Care for dependent elderly people : dealing with health and financing issues

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CARE FOR DEPENDENT ELDERLY PEOPLE: DEALING WITH HEALTH AND FINANCING ISSUES

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Résumé en français // French abstract

La prise en charge des personnes âgées dépendantes: Enjeux financiers et de santé.

Dans un contexte de vieillissement rapide de la population, cette thèse explore les liens existants entre santé et modes de prise en charge des personnes âgées dépendantes et s'intéresse à la question du financement de la dépendance.
La satisfaction des besoins d'aide des personnes âgées dépendantes constitue un objectif central de politiques publiques. Le Chapitre 1 estime l'effet de l'aide informelle (*i.e.* familiale) et de l'aide formelle (*i.e.* professionnelle) à domicile sur la santé mentale des personnes âgées dépendantes en France. Les résultats montrent que l'aide informelle réduit le risque de dépression et que l'aide formelle peut améliorer la santé mentale générale.
De récentes études reconnaissent qu'aider un proche dépendant a des effets négatifs sur la santé des aidants et soulignent l'importance de les soutenir. Le Chapitre 2 s'intéresse à l'effet du soutien social sur la santé des aidants informels. Il montre que l'aide formelle et le soutien informel réduisent les problèmes de santé mentale associés à l'activité d'aide.
Enfin, étant donné la pression financière et fiscale qui pèse sur les systèmes publics, le Chapitre 3 étudie dans quelle mesure les Européens seraient capables de financer leurs périodes de dépendance sur la base de leurs revenus et de leur patrimoine financier et immobilier. Il s'intéresse également au rôle du prêt viager hypothécaire. Les simulations soulignent que seule une faible proportion des individus serait capable de financer l'ensemble de ses dépenses de dépendance. Par ailleurs, le patrimoine immobilier pourrait jouer un rôle important dans le financement de la dépendance.

Mots clés : économie de la santé, vieillissement de la population, dépendance, aidants, aide informelle, aide formelle à domicile, santé mentale, dépression, patrimoine immobilier, prêt viager hypothécaire, variables instrumentales, microsimulation, France, Europe.

Résumé en anglais // English abstract

Care for dependent elderly people: Dealing with health and financing issues.

In the context of a rapidly aging population, this doctoral dissertation explores the relationship between health and long-term care arrangements and addresses the issue of the financing of long-term care.
Meeting the needs of dependent elderly is an important objective of public policy. Chapter 1 estimates the effects of both informal (*i.e.* family) care and formal (*i.e.* professional) home care on the mental health of French dependent elderly. The results highlight that informal care decreases the risk of depression and that formal care can improve general mental health.
Recent studies acknowledge that providing informal care has adverse health effects and emphasize the importance of supporting caregivers. Chapter 2 examines the effect of social support on caregivers' health. It shows that formal care and informal support limit the negative consequences of caregiving on mental health.
Finally, given the increasing financial and fiscal pressure on public systems, Chapter 3 investigates to what extent Europeans elderly are able to pay for their periods of long-term care needs on the basis of their income, financial assets and home equity. It also studies the role of reverse mortgages. The simulations stress that only a small proportion of individuals would be able to finance totally their long-term care expenses and that housing assets may play an important role in long-term care financing.

Key words: health economics, population aging, long-term care, caregivers, informal care, formal home care, mental health, depression, housing assets, reverse mortgage, instrumental variables, microsimulation, France, Europe.

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GENERAL INTRODUCTION

1. Demographic and epidemiological issues

1.1. Population aging

This doctoral dissertation fits within the context of population aging, which raises major financial, intergenerational and health issues. If low fertility rates are playing a role, the main driver of this demographic change is increasing life expectancy, explained by declining mortality rates in older ages. In addition, the aging of the post-war baby-boom generation will accelerate this trend. Eurostat provides population projections (Europop 2013) based on assumptions regarding life expectancy, total fertility rates[1] and migration flows. Table 1 below summarizes the assumptions made and the results of projections for the countries studied in this doctoral dissertation.

Eurostat projections follow a convergence approach. Fertility is assumed to converge over the very-long term to the level of the countries the more advanced in the demographic transition (Northern countries); life expectancy is assumed to increase faster in countries with lower levels (Eastern Europe) and slower in countries with high longevity. The cumulated net migration to the European Union (EU-28) between 2013 and 2060 would be 55 million, mainly concentrated in Italy (15.5 million), in the UK (9.2 million), in Germany (7 million) and in Spain (6.5 million). Life expectancy at age 65 is projected to increase by 4.7 years for men and 4.5 years for women in Europe. Given that health problems are more prevalent at older ages, population aging may increase the number of dependent people who need care. Moreover, the proportion of people aged 80 and older is expected to double in Europe, from 5% in 2013 to 12% in 2060. By contrast, the proportion of people under 14 should remain constant and the proportion of people aged 15-64 is projected to decrease from 66% to 57%. Consequently, the demographic total dependency ratio will increase from 51% in 2013 to 77% in 2060. These figures raise concerns about the financial sustainability of social systems based on the contributions of working people.

[1] The total fertility rate is *"the number of children a woman would have during her lifetime if she were to experience the fertility rates of the period at each age"*. It is *"the sum of the age-specific fertility rates for a particular period (usually a year)"* (French Institute for Demographic Studies, Ined).

Table 1. Population projections.

Country	Gains in life expectancy at age 65 (2013-2060)		Change in fertility rate (2013-2060, p.p.)	Net migration flows (2013-2060, 1000's)	% 80+		Dependency ratio[2]	
	Males	Females			2013	2060	2013	2060
Austria	4.5	4.4	+0.17	1994	5	11	48.3	75.1
Germany	4.7	4.6	+0.23	7041	6	13	51.4	83.2
Sweden	4.1	4.5	-0.01	2273	5	9	56.8	71.3
Netherlands	4.4	4.6	+0.08	810	4	11	51.8	74.4
Spain	4.3	3.8	+0.23	6511	6	15	49.5	77.0
Italy	4.3	4.0	+0.18	15511	6	13	54.4	76.9
France	4.1	3.7	-0.04	3960	6	11	57.1	72.6
France[1]	4.9	5.8	Stable =1.95	4700	6	11	56.4	75.8
Denmark	4.7	5.1	+0.12	755	4	10	54.7	69.8
Belgium	4.6	4.5	+0.06	3192	5	9	53.1	68.4
EU-28	4.7	4.5	0.16	55107	5	12	51.4	76.6

Source: EUROSTAT population projections Europop 2013 (European Commission, 2014).
(1) French projections from the French Institute of Statistics and Economic Studies (Insee, 2010).
(2) Demographic total dependency ratio: (population aged 0-14 + population aged 65+)/(population aged 15-64).

1.2. Old-age dependency is hard to define

While demographic projections are generally considered as particularly reliable – despite uncertainties on the precise level of population aging (Blanchet and Le Gallo, 2008), old-age dependency appears to be more difficult to forecast. First, the very concept of *"dependence"* (or *"dependency"*) is hard to define. The *International Classification of Impairments, Disabilities and Handicaps* (ICIDH), developed by the World Health Organization (WHO, 1980) on the basis of the work of Philip Wood (1975), describes the consequences of disease (or injuries and other disorders) and their implications on the everyday life of individuals. The development of these consequences follows a sequential process: disease may lead to impairment which may, in turn, lead to disability and handicap (or disadvantage). Impairment is a *"loss or abnormality of psychological, physiological, or anatomical structure or function"*. It represents deviation from some biomedical norm and may take various forms (intellectual, psychological, language, aural, ocular, visceral, skeletal, disfiguring or sensory impairments). Disability is characterized by *"any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being"*. It relates to the behavior of individuals and their ability to perform daily life activities (personal care, domestic tasks, communication, mobility, dexterity). Finally, handicap is an environmental and social phenomenon. It is defined as a *"disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual"*. The assessment of handicap is based on six *"survival roles"*: i) orientation, ii) autonomy in regard to personal care (e.g., bathing, dressing, feeding) and other activities of daily living, iii) mobility, iv) use of time including work, education and

leisure, v) social integration, vi) economic activity/independence. In the ICIDH, *"dependence"* on other individuals for activities of daily living is only one of the dimensions of disadvantage. Interestingly, when the individuals are dependent on aids and appliances or on adaptation of dwellings, but not on other persons, the World Health Organization uses the terms *"aided independence"* or *"adapted independence"*. It highlights the importance of the environment in the development of handicap and dependence. Empirical analyses confirm the dynamic nature of the dependence process: difficulties in performing basic activities of daily life are usually preceded by sensory, physical or cognitive functional limitations (see Cambois and Lièvre, 2007; Cambois and Robine, 2003). It should be noted that the distinction between impairment, disability and handicap is not always clear in the ICIDH. Since 2001, the *International Classification of Functioning, Disability and Health* (ICF) (WHO, 2002) has replaced the ICIDH. The aims of the ICF were to better emphasize the role of physical and social environment and to focus on health and functioning, rather than on disability. In this new *"bio-psychosocial"* model, functioning and disability result from dynamic interactions between health conditions, personal factors (e.g., age, gender, coping styles, social background, education and character) and environmental factors (e.g., social attitudes, technology, support and relationships, services and public policies). Disability becomes an umbrella term covering impairments, activity limitations and participation restrictions. Functioning and disability are classified by the means of lists of body functions, body structure, activities, participation and environmental factors. The ICF provides a single list for both activities and participation (e.g., self-care, domestic life, mobility, communication, relationships), making any definition of the concept of *"dependence"* more difficult than with the previous classification.

In the public debate, the notion of *"dependence"* refers to the need for care, help or assistance to perform activities of daily living. In France, dependence is defined as *"the state in which a person, notwithstanding the care he/she may receive, requires help in order to perform basic activities of daily life or regular supervision"* (Article 2, paragraph 3 of Law No 97-60 of 24 January 1997, translation[2]). In Europe, dependence is *"a state in which persons, by reason of lack or loss of physical, psychological or intellectual autonomy, require significant assistance or help in carrying out their usual day-to-day activities"* (Recommendation No R (98) 9,

[22] *"La dépendance mentionnée au premier alinéa est définie comme l'état de la personne qui, nonobstant les soins qu'elles est susceptible de recevoir, a besoin d'être aidée pour l'accomplissement des actes essentiels de la vie ou requiert une surveillance régulière".*

Council of Europe, adopted by the Committee of Ministers on 18 September 1998). Interestingly, the Council of Europe makes clear that *"dependence may afflict any section of the population and not only elderly people. Even though dependence tends to increase with age […] age is not the only criterion of this state"*. Consistent with this view, access to public long-term care benefits do not depend on age in Austria, Germany, Denmark, Sweden, the Netherlands and Spain. By contrast, France (since 1997), Belgium and Italy have set minimum age requirements (60 or 65 years) (Missoc comparative tables, 1 January 2016; country reports of the Ancien project, 2010; Carrino and Orso, 2014). In France, it has been argued that the distinction between handicap (for adults under 60 years of age) and dependence (for 60+) is more political than scientific (Mormiche and Jourdain, 2003), and leads to age segregation (Ennuyer, 2003).

The difficulty in defining the concept of *"dependence"* is reflected in the various measures used to assess long-term care needs. For instance, in health surveys, the questions about restrictions in activities of daily living differ between countries, which complicates data comparison (Cambois and Robine, 2003). The administrative definition of dependence, used to assess eligibility for public long-term care coverage, also varies across European countries (Missoc, 2016; Ancien project, 2010; Carrino and Orso, 2014). In most countries, medical professionals or social workers assess the ability of individuals to perform some basic activities of daily living such as bathing, dressing, going to toilet, transferring and feeding (ADLs, developed by Katz et al., 1963); and some instrumental activities of daily living such as shopping, food preparation or housekeeping (IADLs, developed by Lawton and Brody, 1969). They also generally take into account cognitive abilities. However, the list of ADLs and IADLs used in the needs assessment varies and some items are given more importance in some countries than in others. It leads to differences in eligibility between countries and even within countries when long-term care programs are provided at the local level (Carrino and Orso, 2014).

Therefore, the notion of *"dependence"* is in fact multidimensional and hard to grasp. In the different chapters of this doctoral dissertation, for the sake of simplicity and consistency, the definition of the population of interest is based only on age and activity restrictions. Dependent elderly people are defined as individuals aged 65 and over who report difficulties in performing alone some activities of daily living (at least one ADL or IADL in Chapters 1 and 2, at least two ADLs in Chapter 3).

1.3. …and hard to predict

Let's now focus on the second difficulty arising when trying to forecast the risk of old-age dependency. The extent to which population aging and longevity translate into an increase in the number of dependent elderly and higher long-term care expenditures is nontrivial. It depends on whether additional years of life are spent in good health or not. Three theories have been developed to describe the relationship between increased life expectancy and future health trends: the expansion of morbidity (Gruenberg, 1977), the compression of morbidity (Fries, 1980) and the dynamic equilibrium (Manton, 1982). The first scenario assumes that medical progress improves the survival rate of patients with chronic diseases. The prevalence of diseases increases and gains in longevity are associated with prolonged periods of chronic illnesses and disability. In the second theory, prevention and behavior change decrease or postpone the incidence of diseases. Disability-free and disease-free life expectancy increases, both in absolute terms and as a proportion of total life expectancy. Finally, the dynamic equilibrium constitutes an intermediate hypothesis. It states that medical advancement both improves survival probabilities of sick persons and delays the progression of diseases, leading to a reduction of severe health problems and an expansion of less serious diseases and moderate disability.

These alternative theories can be tested empirically by studying the evolution of the Healthy Life Years indicator (also called disability-free life expectancy) over time. Healthy life years measure the number of years that a person of a given age is expected to live in a healthy condition (*"healthy"* can be defined in many ways). It introduces the concept of quality of life in studies on longevity. Eurostat provides annual statistics on years spent free from long-term activity limitation, using the Global Activity Limitation Indicator (GALI) from the EU-SILC survey (*European Union Statistics on Income and Living Conditions*). In 2014, the Healthy Life Years indicator at age 65 was, on average (in the EU-28), 8.6 years for both men and women. It means that men aged 65 could expect to live 47%[3] of their remaining lives free from activity limitation. The proportion was 40% for women. In all European countries, women spend a smaller proportion of their remaining years of life in good health than men. Healthy life years differ widely across countries, much more than life expectancy, and these health inequalities seem to be increasing (Fouweather et al., 2015). In 2014, the share of healthy life years in total life expectancy at age 65 ranged between 28% in Slovakia and 81%

[3] Proportions are computed by the author, based on Eurostat 2014 data on life expectancy and healthy life years.

in Norway for men and between 19% in Slovakia and 77% in Sweden for women. There is a lack of empirical consensus on whether gains in longevity are spent in good health or not. Results depend on the indicators used and no common pattern emerges in developed countries. France experienced a compression of disability over the 1980s and, since the 1990s, trends in disability-free life expectancy at age 65 have followed a dynamic equilibrium (Cambois et al., 2013, 2008). Indeed, Cambois et al. (2013) show that, at age 65, there has been a compression of life expectancy with ADLs and IADLs (severe disability), and, generally, an expansion of life expectancy with functional limitations (moderate disability) over the 2000s. By contrast, in mid-adulthood (50-65 age group), the authors find an unexpected expansion of disability for most indicators (except ADLs and physical functional limitations for men), especially for women. Regarding other countries, Cambois et al. (2013) stress that, like in France, most countries experienced a compression of disability over the 1980s and a dynamic equilibrium over the 1990s. Since the early 2000s, results appear to be more mixed. Lafortune and Balestat (2007) investigate disability trends in severe disability (ADL limitations) among people aged 65 and older in several countries until 2000-2005. They find evidence of a decline in disability in 5 countries (Denmark, Finland, Italy, the Netherlands and the US), an expansion in disability in 3 countries (Belgium, Japan and Sweden) and a stable rate of severe disability in 2 countries (Australia and Canada). In England, a recent study reports an absolute compression of cognitive impairments between 1991 and 2011, a relative compression of fair/poor self-perceived health and a dynamic equilibrium for ADL and IADL disability (Jagger et al., 2016).

Projections of the future number of dependent elderly and long-term care expenditures rely on assumptions on disability trends. In French projections (Destinie model), three scenarios are considered: i) life expectancy with disability/dependency is constant (all additional years of life are in good health), ii) the share of life expectancy with disability in the total life expectancy at age 65 is constant, iii) constant prevalence rates of dependency at each age. In France, the number of dependent elderly, defined as individuals eligible for the Personal Autonomy Allowance (*Allocation Personnalisée d'Autonomie*), is expected to increase from 1.14 million in 2010 to 1.67 million (+47%) in 2040 in the first scenario, 1.95 million (+71%) in the intermediate scenario and 2.16 million (+89%) in the last scenario (Marbot and Roy, 2015). In 2060, the figures are projected to reach 1.85 million in the first scenario, 2.3 million in the second scenario and 2.7 million in the last scenario (Charpin Report, 2011). Eurostat provides projections for public long-term care expenditure from 2013 to 2060. *"Long-term*

care" can be defined as a *"range of services required by persons with a reduced degree of functional capacity, physical or cognitive, and who are consequently dependent for an extended period of time on help with basic activities of daily living (ADL). This personal care component is frequently provided in combination with help with basic medical services such as nursing care (help with wound dressing, pain management, medication, health monitoring), as well as prevention, rehabilitation or services of palliative care. Long-term care services can also be combined with lower-level care related to domestic help or help with instrumental activities of daily living (IADL)"* (OECD, 2013a). Public long-term care expenditure in the EU-28 is projected to increase from 1.6% of GDP in 2013 to 2.9% in 2060 (+76%) if all gains in life expectancy are spent with disability. Health improvements would lead to a lower expenditure (2.6% of GDP). Finally, if a shift from informal to formal care is assumed, public long-term care expenditure could reach 3.6% of GDP in 2060 (+117%) (European Commission, 2015). These figures highlight that the risk of old-age dependency strongly depends on future disability trends. However, in all scenarios, increased longevity results in significantly higher numbers of individuals in need of long-term care.

2. The support for dependent elderly people in Europe

How is the long-term care risk financed in Europe? What is the role of public coverage and private long-term care insurance? Is care provided informally, by family caregivers and other relatives, or formally, by professional workers? The long-term care risk can be insured by the state, the market or the family and these different forms of coverage may substitute or complement each other (see Section 3 below). A characteristic which seems common to all countries is that the private long-term care insurance market is small. According to the OECD, less than 2% of long-term care expenditures are financed by private insurance in Europe (Germany, Portugal, France, Switzerland, Slovenia, Netherlands, Hungary and Estonia). In France, the proportion of people aged 40 and over who hold a long-term care insurance policy is about 15% (Colombo et al., 2011a). Another solution to cover the long-term care risk could be to use housing assets, in particular through equity release products that enable homeowners to liquidate their housing equity while continuing to live in their home. Long-term care systems differ across Europe regarding the relative roles of the state and the family (Carrino and Orso, 2014; Colombo et al., 2011b; Da Roit and Le Bihan, 2010; Kraus et al., 2011; Verbeek-Oudijk et al., 2014). They are generally grouped in three main clusters: Northern countries (Sweden, the Netherlands and Denmark), Mediterranean countries (Spain and Italy) and Central Europe (Austria, Germany, France and Belgium). In Nordic countries,

public long-term care systems are highly developed and generous. Support for dependent people is mainly professional (through formal home help or in institutions) and informal care is limited. There is no legal obligation to support relatives in Scandinavian countries (Haberkern and Szydlik, 2010). On the other hand, in Mediterranean countries, public long-term care expenditure is low and the role of the family is very important. Central countries are an intermediate (and less homogeneous) group. The English long-term care system is means-tested, older people have to exhaust their assets to be eligible for nursing home coverage and home care benefits are income-tested (Colombo et al., 2011b; Comas-Herrera et al., 2010). To illustrate these differences, in 2013, public long-term care expenditure represented 4.1% of GDP in the Netherlands, 3.6% in Sweden, 2% in France, 1.4% in Germany, 1.8% in Italy and 1% in Spain (European Commission, 2015). In addition, in Mediterranean countries, the share of over-50s who have a child living at home (34% in Spain and 32% in Italy) is much higher than in Scandinavia (5% in Sweden, 9% in the Netherlands and 10% in Denmark). The proportion is equal to 9% in Germany, 13% in France and 14% in Austria (Verbeek-Oudijk et al., 2014). Finally, 15-20% of the 65+ use formal care at home or in institution in Sweden and the Netherlands, 5-10% in Belgium and Germany and less than 5% in Spain and Italy (Colombo et al., 2011b).

In France, the issue of long-term care has been made more acute after the heat wave of summer 2003, which killed 15,000 people (French National Institute of Health and Medical Research, Inserm). Under the presidency of Nicolas Sarkozy (May 2007-May 2012), an important reform of the dependency risk, consisting of the creation of a new branch of social security (the *"fifth risk"*), was discussed and abandoned for financial reasons. Under the presidency of François Hollande (May 2012-…), the Law on the adaptation of society to the aging of the population (*Loi relative à l'adaptation de la société au vieillissement*) has been adopted by the French Parliament on 14 December 2015. This law, among others, increases the Personal Autonomy Allowance (this allowance is described in details in Chapter 1) and recognizes the right to respite for family caregivers. However, it focuses on home care, leaving aside the issue of institutional care. Total French public spending on long-term care represented 24 billion Euros in 2010, including 14 billion for health expenditures, 7.5 billion for expenses associated with the loss of autonomy (long-term care) and 2 billion for accommodation. Private long-term care expenditure was 7 billion Euros (0.7 billion for healthcare, 1.5 billion for long-term care and 4.8 billion for accommodation) (Charpin Report, 2011). The comparison of public and private spending shows that more than 95% of health

expenditures are publicly covered, 83% of long-term care expenditures and only 29% for accommodation. The true cost of long-term care is in fact much higher. Indeed, support of elderly people in France is delivered mainly by family members as informal care. The French High Family Council[4] estimates that 3.6 million elderly people live in ordinary households and receive care due to health problems; 48% of them receive only informal care, 20% only formal care and 32% are helped by both formal and informal care. Care hours provided by family caregivers are estimated at over one billion hours, which would represent 77% of the total hours of care and more than 7 billion Euros if informal care hours were paid at the net French minimum wage.

The future informal care supply is uncertain. The gap between male and female life expectancy is expected to decline, which would, in turn, increase the proportion of older people living with a partner. The rising number of divorces and separations has the opposite effect. In addition, decreasing fertility rates over the 1970s, the 1980s and the 1990s will probably reduce the total number of potential caregivers. Furthermore, women's participation in the labor market, longer careers and the geographical distance between parents and children will increase the opportunity cost of caregiving. Changes in social norms and in the respective roles of men and women in society may also impact the supply of informal care. The Felicie research program (*Future Elderly Living Conditions in Europe*) projects family situations in 9 European countries (Belgium, Czech Republic, Germany, Finland, France, Italy, the Netherlands, Portugal and the UK). Between 2000 and 2030, the number of dependent elderly having neither partner nor surviving children should increase far more slowly than the number of those with close family. In 2030, 22% of dependent women aged 85 and over will have a partner, as compared to only 9% in 2000. The proportion of women with no family is expected to decrease, from 23% in 2000 to 15% in 2030. However, the situation will continue to differ between men and women in 2030, with 53% of men having a partner and 63% of women having only children (Gaymu et al., 2007; Gaymu and FELICIE team, 2008). In addition, situations in which both partners are dependent should become more prevalent. These figures, although interesting, tell nothing about the willingness of potential caregivers, in particular husbands and stepchildren in reconstituted family, to provide informal care.

[4] Haut Conseil de la Famille. 2011. La place des familles dans la prise en charge de la dépendance des personnes âgées (Report).

3. Research questions

This doctoral dissertation in applied microeconomics seeks to contribute to the economic research on long-term care. In 2000, Norton emphasized in the *Handbook of Health Economics* that *"Although the issues in long-term care cut across countries, the published research does not. There are surprisingly few economic studies written in English that focus on issues specific to non-US countries, or use non-US data"* (Norton, 2000). During the last decade, the literature in this area has significantly developed in Europe, with increased data availability. Longitudinal health surveys focusing on people aged 50 and older were launched in Europe in the early 2000s (the *English Longitudinal Study of Ageing* in 2002 and the *Survey of Health Ageing and Retirement in Europe* in 2004) on the model of the US *Health and Retirement Study*. In France, two national surveys on disabled and dependent persons and their caregivers have been conducted in the late 1990s (*Enquête Handicap-Incapacité Dépendance*) and in 2008 (*Enquête Handicap Santé*). This last section of the introduction summarizes the economic literature on long-term care – which lies at the intersection of health economics, economic demography, family economics and labor economics – and introduces the research questions of this doctoral dissertation (see also Figure 1 below).

As underlined by Norton (2000), the importance of the long-term care topic lies not only in its cost for public systems but in *"how long-term care affects economic decisions for individual over a lifetime and across generations"*. A first line of research aims at better understanding intergenerational long-term care choices. Theoretical models have studied living arrangements decisions (living alone, with a child, or in a nursing home), the provision of informal care by children and the demand for formal care (Byrne et al., 2009; Fontaine et al., 2009; Thiébaut et al., 2012 provide very good literature reviews). These models are very diverse. Byrne et al. (2009) distinguish between those that assume that the family share common preferences (Hoerger et al., 1996; Kotlikoff and Morris, 1990; Pezzin et al., 1996; Stabile et al., 2006) and those that use separate utility functions for each family member, generally a parent and children (Byrne et al., 2009; Checkovich and Stern, 2002; Engers and Stern, 2002; Hiedemann and Stern, 1999; Pezzin et al., 2007; Pezzin and Schone, 1999, 1997; Sloan et al., 1997). They also stress that game-theoretic models with several children are needed to study interactions between siblings, free-rider behaviors or competition for inheritance. Fontaine et al. (2009) add that structural econometric models are better than nonstructural ones in capturing interactions between siblings (recent papers generally use a

structural approach). In models with separate utility functions the parent, who is generally not altruistic, allocates money to consumption and formal care. The children choose whether to provide informal care or not and their level of time assistance. They may also provide cash transfers to purchase formal care (Byrne et al., 2009; Engers and Stern, 2002; Hiedemann and Stern, 1999; Pezzin and Schone, 1999, 1997; Sloan et al., 1997). Several studies determine jointly care and work decisions to account for the tradeoff between the supply of informal care, work and leisure (Byrne et al., 2009; Hoerger et al., 1996; Pezzin and Schone, 1999, 1997; Sloan et al., 1997). The utility of the children depends on consumption, leisure, and formal and informal care. The level of care may enter the utility function directly (in most models) or indirectly through the health of the parent (Byrne et al., 2009; Pezzin et al., 1996; Pezzin and Schone, 1999; Stabile et al., 2006; Thiébaut et al., 2012; Van Houtven and Norton, 2004). There are several reasons that could explain caregiving (Bommier, 1995; Thiébaut et al., 2012). Most theoretical models assume that children care about their parents (upward altruism), but they may also help their parents to repay them for early investment, in particular in education (reciprocity). Alternatively, parents may act strategically and influence the decisions of children by conditioning the division of bequests on the care they provide, or by threatening to disinherit them (Bernheim et al., 1985). Thiébaut et al. (2012) stress that some papers include financial transfers from the parent to increase care incentives. Finally, children's behavior may be influenced by social norms (Akerlof and Kranton, 2000).

In empirical studies, health status is the most important determinant of home care arrangements. Older individuals and individuals in poor health are more likely to receive informal care from children and paid domestic help or nursing care. In addition, children in good health are more likely to provide care (for the determinants of care arrangements, see, for instance, Bonsang, 2009, 2007; Brandt et al., 2009; Fontaine et al., 2007; Haberkern and Szydlik, 2010; Motel-Klingebiel et al., 2005; Stabile et al., 2006; Van Houtven and Norton, 2004).

Home care arrangements are also influenced by family composition. Daughters provide more care than do sons and elderly women tend to receive more often informal care and paid domestic help, particularly when they are widowed. When children have family obligations, such as children or a partner, it tends to have a negative effect on informal care provision because of time competition. The geographical distance between parents and children decreases time assistance and increases financial help. Finally, the involvement of one child in care depends on the number of siblings (Bonsang, 2007; Brandt et al., 2009; Haberkern and

Szydlik, 2010). Fontaine et al. (2007) stress that children's caregiving decisions are taken individually when the parent has a spouse and collectively when the parent is alone. Fontaine et al. (2009) show that, in families with two children, the younger and the older child have different behaviors.

The effect of socioeconomic characteristics is less clear. Children with higher income and education level are more likely to help their parents, maybe for reciprocity-based reasons. The effect of work status on informal care has been the subject of little investigation in the literature and existing results are ambiguous due to the two-way causality. Some studies find a negative effect of employment on informal care (Carmichael et al., 2010; Haberkern and Szydlik, 2010), while others find no significant impact (Berecki-Gisolf et al., 2008; Bonsang, 2007; Brandt et al., 2009; Stern, 1995). Moreover, working full-time increases financial transfers to the parent (Bonsang, 2007). The level of income and education of the elderly has no clear effect on formal home care. This may be explained by the potential interrelationship between access to publicly funded care and the socioeconomic status. On the other hand, when children receive financial gifts from the parent or expect to receive inheritance, it seems that they are more likely to help (Bonsang, 2007; Brandt et al., 2009; Haberkern and Szydlik, 2010). Finally, Haberkern and Szydlik (2010) also emphasize the role played by contextual factors, such as the availability of social, health and nursing services in the country, the societal opinion about the role of the state in elderly care and legal obligations between family members.

While theoretical models assume that formal home care and informal care have a positive effect on the utility of the elderly parent – directly or indirectly through health, functioning, or the quality of life – this relationship has not received much attention in the empirical literature. Existing studies rarely estimate the effect of both formal and informal care and use very diverse indicators. Stabile et al. (2006) find no significant effect of the generosity of public home care programs on the self-assessed health of the elderly in Canada. Byrne et al. (2009), on US data, stress that formal and informal care have only a small positive effect on happiness. Finally, Bonsang and Bordone (2013) find on European data that informal care provided by children has a negative effect on women's cognitive functioning.

- 1st Research question (RQ 1): Does home care for dependent elderly people improve their mental health? What is the effect of informal care? Of formal care?

A second line of research, mostly empirical, estimates the consequences of informal care on the labor force participation and the health of informal caregivers. In recent years, special attention has been paid in the economic literature to reverse causality and omitted variables bias. Studies have tried to identify the *causal* impact of informal care. Concerning the effects of informal care on the labor market, Lilly et al. (2007) provide a systematic literature review of articles published between 1986 and 2006. They stress that informal care has a negative influence on labor force participation and hours worked, mainly for coresiding and intensive caregivers. Research on the impact of caregiving on wages is scarce, with inconsistent findings. More recent studies confirm previous results and generally find no impact of informal care on wages (Bolin et al., 2008a; Heitmueller, 2007; Jacobs et al., 2015; Lilly et al., 2010; Van Houtven et al., 2013).

The economic literature also shows that informal care has negative effects on caregivers' physical health, mental health and well-being (Bobinac et al., 2011, 2010; Coe and Van Houtven, 2009; Di Novi et al., 2015; Do et al., 2015; Oshio, 2014; Schmitz and Westphal, 2015; Van den Berg et al., 2014; White-Means, 1997). However, economic studies generally do not assess whether heterogeneous care arrangements lead to different health consequences. In particular, they do not estimate the potential mediating effect of social support on caregivers' health. One exception is White-Means (1997) who takes into account the endogeneity of formal home care decisions and suggests that formal care may protect caregivers' health. Existing studies from other fields (e.g., research in nursing and social work, psychology) generally use non-representative samples of caregivers and are based on correlation analyses.

- 2nd Research question (RQ 2): Does social support protect caregivers' health? What is the effect of informal support, received from the family and social network, on health? What it the effect of formal home care?

Finally, the long-term care literature also addresses the question of long-term care financing and investigates the role of public coverage and of private long-term care insurance. One of the objectives is to assess to what extent public subsidies for formal care may crowd-out family caregiving and modify living arrangements (for theoretical models see, for instance, Hoerger et al., 1996; Pezzin et al., 1996; Sloan et al., 1997, 1996). The empirical relationship between formal and informal care is hard to identify due to the two-way causality

and potential unobserved factors influencing both types of care. Concerning the causal effect of informal care on formal care, American studies find, after controlling for endogeneity, that informal care reduces the use of formal home health care and social services (Greene, 1983; Van Houtven and Norton, 2004), hospital nights, physician visits and outpatient surgery (Van Houtven and Norton, 2004) and the risk of entering into a nursing home (Charles and Sevak, 2005; Lo Sasso and Johnson, 2002). Studies on European data highlight that informal care substitutes/decreases low-skilled home care (paid domestic help) but complements/increases high-skilled home care (nursing care, personal care) and hospital and doctor visits (Bolin et al., 2008b; Bonsang, 2009). Regarding the effect of formal care on informal care, results are more ambiguous, with some studies finding substitution effects (Ettner, 1994; Golberstein et al., 2009; Stabile et al., 2006) and others finding no effect (Arnault, 2015; Christianson, 1988; Pezzin et al., 1996). More generally, Norton (2000) stresses that a means-tested public insurance program, such as Medicaid in the US, may affect savings.

As outlined in Section 2, the private long-term care insurance market is small. This lack of success is partly explained by the unattractiveness of long-term care insurance policies (incomplete coverage, unattractive rules of reimbursement, high loading factors). The literature also points to problems on the demand side of the market: poor financial knowledge of consumers, limited rationality/myopia (misperception of the long-term care risk, denial), state dependence of the utility function (low value of consumption when dependent), and existence of potential substitutes for private LTC insurance (family solidarity and social assistance) (see Brown and Finkelstein, 2009; Fontaine and Zerrar, 2013; Pestieau and Ponthière, 2012 for literature reviews). Indeed, Brown and Finkelstein (2008) and Pauly (1990), show that Medicaid may significantly crowd-out private insurance demand in the US. In addition, Kotlikoff and Spivak (1981) demonstrate that families can "self-insure" against the longevity risk through consumption and bequest arrangements. The same could apply to the disability risk. The non-purchase of private long-term care insurance may also be explained by *intergenerational moral hazard* (Pauly, 1990; Zweifel and Strüwe, 1998). By lowering the cost of formal care, private insurance may provide incentives for children to institutionalize their parents. If the elderly prefer to receive informal care, they may decide not to buy insurance. However, this theory is not supported by the empirical literature. Courbage and Roudaut (2008) show that, in France, private long-term care insurance seems to be purchased to preserve bequests, to protect families against the financial risk associated with disability, and to reduce the burden of potential informal caregivers.

Finally, some authors stress that homeownership may provide self-insurance for long-term care and decrease the demand of private insurance (Davidoff, 2010, 2009; Laferrère, 2012). However, little has been done so far on the relationship between housing and the long-term care financing. Masson (2015) argues that a specific reverse mortgage product for dependent individuals, allowing them to liquidate their home equity while *"aging in place"*, may help finance long-term care. Mayhew et al. (2010) and Stucki (2006) show, respectively on UK and US data, that housing wealth may significantly improves ability to pay for long-term care. However, these studies do not take into account potential disparities in the risk of disability depending on individual characteristics. More generally, the literature does not assess whether individuals can pay for long-term care. One exception is Hussem et al. (2016) who find on Dutch data that, if the elderly had to pay for long-term care up to a limit of 100% of their income, less than half of the costs could be covered by private income on a yearly basis and 64% if dependent individuals are able to smooth the costs over their remaining lifetime.

- 3rd Research question (RQ 3): Will dependent individuals be able to pay for their long-term care needs? What is the role of income, financial assets and housing wealth? Could reverse mortgage products be useful?

4. Research outline / summary

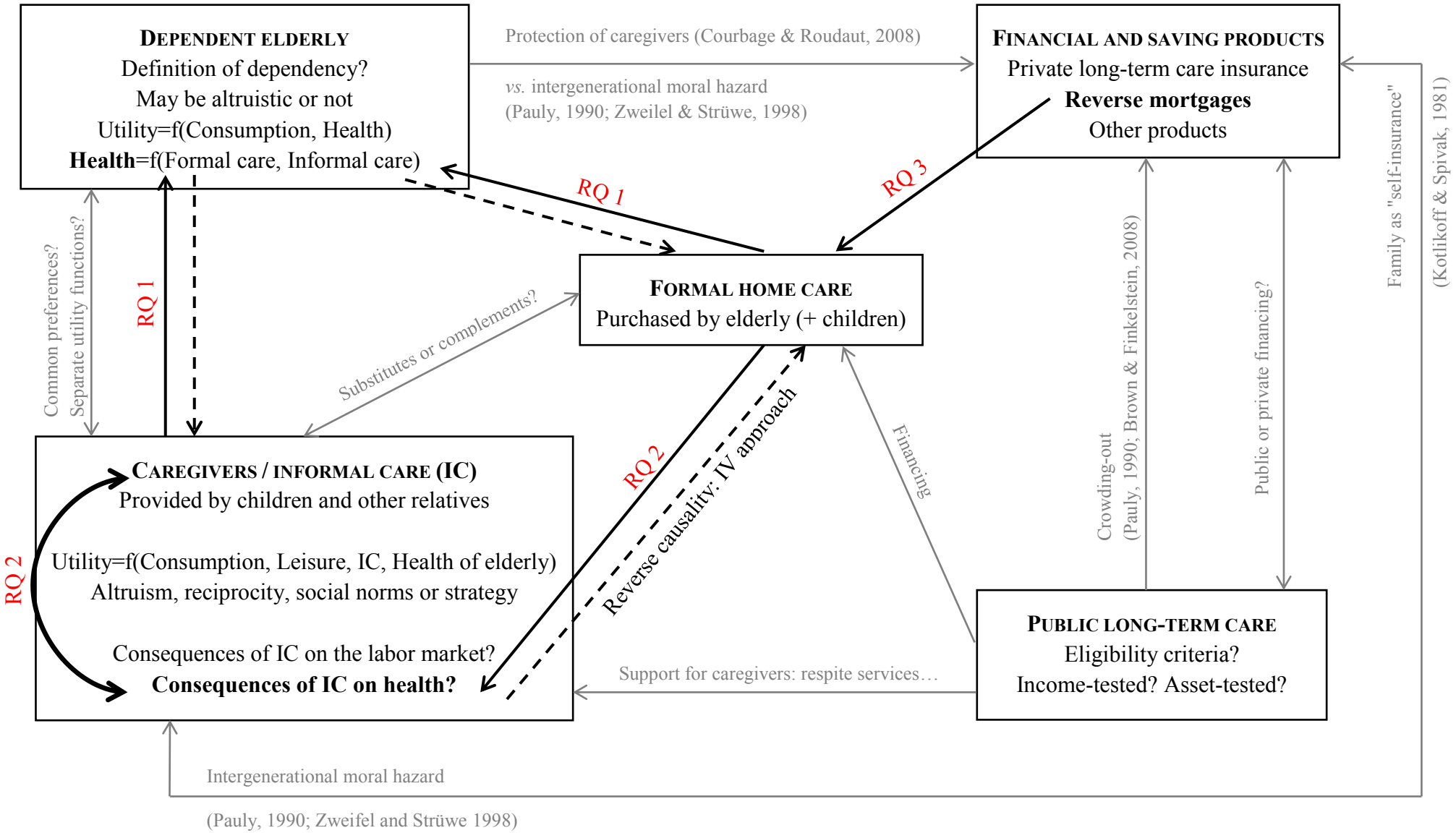
Chapters 1 and 2 of this doctoral dissertation investigate the influence of care arrangements on health. They use the French Disability and Health Survey (*Enquête Handicap Santé*), carried out in 2008 among non-institutionalized people by the French Institute of Statistics (Insee) and the Ministry of Health (Drees). The first chapter estimates the effects of both informal and formal home care on the mental health of elderly individuals needing help with daily activities. Two mental health indicators are considered: depression, on a sample of 4,067 dependent individuals, and the Mental-Health Inventory (MHI-5), on a subsample of 2,117 individuals. The endogeneity of care is adjusted for by the instrumental variables approach, using characteristics of adult children and geographical disparities in access to public long-term care coverage as instruments. The results show that informal care reduces the risk of depression of dependent elderly and that formal care may have positive effects on their general mental health.

The second chapter estimates the effect of social support (informal support received from the family/social network and formal home care) on caregivers' health. It focuses on a sample of

755 non-coresiding caregivers and uses instrumental variables in order to take into account the potential endogeneity of social support. The health status of caregivers is measured both by standard indicators (self-perceived health, chronic morbidity and activity limitations) and by more specific questions asking caregivers whether informal care impacts their health. Estimations show that a one-unit increase in formal care hours significantly reduces the probability that caregiving affects health (-2%) and decreases the risk that caregiving leads to sleep disorders (-2.2%) or depression (-1.7%). In addition, informal support, approached by the number of informal caregivers, limits the risk that caregivers feel morally tired (-8.2%) and that they have palpitations or tachycardia (-5.8%).

The last chapter investigates to what extent elderly Europeans are able to pay for their periods of long-term care needs, on the basis of their income, financial assets and home equity, taking out reverse mortgages when they become dependent. A disability transition model is estimated using SHARE (*Survey of Health, Aging and Retirement in Europe*). Then, the disability trajectories of individuals who are 65 and older in 2013 (23,769 observations) are simulated. The simulations show that the long-term care risk is significant: on average, 57% of the current 65+ will experience at least one period of long-term care needs and the average number of years with disability is 4.3. Then, the ability of individuals to meet their long-term care needs is studied. It focuses on individuals who have no partner when they become dependent and assumes that there is no public coverage and no informal care. Results show that only 7% of dependent individuals can pay for their long-term care needs out of their income. The proportion increases to 18% if financial wealth is depleted, to 23% if real estate (investment or holiday homes, land…) is sold and to 50% if individuals take out reverse mortgages on their main residence. Thus, reverse mortgages may play an important role, particularly in Spain and in Italy. However, half of individuals cannot totally pay for their long-term care expenditures, even if they use all their income and assets. One fifth of dependent individuals can finance less than 5% of their long-term care needs. This chapter also provides analyses by income quintile and briefly simulates the effects of informal care and public long-term care benefits.

Figure 1. Summary of the economic literature on long-term care and research questions.



CHAPTER 1
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DOES HOME CARE FOR DEPENDENT ELDERLY PEOPLE IMPROVE THEIR MENTAL HEALTH?

This chapter is co-written with Thomas BARNAY (University Paris-Est Créteil).

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1. Introduction

In a context of an aging population, maintaining the mental health of older people is important. Indeed, depression and anxiety in older adults are associated with higher healthcare costs (Unützer et al., 1997; Vasiliadis et al., 2013). In addition, poor mental health may accelerate the disability[5]. The effect of pathology on impairments and the effect of functional limitations on disability are higher for depressed individuals than for non-depressed ones (Van Gool et al., 2005). Otherwise, mental health is a major political concern, as underlined in the Comprehensive mental health action plan 2013-2020 (WHO) and in the European Pact for Mental Health and Well-being launched in 2008. This latter initiative makes the mental health of older people one of its five priority areas and invites policy makers and stakeholders to "*provide measures to promote mental health and well-being among older people receiving care (medical and/or social) in both community and institutional settings*". In France, the Law on the adaptation of society to the aging of the population highlights the role of preventing suicide among elderly persons. Indeed, in 2010, people aged 65 and over accounted for 28% of suicides, which often result from undiagnosed and untreated depression.

Several theoretical models include a health production function which has two inputs, formal and informal care (Byrne et al., 2009; Pezzin et al., 1996; Pezzin and Schone, 1999; Stabile et al., 2006; Thiébaut et al., 2012; Van Houtven and Norton, 2004). However, to the best of our knowledge, this function has not received much attention in the empirical literature. Our goal is to estimate from French data the effects of both formal home care (provided by professional workers) and informal care (provided by the family and other relatives) on the mental health of dependent elderly living at home. For this, we use two mental health indicators: depression and the Mental-Health Inventory (MHI-5). We take into account the potential endogeneity of care using an instrumental variables analysis. From a public policy perspective, this study identifies the most effective care arrangements in terms of mental health.

The article is organized as follows: Section 2 offers a summary of the existing literature; Section 3 presents the data and methodology used; Section 4 provides some descriptive statistics, the results of the estimations and robustness tests. Finally, the last section is devoted to discussion and the conclusion.

[5] The disability model (Verbrugge and Jette, 1994) involves four consecutive phases: pathology, impairment, functional limitation and disability.

2. Background

While the literature suggests that informal care may have both positive[6] and negative effects[7] on the emotional well-being of the elderly (see for example Fast et al., 1999, for a literature review), the economic literature sees formal and informal care as inputs in an elderly person's health production function. One type of theoretical model of long-term care arrangements considers a unique utility function for the entire family. Hoerger et al. (1996) consider the effect of public subsidies on the living arrangements of a dependent elderly person (living alone, living with a child or moving into a nursing home). They assume that the family utility increases with informal and formal care and that the marginal utility of care increases with the severity of the disability, but they do not formalize a health production mechanism. Pezzin et al. (1996) also study the impact of a public program on living arrangements and define a health production function. The production of a disabled elderly person's functioning, conditional on the level of disability, requires formal or informal care. Stabile et al. (2006) study the ability of dependent elderly to perform ADLs (activities of daily living). This level of ability is determined by a production function, which depends positively on informal and formal care for a given health status.

Other models examine the decisions of two individuals – a disabled parent and a child – who have different utility functions. Pezzin and Schone (1999) consider informal care and the labor supply of a daughter who has a dependent parent, as well as their living arrangements. A parent's physical health or well-being, conditional on functional or cognitive disability, is defined as a public good whose production depends on formal care (purchased in the market by the parent) and informal care (provided by the daughter). More recently, Thiébaut et al. (2012) build a theoretical model to study the impact of a French reform which would consist of recovering public contributions paid to dependent elderly from part of their estate after their death. They consider a quality of life production function with two inputs: formal and informal care. They assume that informal care is preferred to formal care by the parent and that the marginal productivity of formal care is constant (possible turnover of professional workers), while the marginal productivity of informal care is decreasing (informal caregivers tire more easily).

[6] Elderly people cared for by their children report that they are less restless, lonely, bored and unhappy in comparison with other older people.

[7] Loss of personal control in their lives, stress, tension between needing care and not wanting to be a burden, restricted future outlook, lower psychological morale.

Finally, some models allow for the presence of multiple potential informal caregivers. Van Houtven and Norton (2004) define the parent's health status as a function (adapted from Grossman, 1972) of total informal care (from all children), of formal medical care and of human capital. Byrne et al. (2009) specify a game-theoretic model of family decisions in which children allocate time for work, leisure, informal care and they allocate money for consumption and formal care. The elderly individual(s) (it may be a couple) allocate time for informal care and leisure and they allocate money to consumption and formal care. The health quality of the elderly – which is defined as an *"aggregate measure of true health […] and accommodations made for health problems"* – depends on informal care, formal care and on a set of demographic characteristics. In the latter two references, children are altruistic in the sense that their utility depends on the parent's health.

To our knowledge, only Stabile et al. (2006), Byrne et al. (2009) and Bonsang and Bordone (2013) provide empirical results on the health effects of formal and informal care on the care recipient[8]. The first study uses Canadian data and shows that greater generosity of public home care programs (at the provincial level) leads to a higher probability of reporting good self-assessed health. When it takes into account the potential endogeneity of public generosity, the effect becomes insignificant. Nevertheless, this work does not estimate the effect of informal care. Byrne et al. (2009) use US data and find that formal care and informal care – especially care provided by a spouse – have only small positive effects on the parent's health quality[9]. Furthermore, they show that informal care provided by a child is more effective than formal care; an additional hour of informal care implies a 0.12 % increase in the health quality of parents. Finally, Bonsang and Bordone (2013) use an instrumental variables approach on European data and find that informal care provided by children has a negative effect on women's cognitive functioning. They explain this result by the fact that informal support may favor passive behavior of the elderly. Rice et al. (2009) do not directly study health, but show that more hours of care decrease the probability of unmet needs for assistance in daily life activities. However, this study cannot be easily generalized, since it only concerns the very frail elderly (Medicare and Medicaid dually enrolled elderly) in six states of the US.

[8] By contrast, the recent economic literature has been more interested in estimating health effects of informal care on the caregivers (Coe and Van Houtven, 2009; Do et al., 2015; Van den Berg et al., 2014).

[9] Since there is no direct measure for health quality of parents available in the data, the authors observe it indirectly through its effect on utility (which is measured by a dummy variable indicating if the elderly person was happy during the past week).

3. Method

3.1. Data

In order to estimate the health production function, we use the Ordinary Households section of the French Disability and Health Survey (*Enquête Handicap Santé Ménage*), which was carried out in 2008 among non-institutionalized people by the French Institute of Statistics and the Ministry of Health. This survey provides information on the socioeconomic and socio-demographic characteristics of 29,931 individuals, as well as on their family situation. Furthermore, it gives details on individual deficiencies, functional limitations, activity restrictions and health problems.

We select a sample of 4,067 dependent elderly persons aged 65 and over based on activity restrictions. An individual is considered dependent if she[10] reports difficulties performing at least one ADL or IADL (instrumental activity of daily living) without help. ADLs are the most basic activities of daily life and refer to personal care and functional mobility: bathing, dressing and undressing, eating and drinking, using the bathroom, lying down in and getting up from bed, sitting down in and getting up from a chair. IADLs support an independent life style: shopping, cooking, doing common and less common household chores, doing administrative tasks, managing medication, moving around in all of the rooms of a floor, leaving home, using transportation, finding your way, using a telephone.

3.2. Variables of interest

We are interested in the effects of informal and formal home care on two mental-health variables: depression and the Mental-Health Inventory. The depression variable has a value of 1 if the individual has suffered from depression in the twelve months prior to the survey, and 0 otherwise[11]. We also use a more general mental health measure: the Mental-Health Inventory (MHI-5). This indicator is built from five questions of the Short Form Health Survey (SF-36), which was included in a mail-back questionnaire left for the surveyed individuals. The questions are the following: "*Over the past four weeks, were there times when you… i) felt very anxious; ii) felt so discouraged that nothing could make you feel better; iii) felt calm and relaxed; iv) felt sad and demoralized; and v) felt happy.*" For each question, five response categories are possible (always, often, sometimes, rarely, never) scored from 1 to 5. The total score is then transformed to a 0-100 scale, 100 being the best

[10] In this doctoral dissertation, the feminine pronoun *"she"* is used to describe dependent elderly persons and caregivers.

[11] The survey question is: *"Have you had chronic depression in the past 12 months?"*.

possible health. The MHI-5 is a validated and reliable general mental health measure, but there exists no determined cut-off point that can be used to screen for depressive symptoms (Kelly et al., 2008). Similarly, Hoeymans et al. (2004) stress the need for a valid and internationally comparable cut-off point[12]. For these reasons, and because we are interested in a very particular population, we will use the MHI-5 as a general mental health score and not try to screen for specific symptoms. Estimates of the effect of care on the MHI-5 will focus on the 2,117 individuals who have completed the paper questionnaire[13]. It should be noted that the depression and the MHI-5 variables both measure mental health, they are thus correlated. In addition, some questions in the MHI-5 are very similar to those included in the tests used to screen for depression symptoms (e.g., the CES-D scale and the Geriatric Depression Scale). Nevertheless, we think it is interesting to keep these two variables in the analysis because they allow approaching different dimensions of mental health and they are measured on different time periods (the past year for depression and the past month for the MHI-5).

The main explanatory variables are informal care and formal care hours. It should be mentioned that the care being considered here is aid with activities of daily living: i) personal care (bathing, dressing, meals); ii) household chores (cleaning, making meals); iii) managing the budget, paperwork and administrative processes; iv) ensuring company; v) ensuring supervision; vi) taking care of health problems; vii) shopping or viii) other activities. The informal care variable is equal to 1 if the dependent elderly receives help from family members or other relatives, and 0 otherwise[14]. We use a binary care variable because of missing values (27%) in informal care hours received, especially when the caregiver and the dependent elderly are co-residents. In contrast, we are well-informed about formal care hours (only 3.5% of missing values). From information on the frequency of formal care (daily, weekly or monthly) and care hours received per unit of time, we build a unique variable which gives formal care hours received per week.

[12] The commonly used cut-off point is 52, but many other limits exist (Thorsen et al., 2013).

[13] Appendix B provides a specification that takes into account the potential selection bias.

[14] The informal care variable is built using two questions. First, dependent elderly individuals are asked the following question: "*Are there any non-professional persons (family, friends…) who regularly help you with activities of daily living, who help you financially or materially, or who give you moral support due to a health problem or a disability, including people who live with you?*". Then, dependent elderly persons have to specify the help provided by each caregiver: "*This caregiver helps you i) with activities of daily living like bathing, dressing, household chores…? ii) With financial or material support? iii) With moral support*?". We focus on help with activities of daily living.

3.3. Econometric model

The equation of interest (Eq.1) estimates the effect of informal care (IC) and formal care hours (FCH) on mental health (MH). X_i is a set of characteristics of the dependent elderly and her family. We control for activity restrictions and functional limitations (number of moderate restrictions in ADLs, number of severe restrictions in ADLs; number of moderate restrictions in IADLs, number of severe restrictions in IADLs; and motor, sensory and cognitive limitations), for demographic variables (age and gender), socioeconomic variables (education level – no diploma, Certificate of Primary Education[15], higher diploma –; monthly income; urban area) and family characteristics (living with a partner, having children, recent widowhood, seeing the family less than once a month). We also take into account if individuals answer the survey for themselves or if a third party helps them answer or responds for them (in other words, we control for proxy respondents). All variables are described in Table 2 below.

$$MH_i = \alpha_1 IC_i + \alpha_2 FCH_i + X_i\alpha_3 + \epsilon_i \qquad \text{(Eq.1)}$$

We estimate this equation first treating formal and informal care as exogenous. We use a linear probability model for depression[16] and a standard linear regression for the mental health score. However, this naïve model may be biased due to the potential endogeneity of care variables. First, health measurement errors may exist. Second, poor mental health may increase the probability of receiving formal or informal care and the intensity of the help (*reverse causality*). The empirical literature has mainly highlighted the positive effect of activity restrictions on the probability of receiving formal care (Bonsang, 2009), informal care (Fontaine et al., 2007; Haberkern and Szydlik, 2010) and on informal care hours (Golberstein et al., 2009). Furthermore, some chronic diseases (hypertension, diabetes, stroke, dementia, cancer) increase the probability and the intensity of informal care (Golberstein et al., 2009). Moreover, a poor or very poor self-assessed health increases the use of informal care (Bonsang, 2007) and the probability of formal care (Stabile et al., 2006). Finally, some research has highlighted "*significant influences of emotional and mental disabilities […] on long-term care utilization*" (Portrait et al., 2000). Third, there exist unobserved factors influencing the elderly's mental health that are correlated with formal and informal care. For example, children's health plays a role in the provision of informal care and may impact

[15] The Certificate of Primary Education was delivered at the end of primary school. It has been officially suppressed in 1989.

[16] We use a linear probability model in order to compare these estimations with the model treating care variables as endogenous.

parents' mental health. Similarly, family history of mental health problems may change a dependent elderly person's attitude; it also may increase awareness amongst potential informal caregivers. Furthermore, the medicalization of the health of the elderly facilitates the diagnosis of depression and may increase informal care due to information or guilt put on family members by medical institutions (Weber, 2010).

In order to address this potential endogeneity, we estimate instrumental variables models using two-stage least squares[17]. We estimate two models – one with a binary dependent variable (depression) and one with a continuous dependent variable (the mental health score) – with two endogenous regressors – one binary (informal care) and one continuous (formal care hours). We choose to consider depression and informal care as continuous variables and to estimate linear probability instrumental variables models for several reasons. First, the command to estimate IV-Probit models in Stata (Ivprobit) is appropriate only for use with continuous endogenous regressors. Since informal care is a binary variable, IV-probit models for depression could not be estimated. In addition, IV linear models need weaker assumptions, allow avoiding problems of convergence and the literature acknowledges that the linear probability model gives good estimates of marginal effects, particularly for mean values of the covariates (Angrist, 2009, p. 107; Wooldridge, 2002, p. 465). Since linear probability models violate the assumption of homoscedasticity, robust standard errors are used[18]. It is important to note that the instrument for formal home care is measured at the departmental level (see Subsection 3.4.). However, this chapter does no correct for the presence of within-department correlation, which may result in biased standard errors. An Erratum to this chapter is available after Appendices A and B. It allows the errors within each department to be correlated and replicate the analysis to study to what extent it changes the results.

3.4. Instruments

Since we have two endogenous regressors, we need to find at least two instrumental variables (vector Z_i) that are correlated with formal and informal care, $corr(IC_i, Z_i) \neq 0$ and $corr(FCH_i, Z_i) \neq 0$, but orthogonal to the error term in the mental health equation, $corr(\epsilon_i, Z_i) = 0$. On the one hand, the empirical literature dealing with the effects of informal care on formal care utilization provides good instruments for informal care based on family

[17] Ivreg2 command in Stata, developed by Baum et al. (2007).

[18] Remark: the version published in the *Journal of Health Economics* does not correct for heteroskedasticity problems. However, it gives very similar results.

variables. Van Houtven and Norton (2004) use the number of adult children and the sex of the eldest child to instrument for informal care received by a dependent elderly person; Charles and Sevak (2005) use a set of instruments combining the gender of the children, their marital status and their location; Bolin et al. (2008b) use the number of children and whether or not the oldest child lives more than 100 kilometers away; and Bonsang (2009) chooses the geographical distance and the proportion of daughters. In our study, we consider four instruments for informal care: i) the proportion of daughters, ii) having at least one child who has no child, iii) having at least one child who has no partner, and iv) having at least one child who lives nearby (same building, same town or same department[19]). We assume: i) that daughters have a higher propensity to provide care; that a child who has no child (ii) or no partner (iii) can allocate more time to informal care; and iv) that the opportunity cost of informal care is lower when children live close to the elderly. The exogeneity of where children are located has been challenged in the literature (e.g., children with sick parents may live closer). We nevertheless choose to consider this variable, because it passes our overidentification tests.

On the other hand, instruments are much less developed for formal care. To the best of our knowledge, only Stabile et al. (2006) have discussed this issue. They study the effect of public home care generosity – measured by the spending by province and year per individual aged 65 and older – on home care utilization, informal caregiving and health. They instrument public home care generosity by the share of the population aged 65 and older by province, the level of provincial spending on education and the provincial tax rate. They find that the exogeneity of public home care generosity could not be rejected. In the present work, the instrument for formal care is the proportion of individuals aged 75 and over, living in the community, who received the Personal Autonomy Allowance (PAA, *Allocation Personnalisée d'Autonomie*) at the departmental level in 2008. The Personal Autonomy Allowance, introduced in France in 2002, is a needs-based national program administered at the departmental level by the General Councils; it covers part of the long-term care expenses of individuals at least 60 years of age who need help for activities of daily living. The level of dependence of the elderly is assessed by a medico-social team from the General Council during a home visit using a national classification based on activity restrictions (the AGGIR scale – *Autonomie, Gérontologie, et Groupes Iso-Ressources* –, 6 levels of dependence). The

[19] French departments are equivalent to UK counties.

individual is entitled to receive the PAA only if she is classified in one of the 4 most severe levels of disability (if she needs help on a regular basis). In this case, the General Council offers to the elderly person an assistance package; the maximum amount of aid depends on the level of dependence and the beneficiary pays a contribution based on income (co-payments range from 0 to 90% of the benefit). The beneficiary must declare the persons employed or the home care services used within a period of one month following the date of eligibility. The PAA is paid monthly, either to the elderly or directly to home care services (this generally occurs for authorized services whose price is set by the General Council[20]). Finally, it is interesting to note that the PAA can be used to pay employed family caregivers (other than the spouse). However, in practice, only 8% of the beneficiaries choose this option (Petite and Weber, 2006). In other words, in the vast majority of cases, the PAA is used to finance formal care hours.

We use the proportion of beneficiaries at the departmental level to take into account French disparities in access to PAA[21]. Indeed, several reports from French authorities (the Inspectorate of Social Affairs, 2009[22]; the Court of Auditors, 2009[23]; the National Assembly, 2010[24]) highlight that the General Councils have set up heterogeneous appraisal, decision-making and management processes. These reports stress that this situation leads to a problem of equity between French departments. For instance, application forms display varying degrees of complexity and require varying numbers of supporting documents. Moreover, the AGGIR scale used to assess the level of dependence is very sensitive (poor reproducibility of the classification) and likely to lead to departmental inequalities for eligibility to PAA. The professional profile of medico-social teams, the date and the period of entitlement to PAA may also vary between departments. Finally, a recent study (Arrighi et al., 2015) stresses that French elderly tend to apply more for the PAA in more generous departments (where the subsidy rate is higher).

[20] In around half of the French departments, more than two-thirds of formal care hours are provided by authorized services (Hege et al., 2014).

[21] Approximately 30% of these disparities are neither explained by the socio-demographic structure of the departments nor by departmental policies (Jeger, 2005).

[22] Fouquet A, Laroque M, Puydebois C. 2009. La gestion de l'allocation personnalisée d'autonomie. Synthèse des contrôles de mise en œuvre de l'APA réalisés dans plusieurs départements (Report n°RM2009-024P).

[23] Cour des Comptes. 2009. La prise en charge des personnes âgées dépendantes (Annual report).

[24] Assemblée Nationale. 2010. Rapport d'information sur la prise en charge des personnes âgées dépendantes (Report n°2647).

It should be stressed that we cannot completely exclude the possibility that instruments may have a direct effect on the mental health of the dependent elderly (and thus be correlated with the error term in the main equation). For instance, daughters and children who have no child or no partner may visit the elderly more often, which may have a positive effect on their well-being (independently of the provision of informal care). We partially take into account this effect by controlling for the frequency of family contacts in the regressions. Similarly, daughters may provide higher quality care than do sons (Byrne et al., 2009). Finally, as mentioned above, 70% of the variability in the proportion of beneficiaries of the PAA at the departmental level is in fact explained by the socio-demographic structure or departmental policies, which may influence directly the mental health of the elderly. Nevertheless, the overidentification test and the placebo analysis conducted in the rest of this chapter tend to confirm that the exclusion restrictions are valid.

4. Results

4.1. Descriptive statistics

Table 2 below provides descriptive statistics. They cover both the total sample (4,067 observations), used for estimating depression, and the subsample of individuals (2,117) that have completed the paper questionnaire, used for the estimations of the MHI-5. As far as our variables of interest are concerned, around 8% of individuals had suffered from depression in the twelve months prior to the survey in both samples. The MHI-5 is characterized by an average of 49 (out of 100) and a standard deviation of 21. In the total sample, 68% of individuals receive informal care (as compared to 66% in the subsample) and the average number of formal care hours received per week is 6 (as compared to 5 in the subsample). The large standard deviation of formal care hours (between 12 and 14 hours) underlines the significant dispersion of formal care intensity in both samples.

These samples have similar demographic and socioeconomic characteristics: the mean age of dependent elderly individuals is 79 years old; a large majority are women (around 70%); three quarters of individuals have no diploma or a Certificate of Primary Education; most individuals (76%) live in an urban area; and the mean proportion of individuals aged 75 and older receiving the Personal Autonomy Allowance at the departmental level is around 15%. They are also comparable in terms of family characteristics: 45% of surveyed individuals live with a partner; 4-5% of elderly are recently widowed; 87% have at least one child; and 13%

see their family less than once a month. The majority of individuals (66%) have at least one child who lives nearby; around 40% have one child who has no partner; and 30% have one child who has no child.

By contrast, the two samples are characterized by different levels of dependence. Indeed, in the subsample, the average number of severe restrictions in ADLs is 0.49 and the average number of severe restrictions in IADLs is 2.78, as compared to 0.68 and 3.36, respectively, for the total sample. They are also less frequently limited: 32% report sensory limitations and 31% report cognitive limitations, *versus* 37% and 38%, respectively, for the total sample. This better health status of individuals in the subsample probably explains why they receive less care and why proxy respondents are less present.

Table 2. Descriptive statistics on dependent elderly.

	Total sample		Subsample	
	Mean	Std. dev.	Mean	Std. dev.
Mental health variables				
Depression	0.078	0.268	0.079	0.270
MHI-5	-	-	49.469	20.895
Care variables				
Informal care	0.683	0.465	0.658	0.475
Number of formal care hours per week	6.328	13.569	5.072	11.940
Control variables				
Health controls				
Number of moderate restrictions in ADLs	0.650	1.067	0.603	1.024
Number of severe restrictions in ADLs	0.681	1.506	0.489	1.266
Number of moderate restrictions in IADLs	1.312	1.539	1.347	1.507
Number of severe restrictions in IADLs	3.356	3.422	2.781	3.077
Motor limitation	0.909	0.288	0.891	0.312
Sensory limitation	0.370	0.483	0.321	0.467
Cognitive limitation	0.380	0.486	0.310	0.463
Demographic and socioeconomic controls				
Age	79.194	7.383	78.682	7.194
Female	0.705	0.456	0.729	0.445
Education level				
- No diploma	0.452	0.498	0.409	0.492
- Certificate of Primary Education	0.322	0.467	0.346	0.476
- Higher diploma	0.226	0.418	0.245	0.431
Monthly income				
- Less than 1000 EUR	0.239	0.427	0.232	0.422
- 1000/1500 EUR	0.253	0.435	0.258	0.438
- 1500/2000 EUR	0.163	0.370	0.169	0.375
- More than 2000 EUR	0.247	0.431	0.251	0.434
- Missing value	0.098	0.297	0.090	0.286
Urban area	0.760	0.427	0.757	0.429
Family controls				
Living with a partner	0.451	0.498	0.452	0.498
Widowhood < 2 years	0.042	0.201	0.048	0.213
Having at least one child	0.870	0.336	0.868	0.339
Seeing the family less than once a month	0.138	0.345	0.131	0.337
Proxy respondent	0.341	0.474	0.264	0.441
Instruments				
Having at least one child who has no partner	0.435	0.496	0.412	0.492
Having at least one child who has no child	0.310	0.463	0.299	0.458
Having at least one child who lives in the same building, town or department	0.658	0.474	0.658	0.474
Proportion of daughters	0.440	0.364	0.440	0.369
Proportion of individuals aged 75+ receiving the PAA at the departmental level (per 1,000 inhabitants)	148.934	74.170	146.644	74.932
Number of observations	4,067	4,067	2,117	2,117

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over (1st column: total sample, 2nd column: subsample of individuals that have completed the paper questionnaire).

4.2. Estimation results

Specification tests

Among all possible combinations of two, three, four or five instruments listed in the method section[25], we selected those with the highest first stage *F*-statistics. Finally, we retained i) the proportion of daughters and the proportion of PAA recipients for the depression model; ii) having at least one child who has no partner and the proportion of PAA recipients for the MHI-5 model.

Table 3 summarizes, for both depression and the MHI-5, OLS regressions' results, considering formal and informal care as exogenous, and IV models' results, treating care variables as endogenous. In addition, for IV models, we report the first stage coefficients of instruments and several test statistics. Tables 9, 10, 11 in Appendix A present the complete instrumental variables and OLS estimations for depression and the MHI-5. First of all, the null hypothesis of exogeneity[26] of formal and informal care is rejected in both models (p=0.036 for depression and p=0.006 for the MHI-5), indicating that IV models are preferred to OLS.

Concerning the strength of instruments, the proportion of PAA recipients has a positive and significant at the 5% level impact in the first-stage equation for formal care hours. This result confirms the assumption that the departmental proportion of beneficiaries correlates with access to PAA and thus with formal care. In the first-stage for informal care, a positive and significant at the 1% level effect exists for the proportion of daughters (in the depression model) and having a child who has no partner (in the MHI-5 model). In short, children's availability and propensity to help are good predictors of informal care.

In the depression model, we note that the proportion of PAA recipients is significant in the informal care equation and that the proportion of daughters is a significant predictor of formal care hours. It probably captures the complex relationship between these two types of care. Indeed, the empirical literature shows that informal care substitutes formal home care after controlling for endogeneity (Bolin et al., 2008b; Greene, 1983; Van Houtven and Norton,

[25] The proportion of daughters, having at least one child who has no child, having at least one child who has no partner, having at least one child who lives nearby and the proportion of individuals receiving the PAA.

[26] In the ivreg2 command in Stata, the exogeneity test is the difference of two Sargan-Hansen statistics (one for the equation treating the regressors as endogenous and one for the equation treating the regressors as exogenous). This statistics is distributed as chi-squared with degrees of freedom equal to the number of regressors tested.

2004), and that this substitution effect tends to disappear as the elderly person's level of disability increases (Bonsang, 2009).

The Angrist-Pischke (AP) multivariate *F*-test (Angrist, 2009, p. 217-218) tests whether one particular endogenous regressor is weakly identified. In our case, AP *F*-statistics are generally higher than the conventional *F*=10 threshold used for single endogenous variables and we can significantly reject the null hypothesis that formal and informal care are weakly identified at the 1% level (*F*=11.57 and *F*=12.19, respectively, for informal and formal care in the depression model; *F*=14.75 and *F*=7.50 in the MHI-5 model; $p<0.01$). In addition, the comparison of the Kleibergen-Paap Wald *F*-statistic to Stock and Yogo (2005)'s critical values[27] allows testing the identification of the model as a whole. In our case, the maximum Wald test size distortion ranges between 10% and 15% in the depression model and between 20% and 25% in the MHI-5 model.

Exclusion restrictions cannot be tested in just-identified models. We thus run overidentified models containing three instruments (the proportion of daughters, having a child who has no partner, the proportion of PAA recipients) using limited information maximum likelihood (see Table 8 in Appendix A). The AP *F*-statistics are lower than in the just-identified models and the comparison of the Kleibergen-Paap Wald *F*-statistic to critical values of Stock and Yogo (2005) shows that the maximum Wald test size distortion ranges between 10% and 15% in the depression model and is higher than 25% for the MHI-5 model. Results are similar to those of just-identified models and the Hansen overidentification test cannot reject the null hypothesis that our exclusion restrictions are valid (p=0.567 for depression, p=0.926 for the MHI-5).

[27] Stock and Yogo (2005) tabulate critical values (that depend on the number of endogenous regressors and instruments) that give information on the bias of the IV estimator relative to OLS and on size distortions of the associated Wald statistic. We present results only on size distortions, since the study of the bias requires at least two overidentifying restrictions. The Kleibergen-Paap Wald *F*-statistic is 5.32 in the depression model and 3.89 in the MHI-5 model. The critical value if we want to restrict the size distortion to 10% is 7.03. To limit the size distortion to 15%, it is 4.58. To restrict the size distortion to 20% and 25% the critical values are, respectively, 3.95 and 3.63.

Table 3. Effects of formal and informal care on the mental health of the care recipient.

Dependent variable	Depression		MHI-5	
	OLS	IV	OLS	IV
Informal care	-0.021** (0.010)	-0.416* (0.215)	0.760 (1.026)	19.950 (18.105)
Formal care hours	0.0001 (0.0004)	-0.005 (0.007)	0.046 (0.042)	1.819** (0.895)
First-stage equation for informal care				
At least one child who has no partner	-	-	-	0.077*** (0.021)
Proportion of daughters	-	0.059*** (0.021)	-	-
Proportion of PAA recipients	-	0.0002** (0.0001)	-	0.0001 (0.0001)
First-stage equation for formal care hours				
At least one child who has no partner	-	-	-	-0.487 (0.536)
Proportion of daughters	-	-1.093** (0.546)	-	-
Proportion of PAA recipients	-	0.009** (0.004)	-	0.010** (0.004)
AP *F*-test of instruments for IC	-	11.57***	-	14.75***
AP *F*-test of instruments for FCH	-	12.19***	-	7.50***
Exogeneity test, *p-value*	-	0.036	-	0.006
Number of observations	4,037	4,037	2,117	2,117

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: Regressions include all the control variables listed in Table 2. Robust standard errors are reported in parentheses. For the depression model, the number of observations is 4,037 (while we have a sample of 4,067 dependent elderly persons) because of 30 missing values.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Main results

The comparison of OLS and IV results in Table 3 highlights that when care variables are treated as exogenous, their effect on the mental health of the care recipient is underestimated. This is in line with our discussion on reverse causality in the method section: poor mental health may increase the probability of receiving care and the intensity of the help. This is also consistent with the existence of unobserved variables that may be positively correlated with care variables and with the diagnosis of mental health problems (e.g., family history of mental health problems, the medicalization of the health of the elderly).

The IV results show that receiving informal care reduces the risk of depression by 42% (at the 10% level) and that a one-unit increase in formal care hours improves the MHI-5 by 1.8 points on the 0-100 scale (at the 5% level). To illustrate this idea, individuals who do not receive formal care have a mean estimated MHI-5 of 44.9, while individuals receiving formal care have a mean MHI-5 of 52.6. If we standardize the MHI-5 score (by dividing it by its standard deviation), we obtain that an additional hour of formal care improves the MHI-5 by 0.09 standard deviations. The differential impact of formal and informal care on mental health could be explained by the fact that formal care has an effect in the short run and meets immediate needs (the MHI-5 is measured over the past month) while informal care has an impact in the longer run (depression is measured over the past year). However, we do not want to overemphasize differences between these two measures, which both capture some

underlying mental health with noise. In addition, given the size of standard errors in IV models, the exact magnitude of the effects needs to be interpreted with caution.

Concerning the effect of control variables, the risk of depression significantly increases with restrictions in IADLs and with motor and cognitive limitations (see Table 9 in Appendix A, first column). Otherwise, the mental health score (MHI-5) is significantly deteriorated with severe restrictions in IADLs, moderate and severe restrictions in ADLs, motor limitations and cognitive limitations (see Table 10 in Appendix A, first column). Socioeconomic and family variables have no effect on mental health (for both indicators), except for two factors: being recently widowed, which decreases the MHI-5 by 8 points; and the presence of proxy respondents, which increases the probability of reporting depression. Finally, demographic controls stress that the risk of depression is higher for women and lower for older people.

Determinants of formal and informal care

The determinants of formal and informal care in the first-stage equations (see tables 9 and 10 in Appendix A, columns 2 and 3) are generally consistent with the literature. First, activity restrictions have a positive effect on the receipt of informal care and on formal care hours[28]. In contrast, functional limitations do not seem to play a role, except for motor limitations in the informal care equation.

Second, women receive more formal care than men and have a lower probability of receiving informal care. Possible explanations are that women have less potential caregivers than men, or that husbands who have to care for their spouse use formal care more frequently than wives at given level of dependence (Gaymu et al., 2008). Formal care hours increase with the age of dependent elderly individuals while the probability of informal care falls with age. Because we have rich controls for health status, the age variable does not capture a health effect. However, the age of adult children is higher as the age of elderly dependents increases; the older the children are, the frailer they are, and thus less likely to provide informal care. Better educated elderly are less likely to receive informal care and more likely to receive formal care hours. Indeed, highly educated individuals are more aware and better informed of publicly available formal programs (Stabile et al., 2006). In addition, elderly education is partially a proxy for children's education. Children with a higher education probably have higher wages

[28] By contrast, the negative effect of severe restrictions in ADLs on informal care in the depression model may be explained by a substitution effect between informal and formal care for high levels of dependence.

in the labor market and thus a higher opportunity cost of informal care. The probability of receiving informal care rises with monthly income. This is in line with the positive link between informal care and the expectation of receiving an inheritance highlighted by Bonsang (2007). However, in accordance with Van Houtven and Norton (2004) and Bonsang (2009), income does not influence the intensity of formal care. Finally, family variables play a significant role in the care received. Having a partner has a positive effect on the probability of informal care and a negative effect on formal care hours. Moreover, being recently widowed increases formal care hours, and seeing the family less than once a month diminishes the use of informal care.

4.3. Additional tests

Placebo analysis

The identification strategy relies on the assumption that the proportion of beneficiaries of the Personal Autonomy Allowance reflects French disparities in access to publicly covered formal care, but has no direct effect on the health of dependent elderly people. Thus, for dependent elderly who are too young to be eligible for the PAA (under 60 years of age), this variable should have no impact on mental health. We run OLS regressions testing whether the instrument has a direct effect on mental health for different subgroups of individuals (see Table 4 below). For both depression and the MHI-5, the results show that the proportion of PAA recipients has a significant direct effect on the mental health of dependent elderly eligible to the PAA (column 1) but not on those who are 50-60 years of age (column 3). It suggests that the exclusion restriction for the instrument is valid. Interestingly, if we consider all individuals aged 50-60 independently of their health status, the proportion of PAA beneficiaries slightly reduces the risk of depression (column 2). This may be explained by the fact that, among these individuals, there are potentially caregivers who may benefit from the fact that the persons being cared for receive publicly covered formal care (on this topic, see Chapter 2).

Table 4. Direct effect of the proportion of PAA recipients on mental health.

Dependent variable	Depression (OLS)			MHI-5 (OLS)		
	Studied sample	50-60 years of age	50-60 with at least 1 ADL/IADL	Studied sample	50-60 years of age	50-60 with at least 1 ADL/IADL
Proportion of PAA recipients	-0.0001**	-0.0002***	-0.0001	0.021***	-0.002	-0.001
	(0.00006)	(0.00006)	(0.0002)	(0.006)	(0.006)	(0.011)
Number of observations	4,037	4,846	1,280	2,117	3,201	747

Source: French Disability and Health Survey, 2008.
Note: Regressions include all the control variables listed in Table 2. Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Subsample analysis

In this section, we test whether our results remain stable when we restrict the analysis to subsamples. First, a large proportion of dependent elderly receive no formal care (44% in the depression sample and 46% in the MHI-5 sample). Consequently, it is difficult to assess whether there exist differences according to the number of formal care hours (and not only between dependent elderly helped by formal care and the others). To do so, Table 5 (see below) focuses on dependent elderly who receive formal care (2,266 observations for depression and 1,149 for the MHI-5). Second, as outlined previously, the depression model is estimated on the full sample of dependent individuals whereas the MHI-5 model focuses on individuals that have completed the paper questionnaire. Table 6 presents an additional analysis on depression, using the same subsample than for the MHI-5 (2,104 observations). Another concern in this study is that around 30% of individuals are helped by a proxy respondent to answer the questions. Proxy reporting increases the response-rate to the survey but may be biased. Indeed, studies have shown that there may exist significant differences between proxy and self-reports, particularly for subjective measurements of mental health and well-being (Neumann et al., 2000; Sakshaug, 2014). In Table7, we check whether we obtain the same conclusions than in the main analysis when we focus on dependent individuals that did not use a proxy respondent (2,663 observations for depression and 1,558 observations for the MHI-5).

Table 5. Effect of care on the mental health of the care recipient (FCH>0).

Dependent variable	Depression		MHI-5	
	OLS	IV	OLS	IV
Informal care	-0.010 (0.013)	-0.370 (0.321)	0.125 (1.446)	6.396 (26.763)
Formal care hours	-0.0001 (0.0004)	-0.003 (0.004)	0.061 (0.046)	1.038** (0.410)
First-stage equation for informal care				
At least one child who has no partner	-	-	-	0.060** (0.028)
Proportion of daughters	-	0.060** (0.028)	-	-
Proportion of PAA recipients	-	0.0002 (0.0001)	-	0.00002 (0.0002)
First-stage equation for formal care hours				
At least one child who has no partner	-	-	-	-0.298 (0.950)
Proportion of daughters	-	-0.887 (0.887)	-	-
Proportion of PAA recipients	-	0.023*** (0.007)	-	0.025*** (0.007)
AP *F*-test of instruments for IC	-	5.25**	-	4.65**
AP *F*-test of instruments for FCH	-	17.18***	-	12.43***
Exogeneity test, *p-value*	-	0.184	-	0.012
Number of observations	2,266	2,266	1,149	1,149

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals aged 65+ needing help with one or more ADL or IADL, who receive a strictly positive amount of formal care.
Note: Regressions include all the control variables listed in Table 2. Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1% level.

When we focus on dependent elderly who receive formal support (Table 5), the *F*-statistics associated with the informal care equation are lower than in the main analysis, while the *F*-

statistics associated with formal care are higher than in the main analysis. The positive effect of formal care hours on the MHI-5 remains significant. Indeed, an additional hour of formal care significantly improves the mental health score by 1 point (or 0.05 standard deviations). On the other hand, informal care seems to have no longer effect on the risk of depression. A possible explanation may be that care provided by the family is not effective to limit the risk of depression among highly dependent individuals who receive formal care.

Table 6. Effect of care on the risk of depression for the subsample of individuals that have completed the paper questionnaire.

Dependent variable	Depression	
	OLS	IV
Informal care	-0.034** (0.014)	-0.172 (0.166)
Formal care hours	-0.0003 (0.0006)	-0.004 (0.008)
First-stage equation for informal care		
At least one child who has no partner	-	0.075*** (0.021)
Proportion of PAA recipients	-	0.0001 (0.0001)
First-stage equation for formal care hours		
At least one child who has no partner	-	-0.430 (0.536)
Proportion of PAA recipients	-	0.010** (0.004)
AP *F*-test of instruments for IC	-	14.18***
AP *F*-test of instruments for FCH	-	7.64***
Exogeneity test, *p-value*	-	0.584
Number of observations	2,104	2,104

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals aged 65+ needing help with one or more ADL or IADL, who have completed the paper questionnaire.
Note: Regressions include all the control variables listed in Table 2. Robust standard errors are reported in parentheses. The number of observations is 2,104 (as compared to 2,117 for the MHI-5 in Table 3) because of missing values.
*: significant at the 10% level, **: 5% level, ***: 1% level.

When we restrict the analysis of depression to the same subsample than for the MHI-5 (Table 6), the exogeneity of formal and informal care cannot be rejected, indicating that OLS are preferred to the IV model. OLS estimates confirm that informal care significantly reduces the risk of depression of dependent elderly, though the magnitude of the effect seems much lower than for the total sample (-3.4%).

Table 7. Effect of care on mental health for individuals that did not use a proxy respondent.

Dependent variable	Depression		MHI-5	
	OLS	IV	OLS	IV
Informal care	-0.033*** (0.011)	-0.643** (0.299)	0.483 (1.117)	12.983 (18.792)
Formal care hours	0.0004 (0.0007)	-0.001 (0.012)	-0.020 (0.081)	2.074 (1.386)
First-stage equation for informal care				
At least one child who has no partner	-	-	-	0.083*** (0.025)
Proportion of daughters	-	0.063** (0.028)	-	-
Proportion of PAA recipients	-	0.0002* (0.0001)	-	0.0002 (0.0002)
First-stage equation for formal care hours				
At least one child who has no partner	-	-	-	-0.785* (0.421)
Proportion of daughters	-	-0.821 (0.512)	-	-
Proportion of PAA recipients	-	0.008** (0.004)	-	0.006 (0.004)
AP *F*-test of instruments for IC	-	7.67***	-	10.77***
AP *F*-test of instruments for FCH	-	8.65***	-	4.68**
Exogeneity test, *p-value*	-	0.008	-	0.106
Number of observations	2,663	2,663	1,558	1,558

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals aged 65+ needing help with one or more ADL or IADL, who have answered the survey by themselves.
Note: Regressions include all the control variables listed in Table 2. Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Finally, when we focus on dependent elderly that did not use a proxy respondent (Table 7) the effects are broadly consistent with those estimated in the main analysis. Indeed, results show that informal care decreases the risk of depression by 64%. This effect seems higher than in the total sample (64% as compared to 41%) but we cannot test whether this difference is significant or not. The IV results for the MHI-5 stress that the instrument for formal care is weaker (F=4.68) than in the main analysis (F=7.50). This weak instruments problem and the smaller sample size (1,558 observations as compared to 2,117 in the main analysis) increase the bias of the two-stage least squares estimator and the imprecision of estimates (the standard error of the formal care estimate is 55% higher than in the main analysis). Nevertheless, the estimated coefficient of formal care (2.074) is of the same order of magnitude than in Table 3 and almost significant (its p-value is equal to 0.135). In addition, the endogeneity of care variables in the MHI-5 model is rejected only at the 11% level (p=10.6). These results suggest that the effect of formal care on the MHI-5 is similar in the total sample and when we focus on dependent elderly who have answered the survey by themselves.

Appendix B provides an alternative methodology using simultaneous equations models. This specification takes into account the fact that depression and informal care are binary variables and makes it possible to add a selection equation in the MHI-5 model. However, it relies on the strong assumption that the error terms of the different equations follow a multivariate

normal distribution. The results are consistent with those estimated using instrumental variables models.

5. Discussion

Our contribution to the literature is to empirically estimate the effects of both informal and formal home care on mental health while controlling for the endogeneity of care. The results show that informal care reduces the risk of depression of dependent elderly and that formal care increases their general mental health (measured by the Mental-health Inventory, MHI-5). This suggests that access to care is important to protect the mental health of dependent elderly people. Informal care tends to have a long term effect (depression is measured over the past year) while formal care plays an important role in the shorter run and meets more immediate needs (the MHI-5 is measured over the past month). Thus, formal and informal care should be considered as complementary factors when implementing public policies.

It seems easier to promote formal home care, by increasing its financial accessibility, than informal care, which depends mainly on family dynamics and incentives. For instance, the Law on the adaptation of society to the aging of the population has recently increased the amount of the Personal Autonomy Allowance. Nevertheless, policy makers could also encourage informal support by recognizing the important role played by family caregivers, implementing respite care, reinforcing counseling and training services or reconciling paid employment and informal care.

Despite these interesting results, our study has some limitations that must be kept in mind. First, as we briefly discussed in the Econometric section, this chapter does no correct for the presence of within-department correlation. An Erratum is available after Appendices A and B, it stresses that using cluster-robust standard errors does not change the main conclusions of the study. Second, we use declarative data and subjective measures of mental health, which may result in response biases (recall bias, social desirability bias). More objective measures such as the medical consumption of antidepressants may be interesting, but are not available in the survey. In addition, longitudinal data would allow us to control for unobserved individual heterogeneity, and would enable us to observe the effects of formal care and informal care for the same individual throughout the whole process of dependence.

Future research could investigate whether formal and informal care have heterogeneous effects on the health of the care recipient. For instance, the effectiveness of care may depend on the level of dependence, the gender of the dependent elderly or the relationship between

the elderly and informal caregivers. Byrne et al. (2009) stress that informal care provided to women is significantly less effective than informal care to men and that daughters provide higher quality care than do sons. On the other hand, Van Houtven and Norton (2008) find no gender difference in effectiveness of informal care provided by adult children. It would also be interesting to study the effect of formal and informal care for subgroups of particular interest, such as single elderly women who are at higher risk of nursing home entry.

Appendix A. Additional information on IV and OLS models.

Table 8. Overidentified instrumental variables models.

Dependent variable	Depression	MHI-5
	Overidentified IV	Overidentified IV
Informal care	-0.339** (0.151)	20.544 (16.769)
Formal care hours	-0.006 (0.007)	1.789** (0.818)
Equation for informal care		
At least one child who has no partner	0.051*** (0.014)	0.076*** (0.020)
Proportion of daughters	0.057*** (0.021)	0.052* (0.029)
Proportion of PAA recipients	0.0002* (0.0001)	0.0001 (0.0001)
Equation for formal care hours		
At least one child who has no partner	0.072 (0.417)	-0.473 (0.537)
Proportion of daughters	-1.096** (0.547)	-1.158* (0.646)
Proportion of PAA recipients	0.009** (0.004)	0.010** (0.004)
AP *F*-test of instruments for IC	12.09***	8.44**
AP *F*-test of instruments for FCH	6.40***	4.95***
Exogeneity test, *p-value*	0.019	0.005
Hansen J statistic, *p-value*	0.567	0.926
Number of observations	4,037	2,117

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: In these overidentified models, we use limited information maximum likelihood rather than two-stage least squares because it is more robust to weak instruments. Regressions include all the control variables listed in Table 2. Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1%.

Table 9. Instrumental variables for the risk of depression (complete results).

	Depression	First-stage for informal care	First-stage for formal care hours
Intercept	0.547*** (0.172)	0.554*** (0.087)	-13.307*** (2.466)
Care variables			
Informal care	-0.416* (0.215)	-	-
Formal care hours	-0.005 (0.007)	-	-
Health controls			
Number of moderate ADL restrictions	0.014 (0.009)	0.019*** (0.006)	0.898*** (0.214)
Number of moderate IADL restrictions	0.023** (0.009)	0.035*** (0.005)	0.432*** (0.143)
Number of severe ADL restrictions	-0.004 (0.018)	-0.020*** (0.005)	2.250*** (0.328)
Number of severe IADL restrictions	0.023** (0.010)	0.039*** (0.003)	0.625*** (0.134)
Motor limitation	0.052** (0.026)	0.087*** (0.026)	0.227 (0.469)
Sensory limitation	0.019 (0.012)	0.020 (0.014)	-0.416 (0.444)
Cognitive limitation	0.037** (0.015)	-0.026 (0.016)	0.780* (0.452)
Demographic and socioeconomic controls			
Age	-0.005*** (0.002)	-0.003*** (0.001)	0.165*** (0.030)
Female	0.037* (0.019)	-0.045*** (0.015)	1.550*** (0.466)
Education level			
- No diploma	-	-	-
- Certificate of Primary Education	0.004 (0.015)	-0.026* (0.016)	0.877* (0.462)
- Higher diploma	-0.030 (0.031)	-0.109*** (0.019)	1.773*** (0.589)
Monthly income			
- Less than 1000 EUR	-	-	-
- 1000/1500 EUR	0.016 (0.015)	0.017 (0.021)	0.177 (0.477)
- 1500/2000 EUR	0.012 (0.020)	0.054** (0.023)	0.745 (0.755)
- More than 2000 EUR	0.021 (0.022)	0.078*** (0.021)	-0.027 (0.624)
Rural area	-0.010 (0.014)	-0.024 (0.016)	0.725 (0.464)
Family controls			
Living with a partner	0.048 (0.035)	0.143*** (0.016)	-1.406*** (0.482)
Widowhood < 2 years	-0.011 (0.041)	-0.050 (0.036)	4.246*** (1.328)
At least one child	0.011 (0.023)	0.020 (0.024)	-1.029 (0.692)
Seeing the family less than once a month	-0.017 (0.032)	-0.122*** (0.021)	-0.073 (0.548)
Proxy respondent	0.065** (0.030)	0.125*** (0.017)	-0.190 (0.526)
Instruments			
Proportion of daughters	-	0.059*** (0.021)	-1.093** (0.546)
Proportion of PAA recipients	-	0.0002** (0.0001)	0.009** (0.004)
Number of observations	4,037	4,037	4,037

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Table 10. Instrumental variables for the MHI-5 (complete results).

	MHI-5	First-stage for informal care	First-stage for formal care hours
Intercept	40.366** (16.714)	0.703*** (0.123)	-13.664*** (2.840)
Care variables			
Informal care	19.950 (18.105)	-	-
Formal care hours	1.819** (0.895)	-	-
Health controls			
Number of moderate ADL restrictions	-3.043*** (0.955)	0.016* (0.009)	0.604** (0.270)
Number of moderate IADL restrictions	-0.968 (0.893)	0.040*** (0.007)	0.151 (0.169)
Number of severe ADL restrictions	-4.916** (2.260)	-0.013 (0.008)	2.280*** (0.572)
Number of severe IADL restrictions	-2.635** (1.125)	0.042*** (0.005)	0.566*** (0.198)
Motor limitation	-9.174*** (2.630)	0.105*** (0.033)	0.348 (0.418)
Sensory limitation	-1.971 (1.506)	0.027 (0.021)	0.107 (0.585)
Cognitive limitation	-7.224*** (1.681)	-0.019 (0.023)	0.950 (0.636)
Demographic and socioeconomic controls			
Age	0.198 (0.172)	-0.005*** (0.001)	0.151*** (0.035)
Female	-3.776 (2.543)	-0.063*** (0.022)	2.090*** (0.587)
Education level			
- No diploma	-	-	-
- Certificate of Primary Education	0.130 (1.510)	-0.021 (0.023)	0.574 (0.515)
- Higher diploma	0.928 (2.543)	-0.102*** (0.026)	1.649*** (0.621)
Monthly income			
- Less than 1000 EUR	-	-	-
- 1000/1500 EUR	0.567 (1.702)	0.012 (0.030)	-0.492 (0.526)
- 1500/2000 EUR	2.126 (2.412)	0.049 (0.032)	-0.202 (0.886)
- More than 2000 EUR	1.572 (2.642)	0.096*** (0.031)	0.051 (0.792)
Rural area	1.584 (1.556)	-0.010 (0.022)	-0.022 (0.591)
Family controls			
Living with a partner	-4.033 (3.000)	0.165*** (0.022)	-1.177** (0.599)
Widowhood < 2 years	-8.159** (3.470)	-0.048 (0.050)	2.558** (1.031)
At least one child	-1.829 (1.781)	-0.016 (0.031)	0.081 (0.623)
Seeing the family less than once a month	-1.388 (3.154)	-0.124*** (0.030)	0.565 (0.791)
Proxy respondent	0.804 (2.604)	0.104*** (0.025)	0.073 (0.638)
Instruments			
At least one child who has no partner	-	0.077*** (0.021)	-0.487 (0.536)
Proportion of PAA recipients	-	0.0001 (0.0001)	0.010** (0.004)
Number of observations	2,117	2,117	2,117

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Table 11. OLS models for the risk of depression and the MHI-5 (complete results).

	Depression	MHI-5
Intercept	0.373*** (0.057)	34.559*** (5.623)
Care variables		
Informal care	-0.021** (0.010)	0.760 (1.026)
Formal care hours	0.0001 (0.0004)	0.046 (0.042)
Health controls		
Number of moderate ADL restrictions	0.001 (0.005)	-1.709*** (0.478)
Number of moderate IADL restrictions	0.006* (0.003)	0.128 (0.356)
Number of severe ADL restrictions	-0.008* (0.004)	-1.039** (0.469)
Number of severe IADL restrictions	0.004* (0.002)	-0.762*** (0.239)
Motor limitation	0.016 (0.014)	-6.377*** (1.426)
Sensory limitation	0.013 (0.009)	-1.304 (0.991)
Cognitive limitation	0.043*** (0.011)	-5.904*** (1.110)
Demographic and socioeconomic controls		
Age	-0.005*** (0.001)	0.353*** (0.065)
Female	0.048*** (0.009)	-1.442 (1.062)
Education level		
- No diploma	-	-
- Certificate of Primary Education	0.013 (0.010)	0.105 (1.026)
- Higher diploma	0.009 (0.012)	0.868 (1.217)
Monthly income		
- Less than 1000 EUR	-	-
- 1000/1500 EUR	0.010 (0.013)	-0.193 (1.312)
- 1500/2000 EUR	-0.011 (0.014)	2.422 (1.514)
- More than 2000 EUR	-0.007 (0.013)	3.236** (1.466)
Rural area	-0.002 (0.010)	0.954 (1.045)
Family controls		
Living with a partner	0.0003 (0.010)	-3.143*** (1.067)
Widowhood < 2 years	-0.013 (0.020)	-4.828** (2.174)
At least one child	-0.001 (0.013)	-1.718 (1.473)
Seeing the family less than once a month	0.032** (0.014)	-2.937** (1.439)
Proxy respondent	0.017 (0.012)	2.826** (1.243)
Number of observations	4,037	2,117

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Appendix B. Simultaneous equations models.

We estimate jointly mental health (equation 1, probit model for depression, linear model for the MHI-5), the receipt of informal care (equation 2, probit model) and formal care hours (equation 3, linear model) using simultaneous equations models. These models rely on the assumption that the error terms of equations (1), (2) and (3) follow a multivariate normal distribution and are estimated by the maximum likelihood method (CMP package in Stata; Roodman, 2011).

As outlined in the main analysis, the subsample used for the MHI-5 model represents only about half of the surveyed individuals (2,117 out of 4,067), which may result in a selection bias (Heckman, 1979). Thus, we add a selection equation (equation 4, probit model) to our simultaneous equations model for the MHI-5. In order to identify our model, we need an exclusion variable that appears in the selection equation but does not affect mental health. We use the fact of having voted or not in the 2007 French presidential and legislative elections. Even if we cannot completely rule out the possibility that voting behavior may be influenced by mental health, we think it is above all a good indicator of social participation and of the desire to give an opinion (and, thus, of the probability of returning the questionnaire).

Table 12 below (columns 1 and 2) presents the results of the simultaneous three-equations models for depression and for the MHI-5. The last column provides estimations for the MHI-5 model with selection. The effects of care variables on the mental health of dependent elderly individuals are consistent with those estimated using instrumental variables.

Table 12. Simultaneous equations models.

Dependent variable	Depression	MHI-5	MHI-5 with selection
	Simultaneous 3-equations model	Simultaneous 3-equations model	Simultaneous 4-equations model
(1) Mental health equation			
Informal care	-0.251*** (0.054)	2.411 (5.331)	0.738 (6.275)
Formal care hours	-0.008 (0.010)	1.974* (1.022)	2.387** (1.213)
(2) Informal care equation			
At least one child who has no partner	-	0.071*** (0.020)	0.053*** (0.015)
Proportion of daughters	0.067*** (0.020)	-	-
Proportion of PAA recipients	0.0002** (0.0001)	0.0001 (0.0001)	0.0002* (0.0001)
(3) Equation for formal care hours			
At least one child who has no partner	-	-0.102 (0.424)	0.031 (0.428)
Proportion of daughters	-0.845 (0.690)	-	-
Proportion of PAA recipients	0.009*** (0.003)	0.010** (0.004)	0.009** (0.003)
(4) Selection equation			
Has not voted in the 2007 French presidential and legislative elections	-	-	-0.042** (0.020)
Correlation between mental health and IC	0.519	0.099	0.151
Correlation between mental health and FCH	0.457	-0.723**	-0.820***
Correlation between IC and FCH	-0.184***	-0.186***	-0.187***
Correlation between selection and health	-	-	0.203
Correlation between selection and IC	-	-	0.236
Correlation between selection and FCH	-	-	-0.344
Number of observations	4,037	2,117	4,067

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: Regressions include all the control variables listed in Table 2. In the selection, depression and informal care equations, the figures given correspond to average marginal effects. Robust standard errors are reported in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1%.

ERRATUM to Chapter 1. Clustering at the departmental level.

The instrument for formal home care (the proportion of beneficiaries of the Personal Autonomy Allowance) is measured at the departmental level. Thus, observations within each department may be correlated as a result of common unobserved effects. However, Chapter 1 does no correct for the presence of within-cluster correlation, which may result in standard errors that are seriously biased downward and confidence intervals that are too small. The need to adjust standard errors when estimating the effect of an aggregate policy variable on micro-units has been first highlighted by Moulton (1990) (see also Colin Cameron and Miller (2015) for a recent review on cluster-robust inference). In this Erratum, we allow the errors within each of the 97 French departments to be correlated and replicate the analysis to study to what extent it changes the results. These cluster-robust standard errors are also robust to heteroskedasticity.

Replication of the main analysis with departmental clusters

Table 13 below reproduces the main analysis of Chapter 1 with cluster-robust standard errors. The Angrist-Pischke *F*-tests show that the proportion of beneficiaries of the PAA is a weaker instrument (F=5.14 in the depression model and F=6.10 in the MHI-5 model) than when standard errors are not corrected for within-cluster correlation (F=12.19 and F=7.50). On the other hand, the instruments for informal care have higher *F*-statistics (F=13.46 for depression and F=20.58 for the MHI-5). The Kleibergen-Paap Wald *F*-statistics indicate that the maximum Wald test size distortion ranges between 10% and 15% in the depression model and is higher than 25% in the MHI-5 model. Consequently, instrumental variables results should be interpreted with caution for the MHI-5 model. In overidentified models (Table 14) the AP *F*-statistics for formal care hours are very small. Nevertheless, the results seem to be similar to those of just-identified models and the Hansen overidentification test suggests that the exclusion restrictions are valid (p=0.532 for depression, p=0.903 for the MHI-5).

In Table 13, the null hypothesis of exogeneity of formal and informal care is rejected in the depression model at the 10% level (p=0.089) and the IV model shows that receiving informal care reduces the risk of depression by 42% (at the 10% level), which is consistent with the results of Chapter 1. On the other hand, contrary to the case where within-cluster correlation is not taken into account, exogeneity could not be rejected in the MHI-5 model (p=0.248) and formal care hours have no significant effect on mental health.

Interestingly, simultaneous equations models (Table 15), which take into account the fact that depression and informal care are binary variables, provide results that are very similar to those of Chapter 1. But, these models rely on strong assumptions on error terms.

Table 13. Effect of care on the mental health of the care recipient (clustered).

Dependent variable	Depression		MHI-5	
	OLS	IV	OLS	IV
Informal care	-0.021** (0.009)	-0.416* (0.219)	0.760 (1.019)	19.950 (16.382)
Formal care hours	0.0001 (0.0004)	-0.005 (0.006)	0.046 (0.035)	1.819* (0.960)
First-stage equation for informal care				
At least one child who has no partner	-	-	-	0.077*** (0.018)
Proportion of daughters	-	0.059*** (0.019)	-	-
Proportion of PAA recipients	-	0.0002** (0.0001)	-	0.0001 (0.0001)
First-stage equation for formal care hours				
At least one child who has no partner	-	-	-	-0.487 (0.550)
Proportion of daughters	-	-1.093* (0.618)	-	-
Proportion of PAA recipients	-	0.009 (0.005)	-	0.010** (0.005)
AP *F*-test of instruments for IC	-	13.46***	-	20.58***
AP *F*-test of instruments for FCH	-	5.14**	-	6.10**
Exogeneity test, *p-value*	-	0.089	-	0.248
Number of observations	4,037	4,037	2,117	2,117

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: Regressions include all the control variables listed in Table 2. Standard errors are reported in parentheses and clustered at the departmental level (97 clusters in the depression model, 87 clusters in the MHI-5 model).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Table 14. Overidentified instrumental variables models (clustered).

Dependent variable	Depression	MHI-5
	Overidentified IV	Overidentified IV
Informal care	-0.339** (0.143)	20.544 (15.418)
Formal care hours	-0.006 (0.006)	1.789* (0.963)
Equation for informal care		
At least one child who has no partner	0.051*** (0.013)	0.076*** (0.018)
Proportion of daughters	0.057*** (0.019)	0.052** (0.026)
Proportion of PAA recipients	0.0002* (0.0001)	0.0001 (0.0001)
Equation for formal care hours		
At least one child who has no partner	0.072 (0.450)	-0.473 (0.552)
Proportion of daughters	-1.096* (0.624)	-1.158* (0.637)
Proportion of PAA recipients	0.009 (0.005)	0.010** (0.004)
AP *F*-test of instruments for IC	11.78**	12.99***
AP *F*-test of instruments for FCH	2.85*	3.09*
Exogeneity test, *p-value*	0.061	0.208
Hansen J statistic, *p-value*	0.532	0.903
Number of observations	4,037	2,117

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: In these overidentified models, we use limited information maximum likelihood rather than two-stage least squares because it is more robust to weak instruments. Regressions include all the control variables listed in Table 2. Standard errors are reported in parentheses and clustered at the departmental level (depression model: 97 clusters, MHI-5 model: 87 clusters).
*: significant at the 10% level, **: 5% level, ***: 1%.

Table 15. Simultaneous equations models (clustered).

Dependent variable	Depression	MHI-5	MHI-5 with selection
	Simultaneous 3-equations model	Simultaneous 3-equations model	Simultaneous 4-equations model
(1) Mental health equation			
Informal care	-0.251*** (0.054)	2.411 (5.307)	0.738 (7.317)
Formal care hours	-0.008 (0.010)	1.974* (1.043)	2.387** (1.144)
(2) Informal care equation			
At least one child who has no partner	-	0.071*** (0.017)	0.053*** (0.013)
Proportion of daughters	0.067*** (0.018)	-	-
Proportion of PAA recipients	0.0002** (0.0001)	0.0001 (0.0001)	0.0002* (0.0001)
(3) Equation for formal care hours			
At least one child who has no partner	-	-0.102 (0.392)	0.031 (0.549)
Proportion of daughters	-0.845 (0.646)	-	-
Proportion of PAA recipients	0.009* (0.005)	0.010** (0.005)	0.009 (0.005)
(4) Selection equation			
Has not voted in the 2007 French presidential and legislative elections	-	-	-0.042* (0.025)
Correlation between mental health and IC	0.519*	0.099	0.151
Correlation between mental health and FCH	0.457	-0.723**	-0.820***
Correlation between IC and FCH	-0.186***	-0.186***	-0.187***
Correlation between selection and health	-	-	0.203
Correlation between selection and IC	-	-	0.236
Correlation between selection and FCH	-	-	-0.344
Number of observations	4,037	2,117	4,067

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals needing help with one or more ADL or IADL, aged 65 and over.
Note: Regressions include all the control variables listed in Table 2. In the selection, depression and informal care equations, the figures given correspond to average marginal effects. Standard errors are reported in parentheses and clustered at the departmental level (depression model: 97 clusters, MHI-5 model: 87 clusters).
*: significant at the 10% level, **: 5% level, ***: 1%.

Replication of the placebo analysis with departmental clusters

As explained in Subsection 4.3. of Chapter 1, in order to be a valid instrument, the proportion of beneficiaries of the PAA in the departments should have no direct effect on the mental health of dependent elderly. This means that this variable should have no impact on dependent elderly who are too young to be eligible for the PAA (under 60 years of age). For both depression and the MHI-5, the results in Table 16 confirm that the proportion of PAA recipients does not influence the mental health of the dependent elderly who are 50-60 years of age (column 3), which shows that the exclusion restriction is valid.

Table 16. Direct effect of the proportion of PAA recipients on mental health (clustered).

Dependent variable	Depression (OLS)			MHI-5 (OLS)		
	Studied sample	50-60 years of age	50-60 with at least 1 ADL/IADL	Studied sample	50-60 years of age	50-60 with at least 1 ADL/IADL
Proportion of PAA recipients	-0.0001*** (0.00004)	-0.0002** (0.00006)	-0.0001 (0.0001)	0.021*** (0.007)	-0.002 (0.010)	-0.001 (0.019)
Number of observations	4,037	4,846	1,280	2,117	3,201	747

Source: French Disability and Health Survey, 2008.
Note: Regressions include all the control variables listed in Table 2. Standard errors are reported in parentheses and clustered at the departmental level (depression model: 97 clusters in column 1, 97 in column 2 and 92 in column3; MHI-5 model: 87 clusters in column 1, 88 in column 2 and 747 in column 3). *: significant at the 10% level, **: 5% level, ***: 1% level.

Replication of the subsample analysis with departmental clusters

When the sample is restricted to dependent elderly who receive formal support (Table 17), the *F*-statistics associated with formal care are higher than in the total sample (F=8.34 in the depression model and F=11.54 in the MHI-5 model). In addition, the exogeneity tests highlight that formal and informal care are endogenous in the MHI-5 model (p=0.069). The IV model for the MHI-5 shows that a one-unit increase in formal care hours significantly improves the mental health score by 1 point (or 0.05 standard deviations). On the other hand, informal care has no longer effect; it seems to be ineffective in reducing the risk of depression among highly dependent individuals. These results are in line with those obtained without clustering the errors.

As in the Chapter 1, when we restrict the analysis of depression to the same subsample than for the MHI-5 (Table 18), the exogeneity of care variables cannot be rejected, indicating that OLS are preferred to instrumental variables. OLS results confirm that informal care significantly limits the risk of depression, though the magnitude of the effect is lower than for the total sample (-3.4%).

Finally, when we focus on dependent elderly that did not use a proxy respondent (Table 19), the effects are similar to those of the main analysis. Indeed, informal care decreases the risk of depression by 64%, while formal care hours have no effect.

Table 17. Effect of care on the mental health of the care recipient (FCH>0, clustered).

Dependent variable	Depression		MHI-5	
	OLS	IV	OLS	IV
Informal care	-0.010 (0.014)	-0.370 (0.314)	0.125 (1.440)	6.396 (22.938)
Formal care hours	-0.0001 (0.0005)	-0.003 (0.004)	0.061 (0.042)	1.038*** (0.236)
First-stage equation for informal care				
At least one child who has no partner	-	-	-	0.060** (0.027)
Proportion of daughters	-	0.060** (0.026)	-	-
Proportion of PAA recipients	-	0.0002 (0.0001)	-	0.00002 (0.0002)
First-stage equation for formal care hours				
At least one child who has no partner	-	-	-	-0.298 (0.954)
Proportion of daughters	-	-0.887 (0.927)	-	-
Proportion of PAA recipients	-	0.023** (0.010)	-	0.025*** (0.008)
AP *F*-test of instruments for IC	-	5.98**	-	4.99**
AP *F*-test of instruments for FCH	-	8.34***	-	11.54***
Exogeneity test, *p-value*	-	0.210	-	0.069
Number of observations	2,266	2,266	1,149	1,149

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals aged 65+ needing help with one or more ADL or IADL, who receive a strictly positive amount of formal care.
Note: Regressions include all the control variables listed in Table 2. Standard errors are reported in parentheses and clustered at the departmental level (depression model: 96 clusters, MHI-5 model: 84 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Table 18. Effect of care on the risk of depression for the subsample of individuals that have completed the paper questionnaire (clustered).

Dependent variable	Depression	
	OLS	IV
Informal care	-0.034*** (0.013)	-0.172 (0.124)
Formal care hours	-0.0003 (0.0005)	-0.004 (0.005)
First-stage equation for informal care		
At least one child who has no partner	-	0.075*** (0.018)
Proportion of PAA recipients	-	0.0001 (0.0001)
First-stage equation for formal care hours		
At least one child who has no partner	-	-0.430 (0.551)
Proportion of PAA recipients	-	0.010** (0.005)
AP *F*-test of instruments for IC	-	19.20***
AP *F*-test of instruments for FCH	-	6.40**
Exogeneity test, *p-value*	-	0.414
Number of observations	2,104	2,104

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals aged 65+ needing help with one or more ADL or IADL, who have completed the paper questionnaire.
Note: Regressions include all the control variables listed in Table 2. Standard errors are reported in parentheses and clustered at the departmental level (87 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Table 19. Effect of care on mental health for individuals that did not use a proxy respondent (clustered).

Dependent variable	Depression		MHI-5	
	OLS	IV	OLS	IV
Informal care	-0.033*** (0.012)	-0.643** (0.258)	0.483 (1.101)	12.983 (18.108)
Formal care hours	0.0004 (0.0006)	-0.001 (0.012)	-0.020 (0.038)	2.074** (0.992)
First-stage equation for informal care				
At least one child who has no partner	-	-	-	0.083*** (0.021)
Proportion of daughters	-	0.063*** (0.024)	-	-
Proportion of PAA recipients	-	0.0002* (0.0001)	-	0.0002 (0.0001)
First-stage equation for formal care hours				
At least one child who has no partner	-	-	-	-0.785 (0.505)
Proportion of daughters	-	-0.821 (0.505)	-	-
Proportion of PAA recipients	-	0.008** (0.003)	-	0.006* (0.003)
AP *F*-test of instruments for IC	-	11.24***	-	13.90***
AP *F*-test of instruments for FCH	-	7.72***	-	5.76**
Exogeneity test, *p-value*	-	0.016	-	0.329
Number of observations	2,663	2,663	1,558	1,558

Source: French Disability and Health Survey, 2008.
Field: Dependent individuals aged 65+ needing help with one or more ADL or IADL, who have answered the survey by themselves.
Note: Regressions include all the control variables listed in Table 2. Standard errors are reported in parentheses and clustered at the departmental level (depression model: 96 clusters, MHI-5 model: 85 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Summary

To sum up, using cluster-robust standard errors does not change the results concerning the effect of informal care on the mental health of dependent elderly people. Informal care decreases the probability of depression in the total sample and in most subsamples (except when the analysis is restricted to dependent elderly who receive formal care). In contrast, the effect of formal care is less clear. The reason for this is that the identification of this effect

relies on the proportion of beneficiaries of the Personal Autonomy Allowance at the departmental level, and, when the within-department correlation of error terms is accounted for, this instrument is more likely to be affected than other variables. While the estimates of Chapter 1 show that formal care has a beneficial effect on the MHI-5 in the main sample and in the different subsamples studied, the results of this erratum stress that formal care has a positive effect on the MHI-5 only for dependent elderly that receive a strictly positive amount of formal care. Nevertheless, it does not change the main implication of the paper which is that better access to formal and informal care is likely to have positive effects on the mental health of (at least some categories of) dependent elderly people.

CHAPTER 2
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FORMAL HOME CARE, INFORMAL SUPPORT AND CAREGIVER HEALTH: SHOULD OTHER PEOPLE CARE?

1. Introduction

As underlined in the general introduction, informal caregivers are the main providers of support for dependent elderly people in France. They may become even more important in the future, given that population aging puts increasing pressures on the sustainability of public systems. It is thus important to understand the consequences of informal care (i.e., care provided by the family, friends and neighbors) on caregivers' health. Recent reports from the European Commission (2009) and the OECD (2011) have acknowledged the importance of supporting caregivers. In France, the Law on the adaptation of society to the aging of the population recognizes the right to respite for family caregivers (additional hours of formal home care, day-care services, temporary accommodation), reinforces counseling and training services and underlines the need to reconcile paid employment and informal care.

So far, the economic literature has been more interested in the effect of informal care on the labor market (see; e.g., Lilly et al., 2010, 2007) than in caregivers' health. In addition, studies that estimate health effects of informal care generally do not assess whether heterogeneous care arrangements lead to different health consequences. It is important to investigate the effect of informal care on health, not only because it is costly in terms of caregivers' well-being, but also because health problems can lead to many other negative consequences. Indeed, caregivers seem to be characterized by a higher probability of medication use (Do et al., 2015; Van Houtven et al., 2005), the cost of which is borne by informal caregivers and by public expenditures. In addition, it has been shown that problems of depression among caregivers are associated with missed work (Wilson et al., 2007), which represents an economic cost to caregivers, care employers and to society as a whole. Caregivers' stress and burden may also lead to early institutionalization of dependent elderly people (Spillman and Long, 2009; Yaffe et al., 2002). In France, it has been estimated that 29% of nursing home expenditures are covered by public expenditures, while 71% remain the responsibility of care recipients and their families (Charpin Report, 2011). Finally, caregivers' health problems may decrease the quality of informal care and even increase the risk of elder abuse (Schulz and Beach, 1999; Smith et al., 2011), which is costly in terms of the well-being of dependent elderly people.

This work aims to estimate from French data the effect of social support (informal support and formal home care) on the health of non-coresiding informal caregivers. Informal support

is defined as the assistance that the caregivers receive from family and other members of the social network (e.g., friends and neighbors). In terms of public policies, this work explores to what extent a subsidy on formal care could protect caregivers' health.

This article is organized as follows: Section 2 summarizes the existing literature; Section 3 presents the data and methodology used; Section 4 provides some descriptive statistics, the results of the estimations and sensitivity tests. The last section concludes.

2. Background

Theoretically, this study falls within both the health capital model (Grossman, 1972) and the stress process model, which was developed within the psychology and the sociology of mental health (Lawton et al., 1991; Pearlin et al., 1990). In the first model, caregivers may invest in formal home care services in order to reduce the caregiving burden and protect their health. The latter model assumes that caregivers' health and well-being is the consequence of a dynamic process which depends on the socioeconomic characteristics of the caregivers, the stressors to which they are exposed and social support. Social support may mitigate the intensity of caregiving stressors and their impact on health. More specifically, Pearlin et al. (1990) explain that social support may lessen primary and secondary stressors. Primary stressors stem directly from the objective caregiving demand (cognitive status of the dependent elderly person, number of activity restrictions…) and the intensity of care provided. These stressors may lead to more subjective problems (secondary stressors) such as strains in roles and activities outside caregiving (family conflict, job-caregiving conflict, economic strains, constriction of social life) and intra-psychic strains (loss of self-esteem, loss of mastery, loss of self, role captivity…).

Empirically, the health and well-being effects of providing informal care have been first documented in research in psychology, public health, epidemiology and medicine through meta-analyses that compare groups of caregivers with non-caregivers (Pinquart and Sörensen, 2003; Vitaliano et al., 2003) and longitudinal studies that examine transitions of individuals into and out of caregiving (Burton et al., 2003; Hirst, 2005; O'Reilly et al., 2008; Schulz et al., 2003; Seltzer and Li, 2000). While meta-analyses do not take into account endogeneity problems in the relationship between informal care and health, longitudinal studies allow investigating more causal effects. The results indicate that informal care has negative effects on both physical health (self-reported health, physical symptoms, antibodies and stress hormones) and mental health (stress, depression, distress and loss of subjective well-being) of

caregivers. However, in general, these studies use non-representative samples that over-represent caregivers of demented elderly (Pinquart and Sörensen, 2003; Vitaliano et al., 2003; Yee and Schulz, 2000).

More recently, the economic literature has addressed this topic. Most papers adjust for the endogeneity of informal care with the use of instrumental variables methods (Coe and Van Houtven, 2009; Do et al., 2015), fixed effects models that control for time-invariant unobserved heterogeneity (Oshio, 2014; Van den Berg et al., 2014) or propensity score matching (Di Novi et al., 2015; Schmitz and Westphal, 2015). Other economic studies have not taken into account the endogeneity problem but have underlined the importance of controlling for the health characteristics of dependent elderly persons (Bobinac et al., 2011, 2010; Byrne et al., 2009). Estimates confirm that informal care has negative consequences on health and well-being. Informal care significantly decreases the health-related quality of life (Bobinac et al., 2011); it increases the probability of having pain that affects daily activities and of reporting fair or poor health (Do et al., 2015); and it leads to heart conditions for single caregiver men who provide continued caregiving (Coe and Van Houtven, 2009). With regard to mental health, informal care has negative effects on happiness (Bobinac et al., 2010) and life satisfaction (Van den Berg et al., 2014), and it is positively associated with burden (Byrne et al., 2009) and psychological distress (Oshio, 2014). Caregiving also increases the depression index of married caregivers who provide continued caregiving (Coe and Van Houtven, 2009). Schmitz and Westphal (2015) show that informal care has negative short-term effects on mental health, which fade out over time.

While the health consequences of providing informal care are well established, less is known concerning the mediating effect of social support on caregivers' health. To the best of my knowledge, the economic literature has not assessed the effects of informal support and formal care on caregiver's health, with the exception of White-Means (1997). Most existing studies come from research in nursing and social work, psychology, public health, epidemiology and medicine. They highlight that the use of formal care (home care, daycare and respite care) has no effect on caregivers' physical health (measured by self-reported health and the functional status) or on mental health (measured by burden, depression, stress, anxiety, distress, burnout and general well-being) (Chappell and Reid, 2002; Choo et al., 2003; Ducharme et al., 2007; Greenberger and Litwin, 2003; Herrera et al., 2009; Lee et al., 2007; Moon and Dilworth-Anderson, 2015; Mui, 1995; Okabayashi et al., 2008; Pinquart and Sörensen, 2007; Raina et al., 2004; Séoud et al., 2007; Tennstedt et al., 1992; Winslow, 1997;

Zanetti et al., 1996). By contrast, informal support received from the family and social network protects caregivers' mental health (Alvira et al., 2014; Chappell and Reid, 2002; Choo et al., 2003; Clyburn et al., 2000; Greenberger and Litwin, 2003; Lee et al., 2007; Moon and Dilworth-Anderson, 2015; Pinquart and Sörensen, 2007; Raina et al., 2004), but it seems to have no effect on self-reported health (Ducharme et al., 2007; Moon and Dilworth-Anderson, 2015; Raina et al., 2004; Tennstedt et al., 1992). However, there are two important limitations to these studies. First, they generally use non-representative samples of caregivers of people with dementia (Alvira et al., 2014; Choo et al., 2003; Clyburn et al., 2000; Winslow, 1997; Zanetti et al., 1996) or of caregivers living in very particular geographical areas (Herrera et al., 2009; Lee et al., 2007; Okabayashi et al., 2008). Second, they are based on correlation analyses or standard linear regressions that do not take into account the potential simultaneity bias between caregivers' health and social support. Interestingly, White-Means (1997) accounts for the endogeneity of formal home care decisions by including the estimated probability of formal care utilization in the health equation. Contrary to other studies, the author finds that formal care protects caregivers' health.

This work contributes in several ways to the existing literature. First, it estimates the effect of social support (informal support received from the family/social network and formal home care) on the health of non-coresiding caregivers, while also taking into endogeneity biases with an instrumental variables approach. Second, it uses data that provide valuable information on the characteristics of both the caregivers and the dependent elderly persons. Finally, it provides insights on the health effects of informal care in France.

3. Method

3.1. Data

In order to study the relationship between social support and caregivers' health, I use the Households section and the Caregivers section of the French Disability and Health Survey (*Enquête Handicap Santé*). This cross-sectional survey, carried out in 2008-2009 by the French Institute of Statistics and the Ministry of Health, provides valuable information on both non-institutionalized dependent people (in the Households section of the survey) and their caregivers (in the Caregivers section).

4,151 dependent elderly persons aged 65 and over and living in the community were selected from the Households section based on activity restrictions (difficulties in performing alone at least one essential activity of daily living ADL or one instrumental activity of daily living

IADL). Among these dependent persons, 3,440 received informal care and they listed a total number of 3,542 non-coresiding informal caregivers and 2,047 coresiding caregivers, providing aid with daily life tasks, financial/material aid or moral support. However, the instrument used in the following analysis does not work for coresiding caregivers, and the endogeneity problem could not be addressed[29]. Consequently, the remainder of the paper focuses on non-coresiding caregivers. I recognize the limitation of excluding coresiding caregivers, who generally provide intensive care, from the analysis. Some of the 2,047 non-coresiding caregivers did not fall within the scope of the Caregivers section, could not be contacted or did not respond to the survey, which leaves us with 1,107 non-coresiding caregivers. In addition, I removed the few caregivers who provided only financial or material assistance, who are at lower risk of health problems, and the caregivers who helped several persons. Indeed, information was available on only one care relationship, and I wanted to exclude health variations associated with multiple caregiving roles. The final sample contains 755 non-coresiding caregivers after deleting missing values (see Appendix C for a more detailed description of the sample selection). The descriptive statistics in Section 4 compare this sample with non-coresiding caregivers excluded from the study.

3.2. Variables of interest

In this study, the effect of social support on caregivers' health is approached through three standard health indicators (self-perceived health, longstanding illness or health problem, Global Activity Limitation Indicator - GALI[30]) and eight more specific questions. The self-perceived health variable is dichotomized in order to have a sufficient number of observations in each category: it takes the value one if the caregiver reports fair, bad or very bad health and 0 otherwise. The second standard health indicator is equal to 1 if the individual has a longstanding illness or health problem and 0 otherwise. Finally, the GALI variable takes the value 1 if the individual is limited (severely or not) and 0 otherwise.

[29] For the sample of 840 coresiding caregivers that have answered to the Caregivers section of the survey, the Angrist-Pischke *F*-statistic associated with formal support in the instrumental variables model is equal to 0.092 and the maximum Wald test size distortion exceeds 25%.

[30] The questions are the following:

- Self-perceived health: *"How is your health in general? Very good / good / fair / bad / very bad."*
- Longstanding illness or health problems: *"Do you have any longstanding illness or health problem? Yes / no."*
- Global Activity Limitation Indicator (GALI): *"For at least the past 6 months, to what extent have you been limited because of a health problem in activities people usually do? Severely limited / limited but not severely / not limited at all."*

These measures are commonly used in the literature, but are very general and focus rather on physical health. Thus, I also use complementary health questions that directly ask caregivers whether informal care has negative effects on their health:

- *"Do you feel that providing informal care affects your health? Yes / no."*
- *"I am now going to read you a list of some less positive aspects of caregiving. Tell me if they currently apply to you:*

Do you feel physical fatigue? Yes / no.
Do you have sleep disorders? Yes / no.
Do you feel morally tired? Yes / no.
Do you feel depressive? Yes / no.
Do you feel anxious, stressed, overworked? Yes / no.
Do you have back problems? Yes / no.
Do you have palpitations, tachycardia? Yes / no."

For each of these questions, I create a binary variable that is equal to 1 if the caregiver answers *"yes"* and 0 if she answers *"no"*. These indicators are interesting in that they capture health variations and focus on how caregivers experience informal care. In addition, even if subjective data may result in response bias, the economic literature acknowledges more and more that subjective measures provide valuable information. For example, recent reports highlight that the subjective well-being is an important tool given that individuals are *"the best judges of their own conditions"* and that it *"provides an insight into human behavior and decision making"* (Commission on the Measurement of Economic Performance and Social Progress, Stiglitz, Sen, Fitoussi, 2009; OECD, 2013b). Nevertheless, it should be kept in mind that these variables are very specific and presuppose that individuals are aware of the health consequences of caregiving.

The main explanatory variables are formal support and informal support. Formal support is measured by the number of formal home care hours received per week as reported by the dependent elderly persons in the Households survey. In the literature, there is no consensus on the measure of informal support received from the family/social network. It is generally approached by instrumental (i.e., tangible) support such as assistance with informal care, by emotional support, by scales of perceived support or by the number of informal caregivers. In this study, informal support is approached by the total number of informal caregivers reported by the dependent elderly persons. This variable refers to both coresiding and non-coresiding caregivers and goes from one to ten. Using these measures of formal and informal support

reported by the dependent elderly persons, rather than the perception of social support by caregivers, may help limit potential biases.

3.3. Econometric model

The effects of formal home care (FHC_i) and informal support (IS_i) on caregivers' health (H_i) are first estimated by ordinary least squares (Eq.2 below). I use linear probability models, rather than probit models, in order to compare these estimations with instrumental variables models[31]. The control variables, X_i, are: demographic and socioeconomic characteristics of the caregiver (age, sex, education level, working or not and monthly household income); family characteristics of the caregiver (living with a partner or not and having at least one child or not) and of the care recipient (living with a partner or not); the frequency of informal care (daily, weekly or less intensive assistance); the caregiver type (daughter, son, child-in-law, sibling, friend or neighbor, other); the supply of nursing home beds in the department of the care receiver and, finally, the monthly income and the health of the dependent elderly (number of restrictions in ADLs, in IADLs and cognitive limitations). Controlling for the health of the care receiver is important, since it has a direct effect on caregivers' health and subjective well-being (Bobinac et al., 2011, 2010). In addition, the health of the dependent elderly gives information on the difficulty of providing informal care (Pearlin et al., 1990). More precisely, the literature shows that providing informal care for demented people is more harmful to health than providing care for individuals with only physical problems (Pinquart and Sörensen, 2007, 2003; Schulz and Sherwood, 2008).

It should be noted that in this study, care intensity is used only as a control variable. The economic literature instruments the informal care variable with variables for the health of dependent elderly persons and for the characteristics of siblings and family members (see, e.g., Coe and Van Houtven, 2009; Do et al., 2015; Van Houtven et al., 2005). These instruments cannot be applied here since the study considers both family and non-family caregivers and assumes that the health characteristics of dependent elderly people have a direct effect on caregivers' health. In addition, while the literature uses samples containing both caregivers and non-caregivers, this study focuses only on caregivers and thus takes place after the decision to provide care. Consequently, I treat informal care as exogenous and hypothesize that the potential for endogeneity is smaller when using a frequency of care variable rather than hours of care. However, one must recognize that there may be limitations to this strategy.

[31] Probit models give very similar results.

$$H_i = \alpha_1 FHC_i + \alpha_2 IS_i + X_i\alpha_3 + \epsilon_i \quad \text{(Eq.2)}$$

Formal home care and informal support may be endogenous in standard linear models. Indeed, informal caregivers may purchase formal care hours if they have health problems. Similarly, they may ask other family members to help them with caregiving. This reverse causality bias is likely to underestimate the positive effect of social support on caregivers' health. In addition, some unobserved factors may be correlated to both social support and caregivers' health (e.g., the initial health status of the caregiver, before providing care).

In order to address this potential endogeneity, linear probability instrumental variables models are estimated using two-stage least squares. Indeed, the command to estimate IV-Probit models in Stata (Ivprobit) is appropriate only for use with continuous endogenous regressors. Since the measure of informal support (the number of caregivers, from 1 to 10) is discrete, IV-probit models could not be estimated. In addition, linear models need weaker assumptions, allow avoiding problems of convergence and give good estimates of marginal effects (Angrist, 2009, p. 107; Wooldridge, 2002, p. 455). Since the instrument for formal home care is at the departmental level (see below), I allow the errors within each of the 89 departments to be correlated. These cluster-robust standard errors are also robust to heteroskedasticity[32].

3.4. Instruments

In order to identify the causal effect of social support on caregivers' health, one has to find at least two instruments (vector Z_i) that are correlated with formal care, $corr(Z_i, FHC_i) \neq 0$, and with informal support, $corr(Z_i, IS_i) \neq 0$, but that are orthogonal to the error term in the health equation, $corr(Z_i, \epsilon_i) = 0$. As already mentioned in the previous chapter, instruments for formal care are not well developed in the economic literature. Like in Chapter 1, the present work uses the proportion of individuals aged 75 and over, living in the community, who received the Personal Autonomy Allowance (PAA, *Allocation Personnalisée d'Autonomie*) at the departmental level[33] in 2008. It captures French disparities in access to PAA (see Chapter 1, Subsection 3.4. for further details). It should be kept in mind that this variability in the proportion of beneficiaries of the PAA partly reflects socioeconomic and political differences between French departments, which may have a direct impact on

[32] It should be stressed that some caregivers in the sample provide care to the same dependent elderly person. Indeed, the 755 caregivers provide care to 533 dependent elderly persons. The effect of social support on caregivers' health remains unchanged when errors are also allowed to be correlated for the caregivers of the same dependent elderly person.

[33] In the department of the dependent elderly person being cared for.

caregivers' health. It may also be correlated with the local supply of nursing home beds. For instance, it is possible that in departments with few nursing homes, more individuals live in the community and receive the PAA. The regressions partly take into account these effects by controlling for the number of nursing home beds in the departments.

As far as informal support is concerned, the number of caregivers is instrumented by the number of daughters of the dependent elderly persons. It relies on the assumptions that women have a higher propensity to provide care than men and that when the dependent persons have several children, the burden of caregiving can be shared between siblings. However, one cannot completely rule out the possibility that the number of daughters of the elderly has a direct effect on caregivers' mental health, particularly for children caring for a parent. Indeed, sisters may provide emotional support, even if they do not directly help with caregiving.

4. Results

4.1. Descriptive statistics

Table 20 below provides descriptive statistics for both the subsample of 755 non-coresiding caregivers considered in this study (1st and 2nd columns) and the subsample of 1,665 non-coresiding caregivers reported by the dependent persons but excluded from the analysis (3rd and 4th columns). Characteristics of the former are reported by the caregivers themselves, whereas characteristics of the latter are provided by the dependent elderly persons. In short, the comparison of the two groups shows that the subsample of caregivers used for estimations over-represents daily caregivers (38.5% of caregivers as compared to 32.5% in the excluded subsample[34]), daughter caregivers (44% *vs.* 30%) and caregivers providing care to someone who does not live with a partner (79% *vs.* 64%). In addition, the studied subsample seems to be characterized by caregivers providing care to dependent elderly with lower incomes (37% receive less than 1000 euros per month) and poorer health than in the excluded subsample. This should be kept in mind in the remainder of the paper.

Among caregivers considered in the following analysis, 23% report activity limitations (GALI), 28% report a fair, bad or very bad self-perceived health, 42% have a longstanding illness or health problem and 11.5% feel that providing informal care affects their health. The

[34] These figures are computed on non-missing values for the frequency of informal care.

most commonly reported negative consequences of caregiving are anxiety/stress/overwork (27.5% of the sample), back problems (27%), moral and physical fatigue (24% and 21%) and sleep disorders (17%). Depression and palpitations/tachycardia, reported by, respectively, 10.5% and 9% of caregivers, are much less common. On average, dependent elderly persons have 2.7 caregivers and receive 8 hours of formal home care per week.

As regard control variables, most caregivers are daughters or sons (68%), women (65%), less than 60 years of age (68%), live with a partner (89%) and have children (84%). Around half of individuals work, 27.5% have no diploma and 17% receive less than 1200 euros per month. Finally, dependent elderly have on average 1.4 restrictions in ADLs, 5.5 restrictions in IADLs and 46% report cognitive limitations.

Table 20. Descriptive statistics on caregivers.

	Studied subsample		Excluded subsample	
	Mean	Std. dev.	Mean	Std. dev.
Health variables				
Self-perceived health (fair, bad, very bad)	0.282	0.450	-	-
Longstanding illness or health problem	0.423	0.494	-	-
Global Activity Limitation Indicator (GALI)	0.232	0.422	-	-
Caregiving affects health	0.115	0.320	-	-
Physical fatigue	0.216	0.412	-	-
Sleep disorders	0.171	0.377	-	-
Moral fatigue	0.236	0.425	-	-
Depression	0.105	0.306	-	-
Anxiety, stress, overwork	0.275	0.447	-	-
Back problems	0.268	0.443	-	-
Palpitation, tachycardia	0.094	0.292	-	-
Social support				
Number of informal caregivers	2.736	1.832	2.997	2.062
Number of formal care hours per week	8.326	13.496	6.643	11.887
Control variables				
Care arrangements				
Frequency of informal care				
- Daily	0.385	0.487	0.180	0.384
- Weekly	0.473	0.500	0.285	0.451
- Less often	0.139	0.346	0.088	0.283
- Missing value	0.003	0.051	0.447	0.497
Relationship between the caregiver and the elderly person				
- Daughter	0.437	0.496	0.300	0.459
- Son	0.240	0.427	0.235	0.424
- Friend or neighbor	0.098	0.298	0.137	0.344
- Other relatives	0.070	0.256	0.279	0.449
- Child-in-law	0.065	0.247	-	-
- Sibling	0.049	0.216	0.045	0.207
- Grandchild	0.041	0.199	-	-
Demographic and socioeconomic controls				
Age				
- Less than 50 years of age	0.309	0.462	0.316	0.465
- Between 50 and 60 years of age	0.367	0.482	0.338	0.473
- Between 60 and 70 years of age	0.209	0.407	0.187	0.390
- 70 and older	0.115	0.320	0.103	0.304
- Missing value	0.000	0.000	0.055	0.229
Female	0.652	0.477	0.599	0.490
Education level				
- No diploma or Certificate of primary education (low)	0.275	0.447	-	-
- Junior school certificate or vocational qualification (medium)	0.391	0.488	-	-
- Higher diploma (high)	0.277	0.448	-	-

-Missing value	0.057	0.232	-	-
Work	0.519	0.500	-	-
Monthly household income				
- Less than 1200 EUR	0.168	0.374	-	-
- 1200-1800 EUR	0.192	0.394	-	-
- 1800-2500 EUR	0.179	0.383	-	-
- 2500-4000 EUR	0.195	0.396	-	-
- More than 4000 EUR	0.094	0.292	-	-
- Missing value	0.172	0.378	-	-
Family controls				
Living with a partner	0.891	0.311	-	-
Having at least one child	0.844	0.363	-	-
Characteristics of the dependent elderly				
Number of restrictions in ADLs	1.419	1.666	1.423	1.771
Number of restrictions in IADLs	5.461	2.910	5.122	3.018
Cognitive limitations	0.458	0.499	0.398	0.490
Not living with a partner	0.792	0.406	0.637	0.481
Monthly income				
- Less than 1000 EUR	0.367	0.482	0.288	0.453
- 1000/1500 EUR	0.297	0.457	0.279	0.449
- 1500/2000 EUR	0.123	0.329	0.166	0.372
- More than 2000 EUR	0.159	0.366	0.171	0.376
- Missing value	0.054	0.227	0.096	0.295
Number of nursing home beds at the departmental level (per 1,000 inhabitants aged 75+)	74.127	25.617	73.041	24.613
Instrument				
Proportion of individuals aged 75+ receiving the PAA at the departmental level (per 1,000 inhabitants)	144.708	71.992	140.663	70.291
Number of daughters of the dependent elderly person	1.789	1.669	1.616	1.567
Number of observations	755	755	1,665	1,665

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons (1st and 2nd columns: caregivers considered in the study; 3rd and 4th columns: caregivers reported by the dependent elderly persons in the Households survey, who fall within the scope of the Caregivers survey but are excluded from the study).

4.2. Estimation results

Specification tests

Tables 21 and 22 below summarize the results of OLS and IV models, for the different health indicators (models on standard health variables are presented in Table 21 and models on the effects of caregiving on health are in Table 22). Table 31 in Appendix E presents the effects of control variables on caregivers' health. First of all, the null hypothesis of exogeneity[35] of formal care is rejected in the model that estimates whether caregiving affects health (p=0.024), in the model for sleep disorders (p=0.087) and in the model for depression (p=0.031). The exogeneity of informal support, measured by the number of informal caregivers, is rejected in the study of sleep disorders (p=0.052), moral fatigue (p=0.061) and palpitations/tachycardia (p=0.035). For these health variables, IV models are preferable to OLS. Concerning the strength of the instruments, the proportion of PAA recipients has a positive and significant effect at the 1% level in the formal care equation (coefficient:

[35] In the ivreg2 command in Stata, the exogeneity test is the difference of two Sargan-Hansen statistics (one for the equation treating the regressor(s) as endogenous and one for the equation treating the regressor(s) as exogenous). This statistics is distributed as chi-squared with degrees of freedom equal to the number of regressors tested.

0.021***). Similarly, the number of daughters of the dependent elderly persons has a positive effect at the 1% level on the number of caregivers (coefficient: 0.247***). The Angrist-Pischke *F*-statistics for formal home care and informal support are equal, respectively, to 13.12 and 15.37, which is higher than the conventional *F*=10 threshold (Staiger and Stock, 1997), and significant at the 1% level. Furthermore, the comparison of the Kleibergen-Paap Wald *F*-statistic to Stock and Yogo (2005)'s critical values[36] shows that the maximum Wald test size distortion ranges between 10% and 15%. The exclusion restriction cannot be tested in this study, since there is only one instrument.

Table 21. Effect of social support on caregivers' health – standard indicators.

Dependent variables	Effect of social support on health		Exogeneity tests, *p-value*		
	FCH	IS	FCH	IS	Global
Self-perceived health (fair, bad, very bad)					
OLS	-1.43e-6 (0.001)	0.001 (0.009)	-	-	-
IV-2SLS	-0.007 (0.011)	-0.036 (0.052)	0.563	0.478	0.705
Longstanding illness or health problem					
OLS	-0.002 (0.001)	0.003 (0.011)	-	-	-
IV-2SLS	-0.009 (0.014)	-0.034 (0.057)	0.644	0.546	0.741
Global Activity Limitation Indicator (GALI)					
OLS	-0.002 (0.001)	-0.007 (0.009)	-	-	-
IV-2SLS	0.003 (0.012)	-0.042 (0.043)	0.647	0.388	0.594
First-stage equation for formal care hours (IV)					
Proportion of PAA recipients	0.021*** (0.006)				
Number of daughters	-0.055 (0.288)				
First-stage equation for informal support (IV)					
Proportion of PAA recipients	-0.002 (0.001)				
Number of daughters	0.247*** (0.063)				
AP *F-test* for FCH	13.124***				
AP *F-test* for IS	15.372***				
Number of observations	755				

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons.
Note: regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level (89 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

[36] The Kleibergen-Paap Wald *F*-statistic is 6.26. The critical values that allow restricting the size distortion to 15% and 10% are, respectively, 4.58 and 7.03.

Table 22. Effect of social support on caregivers' health – health consequences of caring.

Dependent variables	Effect of social support on health		Exogeneity tests, *p-value*		
	FCH	IS	FCH	IS	Global
Caregiving affects health					
OLS	-0.001 (0.001)	-0.002 (0.010)	-	-	-
IV-2SLS	**-0.020* (0.011)**	-0.044 (0.048)	0.024	0.382	0.060
Physical fatigue					
OLS	7.90e-5 (0.002)	-0.002 (0.010)	-	-	-
IV-2SLS	-0.006 (0.009)	-0.056 (0.046)	0.505	0.151	0.331
Sleep disorders					
OLS	-0.002 (0.001)	0.003 (0.008)	-	-	-
IV-2SLS	**-0.022** (0.010)**	-0.082 (0.051)	0.087	0.052	0.029
Moral fatigue					
OLS	**-0.002* (0.001)**	-0.004 (0.012)	-	-	-
IV-2SLS	-0.013 (0.010)	**-0.082* (0.047)**	0.380	0.061	0.127
Depression					
OLS	-0.001 (0.001)	-0.004 (0.007)	-	-	-
IV-2SLS	**-0.017* (0.009)**	-0.024 (0.033)	0.031	0.679	0.090
Anxiety, stress, overwork					
OLS	-2.76e-4 (0.002)	-0.016 (0.012)	-	-	-
IV-2SLS	-0.002 (0.011)	-0.071 (0.051)	0.936	0.234	0.491
Back problems					
OLS	-0.001 (0.001)	-0.008 (0.008)	-	-	-
IV-2SLS	-0.010 (0.012)	-0.027 (0.047)	0.512	0.735	0.765
Palpitations, tachycardia					
OLS	-0.001 (0.001)	-0.010* (0.006)	-	-	-
IV-2SLS	-0.010 (0.009)	**-0.058** (0.025)**	0.350	0.035	0.030
First-stage equation for formal care hours (IV)					
Proportion of PAA recipients	0.021*** (0.006)				
Number of daughters	-0.055 (0.288)				
First-stage equation for informal support (IV)					
Proportion of PAA recipients	-0.002 (0.001)				
Number of daughters	0.247*** (0.063)				
AP *F-test* for FCH	13.124***				
AP *F-test* for IS	15.372***				
Number of observations	755				

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons.
Note: regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level (89 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Effect of social support

Comparing OLS and IV results highlights the importance of adjusting for the endogeneity of formal care and informal support. Indeed, while naïve models find generally no significant effect, IV estimations show that social support reduces the risk that caregiving affects health and the risk that it leads to sleep disorders, moral fatigue, depression or palpitations/tachycardia. The simultaneity bias thus results in an underestimation of the beneficial effects of social support on caregivers' health and may explain why most of the existing studies find no effect of formal care.

More specifically, social support seems to have no significant effect on standard health variables (self-perceived health, longstanding illness or health problem, GALI) and physical health (physical fatigue, back problems). By contrast, a one-unit increase in formal home care

hours reduces the risk that caregiving affects health by 2% and decreases the probability that caregiving leads to sleep disorders and depression by, respectively, 2.2% and 1.7%. Formal care has also a small impact on moral fatigue. As far as informal support is concerned, when the number of informal caregivers increases by one unit, it reduces the risk that caregivers feel morally tired and that they have palpitations or tachycardia by, respectively, 8.2% and 5.8%. These results highlight that the effect of social support depends on which aspect of health is measured and that the effects are more pronounced when caregivers are asked about the interaction between their health and the care they provide than with more general questions.

As already mentioned in this chapter, the exogeneity of the instrument for informal support (the number of daughters of the dependent elderly) may be called into question. Thus, as an alternative specification, I have also estimated a simpler model in which only the effect of formal care is assessed (see Appendix D). In this model, the endogenous regressor can be considered as continuous and IV-Probit models can be estimated. The results are consistent with those of the main analysis and IV linear probability models and IV-Probit models provide similar results (except, to some extent, for sleep disorders).

Other determinants of caregivers' health

Concerning other care arrangements, daily care raises the probability that informal care generates physical fatigue, moral fatigue, anxiety or back problems[37] (see Appendix E). Caregivers' health also depends on the relationship between the caregiver and the elderly person. Indeed, the risk of health problems is generally lower for children-in-law, friends and neighbors and adult grandchildren than for adult children. These effects might be explained by differences in initial health, in family ties and in the decision to provide informal care. They are in line with Hirst (2005), who shows that providing care to a friend or neighbor decreases the risk of distress and with Do et al. (2015), who find that the health effect of care is higher for daughters than for daughters-in-law. Regarding demographic and socioeconomic characteristics, women report more often that caregiving leads to health problems, fatigue, sleep disorders, depression or anxiety. In contrast, caregivers' income has a protective effect on most health variables. Individuals who work and individuals with higher education are characterized by better general health indicators (self-perceived heath, longstanding illness or health problems, GALI) but report more often that caregiving has negative health

[37] This result should be interpreted with caution, because the potential endogeneity of care intensity is not accounted for.

consequences. The positive effect of work on health is probably due to selection effects. Caregivers who live with a partner and who have children have a higher probability of reporting fair or bad self-perceived health, longstanding illnesses or health problems, anxiety and palpitations. This may be explained by the fact that caregiving may interfere with private and family life. Finally, restrictions in activities of daily living of the elderly increase the risk of caregivers' health problems. Caregivers also report more often difficulties when the care receiver has higher incomes. In contrast, when the dependent elderly person lives with a partner, it decreases the health risk. The presence of a spouse, who generally provides the majority of assistance, can be interpreted as a form of informal support for adult children and other non-coresiding caregivers.

What are the mechanisms at work?

In order to better understand the effect of social support on caregivers' health, I have included in IV models the type of care provided and role strains (see Table 23 below). If formal care and informal support are no longer significant, this would imply that the positive effect of social support on health is entirely explained by a reorganization of the care provided and by a better articulation of caregiving with family, social and professional life. These alternative models are estimated only for health dimensions that were affected by social support in the main analysis.

The type of care is measured through dummy variables indicating whether the caregiver provides personal care (33% of the sample), moral support (96%), supervision (34%), or help with administrative tasks (65%), with health problems (68%), with household chores (91%) or with mobility (22%). In addition, six indicators are used to control for potential role strains associated with caregiving. Four dummy variables indicate whether providing care reduces the quality of the relationship of the caregiver with her partner (5%), her children (2%), the elderly (6%) or friends (6%). Another variable identifies individuals who have the impression that caregiving represents a financial burden (7% of the sample). Finally, the last indicator measures whether caregivers have made adjustments in their working life, have had to give up a professional change, or have taken time off to care for the dependent elderly (20% of the sample).

The results show that the negative consequences of caregiving on family and social relationships and on working life have also a strong effect on caregivers' health. When the type of care and role strains are taken into account, the effect of informal support on moral fatigue and the effect of formal care on depression are no longer significant. It suggests that,

for these health indicators, the effect of social support on health is entirely explained by a reorganization of the care provided and by changes in family, social and professional life. However, these results are only meant to give some insights. Indeed, a full understanding of all mechanisms at work would require an in-depth analysis and is outside the scope of this study. Role strains and the type of care are very likely to be endogenous, which makes the different effects difficult to disentangle. For this reason, and for the sake of parsimony, other estimations reported in this paper do not control for these variables.

Table 23. Inclusion of the type of care and role strains in IV-2SLS models.

	Caregiving affects health	Sleep disorders	Moral fatigue	Depression	Palpitations, tachycardia
Social support					
Formal care hours	**-0.019**** (0.009)	**-0.019*** (0.010)	-0.007 (0.009)	-0.010 (0.009)	-0.010 (0.008)
Informal support	-0.042 (0.047)	-0.075 (0.052)	-0.072 (0.050)	-0.024 (0.032)	**-0.053*** (0.029)
Role strains					
Relationship elderly	0.234*** (0.084)	0.155** (0.077)	0.163* (0.085)	0.174** (0.070)	0.063 (0.052)
Relationship partner	0.161** (0.082)	0.297*** (0.080)	0.219*** (0.080)	0.074 (0.059)	0.073 (0.057)
Relationship children	0.017 (0.139)	0.186 (0.118)	0.162 (0.161)	0.210* (0.120)	0.068 (0.098)
Relationship friends	0.174** (0.076)	0.073 (0.069)	0.179*** (0.069)	0.045 (0.068)	-0.025 (0.052)
Job-caregiving	0.073** (0.037)	0.133*** (0.046)	0.133*** (0.040)	0.035 (0.034)	0.093** (0.044)
Financial burden	0.025 (0.077)	0.124 (0.096)	0.238*** (0.083)	0.037 (0.054)	0.111 (0.077)
Type of care					
Household chores	-	-	-	-	-
Administrative tasks	0.030 (0.034)	0.029 (0.039)	0.039 (0.035)	0.007 (0.033)	0.037 (0.034)
Health problems	-0.023 (0.034)	-0.002 (0.033)	-0.003 (0.037)	0.027 (0.026)	-0.004 (0.028)
Personal care	0.040 (0.041)	0.025 (0.049)	-0.038 (0.043)	-0.021 (0.032)	-0.004 (0.029)
Mobility	0.014 (0.043)	0.060 (0.050)	0.025 (0.047)	-0.020 (0.045)	0.013 (0.040)
Moral support	-0.012 (0.072)	-0.058 (0.084)	-0.065 (0.078)	0.016 (0.053)	-0.017 (0.050)
Supervision	-0.042 (0.030)	-0.011 (0.036)	0.031 (0.037)	-0.015 (0.034)	0.010 (0.032)
First-stage for FCH					
PAA recipients	0.021*** (0.006)				
Number of daughters	0.055 (0.283)				
First-stage for IS					
PAA recipients	-0.001 (0.001)				
Number of daughters	0.218*** (0.060)				
AP *F-test* for FCH	13.869***				
AP *F-test* for IS	13.456***				
Exog. tests, *p-value*					
Formal care hours	0.026	0.105	0.642	0.170	0.284
Informal support	0.472	0.122	0.123	0.643	0.122
Global	0.060	0.051	0.288	0.330	0.073
Observations	755				

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons.
Note: regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level (89 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

4.3. Additional tests

Placebo analysis

The identification of the effect of formal support relies on the assumption that the proportion of beneficiaries of the Personal Autonomy Allowance reflects French disparities in access to publicly covered formal care, but has no direct effect on caregivers' health. Thus, this variable should have no impact on the health of caregivers providing care to persons who are too young to be eligible to the PAA (under 60 years of age). I have estimated OLS regressions testing whether the instrument has a direct effect on the health of such caregivers (Table 24). The results underline that the proportion of beneficiaries of the PAA has a small but significant effect on longstanding illnesses or health problems, sleep disorders, anxiety and back problems, which questions the validity of the exclusion restriction in these models. However, most of the effects found in the main analysis relate to health indicators that are not influenced by the proportion of PAA recipients (general health consequences of caregiving, moral fatigue, depression, palpitations), with the exception of sleep disorders. For these health indicators, one can be relatively confident that the exclusion restriction for the instrument of formal support is valid.

Table 24. Direct effect of the proportion of PAA recipients on caregivers' health.

Dependent variables	Effect of the proportion of PAA recipients (OLS)
Self-perceived health (fair, bad, very bad)	-2.74e-4 (4.89e-4)
Longstanding illness or health problem	**-0.001**** (4.94e-4)
Global Activity Limitation Indicator (GALI)	-6.52e-4 (4.74e-4)
Caregiving affects health	4.10e-4 (2.96e-4)
Physical fatigue	-4.75e-4 (4.17e-4)
Sleep disorders	**-0.001*** (4.95e-4)
Moral fatigue	-7.95e-4 (5.69e-4)
Depression	-2.00e-4 (2.55e-4)
Anxiety, stress, overwork	**-0.001*** (0.001)
Back problems	**-0.001***** (3.4e-4)
Palpitations, tachycardia	3.33e-4 (4.75e-4)
Number of observations	165

Source: French Disability and Health Survey, 2008.
Note: Regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Subsample analysis

This subsection tests whether the results change when the analysis is restricted to subsamples. First, in the main sample, a large proportion of non-coresiding caregivers (34%) provide care to dependent elderly persons who receive no formal care. Consequently, it is difficult to assess whether there exist differences according to the number of formal care hours (and not only between caregivers assisted by formal support and the others). To do so, tables 25 and 26 focus on caregivers who help someone who receives formal care (499 observations).

In addition, the sample of non-coresiding caregivers covers very different situations. In order to study a more homogenous group, tables 27 and 28 present the results for children providing care to a parent who has no spouse (382 observations).

Focus on caregivers of dependent elderly persons who receive formal care

Table 25. Effect of social support (FCH>0) – standard indicators.

Dependent variables	Effect of social support on health		Exogeneity tests, *p-value*		
	FCH	IS	FCH	IS	Global
Self-perceived health (fair, bad, very bad)					
OLS	-1.35e-4 (0.001)	-0.001 (0.011)	-	-	-
IV-2SLS	1.16e-4 (0.008)	0.016 (0.052)	0.983	0.740	0.944
Longstanding illness or health problem					
OLS	-0.002 (0.002)	-0.001 (0.014)	-	-	-
IV-2SLS	0.002 (0.011)	-0.039 (0.051)	0.668	0.459	0.740
Global Activity Limitation Indicator (GALI)					
OLS	**-0.003* (0.001)**	-0.007 (0.011)	-	-	-
IV-2SLS	0.004 (0.009)	-0.047 (0.045)	0.360	0.345	0.505
First-stage equation for formal care hours (IV)					
Proportion of PAA recipients	0.042*** (0.015)				
Number of daughters	0.347 (0.430)				
First-stage equation for informal support (IV)					
Proportion of PAA recipients	-0.001 (0.002)				
Number of daughters	0.299*** (0.094)				
AP *F-test* for FCH	8.370***				
AP *F-test* for IS	9.941***				
Number of observations	499				

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons who receive formal care.
Note: regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level (79 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Estimations on the subsample (tables 25 and 26) confirm that an additional hour of formal care decreases the risk that caregiving affects health (by 1.7% as compared to 2% in the total sample) and the probability of sleep disorders (by 1.1% *vs.* 2.2% in the total sample). On the contrary, depression is no longer influenced by formal care. Concerning informal support, the effect of the number of caregivers remains significant for palpitations and tachycardia (-5.4% as compared to -5.8% in the main analysis), but not for moral fatigue. While social support does not influence physical health in the main analysis, formal care reduces the probability of physical fatigue (-1.3%) in the subsample. It also (very) slightly decreases activity limitations.

Table 26. Effect of social support (FCH>0) – health consequences of caring.

Dependent variables	Effect of social support on health		Exogeneity tests, *p-value*		
	FCH	IS	FCH	IS	Global
Caregiving affects health					
OLS	-0.001 (0.001)	-0.002 (0.012)	-	-	-
IV-2SLS	**-0.017** (0.008)**	0.028 (0.045)	0.039	0.364	0.116
Physical fatigue					
OLS	-4.24e-4 (0.002)	-0.006 (0.012)	-	-	-
IV-2SLS	**-0.013** (0.006)**	-0.002 (0.047)	0.073	0.810	0.207
Sleep disorders					
OLS	-0.002* (0.001)	0.009 (0.009)	-	-	-
IV-2SLS	**-0.011* (0.007)**	-0.060 (0.050)	0.241	0.115	0.042
Moral fatigue					
OLS	**-0.003* (0.001)**	-0.003 (0.013)	-	-	-
IV-2SLS	9.07e-5 (0.007)	-0.027 (0.043)	0.685	0.537	0.811
Depression					
OLS	-0.002 (0.001)	-0.003 (0.009)	-	-	-
IV-2SLS	-0.011 (0.007)	-0.014 (0.032)	0.112	0.863	0.190
Anxiety, stress, overwork					
OLS	-0.001 (0.001)	-0.011 (0.016)	-	-	-
IV-2SLS	-0.005 (0.008)	-0.030 (0.052)	0.674	0.760	0.755
Back problems					
OLS	-0.001 (0.002)	-0.012 (0.012)	-	-	-
IV-2SLS	-0.008 (0.008)	0.016 (0.054)	0.492	0.539	0.744
Palpitations, tachycardia					
OLS	-0.001 (0.001)	-0.009 (0.007)	-	-	-
IV-2SLS	0.001 (0.006)	**-0.054** (0.026)**	0.661	0.085	0.160
First-stage equation for formal care hours (IV)					
Proportion of PAA recipients	0.042*** (0.015)				
Number of daughters	0.347 (0.430)				
First-stage equation for informal support (IV)					
Proportion of PAA recipients	-0.001 (0.002)				
Number of daughters	0.299*** (0.094)				
AP *F-test* for FCH	8.370***				
AP *F-test* for IS	9.941***				
Number of observations	499				

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons who receive formal care.
Note: regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level (79 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Focus on children who provide care to a parent who has no spouse

When the analysis is restricted to children providing care to a single parent (tables 27 and 28), the effect of formal care on health becomes insignificant. The number of informal caregivers decreases the probability of moral fatigue (-12.8% as compared to -8.2% in the main analysis) and palpitations (-6.8% *vs.* -5.8% in the main analysis). However, the exogeneity of informal support could not be rejected in the model for palpitations and tachycardia (p=0.146). Similarly, informal support limits the risk of sleep disorders and anxiety in IV models, but the exogeneity test cannot reject the hypothesis of exogeneity (p=0.112 for sleep disorders and p=0.124 for anxiety). These results may be explained by a lack of statistical power due to the smaller number of observations. Alternatively, it is possible that social support alone is not

effective in protecting the health of children, who are probably more involved in caregiving than other non-coresiding caregivers.

Table 27. Effect of social support on child carers – standard indicators.

Dependent variables	Effect of social support on health		Exogeneity tests, *p-value*		
	FCH	IS	FCH	IS	Global
Self-perceived health (fair, bad, very bad)					
OLS	0.002 (0.002)	0.014 (0.013)	-	-	-
IV-2SLS	-0.010 (0.011)	0.036 (0.059)	0.294	0.587	0.548
Longstanding illness or health problem					
OLS	-4.03e-4 (0.002)	-0.011 (0.017)	-	-	-
IV-2SLS	-0.001 (0.014)	-0.044 (0.068)	0.986	0.630	0.886
Global Activity Limitation Indicator (GALI)					
OLS	-0.001 (0.001)	-0.006 (0.014)	-	-	-
IV-2SLS	-0.006 (0.009)	-0.033 (0.047)	0.624	0.628	0.784
First-stage equation for formal care hours (IV)					
Proportion of PAA recipients	0.028*** (0.011)				
Number of daughters	0.543 (0.427)				
First-stage equation for informal support (IV)					
Proportion of PAA recipients	-0.004** (0.002)				
Number of daughters	0.262*** (0.058)				
AP *F-test* for FCH	10.565***				
AP *F-test* for IS	23.407***				
Number of observations	382				

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding children who provide care to a parent who has no spouse.
Note: regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level (79 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Table 28. Effect of social support on child carers – health consequences of caring.

Dependent variables	Effect of social support on health		Exogeneity tests, *p-value*		
	FCH	IS	FCH	IS	Global
Caregiving affects health					
OLS	-2.93e-4 (0.002)	-0.005 (0.011)	-	-	-
IV-2SLS	-0.016 (0.013)	-0.058 (0.039)	0.117	0.338	0.007
Physical fatigue					
OLS	1.11e-4 (0.002)	0.001 (0.014)	-	-	-
IV-2SLS	-0.014 (0.011)	-0.039 (0.043)	0.125	0.490	0.228
Sleep disorders					
OLS	-0.001 (0.001)	0.001 (0.010)	-	-	-
IV-2SLS	-0.009 (0.009)	-0.075* (0.039)	0.387	0.112	0.132
Moral fatigue					
OLS	0.001 (0.002)	-0.002 (0.015)	-	-	-
IV-2SLS	-0.014 (0.013)	**-0.128*** (0.045)**	0.292	0.016	0.012
Depression					
OLS	3.68e-4 (0.002)	-0.006 (0.012)	-	-	-
IV-2SLS	-0.011 (0.008)	-0.009 (0.041)	0.072	0.916	0.186
Anxiety, stress, overwork					
OLS	0.003 (0.002)	-0.024 (0.015)	-	-	-
IV-2SLS	-0.005 (0.011)	-0.125** (0.056)	0.585	0.124	0.185
Back problems					
OLS	-0.002 (0.002)	-0.001 (0.017)	-	-	-
IV-2SLS	-0.004 (0.011)	0.043 (0.029)	0.806	0.424	0.719
Palpitations, tachycardia					
OLS	-1.25e-4 (0.001)	-0.010 (0.009)	-	-	-
IV-2SLS	-0.005 (0.007)	-0.068** (0.034)	0.589	0.146	0.177
First-stage equation for formal care hours (IV)					
Proportion of PAA recipients	0.028*** (0.011)				
Number of daughters	0.543 (0.427)				
First-stage equation for informal support (IV)					
Proportion of PAA recipients	-0.004** (0.002)				
Number of daughters	0.262*** (0.058)				
AP *F-test* for FCH	10.565***				
AP *F-test* for IS	23.407***				
Number of observations	382				

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding children who provide care to a parent who has no spouse.
Note: regressions include all the control variables listed in Table 20.
Standard errors are reported in parentheses and clustered at the departmental level (79 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

5. Discussion

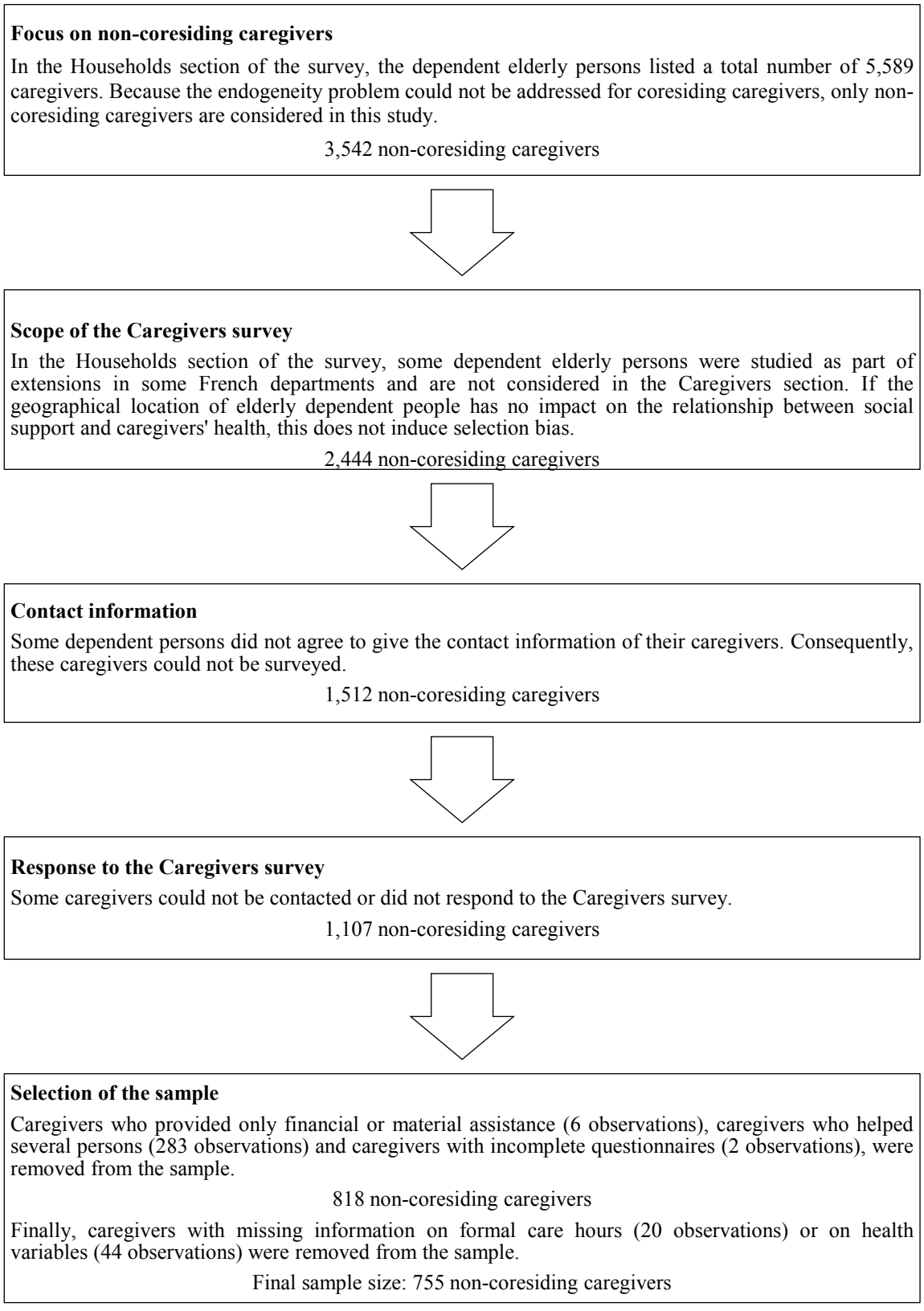
The objective of this work was to estimate the effect of social support (informal support and formal home care) on the health of non-coresiding caregivers, while taking into account endogeneity bias with an instrumental variables approach. Contrary to most of the existing studies, which do not take into account the endogeneity of formal care, IV estimations show that a one-unit increase in formal care hours significantly reduces the probability that caregiving affects health (-2%) and decreases the risk that caregiving leads to sleep disorders (-2.2%) or depression (-1.7%). Regarding informal support, the number of informal caregivers limits the risk that caregivers feel morally tired (-8.2%) and that they have palpitations or tachycardia (-5.8%). By contrast, social support seems to have no effect on physical health.

When the sample is restricted to children who provide care to single parents, most effects become insignificants.
In terms of public policies, improving financial access to formal home care services could protect the health of non-coresiding caregivers. Policies aimed at encouraging informal support and solidarity, not only from family members but also from the social network of dependent elderly people, may also have beneficial health effects.

A limitation of this study is that it focuses on non-coresiding caregivers, which limits the generalizability of the results. Future research could investigate the effect of social support on caregiving spouses and other coresiding caregivers, who are generally highly burdened and at higher risk of health problems. It should also be noted that the measure of mental health in this study is based on specific questions that directly ask caregivers whether informal care has negative health effects. These indicators are interesting in that they capture health variations and focus on how caregivers experience informal care. However, they have not been widely used in the literature, which makes it difficult to compare the present results with existing studies. Thus, it would be interesting to reproduce the analysis with more standard measures of mental health. More generally, further research is needed to fully understand the channels through which social support may affect caregivers' health: is it a direct effect? Is it an indirect effect through other aspects of caregivers' life? Longitudinal data that allow controlling for baseline health characteristics and observing health transitions and changes in care arrangements and caregivers' life would be of particular interest.

Appendix C. Description of the sample selection.

Figure 2. Description of the sample selection of caregivers.



Source: French Disability and Health Survey, 2008-2009.

Appendix D. Effect of formal support on caregivers' health.

Table 29. Effect of formal support on caregivers' health – standard indicators.

Dependent variables	Effect of FCH on health	Exogeneity test, *p-value*
Self-perceived health (fair, bad, very bad)		
OLS	-9.39e-6 (0.001)	-
IV-2SLS	-0.005 (0.010)	0.615
IV-Probit	-0.005 (0.009)	0.601
Longstanding illness or health problem		
OLS	-0.002 (0.001)	-
IV-2SLS	-0.007 (0.013)	0.694
IV-Probit	-0.007 (0.012)	0.693
Global Activity Limitation Indicator (GALI)		
OLS	-0.002 (0.001)	-
IV-2SLS	0.005 (0.011)	0.536
IV-Probit	0.005 (0.011)	0.505
First-stage equation (IV-2SLS)		
Proportion of PAA recipients	0.021*** (0.006)	
First-stage equation (IV-Probit)		
Proportion of PAA recipients	0.021*** (0.005)	
AP *F-test* for FCH (IV-2SLS)	14.187***	
Number of observations	755	

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons.
Note: regressions include all the control variables listed in Table 20. In the IV-2SLS models, the endogeneity test is the difference of two Sargan-Hansen statistics. In the IV-Probit models, the Wald test of exogeneity tests whether error terms in the structural equation and the reduced form equation for the endogenous variable are correlated.
In the IV-Probit models, the figures given correspond to average marginal effects.
Standard errors are reported in parentheses and clustered at the departmental level (89 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

Table 30. Effect of formal support on caregivers' health – health consequences of caring.

Dependent variables	Effect of FCH on health	Exogeneity test, *p-value*
Caregiving affects health		
OLS	-0.001 (0.001)	-
IV-2SLS	**-0.018* (0.009)**	0.031
IV-Probit	**-0.017** (0.007)**	0.010
Physical fatigue		
OLS	9.54e-5 (0.002)	-
IV-2SLS	-0.004 (0.008)	0.651
IV-Probit	-0.004 (0.008)	0.600
Sleep disorders		
OLS	-0.002* (0.001)	-
IV-2SLS	-0.018** (0.009)	0.124
IV-Probit	**-0.017*** (0.006)**	0.018
Moral fatigue		
OLS	**-0.002* (0.001)**	-
IV-2SLS	-0.009 (0.009)	0.525
IV-Probit	-0.008 (0.007)	0.470
Depression		
OLS	-0.001 (0.001)	-
IV-2SLS	**-0.016* (0.008)**	0.031
IV-Probit	**-0.020*** (0.006)**	0.004
Anxiety, stress, overwork		
OLS	-9.92e-5 (0.002)	-
IV-2SLS	0.002 (0.011)	0.870
IV-Probit	0.003 (0.011)	0.810
Back problems		
OLS	-0.001 (0.001)	-
IV-2SLS	-0.009 (0.011)	0.549
IV-Probit	-0.007 (0.011)	0.639
Palpitations, tachycardia		
OLS	-0.001 (0.001)	-
IV-2SLS	-0.007 (0.009)	0.515
IV-Probit	-0.007 (0.010)	0.487
First-stage equation (IV-2SLS)		
Proportion of PAA recipients	0.021*** (0.006)	
First-stage equation (IV-Probit)		
Proportion of PAA recipients	0.021*** (0.005)	
AP *F-test* for FCH (IV-2SLS)	14.187***	
Number of observations	755	

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons.
Note: regressions include all the control variables listed in Table 20. In the IV-2SLS models, the endogeneity test is the difference of two Sargan-Hansen statistics. In the IV-Probit models, the Wald test of exogeneity tests whether error terms in the structural equation and the reduced form equation for the endogenous variable are correlated.
Standard errors are reported in parentheses and clustered at the departmental level (89 clusters).
In the IV-Probit models, the figures given correspond to average marginal effects.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Appendix E. Effects of control variables.

Table 31. Effects of control variables on caregivers' health.

	Self-perceived health (OLS)	Longstanding illness/health problem (OLS)	GALI (OLS)	Caregiving affects health (IV)	Physical fatigue (OLS)	Sleep disorders (IV)	Moral fatigue (OLS)	Depression (IV)	Anxiety, stress, overwork (OLS)	Back problems (OLS)	Palpitations, tachycardia (IV)
Care arrangements											
Frequency of care											
- Daily	0.068	0.003	-0.018	-0.023	**0.084***	-0.055	**0.098****	-0.023	**0.103***	**0.120*****	-0.012
	(0.051)	(0.061)	(0.051)	(0.092)	(0.042)	(0.078)	(0.046)	(0.072)	(0.057)	(0.044)	(0.051)
- Weekly	0.028	0.016	-0.048	-0.080	-0.014	-0.044	0.022	-0.048	**0.096****	0.069	0.023
	(0.050)	(0.062)	(0.044)	(0.064)	(0.036)	(0.061)	(0.043)	(0.046)	(0.046)	(0.047)	(0.041)
- Less often	-	-	-	-	-	-	-	-	-	-	-
Relationship											
- Daughter	-	-	-	-	-	-	-	-	-	-	-
- Son	-0.001	-0.029	-0.125	0.043	-0.035	0.035	0.003	0.007	0.057	-0.086	0.076
	(0.079)	(0.089)	(0.075)	(0.086)	(0.043)	(0.086)	(0.055)	(0.064)	(0.070)	(0.069)	(0.061)
- Friend/neighbor	-0.086	**-0.150***	**-0.170*****	**-0.129****	**-0.181*****	**-0.162****	**-0.167*****	**-0.105****	**-0.141****	-0.109	0.018
	(0.079)	(0.084)	(0.063)	(0.055)	(0.049)	(0.066)	(0.060)	(0.045)	(0.064)	(0.075)	(0.050)
- Child-in-law	0.028	0.072	0.018	-0.088	**-0.120***	**-0.136****	-0.102	**-0.122****	**-0.124***	-0.109	-0.040
	(0.080)	(0.080)	(0.072)	(0.072)	(0.065)	(0.065)	(0.070)	(0.052)	(0.072)	(0.073)	(0.041)
- Sibling	-0.101	0.018	0.096	-0.043	-0.009	0.001	-0.098	-0.085	-0.025	**-0.134***	-0.054
	(0.101)	(0.092)	(0.102)	(0.084)	(0.080)	(0.095)	(0.089)	(0.065)	(0.098)	(0.081)	(0.061)
- Grandchild	-0.050	0.025	**-0.135****	**-0.186*****	-0.105	-0.103	**-0.180****	-0.085	-0.043	**-0.141***	-0.033
	(0.086)	(0.063)	(0.064)	(0.072)	(0.082)	(0.082)	(0.074)	(0.068)	(0.085)	(0.084)	(0.049)
Demographic, socioeconomic controls											
Age											
- Less than 50	-	-	-	-	-	-	-	-	-	-	-
- 50-60	0.017	0.067	0.044	-0.047	-0.020	-0.026	-0.024	0.005	-0.031	-0.058	-0.041
	(0.037)	(0.048)	(0.042)	(0.050)	(0.037)	(0.042)	(0.034)	(0.033)	(0.042)	(0.046)	(0.031)
- 60-70	-0.010	**0.138****	-0.063	-0.014	-0.015	-0.017	-0.044	0.016	-0.048	-0.047	-0.018
	(0.052)	(0.063)	(0.052)	(0.056)	(0.052)	(0.053)	(0.044)	(0.043)	(0.057)	(0.061)	(0.050)
- 70 and older	**0.198****	0.131	0.029	0.106	0.016	0.090	0.015	0.064	0.003	-0.019	0.097
	(0.085)	(0.090)	(0.085)	(0.083)	(0.068)	(0.076)	(0.069)	(0.068)	(0.073)	(0.080)	(0.070)
Female	0.060	-0.057	**-0.103***	**0.087***	**0.123*****	**0.138*****	**0.181*****	**0.077***	**0.185*****	0.058	0.070
	(0.060)	(0.068)	(0.059)	(0.052)	(0.036)	(0.052)	(0.043)	(0.042)	(0.056)	(0.054)	(0.046)
Education level											
- Low	-	-	-	-	-	-	-	-	-	-	-
- Medium	**-0.094***	-0.034	-0.036	0.036	0.007	0.004	0.021	**0.058***	0.034	0.005	0.005
	(0.049)	(0.054)	(0.042)	(0.034)	(0.034)	(0.043)	(0.036)	(0.031)	(0.037)	(0.041)	(0.034)

- High	**-0.095***	-0.075	-0.055	**0.133*****	0.016	0.068	0.075	0.072	0.066	-0.031	0.030
	(0.053)	(0.056)	(0.053)	(0.049)	(0.041)	(0.070)	(0.046)	(0.044)	(0.045)	(0.047)	(0.050)
Work	**-0.096****	**-0.133*****	**-0.110*****	0.019	**0.090****	-0.011	-0.032	-0.016	-0.006	0.059	-0.033
	(0.039)	(0.048)	(0.040)	(0.032)	(0.037)	(0.043)	(0.035)	(0.028)	(0.040)	(0.043)	(0.032)
Monthly household income											
- Less than 1200 EUR	-	-	-	-	-	-	-	-	-	-	-
- 1200-1800 EUR	-0.084	-0.015	-0.078	0.035	-0.054	-0.062	-0.064	-0.040	0.006	-0.004	0.003
	(0.059)	(0.060)	(0.057)	(0.050)	(0.056)	(0.072)	(0.056)	(0.051)	(0.053)	(0.054)	(0.039)
- 1800-2500 EUR	-0.102	-0.045	-0.050	-0.008	**-0.124***	-0.036	**-0.123****	-0.034	-0.076	-0.075	0.016
	(0.066)	(0.074)	(0.053)	(0.059)	(0.067)	(0.079)	(0.055)	(0.063)	(0.063)	(0.062)	(0.054)
- 2500-4000 EUR	**-0.202*****	-0.049	**-0.129****	-0.084	-0.064	**-0.180****	**-0.127****	**-0.156****	-0.103	-0.095	**-0.103***
	(0.063)	(0.067)	(0.060)	(0.060)	(0.059)	(0.075)	(0.053)	(0.065)	(0.064)	(0.065)	(0.059)
- More than 4000 EUR	**-0.290*****	**-0.193****	**-0.210*****	-0.097	**-0.168****	-0.134	**-0.144****	**-0.125***	**-0.164****	**-0.215*****	-0.081
	(0.075)	(0.074)	(0.074)	(0.084)	(0.069)	(0.104)	(0.062)	(0.068)	(0.074)	(0.066)	(0.056)
Family controls											
Living with a partner	**0.095***	**0.118****	-0.022	0.028	0.013	0.084	0.076	0.065	0.006	-0.041	0.067
	(0.051)	(0.056)	(0.051)	(0.050)	(0.050)	(0.061)	(0.051)	(0.049)	(0.059)	(0.046)	(0.044)
Having at least one child	**0.072***	0.040	0.036	-0.015	-0.060	0.067	-0.006	0.055	**0.085***	0.084	**0.091****
	(0.038)	(0.049)	(0.049)	(0.045)	(0.044)	(0.050)	(0.042)	(0.039)	(0.044)	(0.058)	(0.037)
Dependent elderly											
Number of ADLs	**0.019***	0.021	**0.031*****	**0.046****	0.020	**0.045****	**0.026***	**0.042****	0.010	**0.030****	**0.029***
	(0.011)	(0.014)	(0.011)	(0.022)	(0.013)	(0.021)	(0.014)	(0.017)	(0.014)	(0.012)	(0.017)
Number of IADLs	-0.008	-0.011	-0.008	**0.045***	0.005	**0.060****	0.012	0.027	0.010	-0.002	0.022
	(0.007)	(0.010)	(0.007)	(0.024)	(0.008)	(0.025)	(0.009)	(0.019)	(0.009)	(0.007)	(0.016)
Cognitive limitations	-0.011	0.014	**-0.084****	0.058	0.025	-0.001	**0.066***	0.041	0.024	0.008	0.005
	(0.036)	(0.042)	(0.036)	(0.044)	(0.036)	(0.040)	(0.038)	(0.034)	(0.043)	(0.038)	(0.027)
Living with a partner	-0.036	**-0.083***	-0.032	**-0.077***	-0.060	**-0.076***	**-0.072***	**-0.106****	0.017	-0.055	-0.016
	(0.050)	(0.046)	(0.044)	(0.047)	(0.039)	(0.044)	(0.042)	(0.044)	(0.047)	(0.041)	(0.038)
Monthly income											
- Less than 1000 EUR	-	-	-	-	-	-	-	-	-	-	-
- 1000/1500 EUR	-0.054	0.018	-0.007	0.034	0.040	0.063	0.041	0.052	0.038	**0.084***	0.013
	(0.039)	(0.046)	(0.038)	(0.051)	(0.038)	(0.057)	(0.037)	(0.036)	(0.045)	(0.048)	(0.032)
- 1500/2000 EUR	-0.051	0.018	-0.023	0.047	0.030	**0.158****	0.100	0.053	0.048	0.039	**0.088****
	(0.050)	(0.066)	(0.048)	(0.066)	(0.043)	(0.069)	(0.064)	(0.054)	(0.043)	(0.053)	(0.040)
- More than 2000 EUR	0.068	**0.141***	0.037	0.121	0.092	**0.197****	**0.187*****	**0.121***	**0.124****	**0.156*****	**0.106****
	(0.048)	(0.073)	(0.055)	(0.090)	(0.058)	(0.093)	(0.052)	(0.067)	(0.061)	(0.057)	(0.054)
Nursing home beds	4.96e-4	0.001	5.00e-4	-0.001	-6.26e-4	2.39e-4	0.001	3.59e-4	0.001	4.54e-4	1.11e-4
	(5.58e-4)	(0.001)	(5.36e-4)	(0.001)	(4.85e-4)	(8.46e-4)	(0.001)	(7.37e-4)	(0.001)	(6.29e-4)	(0.001)
Number of observations	755										

Source: French Disability and Health Survey, 2008-2009.
Field: non-coresiding informal caregivers of dependent elderly persons.
Standard errors are reported in parentheses and clustered at the departmental level (89 clusters).
*: significant at the 10% level, **: 5% level, ***: 1% level.

CHAPTER 3
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FINANCING LONG-TERM CARE THROUGH HOUSING IN EUROPE

This chapter is co-written with Carole Bonnet (Ined) and Anne Laferrère (Insee, Crest, and University Paris-Dauphine).

1. Introduction

Population projections indicate that, if care arrangements are kept constant, public expenditure on long-term care (LTC) will increase from 1.6% of GDP in 2013 to 2.8% in 2060[38] in the European Union (European Commission, 2015). Maintaining the financial and fiscal sustainability of LTC systems constitutes a major challenge in a context of population aging and the elderly will probably need to consider, at least to some extent, private financing arrangements for LTC expenses. At first sight, the ability of individuals to pay for their periods of disability appears to be low without any public LTC coverage. Indeed, the cost of LTC (between 23,000 and 52,000 euros per year according to our estimates, see Subsection 4.3) is generally much higher than the incomes[39] of older people. In OECD countries, in 2012-13, people aged 75 and over had incomes that were on average 20% lower than those of the total population (OECD, 2015). In the European Union, in 2013, 14% of the total population aged 65 and over were at risk of poverty (*i.e.* had incomes below 60% of the national median income). This situation is unlikely to improve given that the public pension replacement rate is projected to decrease by 12 percentage points between 2013 and 2060 (European Commission, 2015). In a recent work, Hussem et al. (2016) simulate the lifetime costs of LTC for Dutch elderly aged 65 and over. They find that, if the elderly had to pay for LTC up to a limit of 100% of their income, less than half of the costs could be covered by private income on a yearly basis and 64% if dependent individuals are able to smooth the costs over their remaining lifetime.

In addition, as emphasized in the general introduction, the private LTC insurance market, that could help financing LTC, is generally small. One reason for the low demand of private insurance is that individuals may use their housing wealth to finance the risk of LTC expenditures. Davidoff (2010, 2009) shows theoretically that home equity, which can be liquidated in the event of LTC needs, may substitute for LTC insurance. Interestingly, Fontaine et al. (2014) find on French data that the probability of purchasing LTC insurance is 4 to 7 percentage points lower (at the 10% level) for homeowners living in a house worth over 300,000 euros than for non-owners. Costa-Font and Rovira-Forns (2008) estimate the willingness to pay for hypothetical LTC insurance in Catalonia (Spain) and find that housing tenure reduces the probability of insurance coverage demand. These results suggest that

[38] If a shift from informal to formal care is assumed, public long-term care expenditure could reach 3.6% of GDP in 2060.

[39] Incomes from employment, self-employment, capital and public transfers, net of taxes and contributions.

homeownership may provide "self-insurance" for LTC (for a more detailed discussion on this topic, see Laferrère, 2012).

Thus, investigating the role of homeownership in LTC financing seems important, particularly because housing dominates the structure of elderly wealth. In the 5th wave of SHARE (*Survey of Health Aging and Retirement in Europe,* 2013), in the 9 countries studied in this paper (Austria, Germany, Sweden, the Netherlands, Spain, Italy, France, Denmark and Belgium), 71% of individuals had a strictly positive home equity (market value of the house less remaining mortgage payments). Among these individuals, the median home equity was on average 13 times higher than the median annual income and 20 times higher than the median financial wealth (authors' computations).

The general objective of this research is to investigate to what extent European elderly are able to pay for their periods of long-term care needs, on the basis of their income, financial assets and home equity. To do so, we adopt a life-cycle approach and assume that individuals take out reverse mortgages (RM, see Subsection 2.3) when they become dependent, in order to convert their home equity into cash. This will allow studying in details to what extent home ownership may be used to finance LTC expenditures. Our contribution to the literature is threefold. First, using the longitudinal dimension of SHARE, we estimate a disability transition model for 9 European countries, taking into account the effect of income and education on disability. Second, we simulate the disability trajectories of individuals who are 65 and older in 2013. It allows studying the expected lifetime risk of needing LTC in this population. To our knowledge, there are no other studies that estimate the lifetime risk of disability in several European countries, controlling for the effect of the socioeconomic status. Finally, we focus on individuals who have no partner when they become dependent and study their ability to pay for their LTC needs, assuming that there is no public coverage and no informal care. We assess the role of housing in LTC financing by simulating the lump-sum payments that could be extracted from RMs when individuals become dependent. Since we simulate disability trajectories at the microeconomic level, we are able to study the dispersion in the ability to pay for LTC across individuals.

The article is organized as follows: Section 2 presents the different means to extract home equity and offers a summary of the existing literature on the relationship between housing and LTC financing; Section 3 presents the data and variables used; Section 4 describes the

methodology and the assumptions of the paper; Section 5 provides the results of the simulations (LTC risk and ability to pay), sensitivity tests and alternative scenarios (introduction of informal care and public LTC coverage). Finally, the last section is devoted to discussion and the conclusion.

2. Aging and housing

2.1. Downsizing

Housing wealth is a particular asset. It is both a consumption and an investment good, illiquid and indivisible. This section reviews the different means to unlock home equity and describes the dynamics of housing in old age. First, homeowners can downsize/reduce their housing equity by selling their house and moving to a less expensive home (as owners or tenants). However, the literature suggests that, contrary to the predictions of the life-cycle model, housing equity is typically not reduced to support consumption at old age. (Venti and Wise, 2001, 2000, 1991) show that, in the US, most elderly homeowners are unlikely to move. Moreover, the movers generally do not reduce home equity, except *house-rich* and *cash-poor* families. However, when precipitating shocks occur, households are more likely to liquidate housing wealth. 10% of households discontinue home ownership when a spouse dies and 35% when a spouse enters a nursing home. Recent studies on European data confirm that residential mobility of the elderly is low (about 2% per year for households aged 50+) and mainly driven by shocks on health or household composition (Angelini et al., 2014; Angelini and Laferrère, 2012; Bonnet et al., 2010). Older (65+) and low-income households seem to be more likely to reduce housing consumption. Interestingly, elderly homeowners in poor health are more likely to move (Angelini et al., 2014) and, conditional on moving, to choose smaller dwellings (Angelini and Laferrère, 2012). It suggests that they anticipate the risk of disability.

A disadvantage of downsizing is that the elderly have to sell their home, which may be detrimental to their well-being. Indeed, it is widely acknowledged that most people would prefer to *"age in place"* (despite the lack of uniform and comparable data). In Spain, 78% of the elderly aged 55+ would prefer to stay in their home in case of old age dependency rather than living in a nursing home (16%) or in a relative's home (6%) (Costa-Font et al., 2009). In France, 90% of surveyed individuals would prefer to adapt their home in order to age in place, rather than moving to a nursing home (Opinion Way, 2012). In the US, 87% of people aged 65+ want to stay in their home and community as they age (AARP, 2014).

2.2. Home reversions

Equity release schemes enable homeowners to liquidate all or part of their housing equity, while continuing to live in their home. There are two types of Equity release schemes, home reversions and reverse mortgages. Home reversions are sale arrangements, mainly available in France ("sales *en viager*") and in the UK. The homeowner sells all (in the French case) or part of the house and receives an annuity, a lump-sum payment or a combination of the two. She retains the right to stay in the home but the house property is transferred to the buyer (an individual in France, a home reversion company in the UK). However, this type of sale arrangement is rarely used (see Masson, 2015 and Laferrère, 2012 for some reasons of this lack of success in France). In Europe, the estimated number of home reversion contracts represents one third of the Equity release schemes market (Reifner et al., 2009). In the UK, in 2014, less than 1% of equity release customers took out home reversions (Equity Release Council, market report spring 2015). In France, the number of sales *en viager* is low (less than 4,000 per year) and is declining (Jachiet et al., 2004).

2.3. Reverse mortgages

In this research, we focus on reverse mortgages (called *"lifetime mortgages"* in the UK). RMs are credit operations which, contrary to home reversions, do not imply any transfer of ownership. Elderly homeowners (62+ for the US Home Equity Conversion Mortgages, 55+ for the UK Aviva lifetime mortgages, 65+ in France) borrow against all or part of the value of their homes. RMs do not require medical or income tests and thus are accessible to poor health and low income individuals (they must only have the financial resources to continue paying property taxes and insurance). The borrower (or borrowers in the case of a couple) receives an annuity, a lump-sum payment or some combination of the two. The older[40] she is, the sooner she will repay the loan and the higher are the payments (see Subsection 4.4 for further details). The borrower does not need to make any repayments as long as she continues to live in the home. It implies that, contrary to traditional mortgages, interests are added to the loan balance and the debt grows over time. When the (last) borrower dies, sells the house or permanently moves out, the RM is closed and the loan is repaid. The children can reimburse the credit to the lender and keep the house. Alternatively, heirs can choose to sell it and, if the sale price is higher than the debt, they will keep the difference. The longevity risk and the risk on housing prices are transferred to the lender. Indeed, the borrower's liability is limited to the value of the property at the end of the contract (no negative equity guarantee). If the loan

[40] In the case of a couple, it is the age of the younger partner that is used to determine reverse mortgage payments.

value exceeds the sale price of the home, the lender is not allowed to seize other assets (non-recourse loan). It is worth noting that, while a private LTC insurance has to be purchased relatively early (before the disability occurs), RMs can be purchased at very old age, regardless of the health status. Thus, RMs do not require anticipating the risk of LTC expenditures.

RM products, which have existed for many years in the US and the UK, have been gaining increasing attention in Europe in recent years. Overall, the RM market is small, even in the US. But it seems to be increasing due to the development of housing, innovation and deregulation in the financial markets (OECD, 2014) and the aging of baby boomers. In the US, in 2010, only 2 to 3 percent of eligible homeowners had a RM (Consumer Financial Protection Bureau, 2012). With a market share of more than 90%, the Home Equity Conversion Mortgage (HECM), insured by the Federal Housing Administration, dominates the US RM market (Shan, 2011). The number of new HECM loans increased from less than 7,000 in 2000 to more than 110,000 in 2009. After the subprime mortgage crisis, it decreased to about 55,000 in 2012. In Europe, the RM market represented 3.31 billion euros in 2007 – less than 0.1% of the ordinary mortgage market.

The effect of RM on the economic well-being of the elderly seems to be mainly restricted to the oldest age-groups and is higher for single individuals than for couples (Hancook, 1998 on UK data; Sinai and Souleles, 2007; Venti and Wise, 1991 on US data). According to Venti and Wise (1991), reverse annuity mortgage payments would increase by 35% the income of low-income couples aged 85 and over and would double the income of low-income single homeowners. Ong (2008) finds a bigger effect in Australia (+71% on average for homeowners aged 65+). In Europe, reverse annuity mortgages could reduce income vulnerability among homeowners aged 65 and over. If homeowners convert 100% of their housing wealth at a 7% interest rate, it would decrease income vulnerability by 23 percentage points in Spain, 18 p.p. in Belgium, 13 p.p. in Italy and 11 p.p. in France. The effect is smaller in Sweden, Austria and the Netherlands (less than 4 p.p.) (Moscarola et al., 2015 using SHARE data).

2.4. Housing and LTC financing

Little has been done so far on the relationship between housing and the LTC financing. Masson (2015) suggests that a specific reverse mortgage product for dependent individuals (*"prêt viager dépendance"*) may help finance LTC costs and support *"aging in place"* in France (see also Stucki, 2005 for a discussion in the US context). He explains that dependent

individuals could provide a medical certificate to the bank and, since they have a shorter life expectancy, obtain a more attractive interest rate. It is interesting to note that it is already the case in the UK (Aviva lifetime mortgage, the market leader) where individuals have the possibility to borrow a higher amount if they have certain medical conditions or lifestyle factors affecting their health. In addition, Masson (2015) stresses that the decision to liquidate part or all of the home equity – and, thus, to reduce inheritance – would be made with the family's agreement. Thus, RMs could be used to finance formal home care, which would reduce the burden associated with informal caregiving[41]. A limiting factor may be that, with current RM products, the borrower generally needs to repay the loan if she moves permanently to a nursing home (for more than 12 months in the US).

Existing empirical studies confirm that home equity can significantly improve the ability of dependent individuals to pay for their LTC needs. Stucki (2006) shows on US data that homeowners who have restrictions in basic activities of daily living have, on average, important amounts of home equity (median value: $75,000). If they take out RM, they will get a lump-sum payment of about $30,000 to $49,000. However, the author stresses that home equity will generally not be sufficient to pay the total cost of LTC. Mayhew et al. (2010) study whether households aged 65+ in the UK are able to pay for 1, 2 or 3 years of LTC. They find that 400,000 households out of 6.5 million can finance more than one year of LTC with their incomes. It increases to 3 million if savings are included and to 4.6 million if housing assets are added. Out of these 4.6 million households, 4.2 million can afford care for more than three years. These studies are cross-sectional and do not allow assessing the lifetime cost of LTC. They also do not take into account potential differences in the risk of disability according to the socioeconomic status. If low income and poorly educated individuals are more likely to face periods of LTC needs, it has important implications in terms of social inequalities and public policies.

Interestingly, homeownership and housing equity seem to decrease the risk of disability, LTC expenditures and institutionalization (Bockarjova et al., 2014; Costa-Font, 2008; Rouwendal and Thomese, 2013). Thus, RM products may not be adequate for those with the higher needs.

41 See, Lilly et al. (2007) for a literature review on the consequences of informal care on the labor market. For the effect of informal care on caregiver's health, see Bobinac et al. (2010), Coe and Van Houtven (2009), Di Novi et al. (2015), Do et al. (2015), Oshio (2014), Schmitz and Westphal (2015) and Van den Berg et al. (2014).

3. Data

This paper uses data from SHARE Waves 1, 2, 3 (SHARELIFE), 4 and 5[42]. SHARE (*Survey of Health Aging and Retirement in Europe*) is a longitudinal and multidisciplinary database of micro-data on health, socioeconomic status and social and family networks. It provides information on individuals aged 50 and older in 20 European countries, interviewed every two years. Partners/spouses of target persons are also eligible for a SHARE interview, regardless of age. These data are of particular interest because they provide both information on limitations with instrumental and basic activities of daily living, which allow measuring the risk of needing long-term care (LTC), and precise information on income, financial and housing assets. In addition, the survey follows individuals when they enter a nursing home. When they die, an end-of-life interview is conducted with relatives, friends or neighbors.

We focus on individuals aged 65 and over in the 5th wave (2013) in 9 countries: Austria, Germany, Sweden, the Netherlands, Spain, Italy, France, Denmark, and Belgium (23,769 observations). We chose these countries because they have been surveyed since the first wave of SHARE and are characterized by different types of welfare state. Table 32 provides some descriptive statistics. The sample is characterized by a majority of women (57%), individuals in couples (64%), who have children (88%) and an average age of 75. We also use the longitudinal dimension of the survey (wave 1: 2004/05, wave 2: 2006/07, wave 3: 2008/09, wave 4: 2011/12 and wave 5: 2013) to estimate disability trajectories of individuals (Subsection 4.1).

Finally, we use life tables from the Human Mortality Database, which provide information on the probability of death and life expectancy in the general population by age and sex in each country, to adjust our mortality estimations and to simulate reverse mortgages (Subsection 4.4). We use the most recent information available: data for year 2009 for Italy; 2011 for Germany, Sweden and Denmark; 2012 for the Netherlands, Spain and Belgium; 2013 for France and 2014 for Austria.

[42] DOIs: 10.6103/SHARE.w1.260, 10.6103/SHARE.w2.260, 10.6103/SHARE.w3.100, 10.6103/SHARE.w4.111, 10.6103/SHARE.w5.100. See Borsch-Supan et al. (2013) for methodological details.

Table 32. Descriptive statistics on European elderly.

Mean (standard deviation) *Median*	Total	Austria	Germany	Sweden	Netherlands	Spain	Italy	France	Denmark	Belgium
Age	75.152	74.874	75.125	74.356	74.211	75.650	74.982	75.519	73.904	75.229
	(7.351)	(7.285)	(6.872)	(7.310)	(7.431)	(7.634)	(7.365)	(7.713)	(7.263)	(7.505)
Female	0.572	0.577	0.562	0.553	0.544	0.579	0.573	0.590	0.540	0.572
	(0.495)	(0.494)	(0.496)	(0.497)	(0.498)	(0.494)	(0.495)	(0.492)	(0.499)	(0.495)
Couple	0.639	0.568	0.676	0.683	0.660	0.605	0.643	0.595	0.682	0.655
	(0.480)	(0.495)	(0.468)	(0.465)	(0.474)	(0.489)	(0.479)	(0.491)	(0.466)	(0.475)
At least one child	0.884	0.880	0.883	0.925	0.911	0.888	0.863	0.888	0.924	0.888
	(0.321)	(0.325)	(0.322)	(0.264)	(0.285)	(0.315)	(0.344)	(0.316)	(0.265)	(0.316)
Education level										
- Pre-primary/primary	0.369	0.179	0.025	0.323	0.173	0.741	0.601	0.454	0.195	0.261
	(0.483)	(0.383)	(0.156)	(0.468)	(0.378)	(0.438)	(0.490)	(0.498)	(0.397)	(0.439)
- Secondary/post-secondary	0.459	0.582	0.713	0.418	0.607	0.194	0.353	0.350	0.474	0.470
	(0.498)	(0.493)	(0.452)	(0.493)	(0.489)	(0.396)	(0.478)	(0.477)	(0.499)	(0.499)
- Tertiary	0.172	0.239	0.262	0.259	0.220	0.065	0.046	0.196	0.331	0.269
	(0.377)	(0.426)	(0.440)	(0.438)	(0.415)	(0.247)	(0.210)	(0.397)	(0.471)	(0.443)
Disability status										
2+ ADLs (dependent)	0.101	0.090	0.098	0.043	0.051	0.137	0.119	0.082	0.060	0.118
	(0.301)	(0.286)	(0.297)	(0.203)	(0.221)	(0.344)	(0.323)	(0.275)	(0.238)	(0.323)
Resources (in euros)										
Equivalised annual household income	19,996	20,789	20,860	32,293	25,009	10,124	12,249	27,725	25,083	37,990
	(59,875)	(14,101)	(15,348)	(18,962)	(28,027)	(8,062)	(15,849)	(128,814)	(14,680)	(49,669)
	15,082	*18,251*	*17,430*	*27,688*	*20,118*	*8,468*	*10,323*	*19,110*	*21,106*	*20,714*
Value of household net financial assets	44,548	22,642	35,471	94,539	109,887	12,042	14,090	80,310	113,627	89,359
	(139,807)	(54,332)	(77,780)	(138,870)	(266,438)	(25,811)	(32,111)	(236,479)	(187,053)	(145,582)
	9,000	*6,223*	*11,500*	*46,141*	*24,000*	*2,584*	*2,881*	*17,300*	*40,225*	*35,000*
Owners (main residence)	0.724	0.490	0.582	0.527	0.589	0.921	0.817	0.779	0.672	0.742
	(0.447)	(0.500)	(0.493)	(0.499)	(0.492)	(0.270)	(0.387)	(0.415)	(0.470)	(0.438)
Net value of main residence (if owner, >0)	241,220	284,247	224,262	236,796	242,856	217,023	231,813	282,178	212,944	286,789
	(246,635)	(234,070)	(165,752)	(220,864)	(140,998)	(452,308)	(152,047)	(191,418)	(170,049)	(129,309)
	200,000	*200,000*	*195,000*	*173,028*	*215,000*	*120,000*	*200,000*	*240,000*	*160,901*	*250,000*
Own other real estate or land	0.179	0.131	0.121	0.307	0.063	0.223	0.171	0.245	0.226	0.193
	(0.383)	(0.338)	(0.327)	(0.461)	(0.243)	(0.416)	(0.377)	(0.430)	(0.418)	(0.395)
Value of other real estate/land (if other real estate)	237,511	246,054	302,679	224,919	216,820	245,300	201,016	219,711	203,710	243,449
	(365,749)	(297,720)	(406,699)	(258,169)	(228,787)	(672,413)	(161,563)	(159,876)	(183,796)	(211,429)
	150,000	*150,000*	*140,000*	*115,352*	*150,000*	*110,000*	*150,000*	*199,537*	*134,084*	*200,000*
Number of observations	23,769	2,417	2,624	2,907	2,206	3,717	2,700	2,435	1,986	2,777

Source: SHARE data, wave 5.
Individuals aged 65 and over.
The statistics are weighted using calibrated individual weights.

3.1. Disability status

Dependent persons in wave 5 are identified using restrictions in basic activities of daily living (ADLs). We consider 6 ADLs (dressing, walking across a room, bathing or showering, eating, getting in/out of bed and using the toilet)[43] and assume that those who report difficulties with at least 2 of these activities are in need of LTC. A cutoff of 2 ADL difficulties rather than only one is chosen because the data provide no information on the degree of difficulties and we do not want a too broad definition of disability[44]. In addition, in the US, the individuals must need substantial assistance in performing at least 2 ADLs to trigger Medicaid and private long-term care insurance benefits (Brown and Finkelstein, 2007). Table 32 above shows that, on average, 10% of the 65+ were dependent in 2013. The proportion was higher in Southern Europe (14% in Spain and 12% in Italy) than in Northern Europe (4% in Sweden, 5% in the Netherlands and 6% in Denmark).

3.2. Income and assets

In order to study whether individuals are able to pay for their long-term care expenses, we need information on incomes, financial and housing assets. Monetary variables have a non-negligible number of missing values, thus we use SHARE imputations[45] to maintain the sample size. The annual household income (net of taxes and contributions) is the sum of all individual components. Our measure of income includes earnings from employment and self-employment, public and occupational old age pensions, early-retirement, survivor pensions, public war pensions, public and occupational disability insurances, public unemployment benefits, regular life insurance payments, private annuity or private pension payments, long-term care payments from private insurance companies, housing allowances, child and other benefits, poverty relief programs, alimonies and regular payments from charities. In this paper, we consider that there is no public LTC coverage (except in Subsection 5.5.), thus we remove public LTC insurance payments from income[46]. Finally, we compute an equivalised household income by dividing the total income by the weighted number of household

[43] The question is the following: *"Please tell me if you have any difficulty with these [activities] because of a physical, mental, emotional or memory problem. Again exclude any difficulties you expect to last less than three months"*.

[44] The reader should nevertheless keep in mind that the definition of dependence used in this paper probably covers very different situations. For illustration purpose, in the French Disability and Health Survey (*Enquête Handicap Santé*, 2008), individuals with 2+ ADL limitations report only moderate difficulties in 19% of the cases, at least one important difficulty in 26% of the cases and cannot do alone at least one basic activity of daily living in 55% of the cases (authors' computation).

[45] Fully conditional specification method, see Van Buuren et al. (2006).

[46] Only 271 individuals reported public LTC insurance payments.

members (OECD modified scale[47]). This measure facilitates the comparison of living standards between households of different size and is less likely to change over time.

We also use information on household financial assets net of financial liabilities. It includes bank/transaction/saving/postal accounts, government and corporate bonds, stocks, shares, mutual funds, individual retirement accounts, contractual savings for housing and the face value of whole-life insurance policies.

Finally, we take into account the value of housing assets. When an individual owns her main residence, she is asked the following question: *"In your opinion, how much would you receive if you sold your property today?"*[48]. We adjust this amount for the percentage owned by the respondent and her spouse (100% in 80% of the cases) and mortgages on the main residence (see Eq.3). Around 10% of owners aged 65+ have to pay a mortgage and the average value is 58,000 euros. The net home value (or home equity), H, is the key variable used to simulate the equity that could be released through RMs when individuals become dependent (Subsection 4.4). We also take into account the ownership of other real estate (secondary homes, holiday homes, land or forestry) that can be sold to finance long-term care needs.

$$H = \%\ owned \times home\ value - value\ of\ mortgages \qquad \text{(Eq.3)}$$

It should be noted that homeowners overestimate the value of their homes. Venti and Wise (2001) focus on recent movers and compare sales prices to the respondents' assessments of home value two years earlier on US data (1992-1998). They find that the home value was overestimated by 15 to 20% based on a comparison of means and by 6 to 7% based on medians. This is confirmed by Benítez-Silva et al. (2015) who account for measurement errors and selectivity and show that the overestimation bias is about 8% on average (1994-2002 period). In the Netherlands, the comparison of actual housing prices data with perceived home values on the 2003-2012 period suggests that the median homeowner overestimates house prices by 13% (Van der Cruijsen et al., 2014). Subsection 5.4 considers different home values and studies to what extent it changes the results.

[47] This equivalence scale assigns a weight of 1 to the household head, of 0.5 to each additional household member and of 0.3 to each child under 14. Given that we study individuals who are 65 and older, we assume that households are composed solely of adults.

[48] We do not take into account members of housing cooperatives, which are a particular type of housing tenure (it concerns 790 individuals in the sample, 753 of which live in Sweden or Denmark). Co-ops are currently not eligible for the US Home Equity Conversion Mortgage Program.

Incomes and assets differ widely across Europe (Table 32). The equivalised household annual income ranges between 10,000 euros in Spain and 38,000 euros in Belgium; the value of the net financial assets varies from 12,000 euros in Spain to 114,000 euros in Denmark and the proportion of homeowners goes from 49% in Austria to 92% in Spain. Among homeowners, the net home value is on average 241,000 euros. It seems that reverse mortgages may help pay for long-term care in Spain and Italy, where incomes and financial wealth are low whereas homeownership rates are particularly high. In contrast, reverse mortgages will probably be less attractive in Sweden and the Netherlands where individuals have high incomes and financial assets and are less often owners.

4. Methodology

Our strategy to investigate the role of income, financial assets and housing wealth in financing long-term care expenses consists in five steps. First, using the longitudinal dimension of SHARE, we estimate a disability transition model (4.1). Second, we use this model to simulate disability trajectories of individuals who are 65 and older in wave 5 of SHARE (2013) (4.2). Third, the annual cost of LTC is approached (4.3). The combination of steps 2 and 3 allows describing the expected lifetime cost of long-term care for people aged 65 and over. In step 4, we simulate the lump-sum payments that could be extracted from reverse mortgages when individuals become dependent (4.4). This finally allows computing the proportion of individuals in each country who are able to pay for their expected LTC needs (4.5).

4.1. Transition model

Dependent individuals in 2013 are identified by restrictions in basic activities of daily living, but we have no information on the risk of needing LTC over the remaining lifetime and on the number of years with disability. We use microsimulation to get a picture of disability trajectories and to study the ability to finance periods of dependence. In order to simulate these trajectories, we need a transition model. In the literature, most mortality and disability models depend only on age and sex and were estimated on US data (Crimmins et al., 2009; Fong et al., 2013; Friedberg et al., 2014; Rickayzen and Walsh, 2002; Robinson, 1996). However, French studies suggest that the education level may impact the incidence of disability and the probability of recovery (Cambois and Lièvre, 2007; Duée and Rebillard, 2006).

Since the objective is to investigate to what extent individuals are able to pay for long-term care, it seems important to take into account the impact of the socioeconomic status on mortality and LTC needs. We use waves 1 (2004/05), 2 (2006/07), 3 (2008/09), 4 (2011/12) and 5 (2013) of SHARE to estimate the effect of age, sex, income and education on transitions between 3 states: non-dependent (< 2 ADLs), dependent (2+ ADLs) and dead[49]. Transitions are computed over periods of two years and three separate logit models are run, one for the probability of dying, one for the incidence of disability and one for the probability of recovery.

Mortality

In order to estimate the logit model for the probability of dying, we use the observed mortality in SHARE between waves 1 and 2, 2 and 3, and 4 and 5[50]. The regression analysis focuses on individuals for whom we know the disability status (dependent or not) in the initial wave and for whom we observe whether they are alive or deceased two years later, which leaves 31,203 observations (see Table 43 in Appendix F for further details on observed mortality and baseline transition probabilities). Table 33 presents the estimation results. It shows that the probability of dying is 6.7 percentage points higher for dependent individuals than for non-dependent ones. Men and older individuals face a higher risk of death, while income and education seem to have a protective effect. Country dummies suggest that transitions to death are less frequent in France and Belgium. The last variable in the table controls for the duration between the two dates of interview.

[49] Due to sample size limitations, we consider only one level of dependence (2+ ADLs). In addition, to simplify the analysis, we do not take into account where the disability takes place (at home or in institution). If we do not consider accommodation costs and day-to-day living costs (meals, laundry…) in nursing homes, we can make the assumption that the cost of long-term care is the same at home and in institution.

[50] Mortality is observed thanks to end-of-life interviews with proxy respondents or from information gathered by the interviewers. Wave 3 questionnaire (SHARELIFE), which focuses on people's life histories, differs from the ones of the other waves and provides no information on ADLs. Since we need to know the initial disability status to explain mortality, we cannot use transitions between waves 3 and 4 in the logit model for the probability of dying. Similarly, estimations of the incidence of disability and the probability of recovery require information on the ADLs both in the initial and final waves and thus do not use transitions between waves 2 and 3 and waves 3 and 4.

Table 33. Probability of dying between two waves.

Age	0.005*** (0.000)
Female	-0.029*** (0.003)
Dependent (2+ ADLs)	0.067*** (0.003)
Equivalised household income (country level)	
- 1st quintile	-
- 2nd quintile	-0.006* (0.004)
- 3rd quintile	-0.007** (0.004)
- 4th quintile	-0.007* (0.004)
- 5th quintile	-0.010** (0.004)
Education level	
- Pre-primary/primary	-
- Secondary/post-secondary	-0.006* (0.003)
- Tertiary	-0.009** (0.004)
Country	
- Austria	-
- Germany	-0.003 (0.006)
- Sweden	-0.004 (0.005)
- Netherlands	-0.004 (0.006)
- Spain	0.003 (0.005)
- Italy	-0.003 (0.005)
- France	-0.013** (0.005)
- Denmark	0.008 (0.006)
- Belgium	-0.017*** (0.005)
Time between the two waves - 24 months	0.002*** (0.000)
Number of observations: 31,203	

Source: SHARE, waves 1, 2, 3, 4, 5.
Individuals aged 65 and over and whose status (dependent or non-dependent) is known in the initial wave.
Average marginal effects. Standard errors in parentheses.
*: significant at the 10% level, **: 5% level, ***: 1% level.

Comparisons of estimated probabilities of death by country, sex and age with life tables from the Human Mortality Database indicate that SHARE underestimates mortality. This is due to missing records of deaths, linked to the fact that individuals in institutions are not initially sampled in the survey in most countries and that some respondents are lost to follow-up. We compute a correction factor by country, sex and age[51] to adjust SHARE estimated probabilities to life tables. For example, the mean estimated probability of death (over a two-year period) among French women who are 80 years old in the sample (54 observations) is 4.25%. In the Human Mortality Database, the two-year probability of dying is 5.91%. Thus, the correction factor is equal to 1.39 (0.0591/0.0425). In the microsimulation, we multiply the estimated probability of death of 80 years old French women by 1.39. Table 44 in Appendix F provides the mean correction factor in each country. It suggests that SHARE mortality is particularly underestimated in the Netherlands and in Belgium (high correction factors).

[51] Individuals aged 85-89 years and 90-99 years are grouped to have a sufficient number of observations. We do not compute correction factors for 100+ years old due to a lack of observations.

Disability transition of individuals who survive

The logit models for the probability of becoming dependent and the probability of recovery use observed transitions between waves 1 and 2 and waves 4 and 5 of SHARE (see Table 45 in Appendix F for further details). The estimation of the incidence of ADL limitations focuses on individuals who are non-dependent in the initial wave (< 2 ADLs), who survive between the two waves and whose disability status is known in the final wave (17,803 observations). The probability of recovering from disability is estimated on those who are dependent (2+ ADLs) in the initial wave, are still alive two years later and whose number of ADL limitations is known (1,248 observations). We assume that an individual becomes dependent only if she reports at least 2 ADL limitations in the second period. To recover from disability, a person must report no difficulty in performing basic activities of daily living (total recovery). It takes into account the potential variability in reporting health problems and the fact that individuals may adapt to their limitations.

The probability of becoming dependent is higher for women and increases with age (Table 34). Interestingly, individuals with low income or poorly educated face a bigger risk of needing long term care. The incidence of ADL disability seems to be lower in Northern Europe and in France. For dependent individuals, the probability of recovery is mainly explained by age.

Table 34. Disability transitions.

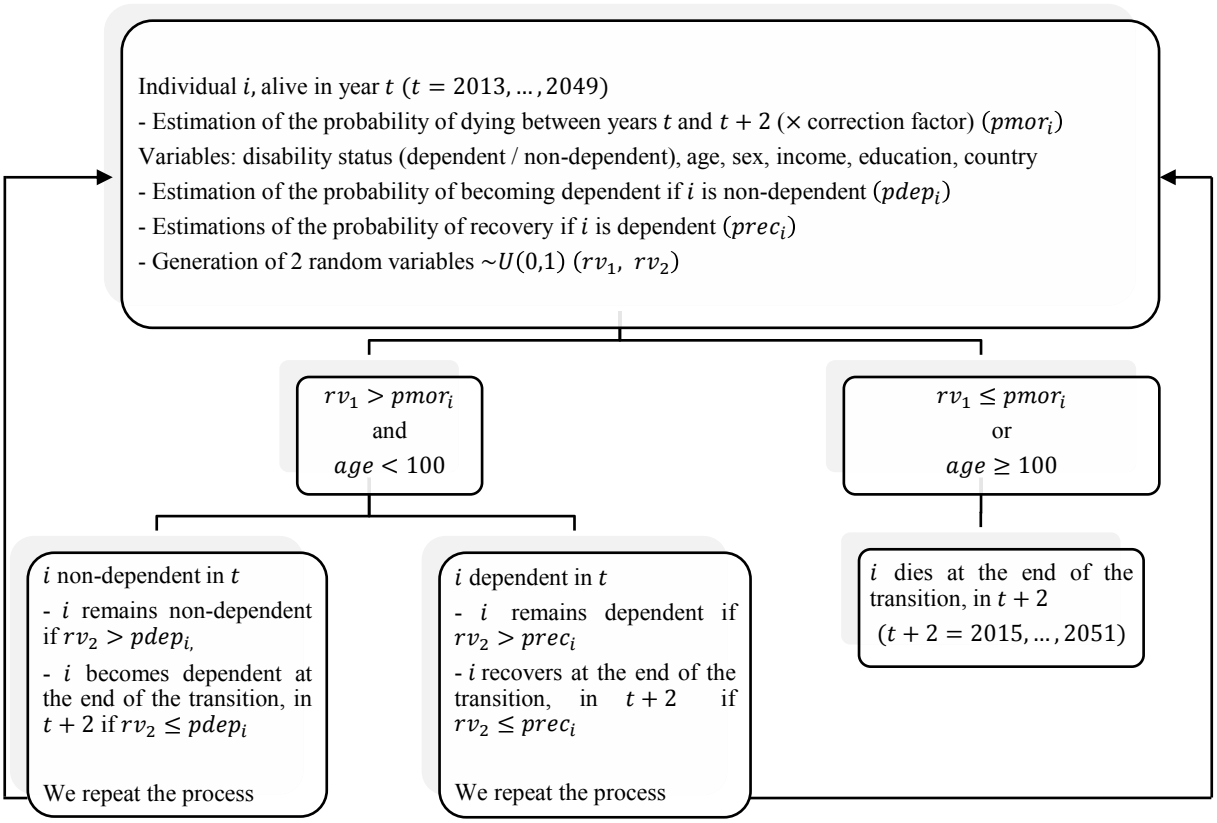
	Becoming dependent (2+ ADLs)	Recovery (No ADL)
Age	0.006*** (0.000)	-0.011*** (0.001)
Female	0.012*** (0.004)	0.009 (0.024)
Equivalised household income (country level)		
- 1st quintile	-	-
- 2nd quintile	-0.008 (0.005)	0.045 (0.032)
- 3rd quintile	-0.014*** (0.005)	0.012 (0.036)
- 4th quintile	-0.023*** (0.005)	0.025 (0.036)
- 5th quintile	-0.025*** (0.006)	0.025 (0.040)
Education level		
- Pre-primary/primary	-	-
- Secondary/post-secondary	-0.016*** (0.004)	0.052* (0.030)
- Tertiary	-0.027*** (0.006)	0.026 (0.044)
Country		
- Austria	-	-
- Germany	0.013* (0.008)	-0.037 (0.054)
- Sweden	-0.042*** (0.008)	0.033 (0.055)
- Netherlands	-0.036*** (0.009)	-0.083 (0.069)
- Spain	0.009 (0.007)	0.058 (0.042)
- Italy	0.004 (0.007)	0.014 (0.047)
- France	-0.021*** (0.007)	0.049 (0.044)
- Denmark	-0.023*** (0.008)	-0.117* (0.070)
- Belgium	-0.006 (0.006)	-0.077* (0.045)
Time between the two waves - 24 months	0.000 (0.000)	0.006** (0.003)
Number of observations	17,803	1,248

Source: SHARE, waves 1, 2, 4, 5.
1st column: Individuals aged 65 and over and non-dependent (< 2 ADLs) in the initial wave.
2nd column: Individuals aged 65 and over and dependent (2+ ADLs) in the initial wave.
Average marginal effects. Standard errors in parentheses. *: significant at the 10% level, **: 5% level, ***: 1% level.

4.2. Microsimulation

The disability transition model described in the previous section allows estimating individual probabilities of transitions as a function of age, sex, income, level of education, country and initial disability status. We then simulate disability transitions of individuals over a two-year period by comparing the estimated probabilities with a random variable that follows a continuous uniform distribution on [0;1]. We repeat this process to simulate disability trajectories of individuals who are 65 and older in 2013 until year 2051. We assume that centenarians die with a probability of one so that all wave 5 individuals are dead in 2051 (the simulation process is described in Figure 3 below). It is worth mentioning that the disability transition model does not account for potential changes in disability rates and mortality trends during the simulation period. Since simulations rely on random numbers and may be affected by stochastic variability, we run the model 10 times to obtain more stable and robust results. The result section presents the mean LTC risk and the mean ability to pay for LTC needs across these 10 replications of simulations. The study of the distribution of ability to pay focuses on the 10th simulation (but other simulations give very similar results).

Figure 3. Description of the microsimulation process.



4.3. LTC cost

In order to study the ability to pay for LTC expenses, we need to estimate the average cost of LTC at the country level. We focus on dependent individuals (2+ ADLs) in wave 5 and calculate how many hours of care per week they need using a conversion table relating restrictions in basic/instrumental activities of daily living to home help needs. Table 46 in Appendix F summarizes the assumptions of this paper (based on Pampalon et al., 1991) and provides a comparison with the assessment of needs used in Austrian and German long-term care systems (Carrino and Orso, 2014). We find that, on average, dependent individuals need between 26 hours (in Denmark) and 33 hours (in Spain) of care per week (Table 35). They need 27 hours in France, to be compared to the 31.5 hours of weekly care (from professional workers and/or relatives) reported by beneficiaries of public LTC coverage according to Petite and Weber (2006). It should be stressed that the time of assistance needed for each activity of daily living is assumed to be the same in the different countries (this is a kind of "universal"

need). Therefore, the observed differences are entirely due to differences in the type and the number of activity restrictions reported by individuals.

The need for care is then evaluated in monetary terms by applying the hourly labor cost in the human health and social work sector (upper bound of LTC cost) or in accommodation and food service activities (lower bound) in each country (Eurostat data, 2012). Table 35 shows that the annual cost of LTC ranges between 23,000 euros in Germany and 39,000 euros in Denmark if we use labor costs in accommodation and food services. If we apply labor costs in the health and social work sector, the LTC cost goes from 38,000 euros in Germany to 51,000 euros in Sweden. This is consistent with Mayhew et al. (2010) who use a weekly cost of care of £500 (33,366 euros per year). In the US, the national median hourly rate is $20 for homemaker services (household tasks) and home health aide services (personal care) (Genworth cost of care survey, 2015). It is worth noting that the annual LTC cost is generally much higher than the average annual income (Table 32), except in Belgium for the lower bound of LTC cost. It is particularly true in Spain and Italy.

In the main analysis, we assume that there is no public LTC insurance and no informal care provided by relatives, friends or neighbors. In other words, dependent individuals have to bear the full cost of LTC. Public coverage and family care will be briefly introduced in Subsection 5.5. The reader should also keep in mind that we probably overestimate the LTC cost. Indeed, we have no information on the degree of restriction in activities of daily living and assume that all individuals need comprehensive care.

Table 35. Average LTC needs and LTC costs in each country.

	Number of observations used	Average LTC need (hours/week)	Hourly labor cost in accommodation and food services (€)	Average annual cost of LTC (lower bound)	Hourly labor cost in human health and social work (€)	Average annual cost of LTC (upper bound)
Austria	206	27.669	16.8	24,172	28.5	41,006
Germany	222	26.877	16.6	23,200	27.7	38,714
Sweden	123	28.669	25.3	37,716	34.5	51,431
Netherlands	103	26.334	18.2	24,923	32.5	44,505
Spain	454	33.477	13.8	24,023	22.3	38,820
Italy	285	28.079	18.0	26,282	28.3	41,320
France	206	26.557	23.0	31,763	29.3	40,463
Denmark	121	26.245	28.5	38,896	35.7	48,722
Belgium	294	26.872	21.3	29,764	30.5	42,619

Source: SHARE, wave 5 and Eurostat data (2012).
Individuals aged 65+ and dependent (2+ ADLs) in wave 5.
Weighted statistics.

4.4. Simulation of reverse mortgages

We assess the role of housing in LTC financing by assuming that individuals take out a reverse mortgage as soon as they become dependent (at age 84.5 on average in the simulations)[52]. Individuals have the choice between different payment options. In the US (Home Equity Conversion Mortgage, HECM), for adjustable interest rate mortgages, borrowers can select one of the following plans: tenure payment (equal monthly payments as long as the individual lives in the home, also called reverse annuity mortgage), term payment (equal monthly payments for a specified period of time), line of credit (unscheduled payments at times and in amount of the borrower's choosing until the line of credit is exhausted) or some combination of term/tenure payment with a line of credit. In late 2007, fixed-rate HECMs, in which the borrower receives a single lump sum disbursement at mortgage closing, have been introduced. In the UK (Aviva fixed-rate lifetime mortgages), cash can be accessed as a one-off lump-sum payment or as a combination of an initial lump-sum and access to more releases in the future. In France (Crédit Foncier, the only provider of RM), borrowers can choose between an annuity and a lump-sum payment. Here, we focus on one-off lump-sum payments for two reasons. First, it is the most popular option. In the US, in 2007, *"87 percent of borrowers chose a line of credit, and 13 percent chose a monthly disbursement plan. […] The median [line-of-credit] borrower […] took out 82 percent of their available funds within the first year, and three-quarters of borrowers took at least half of their available funds within the first year. Starting in early 2009, the fixed-rate product [introduced in late 2007], which requires a lump-sum disbursement, began to dominate the market. During fiscal year 2011, 69 percent of loans originated were fixed-rate, lump-sum […]"* (Consumer Financial Protection Bureau, 2012). The second reason is that lump-sum payments may be more attractive to the borrower than annuities if she dies early, which is likely to be the case for dependent individuals if the bank do not adjust life tables to the disability status. In our simulations, the life expectancy of individuals who become dependent is on average 21% lower than that predicted by life tables for the general population (Human Mortality Database). The lump-sum option is also less risky for the borrower if the lender goes bankrupt (Mitchell and Piggott, 2004).

[52] In fact, individuals may recover from disability (in particular at younger ages) and will probably use reverse mortgages only when they are sure that their health will continue to deteriorate. To simplify the analysis, we consider that individuals take a reverse mortgage during their first period of disability. Subsection 5.3. stresses that the results remain stable when a 20% lower life expectancy is used (or, put another way, when individuals take out reverse mortgages later).

We use equation Eq.4 below to compute the maximum lump-sum amount L that dependent individuals can receive. This formula relies on the general rule that the expected sale value of the house should not exceed the accumulated debt at the time of the borrower's death[53]. The lump-sum payment increases with the net value of the main residence H and the growth rate of housing prices (g) and decreases with the interest rate of the reverse mortgage (m) and the remaining life expectancy of the borrower (e). Indeed, older individuals will repay the loan sooner; hence fewer interests will be accumulated, allowing a higher loan.

$$L = H \times \frac{(1+g)^e}{(1+m)^e}, \qquad m > g \tag{Eq.4}$$

We use the life tables from the Human Mortality Database to have information on the remaining life expectancy by age in each country. We do not distinguish between male and female life expectancy because, since 2012, European insurers have switched to unisex pricing to ensure "gender equality" (Court of Justice of the European Union, judgment of 1st March 2011). We assume that individuals borrow on 100% of the home value and that the growth rate of housing prices (g) is 0[54]. The reverse mortgage interest rate (m) is set at 8% and includes the mortgage insurance premium, up-front costs (origination fees, closing costs, up-front mortgage insurance premium) and servicing fees. This 8% interest rate assumption is consistent with previous literature (Bishop and Shan, 2008; Hancook, 1998; Moscarola et al., 2015; Ong, 2008; Venti and Wise, 1991) and with the interest rates observed on the US, UK and French markets. In the US, the expected interest rate of HECMs (10-year Treasury rate or 10-year LIBOR swap rate plus a lender's margin) has decreased from 9.8% in 1990 to 4.9% in 2012. To obtain the total compounding rate charged to borrowers one has to add the annual mortgage insurance premium equal to 1.25%. In the UK (Aviva lifetime mortgages) the annual interest rate was 7.19% in September 2015. In France (Crédit Foncier), the rate is about 8% (Ogg, 2012). These high interest rates may be explained by the small size of the market and by the fact that the lender faces multiple risks (a longevity risk, an interest rate risk and a risk on housing prices). Subsections 5.3 and 5.4 test the sensitivity of the results to changes in the maximum loan amount, in life tables and in the interest rate.

To illustrate Eq.4, let's consider an individual who owns a 200,000 euros house and becomes dependent at age 84 (his/her remaining life expectancy is 7.57 years according to French life

[53] We assume the contract ends at the borrower's death, not when she leaves the home as it is generally the case in the US and in the UK.

[54] In times of house prices inflation, we thus get a lower bound of the lump-sum payment.

tables from the Human Mortality Database). If she takes out a reverse mortgage at an annual interest rate of 8%, she will receive a capital of 111,689 euros.

4.5. Ability to pay for LTC needs

Once disability trajectories, lump-sum reverse mortgage payments and LTC costs are estimated, it is possible to study the ability of individuals to pay for their periods of LTC needs. We assume that they use their income and assets by decreasing order of liquidity. First, we consider only the equivalised household income, from which we deduct food consumption, annual rents and home-related expenditures (variable I). Then, we analyze to what extent using household net financial assets (F) and selling real estate (RE) other than the main residence help dependent individuals to pay for their periods of disability (all these variables are described in Section 3). When financial assets are used, interests and dividends from financial investments (f) are deducted from the household income. Similarly, rental income (r) is deducted when individuals sell their real estate. Finally, we investigate the effect of lump-sum reverse mortgage payments (L) on LTC financing. The analysis of the ability to pay for periods of disability is based on the comparison of incomes, assets and annual LTC costs (C) at the time when individuals become dependent, as described in Table 36 below.

Table 36. Theoretical analysis of the ability to pay for LTC.

Income I	$I < C$	Inability to pay for LTC
	$I \geq C$	Ability to pay for LTC without any restriction
Income I and financial assets F	$I - f < C \; and \; F \leq 0$	Inability to pay for LTC
	$I - f \geq C$	Ability to pay for LTC without any restriction
	$I - f < C \; and \; F > 0$ $D = \frac{F}{C - (I - f)}$	Ability to pay for some years (D) of LTC
Income I, financial assets F and real-estate RE (other than the main residence)	$I - f - r < C \; and \; F + RE \leq 0$	Inability to pay for LTC
	$I - f - r \geq C$	Ability to pay for LTC without any restriction
	$I - f - r < C \; and \; F + RE > 0$ $D = \frac{F + RE}{C - (I - f - r)}$	Ability to pay for some years (D) of LTC
Income I, financial assets F, real estate RE and lump-sum reverse mortgage payments L	$I - f - r < C \; and \; F + RE + L \leq 0$	Inability to pay for LTC
	$I - f - r \geq C$	Ability to pay for LTC without any restriction
	$I - f - r < C \; and \; F + RE + L > 0$ $D = \frac{F + RE + L}{C - (I - f - r)}$	Ability to pay for some years (D) of LTC

Note: To simplify the analysis, we do not subtract from income the repayment of financial debts $(F < 0)$. It avoids having to make assumptions about debt repayments and concerns only few individuals (957 individuals in the sample of 65+ in wave 5 have financial debts).

One difficulty is that incomes and assets are known only in wave 5. Their value when individuals become dependent depends on many factors such as the evolution of inflation, labor costs, pension indexation rules, interest rates, housing prices and life histories. We make simplifying assumptions. First, we assume that annual LTC costs (and thus labor costs) do not vary during the simulation period (2013-2051). Second, the equivalised household income remains unchanged, even if the individual loses her spouse (survivor's pensions preserve the living standards of widows and widowers). Finally, after one's spouse death, financial and housing assets do not change if the individual has no children and are divided by two if there are children[55].

The analysis of the ability to pay for LTC focuses on individuals who have no partner/spouse when they experience LTC needs. This includes individuals who had no partner/spouse in 2013 and individuals who become dependent after the death of their partner/spouse (see Table 47 in Appendix F for more details). In Brief, we focus on vulnerable elderly people who are not helped by their partner/spouse (between 6,694 and 6,794 observations depending on the simulation). The assumption that there is no informal care is more credible among these individuals. In addition, single individuals are more likely to take out reverse mortgages. In the late 2000s, 37% of the borrowers were couples and 43% were single females (Consumer Financial Protection Bureau, 2012).

5. Results

5.1. Long-term care risk

The model simulates the disability trajectories of individuals who are 65 and older in wave 5 of SHARE. It allows computing the lifetime risk of needing LTC in this population. Table 37 presents the mean LTC risk and the mean LTC duration (if any) across 10 replications of simulations. It shows that 57% of individuals will experience at least one period of LTC needs (2+ ADLs) and the average number of years of disability is 4.3[56]. The probability of needing LTC is higher for women (66%) than for men (46%) and women face longer periods of disability (4.6 years as compared to 3.7 for men). Interestingly, socioeconomic status seems to play an important role in explaining the LTC risk. In the 1st income quintile, 62% of individuals are expected to become dependent, while the proportion is only 50% among the richest individuals. Similarly, poorly educated individuals have a 65% risk of needing LTC as

[55] We abstract from differences in inheritance laws between European countries.

[56] Since transitions are simulated over periods of 2 years, LTC durations are calculated by multiplying the number of periods of LTC needs by a factor of 2. Thus, it should be noted that the LTC duration is a discrete variable.

compared to 46% for individuals who have completed tertiary education. By contrast, the duration of LTC needs seems to be less sensitive to socioeconomic status. It suggests that social inequalities in health persist at very old ages. Finally, there exist country differences: the probability and the duration of LTC needs are lower in Northern Europe (Sweden, the Netherlands, and Denmark) than in the South (Spain, Italy). This may be explained by the fact that institutional care is much more common in Northern than in Southern Europe (Colombo et al., 2011b). Thus, if SHARE imperfectly follows individuals when they enter nursing home, attrition leads to an underestimation of LTC risk in Northern Europe. It is also possible that elderly individuals report fewer restrictions in ADLs in the North than in the South of Europe because housing is better adapted to the needs of people with disability. This would also partly explain the socioeconomic gradient. It should be kept in mind that these results are based on a disability transition model that may be biased due to attrition.

While some studies have estimated the risk of nursing home utilization (see, for example, Friedberg et al., 2014 for a summary), the literature on the lifetime risk of disability is relatively scarce. Table 48 in Appendix G summarizes existing results from the last 10 years (see also Kemper et al., 2005 for some older references). We find a generally higher probability of needing LTC than in the literature, probably because of our broad definition of disability. The LTC duration though is rather consistent with previous findings.

Table 37. Simulated LTC risk and LTC duration.

	Probability of needing LTC	LTC duration if > 0 (years)
Total	0.571 (0.004)	4.271 (0.030)
Male	0.458 (0.006)	3.726 (0.051)
Female	0.655 (0.009)	4.556 (0.050)
Equivalised household income (country level)		
- 1st quintile	0.622 (0.009)	4.227 (0.080)
- 2nd quintile	0.618 (0.010)	4.263 (0.135)
- 3rd quintile	0.575 (0.013)	4.408 (0.113)
- 4th quintile	0.533 (0.010)	4.196 (0.094)
- 5th quintile	0.504 (0.014)	4.256 (0.082)
Education level		
- Pre-primary/primary	0.645 (0.006)	4.445 (0.085)
- Secondary/post-secondary	0.550 (0.008)	4.155 (0.028)
- Tertiary	0.464 (0.014)	4.114 (0.108)
Country		
- Austria	0.558 (0.008)	4.181 (0.132)
- Germany	0.588 (0.010)	4.164 (0.045)
- Sweden	0.340 (0.007)	3.405 (0.079)
- Netherlands	0.340 (0.012)	3.674 (0.114)
- Spain	0.676 (0.011)	4.826 (0.099)
- Italy	0.630 (0.012)	4.493 (0.124)
- France	0.514 (0.011)	3.835 (0.090)
- Denmark	0.418 (0.008)	4.181 (0.149)
- Belgium	0.554 (0.011)	4.267 (0.078)
Number of observations: 23,769		

Source: SHARE. We simulate trajectories of wave 5 individuals, using the transition model described in Subsection 4.1. Individuals aged 65 and over in wave 5.
The figures given correspond to the means of the (weighted) LTC risk and the (weighted) LTC duration across 10 replications of simulations. Standard deviations between the means of the 10 replications are reported in parentheses.

Concerning the distribution of the LTC duration (Figure 4), among men who experience at least one period of disability, 54% will have to finance 2 years of LTC, 25% will have to pay for 4 years, and 21% will need care for 6 years or longer (computed from the 10th simulation; other simulations give very similar results). For women, the proportions are 43%, 24% and 33%. These results are in line with Brown and Finkelstein (2008) who use a transition model based on 1982-1994 US data and find that the probability of using care for more than 5 years is 17% for men and 31% for women.

Figure 4. Distribution of the LTC duration for males and females.

Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who experience at least one period of LTC needs (12,220 individuals).
The distribution presented here corresponds to the 10th simulation (other simulations give very similar results). Weighted distributions using calibrated individual weights.

5.2. Ability to pay for LTC

The previous section has shown that the LTC risk is significant: 57% of individuals aged 65 and older will have to finance, on average, 4 years of LTC needs. Given the high cost of LTC (between 23,000 and 52,000 euros per year, see Subsection 4.3), it is important to assess whether individuals are able to finance these periods of disability. As explained above, we focus on individuals who experience at least one period of LTC needs and who have no partner when they become dependent (between 6,694 and 6,794 observations depending on the simulation). Table 49 in Appendix H provides comparative statistics on the total sample and on the subsample of dependent individuals who have no partner. In addition, we assume that there is no public coverage for LTC and no informal care[57]. In the remaining of the paper, we study both the proportion of individuals who are able to pay for their periods of LTC needs (mean across 10 replications of simulations) and the distribution of the ability to pay. The analysis of the distribution focuses on the 10th simulation (other simulations give very similar results).

[57] See Subsection 5.5 for other assumptions.

If we consider the lower bound of LTC cost, on average, only 7% of dependent individuals can pay for their LTC needs out of their income. The proportion increases to 18% if individuals deplete their financial wealth, 23% if they sell their other real estate and to 50% if they take out reverse mortgages on their main residence (Table 38). Thus, on average, half of individuals cannot totally pay for LTC, even if they use all their income and assets. The picture is even worse if we consider the upper bound of LTC cost; under this assumption, only 37% can finance their LTC needs. These results highlight the need for additional forms of LTC coverage.

At the country level, the proportion of individuals who are able to totally pay for their LTC needs (with income, assets, and reverse mortgages) ranges between 40% in Austria and 67% in Belgium if we consider the lower cost of LTC; the figures are, respectively, 27% and 58% if we consider the upper cost. In most countries (Austria, Germany, Sweden, the Netherlands, Spain, Italy, Denmark), only 40 to 50% can finance their periods of disability by themselves. The proportion is higher in France (63%) and Belgium (67%) where incomes, financial and housing assets are, on average, higher (see descriptive statistics in Table 32).

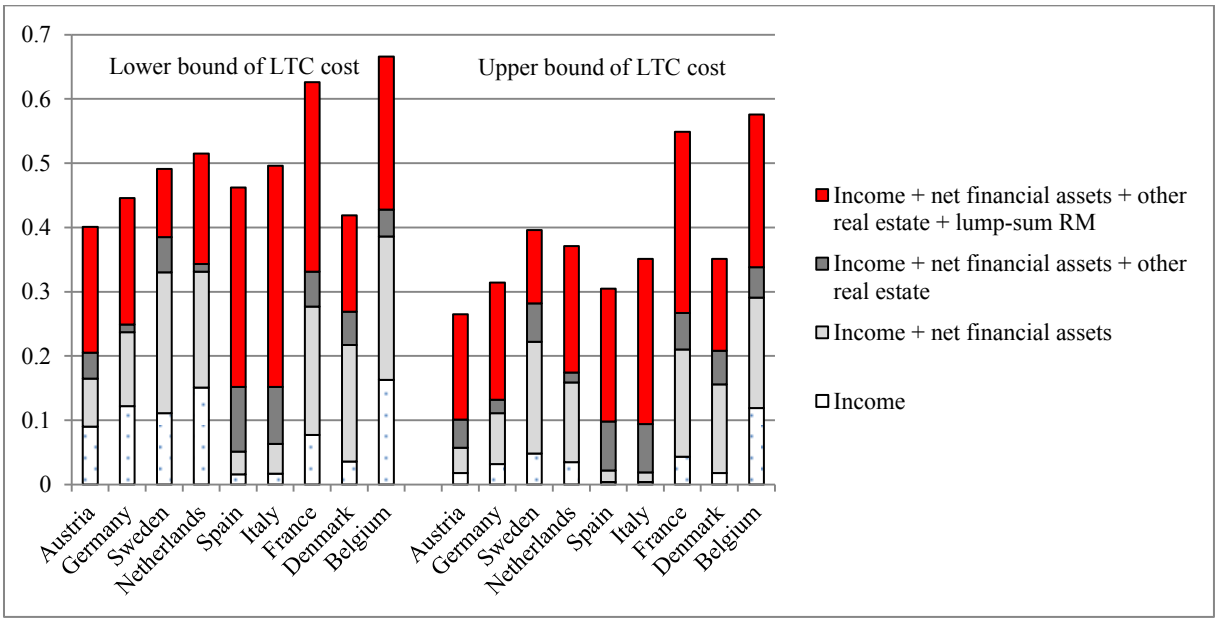
While only 23% of individuals can pay for their LTC needs based on income, financial assets and other real estate (15% with the upper bound of LTC cost), the proportion more than doubles when reverse mortgage payments are taken into account. Indeed, the proportion of homeowners is important among European aged 65 and older and the value of home is generally much higher than incomes and financial wealth (Table 32). To give an example, in the 10th simulation, dependent homeowners receive an average lump-sum payment of 147,768 euros when they take out reverse mortgages (1st quartile: 65,484 euros, median: 109,493 euros, 3rd quartile: 170,902 euros; data not shown). These amounts are higher than the annual cost of LTC. Figure 5 shows that the potential role of reverse mortgages is particularly important in Spain and Italy where a large proportion of individuals is *cash-poor* and *house-rich*. In contrast, reverse mortgages seem less useful in Sweden where individuals have high incomes and financial assets and are less often homeowners.

Table 38. Proportion of dependent individuals who are able to pay for their LTC needs.

	Equivalised household income	+ Net financial assets	+ Other real estate	+ Lump-sum RM
		Lower bound of LTC cost		
Total	0.070 (0.004)	0.177 (0.006)	0.234 (0.007)	0.502 (0.010)
Country				
- Austria	0.090 (0.007)	0.165 (0.014)	0.205 (0.014)	0.401 (0.017)
- Germany	0.122 (0.007)	0.237 (0.010)	0.249 (0.009)	0.446 (0.014)
- Sweden	0.111 (0.015)	0.330 (0.017)	0.385 (0.018)	0.491 (0.018)
- Netherlands	0.151 (0.015)	0.331 (0.018)	0.343 (0.017)	0.515 (0.018)
- Spain	0.016 (0.005)	0.051 (0.011)	0.152 (0.019)	0.462 (0.020)
- Italy	0.017 (0.003)	0.063 (0.008)	0.152 (0.013)	0.496 (0.019)
- France	0.077 (0.011)	0.277 (0.010)	0.331 (0.008)	0.626 (0.015)
- Denmark	0.036 (0.006)	0.217 (0.007)	0.269 (0.009)	0.419 (0.008)
- Belgium	0.163 (0.015)	0.386 (0.016)	0.428 (0.016)	0.666 (0.016)
		Upper bound of LTC cost		
Total	0.025 (0.002)	0.099 (0.005)	0.152 (0.007)	0.375 (0.011)
Country				
- Austria	0.018 (0.003)	0.057 (0.009)	0.101 (0.009)	0.265 (0.016)
- Germany	0.032 (0.004)	0.111 (0.006)	0.132 (0.007)	0.314 (0.011)
- Sweden	0.048 (0.011)	0.222 (0.019)	0.282 (0.022)	0.396 (0.023)
- Netherlands	0.035 (0.009)	0.159 (0.024)	0.174 (0.025)	0.371 (0.019)
- Spain	0.004 (0.002)	0.022 (0.005)	0.098 (0.012)	0.305 (0.016)
- Italy	0.004 (0.002)	0.019 (0.002)	0.094 (0.011)	0.351 (0.025)
- France	0.043 (0.008)	0.210 (0.014)	0.267 (0.014)	0.549 (0.017)
- Denmark	0.018 (0.004)	0.156 (0.006)	0.208 (0.009)	0.351 (0.012)
- Belgium	0.119 (0.011)	0.291 (0.017)	0.338 (0.016)	0.576 (0.016)
Number of observations: between 6,694 and 6,794 depending on the simulation.				

Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.
The figures correspond to the mean of the (weighted) ability to pay across 10 replications of simulations. Standard deviations between the means of the 10 replications are reported in parentheses.
Reading: In Austria, if we consider the lower bound of LTC cost, 9% of dependent individuals on average can pay for their LTC needs with their income. The proportion goes to 16.5% when net financial assets are added, to 20.5% if real estate is taken into account and to 40.1% if lump-sum reverse mortgages on the main residence are added.

Figure 5. Proportion of dependent individuals who are able to pay for their LTC needs.



Source: SHARE data, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

Beyond the proportion of individuals who can totally finance their LTC needs, it is interesting to study the distribution of the ability to pay. Indeed, if most individuals can pay for 75% or more of their LTC expenses, the implications in terms of public policies will be very different than if most individuals can pay for less than 10% of their LTC needs.

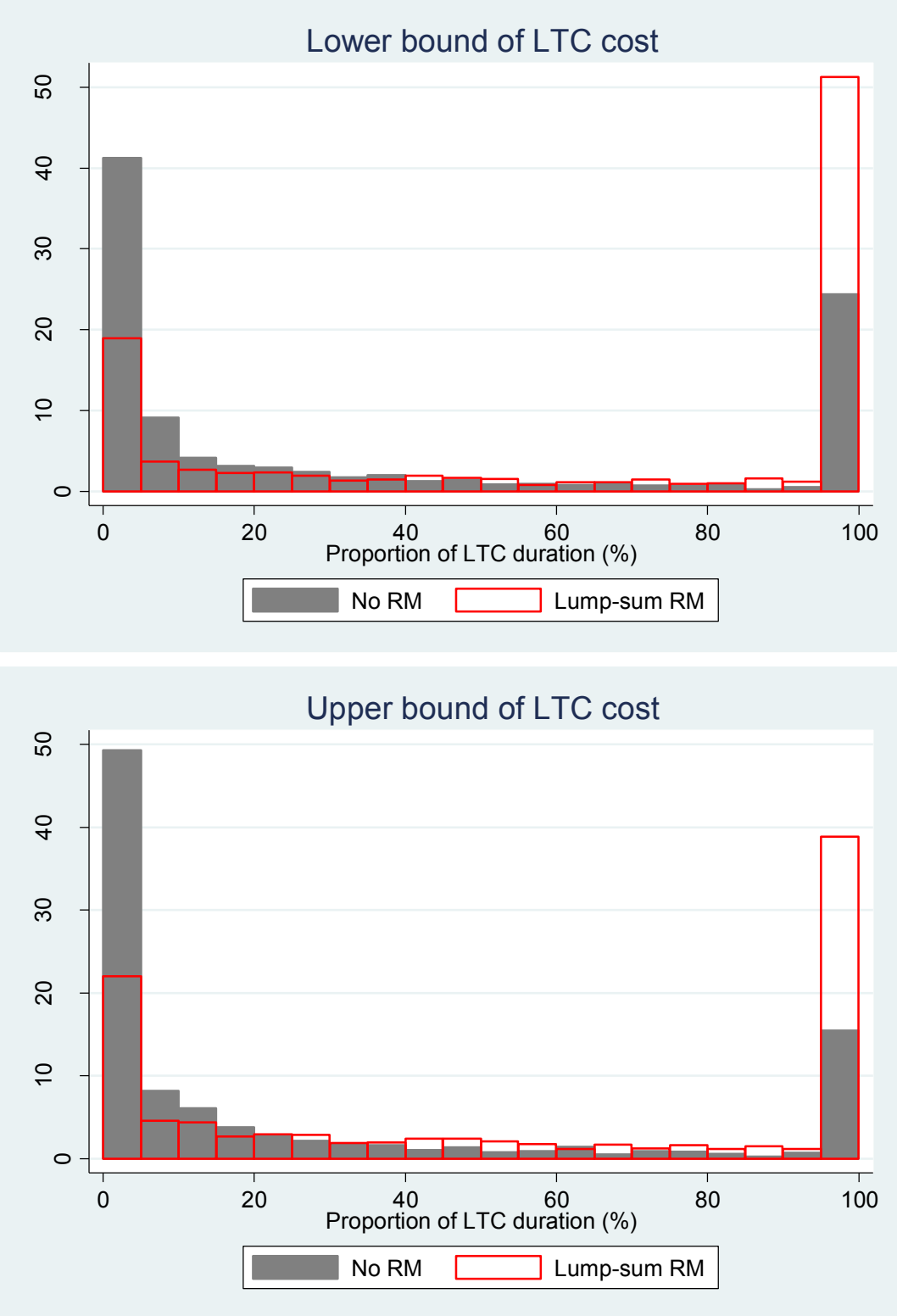
We study the proportion of LTC duration that individuals are able to finance, defined as the ratio between the number of years of LTC (D) they can pay for (see Subsection 4.5) and their effective LTC duration. If we consider income, financial assets and secondary homes (in grey), 41% of dependent individuals can finance 0 to 5% of their LTC duration, 9% can finance 5 to 10% and 24% can pay for 95% and more of their periods of LTC needs (lower bound of LTC cost) (Figure 6). When lump-sum reverse mortgage payments are added (in red), these proportions are equal, respectively, to 19%, 4% and 51%. More generally, reverse mortgages increase the proportion of individuals who can pay for 40% and more of their LTC duration to 66% (as compared to 33% without reverse mortgages)[58]. To sum up, these distributions show that a significant proportion of dependent individuals can only pay for a very small part of their LTC expenditures, even if they take out reverse mortgages. As 40% of the expected LTC duration is, according to our estimate, approximately 2 years, it means that two-thirds of the population is able to pay for 2 years of expenses. This gives some interest to a public policy that would ask people to pay for their LTC expenses for two years, or up to a cap on their expenses, and then cover 100% of expenses above this duration. The 33% of the population unable to pay would be covered by public insurance from the onset of LTC needs (see the Dilnot Report, 2011, for a similar suggestion in Britain).

Distributions by country (see kernel density estimations, Figure 12 in Appendix I) highlight that the ability to pay for LTC needs without reverse mortgages (grey curves) is particularly low in Spain and Italy, while other countries have similar profiles. In all countries, lump-sum payments from reverse mortgages shift the distribution to the right and thus improve the ability to finance periods of disability (red curves), but not in the same proportion everywhere. As outlined above, the effect of reverse mortgages is small in Sweden and Netherlands (the red and grey distributions are very close). In Austria, Germany, France, Denmark and Belgium, reverse mortgages decrease the proportion of individuals who can pay only for some years of LTC and increase the proportion of individuals who are able to totally finance their LTC needs. In Spain and Italy, reverse mortgage payments strongly reduce the

[58] Similarly, using the upper bound of LTC cost, reverse mortgages increase the proportion of individuals who can finance 20% and more of their LTC needs.

proportion of individuals who can pay only for a very small part of their LTC duration and increase both partial and total ability to pay.

Figure 6. Proportion of LTC that dependent individuals are able to finance.



Source: SHARE data, authors' microsimulation. All countries.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent (6,794 individuals).
The distribution corresponds to the 10th simulation (other simulations give very similar results). Weighted distributions.

Ability to pay for long-term care needs by income quintile

The situation may be very different for high and low-income individuals. Since the poorest individuals face a bigger risk of disability and have less housing wealth, we may think that the development of reverse mortgage products, in the absence of public LTC coverage, will increase socioeconomic inequalities at older ages. Appendix J investigates the ability to pay for long-term care needs by income quintile. Figure 13 indicates that in most countries (except in Spain and Italy), in the top income quintile, reverse mortgage payments have only a small effect on the proportion of individuals who are able to meet LTC needs. These individuals have already enough income and financial wealth to finance their periods of disability. In Sweden, Netherlands and Belgium, in some simulations, all individuals are able to pay for their LTC needs with their income and financial assets (if we use the lower bound of LTC cost). In contrast, in Spain and Italy, even the richest individuals are generally not able to finance their periods of disability out of their income and financial wealth. The proportion strongly increases when housing assets are taken into account. Figures 14 and 15 (Appendix J) show that reverse mortgage payments play an important role in the 1st, 2nd, 3rd and 4th income quintiles. Indeed, the proportion of homeowners is important even among low-income individuals. Among 65+, the average proportion of homeowners is 61% in the 1st income quintile, 67% in the 2nd quintile, 71% in the 3rd quintile, 80% in the 4th quintile and 82% in the 5th quintile (statistics not shown). However, even with reverse mortgages, the proportion of people who can totally pay for their periods of disability is very low, in particular in the first three quintiles of income. The distributions (Figure 16 in Appendix J) for the first two income quintiles suggests that reverse mortgage payments strongly decrease the proportion of individuals that can pay only for a very small part of their LTC needs and increase partial and total ability to pay for LTC. In the 3rd and 4th income quintiles, reverse mortgages mainly increase the proportion of individuals who can (almost) totally pay for LTC. Finally, for the richest individuals, reverse mortgages change the right of the distribution. To sum up, reverse mortgages improve the ability to pay for LTC needs at all income levels, but the proportion of people who can totally finance their periods of disability remains particularly low in the first three income quintiles.

5.3. Sensitivity tests

As discussed in Section 2, since dependent individuals have a shorter life expectancy[59], a bank may be willing to offer a lower interest rate than if the RM is taken before the disability occurs. Alternatively, the bank may use specific life tables for borrowers with ADL disability. Thus, in this subsection, we test the sensitivity of the results to changes in the interest rate (4% instead of 8%) and in life tables (20% lower life expectancy than in the Human Mortality Database) used to simulate reverse mortgages.

The results remain remarkably stable (Table 39). In the baseline scenario, using the lower bound of LTC cost, 50% of individuals can pay for their periods of LTC needs. This proportion is equal to 54% if we use a 4% interest rate and to 52% if we use a 20% lower life expectancy. The distributions of ability to pay, in Figure 7, are also very similar. This may be explained by our assumption that individuals take out reverse mortgages when they become dependent. The lump-sum payment is thus computed on the basis of short life expectancies and changing the parameters makes little difference when compared to the annual LTC cost. In the 10th simulation, dependent homeowners receive an average lump-sum payment of 147,768 euros in the baseline scenario, 161,086 euros with the 20% lower life expectancy and 183,157 euros with the 4% interest rate (not shown).

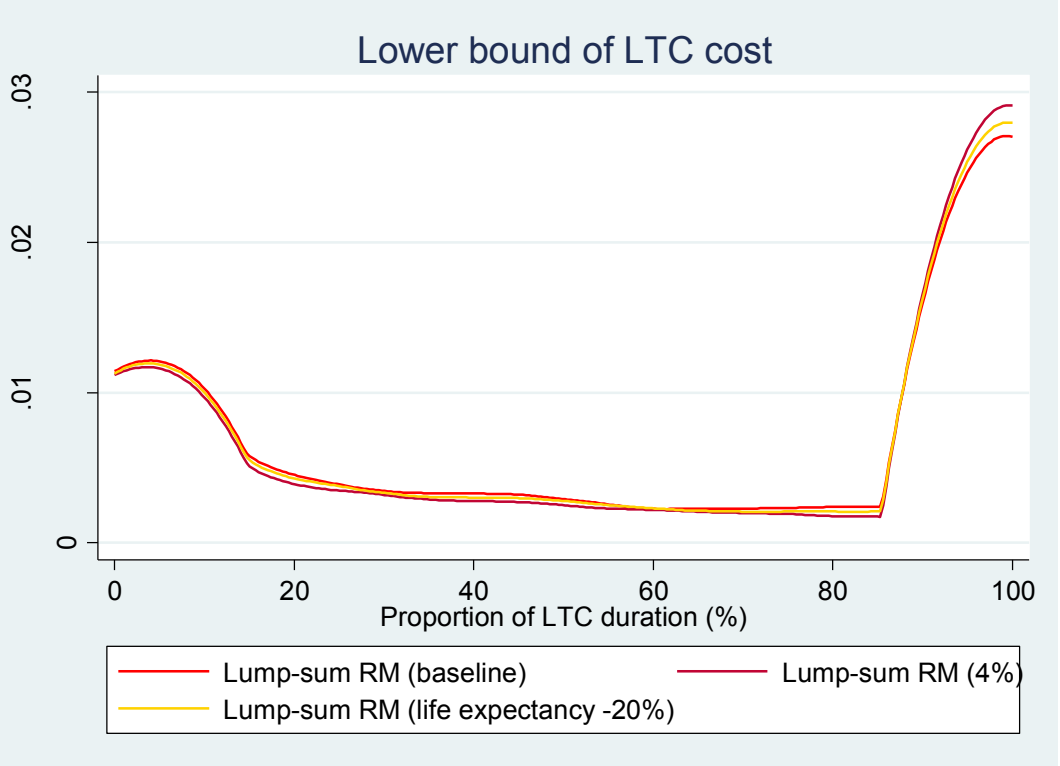
[59] As outlined above, in our simulations, the life expectancy of individuals who become dependent is on average 21% lower than that predicted by life tables for the general population (Human Mortality Database).

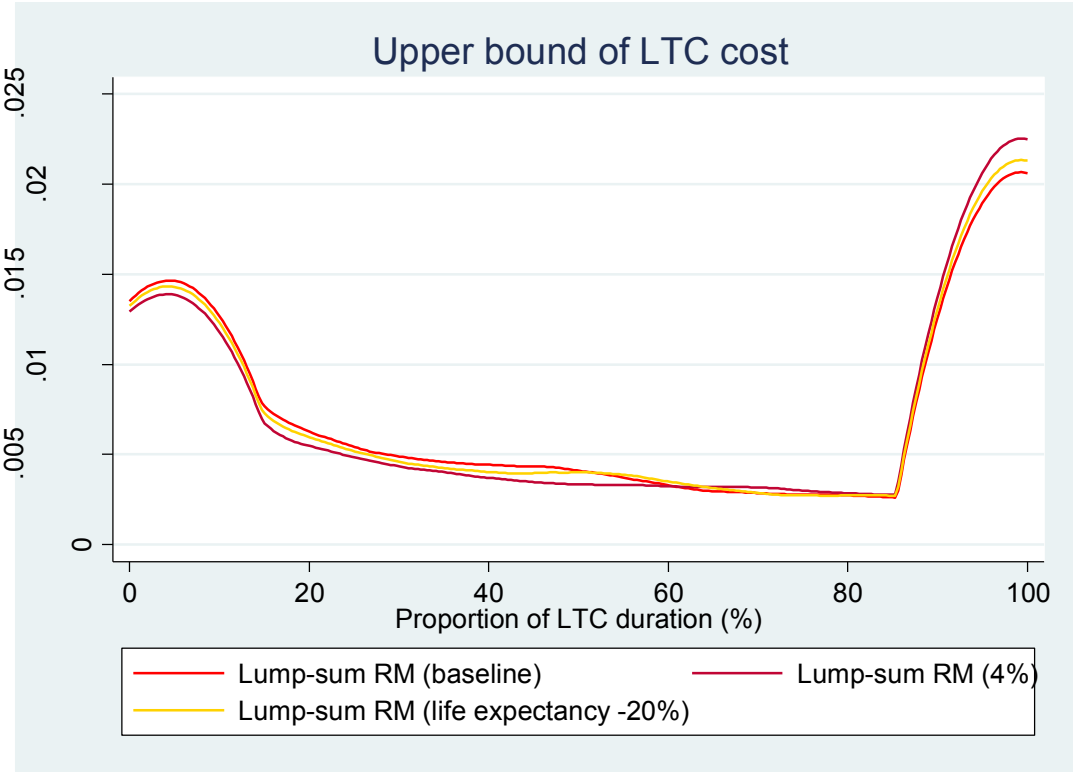
Table 39. Effects of interest rate and life expectancy on ability to pay.

	Lump-sum RM (baseline assumptions)	Lump-sum RM (Interest rate: 4%)	Lump-sum RM (Life expectancy: -20%)
	Lower bound of LTC cost		
Total	0.502 (0.010)	0.539 (0.008)	0.518 (0.008)
Country			
- Austria	0.401 (0.017)	0.418 (0.018)	0.407 (0.017)
- Germany	0.446 (0.014)	0.464 (0.015)	0.454 (0.014)
- Sweden	0.491 (0.018)	0.503 (0.018)	0.496 (0.018)
- Netherlands	0.515 (0.018)	0.524 (0.017)	0.519 (0.017)
- Spain	0.462 (0.020)	0.519 (0.013)	0.485 (0.017)
- Italy	0.496 (0.019)	0.555 (0.023)	0.519 (0.020)
- France	0.626 (0.015)	0.657 (0.015)	0.641 (0.014)
- Denmark	0.419 (0.008)	0.444 (0.012)	0.429 (0.010)
- Belgium	0.666 (0.016)	0.690 (0.015)	0.677 (0.017)
	Upper bound of LTC cost		
Total	0.375 (0.011)	0.417 (0.009)	0.393 (0..009)
Country			
- Austria	0.265 (0.016)	0.289 (0.015)	0.274 (0.014)
- Germany	0.314 (0.011)	0.342 (0.011)	0.325 (0.010)
- Sweden	0.396 (0.023)	0.411 (0.024)	0.403 (0.024)
- Netherlands	0.371 (0.019)	0.391 (0.018)	0.379 (0.018)
- Spain	0.305 (0.016)	0.362 (0.023)	0.330 (0.015)
- Italy	0.351 (0.025)	0.405 (0.021)	0.375 (0.023°
- France	0.549 (0.017)	0.592 (0.016)	0.567 (0.015)
- Denmark	0.351 (0.012)	0.374 (0.014)	0.359 (0.011°
- Belgium	0.576 (0.016)	0.603 (0.015)	0.587 (0.015)
Number of observations: between 6,694 and 6,794 depending on the simulation.			

Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.
The figures given correspond to the mean of the (weighted) ability to pay across 10 replications of simulations. Standard deviations between the means of the 10 replications are in parentheses.

Figure 7. Effects of interest rate and life expectancy on the distribution of ability to pay.





Source: SHARE, authors' microsimulation. All countries.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent (6,794 individuals).
The distribution corresponds to the 10th simulation. Weighted distributions.

5.4. Reverse mortgage on a fraction of the home

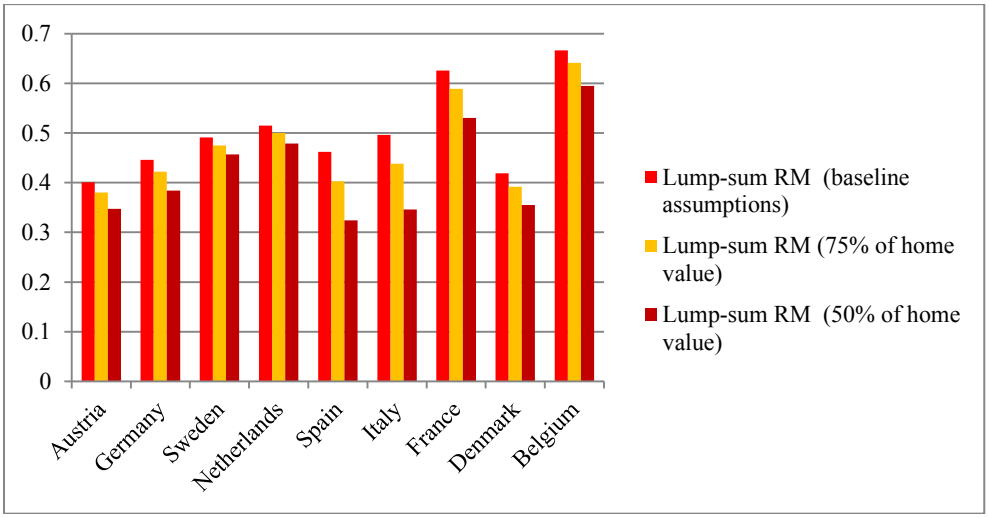
So far, we have assumed that individuals borrow on 100% of the home value. However, in practice, lenders limit the initial loan amount in order to reduce the risk that the debt on house might exceed the sale price of the home. In addition, in the presence of a bequest motive, individuals may prefer to take out smaller loans in order to protect their inheritance. In this subsection, we assume that individuals borrow only 50% or 75% of home equity. Table 40 shows that, on average, the proportion of dependent individuals who can pay for LTC is equal to 50% with baseline assumptions, to 46% if individuals borrow on only 75% of their home value and to 40% if they borrow on only 50% of home equity. The decrease is relatively higher in Spain and Italy than in other European countries (Figure 8). The distribution of the proportion of LTC duration that can be financed (Figure 9) indicates that reverse mortgages, even if individuals borrow only a fraction of their home value, improve the ability to pay compared to the case without reverse mortgage.

Table 40. RM on a fraction of the home value: effect on ability to pay.

	Lump-sum RM (baseline assumptions)	Lump-sum RM (75% of home value)	Lump-sum RM (50% of home value)
	Lower bound of LTC cost		
Total	0.502 (0.010)	0.462 (0.009)	0.400 (0.011)
Country			
- Austria	0.401 (0.017)	0.380 (0.016)	0.347 (0.016)
- Germany	0.446 (0.014)	0.422 (0.016)	0.384 (0.014)
- Sweden	0.491 (0.018)	0.475 (0.018)	0.457 (0.019)
- Netherlands	0.515 (0.018)	0.500 0.019)	0.479 (0.015)
- Spain	0.462 (0.020)	0.403 (0.022)	0.324 (0.017)
- Italy	0.496 (0.019)	0.438 (0.018)	0.346 (0.021)
- France	0.626 (0.015)	0.589 (0.013)	0.530 (0.016)
- Denmark	0.419 (0.008)	0.392 (0.011)	0.355 (0.013)
- Belgium	0.666 (0.016)	0.641 (0.013)	0.595 (0.016)
	Upper bound of LTC cost		
Total	0.375 (0.011)	0.327 (0.011)	0.270 (0.009)
Country			
- Austria	0.265 (0.016)	0.235 (0.016)	0.191 (0.012)
- Germany	0.314 (0.011)	0.278 (0.013)	0.234 (0.010)
- Sweden	0.396 (0.023)	0.375 (0.019)	0.351 (0.019)
- Netherlands	0.371 (0.019)	0.335 (0.018)	0.290 (0.020)
- Spain	0.305 (0.016)	0.251 (0.015)	0.196 (0.013)
- Italy	0.351 (0.025)	0.278 (0.021)	0.206 (0.015)
- France	0.549 (0.017)	0.508 (0.018)	0.444 (0.016)
- Denmark	0.351 (0.012)	0.324 (0.012)	0.289 (0.014)
- Belgium	0.576 (0.016)	0.537 (0.015)	0.481 (0.019)
Number of observations: between 6,694 and 6,794 depending on the simulation.			

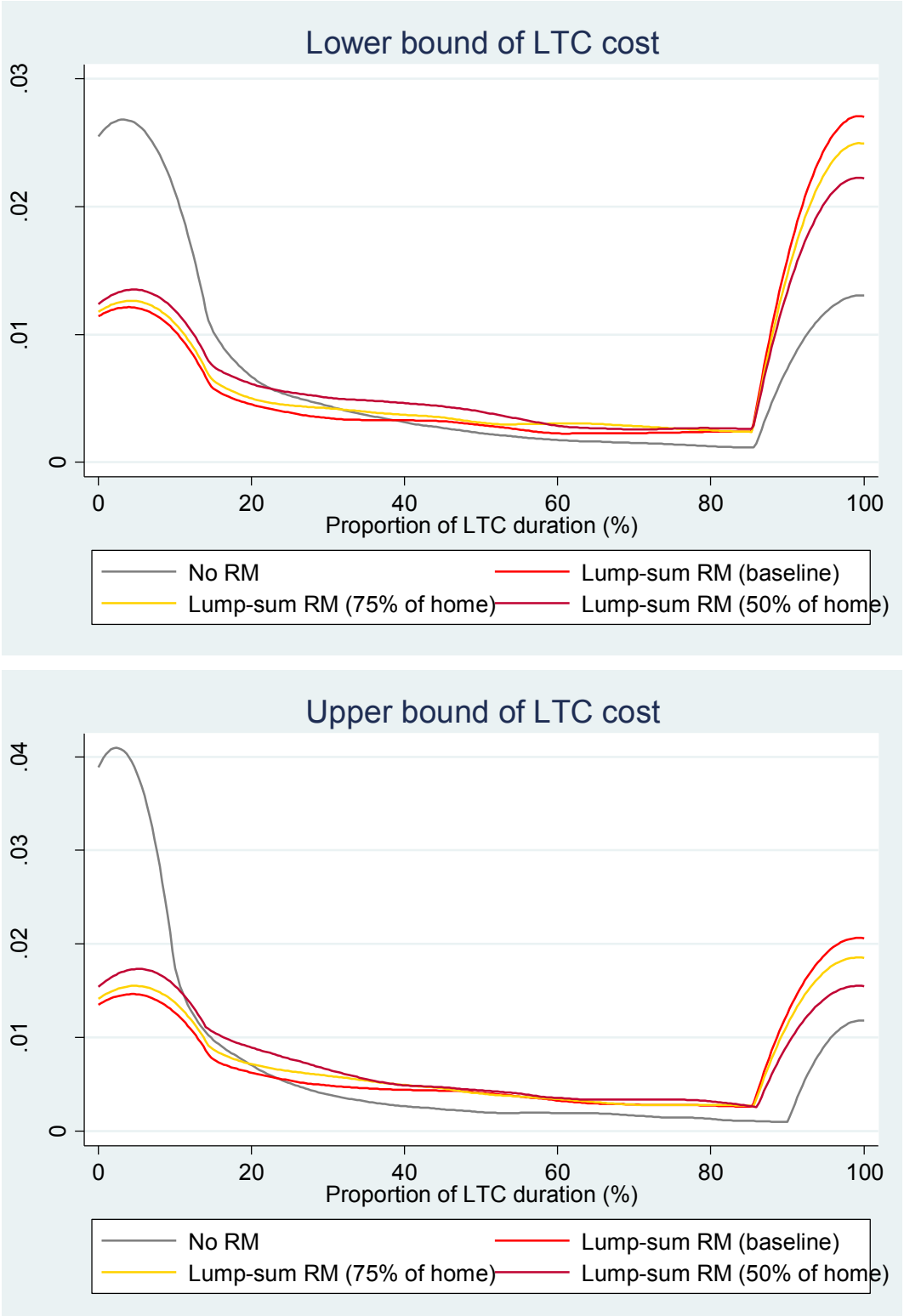
Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.
Mean of the (weighted) ability to pay across 10 replications of simulations. Standard deviations between the means of the 10 replications are in parentheses.

Figure 8. RM on a fraction of the home: effect on ability to pay.



SHARE, authors' microsimulation (lower bound of LTC cost).
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

Figure 9. RM on a fraction of the home: effect on the distribution of ability to pay.



Source: SHARE, authors' microsimulation. All countries.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent (6,794 individuals).
The distribution corresponds to the 10th simulation. Weighted distributions.

5.5. The role of informal care and public LTC coverage

In the main analysis, we have assumed that there was no public coverage for LTC and no informal care provided by relatives, friends or neighbors. However, in practice, the cost of LTC is generally shared between the dependent elderly, their family (through informal care provision or formal care purchase) and the State (through public coverage)[60]. A brief description of the different European LTC systems can be found in the general introduction. In this subsection, in the interests of simplification, we do not take into account the diversity of care arrangements in Europe. We simply assume that the LTC cost borne by dependent individuals is 25% or 50% lower when they had children in wave 5. This corresponds to the case where children provide informal care or purchase formal services (voluntarily or due to legal obligation). We also simulate the effect of public LTC coverage on the ability to pay for LTC needs and on social inequalities. We mimic a simple income-tested system and assume that 80% of the LTC cost is publicly covered for dependent individuals in the 1st income quintile, 60% for the 2nd quintile, 40% for the third quintile, 10% for the 4th quintile and 5% for the 5th quintile[61]. The analysis uses the lower bound of LTC cost.

Informal care

Table 41 stresses that, in the baseline scenario, the proportion of dependent individuals who are able to pay for their LTC needs is the same whether they have children or not. When we assume that the LTC cost is lower for individuals who have children, it increases their ability to pay. When the LTC cost is 25% lower, the proportion of individuals with children who can pay for LTC (with incomes, financial assets, secondary homes and reverse mortgages) is 58%, as compared to 51% for individuals without children. If the LTC cost was 50% lower, 68% of individuals who have children could totally finance their periods of disability. The distribution of the ability to pay (Figure 10) confirms that individuals without children would have more difficulty paying their LTC expenses under such assumptions.

[60] As outlined in the introduction, the private purchase of LTC insurance is rare in most countries. Here, income from private LTC insurance is included.

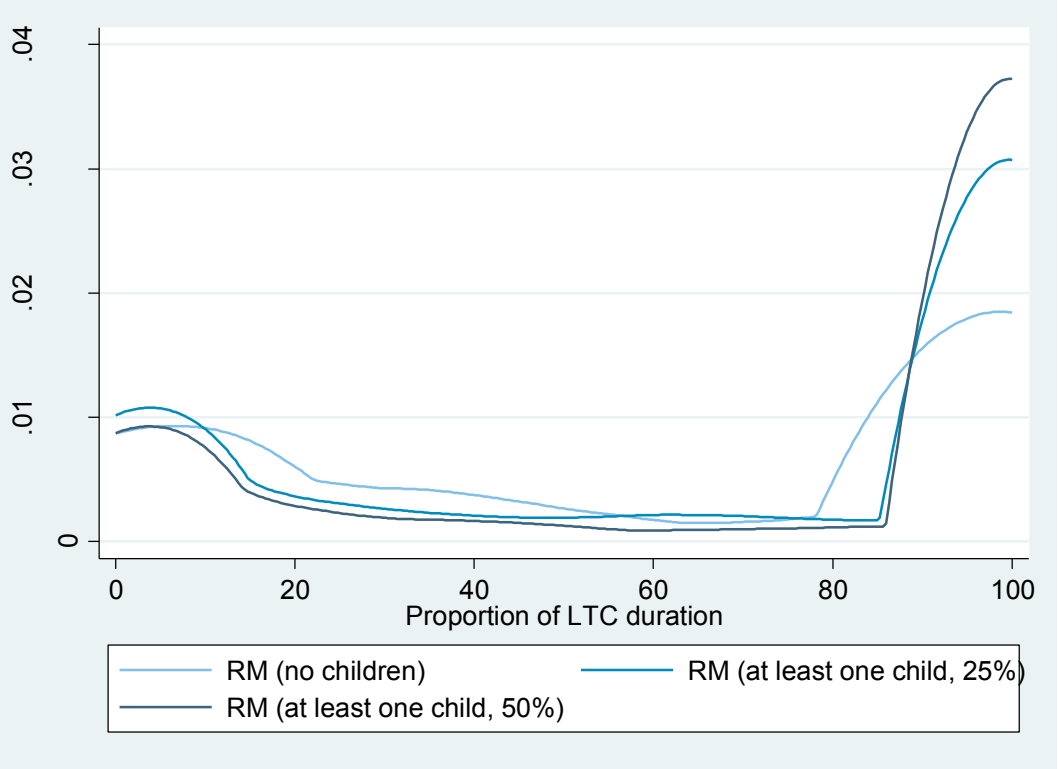
[61] We abstract from the issue of financing such public LTC insurance system.

Table 41. Effect of informal care on ability to pay.

		Equivalised household income	+ Net financial assets	+ Other real estate	+ Lump-sum RM
Baseline scenario	Total	0.070 (0.004)	0.177 (0.006)	0.234 (0.007)	0.502 (0.010)
	No children	0.073 (0.011)	0.200 (0.012)	0.249 (0.012)	0.509 (0.013)
	At least one child	0.069 (0.004)	0.172 (0.006)	0.231 (0.008)	0.501 (0.011)
LTC cost -25%	Total	0.118 (0.006)	0.247 (0.008)	0.299 (0.008)	0.567 (0.009)
	At least one child	0.127 (0.005)	0.256 (0.009)	0.309 (0.009)	0.578 (0.012)
LTC cost -50%	Total	0.220 (0.007)	0.354 (0.010)	0.402 (0.008)	0.654 (0.009)
	At least one child	0.248 (0.007)	0.384 (0.010)	0.432 (0.008)	0.682 (0.010)
Number of observations: between 6,694 and 6,794 depending on the simulation (14% have no children).					

Source: SHARE, authors' microsimulation (lower bound of cost).
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.
The figures given correspond to the mean of the (weighted) ability to pay across 10 replications of simulations. Standard deviations between the means of the 10 replications are in parentheses.

Figure 10. Effect of informal care on the distribution of ability to pay.



Source: SHARE, authors' microsimulation (lower bound of LTC cost). All countries.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent (6,794 individuals).
The distribution corresponds to the 10th simulation. Weighted distributions.

Public LTC coverage

While only 7% of individuals can pay for their LTC needs out of their income in the baseline scenario, this proportion more than doubles (16%) when adding public LTC coverage (Table 42). Similarly, the proportion of individuals who can pay for LTC with income and financial assets increases from 18% to 35%. If we add all housing assets, 68% of dependent individuals can totally finance their LTC expenses with public coverage, as compared to 50% in the

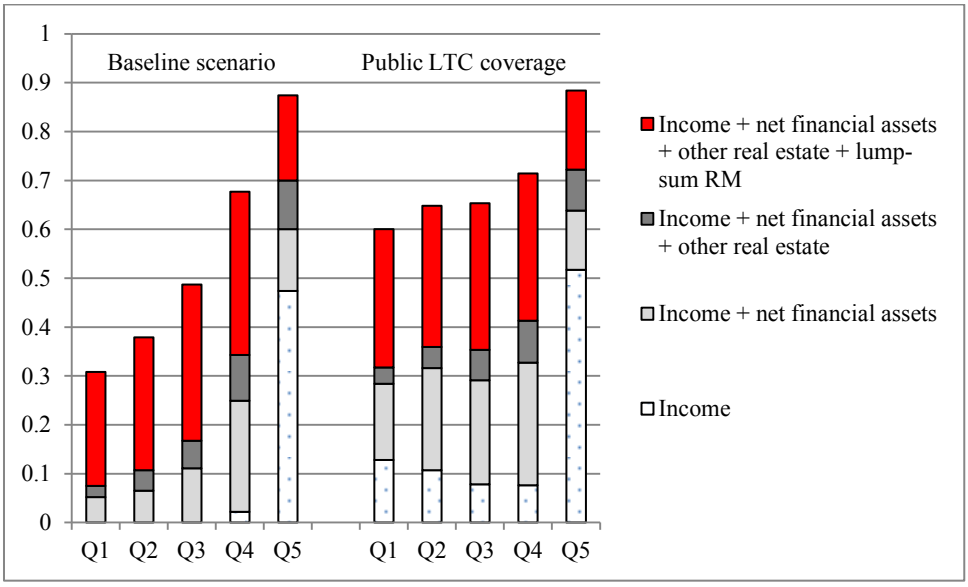
baseline scenario. Quite obviously, the ability to pay for LTC significantly increases when part of the cost is publicly financed. In addition, since we have assumed that copayments increase with income, public LTC coverage reduces social inequalities (Figure 11). Distributions by income quintile (see Figure 17 in Appendix K) show that public LTC benefits increase the ability to pay for periods of disability in the first three income quintiles. For the 4th quintile, public coverage has mainly an effect at the right of the distribution. As expected, there is almost no effect in the 5th income quintile since we have assumed that only 5% of the LTC cost is publicly funded in this group.

Table 42. Effect of public LTC coverage on ability to pay.

		Equivalised household income	+ Net financial assets	+ Other real estate	+ Lump-sum RM
Baseline scenario	Total	0.070 (0.006)	0.177 (0.009)	0.234 (0.009)	0.502 (0.008)
	Q1	0.000 (0.000)	0.052 (0.005)	0.075 (0.008)	0.308 (0.013)
	Q2	0.000 (0.000)	0.065 (0.009)	0.107 (0.009)	0.379 (0.011)
	Q3	0.000 (0.000)	0.111 (0.010)	0.167 (0.016)	0.487 (0.017)
	Q4	0.022 (0.004)	0.249 (0.019)	0.343 (0.021)	0.677 (0.018)
	Q5	0.474 (0.014)	0.600 (0.012)	0.700 (0.014)	0.874 (0.014)
Public LTC coverage	Total	0.158 (0.006)	0.349 (0.008)	0.406 (0.008)	0.680 (0.009)
	Q1, 80%	0.128 (0.005)	0.284 (0.011)	0.317 (0.012)	0.600 (0.019)
	Q2, 60%	0.107 (0.009)	0.316 (0.017)	0.359 (0.016)	0.648 (0.017)
	Q3, 40%	0.078 (0.007)	0.291 (0.018)	0.353 (0.018)	0.653 (0.023)
	Q4, 10%	0.076 (0.006)	0.327 (0.015)	0.413 (0.017)	0.714 (0.013)
	Q5, 5%	0.517 (0.017)	0.638 (0.015)	0.722 (0.019)	0.884 (0.012)
Number of observations: between 6,694 and 6,794 depending on the simulation.					

Source: SHARE, authors' microsimulation (lower bound of LTC cost).
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.
The figures given correspond to the mean of the (weighted) ability to pay across 10 replications of simulations. Standard deviations between the means of the 10 replications are in parentheses.

Figure 11. Effect of public LTC coverage on ability to pay.



Source: SHARE, authors' microsimulation (lower bound of LTC cost). All countries.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

6. Discussion

6.1. Summary of the results

The objective of this research was to investigate to what extent European elderly are able to pay for their periods of long-term care (LTC) needs, on the basis of their income, financial assets and home equity, assuming individuals take out reverse mortgages (RM) when they become dependent. We have estimated a disability transition model on European data, taking into account the effect of the socioeconomic status. Then, we have simulated the disability trajectories of individuals who were 65 and older in 2013 until year 2051, in order to study the lifetime risk of needing LTC. The results show that the LTC risk is significant: 57% of individuals will experience at least one period of disability, for 4 years on average. In addition, the risk appears to be higher for low-income individuals (62%) and poorly educated individuals (65%), which suggests that social inequalities in health persist at very old ages. According to our simulations, one-fifth of dependent men and one-third of dependent women will need care for 6 years or longer.

Then, we have studied the ability of the elderly to pay for their periods of LTC needs, focusing on individuals who have no partner when they become dependent and assuming that there is no public coverage and no informal care. Only 7% of dependent individuals will be able to totally pay for their LTC needs out of their income. The proportion increases to 18% if individuals deplete their financial wealth, 23% if real estate (investment or holiday homes, land…) is sold and to 50% if individuals take out RMs on their main residence. Thus, RMs play an important role, even if individuals borrow only 75% or 50% of home equity. This is particularly true in Spain and Italy where a large proportion of the elderly is *cash-poor* and *house-rich*. In contrast, the effect of RMs is smaller in Sweden and in the Netherlands. The distribution of the ability to pay shows that 20% of dependent individuals can finance only 0-5% of their LTC duration, while 50% can pay for 95% and more. These results are robust to changes in interest rate and life expectancy assumptions.

In the top income quintile, RM payments have almost no effect on the ability to meet LTC needs, except in Spain and in Italy. Indeed, these individuals have already enough income and financial wealth to finance their periods of disability. By contrast, RMs play an important role in the other income quintiles. However, the proportion of people who can pay for their periods of disability remains very small for low-income individuals.

Finally, we have briefly assessed the role of informal care and public LTC coverage. We have assumed that the LTC cost was 50% lower for individuals with children. In this case, the proportion of individuals with children who can pay for LTC increases to 68%, as compared to 50% for individuals without children. Quite obviously, public LTC coverage improves the ability to finance periods of disability and, if copayments increase with income, it reduces social inequalities.

6.2. Implications for public policy

The results of this study stress that housing assets and RMs could play an important role in LTC financing. In a context of fiscal and financial pressures on public systems, this would allow shifting part of the burden of LTC financing on older generations, rather than increasing the contributions paid by future generations, who are already highly taxed and have more unstable career paths and economic situations. It could be possible, for instance, to increase the participation of the richest elderly in the financing of LTC and to provide more support to economically vulnerable individuals. In addition, reducing housing wealth, and thus inheritance, may limit the transmission of inequality.

This study also shows that, on average, half of individuals cannot totally pay for LTC, even if they use all their income and assets. One fifth of dependent individuals can finance less than 5% of their LTC needs. It highlights the need for additional LTC coverage, provided by the State, the market or the family. However, the interrelationship between these different forms of insurance is quite complex and is not captured in our model. For example, by reducing the expected inheritance of children, RMs may weaken incentives to provide informal care (Bernheim et al., 1985). On the other hand, the parents may threaten the children to liquidate housing assets in order to receive more attention.

Furthermore, public LTC benefits, if they are not asset-tested, may crowd-out the purchase of RMs. Likewise, a means-tested public insurance program may affect wealth accumulation. Descriptive statistics in Table 32 are quite revealing. They show that the proportion of homeowners is particularly high in Mediterranean countries, where public LTC expenditure is low and elderly must rely on their children and their assets. By contrast, there are fewer homeowners in Northern countries, where LTC systems are generous. These differences suggest that individuals incorporate public policies when taking economic decisions. Thus, public LTC coverage appears implicitly in this analysis.

Finally, we have suggested so far that home equity may substitute for private LTC insurance. But RMs could also be used to encourage the purchase of LTC insurance. To this end, the

American Homeownership and Economic Opportunity Act of 2000 amended the National Housing Act to waive the upfront premium for HECMs used for the payment of LTC insurance policies (Ahlstrom et al., 2004). All these elements question the design of public policies.

In this analysis, we have assumed that all homeowners take out RMs when they become dependent. It should be borne in mind that, in practice, the RM market is very small. The most common explanation is that costs and fees are too high. According to the Consumer Financial Protection Bureau (2012), for HECM loans, the initial insurance premium represents 2% of the home value and the monthly insurance premium is equal to 1.25% of the loan balance. Lenders charge an origination fee up to 2% of the home value. There are also closing costs, counseling fees and servicing fees. Because of the high up-front costs, RMs are not appropriate if the elderly intend to move out of the house in a short period of time. The literature also points to regulatory and legal uncertainties, low origination fees for lenders, the risk of under-maintenance of the home, products' complexity and tax issues (Davidoff et al., 2014; Eschtruth and Tran, 2001; Masson, 2015; Mitchell and Piggott, 2004).

The demand for RMs is likely to remain low in Europe, even with financially more attractive products. An important obstacle is that RMs exhaust or significantly reduce home equity and thus inheritance. Consequently, individuals who have bequest motives will probably be less likely to take out RMs, which are sometimes perceived as "shameful" and "anti-family" products (Assier Andrieu and Gotman, 2009; Masson, 2015). For example, Dillingh et al. (2013) show that having offspring decreases the probability of being interested in RMs by 35 percentage points in the Netherlands. Inheritance tax and a favorable fiscal treatment of RMs may be useful tools to increase incentives to purchase RMs.
On the other hand, care preferences of elderly may also influence the demand for RMs. Indeed, many aging parents declare they do not want to be a burden for their children. RMs may allow dependent elderly to purchase formal home care and preserve their autonomy. Children and other relatives could provide, for instance, emotional support and help with domestic tasks, while personal care would be provided professionally. Furthermore, in the future, children may prefer to receive a smaller share of the inheritance rather than provide burdensome care to their parents, sometimes at the expense of their health and career.

More generally, European elderly probably have different attitudes than the Americans toward homeownership and debts. Interestingly, Dillingh et al. (2013) stress that, in the Netherlands, individuals who are not interested in RMs generally report that they do not want to be "too dependent on the bank" and that they want to have "as little debt as possible". Another interesting result from the literature is that income and education have a positive effect on the willingness to take out RMs, after controlling for housing wealth (Costa-Font et al., 2010; Dillingh et al., 2013). It suggests that, if LTC costs are shifted to the elderly, RMs would not be of great assistance for low-income individuals (even if, in theory, they could benefit from such financial products). Finally, cultural differences between countries will probably lead to a heterogeneous development of the RM market in Europe. On average, in Europe, 17% of non-retired individuals report that they would consider borrowing against their home or selling it while keeping the right to live in it. This proportion is higher in Northern Europe (35% in Denmark, 29% in Sweden and 24% in the Netherlands) than in other countries. Among retirees, 25% of individuals have borrowed against their home or are planning to do so in Denmark, 12% in Sweden and less than 10% in other countries (Flash Eurobarometer, 2008). RMs seem to be seen as a last resort, a way to face economic difficulties in Spain and Italy (Costa-Font et al., 2010; Fornero et al., 2016), while, in the Netherlands, elderly would primarily use RMs for consumption smoothing (Dillingh et al., 2013).

6.3. Limitations of this study

As mentioned above, this study is limited in that it does not take into account the interrelationship between public LTC coverage, family care and private LTC financing. While modeling the behavior and reactions of individuals would be quite complicated, a first step could be to relax some simplifying assumptions and to simulate more realistic scenarios. We could integrate the provision of informal care in the microsimulation model and assume that it depends on the geographical proximity and the gender of children. We could also take into account European differences in public LTC coverage. In addition, due to sample size limitations, we consider only one level of dependence. It would be instructive to define different degrees of dependence, to allow the consumption of LTC services to vary from one individual to another and to study in more details the dispersion of LTC costs.

Another limitation is that attrition may bias the results of the disability transition model. In particular, if the survey imperfectly follows individuals when they enter nursing home, attrition leads to an underestimation of the LTC risk. This is likely to be the case in Northern

countries, where institutional care is more common. In addition, the transition model does not take into account potential changes in disability and mortality trends (see general introduction). It would be interesting to consider alternative scenarios regarding the evolution of disability in the next decades.

Lastly, we think it would be worthwhile to replicate our model on English data (ELSA). Indeed, the English LTC system is means-tested, older people have to exhaust their assets to be eligible for nursing home coverage and home care is income-tested (Colombo et al., 2011b). Lifetime mortgages, which have existed for many years in England, may thus be of particular interest to help finance LTC needs.

Appendix F. Additional details on the methodology.

Table 43. Observed mortality between waves 1-2, waves 2-3, and waves 4 and 5.

Initial status	Final status			
	Alive	Deceased	Missing information	Total
< 2 ADLs (non-dependent)	**27,587**	**1,129**	6,711	35,427
	(0.779)	(0.032)	(0.189)	
2+ ADLs (dependent)	**1,906**	**581**	738	3,225
	(0.591)	(0.180)	(0.229)	
Alive (disability status unknown)	77	8	137	222
	(0.347)	(0.036)	(0.617)	
Total	29,570	1,718	7,586	38,874
	(0.761)	(0.044)	(0.195)	

Source: SHARE, waves 1, 2, 3, 4, 5.
Individuals aged 65 and over in the initial wave.
Figures without parentheses represent the number of observations. Percentages in line are reported in parentheses.
Figures in bold correspond to the observations used to estimate the transition model.

Table 44. Correction factor for the probability of mortality.

	Mean (standard deviation)	Min	Max
Total	1.475 (0.335)	0.592	2.388
Country			
- Austria	1.353 (0.228)	0.976	1.832
- Germany	1.540 (0.188)	1.166	1.884
- Sweden	1.572 (0.239)	0.996	1.935
- Netherlands	1.783 (0.257)	1.365	2.323
- Spain	1.008 (0.147)	0.592	1.263
- Italy	1.291 (0.203)	0.904	1.586
- France	1.541 (0.262)	0.994	2.122
- Denmark	1.294 (0.156)	0.969	1.696
- Belgium	1.897 (0.240)	1.392	2.388

Source: SHARE, waves 1, 2, 3, 4, 5 and life tables from the Human Mortality Database.
Individuals aged 65 and over in wave 5.

Table 45. Observed disability status transitions between waves 1-2 and waves 4 and 5.

Initial disability status	Final disability status					
	Non-dependent	Dependent	Alive (disability status unknown)	Deceased	Missing information	Total
< 2 ADLs (non-dependent)	**16,783**	**1,020**	1,336	812	5,176	25,127
	(0.668)	(0.041)	(0.053)	(0.032)	(0.206)	
2+ ADLs (dependent)	**272**	**976**	118	378	591	2,335
	(0.116)	(0.418)	(0.051)	(0.162)	(0.253)	
Alive (disability status unknown)	0	0	58	5	118	181
	(0.000)	(0.000)	(0.320)	(0.028)	(0.652)	
Total	17,055	1,996	1,512	1,195	5,885	27,643
	(0.618)	(0.072)	(0.054)	(0.043)	(0.213)	

Source: SHARE, waves 1, 2, 4, 5.
Individuals aged 65 and over in the initial wave.
Figures without parentheses represent the number of observations. Percentages in line are reported in parentheses.
Figures in bold correspond to the observations used to estimate the transition model.

Table 46. Hours of care needed for different activities of daily living (per week).

SHARE activities of daily living	Assumptions used in this paper	Pampalon et al. (1991)	Austrian assessment of needs (Carrino and Orso, 2014)	German assessment of needs (Carrino and Orso, 2014)
Bathing/showering	4	4	6.25	6.53
Dressing	4.67	4.67	5	Unspecified
Using the toilet (+ transfers)	7	7	Unspecified	4.67
Eating	14	14	7.5	5.95
Getting in/out of bed	4.67	4.67	3.75	0.47
Walking across a room	3.5	3.5		Unspecified
Shopping for groceries	1.63	3.25	2.5	Unspecified
Preparing hot meal	3.5	7	7.5	Unspecified
Doing work around the house or garden	6	12	7.5	Unspecified

Source: Carrino and Orso (2014), Pampalon et al. (1991).
We divide by 2 Pampalon et al.'s hours of care needed for shopping, preparing meals and doing work around the house and garden. Compared to 1991, more and more ready-made meals and household appliances are cheaply available, reducing such time costs. We also wanted to limit the overestimation of LTC costs.

Table 47. Sample selection for the analysis of ability to pay (10th simulation).

Situation in 2013 (wave 5).		At least one period of disability (10^{th} simulation)	No partner/spouse when disability occurs (10^{th} simulation)
No partner/spouse	7,466	4,326	4,326
Couple (partner/spouse interviewed)	12,440	6,247	2,468
Couple (partner/spouse not interviewed)	3,863	1,647	Date of death of the partner/spouse unknown
Total	23,769	12,220	**6,794**

Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5.
The figure in bold corresponds to the observations used to study ability to pay (in the 10^{th} simulation).

Appendix G. LTC risk and duration in the literature.

Table 48. LTC risk and duration in the literature.

Model	Data sources	Definition of LTC needs	Probability	Duration (if >0)
This study	European data (SHARE waves 1 to 5)	2+ ADLs	Total: 57% Male: 46% Female: 66%	Total: 4.3 Male: 3.7 Female: 4.6
Kemper et al., 2005	US data (Numerous datasets. Disability transitions and mortality rates are estimated using the 1994 National Long-Term Care Survey)	1+ ADL limitations, four IADL limitations, or using formal LTC services	Total: 69% Male: 58% Female: 79%	Total: 3 Male: 2.2. Female: 3.7
Duée and Rebillard, 2006	French data (*Handicap-Incapacité-Dépendance* 1998-2001 + Destinie model)	Levels of dependence 1 to 4 on the AGGIR scale (help needed for ADLs on a regular basis)	Total: 41% Male: 29% Female: 52%	Total: 4.4 Male: 3.7 Female: 4.7
Brown and Finkelstein, 2004, 2008	US data (Actuarial model of health and care transition probabilities developed by the Society of Actuaries' long-term care insurance valuation methods task force. 1982-1994 National Long-term Care Surveys and 1985 National Nursing Home Survey)	The authors do not study the risk of having LTC needs but the probability of care utilization (nursing home, assisted living, home health care), which is likely to be lower. In addition, they consider only reimbursement-eligible care utilization (care received by individuals who need substantial assistance in at least 2 ADLs).	Total: - Male: 40% Female: 54%	Total: - Male: 2.9 Female: 4.2
Fong et al., 2013	US data (Health and Retirement Study, 1998-2010)	2+ ADLs	Total: - Male: 37% Female: 54%	-

Appendix H. Characteristics of dependent individuals who have no partner.

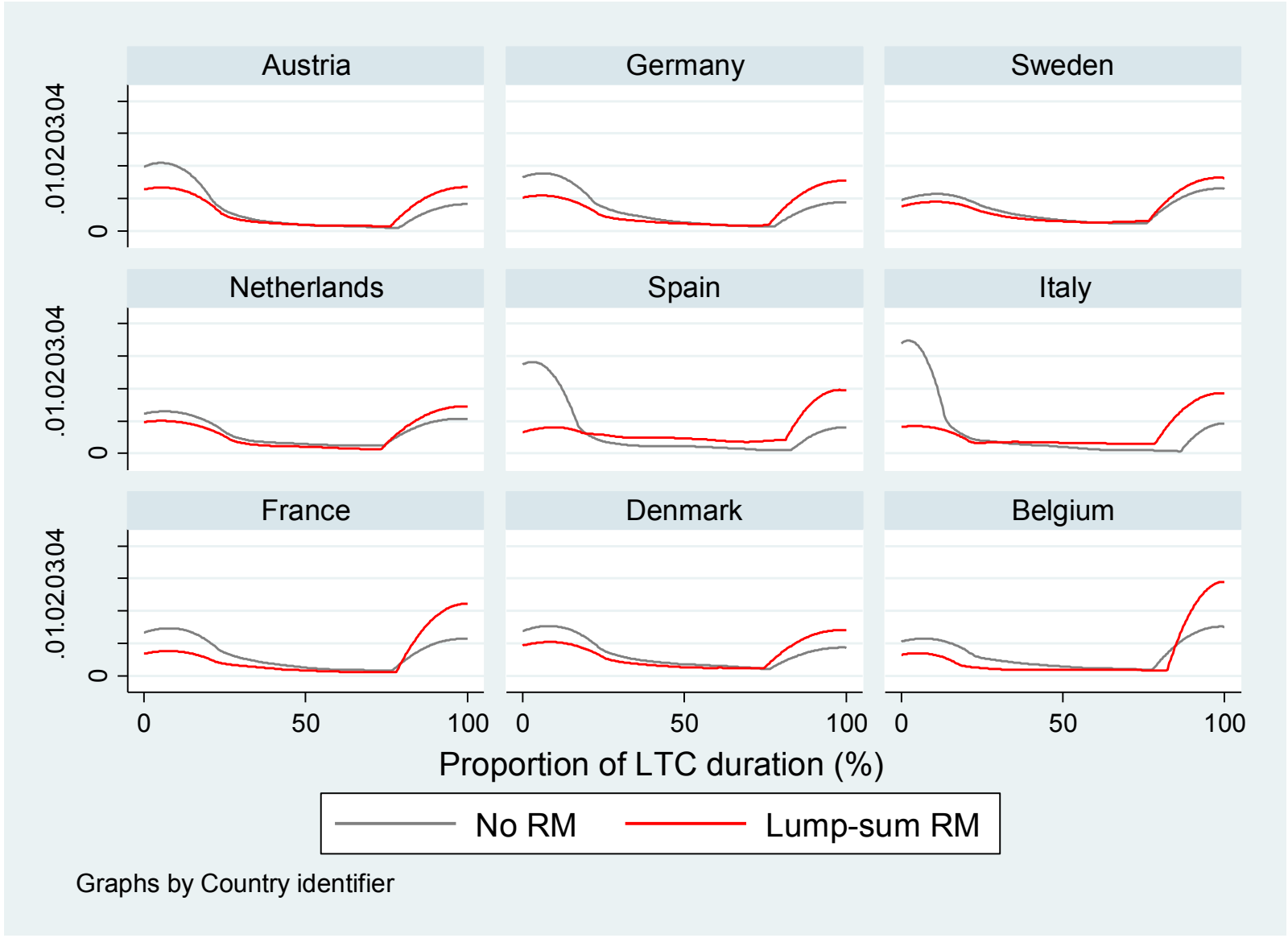
Table 49. Characteristics of the total sample and of individuals who have no partner.

Mean (standard deviation) *Median* Wave 5 characteristics	Total sample	Individuals who experience at least one period of disability and have no partner when they become dependent (10^{th} simulation)
Age	75.152	76.970
	(7.351)	(7.751)
Female	0.572	0.790
	(0.495)	(0.407)
Couple	0.639	0.313
	(0.480)	(0.464)
At least one child	0.884	0.833
	(0.321)	(0.373)
Education level		
- Pre-primary/primary	0.369	0.442
	(0.483)	(0.497)
- Secondary/post-secondary	0.459	0.426
	(0.498)	(0.495)
- Tertiary	0.172	0.131
	(0.377)	(0.338)
Disability status		
2+ ADLs (dependent)	0.101	0.175
	(0.301)	(0.380)
Resources (in euros)		
Equivalised annual household income	19,996	15,924
	(59,875)	(24,300)
	15,082	12,520
Value of household net financial assets	44,548	39,526
	(139,807)	(155,118)
	9,000	*5,000*
Owners (main residence)	0.724	0.655
	(0.447)	(0.475)
Net value of main residence (if owners, >0)	241,220	231,740
	(246,635)	(311,388)
	200,000	*180,000*
Other real estate or land	0.179	0.140
	(0.383)	(0.347)
Value of other real estate/land (if other real estate)	237,511	237,829
	(365,749)	(374,875)
	150,000	*150,000*
Number of observations	23,769	6794

Source: SHARE, wave 5.
Individuals aged 65 and over.
Weighted statistics.

Appendix I. LTC duration that dependent individuals are able to finance at the country level.

Figure 12. Distribution of ability to pay by country.



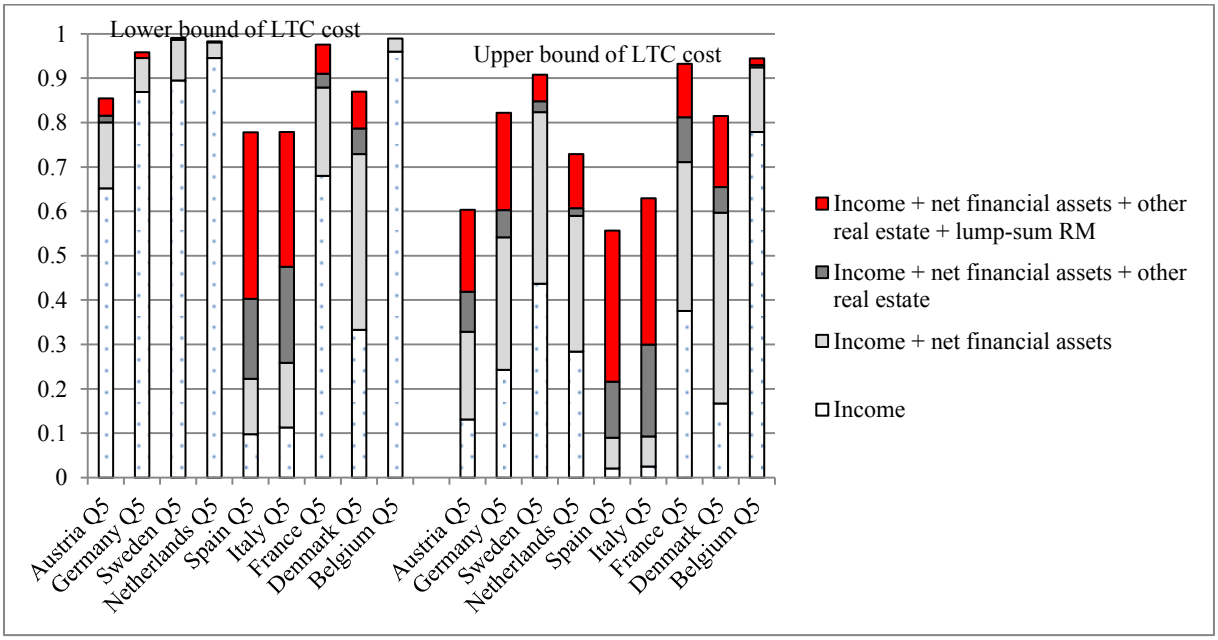
Source: SHARE, microsimulation (lower bound of LTC cost).

Individuals aged 65 and over in wave 5 and who have no partner when they become dependent (6,794 individuals).

The distribution presented here corresponds to the 10th simulation. Weighted distributions.

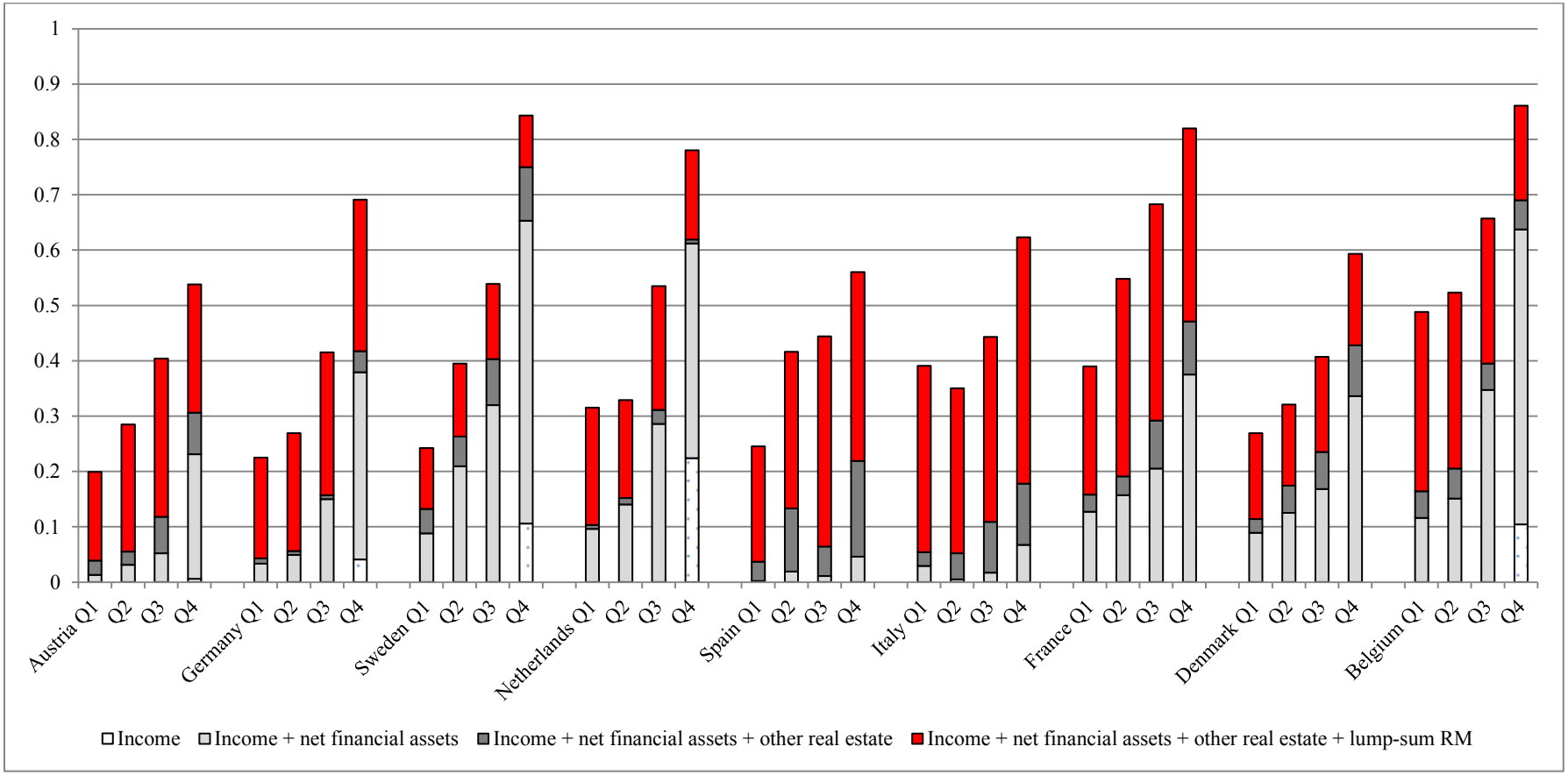
Appendix J. Ability to pay for long-term care needs by income quintile.

Figure 13. Ability to pay in the 5th income quintile.



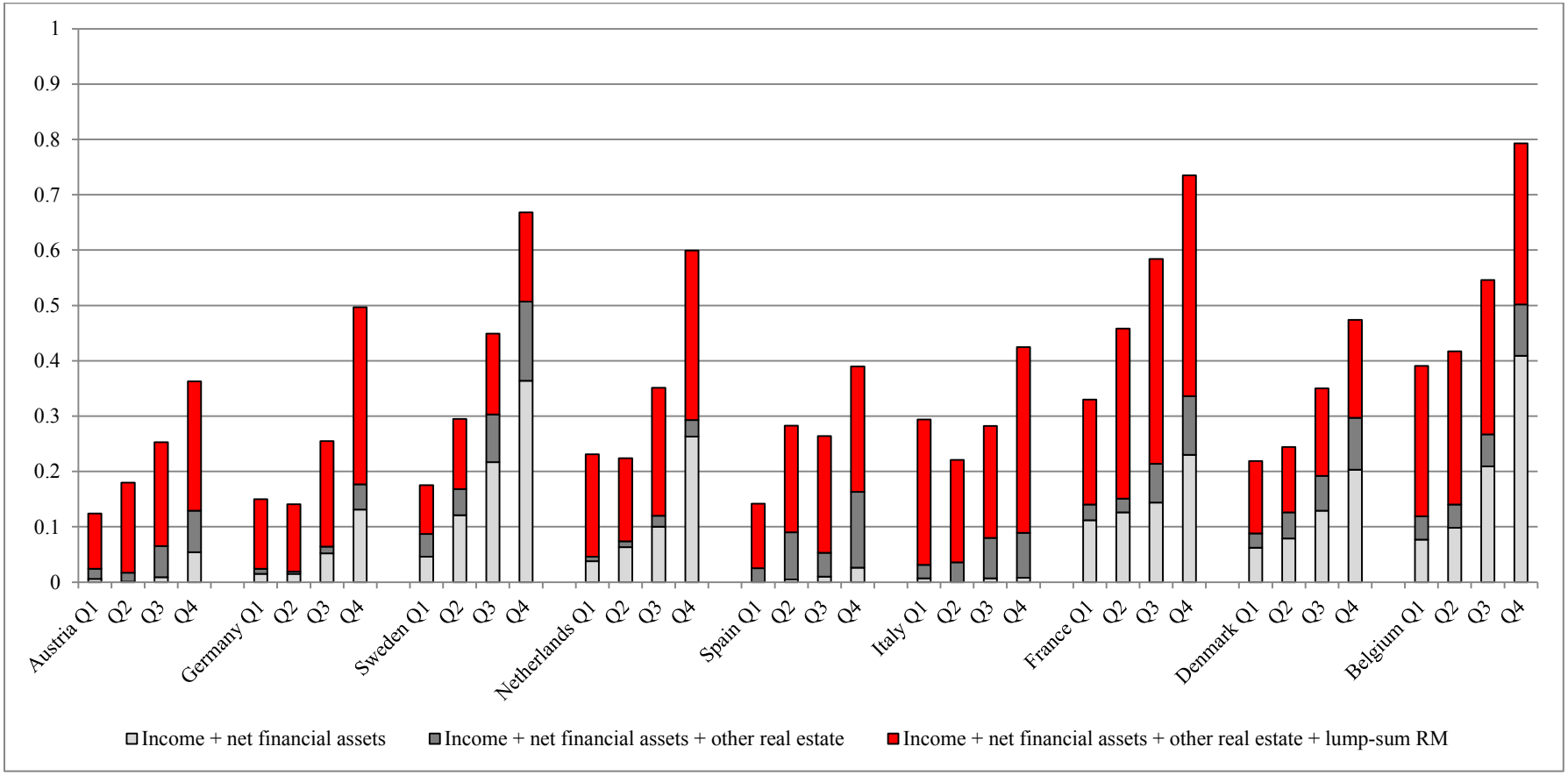
Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

Figure 14. Ability to pay in income quintiles 1 to 4 (lower bound of cost).



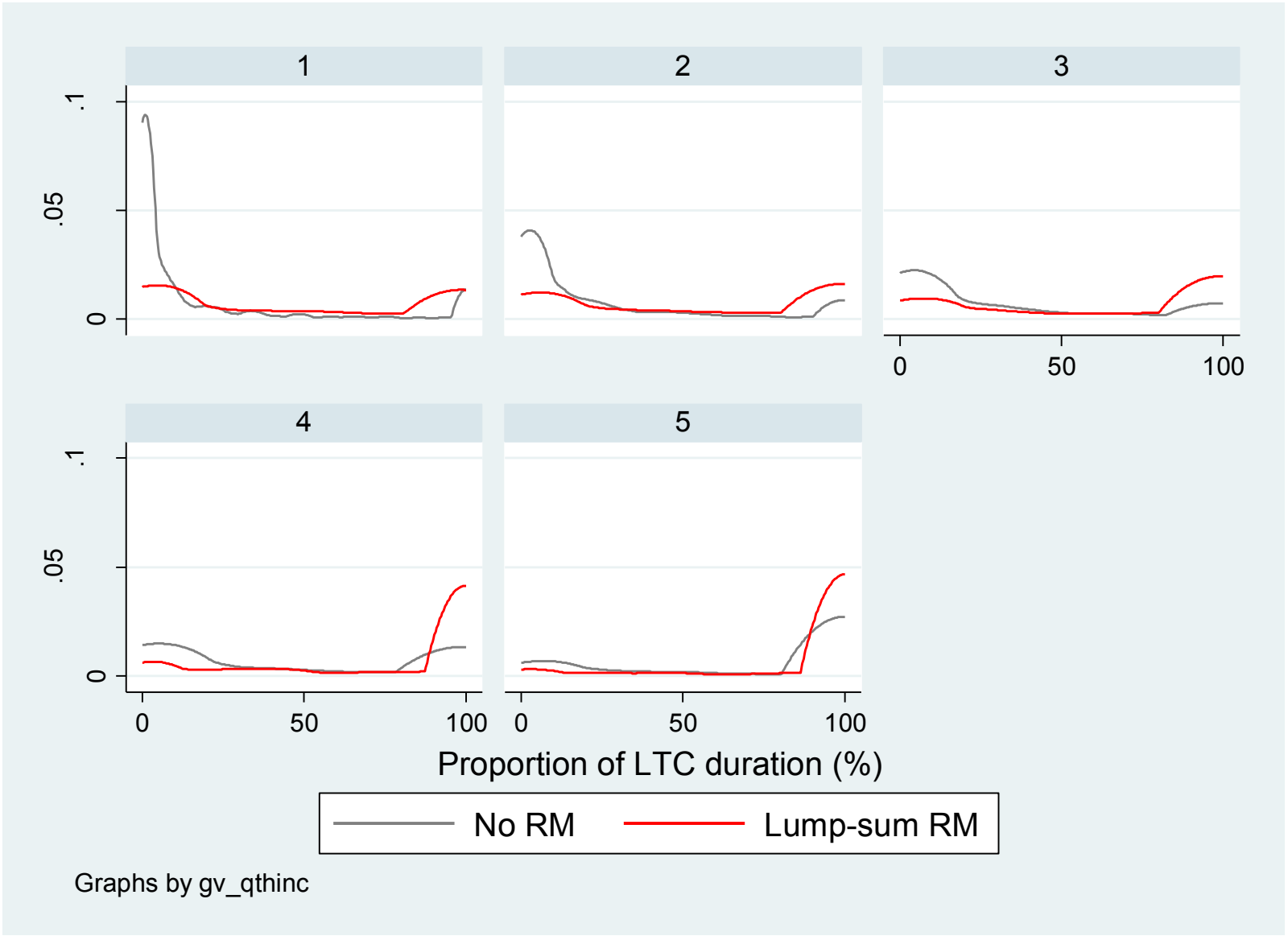
Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

Figure 15. Ability to pay in income quintiles 1 to 4 (upper bound of cost).



Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

Figure 16. Distribution of ability to pay by income quintile.



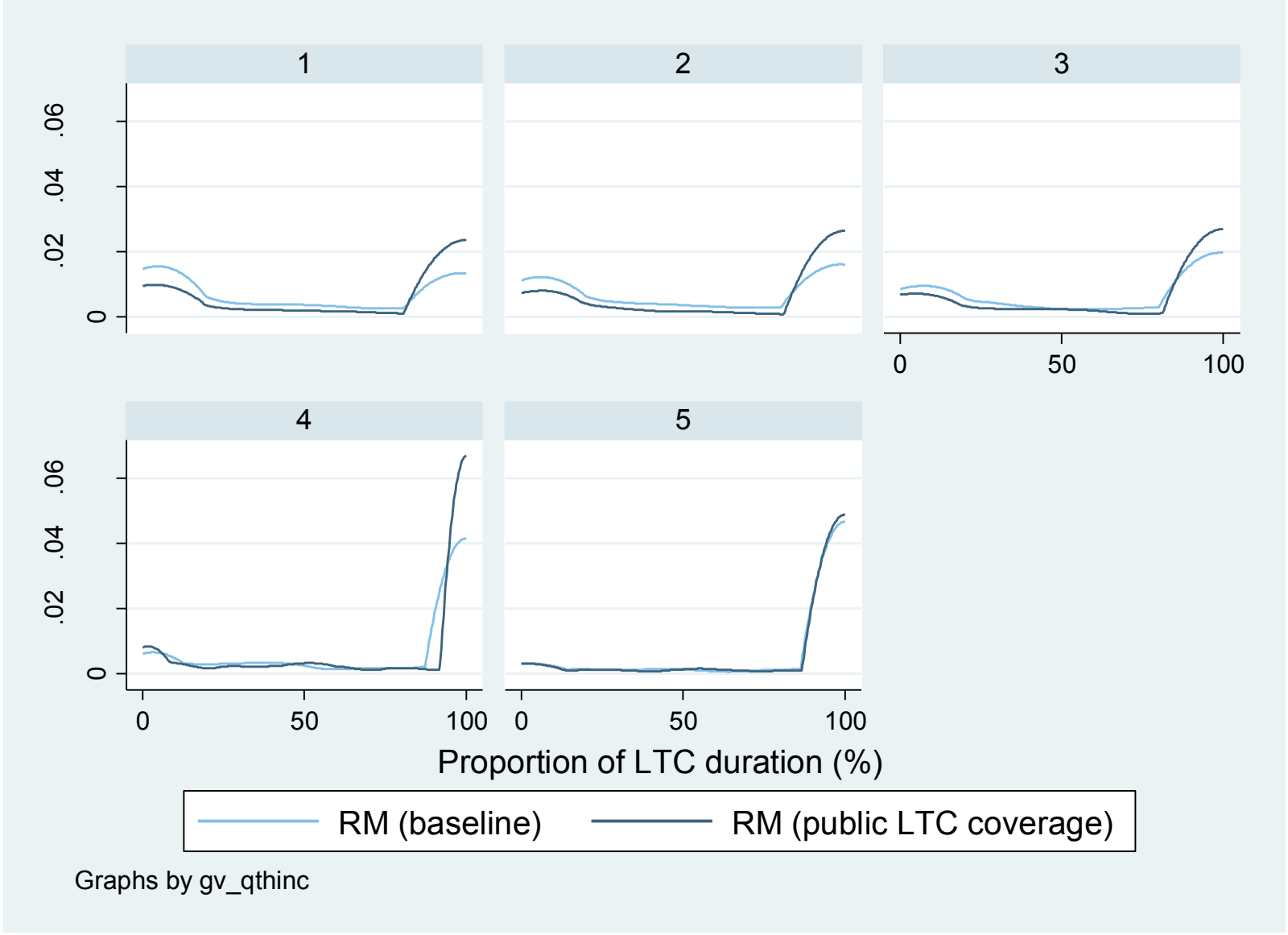
Source: SHARE, microsimulation (lower bound of LTC cost). All countries.

Individuals aged 65 and over in wave 5 and who have no partner when they become dependent (6,794 individuals).

The distribution corresponds to the 10th simulation. Weighted distributions.

Appendix K. The role of public LTC coverage.

Figure 17 Effect of public LTC coverage on the distribution of ability to pay, by income quintile.



Source: SHARE, microsimulation (lower bound of LTC cost). All countries.

Individuals aged 65 and over in wave 5 and who have no partner when they become dependent (6,794 individuals).

The distribution corresponds to the 10th simulation. Weighted distributions.

GENERAL CONCLUSION

While the theoretical literature on long-term care choices implicitly assumes that formal and informal care have beneficial effects on the health or the well-being of the elderly, this relationship has rarely been tested empirically. Indeed, the empirical literature has been more interested in caregivers' health (and labor supply), rather than on dependent elderly people. In addition, existing studies on caregivers do not take into account the diversity of care arrangements. They generally focus on the effect of providing informal care, without controlling for the existence of professional care and support from other family members or the social network. The objective of Chapters 1 and 2 was to better understand the effects of care arrangements on the health of both dependent elderly and their informal caregivers. The main methodological difficulty was the interrelationship between health and care decisions. To address this endogeneity bias, we used an instrumental variables approach. Good instruments for formal home care are difficult to find and, consequently, not well developed in the literature. We chose to use the proportion of beneficiaries of the Personal Autonomy Allowance in each French department, to capture French disparities in access to public long-term care coverage. In addition, the endogeneity of informal care (in Chapter 1) and informal support (in Chapter 2) is taken into account using characteristics of adult children. The results of the estimations highlight the importance of taking into account the endogeneity bias, since it changes the conclusions of the studies.

Chapter 1 shows that, in France, informal care significantly decreases the risk of depression of dependent elderly and formal care may improve their general mental health (measured by the Mental-Health Inventory). In addition, Chapter 2 suggests that formal home care and informal support limit mental health problems among caregivers. In both chapters, formal and informal care seem to have complementary effects.

In terms of public policies, these results suggest that improving access to formal home care could have positive effects on the health of both dependent persons and their informal caregivers. This could be achieved, for instance, by increasing the amount of the Personal Autonomy Allowance. This is one of the measures of the French Law on the adaptation of society to the aging of the population, adopted by the Parliament in December 2015. In addition, extending the eligibility to moderately dependent individuals (e.g., to the 5^{th} level of dependence, the GIR 5 in France) may delay the development of more severe forms of disability. Since the results of Chapters 1 and 2 also indicate that informal care has positive effects on the health of the elderly, and that shared informal caregiving responsibilities reduce health problems among caregivers, policymakers should provide support for informal

caregivers. The Law on the adaptation of society to the aging of the population establishes a right to respite for family caregivers. It finances daycare services and short-stay institutions for the elderly up to a limit of 500 euros per year. Measures to help caregivers to combine caring responsibilities with paid employment also seem important. In France, care leaves already exist but they are unpaid and the caregiver must have at least 2 years of seniority in the company. Thus, it does not provide much help to informal caregivers with short-term contracts and financial difficulties. Finally, counseling and training services for caregivers may represent interesting options. Of course, such measures are costly. Existing studies find some evidence of a small positive effect of caregiver support in terms of burden and mental or physical health. However, it is stressed that they have methodological weaknesses and that few studies have conducted cost-effectiveness evaluations (Lopez-Hartmann et al., 2012; Mason et al., 2007; Pickard, 2004).

Little is known on the ability of individuals to meet their long-term care needs. We know that the private insurance market is small and that public benefits do not cover the full cost of long-term care, but alternative means to finance long-term care expenditures have not received much attention in the literature. The objective of the last chapter was to investigate the ability of European elderly to pay for their long-term care needs on the basis of their income and assets, and to study the role of reverse mortgage products. Results show that, while more than half of the current 65+ will experience periods of disability, only a small proportion of them will be able to finance their long-term care expenses. In the absence of public coverage and informal care, only 7% of dependent individuals will be able to pay for long-term care out of their income, 18% if financial assets are depleted and 50% if individuals take out reverse mortgages to extract home equity. Thus, reverse mortgages may play an important role in the long-term care financing, particularly for *house-rich* and *income-poor* individuals.

However, the results suggest that half of the dependent elderly cannot totally pay for long-term care and one fifth can finance less than 5% of their needs. It should also be kept in mind that the reverse mortgage market is very small in practice. It highlights the necessity for additional coverage, provided publicly or by informal caregivers. It is all the more important that Chapter 1 stresses that formal and informal care have positive effects on the mental health of dependent elderly. In addition, the strong effect of housing assets on the ability to pay for long-term care questions the eligibility criteria for publicly funded care. In France, access to

the Personal Autonomy Allowance depends only on the level of dependence, but the beneficiary pays a contribution based on income and financial wealth. Housing assets are not taken into account, which may generate important inequalities. Indeed, two persons with the same income and financial wealth will get the same amount of Personal Autonomy Allowance, even if one has no home equity and the other owns housing assets. It would be possible, using assets tests, to provide more support to the most vulnerable elderly. For instance, a recent report in the UK (Dilnot Report, 2011) recommends capping the lifetime contribution to long-term care costs at between £25,000 and £50,000. After the cap is reached, individuals would receive full public support. Those who are unable to pay would be covered by public insurance from the onset of long-term care needs.

The definition of dependent elderly people in this doctoral dissertation is based only on age and restrictions in activities of daily living. Similarly, in Chapters 1 and 2, the health status of elderly persons and caregivers is approached using simple indicators, generally binary variables. However, as underlined in the introduction, the notion of *"dependence"* and, *a fortiori*, the concept of *"health"* are multidimensional. In particular, the physical and social environment of the elderly should be taken into account. Chapters 1 and 2 incorporate a social dimension in that they study the interaction between informal care or informal support and health. In future analyses, it would be interesting to also account for care equipment, such as stair-lifts and wheelchair ramps, and home adaptation. These technologies may promote the elderly's autonomy and will probably become more common in coming years.

Chapters 1 and 2 could be extended in several directions. Future research could study whether the effect of formal and informal care on the health of dependent elderly depends on the level of dependence and the type of disability (cognitive or physical). For instance, informal care may have an effect only for moderately dependent persons while formal care may be more effective for severe disability and persons with cognitive impairments. In addition, Chapter 2 focuses on caregivers' health. However, other outcomes might also be important, such as the effect of caregiving on family conflicts, economic strains and social life (Pearlin et al., 1990). To my knowledge, these dimensions, which may in turn impact caregivers' health and well-being, have not been studied in the economic literature.

The model of Chapter 3 could be used to simulate more realistic informal care and public policies scenarios. It would also be instructive to replicate this model for England, where access to public funded long-term care is means-tested. In addition, future research could

investigate more specifically how people finance nursing home costs. The literature is very scarce on this topic and mainly qualitative (Billaud, 2012). SHARE (the *Survey of Health Ageing and Retirement in Europe*) and ELSA (*English Longitudinal Study of Ageing*) follow individuals when they enter nursing homes and provide precise information on homeownership, incomes, financial assets and financial and material gifts. It is thus possible to study the impact of nursing home entry on financial and housing assets. It will highlight the financing strategies of older people and their family across time (do they deplete first financial assets that are more liquid? Do they sell or rent the home? Do they receive private transfers from children?). Interestingly, wave 2 of ELSA asks individuals what are the chances that they will move to a nursing home in the next five years. This information makes it possible to study whether individuals who anticipate the nursing home risk have specific financial behaviors.

REFERENCES

Ahlstrom, A., Tumlinson, A., Lambrew, J., 2004. Linking Reverse Mortgages and Long-Term Care Insurance. Primer, The Brookings Institution and Georges Washington University.

Akerlof, G.A., Kranton, R.E., 2000. Economics and Identity*. Quarterly Journal of Economics 115, 715–753. doi:10.1162/003355300554881

Alvira, M.C., Risco, E., Cabrera, E., Farré, M., Rahm Hallberg, I., Bleijlevens, M.H.C., Meyer, G., Koskenniemi, J., Soto, M.E., Zabalegui, A., The RightTimePlaceCare Consortium, 2014. The association between positive-negative reactions of informal caregivers of people with dementia and health outcomes in eight European countries: a cross-sectional study. Journal of Advanced Nursing. doi:10.1111/jan.12528

Angelini, V., Brugiavini, A., Weber, G., 2014. The dynamics of homeownership among the 50+ in Europe. Journal of Population Economics 27, 797–823. doi:10.1007/s00148-013-0477-5

Angelini, V., Laferrère, A., 2012. Residential Mobility of the European Elderly. CESifo Economic Studies 58, 544–569. doi:10.1093/cesifo/ifr017

Angrist, J.D., 2009. Mostly harmless econometrics: an empiricist's companion. Princeton University Press, Princeton.

Arnault, L., 2015. La prise en charge des personnes âgées dépendantes: analyse microéconométrique de l'aide familiale. Université Paris-Dauphine, Paris.

Arrighi, Y., Davin, B., Trannoy, A., Ventelou, B., 2015. The non-take up of long-term care benefit in France: A pecuniary motive? Health Policy 119, 1338–1348. doi:10.1016/j.healthpol.2015.07.003

Assier Andrieu, L., Gotman, A., 2009. Réversion du principe du logement humain - Chronique du prêt hypothécaire inversé. Rapport de recherche pour le Ministère de l'Ecologie, de l'Energie, du Développement Durable et de l'Aménagement du Territoire - Plan Urbanisme Construction Architecture (PUCA).

Baum, C.F., Schaffer, M.E., Stillman, S., 2007. Ivreg2: Stata module for extended instrumental variables/2SLS, GMM and AC/HAC, LIML and k-class regression.

Benítez-Silva, H., Eren, S., Heiland, F., Jiménez-Martín, S., 2015. How well do individuals predict the selling prices of their homes? Journal of Housing Economics 29, 12–25. doi:10.1016/j.jhe.2015.04.001

Berecki-Gisolf, J., Lucke, J., Hockey, R., Dobson, A., 2008. Transitions into informal caregiving and out of paid employment of women in their 50s. Social Science & Medicine 67, 122–127. doi:10.1016/j.socscimed.2008.03.031

Bernheim, B.D., Shleifer, A., Summers, L.H., 1985. The Strategic Bequest Motive. Journal of Political Economy 93, 1045–1076.

Billaud, S., 2012. Financer le vieillissement en institution par le patrimoine en milieu modeste. Retraite et société 62, 105–125.

Bishop, T.B., Shan, H., 2008. Reverse Mortgages: A Closer Look at HECM Loans.

Blanchet, D., Le Gallo, F., 2008. Les projections démographiques: Principaux mécanismes et retour sur l'expérience française. Revue économique 59, 893–912. doi:10.3917/reco.595.0893

Bobinac, A., van Exel, N.J.A., Rutten, F.F.H., Brouwer, W.B.F., 2011. Health effects in significant others: separating family and care-giving effects. Medical decision making: an international journal of the Society for Medical Decision Making 31, 292–298. doi:10.1177/0272989X10374212

Bobinac, A., van Exel, N.J.A., Rutten, F.F.H., Brouwer, W.B.F., 2010. Caring for and caring about: disentangling the caregiver effect and the family effect. Journal of health economics 29, 549–556. doi:10.1016/j.jhealeco.2010.05.003

Bockarjova, M., Polder, J., Rouwendal, J., 2014. Long Term Care, Wealth and Housing. Netspar Discussion Paper No. 01/2014-099.
Bolin, K., Lindgren, B., Lundborg, P., 2008a. Your next of kin or your own career? Journal of Health Economics 27, 718–738. doi:10.1016/j.jhealeco.2007.10.004
Bolin, K., Lindgren, B., Lundborg, P., 2008b. Informal and formal care among single-living elderly in Europe. Health economics 17, 393–409. doi:10.1002/hec.1275
Bommier, A., 1995. Peut-on compter sur ses enfants pour assurer ses vieux jours ? L'exemple de la Malaisie. Économie & prévision 121, 75–86. doi:10.3406/ecop.1995.5761
Bonnet, C., Gobillon, L., Laferrère, A., 2010. The effect of widowhood on housing and location choices. Journal of Housing Economics 19, 94–108. doi:10.1016/j.jhe.2010.04.003
Bonsang, E., 2009. Does informal care from children to their elderly parents substitute for formal care in Europe? Journal of Health Economics 28, 143–154. doi:10.1016/j.jhealeco.2008.09.002
Bonsang, E., 2007. How do middle-aged children allocate time and money transfers to their older parents in Europe? Empirica 34, 171–188. doi:10.1007/s10663-007-9034-3
Bonsang, E., Bordone, V., 2013. The Effect of Informal Care from Children on Cognitive Functioning of Older Parents. Netspar Discussion Paper No. 01/2013-008.
Borsch-Supan, A., Brandt, M., Hunkler, C., Kneip, T., Korbmacher, J., Malter, F., Schaan, B., Stuck, S., Zuber, S., on behalf of the SHARE Central Coordination Team, 2013. Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). International Journal of Epidemiology 42, 992–1001. doi:10.1093/ije/dyt088
Brandt, M., Haberkern, K., Szydlik, M., 2009. Intergenerational Help and Care in Europe. European Sociological Review 25, 585–601. doi:10.1093/esr/jcn076
Brown, J., Finkelstein, A., 2004. The Interaction of Public and Private Insurance: Medicaid and the Long-Term Care Insurance Market (No. w10989). National Bureau of Economic Research, Cambridge, MA.
Brown, J.R., Finkelstein, A., 2009. The Private Market for Long-Term Care Insurance in the United States: A Review of the Evidence. Journal of Risk and Insurance 76, 5–29. doi:10.1111/j.1539-6975.2009.01286.x
Brown, J.R., Finkelstein, A., 2008. The Interaction of Public and Private Insurance: Medicaid and the Long-Term Care Insurance Market. American Economic Review 98, 1083–1102. doi:10.1257/aer.98.3.1083
Brown, J.R., Finkelstein, A., 2007. Why is the market for long-term care insurance so small? Journal of Public Economics 91, 1967–1991. doi:10.1016/j.jpubeco.2007.02.010
Burton, L.C., Zdaniuk, B., Schulz, R., Jackson, S., Hirsch, C., 2003. Transitions in spousal caregiving. The Gerontologist 43, 230–241.
Byrne, D., Goeree, M.S., Hiedemann, B., Stern, S., 2009. Formal home health care, informal care, and family decision making. International Economic Review 50, 1205–1242. doi:10.1111/j.1468-2354.2009.00566.x
Cambois, E., Blachier, A., Robine, J.-M., 2013. Aging and health in France: an unexpected expansion of disability in mid-adulthood over recent years. The European Journal of Public Health 23, 575–581. doi:10.1093/eurpub/cks136
Cambois, E., Clavel, A., Romieu, I., Robine, J.-M., 2008. Trends in disability-free life expectancy at age 65 in France: consistent and diverging patterns according to the underlying disability measure. European Journal of Ageing 5, 287–298. doi:10.1007/s10433-008-0097-1
Cambois, E., Lièvre, A., 2007. Les passages de l'autonomie à la dépendance. Gérontologie et société 121, 85–102. doi:10.3917/gs.121.0085

Cambois, E., Robine, J.-M., 2003. Concepts et mesure de l'incapacité : définitions et application d'un modèle à la population française. Retraite et société 39, 59–91.
Carmichael, F., Charles, S., Hulme, C., 2010. Who will care? Employment participation and willingness to supply informal care. Journal of Health Economics 29, 182–190. doi:10.1016/j.jhealeco.2009.11.003
Carrino, L., Orso, C.E., 2014. Eligibility and inclusiveness of Long-Term Care Institutional frameworks in Europe: a cross-country comparison. Ca' Foscari University of Venice, Department of Economics Working Paper.
Chappell, N.L., Reid, R.C., 2002. Burden and well-being among caregivers: examining the distinction. The Gerontologist 42, 772–780.
Charles, K.K., Sevak, P., 2005. Can family caregiving substitute for nursing home care? Journal of Health Economics 24, 1174–1190. doi:10.1016/j.jhealeco.2005.05.001
Charpin, J.-M., Tlili, C., 2011. Perspectives démographiques et financières de la dépendance.
Checkovich, T.J., Stern, S., 2002. Shared Caregiving Responsibilities of Adult Siblings with Elderly Parents. The Journal of Human Resources 37, 441. doi:10.2307/3069678
Choo, W.-Y., Low, W.-Y., Karina, R., Poi, P.J.H., Ebenezer, E., Prince, M.J., 2003. Social support and burden among caregivers of patients with dementia in Malaysia. Asia-Pacific Journal of Public Health / Asia-Pacific Academic Consortium for Public Health 15, 23–29.
Christianson, J.B., 1988. The evaluation of the National Long Term Care Demonstration. 6. The effect of channeling on informal caregiving. Health Services Research 23, 99–117.
Clyburn, L.D., Stones, M.J., Hadjistavropoulos, T., Tuokko, H., 2000. Predicting caregiver burden and depression in Alzheimer's disease. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences 55, S2-13.
Coe, N.B., Van Houtven, C.H., 2009. Caring for mom and neglecting yourself? The health effects of caring for an elderly parent. Health economics 18, 991–1010. doi:10.1002/hec.1512
Colin Cameron, A., Miller, D.L., 2015. A Practitioner's Guide to Cluster-Robust Inference. Journal of Human Resources 50, 317–372. doi:10.3368/jhr.50.2.317
Colombo, F., Llena-Nozal, A., Mercier, J., Frits, T., 2011a. Chapter 8 - Private Long-term Care Insurance: A Niche or a "Big Tent"?, in: Help Wanted? Providing and Paying for Long-Term Care, OECD Health Policy Studies.
Colombo, F., Llena-Nozal, A., Mercier, J., Frits, T., 2011b. Chapter 7 - Public Long-term Care Financing Arrangements in OECD Countries, in: Help Wanted? Providing and Paying for Long-Term Care, OECD Health Policy Studies.
Comas-Herrera, A., Pickard, L., Wittenberg, R., Malley, J., King, D., 2010. The long-term care system for the elderly in England. Enepri Research Report NO. 74.
Consumer Financial Protection Bureau, 2012. Reverse mortgages. Report to Congress.
Costa-Font, J., 2008. Housing assets and the socio-economic determinants of health and disability in old age. Health & Place 14, 478–491. doi:10.1016/j.healthplace.2007.09.005
Costa-Font, J., Elvira, D., Mascarilla-Miro, O., 2009. `Ageing in Place'? Exploring Elderly People's Housing Preferences in Spain. Urban Studies 46, 295–316. doi:10.1177/0042098008099356
Costa-Font, J., Gil, J., Mascarilla, O., 2010. Housing Wealth and Housing Decisions in Old Age: Sale and Reversion. Housing Studies 25, 375–395. doi:10.1080/02673031003711014
Costa-Font, J., Rovira-Forns, J., 2008. Who is willing to pay for long-term care insurance in Catalonia? Health Policy 86, 72–84. doi:10.1016/j.healthpol.2007.09.011

Courbage, C., Roudaut, N., 2008. Empirical Evidence on Long-term Care Insurance Purchase in France. The Geneva Papers on Risk and Insurance - Issues and Practice 33, 645–658.

Crimmins Eileen M., Hayward Mark D., Hagedorn Aaron, Saito Yasuhiko, Brouard Nicolas, 2009. Change in Disability-Free Life Expectancy for Americans 70 Years Old and Older. Demography 46, 627–646. doi:10.1353/dem.0.0070

Da Roit, B., Le Bihan, B., 2010. Similar and Yet So Different: Cash-for-Care in Six European Countries' Long-Term Care Policies: Six European Countries' Long-Term Care Policies. Milbank Quarterly 88, 286–309. doi:10.1111/j.1468-0009.2010.00601.x

Davidoff, T., 2010. Home equity commitment and long-term care insurance demand. Journal of Public Economics 94, 44–49. doi:10.1016/j.jpubeco.2009.09.006

Davidoff, T., 2009. Housing, Health, and Annuities. Journal of Risk and Insurance 76, 31–52. doi:10.1111/j.1539-6975.2009.01287.x

Davidoff, T., Gerhard, P., Post, T., 2014. Reverse Mortgages: What Homeowners (Don't) Know and How it Matters.

Di Novi, C., Jacobs, R., Migheli, M., 2015. The Quality of Life of Female Informal Caregivers: From Scandinavia to the Mediterranean Sea. European Journal of Population 31, 309–333. doi:10.1007/s10680-014-9336-7

Dillingh, R., Prast, H., Urzí Brancati, M.C., Rossi, M., 2013. The psychology and economics of reverse mortgage attitudes: evidence from the Netherlands. Center for Research on Pensions and Welfare Policies.

Dilnot, A., Warner, L.N., Williams, D.J., 2011. Fairer Care Funding. The Report of the Commission on Funding of Care and Support.

Do, Y.K., Norton, E.C., Stearns, S.C., Van Houtven, C.H., 2015. Informal Care and Caregiver's Health. Health Economics 24, 224–237. doi:10.1002/hec.3012

Ducharme, F., Lévesque, L., Zarit, S.H., Lachance, L., Giroux, F., 2007. Changes in health outcomes among older husband caregivers: a one-year longitudinal study. International Journal of Aging & Human Development 65, 73–96.

Duée, M., Rebillard, C., 2006. La dépendance des personnes âgées: une projection en 2040. Données sociales : La société française - Edition 2006.

Engers, M., Stern, S., 2002. Long-term care and family bargaining. International Economic Review 43, 73–114. doi:10.1111/1468-2354.t01-1-00004

Ennuyer, B., 2003. Histoire d'une catégorie : « personnes âgées dépendantes », in: Martin, C. (Ed.), La dépendance des personnes âgées: Quelles politiques en Europe?, Collection Res Publica. Presses Univ. de Rennes, Rennes.

Eschtruth, A.D., Tran, L.C., 2001. A Primer on Reverse Mortgages. Center for Retirement Research at Boston College.

Ettner, S.L., 1994. The effect of the Medicaid home care benefit onlong long-term care choices of the elderly. Economic Inquiry 32, 103–127. doi:10.1111/j.1465-7295.1994.tb01315.x

European Commission, 2015. The 2015 pension adequacy report: current and future income adequacy in old age in the EU : volume I. Publications Office, Luxembourg.

European Commission, Economic Policy Committee of the European Communities, 2015. The 2015 ageing report economic and budgetary projections for the 28 EU Member States (2013-2060). Publications Office, Luxembourg.

European Commission, Economic Policy Committee of the European Communities, 2014. The 2015 ageing report underlying assumptions and projection methodologies. [Publications Office], [Luxembourg].

Fast, J.E., Williamson, D.L., Keating, N.C., 1999. The hidden costs of informal elder care. Journal of Family and Economic Issues 20, 301–326. doi:10.1023/A:1022909510229

Flash Eurobarometer, 2008. Family life and the needs of an ageing population, Analytical report.
Fong, J.H., Shao, A.W., Sherris, M., 2013. Multistate Actuarial Models of Functional Disability. Australian School of Business Research Paper.
Fontaine, R., Gramain, A., Wittwer, J., 2009. Providing care for an elderly parent: interactions among siblings? Health Economics 18, 1011–1029. doi:10.1002/hec.1533
Fontaine, R., Gramain, A., Wittwer, J., 2007. Les configurations d'aide familiales mobilisées autour des personnes âgées dépendantes en Europe. Economie et statistique 403, 97–115. doi:10.3406/estat.2007.7090
Fontaine, R., Plisson, M., Zerrar, N., 2014. Dans quelle mesure les préférences individuelles contraignent-elles le développement du marché de l'assurance dépendance ? Economie et statistique 474, 35–68.
Fontaine, R., Zerrar, N., 2013. Comment expliquer la faible disposition des individus à se couvrir face au risque dépendance ? Une revue de la littérature. Questions d'économie de la Santé 188.
Fornero, E., Rossi, M., Urzí Brancati, M.C., 2016. Explaining why, right or wrong, (Italian) households do not like reverse mortgages. Journal of Pension Economics and Finance 15, 180–202. doi:10.1017/S1474747215000013
Fouweather, T., Gillies, C., Wohland, P., Van Oyen, H., Nusselder, W., Robine, J.-M., Cambois, E., Jagger, C., for the JA: EHLEIS Team, 2015. Comparison of socio-economic indicators explaining inequalities in Healthy Life Years at age 50 in Europe: 2005 and 2010. The European Journal of Public Health 25, 978–983. doi:10.1093/eurpub/ckv070
Friedberg, L., Hou, W., Sun, W., Webb, A., Zhenyu, L., 2014. New evidence on the risk of requiring long-term care. CRR WP 2014-12, Center for Retirement Research at Boston College.
Fries, J.F., 1980. Aging, natural death, and the compression of morbidity. The New England Journal of Medicine 303, 130–135. doi:10.1056/NEJM198007173030304
Gaymu, J., Ekamper, P., Beets, G., 2007. Who will be caring for Europe's dependent elders in 2030? Population 62, 789. doi:10.3917/popu.704.0789
Gaymu, J., FELICIE team, 2008. What family support will dependent elders have in 2030? European projections. Population & Societies 444.
Gaymu, J., Festy, P., Poulain, M., 2008. Future elderly living conditions in Europe. Institut national d'études démographiques, Cahier n°162, Paris.
Golberstein, E., Grabowski, D.C., Langa, K.M., Chernew, M.E., 2009. Effect of Medicare home health care payment on informal care. Inquiry: a journal of medical care organization, provision and financing 46, 58–71.
Greenberger, H., Litwin, H., 2003. Can burdened caregivers be effective facilitators of elder care-recipient health care? Journal of Advanced Nursing 41, 332–341.
Greene, V.L., 1983. Substitution between formally and informally provided care for the impaired elderly in the community. Medical care 21, 609–619.
Grossman, M., 1972. On the concept of health capital and the demand for health. The Journal of Political Economy 80, 223–255.
Gruenberg, E.M., 1977. The failures of success. The Milbank Memorial Fund Quarterly. Health and Society 55, 3–24.
Haberkern, K., Szydlik, M., 2010. State care provision, societal opinion and children's care of older parents in 11 European countries. Ageing and Society 30, 299–323. doi:10.1017/S0144686X09990316
Hancook, R., 1998. Can Housing Wealth Alleviate Poverty among Britain's Older Population? Fiscal Studies 19, 249–272. doi:10.1111/j.1475-5890.1998.tb00287.x

Heckman, J.J., 1979. Sample Selection Bias as a Specification Error. Econometrica 47, 153. doi:10.2307/1912352
Hege, R., Roquebert, Q., Tenand, M., Gramain, A., 2014. La tarification des services d'aide à domicile : un outil au service des politiques départementales ? Collection Notes MODAPA 2.
Heitmueller, A., 2007. The chicken or the egg? Journal of Health Economics 26, 536–559. doi:10.1016/j.jhealeco.2006.10.005
Herrera, A.P., Lee, J.W., Nanyonjo, R.D., Laufman, L.E., Torres-Vigil, I., 2009. Religious coping and caregiver well-being in Mexican-American families. Aging & Mental Health 13, 84–91. doi:10.1080/13607860802154507
Hiedemann, B., Stern, S., 1999. Strategic play among family members when making long-term care decisions. Journal of Economic Behavior & Organization 40, 29–57. doi:10.1016/S0167-2681(99)00041-4
Hirst, M., 2005. Carer distress: A prospective, population-based study. Social Science & Medicine 61, 697–708. doi:10.1016/j.socscimed.2005.01.001
Hoerger, T.J., Picone, G.A., Sloan, F.A., 1996. Public Subsidies, Private Provision of Care and Living Arrangements of the Elderly. The Review of Economics and Statistics 78, 428. doi:10.2307/2109790
Hoeymans, N., Garssen, A.A., Westert, G.P., Verhaak, P.F.M., 2004. Measuring mental health of the Dutch population: a comparison of the GHQ-12 and the MHI-5. Health and Quality of Life Outcomes 2, 23. doi:10.1186/1477-7525-2-23
Hussem, A., van Ewijk, C., ter Rele, H., Wong, A., 2016. The ability to pay for long-term care in the Netherlands: a life-cycle perspective. CPB Netherlands Bureau for Economic Policy Analysis CPB Discussion Paper 321.
Jachiet, N., Friggit, J., Vorms, B., Taffin, C., 2004. Rapport sur le prêt viager hypothécaire et la mobilisation de l'actif résidentiel des personnes âgées.
Jacobs, J.C., Van Houtven, C.H., Laporte, A., Coyte, P.C., 2015. Baby Boomer caregivers in the workforce: Do they fare better or worse than their predecessors? The Journal of the Economics of Ageing 6, 89–101. doi:10.1016/j.jeoa.2015.05.001
Jagger, C., Matthews, F.E., Wohland, P., Fouweather, T., Stephan, B.C.M., Robinson, L., Arthur, A., Brayne, C., 2016. A comparison of health expectancies over two decades in England: results of the Cognitive Function and Ageing Study I and II. The Lancet 387, 779–786. doi:10.1016/S0140-6736(15)00947-2
Jeger, F., 2005. L'Allocation personnalisée d'autonomie : une analyse des disparités départementales en 2003. Etudes et Résultats 372.
Katz, S., Ford, A.B., Moskowitz, R.W., Jackson, B.A., Jaffe, M.W., 1963. Studies of illness in the aged. The Index of ADL: A standardized measure of biological and psychosocial function. JAMA 185, 914–919.
Kelly, M.J., Dunstan, F.D., Lloyd, K., Fone, D.L., 2008. Evaluating cutpoints for the MHI-5 and MCS using the GHQ-12: a comparison of five different methods. BMC Psychiatry 8, 10. doi:10.1186/1471-244X-8-10
Kemper, P., Komisar, H.L., Alecxih, L., 2005. Long-term care over an uncertain future: what can current retirees expect? Inquiry: A Journal of Medical Care Organization, Provision and Financing 42, 335–350.
Kotlikoff, L.J., Morris, J.N., 1990. Why Don't the Elderly Live with Their Children? A New Look, in: Wise, D.A. (Ed.), Issues in the Economics of Aging, A National Bureau of Economic Research Project Report. University of Chicago Press, Chicago.
Kotlikoff, L.J., Spivak, A., 1981. The Family as an Incomplete Annuities Market. Journal of Political Economy 89, 372–391.

Kraus, M., Riedel, M., Mot, E., Willemé, P., Röhrling, G. (Eds.), 2011. A typology of long-term care systems in Europe, ENEPRI research report. ENEPRI, Brussels.

Laferrère, A., 2012. Housing Wealth as Self-insurance for Long-Term Care, in: Costa-Font, J., Courbage, C. (Eds.), Financing Long-Term Care in Europe: Institutions, Markets and Models. Palgrave Macmillan UK, London, pp. 73–90.

Lafortune, G., Balestat, G., 2007. Trends in Severe Disability Among Elderly People: Assessing the Evidence in 12 OECD Countries and the Future Implications. OECD Health Working Papers NO. 26.

Lawton, M.P., Brody, E.M., 1969. Assessment of Older People: Self-Maintaining and Instrumental Activities of Daily Living. The Gerontologist 9, 179–186. doi:10.1093/geront/9.3_Part_1.179

Lawton, M.P., Moss, M., Kleban, M.H., Glicksman, A., Rovine, M., 1991. A two-factor model of caregiving appraisal and psychological well-being. Journal of Gerontology 46, P181-189.

Lee, M., Yoon, E., Kropf, N.P., 2007. Factors affecting burden of South Koreans providing care to disabled older family members. International Journal of Aging & Human Development 64, 245–262.

Lilly, M.B., Laporte, A., Coyte, P.C., 2010. Do they care too much to work? The influence of caregiving intensity on the labour force participation of unpaid caregivers in Canada. Journal of Health Economics 29, 895–903. doi:10.1016/j.jhealeco.2010.08.007

Lilly, M.B., Laporte, A., Coyte, P.C., 2007. Labor market work and home care's unpaid caregivers: a systematic review of labor force participation rates, predictors of labor market withdrawal, and hours of work. The Milbank Quarterly 85, 641–690. doi:10.1111/j.1468-0009.2007.00504.x

Lo Sasso, A.T., Johnson, R.W., 2002. Does Informal Care from Adult Children Reduce Nursing Home Admissions for the Elderly? Inquiry 39, 279–297.

Lopez-Hartmann, M., Wens, J., Verhoeven, V., Remmen, R., 2012. The effect of caregiver support interventions for informal caregivers of community-dwelling frail elderly: a systematic review. International Journal of Integrated Care 12, e133.

Manton, K.G., 1982. Changing concepts of morbidity and mortality in the elderly population. The Milbank Memorial Fund Quarterly. Health and Society 60, 183–244.

Marbot, C., Roy, D., 2015. Projections du coût de l'APA et des caractéristiques de ses bénéficiaires à l'horizon 2040 à l'aide du modèle Destinie. Economie et Statistique 185–209.

Mason, A., Weatherly, H., Spilsbury, K., Arksey, H., Golder, S., Adamson, J., Drummond, M., Glendinning, C., 2007. A systematic review of the effectiveness and cost-effectiveness of different models of community-based respite care for frail older people and their carers. Health Technology Assessment (Winchester, England) 11, 1–157, iii.

Masson, A., 2015. L'épargnant propriétaire face à ses vieux jours. Revue française d'économie XXX, 129-177. doi:10.3917/rfe.152.0129

Mayhew, L., Karlsson, M., Rickayzen, B., 2010. The Role of Private Finance in Paying for Long Term Care. The Economic Journal 120, 478–504. doi:10.1111/j.1468-0297.2010.02388.x

Mitchell, O.S., Piggott, J., 2004. Unlocking housing equity in Japan. Journal of the Japanese and International Economies 18, 466–505. doi:10.1016/j.jjie.2004.03.003

Moon, H., Dilworth-Anderson, P., 2015. Baby boomer caregiver and dementia caregiving: findings from the National Study of Caregiving. Age and Ageing 44, 300–306. doi:10.1093/ageing/afu119

Mormiche, P., Jourdain, A., 2003. Définitions du handicap et de la dépendance dans les enquêtes statistiques, in: Martin, C. (Ed.), La dépendance des personnes âgées: Quelles politiques en Europe?, Collection Res Publica. Presses Univ. de Rennes, Rennes.

Moscarola, F.C., d'Addio, A.C., Fornero, E., Rossi, M., 2015. 21. Reverse mortgage: a tool to reduce old age poverty without sacrificing social inclusion, in: Börsch-Supan, A., Kneip, T., Litwin, H., Myck, M., Weber, G. (Eds.), Ageing in Europe - Supporting Policies for an Inclusive Society. DE GRUYTER, Berlin, München, Boston.

Motel-Klingebiel, A., Tesch-Roemer, C., Von Kondratowitz, H.-J., 2005. Welfare states do not crowd out the family: evidence for mixed responsibility from comparative analyses. Ageing and Society 25, 863–882.

Moulton, B.R., 1990. An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units. The Review of Economics and Statistics 72, 334. doi:10.2307/2109724

Mui, A.C., 1995. Perceived health and functional status among spouse caregivers of frail older persons. Journal of Aging and Health 7, 283–300.

Neumann, P.J., Araki, S.S., Gutterman, E.M., 2000. The use of proxy respondents in studies of older adults: lessons, challenges, and opportunities. Journal of the American Geriatrics Society 48, 1646–1654.

Norton, E.C., 2000. Chapter 17 Long-term care, in: Culyer, A.J., Newhouse, J.P. (Eds.), Handbook of Health Economics. Elsevier, pp. 955–994.

OECD, 2015. Chapter 8 - Incomes and poverty of older people, in: Pensions at a Glance 2015 OECD and G20 Countries. OECD Publishing, [Paris, France].

OECD, 2014. Chapter 2 - The role of housing, financial wealth and public services for adequate living standards in old age, in: Pensions at a Glance 2013 OECD and G20 Indicators. OECD Publishing, Paris.

OECD, 2013a. A Good Life in Old Age?, OECD Health Policy Studies. OECD Publishing.

OECD, 2013b. OECD Guidelines on Measuring Subjective Well-being. OECD Publishing.

Ogg, J., 2012. Le prêt viager hypothécaire. Retraite et société 62, 167–173.

Okabayashi, H., Sugisawa, H., Takanashi, K., Nakatani, Y., Sugihara, Y., Hougham, G.W., 2008. A longitudinal study of coping and burnout among Japanese family caregivers of frail elders. Aging & Mental Health 12, 434–443. doi:10.1080/13607860802224318

Ong, R., 2008. Unlocking Housing Equity Through Reverse Mortgages: The Case of Elderly Homeowners in Australia. European Journal of Housing Policy 8, 61–79. doi:10.1080/14616710701817166

O'Reilly, D., Connolly, S., Rosato, M., Patterson, C., 2008. Is caring associated with an increased risk of mortality? A longitudinal study. Social Science & Medicine 67, 1282–1290. doi:10.1016/j.socscimed.2008.06.025

Oshio, T., 2014. The association between involvement in family caregiving and mental health among middle-aged adults in Japan. Social Science & Medicine 115, 121–129. doi:10.1016/j.socscimed.2014.06.016

Pampalon, R., Colvez, A., Bucquet, D., 1991. Etablissement d'une table de passage de la dépendance des personnes âgées au besoin d'aide à domicile. Revue D'épidémiologie Et De Santé Publique 39, 263–273.

Pauly, M.V., 1990. The Rational Nonpurchase of Long-Term-Care Insurance. Journal of Political Economy 98, 153–168.

Pearlin, L.I., Mullan, J.T., Semple, S.J., Skaff, M.M., 1990. Caregiving and the Stress Process: An Overview of Concepts and Their Measures. The Gerontologist 30, 583–594. doi:10.1093/geront/30.5.583

Pestieau, P., Ponthière, G., 2012. Long-Term Care Insurance Puzzle, in: Costa-Font, J., Courbage, C. (Eds.), Financing Long-Term Care in Europe: Institutions, Markets and Models. Palgrave Macmillan UK, London, pp. 41–52.

Petite, S., Weber, A., 2006. Les effets de l'Allocation personnalisée d'autonomie sur l'aide dispensée aux personnes âgées. Etudes et Résultats 459.

Pezzin, L.E., Kemper, P., Reschovsky, J., 1996. Does Publicly Provided Home Care Substitute for Family Care? Experimental Evidence with Endogenous Living Arrangements. The Journal of Human Resources 31, 650–676. doi:10.2307/146270

Pezzin, L.E., Pollak, R.A., Schone, B.S., 2007. Efficiency in Family Bargaining: Living Arrangements and Caregiving Decisions of Adult Children and Disabled Elderly Parents. CESifo Economic Studies 53, 69–96. doi:10.1093/cesifo/ifm004

Pezzin, L.E., Schone, B.S., 1999. Intergenerational Household Formation, Female Labor Supply and Informal Caregiving: A Bargaining Approach. The Journal of Human Resources 34, 475–503. doi:10.2307/146377

Pezzin, L.E., Schone, B.S., 1997. The Allocation of Resources in Intergenerational Households: Adult Children and Their Elderly Parents. The American Economic Review 87, 460–464.

Pickard, L., 2004. The effectiveness and cost-effectiveness of support and services to informal carers of older people. Audit Commission.

Pinquart, M., Sörensen, S., 2007. Correlates of physical health of informal caregivers: a meta-analysis. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences 62, P126-137.

Pinquart, M., Sörensen, S., 2003. Differences between caregivers and noncaregivers in psychological health and physical health: A meta-analysis. Psychology and Aging 18, 250–267. doi:10.1037/0882-7974.18.2.250

Portrait, F., Lindeboom, M., Deeg, D., 2000. The use of long-term care services by the Dutch elderly. Health economics 9, 513–531.

Raina, P., McIntyre, C., Zhu, B., McDowell, I., Santaguida, L., Kristjansson, B., Hendricks, A., Massfeller, H., Chambers, L., 2004. Understanding the influence of the complex relationships among informal and formal supports on the well-being of caregivers of persons with dementia. Canadian Journal on Aging = La Revue Canadienne Du Vieillissement 23 Suppl 1, S49-59.

Reifner, U., Clerc-Renaud, S., Pérez-Carrillo, E.F., Tiffe, A., Knobloch, M., 2009. Study on Equity Release Schemes in the EU Part I: General Report. Institut für Finanzdienstleistungen e.V.

Rice, J.B., Kasper, J.D., Pezzin, L.E., 2009. A comparative analysis of Medicaid long-term care policies and their effects on elderly dual enrollees. Health economics 18, 275–290. doi:10.1002/hec.1367

Rickayzen, B.D., Walsh, D.E.P., 2002. A Multi-State Model of Disability for the United Kingdom: Implications for Future Need for Long-Term Care for the Elderly. British Actuarial Journal 8, 341–393. doi:10.1017/S1357321700003755

Robinson, J., 1996. A long-term care status transition model. The Old-Age Crisis - Actuarial Opportunities. The 1996 Bowles Symposium.

Roodman, D., 2011. Fitting fully observed recursive mixed-process models with cmp. The Stata Journal 11, 159–206.

Rouwendal, J., Thomese, F., 2013. Homeownership and Long-Term Care. Housing Studies 28, 746–763. doi:10.1080/02673037.2013.759179

Sakshaug, J.W., 2014. Proxy Reporting in Health Surveys, in: P. Johnson, T. (Ed.), Health Survey Methods. John Wiley & Sons, Inc., Hoboken, NJ, USA, pp. 367–381.

Schmitz, H., Westphal, M., 2015. Short- and medium-term effects of informal care provision on female caregivers' health. Journal of Health Economics. doi:10.1016/j.jhealeco.2015.03.002

Schulz, R., Beach, S.R., 1999. Caregiving as a risk factor for mortality: the Caregiver Health Effects Study. JAMA: the journal of the American Medical Association 282, 2215–2219.

Schulz, R., Mendelsohn, A.B., Haley, W.E., Mahoney, D., Allen, R.S., Zhang, S., Thompson, L., Belle, S.H., 2003. End-of-Life Care and the Effects of Bereavement on Family Caregivers of Persons with Dementia. New England Journal of Medicine 349, 1936–1942. doi:10.1056/NEJMsa035373

Schulz, R., Sherwood, P.R., 2008. Physical and Mental Health Effects of Family Caregiving: AJN, American Journal of Nursing 108, 23–27. doi:10.1097/01.NAJ.0000336406.45248.4c

Seltzer, M.M., Li, L.W., 2000. The dynamics of caregiving: transitions during a three-year prospective study. The Gerontologist 40, 165–178.

Séoud, J., Nehmé, C., Atallah, R., Zablit, C., Yérétzian, J., Lévesque, L., Giroux, F., Ducharme, F., 2007. The health of family caregivers of older impaired persons in Lebanon: An interview survey. International Journal of Nursing Studies 44, 259–272. doi:10.1016/j.ijnurstu.2005.11.034

Shan, H., 2011. Reversing the Trend: The Recent Expansion of the Reverse Mortgage Market: The Recent Expansion of the Reverse Mortgage Market. Real Estate Economics 39, 743–768. doi:10.1111/j.1540-6229.2011.00310.x

Sinai, T., Souleles, N., 2007. Net Worth and Housing Equity in Retirement (No. w13693). National Bureau of Economic Research, Cambridge, MA.

Sloan, F.A., Hoerger, T.J., Picone, G., 1996. , in: Eisen, R., Sloan, F.A. (Eds.), Long-Term Care: Economic Issues and Policy Solutions. Springer US, Boston, MA, pp. 45–78.

Sloan, F.A., Picone, G., Hoerger, T.J., 1997. The supply of children's time to disabled elderly parents. Economic Inquiry 35, 295–308. doi:10.1111/j.1465-7295.1997.tb01911.x

Smith, G.R., Williamson, G.M., Miller, L.S., Schulz, R., 2011. Depression and quality of informal care: A longitudinal investigation of caregiving stressors. Psychology and Aging 26, 584–591. doi:10.1037/a0022263

Spillman, B.C., Long, S.K., 2009. Does high caregiver stress predict nursing home entry? Inquiry: A Journal of Medical Care Organization, Provision and Financing 46, 140–161.

Stabile, M., Laporte, A., Coyte, P.C., 2006. Household responses to public home care programs. Journal of Health Economics 25, 674–701. doi:10.1016/j.jhealeco.2005.03.009

Staiger, D., Stock, J.H., 1997. Instrumental variables regression with weak instruments. Econometrica 65, 557–586.

Stern, S., 1995. Estimating Family Long-Term Care Decisions in the Presence of Endogenous Child Characteristics. The Journal of Human Resources 30, 551. doi:10.2307/146035

Stock, J., Yogo, M., 2005. Testing for weak instruments in linear IV regression., in: Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg. Cambridge University Press, New York, pp. 80–108.

Stucki, B.R., 2006. Using Reverse Mortgages to Manage the Financial Risk of Long-Term Care. North American Actuarial Journal 10, 90–102. doi:10.1080/10920277.2006.10597415

Stucki, B.R., 2005. Use Your Home to Stay at Home. Expanding the Use of Reverse Mortgages for Long-Term Care: A Blueprint for Action. Report from the National Council of Aging.

Tennstedt, S., Cafferata, G.L., Sullivan, L., 1992. Depression among caregivers of impaired elders. Journal of Aging and Health 4, 58–76.
Thiébaut, S.P., Ventelou, B., Garcia-Peñalosa, C., Trannoy, A., 2012. Une analyse microéconomique du gage patrimonial dans l'aide aux personnes dépendantes. Revue économique 63, 339. doi:10.3917/reco.632.0339
Thorsen, S., Rugulies, R., Hjarsbech, P.U., Bjorner, J., 2013. The predictive value of mental health for long-term sickness absence: the Major Depression Inventory (MDI) and the Mental Health Inventory (MHI-5) compared. BMC Medical Research Methodology 13, 115. doi:10.1186/1471-2288-13-115
Unützer, J., Patrick, D.L., Simon, G., Grembowski, D., Walker, E., Rutter, C., Katon, W., 1997. Depressive symptoms and the cost of health services in HMO patients aged 65 years and older. A 4-year prospective study. JAMA 277, 1618–1623.
Van Buuren, S., Brand, J.P.L., Groothuis-Oudshoorn, C.G.M., Rubin, D.B., 2006. Fully conditional specification in multivariate imputation. Journal of Statistical Computation and Simulation 76, 1049–1064. doi:10.1080/10629360600810434
Van den Berg, B., Fiebig, D.G., Hall, J., 2014. Well-being losses due to care-giving. Journal of Health Economics 35, 123–131. doi:10.1016/j.jhealeco.2014.01.008
Van der Cruijsen, C., Jansen, D.-J., van Rooij, M., 2014. The rose-colored glasses of homeowners. DNB Working Paper, De Nederlandsche Bank.
Van Gool, C.H., Kempen, G.I.J.M., Penninx, B.W.J.H., Deeg, D.J.H., Beekman, A.T.F., van Eijk, J.T.M., 2005. Impact of depression on disablement in late middle aged and older persons: results from the Longitudinal Aging Study Amsterdam. Social Science & Medicine 60, 25–36. doi:10.1016/j.socscimed.2004.04.021
Van Houtven, C.H., Coe, N.B., Skira, M.M., 2013. The effect of informal care on work and wages. Journal of Health Economics 32, 240–252. doi:10.1016/j.jhealeco.2012.10.006
Van Houtven, C.H., Norton, E.C., 2008. Informal care and Medicare expenditures: Testing for heterogeneous treatment effects. Journal of Health Economics 27, 134–156. doi:10.1016/j.jhealeco.2007.03.002
Van Houtven, C.H., Norton, E.C., 2004. Informal care and health care use of older adults. Journal of health economics 23, 1159–1180. doi:10.1016/j.jhealeco.2004.04.008
Van Houtven, C.H., Wilson, M.R., Clipp, E.C., 2005. Informal Care Intensity and Caregiver Drug Utilization. Review of Economics of the Household 3, 415–433. doi:10.1007/s11150-005-4942-0
Vasiliadis, H.-M., Dionne, P.-A., Préville, M., Gentil, L., Berbiche, D., Latimer, E., 2013. The Excess Healthcare Costs Associated With Depression and Anxiety in Elderly Living in the Community. The American Journal of Geriatric Psychiatry 21, 536–548. doi:10.1016/j.jagp.2012.12.016
Venti, S., Wise, D., 2001. Aging and Housing Equity: Another Look (No. w8608). National Bureau of Economic Research, Cambridge, MA.
Venti, S., Wise, D., 2000. Aging and Housing Equity (No. w7882). National Bureau of Economic Research, Cambridge, MA.
Venti, S.F., Wise, D.A., 1991. Aging and the income value of housing wealth. Journal of Public Economics 44, 371–397. doi:10.1016/0047-2727(91)90020-3
Verbeek-Oudijk, D., Woittiez, I., Eggink, E., Putman, L., Netherlands, Sociaal en Cultureel Planbureau, 2014. Who cares in Europe?: a comparison of long-term care for the over-50's in sixteen European countries.
Verbrugge, L.M., Jette, A.M., 1994. The disablement process. Social Science & Medicine (1982) 38, 1–14.

Vitaliano, P.P., Zhang, J., Scanlan, J.M., 2003. Is Caregiving Hazardous to One's Physical Health? A Meta-Analysis. Psychological Bulletin 129, 946–972. doi:10.1037/0033-2909.129.6.946

Weber, F., 2010. Les rapports familiaux reconfigurés par la dépendance. Regards croisés sur l'économie 7, 139–151. doi:10.3917/rce.007.0139

White-Means, S.I.I., 1997. The demands of Persons with disabilities for home health care and the economic consequences for informal caregivers. Social Science Quarterly 78, 955–971.

WHO, 2002. Towards a Common Language for Functioning, Disability and Health ICF. WHO/EIP/GPE/CAS/01.3.

WHO, 1980. International Classification of Impairments, Disabilities, and Handicaps.

Wilson, M.R., Houtven, C.H., Stearns, S.C., Clipp, E.C., 2007. Depression and Missed Work among Informal Caregivers of Older Individuals with Dementia. Journal of Family and Economic Issues 28, 684–698. doi:10.1007/s10834-007-9081-8

Winslow, B.W., 1997. Effects of formal supports on stress outcomes in family caregivers of Alzheimer's patients. Research in Nursing & Health 20, 27–37.

Wood, P.H.N., 1975. Classification of impairments and handicaps. WHO/ICD9/REV. CONF/75.15 (Unpublished document).

Wooldridge, J.M., 2002. Econometric analysis of cross section and panel data. MIT Press, Cambridge, Mass.

Yaffe, K., Fox, P., Newcomer, R., Sands, L., Lindquist, K., Dane, K., Covinsky, K.E., 2002. Patient and caregiver characteristics and nursing home placement in patients with dementia. JAMA 287, 2090–2097.

Yee, J.L., Schulz, R., 2000. Gender differences in psychiatric morbidity among family caregivers: a review and analysis. The Gerontologist 40, 147–164.

Zanetti, O., Magni, E., Sandri, C., Frisoni, G.B., Bianchetti, A., Trabucchi, M., 1996. Determinants of burden in an Italian sample of Alzheimer's patient caregivers. Journal of Cross-Cultural Gerontology 11, 17–27. doi:10.1007/BF00116263

Zweifel, P., Strüwe, W., 1998. Long-Term Care Insurance in a Two-Generation Model. The Journal of Risk and Insurance 65, 13–32. doi:10.2307/253489