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ABSTRACT

The Mental Health Consequences of Spousal Bereavement*

We examine the dynamic effects of the loss of a spouse on mental health. We use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) for 28 European countries over the period 2004-2022 and estimate event study regressions to examine how individuals' mental health changes over the transition into widowhood. We find no evidence of changes in mental health before the death of a spouse due to anticipation or caregiving effects. Bereaved individuals experience up to 1.5 additional depressive symptoms and their risk of depression increases by around 20 percentage points, with similar effects for men and women. Individuals adapt relatively quickly and their risk of depression reverts to baseline levels within 3 years of the death. We provide suggestive evidence that this adaptation is in part due to increased rates of social participation. We also find some evidence that the impact on mental health is stronger for individuals living in Eastern Europe and in countries with strong family ties. In addition, individuals in countries with stronger family ties adapt less quickly.

JEL Classification: I14, J12, J14

Keywords: widowhood, mental health, adaptation, anticipation, depression, SHARE, event study

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1 Introduction

The loss of loved ones is a tragic yet inescapable aspect of the human condition. Older adults frequently experience bereavement as they outlive their parents, friends, and spouses. The loss of a spouse in particular can be a disruptive event with potentially long-lasting consequences for the surviving partner. Beyond grief, widows and widowers may also experience reduced financial resources and smaller social networks. It is therefore crucial to understand how the transition into widowhood affects older adults' lives and whether and how they adapt to the loss to ensure that the surviving partner receives the required support to cope with this major life event.

This paper studies the impact of the loss of a spouse on mental health among older Europeans, by exploiting an event study framework to examine its dynamic effects over time. Previous research shows that spousal bereavement can have severe consequences for mental health (e.g., Lee et al. 2001; Peña-Longobardo et al. 2021; Schaan 2013; Siflinger 2017; Streeter 2020; Tseng et al. 2017). Yet, it is not well understood how this effect unfolds dynamically across the transition to widowhood. For example, some individuals might experience a deterioration of mental health already before the death of their spouse. Such anticipation effects could occur, e.g., because individuals expect that their spouse may not survive, or because the death is preceded by a care spell, which can negatively affect mental health (Schmitz and Westphal 2015). Siflinger (2017) provides evidence for such anticipation effects in the US, which can bias estimates of the impact of widowhood on mental health towards zero. There is also substantial disagreement on whether and how quickly individuals adapt to the loss of their spouse. Tseng et al. (2017) report that older adults in Taiwan adapt within 4 years of bereavement. In contrast, Streeter (2020) finds that in the US symptoms can persist up to 8 years after the death of a spouse. The mechanisms behind this adaptation (or lack thereof) are not well understood.

In this study, we use data from the Survey of Health, Ageing and Retirement in Europe (SHARE), covering 28 European countries during the period 2004 to 2022. We focus on 6,739 individuals who are initially observed as married and later experience the death

of their spouse during the study period. We estimate event study regressions that allow us to trace out the dynamic effects of the impact of spousal loss on mental health. We find no significant anticipation effects. In contrast to Siflinger (2017), we directly observe caregiving, which allows us to rule it out as a potential source of anticipation effects. We find that spousal loss leads to an increase in depressive symptoms by up to 1.5 symptoms (an increase of 0.6 standard deviations (SD)), and it increases the risk of depression by around 20 percentage points. Reassuringly, mental health appears to return to baseline levels within 3 years of the death of the spouse. We also provide suggestive evidence that this adaptation might in part stem from increased levels of engagement in social activities.

We further consider differences in the impact of bereavement and the adaptation process between men and women. The empirical evidence on such gender differences is mixed. Schaan (2013) finds similar patterns for men and women. Peña-Longobardo et al. (2021) report stronger effects on women, whereas most other studies find stronger effects on men (Espinosa and Evans 2008; Lee et al. 2001; Siflinger 2017; Streeter 2020). Beyond the initial impact, there may also be gender differences in the adaptation process. Lee et al. (2001) and Siflinger (2017) suggest that men adapt faster than women, in part because women face more severe financial consequences in the long term (Bíró 2013; Streeter 2020). Our study finds no evidence of gender differences, neither in the initial impact of widowhood nor in the adaptation process. However, our analysis of heterogeneity across age groups shows some differences between men and women — while the impact is strongest for men aged 50 to 59 and decreases with age, the negative impact for women only emerges among women aged 60 and above and appears to increase in intensity with age. Finally, we consider heterogeneity at the individual- and country-level, and we find that individuals in Eastern Europe and in countries with stronger family ties adapt less quickly to the loss.

Our study addresses several important gaps in the literature on the mental health effects of widowhood. First, our paper estimates a credibly identified causal effect of spousal loss on mental health. Our event study regressions based on recently developed estimators (Callaway and Sant'Anna 2021) allow us to examine the dynamics of mental health across the transition to widowhood, including anticipation and adaptation effects.

In contrast to Siflinger (2017), our event study approach does not rely on differences between (self-reported) expected and unexpected deaths to address potential anticipation effects. Instead, following Fadlon and Nielsen (2021), we assume that any anticipation effects are limited to the 24 months preceding the death of the spouse and that there are no systematic changes in mental health 3-5 years before the event. Our event study graphs provide suggestive evidence for this assumption. Second, to the best of our knowledge, we are the first study to provide evidence on potential mechanisms for adaptation effects. Our analysis allows us to rule out caregiving as a potential source of bias. Instead, we show that higher levels of social participation might partly explain why the risk of depression returns back to baseline levels within 3 years of the death of the spouse. Third, we systematically examine effect heterogeneity in both the initial impact of widowhood and the adaptation process. We find interesting differences by gender across age groups as well as across regions in Europe.

The remainder of the paper is structured as follows: Section 2 describes our working sample, defines the primary outcome, and presents descriptive statistics. Section 3 discusses the empirical challenge and describes our event study approach. Section 4 presents the main results and heterogeneous effects at both the individual and country levels, as well as potential mechanisms. Section 5 provides a series of robustness checks, including the use of alternative event study estimators, different outcome measures, varying control groups, and a discussion of selective mortality. Section 6 concludes.

2 Data

We use data from the Survey of Health, Ageing and Retirement in Europe (SHARE), which focuses on individuals aged 50 and above from 28 European countries (including Israel) (Börsch-Supan et al. 2013). The survey started in 2004, and collects data biannually. SHARE conducts interviews with all household members in eligible households, including, e.g., spouses below age 50. The survey collects information about the respondent's household characteristics, individual attitudes, and socioeconomic and health conditions. One of the advantages of SHARE is that it provides information on

individuals living under different welfare and policy regimes, which allows us to study the potential moderating role of institutions and policies. In addition, SHARE includes an end-of-life questionnaire, which is administered when a respondent has died. This interview is conducted with a proxy respondent—such as a family member, household member, neighbor, or another close contact—either in person or by phone. The end-of-life questionnaire collects valuable information on the deceased's final year, including the time and cause of death as well as the duration of disease if any.

2.1 Working sample

For our analysis, we pool data across all countries for the time period 2004-2022 (i.e., waves 1-9).[1] We then select all individuals aged between 50 and 90,[2] who are initially married and for whom we observe the subsequent death of their spouse. This means that all individuals in our sample are observed for at least two waves of the survey. All individuals who either remain married, separated, or divorced are excluded from the analysis. In total, our sample includes 27,180 observations from 6,739 individuals, who are observed for (on average) 3 waves (i.e., 6 years) before the transition to widowhood and 2.70 waves after the event. Appendix Fig. A1 reports the distribution of the years before and after the event. There is a substantial number of observations between *t-5* and *t+5*, which allows us to examine the dynamic effects of bereavement in longer time window. We also note that the distribution is fairly symmetric, which suggests that selective mortality is unlikely to play a major role.[3] Appendix Fig. A2 shows the distribution of the event over calendar years.[4]

[1] In a robustness check, we exclude wave 9 to ensure that our results are not driven by deaths that occurred during the COVID-19 pandemic.

[2] We restrict our sample to individuals under age 90, because the subsample of individuals above 90 is too small to be included in our analysis of effect heterogeneity between age groups.

[3] We discuss this problem in more detail in section 5.4.

[4] In wave 7, about 900 cases had missing information on the year of the spouse's death. This means that while the change in marital status was recorded in that wave, the exact year of the husband's death was not reported. For these cases, we have assumed that the year of death had to be the previous year (2016). This assumption may introduce some measurement error — some individuals could have been widowed shortly after the wave 6 interview in 2015, but we record 2016 as the year of the spouse's death. However, when we examined the distribution of the missing year of death data by country for wave 7, only Hungary and Estonia had notably higher percentages —about 12% each — while the other countries had missing values ranging between 5% and 8% at most. We re-run the main analysis without Hungary and Estonia

Fig. A3 shows the distribution of causes of death for 5,226 individuals (out of 6,739 in our working sample).[5] Around 1/3 of the deaths occur due to cancer, while heart disease, stroke and other cardiovascular diseases account for 39% of all deaths. While most deaths occur after more than a year of illness (Fig. A4), there is a substantial proportion of deaths that occur after very brief episodes of illness (e.g., around 20% of individuals experienced the death of the partner within one month of the illness, 17% within 5 months and 11% between 6 and 11 months).

2.2 Primary outcome: Depression

Our main outcome of interest is respondent's mental health as measured by the EURO-D score. The EURO-D score was developed as a common instrument to measure depressive symptoms across different countries in Europe (Prince et al. 1999). SHARE respondents are asked 16 questions, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. Thus, the total EURO-D score can vary between 0 ("not depressed") and 12 ("very depressed") (Mehrbrodt et al. 2019). We consider two outcomes based on the EURO-D scale — (i) the total score of depressive symptoms, and (ii) a binary indicator for individuals with four or more depressive symptoms, who are considered to suffer from depression (Prince et al. 1999). As an additional outcome, we also include the use of medication for anxiety or depression, based on respondents' answers to whether they currently take such drugs at least once a week.

2.3 Additional outcomes

Our main specification controls for age as well as individual and year fixed effects. We also consider several secondary outcomes that might explain possible anticipation or

and the results do not change.

[5]The information on cause of death was taken from the end-of-life questionnaire, and therefore is not available for all individuals included in our working sample.

adaptation effects. These include informal caregiving, volunteering, participation in clubs, and recreational activities. Informal caregiving is measured using a question whether respondents provided help to anyone in the last year. Our measure of volunteering considers whether respondents provided voluntary or charity work. Participation in clubs considers whether individuals participated in sports clubs, social clubs or any other club activities in the last year. We create a measure of recreational activities, which includes (i) participation in education or training courses, (ii) playing cards or chess, (iii) reading, or (iv) solving crosswords, puzzles or Sudokus. For all variables, respondents are instructed to indicate whether they participated in these activities in the last 12 months or not. For informal care provision, volunteering, and participation in club activities, we therefore use binary variables that indicate whether individuals participated in the respective activity or not. The outcome measuring recreational activities is based on four different activities, and therefore varies between values of 0 and 4.

2.4 End-of-life information

To address potential bias from selective mortality, we incorporate two additional variables from the SHARE end-of-life questionnaire. The first captures the main cause of death, as reported by the proxy respondent. This includes a range of categories such as cancer, heart attack, stroke, other cardiovascular diseases, respiratory and digestive system diseases, severe infectious diseases, accidents or suicide, and — starting in wave 9 — Covid-19 or related complications. An open-ended option also allows for specification of other causes. The second variable measures the duration of illness before death, categorized as less than one month, between one and six months, between six months and one year, or one year or more. There is also an option for cases where the deceased was not ill prior to death. Together, these variables provide insight into the health trajectory leading up to death and help to account for differences in mortality risk across individuals.

2.5 Descriptive statistics

Table 1 shows descriptive statistics for our working sample. The large majority of individuals included in our study are women (74.7%). Average age is 73 years. 16% of respondents have high education (i.e., some tertiary education). On average, respondents report around 3 depressive symptoms, and about 38% of respondents are considered to suffer from depression.

3 Methods

3.1 Empirical challenges

Mortality risks are related to individual characteristics such as, e.g., education (Bijwaard et al. 2019) or income (Rehnberg 2020), and because individuals tend to choose spouses with similar characteristics (Conley et al. 2016), the mortality risk is likely also related to (observed and unobserved) characteristics of the surviving spouse. This implies that estimates from a simple regression of mental health on widowhood are likely biased due to unobserved individual characteristics that are related to a person's mental health as well as their spouse's risk of dying. Previous studies have addressed such mortality selection through the use of panel data methods such as fixed effects regressions, which eliminate the influence of time-invariant unobserved confounders (e.g., Bíró 2013; Siflinger 2017; Streeter 2020). In fixed effects (FE) regressions, the impact of widowhood on mental health is only identified through changes in mental health within individuals as they experience the loss of their spouse. However, time-varying characteristics that are related to both mental health and the risk of spousal loss remain a concern. This is obviously the case for age, but shocks such as job loss also affect the mortality risk (Sullivan and Von Wachter 2009) as well as the mental health of spouses (Marcus 2013). Bias from such time-varying confounders can be potentially resolved in a difference-in-differences design (DID) (e.g., Tseng et al. 2017) by comparing changes in mental health over the transition to widowhood to changes over time occurring in a control group. DID designs allow for level differences between the treatment and the

Table 1: Descriptive statistics of the working sample, 2004-2022

	N	Mean	SD	Min	Max
Demographics					
Female	27,180	0.747	0.434	0	1
Age	27,180	72.669	8.832	50	90
Number of children	27,006	2.353	1.463	0	17
Number of grandchildren	27,006	3.663	3.329	0	23
High education	27,180	0.157	0.363	0	1
Retired	27,180	0.703	0.457	0	1
Household income	27,103	23,571	35,286	0	1,329,785
Age at widowhood	27,180	73.418	8.244	50	90
Health Related Outcomes					
EURO-D score (0-12)	27,180	3.076	2.491	0	12
Depressed (EURO-D>3)	27,180	0.379	0.485	0	1
Any informal care	24,520	0.224	0.417	0	1
Participation in club activities	20,464	0.229	0.420	0	1
Volunteering	20,464	0.135	0.341	0	1
Number of recreational activities	27,180	1.104	1.137	0	4
Any drug for anxiety	27,073	0.087	0.282	0	1

Notes: The table reports summary statistics of our working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. Household income is calculated by accounting for all reported sources, including labor income, pension income, annuities or private pensions, alimony, rental income, income received by other household members, interest from bank accounts or bonds, and dividends from stocks or mutual funds. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. We consider two outcomes based on the EURO-D scale — (i) the total score of depressive symptoms, and (ii) a binary indicator for individuals with four or more depressive symptoms. The measure for recreational activities is defined with a value from 0 to 4, which includes (i) participation in education or training courses, (ii) playing cards or chess, (iii) reading, or (iv) solving crosswords, puzzles or Sudokus.
Source: SHARE v9, own calculations.

control group, but require the assumption of parallel trends. Here, this implies that the model allows for differences in average mental health between individuals experiencing spousal bereavement and those who do not, regardless of whether such differences stem from selection on time-invariant or time-varying unobserved confounders. Instead, it assumes that in the absence of spousal loss, trends in mental health over time would

have been similar between both groups. The plausibility of this assumption clearly depends on the choice of the control group. Anticipation effects represent a challenge both for the FE approach as well as for DID designs. Some individuals might experience depressive symptoms already before the eventual death of their spouse, e.g., because they expect their spouse to die in the near future, or because they provide care for their sick spouse (Schmitz and Westphal 2015). Such anticipation effects violate the parallel trend assumption in a DID design. Likewise, a comparison of depressive symptoms before and after the loss of a spouse in a FE regression will be biased if anticipation effects are neglected. Siflinger (2017) shows in her analysis of US data that such anticipation effects are large and lead to an underestimation of the true effects of widowhood on mental health.

3.2 Event study framework

We estimate the effect of spousal bereavement on mental health in an event study design. Event studies are closely related to both FE regression and DID designs (Miller 2023). Our event study uses a sample restricted to individuals for whom we observe the transition into widowhood to estimate the effect of this transition as the change in mental health after the loss of a spouse relative to an earlier reference period. Similar to a FE regression, our event study regression only identifies the effect of spousal loss from changes in mental health within individuals over time, thereby eliminating potential bias from time-invariant unobserved factors. However, in contrast to a FE regression, our event study provides us with estimates of dynamic changes in mental health before the transition to widowhood, which allows us to detect potential anticipation effects without relying on self-reports (as in Siflinger 2017). Moreover, similar to a DID design our event study allows us to examine pre-treatment trends to identify potential bias from time-varying unobserved factors. In the presence of such time-varying confounders, we would expect to find significant changes in mental health before the event, unless the timing of widowhood perfectly coincides with changes in these omitted factors. Put differently, if we assume that the timing (but not the incidence) of spousal death is as good as random during our study period, our results should not be affected by

time-varying confounders that affect both mental health and the risk of experiencing bereavement during the study period. An important difference to DID designs is that by excluding "never-treated" individuals from our sample, we do not have to worry about the comparability of our treatment and control group. Instead, we have to assume that there are no significant pre-treatment trends conditional on the covariates in our model. Formally, we consider the following regression model (Miller 2023):

$$y_{it} = \sum_{j \in \{-m,\ldots,0,\ldots,n\}} \gamma_j D_{i,t-j} + \alpha_i + \delta_t + \beta_1 \text{age}_{it} + \epsilon_{it} \tag{1}$$

In this model, we observe individual i for m periods before the event of widowhood and for n periods after the event. $D(i, t-j)$ is a binary indicator for the time to event, i.e., it takes a value of 1 if the event occurred j periods before the current calendar time period t. The corresponding coefficient, γ_j, measures average mental health at event time j. It is common practice to designate a reference period by setting one of the γ_j's to zero and estimating eq. (1) with a constant that captures average mental health in the reference period. In this case, γ_j measures the change in mental health at event time j relative to the reference period. We discuss the choice of the reference period in more detail in Section 3.3. α_i are individual-fixed effects, δ_t fixed effects for calendar time, and β_1 is the coefficient for age.

As discussed above, the event study model in eq. (1) is closely related to FE regressions and DID designs. A FE regression of mental health on widowhood can be written as

$$y_{it} = \gamma D_{it} + \alpha_i + \delta_t + \beta_1 \text{age}_{it} + \epsilon_{it} \tag{2}$$

Here, D_{it} is a binary indicator for individuals who lost their spouse before period t. Eq. (2) is nested as a special case within eq. (1) – essentially, the FE regression imposes the restrictions $\gamma_j = \beta_0 \quad \forall j < 0$ and $\gamma_j = \gamma \quad \forall j \geq 0$. In other words, the model assumes that there are no changes in mental health before the event, and the change in mental health after the event is instantaneous and constant over time. Similarly, if the sample used for estimation of eq. (1) includes units who never experience the event, then eq. (1) is a dynamic extension of the standard two-way fixed effects (TWFE) estimator for DID

designs:

$$y_{it} = \gamma \cdot \text{Treated}_i \cdot \text{Post}_{it} + \alpha_i + \delta_t + \beta_1 \text{age}_{it} + \epsilon_{it} \tag{3}$$

Eq. (3) imposes the same constraints as eq. (2), i.e., $\gamma_j = \beta_0 \quad \forall j < 0$ and $\gamma_j = \gamma \quad \forall j \geq 0$.

In summary, while our event study model in eq. (1) is closely related to FE regressions (eq. (2)) and DID designs (eq. (3)), it offers two advantages: First, we estimate a fully dynamic specification without imposing constraints on trends before and after the event. Second, we do not have to designate a control group of individuals who do not experience the event, rather individuals who experience the death of their spouse later serve as controls for individuals who experience bereavement earlier.

3.3 Interpretation of event study terms

The coefficients γ_j measure changes in mental health at event time j. For $j \geq 0$, we interpret these terms as the causal, dynamic effect of spousal bereavement on mental health. The two most common scenarios discussed in the literature on widowhood are that the effect decreases over time as individuals adapt to the loss (e.g., Tseng et al. 2017), or that the effect remains largely constant (Siflinger 2017). However, it is at least theoretically possible that the effect might also increase over time, e.g., if the loss of a spouse also has a long-lasting effect on financial resources.

Interpreting the γ_j's for $j \geq 0$ as causal effects requires us to assume that (conditional on the covariates in our model) there are no significant trends in mental health, i.e., in the absence of the event we would observe no systematic changes in mental health (other than those modeled through our covariates, which include an age trend). For $j < 0$, the γ_j's capture the pre-event trends in mental health, which we can use as a placebo test for this assumption. In the absence of anticipation effects, any significant changes in mental health before the death of a spouse might suggest potential problems, e.g., due to omitted variable bias or selection. Conversely, if the γ_j's for $j < 0$ are statistically indistinguishable from zero, it seems reasonable to assume that in the absence of the event, the γ_j's for $j \geq 0$ would also be statistically insignificant, which allows for a causal interpretation of any

effects we might find.

However, it is possible that some individuals in our study anticipate the death of their spouse, in which case they might experience an increase in depressive symptoms before the event occurs. In our model, this would imply that some of the γ_j's for $j < 0$ are statistically significant. Anticipation effects should occur close to the event and should be in the same direction as the change in mental health observed after the event. Increases in depressive symptoms due to the anticipated death of a spouse should be considered as part of the causal effect of spousal loss on depressive symptoms. This can be achieved by designating an earlier period as the reference period. Siflinger (2017) finds that for expected deaths, the risk of depression starts to increase around 7 months before the death of the spouse. For our analysis, we therefore assume that any anticipation effects are likely limited to the year preceding the death of the spouse. We therefore choose $j = -2$ as our reference period. This means that our estimate of the effect of spousal bereavement is based on the estimated change in mental health after the transition to widowhood relative to two years before the death of the spouse.

3.4 Estimation

As noted above, our event study in eq. (1) is closely related to the TWFE estimator for DID designs with staggered treatment timing. Recent work on DID designs shows that this TWFE estimator can be problematic, because the estimate will be a weighted average of all possible 2x2 DID estimates with weights that, first, depend on the timing of treatment and the length of the panel (and are therefore open to manipulation); and, second, which might even be negative due to "forbidden" comparisons that use early-treated units as control groups for late-treated units (Goodman-Bacon 2021). These concerns apply also to TWFE estimates of our event study, and we therefore use recently proposed alternative estimators for DID designs to estimate our event study regression in eq. (1). For our main specification, we use the estimator proposed by Callaway and Sant'Anna (CS) 2021, which allows for limited anticipation effects by choosing an earlier reference period. In a sensitivity analysis, we show that the results from our main specification are qualitatively similar to those we obtain using the TWFE estimator and

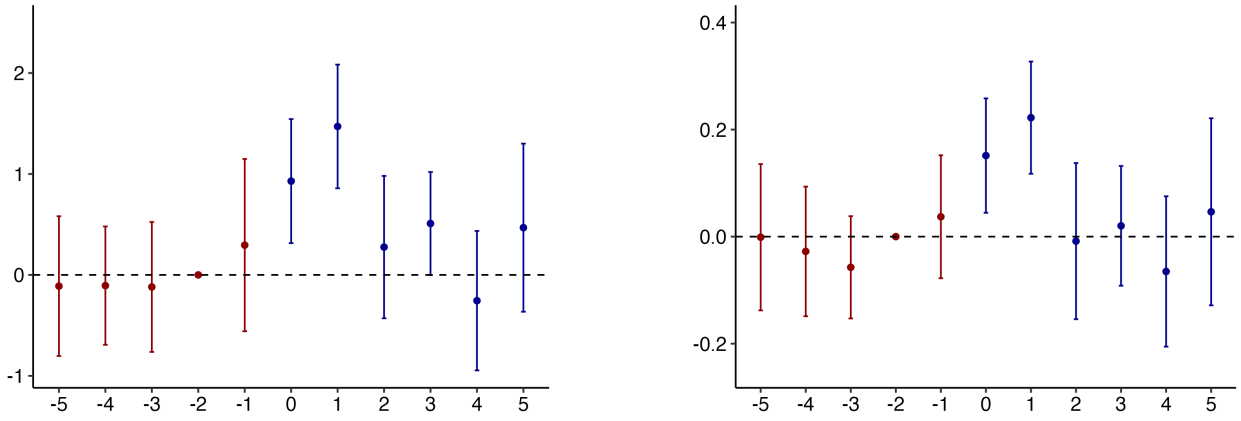
the SA estimator (Sun and Abraham 2021). We estimate our event study regressions using the inverse probability weights approach proposed by Callaway and Sant'Anna (2021) using not yet treated individuals as the control group. We allow for an unbalanced panel to maximize the number of events in our sample. Standard errors are clustered at the individual level.

4 Results

4.1 Pooled estimation

Fig. 1 shows the estimated event study terms for all individuals in our working sample for a period ranging from 5 years before the event to 5 years after the death of a spouse. The Panel (a) shows estimates for the total EURO-D score (ranging from 0 to 12). We note that the number of depressive symptoms remains constant between 5 to 2 years before the event. In the year before the death of a spouse, the number of depressive symptoms appears to increase slightly, although the estimate is not significantly different from the reference period. Our estimates suggest that the loss of a spouse leads to a sharp increase in the number of depressive symptoms in the first two years after bereavement — individuals report up to 1.5 additional depressive symptoms. These are large effects, representing a change of 48% over the mean (Table 1) or around 0.6 standard deviations. The estimates for later periods seem to indicate an adaptation effect – the estimated change in years 3 and 4 after bereavement are considerably smaller (and not statistically significant in year 3). 5 years after the transition to widowhood the number of depressive symptoms seems to have returned to baseline levels.

The results for our binary indicator of depression in Panel (b) are qualitatively similar. We find no evidence of significant pre-trends. After the transition to widowhood, the risk of depression increases sharply by around 20 percentage points in the first two years, but from year 3 onwards the risk returns to baseline. Our estimates of the effect of widowhood are quantitatively similar to Siflinger (2017)'s estimates for the US, although in contrast to Siflinger (2017) we do not find any evidence for significant



(a) EURO-D Score (0-12)

(b) Depression (EURO-D >3)

Figure 1: Event study estimates of spousal loss on depression

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score (Panel (a)) and the risk of depression (Panel (b)) in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. We consider two outcomes based on the EURO-D scale – (i) the total score of depressive symptoms (panel a), and (ii) a binary indicator for individuals with four or more depressive symptoms (panel b). All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

anticipation effects. Appendix Table A1 shows the estimated coefficients (corresponding to Fig. 1) for each period.

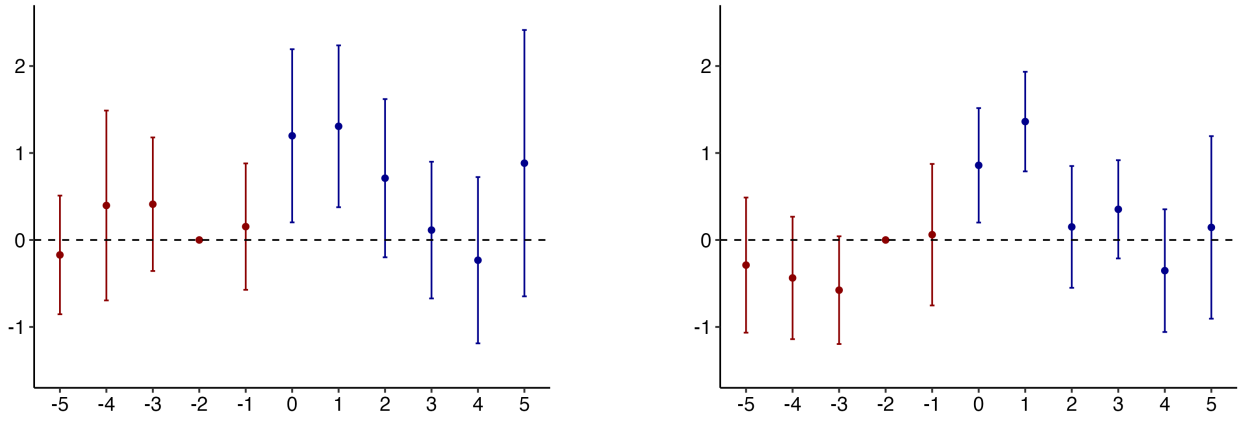
4.2 Differences by gender

Next, we examine whether the effect of spousal loss differs for men and women. Women are more likely to survive their partner, because on average women are around 3 years younger than their partners in our sample and women have a longer life expectancy. Especially among older cohorts, the death of the husband has a larger impact on financial resources of the household than the death of the wife (Bíró 2013), and therefore the impact of widowhood on mental health might also be larger for women. On the other hand, men might not expect to survive their spouse and might therefore be more strongly affected by the loss of their partner (Siflinger 2017). The empirical evidence is mixed, with studies reporting stronger effects for women (Peña-Longobardo et al. 2021), stronger effects for men (Lee et al. 2001; Streeter 2020), or no significant differences by gender (Schaan 2013). Similarly, there might be differences in adaptation to widowhood. Siflinger (2017) finds that men adapt faster to widowhood than women, in part because the financial consequences of widowhood exert a long-lasting influence on women. In contrast, Streeter (2020) finds that women's mental health adapts faster to widowhood, and Espinosa and Evans (2008) find a similar pattern for mortality risks.

Fig. 2 shows our estimates for the EURO-D score for men (Panel (a)) and women (Panel (b)). The point estimates seem to indicate slightly larger initial effects for men, although there is substantial uncertainty around these estimates and the difference is therefore not statistically significant. Similarly, we do not observe significant differences in the adaptation process – for both men and women we no longer find significant effects of widowhood on mental health three years after the event. Appendix Fig. A5 shows that the risk of depression follows the same pattern.

4.3 Differences by age

We re-estimate our event study regressions for 10-year age groups (50-59, 60-69, 70-79, and 80-90) without controlling for age. This serves three purposes: First, it appears plausible that the effects of widowhood might differ by age, e.g., because older individuals might be more accustomed to coping with bereavement and grief. Second,



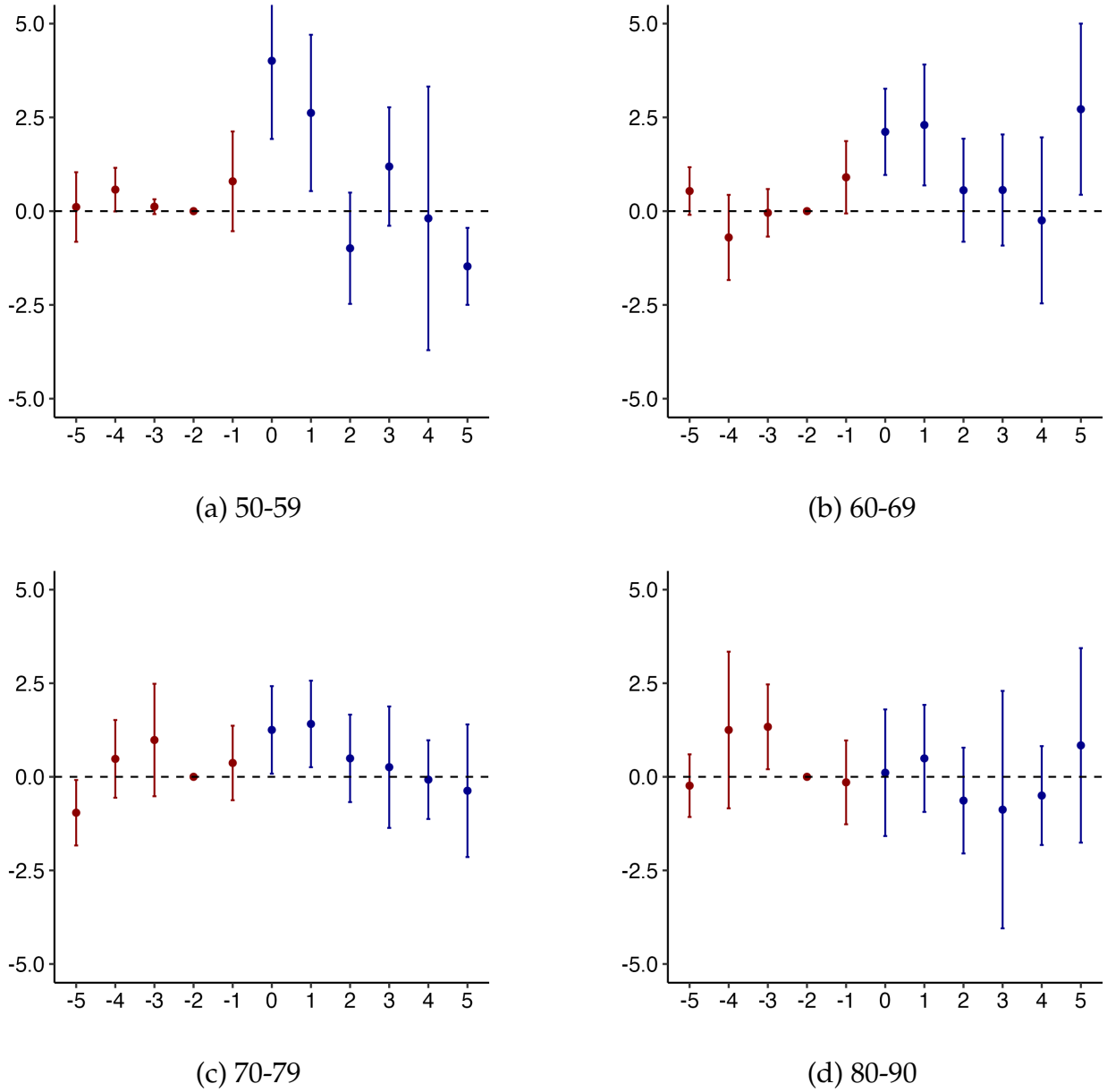
(a) Men (b) Women

Figure 2: Event study estimates of spousal loss for the EURO-D score by gender

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score for men (Panel (a)) and women (Panel (b)) in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

the critical assumption that the timing of spousal loss is random is more likely to hold in a more homogeneous sample, where bereavement occurs at similar ages. Third, it effectively accounts for life cycle effects, addressing a primary concern in identifying factors influencing mental health of widowers and widows in our context.

Figs. 3 and 4 show separate estimates for the EURO-D score for each age group for men and women. For men (Fig. 3), the effects decrease with age: Men aged 50-59 experience up to 4 additional depressive symptoms after the loss of their partners, whereas for men aged 60-69 this decreases to around 2.5 and men aged 70-79 experience on average around 1 additional depressive symptom. For men aged 80 to 90 years old the effects are no longer statistically significant. This suggests, in line with Siflinger (2017)'s results, that unexpected deaths exert a particularly strong effect on men. For women (Fig. 4), on the other hand, we find no significant effects in the youngest age group. The increase in depressive symptoms only emerges among women aged 60 and older, and it appears to increase with age from 1.5 additional depressive symptoms for



(a) 50-59

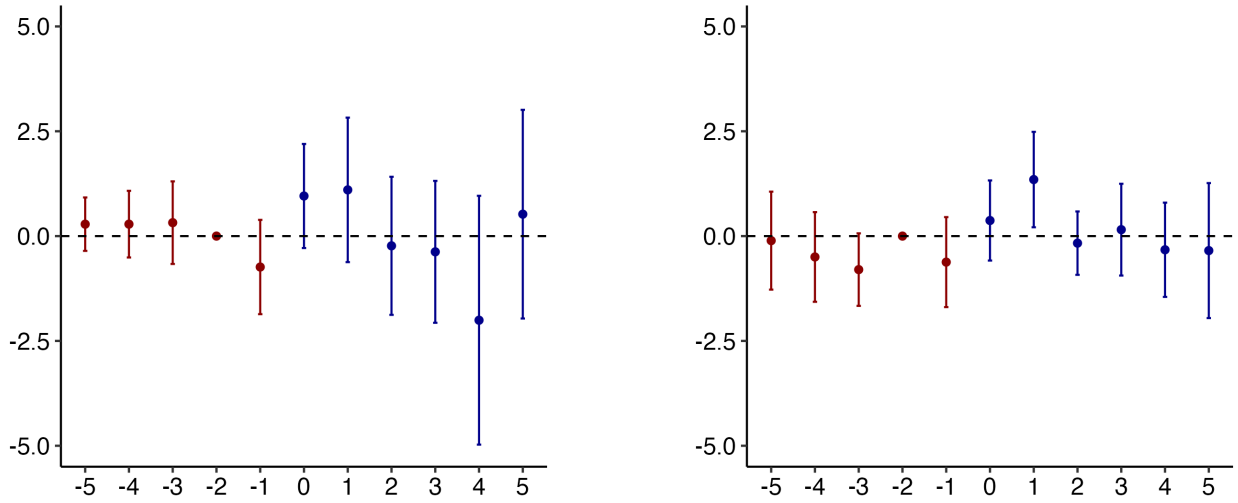
(b) 60-69

(c) 70-79

(d) 80-90

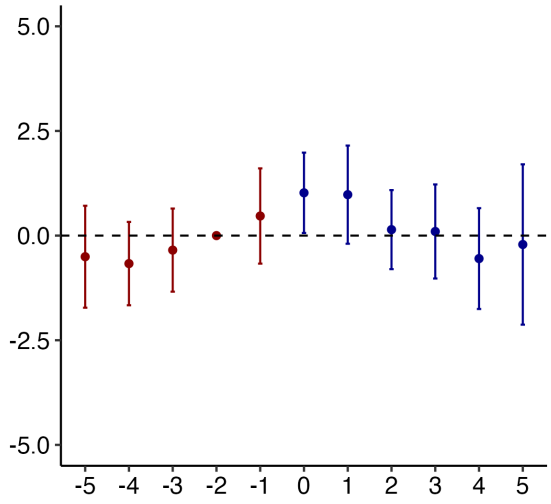
Figure 3: Event study estimates of spousal loss for the EURO-D score by age group for men

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score for men by age group in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is the total score of depressive symptoms and defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

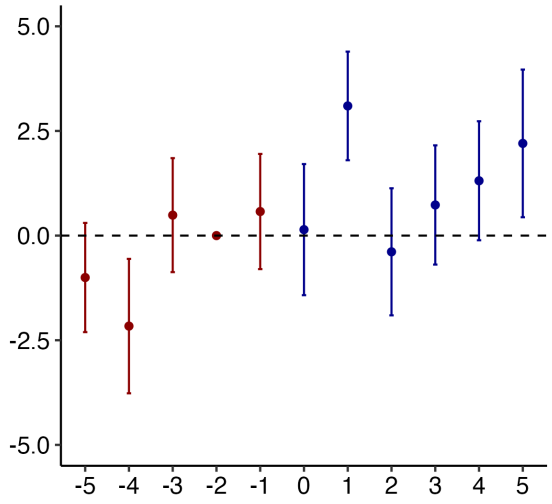


(a) 50-59

(b) 60-69



(c) 70-79



(d) 80-90

Figure 4: Event study estimates of spousal loss for the EURO-D score by age group for women

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score for women by age group in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is the total score of depressive symptoms and defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

women aged 60-69 to over 2.5 additional symptoms for women aged 80-90. The results for the risk of depression are qualitatively similar (see Appendix Figs. A6 and A7).

4.4 Individual effect heterogeneity

We further consider income and family composition as potential sources of effect heterogeneity. The death of a partner can result in both short-term costs (e.g., medical expenditures in the last weeks of life or expenditures for the funeral) and reduce the financial resources of the household in the long term, which can substantially affect the quality of life of the surviving spouse (Streeter 2020). It is plausible that individuals in high-income households are less affected by such changes, since accumulated wealth might allow the surviving partner to maintain their standard of life despite the decrease in household income.[6] We therefore re-estimate our event study separately for individuals in low-, medium- and high-income households. We split the sample by individuals within the 33rd percentile (low income) or from the 34th to 66th percentile (middle income) or above the 66th percentile (high income) based on the household income observed in our reference period (t-2) or the nearest observation to the reference period. Figs. A8 and A9 do not show a clear pattern: While the effects for medium-income households appear to be slightly larger than those for low-income households, estimates for low- and high-income households appear very similar.

We also consider effect heterogeneity based on the number of children and grandchildren. Individuals with larger families likely have more frequent social contacts, which might mitigate the negative impact of the death of their partner on their mental health. While estimates for individuals with at most 2 children appear to be slightly larger than estimates for individuals with 3 or more children, the difference is relatively small and there is substantial uncertainty around all estimates (see Appendix Figs. A10 and A11). For grandchildren, we find that the increase in depressive symptoms in year t is smaller (and not statistically significant) for individuals with 4 more grandchildren compared to those with at maximum 3 grandchildren (Appendix

[6]For example, individuals who do not own their home might need to relocate if they cannot afford their rent on a single income, whereas homeowners can continue to live in their familiar environment.

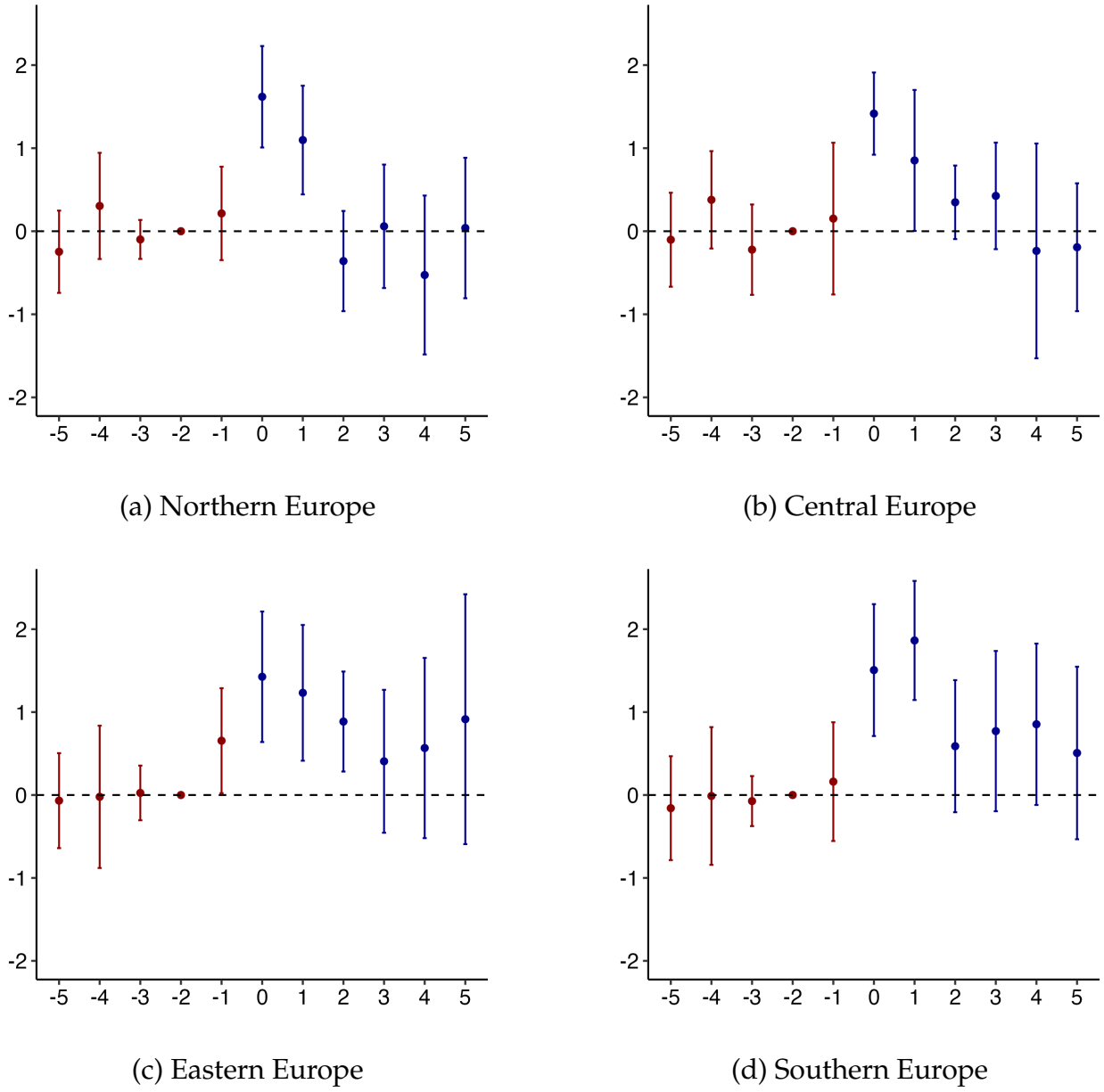
Figs. A12 and A13). However, effects in year *t+1* are very similar, which suggests that the difference in year *t* might be a statistical artifact.

4.5 Country-level heterogeneity

An important advantage of the SHARE study is that it allows us to examine whether the effects of widowhood differ across institutional settings. First, we consider heterogeneity across geographical areas. We split our sample into four groups: Northern Europe (Finland, Denmark, Sweden), Central Europe (France, Germany, Austria, Belgium, Switzerland, the Netherlands, Luxembourg), Eastern Europe (Slovenia, Poland, Estonia, Lithuania, Hungary, Czech Republic, Slovakia, Croatia, Bulgaria, Latvia and Romania), and Southern Europe (Italy, Spain, Malta, Greece, Israel, Cyprus, Portugal), and we re-estimate our preferred event study specification for each country group. The results show very similar patterns for all groups in Fig. 5. We note a prolonged impact of bereavement on mental health in Eastern Europe, where the effect remains significant in year *t+2*. Appendix Fig. A14 shows similar pattern for the risk of depression outcome.

Next, we group countries based on the strength of their family ties into a group with weak and a group with strong family ties (Italy, Spain, Poland, Slovenia and Romania) based on Alesina and Giuliano (2010). On the one hand, social support from family members might help bereaved individuals to cope with their loss. On the other hand, it is also possible that the loss of a partner (and rupture of the family) might have a stronger impact on well-being and mental health in settings where the family is an important provider of help and support. Fig. 6 below suggest that the initial impact on depressive symptoms might be stronger and individuals adapt less quickly in countries with strong family ties — we note marginally significant ($p¡0.1$) increases in depressive symptoms even at *t+3* and *t+5*. For the risk of depression (Fig. A15) we observe no differences.

Finally, we consider heterogeneity based on the generosity of survivors' pensions. Survivors' pensions are designed to mitigate the financial impact of the loss of a spouse or parent, and we therefore expect that the impact of widowhood on mental health



(a) Northern Europe

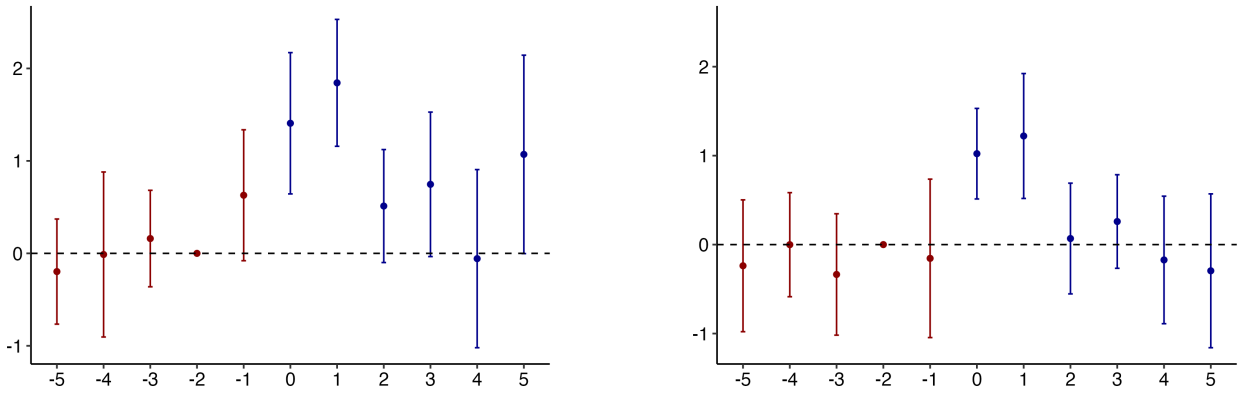
(b) Central Europe

(c) Eastern Europe

(d) Southern Europe

Figure 5: Heterogeneity: Event study estimates of spousal loss for the EURO-D score by geographic region

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score by geographic region in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. Countries are grouped into four geographic regions: Northern Europe (Finland, Denmark, Sweden), Central Europe (France, Germany, Austria, Belgium, Switzerland, the Netherlands, Luxembourg), Eastern Europe (Slovenia, Poland, Estonia, Lithuania, Hungary, Czech Republic, Slovakia, Croatia, Bulgaria, Latvia, Romania), and Southern Europe (Italy, Spain, Malta, Greece, Israel, Cyprus, Portugal). The outcome variable EURO-D score is the total score of depressive symptoms and defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals. Source: SHARE v9, own calculations.



(a) High Family Ties

(b) Low Family Ties

Figure 6: Heterogeneity: Event study estimates of spousal loss for the EURO-D score by family ties

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score by family ties in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. Countries with strong family ties include Italy, Spain, Poland, Slovenia and Romania. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

might be less pronounced in countries with more generous survivors' pensions.[7] Our estimates, however, show little differences between both groups (Appendix Figs. A16-A17). Although the initial impact of widowhood might be stronger in countries with less generous pensions, the difference appears to be fairly small and due to the substantial uncertainty around our estimates we cannot conclude that survivors' pensions play a role in mitigating the impact of widowhood.

In summary, our analyses of heterogeneity suggest that the impact of spousal loss on depression is stronger in Eastern Europe as well as for individuals in countries with strong family ties. However, given the substantial uncertainty around our estimates it is difficult to draw definitive conclusions.

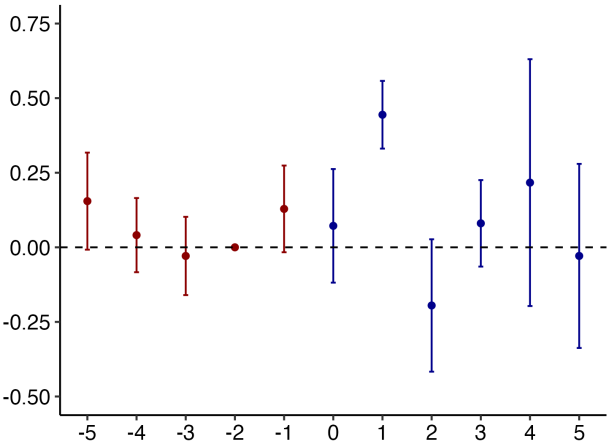
[7]Countries with less generous survivor pension schemes are Sweden, Finland, Denmark, the Netherlands, Spain, France, Lithuania, Latvia and Czech Republic. In these countries the survivor is entitled to a compensation which is below or at maximum 60% of the old-age pension for which the deceased spouse would have been eligible. In the Netherlands the survivor pension is a flat-rate benefit. See European Commission (2025) for more details.

4.6 The role of informal care provision

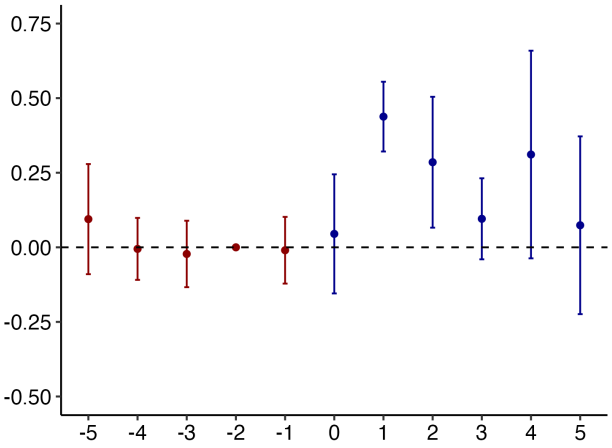
Spouses are one of the most important providers of informal care for older adults (Eibich 2023) and informal care provision can negatively affect the mental health of the caregiver (Schmitz and Westphal 2015; Bom and Stöckel 2020). If individuals provide care for their sick spouse and the care episode ends with their death, then the potential mental health effect of care provision might bias our estimates of the consequences of spousal loss. We therefore examine patterns of informal care provision around the transition to widowhood. Fig. A18 shows estimates from an event study regression, where the outcome measures whether individuals provided help to anyone in the last 12 months. We find no changes before or after the death of the spouse. This finding is in contrast to Siflinger (2017), who argues that caregiving imposes a substantial burden in the years preceding bereavement.

4.7 Potential mechanisms for adaptation

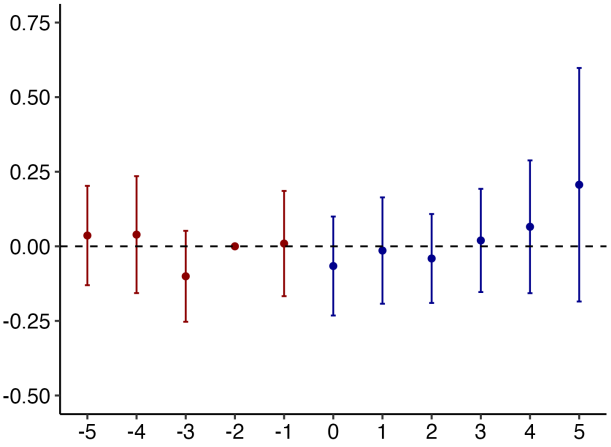
Finally, we consider several mechanisms that might explain the adaptation effects we observe in Fig. 7. Panel (a) shows an event study of participation in clubs, Panel (b) shows an event study of voluntary work provision around the transition to widowhood, and Panel (c) shows estimates for recreational activities. For club activities and volunteering, we find suggestive evidence that individuals are more likely to engage in such activities after the loss of their spouse. Since both social participation (Wilding et al. 2023) and volunteering (Mosca and Wright 2017) are linked to better mental health, it appears plausible that these activities might explain part of the adaptation to widowhood observed in our event study. We find no significant changes in recreational activities.



(a) Participation in club activities



(b) Volunteering



(c) Recreational activities

Figure 7: Mechanism: Event study estimates of spousal loss

Notes: The figure shows potential mechanisms through which the effect of spousal loss (occurring at j=0) on mental health. Club activities in Panel (a) include sports, social or any other clubs. The measure of recreational activities in Panel (c) includes (i) participation in education or training courses, (ii) playing cards or chess, (iii) reading, or (iv) solving crosswords, puzzles or Sudokus. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

5 Robustness

5.1 Alternative estimators

Appendix Fig. A19 show estimates from several alternative event study estimators. Panel (a) shows estimates from a standard two-way fixed effects regression. The results are qualitatively similar to those from our preferred specification — we find a small anticipation effect one year before the transition to widowhood, followed by a large increase in the risk of depression after the loss of a spouse. In contrast to the estimates from our CS estimator, the TWFE estimates show a considerably slower adaptation. Panel (b) shows estimates using the event study estimator proposed by Sun and Abraham (2021). We see no anticipation effect in the years prior to the event. The results are similar in terms of magnitude to our baseline results which follow the Callaway and Sant'Anna (2021) method. The adaptation occurs from the second year after the event and, by the fourth year, depression levels have reverted back to baseline. Similar results are also found using the estimators proposed by Borusyak et al. (2024) in Panel (c) and De Chaisemartin and d'Haultfoeuille (2020) in Panel (d). The analysis for the risk of depression with alternative methods in Appendix Fig. A20 is similarly robust.

5.2 Alternative outcomes

Similar to other self-reported measures, the EURO-D scale is susceptible to possible biases. For example, recall bias might lead to an overestimate of the speed of adaptation, or hedonic adaptation would imply that we underestimate the initial impact of the event or overestimate the extent of adaptation. To address such concerns, we explore an alternative outcome that should be less affected by such concerns. Appendix Fig. A21 shows event study estimates for the probability of using drugs against anxiety. We note a significant increase in the use of anxiety drugs for both men and women up to 2 years after the event. We also examine whether any particular item of the EURO-D score is driving our results. We find that our baseline results are primarily driven by an increase in tearfulness and fatigue (see Appendix Fig. A22 for the event study estimates for these

outcomes).

5.3 Alternative control group

We consider an alternative event study design, which uses individuals that do not lose their partner as an alternative control group. An event study based on such a "hybrid" data structure (Miller 2023) uses two sources of variation for identification — the comparison of widowed individuals to those who do not lose their partner (similar to a DID design), and the comparison of individuals who lose their partner earlier to those who lose their partner later. In contrast, our preferred specification only relies on variation in the timing of widowhood. The results (Appendix Fig. A23) are similar to those from our preferred specification, with one exception — we observe a significant increase in depressive symptoms four years after the event.

5.4 Selective mortality

If the loss of a partner increases mortality risk, we might underestimate the effect of widowhood on mental health — it seems plausible that individuals whose mental health is affected strongly by the death of their spouse might also be those who face an elevated mortality risk, while less affected individuals probably fare better both in terms of their mental health and their mortality risk. We cannot address selective mortality in the short-term, because we do not observe individuals if they die shortly after their spouse and before taking part in another wave of SHARE. In the long-term, selective mortality implies that we are more likely to observe individuals in the first few years after the death of their spouse than in later years. While the distribution of event time in Appendix Fig. A1 shows that the number of observations decreases with event time, the same is true for years before the event. The distribution appears to be fairly symmetric, which suggests that the decrease in the number of observation might simply reflect panel attrition rather than selective mortality. We observe the deaths of 912 out of 6,739 individuals (13.5%) of our working sample. Of these, approximately half die in the first 4 years after the death of their spouse. We examine whether this represents an unusual

rate of mortality by comparing the number of deaths observed in our working sample to those observed in the overall SHARE study population. We estimate a propensity score matching model using an indicator of sample membership (included in our working sample vs. not included) as the treatment variable and a binary indicator for respondents that have died as the outcome variable. We match on age, years of education, limitations in activities of daily living (ADLs) and in instrumental activities of daily living, the number of self-reported chronic diseases (cancer, stroke, diabetes, arthritis, hypertension, heart and lung disease) and income, with exact matching on years of education, age and ADLs. The results shown in Table A2 suggest that there are no significant differences in mortality rates between men included in our sample and men who are not part of our working sample. Women included in our sample are significantly less likely to die than women that are not part of our sample, i.e., the women in our working sample appear to be positively selected on mortality risk. Taken together, we argue that selective mortality is unlikely to bias our findings.

5.5 Other robustness checks

We conduct two additional robustness check: First, we exclude SHARE wave 9 (collected in 2021/22) from our working sample to ensure that our results are not driven by deaths that occurred during the COVID-19 pandemic. Appendix Fig. A24 shows that the exclusion of these observations does not affect our results. Second, we exclude individuals whose partner had been ill for more than a year before their death (2,485 individuals). Anticipation effects are more likely for deaths that occur following a long period of illness, and we expect that individuals whose partner died after a long period of illness were more likely involved in caregiving. Consequently, we expect that our results for deaths that occur unexpectedly or after a short period of illness should be less affected by potential bias from anticipation or caregiving effects. The results in Appendix Fig. A25 are qualitatively very similar to our main findings with slightly larger point estimates.

6 Discussion

This paper examines the causal effect of spousal loss on the mental health of the surviving spouse. We use data from 28 different European countries participating in the SHARE study. We address the endogeneity of mortality risks by focusing only on individuals for whom we observe the transition into widowhood in our data in an event study. Our regressions estimate the dynamic effects of widowhood on mental health by using individuals who lost their spouse later as a control group for those who lost their spouse earlier in the panel under the assumption that the exact timing of spousal death is random. Our results suggest that losing a spouse has a strong impact on mental health — bereaved individuals report up to 1.5 additional depressive symptoms (an increase by 0.6 SD), and they experience an increase in the risk of depression by around 20 percentage points. These effects are several magnitudes larger than, e.g., the associations between divorce and depression (Zulkarnain and Korenman 2019), which highlights the importance of bereavement as a determinant of depression.[8] However, widows and widowers tend to adapt relatively fast – depressive symptoms and the risk of depression return to baseline levels within 3 years of the loss. Similar to Schaan (2013) but in contrast to most economic studies (e.g., Espinosa and Evans 2008; Siflinger 2017; Streeter 2020), we find no significant differences between men and women, neither in the initial impact of widowhood nor in the adaptation process. However, we do find some evidence of heterogeneity — those living in Eastern Europe and individuals in countries with strong family ties appear to adapt less quickly to the loss. Our results further suggest that informal care provision is unlikely to influence our results. We find that widows and widowers are more likely to participate in club activities and they engage more frequently in voluntary work, and the positive impacts of these activities on mental health might consequently explain part of the adaptation process. There are some important limitations we need to acknowledge. First, the standard errors of our estimates indicate substantial uncertainty, likely due to the limited number of events we

[8] Zulkarnain and Korenman (2019) find that in the US divorce is associated with an increase in the risk of depression by around 4-5 percentage points for women.

observe. It is therefore possible that we might miss smaller differences in mental health, e.g., anticipation effects or long-term effects beyond year 3. Confidence intervals from alternative event study estimators are substantially shorter, however, it is not clear that these estimators are more appropriate. It seems plausible that the substantial uncertainty in our preferred specification simply reflects the limited sample size and substantial heterogeneity (between countries, over time and across individuals). To reduce this uncertainty, it seems more prudent to replicate our analysis on larger samples than to rely on alternative estimators. Our analysis of effect heterogeneity is likewise limited by the substantial uncertainty around our estimates. We provide suggestive evidence that family ties might play a role in shaping the impact of widowhood on mental health, however, substantially larger samples (e.g., based on administrative databases) would be required to establish whether these potential differences are statistically significant. While we considered mortality selection in the medium- and long-run and argue that it is unlikely to play a role, we cannot rule out that the loss of a spouse can affect mortality in the short-term. Such mortality selection would likely mean that we underestimate the true impact of spousal bereavement.

In summary, we find that the loss of a spouse has a substantial impact on older adults' mental health. Although most individuals adapt within a few years, policy makers should consider offering targeted support for newly widowed individuals to mitigate the risk of longer depressive episodes. There is a time to grieve the loss of our loved ones, but there should also be a time to cherish the memories of a shared lifetime.

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Appendix

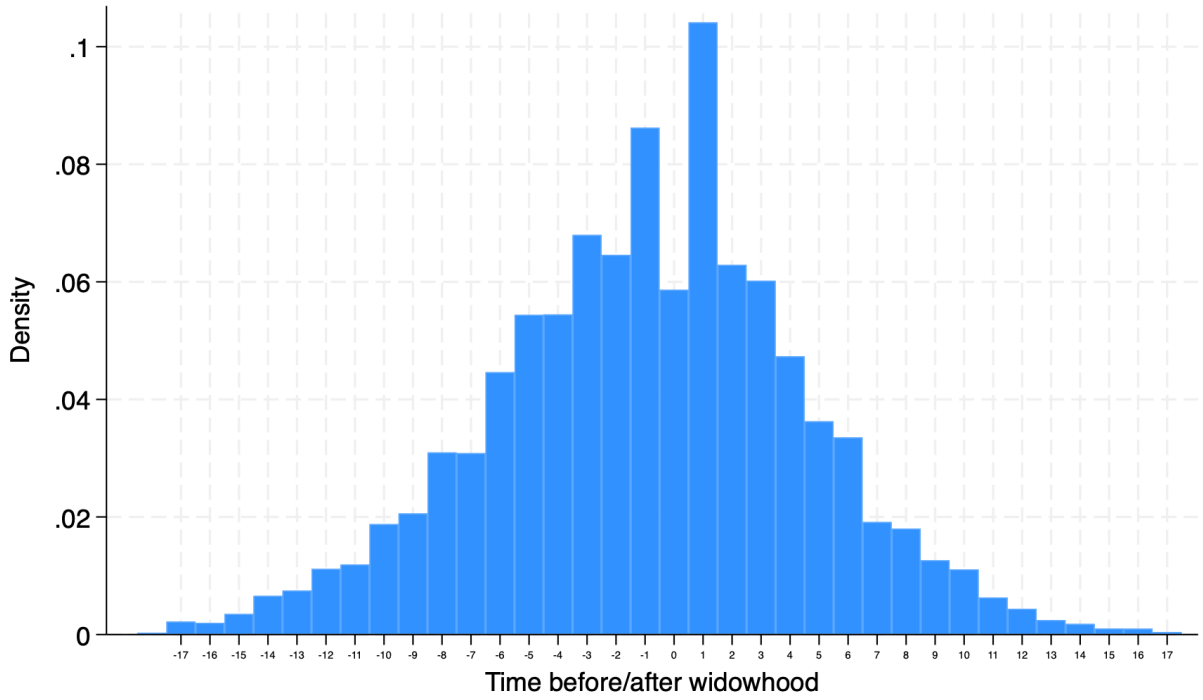


Figure A1: Distribution of years before and after the event of widowhood in the overall sample, 2004-2022

Notes: The figure plots the distribution of distance to the event of widowhood in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. Source: SHARE v9, own calculations.

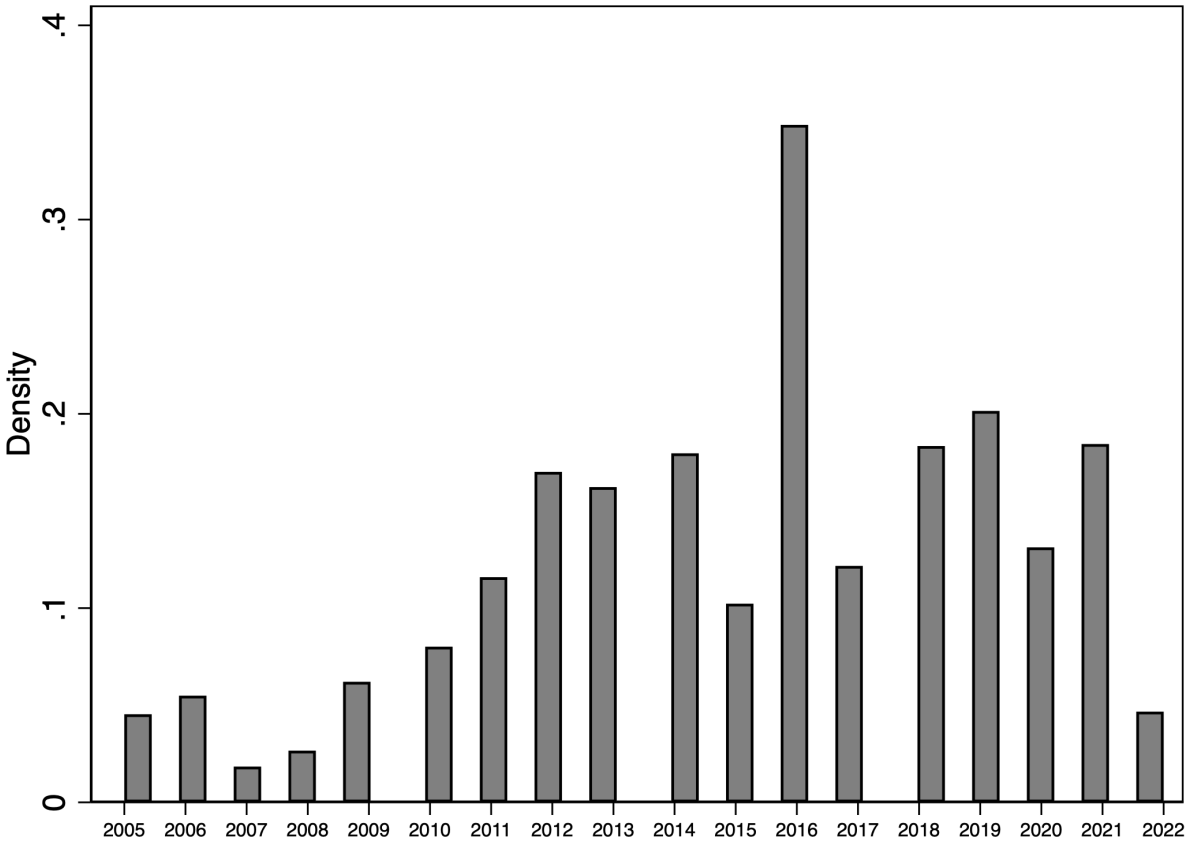


Figure A2: Distribution of calendar years in which the transition into widowhood occurred, 2004–2022

Notes: The figure shows the distribution of calendar years in which the transition into widowhood occurred in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022.
Source: SHARE v9, own calculations.

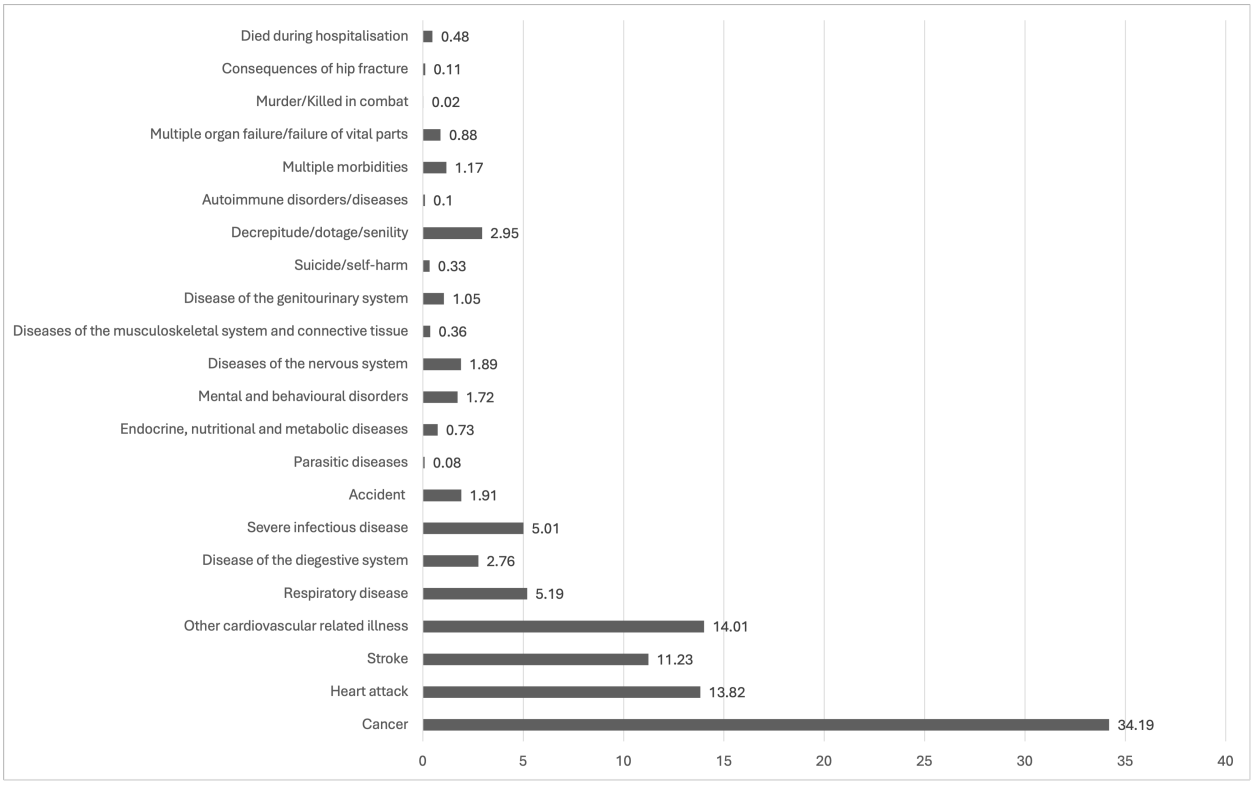


Figure A3: Distribution of causes of death in the event of widowhood, 2004-2022

Notes: The figure plots the distribution of causes of death for individuals aged between 50 and 90 who experienced widowhood in the period 2004-2022. The information on cause of death was taken from the end-of-life questionnaire in SHARE.
Source: SHARE v9, own calculations.

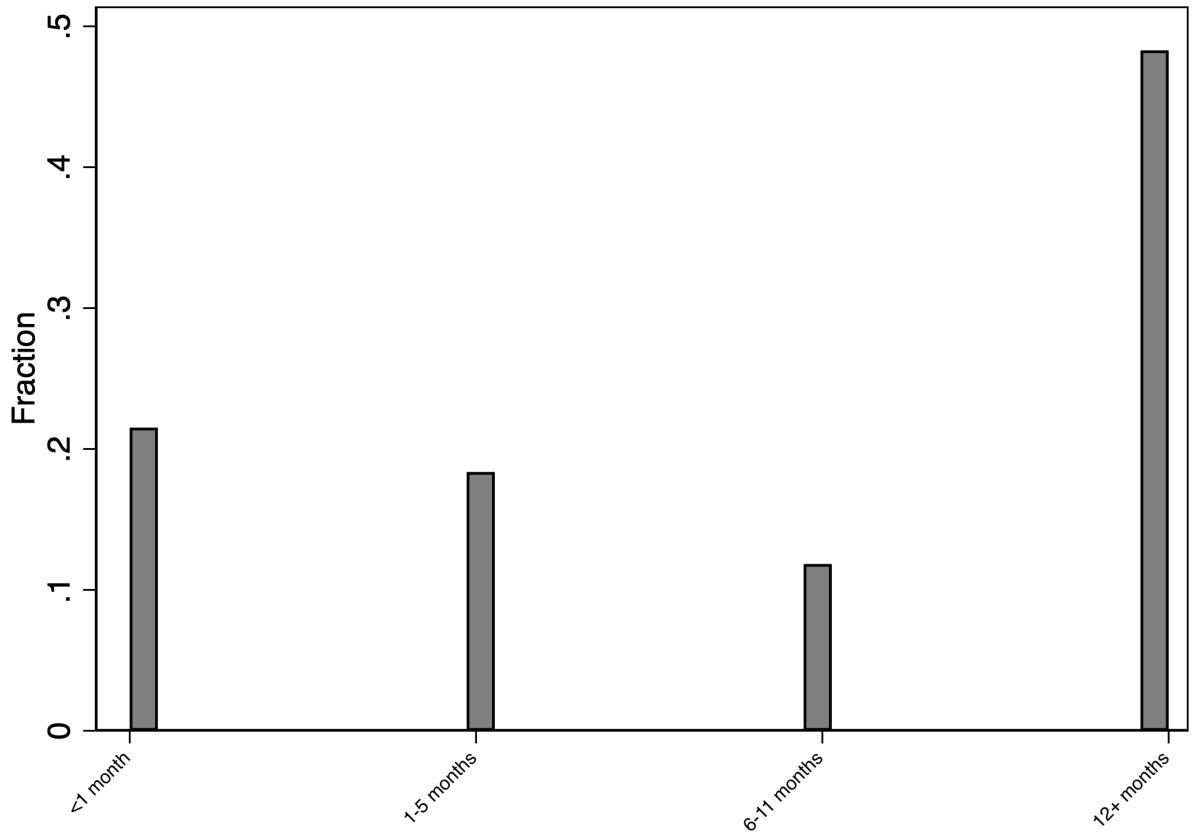
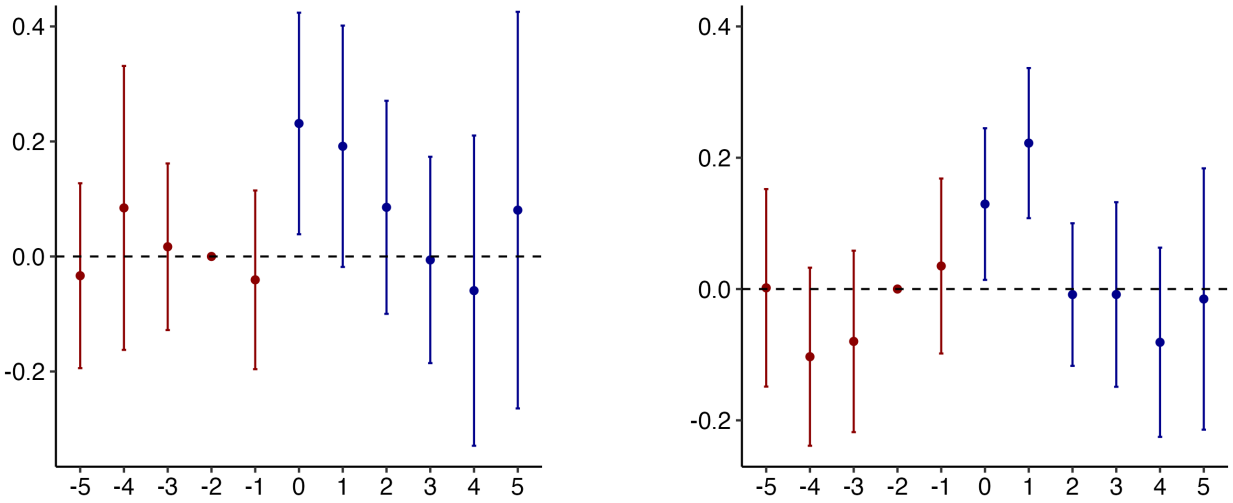


Figure A4: Distribution of the duration of a partner's illness prior to death among widowed individuals, 2004–2022

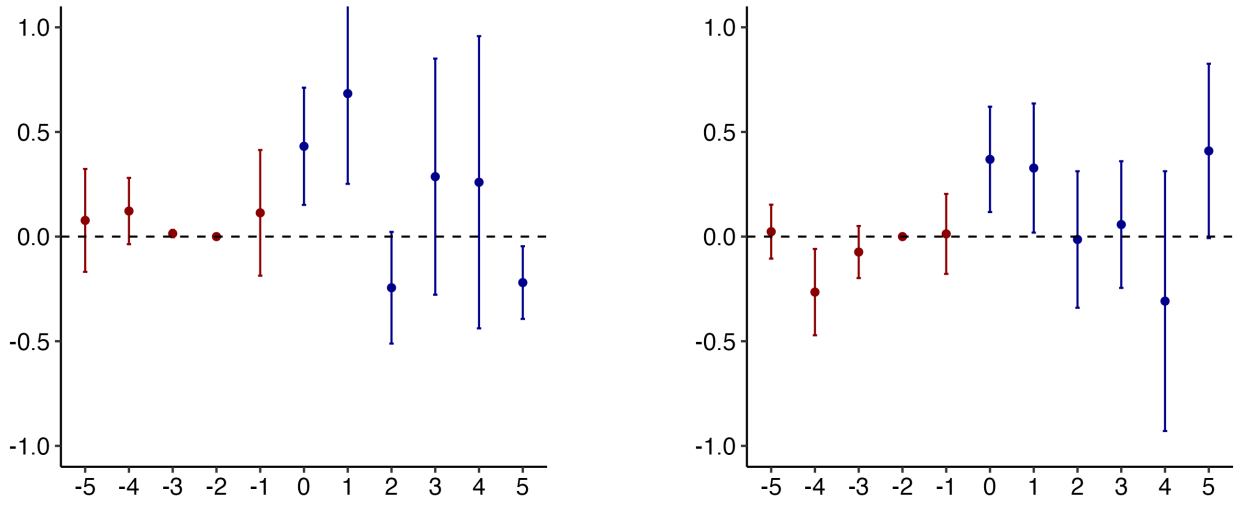
Notes: The figure plots the duration of a partner's illness prior to death among widowed individuals for our working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The information on cause of death was taken from the end-of-life questionnaire in SHARE.
Source: SHARE v9, own calculations.



(a) Men (b) Women

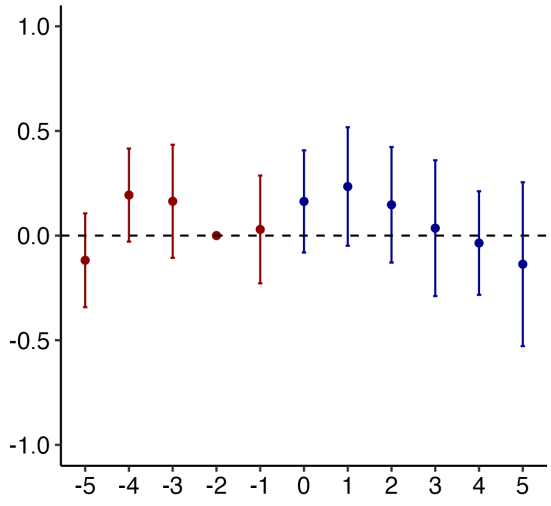
Figure A5: Event study estimates of spousal loss for the risk of depression by gender

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the risk of depression for men (Panel (a)) and women (Panel (b)) in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

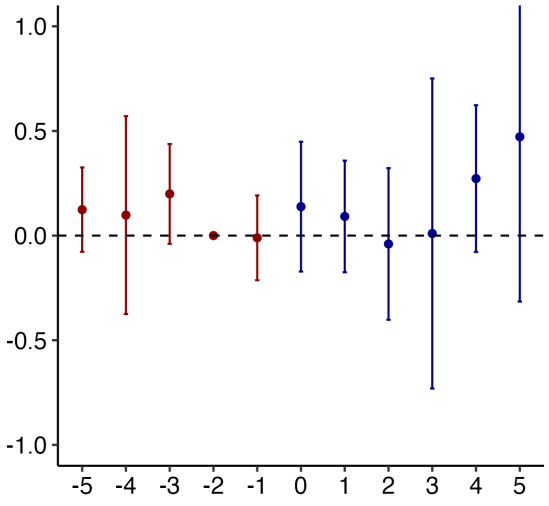


(a) 50-59

(b) 60-69



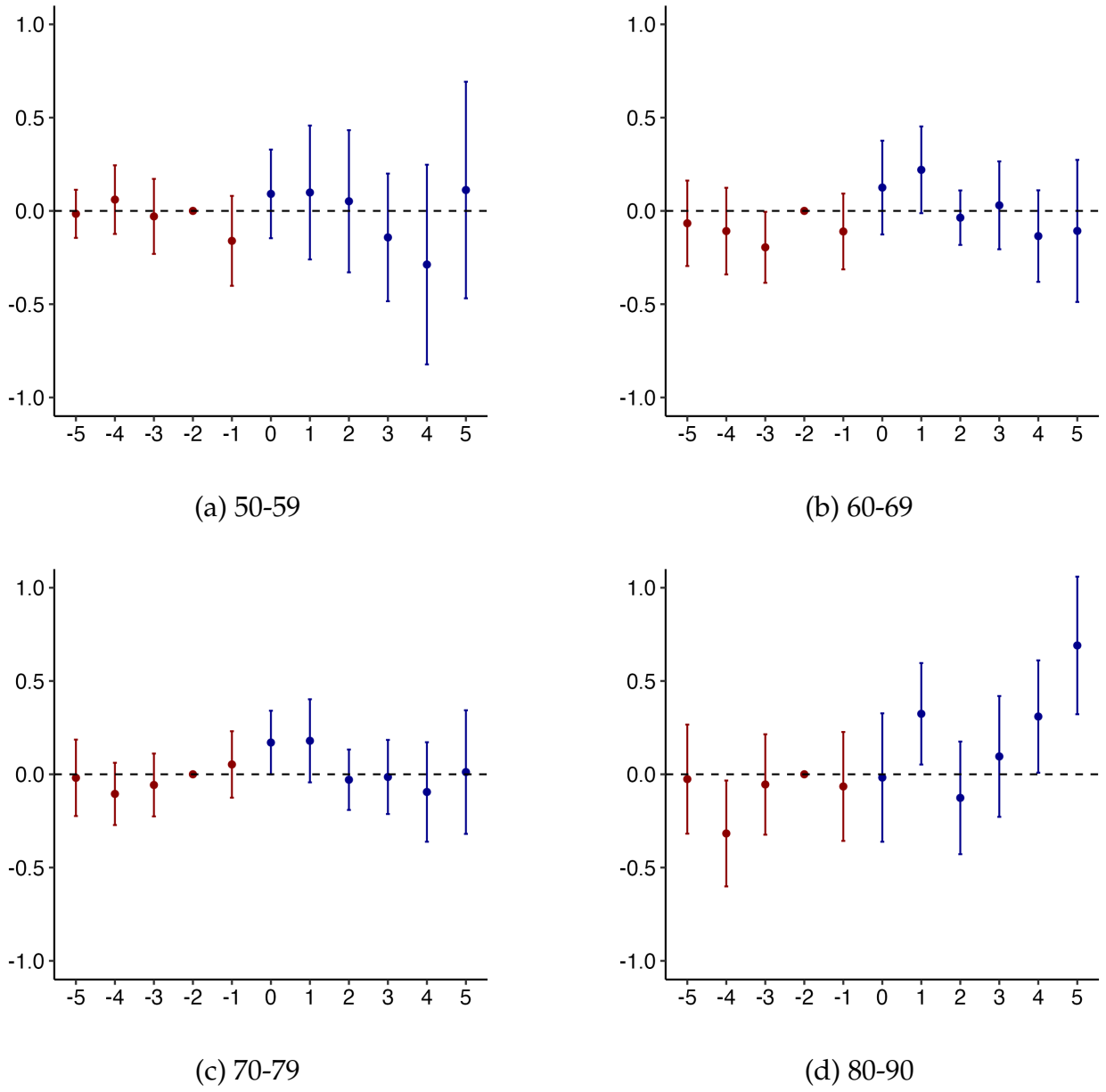
(c) 70-79



(d) 80-90

Figure A6: Event study estimates of spousal loss for the risk of depression by age group for men

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the risk of depression for men by age group in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) 50-59

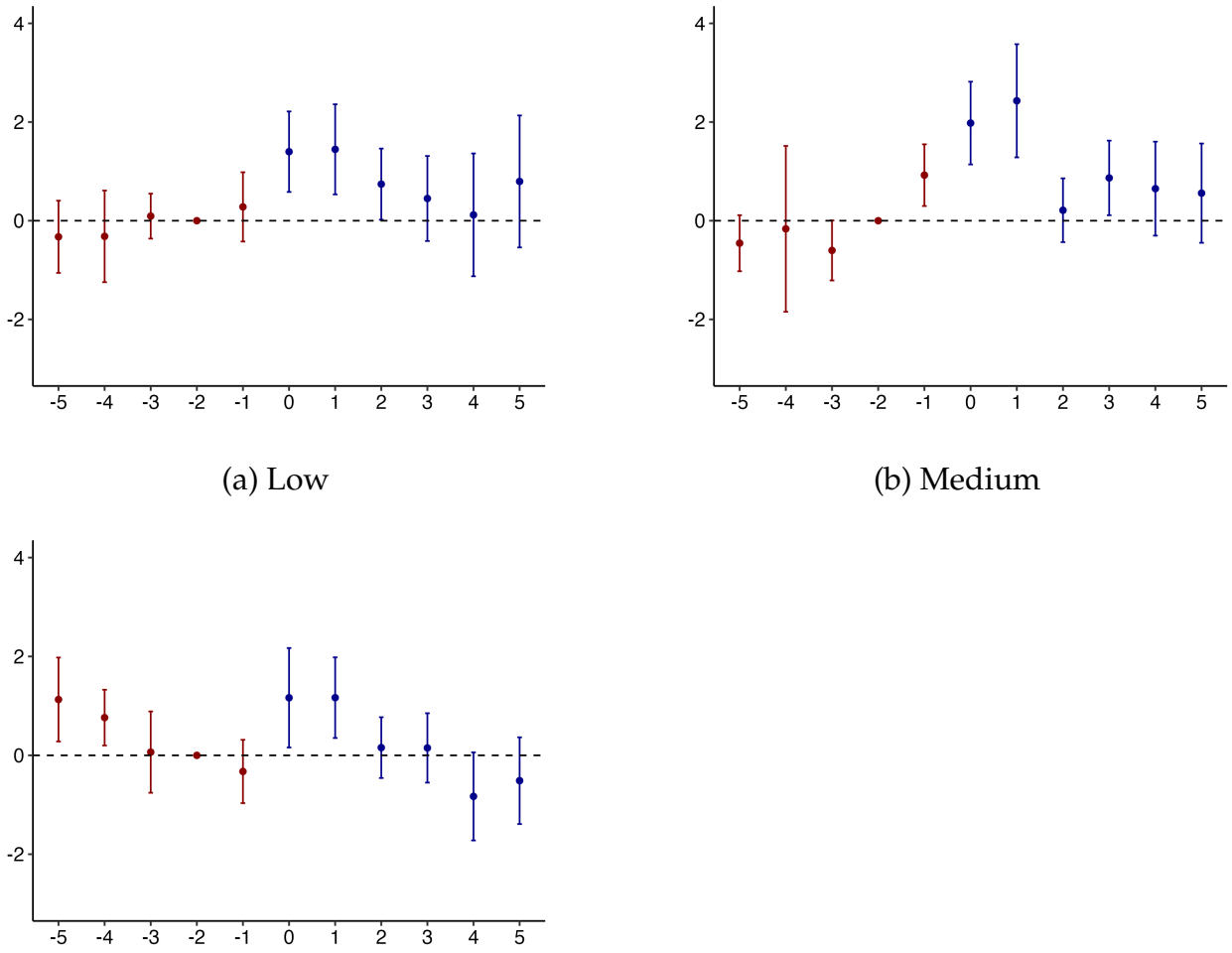
(b) 60-69

(c) 70-79

(d) 80-90

Figure A7: Event study estimates of spousal loss for the risk of depression by age group for women

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the risk of depression for women by age group in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



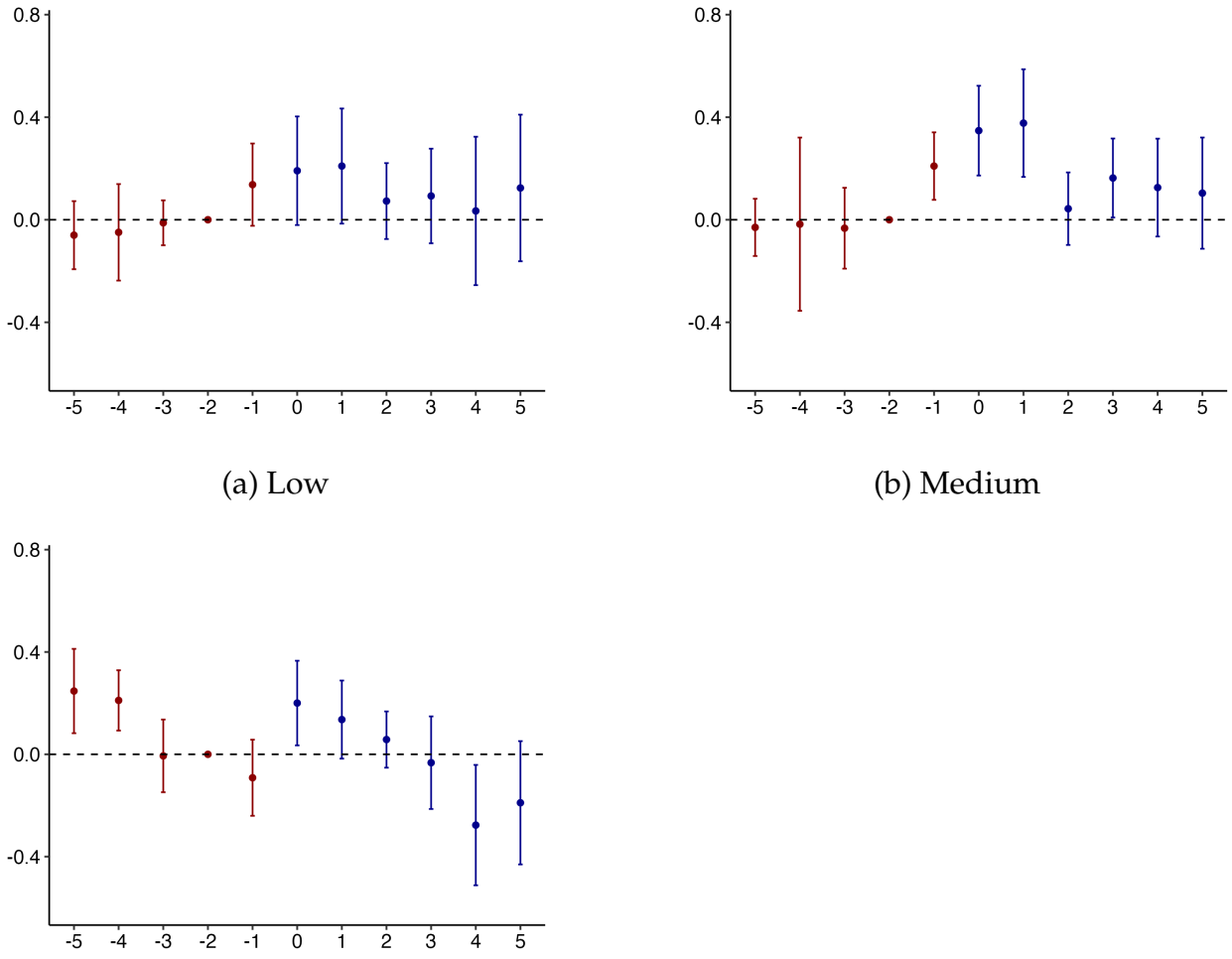
(a) Low

(b) Medium

(c) High

Figure A8: Heterogeneity: Event study estimates of spousal loss for the EURO-D score by households' pre-death income

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score by household income measured prior to the spouse's death in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. Household income is calculated by accounting for all reported sources, including labor income, pension income, annuities or private pensions, alimony, rental income, income received by other household members, interest from bank accounts or bonds, and dividends from stocks or mutual funds. Household income is grouped into low, middle, and high categories by dividing the income distribution into three equal parts, with each group representing one-third of the population. The outcome variable EURO-D score is the total score of depressive symptoms and defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



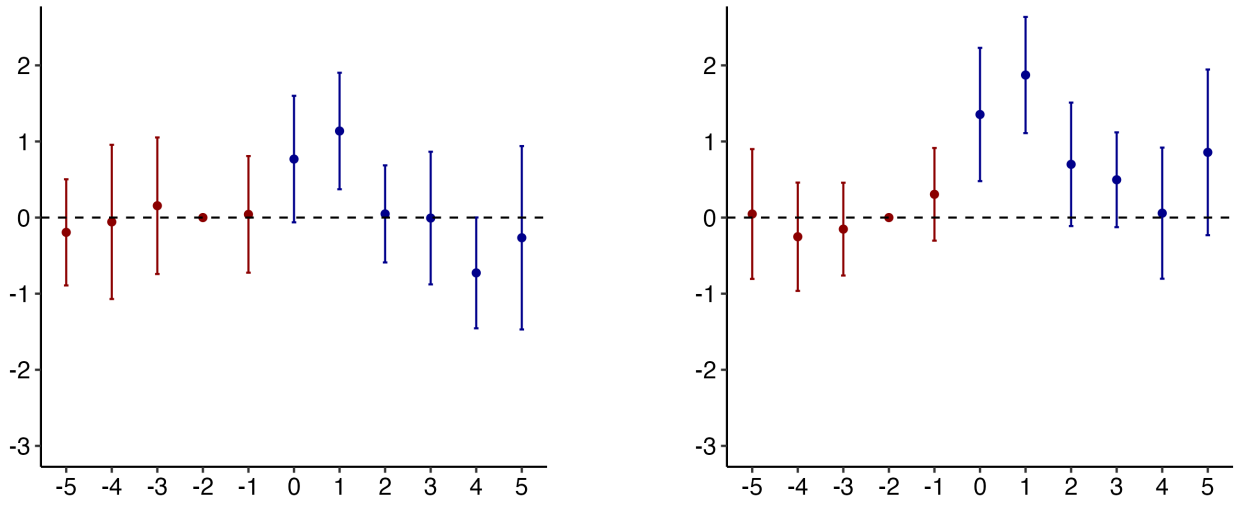
(a) Low

(b) Medium

(c) High

Figure A9: Heterogeneity: Event study estimates of spousal loss for the risk of depression by households' pre-death income

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the risk of depression by household income measured prior to the spouse's death in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. Household income is calculated by accounting for all reported sources, including labor income, pension income, annuities or private pensions, alimony, rental income, income received by other household members, interest from bank accounts or bonds, and dividends from stocks or mutual funds. Household income is grouped into low, middle, and high categories by dividing the income distribution into three equal parts, with each group representing one-third of the population. The outcome variable EURO-D indicator is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

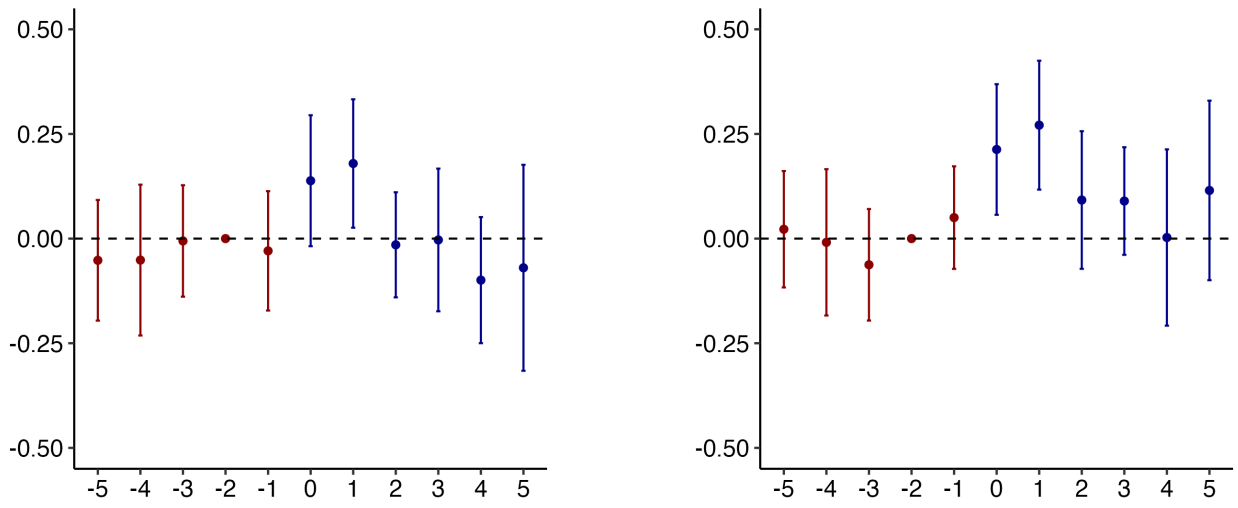


(a) >2 children

(b) ≤2 children

Figure A10: Heterogeneity: Event study estimates of spousal loss for the EURO-D score by the number of children

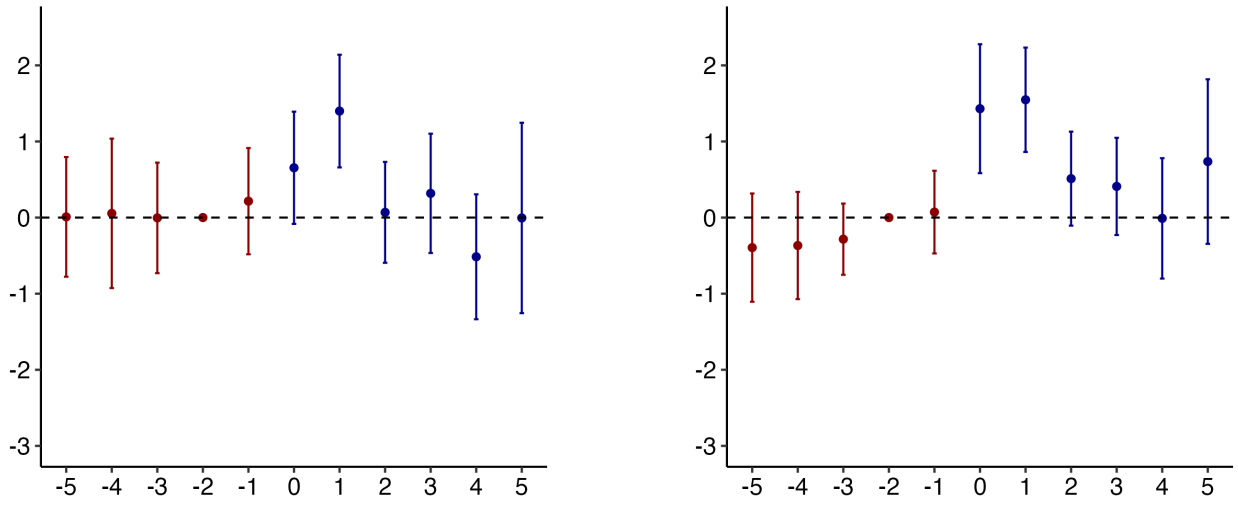
Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) >2 children (b) ≤2 children

Figure A11: Heterogeneity: Event study estimates of spousal loss for the risk of depression by the number of children

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D indicator is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

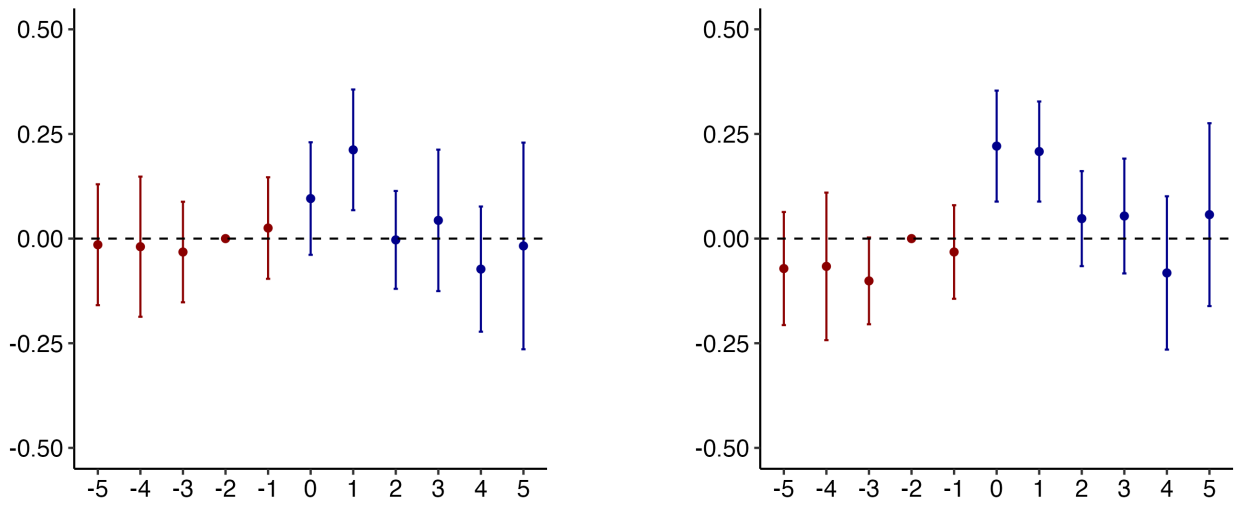


(a) >3 grandchildren

(b) ≤3 grandchildren

Figure A12: Heterogeneity: Event study estimates of spousal loss for the EURO-D score by the number of grandchildren

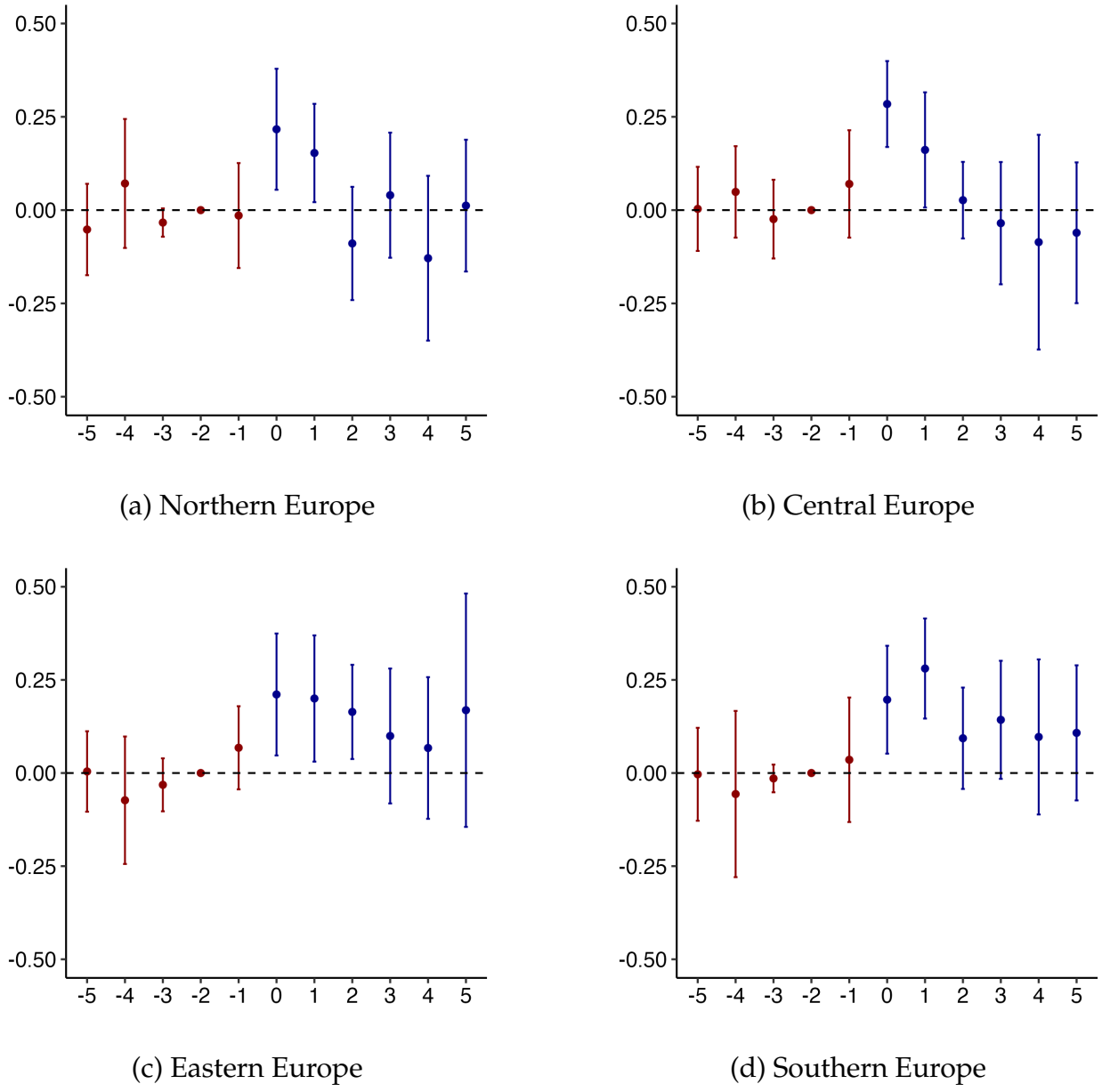
Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the the EURO-D score in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) >3 grandchildren (b) ≤3 grandchildren

Figure A13: Heterogeneity: Event study estimates of spousal loss for the risk of depression by the number of grandchildren

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the the EURO-D score in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D indicator is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) Northern Europe

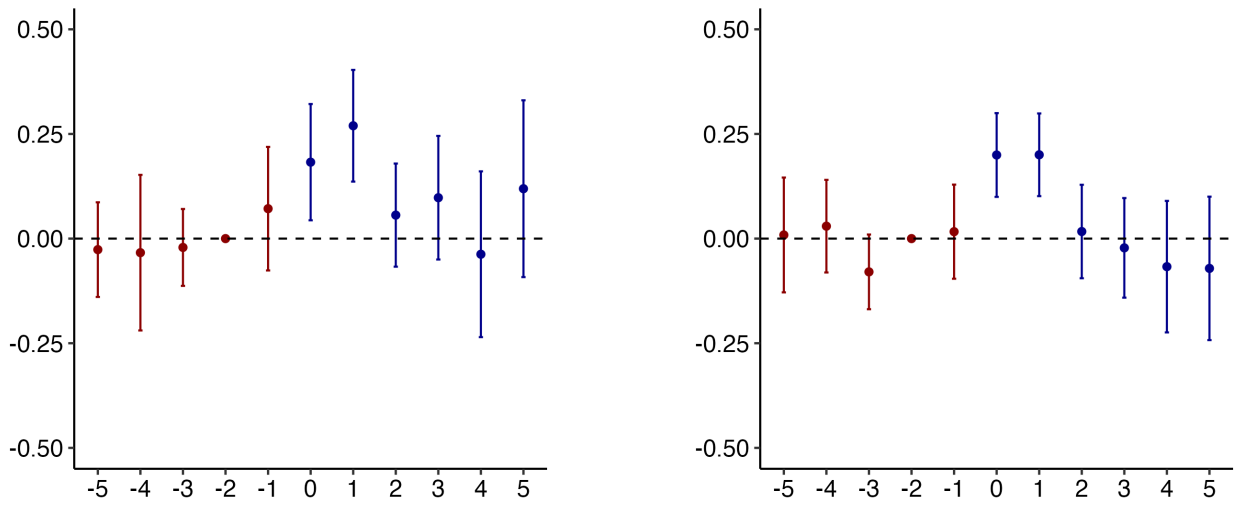
(b) Central Europe

(c) Eastern Europe

(d) Southern Europe

Figure A14: Heterogeneity: Event study estimates of spousal loss for the risk of depression by geographic region

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score by geographic region in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. Countries are grouped into four geographic regions: Northern Europe (Finland, Denmark, Sweden), Central Europe (France, Germany, Austria, Belgium, Switzerland, the Netherlands, Luxembourg), Eastern Europe (Slovenia, Poland, Estonia, Lithuania, Hungary, Czech Republic, Slovakia, Croatia, Bulgaria, Latvia, Romania), and Southern Europe (Italy, Spain, Malta, Greece, Israel, Cyprus, Portugal). The outcome variable EURO-D indicator is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

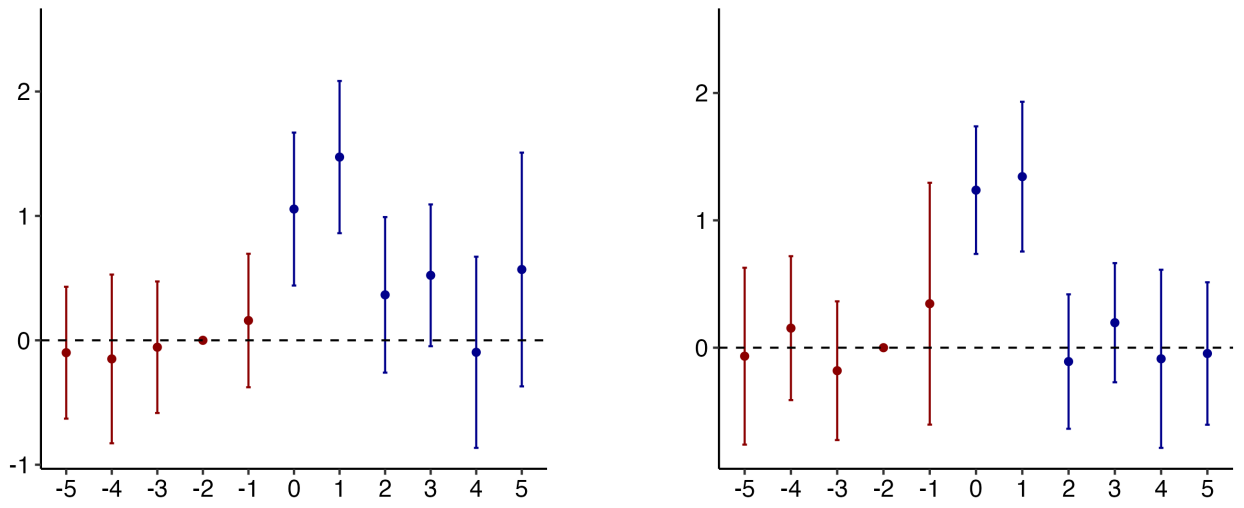


(a) High Family Ties

(b) Low Family Ties

Figure A15: Heterogeneity: Event study estimates of spousal loss for the risk of depression by family ties

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score by family ties in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D indicator is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. Countries with strong family ties include Italy, Spain, Poland, Slovenia and Romania. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

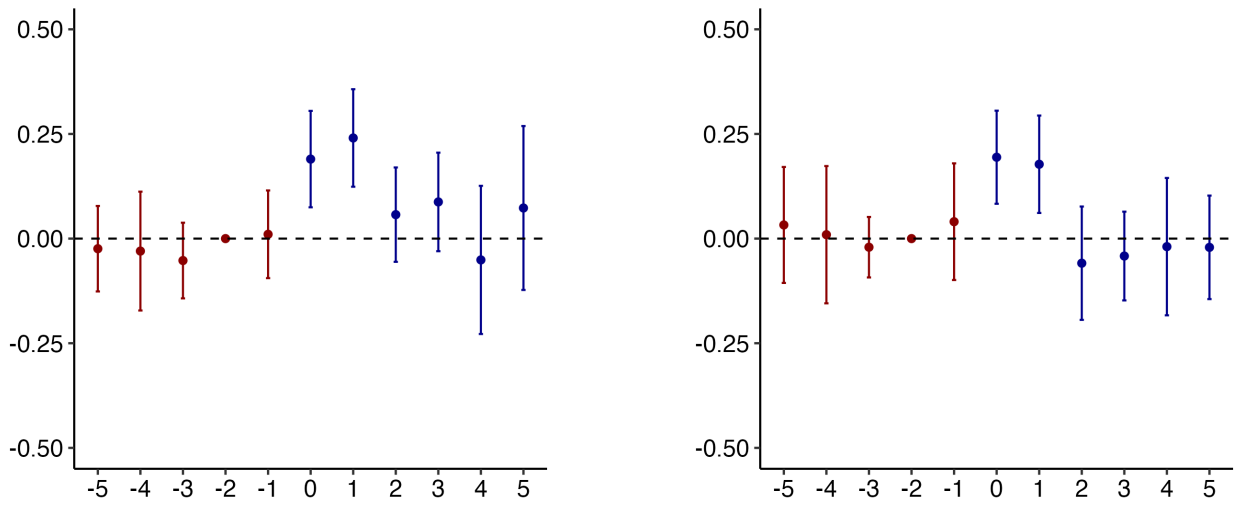


(a) High Survivor Benefits

(b) Low Survivor Benefits

Figure A16: Heterogeneity: Event study estimates of spousal loss for the EURO-D score by survivor scheme generosity

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score by survivor scheme generosity in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. Country with more generous survivor pension schemes are Sweden, Finland, Denmark, the Netherlands, Spain, France, Lithuania, Latvia and Czech Republic. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) High Survivor Benefits

(b) Low Survivor Benefits

Figure A17: Heterogeneity: Event study estimates of spousal loss for the risk of depression by survivor scheme generosity

Notes: The figure shows the heterogeneity of event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score by survivor scheme generosity in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. Country with more generous survivor pension schemes are Sweden, Finland, Denmark, the Netherlands, Spain, France, Lithuania, Latvia and Czech Republic. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

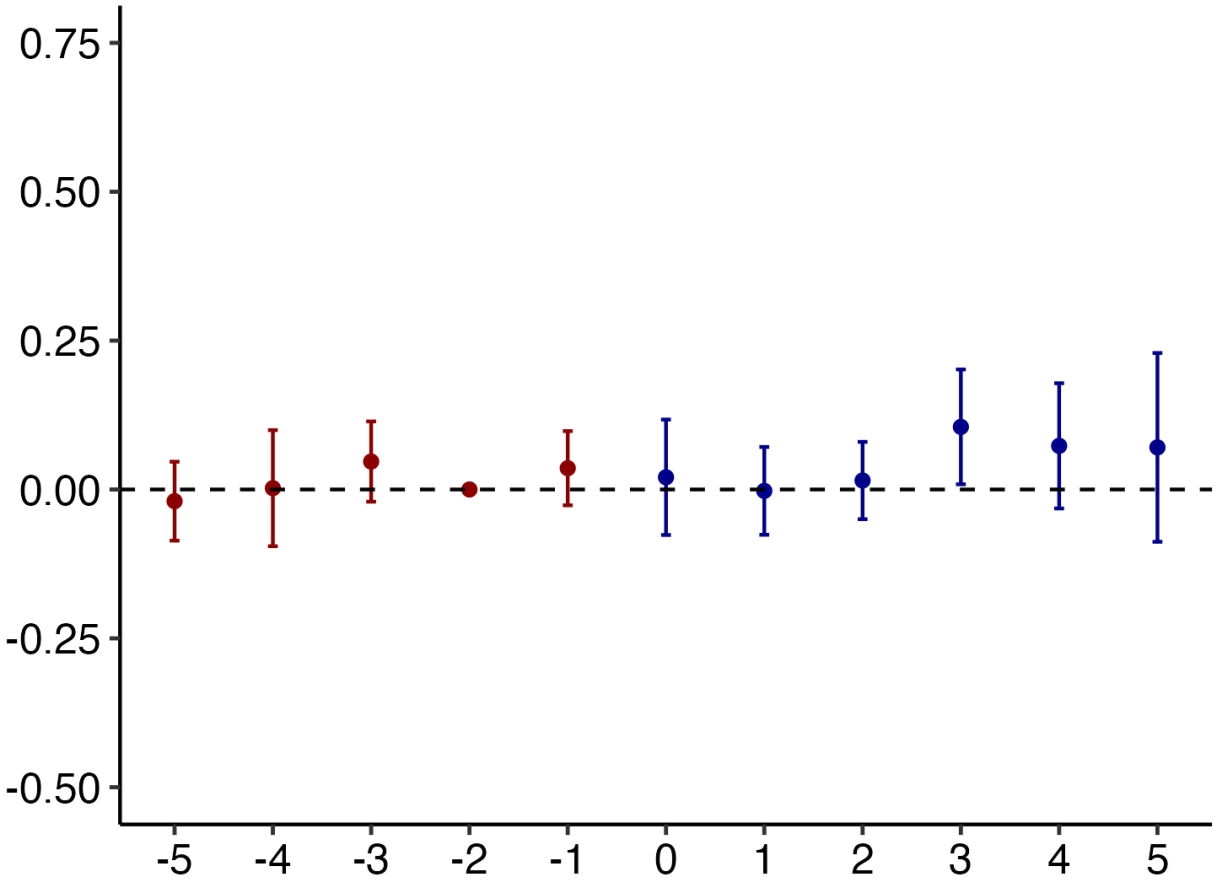
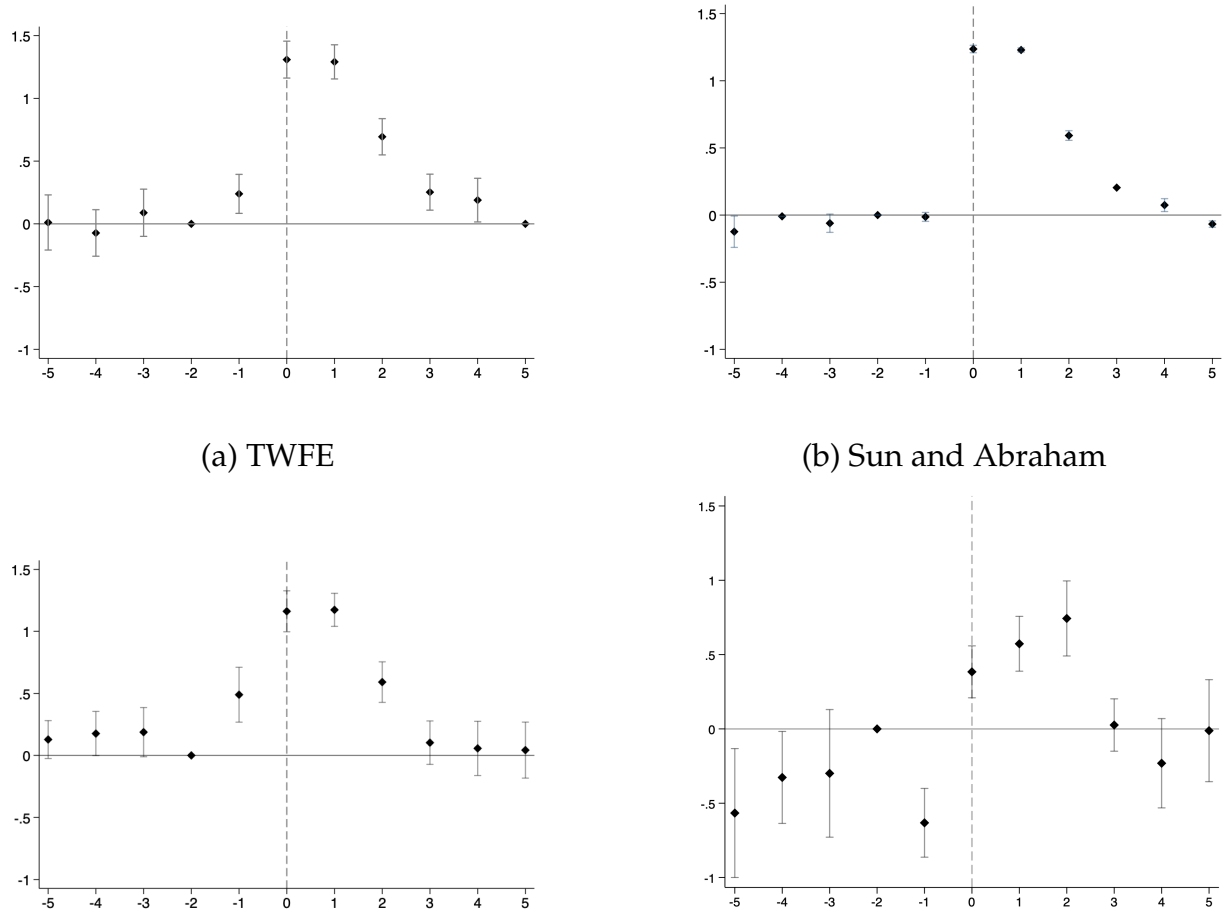


Figure A18: Event study estimates of spousal loss for informal care provision

Notes: The figure shows event study estimates of the effect of spousal loss (occurring at j=0) on the probability to provide informal care. Informal care provision is measured based on a question whether respondents provided unpaid help to anyone in the past 12 months. All estimates are derived using the Callaway-Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) TWFE

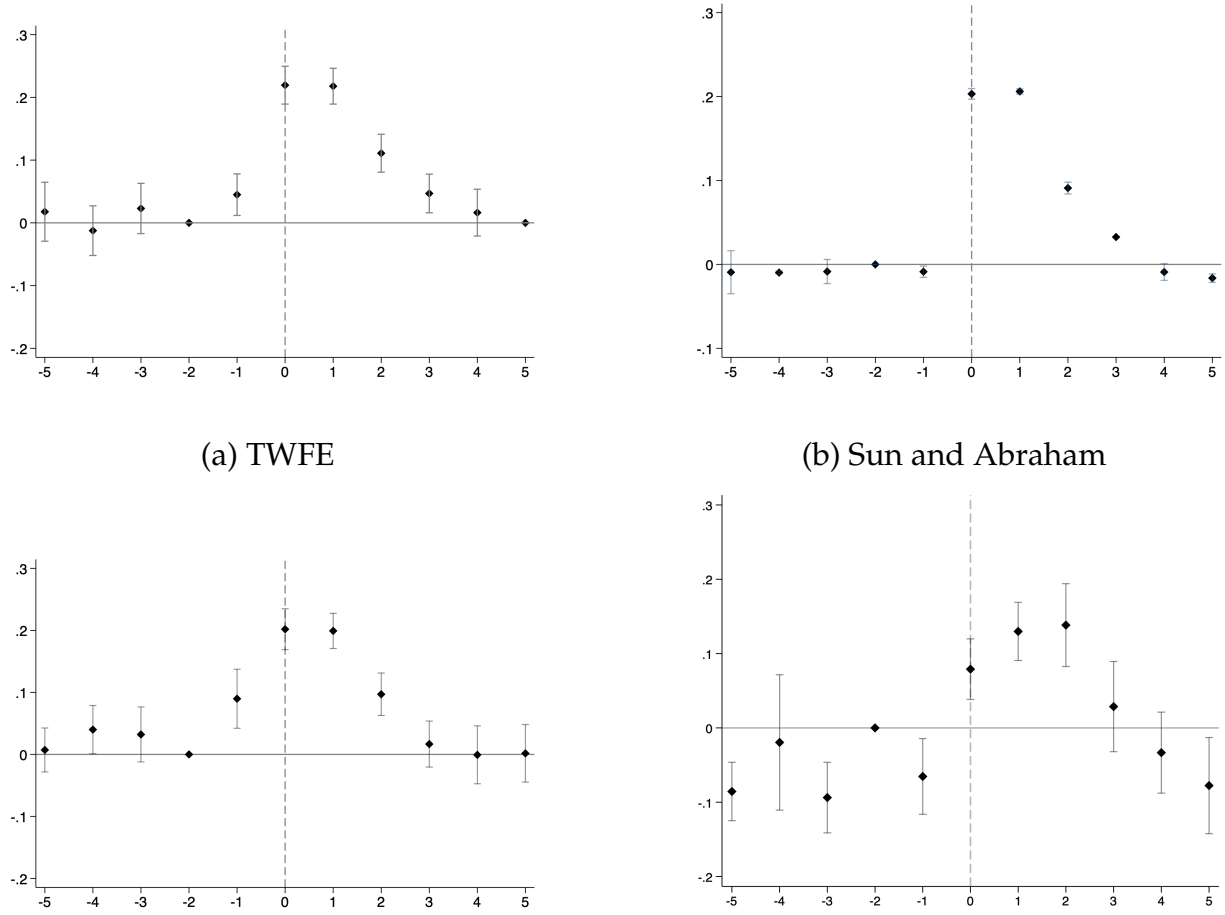
(b) Sun and Abraham

(c) Boryusak et al.

(d) De Chaisemartin & D'Hautefeuille

Figure A19: Robustness: Event study estimates of spousal loss for the EURO-D score using alternative methods

Notes: The figure shows robust event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D score. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. The model controls for age. Standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) TWFE

(b) Sun and Abraham

(c) Boryusak et al.

(d) De Chaisemartin & D'Hautefeuille

Figure A20: Robustness: Event study estimates of spousal loss for the risk of depression using alternative methods

Notes: The figure shows robust event study estimates of the effect of spousal loss (occurring at j=0) on the risk of depression (EURO-D >3). The outcome variable EURO-D indicator is a binary indicator for individuals with four or more depressive symptoms. EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. The model controls for age. Standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

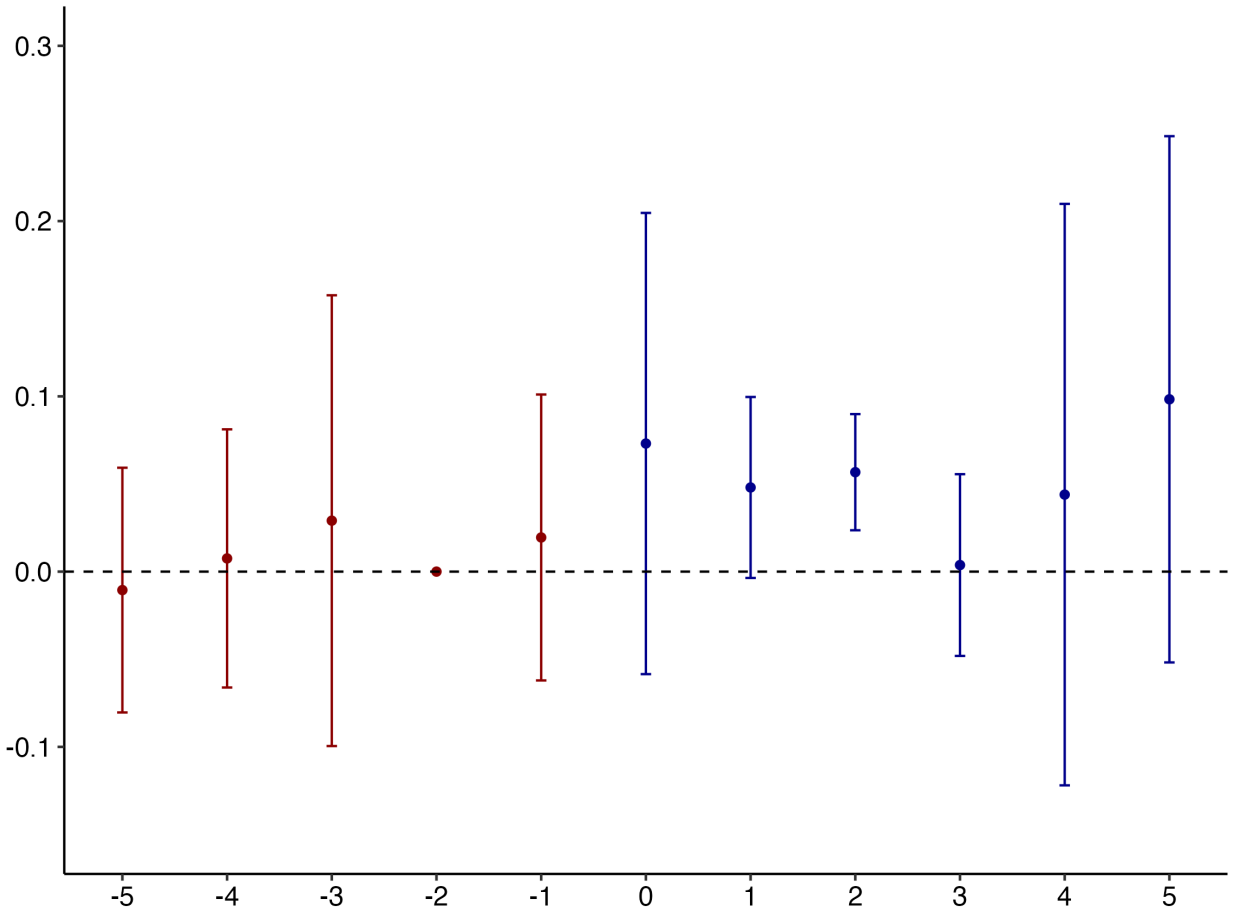
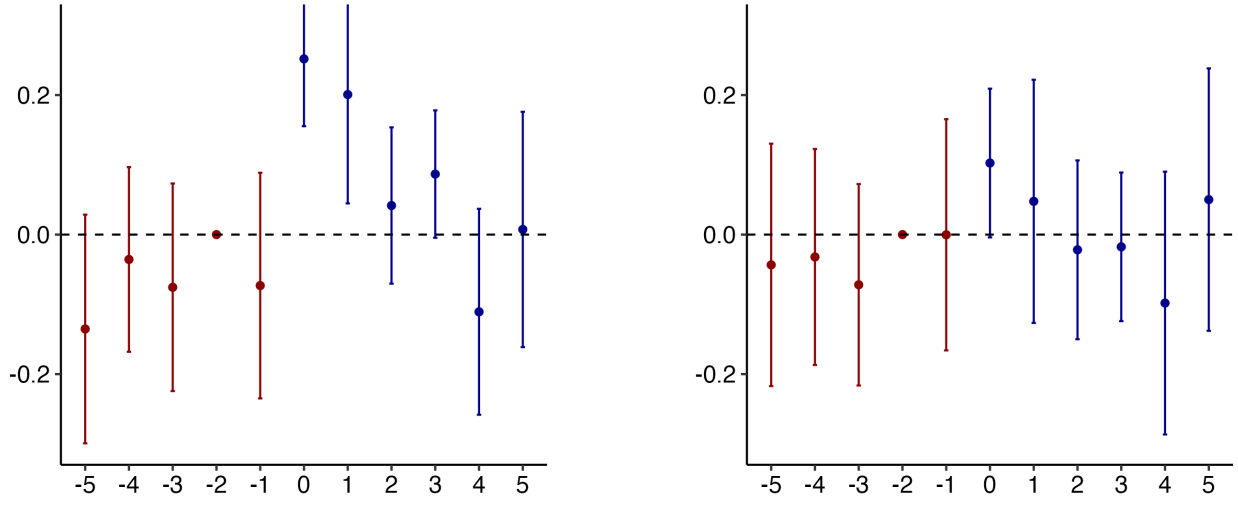


Figure A21: Robustness: Event study estimates of spousal loss for the use of drugs for anxiety

Notes: The figure shows robust event study estimates of the effect of spousal loss (occurring at j=0) on the use of drugs for anxiety in the working sample. All estimates are derived using the Callaway- Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

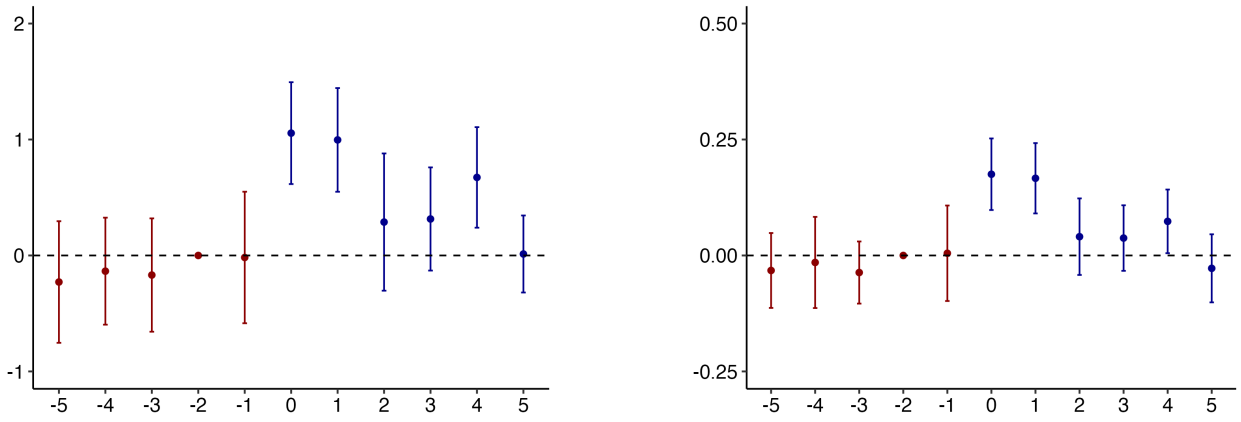


(a) Tearfulness

(b) Fatigue

Figure A22: Robustness: Event study estimates of spousal loss for EURO-D items

Notes: The figure shows robust event study estimates of the effect of spousal loss (occurring at j=0) on the EURO-D items, for tearfulness (panel a) and fatigue (panel b). The 16 EURO-D items asked to SHARE respondents include e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. All estimates are derived using the Callaway- Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

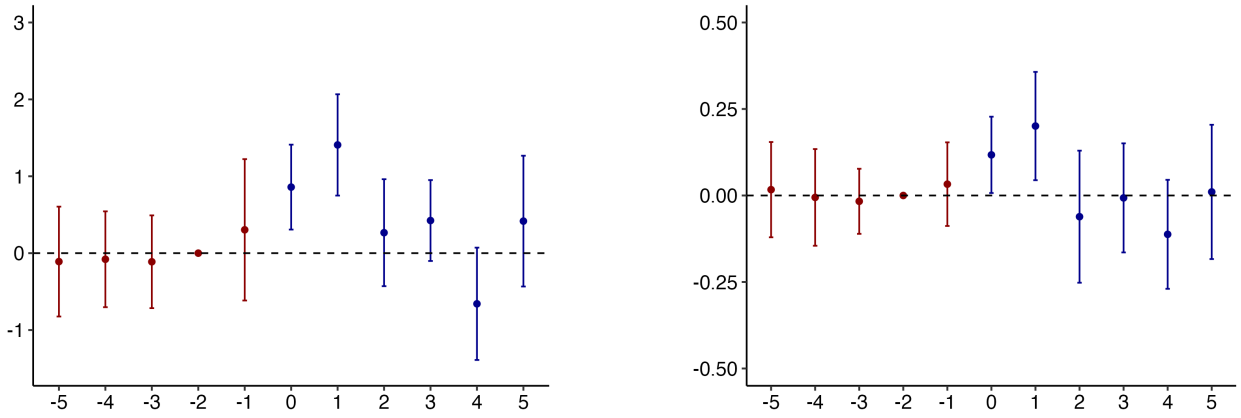


(a) EURO-D Score

(b) Risk of Depression

Figure A23: Robustness: Event study estimates of spousal loss with never treated individuals

Notes: The figure shows robust event study estimates of the effect of spousal loss (occurring at j=0) excluding the never treated individuals. The outcome variable EURO-D score (Panel a) is the total score of depressive symptoms and defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. The outcome variable EURO-D indicator (Panel b) is a binary indicator for individuals with four or more depressive symptoms. All estimates are derived using the Callaway- Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

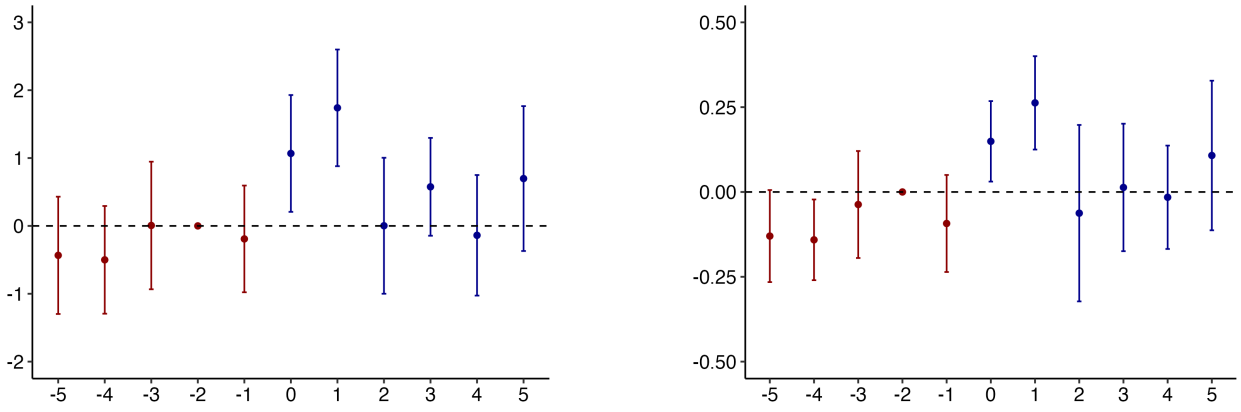


(a) EURO-D score

(b) Risk of Depression

Figure A24: Robustness: Event study estimates of spousal loss for the EURO-D score and the risk of depression excluding Covid years

Notes: The figure shows robust event study estimates of the effect of spousal loss (occurring at j=0) excluding Covid years, for men (panel a) and women (panel b). The outcome variable EURO-D score (Panel a) is the total score of depressive symptoms. It is derived from 16 questions asked of SHARE respondents—for example, whether they felt sad or depressed in the past month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite had been like. These 16 questions are then grouped into 12 items. Each item is scored as 1 if the respondent displays symptoms of depression, and 0 otherwise. The outcome variable EURO-D indicator (Panel b) is a binary indicator for individuals exhibiting four or more depressive symptoms, as measured by the Euro-D score. All estimates are derived using the Callaway- Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.



(a) EURO-D Score

(b) Risk of Depression

Figure A25: Robustness: Event study estimates of spousal loss excluding disease above 1 year

Notes: The figure shows robust event study estimates of the effect of spousal loss (occurring at j=0) excluding cases of spousal death associated with diseases lasting longer than one year. The outcome variable EURO-D score (Panel a) is the total score of depressive symptoms. It is derived from 16 questions asked of SHARE respondents—for example, whether they felt sad or depressed in the past month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite had been like. These 16 questions are then grouped into 12 items. Each item is scored as 1 if the respondent displays symptoms of depression, and 0 otherwise. The outcome variable EURO-D indicator (Panel b) is a binary indicator for individuals exhibiting four or more depressive symptoms, as measured by the Euro-D score. All estimates are derived using the Callaway- Sant'Anna DID estimator with standard errors clustered at the individual level. The bars represent 95 percent confidence intervals.
Source: SHARE v9, own calculations.

Table A1: Dynamic effects of widowhood on depression

Dep. Var.	EURO-D score	EURO-D indicator
Event time		
-5	-0.1112	-0.0011
	(0.2615)	(0.0504)
-4	-0.1063	-0.0276
	(0.2213)	(0.0446)
-3	-0.1192	-0.0573
	(0.2431)	(0.0352)
-2	-	-
	-	-
-1	0.2949	0.0371
	(0.3222)	(0.0423)
0	0.9291***	0.1514***
	(0.2321)	(0.0394)
1	1.4706***	0.2223***
	(0.2314)	(0.0386)
2	0.2756	-0.0084
	(0.2664)	(0.0537)
3	0.5092***	0.0201
	(0.1929)	(0.0412)
4	-0.2554	-0.0651
	(0.2609)	(0.0517)
5	0.468	0.0464
	(0.3145)	(0.0644)
N. of Obs.	27,180	27,180

Notes: The table reports the dynamic coefficients of the effect of spouse loss on depression estimated using Callaway and Sant'Anna (2021) in the working sample of individuals aged between 50 and 90 in SHARE in the period 2004-2022. The outcome variable EURO-D score is defined from the 16 questions asked to SHARE respondents, e.g., whether they felt sad or depressed in the last month, whether they had any hopes for the future, whether they had trouble sleeping, or what their appetite has been like. These 16 questions are then combined into 12 items. Each item is scored with a value of 1 if the respondent displays symptoms of depression, and 0 otherwise. We consider two outcomes based on the EURO-D scale – (i) the total score of depressive symptoms (EURO-D), and (ii) a binary indicator for individuals with four or more depressive symptoms (EURO-D indicator). The model includes 5 years before and after the event, t-2 is the reference period. The method of estimation exploits inverse probability weighting. Standard errors are clustered at the individual level and reported in parenthesis.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Source: SHARE v9, own calculations.

Table A2: Differences in mortality after the event of widowhood

Sample	(1) Female	(2) Male
Dep. Var	Resp.Died	Resp.Died
ATT Survivor Sample	-0.0155***	-0.01
	(0.00594)	(0.012)
Treated	3,215	1,128
Control	32,697	26,234
Observations	35,912	27,362

Notes: This tables reports the estimates using a propensity score matching model on the chances of death of the respondent. We use all the SHARE data, including individuals not affected by the death of the spouse. Our treatment is being part of the survivor sample. The ATT by gender is reported. We match individuals on age, years of education, limitations in activities of daily living (ADLs) and in instrumental activities of daily living, the number of self-reported chronic diseases (cancer, stroke, diabetes, arthritis, hypertension, heart and lung disease) and income, with exact matching on years of education, age and ADLs. Standard errors are clustered at the individual level and reported in parenthesis.
p-values: *** p<0.01, ** p<0.05, * p<0.1
Source: SHARE v9, own calculations.