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# Retirement and Health Investment Behaviors: An International Comparison*

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**Abstract**

This study aims to better understand the effects of retirement on health outcomes, which is of great interest worldwide, by examining the effects of retirement on health investment behaviors. To this end, we conducted a large-scale international comparison of the changes in health investment behaviors after retirement among the populations of seven developed countries using Global Aging Data, exploiting differences in the financial incentives in the pension systems of each country as our identification strategy. The results show that while elderly change their health investment behaviors in some way after retirement, the patterns of the changes in many health investment behaviors differ across each country. Further, a review of the literature and our results suggest that health investment behaviors are not necessarily determinants of the effects of retirement on health.

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

*The authors are responsible for all remaining errors and interpretations. We certify that we have the right to deposit the contribution with MPRA.

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# 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, health is expected to be a key factor, for if an active work life is beneficial for the health of the elderly, policies delaying retirement would thus lead to reduced medical expenses and vice-versa. In this case, as health plays the role of externality, where one's health status may change unintentionally after retirement owing to the introduction of such policies, this should be considered in policy discussions about changes in medical costs.

Along with a growing interest in the effects of policies that delay retirement, investigations of the relationship between retirement and health have increased in the two decades since the seminal study of Kerkhofs and Lindeboom (1997). [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, and the Nishimura et al. (2018) survey of the literature finds that the estimation methods and specific countries surveyed are the main determinants of the varying results reported in the literature.

Another key 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), and attempts to analyze these have increased recently following the Eibich (2015) study, the first to clearly identify and investigate the mechanisms rigorously, using German data. [2] Subsequent examples include Motegi et al. (2016); Kämpfen and Maurer (2016); Ayyagari (2016); Celidoni and Rebba (2017); Zhao et al. (2017); Bertoni et al. (2018); and Kesavayuth et al. (2018). [3] However, as each paper focused only on one country and applied different estimation methods, their findings cannot be directly compared or generalized. [4] As discussed in Nishimura et al. (2018), estimation

[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.

[4] Celidoni and Rebba (2017) used SHARE data, but did not take country heterogeneity into consideration.

methods alone can drive different results in the retirement literature, with Ayyagari (2016), and Insler (2014), for example, obtaining contradictory results on the effects of retirement on smoking behavior even though they both used the same U.S. Health and Retirement Study data. [5] In order to better assess the effects of retirement on health worldwide, the literature must go beyond the limited number of single-country investigations that have occurred to date, and apply the same conditions (i.e., methodology, definitions of variables, sample restrictions, and set of control variables) to each surveyed country in order to conduct a cross-country comparison that permit checks for external validity.

Consequently, our aim in this study is to explore the mechanism behind the effect of retirement on health, and the main contribution of the paper is that we have added new empirical findings to the literature by conducting a large-scale international comparison using harmonized analysis to examine the effects of retirement on health investment behaviors and compare the results across seven major developed countries. Setting the same estimation methods and other research conditions is important in explaining the heterogeneity of the effects observed in the literature, and examining external validity is key to discussing why the observed effects of retirement on health differ across countries because this heterogeneity could be due to heterogeneity in health investment behaviors across countries. Accordingly, in this study, we set the same definitions of variables and sample restrictions for each country, and then checked the correspondence with retirement, health, and health investment behaviors to identify and compare the relationship between retirement and health across the seven countries analyzed. The use of a harmonized methodology and dataset means that, unlike previous studies, we can rule out any observed differences across countries being due to differences in methodology or variable definitions employed.

Specifically, this paper estimates the effects of retirement on health investment behaviors such as alcohol consumption and smoking by using the latest longitudinal data from the U.S., England, other European countries and Japan, harmonizing the data in order to compare the results and applying fixed effects instrumental variables methods to deal with retirement endogeneity. Unobserved characteristics include individuals' preferences that may influence not only their health

[5] Insler (2014) applies fixed effect logit methods to show that the elderly decrease their amount of smoking after retirement, while Ayyagari (2016) applies the bivariate probit method.

investment behaviors but also the decision to retire as well. For our analysis, pension eligibility age was used as the instrumental variable because financial incentives associated with the pension eligibility age affects the retirement decision but is not directly related to an individual's health investment behaviors.

Our results suggest that elderly in many countries change their health investment behaviors in some way, but the patterns of the changes vary by country. Not only the magnitude but also the direction of the change differs by country and are also heterogeneous depending on gender and age. As a result, we cannot present a single unified view of the effects of retirement on health investment behaviors. An additional finding of this study is a verification of the results of Nishimura et al. (2018) through our examination of the heterogeneity of changes in the health outcomes of elderly retirees, suggesting that while some behaviors may be key factors underlying the effect of retirement on health, this does not mean that all health investment behaviors are important determinants of health outcomes after retirement. Finally, we explore which factors might be important in explaining the difference in the change in health investment behaviors, and suggest the level of health care access as one influence.

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 utilized Global Aging Data from the U.S. Health and Retirement Study (HRS) [6] and other related datasets, including the English Longitudinal Study on Aging (ELSA), the Survey on Health, Aging, and Retirement in Europe (SHARE), and the Japanese Study of Aging and Retirement (JSTAR). [7] These datasets constitute panel surveys of elderly individuals, and have

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

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

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 utilized 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. [8] However, when relevant variables were not available in the harmonized datasets, we obtained 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 were chosen for the main analysis, beginning with all waves of data for Western countries (HRS, ELSA and SHARE) and East Asia (CHARLS, JTAR and KLoSA) as of 2016 and then restricting the analysis sample step by step according to the following criteria. First, as pensionable age was the identification strategy in this paper, we restricted our sample to only those countries whose pensionable age information was available by cohort levels, [9] Leaving at this stage the USA, England, Germany, France, Denmark, Switzerland, Czech, Estonia, Japan, China, and Korea. Second, because we utilized a dynamic variation of retirement, we analyzed only countries that had been surveyed more than four times by 2013, which caused us to drop the Czech Republic, Estonia and China from the analysis. Finally, as we are reporting results only when instrumental variables worked well in the first stage regression, we dropped Korea at this stage, leaving the final seven countries reported in our main analysis: the USA, England, Germany,

[8] 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.

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

France, Denmark, Switzerland and Japan. [10]

### 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 were either unemployed or still working after retiring from their career job, we used the variable "complete retirement (CR)", consisting of those who were both "not working for pay" and who were "self-reported retired'. [11] Then, for our robustness check, we considered two other possible definitions of retirement: "partial retirement (PR)", which includes a respondent who was 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 $CR \subset PR \subset NW$. Table 2 presents the summary statistics of each definition of retirement, showing the inclusion relationship along with demographic variables such as age and gender. Section 4.2 reports the results of a robustness check, showing how the estimates differed from the most narrow defined CR used in our main analysis to other less restrictive definitions.

[10] For the United States, we used 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 did not use wave 3 for the SHARE survey because the data is not current but retrospective.

[11] 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 defined 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 used the variable "r@lbrf" in all harmonized datasets.

## 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 followed Bertoni et al. (2018) and investigated alcohol consumption, smoking and physical activity because these three behaviors were included in all datasets and thus could be compared internationally. [12] The measurement scale for health investment behaviors was adjusted to enable an international comparison because each individual dataset used 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 were 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. [13] "Alcohol consumption: Amount" measures the number of drinks per day in HRS, SHARE and JSTAR. [14]

  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.

  The main concern with drinking is that it causes circulatory system diseases. Rehm et al. (2003) finds that the average volume of alcohol consumption increased 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

[12] For example, the information about sleep duration is included in only HRS and JSTAR.

[13] We constructed 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.

[14] We defined 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 divided this number by seven.

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 indexes such as "ADL (activity of daily livings)".

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

  Many papers have showed 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 used 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 on each survey vary slightly, changes in physical activity is not strictly comparable among the four data sets. [15] Nonetheless, from the raw data, the two physical activity variables were constructed for this study.

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

[15] 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"

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 restricted the analysis to the above three lifestyle variables in order 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 were 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 researches used various age range for analysis. [16] For example, Eibich (2015) restricted

[16] e.g. Motegi et al. (2016); over 50, Insler (2014); over 50, Eibich (2015); 55-70, Celidoni and Rebba (2017); 45-85,

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 age range for precise estimation. However, this German phenomenon does not exist in other countries with a different pensionable age, and other studies such as Shai (2018) and Kesavayuth et al. (2018) choose a broader age range of 50-75. Though the age at which pension payments begin fluctuates dynamically, allowing the analysis of individual movements in response to variables, Figure 1 shows that the probability of employment after age 75 has not changed much in many countries, which justifies the upper bound of age 75. For our study, the choice of age range represented a trade-off between precision and international comparison, and we prioritized the latter. Because we observed that retirement age varies across countries, we adopted the wider age range of 50-75. We did however investigate an age range of 50-70 as a robustness check and a second age range of 5 years around the pension eligibility age to show the heterogeneity of pensionable age globally. These are discussed in sections 4.4.

## 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) or the FE method to estimate the effects of retirement on health investment behaviors by using pension eligibility age as the IV. [17]

We estimated the equation as follows:

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

$$retire_{it} = \alpha_0 + \alpha_1 1\{age_{it} \geq A_i^{eb}\} + \alpha_2 1\{age_{it} \geq A_i^{fb}\} + \alpha_3 age_{it} + \alpha_4 age_{it}^2 + \alpha_5 age_{it}^3 + x_{it}'\eta + a_{2i} + \lambda_{2t} + \epsilon_{2it}$$

$$A_i^{eb} : \text{early retirement benefit eligibility age}$$

$$A_i^{fb} : \text{full retirement benefit eligibility age}$$

where $i$ represents an individual and $t$ time. $x_{it}$ represents a set of exogenous control variables

Shai (2018); 50-75, and Kesavayuth et al. (2018); 50-75.

[17] Nishimura et al. (2018) use health outcome as a dependent variable, but the concept of identification strategy is the same.

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 to the detailed definitions provided in Section 2. $\epsilon_{1it}$ and $\epsilon_{2it}$ are unobserved error terms. $a_{1i}$ and $a_{2i}$ represent unobserved individual fixed effects and $\lambda_{1t}$, $\lambda_{2t}$ denote unobserved time effects. The coefficient of interest is $\beta_1$. 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. [18] While the pension eligibility age is exogenous, and the incentive to retire from the labor market increases after one reaches the pension eligibility age because of the ability to earn some income without working, pension eligibility does not directly 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). In this study, we followed the same methods as Nishimura et al. (2018), correcting the pension eligibility age for each cohort. [19] In addition, we also examined the effect of retirement on health investment behaviors, using dummy variables (e.g., $\{age_{it} \geq A_i^{eb}\}$ ) to identify changes in retirement after the pensionable age.

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 was not sufficiently large, and the pension eligibility age also differs across the countries studied. Because RDD estimates have shown the effects on discontinuity points, this makes it difficult to compare results across countries, Accordingly, we instead chose a wide age range (50-75) to capture the pension eligibility ages of all countries and applied FE-IV methods, controlling for age effects flexibly by including linear, squared and cubic

[18] 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.

[19] A table showing pension eligibility ages is attached.

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). We used this source of variation to identify retirement effects, controlling for individual demographics ($x_{it}$) by including the covariates described above because around the early and normal pensionable ages, it is possible that individual demographics such as income change. As we also expect that health investment behaviors also change following retirement, and this is approximated by function of age, we included $age_{it}$, $age_{it}^2$ and $age_{it}^3$ to control for age effects flexibly.

A final note about methodology is that we implemented the Durbin-Wu-Hausman (DWH) test after FE-IV estimation to check the endogeneity of $retire_{it}$, excluding $a_{1i}$ and $\lambda_{1t}$, and either the FE-IV or FE method was applied depending on the DWH results. The FE model is supported when the null hypothesis is not rejected. [20]

# 4 Results

In this paper, we report only the coefficients on the retirement variables for each country, which are 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. Table 4 shows the results from either FE or FE-IV as determined by the DWH test. The results for both FE and FE-IV can be found in Table 15 of Appendix D.

In the discussion below, the results are not addressed when the coefficients of the pensionable age dummy variables for the first stage are not significant. Additionally, the Kleibergen-Paap Wald rk F-statistic, which deals with clustered standard errors, is also attached to test weak instruments. The F-values are meaningful when the results of the first stage are significant, and these are shown in Appendix C. As suggested by Stock and Yogo (2005), it is desirable for all F-statistics to exceed

[20] All models were estimated using the STATA module xtivreg2. (see Schaffer (2010).)

the critical value for the desired maximal size 0.1 of a 5% Wald test. For one endogeneous variable and one IV, the critical value is 16.38, and 19.93 for one endogeneous variable and two IVs. As the value for Denmark is below that, the results for this country need attention. While Japan is also below the critical value, the estimates are unbiased for median value when there is one endogeneous variable and one IV.

### 4.1 Effects of Retirement on Lifestyle Habits (Age: 50-75)

In this section, we report changes in health investment behaviors after retirement and then interpret these results through an international comparison. The main results are shown in Table 4.

- Alcohol Consumption:

  We found that the elderly changed their drinking habits in terms of frequency and amount in five 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 verse.

  In contrast, the frequency of alcohol consumption did change after retirement in some countries, though the signs differed, with the frequency of alcohol consumption (>3d/w) increasing after retirement in England and Germany (0.016 and 0.049) but decreasing in the U.S. (-0.005). This suggests that being non-retired and elderly in England increases the probability of drinking 3 days a week by 4.0% from a baseline probability of 38.1% (Table 3) [21] In Germany, the probability increases by 9.2% from a baseline probability of 53.1% (Table 3), and in the United States, the probability decreases by 2.9% from a baseline probability 17.3% (Table 3). [22] While the impacts for the United States and England seem small, the results for Germany are consistent with Eibich (2015).

  Changes in the amount of alcohol consumption differ by country as well. In the U.S. and

[21] This was calculated it by 0.016/0.42, and the following numbers were calculated in the same way.
[22] In the U.S., the frequency of alcohol consumption (>5d/w) decreased after retirement as well.

Switzerland, the daily amount consumed decreased after retirement (2.6% and 37.1% from baseline) whereas amount consumed increased in Denmark (70.6% from baseline). We found that elderly in Denmark and Switzerland substantially changed the amount of alcohol consumed per day. To sum up, although no statistically significant change in the decision whether to drink or not was found in any of the countries analyzed, changes in the frequency and/or daily intake was found in some countries. The behavioral changes around alcohol consumption after retirement are thus diverse across countries and the impacts differ substantially. This may be due to a cultural and habitual aspects of drinking habits. Because the direction of changes in alcohol consumption after retirement also differs across countries, we cannot make any definitive statement as to whether they improved or deteriorated.

- Smoking:

  We found that elderly changed their smoking habits in three of seven countries; decreasing after retirement in the U.S., Denmark and Japan. Our finding that in no country did retirees increase smoking is consistent with previous research, including Insler (2014), Eibich (2015), Motegi et al. (2016) and Zhao et al. (2017). The magnitude of the marginal effect of smoking is small in the U.S. and Japan (-0.012 and -0.026), which is evaluated for 6.7% and 13.6% at mean level for non-retirees for each country. The magnitude of the U.S. is at a moderate level, and that of Japan is a somewhat larger. The impact for Denmark, however, is very large: 106.5% at mean level. As we are not aware of a sociocultural or medical reason for the large magnitudes for Denmark, it is possible that this may be due to a weak instrument.

  Our results indicate that smoking habits generally improved globally after retirement, with no analyzed country seeing an increase. Possible reasons why elderly reduce smoking could be reduced job stress and the elimination of their work environment, as suggested by Motegi et al. (2016). In other words, many people smoke to relieve job stress and while interacting socially with co-workers, and these smokers typically stop smoking after retirement. However, elderly in the other countries studied did not change their smoking habits, and while the impacts are different, they are not significant.

- Physical Activity:

  Our investigation found that elderly changed their participation in either moderate or vigorous physical activity in five of seven countries after they retired. The probability of vigorous physical activity each week increased after retirement in the U.S., England and Denmark, and decreased in Germany. These were evaluated for each 5.5%, 4.1%, 68.8%, and -8.0% for the U.S., England, Denmark and Germany from baseline for the case of non-retirees. Moderate physical activity increased in England but decreased in Switzerland (16.5% and -5.4% from baseline). Consequently, we can conclude that the elderly in the U.S., England and Denmark increased physical activity after retirement. However, as we found with drinking habits, the behavioral changes in physical activity are diverse, and while it increased in some countries, it did not in others. This differs from previous research that finds that the elderly increased their physical activity after retirement in most cases (Eibich (2015) and Motegi et al. (2016)). In particular, we found disconfirming results among countries that had not been studied previously due to our more fine-grained analysis. For example, while Celidoni and Rebba (2017) and Kesavayuth et al. (2018), using SHARE data, find an increase in physical activities after retirement by Europeans, we found that the results differed across European countries.

  Even though the effects of retirement on physical activities are different across countries as well, from an economic perspective, they can be considered to be positive due to the change in the opportunity cost for physical activity after retirement, which is a possible reason for improvements in exercise. The opportunity cost is measured as the wage per hour, and becomes 0 when an individual stops working. Grossman (1972) also suggests this explanation and a health production model that can explain the effects of relaxing time constraints on health investment behavior due to retirement. Although we have no position on the reason for the observed decrease in exercise after retirement by Germans, it is possible that the decrease in exercise after retirement for the Swiss is due to a reduction in walking related to commuting, as Swiss tend to commute on foot and by train. [23]

[23] Just over half of commuters (52%) used a car as the main means of transport for their commute in Switzerland, compared to about 95% of workers commuting in the United States. See (https://www.bfs.admin.ch/bfs/en/home/statistics/mobility-transport/passenger-transport/commuting.html) and (https://www.bts.gov/content/commuting-work).

According to our results at this point, we have found that while elderly change their health investment behaviors after retirement in many countries, there are differences across countries. Our only conclusive result is that elderly Americans improved their health investment behaviors after retirement because all three lifestyle indicators improved, though the magnitudes were small. In other countries, changes to some indicators improved while others deteriorated. Thus, from the analysis of the age 50-75 sample, we cannot conclude a unified result about health investment behavior after retirement. The behavior of the elderly varies greatly from country to country and does not change much in most cases. In next subsection, we check the robustness of these results. After that, we investigate the cause of these differences by separating the sample and analyzing heterogeneity.

### 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, elderly may change their lifestyle habits gradually, retiring partially first. As lifestyle changes may vary depending on the level of retirement, other definitions of retirement are considered. The results are shown in Table 5. We report only coefficients of each retirement definition.

First, we considered "PR", which is "CR"+ partly retired +not in the labor force, and found similar results as those of "CR". The few differences are that the Swiss did not change their behaviors for the case of "PR". Elderly with status "partly retired" and "not in labor force" changed their lifestyle habits similarly to those who were "retired". Thus, although elderly in many countries appear to change their lifestyle rapidly after retirement, this change seems to be more gradual among the Swiss. Notwithstanding the Swiss case, it appears that our main analysis of retirement affects on health behaviors is relatively robust against varying recognitions of retirement, as captured by "PR".

Second, we considered "NW" (not working for pay) as an alternative definition of retirement, as this is commonly used in the literature (e.g. Coe and Zamarro (2011) and Bonsang et al. (2012)). "NW" includes the unemployed and workers who are not paid, such as people helping with housework or volunteers. There are potentially some differences in the behaviors of this retirement definition compared to the "CR" definition in the main analysis. For example, unemployed elderly may decrease alcohol consumption in preparation for job interviews compared to elderly who were retired. Additionally, volunteers might not increase physical activity after completing that work in the same way as retirees do. As for the results, we found similar results for the U. S., England and Germany, with the sign of the coefficients as expected. The results for France, Denmark, Switzerland and Japan differ for some behaviors, however. We can conjecture that unemployed elderly in these countries changed 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 (column (3) and (6) in Table 6 $\sim$ 8), the countries whose first stage F values satisfied critical values. This is because we would like to distinguish whether differences in main results result from gender heterogeneity or from the accuracy of estimates. Although different tendencies were observed for males and females in the U. S., similar results by gender were observed in England and France. Specifically, in the U.S., alcohol consumption decreased among elderly males but increased among females. Meanwhile, elderly men decreased moderate exercise while elderly females increased vigorous exercise. In England, both elderly males and females increased drinking and physical activity, but did not change smoking habits. In France, neither gender changed behaviors substantially, although elderly men did show an increased probability of drinking. In both England France, although both genders changed their behaviors in the same direction, the size of the coefficients are different between elderly males and females in both England and France.

These patterns may possibly be due to differences in the ways that men and women work as they age. One explanation might be opportunity cost, with elderly males increasing exercise more after retirement than elderly females if the male wage is higher prior to retirement. However, in the United States and England, females increased exercise more than men post retirement, and the impacts are larger for elderly females in England. This suggests that this might not be explainable by Grossman's model. Additionally, some gender differences are not explained in Grossman (1972)'s model, such as preferences for exercise between male and female. Summing up these results, it appears clear that there exist heterogeneity between male and female elderly. [24]

### 4.4 Heterogeneity by Age

In this section, we analyze any heterogeneity of the effects of 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 used 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 aids identification power.

From the 50-75 age range of the main analysis, we first restricted it to age 50-70. Then, as we used $1\{age_{it} \geq A_i^{eb}\}$ and $1\{age_{it} \geq A_i^{fb}\}$ as the IV in this paper, we further restricted the age range from $(A_i^{eb} - 5)$ to $(A_i^{fb} + 5)$, and called this range "+-5". As elderly males and females have a different pension eligibility age, we report here the results by gender.

We found from the beginning of this analysis that the IVs did 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 estimating flexibly by controlling the cubic term of age and the identification power of the IVs. [25] Because of the reduced power of instrumental variables, we found significant results for

[24] For the countries in which first stage F values did not exceed critical values, we observed similar tendencies in Denmark but different results for Germany and Switzerland.

[25] The IVs could work when we included only $age_{it}$ and $age_{it}^2$ as the control variables, but the signs of the coefficients are different significantly between FE and FE-IV depending on the DWH test, so that the coefficients are not

first stage estimation only for the United States, England and France. In these three countries, we found that the elderly may quit their jobs 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. Results for age range “+-5” are shown in columns (5) and (8) of Tables 6, 7 and 8. In addition, results for age range “50-70” are shown in columns (4) and (7) of Tables 6, 7 and 8.

For the U.S., results were robust for some behaviors such as probability of drinking by males and vigorous physical activity by females, but not for other behaviors. One notable point is that the model for the probability of alcohol consumption by females and smoking by males changed depending on the specific age restrictions utilized. This suggest the identification power depends on age restrictions.

Some of these same tendencies were also observed for England and France. Results for England were robust for male and female moderate physical activity and the amount of alcohol consumption by males. Results for France were robust for male probability of drinking. But the results for most of the behaviors are not robust for each country. In addition, the model for moderate physical activities in England and amount of alcohol consumption by females in France changed depending on the specific age restrictions utilized. Thus we can state that heterogeneity in age and gender does exist, so that the results are not robust when analyzed in detail. For the other countries analyzed, in which the IVs did not work perfectly, robustness to age differences is less clear, but the results of this analysis are presented in Tables 16 $\sim$ 19 of Appendix D.

To sum up, in this section, we analyzed two other possible age ranges but could only obtain robust results 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 some age range in some countries. This tradeoff between comparative precision and IV power is a limitation of this and any international comparative paper using this methodology.

interpretable.

### 4.5 Discussion of The Mechanism

In this section, for simplicity, we discuss the effects of retirement on health investment behaviors as the mechanism of the impact of retirement on health outcomes, drawing on the results from Nishimura et al. (2018) and the medical literature discussed in section 2. [26]

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' (ADL), which is a term used in healthcare 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 on self-report health, depression, BMI, and ADL. [27] Thus, as elderly see an improvement in their self-reported health, depression and ADL, but a deterioration in BMI, [28] we can say that the health of elderly generally improves after retirement.

To sum up, despite our attempt to enable international comparisons by using harmonized methodologies (Table 4), there is no unified view of how health investment behaviors change due to heterogeneity by age, gender and across countries. For example, only the United States showed an unequivocal post-retirement improvement in health investment behaviors, so changes in behavior cannot necessarily be a determinant of observed improvements in health after retirement. Furthermore, even in the U. S., health outcomes did not unequivocally improve, with some measures deteriorating even though health investment behaviors improved. Consequently, as 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.

As for alcohol consumption, it decreased post-retirement in the U.S. and Switzerland but increased in England, Germany and Denmark. Although the medical literature suggests that reduced alcohol can lead to improvement in cognition, Nishimura et al. (2018) finds that cognition deteriorated among elderly American after retirement. Furthermore, while the medical literature finds

[26] 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.

[27] The results are summarized in Table 20 in Appendix E.

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

alcohol consumption to be generally associated with increased depression, we found that alcohol consumption increased while depression decreased after retirement in England and Denmark. Thus we cannot find a definitive relationship between retirement, alcohol and health outcomes from the above results.

Similar tendencies were observed for smoking. Elderly in the U.S., Denmark and Japan decreased smoking significantly, but Nishimura et al. (2018) finds no improvements in health indicators in any of those three countries. Further, while Nishimura et al. (2018) finds that depression improved after retirement in the U.S. and Denmark, we found this to be the case in England, where smoking habits did not improve.

As for physical activity, Penedo and Dahn (2005), and Stathopoulou et al. (2006) find that increasing exercise time may lead to improvement in depression and ADL. It also helps to reduce BMI. Although we found that elderly in the U.S. and England increased physical activity after retirement, which are results robust to age range and retirement definition, and Nishimura et al. (2018) also finds reduced levels of depression and improved ADL among the elderly of both countries, they also found that BMI increased. Thus we can conjecture that while changes in physical activity do not directly lead to specific health outcomes. In contrast, we conclude that there is no contradiction between three relationships: retirement, physical activities (health investment behaviors) and ADL (health outcomes). We think that only exercise may work as the mechanism of the effects of retirement on some health outcomes (ADL).

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. Mental improvement is not a consequence of health investment, but is simply a consequence of leaving the workplace and experiencing relief from work-related stress. However, from the results in the United States and England, it seems that retirement may have an impact on exercise and ADL. Based on this, it is possible that health investment (exercise) may be below optimal levels due to working hours constraints and, if that is the case, then there is a role for government to introduce policies to encourage health investment.

### 4.6 Possible Factors Leading to Observed Health Investment Behaviors

In this section, we discuss factors that might explain the differences in the observed health investment behaviors after retirement, which we have found to be heterogeneous across countries. Among several possible candidates, we offer two factors connected to the incentive to invest in health stock: health care access and life expectancy.

Addressing physical activity first, it is expected that investment in exercise will be increased after retirement when health care access is low and life expectancy is high, as elderly have more time to invest in their health after retirement and the payoff will be extended over a longer period of time. For other behaviors, the relationship is less clear as, for example, while it is expected that smoking and drinking will decrease when health care access is low and life expectancy is high if pre-retirees are smoking and drinking to relieve work-related stress. However, if this is the case, then workers will no longer need that outlet to reduce stress.

Figure 3 (a), (b) and (c) shows the relationship between the Healthcare Access and Quality (HAQ) Index and the ratio of the number of coefficients that are 5% statistically significant. The HAQ index was proposed by the GBD 2015 Health Care Access and Quality Collaborators (Barber et al. (2017)) and GBD 2016 Health Care Access and Quality Collaborators (Fullman et al. (2018)). In the former study, the HAQ index is constructed based on a rescaled log age-standardized risk standard death rate by cause to a scale of 0 to 100, [29] and they find a correlation between the HAQ index and health-care access indicators such as health expenditure per capita and proportion of population with formal health coverage. For this paper, we used the more recent version of the study. The horizontal axis in Figure 3 shows the rank of the HAQ index reported by GBD 2016 Health Care Access and Quality Collaborators (2018). In plotting the vertical axes of (a), (b) and (c), we placed the estimated coefficients into one of two categories. Health investment behavior is "improved" when the estimated coefficient is 5 percent significantly negative for alcohol consumption and smoking, and 5 percent significantly positive for physical activity. It is "deteriorated" when the estimated coefficient is 5 percent significantly positive for alcohol consumption and smoking, and

[29] Based on the rescaled death rate, four approaches including principal components analysis (PCA), explanatory factor analysis, arithmetic mean and geometric mean were tested to construct the HAQ index, and the PCA derived HAQ Index was selected.

5 percent significantly negative for physical activity. For each country, we calculated the ratio of the number of “improved” estimated coefficients (Figure 3 (a)), deteriorated estimated coefficients (Figure 3 (b)) and the other coefficients (“unchanged”) (Figure 3 (c)), using the ratio of the number of these estimated coefficients in each country as the vertical axis. [30]

From Figure 3 (c), there is a clear relationship between the rank of the HAQ index and the ratio of the number of “improved” estimated coefficients, for as the rank of the HAQ index becomes higher (i.e. as health care access becomes lower), the ratio of the number of “improved” coefficients for behaviors becomes larger. While here we discuss the relationship between the level of health care and the ratio of the number of “improved” estimated coefficients, it is possible that the difference in the level of health care access in these countries is one of the factors explaining the change in health investment behaviors. In Figure 3 (a), we can also observe the relationship between the rank of the HAQ index and the ratio of the ratio of the number of “unchanged” coefficients. As the rank of the HAQ index becomes higher (i.e. health care access falls), the ratio of the number of “unchanged” coefficients for health behaviors falls. In Figure 3 (b), we do not observe a strong relationship. The relationship between health care access and changes in health investment behaviors is an area for future work.

Similarly, Figure 4 (a), (b) and (c) shows the relationship between life expectancy and the ratios of estimated coefficients. The horizontal axis shows the life expectancy at 2000 in each country. [31]

Because the HAQ Index rank and life expectancy are correlated, it is difficult to check the effect of only life expectancy in Figure 4 (a), (b) and (c). However, since Germany, France and Denmark have similar ranks on the HAQ index , we roughly checked the relationship between life expectancy and the ratio of the number of the estimated coefficients among these three countries. However, according to 4 (a), (b) and (c), in all three categories (“improved”, “deteriorated”, “unchanged”), there appears to not be a strong relationship between life expectancy and any of the ratios of estimated coefficients, so further investigation of the factors explaining differences in the changes in health investment behaviors after retirement is warranted.

[30] Though there are other possibilities, we considered only this measure for the vertical axis.
[31] Source: https://databank.worldbank.org/reports.aspx?source=2&series=SP.DYN.LE00.IN&country=

## 5 Conclusions

This study examined the effects of retirement on health investment behaviors in seven developed countries. We generalized the findings of Eibich (2015) and other studies by providing a framework for international comparison, and we contributed new empirical evidence to the literature. Moreover, we examined 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.

Our results suggest that the elderly change their health investment behaviors in some way after retirement, but the patterns in these changes vary across each country as well as by age and gender. Accordingly, there is no unified view about the effects of retirement on health investment behaviors. Following a verification of the results of Nishimura et al. (2018), we suggest the possibility that, with the exception of physical activity, health investment behaviors are not necessarily key factors in the heterogeneities of the changes in health outcomes of the elderly after retirement.

The study has some limitations. First among them is our use of the same approach as Nishimura et al. (2018) and other extant studies in the literature to analyze 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 deeply. 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. Although health care access and life expectancy were explicitly examined in this study, other social and environmental factors in the workplace may be important and provide more clarity as to the specific mechanism. A more comprehensive study of 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 were working in physically demanding jobs? Heterogeneity in education is important to consider as well.

Finally, choice of age range is a fundamental challenge for international comparative studies in which the pensionable age differs according to countries analyzed. In this study, a wide range of ages 50-75 was chosen for the main analysis in order to accommodate all the countries sampled, but this limits IV power. Another 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. In order to make international comparisons of coefficients, all conditions should be essentially the same. At the same time, however, if they are identical, a source of variation in 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 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 Israe | 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)

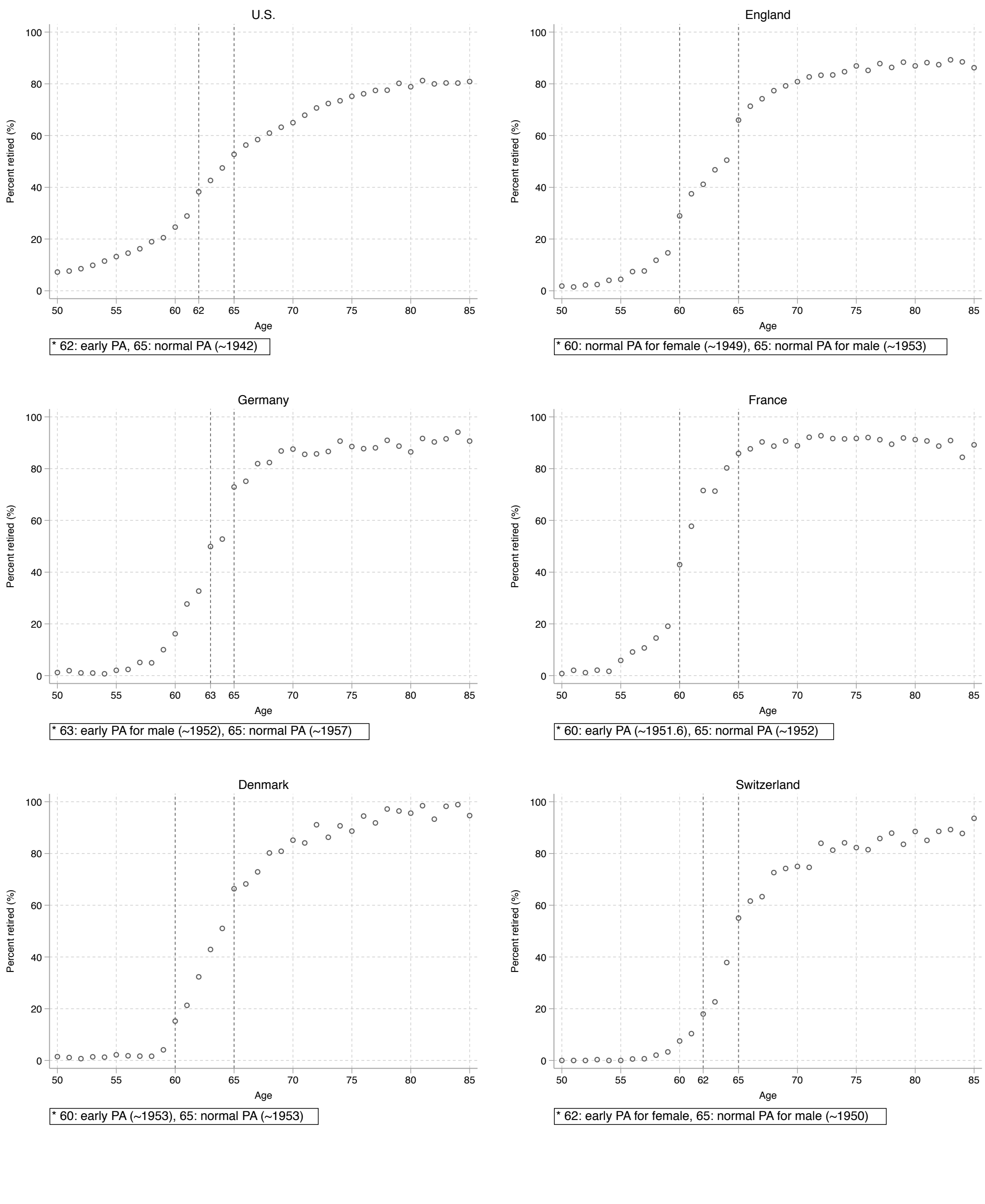


Figure 2: The Proportion of Retired Elderly By Age and Country (Japan)

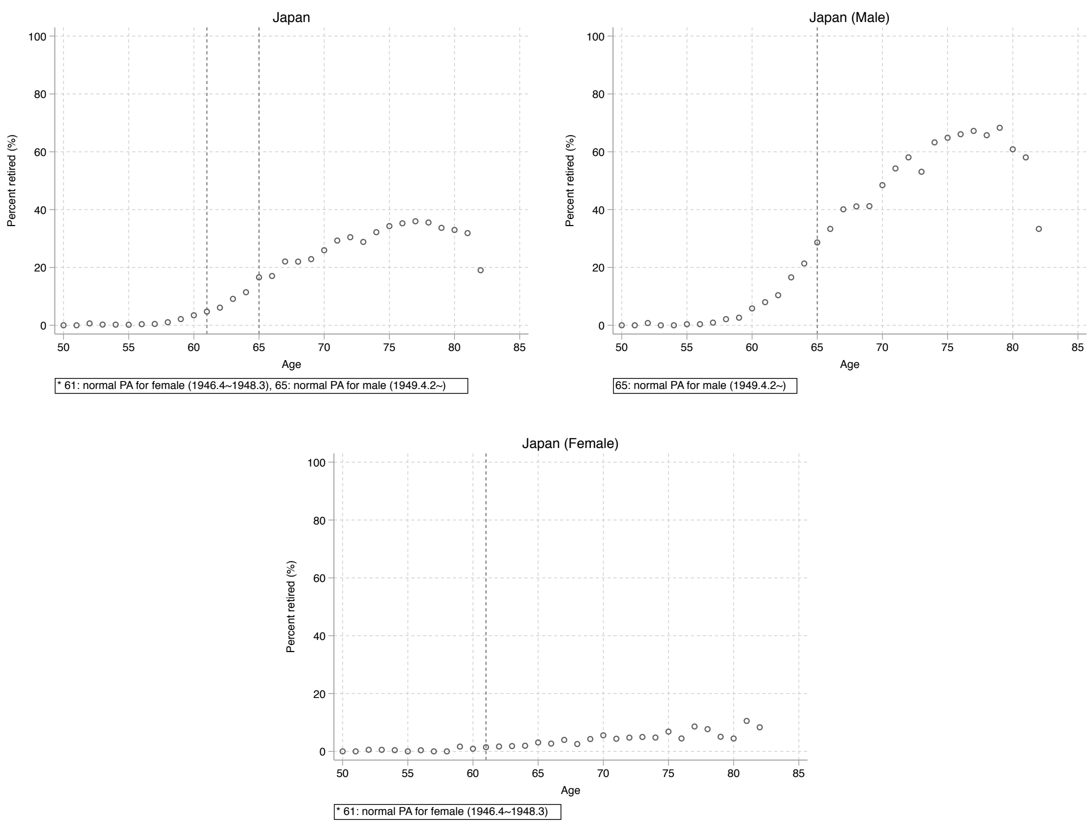


Table 4: Effects of Retirement on Health Investments in 7 Countries

| | Alcohol consumption | | | | | Physical activity | |
|---|---|---|---|---|---|---|---|
| | **Y/N** | **> 3 d/w** | **> 5 d/w** | **Amount** | **Smoking** | **Vigorous** | **Moderate** |
| **U.S.** | | | | | | | |
| Retired | -0.005 | -0.005** | -0.004* | -0.022** | -0.012*** | 0.022*** | -0.004 |
| | (0.003) | (0.002) | (0.002) | (0.009) | (0.002) | (0.005) | (0.005) |
| 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 |
| Model (DWH p) | FE(0.76) | FE(0.45) | FE(0.21) | FE(0.97) | FE(0.21) | FE(0.77) | FE(0.76) |
| **England** | | | | | | | |
| Retired | 0.001 | 0.016** | 0.004 | 0.029 | -0.002 | 0.014** | 0.133*** |
| | (0.004) | (0.007) | (0.006) | (0.020) | (0.003) | (0.007) | (0.034) |
| 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 |
| Model (DWH p) | FE(0.30) | FE(0.83) | FE(0.76) | FE(1.00) | FE(0.97) | FE(0.89) | FE-IV(0.00) |
| **Germany** | | | | | | | |
| Retired | -0.029 | 0.049** | 0.026 | 0.141 | 0.006 | -0.054* | 0.026 |
| | (0.020) | (0.022) | (0.021) | (0.235) | (0.018) | (0.028) | (0.017) |
| 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 |
| Model (DWH p) | FE(0.62) | FE(0.16) | FE(0.56) | FE(0.39) | FE(0.41) | FE(0.31) | FE(0.89) |
| **France** | | | | | | | |
| Retired | 0.016 | 0.019 | -0.003 | 0.043 | 0.005 | -0.015 | 0.001 |
| | (0.015) | (0.017) | (0.019) | (0.186) | (0.012) | (0.025) | (0.017) |
| 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 |
| Model (DWH p) | FE(0.42) | FE(0.34) | FE(0.91) | FE(0.36) | FE(0.93) | FE(0.46) | FE(0.31) |
| **Denmark** | | | | | | | |
| Retired | -0.013 | -0.012 | 0.022 | 1.705* | -0.279** | 0.454* | -0.017 |
| | (0.013) | (0.018) | (0.021) | (0.870) | (0.140) | (0.245) | (0.016) |
| 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 |
| Model (DWH p) | FE(0.86) | FE(0.11) | FE(0.14) | FE-IV(0.03) | FE-IV(0.03) | FE-IV(0.06) | FE(0.98) |
| **Switzerland** | | | | | | | |
| Retired | -0.004 | -0.008 | 0.018 | -0.946* | 0.026 | -0.036 | -0.049** |
| | (0.018) | (0.022) | (0.019) | (0.495) | (0.016) | (0.031) | (0.020) |
| 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 |
| Model (DWH p) | FE(0.13) | FE(0.32) | FE(0.42) | FE(0.23) | FE(0.24) | FE(0.18) | FE(0.21) |
| **Japan** | | | | | | | |
| Retired | -0.001 | -0.006 | 0.010 | 0.013 | -0.026** | 0.024 | |
| | (0.018) | (0.018) | (0.018) | (0.060) | (0.012) | (0.015) | |
| 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 | |
| Model (DWH p) | FE(0.69) | FE(0.93) | FE(0.79) | FE(0.52) | FE(0.42) | FE(0.74) | |

[1] * * $p < .1$, ** ** $p < .05$, *** *** $p < .01$ , Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size).

[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.

Table 5: Robustness Check of Retirement Definition

| | Alcohol consumption | | | | | | | | | | Physical activity | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Y/N | | > 3 d/w | | > 5 d/w | | Amount | | Smoking | | Vigorous | | Moderate | |
| **U.S.** | | | | | | | | | | | | | | |
| **CR** : Coef./Model | -0.005 | FE§ | -0.005 | FE§ | -0.004 | FE§ | -0.022 | FE§ | -0.012 | FE§ | 0.022 | FE§ | -0.004 | FE§ |
| **PR** : Coef./Model | -0.013 | FE§ | -0.008 | FE§ | -0.005 | FE§ | -0.028 | FE§ | -0.013 | FE§ | 0.024 | FE§ | -0.004 | FE§ |
| **NW** : Coef./Model | -0.021 | FE§ | -0.009 | FE§ | -0.004 | FE§ | -0.043 | FE§ | -0.014 | FE§ | 0.021 | FE§ | -0.008 | FE§ |
| **England** | | | | | | | | | | | | | | |
| **CR** : Coef./Model | 0.001 | FE§ | 0.016 | FE§ | 0.004 | FE§ | 0.029 | FE§ | -0.002 | FE§ | 0.014 | FE§ | 0.133 | FE-IV§ |
| **PR** : Coef./Model | 0.001 | FE§ | 0.016 | FE§ | 0.003 | FE§ | 0.027 | FE§ | -0.001 | FE§ | 0.029 | FE§ | 0.140 | FE-IV§ |
| **NW** : Coef./Model | -0.004 | FE§ | 0.012 | FE§ | -0.003 | FE§ | 0.001 | FE§ | -0.004 | FE§ | 0.014 | FE§ | 0.238 | FE-IV§ |
| **Germany** | | | | | | | | | | | | | | |
| **CR** : Coef./Model | -0.029 | FE§ | 0.049 | FE§ | 0.026 | FE§ | 0.141 | FE | 0.006 | FE§ | -0.054 | FE§ | 0.026 | FE§ |
| **PR** : Coef./Model | -0.029 | FE§ | 0.052 | FE§ | 0.016 | FE§ | 0.257 | FE | 0.006 | FE§ | -0.044 | FE§ | 0.025 | FE§ |
| **NW** : Coef./Model | 0.004 | FE | 0.047 | FE | -0.002 | FE | -0.006 | FE | 0.009 | FE | -0.078 | FE | -0.009 | FE |
| **France** | | | | | | | | | | | | | | |
| **CR** : Coef./Model | 0.016 | FE§ | 0.019 | FE§ | -0.003 | FE§ | 0.043 | FE§ | 0.005 | FE§ | -0.015 | FE§ | 0.001 | FE§ |
| **PR** : Coef./Model | 0.018 | FE§ | 0.016 | FE§ | 0.006 | FE§ | 0.121 | FE§ | 0.006 | FE§ | -0.035 | FE§ | 0.011 | FE§ |
| **NW** : Coef./Model | 0.009 | FE§ | 0.008 | FE§ | 0.026 | FE§ | 0.080 | FE§ | 0.017 | FE§ | -0.052 | FE§ | 0.014 | FE§ |
| **Denmark** | | | | | | | | | | | | | | |
| **CR** : Coef./Model | -0.013 | FE | -0.012 | FE | 0.022 | FE | 1.705 | FE-IV | -0.279 | FE-IV | 0.454 | FE-IV | -0.017 | FE |
| **PR** : Coef./Model | -0.008 | FE | -0.010 | FE | 0.029 | FE | 1.691 | FE-IV | -0.275 | FE-IV | 0.492 | FE-IV | -0.020 | FE |
| **NW** : Coef./Model | 0.012 | FE | -0.778 | FE-IV | 0.042 | FE | -0.020 | FE | -0.573 | FE-IV | 1.055 | FE-IV | 0.001 | FE |
| **Switzerland** | | | | | | | | | | | | | | |
| **CR** : Coef./Model | -0.004 | FE§ | -0.008 | FE§ | 0.018 | FE§ | -0.946 | FE§ | 0.026 | FE§ | -0.036 | FE§ | -0.049 | FE§ |
| **PR** : Coef./Model | 0.236 | FE-IV | -0.023 | FE | -0.006 | FE | -0.843 | FE | 0.024 | FE | -0.043 | FE | -0.025 | FE |
| **NW** : Coef./Model | -0.006 | FE | -0.028 | FE | 0.010 | FE | -0.457 | FE | 0.009 | FE | -0.062 | FE | -0.043 | FE |
| **Japan** | | | | | | | | | | | | | | |
| **CR** : Coef./Model | -0.001 | FE | -0.006 | FE | 0.010 | FE | 0.013 | FE | -0.026 | FE | 0.024 | FE | | |
| **PR** : Coef./Model | -0.015 | FE | -0.011 | FE | 0.017 | FE | -0.031 | FE | -0.008 | FE | † | | | |
| **NW** : Coef./Model | -0.038 | FE | -0.028 | FE | -0.019 | FE | -0.082 | FE | -0.027 | FE | † | | | |

[1] $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size) , † 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 added 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 | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | 50-75 | 50-70 | 50-75 | 50-70 | 57-71 | 50-75 | 50-70 | 57-71 |
| Alcohol consumption: Y/N | | | | | | | | |
| Coefficient | -0.005 | -0.005 | -0.018 | -0.015 | -0.013 | 0.119 | 0.193 | 0.007 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE-IV§ | FE-IV§ | FE§ |
| Alcohol consumption: > 3 d/w | | | | | | | | |
| Coefficient | -0.005 | -0.005 | -0.011 | -0.008 | -0.004 | -0.002 | -0.003 | -0.004 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Alcohol consumption: > 5 d/w | | | | | | | | |
| Coefficient | -0.004 | -0.002 | -0.011 | -0.008 | -0.006 | 0.001 | 0.002 | 0.000 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Alcohol consumption: Amount | | | | | | | | |
| Coefficient | -0.022 | -0.025 | -0.053 | -0.056 | -0.013 | -0.003 | -0.005 | -0.001 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Smoking | | | | | | | | |
| Coefficient | -0.012 | -0.014 | 0.055 | 0.063 | -0.015 | -0.009 | -0.010 | -0.004 |
| Model | FE§ | FE§ | FE-IV§ | FE-IV§ | FE§ | FE§ | FE§ | FE§ |
| Physical activity: Vigorous | | | | | | | | |
| Coefficient | 0.022 | 0.021 | 0.005 | 0.008 | 0.020 | 0.033 | 0.029 | 0.034 |
| Model | FE§ | FE§ | FE§ | FE§ | FE | FE§ | FE§ | FE |
| Physical activity: Moderate | | | | | | | | |
| Coefficient | -0.004 | -0.009 | -0.015 | -0.020 | -0.014 | 0.003 | -0.002 | -0.611 |
| Model | FE§ | FE§ | FE§ | FE§ | FE | FE§ | FE§ | FE-IV |

[1] $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size) , † 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 added 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 | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | 50-75 | 50-70 | 50-75 | 50-70 | 60-70 | 50-75 | 50-70 | 55-67 |
| Alcohol consumption: Y/N | | | | | | | | |
| Coefficient | 0.001 | 0.001 | 0.004 | 0.002 | -0.003 | 0.001 | 0.001 | 0.000 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Alcohol consumption: > 3 d/w | | | | | | | | |
| Coefficient | 0.016 | 0.012 | 0.021 | 0.019 | 0.006 | 0.014 | 0.010 | 0.016 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Alcohol consumption: > 5 d/w | | | | | | | | |
| Coefficient | 0.004 | 0.003 | 0.005 | 0.002 | 0.007 | 0.002 | 0.002 | 0.005 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Alcohol consumption: Amount | | | | | | | | |
| Coefficient | 0.029 | 0.049 | 0.098 | 0.131 | 0.099 | -0.015 | -0.008 | -0.008 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Smoking | | | | | | | | |
| Coefficient | -0.002 | -0.004 | -0.002 | -0.004 | -0.009 | -0.003 | -0.005 | -0.009 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Physical activity: Vigorous | | | | | | | | |
| Coefficient | 0.014 | 0.017 | 0.019 | 0.017 | 0.006 | 0.011 | 0.017 | 0.021 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Physical activity: Moderate | | | | | | | | |
| Coefficient | 0.133 | 0.122 | 0.097 | 0.027 | 0.026 | 0.146 | 0.025 | 0.022 |
| Model | FE-IV§ | FE-IV§ | FE-IV§ | FE§ | FE§ | FE-IV§ | FE§ | FE§ |

[1] $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic $\geq$ Stock and Yogo's critical value(10 % maximal IV size) , † 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 added the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

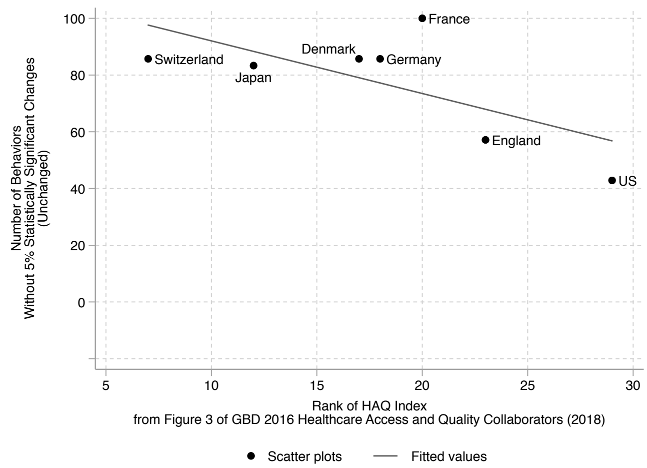
Table 8: Effects of Retirement by Age Range and Gender (France)

| | Full Sample | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | 50-75 | 50-70 | 50-75 | 50-70 | 55-70 | 50-75 | 50-70 | 55-70 |
| Alcohol consumption: Y/N | | | | | | | | |
| Coefficient | 0.016 | 0.028 | 0.030 | 0.037 | 0.045 | 0.007 | 0.022 | 0.031 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Alcohol consumption: > 3 d/w | | | | | | | | |
| Coefficient | 0.019 | 0.225 | 0.029 | 0.048 | 0.052 | 0.009 | 0.191 | 0.243 |
| Model | FE§ | FE-IV§ | FE§ | FE§ | FE§ | FE§ | FE-IV§ | FE-IV§ |
| Alcohol consumption: > 5 d/w | | | | | | | | |
| Coefficient | -0.003 | 0.003 | -0.012 | -0.001 | -0.014 | 0.001 | -0.001 | 0.008 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Alcohol consumption: Amount | | | | | | | | |
| Coefficient | 0.043 | 0.056 | 0.416 | 0.515 | 0.359 | -0.160 | -2.665 | -0.170 |
| Model | FE§ | FE§ | FE§ | FE | FE | FE§ | FE-IV§ | FE |
| Smoking | | | | | | | | |
| Coefficient | 0.005 | -0.000 | 0.000 | -0.001 | 0.006 | 0.002 | -0.006 | -0.017 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Physical activity: Vigorous | | | | | | | | |
| Coefficient | -0.015 | -0.020 | -0.044 | -0.041 | -0.021 | 0.004 | -0.007 | -0.001 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ |
| Physical activity: Moderate | | | | | | | | |
| Coefficient | 0.001 | 0.011 | 0.029 | 0.028 | 0.009 | -0.018 | 0.215 | -0.008 |
| Model | FE§ | FE§ | FE§ | FE§ | FE§ | FE§ | FE-IV§ | FE§ |

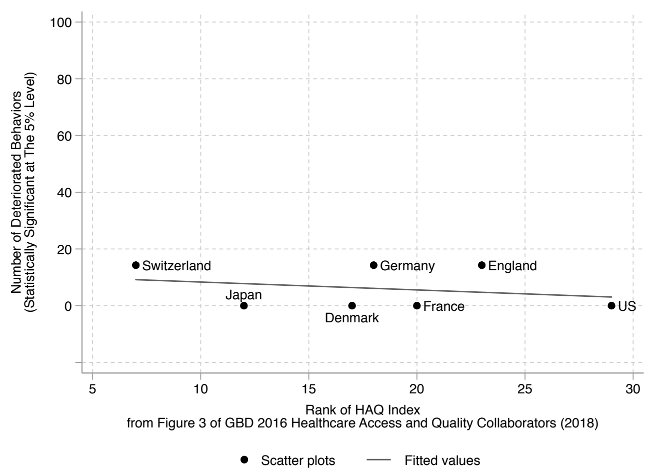
[1] $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size) , † instrumental variables are insignificant in 1st stage regression.

[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 added the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

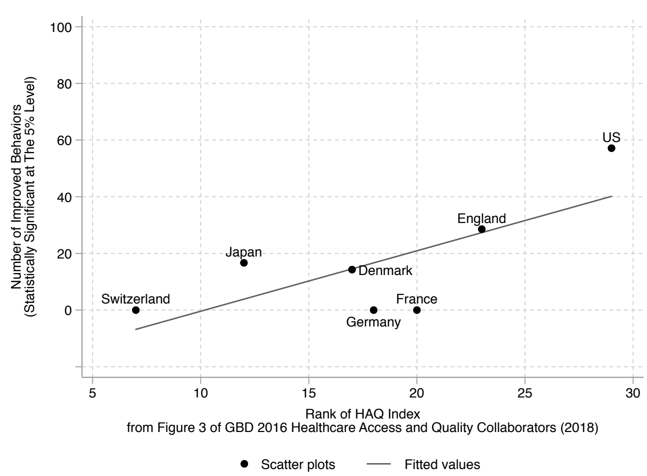
Figure 3: Relationship between Estimated Coefficients and the HAQ Index




(a) Unchanged



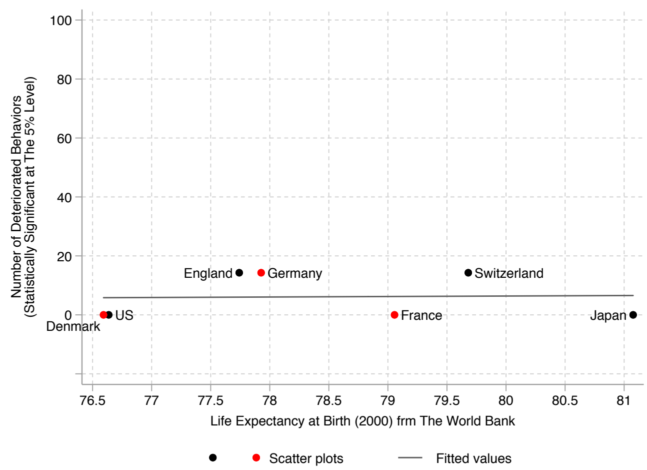

(b) Deteriorated



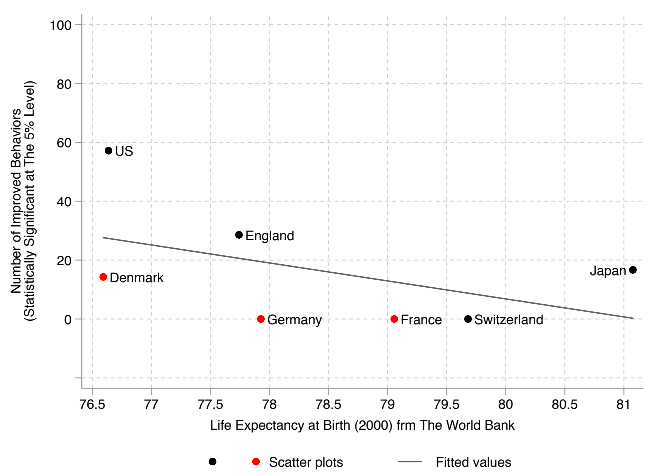

(c) Improved

Figure 4: Relationship between Estimated Coefficients and Life Expectancy


(a) Unchanged




(b) Deteriorated




(c) Improved

# Appendix A: Pension Eligibility Age

In this section, we describe how pensionable age was 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 was 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 was 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 was successfully accessed were the U.S., England, Germany, France, Denmark, Switzerland, Czech, Estonia, Japan, China [32] , 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 did not analyze the countries where detailed information about the pension eligibility age was 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.

[32] 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 9: 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 10: 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 Tables 11 $\sim$ 13 show the covariates of the 2nd stage estimates.

Table 11 shows the results for the probability of drinking habits. We found that the age term has significant effects on drinking habits in many countries, with the linear term negative, the quadratic term positive, and the cubic term with very small effects. As whether elderly drink alcohol or not is dependent on age, methods for controlling for age are important. In contrast, we did not find significant effects for other variables. Drinking habits may not depend very much on economic conditions or family situation in many countries. The United States is the only exception, with those with high incomes and wealth consuming more. In Japan, the home ownership rate is higher than in other developed countries, and houses often function as assets. The trend is similar to that of the United States in that the amount of assets influences consumption. As shown in Table 12, age is an important covariate for smoking. What is an important variable depends on lifestyle. For example, when it comes to smoking, the higher the income of Japanese and Americans, the more likely they are to smoke, while for British people, the higher their assets, the less likely they are to smoke. From Table 13, we see that age is less important for exercise. This may be why we found exercise to be robust to various age ranges we analyzed.

Table 11: Effects of Retirement on Drinking Probability (Age50-75)

| | US | | England | | Germany | | France | | Denmark | | Switzerland | | Japan | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | 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 12: Effects of Retirement on Smoking Probability (Age50-75)

| | US | | England | | Germany | | France | | Denmark | | Swizterland | | Japan | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | 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) |
| $\text{Age}^2$ | -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) |
| $\text{Age}^3$ | 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 13: Effects of Retirement on Moderate Activity (Age50-75)

| | US | | England | | Germany | | France | | Denmark | | Swizterland | | Japan | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | FE-IV | FE | 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 14: Effects of Pensionable Age on Retirement in 7 Countries

| | 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: Other Results (Results for FE and FE-IV and Heterogeneous Effects for Some Countries

Appendix D presents other results that are not discussed in main text. While Table 4 in the main text shows the results of either FE or FE-IV depending on DWH test, Table 15 here shows both the FE and FE-IV results.

Additionally, while section 4 of the main text discusses heterogeneous effects by gender and age for the United States, England and France in Table 16 $\sim$ 19 show the results for other countries: Germany, Denmark, Switzerland and Japan.

Table 15: Effects of Retirement on Health Investments (Age 50-75, FE and FE-IV)

| | Alcohol consumption | | | | | Physical activity | |
|---|---|---|---|---|---|---|---|
| | Y/N | > 3 d/w | > 5 d/w | Amount | Smoking | Vigorous | Moderate |
| **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 |
| DWH p | 0.76 | 0.45 | 0.21 | 0.97 | 0.21 | 0.77 | 0.76 |
| **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 |
| DWH p | 0.30 | 0.83 | 0.76 | 1.00 | 0.97 | 0.89 | 0.00 |
| **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 |
| DWH p | 0.62 | 0.16 | 0.56 | 0.39 | 0.41 | 0.31 | 0.89 |
| **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 |
| DWH p | 0.42 | 0.34 | 0.91 | 0.36 | 0.93 | 0.46 | 0.31 |
| **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 |
| DWH p | 0.86 | 0.11 | 0.14 | 0.03 | 0.03 | 0.06 | 0.98 |
| **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 |
| DWH p | 0.13 | 0.32 | 0.42 | 0.23 | 0.24 | 0.18 | 0.21 |
| **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 | |
| DWH p | 0.69 | 0.93 | 0.79 | 0.52 | 0.42 | 0.74 | |

[1] * * $p < .1$, ** ** $p < .05$, *** *** $p < .01$ , Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size).

[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.

Table 16: Effects of Retirement by Age Range and Gender (Germany)

| | Full Sample | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | 50-75 | 50-70 | 50-75 | 50-70 | 58-70 | 50-75 | 50-70 | 55-70 |
| Alcohol consumption: Y/N | | | | | | | | |
| Coefficient | -0.029 | -0.032 | -0.002 | -0.022 | | -0.046 | -0.041 | -0.042 |
| Model | FE§ | FE | FE | FE | † | FE | FE | FE |
| Alcohol consumption: > 3 d/w | | | | | | | | |
| Coefficient | 0.049 | 0.068 | 0.028 | 0.039 | | 0.067 | 0.089 | 0.079 |
| Model | FE§ | FE | FE | FE | † | FE | FE | FE |
| Alcohol consumption: > 5 d/w | | | | | | | | |
| Coefficient | 0.026 | 0.046 | 0.051 | 0.068 | | 0.011 | 0.027 | 0.025 |
| Model | FE§ | FE | FE | FE | † | FE | FE | FE |
| Alcohol consumption: Amount | | | | | | | | |
| Coefficient | 0.141 | 0.161 | 0.654 | 0.922 | 0.699 | -0.224 | -0.356 | -0.297 |
| Model | FE | FE | FE | FE | FE | FE | FE | FE |
| Smoking | | | | | | | | |
| Coefficient | 0.006 | 0.012 | 0.008 | 0.332 | | 0.002 | -0.000 | 0.011 |
| Model | FE§ | FE | FE | FE-IV | † | FE | FE | FE |
| Physical activity: Vigorous | | | | | | | | |
| Coefficient | -0.054 | -0.031 | -0.032 | -0.010 | | -0.507 | -0.052 | -0.048 |
| Model | FE§ | FE | FE | FE | † | FE-IV | FE | FE |
| Physical activity: Moderate | | | | | | | | |
| Coefficient | 0.026 | 0.029 | 0.005 | 0.004 | | 0.040 | 0.049 | 0.054 |
| Model | FE§ | FE | FE | FE | † | FE | FE | FE |

[1] $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size) , † 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 added the residential area dummy variables into the estimation equation for the U.S., England, and Japan.

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

| | Full Sample | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | 50-75 | 50-70 | 50-75 | 50-70 | 55-70 | 50-75 | 50-70 | 55-70 |
| Alcohol consumption: Y/N | | | | | | | | |
| Coefficient | -0.013 | -0.010 | -0.023 | -0.242 | | -0.003 | -0.004 | 0.732 |
| Model | FE | FE | FE | FE-IV | † | FE | FE | FE-IV |
| Alcohol consumption: > 3 d/w | | | | | | | | |
| Coefficient | -0.012 | -0.300 | 0.005 | 0.015 | | -0.024 | -0.036 | -0.054 |
| Model | FE | FE-IV | FE | FE | † | FE | FE | FE |
| Alcohol consumption: > 5 d/w | | | | | | | | |
| Coefficient | 0.022 | 0.021 | 0.033 | 0.041 | | 0.014 | 0.006 | -0.007 |
| Model | FE | FE | FE | FE | † | FE | FE | FE |
| Alcohol consumption: Amount | | | | | | | | |
| Coefficient | 1.705 | 1.871 | -0.037 | -0.025 | | 1.433 | 1.788 | |
| Model | FE-IV | FE-IV | FE | FE | † | FE-IV | FE-IV | † |
| Smoking | | | | | | | | |
| Coefficient | -0.279 | -0.304 | -0.394 | -0.494 | | -0.020 | -0.025 | 0.006 |
| Model | FE-IV | FE-IV | FE-IV | FE-IV | † | FE | FE | FE |
| Physical activity: Vigorous | | | | | | | | |
| Coefficient | 0.454 | 0.447 | 0.049 | 0.049 | | -0.000 | -0.036 | -0.033 |
| Model | FE-IV | FE-IV | FE | FE | † | FE | FE | FE |
| Physical activity: Moderate | | | | | | | | |
| Coefficient | -0.017 | -0.024 | -0.017 | -0.024 | | -0.023 | -0.024 | -0.015 |
| Model | FE | FE | FE | FE | † | FE | FE | FE |

[1] $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size) , † 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 added 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 (Switzerland)

| | Full Sample | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | 50-75 | 50-70 | 50-75 | 50-70 | 58-70 | 50-75 | 50-70 | 57-69 |
| Alcohol consumption: Y/N | | | | | | | | |
| Coefficient | -0.004 | 0.187 | -0.001 | 0.010 | | -0.002 | -0.016 | -0.014 |
| Model | FE§ | FE-IV§ | FE | FE | † | FE | FE | FE |
| Alcohol consumption: > 3 d/w | | | | | | | | |
| Coefficient | -0.008 | 0.015 | 0.003 | 0.005 | | -0.012 | 0.019 | 0.036 |
| Model | FE§ | FE§ | FE | FE | † | FE | FE | FE |
| Alcohol consumption: > 5 d/w | | | | | | | | |
| Coefficient | 0.018 | 0.025 | -0.003 | 0.014 | | 0.033 | 0.030 | 0.029 |
| Model | FE§ | FE§ | FE | FE | † | FE | FE | FE |
| Alcohol consumption: Amount | | | | | | | | |
| Coefficient | -0.946 | -1.222 | 12.589 | 12.286 | | -0.796 | -1.349 | -1.535 |
| Model | FE§ | FE§ | FE-IV | FE-IV | † | FE | FE | FE |
| Smoking | | | | | | | | |
| Coefficient | 0.026 | 0.046 | -0.002 | 0.038 | | 0.035 | 0.042 | 0.043 |
| Model | FE§ | FE§ | FE | FE | † | FE | FE | FE |
| Physical activity: Vigorous | | | | | | | | |
| Coefficient | -0.036 | -0.014 | -0.060 | -0.076 | | 0.329 | 0.381 | 0.009 |
| Model | FE§ | FE§ | FE | FE | † | FE-IV | FE-IV | FE |
| Physical activity: Moderate | | | | | | | | |
| Coefficient | -0.049 | -0.037 | -0.021 | -0.031 | | -0.065 | -0.042 | -0.660 |
| Model | FE§ | FE§ | FE | FE | † | FE | FE | FE-IV |

[1] $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic $\geq$ Stock and Yogo's critical value(10 % maximal IV size) , † 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 added 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 (Japan)

| | Full Sample | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | 50-75 | 50-70 | 50-75 | 50-70 | 58-70 | 50-75 | 50-70 | 56-68 |
| Alcohol consumption: Y/N | | | | | | | | |
| Coefficient | -0.001 | 0.006 | 0.006 | 0.001 | | | | |
| Model | FE | FE | FE | FE | † | † | † | † |
| Alcohol consumption: > 3 d/w | | | | | | | | |
| Coefficient | -0.006 | -0.016 | 0.011 | -0.009 | | | | |
| Model | FE | FE | FE | FE | † | † | † | † |
| Alcohol consumption: > 5 d/w | | | | | | | | |
| Coefficient | 0.010 | 0.000 | 0.037 | 0.027 | | | | |
| Model | FE | FE | FE | FE | † | † | † | † |
| Alcohol consumption: Amount | | | | | | | | |
| Coefficient | 0.013 | 0.117 | 0.051 | 0.165 | -2.640 | | | |
| Model | FE | FE | FE | FE | FE-IV | † | † | † |
| Smoking | | | | | | | | |
| Coefficient | -0.026 | -0.028 | -0.022 | -0.022 | | | | |
| Model | FE | FE | FE | FE | † | † | † | † |
| Physical activity: Vigorous | | | | | | | | |
| Coefficient | 0.024 | | 0.022 | | | | | |
| Model | FE | † | FE | † | † | † | † | † |
| Physical activity: Moderate | | | | | | | | |
| Coefficient | | | | | | | | |
| Model | | | | | | | | |

1 $p < .1$, $p < .05$, ¿ $p < .01$ , § Kleibergen-Paap Wald rk F statistic ≥ Stock and Yogo's critical value(10 % maximal IV size) , † 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 added 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 20: 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.

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