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Retirement and Loneliness

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Retirement and Loneliness

Abstract

We investigate the short- and long-term effects of retirement on loneliness using panel data from the Survey of Health, Aging, and Retirement in Europe. To estimate causal effects, we exploit differences in retirement eligibility rules across and within countries and use retirement thresholds in an instrumental variable setting. On average, we find that entering retirement leads to a significant reduction in loneliness in the long run, although our results show no clear effect in the short run. The reduction is driven by individuals being less likely to feel socially isolated and lacking companionship. Our results suggest that individuals adapt to retirement by increasing their activity levels and reap the benefits in terms of reduced loneliness and social isolation. Heterogeneity analysis by gender reveals that retirement increases feelings of loneliness for women in the short term, and that this effect appears to be driven by women lacking companionship when their partner is not yet retired.

JEL-Codes: J26, J14, I10

Keywords: Loneliness; social isolation; retirement; instrumental variable; causal effect

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I. Introduction

Loneliness and social isolation are important determinants of well-being. As such they have started receiving the full attention of policy makers (U.S. Surgeon General, 2023; WHO, 2021). Chronic loneliness is linked to a range of adverse outcomes: People experiencing repeated states of loneliness have an increased risk of ill-health, both physical and mental, and all-cause mortality (Barjaková et al., 2023; Cacioppo & Cacioppo, 2018; Christiansen et al., 2016; Erzen & Çikrikci, 2018; Guthmuller, 2022; Hajek et al., 2023; Hawkley et al., 2003; Hawkley & Cacioppo, 2010; Heinrich & Gullone, 2006; Luo et al., 2012; Rico-Uribe et al., 2018; Smith et al., 2021; Steptoe et al., 2013; Valtorta & Hanratty, 2013). Consistently, loneliness is an economic issue as lonely individuals exhibit a higher demand for healthcare services (Mosen et al., 2020), and higher social service needs (Fakoya et al., 2020).

In Europe, it is the elderly who are at the highest risk of loneliness (Eurofound, 2017). This is particularly salient since Europe already has a large population of senior citizens and is growing older still. With increasing life expectancy and low birth rates, the proportion of elderly individuals is expected to increase further in the years ahead (Rouzet et al., 2019). Policymakers have generally reacted to these demographic trends and the subsequent need to ensure funding for public pension schemes by postponing entry into retirement. Retirement, as a significant life event at older age, has wide-reaching consequences for individuals. The causal impact of retirement and the increases in pension eligibility ages on various (mental) health outcomes are well covered in the literature (Coe & Zamarro, 2011; Eibich, 2015; Godard, 2016; Heller-Sahlgren, 2017; Insler, 2014; Rohwedder & Willis, 2010). However, scarce evidence exists on the causal effect of retirement on loneliness (Abramowska-Kmon & Latkowski, 2021; Kim & Moen, 2002).

The direction of the impact of retirement on loneliness may be ambiguous. As retirement involves an abrupt end of social contact at work and fewer interactions with colleagues,

retirement could lead to a reduction of social interactions followed by an increase in loneliness. While retirement does not seem to have an effect on the social network size and its closeness as a whole (Comi et al., 2022; Fletcher, 2014), previous studies have found that retirement causes a significant reduction in the share of colleagues within older adults' social network (Comi et al., 2022; Damman et al., 2015; Fiori et al., 2007). Retirement may also lead to an increase in time spent with friends and family members, increasing the number or frequency of social contacts that may reduce the feeling of loneliness. Similarly, as the share of family ties within the social network increases (Comi et al., 2022), the quality of social connections might increase, resulting in feeling less lonely. For example, Shin et al. 2020 found evidence that social support from the family significantly moderates the negative effect of involuntary retirement on loneliness in the US (Shin et al., 2020).

The effect of retirement on loneliness may also be driven by how well individuals are able to find pastimes and activities to fill in their life in retirement, for instance through social activities. Previous studies have found that social participation is a large protective factor against loneliness among older adults, even for those with low socioeconomic status (Niedzwiedz et al., 2016). Likewise, Salm et al. (2021) find that taking care of grandchildren completely offsets the negative effect of retirement on mental health. The effect of retirement on loneliness may evolve over time. Retirees may feel (more) lonely during the transitional period of retirement, until they adapt to their new status, re-organized their life, and enter into a content retirement routine (Atchley, 1982). In this case, the effect of retirement causes situational loneliness in which retirees think their feelings of loneliness are temporary and will resolve (Gierveld, 1998; Mullins, 2007). Retirees may also experience a honeymoon period just after retirement but feel (more) lonely afterward because retirement does not meet their expectations, which could then lead to chronic loneliness with feelings of hopelessness (Atchley, 1982; Gierveld, 1998).

Further, prior research has pointed to the gendered nature of work and retirement (Godard, 2016; Jarosz, 2022) as well as mental health conditions (Boyd et al., 2015). Women, for example, may have different preferences for social connections in retirement (Jarosz, 2022), which may affect how lonely they end up feeling after retirement and how well they adjust to their new life situation.

Using data from the Survey of Health, Ageing and Retirement in Europe (SHARE), we contribute to the literature by exploiting differences in pension eligibility rules across and within European countries in an instrumental variable framework. This allows us to disentangle endogenous retirement behavior and identify the causal effect of retirement on loneliness. To analyze how the effect evolves over time, we examine both short-term (immediately after retirement) and long-term (four to six years after retirement) effects. While we find no clear effect of retirement on loneliness in the short term, our results show a significant reduction in loneliness because of retirement in the long term in the full sample. To understand these results in more detail, we estimate the effect of retirement on feeling isolated, feeling left out, and lacking companionship. These sub-outcomes are captured by the dimensions of the loneliness scale and reflect different aspects of intimate loneliness (Austin, 1983). Loneliness is an "unacceptable lack of (quality of) certain relationships" (Gierveld, 1998). In this three-item scale, the quantity and the quality of social interactions seems to be captured most by the question on feelings of isolation (House et al., 1988), the quality or intimacy of social connections by the question on lacking companionship (Liu & Rook, 2013) We find a long-term reduction in isolation after retirement, indicating a rise in social interactions. In line with this result, a further analysis shows a long-term increase in the number of activities and group activities. This long-term reduction is present for both men and women. Generally, we see that women's loneliness level is particularly affected by the transition to retirement. This is evident in the companionship dimension capturing the intimacy (quality) of social connections. We do not find any significant effect for men.

However, women are likely affected to a larger extent from a lack of companionship in the short-term and less in the long-term. A couple analysis shows that this short-term increase and long-term decrease in lack of companionship is especially present for women whose partner is still working when they retire.

The remainder of the paper is structured as follows. Section II introduces the data, section III outlines the empirical strategy, section IV presents the results and section V provides evidence of potential mechanisms. Section VI discusses our findings and concludes.

II. Data

Our paper uses data from SHARE, a longitudinal survey of individuals aged 50 or older conducted in Europe and Israel (Börsch-Supan et al., 2013). This data set provides individual-level microdata on health, socio-economic status, and social and family networks that are comparable across countries. We use data from waves 5 (collected in 2013), 6 (collected in 2015), and 8 (collected in late 2019 and early 2020) (Börsch-Supan, 2022a, 2022b, 2022c) in which the UCLA revised loneliness scale (our dependent variable) was collected[1]. Overall, 14 countries participated in each of the three waves (Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, Luxembourg, Slovenia, Spain, Sweden, Switzerland, and Israel). Further, we obtain information on retirement rules from the European Commission's Mutual Information System on Social Protection (MISSOC, 2022) as well as Israel's National Insurance Institute (Israel's National Insurance Institute, 2022).

[1] Wave 7 of SHARE includes a special questionnaire ("SHARELIFE") and was administered to a mostly different set of individuals than previous waves. Therefore, we are not using wave 7, as the scarce availability of information on loneliness levels of individuals from our sample would have limited our sample size severely.

A. Variables

Loneliness, our main dependent variable, is defined as "a situation experienced by the individual as one where there is an unpleasant or inadmissible lack of (quality of) certain relationships. This includes situations in which the number of existing relationships is smaller than is considered desirable or admissible, as well as situations where the intimacy one wishes for has not been realized" (Gierveld, 1998). Loneliness could then include (subjective) social isolation — the (perceived) "lack of, or deficit in, the quantity of a social network" (Mullins, 2007), and emotional isolation — "the lack of person(s) to whom one feels attached" (Mullins, 2007).

In our data, loneliness – is measured by the short three-item version of the Revised UCLA Loneliness Scale ((Hughes et al., 2004; Russell et al., 1980; Russell et al., 1978; Russell, 1996). This measure of loneliness takes into account the multidimensionality of the feelings of loneliness with a scale based on responses to three questions: "How much of the time do you feel …" (1) "…you lack companionship?", (2) "…left out?", and (3) "…isolated from others?". For each of these questions, participants choose between "often", "some of the time" and "hardly ever or never", which yield three, two, and one points, respectively. The scores are added up to calculate the loneliness scale, which thus ranges from 3 (not lonely) to 9 (very lonely). The short version of the Revised UCLA Loneliness Scale has been shown to perform as well as the 20-item-scale to measure the distribution in the feelings of loneliness in the older population (Rusell 1996; Hugues et al., 2004).

Besides the overall level of loneliness, we are interested in the different dimensions of loneliness, i.e., the three components of the loneliness scale, as a first step to exploring potential sources of loneliness. Feeling isolated addresses the discrepancy between one's desired and one's actual quantity and quality of social interactions one has (House et al., 1988). Lack of companionship is concerned with the discrepancy between one's desired and one's actual quality

social (or intimacy) of social connections (Liu & Rook, 2013). Feeling left out is usually the result of feeling excluded from a group of friends or family members in certain situations and relates to the discrepancy between one's desired and one's actual quality or quantity of collective connections ((Austin, 1983), Peplau and Perlman, 1982, Hugues et al., 2004). We construct categorical variables for each of the dimensions of the loneliness scale which are equal to one if the respondent reported feeling a lack of companionship/left out/isolated from others sometimes or often, and zero otherwise.

As a further step to explore sources of loneliness, we use two different outcomes to measure leisure and activities. The first is the number of different types of activities that respondents participated in the year prior to the interview. This measure combines several specific types of activities, such as volunteering or charity work, attending educational training or courses, sports, political or community events, reading, or playing different types of games (word or number games/cards or board games). In addition, we construct a dummy variable equal to one if an individual has participated in a group activity and zero otherwise. We define group activities as volunteering or charity work, attending an education or training course, attending a sports, social, or other type of club, taking part in the activities of a religious, political, or community organization, and playing cards or board games.

We construct our retirement variable based on three definitions. According to our main definition, individuals are classified as retired (the 'treatment' group) if they report being retired at the time of the interview. This definition is similar to Heller-Sahlgren (2017). The control group thus consists of individuals who are working, unemployed, homemakers, permanently ill or disabled, or engaged in other activities. Although not all individuals in the control group are in the labor force, reaching the statutory retirement age may affect them in a similar way to those in the work force since retirement may remove the pressure to find a job or to justify not working to oneself or others (Ponomarenko et al., 2019). Our second definition of retirement additionally

includes homemakers, those who are permanently ill or disabled, and those engaged in other activities if they have not done any paid work in the last four weeks, as these individuals are unlikely to re-enter the labor force shortly before retirement (Eibich & Goldzahl, 2021). The control group for this definition is therefore unemployed, employed, or self-employed individuals. This second definition is close to the one used by Coe and Zamarro (2011), except that Coe and Zamarro count unemployed individuals as retired. In the third definition, analogous to the first definition, we define as retired individuals who report being retired at the time of the interview. The control group, however, is restricted to employed individuals. We consider respondents to be in the labor force if they report being employed, self-employed, or not retired and have done any paid work in the past four weeks, while excluding homemakers, the permanently ill or disabled, and those doing other work. In this way, we can only compare retired people with those who are still working. The first definition is used as baseline specification, and the two alternative definitions serve as robustness checks.

Further, gender is used in the heterogeneity analysis, and we utilize information on age, gender, the number of children, and country of residence in each wave to define retirement eligibility.

B. Sample

Our sample uses observations from all 14 countries and waves 5, 6, and 8 of SHARE. We include individuals between the ages of 50 and 80 at the time of the wave 6 interview (2015). This covers around 10 years below and above the youngest and oldest age retirement rules (see Table A.1 in the appendix). We exclude individuals with missing information in the variables described in Section II.A and individuals who report "undoing" their retirement, i.e., report being retired at one wave and claim not to be retired at a later wave. This dataset includes 58,547 individuals. Our study design allows us to estimate long-term effects, however, it requires balanced panel data. Therefore, we only use individuals who are present in all three waves. The

final dataset is a balanced panel of 19,699 individuals (59,097 observations). Most of the observations lost when balancing the dataset are individuals who participated in waves 5 and 6 but did not participate in wave 8 (30 % of the sample). The main reason for this is that SHARE stopped collecting data for wave 8 in March 2020 due to Covid-19. As a result, fewer people were surveyed in wave 8 than in waves 5 and 6. To address a potential attrition bias, we run robustness checks using inverse probability weighting. The results are reported in Table A7 in the appendix and are discussed in the robustness section.

We use the eligibility for statutory retirement as an instrument for retiring. Standard retirement ages vary by country, gender, birth cohort (France, Germany, Israel), and the number of children (Czech women). The earliest and latest statutory retirement ages in our sample are 57.3 and 67, respectively. An overview of all official retirement ages by country and gender for the years of interest is provided in Table A in the appendix.

Summary statistics by wave and retirement status are shown in Table 1 and Table A2 in the appendix. Average loneliness levels increase by wave, both in the entire sample as well as among retired and non-retired individuals. There are no significant differences between individuals who are retired and those who are not retired. Mean loneliness levels are higher among women compared to men. Average loneliness increases over the waves, i.e., over time. Changes over time are precisely what our study design is picking up.

Table 1: Summary statistics

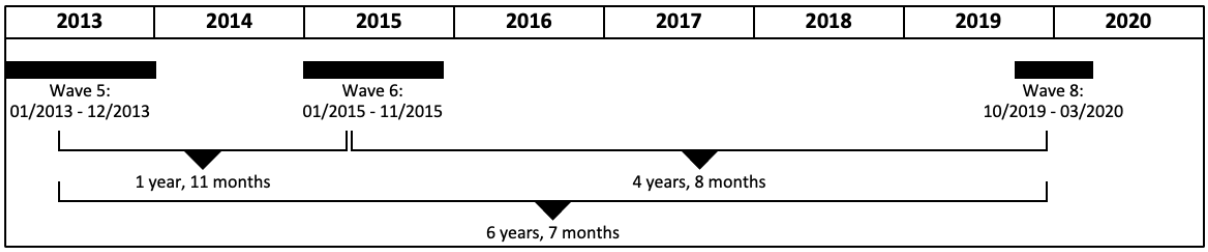
	Whole sample			Men			Women		
	Full	Not Retired	Retired	Full	Not Retired	Retired	Full	Not Retired	Retired
Wave 5									
Age	64.01	58.78	68.80	64.38	58.57	69.08	63.75	58.91	68.58
Female	0.58	0.60	0.55	0.00	0.00	0.00	1.00	1.00	1.00
Loneliness	3.66	3.64	3.69	3.55	3.55	3.56	3.75	3.70	3.79
Feeling isolated	0.12	0.12	0.12	0.10	0.10	0.10	0.13	0.13	0.14
Feeling left out	0.17	0.16	0.18	0.14	0.15	0.14	0.19	0.17	0.20
Lack companionship	0.27	0.25	0.28	0.23	0.21	0.24	0.30	0.28	0.32
Number of activities	2.53	2.54	2.52	2.45	2.49	2.42	2.58	2.57	2.60
Participate in group activity	0.67	0.68	0.65	0.69	0.70	0.68	0.65	0.66	0.64
Observations	19,699	9,410	10,289	8,344	3,733	4,611	11,355	5,677	5,678
Wave 6									
Age	66.01	59.96	70.05	66.38	59.54	70.27	65.75	60.21	69.87
Female	0.58	0.62	0.55	0.00	0.00	0.00	1.00	1.00	1.00
Loneliness	3.73	3.71	3.74	3.61	3.61	3.61	3.82	3.78	3.85
Feeling isolated	0.14	0.13	0.14	0.11	0.12	0.11	0.15	0.14	0.16
Feeling left out	0.19	0.18	0.19	0.16	0.16	0.16	0.21	0.20	0.22
Lack companionship	0.30	0.28	0.30	0.25	0.24	0.25	0.33	0.31	0.34
Number of activities	2.53	2.54	2.53	2.46	2.52	2.42	2.59	2.55	2.61
Participate in group activity	0.66	0.67	0.65	0.67	0.69	0.66	0.65	0.65	0.64
Observations	19,699	7,876	11,823	8,344	3,027	5,317	11,355	4,849	6,506
Wave 8									
Age	70.49	63.38	72.87	70.85	62.39	73.09	70.22	63.92	72.69
Female	0.58	0.65	0.55	0.00	0.00	0.00	1.00	1.00	1.00
Loneliness	3.78	3.74	3.79	3.66	3.60	3.68	3.87	3.81	3.89
Feeling isolated	0.15	0.14	0.15	0.13	0.11	0.13	0.16	0.16	0.17
Feeling left out	0.20	0.19	0.20	0.18	0.16	0.18	0.21	0.20	0.22
Lack companionship	0.30	0.28	0.31	0.26	0.24	0.27	0.33	0.30	0.35
Number of activities	2.49	2.52	2.49	2.39	2.51	2.36	2.57	2.52	2.59
Participate in group activity	0.65	0.67	0.64	0.66	0.70	0.64	0.64	0.65	0.64
Observations	19,699	4,955	14,744	8,344	1749	6,595	11,355	3,206	8,149

Notes: Means. The retired group includes everyone who is retired – by wave - according to retirement definition (1): all individuals who claim to be retired or who self-reported a retirement date predating the interview. The not-retired group includes everyone who is not retired according to this definition. Loneliness refers to the short version of the R-UCLA loneliness scale. Feeling isolated, feeling left out and lack companionship are indicator variables equal to one if respondents felt either of these feelings "some of the time" or "often". The number of activities refers to a specific set of activities respondents have engaged in during the last 12 months. "Participate in group activities" refers to a dummy equal to one if the respondent has engaged in at least one kind of activity classified as a group activity during the last 12 months.

Figure 1 shows interview intervals for waves 5, 6, and 8 of SHARE for individuals in our sample, as well as the time between each of the waves' mean interview dates. We analyze individuals retiring between waves 5 and 6, an interval of about two years. To analyze short-term

effects, we observe their change in loneliness levels between waves 5 and 6. For long-term effects, we observe their change in loneliness levels between waves 6 and 8 that occurs, on average, between about 4.5 years and 6.5 years after retiring. To ensure our long-term estimates are not driven by people retiring between waves 6 and 8, who are in our control group, we run a robustness check where these individuals are removed from the sample entirely.

Figure 1: Data collection of SHARE and average time passed between interviews in our sample



Note: Average time passed between interviews in waves, 5, 6, and 8 of SHARE.
Source: Authors' own representation based on SHARE.

III. Empirical strategy

The effect of retirement on loneliness can be estimated by a first-difference (FD) estimation as:

$$L_{i,t} = \gamma_0 + \gamma_1 R_{i,t-1} + \gamma_2 AGE_{i,t-1} + \gamma_3 AGE^2_{i,t-1} + \delta_m + \alpha_i + \varepsilon_{i,t} \quad (1)$$

where $L_{i,t}$ denotes the individual *i*'s level of loneliness (or our alternative outcome measures) at time *t*, $R_{i,t-1}$ is retirement status in wave $t-1$. Our estimation technique does not require additional control variables since it relies on the random variation in retirement behavior induced by pension policies. We include linear and quadratic age as eligibility ages may vary as well as a set of indicator variables for interview month (δ_m) to account for seasonal trends. Time-invariant individual effects are captured by α_i. Unobserved influences on L are captured by the error term ε. We cluster standard errors at the individual level.

The endogenous nature of the retirement decision may lead to several endogeneity problems. First, there may be reverse causality. An individual's level of loneliness might influence their decision to retire. Second, we are not able to observe and control for all factors that are jointly relevant to loneliness and the retirement decision, such as other major life events like the death of a spouse or friend, adverse health shocks, or unobserved characteristics (Eibich, 2015). Moreover, as Eibich (2015) points out, there may also be justification bias, in which respondents to surveys like SHARE may underreport self-rated outcomes (in our case loneliness) to justify their retirement status. Therefore, to estimate causal effects, we use a source of exogenous variation in retirement behavior: Institutional retirement rules. Table A.1 in the appendix reports the differences in age eligibility rules in the countries and waves included in the sample, for men and women separately. This instrument is highly relevant to predicting retirement but is unlikely to influence loneliness directly. With the same motivation, the instrument is widely applied to study the effect of retirement on life satisfaction, (Bonsang & Klein, 2012; Gorry et al., 2018), general health (Coe & Lindeboom, 2008; Coe & Zamarro, 2011; Fé & Hollingsworth, 2016), mental health (Belloni et al., 2016; Fé & Hollingsworth, 2016; Heller-Sahlgren, 2017; Kolodziej & García-Gómez, 2019; Lindeboom et al., 2002; Salm et al., 2021), cognitive functioning (Celidoni et al., 2017; Fé, 2021; Mazzonna & Peracchi, 2017; Rohwedder & Willis, 2010; Schmitz & Westphal, 2021), health behavior (Bertoni et al., 2018; Godard, 2016), and healthcare use (Gorry et al., 2018).

The decision to retire can be thought of as a dynamic incentive system in which the benefits of retirement are weighed against the benefits of remaining in the labor force (Schmitz & Westphal, 2021). Although some people choose to retire early, likely with reduced benefits, statutory retirement ages act as thresholds at which the probability of retiring increases dramatically as full pension eligibility is reached. Therefore, we use the statutory retirement age

as a source of exogenous variation in retirement behavior. Our instrument for retirement status is defined as being at or above the statutory retirement age of an individual`s country of residence.

To estimate the causal effect of retirement on loneliness we use a two-stage least squares (2SLS) estimation. The first stage estimates an exogenous variation in retirement behavior:

$$R_{i,t-1} = \beta_0 + \beta_1 ELIG_{i,t-1} + \beta_2 AGE_{i,t-1} + \beta_3 AGE^2_{i,t-1} + \delta_m + \alpha_i + \zeta_{i,t} \qquad (2)$$

where $ELIG_{i,t-1}$, the instrument, is a dummy variable equal to one if an individual i is eligible for retirement in $t-1$. The residual values $\hat{R}_{i,t-1}$ are then plugged into the second stage given by eq. (1). This set-up allows us to estimate the long-term effect of retirement on loneliness i.e., the effect of retiring, arising from the changes in retirement eligibility, between wave 5 and wave 6 on the difference in loneliness level between wave 6 and wave 8. Short-term effects of retirement on loneliness are estimated using this 2SLS setup with variables measured at t, instead of $t-1$, i.e. the effect of retiring, driven by the changes in pension eligibility, between wave 5 and wave 6 on the difference in loneliness level between wave 5 and wave 6.

The 2SLS estimation identifies a causal effect of retirement on loneliness if four standard IV assumptions hold: first stage, independence, exclusion restriction, and monotonicity. The first stage assumption refers to the relevance of the instrument, i.e., the instrument must be correlated with the treatment. Like many other studies using this set-up, we show that the first stage assumption is fulfilled as crossing the retirement eligibility threshold elicits a strong response in the probability of retirement (see our first stage results in Table 2). Independence refers to the instrument being as good as randomly assigned, i.e., uncorrelated with the errors. This implies that becoming eligible for retirement must be exogenous to the level of loneliness. As justification, we include the F-statistics for excluding the instrument in the first stage ("first-stage F-statistics") in our regression results. The exclusion restriction states that the instrument – retirement eligibility – must not affect loneliness directly, but only via its effect through the

treatment, retirement. We argue that even though loneliness might be directly affected by many factors, simply becoming eligible for retirement is not one of them. Monotonicity requires that – while the instrument may have no effect on some – those who are affected, are affected in the same way. This assumption would be violated if some individuals chose to retire due to crossing the retirement eligibility threshold, while at the same time, other individuals chose to come out of retirement as a direct result of becoming eligible. Such defying behavior seems implausible. If these assumptions hold, our IV estimate identifies a local average treatment effect (LATE), i.e., the average effect of retirement on loneliness for the compliers who retire because they reach the statutory retirement age.

In addition to running the estimation on the full sample, we split our sample by gender and estimate separate regressions for women and men. Further, we check the robustness of our results with respect to the definition of retirement, the age window of individuals in the dataset, and the composition of the control group.

IV. The impact of retirement on loneliness

A. Main results

Table 2 displays our results estimating the effect of retirement on loneliness and its dimensions. We show the endogenous FD-model from eq. (1) as well as 2SLS results (FD-IV). We report both our short and long-term results and the joint first stage for the IV regression. The results for the endogenous FD estimates in column (1) suggest no effect of retirement on loneliness, neither in the short- nor in the long-term. Our short run 2SLS estimates in column (2) show a positive sign, suggesting that retirement might increase loneliness right after retiring. Still, this effect is not statistically significant. On the contrary, we find that retiring decreases loneliness in the long-term. The estimate is statistically as well as economically significant. The reduction corresponds to approximately a quarter of a standard deviation of the short three-item version of the Revised UCLA (R-UCLA) Loneliness Scale (Russell et al., 1978).

Our first-stage estimate, i.e., estimate of the effect of the statutory retirement eligibility on self-reported retirement, is large and highly statistically significant, suggesting that the instrument is relevant. The F-statistic of the excluded instrument exceed the well-established thresholds of Stock and Yogo (2005) and Olea and Pflueger (2013) by a large margin. As a result, we argue that in line with existing studies, statutory pension eligibility rules are a strong instrument for retirement.

Next, we estimate the effect of retirement on the three dimensions of the loneliness scale separately. As they reflect qualitative, quantitative, and situational aspects of loneliness, we aim to understand different pathways through which retirement affects loneliness. Our FD model suggests very small and mostly statistically insignificant effects of retirement on the three dimensions, both in the short- and long-term. The IV estimates suggest small increases in all dimensions of loneliness in the short run after retirement. However, the estimates are not statistically significant. We find that in the long-term retiring causes the probability of feeling isolated and lacking companionship to decrease by 11.4 and 8.6 percentage points, respectively. The former estimate is statistically significant at the 1%, the latter at the 10% level. This indicates that both the quantity of social interactions (isolation) but also the quality of social connections (lack of companionship) of loneliness improves after retirement, but improvements take time.

Table 2: Estimates of the effect of retirement on (the dimensions of) loneliness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Loneliness		Isolated		Left out		Lack companionship	
	FD	FD-IV	FD	FD-IV	FD	FD-IV	FD	FD-IV
Retired R_t	-0.016	0.135	0.003	0.039	-0.025**	0.012	-0.005	0.031
(short-term)	(0.031)	(0.108)	(0.010)	(0.036)	(0.011)	(0.040)	(0.013)	(0.048)
Retired R_{t-1}	-0.001	-0.300***	-0.007	-0.114***	0.014	-0.052	0.002	-0.086*
(long-term)	(0.031)	(0.108)	(0.010)	(0.035)	(0.011)	(0.041)	(0.013)	(0.049)
First stage	-	0.271***	-	0.271***	-	0.271***	-	0.271***
		(0.012)		(0.012)		(0.012)		(0.012)
First stage F	-	509.17	-	509.17	-	509.17	-	509.17
# Observations	39,398	39,398	39,398	39,398	39,398	39,398	39,398	39,398
# Individuals	19,699	19,699	19,699	19,699	19,699	19,699	19,699	19,699

Note: Estimates of the effect of retirement in the short- and long-term (separate regressions). Column (1) shows estimates of the endogenous first difference regressions (FD), and column (2) shows the results of the first difference 2SLS regressions (FD-IV), our main results. Columns (3) and (4) shows estimate of the effect of retirement on the probability of feeling isolated most or all of the time, and columns (5) and (6) on the probability of feeling left out most or all of the time, and columns (7) and (8) on the probability of feeling a lack of companionship most or all of the time. All regressions include control variables from equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In a further analysis, we account for the gendered nature of retirement (Jarosz, 2022) and mental health (Boyd et al., 2015). Table 3 shows the IV estimates of the separate analysis by gender. Our results in column (1) suggest that women feel lonelier shortly after entering retirement but are feeling less lonely in the long-term. The increase and subsequent reduction are roughly equal in size and both effects are statistically significant at the 5% level. We do not find any statistically significant effects for men.

Women and men both feel significantly less isolated in the long-term. While no effect of retirement is found on the indicator for feeling "left out" for either men or women, retirement increases the feeling of lacking companionship for women in the short term and decreases this feeling in the long-term. We find no such effect for men.

Table 3: IV estimates of the effect of retirement on (dimensions of) loneliness by gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Loneliness		Isolated		Left out		Lack companionship	
	Men	Women	Men	Women	Men	Women	Men	Women
Retired R_t	-0.099	0.336**	0.004	0.070	-0.048	0.064	-0.098	0.141**
(short-term)	(0.157)	(0.149)	(0.050)	(0.052)	(0.060)	(0.055)	(0.070)	(0.067)
Retired R_{t-1}	-0.226	-0.356**	-0.126**	-0.101**	-0.040	-0.064	-0.007	-0.156**
(long-term)	(0.157)	(0.148)	(0.051)	(0.049)	(0.058)	(0.057)	(0.073)	(0.066)
First stage	0.266***	0.274***	0.266***	0.274***	0.266***	0.274***	0.266***	0.274***
	(0.018)	(0.016)	(0.018)	(0.016)	(0.018)	(0.016)	(0.018)	(0.016)
First-stage F	226.20	281.87	226.20	281.87	226.20	281.87	226.20	281.87
# Observations	16,688	22,710	16,688	22,710	16,688	22,710	16,688	22,710
# Individuals	8,344	11,355	8,344	11,355	8,344	11,355	8,344	11,355

Note: Estimates of the effect of retirement in the short- and long-term. All regressions include control variables from equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B. Robustness checks

We check the robustness of our results with respect to the definition of retirement, loneliness as a binary outcome, the age specification, the age window of individuals in the dataset, and the composition of the control group. Tables A3-A5 in the appendix show the results of our robustness checks.

Using the additional retirement definitions as in Heller-Sahlgren (2017), i.e. when we include homemakers, those who are permanently ill or disabled, and those who reported being engaged in "other activities" as retired (definition 2, column 1 in Tables A3-A5) and comparing only those who are employed with those who report being retired (definition 3, column 2), the estimates are similar to the ones with our main specification.

Using a dummy variable as an outcome that equals one if an individual is above the lowest level of loneliness (> 3) in column (3) of Tables A3-A5, we find no effect in the short-term. But in the long run, retiring reduces the probability of being lonely by 11.2 percentage points in the full sample. The gender analysis reveals similar results for women: Table A4, column 3 shows the results. We find a positive and statistically significant effect on the probability of feeling lonely in the short-term (14.2 percentage points) and a significant negative long-term effect (17.7

percentage points). Among men, our analysis shows a negative and statistically significant effect at the 10% level on the probability of feeling lonely short-term, and a negative but not statistically significant long-term effect (Table A5, column 3).

The estimates using age dummies and an additional cubic polynomial of age to more flexibly control for age are robust to the main specification (columns 4 and 5, respectively, in Tables A3-A5).

Following Heller-Sahlgren (2017) and using the earliest and latest statutory retirement ages of the analyzed countries as bounds, we construct different samples with narrower age ranges at wave 6: ages 52-72 (five years to/from the earliest/latest retirement age), 54-70 (+/- three years), and 56-68 (+/- one year). Using narrower age ranges does not qualitatively change the results (Tables A3-A5, columns 6-8).

We measure the impact of retirement on loneliness for individuals who have retired between waves 5 and 6 (the treatment group). The control group is composed of individuals that have never retired across the three waves, individuals that are always retired across the three waves, and individuals who retire between waves 6 and 8 (the later-retired). To check the robustness of our results to the composition of the control group, we run the estimation excluding each group of control individuals one at a time. We find that the exclusion of the never-retired (column 9 of the tables A3-A5), of the always-retired (column 10), or the exclusion of the later-retired (column 11), one at a time, do not qualitatively change our main results.

Additionally, to account for possible attrition, we include estimates of our main regressions with inverse probability weights for the whole sample as well as men and women separately in Table A7 in the appendix. To calculate the weights, we predict individual probabilities of not being included in wave 8 after being included in both wave 5 and 6 (our relevant potential source of attrition). Controls include retirement status, age, squared age, gender, physical health, marital status, level of education and level of loneliness with time-varying variables measured in wave

5, i.e., before treatment. The inverse probability of predicted attrition according to this model is then used to weight our regressions. This may account for attrition under the assumption that attrition is random between treatment and control group given the observed characteristics. When using these weights, our main results remain unchanged and retain their qualitative interpretation (see Table A.7).

V. Potential mechanisms

Next, we turn to potential mechanisms that might explain the impact of retirement on loneliness and its dimensions for men and women. One potential mechanism might be the participation in (group) activities which can increase the quantity and frequency of social interactions, and thus the size of the social network (Barjaková et al., 2023). To test this mechanism, we estimate the effect of retirement on the number of activities undertaken in the previous year and the probability of having participated in a group activity in the previous year (Table 4)[2]. We find statistically significant positive long-term estimates for both men and women. In the long-run, compliers start 0.5 new activities per year, on average, after retiring. Furthermore, retirement seems to have a positive effect on the likelihood of participating in a group activity. This indicates a rise in social interactions. It may even point towards a potential mechanism for how the adjustment to life in retirement works.

[2] We cannot test social network variables directly, as they are not available for wave 5.

Table 4: Retirement and Channels by Gender

	(1)	(2)	(3)	(4)
	Number of activities		Participate in group activity	
	Men	Women	Men	Women
Retired R_t	-0.180	0.005	0.035	0.016
(short-term)	(0.192)	(0.163)	(0.071)	(0.063)
Retired R_{t-1}	0.543***	0.511***	0.128*	0.129**
(long-term)	(0.185)	(0.161)	(0.074)	(0.064)
First stage	0.266***	0.274***	0.266***	0.274***
	(0.018)	(0.016)	(0.018)	(0.016)
First-stage F	226.20	281.87	226.20	281.87
# Observations	16,688	22,710	16,688	22,710
# Individuals	8,344	11,355	8,344	11,355

Note: Estimates of the effect of retirement in the short- and long-term. All regressions include control variables based on equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Another potential mechanism might be more time spent with family members resulting in strengthened family ties and as such an increase in intimate social connections. In another analysis, we therefore focus on couples. We estimate the effect of retirement on loneliness and its dimensions for individuals retiring between waves 5 and 6 whose partner was not retired in wave 6. The results are shown in Table 5. Men have a higher number of observations in this couple analysis (even though there are more women in our overall sample) since they tend to retire earlier than their, on average, younger partner and consequently have a partner who is not retired at wave 6. In Table A6 in the appendix, we analyze the effect of retirement on loneliness for individuals whose partner was retired in wave 6.

Again, the results in Table 5 show that retirement affects particularly women's loneliness levels. Retirement does not seem to affect men – whose partner is not retired with them in wave 6 – in the short-term and only slightly in the long-term, which is driven solely by their decrease in isolation. Women in the same situation are instead affected across time and dimensions. In the short-term, retirement increases their loneliness level in all dimensions but isolation. In the long term, retirement decreases it in all dimensions without exception. Interestingly we do not find

any significant effects when we consider individuals in a partnership whose partners have retired before or along with them in wave 6 (Table A6).

With this in mind, the results for lack of companionship are particularly interesting. Companionship captures the quality of (close) social connections and the enjoyment of spending time with someone close, such as one's partner. We see a short-term increase in lacking companionship for women when the partner is not retired, and thus spends less time with him or her, and a long-term decrease when the partner might have retired between waves 6 and 8 (about two thirds of the women's partner that had not retired in wave 6, had retired in wave 8 in our sample).

Table 5: IV estimates of the effect of retirement on (dimensions of) loneliness if the partner was not retired in wave 6, by gender.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Loneliness		Isolated		Left out		Lack of companionship	
	Men	Women	Men	Women	Men	Women	Men	Women
Retired R_t	0.144	0.808*	0.106	0.138	0.005	0.389**	-0.122	0.325*
(short-term)	(0.261)	(0.472)	(0.086)	(0.169)	(0.100)	(0.173)	(0.122)	(0.194)
Retired R_{t-1}	-0.540*	-0.916**	-0.239***	-0.242**	-0.099	-0.312*	-0.125	-0.359*
(long-term)	(0.286)	(0.379)	(0.091)	(0.115)	(0.100)	(0.172)	(0.129)	(0.195)
First stage	0.275***	0.302***	0.275***	0.302***	0.275***	0.302***	0.275***	0.302***
	(0.031)	(0.051)	(0.031)	(0.051)	(0.031)	(0.051)	(0.031)	(0.051)
First-stage F	78.10	35.07	78.10	35.07	78.10	35.07	78.10	35.07
# Observations	5,308	3,602	5,308	3,602	5,308	3,602	5,308	3,602
# Individuals	2,654	1,801	2,654	1,801	2,654	1,801	2,654	1,801

Note: Estimates of the effect of retirement in the short- and long-term. All regressions include control variables from equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

VI. Conclusion

We examine the short- and long-term effects of retirement on loneliness using data from 13 European countries and Israel. By exploiting differences in retirement eligibility rules between and within countries, we account for the endogenous nature of the retirement decision. Our results suggest that while there is no clear average short-term effect of retirement on loneliness, retirement leads to a significant reduction in loneliness in the long-term. The reduction

corresponds to approximately a quarter of the standard deviation of the short three-item version of the Revised UCLA Loneliness Scale (Russell et al., 1978). These results are driven by individuals being less likely to feel socially isolated or being less likely to feel a lack of companionship some years after retiring. This hints at improvements both in the quantity and quality of social interactions.

Given the gendered nature of work, retirement, and mental health, we extend our analyses to examine possible gender differences in the effects. Retirement seems to affect women's loneliness levels much more than men's and in more dimensions. Women experience an increase in overall loneliness shortly after retirement and a decrease after a few years in retirement. This is due to an increase in lack of companionship (decrease in quality of social connections) shortly after entering retirement, which is reversed in the long-term. Interestingly, our couple analysis shows that this is apparent only for women whose partner is still in the labor force when they enter retirement. Furthermore, women and men both experience a long-term decrease in feeling socially isolated. Indeed, we find that retiring causes both men and women to participate in more activities and be more likely to participate in group activities in the long-term.

Our results suggest that individuals are likely to adapt to life in retirement and, as a result, feel more socially connected and less lonely after several years. As such, we contribute to thine literature on the mental health effects of retirement. Previous evidence on the effect of retirement on mental health is mixed. Some studies find no effect (Coe & Lindeboom, 2008; Coe & Zamarro, 2011; Fé & Hollingsworth, 2016), while others find a positive impact (for certain groups) (Eibich, 2015; Heller-Sahlgren, 2017; Kolodziej & García-Gómez, 2019; Mazzonna & Peracchi, 2017).

At a time when policymakers are increasingly focusing on loneliness as a distinct health issue with far-reaching implications, our findings contribute to a better understanding of how retirement policies affect the well-being of seniors. While concerns about the financial stability

of the social security systems are usually at the center of the debate and a strong argument towards delaying retirement, we also highlight the benefits of retirement, at least when people remain socially active. Retirees can potentially benefit greatly from policies aimed at maintaining or even increasing their social inclusion. In terms of public policy, this can include ensuring better opportunities for retirees to work part-time or volunteer and ensuring age-friendly public infrastructure. Local authorities can contribute, for example, by maintaining inclusive public spaces.

Data availability statement: This paper uses data from SHARE Waves 5, 6, and 8 (DOIs: 10.6103/SHARE.w5.800, 10.6103/SHARE.w6.800, 10.6103/SHARE.w8.800), see Börsch-Supan, Brandt et al. (2013) for methodological details. The SHARE data collection has been funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982) and Horizon 2020 (SHARE-DEV3: GA N°676536, SERISS: GA N°654221) and by DG Employment, Social Affairs & Inclusion. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see www.share-project.org). Other researchers can access these data in the same manner.
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VIII. Appendix

Table A1: Official retirement ages by country, gender, and years of interest

	2013		2015		2019		2020	
Country	Men	Women	Men	Women	Men	Women	Men	Women
Austria	65	60	65	60	65	60	65	60
Belgium	65	65	65	65	65	65	65	65
Czech Republic	62.5	57.33-61.33	62.83	58-62	63.5	59.17-63.17	63.67	59.67-63.67
Denmark	65	65	65	65	65.5	65.5	66	66
Estonia	63	62	63	62.5	63.75	63.75	63.75	63.75
France	60-62	60-62	60-62	60-62	60-62	60-62	62	62
Germany	65-67	65-67	65-67	65-67	65-67	65-67	65-67	65-67
Israel	67	62	67	62	67	62	67	62
Italy	66.25	62.25	66.25	63.75	67	67	67	67
Luxembourg	65	65	65	65	65	65	65	65
Slovenia	65	65	65	65	65	65	65	65
Spain	65	65	65	65	65	65	65	65
Sweden	65	65	65	65	65	65	65	65
Switzerland	65	64	65	64	65	64	65	64

Note: Retirement age of Czech women is based on the number of children; Sweden has flexible retirement age from 61/62, but full pension age is 65.
Source: MISSOC Database. Israeli National Insurance (Israel's National Insurance Institute, 2022).

Table A2: Additional summary statistics

Variable	Whole sample				Men				Women			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Wave 5												
Age	64.01	7.33	48	78	64.38	7.18	48	78	63.75	7.44	48	78
Female	0.58	0.49	0	1	0.00	0.00	0	0	1.00	0.00	1	1
Loneliness	3.66	1.17	3	9	3.55	1.06	3	9	3.75	1.25	3	9
Feeling isolated	0.12	0.32	0	1	0.10	0.30	0	1	0.13	0.34	0	1
Feeling left out	0.17	0.37	0	1	0.14	0.35	0	1	0.19	0.39	0	1
Lack companionship	0.27	0.44	0	1	0.23	0.42	0	1	0.30	0.46	0	1
Number of activities last year	2.53	1.53	0	8	2.45	1.53	0	8	2.58	1.53	0	8
Participate in group activity	0.67	0.47	0	1	0.69	0.46	0	1	0.65	0.48	0	1
Observations	19,699	19,699	19,699	19,699	8,344	8,344	8,344	8,344	11,355	11,355	11,355	11,355
Wave 6												
Age	66.01	7.33	50	80	66.38	7.18	50	80	65.75	7.44	50	80
Female	0.58	0.49	0	1	0.00	0.00	0	0	1.00	0.00	1	1
Loneliness	3.73	1.20	3	9	3.61	1.10	3	9	3.82	1.26	3	9
Feeling isolated	0.14	0.34	0	1	0.11	0.32	0	1	0.15	0.36	0	1
Feeling left out	0.19	0.39	0	1	0.16	0.37	0	1	0.21	0.41	0	1
Lack companionship	0.30	0.46	0	1	0.25	0.43	0	1	0.33	0.47	0	1
Number of activities last year	2.53	1.51	0	7	2.46	1.53	0	7	2.59	1.50	0	7
Participate in group activity	0.66	0.48	0	1	0.67	0.47	0	1	0.65	0.48	0	1
Observations	19,699	19,699	19,699	19,699	8,344	8,344	8,344	8,344	11,355	11,355	11,355	11,355

(continued)

Table A2: Additional summary statistics *(continued)*

Variable	Whole sample				Men				Women			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Wave 8												
Age	70.49	7.31	54	85	70.85	7.15	54	85	70.22	7.42	54	85
Female	0.58	0.49	0	1	0.00	0.00	0	0	1.00	0.00	1	1
Loneliness	3.78	1.26	3	9	3.66	1.14	3	9	3.87	1.33	3	9
Feeling isolated	0.15	0.36	0	1	0.13	0.33	0	1	0.16	0.37	0	1
Feeling left out	0.20	0.40	0	1	0.18	0.38	0	1	0.21	0.41	0	1
Lack companionship	0.30	0.46	0	1	0.26	0.44	0	1	0.33	0.47	0	1
Number of activities last year	2.49	1.48	0	7	2.39	1.47	0	7	2.57	1.49	0	7
Participate in group activity	0.65	0.48	0	1	0.66	0.48	0	1	0.64	0.48	0	1
Observations	19,699	19,699	19,699	19,699	8,344	8,344	8,344	8,344	11,355	11,355	11,355	11,355

Notes: Loneliness refers to the short version of the R-UCLA loneliness scale. Feeling isolated, feeling left out and lack companionship are indicator variables equal to one if respondents felt either of these feelings "some of the time" or "often". The number of activities refers to a specific set of activities respondents have engaged in during the last 12 months. "Participated in group activities" refers to a dummy equal to one if the respondent has engaged in at least one kind of activity classified as a group activity during the last 12 months.

Table A3: Robustness checks: full sample

	(1) Definition 2	(2) Definition 3	(3) DV: Lone > 3	(4) Age dummy	(5) Cubic age term	(6) Ages 52-72	(7) Ages 54-70	(8) Ages 56-68	(9) No never retired	(10) No always retired	(11) No later retired
Loneliness											
Retired R_t	0.172	0.111	0.019	0.264	0.196	0.169	0.152	0.185	0.145	0.161	0.115
(short-term)	(0.137)	(0.136)	(0.051)	(0.166)	(0.125)	(0.115)	(0.124)	(0.144)	(0.119)	(0.106)	(0.104)
Retired R_{t-1}	-0.382***	-0.311**	-0.112**	-0.361**	-0.296**	-0.288**	-0.265**	-0.315**	-0.306**	-0.270**	-0.249**
(long-term)	(0.138)	(0.136)	(0.052)	(0.166)	(0.125)	(0.115)	(0.124)	(0.144)	(0.119)	(0.106)	(0.102)
Isolated											
Retired R_t	0.049	0.031		0.0493	0.0556	0.046	0.032	0.031	0.032	0.054	0.034
(short-term)	(0.046)	(0.046)		(0.0551)	(0.0420)	(0.038)	(0.041)	(0.048)	(0.039)	(0.034)	(0.034)
Retired R_{t-1}	-0.144***	-0.115**		-0.113**	-0.101**	-0.103***	-0.101**	-0.099**	-0.103**	-0.0942***	-0.105***
(long-term)	(0.045)	(0.046)		(0.0541)	(0.0409)	(0.037)	(0.040)	(0.046)	(0.039)	(0.033)	(0.033)
Left out											
Retired R_t	0.015	0.007		0.0282	0.0247	0.020	0.011	0.017	0.004	0.019	-0.002
(short-term)	(0.051)	(0.052)		(0.0635)	(0.0470)	(0.043)	(0.046)	(0.054)	(0.044)	(0.039)	(0.038)
Retired R_{t-1}	-0.066	-0.036		-0.0549	-0.0502	-0.049	-0.025	-0.051	-0.045	-0.075*	-0.030
(long-term)	(0.051)	(0.052)		(0.0631)	(0.0472)	(0.043)	(0.046)	(0.053)	(0.044)	(0.039)	(0.038)
Lack companionship											
Retired R_t	0.039	0.010		0.104	0.0453	0.039	0.045	0.047	0.042	0.023	0.034
(short-term)	(0.061)	(0.062)		(0.0708)	(0.0556)	(0.051)	(0.054)	(0.063)	(0.053)	(0.045)	(0.046)
Retired R_{t-1}	-0.109*	-0.081		-0.115	-0.0902	-0.081	-0.085	-0.086	-0.096*	-0.059	-0.071
(long-term)	(0.062)	(0.063)		(0.0711)	(0.0563)	(0.051)	(0.055)	(0.063)	(0.053)	(0.045)	(0.046)
First stage	0.213***	0.224***	0.270***	0.224***	0.243***	0.259***	0.248***	0.227***	0.263***	0.401***	0.303***
	(0.011)	(0.012)	(0.012)	(0.0135)	(0.0122)	(0.012)	(0.012)	(0.013)	(0.0132)	(0.0175)	(0.013)
First-stage F	84.896	88.834	131.907	43.953		123.890	120.634	115.395	139.719	183.937	136.952
# Observations	39,398	34,148	39,398	39,398	39,398	30,344	26,378	21,044	29,488	18,820	33,556
# Individuals	19,699	17,074	19,699	19,699	19,699	15,172	13,189	10,522	14,744	9,410	16,778

Note: First difference IV estimates of the effect of retirement on (the dimensions of) loneliness in the short- and long—term (separate regressions), as well as the respective first stages for each set of regressions. Column (1) shows estimates using retirement definition 2, column (2) uses retirement definition 3, column (3) uses the main specification, but as outcome a dummy for loneliness levels higher than 3. Column (4) reports the results with age specified as age dummies. Column (5) adds a cubic age term as an additional control. Column (6) uses the main retirement definition but restricts the sub-sample to individuals aged 52-72 in wave 6, (7) uses individuals aged 54-70, and (8) individuals aged 56-68. Column (9) displays results excluding individuals who never retire in the three waves, in column (10) we exclude individuals who are always retired in the three waves, and in column (11), we exclude individuals who retire between waves 6 and 8. All regressions include control variables from equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Robustness checks: women

	(1) Definition 2	(2) Definition 3	(3) DV: Lone > 3	(4) Age dummy	(5) Age 3	(6) Ages 52-72	(7) Ages 54-70	(8) Ages 56-68	(9) No never retired	(10) No always retired	(11) No later retired
Loneliness											
Retired R_t	0.452**	0.367*	0.142**	0.542**	0.420**	0.370**	0.410**	0.432**	0.249	0.330**	0.297**
(short-term)	(0.201)	(0.194)	(0.0706)	(0.225)	(0.170)	(0.158)	(0.169)	(0.187)	(0.160)	(0.147)	(0.140)
Retired R_{t-1}	-0.477**	-0.402**	-0.177**	-0.424*	-0.348**	-0.334**	-0.324*	-0.377**	-0.277*	-0.349**	-0.279**
(long-term)	(0.201)	(0.193)	(0.0687)	(0.220)	(0.169)	(0.157)	(0.167)	(0.186)	(0.157)	(0.141)	(0.137)
Isolated											
Retired R_t	0.094	0.064		0.105	0.0917	0.076	0.081	0.078	0.040	0.089*	0.049
(short-term)	(0.069)	(0.068)		(0.0766)	(0.0587)	(0.055)	(0.058)	(0.064)	(0.055)	(0.048)	(0.048)
Retired R_{t-1}	-0.136**	-0.104		-0.112	-0.0913*	-0.090*	-0.095*	-0.095	-0.072	-0.117***	-0.074
(long-term)	(0.065)	(0.065)		(0.0724)	(0.0552)	(0.051)	(0.054)	(0.061)	(0.053)	(0.044)	(0.045)
Left out											
Retired R_t	0.086	0.063		0.0813	0.0865	0.074	0.077	0.069	0.021	0.074	0.053
(short-term)	(0.074)	(0.075)		(0.0844)	(0.0632)	(0.059)	(0.063)	(0.069)	(0.059)	(0.054)	(0.050)
Retired R_{t-1}	-0.086	-0.047		-0.0296	-0.0550	-0.059	-0.036	-0.052	-0.009	-0.089	-0.049
(long-term)	(0.077)	(0.077)		(0.0848)	(0.0650)	(0.061)	(0.064)	(0.071)	(0.061)	(0.055)	(0.052)
Lack companionship											
Retired R_t	0.189**	0.152*		0.246**	0.174**	0.153**	0.180**	0.190**	0.148**	0.091	0.125**
(short-term)	(0.091)	(0.091)		(0.0978)	(0.0762)	(0.071)	(0.075)	(0.083)	(0.073)	(0.062)	(0.063)
Retired R_{t-1}	-0.209**	-0.178**		-0.229**	-0.163**	-0.148**	-0.161**	-0.183**	-0.161**	-0.104*	-0.120**
(long-term)	(0.089)	(0.089)		(0.0958)	(0.0749)	(0.069)	(0.073)	(0.082)	(0.071)	(0.062)	(0.059)
First stage	0.204***	0.225***	0.274***	0.224***	0.250***	0.264***	0.254***	0.238***	0.280***	0.384***	0.319***
	(0.015)	(0.017)	(0.016)	(0.0177)	(0.0166)	(0.016)	(0.016)	(0.017)	(0.018)	(0.023)	(0.018)
First-stage F	39.556	42.021	71.009	23.578	66.824	66.040	64.272	61.199	75.592	91.019	74.195
# Observations	22,710	18,634	22,710	22,710	22,710	17,574	15,238	12,202	16,298	11,354	19,424
# Individuals	11,355	9,317	11,355	11,355	11,355	8,787	7,619	6,101	8,149	5,677	9,712

Note: First difference IV estimates of the effect of retirement on (the dimensions of) loneliness in the short- and long—term (separate regressions) for women, as well as the respective first stages for each set of regressions. Column (1) shows estimates using retirement definition 2, column (2) uses retirement definition 3, column (3) uses the main specification, but as outcome a dummy for loneliness levels higher than 3. Column (4) reports the results with age specified as age dummies, and (5) as age 3. Column (6) uses the main retirement definition but restricts the sub-sample to individuals aged 52-72 in wave 6, (7) uses individuals aged 54-70, and (8) individuals aged 56-68. Column (9) displays results excluding individuals who never retire in the three waves, in column (10) we exclude individuals who are always retired in the three waves, and in column (11), we exclude individuals who retire between waves 6 and 8. All regressions include control variables from equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A5: Robustness checks: men

	(1) Definition 2	(2) Definition 3	(3) DV: Lone > 3	(4) Age dummy	(5) Age 3	(6) Ages 52-72	(7) Ages 54-70	(8) Ages 56-68	(9) No never retired	(10) No always retired	(11) No later retired
Loneliness											
Retired R_t	-0.119	-0.142	-0.128*	-0.0982	-0.0811	-0.067	-0.182	-0.154	0.031	-0.078	-0.108
(short-term)	(0.190)	(0.193)	(0.075)	(0.254)	(0.188)	(0.170)	(0.186)	(0.231)	(0.180)	(0.167)	(0.159)
Retired R_{t-1}	-0.272	-0.212	-0.037	-0.190	-0.213	-0.222	-0.184	-0.207	-0.332*	-0.088	-0.214
(long-term)	(0.189)	(0.192)	(0.079)	(0.258)	(0.187)	(0.170)	(0.184)	(0.231)	(0.181)	(0.175)	(0.155)
Isolated											
Retired R_t	0.005	0.0002		-0.0164	0.0116	0.013	-0.034	-0.038	0.026	0.0005	0.017
(short-term)	(0.060)	(0.062)		(0.0784)	(0.0600)	(0.054)	(0.059)	(0.074)	(0.057)	(0.050)	(0.050)
Retired R_{t-1}	-0.152**	-0.126*		-0.0994	-0.107*	-0.115**	-0.106*	-0.097	-0.138**	-0.042	-0.146***
(long-term)	(0.062)	(0.064)		(0.0809)	(0.0612)	(0.055)	(0.060)	(0.074)	(0.060)	(0.055)	(0.051)
Left out											
Retired R_t	-0.057	-0.046		-0.0564	-0.0545	-0.045	-0.078	-0.048	-0.014	-0.056	-0.072
(short-term)	(0.072)	(0.074)		(0.0980)	(0.0711)	(0.064)	(0.071)	(0.087)	(0.068)	(0.064)	(0.059)
Retired R_{t-1}	-0.047	-0.027		-0.0657	-0.0479	-0.041	-0.015	-0.061	-0.089	-0.054	-0.009
(long-term)	(0.069)	(0.072)		(0.0968)	(0.0690)	(0.062)	(0.068)	(0.084)	(0.066)	(0.063)	(0.057)
Lack companionship											
Retired R_t	-0.118	-0.131		-0.0580	-0.118	-0.096	-0.126	-0.153	-0.082	-0.081	-0.073
(short-term)	(0.084)	(0.086)		(0.106)	(0.0837)	(0.075)	(0.082)	(0.102)	(0.080)	(0.075)	(0.070)
Retired R_{t-1}	-0.008	0.013		0.0432	0.00163	-0.004	0.006	0.057	-0.021	0.022	-0.021
(long-term)	(0.087)	(0.091)		(0.109)	(0.0864)	(0.078)	(0.085)	(0.104)	(0.082)	(0.074)	(0.073)
First stage	0.221***	0.221***	0.266***	0.225***	0.233***	0.253***	0.239***	0.209***	0.245***	0.387***	0.283***
	(0.017)	(0.017)	(0.017)	(0.0212)	(0.0181)	(0.017)	(0.018)	(0.019)	(0.019)	(0.027)	(0.019)
First-stage F	47.048	47.022	61.174	20.590	57.810	58.063	56.586	54.461	64.585	101.791	63.175
# Observations	16,688	15,514	16,688	16,688	16,688	12,770	11,140	8,842	13,190	7,466	14,132
# Individuals	8,344	7,757	8,344	8,344	8,344	6,385	5,570	4,421	6,595	3,733	7,066

Note: First difference IV estimates of the effect of retirement on (the dimensions of) loneliness in the short- and long—term (separate regressions) for women, as well as the respective first stages for each set of regressions. Column (1) shows estimates using retirement definition 2, column (2) uses retirement definition 3, column (3) uses the main specification, but as outcome a dummy for loneliness levels higher than 3. Column (4) reports the results with age specified as age dummies, and (5) as age 3. Column (6) uses the main retirement definition but restricts the sub-sample to individuals aged 52-72 in wave 6, (7) uses individuals aged 54-70, and (8) individuals aged 56-68. Column (9) displays results excluding individuals who never retire in the three waves, in column (10) we exclude individuals who are always retired in the three waves, and in column (11), we exclude individuals who retire between waves 6 and 8. All regressions include control variables from equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: IV estimates of the effect of retirement on (dimensions of) loneliness if the partner is retired in wave 6, by gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Loneliness		Isolated		Left out		Lack companionship	
	Men	Women	Men	Women	Men	Women	Men	Women
Retired r_t	0.002	0.192	-0.070	-0.026	-0.038	0.069	0.028	0.160
(short-term)	(0.287)	(0.267)	(0.099)	(0.095)	(0.119)	(0.110)	(0.136)	(0.131)
Retired r_{t-1}	-0.169	-0.105	0.008	0.000	-0.061	-0.026	-0.107	-0.136
(long-term)	(0.261)	(0.281)	(0.090)	(0.094)	(0.112)	(0.110)	(0.126)	(0.130)
# Observations	5,280	7,370	5,280	7,370	5,280	7,370	5,280	7,370
# Individuals	2,640	3,685	2,640	3,685	2,640	3,685	2,640	3,685
First stage	0.241***	0.217***	0.241***	0.217***	0.241***	0.217***	0.241***	0.217***
	(0.032)	(0.025)	(0.032)	(0.025)	(0.032)	(0.025)	(0.032)	(0.025)
First-stage F	57.16	75.20	57.16	75.20	57.16	75.20	57.16	75.20

Note: Estimates of the effect of retirement in the short- and long-term on the loneliness scale, and its dimensions, by gender separately and restricted to individuals whose partner is retired in wave 6. All regressions include control variables based on equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A7: Main FD-IV results with inverse probability weights

Panel A	(1)	(2)	(3)
	Loneliness		
	All	Men	Women
Retired R_t	0.147	-0.096	0.366**
(short-term)	(0.112)	(0.165)	(0.154)
Retired R_{t-1}	-0.308***	-0.256	-0.346**
(long-term)	(0.113)	(0.163)	(0.156)

Panel B	(1)	(2)	(3)
	Isolated		
	All	Men	Women
Retired R_t	0.0441	0.00809	0.0772
(short-term)	(0.0374)	(0.0521)	(0.0535)
Retired R_{t-1}	-0.117***	-0.139***	-0.0967*
(long-term)	(0.0364)	(0.0524)	(0.0505)

Panel C	(1)	(2)	(3)
	Left out		
	All	Men	Women
Retired R_t	0.0119	-0.0499	0.0677
(short-term)	(0.0413)	(0.0615)	(0.0559)
Retired R_{t-1}	-0.0597	-0.0463	-0.0730
(long-term)	(0.0417)	(0.0586)	(0.0593)

Panel D	(1)	(2)	(3)
	Lack of companionship		
	All	Men	Women
Retired R_t	0.0307	-0.0967	0.145**
(short-term)	(0.0481)	(0.0703)	(0.0670)
Retired R_{t-1}	-0.0886*	-0.0177	-0.154**
(long-term)	(0.0489)	(0.0731)	(0.0662)
First stage	0.270***	0.264***	0.274***
	(0.0121)	(0.0177)	(0.0164)
First-stage F	500.14	222.12	278.36
# Observations	39,398	22,710	16,688
# Individuals	19,699	11,355	8,344

Note: Estimates of the effect of retirement in the short- and long-term on the loneliness scale (panel A) the probability of feeling isolated (panel B), the probability of feeling left out (panel C), the probability of lack of companionship (panel D) for the entire sample (column 1), women (column 2) and men (column 3). All regressions include control variables based on equations (1) and (2). Standard errors clustered at the individual level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.