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How much risk is mitigated by LTC Insurance? A case study of the public system in Spain

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How much risk is mitigated by LTC protection schemes? A methodological note and a case study of the public LTC system in Spain

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Abstract

We present a methodology to measure the risk of incurring extremely large individual lifetime costs of Long Term Care. We show that this method can be used to compare risk reductions achieved by alternative Long-Term Care (LTC) protection plans. Our proposed methodology is illustrated with a case study. Our estimates show that, according to our proposed risk measure, the Spanish public LTC system mitigates individual risk by more than 30% compared to the situation where no public protection is available. However, Spanish public LTC system still leaves individuals facing very high lifetime costs of care. We estimate that there is a risk of about 1% that a man will have to spend more than 211.8 thousand euros and a risk of about 1% that a women will have to spend about 232.6 thousand euros to cover lifetime LTC costs. Despite the current public Spanish LTC coverage, risk mitigation may still be too low since catastrophic costs of care persists and therefore, we suggest that private insurance should be strongly promoted.

1 Introduction and motivation

One of the main objectives of Long-Term Care projection schemes, public and private, is to mitigate the risk to individuals of being exposed to "catastrophic" costs of care (see, for example, OECD, 2011 and Fernandez et al., 2009), which can occur when a person needs care for a very long period of time. A US-based study suggested that the average value of lifetime long-term care expenditures for people turning 65 in 2005 was approximately $47,000, with

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28% of individuals facing costs in excess of $100,000 (Kemper et al., 2005).

Recent estimates of the distribution of lifetime cost of care in England by Fernández and Forder (2010) show that around a third of people aged 65 and over will spend little on care. However, for a small proportion of people, long-term care costs will represent so-called 'catastrophic' levels of expenditure: 7% of people aged 65 will face lifetime care costs of at least £100,000, and 5 per cent of at least £200,000 (Fernández and Forder,2010, p. 11). Bolance et al. (2010 and 2012) show similar results for the Spanish case and they also point at significant differences between men and women. Women's LTC average expenditure from age 65 to death is much higher that men's, and extreme cases are more frequent.

The effectiveness of LTC protection schemes in terms of their ability to protect people from catastrophic costs, that is, as risk mitigation instruments, has received little attention in the literature. Risk mitigation, when addressing economic losses, usually works by transferring the risk to someone else, who would cover the cost if the loss occurs in exchange of a payment (or premium). Zuchandke et al. (2010) discussed the impact of the introduction of the social long-term care insurance in Germany on financial security assessment, but they did not measure risk mitigation. Risk transfer is easily achieved by sharing the risk with other individuals who may also suffer the same type of loss. A way to mitigate the risk to an individual of having to spend an enormous amount of money on long-term care during his or her lifetime is to be part of a LTC coverage protection scheme that shares the expenditure among participants in the programme (see for example, Barr, 2010, de Castries, 2009). LTC protection can take many different forms, ranging from contribution to a national public LTC system through general or local taxation, to social insurance contributions, to individual or group purchased private insurance. In practice in most countries public and private LTC coverage protection systems coexist and complement each other to different degrees (see, for example, OECD, 2011 and Rodrigues and Schmidt, 2010).

This paper discusses risk measures that are well-known in insurance and financial economics and their potential use for comparing the economic capacity of LTC protection systems as risk transfer instruments. Risk measurement is essentially aimed at evaluating both the likelihood that a loss occurs and the magnitude of this loss. We propose a method to assess how much risk is *mitigated* by a LTC protection system that would otherwise be born by individuals or their families. Our quantitative risk measurement relies on basic statistical concepts such as the estimated statistical distribution of lifetime costs of care, which can be obtained by micro-simulation (Fernandez and Forder, 2011) or by a method inspired on multiple decrement tables (see, Bolancé et al., 2010).

Formal definitions of risk measures are available and their mathematical properties have been studied in the context of risk management, actuarial science and finance (see, for instance, McNeil et al. 2005, Denuit et al. 2005, Coles, 2001, Panjer, 2006, Panjer et al. 2008). Our contribution is to adapt these measures to the analysis and comparison of LTC protection schemes. In the rest of this paper, our loss random variable is the lifetime cost of LTC.

2 Notation and basic concepts

We denote by X_0 the lifetime cost of LTC from a given age t to death assuming that there is no level of protection so that the individual has to pay for all the costs of services aimed at his or her care through the remaining lifetime[2]. At age t the value of X_0 is unknown mainly due to the uncertainty about the probability of needing care, its duration and the inflation of the cost of services. The total lifetime cost spent in LTC will only become known once the person dies. Note that there will also be changes in risk factors and treatments that will have an impact on the evolution of disability rates (see for example, Jagger et al, 2006), so prediction of lifetime LTC cost is difficult. We assume that X_0 is a random variable which follows a probability distribution with a probability distribution function $F_0(x)$, for $x \geq 0$, defined as the probability that the lifetime cost of LTC from age t is not larger than x.

We will use subscript p to denote that the individual lifetime costs of LTC are covered totally or partially by an insurance programme (public or private). Assume X_p is the cost of lifetime LTC for an individual at age t if he or she is covered by a public system or subscribes to a voluntary protection plan so that part (or all) of the cost of LTC in X_0 is covered by an insurance scheme, either private or public or both. Again, and similarly to X_0, the final value of X_p is unknown at age t, and it will only become known once the person dies. At age t, X_p is

[2] The kind of costs considered in this variable are exclusively care costs, i.e. service delivery. Long-term care provision has extensively been studied in the specialized literature and a concensus exists on the fact that care needs depend on the level of disability. We only consider payments related to assistance at home, support from a third person to perform daily life activities, the cost of day care or the cost of residential care. We explicitely exclude sanitary costs or hotel costs, such as meals. Our approach is compatible to similar studies such as the one by Fernández and Forder (2010) for the United Kingdom.

a random variable which follows a probability distribution function $F_p(x)$, $x \geq 0$ which is the probability that the lifetime cost of LTC not covered by the external protection is smaller than x.

We aim at quantifying the risk transferred from X_0 to the protection scheme: that is, from the individual to the insurance plan or the public protection programme (or a combination of both). One simple way to do that is by comparing the distribution of X_0 and X_p or their respective risk measures. We do not explore the decision to purchase LTC insurance protection. Certainly, risk aversion pays a central role in the decision to purchase, as well as wealth, age and personal circumstances (see Pauly, 1990 and Zhou-Richter et al. 2010).

3 Risk mitigation of a protection for LTC lifetime individual expenditure

Using simple risk measures, we can estimate how much a LTC protection scheme will reduce the economic loss for those facing the highest lifetime costs of care (often referred to as catastrophic costs). The simplest risk measure that can be applied in our context is Value-at-Risk, Let us fix a probability level α_0, $\alpha_0 \in (0,1)$. When using Value-at-Risk we are estimating the minimum lifetime cost of LTC that is incurred by the α_0-th proportion of the population that spends more money on LTC (see Jorion, 2007)[3]. The information provided by Value-at-Risk can be useful for insurance companies, especially for the premium calculation of private and supplementary LTC insurance[4].

[3] The notion *Value-at-Risk* with level α_0 (α_0-quantile) of individual lifetime LTC cost under protection scheme *j*, *j*=0 or *j*=*p* means that there is a $(1-\alpha_0)$ proportion of the population aged *t* that spends at least $\mathrm{VaR}_{\alpha_0}(X_0)$ if there is no protection and at least $\mathrm{VaR}_{\alpha_0}(X_p)$ if protection *p* covers him or her. Another way to interpret Value-at-Risk is that an α_0 proportion of the population aged *t* spends during the rest of his or her lifetime less than $\mathrm{VaR}_{\alpha_0}(X_0)$ if there is no protection, and less than $\mathrm{VaR}_{\alpha_0}(X_p)$ under protection *p*. Value-at-Risk has been widely used for assessing financial risk (Jorion, 2001, Klüppelberg et al., 1999). Note that α_0 is often called the confidence level, wheras $(1-\alpha_0)$ is known as the risk level.

[4] We thank the reviewer to point out this fact. We also note that private insurance products may consider coverage up to a maximum accumulated compensation amount.

We will define the performance of protection policy *p* in terms of **risk mitigation**[5], with respect to the scenario where the whole burden is on the individual. Based on the concept of Value-at-Risk we define the first sirk mitigation measure as the difference between Value-at-Risk without and with an insurance protection coverage:

$$RM_1(\alpha_0;0;p) = \mathrm{VaR}_{\alpha_0}(\mathrm{X}_0)\text{-}\mathrm{VaR}_{\alpha_0}(\mathrm{X}_p) \quad (1)$$

The main drawback of $RM_1(\alpha_0;0;p)$ is that there must be a consensus on which is the α_0 level (or quantile) that is going to be chosen for comparative purposes. Once α_0 is fixed, $RM_1(\alpha_0;0;p)$ can be computed for several protection alternatives in order to rank them.

We may consider the concept of Tail-Value-at-Risk, which is useful to measure the average values at risk for all cases above a level α. Let us assume that α_0, $\alpha_0 \in (0,1)$ is a fixed confidence level. We would like to examine all Value-at-Risk at levels between α_0 and 1.

The Tail-Value-at-Risk can be interpreted as an average for all Value-at-Risk cases above a level α_0. We are particularly interested in the expected value of lifetime LTC costs with no protection (X_0) or with protection (X_p) for the $(1-\alpha_0)100\%$ group of individuals aged *t* who will experience costs larger than $\mathrm{VaR}_{\alpha_0}(\mathrm{X}_j)$, for *j*=0 or *j*=*p* respectively. This measure concentrates on the average cost for the group that will incur larger costs.

Note that there are many possible ways to fix the value of α_0. For instance, choosing α_0=75%, then $TVaR_{\alpha_0}(\mathrm{X}_j)$ for *j*=0 or *j*=*p* respectively, correspond to the average cost incurred by the group that exceeds the 75% percentile cost. Alternatively, the value of α_0 can be defined indirectly. For example, let us assume that we define α_0 as the level such that $F_0(x_0)= \alpha_0$ given that x_0 is a fixed amount such as the yearly minimum wage. In this case $(1-\alpha_0)100\%$ is defined as the percent of individuals aged *t* that would face lifetime LTC costs above minimum wage. The value of x_0 could be fixed, for example with respect to a yearly minimum income level. It could also be fixed in absolute terms. Then $TVaR_{\alpha_0}(\mathrm{X}_0)$ would be interpreted as the average lifetime LTC cost incurred by for those who would face a lifetime LTC cost greater than the minimum wage.

Note that if α_0=0, Tail-Value-at-Risk is simply the expected lifetime LTC cost, on average, of all individuals in the population.

[5] This should not be confused with the notion of Risk Margin in another context (see Floreani, 2011)

We will define the amount of risk mitigation of protection *p* with respect to the absence of protection, $RM_2(\alpha;0;p)$, using the concept of Tail-Value-at-Risk as:

$$RM_2(\alpha_0;0;p) = TVaR_{\alpha_0}(X_0)\text{-}TVaR_{\alpha_0}(X_p) \quad (2)$$

In order to compute $RM_2(\alpha_0;0;p)$ first we need to choose a level for α_0. Once α_0 is fixed, $RM_2(\alpha_0;0;p)$ can be calculated for several protection alternatives *p* (or combinations of protection schemes) and one can compare alternatives with respect to the gain in risk mitigation.

The main limitation of the comparative capacity of $RM_2(\alpha_0;0;p)$ in terms of its use to compare alternative *p* policies is that the comparison is made for those facing the highest cost only. However, calculating $RM_2(\alpha_0;0;p)$ is simple, once estimates of the distribution functions of X_0 and X_p are available. Moreover, $RM_2(\alpha_0;0;p)$ can be interpreted as the average LTC cost that is covered by the protection scheme for those individuals that incur the highest (or catastrophic) costs.

It is interesting to note that $TVaR_{\alpha_0}(X_j)$ at a given level is a coherent risk measure that has been used in many areas. It has risen independently in a variety of fields and has been given names such as *Conditional Value-at-risk*, *Conditional Tail Expectation* or *Expected Shortfall* (see Duffie and Pan, 1997; Artzner et al., 1999 and Denuit et al. 2005). It satisfies the so-called axioms of coherence, namely translation invariance, subadditivity, positive homogeneity and monotonicity.

4 Using Tail-Value-at-Risk to rank risk mitigation

Here we define the *relative risk mitigation index*, RM_3, which measures to what extend an LTC protection scheme reduces the average lifetime cost of care for those incurring the highest costs, relative to a baseline scenario where no coverage is available.

Let us assume that X_0 is the *reference cost baseline distribution*. We can define a percent reduction of the Tail-Value-at-Risk at level α_0, which we call the *relative risk mitigation index* as:

$$RM_3(\alpha_0;0;p) = \left(1 - \frac{TVaR_{\alpha_0}(X_p)}{TVaR_{\alpha_0}(X_0)}\right) \cdot 100 \quad (3)$$

Assuming that costs incurred are always positive and that $X_p \leq X_0$ with almost certainty in probability terms, which means that the probability that X_p is larger than X_0 is zero, then it can be shown that $RM_3(\alpha_0; 0; p)$ is a score between zero and 100.

A difficulty in the comparison of X_0 and X_p is that there is no guarantee that the probability of X_0 equals 0 is the same as the probability that X_p equals 0. Individuals may incur cost if there is no protection programme, while they may have to pay nothing when *p* is implemented. The procedure can be extended to compare more than one possible protection schemes.

5 A case study: The public LTC system in Spain

We apply the Risk Mitigation measures discussed above in order to measure the degree to which the Spanish public LTC system mitigates the risk of catastrophic risk of care.

In December 2006 the Spanish parliament approved the Law of Dependence, which was enforced in 2007. The law established a public long-term care (LTC) system and granted new rights to citizens in need of personal assistance. The law was conceived as a fourth pillar to the Spanish welfare system. Since then, the Spanish general budget has assigned increasing levels of funds for citizens needing LTC, and those funds have been set independently of public health funds.

The new Spanish Law of Dependence established an entitlement to public LTC in case of dependence. The system is universal and funded by taxes. Entitlements are based on the severity of dependence and not on the individual's wealth and income. The Spanish regulation establishes a score that varies as a function of the intensity of care needed. The score is a number between 0 and 100. There are three severity levels in the Spanish LTC evaluation system. A person is eligible in: Degree 1, if support is needed once a day (Level I: 25-40 points, Level II: 40-49 points), Degree 2, if assistance is to be provided two or three times per day (Level I: 50-64 points, Level II: 65-74 points) and Degree 3, if assistance is demanded several times during the day (Level I: 75-89 points, Level II: 90+ points). Once an individual becomes eligible, he or she receives a personalized plan and can choose between assistance in kind or in cash, if it he or she prefers to be cared at home and this is indeed possible. Not all degrees and levels are funded. Today only those having dependence level with severity of

Degree 2 or 3 are eligible to obtain an allocation from the public system. It is likely that budget restrictions will hinder the full implementation of the public system protection to all severity levels. It is often argued that the categorization of dependence severity entails some level of moral hazard. Maximum monthly allocations for individuals as a function of care needed for 2009 are shown in Table 1.

Table 1: LTC subsidy in Spain in 2009, Monthly maximum (minimum)[(a)] allocation in euros

Degree of dependence	Level of dependence	Service	Family care[(b)]	Personal assistant
3	II	833.96 (266.57)	520.69	833.96
3	I	625.47 (181.26)	416.98	625.47
2	II	462.18 (103.20)	337.25	
2	I	401.20 (70.70)	300.90	

(a) The minimum possible allocation is the minimum amount that a person in that level should receive
(b) An extra allocation of 162.49 euros is assigned for training and social security contribution of the carer worker

Table 1 indicates that someone who is eligible to receive LTC support from the public system can obtain up to 833.96 euros in cash as a monthly payment for the services received or 520.69 euros monthly for family care, if he prefers that relatives take care of him. In that case, an extra sum of 162.49 euros is given monthly to cover the social security taxes, and the training and education of the person that is employed as the family care-giver. The maximum public support allowance is gradually lowered depending on the severity level of dependence. Currently, the minimum possible allowance is 70.70 euros monthly for people with a severity degree 2, at level I. We should note that once a person is placed into one of the above categories (except for the highest level), if there are signs of deterioration, he or she can apply again to be reclassified.

In 2010, there were 614,750 people receiving some form of allocation. In fact some people maybe receiving more than one benefit. 7,468 people got a prevention plan; 74,775 got tele-assistance; care at home was supplied to 78,968; a care at day or night centre unit was assigned to 39,312 users; residential care was provided to 114,263; supplementary service allocation was given to 50,803 people and supplementary cash allocation for family care was given to 357,599 Spanish citizens. Cash benefits for family care are by far the most popular form of support from the public system.

Note that benefits cover part of the costs of care, not the full cost. For instance, the cost of a care home for a dependent person is higher than the maximum possible allocation for the most severe level of dependence. Therefore individuals or their families need to cover the rest of the costs of care using their own income or wealth.

Bolancé, et al (2010) estimated the distribution function of lifetime LTC cost for men aged 65[6]. A large survey by the Spanish Statistical Institute carried out in 2008 was used to produce the estimate. Respondents were classified as eligible or non-eligible by matching survey respondents to the levels of need that would trigger entitlement to public benefits. They were also rated in the official scale levels of severity. As those authors we also simulated a cohort of men and a cohort of women and compared the distribution of lifetime LTC costs if no public entitlements were available and the distribution of lifetime LTC costs if the entitlements that are established by the Spanish regulation were applied, so that cost would be partially covered by the state. More technical details can be found in the Appendix. The estimation is done using a very simple simulation procedure based on the Spanish period life tables published by the Spanish Statistical Institute, the prevalence of dependence by gender and age estimated from the survey, standard assumptions on the transitions from active to disabled conditions and the yearly cost of care depending on the severity level based on a Spanish average cost of service published by the Ministry of Social Affairs. The yearly cost of care for an individual in the lowest severity level (Degree 1) is on average 13,917 euros, in Degree 2 the yearly cost is on average 12,512 euros. Note that the cost is lower for Degree 2 than for Degree 1 because of day care in nursing homes is cheaper and care at home used for Degree 1. In Degree 3, the yearly average cost of care is 17,296 euros. A standard discount rate could have been incorporated in the simulation assuming, for instance, a 2% yearly cost inflation. The estimation of the distribution function is calculated easily as the empirical distribution function obtained from the simulation process, i.e. the percent of cases that incurred less than each given level of cost. The distribution function of lifetime LTC costs is presented in Figure 1, where the x-axis is the confidence level and the y-axis represents the Value-at-Risk.

[6] Our approach can be applied to any starting point age t. However our discussion is focussed at age 65, which is the current retirement age. Individuals needing LTC before age 65 are usually people whose need of support has been caused by factor other than the natural ageing process.

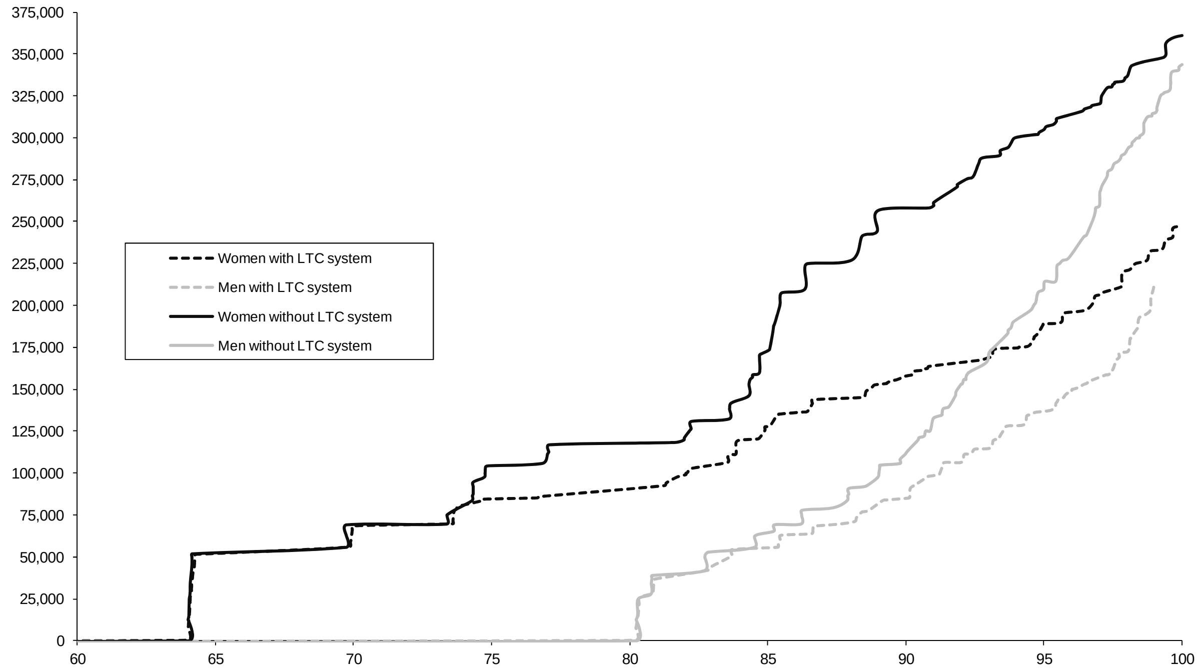

Figure 1: Value-at-Risk for rest of lifetime LTC costs (in euros) of dependence in Spain for those aged 65 in 2008 with and without LTC public system, by gender. The x-axis shows the percentile probability level and the y-axis presents the Value-at-Risk.

Table 2 presents the Value-at-Risk and the Tail-Value at Risk for three levels α_0 which are equal to 90%, 95% and 99% and which correspond respectively to risk levels equal to 10%, 5% and 1% for the distribution of lifetime LTC cost of those aged 65 in 2008 in Spain. Two possibilities are considered: the estimated lifetime LTC cost distribution if individuals pay for all the services, i.e. without any public system coverage, and the distribution when the current public system covers some of the LTC cost

The results show that the Spanish public LTC system risk mitigation effect, as measured by RM_3, exceeds 30% both for men and women at any risk level. In other words, the public system does reduce the risk of very high (or catastrophic) lifetime LTC cost. The introduction of the Spanish LTC public system guarantees that the highest or maximum possible cost incurred by the majority of the population (i.e. 90% or more) is reduced by more than 30% under the public LTC system.

Table 2: Risk measures and relative risk mitigation for lifetime LTC costs of dependence in Spain (2008) with and without the public system

	Men aged 65				
	Value-at-Risk		Tail-Value-at-Risk		Relative Risk Mitigation (RM_3)
Level	Without	With	Without	With	
90%	111.8	84.9	220.1	141.8	36%
95%	210.9	136.9	277.7	175.4	37%
99%	314.6	211.8	330.6	229.4	31%
	Women aged 65				
	Value-at-Risk		Tail-Value-at-Risk		Relative Risk Mitigation (RM_3)
Level	Without	With	Without	With	
90%	251.2	157.8	302.4	192.0	37%
95%	304.7	189.0	331.2	214.5	35%
99%	346.5	232.6	353.3	330.6	31%

Cost is expressed in thousand euros. Without the public protection costs are paid by individuals or their families and with the public system costs are partly covered by the state.

Looking at the most extreme cases, the Tail-Value at Risk is also substantially reduced under the current public LTC system. The average lifetime cost for those people who would incur the highest level of expenditure would be much reduced, especially if we look at the highest decile (90% level).

However, the results also show that, despite the risk mitigation offered by the Spanish LTC public system, there is still a risk of about 1% that a man will face lifetime costs of at least 211.8 thousand euro, and a risk of about 1% that a woman will face lifetime costs of at least 232.6 thousand euro. This suggests that the risk mitigation offered by the Spanish LTC system may still be too low for the small group of people who still face catastrophic costs of care.

6 Discussion

Policy considerations

In the Spanish public LTC system (and other European semi-universal systems), LTC benefits are allocated to people according to severity of need. Benefits cover part of the costs of care.

While this system does result in a reduction in the lifetime costs of care faced by all individuals over the care needs eligibility threshold, it is still possible for people to be exposed to catastrophic costs of care if they need care for a long period of time.

If one of the major aims of the LTC system is to mitigate the risk to individuals of facing very high lifetime costs of care, policy makers may need to consider redesigning the way in which benefits are assigned to individuals, so that account is taken of both the **severity** and the **duration** of care needs. Policy-makers could also consider providing or encouraging additional risk protection designed more specifically to help people who spend a very long period of time requiring care.

In many countries, even if there is a universal public LTC system in place, individuals are expected to make substantial contributions to the costs of their care (see, for example, OECD 2011). This potentially results in individuals who need care over a long period of time being exposed to very high (or catastrophic) lifetime costs of care. As a result, in Germany, France and Spain private long-term care insurance products have been developed with the aim of complementing the public system coverage and provide additional risk mitigation (Comas-Herrera et al., 2011, Courbage and Roudaut, 2008, Guillén and Pinquet, 2008, Kessler, 2008. Mayhew et al., 2010, Taleyson, 2003, Wittenberg et al, 2002 and Richter-Zhou et al., 2010).

Methodological considerations

The risk mitigation index presented in this paper can be used to assess how much protection is achieved by any one possible scheme (or a combination of shemes) at the individual level. Implementation of the method presented here requires an estimate of the statistical distribution of lifetime LTC costs under the different schemes that need to be compared. There are several approaches to obtain an estimate of the probability distribution function for a given population group, but choosing the best statistical approach among possible methods to obtain the distribution estimates depends substantially on the type of data that are available.

It is very important to check carefully the technical hypothesis that are needed for the selected statistical approximation to the estimation of the distribution function of lifetime LTC costs. In the case study presented above there is no parametric assumption on the density shape of the random variable that represents lifetime costs, however several hypothesis were established before obtaining the distribution estimate. When calculating risk mitigation which requires the comparison of several distribution functions, hypothesis used to approximate those functions need to be consistent along the whole process.

The method presented here can also be used to rank the effectiveness of public LTC protection plans across several countries and additional to assess the role of private insurance.

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Appendix

In order to estimate the LTC cost distribution we assume an initial population of size N aged t. To determine on a yearly basis what will be an individual's need of care, i.e. the level of dependence severity, , we assume that the individuals can only remain in the initial severity level, they may deteriorate or die. There are five possible states: Active, Degree 1, Degree 2, Degree 3 or Dead. We assume that individuals cannot recover. This is restrictive but it seems a plausible assumption for elderly individuals and for the very strong scale of dependence considered in our case. The calculation process is as follows:

• Step 1: We assign a proportional number of individuals from the initial population to all possible states except death. We will keep track of the evolution of every single individual in this simulated cohort.

• Step 2: Using the probability of death corresponding to the age and gender of each individual, we update the state after one year. We assume that individuals die and therefore the number of individuals in every state decreases, except for death. We track the trajectory of every single individual in the cohort with respect to the state.

• Step 3: With the individuals that have survived up to the next age, the distribution of individuals among the different severity levels is recomposed using the assumptions of no possible recovery stated above and between states. Transitions between states are tracked.

Steps 2 and 3 are iterated until the maximum age is reached or until no more individuals have survived.

Once the process is finished we consider the trajectory for each individual and compute the accumulated cost incurred, assuming that an active individual does not need care and the yearly cost of care differs according to the severity level. We use average yearly cost of care provided by a national average. Lifetables, ie probability of death by age and sex are taken from the National Statistical Institute and prevalences of severity level are also collected from the National Statistical Institute..

A histogram of the previous accumulated costs for all individuals in the simulated cohort provide an estimate of the random distribution of lifetime LTC costs from the initial age. Given that computation is fast, this distribution estimation method is easily implemented. We used a cohort of 1,000,000 individuals for each gender.

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