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The Causal Effects of Retirement on Mental Health: Looking Beyond the Mean Effects

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Ingo W.K. Kolodziej and Pilar García-Gómez[1]

The Causal Effects of Retirement on Mental Health: Looking Beyond the Mean Effects

Abstract

We analyze the causal effect of retirement on mental health, exploiting differences in retirement eligibility ages across countries and over time using data from the Survey of Health, Ageing and Retirement in Europe. We estimate not only average effects, but also use distributional regression to examine whether these effects are unequally distributed across the mental health distribution. We find unequally distributed protective effects of retirement on mental health. These gains are larger among those above the clinically defined threshold of being at risk of depression. The preserving effects are larger for women, blue collar workers and those in social networks.

JEL Classification: I10, J14, J26

Keywords: Retirement; mental health; economics of the elderly; distributional regression

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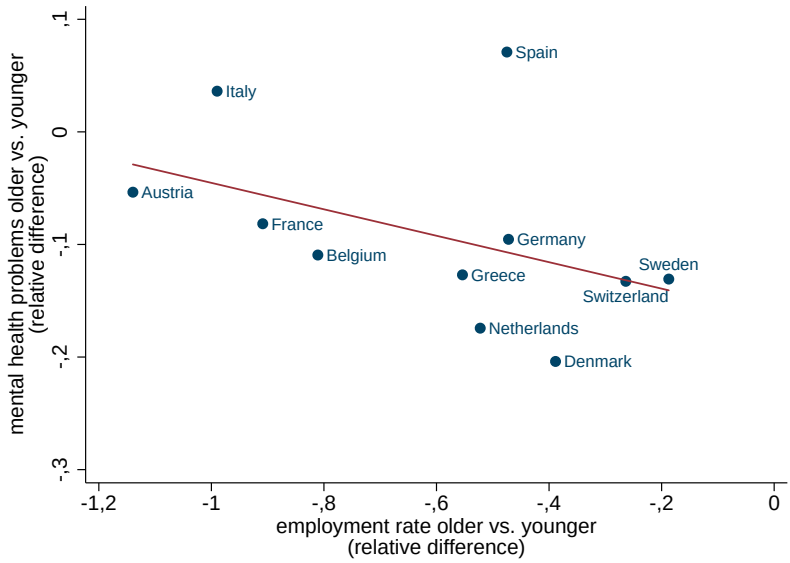
1 Introduction

Several countries have recently reformed their old-age pension systems to discourage early retirement in response to the financial pressures posed by aging societies (OECD, 2011). These reforms are expected to not only affect the sustainability of public finances, but also influence individual well-being. Indeed, if retirement contributes to mental health by removing work-related stress, these reforms may even decrease quality of life. However, retirement can also lead to social isolation (Börsch-Supan and Schuth, 2014) as well as affect various measures of well-being adversely (Bonsang and Klein, 2012). As a result, retirement might lead to an increase in mental health problems. Figure 1 illustrates the relationship between the retirement rate and average mental health status of selected European countries between 2004 and 2013. This figure shows a clear negative correlation between employment rate and mental health status, implying that those who live in countries where people remain in the labor force longer (e.g., Sweden and Switzerland) have on average substantially fewer mental health problems compared with countries where people tend to leave the labor market earlier (e.g., France and Italy). Put simply, the mental health of the elderly is better in countries where people work longer. In this respect, the evidence suggests that retirement may harm mental health. Based on these suggestive findings, this study provides causal estimates of the effect of retirement on mental health. In addition, we go beyond estimating the mean effects by examining how retirement influences the full mental health distribution.

Most previous studies of this topic exploit eligibility ages or variation in public policies on taxes, pensions, and disability as an instrument for retirement. For example, Bonsang et al. (2012), Mazzonna and Peracchi (2012), and Mazzonna and Peracchi (2016) find that withdrawal from the workforce has a negative impact on cognitive functioning. These results are similar to those presented by Rohwedder and Willis (2010) using data from the Health and Retirement Study (HRS), the Survey of Health, Ageing and Retirement in Europe (SHARE), and the English Longitudinal Study of Ageing (ELSA). Coe and Zamarro (2011) use the first wave of SHARE, finding that although retirement preserves general health, the effect on mental health is not significant. Coe and Lindeboom (2008) use data from HRS and also find that re-

Figure 1: Drop in the number of depressive symptoms as a function of a decrease in the employment rate.



Note: The horizontal axis shows the mean employment rate of individuals aged 60–64 relative to that of individuals aged 50–54, i.e., (employment rate at 60–64 – employment rate at 50–54)/[(employment rate at 60–64 + employment rate at 50–54)*0.5]. Similarly, the vertical axis shows the mean score on the EURO-D scale of older individuals versus younger individuals where a higher score means worse mental health, i.e., (average EURO-D at 60–64 - average EURO-D at 50–54)/[(average EURO-D at 60–64 + average EURO-D at 50–54)*0.5]. The regression line shows the country-level estimates from a regression of the mean percentage difference in the EURO-D score on the mean percentage difference in employment and an error term. Data were taken from the Survey of Health, Ageing and Retirement in Europe (SHARE) for 2004–2013. The evidence shown in this figure is inspired by Rohwedder and Willis (2010) and Adam et al. (2006).

tirement does not have an effect on psychological well-being measured by the CESD-8.[1] Eibich (2015) uses financial incentives for retirement in a regression discontinuity design and finds that retirement improves self-reported health and mental health for German retirees. Likewise, Fe and Hollingsworth (2012) also adopt a regression discontinuity design, using the kinks in the density function around default retirement ages in the United Kingdom to find that retirement does not affect mental health, even after taking into account the heterogeneity in the effects stemming from education, occupation, and job satisfaction before retirement.

[1]In related research, de Grip et al. (2012) evaluate a pension reform in the Netherlands and find a strong deterioration in mental health for workers that work a year longer than previous cohorts despite receiving the same benefits.

We follow these previous studies by exploiting the differences in early and normal retirement eligibility ages, both within and across 11 European countries over 2004–2013, using data from four waves of SHARE. We find that, on average, retirement has a positive effect on mental health. Our paper contributes to the body of knowledge on this topic by exploring the effects of retirement on mental health beyond the mean. In particular, we use a distributional regression approach and estimate the effects over the whole mental health distribution.

The analysis reveals that gains from retirement are not equally distributed, highlighting that the protective effect on mental health is especially high for those just above the clinically defined threshold of being at risk of depression. This is especially true for women and non-married individuals as well as blue collar workers as opposed to white collar workers. Further, the health-preserving effect seems to be more pronounced for individuals who engage in social activities, but not for those with access to family support.

The remainder of the paper is structured as follows. Sections 2 and 3 describe the data and empirical strategy. The results are shown in section 4 and section 5 concludes.

2 Data

We use data taken from waves 1, 2, 4, and 5 of SHARE.[2] SHARE is a cross-country multidisciplinary survey covering the population aged 50+ in several European countries. Harmonized data drawn from generic and country-specific questionnaires make cross-national comparisons possible (Börsch-Supan et al., 2009). We include countries present in at least waves 1 and 2, namely Austria, Belgium, Denmark, France, Germany, Italy, Greece, the Netherlands, Spain, Sweden, and Switzerland. As we select individuals sufficiently close to the official retirement ages in these 11 countries, only men and women aged 55–69 are included. However, the results do not change when we use a different age range (see section 4.4). Individuals with incomplete survey records were omitted from the final sample, which consists of 61,289 observations for 37,299 individuals.

Our measures of mental health are based on the EURO-D scale of depressive symptoms,

[2]The third wave (SHARELIFE) does not include information about current mental health and therefore is excluded from our analysis.

which has been validated for cross-country studies to compare prevalence and risk (Castro-Costa et al., 2008; Larraga et al., 2006; Prince et al., 1999). The index is constructed from questions that indicate the presence of problems with depression, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment, and tearfulness. The scale runs from 0–12 and provides a count of the number of depressive symptoms a person has. The cut-off point of depression is four or more depressive symptoms (Prince et al., 1999).

In line with the literature, we consider an individual to be retired when s/he stated that s/he had retired or now considered him/herself to be permanently absent from the labor force (Lazear, 1986), such as permanently sick or disabled, unemployed, a homemaker, and additionally not having performed any paid work in the past month.[3]

Table 1 shows the descriptive statistics for the list of variables and their definitions. On average, retired individuals have 0.5 more depressive symptoms compared with those working (2.3 vs. 1.8). Similarly, 25% (18%) of the retired (working) individuals report four or more such symptoms, suggesting a risk of depression.

In our analysis, we control for other variables expected to influence a person's well-being, including socioeconomic and environmental factors as well as biological and psychological elements (Herrman et al., 2005). We include information about health status, education, income, area of residence, household characteristics, age, and gender. In addition, we include country-specific dummy variables and further control for the seasonal effect, as the prevalence of depression is unevenly distributed throughout the year (Lurie et al., 2006; Lam and Levitan, 2000). Table 1 shows that retirees are older and have a worse health status compared with working individuals. Further, they have lower educational attainment and lower household income, although area of residence and the presence of children in the household show no differences between retirees and workers.

[3]This is the same definition of retirement as used in other studies that examine the effects on health (Rohwedder and Willis, 2010; Bonsang et al., 2012; Coe and Zamarro, 2011; Mazzonna and Peracchi, 2012, 2016). Using the same definition allows us to compare our estimates with those of other studies. However, our results are robust to alternative definitions of retirement (see section 4.4).

Table 1: Summary statistics - pooled sample

	Working	Retired
Dependent variables		
Number of depressive symptoms in the previous month, 0-12	1.795	2.293
Dummy equal to 1 if ind. has less than 1 symptom and 0 otherwise	0.293	0.237
Dummy equal to 1 if ind. has less than 2 symptoms and 0 otherwise	0.546	0.460
Dummy equal to 1 if ind. has less than 3 symptoms and 0 otherwise	0.718	0.627
Dummy equal to 1 if ind. has less than 4 symptoms and 0 otherwise	0.834	0.754
Dummy equal to 1 if ind. has less than 5 symptoms and 0 otherwise	0.908	0.839
Dummy equal to 1 if ind. has less than 6 symptoms and 0 otherwise	0.952	0.903
Dummy equal to 1 if ind. has less than 7 symptoms and 0 otherwise	0.975	0.943
Dummy equal to 1 if ind. has less than 8 symptoms and 0 otherwise	0.987	0.968
Dummy equal to 1 if ind. has less than 9 symptoms and 0 otherwise	0.995	0.985
Dummy equal to 1 if ind. has less than 10 symptoms and 0 otherwise	0.998	0.994
Dummy equal to 1 if ind. has less than 11 symptoms and 0 otherwise	0.999	0.998
Control variables		
Male	0.536	0.430
Age at the time of the interview	59.881	63.394
Dummy equal to 1 if has children	0.897	0.897
Dummy equal to 1 if lower education and 0 otherwise	0.081	0.180
Dummy equal to 1 if medium education and 0 otherwise	0.279	0.341
Dummy equal to 1 if higher education and 0 otherwise	0.207	0.129
Dummy equal to 1 if married and 0 otherwise	0.775	0.769
Dummy equal to 1 if has limitations in general activities of daily living	0.283	0.434
Dummy equal to 1 if has limitations in activities of daily living	0.034	0.082
Dummy equal to 1 if has limitations in instr. activities of daily living	0.045	0.126
Number of limitations in arm function and fine motor skills	0.626	1.339
Dummy equal to 1 if (almost) never involved in phys. act. and 0 otherwise	0.031	0.079
Dummy equal to 1 if area of residence is a city and 0 otherwise	0.198	0.176
Dummy equal to 1 if area of residence is a town and 0 otherwise	0.269	0.281
Dummy equal to 1 if area of residence is a rural area and 0 otherwise	0.191	0.196
Dummy equal to 1 if Household income is in Quartile 1 and 0 otherwise	0.154	0.324
Dummy equal to 1 if Household income is in Quartile 2 and 0 otherwise	0.207	0.289
Dummy equal to 1 if Household income is in Quartile 3 and 0 otherwise	0.294	0.211
Dummy equal to 1 if Household income is in Quartile 4 and 0 otherwise	0.345	0.176
Observations	26,853	34,436

Not reported are seasonal and country dummies. We further include age squared and a dummy on whether information on the living area is missing. Education derived from 1997 ISCED. Equivalent household income is measured in rank quartiles of the whole sample and is PPP adjusted on prices in Germany from 2005 in order to make a cross-country comparison over time possible. IADL describes having problems concerning orientation using a map, preparing a hot meal, shopping for groceries, making telephone calls, taking medications, doing work around the house or garden, managing money. ADL describes having problems concerning dressing, walking across a room, bathing or showering, eating, getting out of bed and using the toilet.

3 Empirical Strategy

3.1 Empirical model

Our interest lies in estimating how retirement affects mental health status across the entire mental health distribution. Therefore, we are interested in the conditional probability that the mental health index (M) falls below some threshold (m). For this, we estimate the conditional distribution function (CDF) as follows:

$$F(m|R,X) = \Pr(M < m|R = r, X = x).$$

We estimate the CDF at a finite number of cut-offs $m_1, \cdots, m_{12}$ by estimating a model for the conditional mean of the binary indicators $D = 1, \{M < m_j\}, j = 1, \cdots, 12$. In other words, we create an indicator variable for each cut-off point of the depression scale that is equal to one if the individual reports having less than the cut-off point and zero otherwise.[4] Hence, we estimate a sequence of linear probability models over the values of the EURO-D scale.[5] This approach is referred to as distributional regression (see Chernozhukov et al., 2013; Foresi and Peracchi, 1995; Koenker et al., 2013; Fortin et al., 2011).[6] Our dependent variable can only take positive values, with a distribution that is severely positively skewed and leptokurtic and has a mass point at zero.[7] While these properties impose rigorous challenges on standard econometric approaches, distributional methods are suitable (c.f. Jones et al., 2015).

This approach is comparable with the more popular quantile regression (Roger Koenker, 1978; Koenker et al., 2013; Chernozhukov et al., 2013; Firpo et al., 2009).[8] While distributional regression and quantile regression both provide information on the distributional effects (Koenker et al., 2013), the former has several advantages in our setting. First, the interpretability of the estimates of distributional regression is more natural as one can directly conclude

[4] The highest value of the depression scale is excluded from the analysis.

[5] The conclusions do not change if we account for the nonlinear relationship at the given thresholds by using a probit model (results available from the authors upon request).

[6] For recent applications of distributional regression in healthcare, see de Meijer et al. (2013) and Jones et al. (2015).

[7] See Figure A1 of the Appendix.

[8] We estimated the effects of retirement on mental health by using quantile regression and found heterogeneous effects across the distribution (results available from the authors upon request).

whether there are differences between groups in the probability that mental health falls below a given threshold (Koenker et al., 2013). Second, we deal with a distribution with a mass point at zero depressive symptoms and a discrete dependent variable. In such a setting, quantile regression would provide a poor approximation; thus, distributional regression is preferred as its approximation is conducted pointwise in the threshold m with no adjustment needed (Chernozhukov et al., 2013).

Instrumental variables

We implement instrumental variable estimations to control for the endogeneity of the retirement decision. People might self-select into (early) retirement because of worse mental health status, unobserved individual characteristics, or personal preferences. This poses a challenge to identifying the effect of retirement on mental health. Hence, we follow the existing literature (Coe and Lindeboom, 2008; Coe and Zamarro, 2011; Rohwedder and Willis, 2010; Bonsang et al., 2012; Mazzonna and Peracchi, 2012, 2016; Eibich, 2015) and exploit the institutional variation in ages for early and normal retirement eligibility across and within European countries. Large spikes in retirement hazards at both the earliest retirement age and at a normal retirement age have previously been found (see e.g. Gruber and Wise, 2004). These policies may induce retirement owing to the monetary incentives available for individuals to retire at a certain age (Gruber and Wise, 2004). Therefore, it seems plausible to assume that statutory retirement ages influence mental health status solely through the effect of retirement. Note that the age thresholds for early and full public retirement benefits differ by country, age, gender, and time period.[9]

Table 2 shows the first-stage regression of the probability of retiring for our sample. Early and full statutory retirement ages are important predictors of retirement decisions, and we see that both coefficients are highly significant. In addition, the F-test of joint significance also rejects the null hypothesis of weak instruments. We argue that our instruments are valid (exogenous) and uncorrelated with the error term, i.e. (unobserved) determinants of depression. Public policies on early and full retirement ages should not directly affect an individual's men-

[9]See Table A1 of the Appendix.

tal health except through retirement status, as it is implausible that retirement policies are established in response to the mental health patterns found within the population (Rohwedder and Willis, 2010).[10]

Table 2: Effects on the probability to be retired

	All	
early	0.109***	(0.007)
full	0.171***	(0.008)
adj. R^2	0.3355	
F-Test	F(39; 61,249) = 1349.87	
Observations	61,289	

Coefficients of other control variables not shown. List of covariates includes gender, age at the time of the interview, age squared, the number of children, education, marital status, indicators on whether the individual has limitations in activities of daily living or in instrumental activities of daily living, the number of mobility limitations, an indicator on physical inactivity, area of residence, household income quartiles, seasonal dummys and country dummys. Standard errors in parentheses. The Staiger-Stock rule of thumb (Staiger and Stock, 1997; Stock et al. 2002) suggests rejection of the null hypothesis of weak instruments with two instruments when the F-statistic is larger than 11.59.$^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

Finally, we evaluate whether the effects of retirement on mental health are heterogeneous across different subgroups of the population. These models have two endogenous variables: retirement R and the interaction between retirement and the dummy variable identifying the group of interest G, e.g., blue collar workers. Therefore, we include as instruments in these models the interactions between early retirement, full retirement, and G (Angrist and Pischke, 2009).

[10]We run a Hansen–Sargan test of overidentifying restrictions and conclude that our instruments are valid. Note that while the failure to reject the null hypothesis does not assure the validity of all instruments, its rejection is a sign of misspecification.

4 Results

4.1 What is the effect of retirement on mental health?

We first estimate the association between retirement and mental health (Table 3). The mean estimates suggest that retired individuals have on average 0.092 more depressive symptoms as measured by the EURO-D scale. We find that the negative association between retirement and mental health disappears in the tails of the distribution, while it ranges between 0.3 and 1.6 percentage points at the other points. For example, retirees have a 1.5 percentage point lower probability of having fewer than three depressive symptoms. The coefficients are negative for all thresholds of the distribution, shifting the distribution function of mental health to the right. However, the differences in the coefficients are small, suggesting a pure location shift (e.g. Foresi and Peracchi, 1995).

By taking into account the endogeneity of the retirement decision, we find that retirement is no longer related to a worsening in mental health, but either has no effect or a protective effect. First, the estimated mean effect on the scale becomes larger and negative. The coefficients are now positive for all thresholds of the distribution, shifting the distribution function of mental health to the left. Indeed, the point estimates differ substantially, opposing a pure location shift. Further, the effect on the probability that an individual has fewer than one, three, or four depressive symptoms is insignificant. However, retirement has a large protective effect on those individuals just over the clinically defined threshold of being at risk of depression. We find that retirement increases the probability of having fewer than five depressive symptoms by 11.1 percentage points. This appears to be relatively high, as the probability of having fewer than five such symptoms is 87.0 percent. Finally, the protective effect is statistically significant at most of the upper part, but the size of the magnitude decreases as mental health worsens.

4.2 Do the effects differ by sex and occupation?

There are gender differences not only in labor market behavior, but also in the prevalence of depression (Fonseca et al., 2014). We find that the mean protective effect is smaller for men compared with women: retirement decreases the number of depressive symptoms by 0.684 for

Table 3: Effects of retirement on mental health

m	Probability EURO-D$\leq m$ in %	Effect of retirement not accounting for endogeneity (OLS)		Effect of retirement accounting for endogeneity (2SLS)	
(i) $\bar{m}$	2.07	0.092***	(0.018)	-0.629***	(0.211)
1	26.2	-0.547	(0.420)	4.938	(4.775)
2	49.8	-1.368***	(0.464)	8.939*	(5.301)
3	66.7	-1.517***	(0.434)	8.009	(5.003)
4	78.9	-1.286***	(0.375)	5.643	(4.319)
5	87.0	-1.609***	(0.313)	11.114***	(3.637)
6	92.5	-1.206***	(0.247)	8.687***	(2.881)
7	95.7	-0.813***	(0.192)	5.505**	(2.246)
8	97.6	-0.417***	(0.145)	4.417***	(1.675)
9	98.9	-0.263***	(0.098)	2.838**	(1.171)
10	99.5	-0.107	(0.066)	1.895**	(0.784)
11	99.9	-0.058	(0.037)	0.476	(0.446)
Observations		61,289		61,289	

Note: The coefficient shown in each case is the indicator on retirement. Coefficient and standard errors for $m = 1$ to $m = 11$ are scaled up by 100 for better interpretability, i.e. these effects are shown in percentage points. Dependent variable in (i) is the Euro-D scale that counts the number of depressive symptoms. Dependent Variable in (1) to (11) is an indicator on whether the individual has less than the indicated number of symptoms. We do not show the prob < 12. List of covariates includes gender, age at the time of the interview, age squared, the number of children, education, marital status, indicators on whether the individual has limitations in activities of daily living or in instrumental activities of daily living, the number of mobility limitations, an indicator on physical inactivity, area of residence, household income quartiles, seasonal dummys and country dummys. Standard errors in parentheses. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

women and by 0.544 for men (Model I in Table 4). These differences are concentrated at two and six symptoms, suggesting that the shift in the remaining mental health distribution is rather similar.

The effects of retirement on mental health may differ by the physical demands and work-related stress of the job from which the individual has retired (Ravesteijn et al., 2013; Mazzonna and Peracchi, 2016). We investigate whether the differences between blue collar and white collar workers influence the effects of retirement on mental health (Model II in Table 4).[11] We find that, on average, retirement decreases the number of depressive symptoms for both blue collar and white collar workers, but the magnitude of the effect is statistically significantly larger for blue collar workers compared to white collar workers. This difference is concentrated in the upper tail of the mental health distribution. The effect of retirement on the probability of having fewer than six depressive symptoms is 2.2 percentage points larger for blue collar workers compared to white collar workers, and this difference remains, albeit smaller, statistically significant on other cut-points in the upper part of the mental health distribution.

4.3 Does social support curb the magnitude of the effect?

There is ample evidence that social support is important for the well-being of the older population (e.g. Fiori et al., 2006; Litwin and Shiovitz-Ezra, 2011). In particular, social support has been found to be significantly associated with depression (Schwarzbach et al., 2014), and participation in social networks can prevent feelings of depression among the elderly (Abu-Rayya, 2006). These aspects are especially important in the setting of retirement given the substantial change in the individual's lifestyle. It is reasonable to assume that having social support in later life is an important factor in an individual's well-being during retirement. In this regard, we take advantage of the rich information on social networks available in SHARE to investigate this channel. We therefore expect different types of social support to influence how retirement affects mental health. First, we proxy for social support by using individuals' marital status and number of children. Not being married might increase the probability of depression in older adults (Fonseca et al., 2014), while it remains unclear whether having children can have

[11] We use information about the last job if the individual is retired. The sample size drops because information on job type is unavailable in some cases.

Table 4: Effects of retirement on mental health, IV-Estimation – Subgroup analysis (1)

	(I)		(II)	
	Retired	Retired x Male	Retired	Retired x Bluecollar
(i)	-0.684***	0.140*	-0.423**	-0.164*
	(0.214)	(0.0732)	(0.213)	(0.0897)
(1)	4.709	-0.880	3.403	1.432
	(4.740)	(1.572)	(4.916)	(1.921)
(2)	9.205*	-3.430*	5.419	3.021
	(5.320)	(1.783)	(5.425)	(2.175)
(3)	8.740*	-2.095	3.292	1.905
	(5.049)	(1.701)	(5.096)	(2.074)
(4)	7.174	-2.107	2.085	0.639
	(4.384)	(1.473)	(4.370)	(1.804)
(5)	12.686***	-1.378	9.433**	1.907
	(3.713)	(1.255)	(3.665)	(1.551)
(6)	10.024***	-2.286**	6.390**	2.183*
	(2.950)	(0.990)	(2.868)	(1.221)
(7)	5.853**	-0.931	4.544**	1.229
	(2.298)	(0.774)	(2.210)	(0.955)
(8)	4.500***	-0.555	3.021*	1.225*
	(1.725)	(0.578)	(1.633)	(0.708)
(9)	2.920**	-0.367	2.000*	1.495***
	(1.192)	(0.400)	(1.153)	(0.503)
(10)	1.725**	0.028	1.757**	0.827**
	(0.806)	(0.265)	(0.785)	(0.351)
(11)	0.479	0.012	0.515	0.374*
	(0.449)	(0.150)	(0.434)	(0.197)
Observations	61,289		51,202	

Note: Dependent variable in (i) is the Euro-D scale that counts the number of depressive symptoms. Dependent Variable in (1) to (11) is an indicator on whether the individual has less than the indicated number of symptoms. We do not show the prob < 12. List of covariates includes gender, age at the time of the interview, the number of children, education, marital status, indicators on whether the individual has limitations in activities of daily living or in instrumental activities of daily living, the number of mobility limitations, an indicator on physical inactivity, area of residence, household income quartiles, seasonal dummys and country dummys. Standard errors in parentheses. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

a causal effect on mental health, specifically on depressive episodes (e.g. Kruk and Reinhold, 2014).

We find that the effects of retirement on mental health vary by marital status (see Model I in Table 5). On average, married individuals have a 0.2 point lower decrease in the number of depressive symptoms than their unmarried counterparts. While the probability of having fewer than five, six or eight depressive symptoms increases significantly, this increase is significantly lower for married individuals. In particular, close to the cut-off point of clinically indicated depression, we observe that while being retired increases the probability of having fewer than five symptoms by 14.2 percentage points for the non-married sample, it only increases by 10.3 percentage points for the married sample. Hence, married individuals seem to benefit less from retirement than non-married individuals. Our results show that the effects are similar for those with and without children (Model II in Table 5).

To draw a more complete picture, we look at more detailed information on participation in social activities. These networks can be endogenous and causality claims should be considered with caution. Descriptive evidence shows that people who engage in social activities on average have fewer mental health problems (Table 6). In particular, we explore participation in the following five types of "voluntary" social networks: voluntary or charity work, educational or training courses, sports or other types of clubs, religious involvement, and political- or community-related organizations. Our results show that the protective effect of retirement on mental health is higher among those that engage in any social activity (see Model I in Table 7). We further explore these differences by type of social activity, finding that this pattern is similar for those that engaged in voluntary or charity work (Model II in Table 7), attended an educational or training course (Model III in Table 7), attended sports, social, or other kinds of clubs (Model IV in Table 7) and were involved in political- or community-related organizations (Model VI in Table 7). In addition, the additional benefits are found along several points of the mental health distribution in all these cases. Therefore, we find no evidence that the protective effects of retirement on mental health are concentrated or exacerbated among individuals with family support but those who participate in social activities benefit more.

Table 5: Effects of retirement on mental health, IV-Estimation – Subgroup analysis (2)

	(I)		(II)	
	Retired	Retired x Married	Retired	Retired x Children
(i)	-0.800***	0.220**	-0.694***	0.0736
	(0.251)	(0.101)	(0.251)	(0.126)
(1)	5.159	-0.802	4.405	0.609
	(5.426)	(1.918)	(5.591)	(2.645)
(2)	10.928*	-2.972	7.734	1.370
	(6.098)	(2.251)	(6.185)	(2.945)
(3)	10.364*	-3.282	9.359	-1.533
	(5.831)	(2.231)	(5.878)	(2.837)
(4)	8.157	-3.016	8.325	-3.046
	(5.099)	(2.008)	(5.093)	(2.505)
(5)	14.167***	-3.888**	12.845***	-1.967
	(4.343)	(1.758)	(4.291)	(2.122)
(6)	11.117***	-2.812*	10.074***	-1.574
	(3.477)	(1.435)	(3.408)	(1.710)
(7)	6.814**	-1.502	5.568**	-0.072
	(2.743)	(1.161)	(2.652)	(1.334)
(8)	5.743***	-1.574*	4.197**	0.249
	(2.067)	(0.880)	(1.970)	(0.982)
(9)	3.774**	-1.022	3.112**	-0.312
	(1.477)	(0.647)	(1.394)	(0.697)
(10)	2.418**	-0.588	2.452**	-0.632
	(0.979)	(0.417)	(0.976)	(0.516)
(11)	0.872	-0.477**	0.782	-0.347
	(0.533)	(0.224)	(0.593)	(0.306)
Observations	61,289		61,289	

Note: Dependent variable in (i) is the Euro-D scale that counts the number of depressive symptoms. Dependent Variable in (1) to (11) is an indicator on whether the individual has less than the indicated number of symptoms. We do not show the prob < 12. List of covariates includes gender, age at the time of the interview, the number of children, education, marital status, indicators on whether the individual has limitations in activities of daily living or in instrumental activities of daily living, the number of mobility limitations, an indicator on physical inactivity, area of residence, household income quartiles, seasonal dummys and country dummys. Standard errors in parentheses. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table 6: Average EURO-D score for participants and non-participants of social activities.

		Females	Males
Working	0 social activities	2.34	1.53
Working	At least 1 social activity	2.15	1.44
Retired	0 social activities	3.02	2.27
Retired	At least 1 social activity	2.47	1.70

Table 7: Effects of retirement on mental health, IV-Estimation – Subgroup analysis (3)

	(I)		(II)		(III)		(IV)		(V)		(VI)	
	retired	Retired x Social	retired	Retired x Charity work	retired	Retired x Educ. training	retired	Retired x Sportclub	retired	Retired x Religious	retired	Retired x Politics
(i)	-0.396*	-0.215***	-0.586***	-0.0744**	-0.554***	-0.161***	-0.549***	-0.175***	-0.391*	0.000329	-0.607***	-0.110*
	(0.217)	(0.0366)	(0.212)	(0.0340)	(0.191)	(0.0623)	(0.212)	(0.0312)	(0.237)	(0.0488)	(0.210)	(0.0624)
(1)	3.945	0.728	5.043	-0.481	3.973	-1.753	3.461	1.791**	1.804	-1.600	4.366	-0.647
	(4.902)	(0.768)	(4.792)	(0.820)	(4.412)	(1.531)	(4.801)	(0.765)	(5.401)	(1.141)	(4.750)	(1.597)
(2)	6.585	2.351***	8.954*	-0.664	9.553*	1.594	7.855	2.825***	2.107	-1.193	8.702*	1.666
	(5.426)	(0.865)	(5.319)	(0.924)	(4.884)	(1.740)	(5.324)	(0.838)	(6.038)	(1.285)	(5.272)	(1.746)
(3)	4.549	2.540***	7.580	0.967	7.654*	1.704	6.931	2.868***	3.103	-0.958	7.698	1.184
	(5.113)	(0.821)	(5.026)	(0.850)	(4.553)	(1.589)	(5.021)	(0.771)	(5.672)	(1.191)	(4.970)	(1.566)
(4)	0.845	4.491***	5.008	1.732**	5.112	2.439*	4.440	3.847***	4.156	0.334	5.527	1.576
	(4.428)	(0.728)	(4.339)	(0.699)	(3.902)	(1.294)	(4.335)	(0.640)	(4.905)	(1.023)	(4.287)	(1.264)
(5)	7.251*	3.551***	10.200***	2.208***	9.038***	3.908***	10.103***	2.857***	9.499**	0.753	10.964***	2.834***
	(3.724)	(0.632)	(3.650)	(0.564)	(3.260)	(1.054)	(3.648)	(0.517)	(4.126)	(0.825)	(3.607)	(1.003)
(6)	5.708*	2.944***	7.736***	1.628***	7.521***	3.313***	7.841***	1.880***	6.260*	1.256**	8.509***	1.695**
	(2.963)	(0.518)	(2.888)	(0.414)	(2.587)	(0.777)	(2.892)	(0.392)	(3.230)	(0.623)	(2.854)	(0.756)
(7)	3.441	2.224***	4.813**	1.278***	4.413**	2.208***	4.965**	0.948***	3.502	0.549	5.357**	1.237**
	(2.326)	(0.413)	(2.253)	(0.299)	(1.996)	(0.539)	(2.253)	(0.288)	(2.520)	(0.479)	(2.221)	(0.556)
(8)	2.812	1.412***	3.948**	0.562**	3.357**	1.412***	3.960**	0.277	4.078**	0.530	4.168**	0.978***
	(1.733)	(0.323)	(1.680)	(0.220)	(1.469)	(0.379)	(1.676)	(0.208)	(1.896)	(0.355)	(1.654)	(0.349)
(9)	2.121*	0.836***	2.637**	0.152	2.517**	0.826***	2.633**	0.202	2.774**	0.273	2.708**	0.245
	(1.211)	(0.233)	(1.173)	(0.145)	(1.023)	(0.226)	(1.172)	(0.132)	(1.320)	(0.232)	(1.156)	(0.258)
(10)	1.568*	0.312**	1.823**	0.100	1.565**	0.336**	1.829**	0.079	1.559*	-0.011	1.861**	0.096
	(0.814)	(0.150)	(0.785)	(0.083)	(0.680)	(0.159)	(0.786)	(0.079)	(0.835)	(0.151)	(0.772)	(0.168)
(11)	0.410	0.086	0.426	-0.043	0.348	0.091	0.430	-0.027	0.138	0.021	0.403	0.074*
	(0.482)	(0.085)	(0.441)	(0.048)	(0.376)	(0.059)	(0.444)	(0.042)	(0.416)	(0.059)	(0.436)	(0.039)
Observations	61,289		61,138		61,138		61,138		40,182		61,138	

Note: Dependent variable in (i) is the Euro-D scale that counts the number of depressive symptoms. Dependent Variable in (1) to (11) is an indicator on whether the individual has less than the indicated number of symptoms. We do not show the prob < 12. List of covariates includes gender, age at the time of the interview, the number of children, education, marital status, indicators on whether the individual has limitations in activities of daily living or in instrumental activities of daily living, the number of mobility limitations, an indicator on physical inactivity, area of residence, household income quartiles, seasonal dummys and country dummys. Standard errors in parentheses. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

4.4 Robustness checks

We test the robustness of our results with respect to the definition of retirement and age range used. The definition of retirement in our analysis included, for example, being unemployed, sick, or a homemaker. Hence, we re-estimate our main analysis by changing the inclusion criteria for non-employed status to test whether the results are driven by individuals in specific subgroups. The results are shown in Table A3, which includes our main definition in the first column (column I) to ease comparability. First, we exclude the permanently sick or disabled from the definition (column II). The results show that although the point estimates are slightly smaller, the main conclusions remain the same. Second, while we earlier classify the unemployed as retired, as this is often a route into early retirement (e.g. Wise, 2016; García-Gómez, 2011), we test whether the conclusions change if we include them in the working category as they could be officially available on the labor market. The results hold independently of whether the sick are included in the group of retired (column III) or excluded from the analysis (column IV). Given these results, it seems highly unlikely that our results are driven by the inclusion of the sick and disabled or that the unemployed are falsely classified as retired.

In our analysis, we include individuals aged 55 to 59. A larger age range leads to a smaller variance, while a smaller age range increases the variance, but minimizes the bias (Eibich, 2015; Lee and Lemieux, 2011). Therefore, we check the robustness of our results to the use of different age ranges (Table A4). We see that changes in the age range alter the magnitude of the estimated effects. However, more importantly, we find that retirement has a protective effect on mental health and that this effect is unequally distributed across the mental health distribution independently of the age range used in the analysis.

5 Discussion and Conclusion

In this study, we estimate the effect of retirement on mental health. We contribute to the body of knowledge on this topic by not only focusing on the average effects, but also evaluating the heterogeneity in such effects by using distributional regression with respect to the mental health distribution. We exploit differences in early and full retirement eligibility ages across

and within countries as a source of identification. We find that, on average, retirement improves mental health. However, there are unequal effects across the mental health distribution. In particular, we find that the effect is not statistically significant for those that have a relatively good mental health status (reporting fewer than four depressive symptoms), which represent 79% of the population. Then, the magnitude of the effect is larger among those individuals just above the clinically defined threshold of depression (four symptoms). The protective effect remains statistically significant for the rest of the distribution, although the magnitude decreases as mental health worsens.

The protective effect of retirement on mental health seems to be higher among those that engage in social activities. In addition, we find that the protective effect of retirement is larger for women, unmarried individuals and blue collar workers. These differences are unevenly distributed along the mental health distribution. Overall, our findings suggest that the most important variable for determining whether mental health is affected after retirement is mental health itself.

These results are especially relevant for the recent and ongoing reforms aimed at increasing the retirement age OECD (2015). Our results suggest that these reforms will not affect the mental health of the vast majority of the population. However, increasing the retirement age can further deteriorate the mental health of the subgroup of older workers whose mental health is already frail. This effect may be exacerbated if these reforms are accompanied by tightening eligibility criteria for individuals with mental health problems in other early retirement routes such as disability insurance.

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A Appendix

Table A1: Eligibility ages for public retirement benefits, Men (Women)

	2004	2005		2006		2007		2010		2011		2012		2013	
	May	January	July	January	July	January	July	January	July	January	July	January	July	January	July
							early								
Austria	61.5 (56.5)	61.9 (56.9)	61.9 (56.9)	62.3 (57.3)	62.3 (57.3)	62.3 (57.3)	62.3 (57.3)	62.9 (57.9)	62.9 (57.9)	62.9 (57.9)	62.9 (57.9)	62.9 (57.9)	62.9 (57.9)	62.9 (57.9)	62.9 (57.9)
Belgium	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Switzerland	64 (62)	64 (62)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)	64 (63)
Denmark	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Spain	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
France	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Germany	60	60	60	60	60.5	61	61.5	63	63	63	63	63	63	63	63
Greece	60 (55)	60 (55)	60 (55)	60 (55)	60 (55)	60 (55)	60 (55)	60 (55)	60 (55)	60 (55)	60 (56)	60 (56)	60 (56)	60.75	60.75
Italy	57	57	57	57	57	57	57	59/60	59/60	60/61	60/61	62	62	62	62
Netherlands	60	60	60	60	60	60	60	60	60	60	63	63	63	63	63
Sweden	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
							normal								
Austria	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)
Belgium	65 (63)	65 (63)	65 (63)	65 (64)	65 (64)	65 (64)	65 (64)	65	65	65	65	65	65	65	65
Switzerland	65 (63)	65 (63)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)	65 (64)
Denmark	65/67	65/67	65/67	65/67	65/67	65/67	65/67	65	65	65	65	65	65	65	65
Spain	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
France	60	60	60	60	60	60	60	60	60	60	60-62	60-62	60-62	60-62	60-62
Germany	65	65	65	65	65	65	65	65	65	65	65	65.1	65.1	65.2	65.2
Greece	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (61)	65 (61)	65 (61)	65 (62)	67	67
Italy	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	65 (60)	66 (62-66)	66.3 (62.3-66.3)	66.3 (62.3-66.3)
Netherlands	65	65	65	65	65	65	65	65	65	65	65	65	65	65.1	65.1
Sweden	65	65	65	65	65	65	65	65	65	65	65	65	65	...	...

Sources: MISSOC (2015), (OECD, 2005, 2007, 2009, 2011, 2013). Note: Eligibility ages with greatest incentives to retire, applicable for those that can collect retirement benefits if they retire in the respective year because they have reached the respective age. No interviews in the years 2008 and 2009. Italy: early retirement age differs by type of occupation (employees/self-employed). Denmark: normal retirement age is 65 and until 2008, normal retirement age is 67 for those born before 1.7.1939. France: as from 1 July 2011 (1 January 2012) normal retirement age increases by four (five) months per birth year to reach 62 for persons born in 1956 (1955) or later. Sweden: from 2013 on, incentives are given to work past the age of 65 and hence our instrument is switched off.

Figure A1: Descriptive statistics – Empirical density and cumulative mental health distribution.

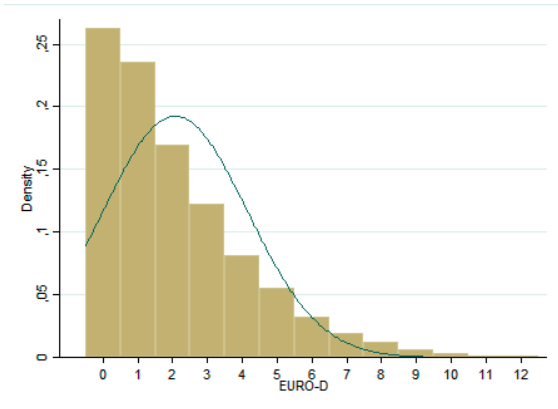

Table A2: Sample Sizes in the respective waves by country and gender

	Wave 1		Wave 2		Wave 4		Wave 5	
	women	men	women	men	women	men	women	men
Austria	497	415	365	300	1300	978	1079	786
Germany	710	713	644	610	435	343	1294	1179
Sweden	801	691	763	623	527	417	1132	943
Netherlands	668	688	713	620	764	658	1119	920
Spain	327	413	406	404	635	665	1220	1242
Italy	522	611	717	667	820	722	1033	931
France	612	558	674	546	1324	1151	1136	943
Denmark	373	345	594	560	524	495	1053	951
Greece	388	564	649	683	0	0	0	0
Switzerland	207	198	341	307	909	843	805	685
Belgium	742	791	721	684	1175	1159	1344	1225
Observations	5,848	5,989	6,589	6,007	8,417	7,436	11,220	9,811

Table A3: Effects of retirement on mental health, IV-Estimation – Different Retirement definitions

	(I) Retired	(II) Retired, excl. permanently sick or disabled	(III) Retired vs. working, incl. unemployed	(IV) Retired, excl. permanently sick or disabled vs. working, incl. unemployed
(i)	-0.629***	-0.500***	-0.498***	-0.420***
	(0.211)	(0.189)	(0.182)	(0.137)
(1)	4.938	4.505	3.469	3.192
	(4.775)	(4.391)	(4.110)	(3.102)
(2)	8.939*	7.538	7.152	5.897*
	(5.301)	(4.846)	(4.567)	(3.437)
(3)	8.009	7.489*	6.124	5.404*
	(5.003)	(4.545)	(4.312)	(3.242)
(4)	5.643	4.907	4.304	4.075
	(4.319)	(3.883)	(3.729)	(2.806)
(5)	11.114***	8.572***	8.702***	7.509***
	(3.637)	(3.223)	(3.130)	(2.348)
(6)	8.687***	6.698***	7.178***	5.712***
	(2.881)	(2.521)	(2.482)	(1.857)
(7)	5.505**	4.280**	4.664**	3.637**
	(2.246)	(1.954)	(1.940)	(1.455)
(8)	4.417***	3.013**	3.641**	2.956***
	(1.675)	(1.441)	(1.447)	(1.086)
(9)	2.838**	1.524	2.362**	1.877**
	(1.171)	(0.988)	(1.012)	(0.760)
(10)	1.895**	1.094*	1.533**	1.240**
	(0.784)	(0.656)	(0.675)	(0.509)
(11)	0.476	0.087	0.350	0.292
	(0.446)	(0.351)	(0.383)	(0.290)
Obs.	61,289	58,864	61,289	60,621

Note: Coefficient and standard errors for $m = 1$ to $m = 11$ are scaled up by 100 for better interpretability, i.e. these effects are shown in percentage points. Dependent variable in (i) is the Euro-D scale that counts the number of depressive symptoms. Dependent Variable in (1) to (11) is an indicator on whether the individual has less than the indicated number of symptoms. We do not show the prob < 12. List of covariates includes gender, age at the time of the interview, age squared, the number of children, education, marital status, indicators on whether the individual has limitations in activities of daily living or in instrumental activities of daily living, the number of mobility limitations, an indicator on physical inactivity, area of residence, household income quartiles, seasonal dummys and country dummys. Standard errors in parentheses. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table A4: Effects of retirement on mental health, IV-Estimation – Different age windows

	age 55-69	age 50-70	age 53-71	age 57-67
(i)	-0.629***	-0.424***	-0.361**	-0.948***
	(0.211)	(0.141)	(0.153)	(0.319)
(1)	4.938	4.405	2.680	3.533
	(4.775)	(3.145)	(3.444)	(7.139)
(2)	8.939*	5.923*	3.993	16.400**
	(5.301)	(3.514)	(3.827)	(7.946)
(3)	8.009	5.196	3.532	14.950**
	(5.003)	(3.343)	(3.632)	(7.523)
(4)	5.643	4.907*	3.809	9.100
	(4.319)	(2.889)	(3.132)	(6.457)
(5)	11.114***	7.140***	7.118***	14.395***
	(3.637)	(2.434)	(2.632)	(5.450)
(6)	8.687***	5.200***	4.750**	11.426***
	(2.881)	(1.935)	(2.089)	(4.336)
(7)	5.505**	3.241**	3.383**	8.192**
	(2.246)	(1.520)	(1.640)	(3.374)
(8)	4.417***	2.528**	2.684**	8.267***
	(1.675)	(1.134)	(1.218)	(2.583)
(9)	2.838**	1.835**	1.968**	4.452**
	(1.171)	(0.799)	(0.855)	(1.779)
(10)	1.895**	1.353**	1.498***	2.733**
	(0.784)	(0.533)	(0.571)	(1.171)
(11)	0.476	0.416	0.432	0.754
	(0.446)	(0.306)	(0.330)	(0.664)
Obs.	61,289	83,966	76,894	44,653

Note: Coefficient and standard errors for $m = 1$ to $m = 11$ are scaled up by 100 for better interpretability, i.e. these effects are shown in percentage points. Dependent variable in (i) is the Euro-D scale that counts the number of depressive symptoms. Dependent Variable in (1) to (11) is an indicator on whether the individual has less than the indicated number of symptoms. We do not show the prob < 12. List of covariates includes gender, age at the time of the interview, age squared, the number of children, education, marital status, indicators on whether the individual has limitations in activities of daily living or in instrumental activities of daily living, the number of mobility limitations, an indicator on physical inactivity, area of residence, household income quartiles, seasonal dummys and country dummys. Standard errors in parentheses. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$