Under One Roof: The Effect of Co-residing with Adult Children on Depression in Later Life

ABSTRACT

Rationale. The number of older parents living without adult children has increased dramatically over the last decades. However, recent trends exacerbated by the Great Recession have led to an increase in intergenerational co-residing.

Methods. We used three waves of data (2004-2010) from the Survey of Health, Ageing and Retirement in Europe (SHARE) collected around the great recession to assess the effects of intergenerational co-residence on mental health in later life (n=50,043). We used an instrumental variable approach that exploits changes in employment opportunities of adult children during the great recession to examine the impact of co-residing with adult children on depression scores measured using the Euro-D scale of depression.

Results. Northern European countries exhibited low levels of both co-residence and depression in older age, while most countries in Eastern and Southern Europe had high levels of both co-residence and depression. In OLS models that controlled for measured characteristics, co-residing with an adult child was not associated with depressive symptoms in older parents (β=-0.0387; 95% CI –0.0892 to 0.0118). By contrast, results from IV models suggest that co-residing with an adult child significantly reduces depressive symptoms by 0.731 points (95% CI -1.261 to -0.200) on the 12-item scale. Results were robust to a series of robustness checks including controls for child characteristics, country-specific time trends, and analyses restricted to homeowners.

Conclusions. Our findings suggest that, in the context of high unemployment rates during the Great Recession in Europe, increased intergenerational exchange between adult children and older parents in the form of co-residence had positive mental health effects on older parents.

Keywords: depression, co-residence, instrumental variables, ageing.

Word count: 7,693 words (without appendix)

RESEARCH HIGHLIGHTS

- High unemployment for young adults has led to increased co-residence with older parents
- IV results suggest that co-residing with an adult child reduces depression in older parents
- Intergenerational exchanges may lead to better mental health in older parents

INTRODUCTION

Since World War II, the number of older people living alone has increased dramatically in most industrialized countries (Glaser, Tomassini, & Grundy, 2004). While there are multiple explanations for these trends, one of the major drivers has been a rise in the proportion of people living without their adult children in older age (Gratton & Gutmann, 2010; Iacovou, 2002). However, recent years have witnessed a reversal in this trend, attributed to an increasing number of children staying longer or moving back to the parental home in response to the high unemployment rates associated with the recent economic downturn (Kahn, Goldscheider, & García-Manglano, 2013; Kaplan, 2012). While some research has characterized these changes in living arrangements (Matsudaira, 2015), few studies have examined the consequences of co-residing with adult children for the mental health of older parents.

Co-residing with adult children may influence mental health in older age through multiple mechanisms. More frequent contact with children may reduce symptoms of depression in older age (Buber & Engelhardt, 2008), but co-residing with adult children may also increase conflict between children and older parents, and lead to a loss of autonomy and independence in older age (Hughes & Waite, 2002; Lang & Schutze, 2002; Silverstein, Chen, & Heller, 1996). This relationship may be crucial to understanding the increasing burden of old-age depression in ageing societies. Across Europe, the prevalence of depressive symptoms in older age ranges from 18% in Denmark and Germany, to 34% in Italy and 37% in Spain (Castro-Costa et al., 2007). Depression is the leading cause of years lived with disability and the fourth leading contributor to the global burden of disease worldwide (Alexopoulos, 2005; Djernes, 2006; Ferrari et al., 2013).

Our study aims to identify the causal impact of living with adult children on the risk of depressive symptoms in older age. We use data from the Survey of Health, Ageing and Retirement in Europe (SHARE), a longitudinal study that follows older people since 2004. A key challenge in studying the relationships between living arrangements and mental health is selection: older men and women in poor health or experiencing major negative events such as widowhood are more likely to co-reside with their children (Choi, 2003; Compton & Pollak, 2014). It is therefore difficult to establish whether co-residing with children influences the mental health of older parents, or whether poor health makes older parents more likely to co-reside with their children. This is an important distinction from a policy standpoint: if the relationship between co-residence and mental health is causal, policies that promote independent living in older age may have important implications for mental health in older age. While recent studies have started to address selection using panel data and propensity score matching methods (Aranda, 2015), our paper builds up on earlier work by using an instrumental variable (IV) approach that exploits exogenous variation over time in the economic opportunities of adult children. Our estimates provide new evidence of the impact of co-residing with adult children on late-life depression.

Background

Co-residence is often conceived as a channel for the exchange of social, emotional, practical and financial support between parents and children (Gierveld, Dykstra, & Schenk, 2012; Glaser et al., 2004). Studies examining the net flow of exchange suggest that parents give on average more support to their children than they receive from them (Choi, 2003; Grundy, 2005; Smits, Van Gaalen, & Mulder, 2010; Ward, Logan, & Spitze, 1992). Notably, studies suggest that the nature of co-residence between parents and children in recent years most often involve the provision of support from parents to children. For example, a recent increase in intergenerational living in the US (Pew Research Center, 2010) has been

attributed to the growing financial instability of younger cohorts and the lengthening of the transition towards 'adulthood' (Billari & Liefbroer, 2010; Furstenberg, Kennedy, McLoyd, Rumbaut, & Settersten, 2004; Kahn et al., 2013; Kaplan, 2012; Lee & Painter, 2013). Likewise, recent evidence shows that becoming unemployed doubles the probability that an adult child moves in with older parents (Wiermers, 2014).

Our study relates to the literature on the impact of intergenerational households on the health of older parents. This literature has so far produced mixed results. On the one hand, emotional and instrumental support from children is associated with better physical and mental health in older age (Roll & Litwin, 2010; Zunzunegui, Béland, & Otero, 2001). Nevertheless, studies suggest that co-residing with adult children is associated with higher depressive symptom among older parents in Singapore (Chan, Malhotra, Malhotra, & Østbye, 2011), South Korea (Jeon, Jang, Rhee, Kawachi, & Cho, 2007), China (Chyi & Mao, 2012) and Israel (Lowenstein & Katz, 2005). Because depression influences the likelihood of receiving family support and co-residing with children, it is difficult to establish in these studies whether co-residing with children leads to poorer mental health, or whether more depressed adults need more care and are therefore more likely to live with their adult children.

More recently, studies have attempted to establish whether there is a causal link between co-residence with children and mental health. Using the number of sons and gender of the eldest child as instrumental variables, Do and Malhotra (2012) found that co-residence reduces depression among older widowed women in South Korea. By contrast, using a similar identification strategy, studies in Indonesia and Japan (Johar & Maruyama, 2013; Maruyama, 2012) have found that co-residence increases the risk of reporting poorer health and depression among older parents. Whether these findings apply to European

countries is unclear, however, due to different cultural norms on intergenerational solidarity and institutional arrangements that may crowd out family support (Buber & Engelhardt, 2008). For example, Aranda (2015) used propensity sore matching and found that 'doubling up' (two or more generations in the same household) has no impact on the risk of depression among parents in Nordic or Western European countries, while it decreases depressive symptoms for older people in Southern European countries.

In this paper, we aim to contribute to this literature by examining the impact of co-residence on the mental health of older parents using a new identification approach that has not been employed in previous studies. We use an IV approach that exploits variation between countries and over time in the employment prospects of adult children. Based on this quasi-experimental approach, our study attempts to control for selection into co-residence and omitted variable bias, exploiting one of the main forces behind recent increases in intergenerational co-residence between parents and children.

DATA

Analytical sample

SHARE is a nationally representative survey designed to provide comparable information on the health, employment and social conditions of Europeans aged 50+ in 17 European countries. Participants in each country were interviewed in 2004/5 and subsequently re-interviewed in 2006/7, 2008/9 and 2010/11 through face-to-face interviews using Computer-assisted personal interviewing (CAPI) technology. Response rates varied from country to country, but overall household response at enrolment was 62% (Börsch-Supan & Jürges, 2005). We used data from assessments in 2004, 2006 and 2010.

Depressive symptoms

The Euro-D scale of depressive symptoms was developed to collect harmonized data on late-life depression across European countries. The Euro-D has been evaluated as reliable and is highly correlated with other mental health measures (Courtin, Knapp, Grundy, & Avendano, 2015; Prince, 2002). The score ranges from 0 to 12, with higher scores indicating higher levels of depressive symptoms. Based on validation studies (Castro-Costa et al., 2008), we used a threshold of three or more symptoms as indication of clinically significant depressive symptoms.

Independent variables

Co-residence was measured with a binary variable indicating whether the respondent was co-residing in the same household with an adult child. Following the approach from previous European studies, children living in the same building were also considered as co-resident (Isengard & Szydlik, 2012).

SHARE measured a wide range of socio-demographic and economic characteristics of both respondents and their children. Respondent's characteristics included gender, age (categorized into 50 to 60, 61 to 70, over 70; using five-year age groups or a linear version of age yielded identical results), marital status (married or in partnership; divorced or single; widowed), highest educational level (primary education or less; secondary education; post-secondary education), the log of household total income, financial distress (whether household is able to make ends meet with great difficulty/difficulty; easily/fairly easily), whether receiving a pension, whether receiving unpaid care in the form of support from outside the household, whether reporting two or more chronic diseases, the number of limitations with activities of daily living (ADLs), and the number of limitations with instrumental activities of daily living (IADLs). The following children's characteristics were assessed: age (up to 20, 21 to 40, over 40 for up to four children, or in seven five-year age categories for the youngest child in alternative specifications), gender, marital status

(married or in partnership; divorced or single; widowed), employment status (employed; unemployed; out of the labor force), and number of children.

EMPIRICAL APPROACH

Older parents living with adult children are likely to differ along several important dimensions from those living without adult children. As a result, an OLS estimate would yield biased estimates of the causal effect of co-residence on mental health. To overcome bias, we use an IV estimation approach that attempts to control for both observed as well as unobserved differences between 'treated' (co-residing parents) and 'untreated' (parents living without their adult children) respondents.

To provide valid estimates, an instrument must meet two conditions. First, the instrument must be correlated with the endogenous variable – whether the respondent resides with an adult child in the same household. Second, the instrument must be distributed independently of the errors process – it must be exogenous and have no direct effect on depressive symptoms other than indirectly through influencing the likelihood of co-residing with adult children. Finding an instrument that fulfils these two criteria is not straightforward. Instrumental variables used in the literature include the gender, birth order and marital status of children. While these variables are strong predictors of co-residence, they may have direct effects on the mental health of older parents (Bonsang, 2009). In this paper, we use as instrument the country-, year-, age- and gender-specific unemployment rate for adult children. Because our models include country fixed effects, variation in the instrument comes from the fact that, within countries, different parents have children of different age and gender combinations. There is also variation in the instrument for parents with multiple children. To illustrate, 64.73% of respondents had children falling in different age categories, and consequently assigned a different instrument. There was also

considerable variation in the cohort- and gender-specific unemployment rate to which each child was exposed in his or her country of residence between 2004 and 2010, a period of fluctuating unemployment rates in European countries. For instance, a respondent's female child aged 25 years in 2004 in Spain would be exposed to the unemployment rate for females aged 25-29 in Spain in that specific year (15.9%), while a respondent's female child of the same age and country but in 2010 would be exposed to an unemployment rate seven percentage points higher (23.3%). Because characteristics of the child such as gender, employment status, marital status and country of residence may be correlated with the mental health of older parents, our models also control for these variables, so that variation in the instrument comes from presumably exogenous differences in unemployment rates, and not from compositional differences in the characteristics of the children. This approach assumes that, conditional on child's characteristics, variation in young people's unemployment rates are exogenous to the mental health of older parents, most of whom are retired. We do not use the individual employment status of the child as instrument because this variable is likely to directly affect the mental health of parents. Instead, we control for child employment status in our analysis. We hope thus to capture variation in co-residence that arises from the potential influence of poor macro-economic conditions on an adult child's decision to leave or return to the parental home, net of any direct effects of the economy on the child employment status.

To assess the validity of the instrument in terms of the first condition, we started by examining the F-statistic in the first-stage IV regression. We estimated a first stage linear regression in which co-residence was the dependent variable and independent variables included the instruments and all control variables included in the second stage. We tested for joint significance of the instruments using the Kleibergen-Paap Wald F-statistic test (Kleibergen & Paap, 2006). The null hypothesis for this test is that the instrument is not

correlated with co-residence. Rejecting the null hypothesis indicates that the instrument predicts co-residence. Although there is no universally accepted rule, an F statistic of 10 or higher is often used as indication of a sufficiently strong instrument (Stock & Yogo, 2005). While the second assumption can never be tested and needs to be theoretically defensible, we use the Hansen-Sargan statistic as overidentification test to examine whether the instruments (unemployment rates for each of the children's age, gender and country group) were correlated with the error term. Rejection of the null hypothesis at the conventional 5% significance level would suggest that the instrument is correlated with depressive symptoms of the respondents, casting doubt on the validity of the instrument (Hansen, 1982).

Our general specification for the first stage regression is as follows:

$$coresid_{ict} = \propto_0 + \propto_1 unemp_{act} + \propto_2 X_{ict} + \propto_3 child_{ict} + \propto_4 country_c + \varepsilon_{ict} \tag{1}$$

Where *coresid* refers to whether respondent *i* in country *c* was co-residing with an adult child at time *t*; *unemp* is the unemployment rate for the age- and gender-specific group a of the child in country *c* and at time *t*; *X* is a vector of respondent's individual characteristics; *child* refers to measured characteristics of each child; *country* captures any stable differences between countries; and ε is the error term.

In the second stage, we regressed the depressive symptoms score on the predicted value of co-residence from the first stage including all controls:

$$dep_{ict} = \beta_0 + \beta_1 \widehat{coresid}_{ict} + \beta_2 X_{ict} + \beta_3 child_{ict} + \beta_4 country_c + \varepsilon_{ict} \tag{2}$$

Where *dep* represents a score of depressive symptoms; $\widehat{coresid}$ reflects the predicted values of co-residence from the first stage; and *X, child* and *country* include the same controls as in equation (1), excluding the instrument. The coefficient of co-residence in the second stage captures the effect of co-residing with an adult child on the depressive symptoms levels of older parents. Robust standard errors are clustered at the first child's country/gender/age level (clustering at the level of other children yielded identical results), which also accounts for intra-individual correlations for individuals in multiple waves.

Data on Unemployment rates

SHARE includes detailed information on up to four children. For each respondent's child corresponding age group, gender and country, we obtained unemployment rates from the Organisation for Economic Co-operation and Development (OECD) labor force survey statistics data. Five-year age bands were used to define age groups for both genders for each of the 17 countries for the three waves the SHARE data spans from 2004 to 2010. **Figure 1** provides an overview of the data for males, with unemployment rates presented by age categories for 2004, 2006 and 2010. We include unemployment rates only for children aged up to age 50, the age at which respondents enter the SHARE survey, to avoid bias induced by stronger correlations between the child age-specific unemployment rate and that from their parents when the children are relatively old. A comparison of the three panels suggests that unemployment rates increased from 2004 through 2010 in most groups, but there is substantial variation in the magnitude of this increase between age cohorts and countries, providing variation for identification.

< Insert Figure 1 here >

We started with a sample of 53,023 parents in SHARE. We included all parents in the analyses but have detailed information for up to four children only (94.38% of the sample). Our final sample, therefore, comprised 50,043 respondents. All analyses were conducted using Stata 13.

RESULTS

Descriptive statistics

Table 1 presents the main characteristics of the sample, by co-residence status. Co-residing parents differed significantly from parents not co-residing with their children along several important dimensions: They had higher levels of depressive symptoms, but they reported less chronic diseases, were younger, and they were less likely to be receiving external informal care than parents not co-residing with children. Co-resident parents were also less likely to receive a pension and to report financial difficulties but they were more likely to be homeowners. In terms of their children's characteristics, co-residents had on average more and younger children than non-co-residing parents, and their children were more likely to be unmarried and unemployed or out of the labor force.

Appendix 1 displays the prevalence of co-residence by country and gender. Overall, 39% of our sample reported living with an adult child, but this ranged from 16.22% in Sweden overall to 66.64% in Poland. Co-residing with an adult child was also common in Greece, Italy, Slovenia and Spain. **Appendix 2** presents the proportion of respondents per country who reported 4 or more depressive symptoms on the Euro-D scale. There were large cross-national differences in depression scores. Denmark had the lowest depression scores (1.78) while the highest scores were observed in Poland (3.68). On average, higher levels

of depressive symptoms were observed in Eastern and Southern European countries than in Northern/Western European countries.

<Insert Table 1 here>

Figure 2 shows that there was a positive correlation between the proportion of intergenerational households in each country and the average depression score at the national level ($r=0.4846$, $p<0.01$). Northern European countries exhibited low levels of both co-residence and depression in older age, while most countries in Eastern and Southern Europe tended to show high levels of both co-residence and depression. This aggregate correlation would seem to indicate that co-residence is associated with higher depressive symptoms. In the next section, we attempt to disentangle the causal nature of this relationship using an IV approach.

< Insert Figure 2 here >

Instrumental variable models

Table 2 summarizes the results from the first-stage, which examined the impact of the instruments (unemployment rates for up to four children) on co-residence in a linear probability model. Full results are presented in **Appendix 3**. Conditional on a wide set of covariates, a one-point increase in the unemployment rate for adult children was associated with a significant increase of about half a percentage in the likelihood of co-residence in older age across the four instruments ($\beta=0.0088$, 95% CI 0.0071 to 0.0106; $\beta=0.0042$, 95% CI 0.0029 to 0.0056; $\beta=0.0032$, 95% CI 0.0015 to 0.0049; $\beta=0.002$, 95% CI -0.0002 to 0.0042). The cluster-robust F statistic for the full sample was 38.88 ($p<0.001$), which provides evidence of the strength of the instruments at the first stage.

Other individual characteristics associated with higher probability of co-residence included being widowed and the number of limitations with IADLs. By contrast, older age, higher education or being divorced or never married were associated with a lower probability of co-residing with children. Older parents were also more likely to co-reside if their child was unemployed, out of the labour force, never married or divorced. These patterns were very similar for men and women.

<Insert Table 2 here>

Table 3 presents results from the second stage in the 2SLS side-by-side results from a regular OLS model for the full sample. In OLS models, co-residing with an adult child was not associated with depressive symptoms among older parents (β=-0.0387; 95% CI –0.0892 to 0.0118). The test of exogeneity of co-residence was however rejected ($p<0.01$), indicating that for the full sample, an IV approach is preferred over OLS.

Results from the IV models are presented in columns four to six (for the full sample and then by gender). First, results from the over identification test (p=0.1640) suggest no evidence of correlation between the instruments and the error term. This test should be interpreted with caution, however, because it assumes the validity of at least one instrument in order to test the overidentification restrictions. Since our instruments are identical in nature, assuming that one is valid will consequently likely imply that the second is valid as well.

Results from our instrumental variable approach suggest that co-residing with an adult child significantly reduces depressive symptoms. The magnitude of this effect appears of clinical significance: co-residing with an adult child reduced depression scores by 0.731 points (95% CI -1.261 to -0.200), which corresponded to more than half a point in the 12-item scale, and a 30% decline relative to the mean Euro-D score for non-coresiding parents

in our sample. No significant differences were found between men and women (last two columns of **Table 3**).

<Insert Table 3 here>

Robustness checks

We carried out a series of supplementary analyses to examine the robustness of our results. The co-residence estimates for these additional models are presented in **Figure 3**.

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Because our data do not enable us to identify residential changes among children over time, we cannot determine whether co-residence arises from changes –or lack of changes- in the residence of the parent, the child or both. To partly address this, we implemented models restricting the sample to older parents who were homeowner-occupiers. Our rationale was that owner-occupiers were less likely to have moved, and more likely to co-reside because of children staying longer at home or moving in with them. The majority of respondents were owner-occupiers (72.03%), although rates of homeownership varied considerably by country, ranging from just 58.47% in Austria to over 90% in Spain. First stage results in the 2SLS model (results available upon request) suggested that instruments were strongly predictive of the probability of co-residing with an adult child ($F = 30.86$; $p<0.001$). Other drivers of co-residence were similar to those reported for the main analysis. Results from the second stage of the 2SLS are consistent with those for the entire sample and suggest that among homeowner-occupiers co-residence was associated with lower depressive symptoms (β=-0.699; 95% CI -1.371 to -0.0264). Full results are presented in **Appendix 4**.

We examined whether our results were robust to incorporating information on the age of children. Results of these models are summarized in **Figure 3** and full results are presented in **Appendix 5** and **6**. We first implemented IV models that included age of each child in three categories. The estimate of the effect of co-residence on depression at the second stage was much larger, albeit less precise compared to the main model. However, the results were consistent with those in our original specification. One concern, however, is that these broad age categories do not capture the most important age at which children leave the parental home (Iacovou, 2002). Therefore, we also implemented models that incorporated controls for the age of the youngest child in the same seven age categories used to define the instrument. In these models, co-residence was still associated with significantly lower depression scores, and estimates were only marginally smaller than those in our main specification. We estimated a model combining the mean of characteristics across all children instead of controlling for individual characteristics of each child. The estimate for this model did not significantly differ from our main specification (**Appendix 7**). Finally, models were robust to incorporating time*country or gender*children's mean age interactions (full results in **Appendix 8** and **9**).

DISCUSSION

Previous research suggests that living arrangements are associated with the mental health and wellbeing of older parents, but the causal nature of this association is unclear. Our study aimed to contribute to this literature by exploiting variations in macro-economic circumstances during the Great Recession across European countries and over time to identify the impact of intergenerational co-residence on the mental health of older parents. We find that co-residing with adult children is associated with a significant reduction in depressive symptoms among older parents. These results are robust to a number of specifications and provide evidence of the potential net benefits of exchanges with children for the mental health of older adults. To provide a sense of clinical significance, we estimated that the effect of co-residence corresponds to a Cohen's *d* of 0.30, a small to medium effect size (Cohen, 1988). The effect of co-residence in our main specification was larger than the effect of having a tertiary degree, being widowed, or having a limitation with ADL, all of which are significant predictors of depression in older age. This suggests that co-residence is likely to be an important predictor of whether an older adult will develop symptoms of depression in older age.

Our results are line with findings by Do and Malhotra (2012) for South Korea, but they contradict those for Indonesia and Japan, where co-residence was associated with poorer health among parents (Johar & Maruyama, 2014; Maruyama, 2012). Two possible explanations account for the difference in findings. First, these studies have all used as instruments the number of sons, which in Asian countries strongly predicts co-residence in older age (Do & Malhotra, 2012; Johar & Maruyama, 2014; Maruyama, 2012). These instruments appeared less relevant in our European sample as first-stage results were weak (results available upon request). Most importantly, we expected the number and gender of the children to have direct effects on parent's mental health beyond those via co-residence,

and we therefore decided not to use these instruments in our analysis. A second possible explanation refers to the different cultural norms on intergenerational solidarity and institutional arrangements that may crowd out family support in European countries (Buber & Engelhardt, 2008). Partly as a result, the experience of co-residence may be fundamentally different for older parents in European and Asian countries, potentially leading to different effects on their mental health.

To our knowledge, only one other European study has examined the causal impact of co-residence on mental health (Aranda, 2015), using propensity score matching to control for endogeneity. Using an alternative identification strategy that exploits exogenous variation in the likelihood of co-residence, our results partly confirm findings by Aranda suggesting that co-residence has positive mental health effects. In his study, Aranda only finds an effect of co-residence in countries with a 'catholic' tradition (Austria, Belgium, France, Italy, Portugal and Spain), but not in countries with a 'protestant' tradition. In supplementary analyses that differentiated between 'catholic' and 'protestant' countries, we found a stronger and significant positive effective of co-residence on mental health for countries with a catholic tradition (results available upon request). We do not adopt this classification, however, as these two groups of countries likely differ along many other dimensions other than religious traditions. Unfortunately, estimates for specific countries or for broad geographical regions (Nordic/Western Europe, Southern Europe and Eastern European countries) were based on small sample sizes and yielded very imprecise estimates in the IV models, which prevented us from deriving any conclusion on between-regional variations.

Co-residing with adult children may influence mental health in older age through multiple mechanisms. More frequent contact with children as well as emotional and instrumental support from co-residing children may help older parents maintain higher levels of physical and mental functioning in older ages (Glaser et al., 2004; Roll & Litwin, 2010; Zunzunegui et al., 2001). Our findings suggest that these benefits may not be outweighed by the potential increase in conflict between children and older parents living together, or by the potential loss of autonomy and independence among parents who live with their adult children (Hughes & Waite, 2002; Lang & Schutze, 2002; Silverstein et al., 1996). This is of particular importance at a time when multi-generational living arrangements have increased as a result of the Great Recession and its aftermath (Kaplan, 2012), a pattern that may have increased contact with children and paradoxically improved parent's mental health. Our findings are also consistent with literature suggesting that parent's provision of instrumental support to their children is associated with improved mental health and cognitive function among older parents themselves (Byers, Levy, Allore, Bruce, & Kasl, 2008; Levy, Slade, & Kasl, 2002).

Study limitations

When interpreting our findings, a number of limitations have to be considered. First, SHARE does not include detailed information on the motives for co-residence or the type and quality of support from and to co-residing adult children. In addition, although SHARE is a panel survey, we did not use panel data analysis techniques because only a limited number of transitions in co-residence status occurred between waves, rendering large standard errors in models that incorporated individual fixed effects. In addition, individual fixed effect models would not address the issue of self-selection into co-residence, which was the major threat to the internal validity of this study. Another

limitation is that our sample was too small to allow country-specific analyses, and we were only able to examine differences across broad geographical regions.

We did not have enough power for detailed sub-group analyses. For example, the effect of co-residence on depression might depend on the gender of the child. As shown in **Appendix 10**, we do not find evidence of a significant difference based on the gender of the youngest child (estimates were only significant for women but they were larger for men and confidence intervals for both estimates overlapped substantially). More detailed sub-group analyses, however, should be the focus of future research with larger sample size.

As with all instrumental variable analyses, we rely on the assumption that our instruments are exogenous, but we have no direct way to test this assumption. For example, one may argue that unemployment rates affecting children could influence the mental health of parents through mechanisms other than through co-residence. While we have no direct way to assess this, in sensitivity analyses, we found that children's unemployment rates were not directly associated with parental depression (results available upon request). In addition, by conditioning our models on children's employment and marital status we control for two of the main mechanisms - other than co-residence - through which increased unemployment rates affecting adult children could influence the mental health of parents. We note also that if we were picking up the 'direct' effect of child unemployment rates, it is likely that our estimates would be in the opposition direction: higher unemployment rates would increase parental depression. In addition, although we cannot rule out that instruments pick up some of the effect of children's age on depression, results from models that control for the age of the youngest child in detailed age categories offer some reassurance that our findings are not fully driven by children's age. While we acknowledge that an IV approach replies on strong assumptions, we believe our instrument is a significant improvement over earlier studies that used child characteristic

as instruments, as the latter might be more likely to have direct effects on the mental health of parents.

Finally, an important consideration in interpreting our findings is the fact that our IV estimates were considerably larger than the OLS. This may suggest that bias arising from reverse causality or omitted variable bias is potentially large, so that OLS estimates underestimate the benefits of co-residence for parent's mental health. In comparing OLS and IV estimates, however, it is also important to note that IV estimates reflect a Local Average Treatment Effect (LATE), i.e. the impact of co-residence among individuals whose co-residence status was a result of the national economic prospects faced by their children. Our IV estimates, therefore, do not capture the causal effect of co-residence for "non-compliers" (respondents whose living arrangements would be unaffected by national economic prospects) and "always compliers" (those who would co-reside with their adult children independently of the characteristics of the instruments) (Imbens & Angrist, 1994).

CONCLUSION

How intergenerational co-residence affects mental health in older age is an important policy question in the context of rising cohabitation rates in the aftermath of the Great Recession. Our findings suggest that in the context of high youth unemployment rates, policies encouraging intergenerational support and exchanges, potentially in the form of co-residence, may result in reduced levels of depressive symptoms among older Europeans. Although current policies that promote independent living in older age may bring benefits, our results are in line with evidence suggesting that isolated older households are at higher risk of poor physical and mental health (Courtin & Knapp, 2015). Our study also highlights the potential role of children and suggests that policies that promote intergenerational exchanges between parents and children may contribute to curb

high rates of depressive symptoms among older people, particularly in the context of high

youth unemployment rates.

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TABLES

Table 1. Description of main variables, by co-residence status (pooled sample)

Variable	Co-resident (N=33,013)	Non co-resident (N=54,514)	P value
Depressive symptoms and health characteristics			
Euro-D: mean (SD)	2.45 (2.31)	2.40 (2.24)	>0.001
Reporting high levels of depressing symptoms[a]: frequency (%)	9,808 (29.71)	15,425 (28.30)	>0.001
Number of limitation with ADLs: mean (SD)	0.18 (0.70)	0.21 (0.71)	0.5050
Number of limitations with IADLs: mean (SD)	0.26 (0.91)	0.29 (0.88)	0.5432
2+ chronic illnesses[b]: frequency (%)	15,042 (45.70)	28,471 (52.37)	>0.001
Demographic characteristics			
Age: mean (SD)	60 (10.30)	66.09 (9.8)	>0.001
Female: frequency (%)	18,645 (56.48)	30,703 (56.32)	0.5782
Male: frequency (%)	14,368 (43.52)	23,811 (43.68)	
Married or in a partnership: frequency (%)	21,813 (78.60)	30,906 (71.37)	>0.001
Divorced or never married: frequency (%)	2,393 (8.62)	5,497 (12.69)	
Widowed: Frequency (%)	3,546 (12.78)	6,899 (15.93)	
Receipt of informal care: frequency (%)	3,880 (17.55)	8,972 (24.19)	>0.001
Socio-economic characteristics			
Pension receipt: frequency (%)	13,978 (42.34)	35,748 (65.58)	>0.001
Secondary education: frequency (%)	14,728 (53.58)	23,132 (54.14)	0.0384
Tertiary education: frequency (%)	5,400 (19.61)	8,752 (20.44)	0.1204
Homeowner: frequency (%)	16,370 (75.94)	25,483 (69.90)	0.0201
Household total income: median	24,100	26,088	
Financial distress: frequency (%)	16,433 (50.52)	19,063 (35.55)	>0.001
Children characteristics			
Number of children: mean (SD)	2.52 (1.27)	2.27 (1.16)	>0.001
Age of child 1: mean (SD)	33.24 (11.73)	40.81 (10.09)	>0.001
Age of child 2: mean (SD)	31.06 (11.62)	38.56 (9.86)	>0.001
Age of child 3: mean (SD)	29.77 (12.20)	38.04 (9.98)	
Age of child 4: mean (SD)	29.86 (12.74)	38.09 (9.91)	
Gender of child 1			>0.001
Female: frequency (%)	12,355 (48.57)	21,473 (51.45)	
Male: frequency (%)	13,083 (51.43)	20,259 (48.55)	

Gender of child 2			>0.001
Female: frequency (%)	10,160 (52.61)	16,032 (50.35)	
Male: frequency (%)	11,277 (52.61)	15,810 (49.65)	
Gender of child 3			>0.001
Female: frequency (%)	4,801 (47.47)	6,588 (49.99)	
Male: frequency (%)	5,304 (52.45)	6,598 (49.91)	
Gender of child 4			>0.001
Female: frequency (%)	1,915 (46.27)	2,484 (48.54)	
Male: frequency (%)	2,222 (53.68)	2,621 (51.22)	
Marital status of child 1			
Married or in a partnership: frequency (%)	10,008 (38.13)	29,852 (67.67)	
Divorced, or never married: frequency (%)	16,025 (61.05)	13,730 (31.12)	
Widowed: frequency (%)	216 (0.82)	532 (1.21)	
Marital status of child 2			>0.001
Married or in a partnership: frequency (%)	8,411 (38.96)	21,812 (64.66)	
Divorced, or never married: frequency (%)	13,028 (60.35)	11,630 (34.48)	
Widowed: frequency (%)	148 (0.69)	289 (0.86)	
Marital status of child 3			
Married or in a partnership: frequency (%)	3,867 (40.23)	8,829 (63.78)	
Divorced, or never married: frequency (%)	5,677 (59.06)	4,917 (35.52)	
Widowed: frequency (%)	69 (0.72)	97 (0.70)	
Marital status of child 4			
Married or in a partnership: frequency (%)	1,832 (47.72)	3,437 (64.57)	
Divorced, or never married: frequency (%)	1,983 (51.65)	1,826 (34.30)	
Widowed: frequency (%)	24 (0.63)	60 (1.13)	
Employment status of child 1			>0.001
Employed: frequency (%)	17,420 (68.20)	35,728 (81.81)	
Unemployed: frequency (%)	2,162 (8.46)	1,754 (4.02)	
Not in the labor force: frequency (%)	5,959 (23.33)	6,190 (14.17)	
Employment status of child 2			>0.001
Employed: frequency (%)	14,045 (67.29)	27,586 (82.55)	
Unemployed: frequency (%)	1,687 (8.08)	1,317 (3.94)	

Not in the labor force: frequency (%)	5,139 (24.62)	4,514 (13.51)	
Employment status of child 3			>0.001
Employed: frequency (%)	5,999 (64.38)	11,066 (80.56)	
Unemployed: frequency (%)	781 (8.38)	658 (4.79)	
Not in the labor force: frequency (%)	2,538 (27.24)	2,012 (14.65)	
Employment status of child 4			>0.001
Employed: frequency (%)	2,400 (65.59)	4,236 (80.56)	
Unemployed: frequency (%)	311 (8.50)	256 (4.87)	
Not in the labor force: frequency (%)	948 (25.91)	766 (14.57)	

[a]Reporting high levels of depressive symptoms is defined as scoring four or higher on the Euro-D scale.

[b]Chronic diseases include high blood pressure, high blood cholesterol, stroke, diabetes, chronic lung disease, asthma, arthritis, osteoporosis, cancer, stomach or duodenal ulcer, Parkinson disease, cataract and hip fracture.

Table 2. First-stage regression of linear probability of co-residing with an adult child

Variables	Full sample	Women	Men
IVs			
Unemployment rate of child 1	0.00890***	0.00956***	0.00833***
	(0.000897)	(0.00105)	(0.00111)
Unemployment rate of child 2	0.00425***	0.00535***	0.00343***
	(0.0007)	(0.000813)	(0.000896)
Unemployment rate of child 3	0.00322***	0.00450***	0.00216
	(0.000862)	(0.00112)	(0.00114)
Unemployment rate of child 4	0.00203	0.000874	0.00329
	(0.00115)	(0.00155)	(0.00169)
Kleibergen-Paap Wald F Statistic	38.88 $F_{(4,490)}$ $p<0.001$	42.73 $F_{(4,478)}$ $p<0.001$	20.88 $F_{(4,480)}$ $p<0.001$

Notes: The models control for all covariates. Full results in Appendix 3. Robust standard errors in parenthesis, with clustering at the level of the instruments. *** $p<0.001$; ** $p<0.01$; * $p<0.05$.

Table 3. OLS and IV-2SLS regressions of Euro-D depressive symptoms scores

Variables	OLS			IV		
	Full sample	Women	Men	Full sample	Women	Men
Explanatory variable of interest						
Co-residing with an adult child	-0.0387	-0.0527	-0.0122	-0.731**	-0.518	-0.818
	(0.0258)	(0.0352)	(0.0366)	(0.27)	(0.36)	(0.312)
Demographic and socioeconomic						
Aged 50 to 60 (ref.)	-	-	-	-	-	-
Aged 61 to 70	-0.140***	-0.148***	-0.127**	-0.223***	-0.230***	-0.184**
	(0.0319)	(0.0432)	(0.046)	(0.0449)	(0.0569)	(0.0586)
Aged over 70	-0.059	-0.153**	0.0611	-0.176**	-0.279***	-0.0612
	(0.0377)	(0.0509)	(0.0552)	(0.0577)	(0.077)	(0.0743)
Male	-0.693***	-	-	-0.715***	-	-
	(0.0222)			(0.0293)		
Primary education (ref.)	-	-	-	-	-	-
Secondary education	-0.273***	-0.342***	-0.165***	-0.269***	-0.348***	-0.147**
	(0.0303)	(0.041)	(0.0438)	(0.037)	(0.0481)	(0.0501)
Tertiary education	-0.415***	-0.579***	-0.209***	-0.409***	-0.571***	-0.209***
	(0.036)	(0.051)	(0.0502)	(0.0468)	(0.0626)	(0.0597)
Married or in a partnership (ref.)	-	-	-	-	-	-
Never married or divorced	0.190***	0.148***	0.239***	0.0975*	0.0946	0.0833
	(0.0327)	(0.0433)	(0.0498)	(0.0448)	(0.05)	(0.0836)
Widowed	0.219***	0.154***	0.378***	0.310***	0.234***	0.425***
	(0.0319)	(0.04)	(0.059)	(0.0429)	(0.0536)	(0.0726)
Pension receipt	0.0681*	0.113**	0.0457	0.0381	0.108*	-0.0175

	(1)	(2)	(3)	(4)	(5)	(6)
	(0.0312)	(0.0429)	(0.0454)	(0.0382)	(0.0488)	(0.0557)
Log of household income	6.72E-08	1.02E-08	2.46E-08	-0.0126	-0.0228	-0.00457
	(6.79E-08)	(1.05E-07)	(8.83E-08)	(0.012)	(0.0143)	(0.0184)
Financial distress	0.575***	0.599***	0.543***	0.602***	0.610***	0.579***
	(0.0246)	(0.0334)	(0.0357)	(0.0336)	(0.0449)	(0.0453)
Informal care receipt	0.349***	0.301***	0.443***	0.343***	0.304***	0.415***
	(0.0285)	(0.0364)	(0.0452)	(0.0367)	(0.0481)	(0.0507)
Health status						
Number of limitations with ADLs	0.341***	0.350***	0.310***	0.316***	0.346***	0.271***
	(0.0253)	(0.0312)	(0.0433)	(0.0363)	(0.0426)	(0.0597)
Number of limitations with IADLs	0.401***	0.384***	0.437***	0.451***	0.406***	0.503***
	(0.0212)	(0.0256)	(0.0379)	(0.036)	(0.0437)	(0.0602)
2+ chronic illnesses	0.816***	0.891***	0.697***	0.825***	0.925***	0.688***
	(0.0223)	(0.031)	(0.0313)	(0.0288)	(0.0379)	(0.036)
Children characteristics						
Number of children	0.0156	-0.00439	0.0416	0.0529	0.00737	0.208
	(0.0289)	(0.0383)	(0.0432)	(0.456)	(0.6)	(0.555)
Child 1 is a male	-0.0579**	-0.0743*	-0.0299	-0.0753**	-0.0444	-0.0635
	(0.0213)	(0.0296)	(0.0298)	(0.0284)	(0.605)	(0.0384)
Child 2 is a male	-0.0157	-0.0247	-0.0089	-0.0602*	0.0846	-0.0245
	(0.0239)	(0.0336)	(0.0329)	(0.0302)	(0.611)	(0.0617)
Child 3 is a male	-0.0890*	-0.0884	-0.099	-0.0497	-0.0580	0.175*
	(0.038)	(0.052)	(0.0542)	(0.0455)	(0.0433)	(0.0826)
Child 4 is a male	-0.124	-0.141	-0.11	-0.117	-0.0729	0.0898
	(0.0632)	(0.086)	(0.0919)	(0.0784)	(0.0611)	(0.0611)

Child 1 is employed (ref.)	-	-	-	-	-	-
Unemployed	0.270***	0.365***	0.106	0.283***	-0.128	0.279**
	(0.0512)	(0.0687)	(0.0744)	(0.0604)	(0.114)	(0.093)
Out of the labor force	0.0493	0.118**	-0.0465	0.133**	0.338***	0.00673
	(0.0302)	(0.0419)	(0.0415)	(0.0476)	(0.086)	(0.059)
Child 2 is employed (ref.)	-	-	-	-	-	-
Unemployed	0.176**	0.163*	0.205*	0.237***	0.155*	0.0537
	(0.0577)	(0.0775)	(0.0843)	(0.0593)	(0.0632)	(0.052)
Out of the labor force	0.0326	0.103*	-0.053	0.0921*	0.214*	0.12
	(0.034)	(0.0481)	(0.0463)	(0.0429)	(0.0882)	(0.139)
Child 3 is employed (ref.)	-	-	-	-	-	-
Unemployed	0.324***	0.426***	0.208	0.297**	0.157*	0.210*
	(0.0864)	(0.118)	(0.124)	(0.0977)	(0.0638)	(0.085)
Out of the labor force	0.165**	0.182**	0.161*	0.195**	0.436**	0.0861
	(0.0506)	(0.0701)	(0.0712)	(0.0668)	(0.144)	(0.559)
Child 4 is employed (ref.)	-	-	-	-	-	-
Unemployed	0.266	0.241	0.29	0.403*	0.179	0.663**
	(0.148)	(0.193)	(0.23)	(0.175)	(0.0914)	(0.25)
Out of the labor force	0.0575	0.00786	0.146	0.149	0.225	0.261
	(0.0824)	(0.113)	(0.119)	(0.101)	(0.235)	(0.14)
Child 1 is married or in a partnership (ref.)		-	-	-	-	-
Never married or divorced	0.0612*	0.0842*	0.0429	0.218***	0.06	0.0439
	(0.0238)	(0.0328)	(0.0334)	(0.0603)	(0.153)	(0.564)
Widowed	-0.015	0.0322	-0.15	0.156	0.210**	0.200**
	(0.106)	(0.129)	(0.169)	(0.172)	(0.0808)	(0.0711)

Child 2 is married or in a partnership (ref.)	-	-	-	-	-	-
Never married or divorced	0.0192	0.00825	0.0555	0.0970*	0.382	-0.287
	(0.0264)	(0.0368)	(0.0366)	(0.0485)	(0.244)	(0.321)
Widowed	0.0481	0.0413	0.152	-0.0576	0.0649	0.132*
	(0.135)	(0.158)	(0.251)	(0.209)	(0.0684)	(0.0588)
Child 3 is married or in a partnership (ref.)	-	-	-	-	-	-
Never married or divorced	-0.0305	0.0123	-0.0801	0.0387	-0.138	0.0854
	(0.0403)	(0.0554)	(0.057)	(0.0582)	(0.285)	(0.322)
Widowed	0.196	0.306	-0.0503	0.749	0.0425	0.0222
	(0.244)	(0.295)	(0.398)	(0.484)	(0.0782)	(0.0712)
Child 4 is married or in a partnership (ref.)	-	-	-	-		
Never married or divorced	0.133*	0.188*	0.0394	0.114	1.071	0.0292
	(0.0669)	(0.0911)	(0.0977)	(0.088)	(0.601)	(0.63)
Widowed	-0.0879	-0.114	0.157	-0.325	0.237	-0.0635
	(0.392)	(0.451)	(0.701)	(1.075)	(0.127)	(0.108)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.496***	1.499***	0.806***	1.78	1.858	0.542
					-	
	(0.161)	(0.216)	(0.237)	(1.824)	(2.401)	(2.226)
Observations	28,252	15,997	12,255	28,252	15,997	12,255
R-squared	0.257	0.231	0.217	0.21	0.194	0.166
				5.109	2.763	2.221
Test of overidentification	-	-	-	(p=0.1640)	(p=0.4296)	(p=0.5279)

Notes: Robust standard errors in parenthesis, with clustering at the instruments level for the 2SLS models. *** $p<0.001$; ** $p<0.01$; * $p<0.05$.
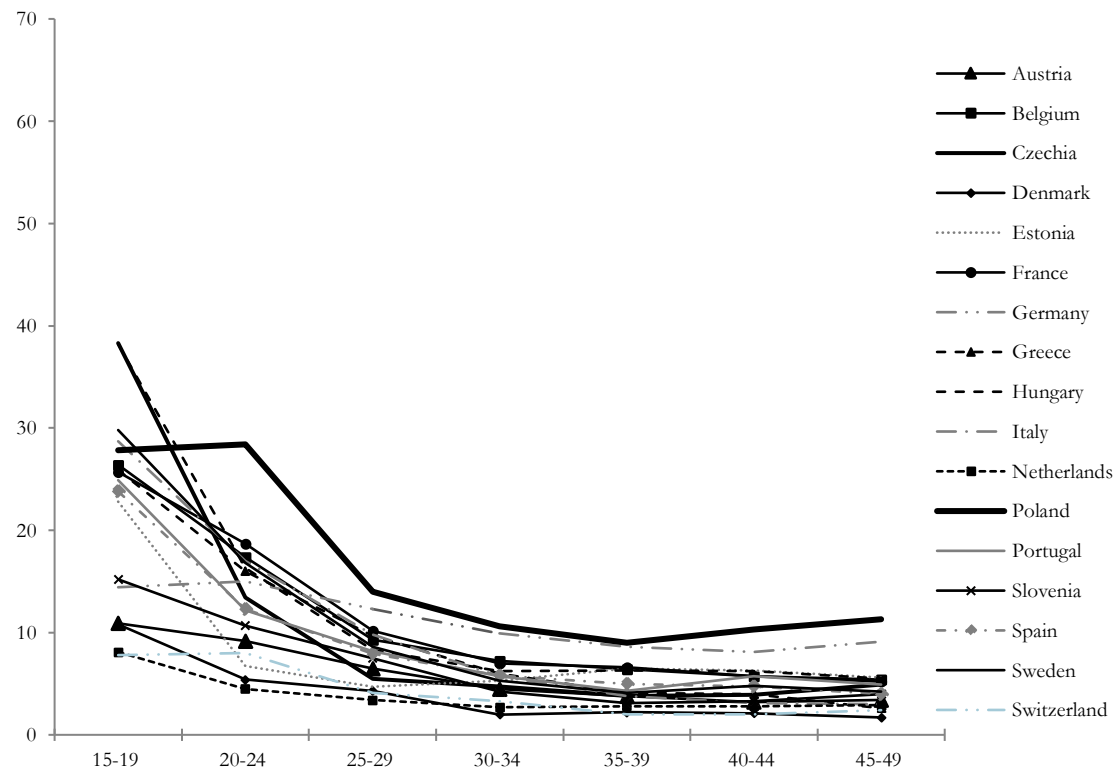
Figure 1. Unemployment rates by age categories for males (2004, 2006, 2010)

2004

2006

2010

Legend: Austria, Belgium, Czechia, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland
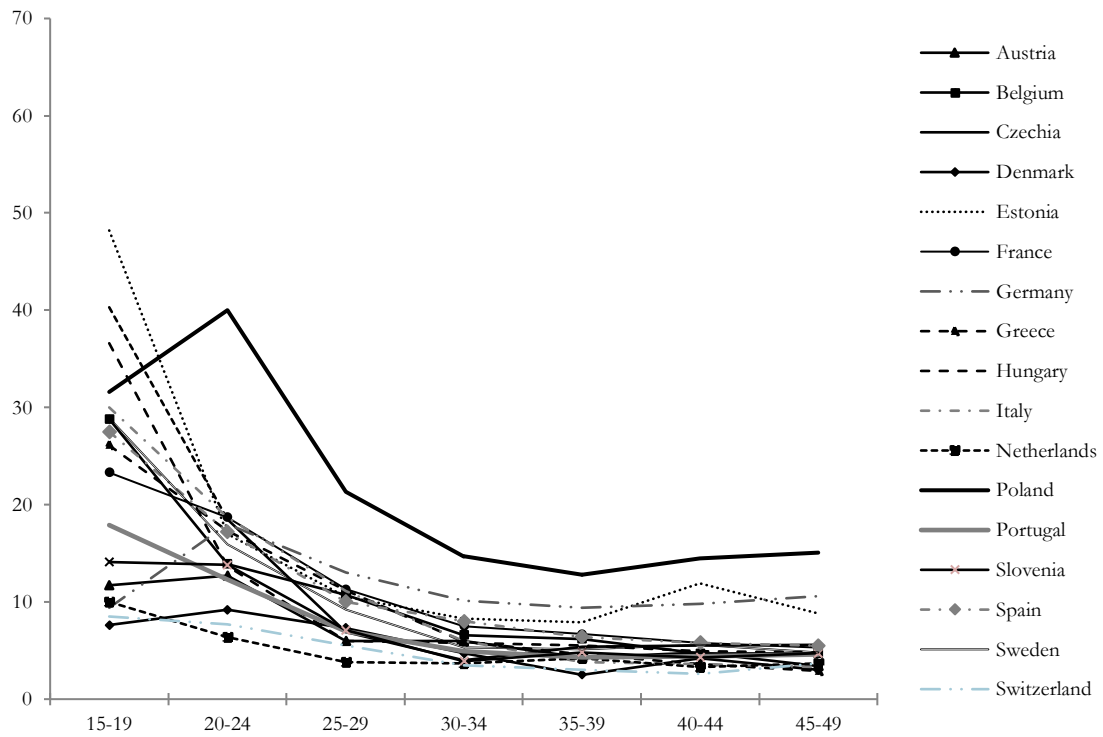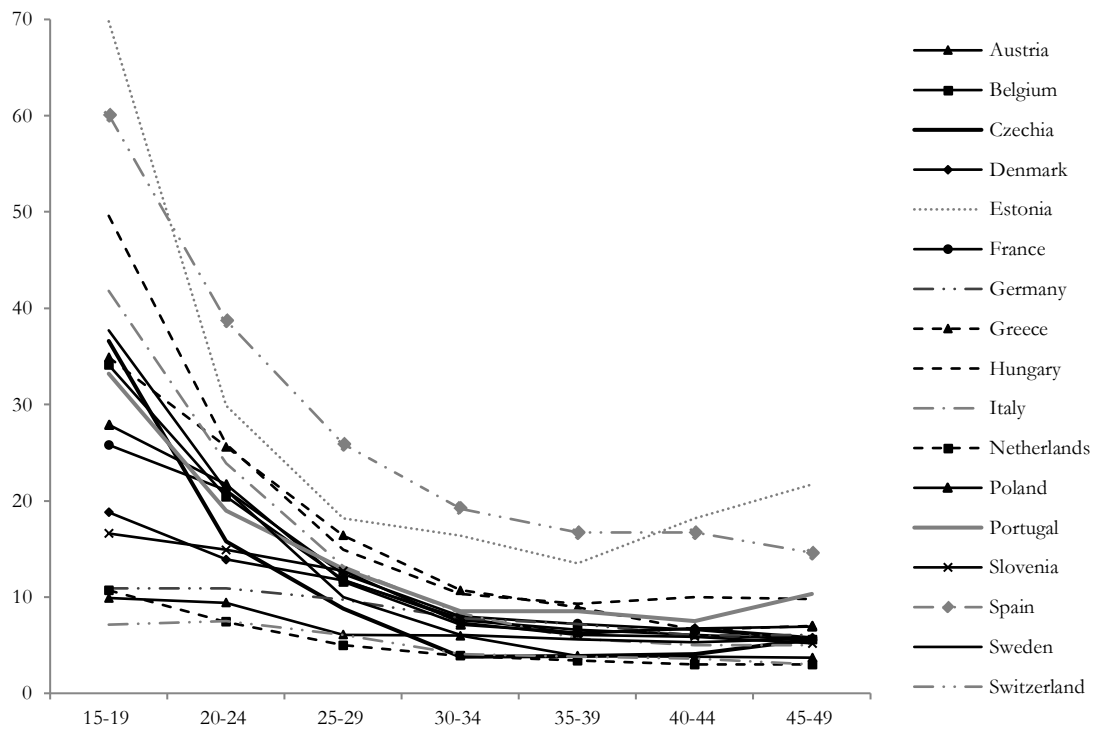
Figure 2. Association between co-residence and average depression scores by countries (pooled sample)
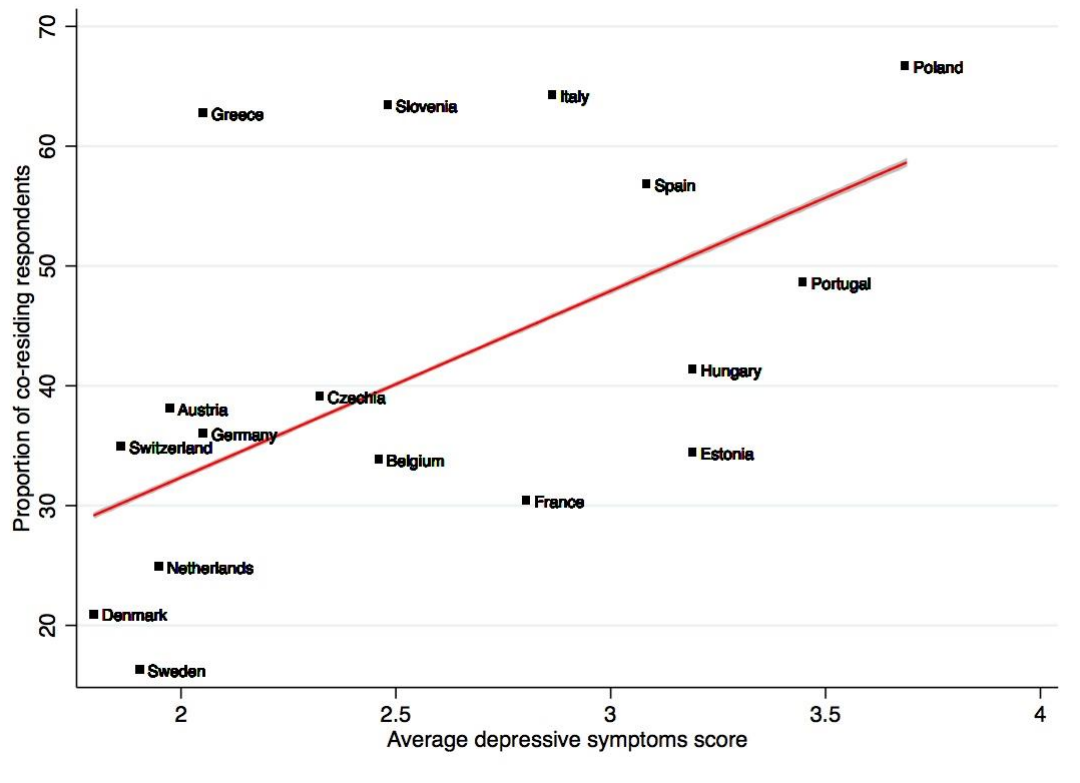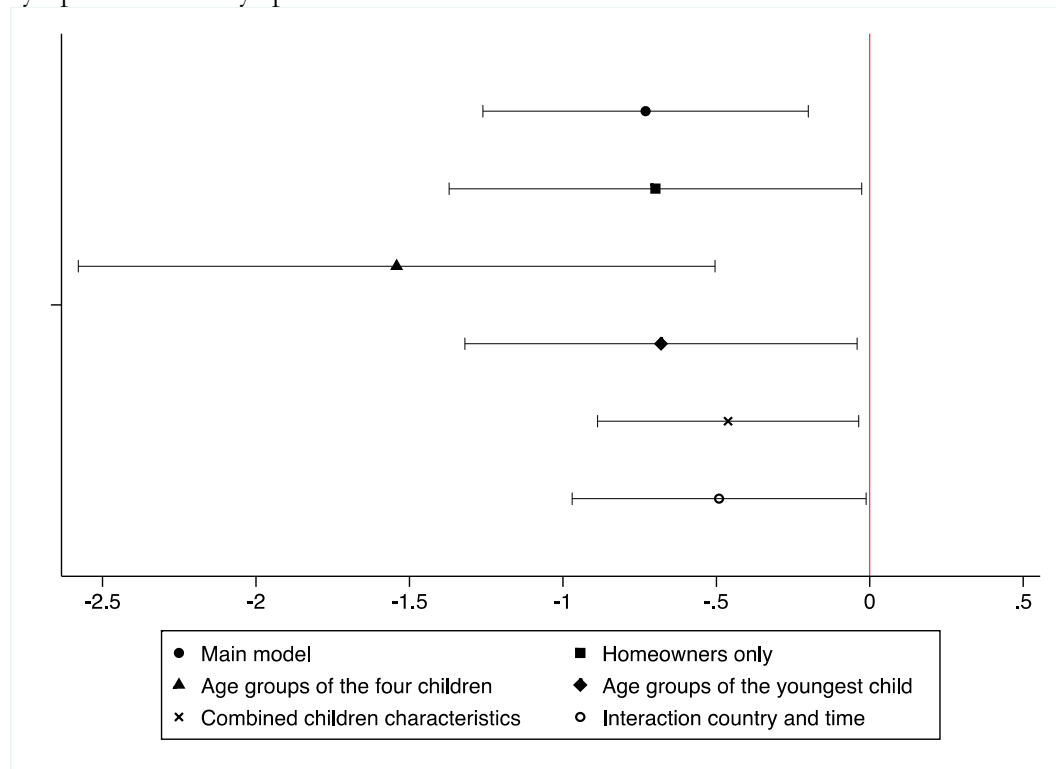
Figure 3. Overview of the effect of intergenerational co-residence on depressive symptoms levels by specification

Notes:

Main model - main specification, with covariates as in Tables 2 & 3.

Homeowners only - includes all covariates from the main model but focuses on a sub-sample of homeowners

Age groups of children - main specification, plus three age categories for each child

Age groups of the youngest child - main specification, age of the youngest child in five-year age categories

Combined children characteristics: replaces the controls for children's characteristics by summary measures of the proportion of daughters, the proportion of married children and the proportion of employed children out of up to four children

Interaction country and time - main specification, plus an interaction term between country of residence and year of survey