The London School of Economics and Political Science

Do living arrangements affect depression in later life? Evidence from Europe and the United States

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Declaration

I certify that this thesis is solely my own work, other than where I have clearly indicated that the work was shared with others, in which case the extent of any work carried out jointly with co-authors is clearly identified (see "Statement of conjoint work").

The total word count for this thesis is 63,676 (excluding thesis bibliography and appendix).

Statement of conjoint work

Part of the work presented in Chapters 4-7 of this thesis has been published or is currently under review in peer-reviewed academic journals. These articles have been co-authored with Dr. Mauricio Avendano from King's College London and T.H. Chan School of Public Health, Dr. Jennifer B. Dowd from King's College London and CUNY School of Public Health, Professor Emily Grundy from the London School of Economics, and Professor Martin Knapp from the London School of Economics.

For these publications, I conceived and designed the studies, obtained the relevant data, conducted the statistical analyses, interpreted the results, and drafted the paper. All co-authors advised on the statistical analyses, reviewed the draft papers and provided feedback on subsequent versions. The published papers from this thesis have the following references:

Courtin, E., Knapp, M., Grundy, E. and M. Avendano (2015) "Are different measures of depressive symptoms in old age comparable? An analysis of the CES-D and Euro-D scales in 13 countries" International Journal of Methods in Psychiatric Research **24**(4): 287-304.

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The published papers are in Appendices 8, 9 and 10.

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A mei et amici

Abstract

Living arrangements of older people in Europe and the US have changed considerably in the last decades. The impact of these changes on mental health in later life is not fully understood. Making use of interdisciplinary ageing datasets (the Survey of Health, Ageing and Retirement in Europe and the Health and Retirement Study in the US), this thesis aims to evaluate how changes in the way older people live influence depressive symptoms in old age – focusing on two types of living arrangements: intergenerational co-residence and housing tenure. Composed of four empirical chapters, this PhD thesis makes four methodological and substantive contributions to the literature. The first chapter sets the stage for a cross-national comparison of the effect of living arrangements on depression. It assesses the comparability of commonly used depressive symptoms measures in the primary ageing datasets (Euro-D and CES-D scales). The second chapter focuses on the effect of early access to homeownership (before the age of 35) and housing stability on later life depression in the US. The findings suggest that accessing the housing ladder early on in the life course and remaining in that home are associated with both lower levels of depressive symptoms and slower progression of depression in later life. The third empirical chapter investigates the association between changes in housing tenure and depression in later life in the US. Using individual fixed-effects models, this analysis assesses whether within-person changes in housing tenure are associated with within-person changes in depressive symptoms. The analyses show that acquiring a home after 50 brings mental health benefits. The fourth empirical chapter evaluates the effects of intergenerational co-residence in 14 European countries. Using an instrumental variable approach to account for reverse causality, the findings suggest that co-residing with an adult child in the context of the 2008 economic crisis can yield mental health benefits for their parents. Taken together, the results presented in this thesis underscore the importance of living arrangements as key life course determinants of depression in old age.

Extended abstract

Background. There is a vast literature documenting the key risk factors for depression in old age. Less is known about whether and to what extent the immediate social environment of older adults – their living arrangements - can impact their mental health. The way older people live has changed considerably over the past decades, in particular for the two types of living arrangements this thesis focuses on: intergenerational co-residence and homeownership.

Objectives. The aim of this thesis is to examine whether changes in homeownership and intergenerational co-residence affect mental health in old age. Data are drawn from the Survey of Health and Retirement in Europe and the US Health and Retirement Study. I implement quasi-experimental approaches to take into account selection into different types of living arrangements and reverse causality.

Key results. The first empirical chapter explores the comparability of two commonly used measures of depressive symptoms in later life: the Euro-D and CES-D scales. Although the two scales were correlated, there were systematic discrepancies in scores by demographic and socioeconomic characteristics. The second empirical chapter adopts a life course approach and examines whether the timing of access to homeownership (early access, defined as before the age of 35) and housing stability are associated with mental health in old age. Findings indicate that early access to the housing ladder and remaining in the same home have a long-run effect on depressive symptoms: it is associated with both a lower level of depressive and a slower age-related decline in mental health. The third empirical chapter evaluates the effect of acquiring a home later in life (after 50) on mental health. Exploiting within-individual changes in housing tenure, I find that becoming homeowner predicted a significant decline in depressive symptoms and that this effect lasts for up to two years before fading away. The final empirical chapter assess the effect of the increase in intergenerational co-residence as a result of the 2008 economic crisis on the mental health of older parents. Results show that co-residence is associated with lower levels of depressive symptoms among older parents.

Empirical contributions. Taken together, the results presented in this thesis underscore the importance of living arrangements as social determinants of mental health in old age. In addition to better-researched factors such as marital status and neighbourhoods characteristics, co-residence and housing tenure might constitute a health advantage in later life. The contributions of the thesis are also methodological. The findings from the exploration of the comparability of the two depressive symptoms score highlight the importance for researchers to be cautious when comparing depressive symptoms levels and associations with risk factors using different measures. The different methods implemented in the empirical chapters are designed to account for the issues of selection and reverse causality. This type of approach could be usefully extended to other types of living arrangements not covered in this thesis.

Implications for policy. Findings suggest that policies encouraging intergenerational support and exchanges, potentially in the form of co-residence, may have benefits for the mental health of older Europeans. The empirical results also add to the growing recognition that homeownership may have public health implications for both current and future

generations. Policies targeted at supporting marginal buyers in acquiring homes may yield important mental health benefits.

Future research directions. Building on the findings that co-residence and homeownership are determinants of depression in old age, a future research agenda should evaluate the mental health effects of policies encouraging these living arrangements (e.g. access to homeownership).

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List of abbreviations

ADLs	Activities of Daily Living
AHEAD	Asset and Health Dynamic Among the Oldest Old
ATT	Average Treatment
CASP-12	Control, Autonomy, Self-realisation and Pleasure scale
CHARLS	China Health, Aging, and Retirement Longitudinal Study
CES-D	Centre for Epidemiologic Studies Depression scale
CODA	Children of the Depression
CRELES	Costa Rican Longevity and Health Aging Study
DALYs	Disability Adjusted Life Years
EBB	Early Baby Boomers
ELSA	English Longitudinal Study of Ageing
GED	General Education Development
HRS	Health and Retirement Study
IADLs	Instrumental Activities of Daily Living
IFLS	Indonesian Family Life Survey
JSTAR	Japanese Study on Aging and Retirement
KLOSA	Korean Longitudinal Study of Aging
LASI	Longitudinal Aging Study in India
LATE	Local Average Treatment Effect
LTV ratio	Loan-To-Value ratio
MHAS	Mexican Health and Ageing Study
MBB	Mid Baby Boomers
NIA	National Institute of Aging
OECD	Organisation for Economic Co-operation and Development
PSM	Propensity Score Matching
SAGE	Study on Global Ageing and Adult Health
SHARE	Survey of Health, Ageing and Retirement in Europe
2SLS	Two-Stage Least Squares
TILDA	Irish Longitudinal Study on Ireland Ageing
IV	Instrumental Variable

Chapter 1

Introduction

1.1. Background: depression in later life and its determinants

Population ageing is one of the major challenges of the 21st century: by 2020 people aged 65 and older will have outnumbered children aged under 5 years (United Nations 2013, Harper 2014). Continuing increases in life expectancy have fuelled considerable research to determine whether these additional years of life would be lived in good or poor health (Fries 1980, Fries 2003). Evidence suggests that cohorts now reaching old age[1] are healthier than their predecessors (Cutler 2001, Manton 2008, Cutler, Ghosh et al. 2013). However, progress has been uneven and important inter-individual variability in healthy ageing remains (Chandola, Ferrie et al. 2007, Mackenbach, Stirbu et al. 2008, Jagger, Gillies et al. 2009, Currie and Schwandt 2016). About a quarter of the variation in health status in old age appears to be due to genetic factors (Brooks-Wilson 2013), with the cumulative effect of social inequalities and health behaviours over the life course accounting for the rest (McGinnis, Williams-Russo et al. 2002, Jagger, Gillies et al. 2009).

The contribution of mental health[2] to healthy ageing has received in the past less attention compared to physical health. However, understanding better the potential determinants of mental health in later life is crucial. Indeed, available projections show

[1]In this thesis, and unless otherwise specified in the text, 'old age' is defined as being aged 50 and older, because it is the age used for inclusion in the main datasets to be used in the empirical chapters. I use old age, older age, late-life and later life as synonymous throughout the thesis.
[2]In the specific context of this thesis, I use 'mental health', 'depression' and depressive symptoms' as synonymous.

that depression will be the leading cause of Disability Adjusted Life Years (DALYs) lost in high-income countries by 2030 (Mathers and Loncar 2006). Depression in old age is the most frequent cause of emotional suffering in later life (Beekman, Copeland et al. 1999). It significantly decreases the quality of life of older adults and has been associated with accelerated ageing, as indicated by a higher associated prevalence of other chronic conditions such as heart disease, stroke and functional disability (Larson, Owens et al. 2001, Blazer 2003, Barth, Schumacher et al. 2004, Arbelaez, Ariyo et al. 2007, Liebetrua, Steen et al. 2008, Covinsky, Yaffe et al. 2010). Depression is also a strong predictor of suicide among older adults (Conwell and Duberstein 2001).

Estimates of the prevalence of depression in the older population vary considerably between countries and depending on the measurement tools. In Western countries, bout 1 to 4% of the population aged 65 and over has major depression[3] (Blazer 2003, Alexopoulos 2005). The prevalence of major depression increases substantially after the ages of 75-80 (Palsson, Ostling et al. 2001, Teresi, Abrams et al. 2001). Rates of major depression in the general population have risen considerably in the recent decades, which suggests that future cohorts of older adults will be more likely to have experienced severe depression over their life course (Compton, Conway et al. 2006). The prevalence of minor depression[4] is higher and has been estimated at around 15% for community-

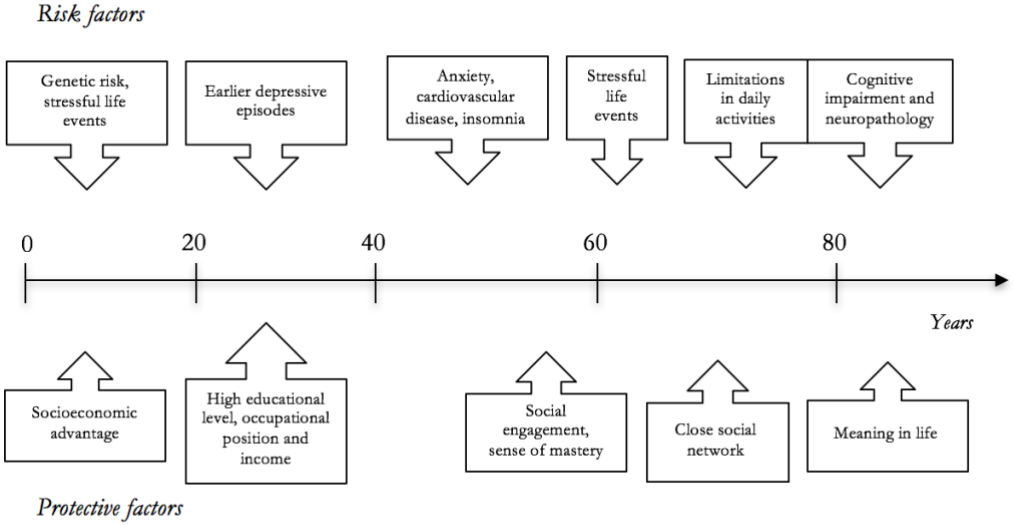
[3]As defined by Alexopolous (2005, p.1962): "Five of the following symptoms must be present: depressed mood, diminished interest, loss of pleasure in all or almost all activities, weight loss or gain (more than 5% of bodyweight), insomnia or hypersomnia, psychomotor agitation or retardation, fatigue, feelings of worthlessness or inappropriate guilt, reduced ability to concentrate, recurrent thoughts of death or suicide. At least one of the symptoms must be either depressed mood or diminished interest or pleasure. The syndrome should last at least 2 weeks, lead to distress or functional impairment, and not be a direct effect of substance use, a medical condition, or bereavement".

[4]As defined by Alexopoulos (2005, p.1962): "At least two but fewer than five of the symptoms of major depressive disorder must be present. The syndrome should last at least 2 weeks, lead to distress or functional impairment, and not be a direct effect of substance use, a medical

dwelling older adults in the US and 18-20% in Europe (Blazer 2003, Castro-Costa, Dewey et al. 2007).

There is a vast literature documenting the key risk factors for depression in later life (Djernes 2006, Vink, Aartsen et al. 2008). Rates of depression tend, for example, to be higher among older women compared to men, although the gender gap in old age is narrower than earlier in the lifespan (Djernes 2006, Fiske, Loebach Wetherell et al. 2009). There is evidence that major depression decreases in early old age compared to middle life (Blazer 2003), but also that subthreshold depressive symptoms are very common in old age (Vink, Aartsen et al. 2008). An overview of risk and protective factors for late-life depression is provided in Figure 1.1.

Figure 1.1. Life course overview of risk and protective factors for late-life depression



Source: Based on evidence reviewed by Djernes 2006; Blazer 2003 and Vink et al. 2008.

The aim of this thesis is to examine whether changes in the way older people live has an impact on late-life depression alongside the factors outlined in Figure 1.1. As noted by

condition, or bereavement. This diagnosis can only be made in patients without a history of major depression, dysthymia, bipolar, or psychotic disorders".

Link and Phelan (1995), a challenge for researchers is to try to understand how social environments place individuals "at risk of risks" or on the contrary constitute a health advantage. A rich body of literature has consequently focused on the effects of neighbourhoods or cities on mental health (e.g. Leventhal and Brooks-Gunn 2003, Galea, Freudenberg et al. 2005, Osypuk, Tchetgen Tchetgen et al. 2013). However, comparatively less research has focused on the immediate social environment of older adults, i.e., their living arrangements (Hughes and Waite 2002). This thesis aims to contribute to address this gap by examining the mental health effects of two types of living arrangements: intergenerational co-residence and housing tenure.

1.2. Motivation: changes in living arrangements in later life in Europe and the US

The immediate social environment formed by the family and how older people organize their living arrangements are particularly salient for their mental health (Hughes and Waite 2002). The presence or absence of a spouse in the household has been the most prominent dimension of living arrangements studied in the literature. Being married and co-habiting has shown consistently positive effects on physical and mental health (for a review: Koball, Moiduddin et al. 2010). However, this previous research does not fully tap into the complexity and evolution of living arrangements in old age, not distinguishing, for example, *among* married couples who also live with their children or have different housing tenures. Possible effects of older people's household structure on health beyond marital cohabitation have been considered in several studies, often focused on one or a few countries (e.g. Netuveli, Wiggins et al. 2006, Gierveld, Dykstra et al. 2012).

It is not possible in this thesis to cover *all* concurrent dimensions of living arrangements and their effects on mental health in old age. I will consequently focus on two important changes in living arrangements in the past decades in Europe and the US: variations in intergenerational co-residence and the rise of homeownership.

1.2.1. Changes in intergenerational co-residence patterns

Since World War II, the number of older people living alone has increased dramatically in most industrialized countries (Glaser, Tomassini et al. 2004). This transformation is of considerable magnitude and has been described as a "quiet demographic revolution" (Elman and Uhlenberg 1995). In 1850, about 70% of White Americans aged 65 and older were co-residing with an adult child. This percentage declined steeply until reaching 13% in 1990, before rising again in 2000 (Ruggles 2007). European countries experienced a similar 'simplification' of the living arrangements of their older populations (Tomassini, Glaser et al. 2004) – with a decrease in the share of older people living with their adult children. Available data show that in the 1950s-1960s, 35-50% of the population aged 65 and over in several Nordic countries and England and Wales were co-habiting with an adult child; this proportion went down to 5-15% in the early 1990s (Grundy 1992, Sundstrom 1994, Grundy 1999).

However, recent years have witnessed a reversal of this trend, largely 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 economic downturn started in 2008 (Kaplan 2012, Kahn, Goldscheider et al. 2013). While some research has characterized these changes (Matsudaira 2016), fewer studies have examined the consequences of co-residing with adult children on the mental health of older parents.

Whether and how these changes have influenced the mental health of older people warrants further evaluation.

1.2.2. Changes in homeownership rates

Changes in homeownership rates have been as remarkable as changes in intergenerational co-residence. During the second half of the 20th Century, many European countries experienced a rapid increase in homeownership rates (Kurz and Blossfeld 2004, Andrews, Caldera Sanchez et al. 2011). Although rates vary considerably across countries, today about 70% of older Europeans and 78% of older Americans own their home (Andrews and Caldera Sanchez 2011, Angelini, Laferrère et al. 2013). Over the past 60 years, homeownership has been the central focus of housing policy in the US and many European countries, based on the premise that homeownership is associated with a range of desirable social outcomes such as children educational outcomes, residential stability and community participation (Rohe, Van Zandt et al. 1991, Rohe and Stewart 1996, Rossi and Weber 1996). Yet, despite its near-universal appeal for both the population and policy-makers, the potential benefits (or harms) of homeownership for health are not fully understood. Social epidemiologists often consider homeownership as a proxy for economic and social status, but its direct health-damaging or health-promoting effects have been less studied.

1.3. Research questions and structure of the thesis

These gaps in the literature give rise to the central research question of this thesis:

What is the effect of changing living arrangements on depressive symptoms in later life in Europe and the US?

This thesis aims to answer this question by focusing on changes in intergenerational co-residence and homeownership patterns. The four sub-questions are as follows:

1. *Are the Euro-D and CES-D scales of depressive symptoms comparable?*
2. *Does the timing of access to homeownership and subsequent residential stability have an impact on depressive symptoms in later life?*
3. *Is acquiring a home in later life associated with lower levels of depressive symptoms?*
4. *Do older parents who co-reside with their adult children have fewer depressive symptoms?*

This section outlines the four sub-questions that form the empirical work of this thesis, including how they fit together, main methods, findings and contributions. The structure of the thesis is then described.

The first empirical chapter – Chapter 4 – assesses the comparability of the two depressive symptoms measures commonly used to measure depression in later life: the Euro-D and the CES-D scales. A growing literature suggests that there are differences in the prevalence of depressive symptoms in later life across countries (Castro-Costa, Dewey et al. 2007, Ploubidis and Grundy 2009, Kok, Avendano-Pabon et al. 2012, Missinne, Vandevive et al. 2014); and also that risk factors may differ depending on the national context (Crimmins, Kim et al. 2011, Siegrist, Lunau et al. 2012, Lunau, Wahrendorf et al. 2013, Di Gessa and Grundy 2014, Riumallo-Herl, Basu et al. 2014). However, these studies have used together different measures of depressive symptoms as outcomes, thus raising a question about the validity of these comparisons as the differences across countries might be in part due to differences across tools. To date, the

comparability of the main depressive symptoms measures used in research focusing on old age has not been systematically assessed. The key research question guiding the first empirical paper is as follows:

Are the Euro-D and CES-D scales of depressive symptoms comparable?

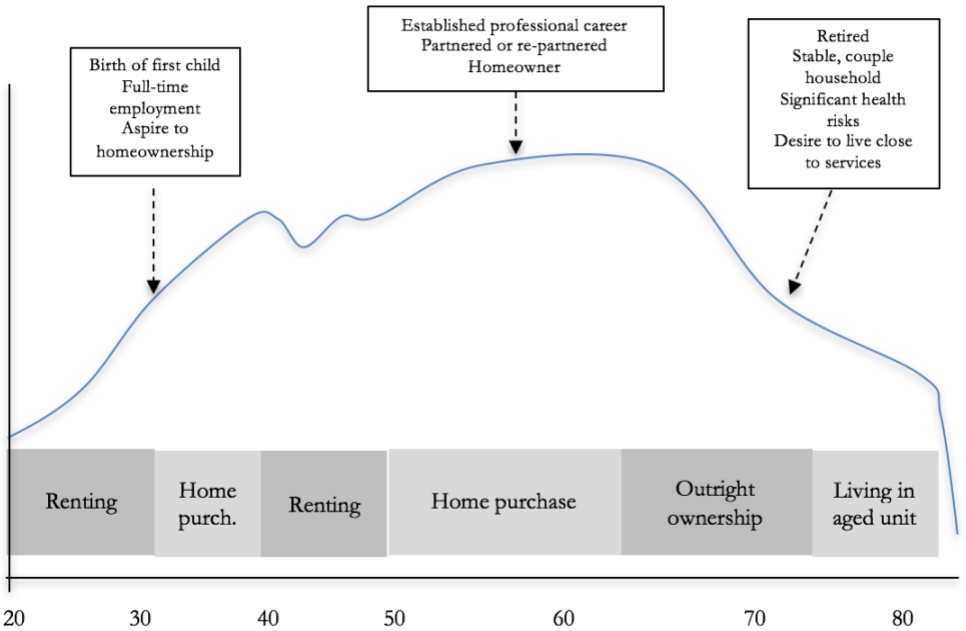
To answer this question, I use data from the second wave of the Survey of Health, Ageing and Retirement in Europe (SHARE), where the two scales have been administered to the same respondents. The chapter examines the comparability of the measures in terms of their distributional properties, population subgroups, sensitivity and specificity and associations with established risk factors for depression in old age. The key methodological contribution of this chapter is to highlight the need for researchers to be cautious when comparing depressive symptom levels and associations with risk factors between surveys that use different measures of depressive symptoms.

The next three empirical chapters of the thesis focus on the effect of living arrangements on depressive symptoms in later life. The sequence of these empirical chapters draws on the literature that described how living arrangements vary over the life course. A large literature has documented a strong association between stages of the life cycle and living arrangements, as households adjust their arrangements depending on their changing demographic, economic and social circumstances.

Figure 1.2 below proposes a schematic overview of a life course approach to living arrangements. As noted by Beer and Faulkner (2011), housing transitions are affected by a combination of age, household structure, economic resources, health and wellbeing, tenure status and values and aspirations. In the first period as described in the figure, the household is establishing itself, and fertility decisions, employment and aspirations to

access the housing ladder are key drivers of decisions related to living arrangements. In the second period, housing wealth has potentially been accumulated and, together with a stable occupation, moving to a new house in a more desirable neighborhood or re-entering the housing market is possible. In the third period, health and wellbeing exert considerable influence on living arrangements – with, for example, the desire to be closer to friends and relatives or to services.

Figure 1.2. Life course approach to living arrangements



Notes: Adapted from Beer and Faulkner (2011)

—— Income over the life course

This representation of decisions related to living arrangements over the life course is intended as a schematic. The aim of empirical chapters 5 to 7 is not to test whether this model or a concurrent one is valid but to understand how different types of living arrangements at different stages of the life course can influence mental health in later life.

The second empirical chapter – Chapter 5 – focuses on the first stages of the life course approach to living arrangements. Although homeownership is often associated in the

literature with better health (e.g. Jones 1995, Dalstra, Kunst et al. 2006, Windle, Burholt et al. 2006, McCann, Grundy et al. 2012), whether the timing of homeownership attainment and residential stability are related to health in old age is unclear. This chapter will consequently examine the impact of owning a home before age 35 on late-life mental health in older Americans. It is guided by the following research question:

Does the timing of access to homeownership and subsequent residential stability have an impact on depressive symptoms in later life?

To answer this question, I use data from the Health and Retirement Study (HRS) and examine whether homeownership by age 35 was associated with mental health levels and trajectories at age 50 and beyond. Using individual fixed-effects and propensity score matching to account for selection into homeownership, I show that early access to homeownership and stability yield long-term mental health benefits in old age, and that financial security (in the form of earlier mortgage repayment and improved financial security) is among the mechanisms involved.

The third empirical chapter – Chapter 6 – looks at the effect of changes in living arrangements in the later stages of the life course. Specifically, I ask whether acquiring a home later in life is associated with positive psychological effects. Historical evidence has shown that access to the housing ladder has been delayed for recent generations (Goodman, Pendall et al. 2015). An important question is consequently whether acquiring a home in later life may still lead to improvements in mental health similar to those observed for younger buyers. The chapter is guided by the following research question:

Is acquiring a home in later life associated with lower levels of depressive symptoms?

I use data from the Health and Retirement Study (HRS) to answer this question. Using individual fixed-effects relating transitions in tenure to transitions in depressive symptoms levels, I show that acquiring a home in later life is associated with lower levels of depressive symptoms in older age, and that this association is sustained for at least two years after the acquisition of the new home.

The final empirical chapter – Chapter 7 – focuses on an important change in living arrangement brought about in part by the by the economic crisis started in 2008: the increase in intergenerational co-residing. Indeed, recent years have seen a reversal in the long-term trend in solo living in old age in industrialized countries. Although several studies have characterized this transformation in intergenerational living arrangements (Matsudaira 2016), its potential effect on the mental health of older parents (aged 50 and over) in Europe is still unclear. The research question for this chapter is the following:

Do older parents who co-reside with their adult children have fewer depressive symptoms?

As for Chapter 6, I use data from SHARE to assess the effects of intergenerational co-residence on mental health in later life. An instrumental variable approach is implemented to account for the issue of reverse causality between co-residence and mental health. In the context of rising youth unemployment rates during the economic crisis in Europe, I find that increased intergenerational exchange between adult children and their parents in the form of co-residence has positive effects on depressive symptoms of older parents.

As further discussed in the literature review and methods sections of this thesis, an important methodological challenge shared by the last three empirical chapters is that of selection into homeownership attainment and co-residence. Those who co-reside with their adult children or become homeowners at different stages of their life course are likely to differ along dimensions also correlated with their mental health (such as early life circumstances, for example). This issue is at the core of the research designs chosen for each empirical chapter. Potential differences by gender were explored in each empirical chapter but not reported as no significant differences were found. Substantive and methodological contributions of the thesis are summarized in Table 1.1 below.

Table 1.1. Overview of the key contributions of the empirical chapters of the thesis

	Research question	What is known on the topic?	What this chapter adds?
Chapter 4	Are the Euro-D and CES-D scales of depressive symptoms comparable?	The two scales have been used alongside each other to examine depression prevalence and risk factors but their comparability has not been assessed to date	*Methodological contribution*: the two scales are broadly comparable but caution should be exercised when using the two in parallel when comparing depressive symptoms prevalence across countries
Chapter 5	Does the timing of access to homeownership and subsequent residential stability have an impact on depressive symptoms in later life?	Homeownership (as opposed to renting) is associated with better health but whether the timing of homeownership and housing stability attainment matter for depressive symptoms in later life is unclear	*Methodological contribution*: Propensity score matching and individual fixed effects are used to address the issue of selection *Substantive contribution*: early access to homeownership

			and residential stability seem to have long-lasting benefits for the mental health of older Americans
Chapter 6	Is acquiring a home in later life associated with lower levels of depressive symptoms?	Homeownership is associated with better health, but whether acquiring a home later in life confers the same benefits as earlier in life is unclear	*Methodological contribution*: A fixed-effects approach is used to deal with selection *Substantive contribution*: Acquiring a home after age 50 is also associated with lower levels of depressive symptoms
Chapter 7	Do older parents who co-reside with their adult children have fewer depressive symptoms?	Intergenerational co-residence has increased as a result of the Great Recession. The impact of this trend on the mental health of older parents is unclear	*Methodological contribution*: An instrumental variable approach is implemented to address the issue of selection *Substantive contribution*: In the context of the Great Recession, intergenerational co-residence is associated with improved mental health of older parents

The aim of this chapter was to set the scene for the thesis by outlining the importance of depressive symptoms in later life and how changes in living arrangements over the life course might impact mental health in old age. The four main empirical chapters, how they fit together and their expected contributions to the literature were then presented.

The rest of this thesis is organized as follows:

Chapter 2 will review the relevant literature and highlight the limitations in what is known of the effect of living arrangements on mental health in later life. The datasets and methods to be used throughout the thesis are described in Chapter 3.

Each of the empirical Chapters 4 to 7 is structured in a similar way: the topic of the chapter is presented in an abstract and the introduction. The data used and the methods are then outlined. Third, the results from the statistical analyses are detailed. And fourth, the main findings are discussed in light of the existing literature, the strengths and limitations of the analyses are presented before conclusions are drawn.

Finally, Chapter 8 brings together the findings of the empirical chapters. After a summary of the key findings, how they fit together and what are the overarching limitations of the work conducted as part of this thesis, I outline the contributions of the thesis as well as policy implications and potential avenues for future research.

Chapter 2

Literature review

This second chapter presents a review of the literature, motivated by two questions: how have the physical and mental health impacts of living arrangements in old age been studied in the existing literature? In what way can research be developed to improve our understanding of the effects of changing living arrangements on depressive symptoms in later life? On that basis, I derive the research questions for the four empirical chapters of the thesis.

The chapter is organized as follows[5]. First, a key prerequisite to the comparison of depression in old age across different settings is the comparability of the outcome measure. I consequently focus this first section on studies that have looked at the comparability of measures of depressive symptoms in old age. Second, I review the available literature on homeownership, with particular attention given to changes over time in those arrangements and impacts on mental health. The third section is organized in a similar fashion but focuses on intergenerational co-residence and depression. At the end of each section I introduce the expected contributions of the empirical chapters.

[5]Performing a systematic literature review in the areas of co-residence and homeownership and their respective impacts on mental health is beyond the scope of this thesis. However, this review offers a comprehensive overview of the extant literature and its limitations. A systematic review would have not been possible as a narrow selection of search terms would likely have meant missing a lot of relevant papers.

2.1. Measuring and comparing depressive symptoms in old age[6]

There is a large literature comparing levels of depressive symptoms across European countries and beyond. In this first section, I describe the developments of this literature: from overcoming the methodological challenges of comparing depression levels measured with different tools with the development of the Euro-D scale to the recent focus on comparing depressive symptoms across sister ageing studies like the English Longitudinal Study of Ageing, the US Health and Retirement Survey and the Survey of Health, Ageing and Retirement in Europe. These surveys include different measures of depression in later life, raising new challenges for cross-national comparisons that the first empirical chapter of this thesis is hoping to contribute to solving.

2.1.2. Comparability across European countries

Considerable cross-national variation in mental health in old age is consistently reported in the literature. Until the development of harmonized measures, it was however not clear whether these differences represented 'real' variations across countries or an artefact due to methodological limitations. In a review of the prevalence of depression in old age, Beekman and colleagues (1999) noted that reported prevalence rates varied considerably across countries. They also noted that these large differences were likely to be attributable to methodological differences across studies included in the review, depending on whether depression was ascertained through psychiatric evaluation, use of diagnostic algorithms or instruments fielded in surveys which measure depressive symptoms (and the latter will be the focus of this thesis).

The validity of cross-national comparisons had indeed long been limited by

[6]The empirical work of this thesis uses the Euro-D and CES-D scales of depressive symptoms. Further details about the two scales and what they measure is given in Chapter 4. This section is centred on discussing how depressive symptoms levels have been compared across countries in previous studies.

methodological challenges and the lack of equivalent data across countries. Between-country differences had been estimated, for instance, *via* the meta-analysis of data from different studies with different sampling designs and populations (Copeland, Beekman et al. 1999); had included only a small sub-sample of patients (Ayuso-Mateos, Vazquez-Barquero et al. 2001, Angst, Gamma et al. 2002); or a unique item for happiness and depression (Hopcroft and Bradley 2007). A review of 27 studies published in 2005 on the size and burden of mental health disorders across Europe concluded that there was little evidence for considerable national differences after accounting for the design, sampling and other methodological differences between studies (Wittchen and Jacobi 2005). Another review published the same year and focused on depression also concluded that variations across country were likely to be partly due to methodological issues (Paykel, Brugha et al. 2005).

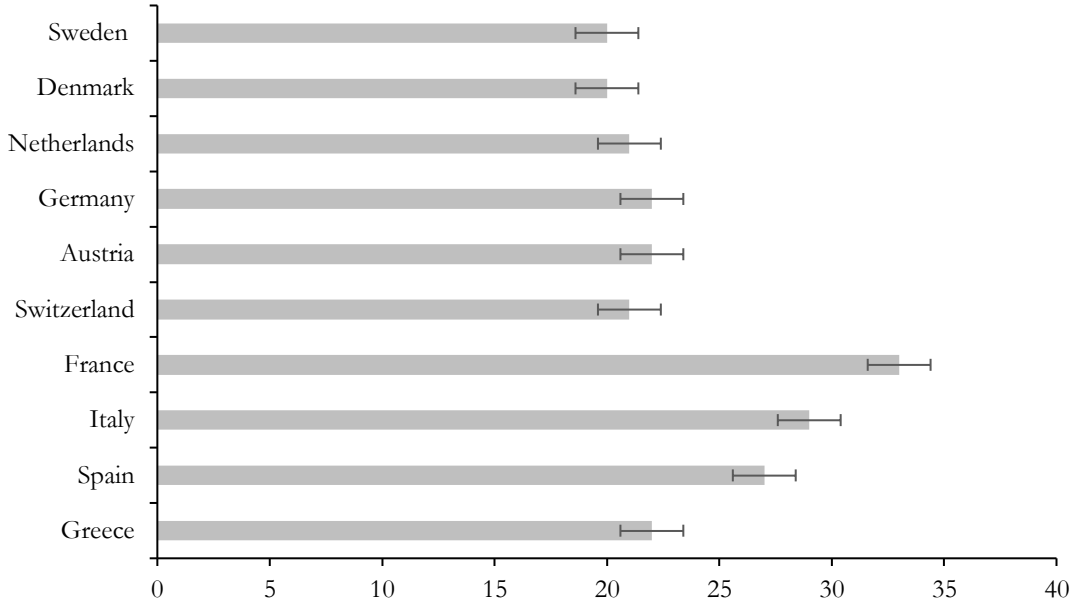
The development of the Survey of Health, Ageing and Retirement in Europe[7] made possible a more robust comparison of depressive symptoms prevalence across the European countries included in the survey (Castro-Costa, Dewey et al. 2007). The survey contains the Euro-D scale of depressive symptoms, a validated measure developed specifically to harmonize data on depressive symptoms in old age in the 11 European countries forming part of the EURODEP study (Prince, Reischies et al. 1999, Prince, Reischies et al. 1999).

Castro-Costa and colleagues (2007) were among the first to make use of the Survey of Health Ageing and Retirement in Europe dataset to compare depressive symptom levels across the ten countries included in the first wave of data. They found significant differences across countries, even after adjusting for compositional differences due to gender, age, duration of education and cognitive function. Figure 2.1 below reports the

[7] Further details about the SHARE dataset are provided in Chapter 3 (data and methods) of this thesis.

prevalence of elevated depressive symptoms across countries, adjusted for gender, age, educational level and cognition.

Figure 2.1. Depression prevalence according to the Euro-D depressive symptoms scale in a selection of European countries



Notes: Prevalence rates and 95% confidence intervals, measured as prevalence of elevated depressive symptoms (defined as Euro-D score of 4 or above) adjusted for gender, age, educational level and cognition (verbal fluency and animal naming scores).
Source: Castro-Costa et al, 2007.

The highest prevalence rates are found in Southern European countries such as France, Italy and Spain. Prevalence rates were 18% to 20% in most other European countries included in the study (Castro-Costa, Dewey et al. 2007).

Despite the improvement in the comparability of the data, a number of challenges to the validity of these comparisons remained. Indeed, a first condition for valid comparison is to ensure that the same concept is being measured in different countries and across gender or different age groups. The studies included in Table 2.1 have all tried to overcome these methodological difficulties. A first group of studies focused on measurement invariance, defined as "the general question […] of whether or not, under different conditions of observing and studying phenomena, measurement operations

yielded measures of the same attribute" (Horn and McArdle 1992, p.117). Castro-Costa and colleagues (2008) used confirmatory factor analysis (CFA) and Rasch modelling to support the validity of the measure and their initial findings on the validity of the Euro-D scale to compare the prevalence and associated risks s of depressive-symptoms across Europe. They found evidence to support the validity of the scale as either a uni-dimensional or bi-dimensional measure (affective suffering and motivation) of depressive symptoms. A similar analysis was conducted for the other measure of depressive symptoms used in this thesis: the eight-item version of the CES-D scale. Van de Velde and colleagues (2010) used multi-group Confirmatory Factor Analysis to eliminate measurement bias in the third wave of the European Social Survey. They confirmed that gender and cross-countries differences in depressive symptoms remained significant after eliminating measurement bias. Missine and colleagues (2014) reproduced this analysis to investigate the measurement equivalence of the CES-D scale across age groups in the SHARE dataset. Their results also indicate that the measure is comparable across age groups and countries. Ploubidis and Grundy (Ploubidis and Grundy 2009) set to investigate the role of country of residence on depressive symptoms using the SHARE data. They established between-country invariance of the Euro-D scale using latent variable modelling. In line with previous studies, they found evidence of considerable cross-national heterogeneity in later-life depression prevalence in Europe. These studies confirmed the patterns described by Castro-Costa, Dewey et al. (2007), with Scandinavian countries exhibiting the lowest levels of depression in later life and Mediterranean countries the highest.

Another methodological challenge is the impact of reporting styles on cross-national differences in self-assessed health in general and depressive symptoms in particular (Salomon, Tandon et al. 2004, Jürges 2007). Indeed, direct comparisons of health

outcomes may be misleading due to country specific response behaviours (Bago d'Uva, Van Doorslaer et al. 2008). Reporting heterogeneity in the case of depressive symptoms was examined using SHARE by Kok and colleagues (2012). Using the anchoring vignettes available for three types of depressive symptoms (mood, sleeping and concentration problems), they found that differences in reporting styles do not explain cross-national and socio-economic differences in depression.

Table 2.1. Overview of the findings of methodological studies comparing depressive symptoms prevalence across Western Europe

Authors	Dataset	Wave	Population	Countries	Measure	Discussion of cross-national differences
Castro-Costa, Dewey et al. (2008)	SHARE	2004	50 and older	11 European countries[1]	Euro-D	Between-country measurement invariance is achieved through confirmatory factor analysis and Rasch modelling. Results show that the Euro-D scale can be used as a uni- or bi-dimensional measure across European countries
Van de Velde, Bracke et al. (2010)	European Social Survey	2006-2007	18-75	25 European countries[2]	CES-D (8 items shorter version)	The focus is on eliminating measurement bias to assess the magnitude of gender differences in depression prevalence. After adjustment, gender and cross-national differences remain significant.
Missinne, Vandevive et al. (2014)	SHARE	2006	50 and older	14 European countries[3]	CES-D (8 items shorter version)	Between-country measurement invariance is achieved through confirmatory factor analysis. Results show that depression levels can be meaningfully compared across age groups and countries.
Ploubidis and Grundy (2009)	SHARE	2004	50 and older	9 European countries[4]	Euro-D and CASP-12 scales	Between-country measurement invariance is established using latent variable modelling. After adjustment for demographic characteristics, there is considerable between-country heterogeneity in both depression and wellbeing.
Kok, Avendano-	SHARE	2004 and	50 and older	10 European	The 3 dimensions of	Reporting heterogeneity does not explain

Pabon et al. (2012)	2006	countries[5]	the Euro-D score included in the vignettes (mood, sleeping and concentration problems)	cross-country differences. These differences are more likely to be explained by different risk factors for depression between countries and socio-economic groups

[1]Sweden, Denmark, Netherlands, Germany, Austria, Switzerland, France, Italy, Spain and Greece.
[2]Austria, Belgium, Bulgaria, Switzerland, Cyprus, Germany, Denmark, Estonia, Spain, Finland, France, UK, Hungary, Ireland, Latvia, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Sweden, Slovenia, Slovakia and Ukraine.
[3]Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland and Belgium.
[4]Denmark, Sweden, Austria, Germany, Netherlands, France, Spain, Italy and Greece.
[5]Denmark, Germany, Netherlands, Belgium, France, Italy, Spain, Greece, Poland, Czech Republic.

2.1.2. Comparability across ageing studies

Researchers have started to compare the drivers of depression in old age beyond the countries covered in SHARE to include survey data from the English Longitudinal Study of Ageing, the Health and Retirement Study (HRS) in the United States and other sister ageing studies (see Table 2.2. for a list of these datasets) in their cross-national comparisons. An obvious advantage of using these surveys together is that they comprise broadly comparable measures on various topics including economic circumstances, health and health behaviours (Börsch-Supan, Hank et al. 2005, Banks, Nazroo et al. 2012, National Institute on Ageing 2014). However, these datasets use different tools to measure depression. The depressive symptom measures used in the sister ageing studies are detailed in Table 2.2. below.

Table 2.2. Overview of the depressive symptoms measures available in the main ageing studies

Dataset	Country	Depressive symptoms measure
Health and Retirement Study (HRS)	United States	8-item CES-D scale
Mexican Health and Ageing Study (MHAS)	Mexico	8-item CES-Dscale
Costa Rican Longevity and Health Aging Study (CRELES)	Costa Rica	15-item Geriatric Depression Scale
English Longitudinal Study of Ageing (ELSA)	England	8-item CES-D scale
Survey of Health, Ageing, and Retirement in Europe	Selected European countries depending on the waves	12-item Euro-D scale
Korean Longitudinal Study of Aging (KLOSA)	Korea	10-item CES-D scale
Indonesia Family Life Survey (IFLS)	Indonesia	10-item CES-D scale
Japanese Study on Aging and Retirement (JSTAR)	Japan	20-item CES-D scale
Study on Global Ageing and Adult Health (SAGE)	China, Ghana, India, Mexico, Russian Federation and South Africa	World Mental Health Survey version of the Composite International Diagnostic Interview and the diagnosis of depression based on the

		International Classification of Diseases (10th revision) Diagnostic Criteria for Research (9 items)
Irish Longitudinal Study on Ageing (TILDA)	Ireland	20-item CES-D scale
China Health, Aging, and Retirement Longitudinal Study (CHARLS)	China	10-item CES-D scale
Longitudinal Aging Study in India (LASI)	India	20-item CES-D scale

With the exception of SHARE, SAGE and CLERES, all surveys include a version of the CES-D scale. Researchers seeking to compare the prevalence of depressive symptoms across surveys and countries will have to include different measures as outcomes.

Recent examples listed in Table 2.3. of such cross-national comparisons include gender differences in self-rated health (including depression) in old age (Crimmins, Kim et al. 2011); the impact of social participation on physical and mental health in later life (Di Gessa and Grundy 2014); the association between psychosocial stress and depression in old age (Siegrist, Lunau et al. 2012, Lunau, Wahrendorf et al. 2013); and the impact of job loss on depression in older ages (Riumallo-Herl, Basu et al. 2014).

These studies have used together the CES-D and Euro-D scales based on their similarities: both instruments are symptoms-oriented, measure the presence or absence of several depressive symptoms, and cover the same types of symptoms. None of the scales is aimed at generating a diagnosis of depression. To date, most studies comparing depression levels across these three surveys have assumed the comparability of these scales without formally testing this assumption. Only two of these studies have further explored the comparability of the scales. First, Riumallo-Herl, Basu et al. (2014) compared the distribution of the two scales and ran their analysis of the effect of job loss on later-life mental on the normalised scales. In sensitivity analyses, they used as outcomes the three items which are common across the two scales: feeling of depression,

restless sleep and life enjoyment. Second, Zamarro, Meijer et al. (2008) concluded in their report that the two scales are too different to be directly compared but could be used to measure individual-level determinants of depression in later life.

Table 2.3. Overview of the studies comparing depressive symptoms levels across ageing studies

Authors	Datasets	Topic	Discussion of comparability of the scales
Crimmins, Kim et al. (2011)	HRS, ELSA and SHARE	Gender differences in self-rated health	No, the EURO-D and CES-D scores are dichotomized based on their validated threshold for elevated depression and the results across dataset are compared
Di Gessa and Grundy (2014)	ELSA and SHARE	Active ageing and self-reported health	No, the EURO-D and CES-D scores are dichotomized based on their validated threshold for elevated depression and the results across dataset are compared
Lunau, Wahrendorf et al. (2013)	HRS, ELSA and SHARE	Work stress and depressive symptoms	No, the EURO-D and CES-D scores are dichotomized based on their validated threshold for elevated depression and the results across dataset are compared
Riumallo-Herl, Basu et al. (2014)	HRS and SHARE	Job loss and depressive symptoms	Yes, the distribution of the Euro-D and CES-D are explored and compared. The two scales are normalised in the main analyses and all models are re-run on the three items that are common across the scales
Siegrist, Lunau et al. (2012)	HRS, ELSA, SHARE and J-STAR	Work stress and depressive symptoms	No, the EURO-D and CES-D scores are dichotomized based on their validated threshold for elevated depression and the results across dataset are compared
Solé-Auró and Crimmins (2013)	HRS, ELSA and SHARE	Healthy ageing	No, the EURO-D and CES-D scores are dichotomized based on their validated threshold for elevated depression and the results across dataset are compared
Zamarro, Meijer et al. (2008)	HRS, ELSA and SHARE	Individual determinants of cognitive function and depression	Yes, given differences in the time frame of the questions, the EURO-D and CES-D are not directly compared but used to compare individual-level drivers of depression in later life

Existing ongoing harmonization efforts have focused on the components of the scales that are comparable across surveys but not on the full scales themselves (Minicuci, Naidoo et al. 2016). Minicuci and colleagues (2016) recommend the use of a dichotomized variable across surveys to indicate whether in the past month or week the respondent has been feeling depressed or sad (a question common to the two scales).

2.1.3. Limitations of the literature and expected contribution of this thesis

Although measurement comparability is an essential pre-requisite for robust comparisons across countries, it is as yet unclear how the CES-D scale compares to the Euro-D scale, and consequently whether cross-national comparisons using these two different measures are valid. Given the implications of depression for healthy ageing, there is a need for research addressing its drivers and consequences across countries. Such research requires in turn reliable tools that accurately measure depression in old age across countries. The comparability of measures of functional limitations across ageing studies has been investigated (Chan, Kasper et al. 2012), but no equivalent assessment has been conducted for mental health measures. In Chapter 4, I exploit data from the second wave of SHARE, which administered both the CES-D and Euro-D scales to a sample of older Europeans in 13 countries to answer the first research question guiding this thesis:

Are the Euro-D and CES-D scales of depressive symptoms comparable?

My aim is to assess the comparability of the scales; their sensitivity and specificity to identify elevated levels of depressive symptoms; and to assess differences in the association of each scale with established risk factors for depression. To my knowledge, this is the first study examining the comparability of the CES-D and Euro-D measures of depressive symptoms.

2.2. Homeownership trends and their impact on health in old age

This second section considers the literature documenting trends in homeownership and their potential effects on health in later life. Changes in homeownership rates have been as remarkable as changes in intergenerational co-residence, especially in the US which will serve as my case study for empirical Chapter 5 and Chapter 6. In many high-income countries, accessing homeownership is considered a valuable goal, often encouraged by pro-homeownership national policies (Li and Yang 2010). Homeownership is considered an important way to accumulate wealth over the life course, and for many individuals, it is the single largest component of their wealth portfolio. Homeownership has also been associated with a range of desirable social outcomes, such as neighbourhood stability, civic engagement and child development and school attendance (Rohe, Van Zandt et al. 1991, Rohe and Stewart 1996).

Yet, despite its near-universal appeal for both the population and policy-makers, the potential benefits (or harms) of homeownership for health are not completely well-understood. Epidemiologists often consider homeownership as a proxy for economic and social status, but its direct health-damaging or health-promoting effects have been less frequently studied.

I will start by presenting the key trends in homeownership in later life and over the life course in Europe and the US. Key determinants of these trends will be presented in a second section. Finally, I will review what is currently known of the impact of owning one's home on health. The main limitations of the literature are related to the issue of selection: homeowners are likely to differ from renters alongside several characteristics, such as family background, also associated with health status in general and depressive symptoms in particular. Housing decisions are closely linked to life course stages. It is,

however, still unclear whether the timing of homeownership and subsequent residential stability matter for health. These gaps in the existing literature will form the basis for the third and fourth expected contributions of this thesis as detailed in Chapter 1: Once selection is accounted for, do the timing of access to homeownership and residential stability have an impact on depressive symptoms? And are the benefits often associated with acquiring a home earlier in life also conferred by accessing homeownership in older age?

2.2.1. Trends in homeownership in Europe and the US

During the second half of the 20th Century, many European countries experienced a rapid increase in homeownership rates (Kurz and Blossfeld 2004, Andrews, Caldera Sanchez et al. 2011). Although rates vary considerably across countries, today about 70% of older Europeans and 78% of older Americans own their home (Andrews and Caldera Sanchez 2011, Angelini, Laferrère et al. 2013). Table 2.4 below presents aggregate homeownership rates across a selection of OECD countries, comparing rates in the 1990s and 2000s.

Table 2.4. Homeownership rates in a selection of OECD countries, 1990-2000

Countries	*Circa 1990s*[1]	*Circa 2000s*[2]
Austria	46.3%	51.6%
Belgium	67.7%	71.7%
Denmark	51%	51.6%
Finland	65.4%	66.0%
France	55.3%	54.8%
Germany	36.3%	41.0%
Italy	64.2%	67.9%
Luxembourg	71.6%	69.3%
Netherlands	47.5%	55.4%
Spain	77.8%	83.2%
Switzerland	33.1%	38.4%
United Kingdom	67.5%	70.7%
United States	66.2%	68.69%

Source: Andrews and Caldera Sanchez (2011)
Notes: [1]1987 for Austria, 1990 for Spain, 1991 for Italy, 1992 for Denmark and

Switzerland, 1994 for France, Germany and the Netherlands, 1995 for Belgium and Finland, 1997 for Luxembourg and the US.
[2]2003 for Australia, 2007 for Germany and the United States.

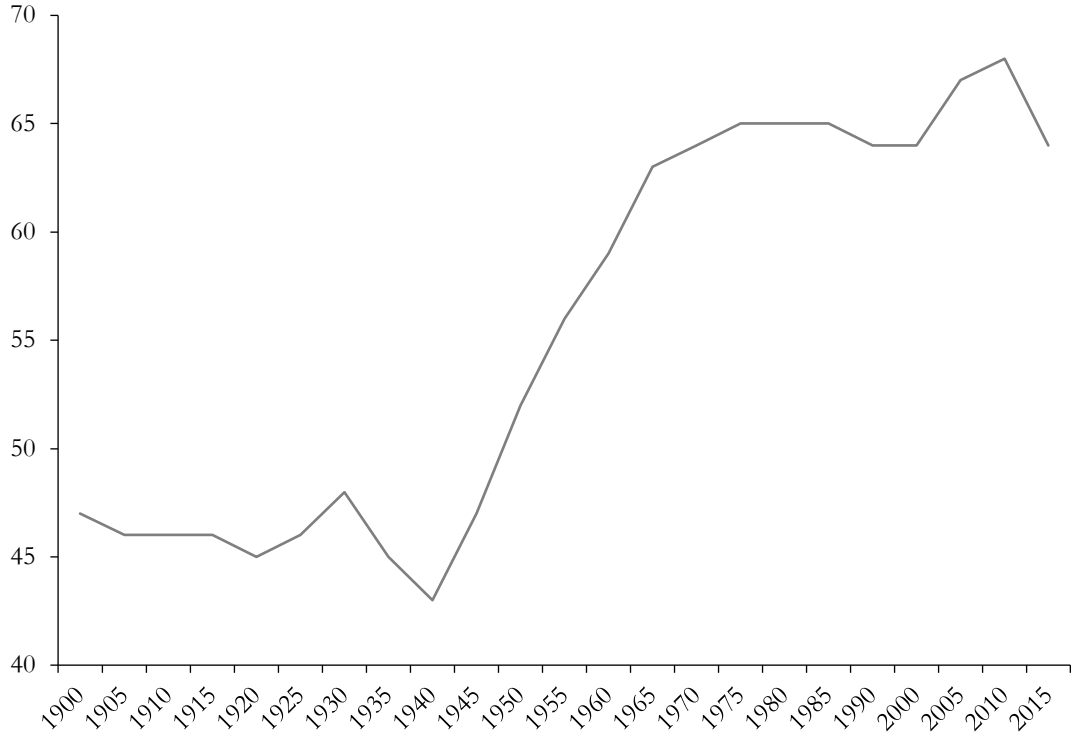
Two trends are evident from this table. First, homeownership rates have increased overall, especially in countries like Spain and Switzerland. Second, there are considerable variations across countries in homeownership rates, with 2000 rates ranging from 41% in Germany to about 70% in countries like Belgium, the UK and the US.

These variations over time and between countries are largely driven by housing policy priorities. European countries differed considerably in their emphasis on homeownership as a social policy objective (Kurz and Blossfeld 2004). In continental Europe, the post-war period was devoted mainly to reconstruction as the housing stock had been largely destroyed (McGuire 1981). A parallel objective in these countries was to ensure that low-income households could access decent housing (Conley and Gifford 2006), through state interventions in public housing, rent-control laws, and subsidies for the private construction of rental housing (Bernardi and Poggio 2004, Kurz 2004, Mulder 2004). Most European countries consequently did not pursue homeownership as a primary social policy objective until the 1960s, and they did so in varied ways (Balchin 2013). The "right-to-buy" policy in the UK in the 1980s was an ambitious programme to promote access to homeownership which came after policies promoting owner occupation, notably tax relief on mortgages. Large numbers of publicly owned social housing were sold to existing tenants as part of the 'right-to-buy' policy (Jones and Murie 2006). In Germany, the policy emphasis in the 1970s was on building privately owned homes, even if they were socially financed (Kleinman 1996). In Italy, the government stimulated purchase by raising the allowable mortgage over the same period (Bernardi and Poggio 2004). In Denmark, a free market strategy was pursued to increase suburban home ownership, whereas in Sweden, a public and social housing strategy was adopted

(Esping-Andersen 1985). These different policy approaches contribute to the differences in homeownership rates across Europe displayed in Table 2.4. For example, in Spain or Italy, more than two-thirds of older adults own a home, and it is often their largest asset. By contrast, in Germany, less than half of households own a home by the time they reach older age (Angelini, Brugiavini et al. 2014).

More complete historical data are available for the US. Homeownership rates from 1900 to 2015 are displayed in Figure 2.2 below. Until World War II, fewer than half of all US homes were owner-occupied. Homeownership rates increased steadily in the post-war period, boosted by economic recovery, the expansion of accessible mortgages and investments in urban developments (Schwartz 2010). The share of homeowners rose from 44% at the end of the Great Depression to 62% in 1960. A first notable decline happened between 1980 and 1986, at a time of increasing interest rates for first time buyers following the recession of the early 1980s. After another increase starting in 1995, US homeownership rates peaked in 2004, at 69% for the entire population. The rate started to decline in 2005 and 2006, before plunging following the foreclosure crisis to reach 63% in 2015 according to the US Census Bureau's Housing Vacancy Survey.

Figure 2.2. Aggregated homeownership rates in the US, 1900-2015



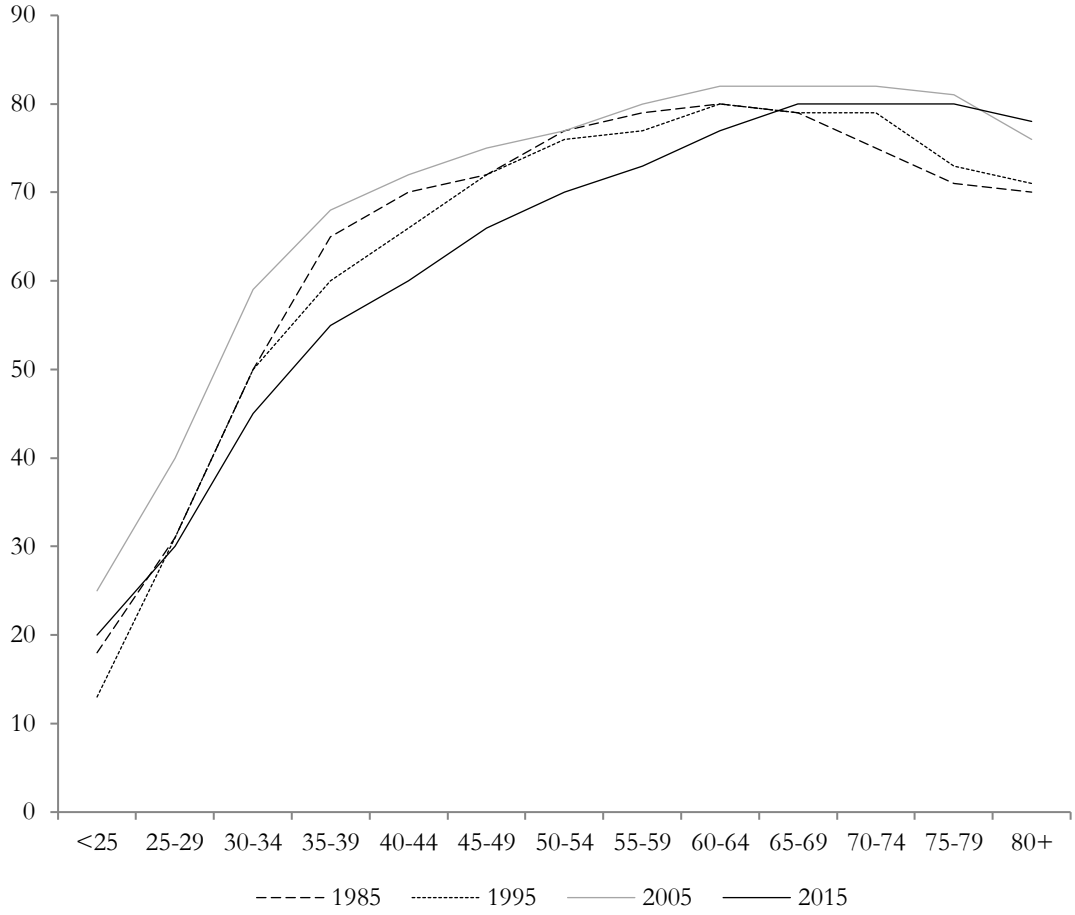
Source: Spader, McCue et al. (2016) based on US Decennial Census, 1900-1960; Housing Vacancy Survey, 1965-2015.

2.2.2. Determinants of homeownership in Europe and the US

Trends in homeownership are driven by a complex array of factors, including favourable economic and employment conditions, changes in individual characteristics and public policies (Spader, McCue et al. 2016). I present the literature on individual-level drivers of homeownership before turning to macro-economic determinants.

High rates of homeownership among older people partly reflect demographic changes and the ageing of the population, with the ageing of cohorts which included large shares of homeowners (Andrews and Caldera Sanchez 2011). Figure 2.3 presents aggregated homeownership rates by age groups (under 25 up to over 80 by five-year age categories) comparing four different periods: 1985, 1995, 2005 and 2015.

Figure 2.3. Homeownership rates by age groups in the US, 1985-2015



Source: Spader, McCue et al. (2016) based on US Census Bureau's Housing Vacancy Survey data.

Although the figure is cross-sectional and consequently influenced by cohort effects, it reveals how much the life course impacts homeownership: it increases steeply between 25 and 34, peaks and then plateaus or declines in later life as older homeowners downsize, live with family members or move to a retirement home. However, the dynamics of homeownership attainment over the life course are changing (Goodman, Pendall et al. 2015). By the eve of the Great Recession in 2008, homeownership rates started to drop and fell for eight consecutive years before reaching their lowest level since the 1980s, with 64.5% of Americans owning a home in 2015 (Joint Center for Housing Studies 2015). This fall in homeownership rates has been particularly dramatic for the generation born around 1965-84, and currently aged 30-50. That generation has

4-5% lower homeownership rates today than baby boomers (born 1946-64, currently aged 50 years and older) of the same age 20 years ago (Joint Center for Housing Studies 2015). There is little evidence of the long-term implications of these trends for the health and wellbeing of current and future generations of older Americans.

In addition to age and life course transitions, other individual-level factors influence the likelihood of homeownership. In the US, homeownership rates are higher among households with higher disposable incomes, and higher levels of education (Andrews and Caldera Sanchez 2011), while they are lower for single-headed households and African American or Hispanic households (Gabriel and Rosenthal 2005). Homeownership rates also vary considerably by ethnicity of the householder. Data presented in Table 2.5 below shows homeownership rates by ethnicity of the householder in the U.S. between 2001 and 2010. For example, at the peak of homeownership rates in 2004, fewer than half of African American and Hispanic households owned a home, compared to more than 70% of white households (Desilva and Elmelech 2012, Kuebler and Tugh 2013).

Table 2.5. Homeownership rates in the US, by ethnicity, 2001-2010 (%)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
US. total	67.4	67.9	68.3	69.0	68.9	68.8	68.1	67.8	67.4	66.9
White, total	71.6	71.8	72.1	72.8	72.7	72.6	72.0	71.7	71.4	71
White, non-Hispanic	74.3	74.5	75.4	76.0	75.8	75.2	75	74.8	74.8	74.4
Black, total	47.4	47.3	48.1	49.1	48.2	47.9	47.2	47.4	46.2	45.4
American Indian	55.4	54.6	54.3	55.6	58.2	58.2	56.9	56.5	56.2	52.3
Asian	53.9	54.7	56.3	59.8	60.1	60.8	60.0	59.5	59.3	58.9
Hispanic	47.3	48.2	46.7	48.1	49.5	49.7	49.7	49.1	48.4	47.5

Notes: Data from the U.S. Census Bureau, IPUMS-CPS, University of Minnesota. The homeownership rate is the percentage of households who are homeowners in the given demographic group.

These ethnic differences are also visible in terms of the timing of access to homeownership. In 2015, the median age of first access to homeownership was 34, but the median age for Black first-time buyers was 38 (Callis and Kresin 2015). As shown in Table 2.6, just over half of Black Americans (56%) owned a home when they reached the age of 55 against 82% of White Americans at the same age.

Table 2.6. Homeownership rates in the US, by age and ethnicity, 2014 (%)

	White	Black	Hispanic	Asian	Other
25-34	48	19	30	33	40
35-44	70	38	45	60	50
45-54	79	51	56	75	63
55-64	82	56	59	75	71
65-74	85	63	63	73	70
75 and over	82	67	68	63	74
Total	72	46	48	60	58

Notes: Data from the U.S. Census Bureau, IPUMS-CPS, University of Minnesota. The homeownership rate is the percentage of households who are homeowners in the given demographic group.

Health problems are also associated with a lower likelihood of homeownership, possibly reflecting the financial strain associated with illness (Andrews and Caldera Sanchez 2011). Yet, these household characteristics do not completely account for changes in homeownership rates. They are also attributable to active national policies that incentivized homeownership (Balchin 2013), such as preferential tax treatment of housing investments and measures to increase access to credit (Andrews, Caldera Sanchez et al. 2011, Fetter 2013). In most European countries, financial deregulation has been associated with an increase in homeownership especially among financially constrained households, via a reduction of the down payments. Empirical research shows that from the late 1970s until the early 1990s, homeownership rates tended to

increase in countries where the typical Loan-to-Value ratio[8] rose, particularly among younger households (Jappelli and Pagano 1989, Chiuri and Jappelli 2003). Homeownership has also been advocated by the US government through interventions in the mortgage market targeting, for example, marginal buyers, war veterans or rent control measures (Fetter 2013, Fetter 2014, Fetter 2016).

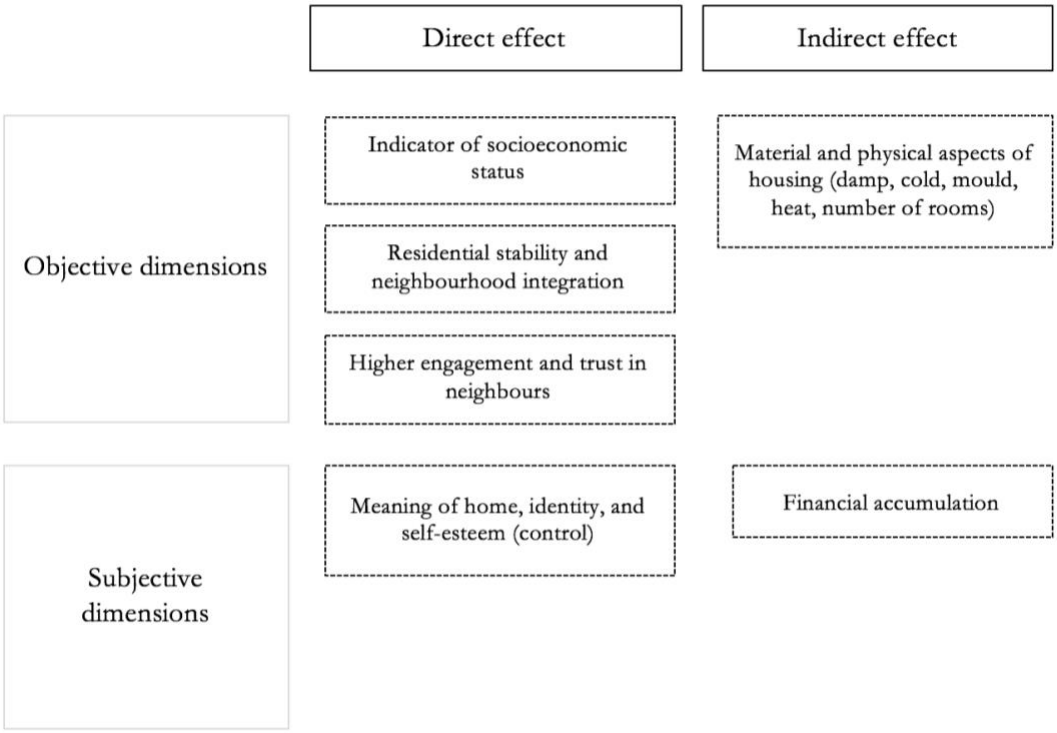
2.2.3. Associations with mental and physical health in later life

The main argument behind pro-homeownership policies is the assumption that owning a home brings important benefits for individuals, families and society more broadly (Rohe, Van Zandt et al. 1991, Rohe and Stewart 1996, Rossi and Weber 1996). For example, research suggests that owning a home is associated with better educational outcomes for children (Green and White 1997, Haurin, Parcel et al. 2002, Dietz and Haurin 2003), social participation and voting behaviour – *e.g.* promoting more investment in green spaces in their neighbourhood (DiPasquale and Glaeser 1999, Engelhardt, Eriksen et al. 2010). I first review the different mechanisms linking homeownership to mental health which have been proposed in the literature. The key findings of the research investigating the impact of homeownership on health as well as their limitations are then presented.

Previous research provides evidence of both direct and indirect pathways through which homeownership may benefit mental health in old age. These pathways are summarized in Figure 2.4.

[8]The Loan-to-Value (LTV) is the ratio between the value of the mortgage and the appraised value of a property. The LTV ratio is a measure of the availability of credit to households: a higher LTV ratio indicates that banks are more likely to approve mortgages with lower down-payments.

Figure 2.4. Overview of the pathways through which homeownership might affect mental health in later life



Source: adapted from Shaw (2004)

Direct mechanisms include higher sense of control and self-esteem (Dupuis 1998, Macintyre 1998, Hiscock, Kearns et al. 2001) and residential stability and social integration (Dietz and Haurin 2003), which in turn may be associated with mental health benefits (Stillman and Liang 2010, Manturuk 2012). Homeownership provides people with an 'ontological security' which might have a positive impact on mental health by promoting a general sense of well-being and a sense of financial security in older age (Netten and Darton 2003, Conley and Gifford 2006).

Indirect mechanisms are social and economic benefits of owning one's home which could have been attained without being a homeowner (Finnigan 2014). They include mainly higher housing quality and wealth accumulation. Homeowners are more likely to live in larger and better-maintained dwellings (Friedman and Rosenbaum 2004), which is associated with lower levels of mental distress and better positive affect (Evans, Wells et

al. 2000, Evans, Wells et al. 2003). Homeownership is also a key vehicle for wealth accumulation. It provides individuals with additional assets that can be drawn upon in times of need. Rasmussen and colleagues (1997) argue that home equity can be used by older people to cover the increasing out-of-pocket costs of health and long-term care, suggesting that they are able to afford a higher level of care and consequently remain healthier longer. Owning one's home is indeed considered as a social insurance mechanism (Conley and Gifford 2006). Earlier in the life course, when unemployment or other financial crises strike, housing equity may assist during difficult financial circumstances (Sherradan 1991). In old age, as mortgages are often paid off before owners retire, it can dramatically reduce costs of living at a time when income may decline (Conley and Gifford 2006). Page-Adams and Vosler (1997) have also argued that economic crises have left people economically vulnerable and that homeowners might be in a better position to handle this vulnerability as they have assets in the form of housing on which they could rely in difficult economic times.

Homeownership may however have undesirable effects that may influence negatively mental health in older age. Homeownership often occurs at the expense of major indebtedness, which may be difficult to maintain for disadvantaged households (Alley, Lloyd et al. 2011, McLaughlin, Nandi et al. 2012, Charters, Harper et al. 2016). For those unable to secure mortgage payments, this may result in the loss of a dwelling, major financial losses, substantial insecurity and the onset of mental illness (Nettleton and Burrows 1998, Nettleton and Burrows 2000, Smith, Searle et al. 2009, Alley, Lloyd et al. 2011, McLaughlin, Nandi et al. 2012, Charters, Harper et al. 2016). Some studies in the US also suggest that, compared to renters, homeowners face a higher risk of unemployment in mid-adulthood because of reduced flexibility to move to jobs located

outside of their commuting range (Oswald 1996, Munch, Rosholm et al. 2006, Battu, Ma et al. 2008). These mechanisms question the premise that homeownership is invariably good for health.

Given the "multi-directional circuitry linking housing and health" (Smith 2012 p.42), it is difficult to determine whether homeownership has a positive or detrimental effect on depression in old age. A tenure status variable is often included as a control in studies of physical or mental health but it has been more rarely the main focus of these studies. In the epidemiological literature, homeownership is often used as an indicator of socioeconomic status and some studies even use ownership as a substitute for income, occupational class or educational level (Macintyre 1998, Dalstra, Kunst et al. 2006). Ownership is strongly correlated with these variables and owning a home is often the largest asset in a household's portfolio in old age. Accumulated disadvantage over the life course in terms of household wealth (and in particular housing wealth) is a strong predictor of mortality and poor health in later life (Demakakos, Biddulph et al. 2016).

There is an apparent consensus in the literature on the benefits of homeownership on a range of health outcomes over the life course and mortality. Those who live in rented housing have more long-term illnesses, report poorer general health and have higher mortality than those who own a home. Table 2.7. presents an overview of the papers which have looked at the association between homeownership and health.

A first group of papers has focused on associations between owning one's home and self-rated health. Dalstra and colleagues (2006) compared the effect of education, income and housing tenure on the self-rated health of older Europeans aged 60-79 years. Health

differences associated with housing tenure were smaller than those due to income and education, but nevertheless significant. Homeownership seemed to have a protective effect on the health of older respondents specifically in countries like England and the Netherlands. Howden-Chapman and her co-authors (2011) investigated the effect of homeownership and housing on the mental health and self-rated health of older people using the UK Whitehall II study[9]. They found that the negative effect of renting *vs.* owning on mental health is evident at baseline but diminishes over time, when other aspects such as housing quality become more important. These findings echo those of Windle, Burholt et al. (2006) who showed that housing tenure predicted health in old age, and that this association was partly mediated by poorer housing conditions in rented properties. Finally, Finnigan (2014) analysed data from the US 2012 March Current Population Survey to demonstrate that there was racial stratification in the association between homeownership and self-rated health. The homeownership advantage was much larger in the white population.

A second group of studies has looked at a combination of health outcomes, consistently finding a positive effect of homeownership in general health, cardiometabolic health and number of long-term illnesses (Macintyre 1998); self-rated health and nursing/residential home admissions (McCann, Grundy et al. 2012); mental health, long-term illnesses and GP consultations (Hiscock, Macintyre et al. 2003).

Finally, Laaksonen and colleagues (2008) used Finnish registry data to investigate whether living in rented housing is linked to all-cause and cause-specific mortality. They find that compared to homeowners, renters had higher mortality risk, in particular for alcohol-related diseases, respiratory diseases, lung cancer, endocrine, metabolic and

[9]Further details on the Whitehall II study are available at: http://www.ucl.ac.uk/whitehallII [last accessed 23/06/2017].

nutritional diseases and infections. These associations remained after controlling for income, occupation and education.

Whether the association between homeownership and health is causal has not been well established. For example, homeowners tend to have higher educational levels and income, better employment prospects, and a wealthier parental socioeconomic background to start with. Homeownership has been shown to often increase residential stability, which is in turn associated with better health over the life course. It is however not clear whether homeownership itself creates stability or whether homeowners are a selected group of more stable and richer households. Reverse causality is also a major concern. Healthier individuals enjoy longer and more stable employment careers, enhancing their ability to accumulate wealth and access to housing finance credit (Andrews and Caldera Sanchez 2011). The association between housing tenure and health is thus likely to be at least partly explained by these multiple influences, and may not exclusively arise from direct beneficial effects of homeownership on health. For example, a number of studies reopened the question of whether homeownership is beneficial for children's outcomes (Mohanty and Raut 2009). Once selection is partly accounted for with an instrumental variable approach or propensity score matching, little evidence of the beneficial effects of homeownership remains (Galster, Marcotte et al. 2007, Barker and Miller 2009).

Table 2.7. Overview of empirical studies assessing the association between homeownership and health in adulthood and/or later life (by alphabetical order)

Authors	Country and dataset	Outcome of interest	Population of interest	Approach	Key findings
Dalstra, Kunst et al. (2006)	National surveys from 10 European countries: Finland, Norway, Denmark, Great Britain, the Netherlands, Belgium, France, Austria, Italy, Catalonia and Spain	Self-rated health	Older Europeans aged 60-79 years	Multiple logistic regression analyses	Compared to education and income, health differences due to housing tenure were smaller but significant, with homeownership associated with better self-reported health. In Great Britain and the Netherlands, housing tenure demonstrated the largest health differences.
Finnigan (2014)	2012 March Current Population Survey	Self-rated health	Americans aged 18 to over 80	Multivariate regression analyses	All homeowners experience a significant health advantage, but Whites benefit more than Blacks and Hispanics.
Hiscock, Macintyre et al. (2003)	Stratified random sample of Scottish adults	Limiting long-standing illness, general health, GP consultations and mental health (Hospital Anxiety and Depression Scale).	Scottish respondents aged 18 to over 80	Multivariate regression analyses	Owner-occupiers reported better health overall than social renter, although part of these differences were explained by individual characteristics such as age, gender and income.
Howden-Chapman, Chandola et al. (2011)	Whitehall II	General Health Questionnaire score	Office-based British civil servants (1985-2009) aged 35-55 at baseline	Multivariate regression analyses	The positive mental health effect of owning one's home diminishes as people get older.

Laaksonen, Martikainen et al. (2008)	Finnish register data	All-cause and cause-specific mortality	Every seventh Finn aged 40 to 80 years old at the end of 1997	Cox proportional hazard ratios	Owner-occupiers have a lower mortality risk than renters, even after adjustment for income, occupation and educational attainment.
Macintyre (1998)	West of Scotland Twenty-07 study	General Health Questionnaire, respiratory function, waist/hip ratio, number of longstanding illnesses, number of symptoms in the last month and systolic blood pressure	Residents if the West of Scotland, in their late 50s	Multivariate regression analyses	Homeownership is associated with better health across a range of outcomes and after controlling for income and psychological traits.
McCann, Grundy et al. (2012)	Northern Ireland Longitudinal Study	Care home admissions, limiting long-term illness and self-rated health	Residents of Northern Ireland aged 65 and over	Cox proportional hazard ratios	Homeowners were less likely to be admitted to care homes compared to renters and had higher self-rated health and lower likelihood of have a limiting long-tern illness.
Windle, Burholt et al. (2006)	Random sample of Wales residents	Self-rated health	Wales residents aged 70 to 99	Multivariate regression analyses	Owner occupiers reported less housing difficulties and better self-rated health than renters.

To my knowledge, only three published papers and a working paper have tried to establish whether the link between homeownership and adult health was causal or due to selection. These studies have focused on young adults in Australia, England and the US and have produced mixed findings. Using propensity score matching, Manturuk (2012) found that homeownership had a positive impact on mental health, entirely mediated by sense of control. Pierse, Carter et al. (2016) looked at the longitudinal association between tenure and psychological distress using individual fixed-effects to account for selection into tenure type. They found that the large cross-sectional associations between renting and psychological distress were not confirmed in longitudinal models. Using the same research design, Stillman and Liang (2010) found to the contrary that becoming a homeowner was associated with higher life satisfaction.

2.2.4. Limitations of the literature and expected contribution of this thesis

Over the last sixty years, homeownership has been the central focus of housing policy in the US and many European countries (Kurz and Blossfeld 2004), based on the premise that homeownership is associated with a range of desirable social outcomes, including better health. A common caveat of existing studies, however, is a lack of understanding of the causal nature of this relationship. In particular, it is not possible to establish from most existing studies whether this association results from selection into homeownership or whether owning a home may indeed lead to better long-term mental health.

Chapter 5 and Chapter 6 of this thesis will aim to address this gap in the literature. Specifically, Chapter 5 will ask whether the timing of access to homeownership and subsequent residential stability matter for later life mental health. Indeed, prior studies looking at the effect of homeownership on health have focused primarily on

contemporaneous associations, and no study to date has examined the long-run effect of homeownership, or how access to homeownership in early adulthood relates to health in older ages. However, the age at which an individual makes the transition from renting to owning matters since it affects his/her ability to remain a homeowner or to purchase a better home in the future, as well as retirement savings by altering the length of time over which the individual benefits from an owned home's price appreciation (Morrow-Jones and Wenning 2005) – conditional on the appreciation in value over time. Homeownership duration has indeed been found to have the strongest positive effect on wealth accumulation (Di, Belsky et al. 2007, Turner and Luea 2009). Early homeowners may thus be able to reap larger benefits from homeownership relative to late homebuyers or households that do not access the housing ladder. Chapter 5 will be guided by the following research question:

Is there a mental health advantage in later life conferred to those who accessed the housing ladder by the age of 35 and remained in the same home?

Historical evidence also shows that accessing homeownership has been delayed for recent generations. An important question is whether acquiring a home in later life may still lead to improvements in mental health similar to those observed for younger buyers. Chapter 6 will consequently answer the following research question:

Is acquiring a home in later life associated with lower levels of depressive symptoms?

Further details about the research design are given in each of my subsequent chapters, but in brief a combination of propensity score matching and fixed-effects will be used to address the issue of selection described earlier in this literature review.

2.3. Patterns of intergenerational co-residence and their impact on health in later life

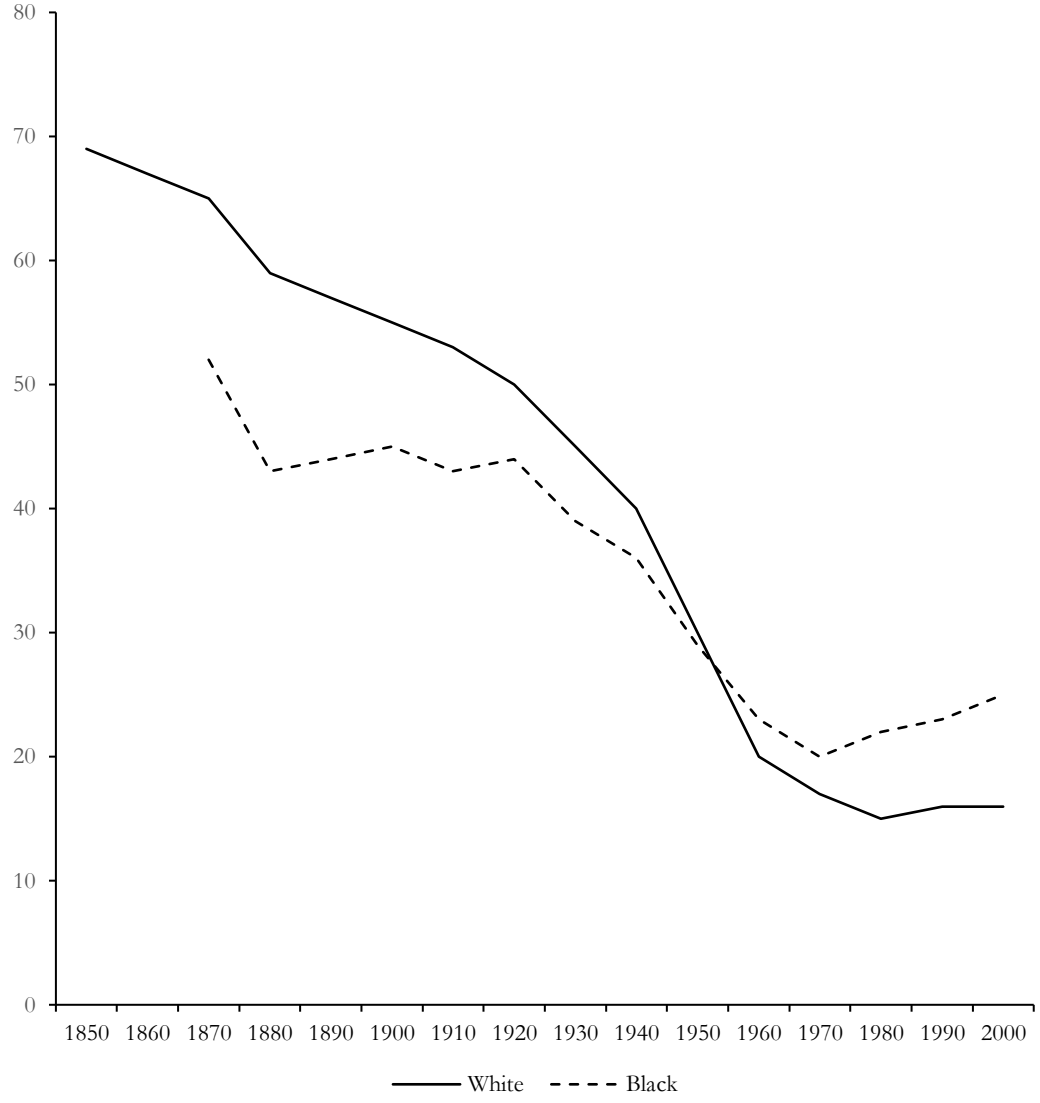
Since World War II, the number of older people living alone has increased dramatically in most industrialized countries (Glaser, Tomassini et al. 2004). While there are multiple explanations for these trends, one of the major drivers has been a rise in the proportion of people living without their adult children in older age (Gratton and Gutmann 2010). However, recent years have witnessed a reversal of this trend, attributed in part 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 (Kaplan 2012, Kahn, Goldscheider et al. 2013). While some research has characterized these changes (Matsudaira 2016), fewer studies have examined the consequences of co-residing with adult children on the mental health of older parents. In this section, I first describe long-term and recent trends in intergenerational living in Europe and the US. Second, I review the determinants of this specific type of living arrangements. Finally, I describe what is currently known of the potential impact of co-residence on the mental health of older people. The limitations of the literature linking co-residence to mental health serve as the basis for the second expected contribution of this thesis: Once the issue of reverse causality is partly accounted for, what is the impact of intergenerational co-residence on depressive symptoms in later life?

2.3.1. Trends in intergenerational co-residence in Europe and the US

Older people in Europe and the US have become more likely to live alone and less likely to co-reside with adult children or other relatives since World War II (Tomassini, Glaser et al. 2004, Ruggles 2007). This transformation is of considerable magnitude and has been described as a "quiet demographic revolution" (Elman and Uhlenberg 1995).

Figure 2.5 displays this dramatic shift in the proportion of older people aged 65 and over co-residing with their adult children in the US between 1850 and 2000. In 1850, about 70% of White Americans aged 65 and over were cohabiting with an adult child. This percentage declined steeply until reaching 13% in 1990, before rising again in 2000 (Ruggles 2007). The trend among African Americans, unmarried men and women and married couples was broadly similar in the US (Ruggles and Brower 2003).

Figure 2.5. Share of older people aged 65 and over co-residing with their adult children in the US by ethnic background, 1850-2000



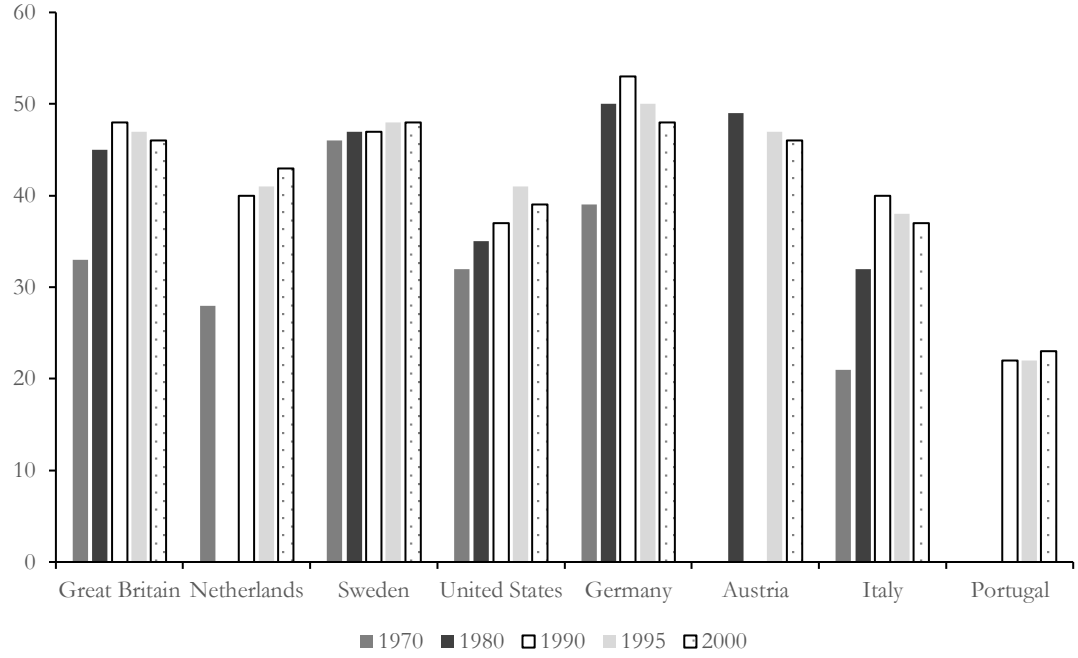
Sources: (Ruggles, Sobek et al. 2004, Ruggles 2007)

European countries experienced a similar 'simplification' of the living arrangements of their older population (Tomassini, Glaser et al. 2004), with exceptions in Eastern European countries like Ukraine which were affected by major economic and political changes and saw a rise in their intergenerational co-residence rates (Bezrukov and Foigt 2002). Available data shows that in the 1950s and 1960s, 35-50% of the population aged 65 and over in a number of Nordic countries and England and Wales were co-habiting

with an adult child; this proportion went down to 5-15% in the early 1990s (Grundy 1992, Sundstrom 1994, Grundy 1999).

Figure 2.6 gives an overview of these trends for one indicator for which comparable historical data are available: the share of older women aged 65 and over living alone (Tomassini, Glaser et al. 2004). There is a clear increase in the proportion of women living alone in all countries between the 1970s and the beginning of the 1990s. The proportion of older women living alone almost doubled in Italy between 1970 and 1990 and increased regularly during that time in countries like the US and Sweden. Starting in 1990, the trend reversed in Italy, Germany and Austria; stabilized in Sweden, US and Britain; but continued in Portugal and the Netherlands.

Figure 2.6. Share of women aged 65 and over living alone in private households in a selection of countries, 1970-2000



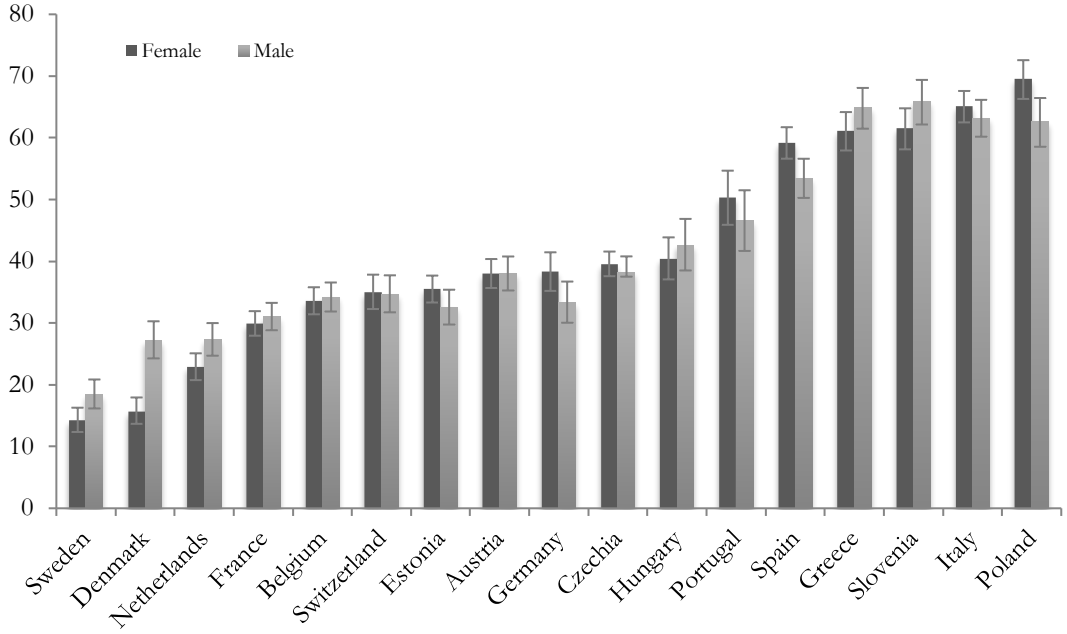
Source: Tomassini, Glaser et al. (2004). Data sources used by the authors - Great Britain: 1971, 1981, 1991, 2001 censuses; 1994 General Household Survey. Italy: 1971, 1981, 1991 censuses; 1994 and 2000 ISTAT's Indagine Multiscopo sulle Famiglie Italiane. Netherlands: 1970, 1980, 1990, 1995, 2000 CBS Monthly statistics. Sweden: 1970, 1989, 1997 ECHP; 2000 Statistics Sweden level of Living Survey. US: US Population Reports, P-20 series. Portugal: 1991, 2001 censuses. Germany: 1970, 1980 (West Germany only). 1991, 1996, 2000 HRSG.

Europe is characterised by substantial cross-national variations in living arrangements. The evidence consistently shows that intergenerational co-residence is more frequent in Southern than in Northern European countries (Tomassini, Glaser et al. 2004, Isengard and Szydlik 2012). Figure 2.7 presents rates of co-residence across a number of European countries included in the SHARE dataset, by gender and for respondents age 50 and over.[10] Overall, 39% of the SHARE respondents reported living with an adult child, but this ranged from 16.2% in Sweden overall to 66.6% in Poland. Co-residing with an adult child was also common in Greece, Italy, Slovenia, Portugal and Spain. This

[10] All countries included in the SHARE dataset are presented in Chapter 3 (Data and methods).

geographical pattern is consistently reported in the literature (Murphy 2008, Isengard and Szydlik 2012, Aranda 2015).

Figure 2.7. Share of older adults aged 50 and over co-residing with an adult child in a selection of European countries, by country and gender, 2004-2010 (pooled sample)



Source: Survey of Health Ageing and Retirement, pooled data waves 1, 2 and 4 (2004, 2006 and 2010).

2.3.2. Determinants of intergenerational co-residence in Europe and the US

The changes described in the previous section have been linked to demographic, cultural and economic factors (Hank 2007). In this second section, I give an overview of findings from studies which have looked into these three major determinants of intergenerational co-residence in Europe and the US.

Demographically, the likelihood of co-residing is driven by characteristics of both children and parents. Mortality declines have led to a higher number of people surviving to older ages and improvements in later life health have been hypothesised to increase the ability of older people to live independently (Schoeni 1997, Kahn, Goldscheider et al.

2013). The drivers of intergenerational co-residence vary depending on the age of older parents and different mechanisms are relevant at different stages of old age. The relationship between age of the parents and intergenerational co-residence has been described as curvilinear: older people are less likely to co-reside in early old age but the probability increases again after 70 (Lin and Rogerson 1995). Children's home leaving age is a key factor for young older people (aged 50 to 65) and varies considerably across Europe (Iacovou 2002). It is often associated with entry into higher education in Northern Europe *vs* family formation in Southern Europe (Billari, Philipov et al. 2001). As parents age, co-residence arrangements are more likely to result from parental needs due to declining health (Silverstein 1995). Marital status is also an important determinant of intergenerational co-residence after 70. Widows, especially in poor health, are more likely to co-reside with their adult children than their divorced or separated counterparts or married women (Hank 2007, Isengard and Szydlik 2012). Divorced fathers, in contrast, are less likely to co-reside with their children than are married parents (Shapiro 2003). Unmarried and childless adult children are the most likely to co-reside with their parents (Choi 2003, Seltzer and Freidman 2014). Gender also matters: mothers have higher likelihood of co-residence compared to fathers (in large part because women are much less likely to still be married in older age) and adult daughters seem to co-reside more often than adult sons (Seltzer and Freidman 2014)– although there is evidence to show that it depends on the age and care needs of the parents (Schmertmann, Boyd et al. 2000).

The large cross-national differences observed across Europe and the US have also been associated with historical and cultural influences (Murphy 2008) and welfare regimes (Albertini, Kohli et al. 2007, Saraceno and Keck 2010). Hank (2007) distinguishes

between three European 'family culture areas': (a) north-western and central Europe where families increasingly live apart; (b) eastern and south-eastern Europe, where multigenerational cohabitation is common; and (c) southern Europe, where tight family links coexist with extended family patterns. These different regional patterns correspond to cultural preferences and expectations regarding intergenerational relationships and long-term care (Motel-Klingebiel, Tesch-Romer et al. 2005).

A number of socioeconomic factors also influence the likelihood of intergenerational co-residing. At the level of older parents first, the expansion of Social Security benefits and the creation of private pensions in the US made living independently in later life more possible (McGarry and Schoeni 2000). Higher incomes overall are associated with a higher likelihood of independent living for older people (Schwartz, Danziger et al. 1984, Costa 1999). Housing tenure is also an influence on intergenerational proximity (Shelton and Grundy 2000). In countries like Italy, where younger generations rely more heavily on their parents to access the housing ladder, parents have been hypothesized to have more influence on where adult children live: close or in the same building (Glaser and Tomassini 2000, Tomassini, Wolf et al. 2003). Greater educational achievement of both parents and children is associated with a lower likelihood of co-residing, in part due to the greater occupational opportunities conferred to children with higher educational achievement. At the child level, there is extensive evidence that higher income and lower unemployment rates are associated with a lower likelihood of co-residing with older parents (Card and Lemieux 1997, Aassve, Billari et al. 2002, Manacorda and Moretti 2006, Iacovou 2010, Wiermers 2014).

Macro-economic factors also have been hypothesized to partly explain the stabilization – across a number of industrialized countries – in the rates of older people living alone

after the 1990s (Tomassini, Glaser et al. 2004). Recent years have even witnessed a reversal of the trend, attributed to adult children staying longer at the parental home or moving back to face the high youth unemployment rates linked to the economic crisis. This trend has been mainly documented in the UK and the US to date, but earlier research in Europe points to the effect of longer training periods and economic uncertainties on the decision of young adults to remain or stay longer at the parental home (Ogg and Renaut 2006). In the UK, Stone, Berrington et al. (2014) used data from the British Household Panel Survey to demonstrate that specific 'turning points' such as completing higher education, unemployment or divorce are the main determinants of young adults' return to their parental home.

In the US, there is considerable anecdotal evidence of young adults deciding to remain or return to the parental home after the 2008 economic downturn as they could not afford to live independently (Kaplan 2012, Kahn, Goldscheider et al. 2013). However, as also shown in Figure 2.2 above, previous research had noted that the proportion of young adults living in the parental home had started to increase again in the 1990s (Ruggles 2007). It is therefore difficult to determine whether the current increase is the continuation of a long-term trend or a result of the economic recession.

Three studies have tried to disentangle historical trends from the effect of the economic crisis and bear particular relevance for this thesis. Matsudaira (2016) estimated how much of this increase in intergenerational co-residence was due to higher housing costs and unemployment rates as a consequence of the economic crisis. Linking data on individual living arrangements of young adults aged 19 to 34 between 1960 and 2011 to the level of unemployment, wages and housing costs in their state of residence, he found that changes in economic conditions causally explained large shares of the changes in co-residence. Economic factors explained 70 to 80% of the change in living arrangements

among men, and 50 to 60% among women (Matsudaira 2016). The effect of economic conditions on the living arrangements of young adults was found across all gender, race, and education subgroups (Matsudaira 2016). This research complements previous evidence from Kahn, Goldscheider et al. (2013). Using US census data, the authors examined whether changes in the financial well-being of different generations are linked to the likelihood of intergenerational co-residence between 1960 and 2010. They found that in the context of the downturn economic considerations have become more salient in young adults' decisions to co-reside, and less important in older adults' decisions to co-reside. They conclude that patterns of intergenerational co-residence broadly parallel trends towards improved economic security of older generations and increased financial strain of younger generations. Specifically, for the period 2000-2010 which will be the focus of the analyses conducted in this thesis, the authors find a 50% increase in the likelihood of young adults aged 20 to 35 having to return to their parents' home in response to unemployment, home foreclosures and divorce. In contrast, for the same period, older people aged 65 and over saw their probability of moving in with an adult child increase only by 5% (Kahn, Goldscheider et al. 2013). The growing financial instability of young adults and its impact on co-residence patterns has also been studied by Wiermers (2014). Using longitudinal data from the US Survey on Income and Program Participation (SIPP), she shows that young adults (aged 20 to 35) who become unemployed during the Great Recession are three times more likely to co-reside with their older parents. She concludes that intergenerational cohabitation might be an important mechanism to moderate the effects of unemployment (Wiermers 2014).

2.3.3. Associations with mental and physical health in later life

A vast literature has investigated the potential association between intergenerational co-residence and parental health. I will review first the hypothesized mechanisms linking co-residence and health – why and how would co-residence influence mental and physical health in later life? Second, I will outline the main findings of the papers which have looked at the association between this specific type of living arrangement and health. An issue with this first cluster of studies is that they did not address selection and reverse causality. In the final section, I will outline why this might be problematic and how recent papers have tried to overcome these limitations.

Predicting whether co-residence will increase or decrease depression among older people is not an easy task. On one hand, co-residence will result in increased contact with children and the fulfilment of family roles, potentially improving the life satisfaction and wellbeing of older parents. Indeed, co-residence has been shown to be associated with greater availability of intra-household emotional and practical support, including help in emergencies, surveillance of health behaviours, and economic benefits (Rendall and Speare 1995, Hank and Buber 2009, Leopold 2012). On the other hand, changes in living arrangements may also result in increased tension among family members, which may ultimately lead to higher depressive symptoms (White and Rogers 1997). In case of co-residence arising from parental needs, the loss of autonomy and dependence on children potentially associated with intergenerational co-residence may have a detrimental impact on depression (Silverstein, Chen et al. 1996, Lang and Schutze 2002).

There is a large empirical literature on the association between living arrangements and the health and mortality of older parents. Table 2.8. reports the main findings of articles

which investigated the association between intergenerational co-residence and health and mortality in old age, deliberately omitting the literature on the effects of living alone or cohabiting with a spouse. The papers looking at intergenerational cohabitation and the health of older parents have so far produced mixed results. A positive effect of this type of living arrangement has for example been found for the self-rated health of older couples sharing their household with adult children in the US (Hughes and Waite 2002) and of the oldest-old in China (Li, Zhang et al. 2009), the psychological wellbeing of older parents in China (Silverstein, Cong et al. 2006). Living with adult children was also associated with a slower cognitive decline of older people living in Northern European countries (Mazzuco, Meggiolaro et al. 2016).

Nevertheless, studies suggest that co-residing with adult children is associated with higher depressive symptoms among older parents in Singapore (Chan, Malhotra et al. 2011), South Korea (Jeon, Jang et al. 2007) and China (Chyi and Mao, 2012); and with lower life satisfaction in Israel (Lowenstein and Katz 2005). Adverse health outcomes were also reported for CHD incidence in Japan (Ikeda, Iso et al. 2009), mobility limitations in the US (Hughes and Waite 2002) and cognition in Southern European countries (Mazzuco, Meggiolaro et al. 2016).

A key limitation of these studies is that they looked at the association between co-residence and health and assumed that physical or mental health would be a function of social exchanges and interactions with adult children brought about by co-residence. However, mental health may influence the likelihood of receiving family support, including in the form of co-residence (Davey and Eggebeen 1998, Okabayashi, Liang et al. 2004). For example, longitudinal research on the impact of family support on psychological wellbeing in the US has shown that the effects of intergenerational support

depend on the health status and expectations of the cared-for person (Silverstein and Bengtson 1994). In sum, because depression is likely to influence the likelihood of co-residing with adult children, it is difficult to establish from the above studies whether for example co-residence is associated with poorer mental health or whether older adults with higher depressive symptoms scores need more support from their children and are consequently more likely to co-reside with them.

Table 2.8. Overview of the studies investigating the association between intergenerational co-residence and health in later life (by alphabetical order)

Authors	Country and dataset	Outcome of interest	Population of interest	Approach	Key findings
Chan, Malhotra et al. (2011)	Social Isolation, Health and Lifestyles Survey (SIHLS) 2009, Singapore	11-item CES-D scale of depressive symptoms	Older Singaporeans≥50	Cross-sectional data, multivariate regressions	Negative effect - living alone and living with at least one child was associated with higher depression levels among older men and women.
Davis, Moritz et al. (1997)	Longitudinal Study of Ageing (LSOA) 1984 and 1986, US	Survival	US community-dwelling men and women≥70	Proportional hazard models	Negative effect – women who lived with someone other than spouse at baseline were at greater risk of dying. No association found among men.
Fujino and Matsuda (2009)	Resident Registry data, Yukuhashi Ciy, Japan	Survival	Residents of Yukuhashi City≥60	Proportional hazard models	No effect of living arrangements on survival among men and women
Hughes and Waite (2002)	Health and Retirement Study, US	Self-rated health, mobility limitations and 8-item CES-D scale	Older Americans aged 51 to 61	Longitudinal data, multivariate regressions	Mixed effect - Widowed or single women living with adult children report poorer health on all outcomes but married couples living with children report better health.

Ikeda, Iso et al. (2009)	Japan Public Health Centre-based Prospective Study (JPHC study), Japan	Incidence of coronary heart disease (CHD) and mortality	Japanese men and women aged 40 to 69	Proportional hazard models	Negative effect – Women living in intergenerational households had a higher risk of CHD then women living with spouses only.
Jeon, Jang et al. (2007)	2001 Korean National Health and Nutrition Examination Survey	Depressive symptoms and suicidal ideation	Older Koreans≥65	Multinomial logistic regression	Negative effect – Intergenerational co-residence was associated with poorer mental health in both men and women.
Li, Zhang et al. (2009)	Chinese Longitudinal Healthy Longevity Survey (CHARLS), China	Mortality, limitations with ADLs, self-rated health	Chinese respondents aged 77 to 122	Multinomial logistic regression	Mixed effect – respondents living with children have higher mortality risk, higher levels of limitations with ADLs but better self-reported health.
Lowenstein and Katz (2005)	Stratified-random sample of respondents, based on the Ministry of Immigration 'Absorption lists', Israel	Life satisfaction, including a general question and specific questions on life in Israel, housing, social activity and contact with services	Migrants from the former Soviet Union to Israel≥65	Cross-sectional data, multivariate regression	Negative findings – intergenerational co-residence was associated with lower life satisfaction
Mazzuco,	Survey of Health,	Cognitive scores	Older Europeans≥50	Multivariate regression	Mixed findings depending

Meggiolaro et al. (2016)	Ageing and Retirement (SHARE)	(orientation, immediate recall, delayed recall, verbal fluency, numeracy)			on country and baseline abilities– living with adult children reduces cognitive decline in Northern European countries, but only among those whose cognitive status was low at baseline. The effect on cognition is negative in Southern European countries.
Silverstein, Cong et al. (2006)	Stratified multistage random sample of respondents from the Anhui Province, China	Psychological wellbeing including depression (measured as a 9-item CES-D scale of depressive symptoms) and life satisfaction	Older Chinese≥50	Cross-sectional data, multivariate regression	Positive effect – older parents living in intergenerational households had better psychological wellbeing.

More recently, several studies have attempted to overcome these limitations to establish whether there is a causal link between intergenerational co-residence and mental or physical health of older parents. Authors have implemented a number of approaches to account for the reverse causality issue mentioned above; in particular Instrumental Variable (IV) approaches.[11] Further details about these studies, their population and outcome of interest and their design are presented in Table 2.9.

Most of this research has focused on Asian countries and the findings are again mixed. Using two children characteristics linked to family care traditions in South Korea as instrumental variables (the number of sons and gender of the eldest child), Do and Malhotra (2012) found that co-residence reduces depressive symptoms among older widowed women. Yamada and Teerawichitchainan (2015) focused on the Vietnamese case and estimated a simultaneous-equation discrete-response model to account for the simultaneity between living arrangements and psychological well-being. They found that co-residing with adult children increased the well-being of older parents. By contrast, using an identification strategy based on cultural drivers of intergenerational cohabitation, studies in China, Indonesia, and Japan (Chyi and Mao 2012, Johar and Maruyama 2014, Maruyama 2015) have found that co-residence lowers happiness levels and increases the risk of reporting poorer health and depression among older parents.

How these findings apply to European countries is still unclear. For example, Aranda (2015) used a difference-in-differences approach and propensity score matching to look at the causal impact of co-residence on mental health in a number of European countries. He found that 'doubling up' (two or more generations in the same household)

[11]Further details about this approach are given in Chapter 3 on Methods and Data, as well as in Chapter 6 where this method is implemented.

has no impact on the risk of depression among parents in 'Protestant' European countries (Sweden, Denmark, Germany, Netherlands and Switzerland), while it decreases depressive symptoms for older people in 'Catholic' countries (France, Belgium, Austria, Italy and Spain).

Table 2.9. Overview of the studies assessing the causal effect of intergenerational co-residence on health in later life (by alphabetical order)

Authors	Country and dataset	Outcome of interest	Population of interest	Approach	Key findings
Aranda (2015)	SHARE, Europe	Euro-D scale of depressive symptoms	Older Europeans≥50	Difference-in-difference propensity score matching approach	Positive effect (-0.540 on the scale) of co-residing on depressive symptoms in Catholic countries (France, Belgium, Austria, Italy and Spain) but not in Protestant countries (Sweden, Denmark, Germany, Netherlands and Switzerland).
Chyi and Mao (2012)	2005 Chinese General Social Survey	Happiness	Older Chinese≥60	Instrumental variable approach, using the age of the eldest son and the number of children	Negative effect of co-residence with adult children on levels of happiness.
Johar and Maruyama (2014)	Indonesia Family Life Survey (IFLS)	Self-rated health	Older Indonesians≥60	Instrumental variable approach, using community-level (traditional rules regarding inheritance and cohabitation) and individual-level instruments (whether the respondent's spouse was chosen by the parents, and the number of children the respondent has).	Negative effect of co-residence on self-reported health.

Maruyama (2015)	Nihon University Japanese Longitudinal Study of Ageing (NUJLSOA)	Self-reported health	Older Japanese≥65	Instrumental variable approach, using land price and rural origins of the respondent	Mixed effect of co-residence, with a non-significant average effect and a negative effect among older parents with unmet care needs and limited resources.
Yamada and Teerawichitchainan (2015)	2011 Vietnam Ageing Survey	Composite measure of psychological well-being (happiness, depression, loneliness, poor appetite, and sleep disorder)	Older Vietnamese≥60	Triangular simultaneous-equation discrete-response model	Positive effect of co-residence on psychological wellbeing, robust to different specifications.

2.3.4. Limitations of the literature and expected contribution of this thesis

Dramatic changes in intergenerational co-residence have happened across Europe and the US in the past decades. Whether and how these changes have influenced the mental health of older people is still unclear. A vast literature has looked at the effect of intergenerational co-residence on physical and mental health, with mixed results. These inconsistencies across studies are likely to be linked to different data, countries and population groups. Crucially, most studies have implemented research designs that did not account for reverse causality: co-residence might affect as well as be affected by depressive symptoms. As noted by Johar and Maruyama (2013), studies that have attempted to address endogeneity issues have mainly been focused on Asian countries. The aim of Chapter 7 is to fill this gap by unpacking the causal mechanisms linking intergenerational co-residence and the mental health of older parents. It will be guided by the second research question of this thesis:

Do older parents who co-reside with their adult children have fewer depressive symptoms?

Further details about the empirical strategy to answer this question are given in chapters three and five. In substance, I will integrate the literature on the macro-economic drivers of co-residence described in section 2.3.2 above and the research on health consequences of intergenerational living arrangements. The quasi-experimental approach presented in Chapter 7 will exploit the variations in youth unemployment rates across the European countries included in the SHARE dataset and overtime to look at the causal effect of co-residence on mental health in later life. This research design attempts to control for reverse causality by exploiting one of the main forces behind recent increases in intergenerational co-residence.

The aim of this literature review was to present the available evidence on the comparability of depressive symptoms measures, the association between intergenerational co-residence and health in old age and between homeownership and health in old age. The limitations of the extant literature were described and used to derive the research questions that will guide the four empirical chapters of this thesis. The next chapter introduces the datasets to be used and the methods to be implemented.

Chapter 3

Data and methods

This chapter provides an overview of the data sources and methods used in the four empirical chapters in this thesis. The two micro-level surveys (SHARE and HRS) are presented in the first section, followed by the macro-level data used in Chapter 6. The variables to be used throughout the empirical chapters are also detailed. Finally, I give an overview of the statistical methods used to answer the research questions. As noted in the literature review chapter, a key challenge in the examination of the relationship between living arrangements and depressive symptoms is to account for selection and reverse causality. In this thesis I implement several approaches aimed at dealing with these issues. This chapter intends to give the rationale for the choice of data and methods, including why some approaches have been abandoned in the course of this study. More specific details on each analytical approach are presented in the respective methods sections of Chapters 5 to 7.

3.1. Data sources

The data used in this work come from two main sources: the Health and Retirement Study in the US and the Survey of Health, Ageing and Retirement in Europe. This first section presents those datasets, focusing on their sample composition, response and retention rates, content, strengths and limitations. Chapter 6 additionally uses macro-level data on unemployment rates in Europe, which are presented in the last part of this section. The datasets and specific variables to be used in each empirical chapter are then detailed.

3.1.1. The Health and Retirement Study (HRS)

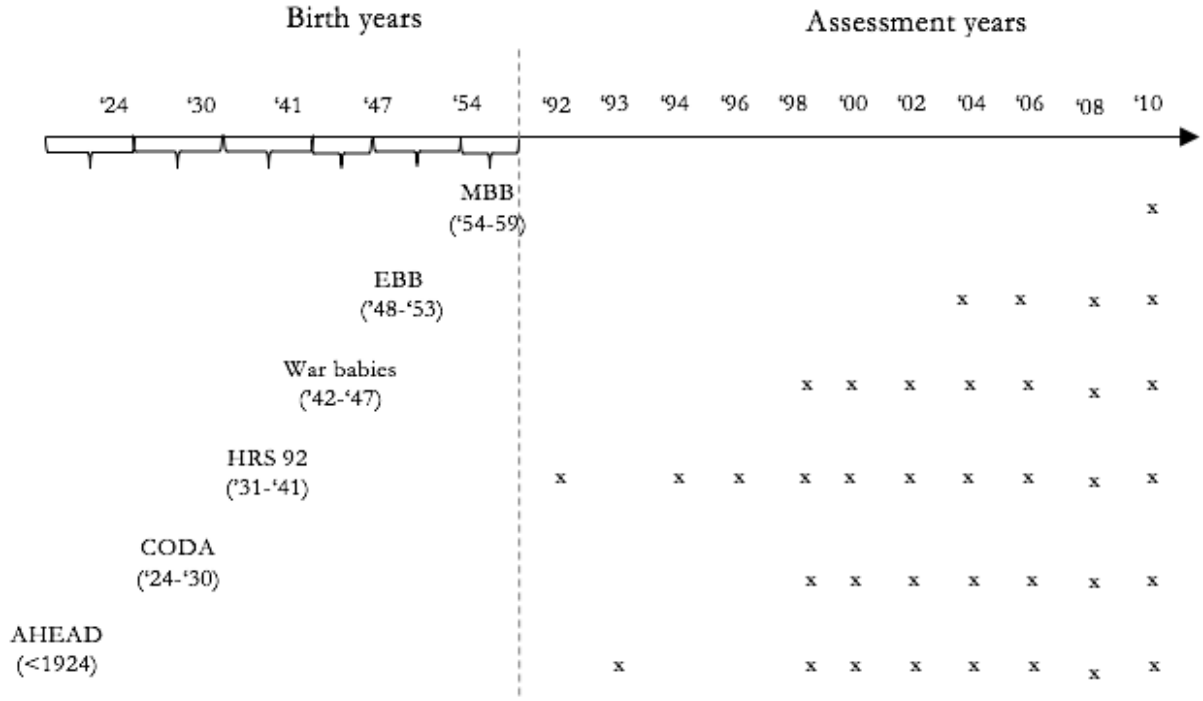
The HRS was established in 1990 to document the health and economic circumstances of older people in the US and how these circumstances changed over time. The idea of creating HRS emerged in the mid-1980s when researchers involved in ageing research recognized that the available data (Retirement History Study, RHS, running from 1969 to 1979) were not sufficient to for research designed to address the challenges of population ageing. Issues identified at the time included the underrepresentation of women and ethnic minorities, the lack of data on health and mental health and the absence of incentives for scholars from different disciplines to collaborate in interdisciplinary ageing research (Hoes and Suzman 2015). And ad-hoc advisory panel of the National Institute of Aging (NIA) consequently recommended in 1988 the creation of a long-term study focused on older adults' health, and its interaction with social, economic, psycho-social factors and retirement behaviour (Hoes and Suzman 2015). The data collection and management is run through a cooperative agreement between the NIA (the primary funder), and the Institute of Social Research at the University of Michigan.

Sample

HRS is a nationally representative longitudinal survey of individuals aged 50 and older at inclusion in the survey. Data have been collected every two years since 1992. As shown in Figure 3.1. below, the HRS sample was built up gradually. The initial 1992 HRS cohort recruited respondents born between 1931 and 1941, as well as their spouses of any age. The AHEAD study (Asset and Health Dynamic Among the Oldest Old) was started separately in 1993 to include the cohort born 1890-1923 and the two studies were merged in 1998. In order to make the sample representative of the US population aged over 50, two additional cohorts were added: the Children of the Depression (CODA), born 1924-1930; and the War Babies born 1942-1947. Since then, HRS has implemented a steady-state design, with the sample being replenished every

six years with younger cohorts. Early Baby Boomers (EBB), born between 1948 and 1953, were added in 2004 and Mid Baby Boomers (MBB), born between 1954 and 1959, were added in 2010.

Figure 3.1. Enrolment and assessment schedule for the HRS birth cohorts



Source: Adapted from Avendano & Glymour (2008).

The sample is based on a multi-stage probability design, with geographical stratification and oversampling of demographic groups. In each sampled household, a brief screening interview is conducted to determine eligibility. A primary respondent (on which all the analyses of Chapters 5 and 7 are based) is randomly selected from all age-eligible household members. The selected respondent answers all questions of the main questionnaire in single-person households. In couple households, a family and a financial respondent are designated. Both respondents are also asked all individual questions. A proxy respondent is used for respondents who are not able to answer the interview questions themselves. About 4% of all interviews have a proxy respondents

at each wave (Sonnega, Faul et al. 2014). Although proxy interviewing is crucial to keep cognitively impaired respondents into the survey (Weir, Faul et al. 2011), in all subsequent analyses in this thesis using HRS data, proxy respondents have been excluded to focus on the core respondent. Baseline interviews are conducted only with community-dwelling older people but respondents who subsequently move to nursing homes are followed by the study. For the purpose of this thesis, I focus exclusively on community dwelling respondents and further details are giving in Chapter 7's methods section.

Response and retention rates

Table 3.1. presents the response rates and sample sizes for each cohort at baseline and follow-up. For each cohort in the dataset, the baseline response rates reflect the percentage of all individuals eligible for HRS who agreed to participate in the baseline interview. Retention rates are based on the wave for which respondents were contacted again. The number of respondents per wave declines across waves in the study period. Attrition in HRS has been shown to be largely attributable to mortality (Cao and Hill 2005). Previous research also suggests that attrition rates due to other reasons than mortality do not differ systematically between population groups: attrition does not seem to have altered the representativeness of the HRS panel (Cao and Hill 2005).

Table 3.1. Response and retention rates of HRS, by wave and cohort

Cohort	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8	Wave 9	Wave 10
Original HRS cohort										
Eligible	15 497	12 777	12 622	12 202	11 762	11 230	10 835	10 026	9587	8919
Interviewed	12 652	11 420	10 964	10 584	10 044	9724	9362	8879	8493	7904
Response rate (%)	81.6	89.4	86.9	86.7	85.4	86.6	86.4	88.6	88.6	88.6
Year	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010
Asset and Health Dynamic Among the Oldest Old cohort										
Eligible		10 229	7554	6512	5526	4559	3766	2979	2362	1708
Interviewed		8222	7027	5951	5000	4107	3365	2700	2142	1526
Response rate (%)		80.4	93.0	91.4	90.5	90.1	89.4	90.6	90.7	89.3
Year		1993	1995	1998	2000	2002	2004	2006	2008	2010
Children of the Depression cohort										
Eligible				3200	2300	2140	1973	1770	1608	1410
Interviewed				2320	2124	1951	1777	1618	1454	1255
Response rate (%)				72.5	92.3	91.2	90.1	91.4	90.4	89.0
Year				1998	2000	2002	2004	2006	2008	2010
War Babies cohort										
Eligible				3619	2652	2630	2612	2539	2488	2445
Interviewed				2529	2410	2384	2295	2237	2165	2138
Response rate (%)				69.9	90.9	90.6	87.9	88.1	87.0	87.4
Year				1998	2000	2002	2004	2006	2008	2010
Early Baby Boomers cohort										
Eligible							4420	3461	3433	3405
Interviewed							3330	3035	2963	2926
Response rate (%)							75.3	87.7	86.3	85.9
Year							2004	2006	2008	2010

Source: adapted from Sonnega et al. (2014).

Variables collected

HRS covers four broad topics which are of relevance for this thesis: financial circumstances (income and wealth); health (physical and mental health, cognition) and healthcare use; work and retirement; and social networks (including family connections). Box 3.1. below provides an overview of the core data collected in most waves.

Box 3.1. Overview of the core variables including in HRS

Sections A and B: Demographics and Background
Including for example: respondent's education, race, marital status and marital history, number of children, military service, citizenship, state of birth and childhood residence, English as main spoken language, length in current residence.
Section C: Health
Including for example: physical and mental conditions and treatment; health behaviors; use of preventive services.
Section D: Cognition
Sections E and F: Family Structure and Transfers
Including for example: structure of extended family relationships, family proximity, intergenerational transfers, time, housing
Section G: Functional Limitations
Including for example: ADLs and IADLs; information on helpers.
Section H: Housing
Including for example: type of home; home value; housing costs; second home information.
Section I: Physical Measures
Sections J–L: Employment and Pensions
Including for example: employment status and history; job search; job characteristics, earnings; retirement plans, pensions.
Section M: Disability
Including for example: benefits receipt and receipt history.
Section N: Health Services and Insurance
Including for example: health providers; drugs; health insurance; hospitalization; in-home care; Medicaid; Medicare; nursing home information.
Section P: Expectations
Including for example: subjective expectations of leaving inheritance, of life expectancy or of moving to nursing home).
Section Q: Assets and Income
Including for example: assets; expenses; income.
Section R: Asset Change
Including for example: real estate sold; residence bought or sold; major home improvement.
Section S: Widowhood and divorce
Section T: Wills, insurance, and trusts: value; beneficiaries.

Source: adapted from Sonnega et al. (2014).

For this thesis, the RAND-HRS Data File was used as the primary source of data for HRS. It was developed at RAND with funding from the NIA and the Social Security Administration (Chien, Campbell et al. 2015). The RAND-HRS file is a user-friendly file derived from all waves of HRS and containing cleaned and harmonized variables. It also includes RAND imputations of wealth and income variables, which have been used in Chapter 5 and 7 of this thesis.

Strengths and limitations

The key strengths of HRS are its sample size and its longitudinal nature. As noted before, HRS has currently 11 waves of data and six birth cohorts. In addition, HRS has been designed to oversample minorities and the response rates for minorities are equivalent to those of whites (Ofstedal and Weir 2011). A potential future issue is the cost of running HRS: cost considerations have forced reductions in the size of the new cohorts, in which participants are also more difficult to retain (Sonnega, Faul et al. 2014).

3.1.2. The Survey of Health, Ageing and Retirement in Europe (SHARE)

The success of HRS led European researchers to develop a sister study in Europe, also aimed at tracking health and retirement trends but in a comparative perspective (Börsch-Supan and Jürges 2005). SHARE was created to respond to the call from the European Commission to "examine the possibility of establishing, in co-operation with Member States, a European Longitudinal Ageing Survey" (Börsch-Supan, Hank et al. 2005).

Like HRS, SHARE is a multidisciplinary survey, but its specificity is to collect longitudinal data on health, socio-economic status and family characteristics across a number of European countries. SHARE currently includes 120,000 individuals aged 50 and above across 27 European countries plus Israel. The survey benefitted from the first European Research Infrastructure Consortium from the European Union, giving it the funding necessary to develop up to 2024 (Borsh-Supan, Brandt et al. 2013).

Sample

The SHARE sample was built up gradually over the years. As shown in Table 3.2. below, 11 countries contributed to the 2004 baseline study. Countries were meant to give a balanced representation of European regions, ranging from Scandinavia (Denmark and Sweden), Central Europe (Austria, France, Germany, Switzerland, Belgium and the Netherlands) to Southern Europe (Spain, Italy and Greece). Further data were collected in Israel. The Czech Republic, Poland and Ireland joined the second wave of data collection in 2006. The same countries participated in the survey's third wave in 2008, which collected retrospective life histories. The fourth wave included four new countries: Estonia, Hungary, Portugal and Slovenia.

Table 3.2. Overview of the countries included in SHARE by wave

	Wave 1 2004	Wave 2 2006	SHARELIFE 2008	Wave 4 2010
Austria	x	x	x	x
Belgium	x	x	x	x
Switzerland	x	x	x	x
Germany	x	x	x	x
Denmark	x	x	x	x
Spain	x	x	x	x
France	x	x	x	x
Greece	x	x	x	
Italy	x	x	x	x
Netherlands	x	x	x	x
Sweden	x	x	x	x
Israel	x	x		
Czech Republic		x	x	x
Ireland		x	x	
Poland		x	x	x
Estonia				x
Hungary				x
Portugal				x
Slovenia				x
Luxembourg				

Source: adapted from Börsch-Supan and Jürges (2005).

Baseline data collection in 2004 targeted cohorts born before 1954. Individuals had to be living in private households, to speak the national language and not to be permanently living in a foreign country in order to be eligible. All partners living in the same household were eligible,

irrespective of their age. The sampling frame varied quite considerably between countries. In countries like Denmark or Sweden, the availability of national population registers made it possible to draw an age-stratified sample. These data were not available in other countries like Greece or Austria, where single or multi-stage sampling was implemented using telephone directories and followed by screening in the field (Börsch-Supan and Jürges 2005).

Table 3.3. Breakdown of wave 1 and 2 samples by country, gender and age

Country	Total	Male	Female	Under 50	50 to 64	65 to 74	75+	Household response rate	Individual response rate
Wave 1 - 2004									
Austria	1,893	783	1,110	44	949	544	356	55.6%	87.5%
Belgium	3,827	1,741	2,086	128	1,947	992	760	39.2%	90.5%
Denmark	1,707	771	936	92	916	369	330	63.2%	93.0%
France	3,193	1,384	1,809	141	1,627	768	657	81%	93.3%
Germany	3,008	1,380	1,628	65	1,569	887	486	63.4%	86.5%
Greece	2,898	1,244	1,654	218	1,450	714	516	63.1%	91.8%
Italy	2,559	1,132	1,427	51	1,342	785	381	54.5%	79.7%
Netherlands	2,979	1,367	1,612	102	1,693	715	462	61.6%	87.8%
Spain	2,396	996	1,400	42	1,079	701	574	53%	73.7%
Sweden	3,053	1,412	1,641	56	1,589	816	592	46.9%	84.6%
Switzerland	1,004	462	542	42	505	252	204	38.8%	86.9%
Total	31,115	13,811	17,304	1,078	16,005	8,259	5,761	61.6%	85.3%
Wave 2 - 2006									
Austria	1,341	546	795	19	544	476	302	Not available	Not available
Belgium	3,169	1,435	1,734	84	1,615	773	697	Not available	Not available
Czech Republic	2,830	1,191	1,639	81	1,569	690	490	Not available	Not available
Denmark	2,616	1,176	1,440	83	1,409	618	506	Not available	Not available
France	2,968	1,273	1,695	117	1,518	718	615	Not available	Not available
Germany	2,568	1,184	1,384	41	1,245	833	449	Not available	Not available
Greece	3,243	1,398	1,845	162	1,624	820	636	Not available	Not available
Ireland	1,134	514	620	27	622	282	203	Not available	Not available
Italy	2,983	1,345	1,638	56	1,364	971	591	Not available	Not available
Netherlands	2,661	1,212	1,449	46	1,478	681	456	Not available	Not available
Poland	2,467	1,074	1,393	42	1,351	605	469	Not available	Not available
Spain	2,228	1,003	1,225	46	958	651	573	Not available	Not available
Sweden	2,745	1,267	1,478	38	1,294	808	605	Not available	Not available
Switzerland	1,462	645	817	37	770	356	299	Not available	Not available
Total	34,415	15,263	19,152	879	17,362	9,282	6,891	Not available	Not available

Source: adapted from Borsh-Supan, Brandt et al. (2013).

As shown in Table 3.3, response rates (defined as the share of households including at least one eligible respondent with whom an interview was conducted) at baseline varied considerably across countries, ranging from 39.2% in Belgium to 81% in France. On average across countries, the response rate was 62% (Borsh-Supan, Brandt et al. 2013). In the second wave of SHARE, response rates were very similar to wave 1 at 61% and refreshment samples were used to increase sample size and compensate for attrition (Borsh-Supan, Brandt et al. 2013). No changes to the sample were implemented for wave 3. In wave 4, the sample size was increased substantially with four new countries and refreshment samples in most participating countries. The retention rate for wave 4 was at 81% (Borsh-Supan, Brandt et al. 2013).

All interviews were conducted using computer-assisted personal interviewing (CAPI). Additional self-administered questionnaires were distributed to respondents after waves 1,2 and 4.

Variables collected

SHARE has been designed as a multidisciplinary survey, mirroring the structure of HRS. It has a core questionnaire stable over time and described in Box 3.2. In addition, additional questions, physical measurements and modules have been added at each wave, *e.g.* social networks at wave 4. In addition, SHARE includes generated variables to facilitate international comparisons (*e.g.* International Standard Classification of Education, ISCED), survey weights and multiple imputations.

Box 3.2. Overview of the core variables including in SHARE

Cover Screen
Year and month of birth, sex, household composition
Demographics
Education, marital status, country of birth and citizenship, parents and siblings
Physical Health
Self-rated health, diseases, weight and height, IADL and ADL limitations
Behavioral risks
Smoking and alcohol, nutrition, physical activity
Cognitive function
Self-rated reading and writing skills, orientation, word list learning immediate and delayed recall, verbal fluency and numeracy
Mental health

Depression scales, quality of life (CASP-12)
Health care
Doctor visits, hospital stays, surgeries, foregone care, out-of-pocket payments
Employment and pensions
Employment status, individual income sources (public benefits, pensions), job, work quality
Children
Number and demographics of children
Social support
Help and care given and received
Financial transfers
Money/gifts given and received
Housing
Owner, tenants, type and features of building
Household income
Income sources of all household members
Consumption
Expenditures for food, goods, services, ability to make ends meet
Assets
Bank and pension accounts, bonds, sticks and funds, savings
Activities
Voluntary work, clubs, religious organizations, motivations
Expectations
Expected inheritances, life expectancy, future prospects
Source: adapted from Borsh-Supan, Brandt et al. (2013).

Strengths and limitations

A limitation of the SHARE data often cited is that of the comparability of measures across countries, with nuances of institutional differences, national cultures and local meanings potentially lost in translation (Blanchet, Debrand et al. 2007).

The different sampling strategies across countries are also potentially problematic. Lack of access to or availability of national registry data in countries such as Greece, Switzerland and Austria could lead to less reliable estimates or systematic errors (De Luca and Rossetti 2008).

3.1.3. Macro-level data: European unemployment rates from the Organization for Economic Cooperation and Development

Chapter 6 of this thesis is based on the matching of national unemployment rates for a given year, country, gender and age group and individual records from SHARE for the period 2004 to

2010. The source of data for comparative unemployment rates was the Organization for Economic Cooperation and Development (OECD) Annual Labour Force Statistics.

For up to four children per respondent, corresponding age-, gender- and country-specific unemployment rates were obtained from the OECD database for the 17 countries included in the analysis. Five-year age bands were used to define age groups for both genders and I include unemployment rates for children only aged 15 to 50, the age at which their parents potentially enter the SHARE survey to avoid bias introduced by stronger correlations between child unemployment rates and that of their parents when the children are 50 and over.

3.1.4. Choice of data sources and variables by empirical chapter

Practical and theoretical considerations influenced the choice of datasets used to address each research question. Table 3.4. provides an overview of the datasets used in each empirical chapter. The second wave of SHARE was to my knowledge the only dataset which administered to the same respondents both the Euro-D and the CES-D scales of depressive symptoms. The assessment of the comparability of the two scales, which is the objective of Chapter 4, is consequently conducted using SHARE wave 2.

Chapter 5 and 7 investigate respectively the effects of early and late homeownership on depressive symptoms in later life. As homeownership rates vary considerably across Europe for cultural and economic reasons (Angelini, Laferrère et al. 2013), I focused these two chapters on the US case. The long follow-up of HRS also meant that more respondents were likely to have transitioned from renting to owning, which is the core identification strategy of Chapter 7, as detailed in the next section.

Finally, my investigation of the effect of intergenerational co-residence on depressive symptoms of older parents in Chapter 6 uses European data from SHARE. Indeed, as outlined in the next

section of this chapter, I will exploit variations in youth unemployment as an instrumental variable to try to establish a causal link between co-residence and depression.

Table 3.4. Datasets used in the four empirical chapters

Chapter	Sample	Ages	Study period	*N*	Predictor variables	Outcome variables
4	SHARE	50+	2006	15,487	Established risk factors for depression in later life[1]	Euro-D and CES-D
5	HRS	50+	1993-2010	27,715	Early access to homeownership	CES-D
6	SHARE	50+	2004-2010	50,043	Co-residing with an adult child	Euro-D
7	HRS	50+	1993-2010	21,960	Becoming homeowner after the age of 50	CES-D

[1]Gender, age in three categories (50 to 60, 61 to 70, over 70), marital status (married or in a partnership; divorced, widowed or single), education in three categories (primary education or less; secondary education; post-secondary education), a measure of economic strain (household is able to make ends meet with difficulty or with some difficulty; household is able to make ends meet easily or fairly easily), the number of chronic illnesses (less than two chronic illnesses; two or more chronic illnesses), limitations in activities of daily living (less than one limitation with activities of daily living; more than one limitation with activities of daily living) reported by the respondent; and country of residence.

Table 3.5. details the main outcome, predictor and independent variables to be used in each empirical chapter, as well as their coding.

Table 3.5. Key variables included in the four empirical chapters

Chapter	Outcome	Predictor	Independent
4	Euro-D and CES-D scales, difference in score and binary indicator of depression based on the Euro-D and CES-D scales	See independent variables	Gender; Age in three categories (50 to 60, 61 to 70) Marital status (married or in a partnership; divorced; widowed or single) Education (primary education or less; secondary education; post-secondary education) Economic strain (household is able to make ends meet with difficulty or with some difficulty; household is able to make ends meet easily or fairly easily) Number of chronic illnesses (less than two chronic illnesses; two or more chronic illnesses) Limitations in ADLs (less than one limitation with ADLs; more than one limitation with ADLs) Country of residence
5	CES-D scale used as a continuous variable and binary indicator of depression based on the CES-D score	Accessing homeownership by age 35; accessing homeownership after age 35; never accessing homeownership	Gender; Age (as a linear term, or splined); Race (White, Black or Hispanic) Marital status (married or in a partnership; separated or divorced; widowed; never married); duration of longest marriage; number of people living in the household; number of children Education (Lower than high school; GED; high school graduate; some college; college and above) Labour force status (employed; unemployed; retired; disabled; not in the labour force) Natural logarithm of total household income and non-housing wealth Self-reported health (fair or poor; excellent, very good, good); tobacco smoking (ever smoked vs. no; currently smoking vs. no); heavy alcohol drinking (consuming more than two drinks per day per week); physical function (number of limitations with ADLs and number of limitations with IADLs) Year of survey and birth cohort (year of birth)
6	Euro-D scale	Co-residing with an adult child vs. not.	Gender, Age (50 to 60, 61 to 70; categorized in five-year age categories or as a linear term) Marital status (married or in a partnership; divorced or single; widowed) Education (primary education or less; secondary education; post-secondary education) Log of household total income; Economic strain (household is able to make ends meet with difficulty or with some difficulty; household is able to make ends meet easily or fairly easily); Pension receipt (yes vs. no) Informal care receipt[2] (yes vs. no) Number of chronic illnesses (less than two chronic illnesses; two or more chronic illnesses)

			Limitations in ADLs (less than one limitation with ADLs; more than one limitation with ADLs); Limitations in IADLs (less than one limitation with IADLs; more than one limitation with IADLs) Number of children; and for up to four children: age (up to 20, 21 to 40, over 40; as mean age; and age of the youngest child in five-year age categories); gender; marital status (married or in a partnership; divorced or single; widowed); employment status (employed; unemployed; out of the labour force)
7	CES-D scale	Accessing homeownership after the age of 50	Gender, age (included as a linear term and squared), race (White, Black or Hispanic) Marital status (married or in partnership, separated or divorced, widowed, never married), Education (lower than high school, GED, high-school graduate, some college, college and above) Labour force status (employed, unemployed, retired, disabled, not in the labour force) Size of the household and number of children Natural logarithms of total household income and non-housing wealth. Self-reported health (dichotomized into fair/poor vs. excellent/very good/good), tobacco smoking (ever smoked vs. no; and currently smoking vs. no), heavy alcohol drinking (based on self-report of consuming more than two drinks per day over five to seven days a week), and physical function (measured by the number of difficulties with activities of daily living - ranging from zero to five and instrumental activities of daily living - ranging from zero to three).

3.2. Methods

The different methods implemented in Chapter 5, 6, and 7 of this thesis relate to the counterfactual framework (Little and Rubin 2000), which posits that "a causal effect is ascertained through a comparison of 'potential outcomes' that would have been observed under different exposures for the same unit" (Oakes and Johnson 2006 p.371). For example, in Chapter 6, estimating the causal effect of intergenerational co-residence on the depressive symptoms of older parents would require observing at the same time the mental health levels of the same respondent under two situations: co-residing with an adult child and not co-residing with an adult child. As noted by Oakes and Johnson (2006), if it was possible to observe both these situations simultaneously, the causal effect would be the difference between the two outcomes under these two scenarios. The fact that it is not possible to observe both states at the same time (one of the states is counterfactual) has been referred to as "the fundamental problem of causal inference" (Holland 1986).

The classic answer to this issue is a randomized controlled trial design, where randomization should ensure that the treated and control groups are identical except for the treatment itself. Returning to the example from my third empirical chapter, the best way to answer the question about intergenerational living arrangements and depressive symptoms would in principle be to randomize young adults to live with their older parents and observe these parents' depressive symptoms distributions. If social experiments can be a convincing solution, they however also suffer from several limitations (*e.g.* providing evidence only for a specific group that is not generalizable to broader populations) and are clearly not always feasible nor desirable (Benson and Hartz 2000, Kaufman, Kaufman et al. 2003, Vandenbroucke, von Elm et al. 2007, Deaton and Cartwright 2016).

In observational studies such as the ones presented in this thesis, a number of methods and tools have been developed to deal with the fact that treatment assignment is not random. These methods have been designed to address the two issues identified in the literature review chapter: (1) selection, where measured and unmeasured individual characteristics are associated with both the exposure and the outcome; (2) reverse causality, where in our example co-residence might be associated with depressive symptoms but higher levels of depression might also be associated with a higher likelihood of co-residence.

The proposed analytical approaches for Chapter 5, 6, and 7 rely on econometric methods developed for the evaluation of policies and interventions that have become increasingly popular in epidemiology and public health (Glymour 2006). Three of these approaches will be explored in the thesis: instrumental variables (Chapter 7), individual fixed-effects (Chapters 5 and 6) and propensity score matching (Chapter 5). These different approaches are of course not without important limitations. Specific limitations are discussed in each chapter and overall challenges are discussed in the discussion section (Chapter 8) of this thesis.

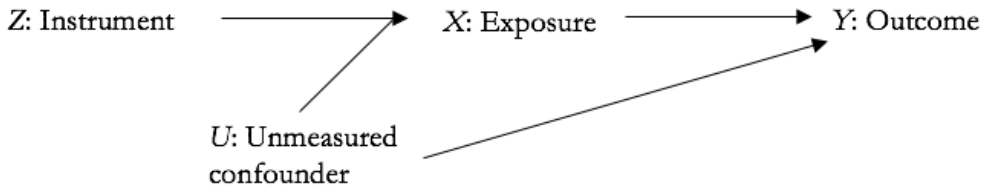
3.2.1. Instrumental variable approach

The standard econometric tool to deal with reverse causality is the use of an instrumental variable approach (IV) (Imbens and Angrist 1994, Angrist, Imbens et al. 1996, Angrist and Krueger 2001). In substance, IV analyses mimic randomization by using an exogenous source of variation to estimate the effect of an exposure on respondents who were exposed as a result of that source of variation or natural experiment. IV approaches are gaining popularity in public health and social epidemiology research concerned for example with the causal effect of education or unemployment on health. Changes in policies and economic

circumstances are often influenced by administrative rules or legislative changes on which individuals have little influence. Variations over time and between states/countries in schooling policies (Glymour, Kawachi et al. 2008, Nguyen, Tchetgen Tchetgen et al. 2017), in unemployment laws (Cylus and Avendano 2017) or in neighbourhood characteristics (Riumallo-Herl, Kawachi et al. 2014) have consequently been used in the epidemiological literature as instruments and have provided very powerful tools to test causal associations.

The main idea behind an IV approach is as follows: "The IV estimate can be interpreted as the average effect that receiving treatment had on those individuals who received the treatment as a result of the value of the instrument" (Glymour 2006 p.432). Figure 3.2 below summarizes the approach, in which *Z* is the instrument (random assignment to treatment), *X* is receiving the treatment (exposure) and *Y* is the outcome of interest. Similar to an RCT scenario, *Z* is a variable that directly affect *X* the exposure and if Z and the outcome *Y* are related, it is because *Z* affects *X* and in turn *X* affects *Y* (Glymour 2006).

Figure 3.2. Instrumental variable approach



Source: Glymour (2006)

In this schematic representation, *Z* is considered to be a valid instrument for the effect of *X* on *Y* provided *Z* and *X* are associated and *Z* does not have an effect on *Y*, except through *X*. IV estimates of the effect of *X* on *Y* are obtained with a two-stage-least-square (2SLS)

analysis: the first stage consists of regressing *X* on *Z* to obtain a predicted value of *X* based on this regression; the second stage consists of using this predicted value of *X* as an independent variable in a regression model of *Y*. The coefficient of the predicted value of *X* is interpreted as the 2SLS IV estimate of the effect of *X* on *Y*. I implemented the 2SLS IV approach with the Stata ivreg2 user-written command, which provides estimates for both the first and second stages as well as associated statistical tests and robust standard errors.

The main difficulty in IV estimation is to identify appropriate instruments: "…the natural experiment for the exposure approach to instrumental variables is fundamentally grounded in theory, in the sense that it is usually a well-developed story or model motivating the choice of instruments. Importantly, these stories have implications that can be used to support or refute a behavioural interpretation of the resulting instrumental variable estimates" (Angrist and Krueger 2001 p.76). To be valid, an instrument needs to fulfil two main conditions: to be relevant (*i.e.* predict the exposure) and exogenous (*i.e.* not associated with the outcome, except through the exposure). Empirically, the first assumption of relevance is easily tested in a 2SLS approach. I can estimate a first-stage linear regression in which co-residence is the dependent variable and the independent variable includes the instrument and all controls in the main regression. I then test for joint significance of the instruments on the dependent variable using the weak identification test based on the Kleibergen-Paap Wald *F* statistic (Kleibergen and Paap 2006). The null hypothesis for this test is that the instrument is not correlated with co-residence. Rejecting the null hypothesis consequently means that the instrument predicts co-residence. An *F*-statistic of 10 or higher is usually considered as an indicator of a strong instrument (Stock and Yogo 2005). While the second assumption cannot be tested and needs to be theoretically defensible, I use the Hansen-Sargan *J* statistic as over identification 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).

Finding an instrument that fulfils these two criteria is not straightforward. An IV approach is applied in Chapter 7 of this thesis. The objective of this chapter is to estimate the effect of co-residing with an adult child on the depressive symptoms of older parents. I explored several possible instruments. Instrumental variables used in the literature include the gender and birth order of children (Bonsang 2009, Do and Malhotra 2012, Maruyama 2012, Johar and Maruyama 2013). I first started by basing my identification strategy on one instrument: the number of sons, proportional on the total number of children. I wanted to exploit the fact that the proportion of male children is random and has an impact on the likelihood of co-residing, thus allowing to account for the endogeneity of co-residence and depression. This instrument has previously been used to examine the impact of support from children on informal and formal care use (Bonsang 2009) or of living arrangement on physical or mental health outcomes in old age in a number of Asian studies detailed in the literature review chapter of this thesis (Do and Malhotra 2012, Maruyama 2012, Johar and Maruyama 2013). I tried to argue that the number of sons as a proportion of the total number of children is a random event that affect the likelihood of co-residing and, in that sense, can mimic an experiment and allow calculating estimates for specific causal effects. On a theoretical level, a consistent finding of the literature on the drivers of co-residence is that sons are more likely than daughters to co-reside as long as parents are relatively young and less likely to need assistance (Isengard and Szydlik 2012). As assessed in previous studies, the number of sons predicts the probability of older people's co-residence with an adult child

(Do and Malhotra 2012, Maruyama 2012). However, the *F*-statistic for this instrument was too weak ($F = 5.62$; $p = 0.0178$ for the whole sample) and it remained difficult to argue that children's gender had no direct effect on depressive symptoms of older parents except through co-residence.

I consequently went back to the literature presented in Chapter 2 which analysed the effect of the economic crisis and youth unemployment on the likelihood of intergenerational co-residence (Kahn, Goldscheider et al. 2013, Wiermers 2014, Matsudaira 2016). Following the approach implemented in these three papers, I use as instrument the country-, year-, age- and gender-specific unemployment rate for adult children. I first confirm that youth unemployment rates predict the likelihood of intergenerational co-residence in the first stage. In the second stage, I estimate whether the predicted measure of intergenerational co-residence, which is now 'purged' of individual-level unobserved characteristics which may be correlated with both co-residence and depressive symptoms, is associated with depressive symptoms levels of older parents.

Because the 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, all 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. I 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, I control for child employment status in all analyses. I 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.

I also experimented with an IV approach for Chapter 5, which looks at the effect of accessing homeownership early in the life course on depressive symptoms in later life. I planned to exploit variations in the Loan-to-Value (LTV) ratio since 1970 to identify the impact of home ownership on late-life symptoms of depression while also assessing the mental health impact of policies promoting access to homeownership. The policy data consisted of country-level data on typical LTV ratios since 1970, a measure of the availability of credit to households in international housing markets that is comparable across countries (Jappelli and Pagano 1989, Chiuri and Jappelli 2003). An increase of the LTV ratio indicates that banks are more likely to approve mortgages with lower down payments, partly reflecting increased availability of housing finance credit and better access to the property market. These incentives for homeownership are independent from individual characteristics and

consequently generate an exogenous variation in homeownership that would allow disentangling the potential causal effect of housing policies on mental health in old age.

LTV ratios were based on data collected by Chiuri and Jappelli (2003). I expected these LTV ratios to be strongly correlated with the probability of being a homeowner at the first stage but exogenous to changes in the depressive symptoms levels of any individual observed in the survey. However, going back to 1970, these ratios are only available averaged by country-decade for the US and most European countries. There was consequently too little variation in the instrument to be a good predictor of the exposure (homeownership). This approach was abandoned for Chapter 5 to focus on individual fixed-effects and propensity score matching.

3.2.2. Individual fixed-effects

The approach implemented in Chapter 7, which relies on an exogenous economic crisis, requires that appropriate data collection at both the individual and macro-levels. Another approach to deal with selection is to use the longitudinal nature of the datasets included in this thesis and apply fixed-effects models (Gunasekara, Richardson et al. 2014). The core idea of these models is that changes over time include both within- and between-individual variations. By focusing on within-individual changes, fixed-effects models control for time-invariant confounding because each individual acts as his/her own control: "the fixed-effects estimate, which relies solely on within-individual changes eliminates confounding by all innumerable and unmeasurable influences. This is the really remarkable promise of the fixed-effects model, and one that makes it so attractive for social epidemiology, where exposures are often heavily confounded by myriad contextual, behavioural and attitudinal quantities that would be difficult to assess exhaustively" (Kaufman 2008 p.624). Fixed-effects models

have been reported to perform particularly well when there is a large number of respondents, low attrition rates and regular data collection over time (Gunasekara, Richardson et al. 2014).

Two conditions need to be fulfilled for individual fixed-effects to be accurate: the outcome measure needs to be measured in a similar way and the exposure needs to change overtime for at least some of the respondents. The data used in Chapters 5 and 6 comply with these two conditions. I consequently estimated individual fixed-effects models in which the dependent variable is the change in depressive symptom scores and the key independent variables are the changes in homeownership status in Chapter 6 and an interaction between age and age of homeownership attainment in Chapter 5.

Concretely, in Chapter 6, these individual fixed-effects models look at mental health changes associated with changes in tenure status, net of observed and unobserved individual time-constant characteristics. I compare the depressive levels of an individual before becoming homeowner to the depressive symptoms levels of that same individual after accessing homeownership. Confounding by measured time-varying variables was taken into account by including in the models a large range of indicators of health, socioeconomic status and demographic characteristics.

In Chapter 5, the exposure (being a homeowner by the age of 35) does not change overtime. I consequently interacted the exposure with the age of the respondents in the individual fixed-effects models. The estimates assess whether individual age trajectories of depressive symptoms differ between early, late and never homeowners.

3.2.3. Propensity Score Matching

The third approach explored in this thesis is Propensity Score Matching (PSM). This method has been used extensively in social epidemiology in the recent years, for example to try to estimate neighbourhood effects on health (Diez Roux, Borrell et al. 2004, Leal, Bean et al. 2011). Although not a panacea (Luo, Gardiner et al. 2010), PSM can be a useful tool for sensitivity analyses and it is used as such in Chapter 5 (exploring the association between early access to homeownership and later life depressive symptoms levels). Rosenbaum and Rubin first introduced propensity score matching in 1983 and defined the propensity score as "the conditional probability of being exposed or treated" (Rosenbaum and Rubin 1983, Rosenbaum and Rubin 1984). The approach tries to mimic an experimental study design by comparing outcomes between groups matched on the probability of being assigned to the exposure of interest, early access to homeownership for this thesis.

In substance, the objective of PSM is first to estimate a likelihood of being treated (the propensity score) based on observable variables in the data and second to match respondents with the same probability of being treated. Conditional on the assumption that unmeasured confounding is not an issue, PSM assumes that any observed difference in the outcome between two matched subjects is due to the treatment alone (Oakes and Johnson 2006). The objective of PSM is to balance observed variables between individuals who were exposed and who were not exposed to the treatment of interest in order to isolate the effect of the treatment.

In Chapter 5, I follow the six steps suggested by Garrido and colleagues to construct and assess propensity scores (Garrido, Kelley et al. 2014). All steps were implemented using the

user-written psmatch2 command in Stata, corrected to incorporate robust standard errors (Leuven and Sianesi 2003).

(1) Choice of observed variables to include in the propensity score

The first step of PSM is to run a logistic regression with early access to homeownership as an outcome (1=early access to homeownership; 0=otherwise), adding potential confounders as independent variables. Covariates to be included in the model should be predictive of the exposure of interest (early access to homeownership in my case) but not a result of it (Brookhart, Schneewiess et al. 2006, Oakes and Johnson 2006, Austin 2011). Available guidance suggests a trade-off between, on the one hand, not including enough variables in the model which can lead to confounding and, on the other hand, efficiency as too many covariates may introduce "noise" in the model (Brooks and Ohsfeldt 2013). Variables included in the final model are: gender, age, years of education, ethnic group, marital status, employment status, self-reported health, health behaviours (drinking and smoking), number of limitations with ADLs and IADLs.

(2) Balance of propensity score

After calculating the propensity score for each respondent in the dataset, I have to ensure that there is 'common support' between the treated and control groups, *i.e.* an overlap of the range of propensity scores across the two groups (Garrido, Kelley et al. 2014). This is subjectively assessed by looking at a graph plotting the propensity scores for both the treated and control group (see Figure 5.3. Overlap in propensity scores by early access to homeownership exposure in Chapter 5).

(3) Balance of covariates across treatment comparison groups and within blocks of the propensity score

The next stage is to check that the propensity score is balanced not only across the two groups but also within each block of the propensity score in order to ensure that the propensity score has been well specified (Imbens 2004). There is no guidance of how much balance is necessary in theory (Garrido, Kelley et al. 2014). In practice, I used the routine provided as part of the psmatch2 Stata command. I performed as recommended several iterations of step two above and all specifications achieved balance for all covariates across groups within blocks. In addition, t-tests were conducted to check the balance of covariates between the two groups (Austin 2009). I found no significant differences between the two groups except for gender.

(4) Choice of matching and weighting strategy

After creating the propensity score and ensuring that it is balanced across groups and blocks, the next step is to choose a strategy to match individuals. Matching strategies match a treated respondent with a control respondent who has the most similar propensity score, either no matter how poor the match (nearest neighbour) or within a certain distance (caliper which can be adjusted). In kernel weighting, no unmatched individuals are discarded: each treated individual has a weight of one and a weighted composite of comparison individuals is used to build a match for each treated individual. Kernel weighting was chosen as a matching strategy for Chapter 5 as it maximizes precision (by not discarding any individuals) while not worsening bias (by assigning greater weight to better matches) (Garrido, Kelley et al. 2014).

(5) Balance of covariates after matching

After choosing the matching strategy, it is important to ensure that it worked well in terms of balancing the treatment and control groups. Means of covariates across unmatched and matched pairs of treated and control groups can be compared to measure the percentage of bias reduction obtained thanks to the matching (Garrido, Kelley et al. 2014). There is no specific guidance on sufficient or insufficient bias reduction after matching but results from Chapter 5 indicate that the reduction ranged from 61.8% to 99.4%.

(6) Estimation of treatment effects

Once a satisfying balance of covariates has been achieved after matching, the models can be run on the matched sample of early and late homeowners. Standard errors are adjusted by bootstrap methods (Leuven and Sianesi 2003). The treatment effect obtained is the average treatment effect on the treated (ATT), *i.e.* in my case the estimated average effect of early access to homeownership on depressive symptoms for individuals who accessed homeownership before the age of 35.

The aim of this chapter was to present the data to be used in the reminder of the thesis as well as an overview of the methods to be implemented to answer the research questions. Further details about both the datasets and the statistical analyses are presented in the corresponding sections of the empirical chapters.

Chapter 4

Are different measures of depressive symptoms in old age comparable?[12]

Background. The Centre for Epidemiologic Studies of Depression (CES-D) and the Euro-D scales are commonly used depressive symptom measures but their comparability has not been assessed to date. This chapter aims to contribute to the literature comparing the drivers of depression in old age across countries by examining whether CES-D (in its eight-item short version) and Euro-D are comparable.

Methods. Data from the Survey of Health, Ageing and Retirement in Europe (SHARE, N = 15,487) covering 13 countries were used to examine the scales' distributional properties, systematic differences between population subgroups, sensitivity and specificity, and associations with established risk factors for depression in old age.

Results. CES-D and Euro-D were strongly correlated (r = 0.6819, p < 0.000). However, agreement between the two scales was moderate. There were systematic discrepancies in scores by demographic and socioeconomic characteristics. CES-D captures a more extreme pool of depressed individuals than Euro-D. Although associations with risk factors are always in the same direction, they are often stronger for CES-D than Euro-D.

Discussion. The findings from this chapter highlight the need for researchers to be cautious when comparing depressive symptoms levels and associations with risk factors between surveys using different measures of depressive symptoms.

[12]A version of this chapter was published in the *International Journal of Methods in Psychiatric Research* (Courtin, Knapp, Grundy & Avendano, 2015). See Appendix 8.

4.1. Introduction

A growing literature based on cross-national comparable data suggests that there are significant differences in the prevalence of later-life depressive symptoms across countries (Castro-Costa, Dewey et al. 2007, Ploubidis and Grundy 2009, Kok, Avendano-Pabon et al. 2012, Missinne, Vandevive et al. 2014). In addition, recent studies suggest that risk factors for depression in later life may differ across countries (Crimmins, Kim et al. 2011, Siegrist, Lunau et al. 2012, Lunau, Wahrendorf et al. 2013, Di Gessa and Grundy 2014, Riumallo-Herl, Basu et al. 2014).

Most of these studies are based on data from harmonized longitudinal ageing studies, such as SHARE, ELSA or HRS. An advantage of using these surveys for cross-national comparison is that they include broadly comparable measures of health, employment, social interactions and wellbeing (Börsch-Supan, Hank et al. 2005, Banks, Nazroo et al. 2012, National Institute on Ageing 2014). However, they use different measures to assess depressive symptoms. While SHARE uses the Euro-D scale of depressive symptoms, HRS and ELSA for example rely on a short version of the Centre for Epidemiological Studies Depression (CES-D) scale. Although measurement comparability is an essential prerequisite for robust comparisons across countries, it is as yet unclear how the CES-D scale compares to the Euro-D scale, and consequently whether cross-national comparisons using these two different measures are valid.

In this chapter, I exploit unique data from the second wave of SHARE, which administered both the CES-D and Euro-D scales to a sample of older Europeans in 13 countries. The aim is to assess the comparability of the scales; their sensitivity and specificity to identify elevated depressive symptoms; and to assess differences in the association of each scale with established risk factors for depression. To my knowledge, this is the first study examining

the comparability of the CES-D and Euro-D measures of depressive symptoms. This chapter is organized as follows. The next section presents the data, measures and analytical strategy. The results are then presented: distribution of the two scores, intra-individual differences, discriminability and finally the respective associations of the two scores with a selection of established risk factors for depressive symptoms in later life. Conclusions regarding the comparability of the two scales and implications for future research are reported in the last section.

4.2. Methods

4.2.1. Data Collection and Participants

SHARE is a longitudinal, nationally representative survey designed to provide comparable information on the health, employment and social conditions of Europeans aged 50+ across Europe. Specific details about the survey are reported in Chapter 3 of this thesis. For this chapter, I used data from the second wave (collected in 2006), which contained measures of both the Euro-D and CES-D for the same respondents. Only respondents with scores from the two scales were included in the analysis, resulting in a final sample of 15,487 respondents.

4.2.2. Measures

I compared two scales of depressive symptoms: (a) the eight-item version of the CES-D scale; and (b) the 12-item EURO-D scale. The original CES-D scale comprises 20 items (Radloff 1977), but shorter versions are frequently used and have been shown to be reliable (Kohout, Berkman et al. 1993). An eight-item version of the CES-D scale was included in the second wave of SHARE, asking respondents whether they had experienced any of the

following symptoms during the previous week: felt depressed, felt that everything was an effort, felt that their sleep was restless, were happy, felt lonely, enjoyed life, felt sad, or were unable to get going. Possible responses were *yes* or *no*. Table 4.1 below displays the questions asked to build the CES-D score.

Table 4.1. Questions asked to build the CES-D score

Time frame: Past week
1. Much of the time during the past week, you felt depressed. Would you say yes or no?
2. Much of the time during the past week, you felt everything you did was an effort. Would you say yes or no?
3. Much of the time during the past week, your sleep was restless. Would you say yes or no?
4. Much of the time during the past week, you were happy. Would you say yes or no?
5. Much of the time during the past week, you felt lonely. Would you say yes or no?
6 Much of the time during the past week, you enjoyed life. Would you say yes or no?
7. Much of the time during the past week, you felt sad. Would you say yes or no?
8. Much of the time during the past week, you were unable to get going. Would you say yes or no?

The score ranges from zero to eight, with higher scores indicating higher levels of depressive symptoms. A cut-off point of three is frequently used to define elevated depressive symptoms levels (Turvey, Wallace et al. 1999, Han 2002). The CES-D scale was originally designed to measure depressive symptom levels in the US but the validity of translated versions has been confirmed for European countries (Fuhrer and Rouillon 1989, Goncalves and Fagulha 2004, Van de Velde, Bracke et al. 2010, Van de Velde, Bracke et al. 2010, Missinne, Vandevive et al. 2014).

The EURO-D scale was developed to collect harmonized data on late-life depressive symptoms in the 11 European countries which took part in the EURODEP study (Prince, Reischies et al. 1999). Five existing depression measures (Geriatric Mental State-AGECAT, SHORT-CARE, CES-D, Zung Self-Rating Depression Scale, and the Comprehensive Psychopathological Rating Scale) were merged to form a 12-item scale (Prince, Reischies et al. 1999) specifically designed to measure depressive symptoms in old age. The Euro-D scale

has been evaluated as reliable and is highly correlated with other mental health measures (Prince, Reischies et al. 1999). Respondents were asked to report whether during the past month they experienced any of the following symptoms: depressed mood, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment and tearfulness. Possible responses were *yes* or *no*. Table 4.2 below displays the questions asked to build the Euro-D score.

Table 4.2. Questions asked to build the Euro-D score

Time frame: Past month
1. In the last month, have you been sad or depressed?
2. Have you been irritable recently?
3. In the last month, have you had too little energy to do the things you wanted to do?
4. In the past month, have you cried at all?
5. What are your hopes for the future?
6. In the last month, have you felt that you would rather be dead?
7. Do you tend to blame yourself or feel guilty about anything?
8. Have you had trouble sleeping recently?
9. In the past month, what is your interest in things?
10. What has your appetite been like?
11. How is your concentration? For example, can you concentrate on a television programme, film or radio programme? Can you concentrate on something you read?
12. What have you enjoyed doing recently?

The score ranges from zero to 12, with higher scores indicating higher levels of depressive symptoms (Prince 2002). A threshold of four has been suggested to measure elevated depressive symptoms levels (Dewey and Prince 2005, Castro-Costa, Dewey et al. 2007, Castro-Costa, Dewey et al. 2008).

4.2.3. Data Analysis

As the two scales include different numbers of items and consequently have different total scores, values were normalized to obtain a common metric for both scales, ranging from 0 to 1. Normalized scales were obtained by dividing individual scores by the country-specific

maximum value for each scale. For CES-D, this value ranged from 0 to 11 or 12 depending on the country, while for Euro-D this ranged from 0 to 8. Roughly, estimates from normalized scores can be translated back into original scales by multiplying coefficients by the mid-range of the maximum value for each scale.

The analyses proceeded through three main stages. First, to assess whether there were systematic differences in the response to each scale by the same respondent, a difference score (Euro-D *minus* CES-D) was used to summarize congruence between the two scales (Edwards 2001). Ordinary least squares (OLS) models were then used to assess the predictors of incongruence, which correspond to key risk factors for depressive symptoms in later life as defined in the literature (Cairney and Krause 2005, Buber and Engelhardt 2011). All multiple linear regression models consequently included gender, age in three categories (50 to 60, 61 to 70, over 70), marital status (married or in a partnership; divorced, widowed or single), education in three categories (primary education or less; secondary education; post-secondary education), a measure of economic strain (household is able to make ends meet with difficulty or with some difficulty; household is able to make ends meet easily or fairly easily), the number of chronic illnesses (less than two chronic illnesses; two or more chronic illnesses), limitations in activities of daily living (less than one limitation with activities of daily living; more than one limitation with activities of daily living) reported by the respondent; and country of residence.

Second, the Euro-D and CES-D scales use different cut-off points to measure elevated depressive symptoms, *i.e.* whether respondents are likely to be clinically depressed. I estimated Cohen's kappa scores (κ) to assess the level of agreement between the two scores in identifying high levels of depressive symptoms. Values for the kappa scores always range

between 0 (agreement equivalent to chance) and 1 (perfect agreement) (Altman 1991). Next, the sensitivity (proportion of depressed individuals identified as depressed) and the specificity (proportion of non-depressed individuals categorized as non-depressed) of the CES-D were estimated, using the Euro-D scale as reference. A perfect match would be described as 100% sensitive (all respondents classified as depressed by the Euro-D scale are classified as depressed by the CESD scale) and 100% specific (all respondents classified as non-depressed in the Euro-D scale are classified as non-depressed by the CESD scale). I used the recommended threshold for elevated depressive symptoms for both scales. In sensitivity analyses, I examined alternative cut-off points (*e.g.* a threshold of three for the Euro-D scale, as sometimes recommended in the literature). I found that results were not sensitive to the specific thresholds and therefore decided to report only the results for the optimal combination between two scores (four for Euro-D and three for CES-D). The Receiver Operating Characteristic (ROC) curve was also used to examine whether the CES-D scale identified the same depressed respondents as the Euro-D scale. The ROC curve (Hanley and McNeil 1982) measures the overall ability of the CES-D scale to discriminate against the criterion of the Euro-D score. The area under the ROC curve measures accuracy: an area of 1 represents a "perfect match", while an area of 0.5 represents a "worthless match". A value between 0.90 and 1 was considered as excellent, between 0.80 and 0.90 as good, and between 0.70 and 0.80 as fair (Hanley and McNeil 1982).

Finally, the associations between each normalized depression score and selected well-established risk factors for depression were explored in a third stage of the analysis. Multiple linear regression models were first estimated to assess whether the associations of depressive symptoms with risk factors differed for the two scales. As mentioned above, key risk factors included gender, age, marital status, education, economic strain, the number of chronic

illnesses, limitations in activities of daily living reported by the respondent; and country of residence (the models were also run separately per country in sensitivity analyses and results are included in the appendix of this thesis). Coefficients report the association between each explanatory variable and the continuous outcome score. Logistic regression was then used to estimate the association between each risk factor and depressive symptomatology. Odds ratios are reported in the corresponding tables. The coefficients or odds ratios obtained for the two scores are from two different equations and consequently the magnitude of associations cannot be compared directly to each other. Cross-equation tests were performed to determine whether the associations between depressive symptom scores and explanatory variables were statistically different across the two scales.

4.3. Results

4.3.1. Descriptive statistics

The correlation between the two scores was 0.6819 (p<0.000), which indicates that the two scales are highly correlated. The scales had a similar level of internal consistency as measured by the Cronbach's alpha (8-item CESD, α = 0.82; 12-item Euro-D, α = 0.72), which are indicative of high reliability in measuring depressing symptoms.

Distributions of the CES-D and Euro-D scores are presented in Figure 4.1. The Kernel density plot shows that the CES-D scale is slightly more skewed to the left than the Euro-D scale (*i.e.* CES-D scores fall under lower depressive symptoms scores than Euro-D scores).

Figure 4.1. Kernel density plot of the normalised CES-D and Euro-D scales

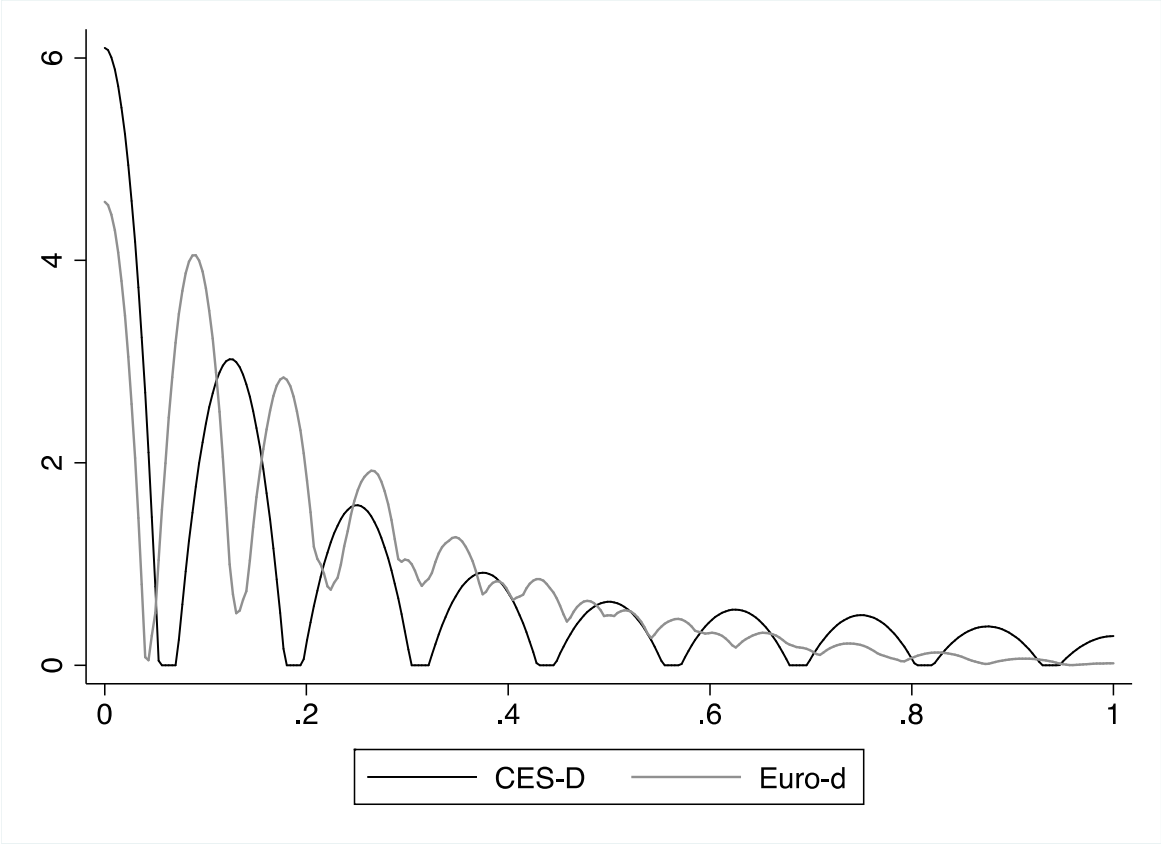


Table 4.3 reports the summary statistics for the two scores for the entire sample and separately by gender and age group in three categories. The mean is 0.20 for both standardized scales, but the larger standard deviation of the CES-D (0.26) compared to the Euro-D (0.20) illustrates the wider spread and left tale of the CES-D scale. Paired t-tests indicated that differences in means were significant only for the youngest age group (higher depression scores using the Euro-D scale) and for respondents aged 70+ (higher depression scores using the CES-D scale).

Table 4.3. Summary statistics of the normalised CES-D and Euro-D scores (*N*=15,487)

	Euro-D			CES-D			Comparison	
	N	Mean	Standard deviation	*N*	Mean	Standard deviation	Paired t-test	*P* value
Entire sample	15,487	0.20	0.20	15,487	0.20	0.26	0.5192	0.6036
Females	8,445	0.23	0.20	8,445	0.23	0.28	-1.3634	0.1728
Males	7,042	0.15	0.17	7,042	0.15	0.22	0.9244	0.3553
50 to 60	6,372	0.18	0.18	6,372	0.17	0.24	3.8248	0.0001
61 to 70	4,812	0.18	0.18	4,812	0.18	0.25	1.4147	0.1572
Over 70	4,303	0.24	0.21	4,303	0.25	0.25	-6.6647	0.0000

4.3.2. Intra-individual differences

The determinants of intra-individual differences in scores are formally explored in Table 4.4, which presents estimates from the linear regression analyses with the difference between the Euro-D and the CES-D score as dependent variable (Euro-S minus CES-D, *Mean*=0.009; *SD*=0.192). A value of 0 for males, for example, would indicate that males do not display different levels of incongruence between the two scores as compared to females. In contrast, a positive value would indicate that males display a larger positive discrepancy between the Euro-D and CES-D scales than do females. Results show that most risk factors examined significantly predicted the difference scores. Males, those over 70 years of age, those with lower educational attainment, those with 2+ chronic diseases, those with one or more limitations in Activities of Daily Living (ADLs), those divorced, widowed or single, and those experiencing economic strain were significantly more likely to have a negative discrepancy between the Euro-D and CES-D scales than their respective counterparts. Significant score differences were also found between countries. Respondents in Sweden, the Netherlands, France, Denmark, Greece, Switzerland, Belgium, and Poland were more likely

to score higher on the Euro-D than the CESD score compared to respondents in Austria (the reference country), while the opposite was true for Italy.

Predicted score differences can be estimated for different individual profiles to illustrate the magnitude of these differences. For example, an Austrian male respondent, aged over 70, single or widowed, with secondary education, reporting both more than one limitation in ADL and more than two chronic conditions will score 0.0844 points higher on the CES-D scale than on the Euro-D scale. In contrast, an Austrian female in the youngest age group without health limitations, higher levels of education and married or in a partnership will have a smaller score difference of 0.054 point.

Table 4.4. Estimated differences in CES-D and Euro-D scores (fully adjusted model)

	Score difference
Male (ref. female)	-0.0116**
	(0.00382)
61 to 70 (ref.: 50 to 60)	0.00184
	(0.00448)
Over 70	-0.0102*
	(0.00503)
Divorced, widowed or single (ref. married)	-0.0374***
	(0.00418)
Secondary education (ref.: primary education or less)	0.00889
	(0.00504)
Post-secondary education	0.0122*
	(0.00569)
Economic strain (ref. no)	-0.0384***
	(0.00453)
2+ chronic diseases (ref. no)	-0.0176***
	(0.00399)
1+ limitations in ADLs (ref. no)	-0.0494***
	(0.00778)
Germany (ref.: Austria)	-0.00997
	(0.0107)
Sweden	0.0506***
	(0.0103)
Netherlands	0.0648***
	(0.0101)
Spain	0.0220

	(0.0115)
Italy	-0.0226*
	(0.0112)
France	0.0598***
	(0.0108)
Denmark	0.0737***
	(0.00998)
Greece	0.0288**
	(0.0111)
Switzerland	0.0411***
	(0.0114)
Belgium	0.0418***
	(0.0103)
Czechia	-0.0113
	(0.0107)
Poland	0.0395***
	(0.0118)
Constant	0.00805
	(0.0104)
Observations	10,536
R-squared	0.068

Notes: Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05.
[1]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.
[2]Activities of daily living include putting on shoes and socks, walking across a room, bathing or showering, eating, getting in and out of bed, using the toilet, including getting up and down.
[3]Low education levels correspond to having a high school degree or lower qualifications.
[4]Economic strain is defined as reporting difficulties to make ends meet in the past month.

4.3.3. Discriminability of the two scales

The Euro-D and the CES-D score use different cut-off points to screen for older people with elevated depressive symptoms levels. The level of agreement between the two scores, as measured by the kappa score, was only moderate (κ=0.529, 95% CI 0.514-0.545). Table 4.5 reports the results of the sensitivity and specificity levels of the CES-D scale, taking the Euro-D scale as reference. Sensitivity was 62.6%, indicating that from all respondents identified as depressed by the Euro-D scale, 62.6% are also classified as depressed by the CES-D scale. This implies that 37.4% of respondents who were identified as depressed by

the Euro-D went 'undetected' by the CES-D scale. In turn, the specificity level was 89.5%, indicating that the CES-D scale identifies as non-depressed 89.5% of respondents categorized as non-depressed by the Euro-D scale. Table 4.5 also displays a positive predictive value of 65.7%, which corresponds to the proportion of respondents identified by the CES-D scale as reporting high depressive symptoms who were also identified by the Euro-D scale as reporting high depressive symptomatology.

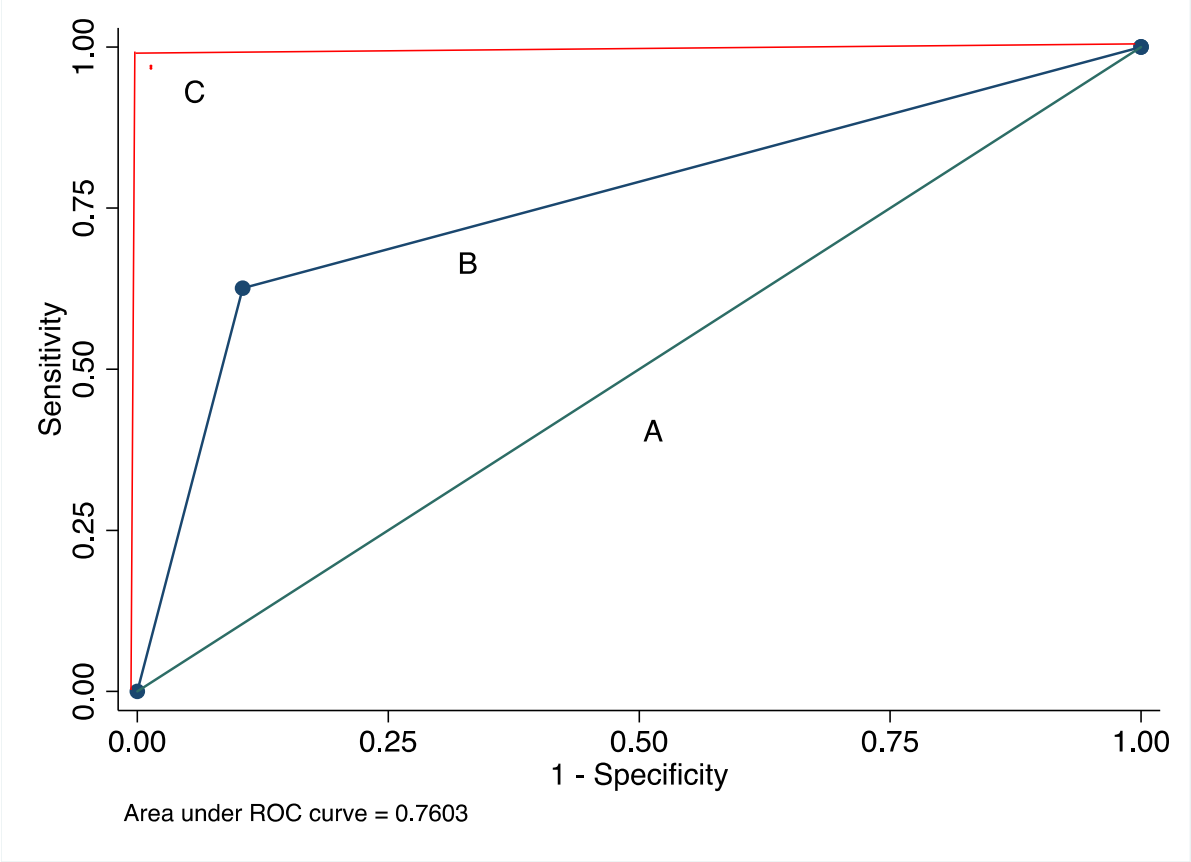
Table 4.5. Cross-tabulation of the depressive symptoms thresholds of the Euro-D and CES-D scores and associated sensitivity and specificity values

	Depressed Euro-D	Non-depressed Euro-D	Total
Depressed CES-D	2,389	1,413	3,802
Non-depressed CES-D	1,258	10,427	11,685
Total	3,647	11,840	15,487

	%	95% CI
Sensitivity	62.8	61.3-64.4
Specificity	89.2	88.7-89.8
Positive predicted value	65.5	63.9-67
Negative predicted value	88.1	87.5-88.6

The ROC curve in Figure 4.2 plots the false (discordant) positives (non-depressed individuals according to the Euro-D scale who were classified as depressed by the CES-D scale) against the true (concordant) positives (non-depressed individuals according to the Euro-D scale also categorised as such by the CES-D scale) for the cut-off points determined above. The area under the curve determines the accuracy of the CES-D cut-off point compared to that of the Euro-D scale, *i.e.* how well the scale separates the sample into those with and without high levels of depressive symptoms with the results of the Euro-D scores as reference. The area under the ROC curve for the sample is 0.7603 (95% CI 0.7522-0.7684), which is considered as fair.

Figure 4.2. Receiver Operating Characteristic (ROC) curve for the CES-D scale of depressive symptoms



Notes:
A - Line of zero discrimination (theoretical)
B - ROC-curve for the CES-D score in the sample (0.7603)
C - Perfect discrimination (theoretical)

4.3.4. Associations with established risk factors

Table 4.6 summarizes results from models that assess whether associations between depressive symptoms scores and established risk factors for depression in old age vary by scale.

Findings from the linear regressions indicate that all predictors were significantly associated with both scales, with the exception of the oldest age group (over 70) for the normalised Euro-D score. Associations with gender were larger for the Euro-D than the CES-D scale, but for most other variables, associations were stronger for the CES-D. The largest

difference between coefficients was found for marital status. Compared to their married counterparts, divorced, widowed or single respondents scored on average 0.0689 points higher (95% CI 0.0583-0.0789) on the CES-D scale but only 0.0299 points higher (95% CI 0.0220-0.0371) on the Euro-D. The two health variables included in the models (number of chronic diseases and of limitations in ADLs) were more strongly associated with the normalised CES-D score. For instance, having more than one limitation in ADLs was associated with scoring 0.176 points higher (95% CI 0.1624-0.2027) on the normalised CES-D scale compared to 0.126 points higher (95% CI 0.1154-0.1448) on the normalised Euro-D score. Similarly, reporting two or more chronic illnesses was associated with scoring 0.0868 points higher (95% CI 0.0809-0.1007) on the normalised CES-D score, versus 0.0692 (95% CI 0.0641-0.0787) on the Euro-D score. Cross-equation tests indicate that associations of depression with age, chronic diseases, marital status, ADLs, educational level and economic strain were significantly stronger for the CES-D than for the Euro-D scale. Only associations with gender were stronger for the Euro-D.

Table 4.6 also displays the results of the logistic regression models, which summarize the association between explanatory variables and depressive symptomatology as ascertained by each scale. With the exception of three country dummies and age above 70 for the CES-D scale, all variables were significantly associated with the odds of being classified as depressed by the two scales. In line with the results from the linear regressions, the largest difference between the two scales was found for marital status. Being divorced, single or widowed is associated with higher odds of being classified as depressed by the CES-D scale (1.861, 95% CI 1.6750-2.0681) than by the Euro-D scale (1.319, 95% CI 1.1873-1.4648). Cross-equation tests suggest no significant difference between the two scales in their associations with health

measures and educational level. However, the association with gender, being over 70, marital status and economic strain was stronger for the CES-D score.

Table 4.6. Linear regressions for the normalized CES-D and Euro-D scores and odds ratios for elevated depressive symptoms

	Linear regressions		Cross-equation tests		Logistic regressions		Cross-equation tests	
	Normalised CES-D	Normalised Euro-D	Chi-squared	*P*-value	CES-D	Euro-D	Chi-squared	*P*-value
Male (ref. female)	-0.0510***	-0.0626***	2.57	0.1087	0.608***	0.470***	20.88	0.0000
	(0.00467)	(0.00353)			(0.0325)	(0.0251)		
61 to 70 (ref.: 50 to 60)	-0.0188***	-0.0170***	3.95	0.0470	0.816**	0.749***	0.00	0.9946
	(0.00544)	(0.00402)			(0.0523)	(0.0473)		
Over 70	0.0116	0.00138	63.24	0.0000	1.012	0.860*	18.72	0.0000
	(0.00622)	(0.00458)			(0.0665)	(0.0567)		
2+ chronic illnesses (ref. no)	0.0868***	0.0692***	120.68	0.0000	2.295***	2.249***	0.36	0.5501
	(0.00499)	(0.00370)			(0.121)	(0.118)		
1+ limitations with ADLs (ref. no)	0.176***	0.126***	152.44	0.0000	3.3365***	2.973***	2.51	0.1128
	(0.0101)	(0.00746)			(0.260)	(0.228)		
Divorced, single or widowed ref. married)	0.0653***	0.0279***	148.24	0.0000	1.861***	1.319***	41.67	0.0000
	(0.00523)	(0.00381)			(0.100)	(0.0707)		
Secondary education (ref.: primary education or less	-0.0313***	-0.0224***	2.73	0.0986	0.760***	0.755***	1.48	0.2244
	(0.00638)	(0.00462)			(0.0469)	(0.0458)		
Post-secondary education	-0.0348***	-0.0226***	56.66	0.0000	0.650***	0.715***	1.61	0.2039
	(0.00704)	(0.00531)			(0.0523)	(0.0555)		
Economic strain (ref. no)	0.0942***	0.0558***	262.06	0.0000	1.841***	1.659***	10.86	0.0010
	(0.00571)	(0.00411)			(0.132)	(0.114)		
Germany (ref.: Austria)	0.0347**	0.0247**	35.22	0.0000	1.408*	1.245	49.92	0.0000
	(0.0133)	(0.00934)			(0.207)	(0.199)		
Sweden	-0.0158	0.0348***	46.11	0.0000	0.739*	1.074	0.18	0.6673
	(0.0130)	(0.00958)			(0.113)	(0.168)		
Netherlands	-0.0310*	0.0338***	84.18	0.0000	0.632**	1.236	9.98	0.0016

	(0.0127)	(0.00931)			(0.1000)	(0.195)		
Spain	0.0274	0.0494***	4.68	0.0305	1.379*	2.004***	0.25	0.6198
	(0.0158)	(0.0109)			(0.210)	(0.313)		
Italy	0.0790***	0.0563***	129.64	0.0000	1.977***	2.433***	1.32	0.2508
	(0.0148)	(0.0101)			(0.280)	(0.357)		
France	0.00220	0.0620***	44.90	0.0000	1.095	2.181***	40.03	0.0000
	(0.0137)	(0.00946)			(0.158)	(0.320)		
Denmark	-0.0658***	0.00785	98.76	0.0000	0.387***	0.915	12.94	0.0003
	(0.0127)	(0.00942)			(0.0674)	(0.151)		
Greece	-0.0409**	-0.0120	12.57	0.0004	0.829	1.004	15.18	0.0001
	(0.0137)	(0.00976)			(0.122)	(0.154)		
Switzerland	-0.0179	0.0232*	9.80	0.0017	0.734	1.239	0.45	0.5012
	(0.0145)	(0.0106)			(0.136)	(0.225)		
Belgium	-0.00145	0.0404***	17.93	0.0000	1.047	1.532**	2.18	0.1396
	(0.0133)	(0.00945)			(0.152)	(0.230)		
Czechia	0.00954	-0.00174	103.79	0.0000	1.244	1.261	46.65	0.0000
	(0.0139)	(0.00947)			(0.176)	(0.190)		
Poland	0.0581***	0.0976***	7.43	0.0064	1.694***	3.708***	43.19	0.0000
	(0.0153)	(0.0104)			(0.244)	(0.548)		
Constant	0.133***	0.141***			0.127***	0.141***		
	(0.0136)	(0.00955)			(0.0196)	(0.0221)		
Observations	10,536	10,536			10,536	10,536		
R-squared	0.236	0.220			0.159	0.144		

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05.

In order to understand how these differences translate back into original scores, Table 4.7 displays the OLS estimates using the original scale rather than the normalized scores. In the first two columns, I report results of the main regression for the normalised Euro-D and CES-D scores. The next two columns present estimates using original scales.

Table 4.7. Linear regressions for the normalized and original CES-D and Euro-D scores

	Normalised CES-D	Normalised Euro-D	Original CES-D	Original Euro-D
Male (ref. female)	-0.0510***	-0.0626***	-0.428***	-0.732***
	(0.00467)	(0.00353)	(0.0377)	(0.0405)
61 to 70 (ref. 50 to 60)	-0.0188***	-0.0170***	-0.174***	-0.202***
	(0.00544)	(0.00402)	(0.0440)	(0.0462)
Over 70	0.0116	0.00138	0.0421	-0.0179
	(0.00622)	(0.00458)	(0.0503)	(0.0527)
2+ chronic illnesses (ref. no)	0.0868***	0.0692***	0.727***	0.819***
	(0.00499)	(0.00370)	(0.0403)	(0.0425)
1+ limitations with ADLS (ref. no)	0.176***	0.126***	1.461***	1.492***
	(0.0101)	(0.00746)	(0.0821)	(0.0859)
Divorced, single or widowed (ref. married)	0.0653***	0.0279***	0.549***	0.335***
	(0.00523)	(0.00381)	(0.0421)	(0.0438)
Secondary education (ref. primary education)	-0.0313***	-0.0224***	-0.318***	-0.323***
	(0.00638)	(0.00462)	(0.0514)	(0.0533)
Post-secondary education	-0.0348***	-0.0226***	-0.367***	-0.333***
	(0.00704)	(0.00531)	(0.0566)	(0.0606)
Economic strain (ref. no)	0.0942***	0.0558***	0.417***	0.389***
	(0.00571)	(0.00411)	(0.0397)	(0.0437)
Germany (ref.: Austria)	0.0347**	0.0247**	0.314**	0.148
	(0.0133)	(0.00934)	(0.108)	(0.109)
Sweden	-0.0158	0.0348***	-0.128	0.0439
	(0.0130)	(0.00958)	(0.105)	(0.108)
Netherlands	-0.0310*	0.0338***	-0.232*	0.239*
	(0.0127)	(0.00931)	(0.103)	(0.108)
Spain	0.0274	0.0494***	0.348**	0.708***
	(0.0158)	(0.0109)	(0.128)	(0.131)
Italy	0.0790***	0.0563***	0.797***	0.819***
	(0.0148)	(0.0101)	(0.119)	(0.121)
France	0.00220	0.0620***	0.0712	0.790***
	(0.0137)	(0.00946)	(0.112)	(0.114)
Denmark	-0.0658***	0.00785	-0.504***	-0.0428
	(0.0127)	(0.00942)	(0.103)	(0.110)
Greece	-0.0409**	-0.0120	-0.0849	-0.108
	(0.0137)	(0.00976)	(0.109)	(0.113)

Switzerland	-0.0179	0.0232*	-0.0925	0.157
	(0.0145)	(0.0106)	(0.117)	(0.122)
Belgium	-0.00145	0.0404***	0.0591	0.346**
	(0.0133)	(0.00945)	(0.108)	(0.110)
Czechia	0.00954	-0.00174	0.230*	0.116
	(0.0139)	(0.00947)	(0.112)	(0.113)
Poland	0.0581***	0.0976***	0.710***	1.401***
	(0.0153)	(0.0104)	(0.123)	(0.124)
Constant	0.133***	0.141***		
	(0.0136)	(0.00955)		
Observations	10,536	10,536	10,536	10,536
R-squared	0.236	0.220	0.219	0.226

Note: Robust standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05

4.3.5. Country-specific models

In supplementary analyses, separate models as presented in Table 4.6 were fitted for each country (see Appendix 4.2). These models revealed no clear systematic differences between countries. Although it is difficult to identify a common pattern, in most countries, associations between health measures and education tended to be systematically stronger for the CES-D than the Euro-D. Gender differences were larger for the Euro-D than for the CES-D scale in many countries, confirming results from Table 4.6. In most countries, the largest difference between the Euro-D and CES-D scores was for associations with gender and marital status.

4.4. Discussion

The objective of this chapter was to assess the comparability of the Euro-D and CES-D scales, two measures of depressive symptoms commonly used in ageing surveys. I found a high correlation between the two scores, but there are important differences in their properties. The CES-D scale is more skewed to the left, resulting in a higher standard deviation compared to the Euro-D scale. Being male, as well as characteristics associated with social disadvantage (older age, divorced/widowed/single, low education, economic strain) and higher levels of physical limitations (two or more chronic diseases and one or

more ADL limitations) are associated with significantly more negative discrepancies in assessments between the Euro-D and CES-D scales. Estimates suggest that the CES-D scale captures a more extreme pool of depressed individuals than the Euro-D scale. As a result, the association between risk factors and depressive symptom scores is often stronger for the CES-D than for the Euro-D scale. These findings highlight the need for some caution in interpreting comparisons of levels and associations with risk factors between surveys using different measures of depressive symptoms.

4.4.1. Limitations and strengths

The main strength of this chapter is to assess depressive symptoms using the Euro-D and CES-D scales for the same respondents in representative samples of Europeans in 13 countries. However, several limitations should be considered. The scales use different reference periods: Euro-D asks about depressive symptoms in the past month while CES-D asks about symptoms in the past week (Zamarro, Meijer et al. 2008). On the other hand, both scales have been shown to have relatively high test-retest reliability over short to medium periods of assessment, suggesting that although differences in reference periods might contribute to differences in scores, they are unlikely to fully account for the systematic differences in distributions observed in this chapter (Radloff 1977, Larraga, Saz et al. 2006).

Second, the cross-sectional nature of CES-D and Euro-D measures in SHARE did not enable me to examine comparatively in-score changes. In addition, I focused only on participants who responded to the questions used to build the two scores. Although focusing on these respondents was necessary in order to compare the scales, caution should be exercised when interpreting the results as respondents included in the study may not be representative of the full sample.

Third, I did not compare the factorial structure of the two scales. Although this is beyond the scope of this chapter, conducting a Confirmatory Factor Analysis (CFA) to compare the properties of the scales would be an interesting avenue for future research.

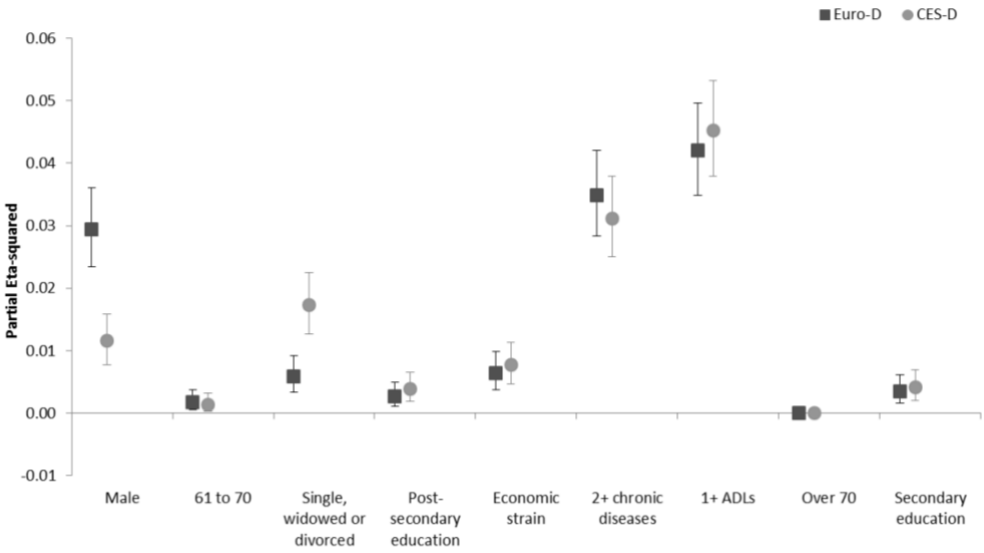
Despite these limitations, this chapter expands upon previous research by assessing the comparability of these two depression scales. An important question is why the same individual (presumably having a single underlying 'true' depressive symptoms state) reports different scores depending on the scale being used, resulting in more cases identified as depressed by the CES-D than by the Euro-D scale. A possible explanation is that the CES-D scale includes items not included in the Euro-D scale. In particular, the CES-D includes two positive affect items (happiness and enjoyment of life), while the Euro-D scale includes only negative affect items. The positive affect items in CES-D may lead to sharper identification of depressed individuals, as those reporting no positive affect are more likely to have higher number of symptoms in the CES-D, while those with no positive affect are not identified by the Euro-D scale, which only asks about negative affect. This may partly explain why individuals with the same level of depression report more depressive symptoms in the CESD than the Euro-D scale.

4.4.2. Implications for future research

Despite high levels of correlation between the two scales, caution in the interpretation of associations with risk factors is required. My results highlight some differences in associations between CES-D and Euro-D with established risk factors for depression. This would suggest that differences in these associations reported in previous comparative studies are to some extent due to the use of different scales. An important question is whether differences between estimates for CES-D and Euro-D are clinically meaningful. In order to provide an estimate of the magnitude of differences in the

associations between risk factors and depressive scores, I computed partial Eta-squared (Richardson 2011). This measure provides an estimate of the clinical significance of the results by comparing the relative sizes of the effects from different risk factors on depressive symptoms levels as measured by the two scales. Figure 4.3 displays the estimates for the two scores side by side, together with their 95% CI.

Figure 4.3. Effect sizes for the Euro-D and CES-D scores per risk factor



For all variables, I find a small to medium effect size, according to Cohen's criterion (Cohen 1988). More importantly for the validity of previous comparative studies using these scales together, I find that the 95% CI overlap for most risk factors, with the exception of gender and marital status. Based on the results presented in Table 4.2 (differences in CES-D and Euro-D depressive symptoms scores), I estimated the effect sizes of the differences between the two scales for gender and marital status. The effect size of the difference between two scores for these two risk factors is of 0.006 and 0.0087 respectively, values which correspond to very small effect sizes according to Cohen's criterion. Together, these results suggest that while the relationship between risk

factors and depressive symptoms sometimes differ between the CES-D and Euro-D scales, conclusions on the clinical significance of the effects are often very similar between the two scales. This adds to the argument in favour of the comparability of the two scales.

There may also be several alternatives to address the differences between the two measures of depressive symptoms. A first approach would be to identify the items that are similar across both scales (depression, sleep, energy to do things), as done in earlier studies for robustness check (Riumallo-Herl, Basu et al. 2014). This approach is still limited by the fact that the internal consistency of the two measures is compromised by using selected items individually. A second approach might be to use a more comprehensive set of measures of wellbeing across surveys and to compare their findings with those of the depressive symptoms scale. For example, SHARE, ELSA and HRS include a 12-item or 19-item version of the CASP scale of wellbeing (Control, Autonomy, Self-Realisation and Pleasure), specifically designed to measure wellbeing in old age (Wiggins, Higgs et al. 2004). Using this scale in combination with depression scores and self-reports of anti-depressant use, has been shown to provide a more comprehensive assessment of mental health in old age (Ploubidis and Grundy 2009, Kruk and Reinhold 2014). However, these extensive measures are costly and unlikely to be available always across different studies and across waves. In addition, the prescription of anti-depressives may differ substantially across countries, introducing another source of potential bias. A third, and potentially more feasible approach derived from this chapter would be to achieve comparability by rescaling the Euro-D items to reflect the levels of depression as measured by the CES-D scale. Following Jürges and colleagues (Jürges, Avendano et al. 2008), it would be possible to make the two measures more comparable by imputing conditional probabilities. Assuming an individual with value 'x'

in the Euro-D scale has systematically lower depressive symptom levels than an individual with the same value in the CES-D scale, it is in principle possible to rescale down the Euro-D values to match the same levels of depressive symptoms captured with the CES-D scale. This would enhance cross-national comparisons of depressive symptoms across countries, and it would diminish the systematic tendency of the CES-D to show stronger associations with risk factors than the Euro-D scale.

4.5. Conclusion

In conclusion, I find that despite a high correlation between the two scales, there are differences in the way individuals report depressive symptoms when using the Euro-D and CES-D scales. My results suggest that while direct comparisons of depressive symptoms levels between countries and using different measures should be avoided, studies that compare associations between risk factors and depressive symptoms across countries using these measures can still be valid. Although the strength of associations differs, this chapter shows that associations between each scale and risk factors are often in the same direction and display similar levels of clinical significance. Rescaling one of the scales or using more comprehensive assessments of wellbeing may be helpful in minimizing bias. The findings of this chapter imply that both scales measure the same underlying concept and, with some adjustments, can be used in comparative studies of the determinants of depression in old age.

Chapter 5

Early access to homeownership, residential stability and mental health of older Americans

Background: Homeownership is often associated with better health in the literature, but whether early access to homeownership and subsequent residential stability are related to health in older ages is not known. This chapter examines the impact of owning a home by age 35 on late-life mental health in older Americans.

Methods: Using longitudinal data (1993-2010) from the Health and Retirement Study (*N*=33,517), I used ordinary least square (OLS), logistic regressions, individual fixed-effects (FE) and propensity score matching (PSM) to examine whether homeownership by age 35 and residential stability were associated with mental health levels and trajectories at age 50 and beyond.

Results: In fully adjusted OLS models, owning a home by age 35 was associated with significantly fewer depressive symptoms (OLS: *b*=-0.0397, 95%CI [Confidence Interval], -0.071 to -0.0017) compared to accessing homeownership later in life, a slower age-related increase in depressive symptoms between age 61 to 75 (FE: *b*=-0.00674, 95%CI -0.012 to -0.0010) but not with a lower likelihood of depressive symptomatology (OR= 0.962, 95%CI 0.908 to 1.021). Findings were confirmed in PSM models that controlled for selection (PSM: *b*=-0.0305, 95%CI -0.052 to -0.0089). Earlier mortgage repayment and improved financial security were among the mechanisms involved.

Discussion: Early homeownership and housing stability yield long-term mental health benefits in older age. However, limitations in the HRS homeownership data mean that I cannot fully tease out the effect of accessing the housing ladder early from that of residential stability. Recent declines in early homeownership rates may increase the burden of mental health for future generations of older Americans.

5.1. Introduction

The number of Americans owning a home increased steadily between 1945 and the early 2000s (Fetter 2013). However, by the eve of the economic crisis which started in 2008, homeownership rates started to drop and fell for eight consecutive years before reaching their lowest level since the 1980s, with 64.5% of Americans owning a home in 2015 (Joint Center for Housing Studies 2015). This fall in homeownership rates has mainly hit the 'baby bust' generation, born around 1965-84, and currently aged 30-50. Baby busters have 8-10% lower homeownership rates today than baby boomers (born 1946-64, currently aged 50 years and older) of the same age 20 years ago (Joint Center for Housing Studies 2015). There is little evidence about possible long-term implications of these trends for the health and wellbeing of current and future generations of older Americans.

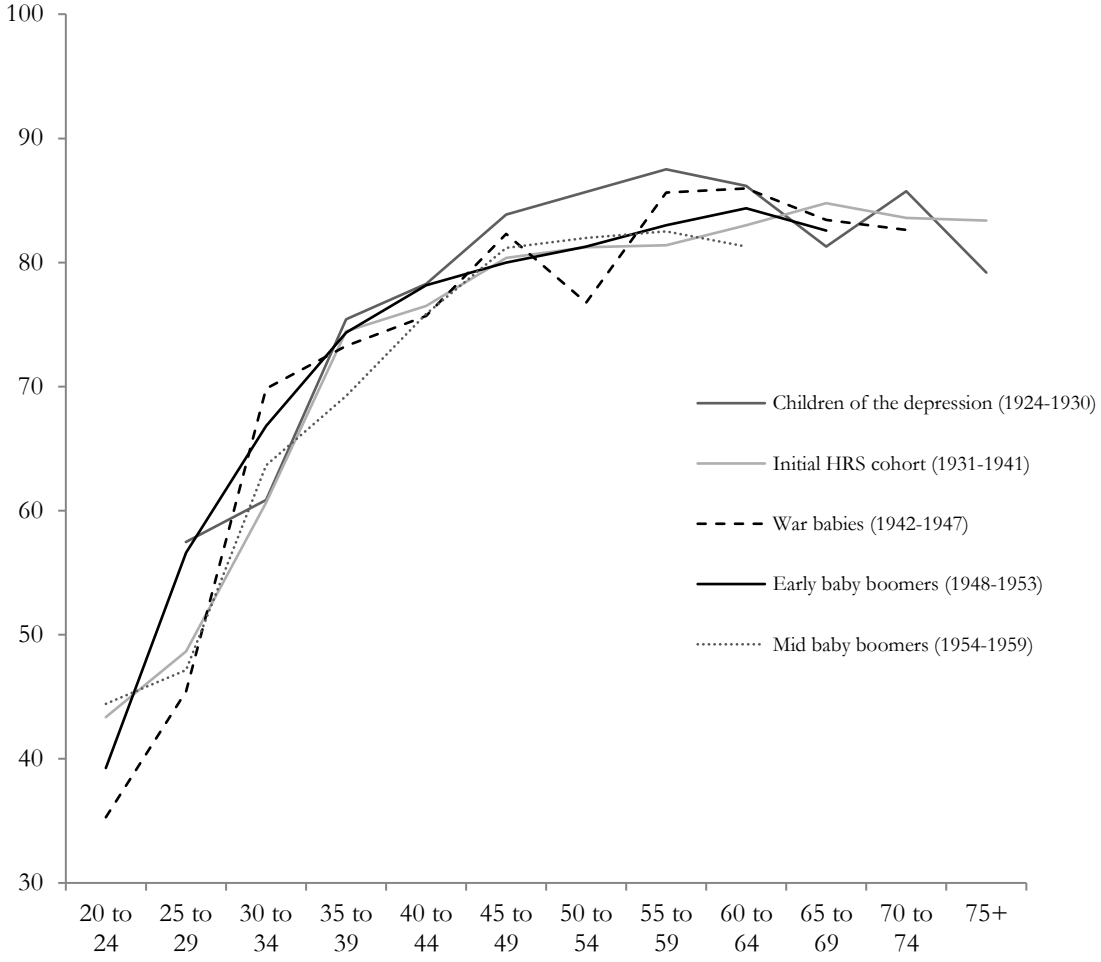
Since World War II, access to homeownership has been the focus of US housing policy. Primarily through intervention in mortgage markets, policies have aimed to extend homeownership to all sectors of society, in particular marginal home buyers (Schwartz 2010). US mortgage policies have traditionally increased homeownership primarily by shifting home purchase earlier in life (Fetter 2013). The underlying assumption has been that owning a home early in life brings important social and economic benefits to families (Chambers, Garriga et al. 2009, Balchin 2013). Findings from a range of disciplines suggest that housing equity represents the largest component of wealth portfolio, enabling households to accumulate assets that can be used to smooth consumption during times of financial hardship and in older age (Rohe, Van Zandt et al. 1991, Schwartz 2010). Other social benefits credited to homeownership include increased residential stability, reduced neighbourhood segregation, higher participation in political and social activities, higher self-esteem and better outcomes for children (Dietz and Haurin 2003). As discussed in Chapter 2 of this thesis, homeownership is also

associated with better health (Jones 1995, Dalstra, Kunst et al. 2006, Windle, Burholt et al. 2006, McCann, Grundy et al. 2012) and lower mortality (Macintyre 1998) – although this relationship is not necessarily causal. Prior studies looking at the effect of homeownership on health have focused primarily on contemporaneous associations and no study to date has examined the long-run effect of homeownership, or how access to homeownership in early adulthood relates to health in older ages. However, the age at which an individual makes the transition from renting to owning matters since it affects his/her ability to remain a homeowner or to purchase a better home in the future, as well as affecting retirement savings by altering the length of time over which the individual benefits from an owned home's potential price appreciation (Morrow-Jones and Wenning 2005). Homeownership duration has indeed been found to have the strongest positive effect on wealth accumulation (Di, Belsky et al. 2007, Turner and Luea 2009). Early homeowners who remained in their home may thus be able to reap larger benefits from homeownership relative to homebuyers who moved or households that do not access the housing ladder at all.

Building on a life-course model of health, I examine in this chapter the long-term effects of early homeownership and subsequent residential stability on the mental health of older US adults. Using longitudinal data from the US Health and Retirement Study (HRS), I hypothesize that Americans accessing the housing ladder before age 35 and who did not move afterwards have better mental health at older ages than those who became homeowners later on or are not homeowners at all. I use age 35 as a cut-off for early access based on the observation that, in the US, homeownership has traditionally risen sharply up to age 35, after which ownership rates increase more slowly before reaching a plateau. Figure 5.1 below displays homeownership rates for the five main cohorts included in the HRS data. Data are from the US census Integrated Public Use Microdata

Series. Across all five cohorts, homeownership rates seem to follow a similar trend by age: a rapid increase in homeownership rates between the ages of 20 and 35; followed by a second phase between the ages of 40 and 65 when homeownership rates keep increasing but at a much slower rate; and a final phase after 65 when homeownership rates are stable or decrease.

Figure 5.1. Trends in homeownership rates by HRS cohorts, 2010



Notes: The cohorts correspond to the main HRS cohorts. Data from decennial Censuses, extracted from Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. 2010. Integrated Public Use Microdata Series: Version 5.0. Minneapolis: University of Minnesota.

By linking homeownership to late-life depression outcomes, this chapter provides important insights into whether recent reversals in age of homeownership following the

2008 economic crisis might have any long-term consequences for the mental health of future generations of ageing Americans.

5.2. Methods

5.2.1. Study population

The Health and Retirement Study (HRS) is a nationally representative study of Americans older than 50 years that was started in 1992. The HRS sample is selected based on a multi-stage area probability sample. Details of the study are provided in Chapter 3 of this thesis. Enrolment occurred in 3 waves (1992, 1993, and 1998), depending on respondents' birth year. HRS included respondents from several birth cohorts: The AHEAD cohort (born 1923 or earlier), the children of the depression (1924-1930), the initial HRS cohort (1931-1941), War babies (1942-1947), and early (1948-1953) and mid baby boomers (1954-1959). Biennial interviews were conducted through 2012, with high wave-to-wave retention rates of around 90%. The dataset used in this chapter comprised all eleven HRS waves between 1993 and 2010, as 1993 was the first year that incorporated measures of depressive symptoms (N=27,715).

5.2.2. Assessment of depressive symptoms

An eight-item version of the CES-D scale was used to measure depressive symptoms (Radloff 1977). CES-D is a valid and reliable scale, which is widely used to measure depression in older age (Kohout, Berkman et al. 1993)[13]. The score ranges from zero to eight, with higher scores indicating higher levels of depressive symptoms. A cut-off point of three is often used to define elevated depressive symptoms (Turvey, Wallace et al. 1999, Han 2002).

[13]Further details on the CES-D depressive symptoms scores and its properties are given in Chapter 4 of this thesis.

5.2.3. Early homeownership assessment

HRS respondents provided information on whether they owned their current home and the year of purchase. I combined this information with the respondent's year of birth to construct a variable indicating the age of purchase of current home. I then constructed the exposure of interest, which indicates whether the respondent owned his/her home by age 35 or earlier; at a later stage of the life course; or is not a homeowner. I chose the age of 35 as cut-off based on trends in homeownership attainment described above as well as evidence suggesting that the age of first homeownership for US cohorts born between 1915 and 1955 ranged from 28 to 33 years (Chevan 1989). In sensitivity analyses, I found that a cut-off point of 30 or 40 yielded very similar estimates. An important limitation of the proposed analysis is that HRS does not include retrospective information on residential histories. I consequently built the exposure on the age of purchase of the current home of the response, which is not necessarily his/her first home. Implications are further discussed in the last section of this chapter.

5.2.4. Controls

Respondent's *demographic characteristics* included gender, age (included as a linear term and splined with notches at the ages of 60 and 75), race (White, Black or Hispanic), marital status (married or in partnership, separated or divorced, widowed, never married), highest educational level (lower than high school, GED, high-school graduate, some college, college and above), labour force status (employed, unemployed, retired, disabled, not in the labour force), duration of the longest marriage, number of people living in the household and number of children.

Financial variables included the natural logarithm of total household income and non-housing wealth. *Physical health and health behaviours* measures comprised self-reported health (dichotomized into fair/poor vs. excellent/very good/good), tobacco smoking (ever smoked vs. no; and currently smoking vs. no), heavy alcohol drinking (based on self-report of consuming more than two drinks per day over 5 to 7 days a week), and physical function (measured by the number of difficulties with activities of daily living [ADLs - ranging from 0 to 5] and instrumental activities of daily living [IADLs - ranging from 0 to 3]).

5.2.5. Statistical analyses

I investigated the association between the timing of access to homeownership, residential stability and later-life depression using first ordinary least square (OLS) regression, controlling for a wide range of potential confounders. To control for potential differences across cohorts and survey years, I estimated cohort- and survey year-fixed effect models. I also evaluated potential mechanisms by estimating effects of early home ownership on indicators of financial wellbeing in later life. The logarithms of the value of mortgages/land contracts for the primary residence, total household net wealth and net financial wealth were used as outcomes in these models (detailed definitions of these outcomes are given under the results tables).

A potential concern mentioned in Chapters 2 and 3 of this thesis is selection into homeownership: early homeowners may be a selective sample along several important dimensions. For example, early homeowners may have a more favourable parental socioeconomic background, higher educational attainment or differ in their early marital and childrearing histories from late homeowners (Mulder and Smits 1999, Mulder and

Wagner 2001, Beer and Faulkner 2011). I experimented with an instrumental variable approach (*e.g.*, using exogenous changes in state loan to value ratios or state-, year-, gender- and race- specific homeownership rates), but I was not able to identify a sufficiently strong instrument for homeownership.

To partly account for selection, I adopted two strategies: individual fixed-effects models and propensity score matching. I first applied individual fixed-effects models (Gardiner, Luo et al. 2009, Leyland 2010) to assess whether individual-age trajectories of depression differed between early, late and not homeowners, introducing an interaction term between age and the exposure. Fixed effects control for potential time-invariant confounders that vary across individuals, such as gender, education and race, and were therefore preferred over random-coefficient models as the main specification. I incorporated controls for a wide range of time-varying variables including changes in employment and marital status. To account for the non-linear association between age and depression, age was splined with notches at 60 and 75 (Mirowsky and Ross 1992, Medalia 2012).

Second, I implemented a propensity score matching (PSM) approach to create a statistically matched set of treated (early homeowners, before the age of 35) and control (late homeowners, after the age of 35) (Rosenbaum and Rubin 1983, D'Agostino 1998), excluding those who never accessed homeownership as PSM can only include binary exposures. PSM aims to minimize the non-random selection into early homeownership using propensity scores derived from predicted probabilities of early homeownership based on measured covariates. In a first stage, I derived propensity scores from a model that regressed early homeownership on a range of covariates. I used a kernel matching estimator with replacement (Caliendo and Kopeinig 2008), which weights observations

based on how well they were matched in the first step. To estimate the matching propensity score, I used Stata's PSMATCH2 command, corrected to incorporate robust standard errors (Leuven and Sianesi 2003).

In all models, standard errors were clustered at the individual level. All analyses were conducted in STATA version 14.0.

5.3. Results

5.3.1. Descriptive statistics

The mean age of access to homeownership in the sample was 37.02 (SD=13.16). 53.03% of the sample had accessed homeownership by the age of 35, 26.25% after the age of 35 and finally 20.72% never became homeowners by the age observed. Table 5.1 presents summary statistics at baseline, by homeownership status. Early and stable homeowners differed significantly from those who were not homeowners or those who became owners later on or had moved after accessing homeownership along several important dimensions. The category 'not homeowner' at baseline appears as a very disadvantaged group, with high levels of poor physical and mental health, higher likelihood of being separated or divorced or in terms of ethnic background, to be Black or Hispanic. The timing of homeownership attainment also seems to matter as those who were homeowners by the age of 35 were less likely to be depressed, to report poor physical or to be divorced, widowed or never married compared to those who accessed the housing ladder later on. They were also more likely to be employed and less likely to have a lower than high school educational level.

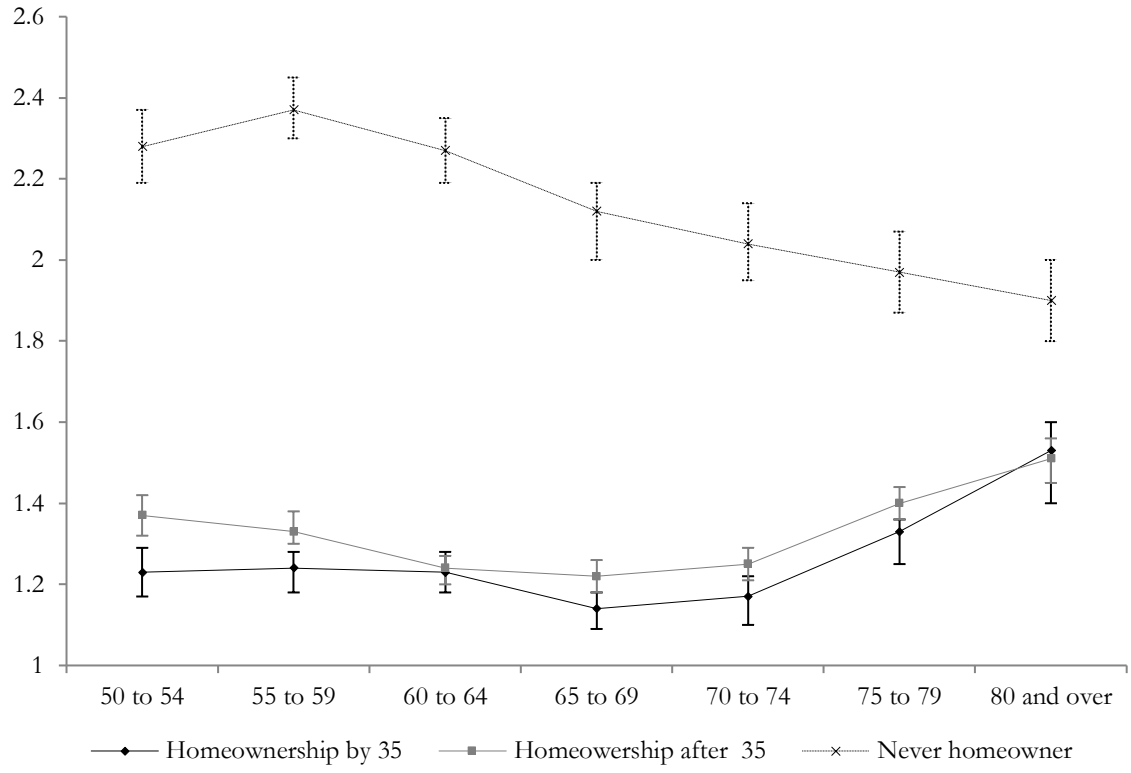
Table 5.1. Summary statistics by homeownership status at baseline

Variable	Statistic	Homeowner by age 35 and still in the same home	Homeowner after 35 or moved	Not homeowner
Depressive symptoms and health characteristics				
CES-D score	Mean (SD)	1.11 (1.82)	1.12 (1.80)	2.20 (2.45)
Depressed	Fraction	15.59%	16.23%	34.49%
Self-reported bad and poor health	Fraction	18.88%	19.85%	39.64%
Ever smoked	Fraction	59.44%	64.21%	71.48%
Currently smoking	Fraction	19.55%	21.77%	34.36%
2+ units of alcohol per day	Fraction			
Number of limitations with ADLs	Mean (SD)	0.07 (0.36)	0.11 (0.49)	0.24 (0.74)
Number of limitations with IADLs	Mean (SD)	0.06 (0.27)	0.08 (0.31)	0.17 (0.48)
Demographic characteristics				
Age	Mean (SD)	57.15 (4.19)	58.44 (4.70)	57.43 (4.09)
Female	Fraction	60.07%	48.58%	59.13%
Male	Fraction	39.93%	42.21%	40.87%
Separated or divorced	Fraction	6.43%	10.11%	32.19%
Widowed	Fraction	5.45%	6.12%	13.47%
Never married	Fraction	1.15%	3.01%	8.02%
Duration of longest marriage	Mean (SD)	31.89 (9.02)	28.26 (11.30)	21.55 (12.78)
Race: Black	Fraction	14.72%	14.32%	31.56%
Race: Hispanic	Fraction	1.89%	3.57%	5.92%
Number of children	Mean (SD)	3.16 (1.90)	3.29 (2.26)	3.30 (2.50)
Number of people living in the household	Mean (SD)	2.57 (1.10)	2.55 (1.23)	2.33 (1.43)
Socio-economic characteristics				
Highest educational level				
Lower than high school	Fraction	19.69%	22.38%	41.16%
GED	Fraction	4.20%	5%	5.39%
High-school graduate	Fraction	40.49%	29.60%	25.64%
Some college	Fraction	18.71%	21.73%	15.65%
College and above	Fraction	16.92%	21.29%	12.16%
Employed full time or part-time	Fraction	58.08%	54.30%	50.79%

Unemployed	Fraction	1.85%	2.90%	5.65%
Retired	Fraction	28.78%	32.60%	27.07%
Disabled	Fraction	1.64%	2.23%	9.20%
Out of the labour force	Fraction	9.65%	7.97%	7.29%
Non-housing wealth	Median	72,226	72,375	5,897
Household total income	Median	42,000	42,500	16,800
Value of all mortgages/land contracts for primary residence	Mean (SD)	10,821 (28,487.26)	34,032 (58,104.96)	-

Figure 5.2. displays average depressive symptoms scores by age categories for early, late and not homeowners, controlling for gender and age at baseline. Respondents who owned a home by the age of 35 and did not move had lower levels of depressive symptoms up to age 60-64, after which levels of depression converged with late homeowners. Those respondents who did not access the housing ladder had consistently higher levels of depressive symptoms compared to homeowners.

Figure 5.2. Average depression score by age group and age at homeownership status, adjusted for gender and age at baseline



5.3.2. Association between early access to homeownership, residential stability and depressive symptoms

Table 5.2 displays the results from the linear models. Race, marital status, educational attainment, employment status, ADL/IADL limitations, income, financial wealth, smoking and alcohol drinking were all significantly associated with depressive symptoms. In a model that controlled for all these factors, respondents who owned a home by age 35 and did not move subsequently had significantly lower levels of depressive symptoms in older age than homeowners who access the housing ladder later or moved (OLS: *b*=-0.0397, 95% CI -0.0714 to -0.0017). It constitutes a 3.5% decrease compared to the mean depressive symptoms score of those who accessed homeownership after the age of 35. Not being a homeowner was on the contrary associated with a 0.06-point increase on the CES-D scale (95% CI 0.0216 to 0.1095).

Table 5.2. Linear association between timing of access to homeownership and CES-D depressive symptoms score

	b	SE	95% CI
Homeowner by age 35 vs. homeowner after 35 (ref.)	-0.0366	0.0177	-.0714, -.0017
Not homeowner	0.0655	0.0224	0.0216, 0.1095
Demographic characteristics			
Female vs. Male (ref.)	0.2146	0.0160	0.1831, 0.2461
Age	0.0194	0.0127	-0.0055, 0.0443
Black vs. White (ref.)	-0.0922	0.0241	-0.1395, -0.0448
Hispanic	0.0227	0.0384	-0.0526, 0.098
Separated or divorced vs. Married or in relationship (ref.)	0.3205	0.0303	0.2610, 0.3801
Widowed	0.4266	0.0251	0.3773, 0.4760
Never married	0.2272	0.0527	0.1238, 0.3306
Duration of longest marriage	0.0008	0.0006	-0.0004, 0.0021
Number of children	0.0006	0.0039	-0.0069, 0.0083
Duration of longest marriage	0.0008	0.0006	-0.0004, 0.0021
Number of person living in the household	0.0091	0.0072	-0.0050, 0.0232
Health status			

Self-reported health: fair/poor vs. excellent/very good/good (ref.)	2.1128	0.0385	2.037, 2.1883
Ever smoked vs. No (ref.)	0.0355	0.0163	0.0035, 0.0676
Currently smoking vs. No (ref.)	0.1765	0.0238	0.1297, 0.2232
2+ alcohol drinks	-0.0050	0.014	-0.0326, 0.0226
Number of limitations with ADLs	0.3469	0.0128	0.3218, 0.3721
Number of limitations with IADLs	0.3723	0.0247	0.3239, 0.4208
Socio-economic characteristics			
GED vs. Lower than high school (ref.)	-0.0759	0.0448	-0.1638, 0.0120
High school graduate	-0.1864	0.0258	-0.2370, -0.1358
Some college	-0.2563	0.0272	-0.3096, -0.2029
College and higher	-0.3145	0.0274	-0.3682, -0.2607
Unemployed vs. employed (ref.)	0.4946	0.0451	0.4062, 0.5831
Retired	0.0743	0.0168	0.0414, 0.1073
Disabled	0.6282	0.0598	0.5109, 0.7454
Not in the labour force	0.1647	0.0286	0.1086, 0.2209
Log of household non-housing wealth[1]	-0.0267	0.0041	-0.0349, -0.0185
Log of household total income	-0.0393	0.0079	-0.0549, -0.0237
Year of birth fixed effects	Yes		
Wave fixed effects	Yes	-	-
Constant	-2.668	1.3022	-5.221, -0.1159
Observations	135,970	-	-
R-squared	0.224	-	-

Notes: Robust standard errors are clustered at the individual level.
[1]The net value of all non-housing wealth is calculated as the sum of all non-housing wealth components (including vehicles and businesses but excluding estate), minus debts.

Logistic regressions of depressive symptomatology are presented in Table 5.3. If early access to homeownership reduces the number of depressive symptoms, it does not decrease the likelihood of reporting clinically high levels of depression (OR= 0.968, 95% CI 0.913 to 1.025). Not being a homeowner is also not statistically associated with depressive symptomatology in the model (OR= 1.061, 95% CI 0.999 to 1.126).

Table 5.3. Association between timing of access to homeownership and likelihood of elevated depressive symptoms

	OR	SE	95% CI	
Homeowner by age 35 vs. Homeowner after 35 (ref.)	0.968	0.0286	0.913	1.025
Not homeowner	1.061	0.0322	0.999	1.126
Demographic characteristics				
Female vs. Male (ref.)	1.372	0.0367	1.301	1.445
Age	1.03	0.0213	0.989	1.072
Black vs. White (ref.)	0.857	0.0301	0.8	0.918
Hispanic	0.989	0.0549	0.887	1.102
Separated or divorced vs. Married or in a relationship (ref.)	1.5	0.0617	1.383	1.626
Widowed	1.727	0.061	1.611	1.851
Never married	1.424	0.109	1.225	1.654
Duration of longest marriage	1.001	0.001	0.999	1.003
Number of person living in the household	1.016	0.01	0.996	1.035
Number of children	0.996	0.00574	0.985	1.007
Health status				
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	3.228	0.0722	3.089	3.373
Ever smoked vs. No (ref.)	1.077	0.0293	1.02	1.135
2+ alcohol drinks	0.946	0.0213	0.904	0.988
Currently smoking vs. No (ref.)	1.266	0.0404	1.189	1.347
Number of limitations with ADLs	1.486	0.0207	1.445	1.526
Number of limitations with IADLs	1.454	0.0407	1.376	1.535
Socio-economic characteristics				
GED vs. Lower than high school (ref.)	0.939	0.0539	0.838	1.05
High school graduate	0.808	0.0274	0.756	0.863
Some college	0.74	0.0281	0.686	0.796
College and higher	0.608	0.026	0.558	0.661
Unemployed vs. Employed (ref.)	1.841	0.105	1.646	2.058
Retired	1.138	0.0325	1.076	1.203
Disabled	1.876	0.118	1.659	2.121
Not in the labour force	1.252	0.0527	1.153	1.36
Log of household non-housing wealth	0.963	0.00585	0.951	0.974
Log of household total income	0.944	0.0117	0.921	0.967
Year of birth fixed effects	Yes	-	-	-

Wave fixed effects	Yes	-	-	-
Constant	0.163	0.279	0.005	4.666
Observations	121,664	-	-	-
Pseudo R2	0.148	-	-	-

Notes: Robust standard errors are clustered at the individual level.

5.3.3. Fixed-effects models

Table 5.4 shows individual fixed effect estimates comparing the age trajectories of early and never homeowners to those who accessed homeownership after the age of 35 or who moved. The significant interaction between early and stable homeownership and the second age spline suggests that early homeownership was associated with a slower progression of depressive symptoms from ages 61 to 75 (FE: *b*=-0.00674, 95% CI -0.012 to -0.0010). Not being a homeowner was not associated with age-related changes in depression.

Table 5.4. Association between early access to homeownership and changes in depressive symptoms score

	b	SE	95% CI	
Not owner*under 60	0.00361	0.0102	-0.016	0.0235
Not owner*61 to 75	-0.00722	0.00404	-0.015	0.001
Not owner*Over 75	-0.00071	0.00504	-0.01	0.009
Early homeowner*under 60	0.00804	0.00615	-0.004	0.02
Early homeowner*61 to 75	-0.00674	0.00289	-0.012	-0.001
Early homeowner*Over 75	-0.00175	0.00655	-0.014	0.011
Demographic characteristics				
Age spline 1: under 60	0.0106	0.0133	-0.015	0.0366
Age spline 2: 61 to 75	-0.00674	0.0128	-0.012	-0.0010
Age spline 3: over 75	0.0451	0.013	-0.019	0.07
Number of children	0.0156	0.00937	-0.002	0.034
Separated or divorced vs. Married or in a partnership (ref.)	0.295	0.043	0.21	0.3788
Widowed	0.603	0.0314	0.5415	0.6647
Never married	0.394	0.128	0.1437	0.6447
Duration of longest marriage	0.0243	0.0023	0.0198	0.0288
Number of person living in the household	0.0152	0.00757	0.0003	0.03
Health status				

Self-reported health: fair/poor vs. Excellent/very good/good (ref.)	0.524	0.0178	0.4892	0.5589
Ever smoked vs. No (ref.)	0.0355	0.29	-0.532	0.6038
Currently smoking (ref.)	-0.124	0.0312	-0.184	-0.0625
2+ alcohol drinks	-0.0656	0.0162	-0.097	-0.033
Number of limitations with ADLs	0.283	0.0123	0.258	0.306
Number of limitations with IADLs	0.193	0.0221	0.149	0.236
Socio-economic characteristics				
Unemployed vs. Employed (ref.)	0.268	0.043	0.183	0.351
Retired	0.0173	0.0163	-0.014	0.049
Disabled	0.351	0.0568	0.239	0.462
Not in the labour force	0.0806	0.0287	0.024	0.136
Log of household non-housing wealth	-0.0127	0.0048	-0.022	-0.003
Log of household total income	-0.0230	0.00746	-0.037	-0.008
Wave fixed effects	Yes			
Constant	-0.197	0.769	-1.703	1.309
Observations	121,695			
Number of individuals	27,715			
R-squared	0.052			

Notes: Robust standard errors are clustered at the individual level.

5.3.4. Financial mechanisms

I investigated potential financial mechanisms that could account for the observed positive association between early homeownership and depression in later life. As shown in Table 5.5, accessing the property market early in life was associated with a 43% reduction in the value of mortgages for the primary residence (95% CI -0.4712 to -0.388) compared to accessing property after 35. In turn, having become homeowner by the age of 35 and stayed in the same home was also associated with a 9.95% increase in financial wealth (95% CI 0.0469 to 0.152) and a 4.67% increase in total wealth (95% CI 0.0164 to 0.077).

Table 5.5. Linear association between timing of access to homeownership and financial outcomes (value of mortgages, value of financial wealth, value of total wealth)

	Value of mortgages[1]				Value of financial wealth[2]				Value of total wealth[3]			
	b	SE	95% CI		*b*	SE	95% CI		*b*	SE	95% CI	
Homeowner by age 35 vs. Homeowner after the age of 35 (ref.)	-0.430	-0.0211	-0.4712	-0.388	0.0995	-0.0268	0.0469	0.152	0.0467	-0.0155	0.0164	0.077
Not homeowner	/	/	/	/	-1.101	-0.0356	-1.171	-1.031	-2.522	-0.0273	-2.575	-2.468
Demographic characteristics												
Female vs. Male (ref.)	-0.0118	-0.0174	-0.0459	0.0223	0.00742	-0.025	-0.0416	0.0564	-0.0149	-0.0159	-0.046	0.0162
Age	0.0106	-0.0192	-0.027	0.0481	-0.0212	-0.0303	-0.0804	0.0381	0.0329	-0.0171	-0.0005	0.0664
Number of children	0.00114	-0.00427	-0.0072	0.0095	-0.0903	-0.0065	-0.103	-0.0775	-0.0478	-0.00375	-0.0551	-0.0404
Black vs. White (ref.)	-0.223	-0.0244	-0.271	-0.175	-1.123	-0.0363	-1.194	-1.051	-0.659	-0.0209	-0.7004	-0.6183
Hispanic	0.141	-0.0376	0.0673	0.2147	-0.451	-0.0608	-0.5704	-0.3322	-0.205	-0.0357	-0.2749	-0.1348
Separated or divorced vs. Married or in a relationship (ref.)	-0.173	-0.0271	-0.225	-0.119	-0.849	-0.0433	-0.9342	-0.7645	-0.574	-0.027	-0.6272	-0.5212
Widowed	-0.190	-0.0298	-0.248	-0.132	-0.664	-0.0356	-0.7334	-0.5938	-0.452	-0.0214	-0.4943	-0.4106
Never married	-0.260	-0.0553	-0.3686	-0.152	-0.534	-0.0843	-0.6988	-0.3685	-0.435	-0.0541	-0.5414	-0.3293

Duration of the longest marriage	-0.00244	-0.000765	-0.0039	-0.0009	0.00818	-0.00106	0.0061	0.0102	-0.00704	-0.000659	0.0057	0.0083
Number of people living in the household	0.0432	-0.00639	0.0306	0.0556	-0.195	-0.0109	-0.2162	-0.1733	-0.0739	-0.00601	-0.0856	-0.062
Health status												
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	-0.0889	-0.0181	-0.1243	-0.0534	-0.371	-0.025	-0.4203	-0.3225	-0.315	-0.0147	-0.3434	-0.2857
Ever smoked vs. No (ref.)	-0.0329	-0.0171	-0.0664	0.0007	-0.0442	-0.0246	-0.0923	0.004	-0.0718	-0.0154	-0.1019	-0.0417
2+ alcohol drinks	0.181	-0.0159	0.15	0.2122	0.539	-0.0217	0.4965	0.5815	0.347	-0.0132	0.3207	0.3724
Number of limitation with ADLs	-0.00576	-0.0121	-0.0293	0.0178	-0.157	-0.0179	-0.1922	-0.1219	-0.107	-0.0103	-0.1267	-0.0865
Number of limitations with IADLs	-0.0039	-0.0223	-0.0475	0.0397	-0.0987	-0.0329	-0.1631	-0.0342	-0.0757	-0.0193	-0.1135	-0.0378
Socio-economic characteristics												
GED vs. Lower than high school (ref.)	0.103	-0.0446	0.016	0.1907	0.391	-0.0678	0.2582	0.5238	0.187	-0.038	0.1127	0.2615
High school graduate	0.192	-0.0292	0.1345	0.2488	0.944	-0.0402	0.865	1.022	0.558	-0.0226	0.5133	0.6017
Some college	0.398	-0.0296	0.339	0.456	1.324	-0.0426	1.2401	1.4069	0.826	-0.0243	0.7788	0.874
College and higher	0.617	-0.0299	0.558	0.6753	2.032	-0.0435	1.947	2.117	1.308	-	1.2574	1.3584

										0.0258		
Unemployed vs. employed (ref.)	0.0478	-0.0317	-0.0144	0.11	-0.254	-0.0577	-0.367	-0.1408	-0.141	-0.0312	-0.2018	-0.0797
Retired	-0.0429	-0.0183	-0.0786	-0.007	0.209	-0.0251	0.159	0.258	0.105	-0.0159	0.0737	0.1361
Disabled	-0.0998	-0.0445	-0.1871	-0.0125	-0.620	-0.0784	-0.773	-0.466	-0.399	-0.0432	-0.4837	-0.3145
Not in the labour force	0.0623	-0.0345	-0.0054	0.1299	0.263	-0.0425	0.179	0.346	0.124	-0.0254	0.07399	0.1737
Cohort fixed effects	Yes				Yes	Yes	Yes	Yes	Yes	Yes		
Year fixed effects	Yes				Yes	Yes	Yes	Yes	Yes	Yes		
Constant	10.43	-0.101	10.22	10.62	5.187	-0.11	4.9709	5.4037	11.93	-0.101		
Observations	44,824				97,248				121,088			
R-squared	0.239				0.309				0.529			

Notes: The outcomes are logged values. The three models include the same controls as the main models, with the exception of the financial variables (net value of non-housing wealth and household total income). Robust standard errors are clustered at the individual level.

[1]This model being about mortgage repayments for the primary residence, it compares only respondents who accessed the housing ladder by the age of 35 and remained in the same home to those who became homeowners later on or moved. Never homeowners are excluded from this model.

[2]The net value of non-housing financial wealth is calculated as the sum of all financial wealth components (net value of checking, savings, money market accounts; government saving bonds, treasury bills; bonds and bond funds; all other savings), minus debts. It does not include the value of IRAs, Keogh plans, vehicles or businesses.

[3]The net value of total wealth is calculated as the sum of all wealth components, minus all debt.

5.3.5. Propensity score matching

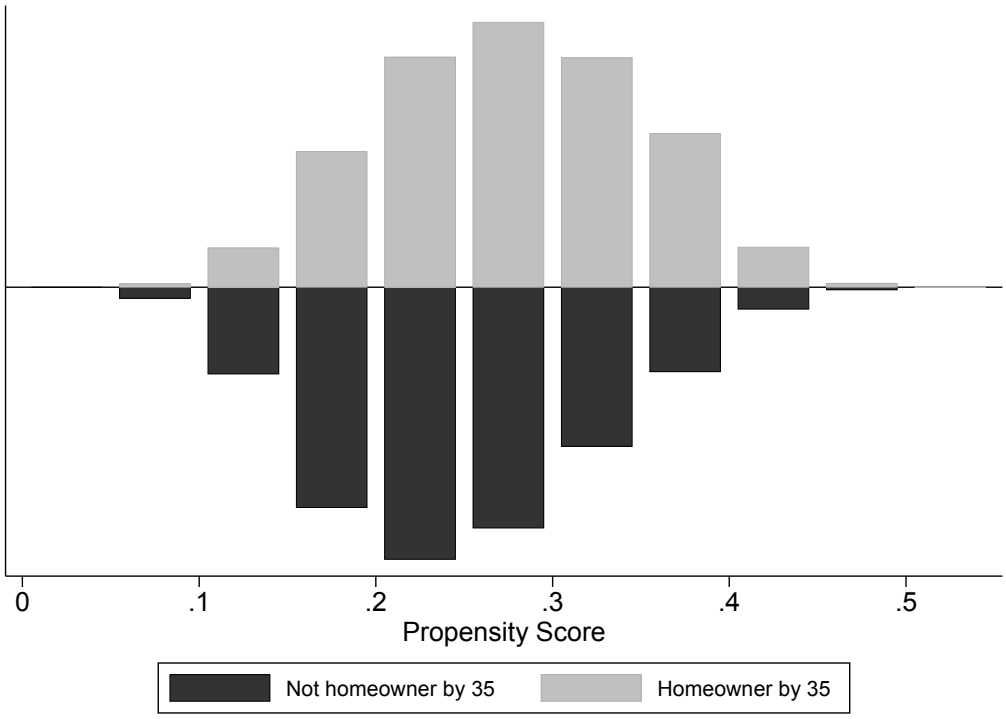
Table 5.6. shows adjusted probability of early and stable homeownership based on the first stage of the propensity score matching. Never having married, being Hispanic and poor self-reported health were associated with a lower likelihood of being a homeowner.

Table 5.6. First step of the PSM: logistic regression of early access to homeownership by individual characteristics

	OR	SE	95% CI	
Female vs. Male (ref.)	0.282	0.014	0.254	0.311
Age	-0.041	0.000	-0.043	-0.039
Years of education	-0.031	0.002	-0.035	-0.026
Black vs. no (ref.)	0.037	0.019	-0. 0009	0.075
Hispanic vs. no (ref.)	-0.444	0.035	-0.513	-0.375
Separated vs. no (ref.)	-0.416	0.025	-0.465	-0.366
Widowed vs. no (ref.)	0.080	0.020	0.040	0.12
Never married vs. no (ref.)	-0.742	0.049	-0.821	-0.628
Unemployed vs. no (ref.)	-0.349	0.057	-0.462	-0.237
Retired vs. no (ref.)	0.136	0.024	0.087	0.185
Disabled vs. no (ref.)	-0.248	0.057	-0.360	-0.137
Employed vs. no (ref.)	-0.117	0.024	-0.169	-0.064
Poor health vs. no (ref.)	-0.074	0.017	-0.108	-0.040
Ever smoked vs no (ref.)	-0.083	0.013	-0.11	-0.057
Ever drinks vs. no (ref.)	-0.075	0.013	-0102	-0.048
Number of limitations with ADLs	-0.055	0.011	-0.077	-0.033
Number of limitations with IADLs	-0.048	0.022	-0.093	-0.003
Constant	2.39	0.073	2.24	2.53

Propensity score distributions suggest that the common support assumption – which requires both treated and untreated units for each value of the predictors - is satisfied (Figure 5.3).

Figure 5.3. Overlap in propensity scores by timing of access to homeownership



In addition, the balancing tests suggest that the kernel-based matching strategy successfully removed most observable differences between treated and controls (Table 5.7), with an overall reduction in bias of 84%.

Table 5.7. Reduction in covariate imbalance after matching on the propensity score

	Unmatched pairs		Matched pairs				
	Access to homeownership before 35 (mean)	Access to homeownership after 35 (mean)	Access to homeownership before 35 (mean)	Access to homeownership after 35 (mean)	% Bias reduction[1]	*t*	*p*-value
Female	0.620	0.541	0.625	0.612	84.4	3.47	0.001
Age	63.55	64.41	64.20	64.33	95.4	-2.00	0.046
Years of education	12.64	12.81	12.67	12.70	85.0	-1.18	0.239
Black	0.13	0.12	0.138	0.137	91.4	0.35	0.728
Hispanic	0.032	0.043	0.033	0.033	95.1	-0.42	0.671
Ever smokes	0.552	0.583	0.548	0.554	81.5	-1.57	0.112
Ever drinks	0.538	0.553	0.531	0.537	61.8	-1.59	0.112
Number of limitations with ADLs	0.177	0.224	0.177	0.177	98.9	-0.11	0.915
Number of limitations with IADLs	0.058	0.076	0.058	0.058	98.8	-0.10	0.918
Poor health	0.212	0.233	0.214	0.214	99.4	-0.04	0.964
Separated or divorced	0.068	0.090	0.068	0.070	91.6	-0.98	0.325
Widowed	0.138	0.149	0.145	0.145	98.8	-0.05	0.957
Never married	0.014	0.027	0.014	0.014	95.0	0.71	0.476
Employed	0.383	0.338	0.359	0.361	95.9	-0.51	0.607
Unemployed	0.014	0.018	0.014	0.015	88.1	-0.50	0.620
Retired	0.493	0.544	0.518	0.519	98.9	-0.16	0.875
Disabled	0.015	0.017	0.015	0.016	65.6	-0.59	0.552

[1]Percent reduction in bias is represented by the percent reduction in standardized differences before and after matching

OLS estimates based on the matched sample presented in Table 5.8. confirm findings from the main models. Early and stable homeownership was associated with lower levels of depressive symptoms in later life (*b*=-0.0305, 95% CI -0.052 to -0.0089) compared to accessing homeownership later in the life course or having moved.

Table 5.8. Linear association between timing of access to homeownership and depressive symptoms on the matched sample of early and late homeowners

	b	SE	95% CI	
Homeowner by age 35 vs. Homeowner after 35 (ref.)	-0.0305	0.011	-0.052	-0.0089
Demographic characteristics				
Female vs. Male (ref.)	0.207	0.0115	0.1846	0.2297
Age	0.0273	0.0107	0.0064	0.0482
Black vs. White (ref.)	-0.0805	0.0184	-0.1164	-0.0444
Hispanic	-0.0109	0.0324	-0.0744	0.0526
Separated or divorced vs. Married or in a relationship (ref.)	0.304	0.027	0.2509	0.3566
Widowed	0.506	0.0216	0.4633	0.548
Never married	0.267	0.054	0.1616	0.3732
Duration of longest marriage	-0.00428	0.00303	-0.0102	0.0016
Number of children	0.000255	0.000545	-0.0008	0.0013
Number of person living in the household	0.0242	0.00644	0.0115	0.0368
Health status				
Self-reported health: fair/poor vs. Excellent/very good/good (ref.)	1.086	0.0187	1.0497	1.1232
Ever smoked vs. No (ref.)	0.0377	0.0117	0.0148	0.0605
Currently smokes vs. No (ref.)	0.219	0.0191	0.1817	0.2564
Drinking	-0.0476	0.0118	-0.0707	-0.0245
Number of limitations with ADLs	0.453	0.0144	0.4252	0.4817
Number of limitations with IADLs	0.485	0.0297	0.4272	0.5436
Socio-economic characteristics				
Number of years of eduction	-0.0423	0.00231	-0.0468	-0.03778
Unemployed vs. Employed (ref.)	0.496	0.0565	0.3856	0.6071
Retired	0.0790	0.015	0.0495	0.1084
Disabled	0.826	0.0729	0.6831	0.9688
Not in the labour force	0.188	0.0246	0.14	0.2365
Log of household non-housing wealth	-0.0351	0.00379	-0.0425	-0.0277
Log of household total income	-0.0390	0.00776	-0.0542	-0.0238
Cohort fixed effects	Yes	-	-	-
Wave fixed effects	Yes	-	-	-

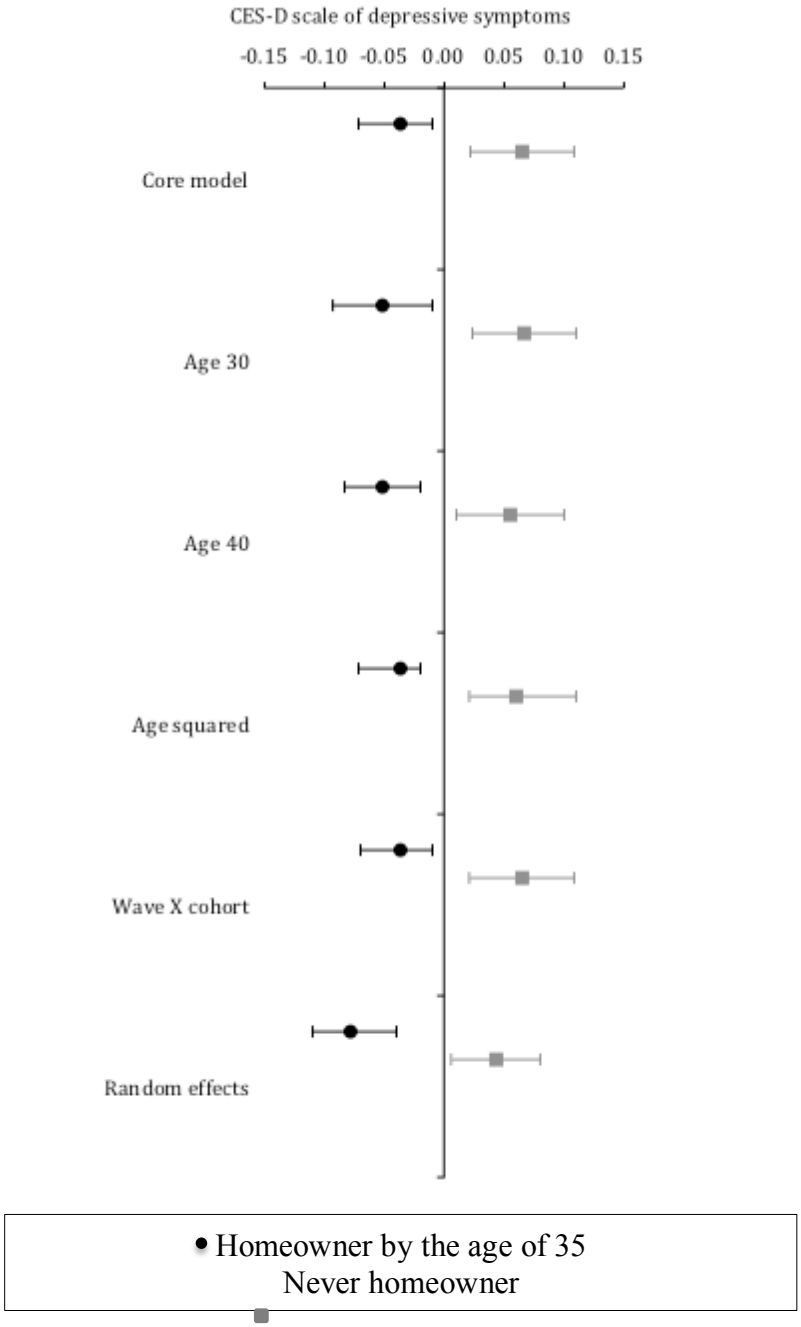
Constant	0.258	9,926	0.112	0.876
Observations	102,313	-	-	-
R-squared	0.203	-	-	

Notes: Robust standard errors are clustered at the individual level.

5.3.6. Sensitivity analyses

A series of supplementary analyses were carried out to examine the robustness of the results. The estimates for a first series of additional models are presented in Figure 5.4 and full results are available in the appendix of this thesis. I first examined whether results were robust to different age cut-offs to define early access to homeownership. Models using age 30 or age 40 to define early access were consistent with the main specification (Appendix 5.1 and 5.2). Models including age and age squared (Appendix 5.3) or an interaction term between the survey wave and the year of birth (Appendix 5.4) did not significantly differ from the core model. Finally, findings were robust to a random effects specification (Appendix 5.5).

Figure 5.4. Overview of the effect of early and stable access and never access to homeownership on depressive symptoms levels by specification



Notes:
Core model - main specification, with covariates as in Table 2. The reference category is homeowner after the age of 35.
Age 30 - includes all covariates from the main model but early access to homeownership is defined at age 30 instead of 35.
Age 40 - includes all covariates from the main model but early access to homeownership is defined at age 30 instead of 35.
Age squared - main specification, but age is modelled at a linear variable and age squared is added.
Wave X cohort: Main specification, plus an interaction term between year of survey and year of birth.
Random effects - random effects model, including all covariates from the main model.

Another potential concern is the fact that I do not have information on the mental health status of the participants before their entry in the survey. To account for this issue, I looked at whether the homeownership measure was associated with having been diagnosed by a doctor with emotional, nervous or psychiatric problems at the first wave, which would reflect underlying psychological issues preceding the CES-D measure. I found no association between early access to homeownership or never accessing the housing ladder and medical diagnosis of psychological problems at baseline (Table 5.9).

Table 5.9. Logistic regression of having been diagnosed by a doctor with emotional, nervous or psychiatric problems by homeownership status at baseline

	OR	SE	95% CI	
Homeowner by age 35 vs. Homeowner after 35 or having moved (ref.)	0.786	0.129	0.5702	1.0847
Not homeowner	0.883	0.187	0.5825	1.3377
Demographic characteristics				
Female vs. Male (ref.)	1.576	0.257	1.1456	2.1686
Age	0.961	0.0183	0.9257	0.9974
Black vs. White (ref.)	0.332	0.0862	0.1992	0.5518
Hispanic	0.458	0.18	0.2113	0.9909
Separated or divorced vs. Married or in a relationship (ref.)	0.844	0.23	0.4944	1.4411
Widowed	1.2	0.376	0.6498	2.2173
Never married	0.289	0.204	0.0728	1.1499
Duration of longest marriage	0.986	0.00755	0.9709	1.0005
Number of person living in the household	1.015	0.0598	0.9046	1.1395
Number of children	1.015	0.0346	0.9492	1.0848
Health status				
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	3.128	0.501	2.2855	4.2809
Ever smoked vs. No (ref.)	1.126	0.194	0.8029	1.5779
2+ alcohol drinks	1.02	0.159	0.7507	1.3846
Currently smoking vs. No (ref.)	1.066	0.186	0.7572	1.5008
Number of limitations with ADLs	1.290	0.12	1.0752	1.5485
Number of limitations with IADLs	1.658	0.278	1.1938	2.3035
Socio-economic characteristics				
GED vs. Lower than high school (ref.)	2.122	0.597	1.2222	3.6843
High school graduate	1.104	0.214	0.7545	1.6141
Some college	1.404	0.305	0.9169	2.1505
College and higher	0.996	0.265	0.5907	1.6775
Unemployed vs. employed (ref.)	2.888	0.836	1.6376	5.0936

Retired	1.460	0.266	1.0219	2.0867
Disabled	1.351	0.538	0.6182	2.9501
Not in the labour force	1.247	0.321	0.7526	2.0645
Log of household non-housing wealth	0.898	0.0425	0.8187	0.9856
Log of household total income	0.95	0.094	0.7823	1.1531
Constant	1.027	1.631	0.0457	23.091
Observations	7,138			
Pseudo R2	0.105			

Notes: Robust standard errors are reported.

5.4. Discussion

In this chapter, I examined the long-term effects of early homeownership and residential stability on mental health in older age. Early homeownership seems to bring mental health benefits in later life, even after accounting for selection and a wide range of socio-demographic and physical health confounders. Lifetime experiences of homeownership were associated with lower levels of depression in later life and slower age-related progression of depressive symptoms. Older Americans who had become homeowners by the age of 35 and did not move houses had lower mortgage repayments and enjoyed more financial wealth in older age. These findings suggest that policies that promote early homeownership may mitigate some of the negative long-term consequences of recent declines in the share of young Americans owning a home (Joint Center for Housing Studies 2015). However, limitations in the retrospective data available in HRS mean that it is difficult to fully disentangle the effect of early access to homeownership and residential stability.

5.4.1. Fit with the existing literature

The results are in line with earlier studies showing that housing tenure is associated with better health and lower mortality (Jones 1995, Macintyre 1998, Dunn 2002, Hiscock, Macintyre et al. 2003, Smith, Easterlow et al. 2003, Dalstra, Kunst et al. 2006, Windle,

Burholt et al. 2006, Laaksonen, Martikainen et al. 2008, Howden-Chapman, Chandola et al. 2011, McCann, Grundy et al. 2012, Pierse, Carter et al. 2016). These studies often conceive housing tenure as a potential indicator of socioeconomic status. I show that it is not just accessing the housing ladder that matters, but also the timing of doing so. Early homeownership *per se*, net of the effect of traditional socioeconomic status indicators such as education, income and wealth, appears associated with better long-term mental health outcomes. I found a "dose-response" relationship between duration of homeownership and health. Never owning a home was associated with considerably poorer mental health outcomes in later life, but early access to homeownership is associated with a 3.5% decline relative to the mean depressive symptoms score for late homeowners. Duration of homeownership consequently matters for the long-term mental health prospects of older Americans.

I hypothesized that duration of homeownership is associated with better mental health outcomes because early access to homeownership may uniquely improve material living standards and enable households to accumulate wealth for consumption in older age (Grundy and Holt 2001). I found that respondents who became homeowners early on in the life course and did not subsequently move had significantly lower mortgage repayments at age 50 and older. Accessing the housing ladder by the age of 35 and not moving can dramatically reduce costs of living as income may decline in the post-retirement years (Conley and Gifford 2006). In addition, homeowners accumulate wealth to the extent that their home's gains value over time (Turner and Luea 2009). The cohorts included in this chapter have experienced unprecedented house-price appreciation (Case and Quigley 2008), which is also likely to contribute to their financial stability and wellbeing in later life (Hamoudi and Dowd 2013, Hamoudi and Dowd 2013). There is some evidence that owning one's home may not be the best saving

mechanism for older households as it constitutes an illiquid asset, consequently difficult to use to finance consumption in later life (Apgar and Di 2006). Results presented in this chapter show however that early homeowners have also accumulated significantly more liquid assets (net financial wealth), which can be directly used to finance the consumption of health-promoting good and services in later life.

The links that I observed between early homeownership and depression in later life may result from different mechanisms. If wealth accumulation seems to be one, other mechanisms will need to be further investigated. Homeownership may also have undesirable effects that may negatively influence mental health in older age. Homeownership often occurs at the expense of major indebtedness, which may be difficult to maintain for disadvantaged households with unstable employment (Alley, Lloyd et al. 2011, McLaughlin, Nandi et al. 2012, Charters, Harper et al. 2016). For those unable to secure mortgage payments, this may result in the loss of a dwelling, major financial losses, substantial insecurity and the onset of mental illness (Nettleton and Burrows 1998, Smith, Searle et al. 2009, Alley, Lloyd et al. 2011, McLaughlin, Nandi et al. 2012, Charters, Harper et al. 2016). Some studies also suggest that, compared to renters, homeowners face a higher risk of unemployment because of reduced flexibility to move to jobs located outside of their commuting range (Oswald 1996, Battu, Ma et al. 2008). If my findings suggest that the benefits of early homeownership and residential stability may outweigh potential harms in the long run, these mechanisms question the premise that homeownership is invariably good for health and should be further researched.

5.4.2. Strengths and limitations

A number of limitations to the analytic approach proposed in this chapter have to be considered. First, I did not have data on residential histories in HRS, and therefore relied on retrospective assessments of the current home. The homeownership variable is based on the respondent's current home, not necessarily their first home. I might consequently be misclassifying a number of respondents as late homeowners when they actually accessed the housing ladder early but have moved before entering the survey at age 50. However, 73.5% of the respondents from the first HRS wave reported having lived in their current home for over fifteen years (so since they were about 35 as recruitment for HRS starts at the age of 50). Residential mobility is consequently limited for the cohorts I am considering in this analysis and the misclassification of early *vs.* late homeowners should consequently be relatively limited. It is however an important limitation of the results as I cannot disentangle whether the positive effect on depressive symptoms comes from early access to homeownership, residential stability or a combination of both. The HRS team recently fielded a mail survey to a subgroup of 11,256 eligible HRS respondents to ask them detailed questions on their residential history[14]. The data are not available to date and as the response rate is only of 59%, it is unclear whether the quality will be high enough to address the issue.

A second limitation is that I have no information on depression levels of respondents prior to their inclusion in the survey. In sensitivity analyses (Table 5.9), I looked at whether early access to homeownership was associated with the likelihood of reporting having been diagnosed by a medical doctor with psychological problems in the first wave of data inclusion. I found no association, indicating that it is unlikely that respondents

[14]Further information is available on the HRS website http://hrsonline.isr.umich.edu/index.php?p=shoavail&iyear=9P [last accessed on 30/05/2017].

with underlying mental health problems would self-select out of homeownership. There is, however, no data available on mental health earlier in life (before entry in the survey).

A third limitation is that PSM relies on the assumption that unobserved characteristics do not influence early access to homeownership (Little and Rubin 2000, Austin 2010, Austin 2011). It consequently remains a possibility that other unobserved factors might have confounded the positive association observed between early access to homeownership and better mental health in later life. Early life circumstances or other factors may partly explain the results presented in this chapter. HRS contains data on childhood circumstances for only a subset of the data and I could not replicate these analyses on that sub-sample due to the small sample size.

5.5. Conclusion

These results add to the growing recognition that homeownership and residential stability may have long-term health effects and have public health implications for both current and future generations of older Americans. Baby boomers and older cohorts in this HRS sample are unique in terms of their homeownership rates, mortgage access and house-price appreciation. Both accessing homeownership early on and remaining in the same house enabled these generations to accumulate wealth over the life course in unprecedented ways. The collapse of the housing bubble has led to a reduction of their housing wealth, so that older Americans relying on their homes to support post-retirement consumption may experience substantial difficulties (Connolly, O'Reilly et al. 2010, Hamoudi and Dowd 2013, Hamoudi and Dowd 2013). Despite this recent financial collapse, these results suggest that having owned a home since early in life can work as a buffer against these shocks and has contributed to homeowners' lower levels of depression. Findings indicate that any prevention programme for depression in older age should take a life course approach and intervene early in life.

These results indeed suggest that social policies affecting young adults can have long-lasting consequences for their mental health in older age (Avendano, Berkman et al. 2015). At the same time as the baby boomers are transitioning into retirement ages, another large cohort, the Millennials (born between 1982 and 2004), are passing through the traditional milestones of adulthood, including first-time homeownership. However, these households were in the prime years of first-time home-buying at the time of the Great Recession and the homeownership rates among households aged 25-34 have decreased by more than nine percentage points since 2004 (Joint Center for Housing Studies 2015). This cohort decline in homeownership rates affecting younger generations may be expected to have important implications for their mental health as they reach older age. Policies targeted at supporting young households in acquiring their homes may yield important benefits. While it may be costly to borrow for young homebuyers, a cost-effectiveness analysis should take into account the savings that will be made in terms of depression prevalence down the line.

Chapter 6

The mental health benefits of buying a home in older age: a fixed-effects analysis in older Americans[15]

Background. Homeownership is consistently associated with better mental health, but whether becoming homeowner later in life has positive psychological effects has not been examined. In this chapter, I assessed whether acquiring a home at age 50 and over is associated with depressive symptoms in a representative sample of older Americans.

Methods. I used individual fixed-effects models based on data from 21,960 respondents aged 50 and older from the Health and Retirement Study (HRS) interviewed biannually between 1993 and 2010. Depressive symptoms were measured using the 8-item Centre for Epidemiologic Studies Depression (CES-D) scale.

Results. Controlling for confounders, acquiring a home at age 50 and over predicted a significant decline in depressive symptoms in the same year (β=-0.0768, 95% CI [confidence interval]: -0.152 to -0.001). The association remained significant after two years (β=-0.0556, 95% CI: -0.134 to -0.004) but was attenuated and no longer significant after four years. Buying a home for reasons associated with 'pull factors' (e.g., moving to a better neighbourhood, improved access to transportation and services) drove this effect (β=-0.426, 95% CI: -0.786 to -0.066), while acquiring a home for reasons associated with 'push factors' (negative factors associated with the previous home or neighbourhood), the desire to be closer to family or friends, downsizing or upsizing did not predict mental health improvements.

Discussion. Findings suggest that there are small but significant benefits to mental health associated with acquiring a home in older age.

[15]A version of this chapter has published in the *American Journal of Epidemiology* (Courtin, Dowd & Avendano, 2017).

6.1. Introduction

The association between housing and health is well-established (Shaw 2004). Previous studies suggest that housing may influence health through three main pathways: neighbourhood characteristics, housing conditions and housing tenure (Acevedo-Garcia, Osypuk et al. 2004, Gibson, Petticrew et al. 2011). Extensive research has focused on establishing the impact of neighbourhood characteristics and housing quality, while less is known about the impact of housing tenure type on health (Gibson, Petticrew et al. 2011). A number of studies have found an association between homeownership and better physical health (Jones 1995, Macintyre 1998, Dunn 2002, Hiscock, Macintyre et al. 2003, Smith, Easterlow et al. 2003, Dalstra, Kunst et al. 2006, Windle, Burholt et al. 2006, Laaksonen, Martikainen et al. 2008, Howden-Chapman, Chandola et al. 2011, McCann, Grundy et al. 2012, Finnigan 2014, Pierse, Carter et al. 2016), mental health (Stillman and Liang 2010, Manturuk 2012) and longevity (Filakti and Fox 1995, Laaksonen, Martikainen et al. 2008). However, whether this relationship is causal has been debated (Acevedo-Garcia, Osypuk et al. 2004). Indeed, an important limitation of these studies is the strong selection associated with homeownership (Clark, Myron et al. 2007). Individual characteristics from childhood to adulthood are likely to be associated with both homeownership and health in later life (Lash and Fink 2003). In addition, healthier individuals enjoy longer and more stable careers (Veldman, Reijneveld et al. 2015), increasing their ability to accumulate wealth (Kessler, Heeringa et al. 2008) and consequently access mortgage loans. These concerns have led to a reassessment of the potential mental health benefits of homeownership in early adulthood (Baker, Bentley et al. 2013). Less is known, however, about the causal association between acquiring a home and mental health in older age.

Today, over 70% Americans aged 50 and over own a home (Joint Center for Housing Studies 2015). The number of Americans who are homeowners increased steadily during the second half of the 20th Century and until the early 2000's, encouraged by active pro-homeownership policies (Fetter 2013). Most Americans access the housing ladder in their thirties (Chevan 1989) but the dynamics of homeownership attainment are changing. There is growing evidence that younger generations of Americans may have delayed their homeownership access as a result of the Great Recession (Bracha and Jamison 2012). For example, there is a 16% difference in homeownership rates among those aged 40 to 45 in 2005 (70%) vs the same age group in 2015 (54%) (Callis and Kresin 2015). Increasing rates of homeownership at the aggregate level also mask persistent inequalities, with subgroups having substantially lower chances of accessing the housing ladder or doing so later on in their life course. Data presented in Table 6.1 below shows homeownership rates by ethnicity of the householder in the U.S. between 2001 and 2010. For example, at the peak of homeownership rates in 2004, less than half of Black and Hispanic households owned a home, compared to more than 70 per cent of white households (Desilva and Elmelech 2012, Kuebler and Tugh 2013).

Table 6.1. Homeownership rates by ethnicity of householder, U.S. Census data, 2001-2010 (%)

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
US. total	*67.4*	*67.9*	*68.3*	*69.0*	*68.9*	*68.8*	*68.1*	*67.8*	*67.4*	*66.9*
White, total	71.6	71.8	72.1	72.8	72.7	72.6	72.0	71.7	71.4	71
White, non-Hispanic	74.3	74.5	75.4	76.0	75.8	75.2	75	74.8	74.8	74.4
Black, total	47.4	47.3	48.1	49.1	48.2	47.9	47.2	47.4	46.2	45.4
American Indian	55.4	54.6	54.3	55.6	58.2	58.2	56.9	56.5	56.2	52.3
Asian	53.9	54.7	56.3	59.8	60.1	60.8	60.0	59.5	59.3	58.9
Hispanic	47.3	48.2	46.7	48.1	49.5	49.7	49.7	49.1	48.4	47.5

Notes: Data from the U.S. Census Bureau, IPUMS-CPS, University of Minnesota. The homeownership rate is the percentage of households who are homeowners in the given demographic group.

These ethnic differences are also visible in terms of the timing of access to homeownership. In 2015, the median age of first access to homeownership was 34, but the median age for Black first-time buyers was 38 (Callis and Kresin 2015). As shown in Table 6.2, just over half of Black Americans (56%) owned a home when they reached the age of 55 against 82% of White Americans at the same age.

Table 6.2. Homeownership rates by age and ethnicity of householder, U.S. Census data, 2014 (%)

	White	**Black**	**Hispanic**	**Asian**	**Other**
25-34	48	19	30	33	40
35-44	70	38	45	60	50
45-54	79	51	56	75	63
55-64	82	56	59	75	71
65-74	85	63	63	73	70
75 and over	82	67	68	63	74
Total	*72*	*46*	*48*	*60*	*58*

Notes: Data from the U.S. Census Bureau, IPUMS-CPS, University of Minnesota. The homeownership rate is the percentage of households who are homeowners in the given demographic group.

Although accessing or re-entering homeownership later in life is currently not very common, these variations in homeownership attainment indicate that this is likely to change in the future and that it is already more frequent among disadvantaged categories of the population. How these trends may impact mental health and well-being in later life

is not clear and it is the focus of this chapter. An important, yet untested, hypothesis is that acquiring a home later in life may lead to improvements in mental health and wellbeing.

Acquiring a home in later life may influence mental health through several mechanisms. Studies suggest that homeownership is associated with better quality of housing (Friedman and Rosenbaum 2004), which is in turn associated with lower levels of mental distress and better positive affect (Evans, Wells et al. 2000, Evans, Wells et al. 2003). Housing conditions are an important determinant of mental health in later life: Compared to their younger counterparts, older people spend more time in their home due to reduced functioning, access to transportation and social networks (Evans, Wells et al. 2003, Garin, Olaya et al. 2014). They also invest more in local services because they are less mobile and are more likely to benefit themselves from these investments than renters (Dietz and Haurin 2003, Chambers, Garriga et al. 2009, Balchin 2013). Acquiring a home later in life may also increase self-esteem, control and autonomy in later life, which are associated with better mental health (Dupuis 1998, Macintyre 1998, Hiscock, Kearns et al. 2001).

This chapter aims to estimate the impact of acquiring a home on depressive symptoms in older age. Depression in older age is a significant problem in the United States: Approximately 7% of Americans above the age of 74 suffer from major depression and 17% from elevated depressive symptoms (Luppa, Sikorski et al. 2012, Zivin, Pirraglia et al. 2013). Major depression is the leading cause of years lived with disability worldwide and the fifth leading cause of disability-adjusted life years in North America (Murray, Vos et al. 2012, Whiteford, Degenhardt et al. 2013). I use data from the Health and Retirement Study, a longitudinal study that follows older Americans since 1992. This paper builds up on earlier work (Stillman and Liang 2010, Manturuk 2012, Baker, Bentley

et al. 2013) by using panel data and individual fixed-effects that exploit individual-level changes in homeownership. The results provide new evidence on the potential mental health effects of acquiring a home in later life.

6.2. Methods

6.2.1. Study population

The Health and Retirement Study (HRS) is a nationally representative study of Americans aged ≥50 started in 1992. The HRS sample is selected based on a multi-stage area probability sample. Further details about the study are provided in Chapter 3 of this thesis. Enrolment occurred in 4 waves (1992, 1993, 1998 and 2004), depending on respondents' birth year. HRS included respondents from several birth cohorts: The AHEAD cohort (born 1923 or earlier), the children of the depression (1924-1930), the initial HRS cohort (1931-1941), War babies (1942-1947), early (1948-1953) and mid baby boomers (1954-1959). Biennial interviews were conducted through 2010, and wave-to-wave retention rates were around 90%. The analytical dataset for this chapter comprised eleven HRS waves starting in 1993, the first year that depressive symptoms were measured, and ending in 2010. I excluded 441 respondents living in nursing homes at the first wave they were observed in the data. Following standard practice in HRS (Friedman, Weden et al. 2016), respondents were right censored upon entry into a nursing home or loss to follow up (N=680). The final sample comprised 20,524 individuals living in the community. The core analyses presented in this chapter are conducted on this sample. Additional analyses exploring whether different reasons for moving have different effects on depressive symptoms are conducted on a smaller sample for which this type of information is available (N=4,195). Further details are provided in section 6.2.3.

6.2.2. Assessment of depressive symptoms

An eight-item version of the CES-D scale was used to measure depressive symptoms (Radloff 1977). CES-D is a valid and reliable scale, widely used to measure depression in older age (Murray, Vos et al. 2012, Courtin, Knapp et al. 2015). Further details about the CES-D score and its properties are given in Chapter 4 of this thesis. The score ranges from zero to eight, with higher scores indicating higher levels of depressive symptoms. A cut-off point of three is often used to define high levels of depressive symptoms (Turvey, Wallace et al. 1999, Han 2002).

6.2.3. Moving to an owner-occupied home after age 50

HRS respondents provided information on their tenure status at each wave of the survey. Individuals who reported living in rented housing at time *t*, but who reported living in an owner-occupied home at time *t*+2, were considered new homeowners. I did not consider as new homeowners those who bought a second residence or a residence to which they did not move. HRS does not include information on residential histories, so this chapter is exclusively looking at transitions from renting to owning a home after 50, regardless of respondents' homeownership status before entering the survey.

HRS also asked respondents who moved to a new residence the reasons for this change. Table 6.3 provides examples of stated reasons for moving houses. In total, there were 47 broad reasons respondents provided for a move. Based on previous literature (Bradley and Van Willigen 2010, Wilmoth 2010), I reclassified these reasons into six broad categories which cover individual- as well as neighbourhood-level drivers for the move: (a) pull factors (e.g. more appealing neighbourhood with better access to transportation and services); (b) push factors (e.g. poor neighbourhood conditions or economic insecurity); (c) the desire to be closer to family or friends; (d) downsizing (moving to a smaller and/or less expensive house); (e) upsizing (moving to a larger home), and (f) the

expressed desire to be a homeowner. Each category was coded as mutually exclusive. Reasons for moving were coded as a categorical variable; with push factors as the reference category. The 'reason-for-move' subsample is smaller than the main analytic sample because HRS collected this information only starting in 1996 (N=4,195, which corresponds to 38% of those who moved).

Table 6.3. Examples of stated reasons by reason-for-move category.

Reason-for-move category	Examples for stated reasons
Pull factors	Business opportunity, closer to work, climate or weather, leisure activities, shopping or other consumption services, inheritance
Push factors	Undesirable characteristics of old neighbourhood, life crisis factors such as spouse died, other changes in relationship status, natural disaster, respondent or spouse/partner was laid off, health problem
Downsizing	Smaller/less expensive house, old home was too expensive, cheaper area, new home requires less upkeep
Upsizing	New home is larger, new home has desirable features
Family and friends	Moved to area where previously lived, moved to house where grew up/bought property previously in the family, moved to be closer to friends, moved to be closer to children and grand-children
Becoming homeowner	Bought a home after renting, wanted to become homeowner, got a good deal to buy

6.2.4. Covariates

Respondent's time-invariant characteristics included gender, race (White, Black or Hispanic), and highest educational level attained (lower than high school, General Education Development [GED], high-school graduate, some college, college or above). Time-varying demographic confounders, measured at each wave, included age (included as a linear term and squared), marital status (married or in partnership, separated or

divorced, widowed, never married), size of the household and number of children. Time-varying socioeconomic characteristics, measured at each wave, included labour force participation (employed, unemployed, retired, disabled, not in the labour force), log natural logarithms of household income and non-housing wealth. Time-varying measures of physical health and behaviour assessed at each wave comprised self-reported health (dichotomized into fair/poor vs. excellent/very good/good), tobacco smoking (ever smoked vs. no; and currently smoking vs. no), heavy alcohol drinking (based on self-report of consuming more than two drinks per day over five to seven days a week), and physical functioning (measured by the number of difficulties with activities of daily living [ADLs - ranging from zero to five] and instrumental activities of daily living [IADLs - ranging from zero to three]).

6.2.5. Data analysis

Hausman specification tests (Hausman 1978) suggested that the assumption of no correlation between explanatory variables and individual characteristics was violated in the random-effects models. Results are presented in Table 6.4. below.

Table 6.4. Random effects association between homeownership and depressive symptoms score among respondents aged 50 years and older in HRS (*N*=20,524), 1993-2010.

	β	95% CI
Homeowner	-0.0543	-0.116, 0.007
Age	-0.0330	-0.048, -0.018
Age squared	0.000184	0.000, 0.002
Separated or divorced (ref. married)	0.194	0.148, 0.239
Widowed	0.363	0.327, 0.397
Never married	0.160	0.071, 0.248
Number of children	0.00159	-0.004, 0.007
Household size	0.0184	0.007, 0.029
Poor self-reported health (ref. good health)	0.727	0.700, 0.753
Currently smoking (ref. no)	0.141	0.107, 0.173
Currently drinking (ref. no)	-0.0465	-0.069, -0.024
Number of limitations with ADLs	0.300	0.283, 0.317

Number of limitations with IADLs	0.258	0.225, 0.291
Depressive symptoms score at previous wave	0.345	0.339, 0.351
Unemployed (ref. employed)	0.370	0.291, 0.448
Retired	0.0385	0.010, 0.066
Disabled	0.457	0.369, 0.544
Not in the labour force	0.166	0.123, 0.209
Log of household non-housing wealth	-0.0248	-0.032, -0.018
Log of household total income	-0.0472	-0.060, -0.034
Survey year fixed effects	Yes	
Constant	2.410	1.871, 2.948
Number of individuals	20,524	

Abbreviations: CI, confidence intervals; ADLs, Activities of Daily Living; IADLs, Instrumental Activities of Daily Living.

I therefore used individual fixed-effects models, which exploit within-individual changes in home ownership, consequently controlling for time-invariant confounders that differ across individuals such as unobserved family background characteristics or pre-existing levels of physical and mental health (Gardiner, Luo et al. 2009, Firebaugh, Warner et al. 2013, Bell and Jones 2015). Fixed-effects models compare the depressive symptom levels of a respondent before buying a home to that same respondent's depression score when he/she becomes homeowner, net of the effect of time invariant characteristics and time-variant control variables (Gunasekara, Richardson et al. 2014). I adjusted for all time-varying factors described above: age, marital status, size of the household, number of children, labour force participation, natural logarithms of total household income and of non-housing wealth, self-reported health, health behaviours (smoking and drinking) and number of limitations with ADLs and IADLs. To minimize the potential impact of reverse causality, I also controlled for the lagged value of depressive symptoms in the previous wave. This approach satisfies the two conditions of fixed-effects models: the outcome variable should be measured for each respondent in a similar fashion for at least two time points; and the exposure variable should vary over time for at least part of the respondents (Croezen, Avendano et al. 2015).

The linear model was as follows:

$$Dep_{it} = \mu_t^1 + \beta^2 homeownership_{it} + \beta^3 X_{it} + \beta^4 Dep_{i,t-1} + \alpha_i^5 + \varepsilon_{it} \quad (1)$$

Where Dep_{it} indicates the depressive symptoms score for individual *i* at time *t;* $homeownership_{it}$ is the homeownership indicator that takes the value 1 of the individual is a homeowner and 0 otherwise; X_{it} a vector of supplementary controls; $Dep_{i,t-1}$ is a control for the depressive symptoms score at the previous wave (two years before); and ε_{it} is the error term. μ_t is a fixed effect for time that accounts for time trends that are constant across individuals; and α_i controls for time-invariant individual characteristics. I used the same model specification to examine the relationship between the six reasons stated for acquiring a house and mental health and introduced an interaction term between acquiring a new home and the reason for the move. Homeownership status was coded as an absorbing state, whereby individuals who became homeowners at some point in the observation period remained homeowners for the rest of follow-up. This specification allowed me to examine both contemporaneous as well as lagged effects of acquiring a home in older age (Noelke and Avendano 2015).

I followed a stepwise approach to build the fixed-effects models, starting with a model that controlled for age, age-squared and survey year only (model 1). I then incorporated additional controls for time-varying variables (model 2). Data were initially analysed separately for men and women but estimates were subsequently pooled because results did not differ by gender. I estimated individual clustered robust standard errors for all estimates. All analyses were conducted in Stata version 14.0.

6.3. Results

6.3.1. Descriptive statistics

Sample baseline characteristics are summarized in Table 6.5, separately for homeowners and renters. The vast majority of respondents (76.2%) were already homeowners at the time they enrolled in the study. The average depressive symptoms score was 1.356 point and 15.98% of respondents had a score superior or equal to three on the CES-D score, corresponding to the cut-off indicating clinical depression symptomatology. Those who were renters at baseline (23.8%) differed from homeowners along several important dimensions. They had higher levels of depressive symptoms (mean CES-D score: 2.257), and they were more likely to report being in poor physical health (41.50%). They were also more likely to be female (56.76%), Black or Hispanic (37.23% and 12.49% respectively), and to have a level of education lower than high school (30.90%) compared to homeowners. Renters at baseline were also more likely to be separated or divorced (30.90%), and had less financial wealth and lower incomes.

Table 6.5. Baseline characteristics of selected participants among HRS respondents aged 50 years and older by homeownership status

	Homeowner (at baseline) (*N*= 18,652)	Renter (at baseline) (*N*=5,812)
Depressive symptoms and health characteristics		
Mean CES-D score (SD)	1.356 (1.87)	2.257 (2.37)
CES-D≥3: n (%)	2,976 (15.98)	2,004 (34.49)
Self-reported bad and poor health: n (%)	3,787 (20.30)	2,412 (41.50)
Ever smoked: n (%)	10,809 (58.23)	3,863 (66.64)
Currently smoking: n (%)	3,737 (20.07)	2,080 (35.81)
Ever drinks any alcohol: n (%)	11,991 (64.29)	3,280 (56.44)
Mean of number of limitations with ADLs (SD)	0.17 (0.637)	0.42 (0.99)
Mean of number of limitations with IADLs (SD)	0.059 (0.297)	0.17 (0.49)
Demographic characteristics		
Mean Age (SD)	56.84 (6.73)	56.22 (6.11)
Female: n (%)	9,927 (53.22)	3,299 (56.76)
Male: n (%)	8,725 (46.78)	2,513 (43.24)
Married: n (%)	15,358 (82.66)	2,750 (47.25)
Separated or divorced: n (%)	1,744 (9.35)	1,794 (30.90)
Widowed: n (%)	973 (5.22)	574 (9.89)

Never married: n (%)	577 (2.77)	694 (11.96)
White: n (%)	14,684 (78.68)	2,934 (50.28)
Black: n (%)	2,877 (15.46)	2,155 (37.23)
Hispanic: n (%)	1,091 (5.86)	723 (12.49)
Mean number of children (SD)	3.242 (2.12)	3.301 (2.50)
Mean number of household members (SD)	2.560 (1.188)	2.332 (1.430)
Education		
Lower than high school: n (%)	3,255 (17.46)	1,979 (34.06)
GED: n (%)	864 (4.63)	360 (6.20)
High-school graduate: n (%)	5,456 (29.27)	1,458 (25.09)
Some college: n (%)	4,466 (23.96)	1,302 (22.41)
College and above: n (%)	4,602 (24.68)	711 (12.24)
Socio-economic characteristics		
Employed: n (%)	11,503 (61.67)	2,909 (50.05)
Unemployed: n (%)	587 (3.15)	456 (7.85)
Retired: n (%)	4,540 (24.34)	1,407 (24.21)
Disabled: n (%)	457 (2.45)	541 (9.31)
Out of the labour force: n (%)	1,565 (8.39)	499 (8.59)
Median non-housing wealth (SD)	63,000 (689,644)	3,700 (206,629)
Median household total income (SD)	50,300 (97,994)	16,800 (40,502)

Abbreviations: CES-D, Centre for Epidemiologic Studies Depression scale; ADLs, Activities of Daily Living ; IADLs, Instrumental Activities of Daily Living; GED, General Education Development.

During the entire study period, a total of 2,462 respondents became homeowners. The majority (64.44%) became homeowners between the ages of 50 and 65.

6.3.2. Drivers of acquiring a home in later life

In order to understand better the drivers of acquiring a home in later life, a random effects model with becoming a homeowner as outcome variable was run. Results are displayed in Table 6.6. They show that being a female, Black or Hispanic, and having divorced, being widowed or never married at the previous wave were key predictors of acquiring an owner-occupier home in the analytical sample.

Table 6.6. random effects association between individual characteristics and acquiring a home among respondents aged 50 years and older in HRS (*N*=20,254), 1993-2010

	β	95% CI
Age	-0.004	-0.006, -0.002
Age squared	0.00003	0.000019, 0.000041
Female (ref. male)	0.005	-0.008, -0.001
Black (ref. White)	0.00	0.0002, 0.011
Hispanic	0.014	0.005, 0.0231
Separated or divorced (ref. married)	0.021	0.015, 0.027
Widowed	0.007	0.003, 0.116
Never married	0.032	0.021, 0.045
Number of children	0.002	0.002, 0.003
Household size	0.001	0.0004, 0.003
Poor self-reported health (ref. good health)	-0.001	-0.004, 0.002
Currently smoking (ref. no)	0.005	0.002, 0.009
Currently drinking (ref. no)	-0.002	-0.004, 0.001
Number of limitations with ADLs	-0.002	-0.004, -0.0004
Number of limitations with IADLs	0.0006	-0.003, 0.004
GED (ref. lower than high school)	-0.005	-0.014, 0.004
High school graduate	-0.0008	-0.006, 0.004
Some college	0.002	-0.003, 0.008
College and above	-0.00004	-0.006, 0.006
Unemployed (ref. employed)	0.003	-0.005, 0.011
Retired	0.0009	-0.002, 0.004
Disabled	0.006	-0.002, 0.016
Not in the labour force	0.0004	-0.004, 0.005
Log of total non-housing wealth	-0.004	-0.005, -0.003
Log of total household income	-0.001	-0.003, 0.0001
Survey year fixed effects	Yes	
Constant	0.251	0.188, 0.314
Number of individuals	20,524	

Abbreviations: CI, confidence intervals; ADLs, Activities of Daily Living; IADLs, Instrumental Activities of Daily Living; GED, General Education Development.

6.3.3. Fixed-effects models

Results from fixed-effects models are displayed in Table 6.7, with model 1 controlling only for age, age squared and survey years and model 2 being the fully adjusted model. Losing a spouse and declining self-reported health were the strongest predictors of increases in depression (β=0.650, 95% CI: 0.577 to 0.723 and β=0.521, 95% CI: 0.479 to

0.562 respectively). Becoming a homeowner predicted a decline in depressive symptoms in the same year (β=-0.0768, 95% CI: -0.152, -0.007), which corresponds to a 6.8% decline relative to the mean CES-D score for homeowners at baseline.

Table 6.7. Contemporaneous associations between changes in homeownership and changes in depressive symptoms score among respondents aged 50 years and older in HRS (*N*=20,524), 1993-2010.

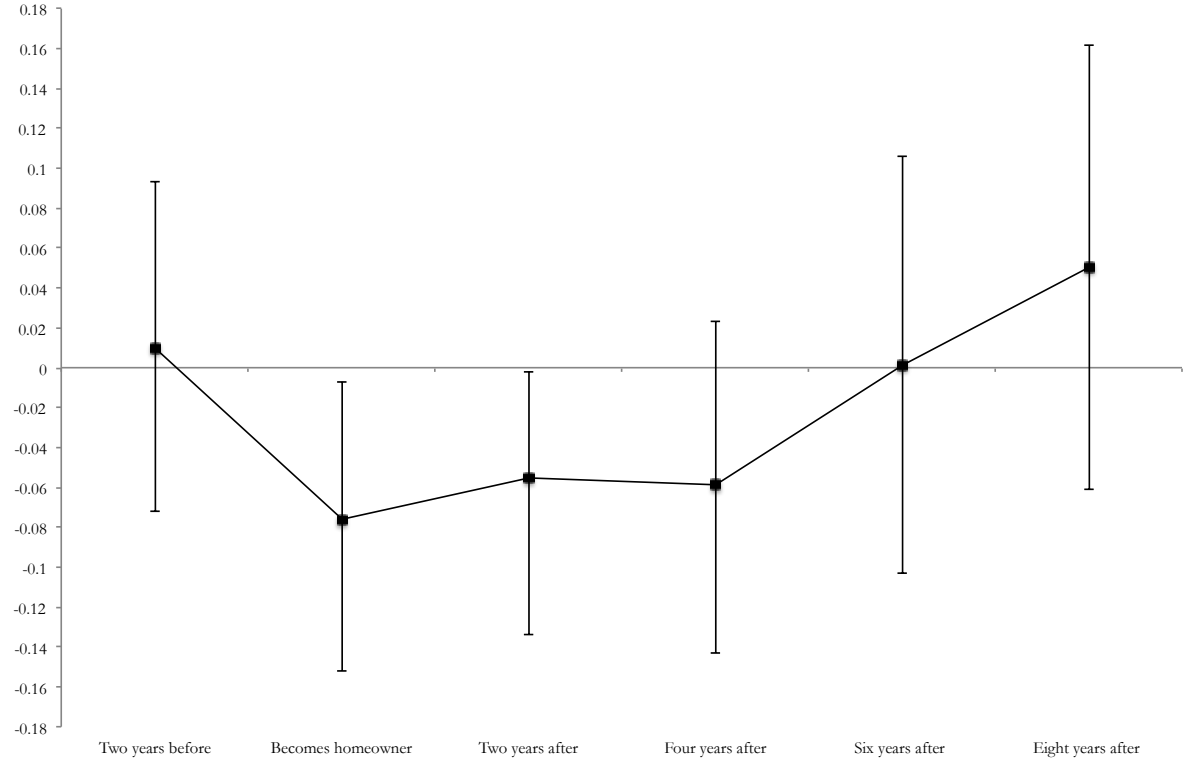
	Model 1		Model 2	
	β	95% CI	β	95% CI
Exposure of interest				
Homeownership	-0.107	-0.179, -0.035	-0.0768	-0.152, -0.007
Demographic characteristics				
Age	-0.120	-0.156, -0.082	-0.0471	-0.084, -0.009
Age squared	0.00123	0.001, 0.001	0.000648	0.0004, 0.0008
Separated or divorced (ref. married)			0.279	0.171, 0.386
Widowed			0.650	0.577, 0.723
Never married			0.474	0.117, 0.830
Number of children			-0.00154	-0.024, 0.021
Household size			0.0210	0.002, 0.039
Health status				
Poor self-reported health (ref. good health)			0.521	0.479, 0.562
Currently smoking (ref. no)			-0.127	-0.198, -0.055
Currently drinking (ref. no)			-0.0419	-0.78, -0.005
Number of limitations with ADLs			0.267	0.237, 0.297
Number of limitations with IADLs			0.203	0.147, 0.258
Depressive symptoms score at the previous wave			-0.00802	-0.019, 0.003
Socioeconomic characteristics				
Unemployed (ref. employed)			0.273	0.168, 0.376
Retired			0.00908	-0.025, 0.044
Disabled			0.348	0.196, 0.498
Not in the labour force			0.0749	0.009, 0.140
Log of household non-housing wealth			-0.0105	-0.021, 0.0009
Log of household total income			-0.0184	-0.034, -0.002
Survey year fixed effects	Yes		Yes	
Constant	3.851	2.046, 5.655	1.016	-0.806, 2.838

R-squared	0.008	0.051
Number of individuals	20,524	20,524

Abbreviations: CI, confidence intervals; ADLs, Activities of Daily Living; IADLs, Instrumental Activities of Daily Living.

Figure 6.1 presents the results of lagged models to examine to what extent this effect was sustained over time. Becoming a homeowner was associated with a reduction in depressive symptoms two years after homeownership (β=-0.0556, 95% CI: -0.134, -0.020). Estimates were similar in magnitude but no longer significant after four years (β=-0.06, 95% CI: -0.143, 0.023).

Figure 6.1. Contemporaneous and lagged associations (β with robust 95% confidence interval) between changes in homeownership and changes in depressive symptoms score among participants aged 50 years and older in HRS (*N*=20,524), 1993-2010.



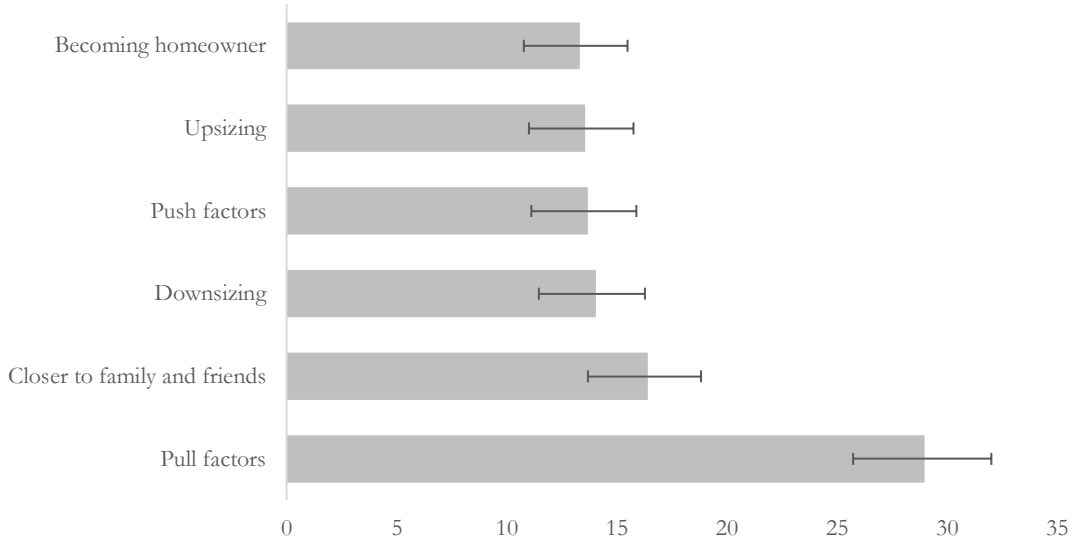
Notes: Fixed-effects coefficients, with robust 95% confidence intervals. Lower values indicate lower levels of depressive symptoms; models include survey year fixed effects and control for age (linear term and squared), marital status, size of the household, number of children, labour force participation, natural logarithms of total household income and of non-housing wealth, self-reported health, health behaviours (smoking and drinking), number of limitations with ADLs and IADLs and depressive symptoms at previous wave.

6.3.4. Results by reason-for-move categories

Respondent's self-reported reasons for moving are summarised in Figure 6.2, focusing only on respondents who moved to owner-occupied housing. Estimates for this figure are based on 1,204 respondents who provided information on the reason for moving (48.9% of all new homeowners). About a third of those who moved to an owner-occupied home (30%) reported pull factors as the main reason to move, *i.e.* positive features of the new neighbourhood or the new home. Only 16.4% reported moving to be closer to family and friends; 13.7% due to push factors - *i.e.* negative factors of their last residence; 14% due to downsizing and 13.6% to upsize. The desire to become

homeowner was mentioned as the reason to move by 13.3% of those who became homeowners.

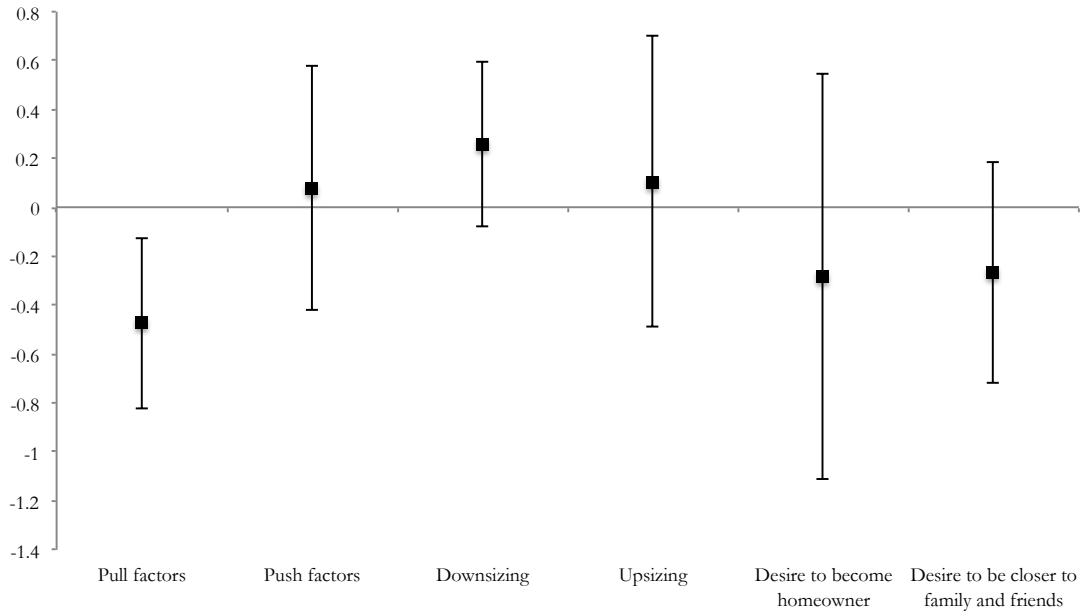
Figure 6.2. Prevalence estimates (%) and standard errors of reason-for-move among new homeowners aged 50 years and older in HRS (N=1,204), 1996-2010.



Notes: Bars represent prevalence estimates for reason-for-move among participants who became homeowners only and excludes those who moved and remained renters or homeowners.

Figure 6.3 explores the association between becoming homeowner and depressive symptoms separately by the reason behind the move in fixed effect models. In these models, the homeownership variable is interacted with a categorical variable indicating the reason to move.

Figure 6.3. Contemporaneous associations (β with robust 95% confidence interval) between reasons-for-move and changes in depressive symptoms score among participants aged 50 years and older in HRS (*N*=4,195), 1996-2010.



Notes: Fixed-effects coefficients, with robust 95% confidence intervals. Lower values indicate lower levels of depressive symptoms. The estimates display the coefficient for the interaction between acquiring a home and reason-for-move. Models include survey year fixed effects and control for age (linear term and squared), marital status, size of the household, number of children, labour force participation, natural logarithms of total household income and of non-housing wealth, self-reported health, health behaviour's (smoking and drinking), number of limitations with ADLs and IADLs and depressive symptoms at previous wave

Full results are presented in Table 6.8. A transition to homeownership motivated by pull factors was associated with a significant decline in depressive symptoms scores (β=-0.426, 95% CI: -0.786, -0.066). By contrast, transitions to homeownership for other reasons were not associated with depressive symptoms.

Table 6.8. Contemporaneous Associations between Changes in Homeownership and Changes in Depressive Symptoms Score by Reason-for-move Category and Among Respondents Aged 50 Years and Older in HRS (N=4,195), 1996-2010.

	β	95% CI
Pull factors x acquiring a home	-0.474	-0.822, -0.128
Push factors x acquiring a home	0.078	-0.405, 0.597
Downsizing x acquiring a home	0.259	-0.074, 0.592
Upsizing x acquiring a home	0.118	-0.469, 0.706
Desire to become homeowner x acquiring a home	-0.370	-1.163, 0.423
Desire to be closer to friends and relatives x acquiring a home	-0.287	-0.765, 0.190
Pull factors (ref. push factors)	0.047	-0.210, 0.304
Downsizing	-0.079	-0.362, 0.204
Upsizing	-0.252	-0.698, 0.192
Desire to become homeowner	-0.209	-0.651, 0.231
Desire to be closer to friends and relatives	-0.128	-0.414, 0.157
Age	0.103	-0.311, 0.517
Age squared	0.002	-0.001, 0.002
Separated or divorced (ref. married)	0.629	0.106, 1.153
Widowed	0.939	0.486, 1.391
Never married	2.028	-0.091, 4.148
Number of children	0.067	-0.087, 0.222
Household size	0.006	-0.117, 0.129
Poor self-reported health	0.651	0.258, 1.043
Currently smoking	0.793	0.057, 1.529
Alcohol consumption	-0.033	-0.370, 0.303
Number of limitations with ADLs	0.113	-0.275, 0.500
Number of limitations with IADLs	0.297	-0.576, 1.171
Depressive symptoms score at previous wave	-0.157	-0.238, -0.076
Unemployed (ref. employed)	-0.736	-1.341, -0.132
Retired	-0.491	-0.814, -0.166
Disabled	-0.491	-0.845, 0.036
Not in the labour force	-0.404	-0.844, 0.035
Log of household non-housing wealth	-0.031	-0.123, 0.061
Log of household total income	-0.014	-0.133, 0.104
Waves fixed effects	Yes	
Constant	-5.17	-24.58, 14.24
Number of individuals	4,195	

Abbreviations: CI, confidence intervals; ADLs, Activities of Daily Living; IADLs, Instrumental Activities of Daily Living.

6.4. Discussion

In this chapter, I investigated the mental health benefits of accessing homeownership later in life. Using fixed-effects models, I found that acquiring a home after age 50 is associated with a reduction in depressive symptoms. These findings indicate that, for up to two years after the acquisition, late access to homeownership may convey mental health benefits.

6.4.1. Fit with the existing literature

These results support findings from previous studies which have shown that homeownership is beneficial for health (Windle, Burholt et al. 2006, Gardiner, Luo et al. 2009) and longevity (Filakti and Fox 1995, Laaksonen, Martikainen et al. 2008). A key challenge in this literature is selection: it is difficult to establish whether an association exists because homeownership influences mental health, or because of unobserved characteristics that confound the relationship between homeownership and mental health. To my knowledge, only three studies have addressed this issue using fixed effect models and Propensity Score Matching (PSM) techniques (Stillman and Liang 2010, Manturuk 2012, Baker, Bentley et al. 2013). The findings presented in this chapter build up on this work by implementing a fixed-effects approach and focusing on transitions in homeownership status among adults aged 50 and over.

To provide a sense of the size of the effect, I estimated that the effect of becoming a homeowner in later life on depressive symptoms corresponds to a Cohen's d effect of 0.12 (Cohen 1988). This effect is small but significant, contrary to studies in the American or Australian adult population which have found no effect of homeownership on mental health measures using a similar fixed-effects design or PSM (Stillman and Liang 2010, Manturuk 2012, Baker, Bentley et al. 2013). The beneficial effects of accessing homeownership later in life may be conferred through a complex array of

mechanisms. First, becoming a homeowner is likely to improve residential stability. Indeed, the median length of time an American household spends in the same house is two years for renters and eight years for homeowners (Rohe and Stewart 1996). Second, improved social contacts and investment in the community and home are likely to be key elements to reduce depressive symptoms among new homeowners. For example, homeowners are likely to be more active to introduce housing improvements and adaptations, which may help them to live independently for longer and maintain social contacts, benefiting their mental health (Oswald, Wahl et al. 2007). The importance of the community and neighbourhood in the decision to move is illustrated by the finding that moves motivated by positive factors ("pull" factors) linked to the new house and neighbourhood are associated with an improvement in depressive symptoms. These moves might improve residential satisfaction, an important predictor of psychological wellbeing in old age (Oswald, Schilling et al. 2002, Bradley and Van Willigen 2010). Homeowners also tend to have better quality housing, which in turn influences depression (Weich, Blanchard et al. 2002). Homeownership might also influence mental health in later life by providing a sense of trust and control on life. Evidence suggests that homeowners interact more with their neighbours and trust more in their community (Oh 2004, Carson, Chappell et al. 2010); they also have higher levels of self-efficacy and perceived control over their life (Dupuis 1998, Macintyre, Ellaway et al. 1998), which have been hypothesized to act as buffers and coping resources for stressful events (Rossi and Weber 1996, Hiscock, Kearns et al. 2001). Homeownership is often considered as a proxy for socioeconomic status alongside income, education and employment, but its direct health effects have been less researched. The findings presented in this chapter indicate that homeownership may be an important measure of changing socioeconomic circumstances in later life, at an age when occupation or income might be less adequate measures of socioeconomic status (Demakakos, Biddulph et al. 2016).

I found that those who accessed homeownership after age 50 had a specific demographic and socioeconomic profile: they were more likely to be female, Black or Hispanic, less educated and poor. Households headed by women and minorities have persistently lower rates of homeownership in the US (Masnick and Di 2001). These results confirm previous reports that high rates of homeownership in the US mask persistent inequalities by race. I did not have enough statistical power to examine the effects of homeownership separately by race. Yet, these results suggest that policies that support older people in accessing homeownership in later life may particularly benefit racial and ethnic minorities that tend to access homeownership later in life (Flippen 2001, Flippen 2004).

6.4.2. Strengths and limitations

This study has several strengths. I used a large, representative and longitudinal sample of older Americans. Using fixed effect models, I controlled for time-invariant characteristics that may confound the relationship between homeownership and mental health. However, some limitations should also be considered. As the modelling strategy explores transitions into homeownership, I cannot disentangle the effect of acquiring a new home from a neighbourhood effect. Results could also reflect the effect of 'snowbird migration' towards sunnier US states (Smith and House 2006). I did not have access to HRS restricted geo-coded data to formally test for this hypothesis. However, I reviewed the available literature on 'snowbird migrants' in the US to determine whether their characteristics would match those of the respondents who become homeowners in this sample. I find that 'snowbird migrants' have very different characteristics from the respondents who acquired a home after the age of 50 in the sample. Indeed, 'snowbird migrants' in the US tend to have higher educational levels, higher incomes, better health and a higher likelihood of being married than 'stayers' (Smith and House 2006).

Empirically, I found in additional analysis presented in Table 7.6 that the characteristics of new homeowners in the analytical sample were very different from those who migrated to the south of the US in older ages: they were more likely to be Black or Hispanic, female or to have divorced, be widowed or never married at the previous wave. Most importantly, studies indicate that 'snowbird migration' is highly correlated with housing wealth and occurs primarily among individuals who already owned a home in their state of origin (Hogan 1987, Hogan and Steinnes 1994).

Second, although I controlled for depressive symptoms score at the previous wave, I cannot completely rule out the possibility of reverse causation. The lagged models, however, are less vulnerable to reverse causality as they show the association between current changes in housing tenure and later changes in depressive symptoms. Third, while the fixed-effects models controlled for a large number of time-varying confounders, unmeasured time-varying confounding remains a potential source of bias. Fourth, I had information on the reason-for-move only for a subset of the analytical sample, which resulted in large standard errors (Gunasekara, Richardson et al. 2014). Finally, attrition is a potential concern in longitudinal studies. However, retention rates are around 85% in HRS and evidence suggests that attrition is not linked to health outcomes (Banks, Muriel et al. 2011). In the sample used in this chapter, 10% of respondents had data missing on the homeownership variable and 14% had data missing on the depressive symptoms score. In sensitivity analyses, I also used Multiple Imputation methods to explore the potential impact of selection associated with missing values. Analyses on the imputed dataset led to essentially the same results (Appendix 7.1).

6.5. Conclusion

The findings of this chapter suggest that accessing homeownership after age 50 reduces depressive symptoms in older age. At baseline, non-homeowners had a range of health and socioeconomic disadvantages compared to homeowners. I found that the well-documented benefits of homeownership for mental health extend to those who acquired a home later in life. These results add to the growing recognition that homeownership may have public health implications for current and future generations of older Americans. Further research is needed to disentangle potential mechanisms. These results suggest that policies that enable disadvantaged older Americans to access homeownership by providing them access to affordable housing may reduce depressive symptoms in older age.

Chapter 7

The effect of co-residing with adult children on depression in later life[16]

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. I this chapter, I used three waves of data (2004 to 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). I implemented an instrumental variable (IV) 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.

Conclusions. Findings presented in this chapter 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.

[16]A version of this chapter is has been published in *Social Science & Medicine* (Courtin & Avendano, 2016).

7.1. Introduction

Since World War II, the number of older people living alone has increased dramatically in most industrialized countries (Glaser, Tomassini et al. 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 and Gutmann 2010). 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 (Kaplan 2012, Kahn, Goldscheider et al. 2013). 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 and 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 (Silverstein, Chen et al. 1996, Hughes and Waite 2002, Lang and Schutze 2002). 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, Dewey 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, Charlson et al. 2013).

This chapter aims to identify the causal impact of living with adult children on the risk of depressive symptoms in older age. I 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 and 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), this chapter 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. The results provide new evidence of the impact of co-residing with adult children on late-life depression.

7.2. Background

Co-residence is often conceived as a channel for the exchange of social, emotional, practical and financial support between parents and children (Glaser, Tomassini et al. 2004, Gierveld, Dykstra et al. 2012). Studies examining the net flow of exchange suggest that parents give on average more support to their children than they receive from them (Ward, Logan et al. 1992, Choi 2003, Grundy 2005, Smits, Van Gaalen et al. 2010). 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' (Furstenberg, Kennedy et al. 2004,

Billari and Liefbroer 2010, Kaplan 2012, Kahn, Goldscheider et al. 2013, Lee and Painter 2013). Likewise, recent evidence shows that becoming unemployed doubles the probability that an adult child moves in with older parents (Wiermers 2014).

This 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 (Zunzunegui, Béland et al. 2001, Roll and Litwin 2010). Nevertheless, studies suggest that co-residing with adult children is associated with higher depressive symptom among older parents in Singapore (Chan, Malhotra et al. 2011), South Korea (Jeon, Jang et al. 2007), China (Chyi and Mao 2012) and Israel (Lowenstein and 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 (Maruyama 2012, Johar and Maruyama 2013) 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 and Engelhardt 2008). For example, Aranda (2015) used propensity score 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.

The objective of this chapter is 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. I 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, this chapter attempts to control for selection into co-residence and omitted variable bias, exploiting one of the leading forces behind recent increases in intergenerational co-residence between parents and children.

7.3. Data

7.3.1. 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 A 2005). Specific details are reported in **Chapter 3** of this thesis. I used data from assessments in 2004, 2006 and 2010.

7.3.2. 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 (Prince 2002). The

score ranges from 0 to 12, with higher scores indicating higher levels of depressive symptoms. Based on validation studies (Castro-Costa, Dewey et al. 2008), I used a threshold of four or more symptoms as indication of clinically significant depressive symptoms.

7.3.3. 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 and 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, or as mean age 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.

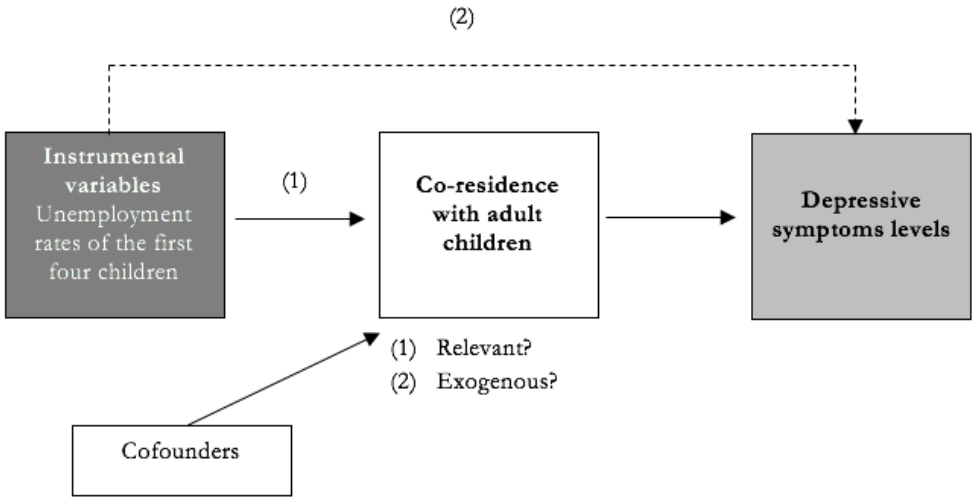
7.4. Empirical approach

7.4.1. Rationale

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, I use an IV estimation approach that attempts to control for both observed as well as unobserved differences between co-residing parents and parents living without their adult children.

To provide valid estimates, an instrument must meet two conditions, summarized in Figure 7.1.

Figure 7.1. Overview of the instrumental variable approach



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 chapter, I use as instrument the country-, year-, age- and gender-specific unemployment rate for adult children. Because the 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, the 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. I 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, I control for child employment status in all analyses. I 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, I started by examining the *F*-Statistic in the first-stage IV regression. I 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. I tested for joint significance of the instruments using the Kleibergen-Paap Wald *F* statistic test (Kleibergen and 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 and Yogo 2005). While the second assumption can never be tested and needs to be theoretically defensible, I use the Hansen-Sargan statistic as over identification 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).

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

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

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

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

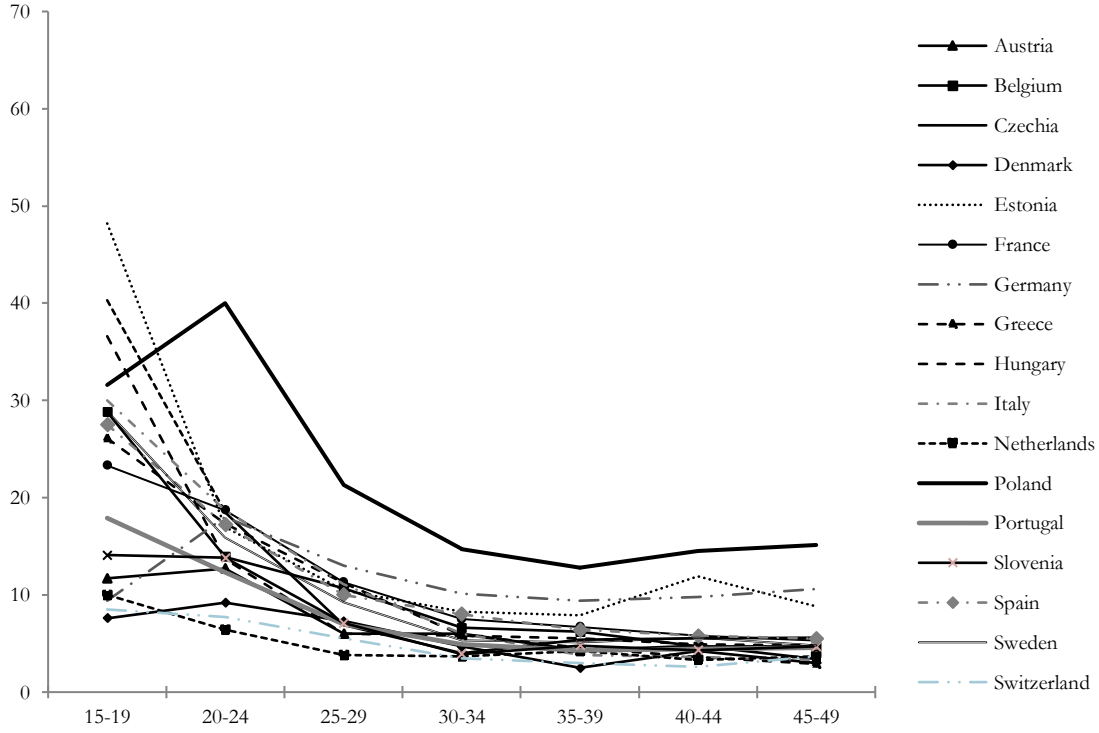
Where *dep* represents a score of depressive symptoms; $\widehat{coresid}$ reflects the predicted values of co-residence from the first stage; and *X, child* and *country* include the same controls as in equation (1), excluding the instrument. The coefficient of co-residence in the second stage captures 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.

7.4.2. Data on unemployment rates

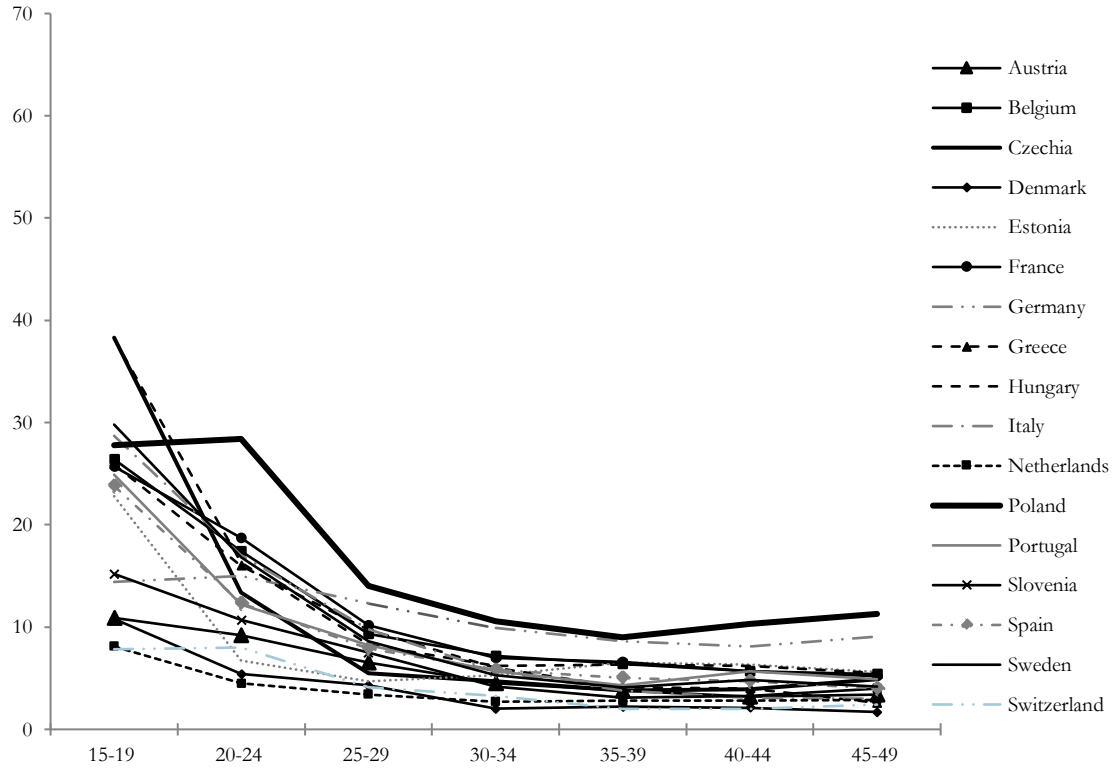
SHARE includes detailed information on up to four children. For each respondent's child corresponding age-group, gender and country, unemployment rates were obtained from the Organisation for Economic Co-operation and Development (OECD) labour force survey statistics data. Five-year age bands were used 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 6.2 provides an overview of the data for males, with unemployment rates presented by age categories for 2004, 2006 and 2010. I 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.

Figure 7.2. Unemployment rates by age categories for males (2004, 2006, 2010)
2004



2006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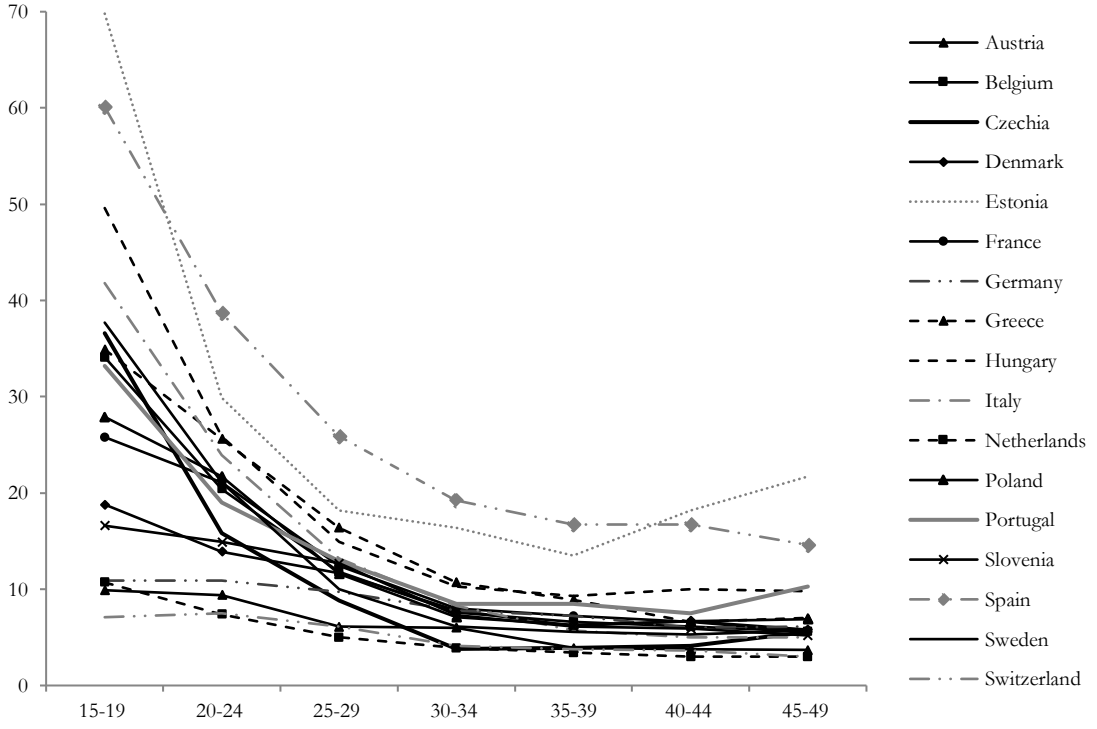
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Greece
Hungary
Italy
Netherlands
Poland
Portugal
Slovenia
Spain
Sweden
Switzerland

I started with a sample of 53,023 parents in SHARE. I included all parents in the analyses but have detailed information for up to four children only (94.38% of the sample). The final sample, therefore, comprised 50,043 respondents.

7.5. Results

7.5.1. Descriptive statistics

Table 6.1 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.

Table 7.1. 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	21,813 (78.60)	30,906 (71.37)	>0.001

partnership: frequency (%)			
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 (47.79)	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 labour 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 labour 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 labour 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.

Figure 7.3 displays the prevalence of co-residence by country and gender. Overall, 39% of the 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.

Figure 7.3. Proportion of co-residents, by country and gender (pooled sample)

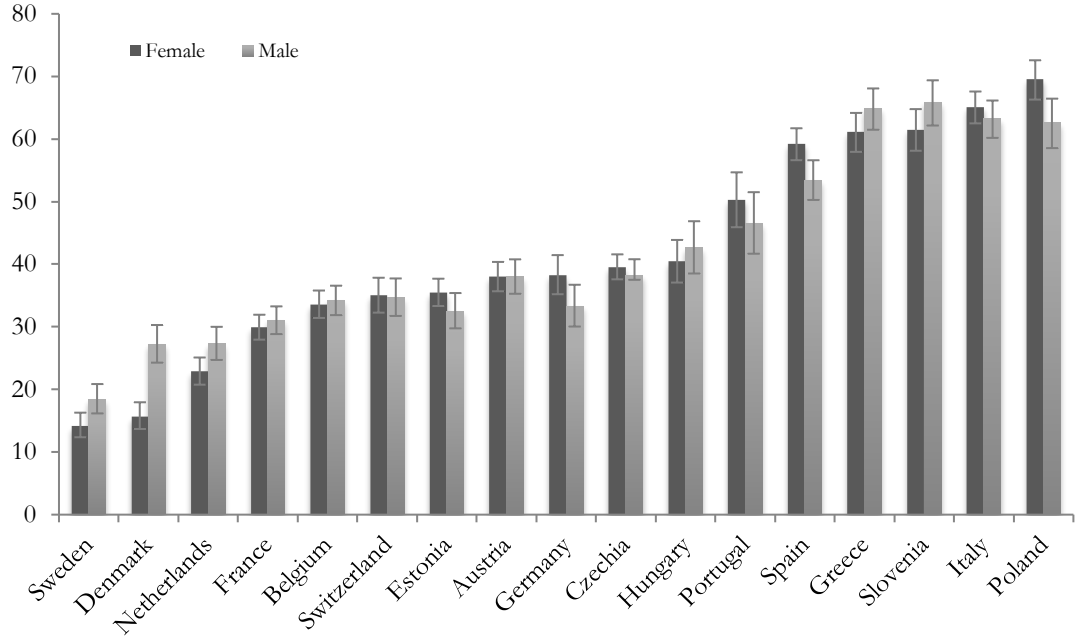


Figure 7.4 presents the proportion of respondents per country who reported 4 or more depressive symptoms on the Euro-D scale. There were large cross-national differences in depression scores. Denmark had the lowest depression scores (1.78) while the highest scores were observed in Poland (3.68). On average, higher levels of depressive symptoms were observed in Eastern and Southern European countries than in Northern/Western European countries.

Figure 7.4. Proportion of respondents reporting four or more depressive symptoms, by country (pooled sample)

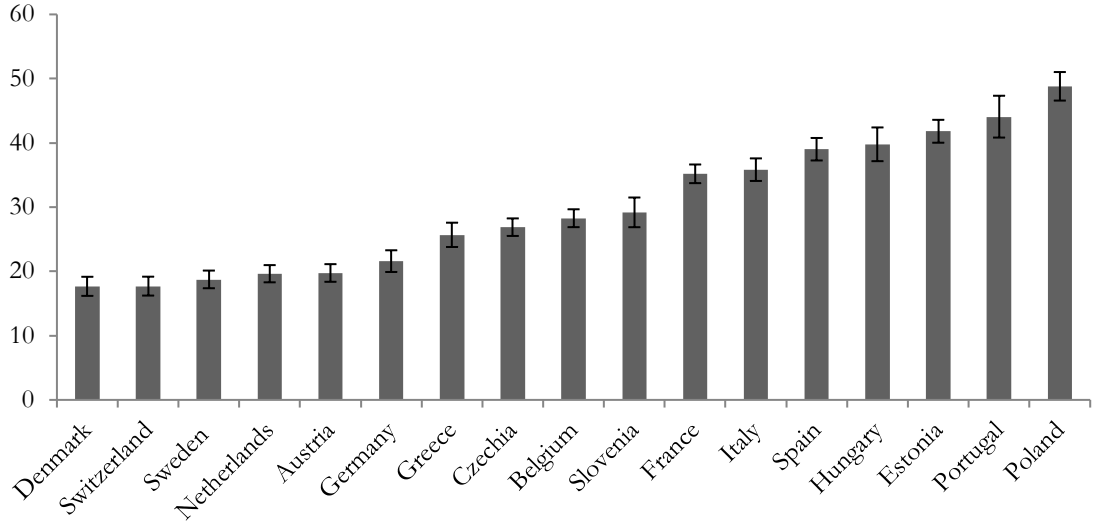
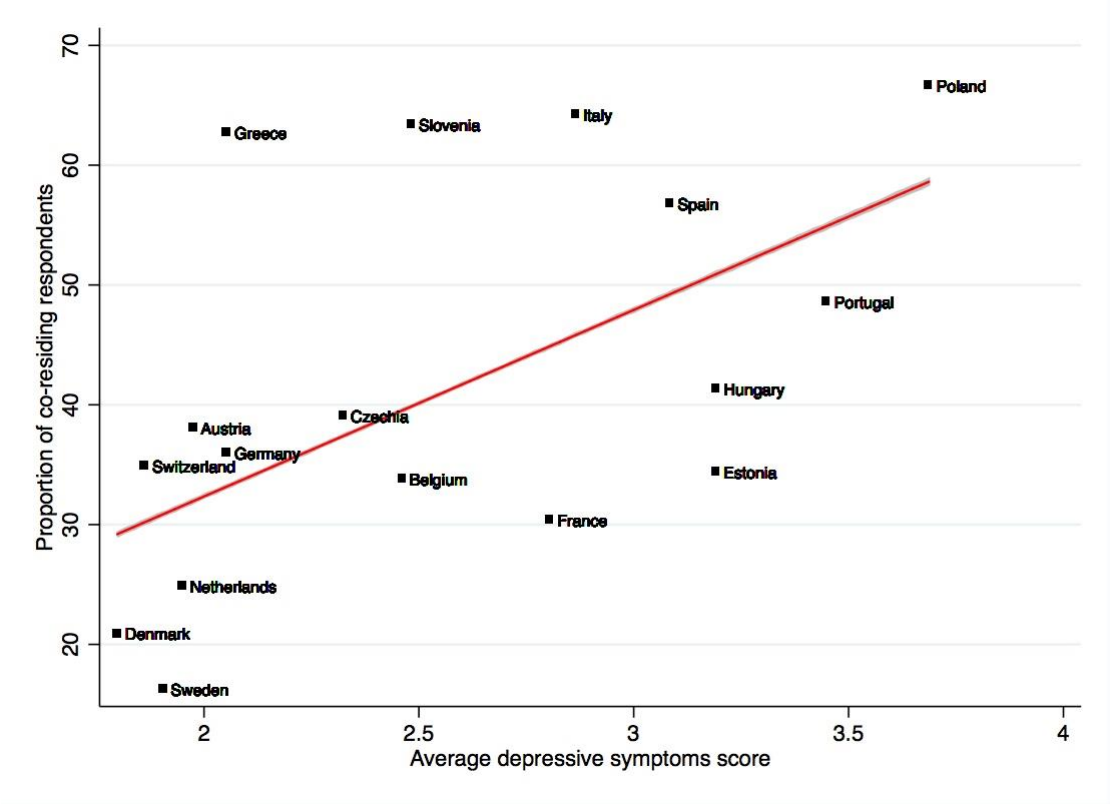


Figure 7.5 shows that there was a positive correlation between the proportion of intergenerational households in each country and the average depression score at the national level (r=0.4846, p<0.01). Northern European countries exhibited low levels of both co-residence and depression in older age, while 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, I attempt to disentangle the causal nature of this relationship using an IV approach.

Figure 7.5. Association between co-residence and average depression scores by countries (pooled sample)



7.5.2. Instrumental variable models

Table 7.2 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 7.1. 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 (β=0.0088, 95% CI 0.0071 to 0.0106; β=0.0042, 95% CI 0.0029 to 0.0056; β=0.0032, 95% CI 0.0015 to 0.0049; β=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.

Table 7.2. 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 7.3 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 over identification restrictions. Since the instruments are identical in nature, assuming that one is valid will consequently likely imply that the second is valid as well.

Results from the 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 Euro-D scale 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 co-residing parents in the sample. No significant differences were found between men and women (last two columns of Table 7.3).

Table 7.3. OLS and IV-2SLS regressions of Euro-D depressive symptoms scores

	OLS			IV		
Variables	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

	(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 labour 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 labour 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 labour 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 labour 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)

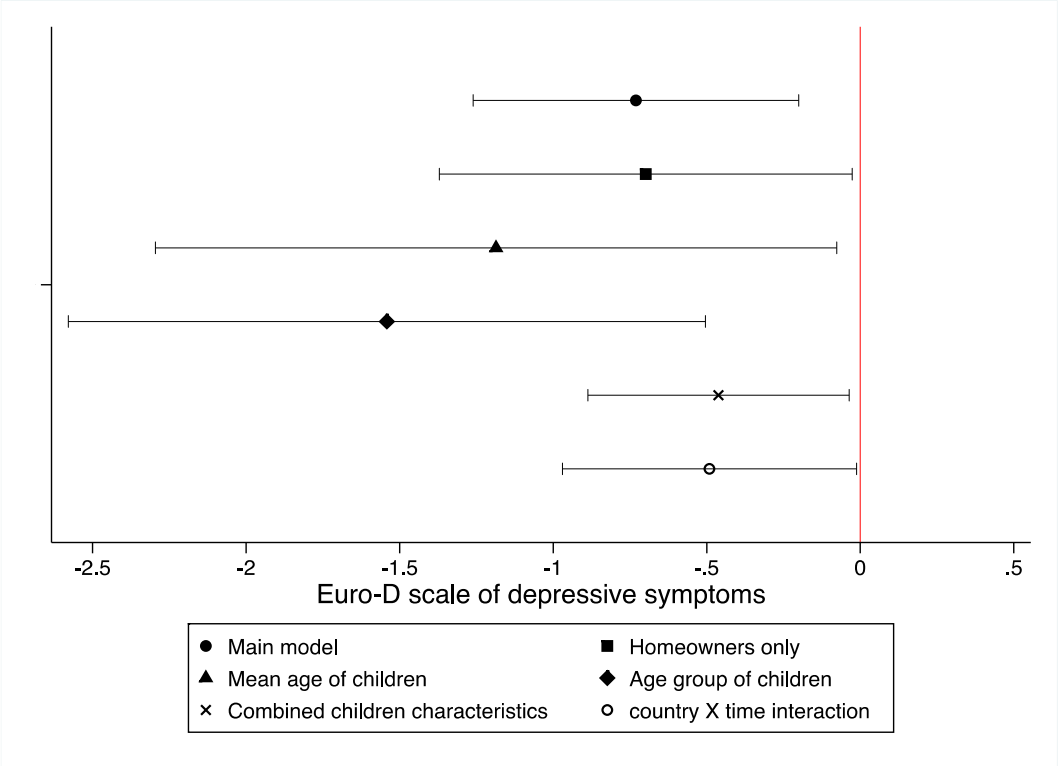
Child 2 is married or in a partnership (ref.)		-	-	-	-	-
Never married or divorced	0.0192	0.00825	0.0555	0.0970*	0.382	-0.287
	(0.0264)	(0.0368)	(0.0366)	(0.0485)	(0.244)	(0.321)
Widowed	0.0481	0.0413	0.152	-0.0576	0.0649	0.132*
	(0.135)	(0.158)	(0.251)	(0.209)	(0.0684)	(0.0588)
Child 3 is married or 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
Test of over identification	-	-	-	5.109 (p=0.1640)	2.763 (p=0.4296)	2.221 (p=0.5279)

Notes: Robust standard errors in parenthesis, with clustering at the instruments level for the 2SLS models. *** $p<0.001$; ** $p<0.01$; * $p<0.05$.

7.5.3. Robustness checks

A series of supplementary analyses were carried out to examine the robustness of the results. The co-residence estimates for these additional models are presented in Figure 7.6.

Figure 7.6. Overview of the effect of intergenerational co-residence on depressive symptoms levels by specification



Notes:
Main model - main specification, with covariates as in Table 7.3.
Homeowners only - includes all covariates from the main model but focuses on a sub-sample of homeowners
Mean age of children - main specification, plus mean age across up to four children
Age group of children - main specification, plus three age categories for each child to the main model
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

Because it is impossible from the data to identify residential changes among children over time, I 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, I

implemented models restricting the sample to older parents who were homeowner-occupiers. The 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 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 7.2.

I also examined whether the results were robust to incorporating information on the age of children. Results from OLS and IV models that included age of each child either in three categories for each child or as mean age across all children are summarized in Figure 6.6 and full results are presented in Appendix 7.3 and 7.4 respectively. 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 the original specification. I 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 the main specification (Appendix 7.5).

Finally, models were robust to incorporating time*country or gender*children's mean age interactions (full results in Appendix 7.6 and 7.7 respectively).

7.6. Discussion

7.6.1. Overview of the results

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. This chapter 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. I 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, I 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 the 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.

These 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 (Maruyama 2012, Johar and Maruyama 2014). 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 and Malhotra 2012, Maruyama 2012, Johar and Maruyama 2014). These instruments appeared less relevant in a European sample. Most importantly, I expected the

number and gender of the children to have direct effects on parent's mental health beyond those via co-residence, and I therefore decided not to use these instruments in the 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 and 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 my 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, the results presented in this chapter 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. I 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 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 (Zunzunegui, Béland et al. 2001, Glaser, Tomassini et al. 2004, Roll and Litwin 2010). Findings from this chapter 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 (Silverstein, Chen et al. 1996, Hughes and Waite 2002, Lang and Schutze 2002). 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. The 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 (Levy, Slade et al. 2002, Byers, Levy et al. 2008).

7.6.2. Study limitations

When interpreting these 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, I 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 the sample was too small to allow country-specific analyses, and I was only able to examine differences across broad geographical regions. I 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 7.8, I 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, I rely on the assumption that the instruments are exogenous, but I 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 I have no direct way to assess this, in sensitivity analyses, I found that children's unemployment rates were not directly associated with parental depression (Table 7.4**.** below).

Table 7.4. Children's unemployment rates and depressive symptoms score

Variables	
Unemployment rate of child 1	0.00294 (0.0143)
Unemployment rate of child 2	0.0214 (0.0145)
Unemployment rate of child 3	0.00207 (0.0111)
Unemployment rate of child 4	0.00356 (0.00882)

Notes: The model includes the same controls as in the main specification. Robust standard errors in parentheses; *** $p<0.001$, ** $p<0.01$, * $p<0.05$

In addition, by conditioning the models on children's employment and marital status I 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. I note also that if I was picking up the 'direct' effect of child unemployment rates, it is likely that the estimates would be in the opposition direction: higher unemployment rates would increase parental depression. Thus, while I acknowledge that an IV approach relies on strong

assumptions, the 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 these findings is the fact that the 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. The 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 and Angrist 1994).

7.7. 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. Findings from this chapter 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,

these results are in line with evidence suggesting that isolated older households are at higher risk of poor physical and mental health (Courtin and Knapp 2015). The chapter 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, particularly in the context of high youth unemployment rates.

Chapter 8

Discussion

The overarching objective of this thesis was to understand the effects of changes in living arrangements on depressive symptoms in old age. The four empirical chapters aimed to answer research questions relating to intergenerational co-residence and homeownership attainment and their relation to depressive symptoms in later life. This final chapter brings together the key findings of this thesis as a whole. It is organized as follows. First, I summarize the main objectives and findings of each chapter. In addition to synthetizing the main findings, their implications for research and policy are discussed in sections 8.2 and 8.3. While the specific limitations of each empirical chapter were discussed in the corresponding sections of Chapters 4-7, overarching limitations of this thesis are described in section 8.4. Finally, potential directions for future research are presented.

8.1. Summary of objectives and findings

This section provides an overview of the main objectives and findings of this thesis. The central aim of this thesis as set out was to examine whether changes in the way older people live have an impact on their mental health in later life. I focused in particular on two types of living arrangements: intergenerational co-residence and housing tenure.

The main research question as described in Chapter 1 was:

What is the effect of changing living arrangements on depressive symptoms in later life in Europe and the US?

The starting point to develop the contributions of this thesis was a review of the existing literature on living arrangements and mental health in Chapter 2. The review of the available evidence outlined three ways in which our understanding of the effect of living arrangements on mental health could be developed: assessing the comparability of the depressive symptoms scales, investigating whether intergenerational co-residence had a causal effect on mental health in later life, and finally whether the timing of homeownership access mattered for mental health in old age. As noted in the literature review chapter, a key challenge in the examination of the relationship between living arrangements and depressive symptoms is to account for selection and reverse causality. The objective of the methods chapter (Chapter 3) was to present the two datasets used in this thesis (SHARE and HRS) and to introduce the different approaches I implemented in the thesis to deal with these issues. Building on the literature review and methods chapters, the rest of the thesis comprised four empirical chapters, corresponding to the sub-research questions outlined below.

The first gap identified in the literature was methodological: the comparability of the most commonly used measures of depressive symptoms in ageing studies was unclear. The comparability of measures of functional limitations across ageing studies, for example, has been investigated (Chan, Kasper et al. 2012), but no equivalent assessment has been conducted for mental health measures. This first gap in the literature guided the first sub-research question of this thesis:

Are the Euro-D and CES-D scales of depressive symptoms comparable?

This first sub-research question was answered in Chapter 4. This chapter made a methodological contribution to the literature on depression in old age by examining the comparability of the two depressive symptoms scales used in this thesis, the CES-D and the Euro-D scales. The empirical approach was based on data from the second wave of SHARE, when the two scales were administered to the same respondents. While the two scales were correlated, there were systematic discrepancies in scores by demographic and socioeconomic characteristics, and the level of agreement between the two scales was moderate. Associations with established risk factors for depression were in the same direction but stronger for CES-D than Euro-D. The findings from this chapter highlight the need for researchers to be cautious when comparing depressive symptom levels and associations with risk factors between surveys using different measures of depressive symptoms.

The second gap identified in the literature concerned the effect of homeownership on mental health. A large body of literature detailed in Chapter 2 has documented an association between homeownership (as opposed to renting) and a range of health outcomes. A common caveat of existing studies, however, is a lack of understanding of the causal nature of this relationship. In particular, it is not possible to establish from existing studies whether this association results from selection into homeownership or whether owning a home may indeed lead to better long-term mental health. The second research question of the thesis was about the timing of access to homeownership and its potential impact on later life mental health. Previous studies looking at the effect of homeownership on health have focused primarily on contemporaneous associations, and no study to date has examined the

long-run effect of homeownership, or how access to homeownership in early adulthood relates to mental health in older ages. The second research question was as follows:

Is there a mental health advantage in later life conferred to those who accessed the housing ladder by the age of 35?

This research question guided Chapter 5, which investigated whether early access to homeownership and subsequent residential stability were associated with mental health in old age among Americans. Using HRS, I found that owning a home by the age of 35 and remaining in the same home were associated with significantly fewer depressive symptoms. It was also associated with a slower age-related decline in depressive symptoms between the ages of 61 and 75. The findings were confirmed in propensity score matching models that controlled for selection into homeownership. In addition, I looked at which mechanisms could explain these associations. I showed that financial security (in the form of earlier mortgage repayments and higher savings) might be among the mechanisms involved. Notwithstanding the important limitations with the data used for this chapter (and in particular the definition of the exposure), these results show that early homeownership and residential stability yielded long-term mental health benefits.

Historical evidence also shows that accessing homeownership has been delayed for recent generations. An important question is whether acquiring a home in later life may still lead to improvements in mental health similar to those observed for younger buyers. The third sub-research question focused on an event that is currently relatively rare but likely to become more frequent: acquiring a home in later life and its effect on mental health. The third sub-research question was therefore:

Is acquiring a home in later life associated with lower levels of depressive symptoms?

In Chapter 6, I used HRS and individual fixed-effects models to investigate whether changes in housing tenure (from renting to owning) after the age of 50 was associated with changes in depressive symptoms. I found that becoming homeowner predicted a significant decline in depressive symptoms in the same year and for up to two years before fading away. So-called 'pull factors' (e.g. moving to a better neighbourhood or improved access to services) drove this positive effect on mental health among new homeowners. Other potential drivers, such as the desire to be closer to friends and family, downsizing or upsizing did not predict depressive symptom levels.

The third limitation identified in the literature was also substantive: although changes in intergenerational co-residence in Europe and the US have been widely documented in the literature, their impact on the depressive symptom levels of older parents is unclear. As described in Chapter 2, a vast literature has looked at the effect of intergenerational co-residence on physical and mental health, with mixed results. These inconsistencies across studies are likely to be linked to different data, countries and population groups. Crucially, most studies have implemented research designs that did not account for reverse causality: co-residence might affect as well as be affected by depressive symptoms. The fourth sub-research of the thesis consequently was:

Do older parents who co-reside with their adult children have fewer depressive symptoms?

Chapter 7 evaluated the effect of co-residing with adult children on depressive symptoms in later life in several European countries which are part of SHARE. The main contribution of this paper was to use an IV approach to identify the causal effect of intergenerational co-residence on mental health. The approach exploited changes in employment opportunities of adult children during the economic crisis which started in 2008. Results from these models

indicate that co-residence was associated with lower levels of depressive symptoms and that these results were robust to the inclusion of additional controls for child characteristics, country-specific time trends and restriction of the sample to homeowners.

Table 8.1 below gives a detailed overview of the key findings of the three empirical chapters which focused on living arrangements. Taken together, these findings point to the importance of living arrangements as a life course determinant of depression in old age. Intergenerational co-residence and homeownership – either accessed before 35 or after 50 – appear as important mental health resources in old age.

Table 8.1. Summary of the findings related to living arrangements

Chapter 5 – Early access to homeownership, residential stability and mental health of older Americans
▪ Early and stable homeowners differed significantly from late homeowners or non-homeowners at baseline: they were less likely to be depressed, to report poor physical health or to be widowed/divorced ▪ In linear models, those who accessed homeownership by the age of 35 and remained in the same home had lower levels of depressive symptoms in old age ▪ In logistic models, early access to homeownership was not associated with the likelihood to report elevated depressive symptoms ▪ In individual fixed-effects models, early access to homeownership and subsequent residential stability were associated with a slower progression of depressive symptoms at the ages 61-75. ▪ Potential mechanisms involve a lower mortgage, and an increase in financial wealth and in total wealth. ▪ The results were confirmed in a PSM model. Sensitivity analyses indicated that these models are robust to different age cut-offs, the inclusion of age and age squared and the introduction of an interaction term between survey year and year of birth.
Chapter 6 – The mental health benefits of acquiring a home in later life: a fixed-effects analysis among older Americans
▪ At baseline, the vast majority of respondents were already homeowners. Those who were renters differed from those who were homeowners alongside a number of dimensions: they had higher levels of depressive symptoms, they were in poorer physical health, were more likely to be female, Black or Hispanic and to have a level of education lower than high school. ▪ In a random-effects model looking at the determinants of accessing homeownership after the age of 50, being a female, Black or Hispanic and having divorced/being widowed/never married at the previous wave were the key predictors. ▪ In fixed-effects models, acquiring a home after 50 predicted a significant decline in

depressive symptoms in the same year and for up to two years before fading away.
- Moves associated with 'pull factors' were driving this effect, while moves motivated by the desire to be closer to family and friends or by downsizing were not associated with depression.
- These results were robust to multiple imputation for missing data.

Chapter 7 – The effect of co-residing with adult children on depression in later life

- Northern European countries had low levels of both co-residence and depressive symptoms in old age compared to Eastern and Southern European countries.
- Respondents who were co-residing differed from those who were not along several important dimensions: they had higher levels of depressive symptoms, reported less chronic diseases and were younger.
- In linear models, co-residing was not associated with depressive symptoms levels.
- In IV models accounting for reverse causality, intergenerational co-residence was associated with a significant reduction in depressive symptoms.
- The results of the IV models were robust to the inclusion of additional controls for children characteristics, country-specific time trends and analyses restricted to homeowners only.

8.2 Contributions to the literature

The findings presented in this thesis make both substantive and methodological contributions to the literature on living arrangements and mental health in later life that have implications for future research in the area.

8.2.1. Substantive contributions

First, the findings demonstrate the importance of living arrangements and changes in those arrangements as social determinants of mental health, alongside established factors such as education, income or neighbourhood characteristics. In Chapter 7, intergenerational co-residence was associated with a significant reduction in depressive symptoms among older parents. That effect was larger than the effect of having a tertiary degree, being widowed, or having a limitation with ADL, all of which are well-established predictors of depression in later life. These findings indicate that the immediate social environment of older adults is

crucial for their mental health. In addition to better researched factors such as marital status or neighbourhoods, intergenerational co-residence might constitute a health advantage in later life and should be considered in research looking at the risk factors for depression in later life.

Similarly, homeownership has often been considered in the literature as a proxy for socioeconomic status alongside income, education and employment, but its direct mental health effects have been less frequently researched. Results from Chapter 5 also showed that the timing of homeownership access matters: early homeownership *per se*, net of the effect of traditional socioeconomic status indicators such as education, income and wealth, was associated with better long-term mental health outcomes. The findings presented in Chapter 6 indicated that homeownership may be an important measure of changing socioeconomic circumstances in later life, at an age when occupation or income might be less adequate measures of socioeconomic status (Demakakos, Biddulph et al. 2016), and it should be included in studies looking at the socio-economic determinants of mental health in later life.

Finally, a vast literature has documented the detrimental effects of the economic crisis which unfolded between 2008 and 2012 on population health (Stuckler, Basu et al. 2009, Kentikelenis, Karanikolos et al. 2011, Karanikolos, Mladovsky et al. 2013). An interesting finding that emerged from the study design adapted in Chapter 7 is that there might be a silver lining to this story. Indeed, I find that older parents who co-resided with their adult children as a result of the crisis in Europe reported lower levels of depressive symptoms. Although it is clear from the literature that the recession impacted the health of the working-age population, there might be a positive collateral effect on the mental health of older generations, which were less directly affected by the crisis. The ability to adjust one's living

arrangement to weather the effects of poor macroeconomic conditions appears as an important health resource in later life, and this deserves further investigation.

8.2.2. Methodological contributions

The findings presented in this thesis also have methodological implications for research.

First, Chapter 4 on the comparability of the scales indicated that, in spite of high levels of correlation between the Euro-D and CES-D scales, caution in the interpretation of associations with risk factors was required. The results highlighted some differences in associations between CES-D and Euro-D with established risk factors for depression, suggesting that differences in these associations as reported in previous comparative studies might be due to some extent to the use of different scales. Further investigation of the magnitude of these differences between scales indicated that the differences were small, with the exception of gender and marital status. Together, these results suggest that while the relationship between risk factors and depressive symptoms sometimes differs between the two scales, conclusions on the clinical significance of the effects are often very similar. Researchers might consider a number of possibilities to address these differences in future research as suggested in Chapter 4: focusing on identical items across the two scales (depression, sleep, energy to do things); including a more comprehensive set of measures of wellbeing in later life such as the 12-item or 19-item version of the CASP scale of wellbeing (Control, Autonomy, Self-Realisation and Pleasure); rescaling the Euro-D items to reflect the levels of depressive symptoms as measured by the CES-D scale as a robustness check.

Second, Chapters 5 to 7 showed the importance of implementing quasi-experimental approaches in observational studies of the impact of social determinants on mental health. The methods implemented have been designed to address the two issues identified in the

literature review chapter: (1) selection, where measured and unmeasured individual characteristics are associated with both the exposure and the outcome; (2) reverse causality, where in my example co-residence might be associated with depressive symptoms, but higher levels of depression might also be associated with a higher likelihood of co-residence. This type of approach is becoming increasing popular in social epidemiology and could be usefully extended to other types of living arrangements not covered in this thesis. For example, there is considerable on-going research on the mental health effects of loneliness and social isolation in later life (e.g. Adams, Sanders et al. 2004, Luanaig and Lawlor 2008, Russell and Taylor 2009). This research is likely also to suffer from selection and reverse causality, biasing the estimates of the association between loneliness and depression. A possible way forward suggested on the basis of the findings of this thesis would be to implement an IV approach similar to the one used in Chapter 7. A number of studies have for example used a measure of social cohesion at the aggregated neighbourhood level as instruments to estimate the causal effect of social isolation on health (DHombres, Rocco et al. 2010, Fiorillo and Sabatini 2015). This approach could be extended to loneliness in later life.

8.3. Implications for policy

The research presented in this thesis also has implications for policy debates on intergenerational housing and access to homeownership. It is worth noting first that Chapter 5 and 6 focused exclusively on the US case and that Chapter 7 included only a selection of European countries, not all countries in Europe.[17] Bearing in mind the differing contexts and

[17] Countries included in the analyses are the following: Austria, Belgium, Czechia, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, the Netherlands, Poland, Portugal, Slovenia and Spain.

policies in different countries, the findings presented in the thesis have two main implications for policy, detailed below.

8.3.1. Promotion of intergenerational housing

Findings from Chapter 7 on intergenerational co-residence suggest that, in the context of high youth unemployment rates, policies encouraging intergenerational support and exchanges, potentially in the form of co-residence, may have mental health benefits for older Europeans. These results echo the renewed attention from national and local policy-makers in many countries to intergenerational programmes and interventions that may counteract the negative perceptions of ageing and foster solidarity between generations (Flanders Cushing and van Vliet 2016). Housing is a key component of intergenerational communities as described in the 2007 WHO Global Age-friendly Cities programme (World Health Organisation 2007, Biggs and Carr 2015). Older people in the US, UK and continental Europe have consistently shown a preference for 'ageing in place' for as long as possible (Kennedy 2010) and a number of innovative housing models could contribute to combine this desire to stay in one's home with intergenerational support. Various forms of shared housing are developing in the US and in Europe. In Spain for example, The City Council of Barcelona and its partners have piloted a co-housing scheme for students to be housed in the homes of older people. The programme started in 1996 and is now operating across the country in 27 cities (Flanders Cushing and van Vliet 2016). A home share initiative similar to the Spanish experience has been developed in the UK and Ireland[18]. These initiatives are developed on the premise of potential advantages for all generations: it would reduce

[18] http://homeshare.org/programmes-worldwide/united-kingdom/ [last accessed 23/06/2017]

loneliness and isolation among adults, facilitate care taking between generations and reduce housing costs (Flanders Cushing and van Vliet 2016).

Although I did not present evidence on the UK as part of this thesis, it is a potentially interesting case for intergenerational living. Indeed, the UK has one of the lowest rates of intergenerational co-residence in Europe, with only 15% of older adults currently co-residing with their adult children (Government Office for Science 2016). Reported barriers to intergenerational co-residence include the absence of adequate housing options and financial concerns (cost of home adaptation and inheritance tax on co-owned properties) (Government Office for Science 2016). The evidence gathered as part of Chapter 6 indicates that removing existing barriers to intergenerational living might have the potential to reduce the burden of depressive symptoms in old age.

8.3.2. Public health implications of homeownership

Results presented in Chapters 5 and 6 add to the growing recognition that homeownership may have public health implications for both current and future generations of older Americans. Findings from Chapter 6 suggest that policies enabling marginal older buyers (e.g. from ethnic minorities, poorer background or women) to access homeownership and encouraging affordable and accessible housing may reduce depressive symptoms levels among older people. Those who accessed homeownership after 50 have a specific demographic and socioeconomic profile: they are more likely to be female, Black or Hispanic and have lower economic resources. Households headed by women and minorities have persistently lower rates of homeownership in the US (Masnick and Di 2001). As their share of the older US population grows, this disparity in homeownership rates implies that more and more older adults will be faced with difficult housing conditions, and will have less

wealth to tap into to meet their needs as they age – with potential consequences for their mental health. An associated issue is that of affordability: homeownership often occurs at the expense of major indebtedness, which may be difficult to maintain for disadvantaged households (Alley, Lloyd et al. 2011, McLaughlin, Nandi et al. 2012, Charters, Harper et al. 2016). For those unable to secure mortgage payments, this may result in the loss of a dwelling, major financial losses, substantial insecurity and the onset of mental health problems (Nettleton and Burrows 1998, Nettleton and Burrows 2000, Smith, Searle et al. 2009, Alley, Lloyd et al. 2011, McLaughlin, Nandi et al. 2012, Charters, Harper et al. 2016). Specific educational and behavioural programmes such as financial counselling may benefit older people to address complex financial situations and be economically secure in later life (Zurlo, Yoon et al. 2014). Chapter 6 also showed that the positive association between homeownership attainment and depression is driven by factors related to accessibility, services and the desirability of the neighbourhood. Proximity to stores, services and adequate transportation allows older homeowners to remain active and socially engaged in their neighbourhoods. This finding echoes the renewed interest from policy makers for the importance of the wider neighbourhood (as opposed to a home in isolation) in healthy ageing: the neighbourhood provides older people with opportunities for social engagement, physical activity and adequate access to care which are crucial for health (Government Office for Science 2016). It also suggests that urban regeneration policies may result in lower levels of depressive symptoms.

Findings from Chapter 5 showed that early access to homeownership enabled respondents to accumulate wealth over the life course. The collapse of the housing bubble has led to a reduction of their housing wealth, so that older Americans relying on their homes to support post-retirement consumption may experience substantial difficulties (Connolly, O'Reilly et al.

2010, Hamoudi and Dowd 2013, Hamoudi and Dowd 2013). Despite this recent financial collapse, these results suggest that having owned a home since early in life can work as a buffer against these shocks and has contributed to homeowners' lower levels of depression. These results suggest that social policies affecting young adults can have long-lasting consequences for their mental health in older age (Avendano, Berkman et al. 2015). At the same time as the baby boomers are transitioning into retirement, another large cohort, the Millennials (born between 1982 and 2004), is passing through the traditional milestones of adulthood, including first-time homeownership. However, these households were in the prime years of first-time home-buying at the time of the 2008 economic crisis and the homeownership rates among households aged 25-34 have decreased by more than nine percentage points since 2004 (Joint Center for Housing Studies 2015). This cohort decline in homeownership rates affecting younger generations may be expected to have important implications for their mental health as they reach older age. Although the evidence presented in Chapters 5 and 6 focuses on the US case, other countries with high but changing homeownership rates will face similar challenges. In the UK for example, recent data have shown wide variations between cohorts but also by regions in homeownership rates (Government Office for Science 2016). Younger households experience considerably more difficulties to access the housing ladder (Belfield, Cribb et al. 2014). The lower rate of homeownership among younger generations has implications for policies such as long-term care which might rely on housing wealth for funding (Government Office for Science 2016). The findings presented in Chapters 5 and 6 indicate that these falling rates will also have implications for population mental health. Policies targeted at supporting young households in acquiring their homes such as the diversification of the type of new buildings or of the range of ownership models (e.g. co-housing or shared ownership) have the potential to

boost homeownership rates among younger generations and may yield important benefits. While it may be costly to borrow for young homebuyers, an evaluation should take into account the savings that will be made in terms of depression prevalence down the line.

8.4 Limitations

As discussed throughout this thesis, there are a number of limitations to consider when interpreting the findings. Specific limitations have been detailed in the four empirical chapters. This section discusses three types of limitations that apply more generally: limitations of the data used, of the methods implemented and of the angle chosen to frame this thesis.

8.4.1. Limitations of the datasets used

The first set of limitations is related to the datasets used. As explained in Chapter 3, practical and theoretical considerations influenced the choice of datasets used to address each research question. Chapter 4 on the comparability of the Euro-D and CES-D scales of depressive symptoms had to be conducted using the second wave of the SHARE dataset as it was, to the best of my knowledge, the only dataset which administered to the same respondents both the Euro-D and the CES-D scale. Chapter 5 and 6 investigated respectively the effect of early and late homeownership on depressive symptoms in later life. As homeownership rates vary considerably across Europe for cultural and economic reasons (Angelini, Laferrère et al. 2013), I focused these two chapters on the US case. The long follow-up of HRS also meant that more respondents were likely to have transitioned from renting to owning, which is the core identification strategy of Chapter 6. A key limitation of HRS for these analyses is that the dataset did not collect life histories data, including

information on residential histories. Having information on previous residences of the respondents and their tenure over time would have helped considerably with the identification strategy of Chapter 5. Indeed, as I only had information on the *current* residence of the respondents, it was difficult to disentangle whether the effect on depressive symptoms was due to having accessed homeownership early in the life course or because of residential stability. Two options were considered to overcome this issue. First, HRS collected life histories data between December 2015 and June 2016. The 2015 Life History Mail Survey (LHMS) will contain variables about residential history that might help identify better respondents who accessed homeownership early in their life course. However, while the questionnaires were mailed to 11,256 eligible HRS respondents, only 6,481 responded and returned the questionnaire. As the data was not available at the date of submission of this thesis, it is unclear whether its quality and sample size would be sufficient to substantially improve the results presented in Chapter 5. A second option considered was to focus on another dataset, which contained residential histories and focused on a country with high homeownership rates. The English Longitudinal Study of Ageing (ELSA) was potentially a good candidate for that strategy. However, the sample size proved too small to run fixed-effects models which exploit changes in tenure status over time. Indeed, the vast majority of respondents were homeowners at baseline (82.70% *vs.* 17.30% renters). Across the seven waves of available data, 3,233 respondents have moved residence, which corresponds to 5% of the sample. Among those, only 242 (7.28% of all moves) changed from renting to owning.

Another data limitation of the two chapters which used HRS is that I did not have access to the HRS geo-restricted data (access limited to institutions based in the US). Consequently, in

Chapter 6, I could not disentangle the effect of acquiring a home in later life from moving for example to a sunnier state or a better neighbourhood.

Finally, my investigation of the effect of intergenerational co-residence on depressive symptoms of older parents in Chapter 7 uses European data from SHARE. This dataset was chosen because I exploited variations in youth unemployment as an instrumental variable to try to establish a causal link between co-residence and depression. The sample size per country or group of countries was too small to look into cross-national differences in this relationship. Previous research on the topic had distinguished between protestant (Sweden, Denmark, Germany, the Netherlands, and Switzerland) and catholic Europe (France, Belgium, Austria, Italy and Spain) (Aranda 2015). I thought that this categorization was blurring other differences across countries which were likely to be relevant to the relationship between co-residence and depression. I could not investigate further whether the effect of intergenerational co-residence on depression varied per sub-groups of European countries. The sample size needed for IV approaches also meant that I did not have enough power for sub-group analyses. More detailed sub-group analyses should be the focus of future research with larger sample size.

8.4.2. Limitations of the methods used

Another set of limitations relates to the methods used in this thesis. As noted in the literature review and methods chapters, a key limitation of the existing literature was that selection or reverse causality effects were not sufficiently taken into account. A primary aim of this thesis was to implement statistical approaches designed to deal with these issues. Of course, these approaches are not without their own limitations and I discuss here the main caveats to have in mind when interpreting the results from Chapters 5, 6 and 7.

The first approach implemented in Chapters 5 and 6 is a fixed-effects model. In Chapter 6, I looked at whether changes in tenure status were associated with changes in depressive symptoms levels, net of observed and unobserved time-constant characteristics. In Chapter 5, the exposure (being a homeowner by the age of 35 and not having moved subsequently) did not change overtime. I interacted the exposure with the age of the respondents in the individual fixed-effects models. The estimates assessed whether individual age trajectories of depressive symptoms differ between early, late and never homeowners. By focusing on these within-individual changes, fixed-effects models are a very effective way to control for time-invariant measured and unmeasured confounding because each individual acts as his/her own control (Gunasekara, Richardson et al. 2014). However, a number of limitations have to be considered. First, fixed-effects models exploit transitions in the exposure. They consequently need a large number of respondents to change their exposure status (from renting to owning for example). This can lead to a lack of precision when sample sizes are small (e.g. when I explored effects by reasons-for-move categories). It also means that these models are not useful for understanding the exposure-outcome association among respondents who do not change their exposure (e.g. continued renting) or for whom I have only one data point. In addition, it is not possible to obtain estimates for time-invariant characteristics such as gender or ethnicity, which would have been particularly relevant for Chapter 6. It is however possible to introduce an interaction term between the time-varying exposure (becoming homeowner) and the time-invariant variable of interest (e.g. ethnicity). I experimented with this interaction but the sample size was too small to yield meaningful results. Finally, although I controlled for a range of time-varying confounders in all models, unmeasured confounding remains a potential issue in all fixed-effects designs (Gunasekara, Richardson et al. 2014).

In Chapter 5, I also used propensity score matching to confirm the main findings. This method tries to mimic an experimental study design by comparing outcomes between groups matched on the probability of being assigned to the exposure of interest, early access to homeownership for that chapter. This approach has been heavily criticized and I decided to include it only to compare to the main results. Two main criticisms of the method are particularly relevant for this thesis. First, PSM only matches individuals on characteristics measured in the dataset and does not account for 'hidden bias', that is unobserved characteristics (Oakes and Johnson 2006). Second, the method is limited to binary exposures (early homeowner vs. late homeowner in the chapter) (Oakes and Johnson 2006). I consequently could not include the third category used in the main models, which is non-homeowner.

Finally, an instrumental variable approach was implemented in Chapter 7 to examine the causal association between intergenerational co-residence and depressive symptoms in old age. I used as instrument the country-, year-, age- and gender-specific unemployment rate for adult children.

This approach assumes that, conditional on children's characteristics, variation in young people's unemployment rates are exogenous to the mental health of older parents, most of whom are retired. I hoped 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. As already mentioned in Chapter 3 on methods, finding a good instrument is challenging. Analyses presented in Chapter 7 showed that the instrument fulfilled the two conditions for validity: relevance (predictor of intergenerational co-residence in the first stage) and exogeneity (not directly related to depressive symptoms). However, an important

limitation of the IV approach per se needs to be considered: the effect measured is a Local Average Treatment Effect (LATE). Indeed, the method produces an estimate of the effect on depressive symptoms only for those respondents whose status has changed because of instrument (youth unemployment rates). The approach does not estimate the effect of co-residence on health among those who did not change their living arrangements because of the economic downturn or would have changed them anyway, irrespective of the crisis. A related criticism is that it is impossible to identify that particular subpopulation in which we find a causal estimate: we have no way of identifying who exactly are those respondents who became co-resident because of changes in youth unemployment rates (Glymour 2006).

8.4.3. Limitations of the focus of the thesis

The third and final set of limitations is about the focus of the thesis. First, not all types of living arrangements were considered in this work. I chose to focus on co-residence and homeownership and purposely left aside important aspects of living arrangement for health in old age such as social isolation and loneliness. Increases in the number of older people living have been documented in Western countries and are often associated with loneliness and isolation (Victor, Scambler et al. 2000), which in turn are key risk factors for poor health in later life (Courtin and Knapp 2015).

Second, my initial intention was to compare the effect of living arrangements across HRS and SHARE, building on the assessment of the comparability of the scales conducted in Chapter 4. However, it proved difficult to compare the effect of homeownership on mental health across the US and European countries as homeownership rates and cultural expectations across countries varied considerably (Angelini, Laferrère et al. 2013). The identification strategy chosen for Chapter 7 on intergenerational co-residence implied that

the focus had to be on European countries, where I had an identical measure of living arrangements and comparable unemployment rates indicators at the national level. But I hope that future research on the drivers of depression in later life across the different ageing studies can take advantage of the methodological work conducted as part of Chapter 4.

A life course approach informed the overall design of this thesis, and in particular Chapter 5. However, due to data limitations in HRS, I could not fully exploit residential mobility patterns over the life course and their potential effects on mental health in old age. Sequence analysis has recently been used in ELSA for example to describe lifetime residential mobility trajectories of three birth cohorts born between 1918 and 1946 (Falkingham, Saage et al. 2016). These trajectories could be linked to mental health outcomes in later life.

Finally, an important blind spot in the research presented in Chapter 7 on co-residence and mental health is that I had no information on the effect of 'doubling-up' – two or more generations under the same roof - on the mental health of children. SHARE includes detailed demographic and socioeconomic information for up to four children but no data are available on their health status. The identification strategy used in the chapter cannot be replicated for the younger generation as one would expect that high youth unemployment rates would have a direct effect on that generation but the potential effect of co-residence on young adults' mental health should be further explored.

8.5. Directions for future research

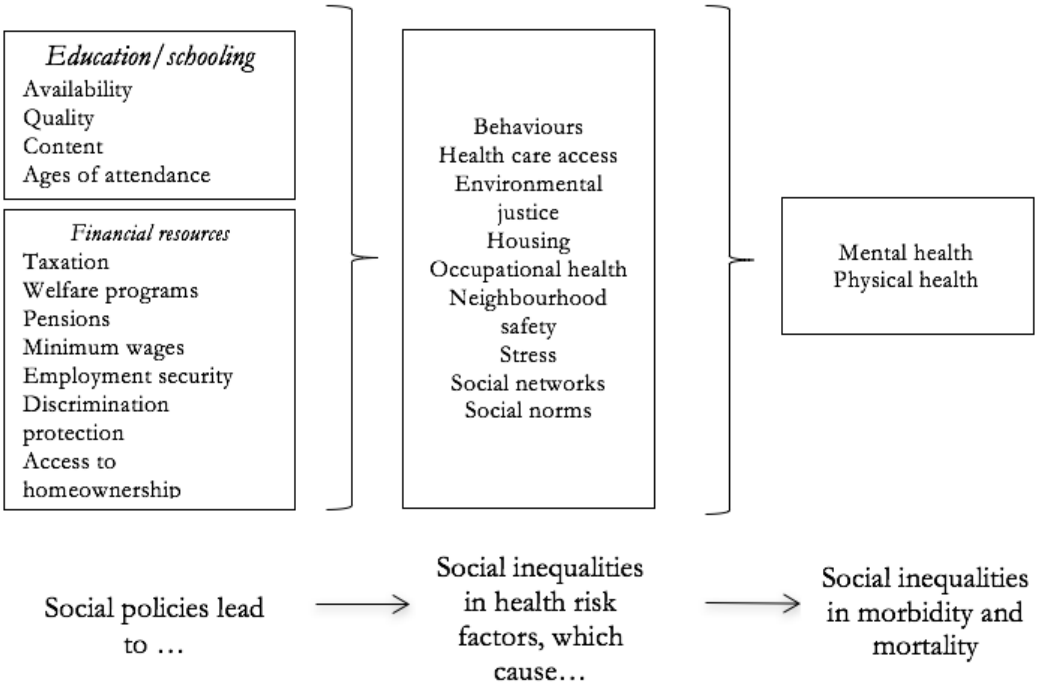
Throughout this thesis, the individual chapters have made a number of recommendations for future research and here I discuss a further two areas where research could build on the findings that I have presented.

The first avenue for future research responds directly to one of the limitation of this thesis, as detailed in the previous section (8.4.1). An important limitation of the results presented in the chapters on homeownership and mental health is that I did not have access to life course residential histories in HRS. Other datasets could be used to overcome this issue, such as ELSA or the British Household Panel Survey. Using sequence analysis to build prototypical trajectories, this research could explore further the complexities of residential mobility, its relationship with other life course events such as family formation and divorce, and identify if certain pathways expose individuals to higher mental health risks than others.

The second area of future research builds on the overarching finding that co-residence and homeownership are determinants of depression in later life. Can we then assume that policies encouraging, for example, access to homeownership also improve health? An increasing number of studies have been devoted in recent years to the investigation of the effect of a range of social policies on health. The available evidence shows that such policies influence population health – even if they were not intended to - by impacting the social determinants of health (Osypuk, Joshi et al. 2014). As displayed in Figure 8.1 below, social policies influence health indirectly because of their effect on social or economic outcomes such as income or education. In turn, these social or economic factors can affect health.

A vast literature has documented the effects of income policies (e.g. Rehkopf, Strully et al. 2014), education policies (e.g. Glymour, Kawachi et al. 2008) and employment policies (e.g. Alderson, Gennetian et al. 2008) on health. Far less is known about housing policies in general and pro-homeownership policies in particular.

Figure 8.1 Policy mechanisms influencing social determinants of mental health



Notes: Adapted from Glymour (2014)

Social policy interventions in the area of housing have predominantly focused on offering housing vouchers as rent subsidies, and the vast majority of the studies of vouchers have been conducted in the US (Osypuk, Joshi et al. 2014). To date, very limited research has focused on policies that seek to improve access to homeownership for marginalized buyers – young and/or poor households. Two policies would be of particular interest: (1) the Right-to-Buy (RTB) policy in the UK introduced by the Housing Act in 1980 and (2) the World War II and Korean War GI Bills in the US. The UK RTB policy gave individuals who were renting their home in the social sector the statutory RTB at a reduced cost. An interesting feature of this policy is that it provides an opportunity to measure the effect of becoming a homeowner without moving to a new neighbourhood – which was a limitation of the results presented in Chapter 7 of this thesis. The policy contributed substantially to the increasing

rates of homeownership in the UK: over two million homes were sold as part of this scheme between 1980 and 2005 (Mullins, Murie et al. 2006).

The US GI Bills also offer an interesting avenue to look into the potential health effects of pro-homeownership policies. For example, the 'Veterans' Readjustement and Assistance Act' of 1952 provided educational subsidies, unemployment benefits and also a government-backed low-interest loan benefit (Vable, Kawachi et al. 2016). These Bills have been credited with being the main influence behind the post war increases in homeownership rates in the US (Fetter 2013). Both policies had a strong impact on homeownership rates among marginal buyers. An analysis of their potential effects on mental health in later life will contribute to our understanding of how social policies influence social determinants of health, and ultimately health itself.

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Appendix

Appendix 4.1. Linear regressions (fully adjusted) for the normalized and original CES-D and Euro-D scores

	Normalised CES-D	Normalised Euro-D	Original CES-D	Original Euro-D
Male	-0.0510***	-0.0626***	-0.428***	-0.732***
	(0.00467)	(0.00353)	(0.0377)	(0.0405)
61 to 70	-0.0188***	-0.0170***	-0.174***	-0.202***
	(0.00544)	(0.00402)	(0.0440)	(0.0462)
Over 70	0.0116	0.00138	0.0421	-0.0179
	(0.00622)	(0.00458)	(0.0503)	(0.0527)
2+ chronic illnesses	0.0868***	0.0692***	0.727***	0.819***
	(0.00499)	(0.00370)	(0.0403)	(0.0425)
1+ limitations with ADLS	0.176***	0.126***	1.461***	1.492***
	(0.0101)	(0.00746)	(0.0821)	(0.0859)
Divorced, single or widowed	0.0653***	0.0279***	0.549***	0.335***
	(0.00523)	(0.00381)	(0.0421)	(0.0438)
Secondary education	-0.0313***	-0.0224***	-0.318***	-0.323***
	(0.00638)	(0.00462)	(0.0514)	(0.0533)
Post-secondary education	-0.0348***	-0.0226***	-0.367***	-0.333***
	(0.00704)	(0.00531)	(0.0566)	(0.0606)
Economic strain	0.0942***	0.0558***	0.417***	0.389***
	(0.00571)	(0.00411)	(0.0397)	(0.0437)
Germany (ref.: Austria)	0.0347**	0.0247**	0.314**	0.148
	(0.0133)	(0.00934)	(0.108)	(0.109)
Sweden	-0.0158	0.0348***	-0.128	0.0439
	(0.0130)	(0.00958)	(0.105)	(0.108)
Netherlands	-0.0310*	0.0338***	-0.232*	0.239*
	(0.0127)	(0.00931)	(0.103)	(0.108)
Spain	0.0274	0.0494***	0.348**	0.708***
	(0.0158)	(0.0109)	(0.128)	(0.131)
Italy	0.0790***	0.0563***	0.797***	0.819***
	(0.0148)	(0.0101)	(0.119)	(0.121)
France	0.00220	0.0620***	0.0712	0.790***
	(0.0137)	(0.00946)	(0.112)	(0.114)
Denmark	-0.0658***	0.00785	-0.504***	-0.0428
	(0.0127)	(0.00942)	(0.103)	(0.110)
Greece	-0.0409**	-0.0120	-0.0849	-0.108
	(0.0137)	(0.00976)	(0.109)	(0.113)
Switzerland	-0.0179	0.0232*	-0.0925	0.157

	(0.0145)	(0.0106)	(0.117)	(0.122)
Belgium	-0.00145	0.0404***	0.0591	0.346**
	(0.0133)	(0.00945)	(0.108)	(0.110)
Czechia	0.00954	-0.00174	0.230*	0.116
	(0.0139)	(0.00947)	(0.112)	(0.113)
Poland	0.0581***	0.0976***	0.710***	1.401***
	(0.0153)	(0.0104)	(0.123)	(0.124)
Constant	0.133***	0.141***		
	(0.0136)	(0.00955)		
Observations	10,536	10,536	10,536	10,536
R-squared	0.236	0.220	0.219	0.226

Note: Robust standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05

Appendix 4.2. Linear regressions (fully adjusted) for the normalized CES-D and Euro-D depressive symptoms scores and odds ratios for elevated depressive symptoms per country

Austria	*Linear regressions*		*Logistic regressions*	
	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0112	-0.0432**	0.999	0.390**
	(0.0240)	(0.0157)	(0.262)	(0.119)
61 to 70	0.00259	0.0229	1.533	1.404
	(0.0264)	(0.0170)	(0.500)	(0.495)
Over 70	0.0386	0.0425*	2.461**	1.670
	(0.0270)	(0.0189)	(0.780)	(0.599)
2+ chronic illnesses	0.0837***	0.0662***	2.068**	2.161**
	(0.0240)	(0.0165)	(0.486)	(0.569)
1+ limitations with ADLs	0.154***	0.122***	3.049***	3.893***
	(0.0432)	(0.0291)	(0.909)	(1.201)
Divorced, single or widowed	0.0474*	0.0149	1.421	0.978
	(0.0239)	(0.0152)	(0.385)	(0.290)
Secondary education	-0.0834*	0.000159	0.762	0.831
	(0.0373)	(0.0235)	(0.219)	(0.263)
Tertiary education	-0.101*	8.56e-05	0.373**	0.957
	(0.0392)	(0.0260)	(0.142)	(0.372)
Economic strain	0.0752***	0.0467**	2.348**	2.047*
	(0.0215)	(0.0149)	(0.677)	(0.668)
Constant	0.127**	0.0740*	0.0679***	0.0806***
	(0.0434)	(0.0292)	(0.0326)	(0.0451)
Observations	473	473	473	473
R-squared	0.168	0.171	0.142	0.134

Belgium				
	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0805***	-0.0921***	0.555**	0.390***
	(0.0157)	(0.0120)	(0.102)	(0.0707)
61 to 70	-0.0304	-0.0253	0.820	0.767
	(0.0184)	(0.0143)	(0.170)	(0.156)
Over 70	-0.0527**	-0.0475***	0.630*	0.576*
	(0.0185)	(0.0143)	(0.137)	(0.125)
2+ chronic illnesses	0.0882***	0.0591***	2.180***	1.653**
	(0.0161)	(0.0123)	(0.379)	(0.289)
1+ limitations with ADLs	0.214***	0.147***	4.337***	4.248***
	(0.0314)	(0.0247)	(1.073)	(1.041)
Divorced, single or widowed	0.0596***	0.0246	1.965***	1.249
	(0.0170)	(0.0126)	(0.353)	(0.225)
Secondary education	-0.0328	-0.00956	0.848	1.029
	(0.0199)	(0.0148)	(0.173)	(0.206)

Tertiary education	-0.0374	-0.0109	0.754	0.780
	(0.0216)	(0.0163)	(0.182)	(0.184)
Economic strain	0.0325*	0.0157	1.400	1.356
	(0.0151)	(0.0119)	(0.264)	(0.243)
Constant	0.175***	0.213***	0.174***	0.290***
	(0.0261)	(0.0196)	(0.0497)	(0.0757)
Observations	978	978	978	978
R-squared	0.193	0.178	0.129	0.105

Czechia

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0233	-0.0401***	0.754	0.666*
	(0.0168)	(0.0112)	(0.126)	(0.119)
61 to 70	-0.0358	-0.0273*	0.736	0.790
	(0.0192)	(0.0128)	(0.144)	(0.166)
Over 70	0.0336	0.0264	1.194	1.335
	(0.0224)	(0.0153)	(0.229)	(0.275)
2+ chronic illnesses	0.101***	0.0719***	2.168***	2.297***
	(0.0169)	(0.0116)	(0.349)	(0.403)
1+ limitations with ADLs	0.164***	0.131***	2.961***	2.418**
	(0.0365)	(0.0282)	(0.796)	(0.651)
Divorced, single or widowed	0.101***	0.0441***	2.041***	1.698**
	(0.0179)	(0.0117)	(0.331)	(0.293)
Secondary education	-0.0245	-0.0350*	0.815	0.807
	(0.0249)	(0.0169)	(0.159)	(0.165)
Tertiary education	-0.0831**	-0.0542**	0.470*	0.488*
	(0.0295)	(0.0200)	(0.141)	(0.154)
Economic strain	0.0607*	0.0100	2.081*	1.058
	(0.0256)	(0.0159)	(0.666)	(0.308)
Constant	0.110**	0.154***	0.127***	0.184***
	(0.0365)	(0.0238)	(0.0515)	(0.0688)
Observations	940	940	940	940
R-squared	0.175	0.180	0.112	0.0975

Switzerland

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0663***	-0.0740***	0.397**	0.343***
	(0.0182)	(0.0151)	(0.121)	(0.0992)
61 to 70	-0.0410	-0.0504**	0.719	0.643
	(0.0214)	(0.0173)	(0.251)	(0.207)
Over 70	-0.0219	-0.0276	0.847	0.726
	(0.0251)	(0.0209)	(0.276)	(0.235)
2+ chronic illnesses	0.0304	0.0408*	1.418	1.527
	(0.0213)	(0.0179)	(0.391)	(0.420)

1+ limitations with ADLs	0.0356	0.0634	1.008	1.150
	(0.0702)	(0.0508)	(0.574)	(0.572)
Divorced, single or widowed	0.0498*	0.0386*	1.749*	1.825*
	(0.0211)	(0.0168)	(0.496)	(0.494)
Secondary education	-0.0200	-0.0441	0.815	0.426*
	(0.0350)	(0.0277)	(0.314)	(0.158)
Tertiary education	-0.0336	-0.0328	0.617	0.580
	(0.0365)	(0.0302)	(0.276)	(0.235)
Economic strain	0.0698***	0.0518***	2.853***	1.742*
	(0.0186)	(0.0153)	(0.900)	(0.477)
Constant	0.144***	0.195***	0.120***	0.315**
	(0.0404)	(0.0324)	(0.0598)	(0.141)
Observations	497	497	497	497
R-squared	0.113	0.156	0.110	0.103

Germany

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0206	-0.0523***	0.797	0.633*
	(0.0162)	(0.0120)	(0.162)	(0.139)
61 to 70	-0.0271	-0.0181	0.614*	0.613*
	(0.0169)	(0.0124)	(0.143)	(0.147)
Over 70	0.0348	-0.0162	1.241	0.674
	(0.0208)	(0.0147)	(0.302)	(0.173)
2+ chronic illnesses	0.105***	0.0855***	3.491***	3.085***
	(0.0170)	(0.0118)	(0.701)	(0.666)
1+ limitations with ADLs	0.207***	0.149***	3.696***	3.391***
	(0.0361)	(0.0270)	(1.070)	(0.977)
Divorced, single or widowed	0.0754***	0.00761	2.130***	0.987
	(0.0185)	(0.0124)	(0.444)	(0.221)
Secondary education	-0.132	-0.0883	0.315	0.271
	(0.124)	(0.0618)	(0.287)	(0.182)
Tertiary education	-0.172	-0.110	0.160*	0.204*
	(0.124)	(0.0623)	(0.148)	(0.141)
Economic strain	0.0644***	0.0183	1.911**	1.300
	(0.0142)	(0.0112)	(0.417)	(0.302)
Constant	0.228	0.237***	0.323	0.572
	(0.123)	(0.0627)	(0.300)	(0.409)
Observations	782	782	782	782
R-squared	0.255	0.204	0.196	0.108

Denmark

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.00116	-0.0174	1.064	0.812
	(0.0130)	(0.0118)	(0.281)	(0.180)

61 to 70	-0.0389**	-0.0668***	0.668	0.310***
	(0.0132)	(0.0122)	(0.212)	(0.0826)
Over 70	0.00590	-0.0427**	0.928	0.419**
	(0.0168)	(0.0151)	(0.298)	(0.121)
2+ chronic illnesses	0.0293*	0.0522***	1.628	2.782***
	(0.0124)	(0.0111)	(0.436)	(0.632)
1+ limitations with ADLs	0.151***	0.113***	3.074**	3.222***
	(0.0362)	(0.0267)	(1.117)	(1.026)
Divorced, single or widowed	0.0368**	0.00697	1.989**	1.019
	(0.0139)	(0.0125)	(0.526)	(0.240)
Secondary education	-0.0174	-0.00357	0.629	0.937
	(0.0192)	(0.0173)	(0.212)	(0.291)
Tertiary education	0.00802	0.00259	1.025	1.378
	(0.0203)	(0.0176)	(0.352)	(0.447)
Economic strain	0.0378**	0.0518***	1.693*	1.975**
	(0.0122)	(0.0113)	(0.419)	(0.434)
Constant	0.0643**	0.136***	0.0520***	0.104***
	(0.0233)	(0.0210)	(0.0236)	(0.0402)
Observations	826	826	826	826
R-squared	0.118	0.118	0.0830	0.0911

Spain

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.110***	-0.0885***	0.430***	0.410***
	(0.0227)	(0.0165)	(0.0848)	(0.0815)
61 to 70	-0.0107	-0.0173	0.958	0.661
	(0.0268)	(0.0199)	(0.235)	(0.168)
Over 70	0.0715*	0.0353	1.376	1.054
	(0.0302)	(0.0207)	(0.348)	(0.253)
2+ chronic illnesses	0.140***	0.0928***	2.344***	2.534***
	(0.0244)	(0.0174)	(0.463)	(0.494)
1+ limitations with ADLs	0.172***	0.119***	2.944***	2.367**
	(0.0405)	(0.0299)	(0.908)	(0.685)
Divorced, single or widowed	0.0389	0.0179	1.376	1.017
	(0.0246)	(0.0175)	(0.275)	(0.204)
Secondary education	-0.00136	-0.0150	0.882	0.698
	(0.0275)	(0.0190)	(0.207)	(0.163)
Tertiary education	-0.0506	-0.0250	0.535	0.877
	(0.0327)	(0.0257)	(0.208)	(0.297)
Economic strain	0.0889**	0.0324	2.152*	2.000*
	(0.0292)	(0.0204)	(0.758)	(0.626)
Constant	0.112**	0.182***	0.160***	0.251***
	(0.0377)	(0.0273)	(0.0652)	(0.0943)
Observations	646	646	646	646

R-squared	0.219	0.198	0.136	0.120

France

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0882***	-0.0760***	0.392***	0.401***
	(0.0165)	(0.0119)	(0.0732)	(0.0674)
61 to 70	0.00629	0.00972	1.101	0.896
	(0.0200)	(0.0138)	(0.227)	(0.168)
Over 70	-0.0306	-0.0275	0.752	0.526**
	(0.0210)	(0.0148)	(0.165)	(0.111)
2+ chronic illnesses	0.0961***	0.0558***	2.306***	1.813***
	(0.0182)	(0.0123)	(0.398)	(0.291)
1+ limitations with ADLs	0.138***	0.109***	2.720***	2.809***
	(0.0348)	(0.0219)	(0.750)	(0.717)
Divorced, single or widowed	0.114***	0.0425***	2.575***	1.621**
	(0.0185)	(0.0126)	(0.451)	(0.260)
Secondary education	-0.0590**	-0.0305*	0.644*	0.661*
	(0.0196)	(0.0139)	(0.122)	(0.117)
Tertiary education	-0.0391	-0.0435**	0.727	0.477**
	(0.0226)	(0.0162)	(0.173)	(0.108)
Economic strain	0.0441*	0.0576***	1.390	1.939**
	(0.0173)	(0.0128)	(0.301)	(0.403)
Constant	0.149***	0.196***	0.184***	0.365***
	(0.0264)	(0.0196)	(0.0568)	(0.104)
Observations	944	944	944	944
R-squared	0.194	0.183	0.149	0.120

Greece

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0677***	-0.0869***	0.447***	0.339***
	(0.0155)	(0.0124)	(0.0897)	(0.0728)
61 to 70	-0.0514**	-0.0186	0.494**	0.785
	(0.0178)	(0.0135)	(0.119)	(0.196)
Over 70	-0.0144	0.0252	0.656	1.156
	(0.0217)	(0.0169)	(0.158)	(0.285)
2+ chronic illnesses	0.0689***	0.0454***	2.024***	1.667*
	(0.0163)	(0.0137)	(0.374)	(0.339)
1+ limitations with ADLs	0.200***	0.165***	3.639***	3.413***
	(0.0386)	(0.0307)	(1.080)	(0.991)
Divorced, single or widowed	0.0822***	0.0306*	2.061***	1.430
	(0.0168)	(0.0130)	(0.395)	(0.284)
Secondary education	-0.0534**	-0.0379**	0.683	0.646
	(0.0178)	(0.0137)	(0.145)	(0.147)

Tertiary education	-0.0702**	-0.0304	0.361**	0.609
	(0.0213)	(0.0175)	(0.112)	(0.182)
Economic strain	0.0798***	0.0403*	2.283*	1.907
	(0.0207)	(0.0162)	(0.863)	(0.728)
Constant	0.122***	0.149***	0.141***	0.143***
	(0.0291)	(0.0222)	(0.0600)	(0.0632)
Observations	955	955	955	955
R-squared	0.203	0.204	0.150	0.136

Italy

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0897***	-0.0864***	0.536***	0.339***
	(0.0193)	(0.0133)	(0.0855)	(0.0728)
61 to 70	0.00986	0.0112	1.070	0.785
	(0.0238)	(0.0157)	(0.201)	(0.196)
Over 70	0.0349	0.0347	1.174	1.156
	(0.0276)	(0.0186)	(0.254)	(0.285)
2+ chronic illnesses	0.139***	0.109***	2.835***	1.667*
	(0.0200)	(0.0136)	(0.455)	(0.339)
1+ limitations with ADLs	0.229***	0.170***	4.496***	3.413***
	(0.0347)	(0.0256)	(1.367)	(0.991)
Divorced, single or widowed	0.0805***	0.0325*	1.616**	1.430
	(0.0224)	(0.0153)	(0.278)	(0.284)
Secondary education	-0.0679**	-0.0374*	0.674*	0.646
	(0.0225)	(0.0147)	(0.118)	(0.147)
Tertiary education	-0.0836**	-0.0576*	0.583	0.609
	(0.0305)	(0.0234)	(0.172)	(0.182)
Economic strain	0.0987**	0.0429	2.287*	1.907
	(0.0327)	(0.0256)	(0.789)	(0.728)
Constant	0.161***	0.166***	0.179***	0.143***
	(0.0412)	(0.0311)	(0.0711)	(0.0632)
Observations	895	895	895	895
R-squared	0.234	0.263	0.146	0.163

Netherlands

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0346**	-0.0568***	0.638	0.339***
	(0.0128)	(0.0111)	(0.147)	(0.0728)
61 to 70	-0.0301*	-0.00637	0.420**	0.785
	(0.0145)	(0.0132)	(0.140)	(0.196)
Over 70	-0.00847	-0.0220	0.802	1.156
	(0.0184)	(0.0142)	(0.219)	(0.285)
2+ chronic illnesses	0.0617***	0.0645***	2.577***	1.667*
	(0.0158)	(0.0133)	(0.598)	(0.339)

1+ limitations with ADLs	0.192***	0.107***	4.827***	3.413***
	(0.0425)	(0.0309)	(1.540)	(0.991)
Divorced, single or widowed	0.0710***	0.0722***	2.262***	1.430
	(0.0156)	(0.0130)	(0.517)	(0.284)
Secondary education	-0.0352	-0.0264	0.609	0.646
	(0.0232)	(0.0188)	(0.167)	(0.147)
Tertiary education	-0.0380	-0.0322	0.633	0.609
	(0.0261)	(0.0210)	(0.216)	(0.182)
Economic strain	0.0413***	0.0179	2.028**	1.907
	(0.0123)	(0.0110)	(0.501)	(0.728)
Constant	0.104***	0.167***	0.0849***	0.143***
	(0.0255)	(0.0215)	(0.0322)	(0.0632)
Observations	859	859	859	859
R-squared	0.175	0.172	0.158	0.110

Poland

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0654**	-0.0822***	0.689*	0.339***
	(0.0205)	(0.0139)	(0.114)	(0.0728)
61 to 70	0.0215	-0.00303	1.162	0.785
	(0.0266)	(0.0171)	(0.242)	(0.196)
Over 70	0.0229	0.0237	1.314	1.156
	(0.0283)	(0.0184)	(0.282)	(0.285)
2+ chronic illnesses	0.155***	0.113***	2.824***	1.667*
	(0.0216)	(0.0141)	(0.483)	(0.339)
1+ limitations with ADLs	0.171***	0.0953***	3.073***	3.413***
	(0.0273)	(0.0176)	(0.599)	(0.991)
Divorced, single or widowed	0.102***	0.0268	1.872***	1.430
	(0.0235)	(0.0155)	(0.327)	(0.284)
Secondary education	-0.0102	-0.0306*	0.819	0.646
	(0.0233)	(0.0155)	(0.153)	(0.147)
Tertiary education	-0.0769**	-0.0508*	0.571*	0.609
	(0.0291)	(0.0213)	(0.156)	(0.182)
Economic strain	0.0778*	0.0494	2.319	1.907
	(0.0382)	(0.0293)	(1.063)	(0.728)
Constant	0.127**	0.221***	0.122***	0.143***
	(0.0433)	(0.0325)	(0.0602)	(0.0632)
Observations	825	825	825	825
R-squared	0.227	0.230	0.152	0.142

Sweden

	Normalised CES-D	*Normalised Euro-D*	*CES-D*	*Euro-D*
Male	-0.0171	-0.0374**	0.767	0.339***

	(0.0133)	(0.0118)	(0.148)	(0.0728)
61 to 70	-0.0366*	-0.0347**	0.539*	0.785
	(0.0159)	(0.0134)	(0.135)	(0.196)
Over 70	0.0135	0.00739	0.988	1.156
	(0.0201)	(0.0162)	(0.247)	(0.285)
2+ chronic illnesses	0.0529***	0.0567***	1.796**	1.667*
	(0.0148)	(0.0121)	(0.362)	(0.339)
1+ limitations with ADLs	0.173***	0.149***	4.202***	3.413***
	(0.0352)	(0.0288)	(1.143)	(0.991)
Divorced, single or widowed	0.0262	0.0157	1.359	1.430
	(0.0141)	(0.0125)	(0.257)	(0.284)
Secondary education	-0.0153	9.00e-05	0.856	0.646
	(0.0169)	(0.0148)	(0.209)	(0.147)
Tertiary education	0.00583	0.00229	1.174	0.609
	(0.0178)	(0.0150)	(0.295)	(0.182)
Economic strain	0.0564***	0.0561***	1.970***	1.907
	(0.0133)	(0.0114)	(0.396)	(0.728)
Constant	0.102***	0.139***	0.0990***	0.143***
	(0.0216)	(0.0184)	(0.0326)	(0.0632)
Observations	916	916	916	916
R-squared	0.127	0.147	0.0980	0.103

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Appendix 5.1. Ordinary Least Squares Regression of CES-D depressive symptoms score - Early access to homeownership defined at age 30

	b	SE	95% CI	
Homeowner by age 30 vs. Homeowner after 30 (ref.)	-0.0508*	0.0214	-0.0926	-0.0089
Never homeowner	0.0673**	0.0222	0.0237	0.1108
Demographic characteristics				
Female vs. Male (ref.)	0.215***	0.0161	0.1836	0.2466
Age	0.0193	0.0127	-0.0056	0.0442
Black vs. White (ref.)	-0.0933***	0.0242	-0.1406	-0.0459
Hispanic	0.0226	0.0384	-0.0527	0.0979
Separated or divorced vs. Married or in a relationship (ref.)	0.321***	0.0304	0.2614	0.3804
Widowed	0.426***	0.0252	0.3769	0.4757
Never married	0.228***	0.0527	0.1241	0.3309
Number of children	0.000767	0.0039	-0.0068	0.0084
Duration of longest marriage	0.000813	0.000667	-0.0004	0.0021
Number of person living in the household	0.00885	0.0072	-0.0052	0.0229
Health status				
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	2.113***	0.0385	2.0372	2.1882
Ever smoked vs. No (ref.)	0.0353*	0.0163	0.0032	0.0672
Currently smoking vs. No (ref.)	0.177***	0.0239	0.1299	0.2234
2+ alcohol drinks	-0.00502	0.0141	-0.0327	0.0226
Number of limitations with ADLs	0.347***	0.0128	0.3218	0.3721
Number of limitations with IADLs	0.372***	0.0247	0.3238	0.4206
Socio-economic characteristics				
GED vs. Lower than high school (ref.)	-0.0762	0.0449	-0.1641	0.0117
High school graduate	-0.186***	0.0258	-0.2369	-0.1357
Some college	-0.257***	0.0272	-0.3101	-0.2035
College and higher	-0.317***	0.0274	-0.3703	-0.2627
Unemployed vs. Employed (ref.)	0.495***	0.0451	0.4065	0.5835
Retired	0.0746***	0.0168	0.0416	0.1075
Disabled	0.628***	0.0598	0.511	0.7455
Not in the labour force	0.165***	0.0286	0.1092	0.2215
Log of household non-housing wealth	-0.0267***	0.00418	-0.0349	-0.0185
Log of household total income	-0.0395***	0.00795	-0.0551	-0.0239
Cohort fixed effects	Yes			
Wave fixed effects	Yes			
Constant	-2.653*	1.303	-5.2061	-0.099
Observations	121,626			
R-squared	0.241			

Notes: Robust standard errors clustered at the individual level, *** p<0.001, ** p<0.01, * p<0.05

Appendix 5.2. Ordinary Least Squares Regression of CES-D depressive symptoms score - Early access to homeownership defined at age 40

	b	SE	95% CI	
Homeowner by age 40 vs. Homeowner after 40 (ref.)	-0.0514**	0.0165	-0.0837	-0.0191
Never homeowner	0.0550*	0.0228	0.0103	0.0996
Demographic characteristics				
Female vs. Male (ref.)	0.215***	0.0161	0.183	0.2459
Age	0.0194	0.0127	-0.0055	0.0443
Black vs. White (ref.)	-0.0913***	0.0242	-0.1386	-0.0439
Hispanic	0.0221	0.0384	-0.0532	0.0973
Separated or divorced vs. Married or in a relationship (ref.)	0.321***	0.0304	0.2615	0.3805
Widowed	0.428***	0.0252	0.3784	0.4772
Never married	0.229***	0.0528	0.1257	0.3326
Number of children	0.000388	0.0039	-0.0072	0.008
Duration of longest marriage	0.000936	0.000671	-0.0003	0.0022
Number of person living in the household	0.00932	0.0072	-0.0047	0.0234
Health status				
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	2.113***	0.0385	2.037	2.1881
Ever smoked vs. No (ref.)	0.0352*	0.0163	0.0031	0.0672
Currently smoking vs. No (ref.)	0.176***	0.0239	0.1295	0.223
2+ alcohol drinks	-0.00536	0.0141	-0.033	0.0223
Number of limitations with ADLs	0.347***	0.0128	0.3218	0.372
Number of limitations with IADLs	0.372***	0.0247	0.324	0.4208
Socio-economic characteristics				
GED vs. Lower than high school (ref.)	-0.0757	0.0448	-0.1636	0.0121
High school graduate	-0.187***	0.0258	-0.2372	-0.1361
Some college	-0.257***	0.0272	-0.31	-0.2034
College and higher	-0.315***	0.0274	-0.3683	-0.2609
Unemployed vs. Employed (ref.)	0.494***	0.0451	0.4053	0.5822
Retired	0.0751***	0.0168	0.0421	0.108
Disabled	0.629***	0.0598	0.5114	0.7458
Not in the labour force	0.165***	0.0286	0.1092	0.2215
Log of household non-housing wealth	-0.0267***	0.00419	-0.0348	-0.0184
Log of household total income	-0.0392***	0.00796	-0.0548	-0.0236
Cohort fixed effects	Yes			
Wave fixed effects	Yes			
Constant	-2.655*	1.301	-5.2054	-0.1036
Observations	121,626			
R-squared	0.241			

Notes: Robust standard errors clustered at the individual level, *** p<0.001, ** p<0.01, * p<0.05

Appendix 5.3. Ordinary Least Squares Regression of CES-D depressive symptoms score - Age modelled as linear and squared terms

	b	SE	95% CI	
Homeowner by age 35 vs. Homeowner after 35 (ref.)	-0.0368*	0.0178	-0.0716	-0.0019
Never homeowner	0.0652**	0.0225	0.0211	0.1092
Demographic characteristics				
Female vs. Male (ref.)	0.214***	0.0161	0.1828	0.2459
Age	0.0134	0.016	-0.018	0.0447
Age squared	4.45E-05	7.04E-05	-0.00009	0.0001
Black vs. White (ref.)	-0.0919***	0.0242	-0.1392	-0.0445
Hispanic	0.023	0.0384	-0.0523	0.0983
Separated or divorced vs. Married or in a relationship (ref.)	0.321***	0.0304	0.261	0.38
Widowed	0.426***	0.0253	0.3764	0.4755
Never married	0.227***	0.0527	0.1238	0.3306
Number of children	0.000698	0.0039	-0.0069	0.0083
Duration of longest marriage	0.000818	0.00067	-0.0004	0.0021
Number of person living in the household	0.00894	0.00722	-0.0052	0.0231
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	2.113***	0.0386	2.0376	2.1888
Ever smoked vs. No (ref.)	0.0357*	0.0164	0.0036	0.0677
Currently smoking vs. No (ref.)	0.176***	0.0239	0.1295	0.2231
2+ alcohol drinks	-0.00503	0.0141	-0.0327	0.0226
Number of limitations with ADLs	0.347***	0.0128	0.3215	0.3718
Number of limitations with IADLs	0.372***	0.0248	0.3231	0.4203
Socio-economic characteristics				
GED vs. Lower than high school (ref.)	-0.0762	0.0449	-0.1641	0.0117
High school graduate	-0.187***	0.0258	-0.2372	-0.13606
Some college	-0.257***	0.0272	-0.3098	-0.2032
College and higher	-0.315***	0.0274	-0.3684	-0.261
Unemployed vs. Employed (ref.)	0.495***	0.0452	0.4068	0.5838
Retired	0.0757***	0.017	0.0423	0.1091
Disabled	0.629***	0.0598	0.5113	0.7458
Not in the labour force	0.166***	0.0287	0.1094	0.222
Log of household non-housing wealth	-0.0267***	0.00418	-0.0349	-0.0185
Log of household total income	-0.0394***	0.00796	-0.055	-0.02381
Cohort fixed effects	Yes			
Wave fixed effects	Yes			
Constant	-2.509	1.329	-5.1152	0.0962
Observations	121,626			
R-squared	0.241			

Robust standard errors clustered at the individual level, *** p<0.001, ** p<0.01, * p<0.05

Appendix 5.4. Ordinary Least Squares Regression of CES-D depressive symptoms score - Interaction term between year of birth and survey wave

	b	SE	95% CI	
Homeowner by age 35 vs. Homeowner after 35 (ref.)	-0.0368*	0.0178	-0.0716	-0.0019
Never homeowner	0.0652**	0.0225	0.0211	0.1092
Demographic characteristics				
Female vs. Male (ref.)	0.214***	0.0161	0.1828	0.2459
Age	0.0246	0.0768	-0.1259	0.1751
Black vs. White (ref.)	-0.0919***	0.0242	-0.1392	-0.0444
Hispanic	0.023	0.0384	-0.0523	0.0982
Separated or divorced vs. Married or in a relationship (ref.)	0.321***	0.0304	0.261	0.3801
Widowed	0.426***	0.0253	0.3763	0.4754
Never married	0.227***	0.0527	0.1238	0.3306
Number of children	0.000699	0.0039	-0.0069	0.0083
Duration of longest marriage	0.000818	0.00067	-0.0004	0.0021
Number of person living in the household	0.00893	0.00722	-0.0052	0.023
Health status				
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	2.113***	0.0386	2.0376	2.1888
Ever smoked vs. No (ref.)	0.0357*	0.0164	0.0036	0.0677
Currently smoking vs. No (ref.)	0.176***	0.0239	0.1295	0.2231
2+ alcohol drinks	-0.00503	0.0141	-0.0327	0.0226
Number of limitations with ADLs	0.347***	0.0128	0.3215	0.3718
Number of limitations with IADLs	0.372***	0.0248	0.3231	0.4203
Socio-economic characteristics				
GED vs. Lower than high school (ref.)	-0.0761	0.0449	-0.164	0.0118
High school graduate	-0.187***	0.0258	-0.2372	-0.136
Some college	-0.257***	0.0272	-0.3098	-0.2032
College and higher	-0.315***	0.0274	-0.3684	-0.261
Unemployed vs. Employed (ref.)	0.495***	0.0452	0.4068	0.5838
Retired	0.0758***	0.017	0.0423	0.1091
Disabled	0.629***	0.0598	0.5113	0.7458
Not in the labour force	0.166***	0.0287	0.1094	0.2221
Log of household non-housing wealth	-0.0267***	0.00418	-0.0349	-0.0185
Log of household total income	-0.0394***	0.00796	-0.055	-0.0238
Cohort fixed effects	Yes			
Wave fixed effects	Yes			
Cohort X Wave	Yes			
Constant	-1.494	6.978	-15.17	12.183
Observations	121,626			
R-squared	0.241			

Robust standard errors clustered at the individual level, *** p<0.001, ** p<0.01, * p<0.05

Appendix 5.5. Random effect estimates of the association between timing of access to homeownership and CES-D depressive symptoms score

	b	SE	95% CI	
Homeowner by age 35 vs. Homeowner after 35 (ref.)	-0.0787***	0.0182	-0.1143	-0.043
Never homeowner	0.0444*	0.0193	0.0065	0.0821
Demographic characteristics				
Female vs. Male (ref.)	0.186***	0.0167	0.1531	0.2187
Age	-0.0152***	0.00108	-0.0172	-0.013
Black vs. White (ref.)	-0.0357	0.0243	-0.0833	0.0118
Hispanic	0.123**	0.0399	0.0447	0.2012
Number of children	0.00146	0.00382	-0.006	0.0089
Separated or divorced vs. Married or in a relationship (ref.)	0.340***	0.0278	0.2857	0.3948
Widowed	0.513***	0.0238	0.4662	0.5593
Never married	0.333***	0.0525	0.2297	0.4354
Duration of longest marriage	0.00190**	0.000669	0.0005	0.0032
Number of person living in the household	0.0101	0.00596	-0.0015	0.0217
Self reported health: fair/poor vs. Excellent/very good/good (ref.)	0.769***	0.0157	0.738	0.7997
Ever smoked vs. No (ref.)	0.103***	0.017	0.0701	0.1367
Currently smoking vs. No (ref.)	0.102***	0.0215	0.0601	0.1442
2+ alcohol drinks	-0.0598***	0.0126	-0.0846	-0.035
Number of limitations with ADLs	0.364***	0.0105	0.3432	0.3845
Number of limitations with IADLs	0.292***	0.02	0.2527	0.3313
Socio-economic characteristics				
GED vs. Lower than high school (ref.)	-0.091	0.0467	-0.1824	0.0004
High school graduate	-0.278***	0.0258	-0.3281	-0.227
Some college	-0.377***	0.0274	-0.4302	-0.3229
College and higher	-0.496***	0.0275	-0.5494	-0.4417
Unemployed vs. Employed (ref.)	0.367***	0.0396	0.2897	0.445
Retired	0.0639***	0.014	0.0365	0.0913
Disabled	0.581***	0.0497	0.4834	0.6783
Not in the labour force	0.152***	0.0245	0.1041	0.2001
Log of household non-housing wealth	-0.0353***	0.00366	-0.0424	-0.0281
Log of household total income	-0.0428***	0.00664	-0.0557	-0.0297
Cohort fixed effects	Yes			
Wave fixed effects	Yes			
Constant	2.630***	0.104	2.4269	2.8335
Observations	121,626			

Robust standard errors clustered at the individual level, *** p<0.001, ** p<0.01, * p<0.05

Appendix 6.1. Contemporaneous Associations between Changes in Homeownership and Changes in Depressive Symptoms Score Among Respondents Aged 50 Years and Older in HRS, Imputed Dataset (N=25,656), 1993-2010

	β	95% CI
Homeowner	-0.077	-0.146, -0.009
Age	-0.0461	-0.080, -0.0117
Age squared	0.0003	0.0001, 0.0004
Separated or divorced (ref. married)	0.285	0.198, 0.372
Widowed	0.651	0.599, 0.704
Never married	0.459	0.189, 0.728
Number of children	0.006	-0.013, 0.025
Household size	0.018	0.003, 0.034
Poor self-reported health (ref. good health)	0.526	0.494, 0.558
Currently smoking (ref. no)	-0.131	-0.189, -0.073
Currently drinking (ref. no)	-0.053	-0.78, -0.005
Number of limitations with ADLs	0.271	0.250, 0.291
Number of limitations with IADLs	0.193	0.155, 0.231
Unemployed (ref. employed)	0.257	0.171, 0.343
Retired	0.009	-0.023, 0.043
Disabled	0.374	0.271, 0.476
Not in the labour force	0.093	0.037, 0.149
Log of total non-housing wealth	-0.009	-0.019, 0.0009
Log of total household income	-0.015	-0.03, -0.0004
Survey year fixed effects	Yes	
Constant	2.24	0.639, 3.856
Number of individuals	25,656	

Abbreviations: CI, confidence intervals; ADLs, Activities of Daily Living; IADLs, Instrumental Activities of Daily Living; GED, General Education Development.

Appendix 7.1. First-stage regression of linear probability of co-residing with an adult child (full results)

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)
Demographic and socioeconomic			
Aged 50 to 60 (ref.)	-	-	-
Aged 61 to 70	-0.0639***	-0.0632***	-0.0593***
	(0.00835)	(0.0103)	(0.0109)
Aged over 70	-0.0538***	-0.0437**	-0.0612***
	(0.0118)	(0.0152)	(0.0144)
Male	-0.0235***	-	-
	(0.00557)		
Primary education (ref.)	-	-	-
Secondary education	-0.0350***	-0.0359***	-0.0342***
	(0.00704)	(0.0098)	(0.00967)
Tertiary education	-0.0634***	-0.0542***	-0.0784***
	(0.0095)	(0.0128)	(0.0121)
Married or in a partnership (ref.)	-	-	-
Never married or divorced	-0.110***	-0.0516***	-0.207***
	(0.00906)	(0.0104)	(0.0131)
Widowed	0.0323***	0.0531***	0.00458
	(0.00892)	(0.0106)	(0.0156)
Pension receipt	-0.0293***	-0.0277**	-0.0421***
	(0.00662)	(0.00868)	(0.01)
Log of household income	0.00555*	0.00544	0.00778
	(0.0027)	(0.00312)	(0.00426)
Financial strain	0.0397***	0.0335***	0.0405***
	(0.00637)	(0.00845)	(0.00927)
Informal care receipt	-0.0114	-0.0220**	0.00169
	(0.00689)	(0.00847)	(0.0105)
Health status			
Number of limitations with ADLs	-0.0126*	-0.0115	-0.0144

	(0.00617)	(0.00777)	(0.00933)
Number of limitations with IADLs	0.0181***	0.0164*	0.0208*
	(0.00494)	(0.00712)	(0.00836)
2+ chronic illnesses	-0.00368	0.000733	-0.00771
	(0.00524)	(0.00651)	(0.00851)
Children characteristics			
Number of children	-0.236*	-0.294*	-0.129
	(0.0922)	(0.116)	(0.139)
Child 1 is a male	-0.0411***	-0.749***	-0.0434***
	(0.00838)	(0.152)	(0.00843)
Child 2 is a male	-0.0472***	-0.401*	-0.0207
	(0.00582)	(0.178)	(0.0143)
Child 3 is a male	-0.0241**	-0.0507***	0.0931***
	(0.00865)	(0.00784)	(0.0181)
Child 4 is a male	-0.0595***	-0.0272*	0.0769***
	(0.0178)	(0.0117)	(0.0126)
Child 1 is employed (ref.)	-	-	-
Unemployed	0.0837***	-0.0313	0.0592**
	(0.0127)	(0.0264)	(0.0183)
Out of the labour force	0.0874***	0.0752***	0.0698***
	(0.00983)	(0.0162)	(0.0135)
Child 2 is employed (ref.)	-	-	-
Unemployed	0.0478***	0.0937***	-0.342***
	(0.0135)	(0.0123)	(0.082)
Out of the labour force	0.0635***	0.0384*	0.00381
	(0.00993)	(0.0183)	(0.0301)
Child 3 is employed (ref.)	-	-	-
Unemployed	-0.00468	0.0582***	0.0662**
	(0.0193)	(0.0125)	(0.0202)
Out of the labour force	0.0705***	-0.0204	-0.354*
	(0.0145)	(0.026)	(0.171)
Child 4 is employed (ref.)	-	-	-
Unemployed	0.0276	0.0763***	0.0909
	(0.0355)	(0.0182)	(0.0598)
Out of the labour force	0.0790***	-0.0105	0.1000**
	(0.0227)	(0.045)	(0.0334)
Child 1 is married or in a partnership (ref.)	-	-	-
Never married or divorced	0.180***	0.0607*	-0.508*
	(0.00767)	(0.0294)	(0.21)

Widowed	0.0244	0.185***	0.174***
	(0.0372)	(0.00897)	(0.00998)
Child 2 is married or in a partnership (ref.)	-	-	-
Never married or divorced	0.122***	0.022	0.0402
	(0.00799)	(0.048)	(0.0547)
Widowed	-0.000828	0.128***	0.115***
	(0.0581)	(0.00974)	(0.0105)
Child 3 is married or in a partnership (ref.)	-	-	-
Never married or divorced	0.105***	-0.0279	0.0534
	(0.0116)	(0.0678)	(0.0948)
Widowed	0.0429	0.0997***	0.112***
	(0.0929)	(0.014)	(0.0168)
Child 4 is married or in a partnership (ref.)	-	-	-
Never married or divorced	0.0577**	0.0441	0.0434
	(0.0182)	(0.112)	(0.174)
Widowed	-0.0701	0.0971***	0.013
	(0.18)	(0.0253)	(0.0262)
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Constant	1.121**	1.294**	0.712
	(0.37)	(0.467)	(0.557)
Observations	28,252	15,997	12,255
R-squared	0.284	0.283	0.296
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: Robust standard errors in parenthesis, with clustering at the level of the instruments. *** $p<0.001$; ** $p<0.01$; * $p<0.05$.

Appendix 7.2. IV-2SLS regressions of Euro-D depressive symptoms scores (homeowners only)

Variables	First stage	Second stage
IVs		
Unemployment rate of child 1	0.00877***	-
	(0.000919)	
Unemployment rate of child 2	0.00382***	-
	(0.000793)	
Unemployment rate of child 3	0.00297**	-
	(0.000981)	
Unemployment rate of child 4	0.00159	-
	(0.00123)	
Explanatory variable of interest		
Co-residing with an adult child	-	-0.694*
		(0.343)
Demographic and socioeconomic		
Aged 50 to 60 (ref.)	-	-
Aged 61 to 70	-0.0782***	-0.180**
	(0.00953)	(0.057)
Aged over 70	-0.0771***	-0.112
	(0.0129)	(0.0743)
Male	-0.0258***	-0.735***
	(0.00602)	(0.0325)
Primary education (ref.)	-	-
Secondary education	-0.0458***	-0.317***
	(0.00796)	(0.0442)
Tertiary education	-0.0792***	-0.488***
	(0.00998)	(0.0563)
Married or in a partnership (ref.)	-	-
Never married or divorced	-0.0946***	0.0925
	(0.0115)	(0.0543)
Widowed	0.0250*	0.330***
	(0.0106)	(0.0533)
Pension receipt	-0.0254**	0.0559
	(0.00802)	(0.0442)
Informal care receipt	-0.0170*	0.359***
	(0.00853)	(0.0456)
Log of household total income	0.00431	-0.0417**
	(0.00311)	(0.0158)
Financial strain	0.0471***	0.5587***
	(0.00734)	(0.04439)
Health status		
Number of limitations with ADLs	-0.0127	0.293***

	(0.00802)	(0.0486)
Number of limitations with IADLs	0.0212***	0.440***
	(0.00622)	(0.0457)
2+ chronic illnesses	0.00272	0.852***
	(0.0062)	(0.0331)
Children characteristics		
Number of children	0.0502***	0.0542
	(0.0107)	(0.053)
Child 1 is a male	-0.0457***	-0.0850*
	(0.00934)	(0.0332)
Child 2 is a male	-0.0476***	-0.0499
	(0.00672)	(0.0343)
Child 3 is a male	-0.0214	0.0337
	(0.0109)	(0.0524)
Child 4 is a male	-0.0578**	-0.0891
	(0.0198)	(0.0949)
Child 1 is employed (ref.)	-	-
Child 1 is unemployed	0.107***	0.329***
	(0.0144)	(0.074)
Child 1 is out of the labour force	0.0996***	0.149*
	(0.0113)	(0.0608)
Child 2 is employed (ref.)	-	-
Child 2 is unemployed	0.0670***	0.204**
	(0.0151)	(0.0743)
Child 2 is out of the labour force	0.0581***	0.0785
	(0.0113)	(0.0495)
Child 3 is employed (ref.)	-	-
Child 3 is unemployed	0.0434	0.423**
	(0.0228)	(0.131)
Child 3 is out of the labour force	0.0752***	0.202**
	(0.0156)	(0.0781)
Child 4 is employed (ref.)	-	-
Child 4 is unemployed	0.0343	0.393
	(0.0412)	(0.256)
Child 4 is out of the labour force	0.0945**	0.15
	(0.029)	(0.133)
Child 1 is married or in a partnership (ref.)	-	-
Child 1 is never married or divorced	0.183***	0.237**
	(0.00858)	(0.0765)
Child 1 is widowed	0.0569	0.135
	(0.0441)	(0.214)
Child 2 is married or in a partnership (ref.)	-	-
Child 2 is never married or divorced	0.139***	0.131*

	(0.00977)	(0.0657)
Child 2 is widowed	-0.0761	-0.208
	(0.0593)	(0.336)
Child 3 is married or in partnership (ref.)	-	-
Child 3 is never married or divorced	0.0991***	0.064
	(0.0134)	(0.0723)
Child 3 is widowed	-0.207*	0.195
	(0.0977)	(0.635)
Child 4 is married or in a partnership (ref.)	-	-
Child 4 is never married or divorced	0.101***	0.306**
	(0.0233)	(0.112)
Child 4 is widowed	-0.136	0.413
	(0.253)	(1.678)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Constant	0.00124	1.972***
Observations	19,684	19,684
R-squared	0.301	0.188

Robust standard errors in parentheses, with clustering at the level of the instruments. *** p<0.001, ** p<0.01, * p<0.05

Appendix 7.3. 2SLS regressions of Euro-D depressive symptoms scores (additional children characteristics: age of the children in age categories)

Variables	First stage	Second stage
IVs		
Unemployment rate of child 1	0.00560***	-
	(0.00114)	
Unemployment rate of child 2	0.00202*	-
	(0.000828)	
Unemployment rate of child 3	0.000576	-
	(0.000903)	
Unemployment rate of child 4	1.78E-06	-
	(0.00134)	
Exposure variable of interest		
Co-residing with an adult child	-	-1.552**
		(0.536)
Demographic and socioeconomic		
Aged 50 to 60 (ref.)	-	-
Aged 61 to 70	-0.0428***	-0.282***
	(0.00821)	(0.0512)
Aged over 70	-0.00977	-0.203**
	(0.0123)	(0.0643)
Male	-0.0308***	-0.766***
	(0.00563)	(0.0354)
Primary education (ref.)	-	-
Secondary education	-0.0434***	-0.372***
	(0.00722)	(0.0427)
Tertiary education	-0.0774***	-0.601***
	(0.00931)	(0.0593)
Married or in a partnership (ref.)	-	-
Never married or widowed	-0.100***	0.0873
	(0.00886)	(0.0641)
Divorced	0.0394***	0.359***
	(0.0087)	(0.047)
Pension receipt	-0.0191**	0.0639
	(0.00652)	(0.0415)
Informal care receipt	-0.0108	0.345***
	(0.0067)	(0.0395)
Log of household total income	0.00431	-0.0417**
	(0.00311)	(0.0158)
Financial strain	0.0471***	0.5587***
	(0.0073)	(0.0443)
Health status		
Number of limitations with ADLs	-0.0108	0.308***

	(0.00601)	(0.0365)
Number of limitations with IADLs	0.0202***	0.478***
	(0.00497)	(0.0365)
2+ chronic illnesses	-0.00237	0.870***
	(0.00509)	(0.0293)
Children characteristics		
Number of children	0.0589***	0.153**
	(0.00847)	(0.0533)
Child 1 is a male	-0.0334***	-0.103**
	(0.0081)	(0.0321)
Child 2 is a male	-0.0416***	-0.104**
	(0.00583)	(0.0365)
Child 3 is a male	-0.0113	-0.051
	(0.00885)	(0.0479)
Child 4 is a male	-0.0544**	-0.115
	(0.0177)	(0.0848)
Child 1 is employed (ref.)	-	-
Child 1 is unemployed	0.0843***	0.417***
	(0.0127)	(0.074)
Child 1 is out of the labour force	0.0572***	0.183***
	(0.00897)	(0.055)
Child 2 is employed (ref.)	-	-
Child 2 is unemployed	0.0483***	0.304***
	(0.0134)	(0.0685)
Child 2 is out of the labour force	0.0371***	0.137**
	(0.00988)	(0.0485)
Child 3 is employed (ref.)	-	-
Child 3 is unemployed	0.00442	0.371***
	(0.019)	(0.103)
Child 3 is out of the labour force	0.0242	0.188*
	(0.0143)	(0.0742)
Child 4 is employed (ref.)	-	-
Child 4 is unemployed	0.00896	0.327
	(0.0365)	(0.21)
Child 4 is out of the labour force	0.0682**	0.177
	(0.0252)	(0.131)
Child 1 is married or in a partnership (ref.)	-	-
Child 1 is never married or divorced	0.169***	0.352***
	(0.00767)	(0.0979)
Child 1 is widowed	0.0316	0.194
	(0.0367)	(0.17)
Child 2 is married or in a partnership (ref.)	-	-
Child 2 is never married or divorced	0.117***	0.205**

	(0.00801)	(0.0753)
Child 2 is widowed	-0.00509	-0.119
	(0.0496)	(0.243)
Child 3 is married or in partnership (ref.)	-	-
Child 3 is never married or divorced	0.0788***	0.0718
	(0.011)	(0.0694)
Child 3 is widowed	-0.0165	0.332
	(0.0878)	(0.48)
Child 4 is married or in a partnership (ref.)	-	-
Child 4 is never married or divorced	0.0609***	0.218*
	(0.0178)	(0.102)
Child 4 is widowed	-0.0261	-0.356
	(0.198)	(1.439)
Child 1 is up to 20 (ref.)	-	-
21 to 40	-0.256***	-0.743***
	(0.0386)	(0.218)
Over 40	-0.309***	-0.796**
	(0.0398)	(0.247)
Child 2 is up to 20 (ref.)	-	-
21 to 40	-0.202***	-0.25
	(0.0255)	(0.15)
Over 40	-0.220***	-0.318
	(0.0277)	(0.164)
Child 3 is up to 20 (ref.)	-	-
21 to 40	-0.244***	-0.317
	(0.0298)	(0.177)
Over 40	-0.276***	-0.361
	(0.0331)	(0.205)
Child 4 is up to 20 (ref.)	-	-
21 to 40	-0.185***	-0.419
	(0.0418)	(0.219)
Over 40	-0.216***	-0.704**
	(0.0495)	(0.262)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Constant	0.934***	3.891***
	(0.091)	(0.679)
Observations	28,252	28,252
R-squared	0.289	0.134

Robust standard errors in parentheses, with clustering at the level of the instruments.
*** p<0.001, ** p<0.01, * p<0.05

Appendix 7.4. 2SLS regressions of Euro-D depressive symptoms scores (additional children characteristics: mean age of all children)

Variables	First stage	Second stage
IVs		
Unemployment rate of child 1	0.00373***	-
	(0.00107)	
Unemployment rate of child 2	0.00172*	-
	(0.000767)	
Unemployment rate of child 3	0.00165*	-
	(0.000782)	
Unemployment rate of child 4	0.000983	-
	(0.00112)	
Exposure variable of interest		
Co-residing with an adult child	-	-1.728*
		(0.814)
Demographic and socioeconomic		
Aged 50 to 60 (ref.)	-	-
Aged 61 to 70	0.0240*	-0.162**
	(0.00939)	(0.0526)
Aged over 70	0.106***	-0.016
	(0.014)	(0.116)
Male	-0.0475***	-0.788***
	(0.00633)	(0.0514)
Primary education (ref.)	-	-
Secondary education	-0.0441***	-0.412***
	(0.00786)	(0.0531)
Tertiary education	-0.0876***	-0.683***
	(0.0102)	(0.0883)
Married or in a partnership (ref.)	-	-
Never married or widowed	-0.117***	0.0691
	(0.00974)	(0.106)
Divorced	0.0444***	0.373***
	(0.00944)	(0.0596)
Pension receipt	-0.00909	0.0794
	(0.00753)	(0.0456)
Informal care receipt	-0.00529	0.337***
	(0.00762)	(0.0448)
Log of household total income	0.000747	-0.0441***
	(0.00301)	(0.013)
Financial strain	0.0621***	0.4582***
	(0.007)	(0.0443)
Health status		
Number of limitations with ADLs	-0.0123	0.273***

	(0.00699)	(0.0457)
Number of limitations with IADLs	0.0198***	0.515***
	(0.00583)	(0.0444)
2+ chronic illnesses	-0.00159	0.878***
	(0.00586)	(0.0313)
Children characteristics		
Number of children	0.0571***	0.146*
	(0.00828)	(0.0633)
Mean age of children	-0.0175***	-0.0333*
	(0.00102)	(0.0162)
Child 1 is a male	-0.0306***	-0.113**
	(0.00878)	(0.0386)
Child 2 is a male	-0.0439***	-0.108*
	(0.00575)	(0.0443)
Child 3 is a male	-0.0153	-0.0619
	(0.00869)	(0.048)
Child 4 is a male	-0.0557**	-0.134
	(0.0169)	(0.0898)
Child 1 is employed (ref.)	-	-
Child 1 is unemployed	0.0649***	0.361***
	(0.0136)	(0.0828)
Child 1 is out of the labour force	0.0394***	0.213***
	(0.00969)	(0.0604)
Child 2 is employed (ref.)	-	-
Child 2 is unemployed	0.0452***	0.302***
	(0.0128)	(0.0715)
Child 2 is out of the labour force	0.0539***	0.148*
	-0.0094	-0.0632
Child 3 is employed (ref.)	-	-
Child 3 is unemployed	0.0065	0.353***
	-0.0176	-0.103
Child 3 is out of the labour force	0.0505***	0.234**
	(0.0136)	(0.0779)
Child 4 is employed (ref.)	-	-
Child 4 is unemployed	0.019	0.457*
	(0.0344)	(0.203)
Child 4 is out of the labour force	0.0835***	0.264*
	(0.0224)	(0.129)
Child 1 is married or in a partnership (ref.)	-	-
Child 1 is never married or divorced	0.135***	0.311**
	(0.00813)	(0.116)
Child 1 is widowed	0.0207	0.33
	(0.0399)	(0.19)

Child 2 is married or in a partnership (ref.)	-	-
Child 2 is never married or divorced	0.107***	0.194*
	(0.0079)	(0.0965)
Child 2 is widowed	0.019	-0.079
	(0.0492)	(0.247)
Child 3 is married or in partnership (ref.)	-	-
Child 3 is never married or divorced	0.0846***	0.105
	(0.0108)	(0.0892)
Child 3 is widowed	-0.000776	0.391
	(0.0813)	(0.465)
Child 4 is married or in a partnership (ref.)	-	-
Child 4 is never married or divorced	0.0628***	0.252*
	(0.0173)	(0.109)
Child 4 is widowed	-0.019	-0.383
	(0.189)	(1.435)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Constant	0.650***	3.350***
	(0.0697)	(0.692)
Observations	28,252	28,252
R-squared	0.307	0.108

Robust standard errors in parentheses, with clustering at the level of the instruments.
*** p<0.001, ** p<0.01, * p<0.05

Appendix 7.5. 2SLS regressions of Euro-D depressive symptoms scores (additional children characteristics: combination of children characteristics)

Variables	First stage	Second stage
IVs		
Unemployment rate of child 1	0.00836***	-
	(0.000794)	
Unemployment rate of child 2	0.00486***	-
	(0.000608)	
Unemployment rate of child 3	0.00527***	-
	(0.000698)	
Unemployment rate of child 4	0.00419***	-
	(0.00103)	
Exposure variable of interest		
Co-residing with an adult child	-	-0.427*
		(0.212)
Demographic and socioeconomic		
Aged 50 to 60 (ref.)	-	-
Aged 61 to 70	-0.0743***	-0.250***
	(0.00834)	(0.0437)
Aged over 70	-0.0633***	-0.240***
	(0.0119)	(0.0578)
Male	-0.0326***	-0.730***
	(0.0055)	(0.0272)
Primary education (ref.)	-	-
Secondary education	-0.0419***	-0.338***
	(0.00704)	(0.0347)
Tertiary education	-0.0635***	-0.541***
	(0.00876)	(0.0432)
Married or in a partnership (ref.)	-	-
Never married or widowed	-0.123***	0.227***
	(0.00862)	(0.0416)
Divorced	0.0307***	0.324***
	(0.00861)	(0.04)
Pension receipt	-0.0258***	0.0924*
	(0.00655)	(0.0374)
Log of household total income	0.00492	-0.0518***
	(0.00251)	(0.0114)
Informal care receipt	-0.0102	0.351***
	(0.00676)	(0.0369)
Financial strain	0.0621***	0.4582***
	(0.007)	(0.0443)
Health status		
Number of limitations with ADLs	-0.0144*	0.349***

	(0.00566)	(0.0348)
Number of limitations with IADLs	0.0210***	0.450***
	(0.00452)	(0.0335)
2+ chronic illnesses	-0.00523	0.881***
	(0.00513)	(0.0271)
Children characteristics		
Number of children	0.0510***	0.0822*
	(0.00769)	(0.0396)
Proportion of married children	-0.296***	-0.238**
	(0.0106)	(0.0782)
Proportion of daughters	-0.0728***	-0.108**
	(0.0092)	(0.0349)
Proportion of employed children	-0.141***	-0.337***
	(0.00899)	(0.0538)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Constant	0.380***	2.705***
	(0.0598)	(0.261)
Observations	28,852	28,852
R-squared	0.297	0.207

Robust standard errors in parentheses, with clustering at the level of the instruments.
*** p<0.001, ** p<0.01, * p<0.05

Appendix 7.6. 2SLS regressions of Euro-D depressive symptoms scores (country X year interaction)

Variables	First stage	Second stage
IVs		
Unemployment rate of child 1	0.00955***	-
	(0.000923)	
Unemployment rate of child 2	0.00457***	-
	(0.000698)	
Unemployment rate of child 3	0.00342***	-
	(0.000855)	
Unemployment rate of child 4	0.00224	-
	(0.00115)	
Exposure variable of interest		
Co-residing with an adult child	-	-0.491*
		(0.244)
Demographic and socioeconomic		
Aged 50 to 60 (ref.)	-	-
Aged 61 to 70	-0.0617***	-0.200***
	(0.00837)	(0.0427)
Aged over 70	-0.0501***	-0.151**
	(0.0116)	(0.0553)
Male	-0.0239***	-0.711***
	(0.00554)	(0.0287)
Primary education (ref.)	-	-
Secondary education	-0.0359***	-0.263***
	(0.00706)	(0.0366)
Tertiary education	-0.0657***	-0.402***
	(0.00952)	(0.0459)
Married or in a partnership (ref.)	-	-
Never married or widowed	-0.107***	0.131**
	(0.00895)	(0.0421)
Divorced	0.0352***	0.312***
	(0.00886)	(0.0427)
Pension receipt	-0.0301***	0.0426
	(0.00665)	(0.038)
Log of household income	0.00911**	-0.00224
	(0.00277)	(0.0122)
Financial strain	0.0403***	0.595***
	(0.00636)	(0.0326)
Informal care receipt	-0.0113	0.346***
	(0.00688)	(0.0365)
Health status		
Number of limitations with ADLs	-0.0128*	0.318***

	(0.00618)	(0.0363)
Number of limitations with IADLs	0.0184***	0.448***
	(0.00493)	(0.0359)
2+ chronic illnesses	-0.00326	0.827***
	(0.00522)	(0.0286)
Children characteristics		
Number of children	-0.228*	0.136
	(0.0929)	(0.452)
Child 1 is a male	-0.0416***	-0.0673*
	(0.00813)	(0.0264)
Child 2 is a male	-0.0472***	-0.049
	(0.00581)	(0.0295)
Child 3 is a male	-0.0251**	-0.0475
	(0.00859)	(0.0452)
Child 4 is a male	-0.0587**	-0.0998
	(0.0179)	(0.078)
Child 1 is employed (ref.)	-	-
Child 1 is unemployed	0.0836***	0.263***
	(0.0127)	(0.0594)
Child 1 is out of the labour force	0.0853***	0.105*
	(0.00987)	(0.0456)
Child 2 is employed (ref.)	-	-
Child 2 is unemployed	0.0468***	0.222***
	(0.0135)	(0.0588)
Child 2 is out of the labour force	0.0603***	0.0661
	(0.00989)	(0.0413)
Child 3 is employed (ref.)	-	
Child 3 is unemployed	-0.00649	0.292**
	(0.0194)	(0.0971)
Child 3 is out of the labour force	0.0695***	0.174**
	(0.0145)	(0.0655)
Child 4 is employed (ref.)	-	-
Child 4 is unemployed	0.0266	0.394*
	(0.0356)	(0.174)
Child 4 is out of the labour force	0.0770***	0.124
	(0.0226)	(0.101)
Child 1 is married or in a partnership (ref.)	-	-
Child 1 is never married or divorced	0.178***	0.167**
	(0.00767)	(0.0553)
Child 1 is widowed	0.0252	0.153
	(0.0372)	(0.17)
Child 2 is married or in a partnership (ref.)	-	-
Child 2 is never married or divorced	0.121***	0.0617

	(0.00801)	(0.0451)
Child 2 is widowed	-0.00412	-0.0682
	(0.0579)	(0.209)
Child 3 is married or in partnership (ref.)	-	-
Child 3 is never married or divorced	0.103***	0.00731
	(0.0116)	(0.0565)
Child 3 is widowed	0.036	0.717
	(0.0922)	(0.483)
Child 4 is married or in a partnership (ref.)	-	-
Child 4 is never married or divorced	0.0548**	0.0916
	(0.0181)	(0.0868)
Child 4 is widowed	-0.0668	-0.297
	(0.183)	(1.062)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Country X year fixed effects	Yes	Yes
Constant	-49.18***	-163.6***
	(9.512)	(32.26)
Observations	28,252	28,252
R-squared	0.286	0.221

Robust standard errors in parentheses, with clustering at the level of the instruments.
*** p<0.001, ** p<0.01, * p<0.05

Appendix 7.7. 2SLS regressions of Euro-D depressive symptoms scores (mean age X gender interactions)

Variables	First stage	Second stage
IVs		
Unemployment rate of child 1	0.00487***	-
	(0.000806)	
Unemployment rate of child 2	0.00196**	-
	(0.000673)	
Unemployment rate of child 3	0.000725	-
	(0.000798)	
Unemployment rate of child 4	0.00283*	-
	(0.00112)	
Exposure variable of interest		
Co-residing with an adult child	-	-1.187*
		(0.575)
Demographic and socioeconomic		
Aged 50 to 60 (ref.)	-	-
Aged 61 to 70	0.0227**	-0.163***
	(0.00766)	(0.0441)
Aged over 70	0.104***	-0.0415
	(0.012)	(0.0894)
Male	-0.0478***	-0.777***
	(0.00559)	(0.0417)
Primary education (ref.)	-	
Secondary education	-0.0359***	-0.263***
	(0.00706)	(0.0366)
Tertiary education	-0.0657***	-0.402***
	(0.00952)	(0.0459)
Married or in a partnership (ref.)	-	-
Never married or widowed	-0.107***	0.131**
	(0.00895)	(0.0421)
Divorced	0.0352***	0.312***
	(0.00886)	(0.0427)
Pension receipt	-0.0301***	0.0426
	(0.00665)	(0.038)
Log of household income	0.00911**	-0.00224
	(0.00277)	(0.0122)
Financial strain	0.0403***	0.595***
	(0.00636)	(0.0326)
Informal care receipt	-0.00923	0.357***
	(0.00684)	(0.0378)
Health status		
Number of limitations with ADLs	-0.0103	0.327***

	(0.00607)	(0.0361)
Number of limitations with IADLs	0.0213***	0.474***
	(0.00505)	(0.0367)
2+ chronic illnesses	0.00112	0.872***
	(0.005)	(0.0293)
Children characteristics		
Number of children	-0.269**	-0.136
	(0.0847)	(0.459)
Mean children age	-0.0160***	-0.0199
	(0.00206)	(0.0128)
Mean children age X gender of child 1	0.000369	-0.00408
	(0.00108)	(0.00366)
Mean children age X gender of child 2	8.75E-06	6.72E-05
	(1.07E-05-	(4.14E-05)
Mean children age X gender of child 3	5.33e-05***	5.27E-05
	(1.16E-05)	(5.88E-05)
Mean children age X gender of child 4	-5.08e-05***	3.74E-08
	(1.47E-05)	(8.44E-05)
Child 1 is a male	-0.0481	0.0418
	(0.0378)	(0.123)
Child 2 is a male	-0.0431***	-0.0814*
	(0.00557)	(0.0367)
Child 3 is a male	-0.0210*	-0.0547
	(0.00834)	(0.0463)
Child 4 is a male	-0.0551**	-0.137
	(0.0169)	(0.081)
Child 1 is employed (ref.)	-	-
Child 1 is unemployed	0.0874***	0.401***
	(0.0123)	(0.077)
Child 1 is out of the labour force	0.0689***	0.168**
	(0.00911)	(0.06)
Child 2 is employed (ref.)	-	-
Child 2 is unemployed	0.0474***	0.303***
	(0.0129)	(0.0634)
Child 2 is out of the labour force	0.0496***	0.115*
	(0.00931)	(0.0498)
Child 3 is employed (ref.)	-	-
Child 3 is unemployed	-0.00613	0.326**
	(0.0189)	(0.101)
Child 3 is out of the labour force	0.0411**	0.198**
	(0.0143)	(0.0697)
Child 4 is employed (ref.)	-	-
Child 4 is unemployed	0.0115	0.420*

	(0.0337)	(0.183)
Child 4 is out of the labor force	0.0803***	0.229*
	(0.0224)	(0.113)
Child 1 is married or in a partnership (ref.)	-	-
Child 1 is never married or divorced	0.157***	0.274**
	(0.0072)	(0.0972)
Child 1 is widowed	0.0434	0.255
	(0.0374)	(0.176)
Child 2 is married or in a partnership (ref.)	-	-
Child 2 is never married or divorced	0.100***	0.108
	(0.00769)	(0.0695)
Child 2 is widowed	0.0376	-0.00831
	(0.0576)	(0.223)
Child 3 is married or in partnership (ref.)	-	-
Child 3 is never married or divorced	0.0789***	0.0326
	(0.0115)	(0.0691)
Child 3 is widowed	0.0534	0.759
	(0.098)	(0.467)
Child 4 is married or in a partnership (ref.)	-	-
Child 4 is never married or divorced	0.0743***	0.163
	(0.175)	(0.106)
Child 4 is widowed	-0.0279	-0.233
	(0.161)	(0.08)
Constant	1.843***	3.522
	(0.34)	(2.057)
Observations	28,852	28,852
R-squared	0.303	0.166

Robust standard errors in parentheses, with clustering at the level of the instruments.
*** p<0.001, ** p<0.01, * p<0.05

Appendix 7.8. IV-2SLS regressions of Euro-D depressive symptoms scores, by gender of the youngest child

	Youngest child is a daughter		*Youngest child is a son*	
Variables	First stage	Second stage	First stage	Second stage
Unemployment rate of child 1	0.0100***	-	0.00868***	-
	0.00115		0.00136	
Unemployment rate of child 2	0.00398***	-	0.00393***	-
	0.00105		0.00091	
Unemployment rate of child 3	0.00316*	-	0.00305*	-
	0.00123	-	0.00122	
Unemployment rate of child 4	0.00236*		0.0019	-
	0.00168		0.00157	
Co-residence	-	-0.682*	-	-0.812
		0.325		0.422
61 to 70 (ref. 50 to 60)	-0.0621***	-0.218***	-0.0621***	-0.227***
	-0.0127	-0.0571	-0.0105	-0.0684
Over 70	-0.0433*	-0.166*	-0.0583***	-0.185*
	-0.0171	-0.076	-0.0148	-0.0834
Male	-0.0230**	-0.738***	-0.0251***	-0.692***
	-0.00833	-0.0432	-0.00722	-0.0394
Secondary education ref. primary education)	-0.0255*	-0.241***	-0.0481***	-0.294***
	-0.01	-0.0498	-0.00974	-0.0561
Tertiary education	-0.0542***	-0.318***	-0.0770***	-0.503***
	-0.0131	-0.0607	-0.0134	-0.0726
Never married or divorced (ref. married or in a partnership)	-0.105***	0.0818	-0.116***	0.112
	-0.0125	-0.0572	-0.0131	-0.0679
Widowed	0.0388**	0.228***	0.0259*	0.397***

	-0.0129	-0.0601	-0.0121	-0.061
Pension receipt	-0.0314***	0.0203	-0.0260**	0.0529
	-0.00926	-0.0508	-0.00948	-0.0558
Log of household income	0.00505	-0.0141	0.0054	-0.0121
	-0.00397	-0.0185	-0.0035	-0.0143
Financial strain	0.0500***	0.588***	0.0287**	0.613***
	-0.00847	-0.048	-0.00934	-0.0469
Number of limitations with ADL	-0.0073	0.380***	-0.0191*	0.246***
	-0.00914	-0.0514	-0.00798	-0.0506
Number of limitations with IADL	0.0124	0.393***	0.0245***	0.511***
	-0.00718	-0.0482	-0.00661	-0.0517
2+ chronic illnesses	-0.00547	0.801***	-0.00254	0.850***
	-0.00716	-0.0393	-0.00746	-0.0418
Number of children	-0.165	-0.0704	-0.340**	0.175
	-0.131	-0.717	-0.12	-0.512
Child 2 is a male	-0.0498***	0.000738	-0.0442***	-0.124**
	-0.00806	-0.0443	-0.00859	-0.0406
Child 3 is a male	-0.0374***	-0.102	-0.0108	-0.00225
	-0.0111	-0.0637	-0.0133	-0.0666
Child 4 is a male	-0.0478*	-0.187	-0.0695*	-0.00583
	-0.0233	-0.0975	-0.0269	-0.12
Child 1 is unemployed (ref. Child 1 is employed)	0.0651***	0.326***	0.107***	0.226*
	-0.0164	-0.0756	-0.0195	-0.0971
Child 1 is out of the labor force	0.0613***	0.143**	0.130***	0.157
	-0.0111	-0.0531	-0.0183	-0.096
Child 2 is unemployed (ref. Child 2 is employed)	0.0702***	0.270**	0.0234	0.207*
	-0.0197	-0.0849	-0.0174	-0.0849

Child 2 is out of the labour force	0.0739***	0.0741	0.0503***	0.109
	-0.0145	-0.0579	-0.0135	-0.062
Child 3 is unemployed (ref. Child 3 is employed)	0.0319	0.396**	-0.0383	0.209
	-0.0262	-0.152	-0.028	-0.124
Child 3 is out of the labour force	0.104***	0.255**	0.0382	0.136
	-0.0185	-0.0936	-0.0227	-0.0931
Child 4 is unemployed (ref. Child 4 is employed)	-0.0247	0.709**	0.0777	0.0715
	-0.0506	-0.236	-0.0485	-0.255
Child 4 is out of the labour force	0.0564	0.121	0.100**	0.167
	-0.0323	-0.127	-0.0306	-0.164
Child 1 is never married or divorced (ref. Child 1 is married or in a partnership)	0.155***	0.227**	0.195***	0.219*
	-0.0101	-0.0691	-0.0112	-0.0978
Child 1 is widowed	0.0193	0.185	-0.0115	0.0361
	-0.04	-0.193	-0.0915	-0.385
Child 2 is never married or divorced (ref. Child 2 is married or in a partnership)	0.126***	0.112	0.119***	0.0894
	-0.0114	-0.0654	-0.0111	-0.0704
Child 2 is widowed	0.0181	-0.257	-0.0351	0.133
	-0.0742	-0.273	-0.09	-0.298
Child 3 is never married or divorced (ref. Child 3 is married or in a partnership)	0.107***	-0.0214	0.104***	0.112
	-0.0159	-0.0797	-0.0168	-0.0823
Child 3 is widowed	0.0832	1.469*	-0.0241	-0.45
	-0.124	-0.582	-0.13	-0.739
Child 4 is never married or divorced (ref. Child 4 is married or in a partnership)	0.0627*	0.218	0.0502	-0.00965
	-0.0252	-0.129	-0.026	-0.117

Child 4 is widowed	0.0671	0.331	-0.578***	-2.373***
	-0.159	-1.261	-0.0358	-0.278
Informal care receipt	-0.001	0.363***	-0.021	0.322***
	-0.0085	-0.0534	-0.0108	-0.0517
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	16,938	16,938	11,314	11,314
R-squared	0.278	0.207	0.294	0.214

Robust standard errors in parentheses, with clustering at the level of the instruments.
*** p<0.001, ** p<0.01, * p<0.05

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Are different measures of depressive symptoms in old age comparable? An analysis of the CES-D and Euro-D scales in 13 countries

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Abstract

The Centre for Epidemiologic Studies of Depression (CES-D) and the Euro-D are commonly used depressive symptom scales but their comparability has not been assessed to date. This article aims to contribute to the literature comparing the drivers of depression in old age across countries by examining whether CES-D (in its eight-item short version) and Euro-D are comparable. Data from the Survey of Health, Ageing and Retirement in Europe (SHARE, $N = 15{,}487$) covering 13 countries was used to examine the scales' distributional properties, systematic differences between population subgroups, sensitivity and specificity, and associations with established risk factors for depression in old age. CES-D and Euro-D were strongly correlated ($r = 0.6819$, $p < 0.000$). However, agreement between the two scales was moderate. There were systematic discrepancies in scores by demographic characteristics. CES-D captures a more extreme pool of depressed individuals than Euro-D. Although associations with risk factors are always in the same direction, they are often stronger for CES-D than Euro-D. Findings highlight the need to be cautious when comparing depression levels and associations with risk factors between surveys using different measures of depressive symptoms.

Introduction

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). Depression is also the most frequent cause of emotional suffering in later life (Beekman *et al.*, 1999). A growing literature based on cross-national comparable data suggests that there are significant differences in the prevalence of later-life depressive symptoms across countries (Castro-Costa *et al.*, 2007; Kok *et al.*, 2012; Missinne *et al.*, 2014; Ploubidis and Grundy, 2009). In addition, recent studies suggest that risk factors for depression may differ cross-nationally (Crimmins *et al.*, 2011; Di Gessa and Grundy, 2014; Lunau *et al.*, 2013; Riumallo-Herl *et al.*, 2014; Siegrist *et al.*, 2012). Most of these studies are based on data from harmonized longitudinal ageing studies, such as the Survey of Health, Ageing and Retirement in Europe (SHARE), the English

Longitudinal Study of Ageing (ELSA) and the Health and Retirement Survey (HRS) in the United States (US). An advantage of these surveys is that they include broadly comparable measures of health, employment, social interactions and well-being (Banks *et al.*, 2012; Börsch-Supan *et al.*, 2005; National Institute on Ageing, 2014). However, they use different measures to assess depressive symptoms. While SHARE uses the Euro-D scale of depressive symptoms, HRS and ELSA rely on a short version of the Centre for Epidemiological Studies Depression (CES-D) scale. Although measurement comparability is an essential prerequisite for robust comparisons across countries, it is as yet unclear how the CES-D scale compares to the Euro-D scale, and whether cross-national comparisons using these two different measures are valid.

In this paper, we exploit unique data from the second wave of SHARE, which administered both the CES-D and Euro-D scales to a sample of older Europeans in 13 countries. Our aim was to assess the comparability of the scales; their sensitivity and specificity to identify depression caseness; and to assess differences in the association of each scale with established risk factors for depression. To our knowledge, this is the first study examining the comparability of the CES-D and Euro-D measures of depressive symptoms.

Methods

Data collection and participants

SHARE is a longitudinal, nationally representative survey designed to provide comparable information on the health, employment and social conditions of Europeans aged 50+ in 13 countries (Austria, Belgium, Czechia, Denmark, France, Germany, Greece, Italy, Poland, Spain, Sweden, Switzerland and the Netherlands). Specific details about the survey are available elsewhere (Börsch-Supan and Jürges, 2005). Participants in each country were interviewed in 2004/2005 and subsequently re-interviewed in 2006/2007, 2008/2009, 2010/2011 and 2012/2013 through face-to-face interviews using computer-assisted personal interviewing (CAPI) technology. Expert agencies translated items, with extensive pre-testing to ensure comparability. Response rates varied from country to country, but overall household response at enrolment was 62% (Börsch-Supan and Jürges, 2005). For our analysis, we used data from the second wave, which contained measures of both the Euro-D and CES-D for the same respondents. Only respondents with scores from the two scales were included in the analysis, resulting in a final sample of 15,487 respondents.

Measures

We compared two scales of depressive symptoms: (a) the eight-item version of the CES-D scale; and (b) the 12-item EURO-D scale. The original CES-D scale comprises 20 items (Radloff, 1977), but shorter versions are frequently used and have been shown to be reliable (Kohout *et al.*, 1993). An eight-item version of the CES-D scale was included in the second wave of SHARE, asking respondents whether they had experienced any of the following symptoms during the previous week: felt depressed, felt that everything was an effort, felt that their sleep was restless, were happy, felt lonely, enjoyed life, felt sad, or were unable to get going. Possible responses were *yes* or *no*. The score ranges from zero to eight, with higher scores indicating higher levels of depressive symptoms. A cutoff point of three is frequently used to define depression caseness (Han, 2002; Turvey *et al.*, 1999). The CES-D scale was originally designed to measure depressive symptom levels in the US but the validity of translated versions has been confirmed for European countries (Fuhrer and Rouillon, 1989; Goncalves and Fagulha, 2004; Missinne *et al.*, 2014; Van de Velde *et al.*, 2010a, 2010b).

The EURO-D scale was developed to collect harmonized data on late-life depressive symptoms in the 11 European countries which took part in the EURODEP study (Prince *et al.*, 1999). Five existing depression measures (Geriatric Mental State-AGECAT, SHORT-CARE, CES-D, Zung Self-rating Depression Scale, and the Comprehensive Psychopathological Rating Scale) were merged to form a 12-item scale (Prince *et al.*, 1999). The Euro-D has been evaluated as reliable and is highly correlated with other mental health measures (Prince *et al.*, 1999). Respondents were asked to report whether during the past month they experienced any of the following symptoms: depressed mood, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment and tearfulness. Possible responses were *yes* or *no*. The score ranges from zero to 12, with higher scores indicating higher levels of depressive symptoms (Prince, 2002). A threshold of four has been suggested for depression caseness (Castro-Costa *et al.*, 2007, 2008; Dewey and Prince, 2005).

Data analysis

As the two scales include different numbers of items and consequently have different total scores, values were normalized to obtain a common metric for both ranging from zero to one. Normalized scales were obtained by dividing individual scores by the country-specific maximum value for each scale. For Euro-D, this value ranged from zero

to 11 or 12 depending on the country, while for CES-D this ranged from zero to eight. Roughly, estimates from normalized scores can be translated into original scales by multiplying coefficients by the mid-range of the maximum value for each scale.

First, to assess whether there were systematic differences in the response to each scale by the same respondent, a difference score (Euro-D minus CES-D) was used to summarize congruence between the two scales (Edwards, 2001). Ordinary least squares (OLS) models were then used to assess the predictors of incongruence (Buber and Engelhardt, 2011; Cairney and Krause, 2005). All multiple linear regression models included gender, age in three categories (50 to 60, 61 to 70, over 70), marital status (married or in a partnership; divorced, widowed or single), education in three categories (primary education or less; secondary education; post-secondary education), a measure of economic strain (household is able to make ends meet with difficulty or with some difficulty; household is able to make ends meet easily or fairly easily), the number of chronic illnesses (less than two chronic illnesses; two or more chronic illnesses), limitations in activities of daily living (ADLs) (less than one limitation with ADLs; more than one limitation with ADLs) reported by the respondent; and country of residence.

The Euro-D and CES-D scales use different cutoff points to determine depression caseness, i.e. whether respondents are likely to be clinically depressed. We estimated Cohen's kappa (κ) scores to assess the level of agreement between the two scores in identifying depression caseness. Values range between zero (agreement equivalent to chance) and one (perfect agreement) (Altman, 1991). Next, the sensitivity (proportion of depressed individuals identified as depressed) and the specificity (proportion of non-depressed individuals categorized as non-depressed) of the CES-D were estimated, using the Euro-D scale as reference. A perfect match would be described as 100% sensitive (all respondents classified as depressed by the Euro-D scale are classified as depressed by the CES-D scale) and 100% specific (all respondents classified as non-depressed in the Euro-D scale are classified as non-depressed by the CES-D scale). We used the recommended threshold for caseness for depression for both scales. In sensitivity analyses, we examined alternative cutoff points (e.g. a threshold of three for the Euro-D scale, as sometimes recommended in the literature). We found that results were not sensitive to the specific thresholds and therefore decided to report only the results for the optimal combination between two scores (four for Euro-D and three for CES-D). The Receiver Operating Characteristic (ROC) curve was also used to examine whether the CES-D scale identified the same depressed respondents as the Euro-D scale. The ROC curve (Hanley and McNeil, 1982) measures the overall ability of the CES-D scale to discriminate against the criterion of the Euro-D score. The area under the ROC curve measures accuracy: an area of one represents a "perfect match", while an area of 0.5 represents a "worthless match". A value between 0.90 and 1 was considered as excellent, between 0.80 and 0.90 as good, and between 0.70 and 0.80 as fair (Hanley and McNeil, 1982).

Finally, the associations between each normalized depression score and selected well-established risk factors for depression were explored. Multiple linear regression models were first estimated to assess whether the associations of depressive symptoms with risk factors differed for the two scales. Coefficients report the association between each explanatory variable and the continuous outcome score. Logistic regression was then used to estimate the association between each risk factor and depressive symptomatology. Cross-equation tests were performed to determine whether the associations between depressive symptom scores and explanatory variables were statistically different across the two scales.

All analyses were conducted using Stata 13 (StataCorp, 2013).

Results

Descriptive statistics

The correlation between the two scores was 0.6819 ($p < 0.000$). The scales had a similar level of internal consistency as measured by the Cronbach's alpha (eight-item CES-D, $\alpha = 0.82$; 12-item Euro-D, $\alpha = 0.72$), which are indicative of high reliability in measuring depressing symptoms.

Distributions of the CES-D and Euro-D scores are presented in Figure 1. The Kernel density plot shows that the CES-D scale is more skewed to the left than the Euro-D scale (i.e. CES-D scores fall under lower depressive symptoms scores than Euro-D scores). Table 1 reports the summary statistics for the two scores for the entire sample and separately by gender and age group. The mean is 0.20 for both scales, but the larger standard deviation of the CES-D (0.26) compared to the Euro-D (0.20) illustrates the wider spread and left tale of the CES-D scale. Paired *t*-tests indicated that differences in means were significant only for the youngest age group (higher depression scores using the Euro-D scale) and for respondents aged 70+ (higher depression scores using the CES-D scale).

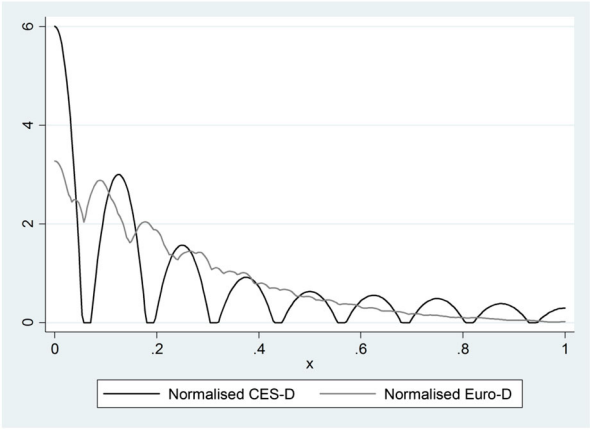

Figure 1. Kernel density plot of the normalized CES-D and Euro-D scales.

Intra-individual differences

The determinants of intra-individual differences in scores are formally explored in Table 2, which presents estimates from the linear regression analyses with the difference between the Euro-D and the CES-D score as dependent variable [Mean = 0.009; standard deviation (SD) = 0.192]. A value of zero for males, for example, would indicate that males do not display different levels of incongruence as compared to females. In contrast, a positive value would indicate that males display a larger positive discrepancy between the Euro-D and CES-D scales than do females. Results show that most variables examined significantly predict the difference scores. Males, those over 70 years of age, those with lower educational attainment, those with 2+ chronic diseases, those with one or more limitations in ADLs, those divorced, widowed or single, and those experiencing economic strain are significantly more likely to have a negative discrepancy between the Euro-D and CES-D scales than their respective counterparts. Significant score differences were also found between countries. Respondents in Sweden, the Netherlands, France, Denmark, Greece, Switzerland, Belgium, and Poland were more likely to score higher on the Euro-D than the CES-D score compared to respondents in Austria (the reference country), while the opposite was true for Italy.

Predicted score differences can be estimated for different individual profiles to illustrate the magnitude of these differences. For example, an Austrian male respondent, aged over 70, single or widowed, with secondary education, reporting both more than one limitation in ADL and more than two chronic conditions will score 0.0844 points higher on the CES-D scale than on the Euro-D scale. In contrast, an Austrian female in the youngest age group without health limitations, higher levels of education and married or in a partnership will have a smaller score difference of 0.054 point.

Discriminability of the two scales

The Euro-D and the CES-D score use different cutoff points to screen for older people with depression. The level of agreement between the two scores, as measured by the kappa score, was moderate [$\kappa = 0.529$, 95% confidence interval (CI) 0.514–0.545]. Table 3 reports the results of the sensitivity and specificity levels of the CES-D scale, taking the Euro-D scale as reference. Sensitivity was 62.6%, indicating that from all respondents identified as depressed by the Euro-D scale, 62.6% are also classified as depressed by the CES-D scale. This implies that 37.4% of respondents who were identified as depressed by the Euro-D went "undetected" by the CES-D scale. In turn, the specificity level was 89.5%, indicating that the CES-D scale identifies as non-depressed 89.5% of respondents categorized as non-depressed by the Euro-D scale. Table 3 also displays a positive predictive value of 65.7%, which corresponds to the proportion of respondents identified

Table 1. Summary statistics of the normalized CES-D and Euro-D scores ($N = 15{,}487$)

	Euro-D			*CES-D*			*Comparison*	
	N	Mean	Standard deviation	*N*	Mean	Standard deviation	Paired *t*-test	*P* Value
Entire sample	15,487	0.20	0.20	15,487	0.20	0.26	0.5192	0.6036
Females	8,445	0.23	0.20	8,445	0.23	0.28	−1.3634	0.1728
Males	7,042	0.15	0.17	7,042	0.15	0.22	0.9244	0.3553
50 to 60	6,372	0.18	0.18	6,372	0.17	0.24	3.8248	0.0001
61 to 70	4,812	0.18	0.18	4,812	0.18	0.25	1.4147	0.1572
Over 70	4,303	0.24	0.21	4,303	0.25	0.25	−6.6647	0.0000

Table 2. Estimated differences in CES-D and Euro-D depressive symptoms scores (fully adjusted model)

	Score difference
Male	−0.0116** (0.00382)
61 to 70 (ref.: 50 to 60)	0.00184 (0.00448)
Over 70	−0.0102* (0.00503)
Divorced, widowed or single	−0.0374*** (0.00418)
Secondary education (ref.: primary education or less)	0.00889 (0.00504)
Post-secondary education	0.0122* (0.00569)
Economic strain	−0.0384*** (0.00453)
2+ chronic diseases	−0.0176*** (0.00399)
1+ limitations in ADLs	−0.0494*** (0.00778)
Germany (ref.: Austria)	−0.00997 (0.0107)
Sweden	0.0506*** (0.0103)
Netherlands	0.0648*** (0.0101)
Spain	0.0220 (0.0115)
Italy	−0.0226* (0.0112)
France	0.0598*** (0.0108)
Denmark	0.0737*** (0.00998)
Greece	0.0288** (0.0111)
Switzerland	0.0411*** (0.0114)
Belgium	0.0418*** (0.0103)
Czechia	−0.0113 (0.0107)
Poland	0.0395*** (0.0118)
Constant	0.00805 (0.0104)
Observations	10,536
R-Squared	0.068

Robust standard errors in parentheses.
***$p < 0.001$,**$p < 0.01$,*$p < 0.05$.
[1]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.
[2]Activities of daily living (ADLs) include putting on shoes and socks, walking across a room, bathing or showering, eating, getting in and out of bed, using the toilet, including getting up and down.
[3]Low education levels correspond to having a high school degree or lower qualifications.
[4]Economic strain is defined as reporting difficulties to make ends meet in the past month.

by the CES-D scale as reporting high depressive symptoms who were also identified by the Euro-D scale as reporting high depressive symptomatology.

The ROC curve in Figure 2 plots the false (discordant) positives (non-depressed individuals according to the Euro-D scale who were classified as depressed by the CES-D scale) against the true (concordant) positives for the cutoff points determined earlier. The area under the curve determines the accuracy of the CES-D cutoff point compared to that of the Euro-D scale, i.e. how well the scale separates the sample into those with and without high levels of depressive symptoms with the results of the Euro-D scores as reference. The area under the ROC curve for our sample is 0.7603 (95% CI 0.7522–0.7684), which is considered as fair.

Table 3. Cross-tabulation of the depression thresholds of the Euro-D and CES-D scores and associated sensitivity and specificity values

	Depressed Euro-D	*Non-depressed Euro-D*	*Total*
Depressed CES-D	2,389	1,413	3,802
Non-depressed CES-D	1,258	10,427	11,685
Total	3,647	11,840	15,487
		%	95% CI
Sensitivity		62.8	61.3–64.4
Specificity		89.2	88.7–89.8
Positive predicted value		65.5	63.9–67
Negative predicted value		88.1	87.5–88.6

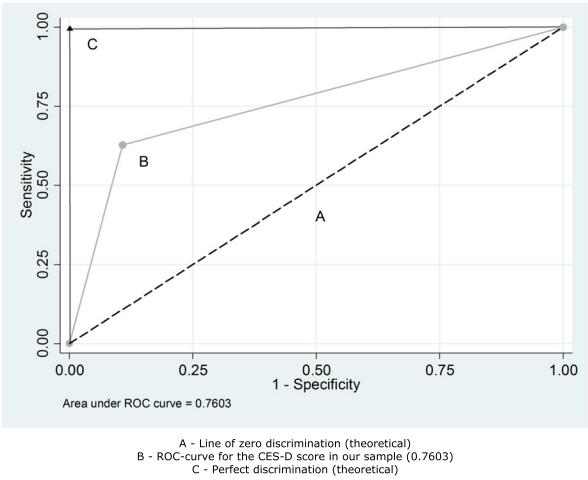

Figure 2. Receiver operating characteristic (ROC) curve for the CES-D scale of depressive symptoms. A, Line of zero discrimination (theoretical); B, ROC-curve for the CES-D score in our sample (0.7603); C, perfect discrimination (theoretical).

Associations with established risk factors

Table 4 summarizes results from models that assess whether associations between depressive symptoms scores

Table 4. Linear regressions for the normalized CES-D and Euro-D depressive symptoms scores and odds ratios for caseness for depression (fully adjusted models)

	Linear regressions		*Cross-equation tests*		*Logistic regressions*		*Cross-equation tests*	
	Normalized CES-D	Normalized Euro-D	Chi-squared	*P*-Value	CES-D	Euro-D	Chi-squared	*P*-Value
Male	−0.0510***	−0.0626***	2.57	0.1087	0.608***	0.470***	20.88	0.0000
	(0.00467)	(0.00353)			(0.0325)	(0.0251)		
61 to 70 (ref.: 50 to 60)	−0.0188***	−0.0170***	3.95	0.0470	0.816**	0.749***	0.00	0.9946
	(0.00544)	(0.00402)			(0.0523)	(0.0473)		
Over 70	0.0116	0.00138	63.24	0.0000	1.012	0.860*	18.72	0.0000
	(0.00622)	(0.00458)			(0.0665)	(0.0567)		
2+ chronic illnesses	0.0868***	0.0692***	120.68	0.0000	2.295***	2.249***	0.36	0.5501
	(0.00499)	(0.00370)			(0.121)	(0.118)		
1+ limitations with ADLs	0.176***	0.126***	152.44	0.0000	3.3365***	2.973***	2.51	0.1128
	(0.0101)	(0.00746)			(0.260)	(0.228)		
Divorced, single or widowed	0.0653***	0.0279***	148.24	0.0000	1.861***	1.319***	41.67	0.0000
	(0.00523)	(0.00381)			(0.100)	(0.0707)		
Secondary education (ref.: primary education or less	−0.0313***	−0.0224***	2.73	0.0986	0.760***	0.755***	1.48	0.2244
	(0.00638)	(0.00462)			(0.0469)	(0.0458)		
Post-secondary education	−0.0348***	−0.0226***	56.66	0.0000	0.650***	0.715***	1.61	0.2039
	(0.00704)	(0.00531)			(0.0523)	(0.0555)		
Economic strain	0.0942***	0.0558***	262.06	0.0000	1.841***	1.659***	10.86	0.0010
	(0.00571)	(0.00411)			(0.132)	(0.114)		
Germany (ref.: Austria)	0.0347**	0.0247**	35.22	0.0000	1.408*	1.245	49.92	0.0000
	(0.0133)	(0.00934)			(0.207)	(0.199)		
Sweden	−0.0158	0.0348***	46.11	0.0000	0.739*	1.074	0.18	0.6673
	(0.0130)	(0.00958)			(0.113)	(0.168)		
Netherlands	−0.0310*	0.0338***	84.18	0.0000	0.632**	1.236	9.98	0.0016
	(0.0127)	(0.00931)			(0.1000)	(0.195)		
Spain	0.0274	0.0494***	4.68	0.0305	1.379*	2.004***	0.25	0.6198
	(0.0158)	(0.0109)			(0.210)	(0.313)		
Italy	0.0790***	0.0563***	129.64	0.0000	1.977***	2.433***	1.32	0.2508
	(0.0148)	(0.0101)			(0.280)	(0.357)		
France	0.00220	0.0620***	44.90	0.0000	1.095	2.181***	40.03	0.0000
	(0.0137)	(0.00946)			(0.158)	(0.320)		
Denmark	−0.0658***	0.00785	98.76	0.0000	0.387***	0.915	12.94	0.0003
	(0.0127)	(0.00942)			(0.0674)	(0.151)		
Greece	−0.0409**	−0.0120	12.57	0.0004	0.829	1.004	15.18	0.0001
	(0.0137)	(0.00976)			(0.122)	(0.154)		
Switzerland	−0.0179	0.0232*	9.80	0.0017	0.734	1.239	0.45	0.5012
	(0.0145)	(0.0106)			(0.136)	(0.225)		
Belgium	−0.00145	0.0404***	17.93	0.0000	1.047	1.532**	2.18	0.1396
	(0.0133)	(0.00945)			(0.152)	(0.230)		
Czechia	0.00954	−0.00174	103.79	0.0000	1.244	1.261	46.65	0.0000
	(0.0139)	(0.00947)			(0.176)	(0.190)		
Poland	0.0581***	0.0976***	7.43	0.0064	1.694***	3.708***	43.19	0.0000
	(0.0153)	(0.0104)			(0.244)	(0.548)		
Constant	0.133***	0.141***			0.127***	0.141***		
	(0.0136)	(0.00955)			(0.0196)	(0.0221)		
Observations	10,536	10,536			10,536	10,536		
R-Squared	0.236	0.220			0.159	0.144		

Robust standard errors in parentheses.***$p < 0.001$,**$p < 0.01$,*$p < 0.05$.

and established risk factors for depression in old age vary by scale. Findings from the linear regressions indicate that all predictors were significantly associated with both scales, with the exception of the oldest age group (over 70) for the normalized Euro-D score. Associations with gender were larger for the Euro-D than the CES-D scale, but for most other variables, associations were stronger for the CES-D. The largest difference between coefficients was found for marital status. Compared to their married counterparts, divorced, widowed or single respondents scored on average 0.0689 points higher (95% CI 0.0583–0.0789) on the CES-D scale but only 0.0299 points higher (95% CI 0.0220–0.0371) on the Euro-D. The two health variables included in the models (number of chronic diseases and of limitations in ADLs) were more strongly associated with the normalized CES-D score. For instance, having more than one limitation in ADLs was associated with scoring 0.176 points higher (95% CI 0.1624–0.2027) on the normalized CES-D scale compared to 0.126 points higher (95% CI 0.1154–0.1448) on the normalized Euro-D score. Similarly, reporting two or more chronic illnesses was associated with scoring 0.0868 points higher (95% CI 0.0809–0.1007) on the normalized CES-D score, versus 0.0692 (95% CI 0.0641–0.0787) on the Euro-D score. Cross-equation tests indicate that associations of depression with age, chronic diseases, marital status, ADLs, educational level and economic strain were significantly stronger for the CES-D than for the Euro-D scale. Only associations with gender were stronger for the Euro-D. In order to understand how these differences translate back into original scores, Table A1 in the Appendix displays the OLS estimates using the original scale rather than the normalized scores. In the first two columns, we report results of the main regression for the normalized Euro-D and CES-D scores. The next two columns present estimates using original scales.

Table 4 also displays the results of the logistic regression models, which summarize the association between explanatory variables and depressive symptomatology as ascertained by each scale. With the exception of three country dummies and age above 70 for the CES-D scale, all variables were significantly associated with the odds of being classified as depressed by the two scales. In line with the results from the linear regressions, the largest difference between the two scales was found for marital status. Being divorced, single or widowed is associated with higher odds of being classified as depressed by the CES-D scale (1.861, 95% CI 1.6750–2.0681) than by the Euro-D scale (1.319, 95% CI 1.1873–1.4648). Cross-equation tests suggest no significant difference between the two scales in their associations with health measures and educational level. However, the association with gender, being over 70, marital status and economic strain was stronger for the CES-D score.

Country-specific models

In supplementary analyses, separate models as presented in Table 4 were fitted for each country (see Appendix, Table A2). These models revealed no clear systematic differences between countries. Although it is difficult to identify a common pattern, in most countries, associations between health measures and education tended to be systematically stronger for the CES-D than the Euro-D. Gender differences were larger for the Euro-D than for the CES-D scale in many countries, confirming results from Table 4. In most countries, the largest difference between the Euro-D and CES-D scores was for associations with gender and marital status.

Discussion

Our aim was to assess the comparability of the Euro-D and CES-D scales, two measures commonly used in ageing surveys. We found a high correlation between the two scores, but there are important differences in their properties. The CES-D scale is more skewed to the left resulting in a higher standard deviation compared to the Euro-D scale. Being male, as well as characteristics associated with social disadvantage (older age, divorced/widowed/single, low education, economic strain) and higher levels of physical limitations (two or more chronic diseases and one or more ADLs limitations) are associated with significantly more negative discrepancies in assessments between the Euro-D and CES-D scales. Sensitivity estimates suggest that the CES-D scale captures a more extreme pool of depressed individuals than the Euro-D scale. As a result, the association between risk factors and depressive symptom scores is often stronger for the CES-D than for the Euro-D scale. Our findings highlight the need for some caution in interpreting comparisons of levels and associations with risk factors between surveys using different measures of depressive symptoms.

Limitations and strengths

Our study is unique by assessing depressive symptoms using the Euro-D and CES-D scales for the same respondents in representative samples of Europeans in 13 countries. However, several limitations should be considered. The scales use different reference periods: Euro-D asks about depressive symptoms in the past month while CES-D asks about symptoms in the past week (Zamarro *et al.*, 2008). However, both scales have been shown to

have relatively high test–retest reliability over short to medium periods of assessment, suggesting that although differences in reference periods might contribute to differences in scores, they are unlikely to fully account for the systematic differences in distributions observed in our study (Larraga *et al.*, 2006; Radloff, 1977). In addition, the cross-sectional nature of CES-D and Euro-D measures in SHARE did not enable us to examine comparatively in-score changes. Moreover, our paper focused only on participants who responded to the questions used to build the two scores. Although focusing on these respondents was necessary in order to compare the scales, caution should be exercised when interpreting the results as respondents included in the study may not be representative of the full sample.

Despite these limitations, our study expands upon previous research by assessing the comparability of these two depression scales. An important question is why the same individual (presumably having a single underlying true depression state) reports different scores depending on the scale being used, resulting in more cases identified as depressed by the CES-D than by the Euro-D scale. A possible explanation is that the CES-D scale includes items not included in the Euro-D scale. In particular, the CES-D includes two positive affect items (happiness and enjoyment of life), while the Euro-D scale includes only negative affect items. The positive affect items in CES-D may lead to sharper identification of depressed individuals, as those reporting no positive affect are more likely to have higher number of symptoms in the CES-D, while those with no positive affect are not identified by the Euro-D scale, which only asks about negative affect. This may partly explain why individuals with the same level of depression report more depressive symptoms in the CES-D than the Euro-D scale.

Implications for future research

Despite high levels of correlation between the two scales, caution in the interpretation of associations with risk factors is required. Our results highlight some differences in associations between CES-D and Euro-D with established risk factors for depression. This would suggest that differences in these associations reported in previous comparative studies are to some extent due to the use of different scales. However, an important question is whether differences between estimates for CES-D and Euro-D are clinically meaningful. In order to provide an estimate of the magnitude of differences in the associations between risk factors and depressive scores, we computed partial Eta-squared (Richardson, 2011). This measure provides an estimate of the clinical significance of the results by comparing the relative sizes of the effects from different risk factors on depressive symptoms levels as measured by the two scales. Figure 3 displays the estimates for the two scores side by side, together with their 95% CI. For all variables, we find a small to medium effect size, according to Cohen's criterion (Cohen, 1988). More importantly for the validity of previous comparative studies using these scales together, we find that the 95% CI overlap for most risk factors, but gender and marital status. Based on the results presented in Table 2 (differences in CES-D and Euro-D depressive symptoms scores), we estimated the effect sizes of the differences

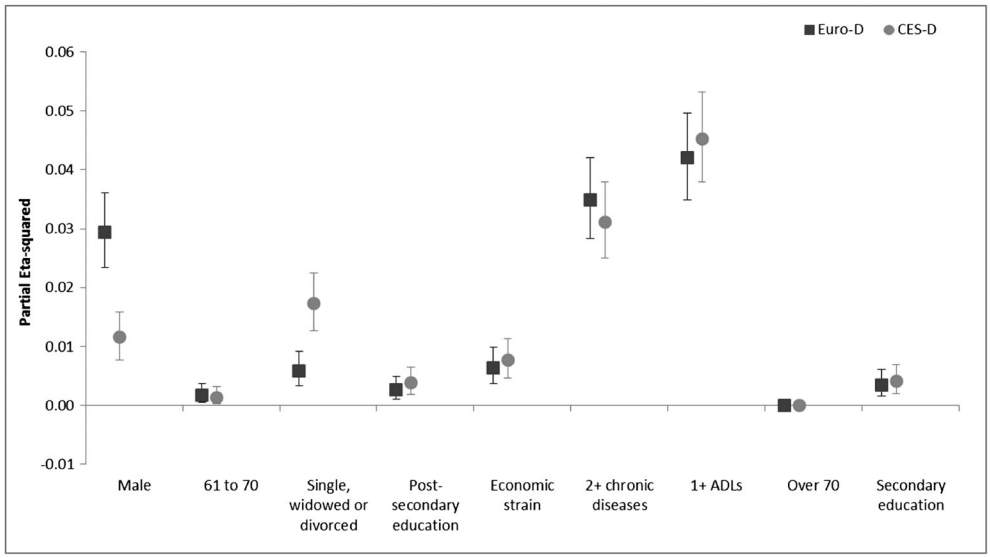

Figure 3. Effect sizes for the Euro-D and CES-D scores per risk factor.

between the two scales for gender and marital status. The effect size of the difference between two scores for these two risk factors is of 0.006 and 0.0087, respectively, values which correspond to very small effect sizes according to Cohen's criterion. Together, these results suggest that while the relationship between risk factors and depressive symptoms sometimes differ between the CES-D and Euro-D scales, conclusions on the clinical significance of the effects are often very similar between the two scales. This adds to the argument in favour of the comparability of the two measures.

There may also be several alternatives to address the differences between the two measures of depressive symptoms. A first approach would be to identify the items that are similar across both scales (e.g. depression, sleep, energy to do things), as done in earlier studies for robustness check (Riumallo-Herl *et al.*, 2014). This approach is still limited by the fact that the internal consistency of the two measures is compromised by using selected items individually. A second approach might be to use a more comprehensive set of measures of well-being across surveys and to compare their findings with those of the depressive symptoms scale. For example, SHARE, ELSA and HRS include a 12-item or 19-item version of the CASP scale of well-being (Control, Autonomy, Self-realization and Pleasure), specifically designed to measure well-being in old age (Wiggins *et al.*, 2004). Using this scale in combination with depression scores and self-reports of anti-depressant use has been shown to provide a more comprehensive assessment of mental health in old age (Kruk and Reinhold, 2014; Ploubidis and Grundy, 2009). However, these extensive measures are costly and unlikely to be available always across different studies and across waves. In addition, the prescription of anti-depressives may differ substantially across countries, again introducing a source of potential bias. A third, and potentially more feasible approach derived from our study would be to achieve comparability by rescaling the Euro-D items to reflect the levels of depression as measured by the CES-D scale. Following Jürges *et al.* (2008), it would be possible to make the two measures more comparable by imputing conditional probabilities. Assuming an individual with value x in the Euro-D scale has systematically lower depressive symptom levels than an individual with the same value in the CES-D scale, it is in principle possible to rescale down the Euro-D values to match the same levels of depressive symptoms captured with the CES-D scale. This would enhance cross-national comparisons of depressive symptoms across countries, and it would diminish the systematic tendency of the CES-D to show stronger associations with risk factors than the Euro-D scale.

In conclusion, we find that despite a high correlation between the two scales, there are differences in the way individuals report depressive symptoms when using the Euro-D and CES-D scales. Our results suggest that while direct comparisons of depressive symptoms levels between countries and using different measures should be avoided, studies that compare associations between risk factors and depressive symptoms across countries using these measures can still be valid. Although the strength of associations differs, our study shows that associations between each scale and risk factors are often in the same direction and display similar levels of clinical significance. Rescaling one of the scales or using more comprehensive assessments of well-being may be helpful in minimizing bias. Our findings imply that both scales measure the same underlying concept and, with some adjustments, can be used in comparative studies of the determinants of depression in old age.

Declaration of interest statement

The authors have no competing interests.

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Appendix

Table A1. Linear regressions (fully adjusted) for the normalized and original CES-D and Euro-D scores

	Normalized CES-D	*Normalized Euro-D*	*Original CES-D*	*Original Euro-D*
Male	−0.0510***	−0.0626***	−0.428***	−0.732***
	(0.00467)	(0.00353)	(0.0377)	(0.0405)
61 to 70	−0.0188***	−0.0170***	−0.174***	−0.202***
	(0.00544)	(0.00402)	(0.0440)	(0.0462)
Over 70	0.0116	0.00138	0.0421	−0.0179
	(0.00622)	(0.00458)	(0.0503)	(0.0527)
2+ chronic illnesses	0.0868***	0.0692***	0.727***	0.819***
	(0.00499)	(0.00370)	(0.0403)	(0.0425)
1+ limitations with ADLS	0.176***	0.126***	1.461***	1.492***
	(0.0101)	(0.00746)	(0.0821)	(0.0859)
Divorced, single or widowed	0.0653***	0.0279***	0.549***	0.335***
	(0.00523)	(0.00381)	(0.0421)	(0.0438)
Secondary education	−0.0313***	−0.0224***	−0.318***	−0.323***
	(0.00638)	(0.00462)	(0.0514)	(0.0533)
Post-secondary education	−0.0348***	−0.0226***	−0.367***	−0.333***
	(0.00704)	(0.00531)	(0.0566)	(0.0606)
Economic strain	0.0942***	0.0558***	0.417***	0.389***
	(0.00571)	(0.00411)	(0.0397)	(0.0437)
Germany (ref.: Austria)	0.0347**	0.0247**	0.314**	0.148
	(0.0133)	(0.00934)	(0.108)	(0.109)
Sweden	−0.0158	0.0348***	−0.128	0.0439
	(0.0130)	(0.00958)	(0.105)	(0.108)
Netherlands	−0.0310*	0.0338***	−0.232*	0.239*
	(0.0127)	(0.00931)	(0.103)	(0.108)
Spain	0.0274	0.0494***	0.348**	0.708***
	(0.0158)	(0.0109)	(0.128)	(0.131)
Italy	0.0790***	0.0563***	0.797***	0.819***
	(0.0148)	(0.0101)	(0.119)	(0.121)
France	0.00220	0.0620***	0.0712	0.790***
	(0.0137)	(0.00946)	(0.112)	(0.114)
Denmark	−0.0658***	0.00785	−0.504***	−0.0428
	(0.0127)	(0.00942)	(0.103)	(0.110)
Greece	−0.0409**	−0.0120	−0.0849	−0.108
	(0.0137)	(0.00976)	(0.109)	(0.113)
Switzerland	−0.0179	0.0232*	−0.0925	0.157
	(0.0145)	(0.0106)	(0.117)	(0.122)
Belgium	−0.00145	0.0404***	0.0591	0.346**
	(0.0133)	(0.00945)	(0.108)	(0.110)
Czechia	0.00954	−0.00174	0.230*	0.116
	(0.0139)	(0.00947)	(0.112)	(0.113)
Poland	0.0581***	0.0976***	0.710***	1.401***
	(0.0153)	(0.0104)	(0.123)	(0.124)
Constant	0.133***	0.141***		
	(0.0136)	(0.00955)		
Observations	10,536	10,536	10,536	10,536
R-Squared	0.236	0.220	0.219	0.226

Robust standard errors in parentheses.***$p < 0.001$,**$p < 0.01$,*$p < 0.05$.

Table A2. Linear regressions for the normalized CES-D and Euro-D depressive symptoms scores and odds ratios for caseness for depression per country (fully adjusted)

	Linear regressions		Logistic regressions	
	Normalized CES-D	Normalized Euro-D	CES-D	Euro-D
Austria				
Male	−0.0112	−0.0432**	0.999	0.390**
	(0.0240)	(0.0157)	(0.262)	(0.119)
61 to 70	0.00259	0.0229	1.533	1.404
	(0.0264)	(0.0170)	(0.500)	(0.495)
Over 70	0.0386	0.0425*	2.461**	1.670
	(0.0270)	(0.0189)	(0.780)	(0.599)
2+ chronic illnesses	0.0837***	0.0662***	2.068**	2.161**
	(0.0240)	(0.0165)	(0.486)	(0.569)
1+ limitations with ADLs	0.154***	0.122***	3.049***	3.893***
	(0.0432)	(0.0291)	(0.909)	(1.201)
Divorced, single or widowed	0.0474*	0.0149	1.421	0.978
	(0.0239)	(0.0152)	(0.385)	(0.290)
Secondary education	−0.0834*	0.000159	0.762	0.831
	(0.0373)	(0.0235)	(0.219)	(0.263)
Tertiary education	−0.101*	8.56e − 05	0.373**	0.957
	(0.0392)	(0.0260)	(0.142)	(0.372)
Economic strain	0.0752***	0.0467**	2.348**	2.047*
	(0.0215)	(0.0149)	(0.677)	(0.668)
Constant	0.127**	0.0740*	0.0679***	0.0806***
	(0.0434)	(0.0292)	(0.0326)	(0.0451)
Observations	473	473	473	473
R-Squared	0.168	0.171	0.142	0.134
Belgium				
Male	−0.0805***	−0.0921***	0.555**	0.390***
	(0.0157)	(0.0120)	(0.102)	(0.0707)
61 to 70	−0.0304	−0.0253	0.820	0.767
	(0.0184)	(0.0143)	(0.170)	(0.156)
Over 70	−0.0527**	−0.0475***	0.630*	0.576*
	(0.0185)	(0.0143)	(0.137)	(0.125)
2+ chronic illnesses	0.0882***	0.0591***	2.180***	1.653**
	(0.0161)	(0.0123)	(0.379)	(0.289)
1+ limitations with ADLs	0.214***	0.147***	4.337***	4.248***
	(0.0314)	(0.0247)	(1.073)	(1.041)
Divorced, single or widowed	0.0596***	0.0246	1.965***	1.249
	(0.0170)	(0.0126)	(0.353)	(0.225)
Secondary education	−0.0328	−0.00956	0.848	1.029
	(0.0199)	(0.0148)	(0.173)	(0.206)
Tertiary education	−0.0374	−0.0109	0.754	0.780
	(0.0216)	(0.0163)	(0.182)	(0.184)
Economic strain	0.0325*	0.0157	1.400	1.356
	(0.0151)	(0.0119)	(0.264)	(0.243)
Constant	0.175***	0.213***	0.174***	0.290***
	(0.0261)	(0.0196)	(0.0497)	(0.0757)
Observations	978	978	978	978
R-Squared	0.193	0.178	0.129	0.105

(*Continues*)

Table A2. (Continued)

	Linear regressions		Logistic regressions	
	Normalized CES-D	Normalized Euro-D	CES-D	Euro-D
Czechia				
Male	−0.0233	−0.0401***	0.754	0.666*
	(0.0168)	(0.0112)	(0.126)	(0.119)
61 to 70	−0.0358	−0.0273*	0.736	0.790
	(0.0192)	(0.0128)	(0.144)	(0.166)
Over 70	0.0336	0.0264	1.194	1.335
	(0.0224)	(0.0153)	(0.229)	(0.275)
2+ chronic illnesses	0.101***	0.0719***	2.168***	2.297***
	(0.0169)	(0.0116)	(0.349)	(0.403)
1+ limitations with ADLs	0.164***	0.131***	2.961***	2.418**
	(0.0365)	(0.0282)	(0.796)	(0.651)
Divorced, single or widowed	0.101***	0.0441***	2.041***	1.698**
	(0.0179)	(0.0117)	(0.331)	(0.293)
Secondary education	−0.0245	−0.0350*	0.815	0.807
	(0.0249)	(0.0169)	(0.159)	(0.165)
Tertiary education	−0.0831**	−0.0542**	0.470*	0.488*
	(0.0295)	(0.0200)	(0.141)	(0.154)
Economic strain	0.0607*	0.0100	2.081*	1.058
	(0.0256)	(0.0159)	(0.666)	(0.308)
Constant	0.110**	0.154***	0.127***	0.184***
	(0.0365)	(0.0238)	(0.0515)	(0.0688)
Observations	940	940	940	940
R-Squared	0.175	0.180	0.112	0.0975
Switzerland				
Male	−0.0663***	−0.0740***	0.397**	0.343***
	(0.0182)	(0.0151)	(0.121)	(0.0992)
61 to 70	−0.0410	−0.0504**	0.719	0.643
	(0.0214)	(0.0173)	(0.251)	(0.207)
Over 70	−0.0219	−0.0276	0.847	0.726
	(0.0251)	(0.0209)	(0.276)	(0.235)
2+ chronic illnesses	0.0304	0.0408*	1.418	1.527
	(0.0213)	(0.0179)	(0.391)	(0.420)
1+ limitations with ADLs	0.0356	0.0634	1.008	1.150
	(0.0702)	(0.0508)	(0.574)	(0.572)
Divorced, single or widowed	0.0498*	0.0386*	1.749*	1.825*
	(0.0211)	(0.0168)	(0.496)	(0.494)
Secondary education	−0.0200	−0.0441	0.815	0.426*
	(0.0350)	(0.0277)	(0.314)	(0.158)
Tertiary education	−0.0336	−0.0328	0.617	0.580
	(0.0365)	(0.0302)	(0.276)	(0.235)
Economic strain	0.0698***	0.0518***	2.853***	1.742*
	(0.0186)	(0.0153)	(0.900)	(0.477)
Constant	0.144***	0.195***	0.120***	0.315**
	(0.0404)	(0.0324)	(0.0598)	(0.141)
Observations	497	497	497	497
R-Squared	0.113	0.156	0.110	0.103

(*Continues*)

Table A2. (Continued)

	Linear regressions		Logistic regressions	
	Normalized CES-D	Normalized Euro-D	CES-D	Euro-D
Germany				
Male	−0.0206	−0.0523***	0.797	0.633*
	(0.0162)	(0.0120)	(0.162)	(0.139)
61 to 70	−0.0271	−0.0181	0.614*	0.613*
	(0.0169)	(0.0124)	(0.143)	(0.147)
Over 70	0.0348	−0.0162	1.241	0.674
	(0.0208)	(0.0147)	(0.302)	(0.173)
2+ chronic illnesses	0.105***	0.0855***	3.491***	3.085***
	(0.0170)	(0.0118)	(0.701)	(0.666)
1+ limitations with ADLs	0.207***	0.149***	3.696***	3.391***
	(0.0361)	(0.0270)	(1.070)	(0.977)
Divorced, single or widowed	0.0754***	0.00761	2.130***	0.987
	(0.0185)	(0.0124)	(0.444)	(0.221)
Secondary education	−0.132	−0.0883	0.315	0.271
	(0.124)	(0.0618)	(0.287)	(0.182)
Tertiary education	−0.172	−0.110	0.160*	0.204*
	(0.124)	(0.0623)	(0.148)	(0.141)
Economic strain	0.0644***	0.0183	1.911**	1.300
	(0.0142)	(0.0112)	(0.417)	(0.302)
Constant	0.228	0.237***	0.323	0.572
	(0.123)	(0.0627)	(0.300)	(0.409)
Observations	782	782	782	782
R-Squared	0.255	0.204	0.196	0.108
Denmark				
Male	−0.00116	−0.0174	1.064	0.812
	(0.0130)	(0.0118)	(0.281)	(0.180)
61 to 70	−0.0389**	−0.0668***	0.668	0.310***
	(0.0132)	(0.0122)	(0.212)	(0.0826)
Over 70	0.00590	−0.0427**	0.928	0.419**
	(0.0168)	(0.0151)	(0.298)	(0.121)
2+ chronic illnesses	0.0293*	0.0522***	1.628	2.782***
	(0.0124)	(0.0111)	(0.436)	(0.632)
1+ limitations with ADLs	0.151***	0.113***	3.074**	3.222***
	(0.0362)	(0.0267)	(1.117)	(1.026)
Divorced, single or widowed	0.0368**	0.00697	1.989**	1.019
	(0.0139)	(0.0125)	(0.526)	(0.240)
Secondary education	−0.0174	−0.00357	0.629	0.937
	(0.0192)	(0.0173)	(0.212)	(0.291)
Tertiary education	0.00802	0.00259	1.025	1.378
	(0.0203)	(0.0176)	(0.352)	(0.447)
Economic strain	0.0378**	0.0518***	1.693*	1.975**
	(0.0122)	(0.0113)	(0.419)	(0.434)
Constant	0.0643**	0.136***	0.0520***	0.104***
	(0.0233)	(0.0210)	(0.0236)	(0.0402)
Observations	826	826	826	826
R-Squared	0.118	0.118	0.0830	0.0911

(*Continues*)

Table A2. (Continued)

	Linear regressions		Logistic regressions	
	Normalized CES-D	Normalized Euro-D	CES-D	Euro-D
Spain				
Male	−0.110***	−0.0885***	0.430***	0.410***
	(0.0227)	(0.0165)	(0.0848)	(0.0815)
61 to 70	−0.0107	−0.0173	0.958	0.661
	(0.0268)	(0.0199)	(0.235)	(0.168)
Over 70	0.0715*	0.0353	1.376	1.054
	(0.0302)	(0.0207)	(0.348)	(0.253)
2+ chronic illnesses	0.140***	0.0928***	2.344***	2.534***
	(0.0244)	(0.0174)	(0.463)	(0.494)
1+ limitations with ADLs	0.172***	0.119***	2.944***	2.367**
	(0.0405)	(0.0299)	(0.908)	(0.685)
Divorced, single or widowed	0.0389	0.0179	1.376	1.017
	(0.0246)	(0.0175)	(0.275)	(0.204)
Secondary education	−0.00136	−0.0150	0.882	0.698
	(0.0275)	(0.0190)	(0.207)	(0.163)
Tertiary education	−0.0506	−0.0250	0.535	0.877
	(0.0327)	(0.0257)	(0.208)	(0.297)
Economic strain	0.0889**	0.0324	2.152*	2.000*
	(0.0292)	(0.0204)	(0.758)	(0.626)
Constant	0.112**	0.182***	0.160***	0.251***
	(0.0377)	(0.0273)	(0.0652)	(0.0943)
Observations	646	646	646	646
R-Squared	0.219	0.198	0.136	0.120
France				
Male	−0.0882***	−0.0760***	0.392***	0.401***
	(0.0165)	(0.0119)	(0.0732)	(0.0674)
61 to 70	0.00629	0.00972	1.101	0.896
	(0.0200)	(0.0138)	(0.227)	(0.168)
Over 70	−0.0306	−0.0275	0.752	0.526**
	(0.0210)	(0.0148)	(0.165)	(0.111)
2+ chronic illnesses	0.0961***	0.0558***	2.306***	1.813***
	(0.0182)	(0.0123)	(0.398)	(0.291)
1+ limitations with ADLs	0.138***	0.109***	2.720***	2.809***
	(0.0348)	(0.0219)	(0.750)	(0.717)
Divorced, single or widowed	0.114***	0.0425***	2.575***	1.621**
	(0.0185)	(0.0126)	(0.451)	(0.260)
Secondary education	−0.0590**	−0.0305*	0.644*	0.661*
	(0.0196)	(0.0139)	(0.122)	(0.117)
Tertiary education	−0.0391	−0.0435**	0.727	0.477**
	(0.0226)	(0.0162)	(0.173)	(0.108)
Economic strain	0.0441*	0.0576***	1.390	1.939**
	(0.0173)	(0.0128)	(0.301)	(0.403)
Constant	0.149***	0.196***	0.184***	0.365***
	(0.0264)	(0.0196)	(0.0568)	(0.104)
Observations	944	944	944	944
R-Squared	0.194	0.183	0.149	0.120

(*Continues*)

Table A2. (Continued)

	Linear regressions		Logistic regressions	
	Normalized CES-D	Normalized Euro-D	CES-D	Euro-D
Greece				
Male	−0.0677***	−0.0869***	0.447***	0.339***
	(0.0155)	(0.0124)	(0.0897)	(0.0728)
61 to 70	−0.0514**	−0.0186	0.494**	0.785
	(0.0178)	(0.0135)	(0.119)	(0.196)
Over 70	−0.0144	0.0252	0.656	1.156
	(0.0217)	(0.0169)	(0.158)	(0.285)
2+ chronic illnesses	0.0689***	0.0454***	2.024***	1.667*
	(0.0163)	(0.0137)	(0.374)	(0.339)
1+ limitations with ADLs	0.200***	0.165***	3.639***	3.413***
	(0.0386)	(0.0307)	(1.080)	(0.991)
Divorced, single or widowed	0.0822***	0.0306*	2.061***	1.430
	(0.0168)	(0.0130)	(0.395)	(0.284)
Secondary education	−0.0534**	−0.0379**	0.683	0.646
	(0.0178)	(0.0137)	(0.145)	(0.147)
Tertiary education	−0.0702**	−0.0304	0.361**	0.609
	(0.0213)	(0.0175)	(0.112)	(0.182)
Economic strain	0.0798***	0.0403*	2.283*	1.907
	(0.0207)	(0.0162)	(0.863)	(0.728)
Constant	0.122***	0.149***	0.141***	0.143***
	(0.0291)	(0.0222)	(0.0600)	(0.0632)
Observations	955	955	955	955
R-Squared	0.203	0.204	0.150	0.136
Italy				
Male	−0.0897***	−0.0864***	0.536***	0.339***
	(0.0193)	(0.0133)	(0.0855)	(0.0728)
61 to 70	0.00986	0.0112	1.070	0.785
	(0.0238)	(0.0157)	(0.201)	(0.196)
Over 70	0.0349	0.0347	1.174	1.156
	(0.0276)	(0.0186)	(0.254)	(0.285)
2+ chronic illnesses	0.139***	0.109***	2.835***	1.667*
	(0.0200)	(0.0136)	(0.455)	(0.339)
1+ limitations with ADLs	0.229***	0.170***	4.496***	3.413***
	(0.0347)	(0.0256)	(1.367)	(0.991)
Divorced, single or widowed	0.0805***	0.0325*	1.616**	1.430
	(0.0224)	(0.0153)	(0.278)	(0.284)
Secondary education	−0.0679**	−0.0374*	0.674*	0.646
	(0.0225)	(0.0147)	(0.118)	(0.147)
Tertiary education	−0.0836**	−0.0576*	0.583	0.609
	(0.0305)	(0.0234)	(0.172)	(0.182)
Economic strain	0.0987**	0.0429	2.287*	1.907
	(0.0327)	(0.0256)	(0.789)	(0.728)
Constant	0.161***	0.166***	0.179***	0.143***
	(0.0412)	(0.0311)	(0.0711)	(0.0632)
Observations	895	895	895	895
R-Squared	0.234	0.263	0.146	0.163

(*Continues*)

Table A2. (Continued)

	Linear regressions		Logistic regressions	
	Normalized CES-D	Normalized Euro-D	CES-D	Euro-D
Netherlands				
Male	−0.0346**	−0.0568***	0.638	0.339***
	(0.0128)	(0.0111)	(0.147)	(0.0728)
61 to 70	−0.0301*	−0.00637	0.420**	0.785
	(0.0145)	(0.0132)	(0.140)	(0.196)
Over 70	−0.00847	−0.0220	0.802	1.156
	(0.0184)	(0.0142)	(0.219)	(0.285)
2+ chronic illnesses	0.0617***	0.0645***	2.577***	1.667*
	(0.0158)	(0.0133)	(0.598)	(0.339)
1+ limitations with ADLs	0.192***	0.107***	4.827***	3.413***
	(0.0425)	(0.0309)	(1.540)	(0.991)
Divorced, single or widowed	0.0710***	0.0722***	2.262***	1.430
	(0.0156)	(0.0130)	(0.517)	(0.284)
Secondary education	−0.0352	−0.0264	0.609	0.646
	(0.0232)	(0.0188)	(0.167)	(0.147)
Tertiary education	−0.0380	−0.0322	0.633	0.609
	(0.0261)	(0.0210)	(0.216)	(0.182)
Economic strain	0.0413***	0.0179	2.028**	1.907
	(0.0123)	(0.0110)	(0.501)	(0.728)
Constant	0.104***	0.167***	0.0849***	0.143***
	(0.0255)	(0.0215)	(0.0322)	(0.0632)
Observations	859	859	859	859
R-Squared	0.175	0.172	0.158	0.110
Poland				
Male	−0.0654**	−0.0822***	0.689*	0.339***
	(0.0205)	(0.0139)	(0.114)	(0.0728)
61 to 70	0.0215	−0.00303	1.162	0.785
	(0.0266)	(0.0171)	(0.242)	(0.196)
Over 70	0.0229	0.0237	1.314	1.156
	(0.0283)	(0.0184)	(0.282)	(0.285)
2+ chronic illnesses	0.155***	0.113***	2.824***	1.667*
	(0.0216)	(0.0141)	(0.483)	(0.339)
1+ limitations with ADLs	0.171***	0.0953***	3.073***	3.413***
	(0.0273)	(0.0176)	(0.599)	(0.991)
Divorced, single or widowed	0.102***	0.0268	1.872***	1.430
	(0.0235)	(0.0155)	(0.327)	(0.284)
Secondary education	−0.0102	−0.0306*	0.819	0.646
	(0.0233)	(0.0155)	(0.153)	(0.147)
Tertiary education	−0.0769**	−0.0508*	0.571*	0.609
	(0.0291)	(0.0213)	(0.156)	(0.182)
Economic strain	0.0778*	0.0494	2.319	1.907
	(0.0382)	(0.0293)	(1.063)	(0.728)
Constant	0.127**	0.221***	0.122***	0.143***
	(0.0433)	(0.0325)	(0.0602)	(0.0632)
Observations	825	825	825	825
R-Squared	0.227	0.230	0.152	0.142

(*Continues*)

Table A2. (Continued)

	Linear regressions		Logistic regressions	
	Normalized CES-D	Normalized Euro-D	CES-D	Euro-D
Sweden				
Male	−0.0171	−0.0374**	0.767	0.339***
	(0.0133)	(0.0118)	(0.148)	(0.0728)
61 to 70	−0.0366*	−0.0347**	0.539*	0.785
	(0.0159)	(0.0134)	(0.135)	(0.196)
Over 70	0.0135	0.00739	0.988	1.156
	(0.0201)	(0.0162)	(0.247)	(0.285)
2+ chronic illnesses	0.0529***	0.0567***	1.796**	1.667*
	(0.0148)	(0.0121)	(0.362)	(0.339)
1+ limitations with ADLs	0.173***	0.149***	4.202***	3.413***
	(0.0352)	(0.0288)	(1.143)	(0.991)
Divorced, single or widowed	0.0262	0.0157	1.359	1.430
	(0.0141)	(0.0125)	(0.257)	(0.284)
Secondary education	−0.0153	9.00e − 05	0.856	0.646
	(0.0169)	(0.0148)	(0.209)	(0.147)
Tertiary education	0.00583	0.00229	1.174	0.609
	(0.0178)	(0.0150)	(0.295)	(0.182)
Economic strain	0.0564***	0.0561***	1.970***	1.907
	(0.0133)	(0.0114)	(0.396)	(0.728)
Constant	0.102***	0.139***	0.0990***	0.143***
	(0.0216)	(0.0184)	(0.0326)	(0.0632)
Observations	916	916	916	916
R-Squared	0.127	0.147	0.0980	0.103

Robust standard errors in parentheses.***$p < 0.001$,**$p < 0.01$,*$p < 0.05$.

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Under one roof: The effect of co-residing with adult children on depression in later life

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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 (IV) 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 ($\beta = -0.0387$; 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.

1. Introduction

Since World War II, the number of older people living alone has increased dramatically in most industrialized countries (Glaser et al., 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 and 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 and 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 and Waite, 2002; Lang and Schutze, 2002; Silverstein et al., 1996). This relationship may be crucial to understanding the increasing burden of old-age depression in ageing societies. Across Europe, the

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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 and 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.

2. Background

Co-residence is often conceived as a channel for the exchange of social, emotional, practical and financial support between parents and children (Gierveld et al., 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 et al., 2010; Ward et al., 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 and Liefbroer, 2010; Furstenberg et al., 2004; Kahn et al., 2013; Kaplan, 2012; Lee and 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 and Litwin, 2010; Zunzunegui et al., 2001). Nevertheless, studies suggest that co-residing with adult children is associated with higher depressive symptom among older parents in Singapore (Chan et al., 2011), South Korea (Jeon et al., 2007), China (Chyi and Mao, 2012) and Israel (Lowenstein and 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 and 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 and 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.

3. Data

3.1. 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 and Jürges, 2005). We used data from assessments in 2004, 2006 and 2010.

3.2. 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 et al., 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.

3.3. 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 and 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.

4. Empirical approach

4.1. Rationale

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 and 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 and 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:

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

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:

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

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.

4.2. 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. Fig. 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.

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.

5. Results

5.1. 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.

Fig. 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

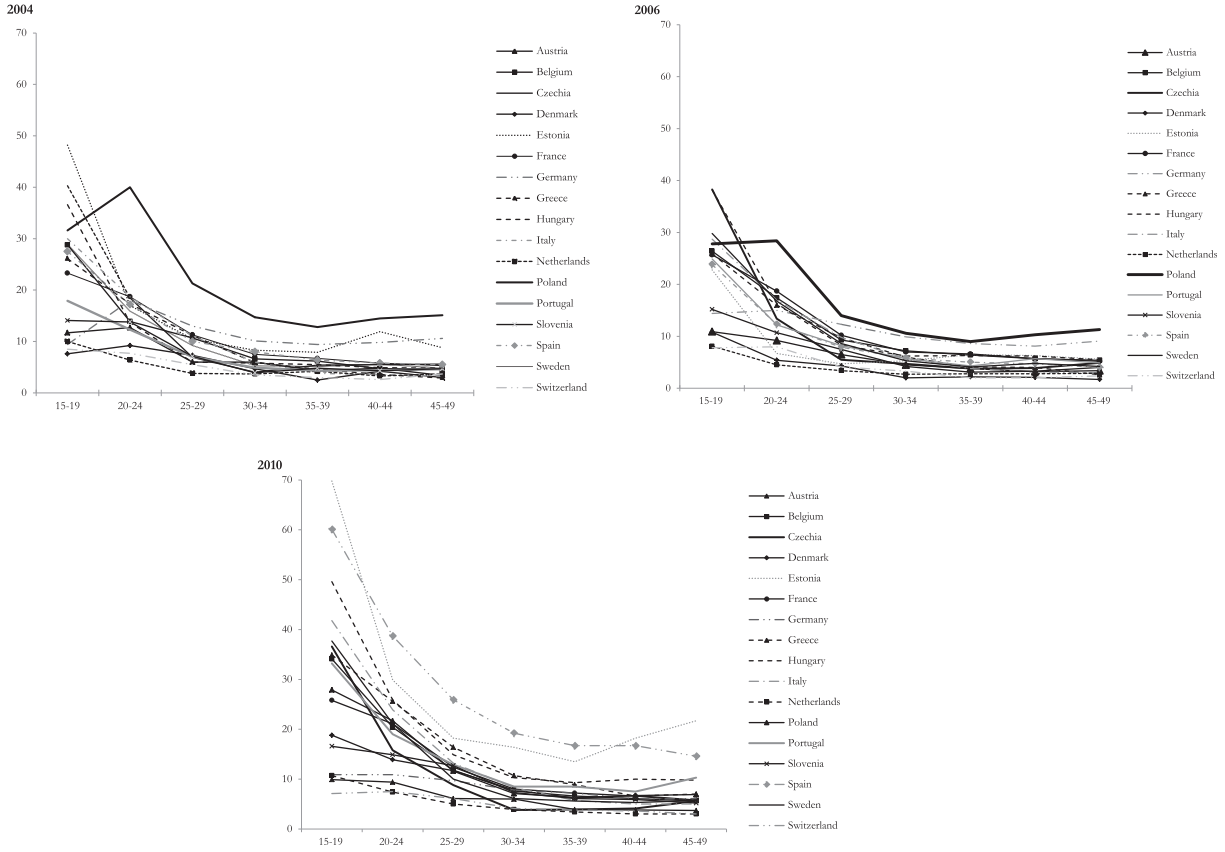


Fig. 1. Unemployment rates by age categories for males (2004, 2006, 2010).

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

	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 (%)	9808 (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 (%)	2393 (8.62)	5497 (12.69)	
Widowed: Frequency (%)	3546 (12.78)	6899 (15.93)	
Receipt of informal care: frequency (%)	3880 (17.55)	8972 (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 (%)	5400 (19.61)	8752 (20.44)	0.1204
Homeowner: frequency (%)	16,370 (75.94)	25,483 (69.90)	0.0201
Household total income: median (in euros)	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 (%)	4801 (47.47)	6588 (49.99)	
Male: frequency (%)	5304 (52.45)	6598 (49.91)	
Gender of child 4			>0.001
Female: frequency (%)	1915 (46.27)	2484 (48.54)	
Male: frequency (%)	2222 (53.68)	2621 (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 (%)	8411 (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 (%)	3867 (40.23)	8829 (63.78)	
Divorced, or never married: frequency (%)	5677 (59.06)	4917 (35.52)	
Widowed: frequency (%)	69 (0.72)	97 (0.70)	
Marital status of child 4			
Married or in a partnership: frequency (%)	1832 (47.72)	3437 (64.57)	
Divorced, or never married: frequency (%)	1983 (51.65)	1826 (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 (%)	2162 (8.46)	1754 (4.02)	
Not in the labor force: frequency (%)	5959 (23.33)	6190 (14.17)	
Employment status of child 2			>0.001
Employed: frequency (%)	14,045 (67.29)	27,586 (82.55)	
Unemployed: frequency (%)	1687 (8.08)	1317 (3.94)	
Not in the labor force: frequency (%)	5139 (24.62)	4514 (13.51)	
Employment status of child 3			>0.001
Employed: frequency (%)	5999 (64.38)	11,066 (80.56)	
Unemployed: frequency (%)	781 (8.38)	658 (4.79)	
Not in the labor force: frequency (%)	2538 (27.24)	2012 (14.65)	
Employment status of child 4			>0.001
Employed: frequency (%)	2400 (65.59)	4236 (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.

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.

5.2. 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.

Table 3 presents results from the second stage of the 2SLS together with 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 ($\beta = -0.0387$; 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 others are 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).

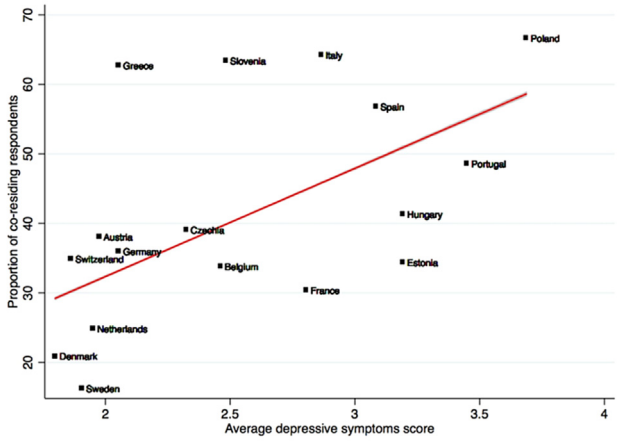


Fig. 2. Association between co-residence and average depression scores by countries (pooled sample).

5.3. 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 Fig. 3.

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 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 ($\beta = -0.699$; 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 Fig. 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).

6. Discussion

6.1. Overview of the results

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-

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

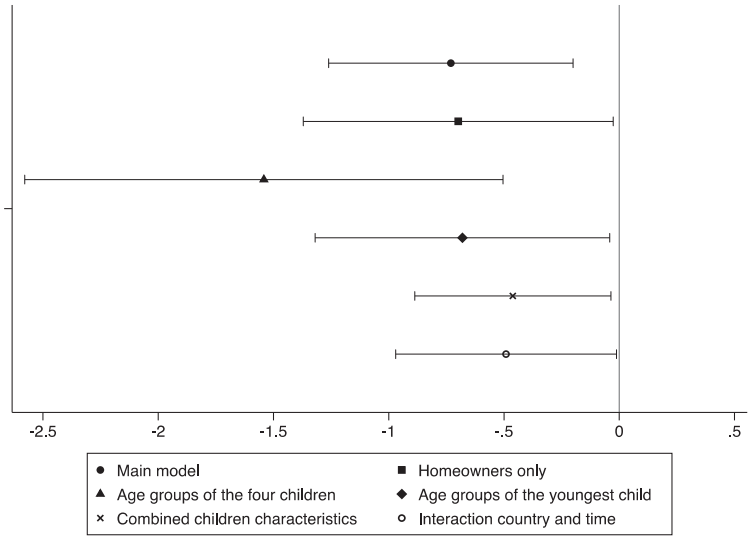
	Full sample	Women	Men
IVs			
Unemployment rate of child 1	0.00890*** (0.000897)	0.00956*** (0.00105)	0.00833*** (0.00111)
Unemployment rate of child 2	0.00425*** (0.0007)	0.00535*** (0.000813)	0.00343*** (0.000896)
Unemployment rate of child 3	0.00322*** (0.000862)	0.00450*** (0.00112)	0.00216 (0.00114)
Unemployment rate of child 4	0.00203 (0.00115)	0.000874 (0.00155)	0.00329 (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.

	OLS			IV		
	Full sample	Women	Men	Full sample	Women	Men
Explanatory variable of interest						
Co-residing with an adult child	−0.0387 (0.0258)	−0.0527 (0.0352)	−0.0122 (0.0366)	−0.731** (0.27)	−0.518 (0.36)	−0.818 (0.312)
Demographic and socioeconomic						
Aged 50 to 60 (ref.)	–	–	–	–	–	–
Aged 61 to 70	−0.140*** (0.0319)	−0.148*** (0.0432)	−0.127** (0.046)	−0.223*** (0.0449)	−0.230*** (0.0569)	−0.184** (0.0586)
Aged over 70	−0.059 (0.0377)	−0.153** (0.0509)	0.0611 (0.0552)	−0.176** (0.0577)	−0.279*** (0.077)	−0.0612 (0.0743)
Male	−0.693*** (0.0222)	–	–	−0.715*** (0.0293)	–	–
Primary education (ref.)	–	–	–	–	–	–
Secondary education	−0.273*** (0.0303)	−0.342*** (0.041)	−0.165*** (0.0438)	−0.269*** (0.037)	−0.348*** (0.0481)	−0.147** (0.0501)
Tertiary education	−0.415*** (0.036)	−0.579*** (0.051)	−0.209*** (0.0502)	−0.409*** (0.0468)	−0.571*** (0.0626)	−0.209*** (0.0597)
Married or in a partnership (ref.)	–	–	–	–	–	–
Never married or divorced	0.190*** (0.0327)	0.148*** (0.0433)	0.239*** (0.0498)	0.0975* (0.0448)	0.0946 (0.05)	0.0833 (0.0836)
Widowed	0.219*** (0.0319)	0.154*** (0.04)	0.378*** (0.059)	0.310*** (0.0429)	0.234*** (0.0536)	0.425*** (0.0726)
Pension receipt	0.0681* (0.0312)	0.113** (0.0429)	0.0457 (0.0454)	0.0381 (0.0382)	0.108* (0.0488)	−0.0175 (0.0557)
Log of household income	6.72E-08 (6.79E-08)	1.02E-08 (1.05E-07)	2.46E-08 (8.83E-08)	−0.0126 (0.012)	−0.0228 (0.0143)	−0.00457 (0.0184)
Financial distress	0.575*** (0.0246)	0.599*** (0.0334)	0.543*** (0.0357)	0.602*** (0.0336)	0.610*** (0.0449)	0.579*** (0.0453)
Informal care receipt	0.349*** (0.0285)	0.301*** (0.0364)	0.443*** (0.0452)	0.343*** (0.0367)	0.304*** (0.0481)	0.415*** (0.0507)
Health status						
Number of limitations with ADLs	0.341*** (0.0253)	0.350*** (0.0312)	0.310*** (0.0433)	0.316*** (0.0363)	0.346*** (0.0426)	0.271*** (0.0597)
Number of limitations with IADLs	0.401*** (0.0212)	0.384*** (0.0256)	0.437*** (0.0379)	0.451*** (0.036)	0.406*** (0.0437)	0.503*** (0.0602)
2 + chronic illnesses	0.816*** (0.0223)	0.891*** (0.031)	0.697*** (0.0313)	0.825*** (0.0288)	0.925*** (0.0379)	0.688*** (0.036)
Children characteristics						
Number of children	0.0156 (0.0289)	−0.00439 (0.0383)	0.0416 (0.0432)	0.0529 (0.456)	0.00737 (0.6)	0.208 (0.555)
Child 1 is a male	−0.0579** (0.0213)	−0.0743* (0.0296)	−0.0299 (0.0298)	−0.0753** (0.0284)	−0.0444 (0.605)	−0.0635 (0.0384)
Child 2 is a male	−0.0157 (0.0239)	−0.0247 (0.0336)	−0.0089 (0.0329)	−0.0602* (0.0302)	0.0846 (0.611)	−0.0245 (0.0617)
Child 3 is a male	−0.0890* (0.038)	−0.0884 (0.052)	−0.099 (0.0542)	−0.0497 (0.0455)	−0.0580 (0.0433)	0.175* (0.0826)
Child 4 is a male	−0.124 (0.0632)	−0.141 (0.086)	−0.11 (0.0919)	−0.117 (0.0784)	−0.0729 (0.0611)	0.0898 (0.0611)
Child 1 is employed (ref.)	–	–	–	–	–	–
Unemployed	0.270*** (0.0512)	0.365*** (0.0687)	0.106 (0.0744)	0.283*** (0.0604)	−0.128 (0.114)	0.279** (0.093)
Out of the labor force	0.0493 (0.0302)	0.118** (0.0419)	−0.0465 (0.0415)	0.133** (0.0476)	0.338*** (0.086)	0.00673 (0.059)
Child 2 is employed (ref.)	–	–	–	–	–	–
Unemployed	0.176** (0.0577)	0.163* (0.0775)	0.205* (0.0843)	0.237*** (0.0593)	0.155* (0.0632)	0.0537 (0.052)
Out of the labor force	0.0326 (0.034)	0.103* (0.0481)	−0.053 (0.0463)	0.0921* (0.0429)	0.214* (0.0882)	0.12 (0.139)
Child 3 is employed (ref.)	–	–	–	–	–	–
Unemployed	0.324*** (0.0864)	0.426*** (0.118)	0.208 (0.124)	0.297** (0.0977)	0.157* (0.0638)	0.210* (0.085)
Out of the labor force	0.165** (0.0506)	0.182** (0.0701)	0.161* (0.0712)	0.195** (0.0668)	0.436** (0.144)	0.0861 (0.559)
Child 4 is employed (ref.)	–	–	–	–	–	–
Unemployed	0.266 (0.148)	0.241 (0.193)	0.29 (0.23)	0.403* (0.175)	0.179 (0.0914)	0.663** (0.25)
Out of the labor force	0.0575 (0.0824)	0.00786 (0.113)	0.146 (0.119)	0.149 (0.101)	0.225 (0.235)	0.261 (0.14)
Child 1 is married or in a partnership (ref.)		–	–	–	–	–
Never married or divorced	0.0612* (0.0238)	0.0842* (0.0328)	0.0429 (0.0334)	0.218*** (0.0603)	0.06 (0.153)	0.0439 (0.564)
Widowed	−0.015 (0.106)	0.0322 (0.129)	−0.15 (0.169)	0.156 (0.172)	0.210** (0.0808)	0.200** (0.0711)
Child 2 is married or in a partnership (ref.)		–	–	–	–	–
Never married or divorced	0.0192 (0.0264)	0.00825 (0.0368)	0.0555 (0.0366)	0.0970* (0.0485)	0.382 (0.244)	−0.287 (0.321)
Widowed	0.0481 (0.135)	0.0413 (0.158)	0.152 (0.251)	−0.0576 (0.209)	0.0649 (0.0684)	0.132* (0.0588)
Child 3 is married or in a partnership (ref.)		–	–	–	–	–
Never married or divorced	−0.0305 (0.0403)	0.0123 (0.0554)	−0.0801 (0.057)	0.0387 (0.0582)	−0.138 (0.285)	0.0854 (0.322)
Widowed	0.196 (0.244)	0.306 (0.295)	−0.0503 (0.398)	0.749 (0.484)	0.0425 (0.0782)	0.0222 (0.0712)
Child 4 is married or in a partnership (ref.)		–	–	–	–	
Never married or divorced	0.133* (0.0669)	0.188* (0.0911)	0.0394 (0.0977)	0.114 (0.088)	1.071 (0.601)	0.0292 (0.63)
Widowed	−0.0879 (0.392)	−0.114 (0.451)	0.157 (0.701)	−0.325 (1.075)	0.237 (0.127)	−0.0635 (0.108)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.496*** (0.161)	1.499*** (0.216)	0.806*** (0.237)	1.78 (1.824)	1.858 -(2.401)	0.542 (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
Test of overidentification	–	–	–	5.109 ($p = 0.1640$)	2.763 ($p = 0.4296$)	2.221 ($p = 0.5279$)

Notes: Robust standard errors in parenthesis, with clustering at the instruments level for the 2SLS models. ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$.



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

Fig. 3. Overview of the effect of intergenerational co-residence on depressive symptoms levels by specification.

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 and 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 and Malhotra, 2012; Johar and 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 and 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 and 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 and Waite, 2002; Lang and 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 et al., 2008; Levy et al., 2002).

6.2. 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 and Angrist, 1994).

7. 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 and 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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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2016.09.020.

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Original Contribution

The Mental Health Benefits of Acquiring a Home in Older Age: A Fixed-Effects Analysis of Older US Adults

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Homeownership is consistently associated with better mental health, but whether becoming a homeowner in later in life has positive psychological benefits has not, to our knowledge, been examined. We assessed whether acquiring a home after age 50 years was associated with depression in a representative sample of older US adults. We used individual fixed-effects models based on data from 20,524 respondents aged ≥50 years from the Health and Retirement Study, who were interviewed biennially during 1993–2010. Depressive symptoms were measured using the 8-item Center for Epidemiologic Studies Depression Scale. Controlling for confounders, becoming a homeowner in later life predicted a decline in depressive symptoms in the same year (β = −0.0768, 95% confidence interval (CI): −0.152, −0.007). The association remained significant after 2 years (β = −0.0556, 95% CI: −0.134, −0.001) but weakened afterward. Buying a home for reasons associated with positive characteristics of the new house or neighborhood drove this association (β = −0.426, 95% CI: −0.786, −0.066), while acquiring a home for reasons associated with characteristics of the previous home or neighborhood, the desire to be closer to relatives, downsizing, or upsizing did not predict mental health improvements. Findings suggest that there are small but significant benefits for mental health associated with acquiring a home in older age.

aging; depression; fixed-effects models; homeownership; housing

Abbreviations: CES-D, Center for Epidemiologic Studies Depression Scale; CI, confidence interval; HRS, Health and Retirement Study.

The association between housing and health is well-established (1). Previous studies suggest that housing might influence health through three main pathways: neighborhood characteristics, housing conditions, and housing tenure (2, 3). Extensive research has focused on establishing the impact of neighborhood characteristics and housing quality on health, while less is known about the benefits or harms of housing tenure type (3). A number of studies have found an association between homeownership and better physical health (4–15), mental health (16, 17), and longevity (15, 18). However, whether this relationship is causal has been debated (2). Indeed, an important limitation of these studies is the strong selection associated with homeownership (19). Individual characteristics from childhood to adulthood are likely to be associated with both homeownership and health in later life (20). In addition, healthier individuals enjoy longer and more stable careers (21), increasing their ability to accumulate wealth (22) and consequently access mortgage loans. These concerns have led to a reassessment of the potential benefits to mental health of homeownership in early adulthood (23). Less is known, however, about the causal association between acquiring a home and mental health in older age.

Today, over 70% of US adults aged 50 years or older own a home (24). The number of Americans who are homeowners increased steadily during the second half of the 20th Century and until the early 2000s, encouraged by active policies favoring homeownership (25). In the United States, most access the housing ladder in their 30s (26), but the dynamics of homeownership attainment are changing. There was, for example, a 16-point difference between the homeownership rate of those aged 40–44 years in 2005 (70%) and 2015 (54%) (27). Aggregate homeownership rates also mask important disparities (28). Homeownership access has historically been low for black households: In 2015, 56% of black persons aged 55–64

years were homeowners, as opposed to 82% of white persons of the same ages. In 2015, one-third of black persons in the United States were not homeowners (27). Whether delayed access to homeownership has implications for mental health in later life is not clear. An important, yet untested, hypothesis is that acquiring a home later in life might lead to improvements in mental health and wellbeing.

Acquiring a home in later life might influence mental health through several mechanisms. Studies suggest that homeownership is associated with better quality of housing (29), which is in turn associated with lower levels of mental distress and greater positive affect (30, 31). Housing conditions are an important determinant of mental health in old age: Compared with their younger counterparts, older people spend more time in their homes due to reduced functioning, access to transportation, and social networks (30, 32). They also invest more in local services because they are less mobile and are more likely to benefit themselves from these investments than renters (33–35). Acquiring a home later in life might also increase self-esteem, control, and autonomy, which are associated with better mental health (8, 36, 37).

This study aimed to estimate the impact of acquiring a home on depressive symptoms in older age. Depression in older age is a significant problem in the United States: Approximately 7% of adults above the age of 74 suffer from major depression and 17% from elevated depressive symptoms (38, 39). Major depression is the leading cause of years lived with disability worldwide and the fifth leading cause of disability-adjusted life years in North America (40, 41). We used data from the Health and Retirement Study (HRS), a longitudinal study that has followed older US adults since 1992. Our paper builds on earlier work (16, 17, 23) by using panel data and individual fixed-effects models that leverage individual-level changes in homeownership. Our estimates provide new evidence for the potential mental health benefits of acquiring a home in later life.

METHODS

Study population

HRS is a nationally representative study of US adults aged ≥50 years, started in 1992. The HRS sample is selected based on a multistage area-probability sample. Details of the study are provided elsewhere (42). Enrollment occurred in 4 waves (1992, 1993, 1998, and 2004), depending on respondents' birth years. HRS included respondents from several birth cohorts: Asset and Health Dynamics Among the Oldest Old cohort (born 1923 or earlier), children of the Depression (1924–1930), the initial HRS cohort (1931–1941), War babies (1942–1947), and early (1948–1953) and middle Baby Boomers (1954–1959). Biennial interviews were conducted through 2010, and wave-to-wave retention rates were approximately 90%. Our data set comprised 11 HRS waves starting in 1993, the first year that depressive symptoms were measured, and ending in 2010. We excluded 441 respondents living in nursing homes at the first wave in which they were observed in our data. Respondents were right censored upon entry into a nursing home or loss to follow-up ($n = 680$). The final sample comprised 20,524 individuals living in the community.

Assessment of depressive symptoms

An 8-item version of the Center for Epidemiologic Studies Depression Scale (CES-D) was used to measure depressive symptoms (43). CES-D is a valid and reliable scale, widely used to measure depression in older age (40, 44). The score range is 0–8, with higher scores indicating higher levels of depressive symptoms. A cutoff point of 3 is often used to define elevated levels of depressive symptoms (45, 46).

Moving to an owner-occupied home after age 50 years

HRS respondents provided information on their tenure status at each wave of the survey. Individuals who reported living in rented housing at time t, but who reported living in an owner-occupied home at time $t + 2$ years, were considered new homeowners. We did not consider as new homeowners those who bought a second residence or a residence to which they did not move. HRS does not include information on residential histories, so this study is exclusive to transitions from renting to owning a home after 50, regardless of respondents' homeownership status before entering the survey.

HRS also asked respondents who moved to a new residence about the reasons for this change. Web Table 1 (available at https://academic.oup.com/aje) provides examples of stated reasons for moving house. In total, there were 47 broad reasons respondents provided for a move. Based on previous literature (47, 48), we classified these reasons into 6 broad categories that cover individual- as well as neighborhood-level drivers for the move: 1) pull factors (e.g., more appealing neighborhood with better access to transportation and services); 2) push factors (e.g., poor neighborhood conditions or economic insecurity); 3) the desire to be closer to family or friends; 4) downsizing (moving to a smaller and/or less expensive house); 5) upsizing (moving to a larger home); and 6) the expressed desire to be a homeowner. Each category was coded as mutually exclusive. Reasons for moving were coded as a categorical variable, with push factors as the reference category. The "reason-for-move" subsample is smaller than the main analytic sample because HRS collected this information starting only in 1996 ($n = 4{,}195$, which corresponds to 38% of those who moved).

Covariates

Respondent's time-invariant characteristics included sex, race/ethnicity (white, black, or Hispanic), and highest educational level attained (less than high-school graduation, General Education Development certificate, high-school graduate, some college, college or above).

Time-varying demographic confounders, measured at each wave, included age (included as a linear term and squared), marital status (married or in partnership, separated or divorced, widowed, never married), size of the household, and number of children. Time-varying socioeconomic characteristics, measured at each wave, included labor-force participation (employed, unemployed, retired, disabled, not in the labor force), natural logarithms of household income, and nonhousing wealth. Time-varying measures of physical health and behavior assessed at each wave comprised self-reported health (dichotomized into fair/poor vs.

excellent/very good/good), tobacco smoking (ever smoked vs. no; currently smoking vs. no), heavy alcohol drinking (based on self-report of consuming more than 2 drinks per day over 5–7 days a week), and physical functioning (measured by the number of difficulties with activities of daily living (range, 0–5) and instrumental activities of daily living (range, 0–3)).

Data analysis

Hausman specification tests (49) suggested that the assumption of no correlation between explanatory variables and individual characteristics was violated in the random-effects models (results presented in Web Table 2). We therefore implemented individual fixed-effects models, which use within-individual changes in homeownership, consequently controlling for time-invariant confounders that differ across individuals, such as unobserved family background characteristics or preexisting levels of physical and mental health (50–52). Fixed-effects models compared the depressive symptom levels of a respondent before buying a home with that same respondent's depression score when he/she became a homeowner, net of the effect of time-invariant characteristics and time-variant control variables (53). We adjusted for all time-varying factors described above: age, marital status, size of the household, number of children, labor-force participation, natural logarithms of total household income and of nonhousing wealth, self-reported health, health behaviors (smoking and drinking), and number of limitations with activities of daily living and instrumental activities of daily living. To minimize the potential impact of reverse causality, we also controlled for the lagged value of depressive symptoms in the previous wave. Our approach satisfied the 2 conditions of fixed-effects models: The outcome variable should be measured for each respondent in a similar fashion for at least 2 time points, and the exposure variable should vary over time for at least part of the respondents (54).

Our linear model was as follows:

$$Dep_{it} = \mu_t^1 + \beta^2\, homeownership_{it} + \beta^3 X_{it} + \beta^4 Dep_{i,t-1} + \alpha_i^5 + \varepsilon_{it}$$

where Dep_{it} indicates the depressive symptoms score for individual i at time t; $homeownership_{it}$ is the homeownership indicator that takes the value 1 if the individual is a homeowner and 0 otherwise; X_{it} a vector of supplementary time-varying controls; $Dep_{i,t-1}$ is a control for the depressive symptoms score at the previous wave (2 years before); and ε_{it} is the error term. μ_t is a fixed effect for time that accounts for time trends that are constant across individuals, and α_i controls for time-invariant individual characteristics.

We used the same model specification to examine the relationship between the 6 reasons stated for acquiring a house and mental health and introduced a term for interaction between acquiring a new home and the reason for the move. The estimate of interest (the interaction term) captures the change in depressive symptoms for a renter after becoming a homeowner due to a specific reason, relative to the change in depressive symptoms for respondents moving for the same reason but remaining homeowners or renters. In all models, homeownership status was coded as an absorbing state, whereby individuals who became homeowners at some point in the observation period remained homeowners for the rest of follow-up. This specification allowed us to examine both contemporaneous as well as lagged effects of acquiring a home in older age (55).

We followed a stepwise approach to build the fixed-effects models, starting with a model that controlled for age, age-squared, and survey year only (model 1). We then incorporated additional controls for time-varying variables (model 2). Data were initially analyzed separately for men and women, but estimates were subsequently pooled because results did not differ by sex. We estimated individual clustered robust standard errors for all estimates. All analyses were conducted using Stata, version 14.0 (StataCorp LP, College Station, Texas).

RESULTS

Sample baseline characteristics are summarized in Table 1, separately for homeowners and renters. The vast majority of respondents (76.2%) were already homeowners at the time they enrolled in the study. The average depressive symptoms score was 1.356 points, and 15.98% of respondents had a score of ≥3 on the CES-D, corresponding to the cutoff indicating clinical depression symptomatology. Those who were renters at baseline (23.8%) differed from homeowners along several important dimensions. They had higher levels of depressive symptoms (mean CES-D score = 2.257), and they were more likely to report being in poor physical health (41.50%). Compared with homeowners, renters were also more likely to be female (56.76%), black (37.23%), or Hispanic (12.49%) and to have a level of education less than high-school graduation (30.90%). Renters at baseline were also more likely to be separated or divorced (30.90%) and had less financial wealth and lower incomes.

During the entire study period, a total of 2,462 respondents became homeowners. The majority (64.44%) became homeowners between the ages of 50 and 65 years. Results from a random-effects model (Web Table 3) showed that being a female, black, or Hispanic as well as having divorced, being widowed, or being never married at the previous wave were key predictors of acquiring an owner-occupied home in our sample. Results from fixed-effects models are presented in Table 2. Losing a spouse (β = 0.650, 95% confidence interval (CI): 0.577, 0.723) and declining self-reported health (β = 0.521, 95% CI: 0.479, 0.562 respectively) were the strongest predictors of increases in depressive symptoms. Becoming a homeowner predicted a decline in depressive symptoms in the same year (β = −0.077, 95% CI: −0.152, −0.007), which corresponded to a 6.8% decline relative to the mean CES-D score for homeowners at baseline in our sample.

Figure 1 displays the results of lagged models to examine to what extent this association was sustained over time. Becoming a homeowner was associated with a reduction in depressive symptoms 2 years after homeownership (β = −0.056, 95% CI: −0.134, −0.020). Estimates were similar in magnitude but no longer significant after 4 years (β = −0.06, 95% CI: −0.143, 0.023).

Respondent's self-reported reasons for moving are summarized in Web Figure 1, focusing only on respondents who

Table 1. Baseline Characteristics of Selected Participants Among Respondents Aged 50 Years or Older, According to Homeownership Status, Health and Retirement Study, United States, 1993–2010

Characteristic	Homeowner (n = 18,652)		Renter (n = 5,812)	
	No. of Participants	%	No. of Participants	%
Depressive symptoms score or health characteristic				
CES-D score[a]	1.356 (1.87)		2.257 (2.37)	
CES-D score of ≥3	2,976	15.98	2,004	34.49
Self-reported bad or poor health	3,787	20.30	2,412	41.50
Ever smoked	10,809	58.23	3,863	66.64
Currently smoking	3,737	20.07	2,080	35.81
Ever drinks any alcohol	11,991	64.29	3,280	56.44
No. of limitations with ADL[a]	0.17 (0.637)		0.42 (0.99)	
No. of limitations with IADL[a]	0.059 (0.297)		0.17 (0.49)	
Demographic characteristic				
Age, years[a]	56.84 (6.73)		56.22 (6.11)	
Female	9,927	53.22	3,299	56.76
Male	8,725	46.78	2,513	43.24
Married	15,358	82.66	2,750	47.25
Separated or divorced	1,744	9.35	1,794	30.90
Widowed	973	5.22	574	9.89
Never married	577	2.77	694	11.96
White	14,684	78.68	2,934	50.28
Black	2,877	15.46	2,155	37.23
Hispanic	1,091	5.86	723	12.49
No. of children[a]	3.242 (2.12)		3.301 (2.50)	
No. of household members[a]	2.560 (1.188)		2.332 (1.430)	
Educational level				
Less than high-school graduation	3,255	17.46	1,979	34.06
GED certificate	864	4.63	360	6.20
High-school graduate	5,456	29.27	1,458	25.09
Some college	4,466	23.96	1,302	22.41
College or above	4,602	24.68	711	12.24
Socioeconomic characteristic				
Employed	11,503	61.67	2,909	50.05
Unemployed	587	3.15	456	7.85
Retired	4,540	24.34	1,407	24.21
Disabled	457	2.45	541	9.31
Out of the labor force	1,565	8.39	499	8.59
Nonhousing wealth, $[b]	63,000 (689,644)		3,700 (206,629)	
Household total income, $[b]	50,300 (97,994)		16,800 (40,502)	

Abbreviations: ADL, activities of daily living; CES-D, Center for Epidemiologic Studies Depression Scale; GED, General Education Development; IADL, instrumental activities of daily living.

[a] Expressed as mean values (standard deviations).

[b] Expressed as median values (standard deviations).

moved to owner-occupied housing. Estimates for this figure were based on 1,204 respondents who provided information on the reason for moving (48.9% of all new homeowners). About one-third of those who moved to an owner-occupied home (30%) reported pull factors as the main reason to move (i.e., positive features of the new neighborhood or the new home). Only 16.4% reported moving to be closer to family and friends, 13.7% due to push factors (i.e., negative factors

Table 2. Contemporaneous Associations Between Changes in Homeownership and Changes in Depressive Symptoms Score Among Respondents Aged 50 Years or Older ($n = 20,524$), Health and Retirement Study, United States, 1993–2010

Characteristic	Model 1[a]		Model 2[a]	
	β	95% CI	β	95% CI
Exposure of interest				
Homeownership	−0.107	−0.179, −0.035	−0.077	−0.152, −0.007
Demographic characteristic				
Age	−0.120	−0.156, −0.082	−0.0471	−0.084, −0.009
Age squared	0.001	0.001, 0.001	0.001	0.0004, 0.001
Separated or divorced[b]			0.279	0.171, 0.386
Widowed			0.650	0.577, 0.723
Never married			0.474	0.117, 0.830
No. of children			−0.002	−0.024, 0.021
Household size			0.0210	0.002, 0.039
Health status				
Poor self-reported health[c]			0.521	0.479, 0.562
Currently smoking[d]			−0.127	−0.198, −0.055
Currently drinking[e]			−0.042	−0.78, −0.005
No. of limitations with ADL			0.267	0.237, 0.297
No. of limitations with IADL			0.203	0.147, 0.258
Depressive symptoms score at previous wave			−0.008	−0.019, 0.003
Socioeconomic characteristic				
Unemployed[f]			0.273	0.168, 0.376
Retired			0.009	−0.025, 0.044
Disabled			0.348	0.196, 0.498
Not in the labor force			0.075	0.009, 0.140
Log of household nonhousing wealth			−0.011	−0.021, 0.001
Log of household total income			−0.018	−0.034, −0.002

Abbreviations: ADL, activities of daily living; CI, confidence interval; IADL, instrumental activities of daily living.
[a] Models included survey-year fixed effects.
[b] Reference category: married.
[c] Reference category: excellent/good self-rated health.
[d] Reference category: not currently smoking.
[e] Reference category: not currently drinking.
[f] Reference category: employed.

of their last residence), 14% due to downsizing, and 13.6% due to upsizing. The desire to become a homeowner was mentioned as the reason to move by 13.3% of those who became homeowners.

Figure 2 explores the association between becoming a homeowner and depressive symptoms separately according to the reasons for moving, in fixed-effects models. In these models, we used a term for interaction between homeownership and the categorical variable indicating the reason for the move. Full results are presented in Web Table 4. A transition to homeownership motivated by pull factors was associated with a significant decline in depressive symptoms scores ($\beta = -0.426$, 95% CI: −0.786, −0.066). By contrast, transitions to homeownership for other reasons were not associated with depressive symptoms.

DISCUSSION

In this paper, we investigated the mental health benefits of accessing homeownership later in life. Using fixed-effects models, we found that acquiring a home after age 50 is associated with a reduction in depressive symptoms. These findings indicate that, for up to 2 years after the acquisition, late access to homeownership might convey mental health benefits.

Our results support findings from previous studies showing that homeownership is beneficial for health (7, 51) and longevity (15, 18). A key challenge in this literature is selection: It is difficult to establish whether an association exists because homeownership influences mental health or because of unobserved characteristics that confound the relationship between homeownership

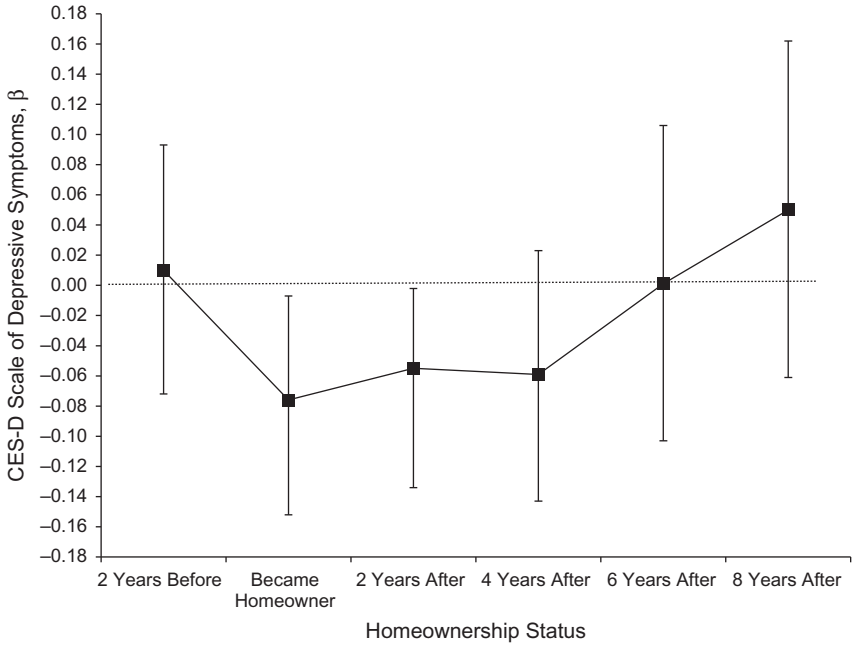

Figure 1. Contemporaneous and lagged associations (β with robust 95% confidence interval) between changes in homeownership and changes in depressive symptoms score among participants aged 50 years or older (n = 20,524), Health and Retirement Study, United States, 1993–2010.

and mental health. To our knowledge, only 3 studies have addressed this issue using fixed-effects models and propensity score–matching techniques (16, 17, 23). Our study builds on this work by implementing a fixed-effects approach and focusing on transitions in homeownership status among adults aged 50 years or older.

To provide a sense of the size of the association, we estimated that the benefit of becoming a homeowner in later life with

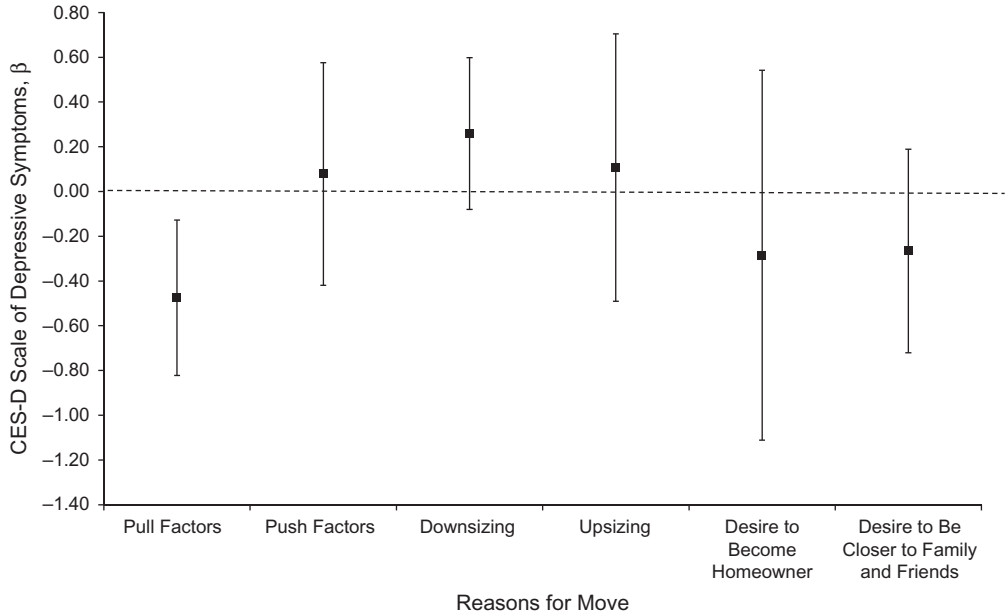

Figure 2. Contemporaneous associations (β with robust 95% confidence interval) between a move for a given reason and the change in depressive symptoms score among participants aged 50 years or older (n = 4,195), Health and Retirement Study, United States, 1996–2010. Fixed-effects coefficients with robust 95% confidence intervals; lower values indicate lower levels of depressive symptoms. Models included survey-year fixed effects and controlled for sociodemographic characteristics, wealth, income, health status, and depressive symptoms scores from the previous wave.

respect to depressive symptoms corresponded to a Cohen's *d* effect of 0.12 (56). This effect is small but significant, contrary to studies of adult populations in the United States, Australia, and New Zealand that have found no association of homeownership with mental health measures using a similar fixed-effects design or propensity score matching (16, 17, 23).

The benefits of accessing homeownership later in life might be conferred through a complex array of mechanisms. First, becoming a homeowner is likely to improve residential stability. Indeed, the median length of time an American household spends in the same house is 2 years for renters and 8 years for homeowners (57). Second, improved social contacts and investment in the community and home are likely to be key elements that reduce depressive symptoms among new homeowners. For example, homeowners are likely to be more active to introduce housing improvements and adaptations, which might help them to live independently for longer and maintain social contacts, benefiting their mental health (58). The importance of the community and neighborhood in the decision to move is illustrated by our finding that moves motivated by positive factors ("pull" factors) linked to the new house and neighborhood are associated with an improvement in depressive symptoms. These moves might improve residential satisfaction, an important predictor of psychological well-being in old age (47, 59). Homeowners also tend to have better quality housing, which in turn influences depression (60). Homeownership might also influence mental health in later life by providing a sense of trust and control in life. Evidence suggests that homeowners interact more with their neighbors and trust their community more (61, 62); they also have higher levels of self-efficacy and perceived control over their life (8, 37), which have been hypothesized to act as buffers and coping resources for stressful events (36, 63). Homeownership is often considered as a proxy for socioeconomic status alongside income, education, and employment, but its direct health effects have been less researched. Our findings indicate that homeownership might be an important measure of changing socioeconomic circumstances in later life, at an age when occupation or income might be less adequate measures of socioeconomic status (64).

We found that those who accessed homeownership after age 50 years had a specific demographic and socioeconomic profile: They were more likely to be female, black or Hispanic, less educated, and poor. Households headed by women and minorities have persistently lower rates of homeownership in the United States (65). These results confirm previous reports that high rates of homeownership in the United States mask persistent inequalities by race/ethnicity. For example, at the peak of homeownership rates in 2004, less than half of black and Hispanic households owned a home, compared with more than 70% of white households (28, 66). In 2015, the median age of first access to homeownership was 31 years, but the median age for black first-time buyers was 37 years, and only approximately half of black Americans owned a home when they reached the age of 50 years (27). We did not have the statistical power to examine the benefits of homeownership separately by race/ethnicity. Yet our results suggest that policies that support older people in accessing homeownership in later life might particularly benefit racial and ethnic minorities, who tend to access home ownership at older ages (67, 68).

This study has several strengths. We used a large, representative, longitudinal sample of older US adults. Using fixed-effects models, we controlled for time-invariant characteristics that might confound the relationship between homeownership and mental health. However, some limitations should also be considered. Because our modeling strategy explores transitions into homeownership, we cannot disentangle the effect of acquiring a new home from a neighborhood effect. Results could also reflect the effect of "snowbird migration" toward sunnier US states (69). Yet in supplementary analyses presented in Web Table 3, we found that new homeowners in our sample were very different from those who migrated to the south of the United States at older ages: They were more likely to be black or Hispanic, female, or to have divorced, be widowed, or never married at the previous wave. Most importantly, studies indicate that snowbird migration occurs primarily among individuals who already owned a home in their state of origin (70, 71). Second, although we controlled for depressive symptoms score at the previous wave, we cannot completely rule out the possibility of reverse causation. Our lagged models, however, are less vulnerable to reverse causality —they show the association between current changes in housing tenure and later changes in depressive symptoms. Third, while our fixed-effects models controlled for a large number of time-varying confounders, unmeasured time-varying confounding remains a potential source of bias. Fourth, we had information on the reason for the move for only a subset of our sample, which resulted in large standard errors (53). Finally, attrition is a potential concern in longitudinal studies; however, retention rates are approximately 85% in the HRS, and evidence suggests that attrition is not linked to health outcomes (72). In our sample, 10% of respondents had data missing for the homeownership variable, and 14% had data missing for the depressive symptoms score. In sensitivity analyses, we also used multiple imputation methods to explore the potential impact of selection associated with missing values. Analyses of the imputed data set led to essentially the same results (Web Table 5).

In conclusion, we found that accessing homeownership after age 50 years reduced depressive symptoms in older age. At baseline, nonhomeowners had a range of health and socioeconomic disadvantages compared with homeowners. We found that the well-documented benefits of homeownership for mental health extended to those who acquired a home later in life. These results add to the growing recognition that homeownership might have public health implications for current and future generations of older US adults. Further research is needed to disentangle potential mechanisms. Our results suggest that policies that enable disadvantaged older US adults to access homeownership by providing them access to affordable housing might reduce depressive symptoms in older age.

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