

The Causal Effects of Aging and Retirement on Social Networks and Loneliness in Europe

An Instrumental Variable Approach

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1 Introduction

It is expected that by 2060 the proportion of the population of the European Union aged above 65 will have increased to 30% and the proportion of those aged above 80 to have increased to 12% (Davies, 2014). This has prompted increase interest in research on issues such as determinants of the timing retirement, how retirement effects one's health, life satisfaction, the quality of pensions, et cetera (Ekerdt, 2010). Often such studies have come to contradicting conclusions. MacBride (1976), for example, shows that it is often not clear whether the outcomes being studied, such as health, are the result of retirement per se or just aging. One area where such unclarity exists is regarding pensioners' social wellbeing. Some research, for example have shown that pensioners' social satisfaction can often be quite low, with upwards to 40% of the retired population indicating having low life satisfaction (ibid.). But again, it remains unclear whether this is a matter of retirement or age, as some studies have shown advanced age being a major factor contributing to a deterioration of social well-being (Savikko et al. 2005)

Another problem that has plagued research regarding retirement is that of endogeneity. In our case, for example, it is reasonable to assume that individuals are timing their retirement based on their social situations. Those with limited social networks could possibly be delaying retirement out of fear of becoming isolated, as the only social interactions they have are work relations. On the other hand, those with many friends and family could possibly be eager to retire early in order to be able to spend more time with them. This then would cause the results of such a research to be biased and imply that retirement has a positive effect on individuals' social measures. As such, studies so far have tended to focus on correlations between age and outcomes such as loneliness (c.f. Sundström et al., 2009), rather than ascertaining a causal relationship between retirement and such outcomes.

Such methodological hurdles are especially a problem, since besides such social issues being a problem in and of itself, a lack of social well-being has also been shown to lead to passive death wishes (Ayalon & Shiovitz-Ezra, 2011), and cause health problems among the elderly (Lou et al., 2012; Holt-Lunstad et al. 2015) leading to increased mortality rates, and is increasingly becoming a focal point in health policies aimed at the elderly (Cohen-Mansfield & Perach, 2015) further underlying the importance of researching the effect of retirement on social satisfaction, loneliness, and other measures of social well-being. Moreover, such health effects combined with the fact that loneliness has been shown to increase

doctor visits among the elderly (Ellaway et al. 1999), indicates that there is also a public financial side to declining social well-being, possibly compounding the pressure that retirement already exerts on welfare provisions.

However, there are no definitive indications as to whether this causal relationship is positive or negative. On the one hand Heaven et al. (2013) point out that retirement causes major shifts in the lives of people, possibly leading to distortions in their social environment, including a deterioration of their social networks. Ekerdt posits that:

[e]mployment affords the individual many things that retirement may disrupt: a stream of income, a footing under family life, a regime for body and self-care, a daily schedule, geographic fixity, *social networks*, and a basis of self-definition. When work ends, the way that life is reorganized deserves a thorough study (2010, p. 77, italics added)

Moreover, Segel Karpas et al. (2018) found that “employment can be considered a protective factor, buffering the adverse effects of loneliness on depressive symptoms” (p. 139).

On the other hand, Bogaard et al. (2014) have shown that whereas retirement does cause shifts in persons’ social interactions, it is more a change in the nature of these interactions rather than quality. Those persons studied seemed to shift their social activities from professional work relations to caritative civic engagement and instrumental support to family and friends. Such activities have been shown to increase social satisfaction among pensioners and reduce loneliness (Niedzwiedz et al., 2016). It has also been shown that when older adults engage in leisure-time physical activities, this can also reduce feeling of loneliness (Kim et al. 2017). It is possible that as individuals retire, they will have more time for such activities, to the benefit of their social well-being.

This then shows, that despite being highly relevant, there is still unclarity as to what exactly the effects of retirement are on individuals’ social well-being. In this study we aim to contribute to the debate at hand by researching the causal mechanism between these two aspects. Our main research question at hand is: “What is the causal effect of retirement and aging on the social well-being of individuals?”. We address this research question by conducting an empirical study, employing a jointly estimated instrumental variable model, by making use of the variation in early and full retirement ages across Europe, thus resolving the problem of endogeneity. In doing so we make use of the Survey on Health Aging and Retirement in Europe (SHARE). To preclude, we find that, although retirement does have a negative effect on the size of individuals’ social networks, this does not coincide with negative effects on

how respondents evaluate their social well-being, and that in some instances, we even see positive effects. We find that lower levels of social well-being among older persons are in fact due to aging, rather than retirement. We exploit the longitudinal character of the SHARE dataset and repeat the analysis using a fixed effects regression, showing that these results are largely robust against methodological choices.

In the next chapter we will lay out our theoretical framework and hypotheses. In the third section we will discuss our methods. In section four we will describe our data. In section five we present our results, and finally section six concludes.

2 Theory & Hypotheses

In the previous section we have already started to give shape to our theoretical framework. In this section we will further develop our theory, first by conceptualizing our main variables of interest, and then by developing hypotheses.

Heaven et al. (2013) distinguish three areas in which the conceptualization of social relations with regard to health and well-being can be categorized: social networks, social and emotional support, and social roles. Within our research question it is especially social networks that seem relevant as this is what is expected to be impacted by retirement (Ekerdt, 2010). As such, some have often used the size of social networks as outcome variable (c.f. Van Tilburg, 2003). However, as has been eluded to in the previous section, size of social network is not necessarily the same as quality of social network. One could have many friends, but still not be satisfied with their social network, or vice versa. As such, a second possible conceptualization of our outcome variable is social network satisfaction, rather than size. Yet a third relevant conceptualization would be to measure if individuals feel more or less left out after retirement. It is conceivable that this measure may actually be affected positively by retirement, as individuals now have more time for social activities, despite a loss in social network size. Lastly, a direct measure for loneliness would also be highly relevant, as it is especially this emotion that has been shown to cause health issues (Cornwell & Wait, 2009), and as Segel Karpas et al. (2016) point out, loneliness – a subjective feeling – is distinct from aloneness – an objective state of lack of lack of social ties. As such our final two possible measures would allow us to be able to distinguish between these two.

These possible conceptualizations can be distinguished based on whether they are objective or subjective measures of social outcomes. At first instance, a subjective measure would seem more appropriate since, as already noted, it seems that it is such subjective feelings such as loneliness and social satisfaction, that are relevant; not so much in objective measures such as the size of respondents' social network. However, with such subjective measures we run a risk analogous to justification bias, where respondents choose to believe that they have retired for certain reasons after the fact. In our case, for example, respondents could possibly be in denial of a deterioration of their social condition caused by retirement, or possibly convince themselves, after already having retired, that they actually rationally chose to do so in order to have more time for family and friends, leading them to inflate their feelings of

social satisfaction after retiring, causing the data to wrongfully show an increase in social satisfaction measures as a result of retirement.

In dealing with this justification bias problem, but with regard to health measures – that is, respondents claiming post hoc that they choose to retire because of ill health, despite this not being the case – Bound et al. (1999) suggest alleviating this problem by creating a health index by regressing respondents' subjective health measures on to objective health measures, and using the fitted values of that regression as outcome variable. In our case we could thus use the fitted values of our subjective measures regressed onto our objective measures as outcome variable. However, this would not be without problems. First of all, this would be somewhat self-defeating, since we are not interested in objective social measures, but subjective ones, but only that we want such subjective measures to truly reflect respondents' feelings without being confounded by possible denial. Secondly, doing so would cancel out the variation among respondents in how they subjectively evaluate their objective social status. As noted before, one person could be very content with a small social network, whereas the other can feel isolated despite having a large social network. Such variation is clearly highly relevant to our research at hand, since again it is these subjective measures that we are interested in. In the case of studying health effects, on the other hand, it is in fact desirable to cancel out such variation, as different people evaluate the same objective health status differently. Since in our case such an approach would be counter-productive, we will thus choose to simply use all four outcome variables; three subjective ones and one objective one.

Based on the literature in the previous section, we can expect that the mechanism through which retirement would affect social outcomes is first by causing a reduction in social network size and/or quality, leading to reduced social well-being reflected in a deterioration of social network satisfaction, feeling increasingly left out, and loneliness. However, we have also seen that there seems to be no clear relation between retirement and social measures. Where some individuals may experience such a transition as positive, others may not (Ekerdt, 2010). As such we expect there to be no overall causal relationship between retirement and these three social measures. Our first hypothesis is thus:

H1: Retirement has no overall causal effect on social networks size (H1a) or satisfaction (H1b), nor does it have a general causal effect on feeling left out (H1c) or loneliness (H1d).

Furthermore, as MacBride (1976) points out, such effects are often due to aging rather than retirement per se. Our second hypothesis is thus:

H2: Negative effects on social network size (H2a), social network satisfaction (H2b), feeling left out (H2c), and loneliness (H2d) are caused by aging rather than retirement.

However, there are indications that such negative outcomes are predominantly concentrated among certain high-risk groups. Those of lower income classes, lower education, not married or partnered, and women seem to have higher chances to indicate that they feel lonely (Aylaz et al. 2012; Niedzwiedz et al., 2016; Vozikaki et al., 2018). We thus hypothesize that:

H3: Insofar retirement negatively affects social network size, it will be concentrated on those with lower income (H3a), lower educational attainment (H3b), those who are not married or in a registered partnership (H3c) and women (H3d).

H4: Insofar retirement negatively affects social networks satisfaction, it will be concentrated on those with lower income (H4a), lower educational attainment (H4b), those who are not married or in a registered partnership (H4c) and women (H4d).

H5: Insofar retirement negatively affects feeling left out, it will be concentrated on those with lower income (H5a), lower educational attainment (H5b), those who are not married or in a registered partnership (H5c) and women (H5d).

H6: Insofar retirement negatively affects loneliness, it will be concentrated on those with lower income (H6a), lower educational attainment (H6b), those who are not married or in a registered partnership (H6c) and women (H6d).

Finally, we expect there to be positive self-selection regarding retirement timing and social outcomes. As Ekerdt (2010) points out, those who perceive retirement to be harmful will try to prevent such from happening. Moreover, MacBride (1976) shows that the most important determinant of retirement satisfaction is willingness to retire. Assuming rational agents, this can also be applicable the other way around: those who expect to be satisfied with retirement are those who choose to retire. Our final hypothesis is thus:

H7: Those who are more likely to experience a gain in social network size (H7a), social network satisfaction (H7b), and/or experience a decrease in feeling left out (H7c) or loneliness (H7d), are those most likely to retire.

The methods we will use to test these hypotheses are discussed in the following section.

3 Methods

A simplistic approach to the research question at hand would be to run an OLS or ordered probit regression (depending on which outcome variable we are analyzing) in the form of

$$y_{it} = \alpha + \beta D_{it} + X_{it}\gamma + C_{it}\delta + T_t\lambda + \varepsilon_{it}$$

where y_{it} is our dependent variable (for example loneliness), D_{it} is a dummy variable indicating whether or not the respondent is retired, X_{it} is a vector of control variables including age, C_{it} represents a vector of country dummies added to the regression in order to control for country specific effects. This would be necessary since it is possible that such effects would otherwise confound our results, for example, if countries with certain welfare systems also happen to be characterized by social structures differing from other countries. Similarly, T_t denotes a vector of period dummies to control period fixed effects, and lastly ε_{it} is the residual.

However, such an approach would not be able to control for endogeneity. It is fair to assume that a respondent's choice to retire is partly motivated by (their satisfaction with) their social situation. Those who have a relatively limited social network, for example, can presumably be less inclined to retire, seeing as the only social contact they have is that received via working relations, and as such would fear risking social isolation if they were to retire. On the other hand, those with a larger social network could actually be inclined to retire earlier in order to have more time to spend with friends and family.

A better approach thus would be to employ an instrumental variable regression, comparable to that employed by Coe and Zamarro (2010) in analyzing the effects of retirement on health. Here we can use the large variation in (early) retirement ages across European countries as instruments to find the causal relationship between retirement and our social outcome measures. In doing so we first estimate the following ordered probit model, with standard errors clustered at the individual level:

$$y_{it}^* = \alpha + \beta D_{it} + X_{it}\gamma + C_{it}\delta + T_t\lambda + u_{it}$$

where y_{it}^* denotes the latent variable level of our ordered outcome variables, such as loneliness or feelings of being left out, of individual i at time t . We observe these outcomes (y) such that:

$$y_{it} = \begin{cases} 1 & \text{if } y_{it}^* \leq \alpha_1 \\ 2 & \text{if } \alpha_1 < y_{it}^* \leq \alpha_2 \\ \vdots & \\ J & \text{if } \alpha_{J-1} < y_{it}^* \end{cases}$$

These unknown cutoffs satisfy the condition that $\alpha_1 < \alpha_2 < \dots < \alpha_{J-1}$. Next, as before, D_{it} denotes a dummy variable indicating retirement, X_{it} is a vector of control variables including age, and C_{it} represents a vector of country dummies, T_t denotes a vector of period dummies, and finally, u_{it} denotes the residual.

We then jointly model the endogenous variable D_{it} by maximum likelihood by the following probit model, again with standard errors clustered at the individual level:

$$D_{it} = \kappa + \theta_1 E_{it} + \theta_2 R_{it} + X_{it}\pi + C_{it}\rho + T_t\tau + v_{it}$$

where D_{it} once again denotes the dummy variable indicating retirement, E_{it} is a dummy variable indicating having reached early retirement age, and R_{it} is a dummy variable indicating whether the respondent has reached the age of full retirement, X_{it} is again a vector of control variables including age, C_{it} and T_t again represent a vector of country and period dummies, respectively, added to the regression in order to control for country and period specific effects, and v_{it} is the residual. The above regression can be interpreted as reflecting the increase in the probability of retirement as respondents increase in age, with two discontinuities at each retirement age. This is shown in stylized fashion below in figure 1.

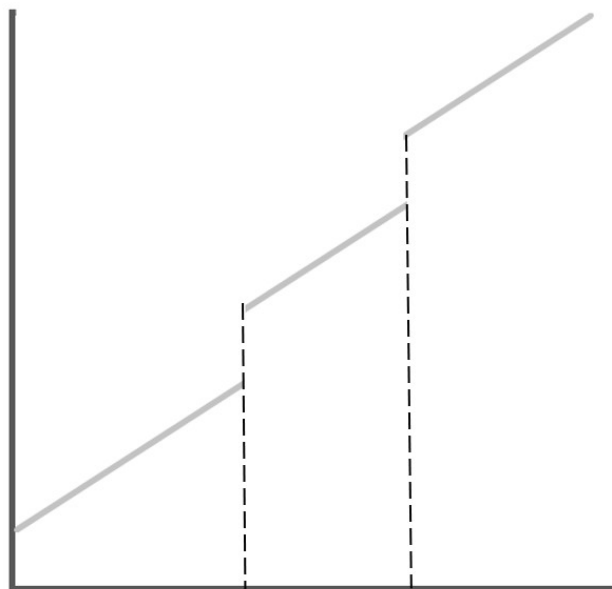


Figure 1. Probability of Retirement by age, discontinuous at early and full retirement age

In order for such an instrumental variable regression to be valid, the instrument must meet three requirements: relevance, independence, and exclusion (Angrist & Pischke, 2015, p. 106). Relevance simply means that the instrument has a causal effect on the endogenous variable. In our case, besides it being in itself obvious that reaching the retirement age will have an effect on retirement, this has also been proven empirically (Hurd, 1990; Lumsdaine & Mitchel, 1999; Staubli & Zweimüller, 2013) and thus this requirement is met. For the sake of completeness, we will check for this by presenting the retirement probit results separately before continuing with the IV estimates. The second principle, independence, requires that the instrument be randomly assigned and not be related to any omitted variable. This requirement is met as well, since respondents cannot control what retirement age they are subject to. Finally, exclusion refers to the principle that the instrument should affect the outcome variable only through the endogenous variable. This requirement is also met, since it would be highly unreasonable for us to believe that, for some reason, reaching the age of retirement would cause a sudden change in one's social situation, other than through causing retirement.

Besides the IV model, we will also present our OLS results (for our social network size outcome) and ordered probit results (for our other outcomes) in order to test for self-selection. If we see, for example, that there is a positive correlation between retirement and social network size in the OLS regression, but not in the IV regression, this could indicate that there is a correlation between retirement and social network size, not because of a general causal relation, but because those who stand to gain socially from retiring have a higher propensity to retire than those who do not, causing the OLS coefficient to be biased.

Lastly, in order to check for differential effects on different groups we will rerun the regressions differentiating between specific groups, in order to assess whether or not this is indeed the case. We will do this for gender, income groups, educational achievement and marital status, as per our hypotheses. We must however bear in mind that selecting cases based on endogenous variables can bias our outcomes. As such we must view these results, with the exception of those selecting based in gender, as tentative. When analyzing the effect on the size of social networks, we must also bear in mind that those with a smaller social network can be expected to undergo smaller absolute effects on their social network. For example, if we find that those who are of lower social economic groups have smaller social networks, and that retirement has a negative causal impact on the size of social networks, we may expect to see that those in lower social economic groups have a smaller absolute decrease in the size of their social

network, but possibly still a larger relative decrease. For this reason, when analyzing the possible differential effects, we will also use the natural logarithm of the outcome variable at hand that is:

$$\ln(y_{it}) = \alpha + \beta D_{it} + X_{it}\gamma + C_{it}\delta + T_t\lambda + u_{it}$$

Another approach we could have taken was to employ a fixed effects regression in the form of

$$y_{it} = \alpha + \beta D_{it} + X_{it}\gamma + u_i + \varepsilon_{it}$$

where again y_{it} is our outcome variable of individual i at time t , D_{it} again denotes a retirement dummy, and X_{it} is again a vector of control variables. With such an approach we would also be able to limit the effects of endogeneity, since we would now be comparing the same individuals over time, meaning that our results would only be biased if it was so that individuals would, for example, experience a gain in social network and as a result of that chose to retire. This, however, seems much less likely than the issues that would cause our OLS and ordered probit estimates to be biased, as explained before. However, as we will see in the next section, our data does not cover a long enough time span to be able to make proper panel estimates. We will nevertheless use this secondary method in order to test the robustness of our results.

In the following section we will discuss our data, before moving on to the substantive analyses where we will apply these methods.

4 Data

4.1 Data Set & Sample Selection

For our research we will use data from the fourth, fifth and sixth wave of the SHARE longitudinal Survey of Health Aging and Retirement in Europe conducted in 2011, 2013 and 2015 respectively. This data set contains extensive data on a wide array of variables, such as financial variables, information on both objective and subjective health measures, assets, and consumption, obtained via a computer-assisted personal interview (CAPI). We choose only these three waves since our outcome variables are not available for the previous waves. Whereas one of our outcomes – feeling left out – is available for the last three waves, the other the outcomes are only available for two of the last three waves. The country composition of the dataset with corresponding retirement ages can be seen in table 1.

We select only those aged between 50 and 75, as we are only interested in those around the early and full retirement ages. Taking a too large age range would also put us at greater risk of our results being

<i>Country</i>	<i>%</i>	<i>Early Retirement Age</i>	<i>Full Retirement Age</i>
<i>Austria</i>	7.21	64	65
<i>Belgium</i>	8.60	60	65
<i>Czech Republic</i>	8.88	60	62
<i>Denmark</i>	5.54	-	65
<i>Estonia</i>	9.10	60	63
<i>France</i>	7.26	57	62
<i>Germany</i>	6.52	63	65
<i>Greece</i>	2.58	62	67
<i>Hungary</i>	1.65	-	62
<i>Israel</i>	2.21	-	67
<i>Italy</i>	7.43	57	65
<i>Luxembourg</i>	1.77	57	60
<i>Netherlands</i>	3.76	-	65
<i>Poland</i>	1.83	-	65
<i>Portugal</i>	2.06	65	66
<i>Slovenia</i>	5.39	-	58
<i>Spain</i>	7.56	61	65
<i>Sweden</i>	5.44	61	65
<i>Switzerland</i>	5.22	63	65
<i>Total</i>	141,288		

Table 1. Country Frequency & Retirement Ages for 2014

confounded by cohort effects. We also exclude those who are permanently sick or disabled, as their

transition into retirement are inherently different to those who transition from working. Summary statistics for our dataset can be seen in table 2 below.

<i>Variable</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>	<i>N</i>
<i>Age</i>	62.949	6.908	50	75	141,288
<i>Aged Past Early Retirement Age</i>	0.531		0	1	74,988
<i>Aged Past Full Retirement Age</i>	0.486		0	1	68,665
<i>Gender</i>					
<i>Men</i>	0.445		0	1	63,850
<i>Women</i>	0.555		0	1	79,480
<i>Employment Status</i>					
<i>Retired</i>	0.529		0	1	75,382
<i>Employed or self-employed</i>	0.338		0	1	47,911
<i>Unemployed</i>	0.037		0	1	5,455
<i>Homemaker</i>	0.082		0	1	11,649
<i>Other</i>	0.013		0	1	1,904
<i>Physical Limitation Index</i>	1.200	1.963	0	10	140,879
<i>Educational Attainment</i>					
<i>Basic/Primary</i>	0.143		0	1	19,974
<i>Secondary</i>	0.533		0	1	75,727
<i>Post-Secondary/Tertiary</i>	0.288		0	1	40,495
<i>Marital Status</i>					
<i>Married</i>	0.713		0	1	43,686
<i>Registered Partnership</i>	0.019		0	1	1,113
<i>Separated</i>	0.014		0	1	838
<i>Never Married</i>	0.057		0	1	3,447
<i>Divorced</i>	0.097		0	1	5,799
<i>Widowed</i>	0.010		0	1	6,096
<i>Equivalentized Household Income</i>	3,842.77	5,5923.12	0	9,999,999	76,700

Table 2. Summary Statistics

4.2 Dependent Variables

As stated before we have four outcome variables: social network size, social network satisfaction, feeling left out, and feeling lonely. The first variable, social network size, is a generated variable based on another question where respondents were asked to mention persons who they consider confidants. The fact that this is a generated variable also helps mitigate the risk of justification bias, as noted earlier, since if respondents were simply asked how large their social network is, they could have inflated the size, possibly due to being in denial of their loss in social network after retiring.

Secondly, we will look at respondent's satisfaction with their social network. Here respondents were asked the question: "Overall, on a scale from 0 to 10, where 0 means completely dissatisfied and 10 means completely satisfied, how satisfied are you with the [relationship that you have with the person/relationships that you have with all the people] we have just talked about?", referring to the people they mentioned to be in their social network.

Next, we will look at the effect of retirement on how often respondents feel left out. Here respondents were asked: "How often do you feel left out of things?". They could answer on a four-point scale: 1. often, 2. sometimes, 3. rarely, 4. never. It must thus be noted here that a higher score indicates feeling left out less often.

Lastly, we look at loneliness. Here respondents were asked: "How much of the time do you feel lonely?". Here they could answer: 1. often, 2. some of the time, 3. hardly ever or never. Thus, once again a higher score indicates such feelings occurring less often. How these outcomes relate to our main variable of interest, retirement, can be seen in table 3 below. We can see that those who are retired have on average a slightly smaller social network and marginally lower social network satisfaction. We also see that they have higher frequencies of feeling left out and lonely.

4.3 Explanatory Variables

There are multiple ways of measuring our main explanatory variable, retirement. Cou and Zamarro (2011), for example, look at a sudden decrease in working hours, as they believe that respondents could claim to be retired in the strict sense of the word, but still be engaging in quasi-labor, such as volunteering. In our case however, we are in fact interested in retirement in the stricter sense of

the word, that is, the ceasing of formal labor at the end of one’s career, rather than ceasing any type of activities that could be considered work all together. Measuring hours worked would, furthermore, not be desirable for our specific research question at hand, since one of the reasons we expect there not to be any major shifts in respondent’s social measures precisely because they may switch to other forms of activities such as volunteer work. As such we will simply look at whether or not respondents indicated to be retired or not.

	<i>Not Retired</i>	<i>Retired</i>	<i>Std. Dev.</i>
<i>Average Social Network Size</i>	2.671	2.555	1.595
<i>Average Social Network Satisfaction</i>	8.963	8.953	1.217
<i>Feeling Left Out</i>			
<i>Often</i>	3.78%	5.10%	
<i>Sometimes</i>	15.23%	17.26%	
<i>Rarely</i>	27.41%	24.63%	
<i>Never</i>	53.58%	53.01%	
<i>Feeling Lonely</i>			
<i>Often</i>	4.33%	5.23%	
<i>Some of the Time</i>	16.09%	17.50%	
<i>Rarely Ever/Never</i>	79.58%	77.27%	

Table 3. Outcome Variables by Retirement Status

As we can see in table 2, 52.9% of respondents in our sample were retired. In our analysis we will use being aged past the age of early and full retirement as instruments. We use data from the OECD (2015) regarding retirement ages for 2014, as reliable and consistent data for the specific years of our dataset were not available. Though there has been a trend in increasing retirement ages, this should not affect our analysis drastically, as these increases are often implemented incrementally by raising the retirement ages a few months at a time per year. Since we measure age in full years, our results would only be affected if we are off by at least a full year. In our sample 53.1% of the respondents were above the age of early retirement, while 48.6% were above the age of full retirement.

Our second explanatory variable is age. As stated before, we expect age to be the true underlying reason for loneliness among older citizens rather than retirement per se. The average age in our data set is just under 63.

4.4 Control Variables

First, we control for respondents being physically limited. This is necessary since being physically impaired could influence an individual's decision to retire earlier, but has also been shown to have negative effects on the social well-being of the elderly (Luhmann & Hawkey, 2016; Niedzwiedz et al. 2015). However, as we have seen before, our social outcome measures have been shown to affect respondents' health. Thus, adding such health measures to our regression could bias our outcomes as a result of reverse causality. However, there were no indications that being physically limited was one of the health measures that could be influenced by our outcomes of interest. We calculate a physical limitation index using semi-objective measures of physical limitations. Respondents were asked to indicate if they experience difficulties with 10 every day physical task, such as among other, walking 100 meters, climbing several flights of stairs, stooping/kneeling/crouching, and lifting or carrying weights over 5 kilos. We then calculate the index by giving each respondent a score from 0 to 10 reflecting how many of these actives they indicated to have difficulties with. This then means that a higher score coincides with higher physical limitation. However, due to the fact that this measure remains semi subjective, and that health nevertheless remains a factor that has been shown to be affecting by social variables, we choose not to control for this variable in our baseline regressions, but rather to add it to our extended regression.

Endogeneity remains, however, a problem with our other control variables as well. We would want to control for income, as both a person's retirement decision as well as their social status can be assumed to be influenced by their financial situation. A person with more financial means would find it easier to stop working earlier than one who does not. But it has also reasonable to believe that a person in a higher income class would have a larger social network and be more satisfied with it, partly due to being able to afford social activities more easily. Aylaz et al. (2012) for example found that feelings of loneliness among the elderly are less prevalent among the higher social economic classes. However, it is also possible that a person's income is influenced by their social networks: someone with a large social network could be better positioned to find better paying jobs. It could also be that unobserved

characteristics, such as being charismatic, effects both. As such we again do not add this variable in the baseline regressions, but add it to secondary extended regressions.

We use household income rather than personal income, since these effects would not be bound to the individual but rather the household as a whole. Furthermore, we divide the household income by its size, making use of the square root equivalence scale – the method most recently adopted by the OECD for equalizing household income (OECD, n.d.) – since otherwise larger households would seem to be financially better off than smaller ones, even if the inhabitants each had the same income. It must be noted that this variable contains some outliers, which are clearly due to errors. The highest nominal household income per inhabitant, for example, is shown to be half a quintillion euros, that is a five followed by 17 zeros. Since there is no clear point where these measures are obviously due to errors, we set a somewhat arbitrary cut-off of €10 million per year per inhabitant adjusted for household size equivalency, as this is still reasonable for a wealthy family. This cut-off leads to only 27 observations being omitted.

Next, we also control for respondents' highest educational level attained, according to the 1997 ISCED scale, since this too can be expected to affect both their retirement decision as well as their social measures. However, this too would not be without problems since once again this is an endogenous variable. For this reason, we will also only add this control in the extended regressions. Lastly, we do the same for marital status, since we can expect widows for example, to be more likely to postpone retirement, but also possibly have smaller social networks. But as before, one's marital status could be influenced by one's social network as well.

5 Results

5.1 Instrumental Relevance

As we have mentioned before, one of the requirements for an instrumental variable regression, is that the instrument(s) be relevant, that is to say, that they have a direct relationship with the endogenous explanatory variable we are instrumenting. In that case, that means we have to test if the early and full retirement ages are indeed related to retirement. In table 4 we can see that both being over the full retirement age as well as being over the early retirement age are highly statistically correlated with the decision to retire. In terms of average marginal effects, reaching the early retirement age increases the probability of retiring by 4.2%, while reaching the age of full retirement increases the probability of retirement by 12.6%. This then validates the use of these variable as instruments in our analysis.

	<i>Retirement</i>
<i>Retirement Age</i>	0.603** (0.017)
<i>Early Retirement Age</i>	0.203** (0.018)
<i>Age</i>	1.013** (0.023)
<i>Age² /100</i>	-0.696** (0.018)
<i>Female</i>	-0.288** (0.011)
<i>Constant</i>	-35.550** (0.773)
<i>N</i>	140,341

Table 4. Retirement Outcome Probit Results. Regression includes country and wave dummies to control for country and wave fixed effects. Standard Errors in parentheses, clustered at individual level. * $p < 0.05$ ** $p < 0.01$

5.2 Social Network Size

Below in table 5 we show both the OLS/ordered probit results as well as the IV result for the outcomes social network size, social network satisfaction, feeling left out, and feeling lonely. In table 6 we add education level, household income level, and marital status as controls to our IV models.

What is interesting to note is that, although neither the OLS regression nor the IV regression return statistically significant coefficients for retirement being correlated with a change in the size of a respondent's social network, this coefficient becomes smaller in the IV regression. This supports our

hypothesis H1a, that there is no overall causal effect of retirement on social network size. This also lends some support to our hypothesis H7a, that there is positive self-selection in the retirement decision of respondents. Those who are more likely to gain in social network size seem more likely to retire, whereas those who are more likely not to, seem to choose to postpone retirement. This then leading the endogenous variable to be biased upwards in the OLS in comparison to the IV regression. Next, looking at the effect of aging, we see that our polynomial function peaks at around the age of 58 (that as, where the quadratic function of $0.044 \text{ Age} - 0.00038 \text{ Age}^2$ reaches its maximum), meaning that the effect of aging is negative for the majority of our sample, in support of hypothesis H2a, that states that any negative social outcomes are due to aging, rather than retirement per se. Lastly we also see that women on average have significantly larger social networks than men.

	<i>Social Network Size</i>		<i>Social Network Satisfaction</i>		<i>Feeling Left Out</i>		<i>Feeling Lonely</i>	
	OLS	IV	Ordered Probit	IV	Ordered Probit	IV	Ordered Probit	IV
<i>Retired</i>	0.001 (0.015)	-0.041 (0.047)	-0.017 (0.011)	0.043 (0.035)	-0.012 (0.010)	0.161** (0.031)	-0.052** (0.014)	0.067 (0.040)
<i>Age</i>	0.036* (0.015)	0.044* (0.018)	-0.010 (-0.011)	-0.021 (0.013)	0.061** (0.010)	0.029** (0.011)	0.085** (0.014)	0.063** (0.015)
<i>Age² /100</i>	-0.034** (0.012)	-0.038** (0.013)	0.008 (0.009)	0.015 (0.009)	-0.052** (0.008)	-0.033** (0.008)	-0.073** (0.011)	-0.060** (0.011)
<i>Female</i>	0.464** (0.011)	0.462** (0.012)	0.121** (0.008)	0.124** (0.008)	-0.091** (0.007)	-0.081** (0.008)	-0.299** (0.010)	-0.292** (0.011)
<i>Constant</i>	1.720** (0.483)	1.426** (0.576)						
<i>N</i>	86,224	140,341	82,966	140,341	137,706	140,341	95,069	140,341

Table 5. OLS, Ordered Probit and IV estimates for the outcomes social network size, social network satisfaction, feeling left out and loneliness. Positive coefficients in feeling left out and loneliness models indicate such feelings occur less frequently. Regressions include country and wave dummies to control for country and wave fixed effects. Clustered Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

Next, in the extended regression we see that respondents who were physically limited, did not seem to have social networks that significantly differed in size, compared to those who were not physically limited, in contradiction of our expectations. However, we see that with regards to the effect of education level, we do find support for the findings of Niedzwiedz et al. (2016) and Vozikaki et al. (2018). We see that those who are higher educated tended to have a larger social network. We also see that respondents' household income is statistically significantly positively correlated with the size of respondents' social networks, again in line with existing studies.

		<i>Social Network Size</i>	<i>Social Network Satisfaction</i>	<i>Feeling Left Out</i>	<i>Feeling Lonely</i>
<i>Retired</i>		0.109 (0.122)	0.008 (0.072)	0.161** (0.061)	0.175 (0.097)
<i>Age</i>		-0.030 (0.039)	-0.052* (0.025)	-0.012 (0.020)	-0.014 (0.033)
<i>Age²/100</i>		0.014 (0.028)	0.042* (0.019)	0.005 (0.015)	0.005 (0.025)
<i>Female</i>		0.429** (0.025)	0.154** (0.018)	0.026 (0.014)	-0.090** (0.025)
<i>Physically Limited</i>		0.001 (0.006)	-0.016** (0.004)	-0.120** (0.004)	-0.109** (0.006)
<i>Education</i>		0.005** (0.002)	0.000 (0.001)	0.003* (0.001)	-0.000 (0.003)
<i>Log HH Income</i>		0.050** (0.011)	-0.005 (0.008)	0.043** (0.006)	0.039** (0.010)
<i>Marital Status (married as reference)</i>	Registered Partnership	-0.023 (0.094)	-0.103 (0.066)	-0.119* (0.049)	0.055 (0.101)
	Separated	-0.078 (0.082)	-0.146* (0.067)	-0.301** (0.049)	-0.867** (0.076)
	Never Married	-0.314** (0.044)	-0.234** (0.033)	-0.226** (0.025)	-0.681** (0.040)
	Divorced	-0.057 (0.035)	-0.188** (0.025)	-0.175** (0.020)	-0.788** (0.033)
	Widowed	-0.176** (0.034)	-0.019 (0.026)	-0.140** (0.021)	-1.032** (0.034)
<i>Constant</i>		3.552** (1.259)			
<i>N</i>		30,602	30,602	30,602	30,602

Table 6. IV estimates for the outcomes social network size, social network satisfaction, feeling left out and loneliness. Positive coefficients in feeling left out and loneliness models indicate such feelings occur less frequently. Regressions include country and wave dummies to control for country and wave fixed effects. Clustered Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

Lastly, with regards to marital status, our results lend strong, albeit incomplete support assumptions derived from Niedzwiedz and Vozikaki. We see that those who were widowed, or never married, had fewer persons in their social network compared to those who were married. Also in line with our expectations, those who were in a registered partnership did not have a social network that was statically significantly different in size compared to those who were married. On the other hand, contrary to our expectations, those who were divorced, or married but living separately from their spouses did not have a statistically significantly smaller social network when compared to those who were married.

5.3 Social Network Satisfaction

Next, we see that, as was the case with the previous outcome variable, neither the ordered probit nor the IV estimate, show a statistically significant effect of retirement on social network satisfaction. This on the one hand confirms our hypothesis H1b, that retirement does not have an overall causal effect on social network satisfaction. However, these results also somewhat refute our hypothesis H7b, that due to positive self-selection, those who choose to retire earlier generally have higher satisfaction with their social networks. Though neither coefficient is highly statistically significant, we see that whereas the ordered probit has a negatively signed coefficient, this becomes positively signed in the IV results. This then, albeit weakly, implies that there is actually negative self-selection. This could possibly be caused by respondents experiencing external shocks causing both retirement and a decrease in their social measures. For example, a person's spouse could become seriously ill, leading to this person retiring earlier to take care of their spouse, which would then in turn hamper this person's ability to have proper social interactions. Furthermore, contrary to our hypothesis H2b, we do not find that those who are older tended to be less satisfied with their social network. Lastly, we also see that women tended to be more satisfied with their social networks.

In the extended regression we see that, in line with expectations, those who were physically limited due to health were less satisfied with their social network. On the other hand, we do not find it to be the case for those who are more highly educated or have a higher income, to be more satisfied with their social networks either, in contradiction to our expectations. Regarding marital status, we once again find partial support for our expectations. While the estimate shows that those who were divorced, separated or never married do tend to be less satisfied with their social network when compared to those who were married, and also that this is not the case with those who were in a registered partnership, both of which lend support to our hypothesis, this was not the case for those who were widowed, in contrast to our expectations.

5.4 Feeling Left Out

With regard to feeling left out, it must first be reiterated that positive coefficients indicate that respondents are feeling left out less often. We find that retirement is associated with fewer occurrences of feeling left out in the IV estimate, but not the ordered probit model. Although this contradicts our

hypothesis H1c, it lends support to the notion that, once retired, people tend to have more time for social activities, thus leading them to feel left out less often. In terms of average marginal effect, in our model retirement lowers the probability of feeling left out often, sometimes, and rarely, by 1.4%, 2.9% and 1.7% respectively, while increasing the probability of never feeling left out by 6.0%. The fact that the IV coefficient is much larger and more statistically significant than in the ordered probit model, however, once again seems to indicate that there is no positive self-selection, but rather negative self-selection, as was also the case with regards to social network satisfaction. This then also contradicts our hypothesis H7c. However, as was the case with social network satisfaction, this could be caused by external shocks. Regarding age, in line with our hypothesis H2c, we find that our quadratic age model peaks around the age of 44, meaning that for our entire age range of our data sample, aging causes more frequent feeling of being left out, since our data consists of those age 50-75. Lastly we see that women felt left out more often than men.

Next, in our extended regression we see that, as expected, those who were physically limited, felt left out more often than those who were not. We also find that educational attainment correlates statistically significantly with less frequency in feeling left out. Moreover, the correlation between household income and lack of such feelings are even stronger. And lastly, once again we find partial but strong support for our expectations regarding marital status. Our model shows that being separated, divorced, widowed, or never married, are all associated with higher occurrence of feeling left out, which is again in line with what was expected. Against expectations, however, we see that being in a registered partnership also causes such feelings to occur more often, when compared to being married.

It is interesting to note that age no longer has a statistically significant effect when these controls are added. This could possibly be due to the fact that the people feel left out more often as they age due to declining mobility, which is then captured by the physical limitation variable. However, this could also be due to the fact that we are adding endogenous variables to the regression, causing our results to be biased. If we rerun the regression omitting the physical limitation variable (not shown), the age coefficients remain however statistically insignificant, suggesting the latter to be the case.

5.5 Feeling Lonely

With regards to our final outcome variable, here once again positive coefficients indicate feelings of loneliness occurring less often. We see that the positive causal effect of retirement on lower levels of loneliness, is not statistically significant, thus lending support to our hypothesis H1d. Once again, however, we see that the results contradict our hypothesis H7d. We see that whereas the coefficient is negatively signed and statistically significant in the ordered probit model, it is positively signed in the IV model. However, as was the case with the two previous outcomes, this could again be due to external shocks. In line with our expectations, on the other hand, we see that aging is statistically negatively correlated with feeling lonely less often after the age of 53, supporting our hypothesis H2d. Regarding gender we see that, as expected based on the existing literature, women tend to feel lonely more often than men.

Finally, in our extended regression we see that, in line with expectation, those who have limited mobility feel lonely more often than those who are not. Next we see that whereas education level does not seem to affect feelings of loneliness, we see that those with higher household incomes do tend to feel lonely less often. We also see that the results regarding marital status are exactly in line with expectations. Whereas those who were in a registered partnership did not differ in relation to those who were married, those who were separated, divorced, widowed, or never married, tended to feel lonely more often than those who were married. As with the previous outcome variable, we see that age no longer has a statistically significant effect once more controls are added. Again, this could be either due to declining mobility being the true reason respondents feel lonely more often as they age, or due to endogenous control variables confounding our results. Removing the physical limitation variable from our regression (not shown) once again does not cause the age coefficients to become statistically significant, again suggesting that this is due to the endogeneity of the controls.

5.6 Differential Effects

It is theoretically possible that the reason the effects of retirement on our outcome variables, with the exception of feeling left out, are not significantly different from zero in the IV estimates, is due to the fact that whereas retirement affects certain groups positively, it affects others negatively, thus causing these two effects to cancel each other out when we take the entire sample into account. To check if this is indeed the case we can split the dataset in different groups to see if the effect of retirement is different

among them for the outcome variables at hand. First, we will assess whether this is the case for educational achievement. We do this by running the IV regressions separately for those with a tertiary education level from those who have a secondary or lower educational level. Secondly, we do the same for income groups, by analyzing the upper two quintiles and the lower two separately. Next, we assess whether this is the case for marital status groups, by analyzing those who are married or in a registered partnership separately from those who are separated, divorced, widowed, or who were never married. Lastly, we check to see if there is a difference in effects between men and women. For this last analysis we omit gender as an input variable for obvious reasons. We must reiterate here that selecting on endogenous variables can cause our results to be biased. As such the results other than those differentiated by gender must be regarded as tentative. The results are shown in tables 7 through 11 below.

<i>Social Network Size</i>	<i>Gender</i>		<i>Income</i>		<i>Educational Level</i>		<i>Marital Status</i>	
	Male	Female	Low	High	Low	High	Married	Not Married
<i>Retired</i>	-0.007 (0.065)	-0.148* (0.063)	-0.024 (0.117)	-0.027 (0.095)	0.006 (0.051)	-0.032 (0.097)	0.082 (0.091)	0.129 (0.141)
<i>Age</i>	0.034 (0.026)	0.076** (0.024)	-0.006 (0.042)	0.033 (0.037)	0.048* (0.021)	-0.003 (0.032)	0.033 (0.030)	-0.054 (0.050)
<i>Age²/100</i>	-0.027 (0.020)	-0.064** (0.018)	0.003 (0.030)	-0.033 (0.029)	-0.042** (0.015)	-0.000 (0.025)	-0.035 (0.023)	0.032 (0.037)
<i>Female</i>			0.367** (0.024)	0.572** (0.026)	0.429** (0.014)	0.593** (0.023)	0.472** (0.020)	0.510** (0.033)
<i>Constant</i>	1.586 (0.865)	0.959 (0.763)	2.921* (1.363)	1.914 (1.200)	1.211 (0.670)	3.003** (1.043)	1.861 (0.983)	4.590** (1.640)
<i>N</i>	62,470	77,871	30,624	30,078	98,026	40,466	42,886	15,609

Table 7. IV estimates for social network size outcome, split up by gender, household income per inhabitant (upper two quintiles versus lower two quintiles), highest level of education attained (tertiary education versus secondary or lower), and marital status (married or registered partnership versus separated, divorced, widowed, or never married). Regressions include country and wave dummies to control for country and wave fixed effects. Clustered Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

With regards to social network size, one differential effect stands out. We see that whereas men do not seem to be affected by retirement, we see that women do undergo a statistically significantly large loss in social network as a result of retirement. This then lends strong support to our hypothesis H3d. With regards to the other three group differentials, however, we can see that it does not seem the case that retirement affects these groups differently, since retirement does not return a statistically significant coefficient in any of the regressions, let alone for there to be a difference in effect among groups. This

then does not lend support to our hypotheses H3a/b/c. With regards to age, we do however see larger discrepancies between groups. Whereas men tend not to experience a decline in social network size as they age, women start to experience a decline after the age of 59. Age also seems to negatively affect the size of social networks only for those with lower educational attainment (from the age of 57 onwards) and not those who are higher educated. With regards to marital status, age does not return a statistically significant coefficient for either those who are married or partnered, nor those who were separated, divorced, widowed, or never married. The same is the case for the two income groups.

It is however conceivable that the reason retirement seems to not have an effect within any groups other than women, could be due to social network size growth possibly being exponential. That is to say, those with larger social networks will gain and lose relatively more persons in their network than those with smaller social networks. For example, a person who already has many friends could gain more friends more easily via those existing friends than one who has fewer. Equally, a person with more friends has more friends to lose. We can test if this is indeed confounding our results by using the natural log of respondents' social network size, leading to variables reflecting percentage changes in the outcome. The result of this can be seen below in table 8. We see however that the outcomes of the regression are completely in line with the previous one.

<i>Log Social Network Size</i>	<i>Gender</i>		<i>Income</i>		<i>Educational Level</i>		<i>Marital Status</i>	
	Male	Female	Low	High	Low	High	Married	Not Married
<i>Retired</i>	0.004 (0.026)	-0.058* (0.023)	-0.008 (0.045)	-0.011 (0.034)	-0.006 (0.021)	-0.018 (0.032)	0.022 (0.033)	0.042 (0.055)
<i>Age</i>	0.013 (0.010)	0.025** (0.009)	0.006 (0.016)	0.008 (0.013)	0.019* (0.008)	-0.001 (0.011)	0.017 (0.011)	-0.025 (0.018)
<i>Age² /100</i>	-0.011 (0.008)	-0.021** (0.006)	-0.005 (0.012)	-0.008 (0.010)	-0.016** (0.006)	0.000 (0.009)	-0.016 (0.009)	0.015 (0.013)
<i>Female</i>			0.156** (0.010)	0.209** (0.009)	0.174** (0.005)	0.226** (0.008)	0.185** (0.008)	0.178** (0.013)
<i>Constant</i>	0.405 (0.339)	0.245 (0.278)	0.654 (0.533)	0.669 (0.421)	0.215 (0.262)	0.909* (0.365)	0.345 (0.365)	1.720** (0.588)
<i>N</i>	62,470	77,871	30,624	30,078	98,026	40,466	42,886	15,609

Table 8. IV estimates for natural log of social network size outcome, split up by gender, household income per inhabitant (upper two quintiles versus lower two quintiles), highest level of education attained tertiary education versus secondary or lower), and marital status (married or registered partnership versus separated, divorced, widowed, or never married). Regressions include country and wave dummies to control for country and wave fixed effects. Clustered Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

With regards to our second outcome variable, in table 9 below we can see that once again retirement does not seem to affect the groups with regards to their social network satisfaction differently either, in contrast to our hypothesis H4. Counterintuitively, it seems that retirement may actually cause an increase in social network satisfaction for those who are not married or partnered, whereas it does not seem to have an effect on those who are, as the coefficient becomes positively signed and marginally significant at the $p < 0.1$ level. With regards to age we once again see that this seems to only affect those who are not married, reflected in a marginally statistically significant coefficient, leading to a decrease in social network satisfaction. This however, is in line with intuition. Lastly, we see that gender affects all groups equally.

<i>Social Network Satisfaction</i>	<i>Gender</i>		<i>Income</i>		<i>Educational Level</i>		<i>Marital Status</i>	
	Male	Female	Low	High	Low	High	Married	Not Married
<i>Retired</i>	0.028 (0.048)	0.049 (0.045)	0.068 (0.084)	0.086 (0.066)	0.029 (0.042)	0.045 (0.062)	-0.003 (0.056)	0.185 (0.113)
<i>Age</i>	-0.022 (0.019)	-0.020 (0.017)	-0.042 (0.031)	-0.012 (0.026)	-0.013 (0.016)	-0.034 (0.022)	-0.023 (0.020)	-0.070 (0.036)
<i>Age²/100</i>	0.016 (0.014)	0.014 (0.013)	0.033 (0.023)	0.006 (0.020)	0.009 (0.012)	0.025 (0.017)	0.019 (0.016)	0.052 (0.027)
<i>Female</i>			0.171** (0.018)	0.124** (0.018)	0.132** (0.010)	0.101** (0.016)	0.069** (0.015)	0.279** (0.025)
<i>N</i>	62,470	77,871	30,624	30,078	98,026	40,466	42,886	15,609

Table 9. IV estimates for social network satisfaction outcome, split up by gender, household income per inhabitant (upper two quintiles versus lower two quintiles), highest level of education attained tertiary education versus secondary or lower), and marital status (married or registered partnership versus separated, divorced, widowed, or never married). Regressions include country and wave dummies to control for country and wave fixed effects. Clustered Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

With regard to the third outcome variable shown in table 10 below, we find that there are diverging effects of retiring on feeling left out by educational level. Whereas those who are higher educated seem not to be affected by retirement, those who are lower educated seem to experience a decrease in such feelings, which runs counter to our hypothesis H2b. With regards to aging, it seems that those with higher incomes feel left out more often as they age, whereas with lower income do not do not. Those with lower educational attainment also seem to experience an increase in such feelings as they age, as those who have higher educational levels do not. Though these results are not necessarily what we postulated in our hypothesis H5, they do nevertheless lend support to the idea that those with lower educational attainments are more likely to feel left out as they age, though the opposite is true for the idea that those with lower income being more vulnerable than those with higher income.

<i>Feeling Left Out</i>	<i>Gender</i>		<i>Income</i>		<i>Educational Level</i>		<i>Marital Status</i>	
	Male	Female	Low	High	Low	High	Married	Not Married
<i>Retired</i>	0.174** (0.046)	0.141** (0.040)	0.206** (0.066)	0.206** (0.062)	0.206** (0.038)	0.094 (0.057)	0.136** (0.052)	0.185* (0.082)
<i>Age</i>	0.043** (0.017)	0.021 (0.014)	-0.007 (0.025)	0.042* (0.021)	0.023 (0.014)	0.023 (0.018)	0.023 (0.016)	0.001 (0.027)
<i>Age²/100</i>	-0.044** (0.012)	-0.026* (0.011)	0.004 (0.018)	-0.043** (0.016)	-0.030** (0.009)	-0.025 (0.014)	-0.029* (0.013)	-0.011 (0.020)
<i>Female</i>			-0.028 (0.016)	-0.098** (0.015)	-0.074** (0.009)	-0.080** (0.014)	-0.079** (0.012)	-0.030 (0.020)
<i>N</i>	62,470	77,871	30,624	30,078	98,026	40,466	42,886	15,609

Table 10. IV estimates for feeling left out, split up by gender, household income per inhabitant (upper two quintiles versus lower two quintiles), highest level of education attained (tertiary education versus secondary or lower), and marital status (married or registered partnership versus separated, divorced, widowed, or never married). Positive coefficients indicate such feelings occurring less frequently. Regressions include country and wave dummies to control for country and wave fixed effects. Clustered Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

Turning now to our last outcome variable, in table 11 we see that retirement seems to affect our groups differently with regards to loneliness as well, causing those with high incomes to feel less lonely, but not those with lower income. This is also the case for those who are married or partnered, when compared to those who are not. Furthermore, we see that those who are lower educated also seem to feel lonely more often as they age when compared to those who are more highly educated.

<i>Feeling Lonely</i>	<i>Gender</i>		<i>Income</i>		<i>Educational Level</i>		<i>Marital Status</i>	
	Male	Female	Low	High	Low	High	Married	Not Married
<i>Retired</i>	0.002 (0.062)	0.094 (0.055)	0.088 (0.081)	0.268** (0.085)	0.087 (0.046)	0.051 (0.083)	0.141* (0.083)	0.103 (0.129)
<i>Age</i>	0.078** (0.025)	0.061** (0.020)	0.064* (0.032)	0.068* (0.031)	0.074** (0.019)	0.033 (0.027)	-0.005 (0.029)	-0.033 (0.040)
<i>Age²/100</i>	-0.065** (0.019)	-0.062** (0.015)	-0.059* (0.024)	-0.072** (0.024)	-0.068** (0.014)	-0.036 (0.021)	-0.006 (0.022)	0.008 (0.030)
<i>Female</i>			-0.265** (0.022)	-0.225** (0.022)	-0.310** (0.013)	-0.226** (0.020)	-0.295** (0.022)	-0.119** (0.030)
<i>N</i>	62,470	77,871	30,624	30,078	98,026	40,466	42,886	15,609

Table 11. IV estimates for feeling lonely, split up by gender, household income per inhabitant (upper two quintiles versus lower two quintiles), highest level of education attained (tertiary education versus secondary or lower), and marital status (married or registered partnership versus separated, divorced, widowed, or never married). Positive coefficients indicate such feelings occurring less frequently. Regressions include country and wave dummies to control for country and wave fixed effects. Clustered Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

5.7 Robustness Check

As noted before, another empirical strategy which can be used for the research question at hand is employing a fixed effects regression, where we follow respondents over time to see how our outcome variables are affected over time as they age and retire. Our data, however, do not span a long enough time period for us to be able to do so effectively. However, we can still execute such an analysis to check if its results are broadly in line with our previous findings. In our sample, of the 42.15% of respondents who were not retired at the beginning of period under analysis, 17.83% transitioned to retirement during the period at hand. Conversely, of the 57.85% who were already retired at the beginning of the period, 3.32% came out of retirement. Below in table 12 we can see the results of this analysis.

<i>Fixed Effects</i>	<i>Social Network Size</i>	<i>Social Network Satisfaction</i>	<i>Feeling Left Out</i>	<i>Feeling Lonely</i>
<i>Retired</i>	0.036 (0.032)	0.007 (0.027)	0.037** (0.012)	-0.006 (0.010)
<i>Age</i>	-0.021 (0.033)	0.075** (0.028)	0.091** (0.015)	0.027 (0.015)
<i>Age²/100</i>	0.050 (0.026)	-0.043 (0.022)	-0.050** (0.012)	-0.029* (0.012)
<i>Constant</i>	1.896 (1.044)	5.929** (0.878)	-0.458 (0.484)	2.215** (0.485)
<i>N</i>	86,244	82,966	137,706	95,069

Table 12. Fixed Effects estimates for the outcomes social network size, social network satisfaction, feeling left out and loneliness. Positive coefficients in feeling left out and loneliness models indicate such feelings occur less frequently. Standard Errors in parentheses. * $p < 0.05$ ** $p < 0.01$

We see that the results for our main explanatory variable are exactly in line with our previous findings: whereas there seems to be no effect of retirement on social network size, social network satisfaction, or feeling lonely, retirement does seem to cause decreased occurrence of feeling left out. The effects of ageing do differ to some extent for the outcomes social network satisfaction and feeling left out, showing the effect of aging to remain positive well past the age range of our data selection. This could possibly be due to cohort effects biasing our IV estimates. However, with regards to our main explanatory variable, this check indicates that our results are not sensitive to methodological choices.

6 Conclusion

With the share of retired persons within European countries expected to grow the coming years (Davies, 2014), research regarding this segment of the population is more important than ever. One area of interest is that of loneliness among the elderly, and how retirement possibly affects this (Ekerdt, 2010). Not only because such social factors are important in their own right, but also because they have shown to cause negative health outcomes (Lou et al., 2012; Holt-Lunstad et al. 2015) and increased doctor visits (Ellaway et al. 1999). Though some have hypothesized that we can expect social network deterioration after retirement, possibly leading to higher levels of loneliness (Ekerdt, 2010; Heaven et al., 2013; Segel-Karpas et al. 2018), others have argued that this should not necessarily be the case, as retirement causes changes in the nature of social interactions rather than the quality of it (Bogaard et al. 2014), and that the higher occurrence of these negative social outcomes among older adults is in fact due to aging and not retirement (MacBride, 1975).

In this study we found robust evidence for this second line of argument. Our results suggest that neither social networks, nor social network satisfaction are affected by retirement. Retirement does not cause increased levels of loneliness. Our results regarding feelings of being left out actually show retirement to have a positive causal effect on respondents, implying that once people retire they feel left out less often as they now have more time for social activities. Furthermore, we found only very little evidence that any possible negative effects are concentrated among certain high-risk groups, known to be more susceptible to loneliness (Niedzwiedz et al., 2016; Vozikaki et al., 2018). Our results show that women tend to be more susceptible than men to a loss in social network size caused by retirement. However, this does not seem to lead to lower levels of satisfaction with their social networks, nor to an increase in occurrences of feeling lonely or left out. We also found that those in higher income groups experienced a decrease in feelings of loneliness as a result of retirement, whereas those in lower income groups did not. Counterintuitively, we found that those with lower educational levels experienced a decrease in feeling left out as a result of retirement, whereas those with higher educational attainment did not. Moreover, we found indications that where retirees showed decreasing measures of social wellbeing, this was actually due to aging rather than retiring per se. However, the effect of aging was not robust, indicating that these results could possibly be due to cohort effects.

Lastly, we found only very limited indications that persons were positively self-selecting into retirement: we found only very weak indications those who stood to gain in social network size were self-selecting into retirement. Surprisingly in fact, our data often suggested that respondents were actually negatively self-selecting into retirement, with regards to changes in social network satisfaction, feeling left out, and feeling lonely after retirement. This could possibly be due to external shocks causing respondents to retire, but also negatively affecting their social situation, for example, a spouse falling seriously ill who they now need to take care of. Testing to see if this is indeed the case would be an interesting avenue for future research.

One limitation of our study was that with regards to differential effects among groups, we were not always able to ensure validity of our results, since whether or not individuals belonged to one group or the other was often endogenous to our model. Another limitation was that we were limited in our ability to exploit the longitudinal character of the SHARE data set, as our outcome variables were available for only two or three years. It would be interesting to repeat such a study again, once more data has been made available over a longer time span, employing a dynamic statistical model. However, for so far it seems that any worries regarding the effects of retirement on the social well-being of retirees is unwarranted. In fact, it seems that that retirement could possibly be beneficial, as it allows people to have more time for leisure, leading them to feel left out less often. As such, any efforts targeted at increasing social well-being among retired citizens should be aimed at reducing the possible negative effects of aging, rather than retirement per se.

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