FINANCING LONG-TERM CARE THROUGH HOUSING IN EUROPE

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Abstract

This paper 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. To do so, we adopt a life-cycle approach and assume that individuals take out reverse mortgages when they become dependent, in order to convert their home equity into cash.

A disability transition model is estimated for 9 European countries (Austria, Germany, France, Belgium, Denmark, Sweden, the Netherlands, Spain and Italy) using the longitudinal dimension (2004-2013) of SHARE (*Survey of Health, Ageing and Retirement in Europe*). Then, the disability trajectories of individuals who are 65 and older in 2013 (23,769 observations) are simulated until year 2051. 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. These results are robust to changes in interest rate and life expectancy assumptions. This paper also provides analyses by income quintile and briefly simulates the effects of informal care and public long-term care benefits.

Key words: long-term care; housing; reverse mortgage; public coverage; microsimulation.
JEL: J140; D140; I130; C530.

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[1] 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[2] 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, the private LTC insurance market, that could help financing LTC, is generally small in OECD countries. Only 7% of LTC expenditures are financed by private LTC insurance in the US, and less than 2% in other countries. The proportion of people aged 40 and over who hold a LTC insurance policy is about 5% in the US and 15% in France (Colombo et al., 2011a). This lack of success is partly explained by the unattractiveness of LTC 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 LTC 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

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

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

assistance) (for literature reviews, see Brown and Finkelstein 2009; Fontaine and Zerrar 2013; Pestieau and Ponthière 2012).

Another 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 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[3] she is, the sooner she will repay the loan and the higher are the payments (see Subsection 4.4 for

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

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 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[4]. 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

[4] 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).

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.

3. Data

This paper uses data from SHARE Waves 1, 2, 3 (SHARELIFE), 4 and 5[5]. 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 1 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;

[5] 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.

2011 for Germany, Sweden and Denmark; 2012 for the Netherlands, Spain and Belgium; 2013 for France and 2014 for Austria.

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)[6] 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[7]. 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 1 below 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).

[6] 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"*.

[7] 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).

Table 1. 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.

3.2. 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[8] 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[9]. Finally, we compute an equivalised household income by dividing the total income by the weighted number of household members (OECD modified scale[10]). 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?"*[11]. 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.1). Around 10% of owners aged 65+ have to pay a mortgage and the average value is

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

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

[10] 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.

[11] 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.

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.

$$H = \%\ owned \times home\ value - value\ of\ mortgages \quad \text{(Eq.1)}$$

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.

Incomes and assets differ widely across Europe (Table 1). 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[12]. 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[13]. The regression analysis focuses on

[12] 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.

[13] 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

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 12 in Appendix A for further details on observed mortality and baseline transition probabilities). Table 2 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.

Table 2. 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

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.

compute a correction factor by country, sex and age[14] 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 13 in Appendix A 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).

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 14 in Appendix A 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 3). 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.

[14] 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.

Table 3. Disability transitions.

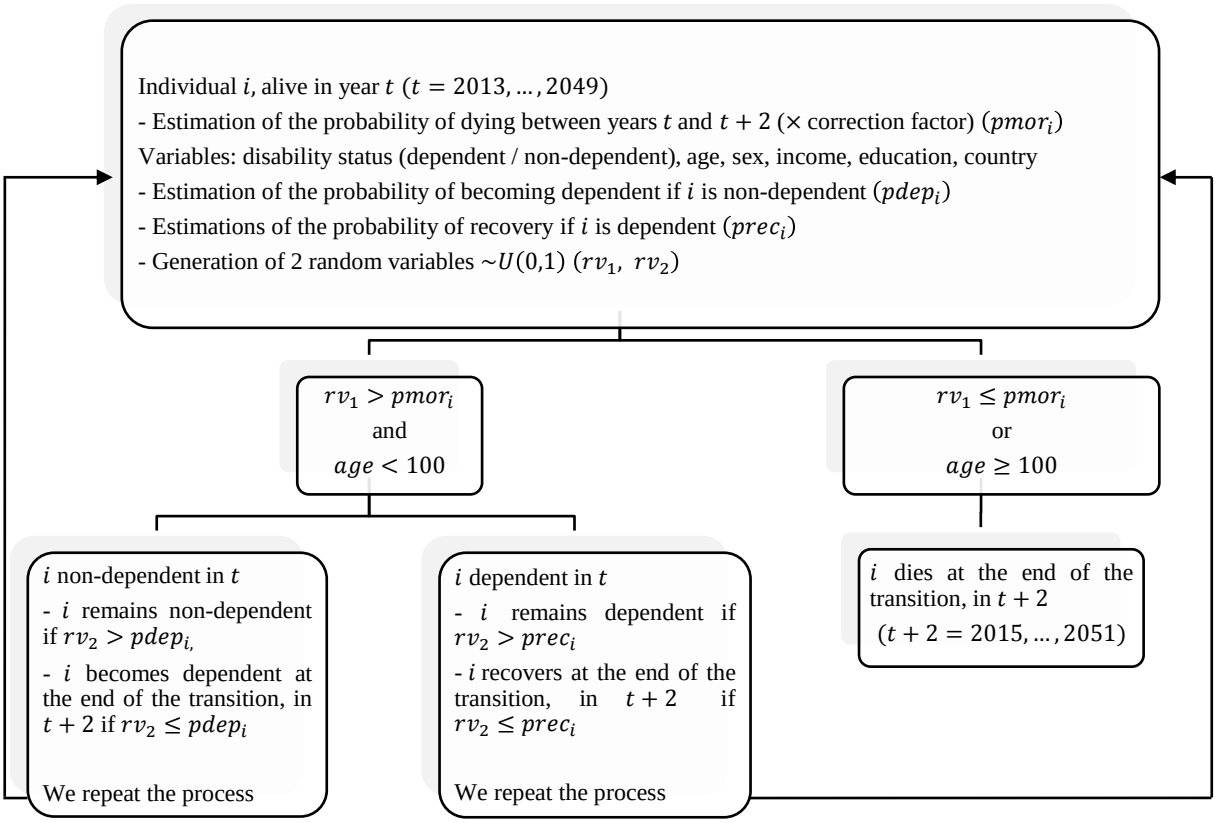
	Becoming dependent (2+ ADLs)	Recovery (No ADL)
Age	0.006*** (0.000)	-0.011*** (0.001)
Female	0.012*** (0.004)	0.009 (0.024)
Equivalised household income (country level)		
- 1st quintile	-	-
- 2nd quintile	-0.008 (0.005)	0.045 (0.032)
- 3rd quintile	-0.014*** (0.005)	0.012 (0.036)
- 4th quintile	-0.023*** (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 1 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 1. 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 15 in Appendix A 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 4). 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 4 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 1), 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 4. 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)[15]. 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).

[15] 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.2 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[16]. 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.

$$L = H \times \frac{(1+g)^e}{(1+m)^e}, \qquad m > g \tag{Eq.2}$$

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[17]. 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.2, 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

[16] 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.

[17] 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 5 below.

Table 5. 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[18].

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 16 in Appendix A 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 6 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[19]. 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

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

[19] 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 17 in Appendix B 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.

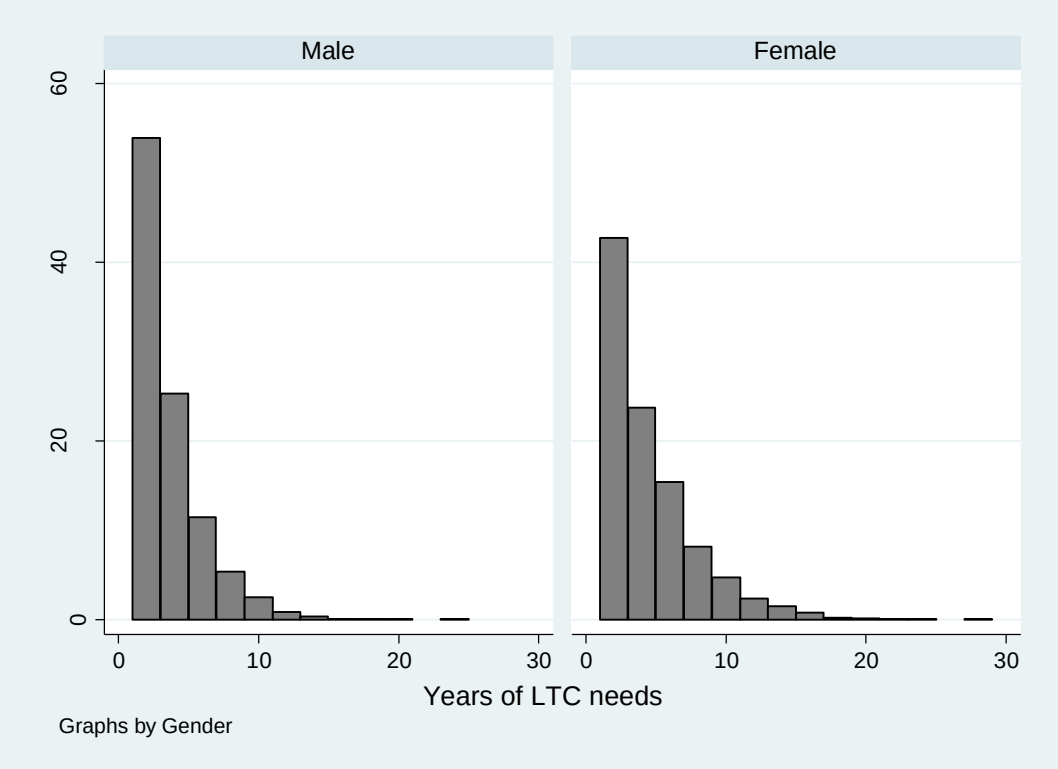
Table 6. Simulated LTC risk and LTC duration.

	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 2), 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 2. 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 18 in Appendix C 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[20]. 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).

[20] 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 7). 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 1).

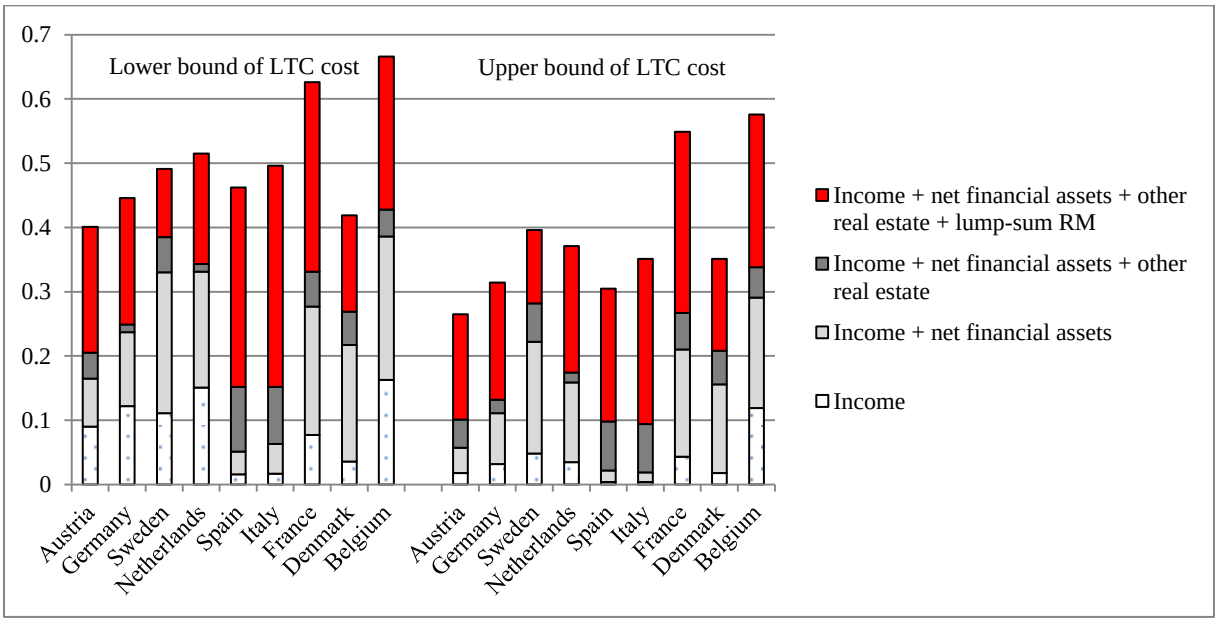
While only 23% of individuals can pay for their LTC needs based on income, financial assets and other real estate (15% with the upper bound of LTC cost), the proportion more than doubles when reverse mortgage payments are taken into account. Indeed, the proportion of homeowners is important among European aged 65 and older and the value of home is generally much higher than incomes and financial wealth (Table 1). To give an example, in the 10^{th} simulation, dependent homeowners receive an average lump-sum payment of 147,768 euros when they take out reverse mortgages (1^{st} quartile: 65,484 euros, median: 109,493 euros, 3^{rd} quartile: 170,902 euros; data not shown). These amounts are higher than the annual cost of LTC. Figure 3 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 7. 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 3. 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.

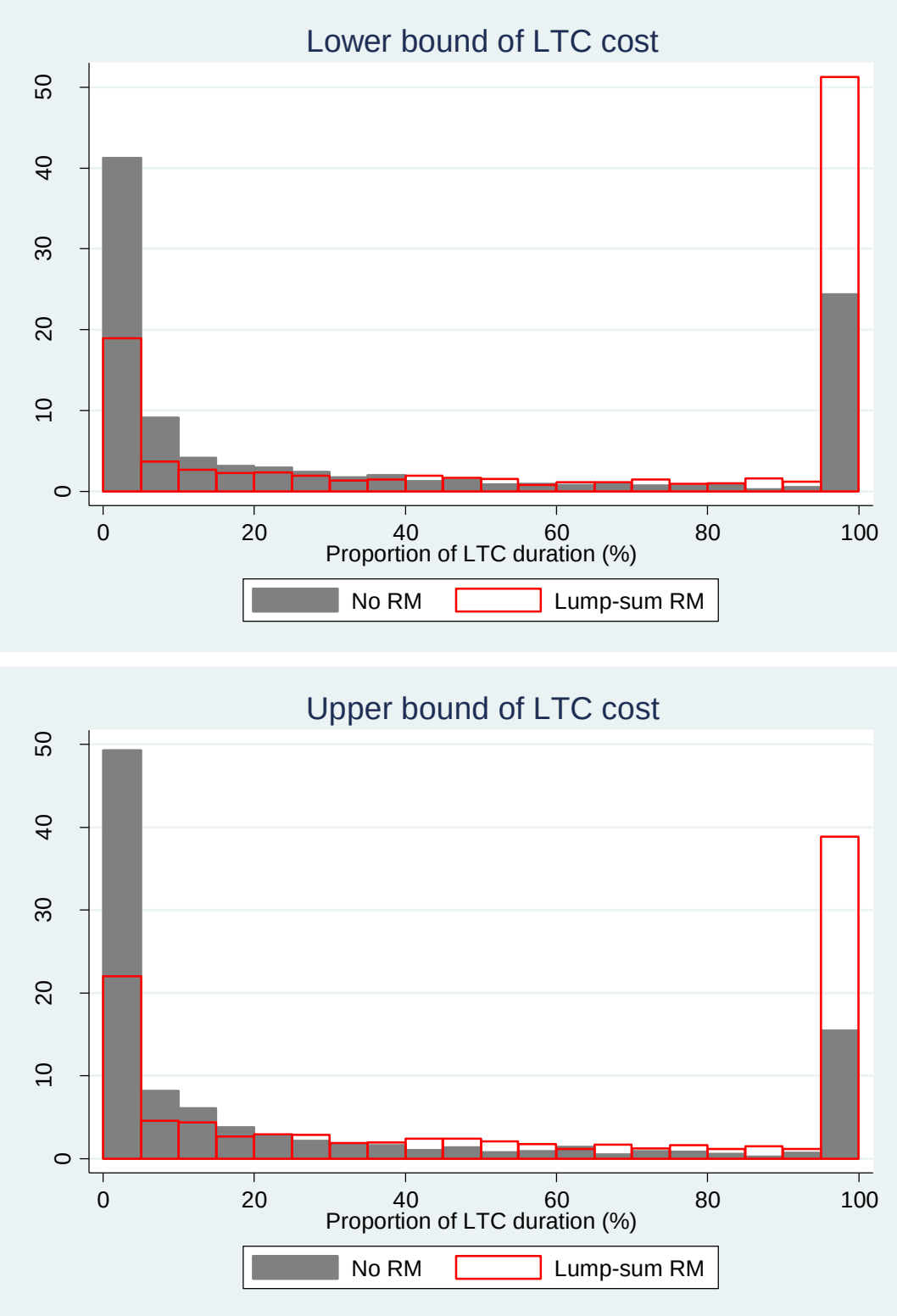
We study the proportion of LTC duration that individuals are able to finance, defined as the ratio between the number of years of LTC (D) they can pay for (see Subsection 4.5) and their effective LTC duration. If we consider income, financial assets and secondary homes (in grey), 41% of dependent individuals 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 4). 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)[21]. 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 10 in Appendix D) 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

[21] 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 4. 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 E investigates the ability to pay for long-term care needs by income quintile. Figure 11 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 12 and 13 (Appendix E) 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 14 in Appendix E) 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[22], 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 8). 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 5, 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).

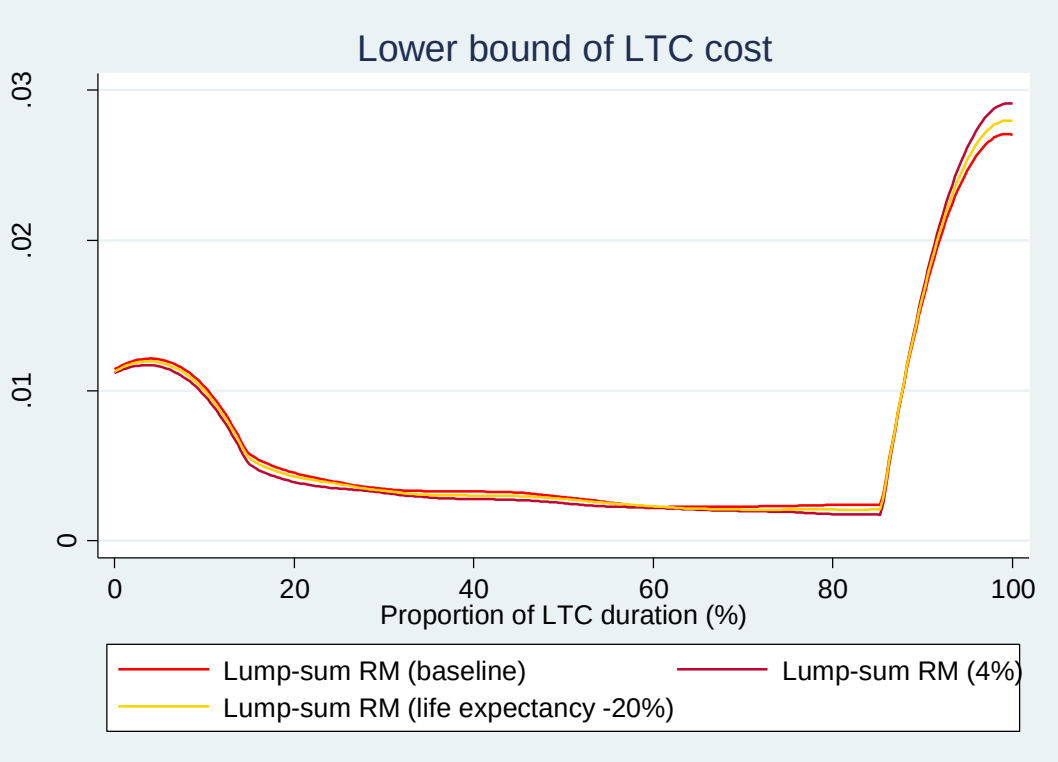
[22] As outlined above, in our simulations, the life expectancy of individuals who become dependent is on average 21% lower than that predicted by life tables for the general population (Human Mortality Database).

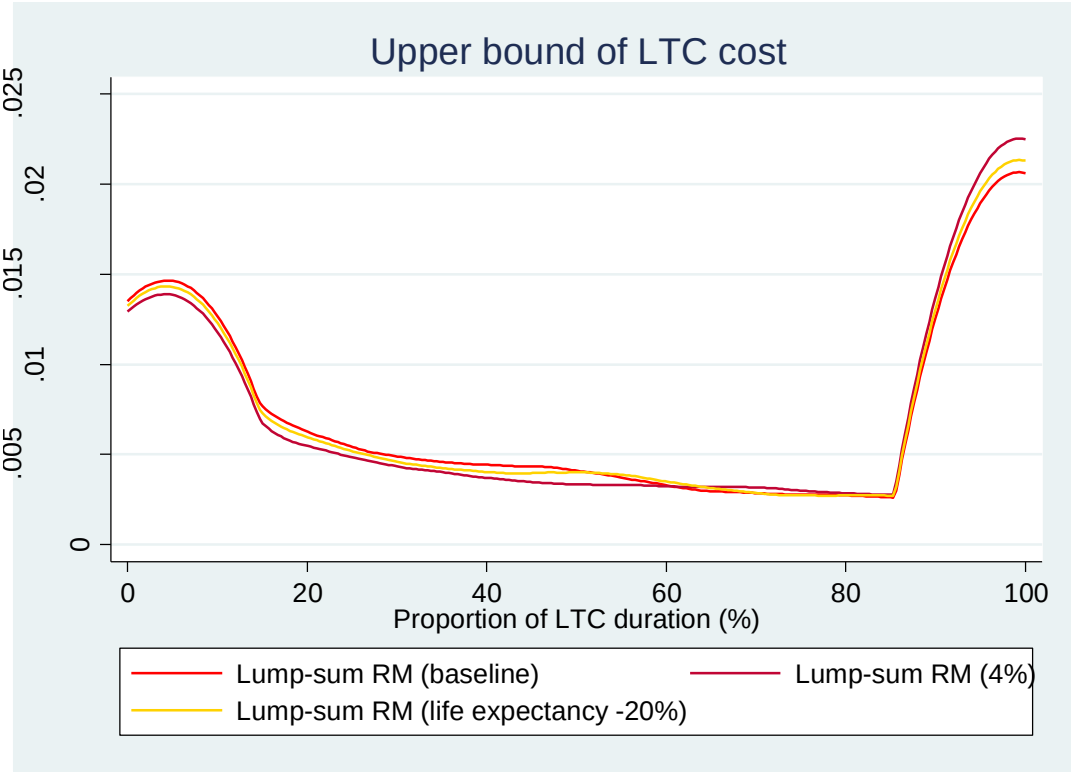
Table 8. Effects of interest rate and life expectancy on ability to pay.

	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 5. 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

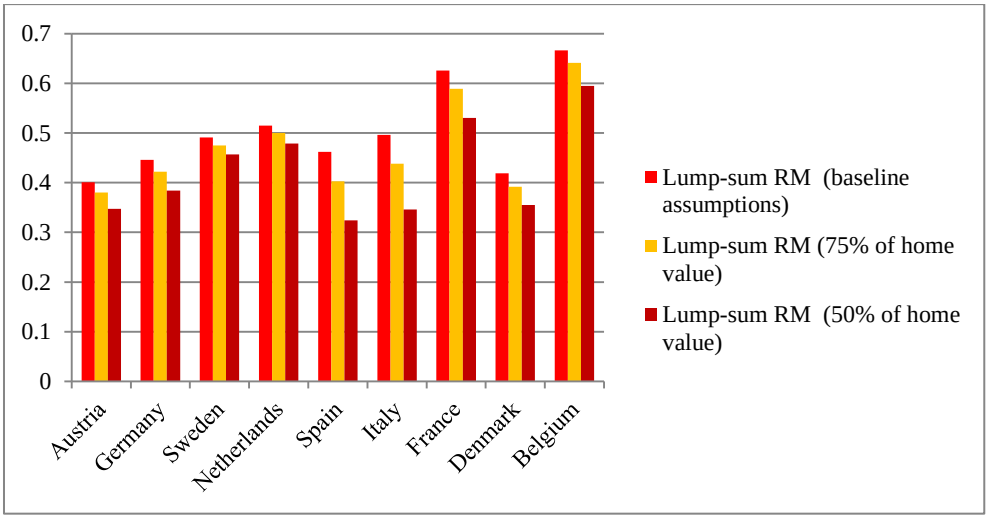
So far, we have assumed that individuals borrow on 100% of the home value. However, in practice, lenders limit the initial loan amount in order to reduce the risk that the debt on house might exceed the sale price of the home. In addition, in the presence of a bequest motive, individuals may prefer to 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 9 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 6). The distribution of the proportion of LTC duration that can be financed (Figure 7) 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 9. 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.			

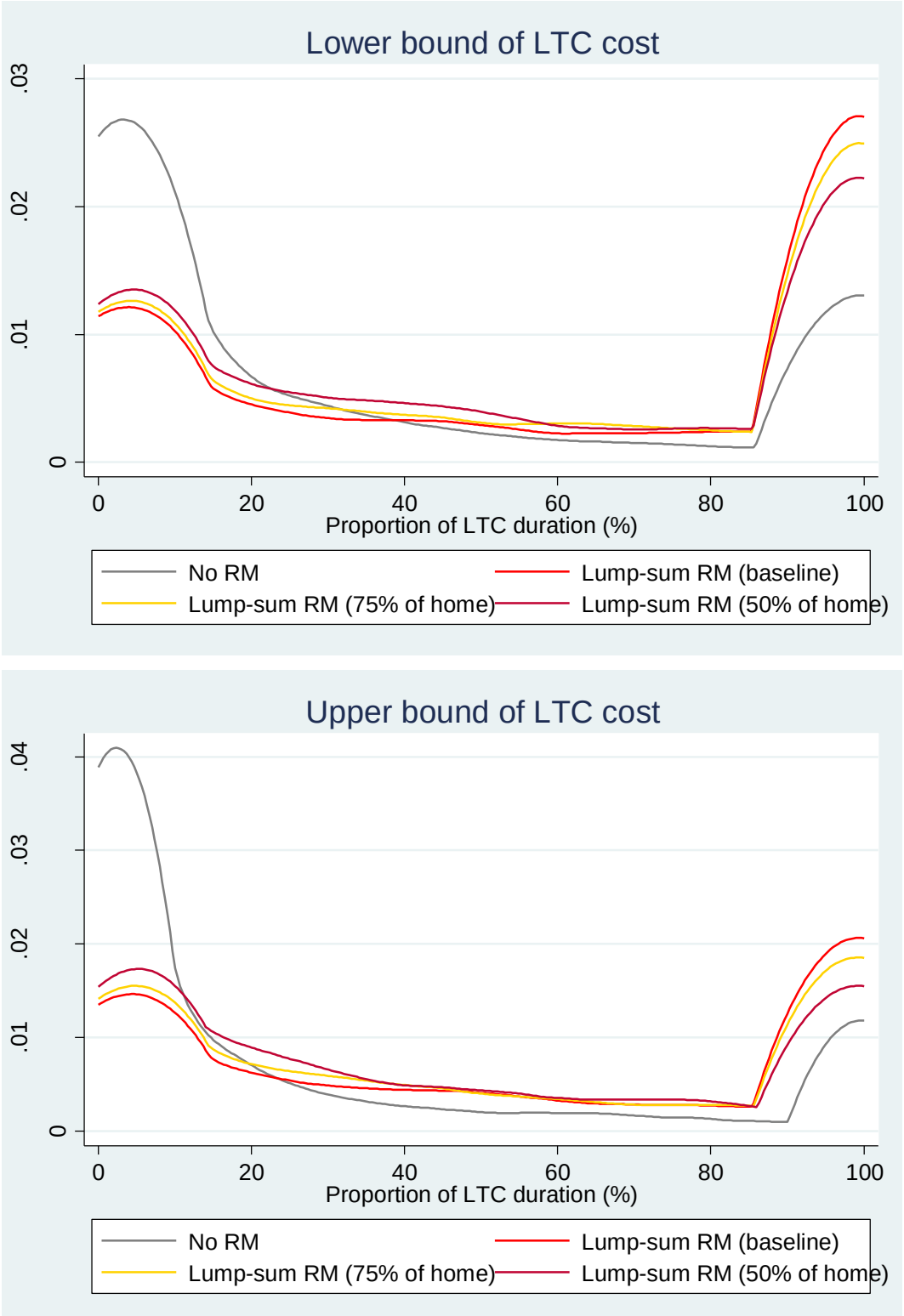
Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.
Mean of the (weighted) ability to pay across 10 replications of simulations. Standard deviations between the means of the 10 replications are in parentheses.

Figure 6. 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 7. 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)[23]. LTC systems differ across Europe[24] but are generally grouped in three main clusters: Northern countries (Sweden, Netherlands and Denmark), Mediterranean countries (Spain and Italy) and Central Europe (Austria, Germany, France and Belgium). In Nordic countries, public LTC 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). By contrast, in Mediterranean countries, public LTC expenditure is low and the role of the family is very important (see Fontaine et al. 2007 and Bonsang 2007 for statistics on care arrangements and time assistance from adult children in different European countries using SHARE data). Central countries are an intermediate (and less homogeneous) group.

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[25]. The analysis uses the lower bound of LTC cost.

Informal care

Table 10 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

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

[24] Da Roit and Le Bihan 2010; Colombo et al. 2011a; Verbeek-Oudijk et al. 2014; Carrino and Orso 2014; Kraus et al. 2011.

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

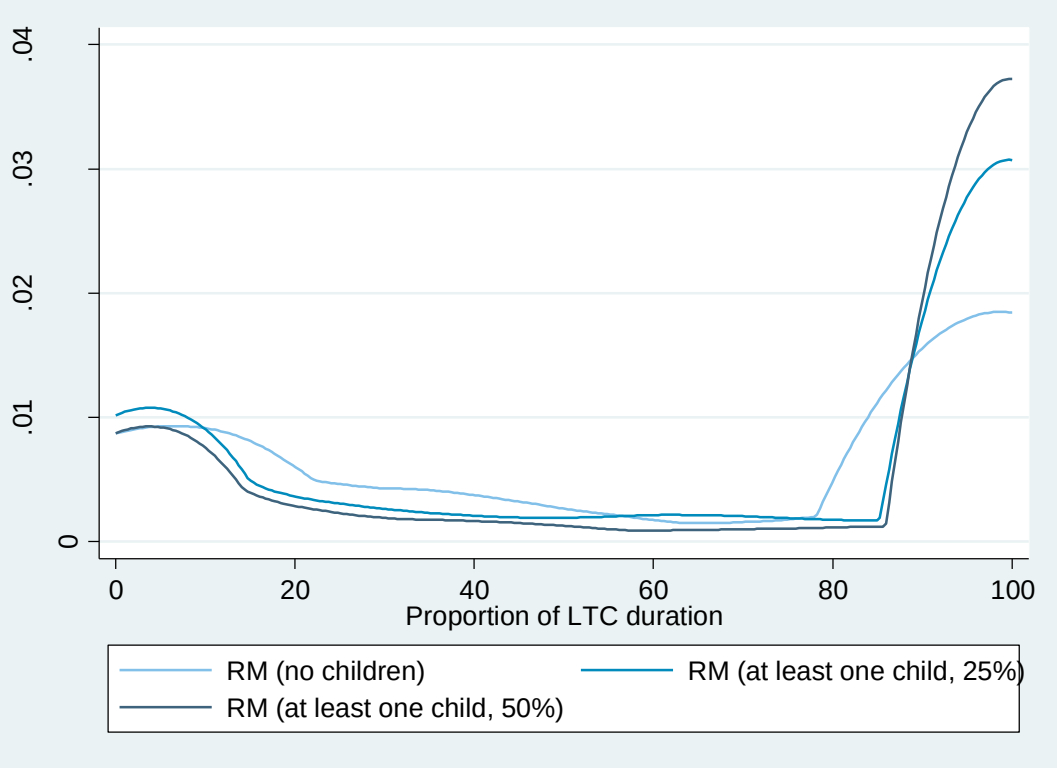
pay for LTC (with incomes, financial assets, secondary homes and reverse mortgages) is 58%, as compared to 51% for individuals without children. If the LTC cost was 50% lower, 68% of individuals who have children could totally finance their periods of disability. The distribution of the ability to pay (Figure 8) confirms that individuals without children would have more difficulty paying their LTC expenses under such assumptions.

Table 10. 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 8. 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 11). 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 9). Distributions by income quintile (see Figure 15 in Appendix F) 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.

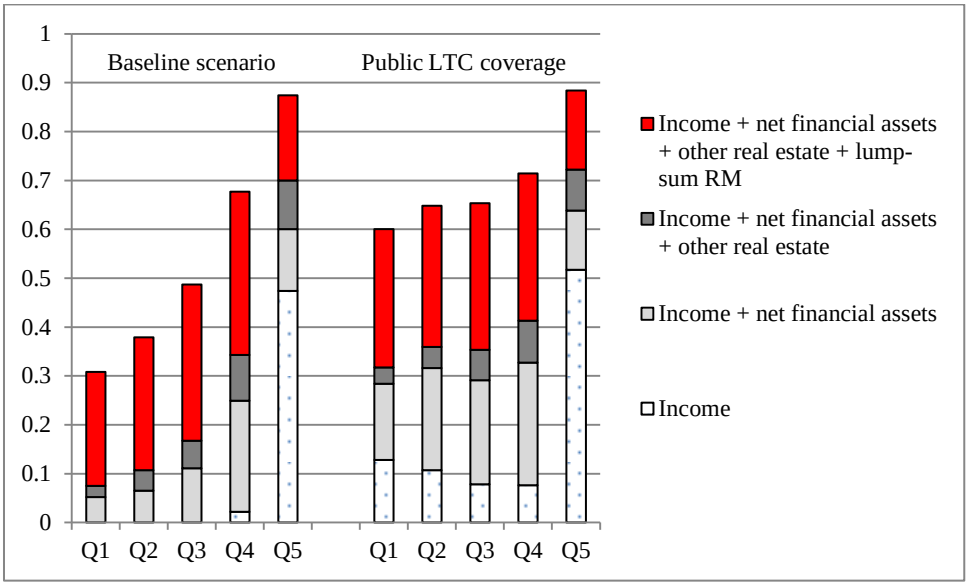
Table 11. Effect of public LTC coverage on ability to pay.

		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 9. 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 1 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. 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 A. Additional details on the methodology.

Table 12. 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 13. 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 14. 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 15. 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 16. 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 B. LTC risk and duration in the literature.

Table 17. 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 C. Characteristics of dependent individuals who have no partner.

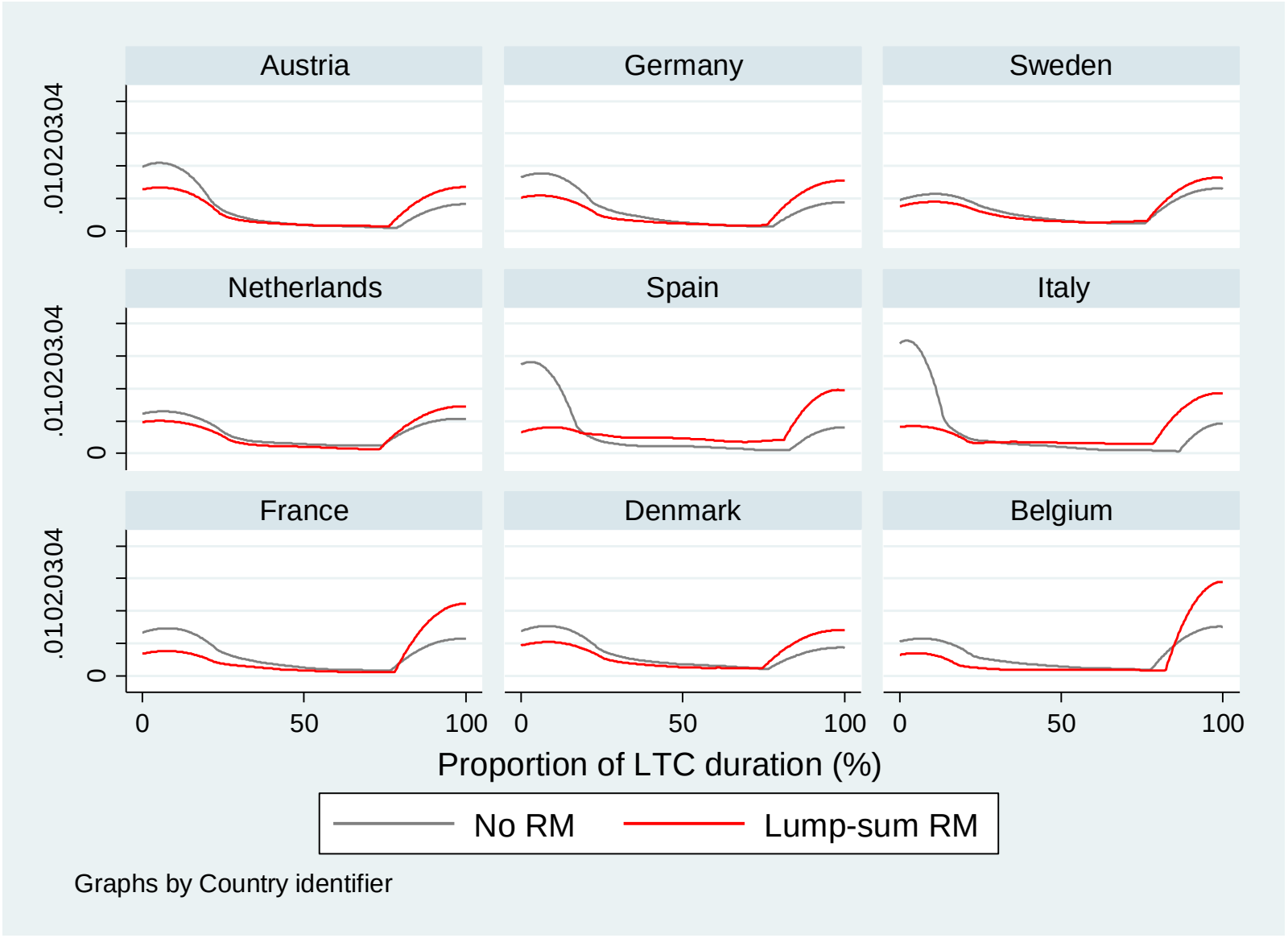
Table 18. Characteristics of the total sample and of individuals who have no partner.

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

Figure 10. Distribution of ability to pay by country.



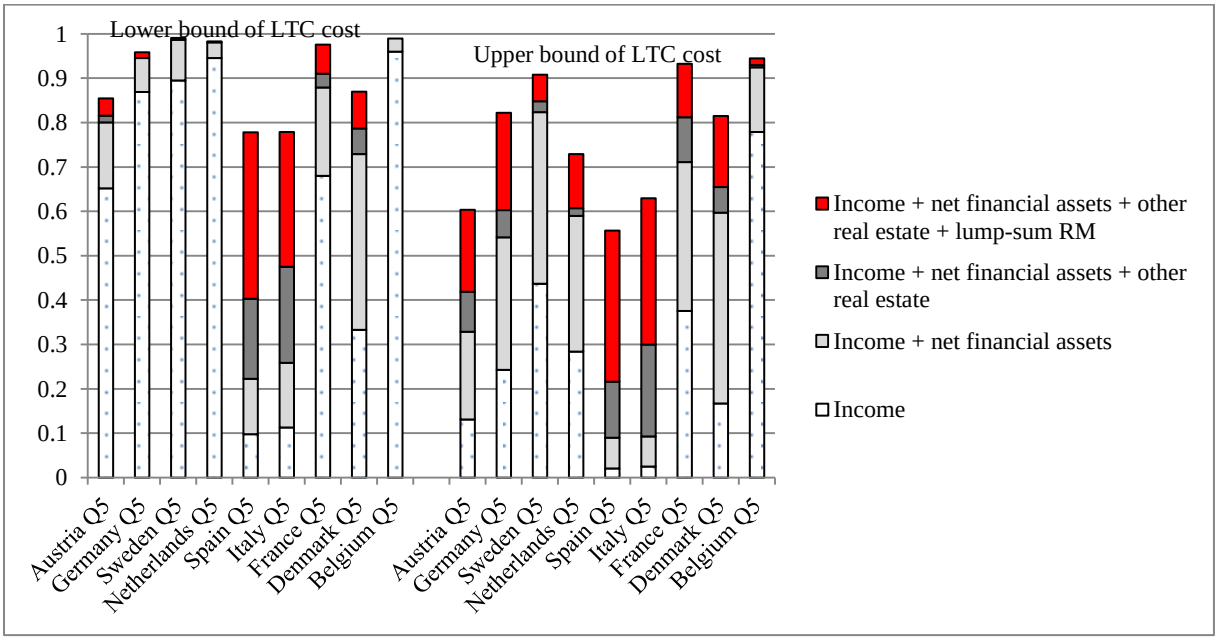
Source: SHARE, microsimulation (lower bound of LTC cost).

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.

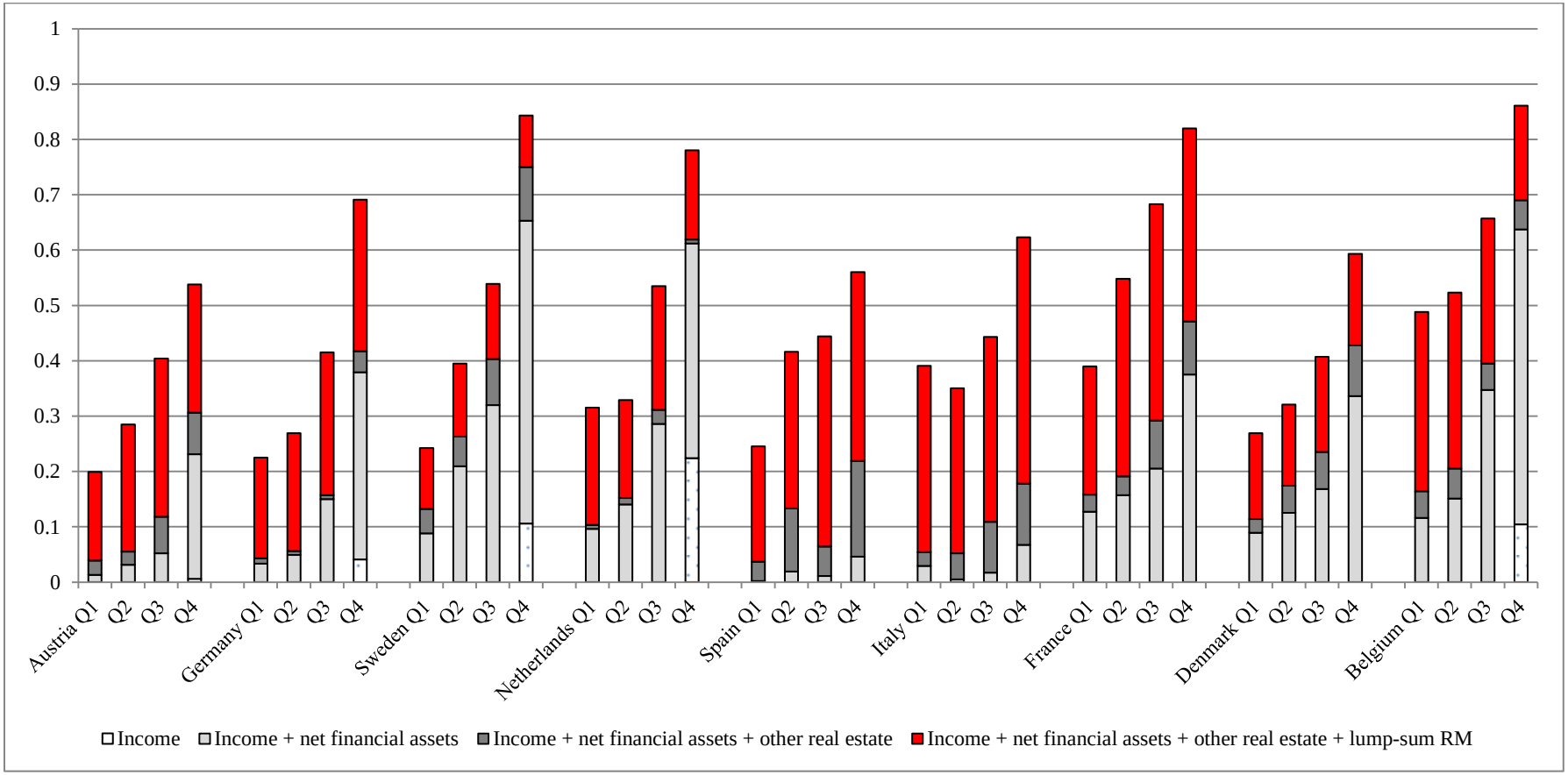
Appendix E. Ability to pay for long-term care needs by income quintile.

Figure 11. Ability to pay in the 5th income quintile.



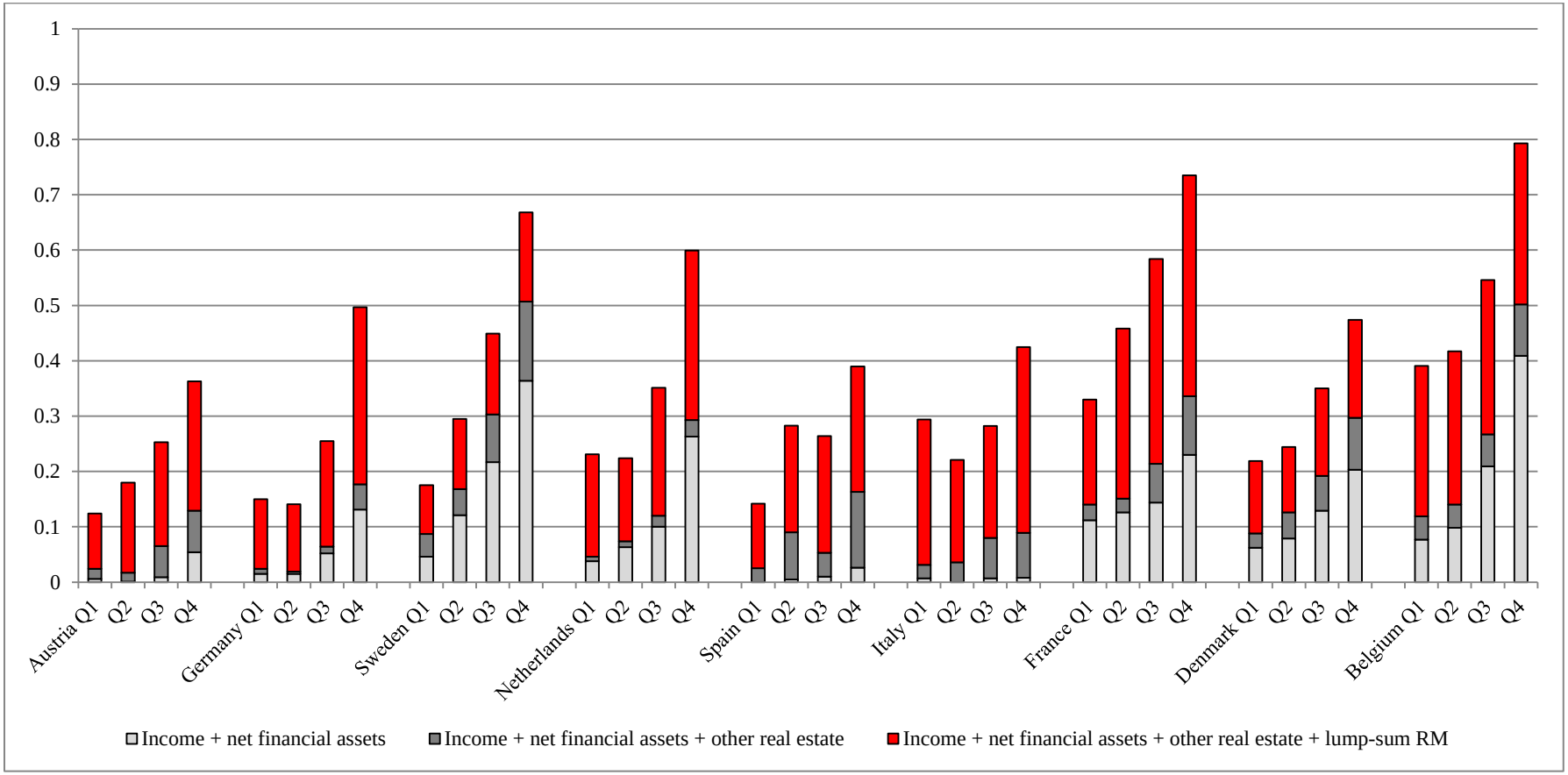
Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

Figure 12. Ability to pay in income quintiles 1 to 4 (lower bound of cost).



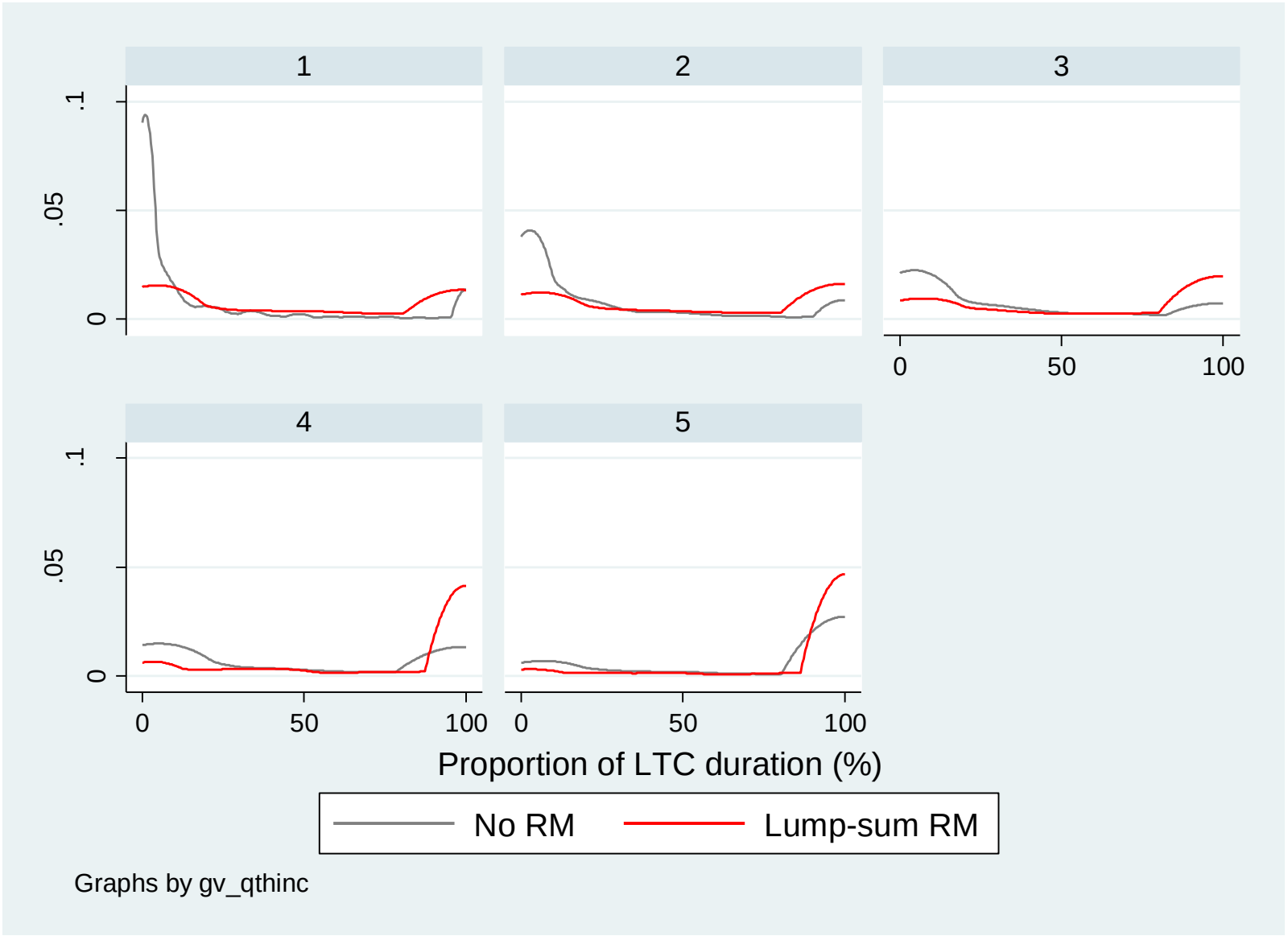
Source: SHARE, authors' microsimulation.
Individuals aged 65 and over in wave 5 and who have no partner when they become dependent.

Figure 13. 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 14. Distribution of ability to pay by income quintile.



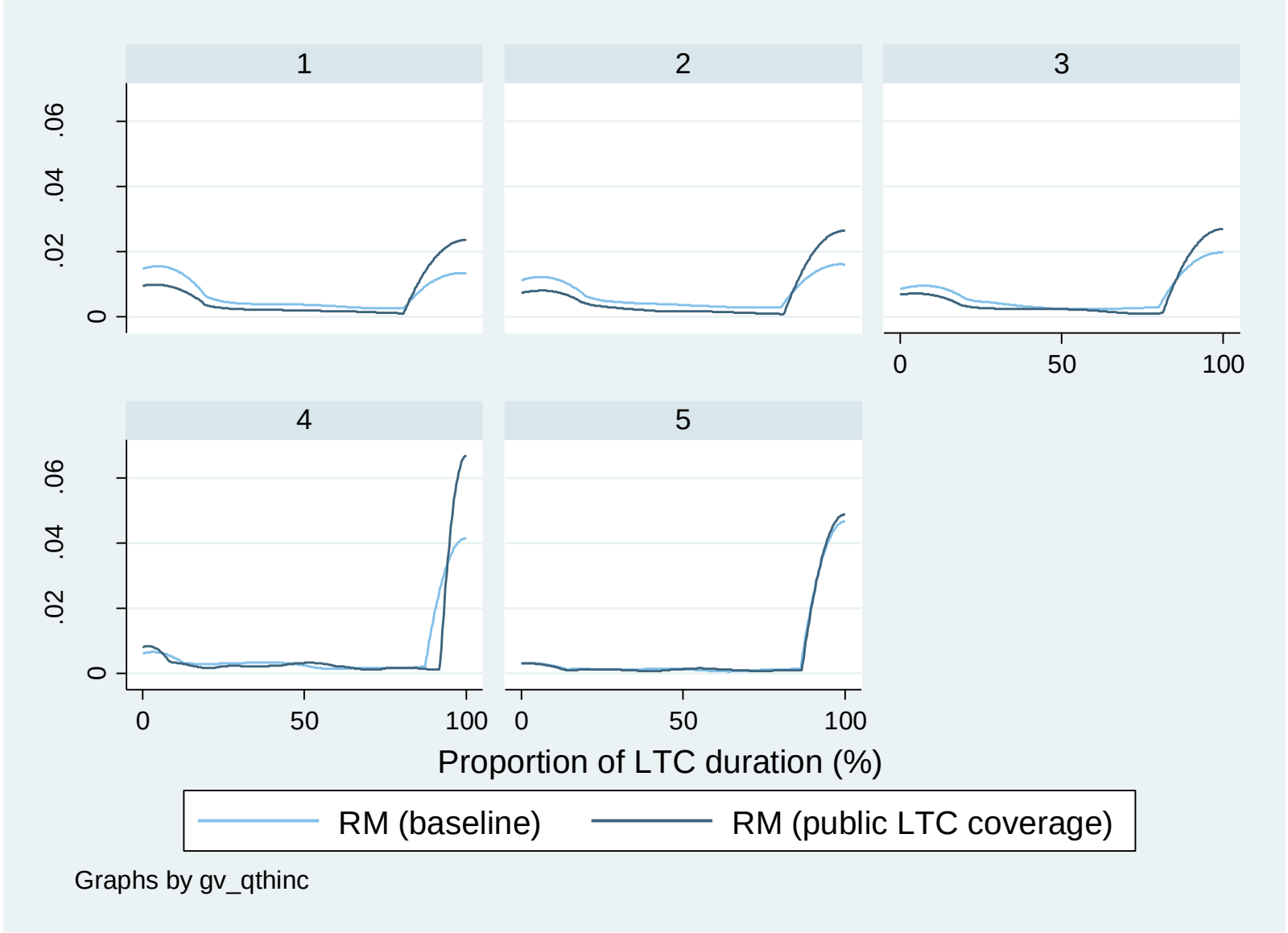
Source: SHARE, microsimulation (lower bound of LTC cost). All countries.

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 F. The role of public LTC coverage.

Figure 15 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.

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