0.395)	(0.588)	(0.268)	(0.376)
Age^3	-0.000***	-0.000***	-0.000**	-0.000**	0.000	0.000	-0.000	-0.000	-0.000***	-0.000	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
= 1 if Married	-0.020***	-0.021***	-0.000	-0.000	-0.029	-0.031	-0.022	-0.022	0.008	0.010	-0.078	-0.074	0.021	0.006
	(0.006)	(0.006)	(0.009)	(0.009)	(0.047)	(0.048)	(0.031)	(0.030)	(0.022)	(0.023)	(0.049)	(0.051)	(0.042)	(0.057)
Number of children	0.004**	0.004**	-0.001	-0.001	0.020	0.021	0.005	0.005	-0.011	-0.011	0.018	0.024*	0.008	0.006
	(0.002)	(0.002)	(0.002)	(0.002)	(0.014)	(0.014)	(0.009)	(0.009)	(0.007)	(0.008)	(0.013)	(0.013)	(0.020)	(0.021)
Income quartile dummies (reference: Q1)														
Q2	0.014***	0.015***	0.004	0.003	0.022	0.020	0.010	0.010	0.010	0.010	0.010	0.014	0.001	0.004
	(0.004)	(0.005)	(0.005)	(0.005)	(0.020)	(0.020)	(0.015)	(0.015)	(0.014)	(0.014)	(0.020)	(0.021)	(0.012)	(0.015)
Q3	0.016***	0.018**	0.011**	0.009	0.005	0.006	0.016	0.016	0.008	0.007	0.010	0.021	-0.007	0.003
	(0.004)	(0.008)	(0.005)	(0.005)	(0.021)	(0.021)	(0.016)	(0.016)	(0.015)	(0.016)	(0.021)	(0.023)	(0.012)	(0.030)
Q4	0.021***	0.024**	0.008	0.005	0.022	0.024	0.021	0.020	0.006	0.005	-0.002	0.007	0.006	0.019
	(0.005)	(0.011)	(0.005)	(0.006)	(0.024)	(0.024)	(0.017)	(0.017)	(0.014)	(0.017)	(0.022)	(0.023)	(0.014)	(0.035)
Wealth quartile dummies (reference: Q1)														
Q2	0.005	0.005	0.002	0.002	-0.046**	-0.047**	0.014	0.013	0.006	0.006	0.005	0.008	0.004	0.006
	(0.004)	(0.004)	(0.007)	(0.007)	(0.023)	(0.023)	(0.020)	(0.020)	(0.013)	(0.012)	(0.024)	(0.025)	(0.012)	(0.013)
Q3	0.018***	0.017***	0.001	0.001	-0.012	-0.012	0.025	0.023	0.010	0.010	0.018	0.018	0.009	0.010
	(0.005)	(0.005)	(0.008)	(0.008)	(0.028)	(0.028)	(0.021)	(0.021)	(0.013)	(0.013)	(0.028)	(0.029)	(0.012)	(0.013)
Q4	0.028***	0.027***	-0.001	-0.000	0.019	0.018	0.024	0.022	0.012	0.011	0.022	0.023	0.011	0.013
	(0.006)	(0.007)	(0.008)	(0.008)	(0.031)	(0.031)	(0.022)	(0.023)	(0.015)	(0.015)	(0.030)	(0.030)	(0.013)	(0.014)
= 1 if own a house	0.007	0.008	0.005	0.005	-0.036	-0.042	0.035	0.037	-0.007	-0.006	-0.063**	-0.045	0.036**	0.036**
	(0.006)	(0.006)	(0.011)	(0.011)	(0.032)	(0.035)	(0.027)	(0.027)	(0.024)	(0.024)	(0.028)	(0.031)	(0.015)	(0.015)
Obs.	134352	134352	38681	38681	4415	4415	8424	8424	5353	5353	3993	3993	7704	7704
1st stage F		161.0		525.6		22.7		75.2		15.1		22.8		4.7
DWH p-value		0.76		0.30		0.62		0.42		0.86		0.13		0.69

[1] * $p < .1$, ** $p < .05$, *** $p < .01$

[2] All specifications also include survey wave fixed effects. Additionally, we added the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 14: Effects of Retirement on Smoking Probability (Age50-75)

	US		England		Germany		France		Denmark		Switzerland		Japan	
	(1) FE	(2) FE-IV	(3) FE	(4) FE-IV	(5) FE	(6) FE-IV	(7) FE	(8) FE-IV	(9) FE	(10) FE-IV	(11) FE	(12) FE-IV	(13) FE	(14) FE-IV
= 1 if Retired	-0.012***	0.023	-0.002	-0.002	0.006	0.096	0.005	0.009	0.001	-0.279**	0.026	0.145	-0.026**	0.267
	(0.002)	(0.029)	(0.003)	(0.019)	(0.018)	(0.111)	(0.012)	(0.051)	(0.016)	(0.140)	(0.016)	(0.103)	(0.012)	(0.393)
Age	-0.004	0.047	0.152***	0.154**	0.357*	0.645	0.233*	0.244	0.309**	-0.353	0.690**	0.981***	-0.042	0.081
	(0.028)	(0.046)	(0.046)	(0.065)	(0.201)	(0.408)	(0.120)	(0.176)	(0.154)	(0.333)	(0.277)	(0.354)	(0.117)	(0.192)
Age^2	-0.002	-0.083	-0.258***	-0.262**	-0.612*	-1.079	-0.376*	-0.395	-0.528**	0.524	-1.111**	-1.580***	0.072	-0.103
	(0.044)	(0.074)	(0.073)	(0.104)	(0.319)	(0.661)	(0.192)	(0.288)	(0.249)	(0.530)	(0.441)	(0.568)	(0.185)	(0.286)
Age^3	0.000	0.000	0.000***	0.000***	0.000*	0.000	0.000*	0.000	0.000**	-0.000	0.000**	0.000***	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
= 1 if Married	-0.003	-0.004	-0.007	-0.007	-0.071*	-0.073*	-0.004	-0.003	-0.008	0.016	-0.022	-0.019	-0.034	-0.055
	(0.004)	(0.004)	(0.008)	(0.008)	(0.040)	(0.039)	(0.022)	(0.022)	(0.024)	(0.028)	(0.031)	(0.033)	(0.030)	(0.042)
Number of children	0.002	0.002	0.000	0.000	-0.003	-0.002	-0.007	-0.007	-0.022**	-0.013	0.004	0.008	0.005	0.003
	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)	(0.010)	(0.007)	(0.007)	(0.009)	(0.010)	(0.008)	(0.009)	(0.015)	(0.016)
Income quartile dummies (reference: Q1)														
Q2	0.004*	0.007**	0.002	0.002	0.021	0.018	-0.009	-0.009	0.006	0.005	0.011	0.014	0.016**	0.022**
	(0.002)	(0.003)	(0.004)	(0.004)	(0.015)	(0.015)	(0.009)	(0.009)	(0.014)	(0.015)	(0.015)	(0.015)	(0.007)	(0.011)
Q3	0.006**	0.011**	0.003	0.003	0.017	0.018	0.002	0.002	0.008	-0.004	0.044**	0.052***	0.021***	0.033*
	(0.003)	(0.005)	(0.004)	(0.005)	(0.016)	(0.016)	(0.011)	(0.011)	(0.015)	(0.018)	(0.017)	(0.019)	(0.008)	(0.019)
Q4	0.004	0.012*	0.006	0.006	0.012	0.015	0.002	0.002	-0.021	-0.044**	0.032	0.038*	0.020**	0.037
	(0.003)	(0.007)	(0.004)	(0.005)	(0.017)	(0.017)	(0.012)	(0.012)	(0.016)	(0.022)	(0.019)	(0.020)	(0.008)	(0.023)
Wealth quartile dummies (reference: Q1)														
Q2	-0.003	-0.004	-0.017***	-0.017***	-0.015	-0.016	-0.006	-0.006	0.012	0.011	-0.001	0.001	0.002	0.004
	(0.003)	(0.003)	(0.006)	(0.006)	(0.019)	(0.019)	(0.012)	(0.012)	(0.015)	(0.016)	(0.017)	(0.018)	(0.008)	(0.009)
Q3	0.002	0.001	-0.024***	-0.024***	-0.006	-0.006	-0.001	-0.001	0.010	0.004	-0.031	-0.031	-0.003	-0.003
	(0.003)	(0.004)	(0.007)	(0.007)	(0.023)	(0.023)	(0.013)	(0.013)	(0.018)	(0.019)	(0.020)	(0.020)	(0.008)	(0.009)
Q4	0.001	-0.001	-0.025***	-0.025***	0.001	0.000	-0.012	-0.011	-0.008	-0.017	-0.037*	-0.036*	0.003	0.003
	(0.004)	(0.004)	(0.008)	(0.008)	(0.026)	(0.026)	(0.014)	(0.014)	(0.021)	(0.023)	(0.022)	(0.022)	(0.008)	(0.008)
= 1 if own a house	0.005	0.005	0.006	0.006	-0.068**	-0.075**	0.032*	0.032*	-0.004	0.013	-0.004	0.009	0.003	0.005
	(0.004)	(0.004)	(0.010)	(0.010)	(0.029)	(0.030)	(0.017)	(0.017)	(0.025)	(0.030)	(0.022)	(0.025)	(0.013)	(0.014)
Obs.	133542	133542	43623	43623	4417	4417	8422	8422	5353	5353	3995	3995	10489	10489
1st stage F		159.6		585.0		22.7		75.2		15.1		22.8		5.7
DWH p-value		0.21		0.97		0.41		0.93		0.03		0.24		0.42

[1] * $p < .1$, ** $p < .05$, *** $p < .01$

[2] All specifications also include survey wave fixed effects. Additionally, we added the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 15: Effects of Retirement on Moderate Physical Activity (Age50-75)

	US		England		Germany		France		Denmark		Swizterland		Japan	
	(1) FE	(2) FE-IV	(3) FE	(4) FE-IV	(5) FE	(6) FE-IV	(7) FE	(8) FE-IV	(9) FE	(10) FE-IV	(11) FE	(12) FE-IV	(13) FE	(14) FE-IV
= 1 if Retired	-0.004	-0.033	0.017***	0.133***	0.026	0.041	0.001	0.074	-0.017	-0.020	-0.049**	-0.208		
	(0.005)	(0.095)	(0.006)	(0.034)	(0.017)	(0.116)	(0.017)	(0.074)	(0.016)	(0.117)	(0.020)	(0.130)		
Age	-0.157**	-0.198	-0.146*	0.151	-0.254	-0.205	-0.335*	-0.127	-0.158	-0.165	-0.325	-0.713*		
	(0.069)	(0.149)	(0.080)	(0.117)	(0.198)	(0.411)	(0.183)	(0.280)	(0.147)	(0.315)	(0.253)	(0.394)		
Age^2	0.276**	0.340	0.274**	-0.209	0.484	0.404	0.537*	0.197	0.321	0.332	0.475	1.101*		
	(0.109)	(0.237)	(0.129)	(0.188)	(0.321)	(0.666)	(0.297)	(0.457)	(0.238)	(0.501)	(0.406)	(0.636)		
Age^3	-0.000***	-0.000	-0.000**	0.000	-0.000	-0.000	-0.000*	-0.000	-0.000	-0.000	-0.000	-0.000*		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
= 1 if Married	-0.025***	-0.024***	-0.011	-0.012	0.121***	0.120***	0.000	0.001	-0.019	-0.019	0.079	0.074		
	(0.009)	(0.009)	(0.014)	(0.014)	(0.042)	(0.041)	(0.041)	(0.042)	(0.024)	(0.026)	(0.059)	(0.060)		
Number of children	0.009**	0.009**	0.002	0.002	0.013	0.013	-0.002	-0.003	0.013	0.014	0.001	-0.004		
	(0.004)	(0.004)	(0.004)	(0.004)	(0.011)	(0.011)	(0.011)	(0.011)	(0.009)	(0.009)	(0.018)	(0.018)		
Income quartile dummies (reference: Q1)														
Q2	0.023***	0.021**	0.007	0.012	0.024	0.023	0.039**	0.038**	-0.003	-0.003	0.039*	0.035*		
	(0.006)	(0.008)	(0.007)	(0.007)	(0.018)	(0.018)	(0.016)	(0.017)	(0.016)	(0.016)	(0.021)	(0.021)		
Q3	0.015**	0.012	0.001	0.013	0.015	0.015	0.026	0.026	-0.015	-0.015	0.033	0.023		
	(0.007)	(0.013)	(0.008)	(0.009)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)	(0.019)	(0.022)	(0.023)		
Q4	0.012	0.007	-0.002	0.017*	0.028	0.028	0.043**	0.045**	0.004	0.004	-0.007	-0.016		
	(0.008)	(0.018)	(0.009)	(0.010)	(0.022)	(0.022)	(0.019)	(0.019)	(0.020)	(0.024)	(0.025)	(0.026)		
Wealth quartile dummies (reference: Q1)														
Q2	0.004	0.005	0.028**	0.028**	0.038**	0.038**	-0.002	0.000	0.032**	0.032**	0.074***	0.071***		
	(0.007)	(0.007)	(0.011)	(0.011)	(0.018)	(0.018)	(0.021)	(0.021)	(0.016)	(0.016)	(0.025)	(0.025)		
Q3	0.010	0.011	0.043***	0.040***	0.051**	0.051**	0.016	0.019	0.021	0.021	0.097***	0.097***		
	(0.008)	(0.009)	(0.013)	(0.013)	(0.024)	(0.024)	(0.023)	(0.023)	(0.019)	(0.020)	(0.029)	(0.029)		
Q4	0.017*	0.018	0.057***	0.052***	0.081***	0.081***	-0.007	-0.004	0.022	0.022	0.072**	0.072**		
	(0.010)	(0.011)	(0.014)	(0.014)	(0.028)	(0.028)	(0.024)	(0.024)	(0.021)	(0.021)	(0.031)	(0.031)		
= 1 if own a house	0.018*	0.017*	0.004	0.005	-0.035	-0.036	0.068**	0.064**	-0.019	-0.019	-0.011	-0.029		
	(0.009)	(0.010)	(0.018)	(0.018)	(0.030)	(0.031)	(0.030)	(0.030)	(0.021)	(0.021)	(0.028)	(0.032)		
Obs.	79372	79372	43946	43946	4417	4417	8424	8424	5351	5351	3995	3995		
1st stage F		65.5		592.1		22.7		75.2		15.1		22.8		
DWH p-value		0.76		0.00		0.89		0.31		0.98		0.21		

[1] * $p < .1$, ** $p < .05$, *** $p < .01$

[2] All specifications also include survey wave fixed effects. Additionally, we added the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Appendix C: First Stage Results

Appendix C features the first-stage results for IV estimations. We found that IV can work because the probability of retirement increases after reaching normal or early pension eligibility age in all countries. One thing to note is that the IV for early pension eligibility age does not work in Switzerland. As can be seen in Figure 1, the proportion of retirees increases at a particular age in some countries. The coefficient for such countries is large (e.g. normal PA in England, early and normal PA in Germany and early PA in France).

Table 16: Effects of Pensionable Age on Retirement in 7Countries

	Alcohol consumption					Physical activity	
	Y/N	**> 3 d/w**	**> 5 d/w**	**Amount**	**Smoking**	**Vigorous**	**Moderate**
U.S.							
= 1 if age ≥ early age	0.093***	0.093***	0.093***	0.092***	0.092***	0.080***	0.079***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
= 1 if age ≥ normal age	0.035***	0.034***	0.034***	0.035***	0.034***	0.034***	0.034***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
Obs.	134352	134064	134064	133942	133542	79320	79372
England							
= 1 if age ≥ normal age	0.234***	0.219***	0.219***	0.194***	0.235***	0.236***	
		0.236***	(0.010)	(0.012)	(0.012)	(0.017)	
		(0.010)	(0.010)	(0.010)			
Obs.	38681	29964	29964	18326	43623	43946	43946
Germany							
= 1 if age ≥ early age	0.128***	0.128***	0.128***	0.140***	0.128***	0.128***	
		0.128***	(0.027)	(0.027)	(0.027)	(0.034)	
		(0.027)	(0.027)	(0.027)			
= 1 if age ≥ normal age	0.146***	0.146***	0.146***	0.190***	0.146***	0.146***	
		0.146***	(0.028)	(0.028)	(0.028)	(0.038)	
		(0.028)	(0.028)	(0.028)			
Obs.	4415	4415	4415	2636	4417	4417	4417
France							
= 1 if age ≥ early age	0.275***	0.275***	0.275***	0.265***	0.275***	0.275***	
		0.275***	(0.022)	(0.022)	(0.022)	(0.026)	
		(0.022)	(0.022)	(0.022)			
= 1 if age ≥ normal age	0.034*	0.034*	0.034*	0.038*	0.034*	0.034*	0.034*
	(0.019)	(0.019)	(0.019)	(0.023)	(0.019)	(0.019)	(0.019)
Obs.	8424	8424	8424	6151	8422	8421	8424
Denmark							
= 1 if age ≥ early age	0.060***	0.060***	0.060***	0.018	0.060***	0.060***	0.060***
	(0.022)	(0.022)	(0.022)	(0.025)	(0.022)	(0.022)	(0.022)
= 1 if age ≥ normal age	0.154***	0.154***	0.154***	0.156***	0.154***	0.154***	0.154***
	(0.028)	(0.028)	(0.028)	(0.033)	(0.028)	(0.028)	(0.028)
Obs.	5353	5353	5353	4000	5353	5352	5351
Switzerland							
= 1 if age ≥ early age	-0.009	-0.009	-0.009	-0.046	-0.010	-0.010	-0.010
	(0.026)	(0.026)	(0.026)	(0.029)	(0.026)	(0.026)	(0.026)
= 1 if age ≥ normal age	0.210***	0.210***	0.210***	0.226***	0.210***	0.210***	
		0.210***	(0.031)	(0.031)	(0.031)	(0.035)	(0.031)
		(0.031)	(0.031)				
Obs.	3993	3993	3993	3227	3995	3994	3995
Japan							
= 1 if age ≥ normal age	0.036**	0.036**	0.036**	0.039**	0.033**	0.037*	
	(0.016)	(0.016)	(0.016)	(0.017)	(0.014)	(0.020)	
Obs.	7704	7704	7704	7150	10489	5215	

[1] * $p < .1$, ** $p < .05$, *** $p < .01$

[2] All specifications include *age* , *age*^{2} , *age*^{3}, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we added the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Appendix D: Results for Heterogeneous Effects for Other Countries

Appendix D presents other results that are not discussed in main text. Additionally, while section 4 of the main text discusses heterogeneous effects by gender and age for the United States, England and France, Table 17 ~ 20 show the results for other countries: Germany, Denmark, Switzerland and Japan.

Table 17: Effects of Retirement by Age Range and Gender (Germany)

	Full Sample		Male			Female		
	50-75 (1)	50-70 (2)	50-75 (3)	50-70 (4)	58-70 (5)	50-75 (6)	50-70 (7)	55-70 (8)
Alcohol consumption: Y/N								
Coefficient	0.037	-0.022	-0.076	-0.142		0.191	0.156	0.219
1st stage F-statistics	C	C	C		†	C	C	
Alcohol consumption: > 3 d/w								
Coefficient	0.274	0.271	0.367	0.254		0.337	0.375	0.253
1st stage F-statistics	C	C	C		†	C	C	
Alcohol consumption: > 5 d/w								
Coefficient	0.110	0.112	0.207	0.126		0.083	0.039	-0.027
1st stage F-statistics	C	C	C		†	C	C	
Alcohol consumption: Amount								
Coefficient	1.034	1.000	2.575	2.534	9.575	-0.289	-0.537	1.306
1st stage F-statistics	C	C		C		C	C	
Smoking								
Coefficient	0.096	0.098	0.293	0.332		-0.083	-0.164	-0.199
1st stage F-statistics	C	C	C		†	C	C	
Physical activity: Vigorous								
Coefficient	-0.240	-0.183	0.065	0.179		-0.507	-0.403	-0.550
1st stage F-statistics	C	C	C		†	C	C	
Physical activity: Moderate								
Coefficient	0.041	0.058	0.058	0.159		-0.031	-0.080	-0.055
1st stage F-statistics	C	C	C		†	C	C	

[1] $p < .1$, $p < .05$, ¿ $p < .01$, C Kleibergen-Paap Wald rk F statistic ≥ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include age , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 18: Effects of Retirement by Age Range and Gender (Denmark)

	Full Sample		Male			Female		
	50-75	50-70	50-75	50-70	55-70	50-75	50-70	55-70
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alcohol consumption: Y/N								
Coefficient	-0.030	-0.038	-0.149	-0.242		0.106	0.140	0.732
1st stage F-statistics	C	C			†			
Alcohol consumption: > 3 d/w								
Coefficient	-0.242	-0.300	-0.167	-0.295		-0.256	-0.285	-0.678
1st stage F-statistics	C	C			†			
Alcohol consumption: > 5 d/w								
Coefficient	-0.214	-0.223	-0.185	-0.171		-0.158	-0.155	0.125
1st stage F-statistics	C	C			†			
Alcohol consumption: Amount								
Coefficient	1.705	1.871	1.977	2.116		1.433	1.788	
1st stage F-statistics	C				†			†
Smoking								
Coefficient	-0.279	-0.304	-0.394	-0.494		-0.143	-0.126	0.031
1st stage F-statistics	C	C			†			
Physical activity: Vigorous								
Coefficient	0.454	0.447	0.557	0.526		0.325	0.281	0.126
1st stage F-statistics	C	C			†			
Physical activity: Moderate								
Coefficient	-0.020	-0.011	-0.031	-0.071		0.011	0.039	-0.296
1st stage F-statistics	C	C			†			

[1] $p < .1$, $p < .05$, ¿ $p < .01$, C Kleibergen-Paap Wald rk F statistic ≥ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include age , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 19: Effects of Retirement by Age Range and Gender (Switzerland)

	Full Sample		Male			Female		
	50-75	50-70	50-75	50-70	58-70	50-75	50-70	57-69
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alcohol consumption: Y/N								
Coefficient	0.160	0.187	0.135	0.263		0.158	0.157	0.265
1st stage F-statistics	C	C			†	C	C	
Alcohol consumption: > 3 d/w								
Coefficient	0.121	0.169	-0.062	0.074		0.207	0.194	0.360
1st stage F-statistics	C	C			†	C	C	
Alcohol consumption: > 5 d/w								
Coefficient	-0.089	-0.069	-0.222	-0.284		-0.079	-0.041	-0.127
1st stage F-statistics	C	C			†	C	C	
Alcohol consumption: Amount								
Coefficient	2.823	2.740	12.589	12.286		1.056	0.870	1.740
1st stage F-statistics	C	C			†	C	C	
Smoking								
Coefficient	0.145	0.127	0.190	0.299		0.092	0.024	0.248
1st stage F-statistics	C	C			†	C	C	
Physical activity: Vigorous								
Coefficient	0.199	0.268	-0.099	0.026		0.329	0.381	0.427
1st stage F-statistics	C	C			†	C	C	
Physical activity: Moderate								
Coefficient	-0.208	-0.221	-0.121	-0.196		-0.264	-0.259	-0.660
1st stage F-statistics	C	C			†	C	C	

[1] $p < .1$, $p < .05$, ¿ $p < .01$, C Kleibergen-Paap Wald rk F statistic ≥ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include age , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Table 20: Effects of Retirement by Age Range and Gender (Japan)

	Full Sample		Male			Female		
	50-75 (1)	50-70 (2)	50-75 (3)	50-70 (4)	58-70 (5)	50-75 (6)	50-70 (7)	56-68 (8)
Alcohol consumption: Y/N								
Coefficient	0.189	0.422	-0.020	0.103				
1st stage F-statistics					†	†	†	†
Alcohol consumption: > 3 d/w								
Coefficient	0.036	0.327	-0.008	0.096				
1st stage F-statistics					†	†	†	†
Alcohol consumption: > 5 d/w								
Coefficient	0.124	0.312	0.163	0.279				
1st stage F-statistics					†	†	†	†
Alcohol consumption: Amount								
Coefficient	-0.824	0.046	-1.348	-1.057	-2.640			
1st stage F-statistics						†	†	†
Smoking								
Coefficient	0.267	0.334	0.057	0.053				
1st stage F-statistics					†	†	†	†
Physical activity: Vigorous								
Coefficient	0.183		0.066					
1st stage F-statistics		†		†	†	†	†	†
Physical activity: Moderate								
Coefficient								
1st stage F-statistics								

[1] $p < .1$, $p < .05$, ¿ $p \leq .01$, C Kleibergen-Paap Wald rk F statistic ≥ 10 , † instrumental variables are insignificant in 1st stage regression.

[2] All specifications include age , age^2 , age^3, married dummy, number of children, household income quartile dummies, household wealth quartile dummies, house ownership, and survey wave fixed effects. Additionally, we add the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

Appendix E: International Comparison of The Effect of Retirement on Health

We summarize the Table 12 and 13 in Nishimura et al. (2018).

Table 21: International comparison of the effect of retirement on health

	Self-report health	Depression	Cognition	BMI	ADL
US	+	+	-	-	+
England	+	+		-	+
Germany	+				+
France	+				
Denmark		+			
Switzerland				-	
Japan					

The red (blue) character indicates the improved (deteriorated) impact.

Acknowledgements

The authors would like to thank the editors and the anonymous referee specially for their valuable feedback. We would also like to thank Peter Eibich, Yuji Genda, Michael Hurd, Hidehiko Ichimura, Yasushi Iwamoto, Daiji Kawaguchi, Salar Jahedi, Bryan Tysinger and participants at the 2017 ASSA Annual Meeting, Japanese Economic Association Autumn Meeting 2016, Comparative International Research Based on the HRS Family of Data, Tokyo Labor Economics Conference at Hitotsubashi University, the National Institute of Population and Social Security Research and Conference for Cross-Country Analysis of Retirement, Health and Well-Being at University of Southern California for their helpful comments on this paper and an earlier version titled "Examining the Changes in Health Investment Behavior After Retirement: A Harmonized Analysis". We would also like to thank Kazuyuki Terada for his extensive support of this research. This research is also partially supported by the Grants-in-Aid for Scientific Research [Research project number: 13J09809 and 19J01042] of the Japan Society for the Promotion of Science (JSPS) Fellows by the Ministry of Education, Science and Culture in Japan. Editing services have been provided by Philip C. MacLellan. The authors are responsible for all remaining errors and interpretations.

The HRS (Health and Retirement Study) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan.

The ELSA (English Longitudinal Study of Ageing) is funded by the US National Institute on Ageing and a consortium of UK government departments coordinated by the Office for National Statistics.

This paper uses data from SHARE Waves 1, 2, 3 (SHARELIFE), 4 and 5 (DOIs: 10.6103 /SHARE.w1.260, 10.6103/SHARE.w2.260, 10.6103/SHARE.w3.100, 10.6103/SHARE.w4.111, 10.6103 /SHARE.w5.100), see Börsch-Supan et al. (2013) for methodological details. The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005 -028857, SHARELIFE: CIT4-CT-2006-028812) and FP7 (SHARE-PREP: N°211909, SHARE-LEAP: N°227822, SHARE M4: N°261982). Additional funding from the German Ministry of Education and Research, the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG00

5842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA _04-064$) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

The Japanese Study of Aging and Retirement (JSTAR) is conducted by the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University, and the University of Tokyo.

References

Angrist, J. D. and Pischke, J.-S. (2008). *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.

Ayyagari, P. (2016). The Impact of Retirement on Smoking Behavior. *Eastern Economic Journal*, 42(2):270–287.

Barber, R. M., Fullman, N., Sorensen, R. J., Bollyky, T., McKee, M., Nolte, E., Abajobir, A. A., Abate, K. H., Abbafati, C., Abbas, K. M., et al. (2017). Healthcare Access and Quality Index Based on Mortality from Causes Amenable to Personal Health Care in 195 Countries and Territories, 1990–2015: A Novel Analysis from the Global Burden of Disease Study 2015. *The Lancet*, 390(10091):231–266.

Barik, J. and Wonnacott, S. (2009). Molecular and Cellular Mechanisms of Action of Nicotine in the CNS. In *Nicotine Psychopharmacology*, pages 173–207. Springer.

Benowitz, N. L. (2010). Nicotine Addiction. *New England Journal of Medicine*, 362(24):2295–2303.

Bertoni, M., Brunello, G., and Mazzarella, G. (2018). Does Postponing Minimum Retirement Age Improve Healthy Behaviors Before Retirement? Evidence from Middle-aged Italian Workers. *Journal of Health Economics*, 58:215–227.

Binh Tran, D. and Zikos, V. (2019). The causal effect of retirement on health: Understanding the mechanisms. *Australian Economic Review*.

Bonsang, E., Adam, S., and Perelman, S. (2012). Does Retirement Affect Cognitive Functioning? *Journal of Health Economics*, 31(3):490–501.

Börsch-Supan, A. (2019). Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 1. Release version: 7.0.0. SHARE-ERIC. Data set. DOI: 10.6103/SHARE.w1.700

Börsch-Supan, A. (2019). Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 2. Release version: 7.0.0. SHARE-ERIC. Data set. DOI: 10.6103/SHARE.w2.700

Börsch-Supan, A. (2019). Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 4. Release version: 7.0.0. SHARE-ERIC. Data set. DOI: 10.6103/SHARE.w4.700

Börsch-Supan, A. (2019). Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 5. Release version: 7.0.0. SHARE-ERIC. Data set. DOI: 10.6103/SHARE.w5.700

Börsch-Supan, A., M. Brandt, C. Hunkler, T. Kneip, J. Korbmacher, F. Malter, B. Schaan, S. Stuck, S. Zuber (2013). Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). International Journal of Epidemiology. DOI: 10.1093/ije/dyt088

Celidoni, M. and Rebba, V. (2017). Healthier Lifestyles after Retirement in Europe? Evidence from SHARE. *The European Journal of Health Economics*, 18(7):805–830.

Charles, K. K. (2004). Is Retirement Depressing?: Labor Force Inactivity and Psychological Well being in Later Life. *Research in Labor Economics*, 23:269–299.

Coe, N. B. and Zamarro, G. (2011). Retirement Effects on Health in Europe. *Journal of Health Economics*, 30(1):77–86.

Eibich, P. (2015). Understanding the Effect of Retirement on Health: Mechanisms and Heterogeneity. *Journal of Health Economics*, 43:1–12.

Fonseca, R., Kapteyn, A., Lee, J., Zamarro, G., and Feeney, K. (2014). A Longitudinal Study of Well-being of Older Europeans: Does Retirement Matter? *Journal of Population Ageing*, 7(1):21–41.

Godard, M. (2016). Gaining Weight through Retirement? Results from The SHARE Survey. *Journal of Health Economics*, 45:27–46.

Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy*, 80(2):223–255.

Insler, M. (2014). The Health Consequences of Retirement. *Journal of Human Resources*, 49(1):195–233.

Johnston, D. W. and Lee, W.-S. (2009). Retiring to The Good Life? The Short-term Effects of Retirement on Health. *Economics Letters*, 103(1):8–11.

Kämpfen, F. and Maurer, J. (2016). Time to Burn (Calories)? The Impact of Retirement on Physical Activity among Mature Americans. *Journal of Health Economics*, 45:91–102.

Kerkhofs, M. and Lindeboom, M. (1997). Age Related Health Dynamics and Changes in Labour Market Status. *Health Economics*, 6(4):407–423.

Kesavayuth, D., Rosenman, R. E., and Zikos, V. (2018). Retirement and Health Behaviour. *Applied Economics*, 50:1–18.

Lee, J. and Smith, J. P. (2009). Work, retirement, and depression. *Journal of Population Ageing*, 2(1-2):57–71.

Lin, Y., Kikuchi, S., Tamakoshi, A., Wakai, K., Kawamura, T., Iso, H., Ogimoto, I., Yagyu, K., Obata, Y., and Ishibashi, T. (2005). Alcohol Consumption and Mortality among Middle-aged and Elderly Japanese Men and Women. *Annals of Epidemiology*, 15(8):590–597.

McGarry, K. (2004). Health and retirement do changes in health affect retirement expectations? *Journal of Human Resources*, 39(3):624–648.

Motegi, H., Nishimura, Y., and Oikawa, M. (2017). Examining the changes in health investment behavior after retirement: A harmonized analysis. *Munich Personal RePEc Archive*, (77674).

Motegi, H., Nishimura, Y., and Oikawa, M. (2019). Retirement and health investment behaviors: An international comparison. *Munich Personal RePEc Archive*, (96133).

Motegi, H., Nishimura, Y., and Terada, K. (2016). Does Retirement Change Lifestyle Habits? *Japanese*

Economic Review, 67(2):169–191.

Müller, T. and Shaikh, M. (2018). Your retirement and my health behavior: Evidence on retirement externalities from a fuzzy regression discontinuity design. *Journal of Health Economics*, 57:45–59.

Nishimura, Y., Oikawa, M., and Motegi, H. (2018). What Explains the Difference in the Effect of Retirement on Health? Evidence from Global Aging Data. *Journal of Economic Surveys*, 32(3):792–847.

Penedo, F. J. and Dahn, J. R. (2005). Exercise and Well-being: A Review of Mental and Physical Health Benefits Associated with Physical Activity. *Current opinion in psychiatry*, 18(2):189–193.

Rehm, J., Room, R., Graham, K., Monteiro, M., Gmel, G., and Sempos, C. T. (2003). The Relationship of Average Volume of Alcohol Consumption and Patterns of Drinking to Burden of Disease: An Overview. *Addiction*, 98(9):1209–1228.

Rohwedder, S. and Willis, R. J. (2010). Mental Retirement. *Journal of Economic Perspectives*, 24(1):119–138.

Sabia, S., Elbaz, A., Britton, A., Bell, S., Dugravot, A., Shipley, M., Kivimaki, M., and Singh-Manoux, A. (2014). Alcohol Consumption and Cognitive Decline in Early Old Age. *Neurology*, pages 10–1212.

Schaffer, M. (2010). xtivreg2: Stata module to perform extended iv/2sls, gmm and ac/hac, liml and k-class regression for panel data models. Available online via `http://repec.org/bocode/x/xtivreg2.html` (last accessed 19.9.2016).

Shai, O. (2018). Is Retirement Good for Men's Health? Evidence Using a Change in The Retirement Age in Israel. *Journal of Health Economics*, 57:15–30.

Stathopoulou, G., Powers, M. B., Berry, A. C., Smits, J. A., and Otto, M. W. (2006). Exercise Interventions for Mental Health: A Quantitative and Qualitative Review. *Clinical Psychology: Science and Practice*, 13(2):179–193.

Stock, J. H. and Yogo, M. (2005). Testing for Weak Instruments in Linear IV Regression. In *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, pages 80–108. Cambridge University Press.

Zhao, M., Konishi, Y., and Noguchi, H. (2017). Retiring for Better Health? Evidence from Health Investment Behaviors in Japan. *Japan and the World Economy*, 42:56–63.

Zhu, R. (2016). Retirement and its consequences for women's health in Australia. *Social Science & Medicine*, 163:117–125.