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The future of Long Term Care in Europe. An investigation using a dynamic microsimulation model*

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Abstract

In this paper we investigate the evolution of public European LTC systems in the forthcoming decades, using the Europe Future Elderly Model (EuFEM), a dynamic microsimulation model which projects the health and socio-economic characteristics of the 50+ population of ten European countries, augmented with the explicit modelling of the eligibility rules of 5 countries. The use of SHARE data allows to have a better understanding of the trends in the demand for LTC differentiated by age groups, gender, and other demographic and social characteristics in order to better assess the distributional effects. We estimate the future potential coverage (or gap of coverage) of each national/regional public home-care system, and then disentangle the differences between countries in a population and a regulation effects. Our analysis offers new insights on how would the demand for LTC evolve over time, what would the distributional effects of different LTC policies be if no action is taken, and what could be potential impact of alternative care policies.

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1 Introduction

The extraordinary improvement in life expectancy and health conditions experienced in the last century in many developed countries has profoundly changed the demographic structure of Western societies. However, despite this extraordinary increase in terms of life expectancy, disease-free life expectancy indicators have increased at a much lower pace. As result, the rate of older people in need of assistance has risen due to a higher prevalence of conditions and to a higher number of disorders limiting the autonomy of individuals (Rechel et al., 2013; EU Commission, 2015; WHO, 2016). At the same time, from the supply-side perspective, the expected increase in the care-workforce is rather modest (Colombo et al., 2011). In this context, it is prominent for the current political and economic debate highlighting the relevance of developing formal and effective Long Term Care (LTC) programs, defined as a range of services required by persons who cannot cope with basic Activities of Daily Living (ADL) and instrumental Activities of Daily Living (iADL) due to a reduced physical and/or cognitive capacity (OECD, 2013).[1]

In this paper we offer new insights on the sustainability of public LTC systems in several European countries over the forthcoming decades, through a set of simulation exercises ("what if" scenarios) implemented using the Europe Future Elderly Model (EuFEM), a novel dynamic micro-simulation model based on SHARE data, which projects and compares both the health and socio-economic characteristics of elderly Europeans and, consequently, the potential demand for home-care given actual eligibility rules.

The health-economics literature has widely documented how the need-for-LTC is not determined by ageing *per se*, but rather by the prevalence of vulnerability levels (EU Commission, 2015), and how including better indicators of health care needs is desirable for a more targeted and effective LTC service utilisation and for better expenditure forecasts (de Meijer et al. 2011). Indeed, limitations in ADL and iADL are widely adopted as covariates to proxy the condition of vulnerability, either in the form of counting or dummy variables (e.g., EU Commission, 2015; Balia and Brau, 2013; de Meijer et al., 2011), or through synthetic indices (Kapteyn and Meijer, 2013; Bonsang, 2009; de Meijer et al., 2015). Cognitive ability and mental health are also often included as additional determinants (Bakx et al., 2014; Kalwij et al., 2014; Jiménez-Martín and Prieto, 2012). Many forecasting studies have accounted for the trends in the prevalence levels of vulnerability in estimating future LTC utilisation and expenditures, without accounting for differences in countries' institutional settings for public LTC services (Spillman, 2004; Lafortune and Balestat, 2007; Manton and Lamb, 2007; Colombo et al., 2011; de Meijer et al., 2011; De Meijer et al., 2012). As an example, the macro-simulation study by EU Commission (2015) and

[1] Recently adopted policies in major developed countries identified new forms of community- and domiciliary-care as sustainable approaches that could prevent institutionalisation, while easing the burden of care on family members under binding public budget constraints (Gori and Fernandez, 2015).

OECD (2016) use data from the System of Health Accounts (SHA), ESSPROS and EU-SILC to produce a projection of the population in need of LTC, setting a fixed threshold of one or more limitations in ADL to define the potential demand for care.

Several analyses have acknowledged that regulation frameworks play an important role in determining the utilisation and the potential coverage of LTC systems in Europe, with particular references to the eligibility criteria, which determine the range of vulnerability conditions accepted for receiving care (Andersen and Newman, 2005; Comas-Herrera et al., 2006; Colombo et al., 2011; de Meijer et al., 2011; Gori and Fernandez, 2015; Kim and Lim, 2015). In particular, Colombo and Mercier (2012) highlight the importance of the choice of the target-population for LTC services, i.e., prioritising some vulnerability profiles with respect to others. For example, they discuss the pros and cons of including iADL in a basic package of care.

As highlighted by de Meijer et al. (2015), changes in the observed or forecasted utilisation rates (across countries and over time) may be driven by two different and confounding causes:

- levels of vulnerability, which may vary across populations (because of specific epidemiological characteristics) and over time because of the ageing process (which, in turn, can be country-specific);
- program's target populations, defined by the range of "objectively vulnerable" profiles accepted for treatment, which are not homogeneous across-countries or regions, thus generating further heterogeneity in LTC service utilisation.

Hence, if individual's eligibility status is not explicitly accounted for, it becomes hard to disentangle which elements of the observed or forecasted care-use result from "objective" health-conditions and which are due to the institutional framework, making difficult to obtain reliable projections or to carry out policies' evaluation.

Despite there is a considerable awareness of these problems among social science researchers, only few studies have been able to account for institutional differences in their analyses. Works by Comas-Herrera et al. (2003), Comas-Herrera et al. (2006), Pickard et al. (2007) and Costa-Font et al. (2008) have produced several country-specific macro-simulations of LTC expenditure by estimating the future numbers of dependent older people using dependency rates taken from official statistics offices in each country. The authors highlight how the definitions used to determine the dependency rates differ across countries, and how this may explain the cross-countries heterogeneity in the forecasted trends. de Meijer et al. (2015) and Bakx et al. (2014) adopt a nonlinear version of the Oaxaca-Blinder decomposition method to show that shifts in LTC use, either among the Dutch elderly or in a comparison with Germany, are

explained by changes in how the LTC system treats disabled elderly rather than by shifts in the prevalence of disability, although the authors underline that they are not able to identify which structural changes have contributed most to trends in LTC use. Jiménez-Martín and Prieto (2012) focus on formal and informal care utilisation in Spain, taking into account nationwide eligibility rules in a micro-data analysis, by assigning to each respondent a score computed according to the current regulation. Apart from this latter study, the literature has not yet provided a comprehensive implementation of eligibility rules into empirical analyses on care use or expenditure, due to the lack of available comparable information on assessment of need and eligibility rules (as highlighted, e.g., in Comas-Herrera et al., 2003). Due to the heterogeneity in the eligibility rules' design, a descriptive analysis of the characteristics of the laws does not allow to draw informative evidence on their impact on LTC coverage. In fact, eligibility rules are typical non-linear functions of vulnerability outcomes, where both the non-linearity behaviour and the weights assigned to each outcome differ greatly across programs.

With the aim of filling these gaps, we produce an up-to-date review of the eligibility and assessment rules of major national and regional European programs of domiciliary LTC and fit them within the EuFEM micro-simulation model to estimate future trends for public home-care coverage, defined as the share of population aged 65+ that would be eligible to formal care-programs, in five European countries namely Austria, Belgium, France, Germany and Spain.[2] Specifically, we link the information on LTC assessment-of-need and eligibility rules with micro-data from SHARE. This allows us to build a simplified individual-specific socio-clinical profile comparable with the requirements of domiciliary LTC programs existing in some EU countries and to generate an individual-specific index proxying respondents' vulnerability status according to the eligibility rules implemented in the respondent's country or region.

Through a direct-adjustment standardisation, we obtain comparable lower-bound coverage rates for each LTC program at the extensive margin, i.e., the share of 65+ individuals who would have access to some form of in-kind/in-cash benefit, according to the minimum eligibility thresholds. This is, we believe, an informative proxy for estimating the "structural differences" existing across countries, which are pivotal for precisely disentangling the specific effects that epidemiological and the regulatory characteristics have on explaining differences in LTC use, both across countries and over time. By projecting such regulation-based coverage rates into the next decades through the implementation of a specific LTC module within the EuFEM micro-simulation model, we provide counter-factual evidence on potential home-care utilisation trends in absence of any substantial reform to the current regulations.

To the best of our knowledge, this is the first time such an approach is applied in this field, allowing

[2]The EuFEM allows projections for 10 European countries namely Austria, Belgium, Denmark, France, Germany, Italy, Spain, Sweden, Switzerland and The Netherlands.

us to improve with respect to the existing literature along several directions: *i)* we are able to estimate the coverage rates resulting from the adoption of country/region specific eligibility rules, which have not been exploited so far, rather than imposing a fictitious definition of vulnerability fixed across countries; *ii)* we can control for the existing heterogeneity in morbidity levels and trends across limitations and across countries using a micro-simulation approach; *iii)* we have a better understanding of the trends in the distribution of the potential demand for LTC due to the use of individual level data, which we can disaggregate by age groups, gender, and other demographic and social characteristics. This is particularly important because, although on average we live longer, several studies have identified large degrees of health inequality among socio-economic groups (e.g., Case and Deaton, 2015; Lynch and von Hippel, 2016). Conversely, due to lack of information on precise individual expenditures for the reviewed programs, as well as to the comparability issues affecting the functional breakdown of LTC expenditure (OECD, 2016; Costa-Font et al., 2008), our conclusions will hold only for LTC use but not for LTC expenditure.

In what follows, the paper is organized in 5 sections. Section 2 summarises how the status of vulnerability for older individuals is defined in the clinical literature and in the European LTC regulations. Section 3 presents the methodology employed to obtain an empirical measure of eligibility and coverage, while Section 4 sketches the functioning of EuFEM, the dynamic micro-simulation model. Section 5 discusses the main data sources and the presents some descriptive statistics. Section 6 illustrates and discusses the results. Finally, Section 7 concludes.

2 The concept of vulnerability in the clinical literature and in European LTC schemes

2.1 The concept of vulnerability in the clinical literature

A necessary condition to assess the need for LTC is to measure the vulnerability status of people and summarise it into a single, encompassing measure, with the purpose of determining access to care. Vulnerability is often documented in the clinical literature as a multi-dimensional concept characterized by conditions of frailty, disability/dependency and comorbidity (Fried et al., 2004). The most prevalent symptoms of vulnerability are usually identified with a loss-of-autonomy in the ADL (Katz et al., 1970), as well as in the iADL (Lawton and Brody, 1969). These taxonomies assess how an individual performs, without assistance, in various functioning domains: bathing, dressing, toileting, transferring, continence, and feeding (ADL); or ability to use the telephone, shopping, food preparation, housekeeping, doing laundry, mode of transportation, responsibility for own medications and ability to handle finances (iADL).

Since the iADL tasks require a more complex neuropsychological organisation than ADL, they measure less severe levels of vulnerability.[3] Besides ADL and iADL losses, further outcomes of vulnerability are the occurrence of limitations in mobility, deterioration in nutritional status, cognition and endurance, weight loss, lowered serum cholesterol levels, and increasing sensitivity to change.[4] Indeed, psychological and emotional state, as well as coping style and social environment, may influence disability as much as the biological or physiological factors (De Vries et al., 2011).

Building an index of vulnerability status requires facing several conceptual hurdles. First, frailty, disability and comorbidity are distinct but overlapping concepts. Frailty and comorbidity are jointly predictors of disability, which, in turn, can exacerbate frailty and comorbidity. The latter, itself, contributes to increase frailty (Fried et al., 2004). Moreover, not all the physiological changes that underlie frailty and disability achieve disease status, so that they are not necessary nor sufficient conditions for ageing or death (Rockwood and Mitnitski, 2007). In particular, frailty is considered a pre-disability state and therefore, unlike disability, it is reversible (there is "potential for intervention", in the words of Conroy, 2009). More generally, the association between vulnerability and ageing is strong, and yet not all elderly adults are vulnerable (De Vries et al., 2011; Pel-Littel et al., 2009).

The complex interaction between numerous risk-factors implies that not every combination of deficits and not every comorbidity is equal in terms of the generated vulnerability, and that no "gold standard" exists in terms of how to measure such composite condition (Fried et al., 2004; Fulop et al., 2010; Sourial et al., 2010; Pilotto and Ferrucci, 2011; Rodriguez-Manas et al., 2013). Current research is actively focused on producing reliable tools that could help identifying (and predicting) vulnerability. Useful reviews of existing measuring-tools are Pel-Littel et al. (2009), De Vries et al. (2011) and Clegg et al. (2013), while a review on screening tools for frailty in primary health care is in Pialoux et al. (2012). Among others, the frailty-index in Mitnitski et al. (2001) and Rockwood and Mitnitski (2007) links the condition of frailty to the accumulation of deficits, while Pilotto et al. (2013) develop and validate a multi-dimensional index of vulnerability and mortality based on a multidimensional assessment schedule (SVaMA) adopted in several Italian regions. Finally, the World Health Organisation (WHO) developed an instrument - the International Classification of Functioning (ICF) - to provide public institutions with a "consistent and internationally comparable" tool to collect data on vulnerability, adopting a bio-psychosocial perspective on the phenomenon (WHO, 2002).

[3] As described in LaPlante (2010), also the ADL scale embeds a paediatric model: as a child matures, the simplest activity, eating, is mastered first, then continence, transferring, toileting, dressing, and bathing. When ageing, losses occur in the reverse order.

[4] An in-depth analysis can be found in Pel-Littel et al. (2009)

2.2 Measures of vulnerability in European LTC regulations

Given the aforementioned lack of a unique clinical perspective, it is reasonable to wonder whether the definitions of vulnerability embedded in national or regional LTC programs exhibit a similar degree of variation. The health economics literature recently started to tackle this topic, highlighting that substantial heterogeneities exist among the LTC systems in Europe: OECD's work by Colombo and Mercier (2012), as well as reports by the European Commission (EU Commission, 2015), and works by Gori and Fernandez (2015), Eleftheriades and Wittenberg (2013), Da Roit and Le Bihan (2010) and Comas-Herrera et al. (2003) detailed how different LTC schemes and different definitions of vulnerability are the outcome of heterogeneous policy objectives, philosophies and institutional frameworks. Such a research focus has a substantial economic relevance, since eligibility requirements have a major role in determining care-programs' coverage and expenditure, as the next section will detail. Nevertheless, even though the lack of harmonisation in the definition of vulnerability (through the usual channels of assessment-of-need and eligibility rules) is largely recognised, less is known in terms of where the existing assessment and eligibility rules differ, and to which extent such differences affect care-coverage. To the best of our knowledge, only Jiménez-Martín and Prieto (2010) and Bakx et al. (2014) established a deeper focus on access-rules in, respectively, Spain and the Netherlands, while Eleftheriades and Wittenberg (2013) and Comas-Herrera et al. (2003) provided a summary for Australia, France, Germany, Italy, The Netherlands, New Zealand and United Kingdom.

Building on the work initiated by Carrino and Orso (2014), we contribute to the existing literature by adding a further level of detail in reviewing and comparing the access-regulations to some European domiciliary LTC programs which enforce region- or nation-wide assessment processes and clear-cut eligibility-rules. Namely, our analysis includes Austria (the cash benefit Pflegegeld), Belgium Flanders and Wallonia (the nursing care program by the National Institute for Sickness and Disability Insurance, the cash benefits Aide á la Personne Âgée (APA) and the Flemish Zorgverzekering), Germany (the mandatory insurance Pflegeversicherung), France (the programs Allocation Personnalisée d'Autonomie and Aide-ménagère à domicile) and Spain (the program regulated by the Ley de Dependencia).[5] Our analysis complements the aforementioned literature in that we detail the way in which different vulnerability outcomes are included in the eligibility rules of the selected programs.

A brief summary of the main characteristics of the reviewed assessment and eligibility rules is depicted in Table 1, while further details are available in the Appendix B and in Carrino and Orso (2014). As

[5]Being the definition of objective vulnerability a crucial component of our analysis, we could not include in this review those SHARE countries where the regulations do not set either a nationwide assessment of need, or a nationwide eligibility rule to access care, namely, Denmark (Schulz, 2010), Italy (Da Roit and Le Bihan, 2010; Gori, 2012)), the Netherlands (Mot and Aouragh, 2010), and Sweden (Socialstyrelsen, 2009).

we can see from Table 1, most of the reviewed programs include some sub-set of the ADL and the iADL limitations together with other mobility tasks. Many programs, such as the Austrian, the Flemish, the German (before January 1st 2017) and the Spanish, include both the ADL and the iADL; others, such as the Belgian home-care program (INAMI), the reformed German system (since 2017) and the French programs exclude iADL from the eligibility decision. Finally, the Belgian cash-benefit APA includes an incomplete list of both taxonomies. The new German and, to a lower extent, the Austrian rules cover a detailed list of self-caring activities, especially with respect to post-surgical conditions (e.g., catheter/stoma care). In terms of the dementia risk associated with ageing, all programs include cognitive and mental abilities in their assessment-of-need, and behavioural issues are also often included. Besides functional and mental limitations, age plays a role in various LTC regulations, which are specifically designed for elderly population and therefore set minimum age-requirements for eligibility (60 years old for the French APA, 65 for the French Aide-ménagère and the Belgian APA). Finally, regulations are carer-blind, i.e., they do not include the utilisation of informal care as an item for the assessment.

3 An operative definition of eligibility and coverage

3.1 A regulation-based index of *need-of-care*

As shown in Section 2, each home-care regulation defines an individual's eligibility status through an assessment of her "objective vulnerability" status. We define a program's coverage rate as the share of population aged 65+ that would be "objectively vulnerable" (i.e., eligible for care) under the program's definition. Our task is now to build an individual-specific "objective vulnerability" index using information from both SHARE and the programs' regulations. Table 2 summarises a comprehensive set of functional and cognitive health-outcomes, which are relevant for eligibility in the country regulations selected for this study and are available in SHARE. Although in what follows we will describe a general formalisation for the construction of the "objective vulnerability" index, the program-specific correspondence between health-outcomes in SHARE and the eligibility rules are detailed in Appendix A.

A generic clinical profile p for individual i living in country j with $p = 1, \ldots, P_j$, $i = 1, \ldots, N_j$, $j = 1, \ldots, J$ and $P_j \leq N_j$, is a vector $\pi_{i,j,p} = \{\alpha^1_{i,j,p}, \ldots, \alpha^H_{i,j,p}\}$ where $\alpha^h_{i,j,p}$ is an indicator for the health limitation h ($h = 1, \ldots, H$) which is equal to 1 if limitation h occurs, and 0 otherwise. We then define $\Phi_j = \{\phi_{j,1}, \ldots, \phi_{j,P}\}$ as the set of all possible profiles, where $\phi_{j,p} = \{\pi_{1,j,p}, \ldots, \pi_{n_{j,p},j,p}\}$ is the generic clinical profile (eventually) shared by $n_{j,p}$ individuals in country j, with $N_j = \sum_{p=1}^{P_j} n_{j,p}$.[6]

We then make the following assumption:

[6]Notice that, since $P_j \leq N_j$, the number of all possible profiles in country j may coincide with the number of individuals living in j. If $P_j = N_j$ then $n_{p,j} = 1$.

Table 1: LTC in Europe

Country	Program	ADL	iADL	Others	Eligibility threshold	Main ADL	Main non-ADL
AT	Pflegegeld		X	M, C	65h/month*	washing, dressing, WC	cooking, housework
BE	APA	P	p	C	7 points	-	-
	INAMI/RIZIV (BESADL)	X		C	washing + dressing + moving or using WC / cognition + washing + dressing	washing / dressing	cognition
	Vlaamse zorgverzekering (BEL profielschaal)	X	X	C	35 points	-	housework, cognition
DE	Pflegeversicherung (before 2017)	X	X	M, C	90m/day* or C	washing, eating, continence	cognition
	Pflegeversicherung (since 2017)	X		M, C	27 need-score out of 100	washing, eating, WC	Therapy-related requirements
ES	Promocion de la Autonomia Personal	X	X	C	25 points	eating, WC	-
FR	APA (AGGIR)	X(a)	(b)	C	2 ADL / cognition	-	cognition
	Action Sociale: Aide ménagère à domicile (AGGIR)	X(a)	(b)	C	washing/cooking/housework	Washing	cooking, housework

B = behavioural issues; C = cognitive limitations; M = advanced medication procedures; (a) Incontinence not included; (b) iADL do not matter for eligibility. * Austria: at least one ADL and one iADL limitations must occur. Germany: at least 45m must come from ADL limitations.

Table 2: Summary of health-limitations included in assessment-of-need scales

ADL-like	Available In SHARE	Not ADL	Available In SHARE
Bathing and hygiene	yes	Communication	yes
Dressing	yes	Shopping for groceries/medicines	yes
Using the toilet	yes	Cooking	yes
Transferring	yes	Housekeeping	yes
Continence	yes	Doing laundry	yes
Feeding	yes	Moving outdoor	yes
Moving indoor	yes	Responsibility for own medications	yes
Hygiene for post-surgery conditions or advanced medications	no	Behavioural/Cognitive impairment	yes
		Other mobility limitations	yes

The underlined tasks do not belong to the Katz's ADL scale, but are treated as basic activities of daily livings in the LTC regulations that include them. The category "hygiene for post-surgery conditions or advanced medications" refers to patients with difficulties in performing advanced medications like enemas or maintenance of tubes/bags resulting from surgical operations. Additional mobility limitations include, e.g., crouching and walking down stairs.

ASSUMPTION 1: For a generic individual i and clinical profile p, the limitations included in $\pi_{i,j,p}$ exhaust all possible ranges of outcomes considered in the reviewed regulation of country j.

Denote with $\tilde{\Phi}_j$ the set of profiles that can be considered as eligible according to any LTC program in country j, that is the range of outcomes accepted for receiving care in country j (Andersen and Newman, 2005). We then define an indicator function determining the extensive-margin eligibility status of an individual i living in country j, $1_{\tilde{\Phi}_j}(\pi_{i,j,p})$ which is equal to 1 if $\pi_{i,j,p} \in \tilde{\Phi}_j$, and 0 otherwise.

Three empirical problems must be acknowledged when comparing actual legislations with micro-data information. First, in line with the existing literature, we focus on main national/regional care-programs, being aware that they are often complemented by small care-programs at community levels. Still, given the extent of the selected programs, we believe that the analysis is informative for both policy makers and health-related researchers. Second, micro-data information are usually self-reported, though interviewers can signal unreliable answers and respondent subjectivity may affect also the health-variables, though reliability of self-reported conditions have been validated by the recent literature.[7] Still, the survey-based prevalence of vulnerability can be both underestimated, e.g., if people do not report limitation/conditions that would be categorized as such by a trained evaluator, and overestimated, e.g., if the answers highlight difficulties that would be considered as "minor" and thus would not require provision of care (EU Commission, 2015).[8] Third, although regulations establish clear-cut assessment and eligibility rules and label them as 'objective' and 'valid nationwide', some degree of subjectivity may remain on the medical team who takes the final decision. Overall, as standard in this type of literature, we assume that the aforementioned issues occur randomly, which should not affect our final results.

[7] See for example works, among others, by Balia and Brau (2013) and LaPlante (2010).

[8] However, SHARE respondents are asked not to report difficulties that are expected to last less than three months.

3.2 Comparability of coverage rates and direct adjustment

We define the national "crude" coverage-rate ω_j as the share of eligible individuals living in country j under any LTC rule in j, that is

$$\omega_j = \frac{E_j}{N_j} \tag{1}$$

where, as defined above, N_j is the observed population of country j and $E_j = \sum_{i=1}^{N_j} 1_{\tilde{\Phi}_j}(\pi_{i,j,p})$ is the number of individuals living in j which are eligible to any program in j. Such a crude-rate provides a sort of ex-ante information on a program's potential coverage, exclusively based on the definition of need-of-care detailed in the law. Thus, the "eligibility" status does not necessarily identify those individuals who are actually "treated" by public programs; furthermore, SHARE does not include information on whether or not an individual made an application for LTC benefits and consequently received a positive, rather than a negative, response. Our eligibility variable can thus be interpreted as the fulfilment of the requirements to obtain publicly funded long-term care through the surveyed programs.

The "crude coverage rates" as in Eq.1 are not easily comparable across countries, since they embed a "regulation-effect" and a "population-effect", which cannot be disentangled at this stage. In either a cross-sectional or a time-variant perspective, a country could report a higher shares of eligible individuals either because its LTC system is on average more inclusive (this is captured by the country-specific eligibility function f), or because its population has worse health-conditions (i.e., the distribution of observed clinical profiles is country-specific), or both (de Meijer et al., 2015).

To allow for international comparison, we adopt a method of adjustment, referred to as "direct-adjustment" (or standardisation) which has long been established in the health-economics literature (see, e.g., Gravelle (2003), Schokkaert and Van de Voorde (2009)), and which shares the same aims as the Oaxaca-decomposition approach (de Meijer et al., 2015). In particular, comparing the coverage rates of countries A and B through the direct-adjustment standardisation requires to apply, separately, the LTC rules of the two countries to a "standard" population (e.g. the population of A plus B). The overall number of individuals eligible under each set of rules should then be expressed as a ratio of the total standard population to produce a directly-adjusted inclusiveness rate that would represent A's and B's inclusiveness if each country had the same health structure as the standard population. The directly-adjusted rates are intended as relative measures of coverage to be used for comparability purposes. Indeed, by considering the whole set of the J countries whose overall population (hereafter, "standard") is $N = \sum_{j=1}^{J} N_j$, we can define the directly-adjusted coverage rate for the LTC regulations implemented by country j as

$$\omega_j^{DA} = \frac{E_j^{DA}}{N} \tag{2}$$

where $E_j^{DA} = \sum_{j=1}^{J} \sum_{i=1}^{N_j} 1_{\tilde{\Phi}_j}(\pi_{i,j,p})$ is the directly-adjusted eligible population in country j. By applying this procedure for each LTC regulation, we obtain program-specific directly-adjusted coverage rates. A different perspective for the directly-adjusted coverage rate consists, on the other hand, in applying a country j's specific LTC regulation to the population of a different country, say s, with $s \neq j$. Also in this case, for each of the available countries we derive the country-specific directly-adjusted coverage rates conditional on specific programs, that is

$$\omega_{j,s}^{DA} = \frac{E_{j,s}^{DA}}{N_j} \tag{3}$$

where $E_{j,s}^{DA} = \sum_{i=1}^{N_j} 1_{\tilde{\Phi}_s}(\pi_{i,j,p})$ is the directly-adjusted eligible population of country j according to the rules of country s, where $1_{\tilde{\Phi}_s}$ is the indicator function determining the extensive-margin eligibility status of an individual i living in country j according to the LTC rules in country s, with $1_{\tilde{\Phi}_s}(\pi_{i,j,p})$ equals to 1 if $\pi_{i,j,p} \in \tilde{\Phi}_s$, and 0 otherwise.

4 Model structure and outcomes

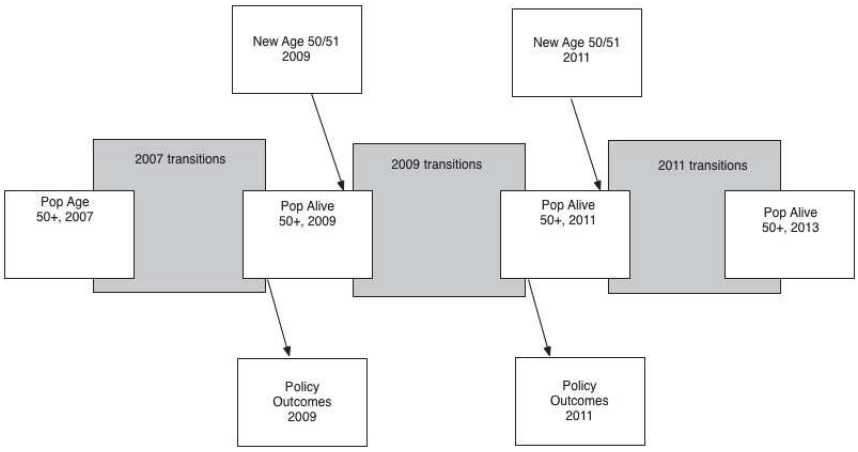
The microsimulation model used in this work stems from the Future Elderly Model (FEM), originally developed to examine health and health care costs among the Medicare population (Goldman et al., 2005). EuFem is indeed the European version of the FEM. It exploits as main data source a harmonized version of SHARE (Survey on Health, Ageing and Retirement in Europe), a European multidisciplinary survey on individuals aged 50 or older and on their spouses, whose design is based on the Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA), and whose details are described in Börsch-Supan et al. (2005) and Börsch-Supan and Jürges (2005).[9]

As for the FEM, the main feature of the EuFEM is that it uses real individuals rather than synthetic cohorts, allowing for larger heterogeneity in behaviour than would be allowed by a cell-based approach (Li and O'Donoghue, 2013). Individuals, in a given year, have a probability to change their condition (status) given a set of specific occurrences corresponding to real life events such as marriage, divorce, fertility, education, labour force participation, illness and, finally, death. Using a first order Markov process, individuals observed in the base year as well as new incoming cohorts are progressively moved forward through time by making these major life events occur to each individual, according to the probabilities of such events happening to real people with specific characteristics.

[9]This analysis uses data from the Harmonized SHARE Version C.2 as of June 2016 developed by the Gateway to Global Aging Data. The Harmonised SHARE defines variables as identically as possible with the RAND HRS, thus greatly simplifying the adaptation of the FEM to the European case. The development of the Harmonized SHARE was funded by the National Institute on Ageing (R01 AG030153, RC2 AG036619, R03 AG043052). For more information, please refer to www.g2aging.org.

The model can be split into three major components: *i*) the initial cohort module, *ii*) the transition module, and *iii*) the policy outcomes module. A schematic overview of the model is provided in Figure 1.

Figure 1: EuFEM model flow



The initial cohort module predicts how the future cohorts of 50-51 years old will look like based on historical trends and taking into account the existing correlations between outcomes.[10] The initial cohort module allows us to generate new cohorts as the simulation proceeds, so that to maintain the population structure in any given year.

Using a first order Markov process and two year time step, the transition module computes, for binary outcomes, the probabilities of entering and exiting different states. The common set of covariates for the transition module includes, as for the FEM, past health conditions, diseases prevalence, country dummies (Italy is the reference), education, gender (female is the reference), gender interacted with education, and age polynomials. BMI and capital income are estimated as continuous outcomes, while ordered models is used to estimate smoking status. Within this framework it is possible to take into account a great deal of heterogeneity and feedback effects. We make several restrictions on the transition risks permitted in the model. First, we only allow feedback from diseases where clinical research supports such a link. For instance, we allow hypertensive patients to have higher risk of heart disease, but we do not allow hypertensive patients to have higher risk of COPD (see Table 3 for a summary of the estimated outcomes

[10]Historical trends for BMI and smoking status are country specific and have been extracted from the European Community Households Panel (ECHP) survey, while chronic diseases are trended using the HS-SISSi database assuming that Italian population trends are applicable to the other considered European countries. The HS-SISSi database is a nationally representative longitudinal database of Italian General Practitioners with detailed medical information for over 1,1 millions unique patients for the period 2000-2015 (Health Search, 2008, 2014). As for the covariance matrices used to take into account the existing correlations between outcomes in simulating the new cohorts, see Table 27 and 28.

by types).

With respect to the standard EuFEM, in this paper we develop a new LTC module by modelling each of the health limitations needed to be considered as eligible for country specific formal LTC programs (see Table 4 for the estimated models). Each outcome is modeled as a non-absorbing outcome, thus allowing at each time step for recovery from the single disability. After transitioning each individual to its disability status, country specific eligibility rules are applied to obtain the eligibility indicators defined in Section 3.2.

Table 3: Estimated outcomes (selected list)

Variable	Type of variable	Type of model	Transition timing
Mortality	binary	probit	absorbing
Chronic Diseases			
Cancer	binary	probit	absorbing
Diabetes	binary	probit	absorbing
Heart disease	binary	probit	absorbing
Hypertension	binary	probit	absorbing
Lung disease	binary	probit	absorbing
Stroke	binary	probit	absorbing
Functional limitations			
Number of difficulties with ADLs	ordered	Ordered probit	Every wave
Number of difficulties with IADLs	ordered	Ordered probit	Every wave
Smoking status	ordered	Ordered probit	Absorbing (not smoking)
BMI, log transformation	continuous	OLS	Every wave
Economic characteristics			
Working for pay	binary	probit	Every wave until age 80+
Annual earnings	continuous	GHREG	Every wave if working for pay
Non-zero wealth	binary	probit	Every wave
Household wealth	continuous	GHREG	Every wave

Finally, in the policy outcomes module individual-level outcomes are aggregated to obtain policy outcomes such as expenditures and disease prevalences.

Given this structure, individuals aged 50 or more enter the simulation with their set of characteristics (demographic, health and economic). At each time step, the survivors make it to the end of that year, at which point we calculate policy outcomes for the year. The simulation process then moves to the following year, replenishing the model with a new cohort of 50-51 years old, whose health profile comes from the initial cohort module. These entrants, along with the survivors from the last period, constitute the new age 50+ population, which then proceeds through the transition module as before. This process is repeated until we reach the final year of the simulation.

Table 4: Eligibility-related estimated outcomes

Variable	Type of variable	Type of model	Transition timing
Sitting 2h	binary	probit	Every step
Getting up	binary	probit	Every step
Climbing stairs	binary	probit	Every step
Dressing	binary	probit	Every step
Walking	binary	probit	Every step
Bathing	binary	probit	Every step
Eating	binary	probit	Every step
Getting in bed	binary	probit	Every step
Using the Toilet	binary	probit	Every step
Reading a map	binary	probit	Every step
Preparing a meal	binary	probit	Every step
Shopping	binary	probit	Every step
Using the phone	binary	probit	Every step
Medications	binary	probit	Every step
Doing housework	binary	probit	Every step
Managing money	binary	probit	Every step
Resting and sleeping	binary	probit	Every step
Enjoyable activities	binary	probit	Every step
Orientation	ordered	oprobit	Every step
Depression (Euro-D ¿4)	binary	probit	Every step

5 Data

In this paper we use data from five waves of SHARE.[11] The latter provides comparable information about respondent's morbidity and disability status, based on self-reports of objective limitations and health conditions. Respondents are asked to report their dependency status in performing fourteen ADL and iADL activities, as well as other specific questions on mobility limitations. All the aforementioned tasks are assessed on a dichotomous scale: a limitation can either occur or fail to occur, but no intensity is measured.

Depression and loss of orientation are covered by two different set of variables. First, the questionnaire assesses a set of 12 mood- and behaviour-related conditions that are then summarised in the EURO-D scale, whose values range from 0 to 12 depending on the number of occurring symptoms. A EURO-D value of 4 (or higher) has been demonstrated to be associated with a clinically significant level of depression Börsch-Supan and Jürges (2005). Secondly, four questions on mental orientation and coherence ask respondents to report the current date, month, year and day of week. Moreover, individuals' memory status is assessed using delayed recall of a ten-word list in wide international use. Following the recent literature

[11]This paper uses data from SHARE Waves 1, 2, 3 (SHARELIFE), 4 and 5. The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812) and FP7 (SHARE-PREP: N 211909, SHARE-LEAP: N 227822, SHARE M4: N 261982). Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_t04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

(Verbeek-Oudijk et al. (2014); Castro-Costa et al. (2007) we define impairment as giving zero or one correct answers in the orientation questions, and memory deterioration as recalling less than three words out of ten. Finally, information is available on the activities a respondent performed in the last month (voluntary/charity work, caring/helping friend, attending courses, taking part to sport/religious/political activities).

Table 5: Population Stock - Socio-Economic variables (N=19,865)

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Male	0.446	0.497	0	1
Age	65.535	10.42	25	105
Married	0.733	0.442	0	1
Retired	0.662	0.473	0	1
Less than high school	0.29	0.454	0	1
Some college and above	0.229	0.42	0	1
HH capital income	3644.5	14880.9	0	516713.5
Working for pay	0.338	0.473	0	1
Individual earnings in 1000s	12.842	27.848	0	200
Austria	0.05	0.218	0	1
Germany	0.106	0.308	0	1
Sweden	0.105	0.306	0	1
Netherlands	0.102	0.303	0	1
Spain	0.082	0.274	0	1
Italy	0.128	0.334	0	1
France	0.123	0.328	0	1
Denmark	0.115	0.319	0	1
Switzerland	0.055	0.229	0	1
Belgium	0.134	0.341	0	1

Our sample population consists of 10 countries, namely Austria, Belgium (Flanders, Wallonia and Bruxelles), Denmark, France, Germany, Italy, Spain, Sweden, Switzerland and The Netherlands. After excluding observations with missing information across all ADL, iADL, mental/cognitive items, the final stock population accounts for 19,865 observations, whose average age is 65.5 years old, and where the share of men is 44.6%. More than a two thirds of our starting population is retired and over 73% is married. Further descriptive statistics are summarised in Table 5 and Table 6, which highlights relevant heterogeneities between countries on the incidence of vulnerability outcomes.

Finally, we have 7,660 observations for the incoming 50-51 cohorts replenishing the model, whose characteristics, for the year 2009 are depicted in Table 7 to 8.

Table 6: Population stock - Health and disability variables (N=19,865)

Variable	Mean	Std. Dev.	Min.	Max.
Hypertension	0.38	0.485	0	1
Diabetes	0.113	0.317	0	1
Cancer	0.07	0.255	0	1
Lung disease	0.074	0.263	0	1
Heart disease	0.161	0.367	0	1
Stroke	0.047	0.211	0	1
Ever smoked	0.504	0.5	0	1
Current smoking	0.18	0.384	0	1
BMI $<$ 25	0.426	0.494	0	1
BMI $>$ = 25 & BMI $<$ 30	0.404	0.491	0	1
BMI $>$ =30	0.17	0.376	0	1
Died	0.017	0.129	0	1
Sitting two hours	0.098	0.298	0	1
Getting up from chair	0.171	0.377	0	1
Climbing one flight of stairs	0.108	0.31	0	1
Dressing, including shoes and socks	0.066	0.249	0	1
Walking across a room	0.02	0.141	0	1
Bathing or showering	0.054	0.226	0	1
Eating, cutting up food	0.017	0.127	0	1
Getting in or out of bed	0.029	0.169	0	1
Using the toilet, incl getting up or down	0.019	0.135	0	1
Using a map in a strange place	0.068	0.252	0	1
Preparing a hot meal	0.035	0.184	0	1
Shopping for groceries	0.059	0.236	0	1
Telephone calls	0.019	0.137	0	1
Taking medications	0.018	0.134	0	1
Doing work around the house or garden	0.107	0.309	0	1
Managing money	0.036	0.187	0	1
Resting and sleeping	0.317	0.465	0	1
Enjoyable activities	0.119	0.324	0	1
Orientation	4.816	0.538	1	5
Eurod score	0.233	0.422	0	1

Table 7: New Cohorts - Socio-economic variables (N=7,660)

Variable	Mean	Std. Dev.	Min.	Max.
Male	0.489	0.5	0	1
Age	51.84	3.647	30.25	77.75
Married	0.858	0.349	0	1
Less than high school	0.111	0.314	0	1
Some college and above	0.315	0.464	0	1
HH capital income	6482.3	19791.9	0	308518
Working for pay	0.789	0.408	0	1
Individual earnings in 1000s	32.566	34.616	0	200
Austria	0.068	0.252	0	1
Germany	0.131	0.337	0	1
Sweden	0.052	0.222	0	1
Netherlands	0.088	0.284	0	1
Spain	0.093	0.291	0	1
Italy	0.102	0.303	0	1
France	0.134	0.341	0	1
Denmark	0.119	0.324	0	1
Switzerland	0.059	0.236	0	1
Belgium	0.153	0.36	0	1

Table 8: New Cohorts - Health and disability variables (N=7,660)

Variable	Mean	Std. Dev.	Min.	Max.
Hypertension	0.228	0.419	0	1
Diabetes	0.055	0.229	0	1
Cancer	0.035	0.184	0	1
Lung disease	0.039	0.193	0	1
Heart disease	0.057	0.231	0	1
Stroke	0.011	0.104	0	1
Ever smoked	0.570	0.495	0	1
Current smoking	0.285	0.451	0	1
BMI $<$ 25	0.467	0.498	0	1
BMI $>=$ 25 & BMI $<$ 30	0.374	0.374	0	1
BMI $>=$30	0.158	0.365	0	1
Died	0	0	0	0
Sitting two hours	0.073	0.261	0	1
Getting up from chair	0.09	0.286	0	1
Climbing one flight of stairs	0.036	0.187	0	1
Dressing, including shoes and socks	0.026	0.158	0	1
Walking across a room	0.005	0.073	0	1
Bathing or showering	0.011	0.105	0	1
Eating, cutting up food	0.005	0.073	0	1
Getting in or out of bed	0.014	0.118	0	1
Using the toilet, incl getting up or down	0.005	0.068	0	1
Using a map in a strange place	0.029	0.168	0	1
Preparing a hot meal	0.006	0.076	0	1
Shopping for groceries	0.014	0.117	0	1
Telephone calls	0.004	0.065	0	1
Taking medications	0.004	0.06	0	1
Doing work around the house or garden	0.041	0.199	0	1
Managing money	0.008	0.092	0	1
Resting and sleeping	0.306	0.461	0	1
Enjoyable activities	0.102	0.303	0	1
Orientation	4.9	0.335	1	5
Eurod score	0.212	0.409	0	1

6 Results

6.1 Crude inclusiveness rates

We start by showing the crude rates for the eligibility status for population aged 65+ in our selected countries from year 2007 to 2051. As already discussed, crude rates represent the share of 65+ individuals that would be defined as eligible to care (i.e., being "objectively vulnerable") according to their own country rules. Table 9 includes the results at both country and program levels: indeed, unlike for Austria and Spain, our review for France, Germany and Belgium is characterized by multiple programs of care. In case of Germany, for the cross validation of the results, we focus on the programs' rules existing before 2017, while our comments on future LTC evolution in Germany refer to the post 2017 rules.[12] Figure 2 reports the same data at program level in a graphical format.

At country level, crude rates illustrate heterogeneity in both levels and trends. First, the proportion of eligible individuals is higher in France and Austria, with averages rates between 15% and 19% in the 2010s and 2020s, and around or above 20% in the 2040s. The French rates are the sum of the APA and Aide ménagère eligibility rates. In particular, roughly two thirds of the France rate is due to the APA program, whose definition of vulnerability apply to 12-13% of the French population in the 2010s-2020s and around 14% in the 2040s. The crude rates of objectively vulnerable individuals for Belgium, Spain and Germany (under the 2017 regulation) lie, roughly, between 11% and 18% throughout the entire time-span, while under the old rules the eligibility rates of Germans range between 14% and 23%. The Belgian rates represent the percentage of individuals who would be eligible to at least one of the three reviewed programs. Among these, the APA has the highest eligibility rates throughout the selected time-span, followed by the national home-care (INAMI/RIZIV) and the Flemish LTC Insurance.[13]

In terms of trends, objective vulnerability rates are predicted to constantly increase (from around 15% to 22%) among Austrians between the 2010s and 2051, while they are decreasing until 2030, for Belgium and France, or 2040, for Germany and Spain. As a result, the French and the Austrian rates are constantly the highest among the selected countries, the gap between France and Austria narrows throughout the years, while the gap between Austria, Belgium, Germany and Spain widens. Finally, Spain's eligibility rates show the slowest increase throughout the years. For this reason, while showing higher rates of vulnerable elder individuals until the end of the 2020s, Spain's rates become the lowest

[12] A detailed description on the rules before 2017 can be found in Carrino and Orso (2014).

[13] Additional tables in Appendix B provide decompositions of such figures by age groups and gender, showing that, in general and across countries, objective vulnerability is higher for women and, as expected, for older age groups. Indeed, in the 2010s and 2020s, the crude eligibility rates for the oldest old individuals lie around 60% in Austria and France (with the rates of the French APA program being around 45%), between 50% and 60% for the German population evaluated under the pre-2017 regulations, between 45% and 50% for Germany (under the 2017 regulation) and for Belgium, and over 50% for Spain.

Table 9: Crude rates by country and program - Aged 65 or more

		Belgium					Austria		Spain	Germany		France	
		Programs		Regions			Programs			Programs		Programs	
Year	APA	INAMI	BEL	BEW	FL	AT1	AT2	AT3		Before 2017	After 2017	AMAD	APA
2007	7.398	8.159	6.755	5.122	5.826	15.443	13.666	13.113	13.261	13.161	12.171	6.865	13.583
2009	8.808	9.420	7.903	5.411	5.199	18.170	15.654	14.074	14.887	15.099	11.798	6.279	13.636
2011	8.842	9.509	7.781	5.236	4.594	18.030	15.415	13.816	13.481	14.702	10.544	6.377	13.291
2013	9.279	9.899	8.202	5.386	4.829	18.924	16.253	14.664	13.160	14.863	10.508	6.192	13.281
2015	9.984	10.705	8.949	5.836	5.051	19.954	17.101	15.474	13.062	15.675	11.082	6.269	13.240
2017	10.788	11.533	9.714	6.212	5.527	20.065	17.437	15.697	13.382	16.170	11.165	6.183	12.439
2019	11.243	11.969	10.206	6.591	5.829	19.568	16.976	15.393	13.834	16.670	11.646	5.910	12.805
2021	11.092	11.857	10.088	6.590	5.878	19.904	17.117	15.492	13.593	17.164	11.898	5.831	12.557
2023	10.825	11.576	9.878	6.507	5.802	19.939	17.139	15.298	13.555	17.599	12.221	5.690	12.461
2025	10.754	11.413	9.762	6.300	5.720	20.434	17.548	15.692	13.275	17.787	12.523	5.596	12.036
2027	10.432	11.094	9.438	6.282	5.535	20.746	17.787	15.869	12.855	17.662	12.312	5.686	11.904
2029	10.358	11.075	9.351	6.227	5.636	20.686	17.805	16.049	12.825	17.329	12.235	5.751	11.699
2031	10.542	11.203	9.639	6.205	5.713	20.836	17.904	16.166	12.538	17.195	11.988	5.771	11.965
2033	10.638	11.289	9.688	6.362	5.553	20.790	18.063	16.264	12.141	16.194	11.550	5.982	12.240
2035	11.123	11.834	10.100	6.642	5.950	21.249	18.425	16.833	12.001	16.299	11.492	6.234	12.504
2037	11.701	12.513	10.666	6.877	6.241	21.568	18.643	16.861	12.164	16.668	11.633	6.189	12.925
2039	12.180	12.969	11.151	7.170	6.505	22.287	19.446	17.610	12.069	17.566	12.038	6.372	13.443
2041	12.581	13.339	11.488	7.437	6.646	23.038	19.979	18.055	12.237	18.562	12.963	6.549	13.730
2043	13.157	13.945	12.054	7.786	6.804	24.114	21.034	19.128	12.472	19.733	13.765	6.544	14.528
2045	13.589	14.442	12.432	8.123	7.158	25.227	22.051	19.995	12.903	21.316	14.911	6.600	14.648
2047	14.369	15.250	13.217	8.458	7.541	25.961	22.854	20.784	13.438	22.291	15.851	6.487	15.199
2049	14.809	15.646	13.627	8.818	7.766	26.906	23.646	21.750	13.962	23.246	16.574	6.714	15.058
2051	15.117	15.925	14.003	9.071	8.034	27.820	24.634	22.692	14.959	23.925	17.159	6.774	14.872

during the 2040s.

6.2 Cross validation analysis of crude rates

Due to the novel perspective of our analysis, it is hard to perform an accurate and proper validation between our estimates and official statistics on LTC utilisation. Indeed, our analysis focuses on the definition of "objective vulnerability" embedded in each LTC regulation, therefore resulting in a proxy for need-of-care based on a combination of functional and cognitive characteristics. Yet, while "need-of-care" is not directly observed in official statistics, the utilization of care and care benefits is (Willemé, 2010). Official statistics on LTC utilisation, when available, provide an ex-post measurement of observed access to care, which can be driven by other determinants rather than the eligibility status *per se*. Moreover, as already highlighted, overall statistics on care-utilisation are hardly comparable across countries due to differences in the definition of LTC services, and to the different taxonomy of services belonging to either the health- or social-care budgets (Pickard et al. (2007); Costa-Font et al. (2015); OECD (2016)). Finally, since we do not categorise individuals by the intensity of their objective vulnerability status, we may include under the "eligible" label individuals who are actually enrolled in nursing-homes, and therefore may not be accounted for as users of a home-care program.

Nevertheless, we have gathered information from different official sources of LTC utilisation to show that our estimates are in line with the available statistics and existing forecasts. In Austria the available data show that, on average, the observed coverage of the national LTC program lies around 15% for the 65+ population in the early 2010s, while being above 50% for the oldest old, thus matching closely our forecasted figures (Riedel and Kraus (2010); OECD (2011); BMASK (2011)).[14] In Belgium, our estimates for the prevalence of "objective vulnerability" closely match those estimated by Karakaya (2009), who implement the same set of rules for the same three programs on administrative data and forecast dependency rates up to 2050. Our results (which are referred to the 65+ population) are in line with theirs (referred to the 60+ population), both for current and future years: e.g., prevalence rates ranging around 9% in the 2010s, and around 12% in the 2040s. Data on actual utilisation of home-care report a coverage of 6.5% in 2007, which is entirely in line with our estimates (between 7% and 9%) for the late 2000s (Gerkens and Merkur (2010)). Similarly, our results for Germany are in line with official statistics. Figures from the late 2000s report that around 11% of the 65+ population received benefits from the LTC program (Schulz, 2010), whereas this number has risen around 13% in more recent years, while the observed coverage for the oldest old population (85+) is estimated at 48%

[14] It is important to point out that observed utilisation rates should be compared with the estimates produced using the threshold of 60 hours of care-need per month, which was then raised to 65 since 2016.

(Bundesamt, 2015). In France, recent statistics show that between 2010 and 2014 around 11.5% of the 65+ population had access to the APA, which is close to our predicted coverage (around 13%), whereas the remaining programs for older individuals covered an additional 2% of the same population, bringing the total coverage around 14% (Borderies et al., 2016). In this respect, our figures, which assign a 6% of coverage to the non-APA programs, seem to overestimate the actual numbers of such complementary assistance. Conversely, the proportion of 85+ individuals which had access to the APA in the late 2000s is estimated at 35% (Charpin and Tlili, 2011), in line with our results which range from 36% in 2007 and 42% in 2010. Moreover, estimates for 2050 set the APA coverage for the 65+ population in the range between 11.5 and 14% (Charpin and Tlili, 2011), in line with our prediction of 14.8%. As for the Spanish system, the new regulations have been progressively implemented since 2007, generating situations of "dependency limbo", i.e., individuals officially assessed as entitled to benefits who have not actually received any provision. The share of 65+ individuals favourably evaluated for LTC benefits (not necessarily receiving it) ranges between 11 and 13% in the early 2010s (Peña Longobardo et al., 2016), thus matching very closely our forecasts.

6.3 Directly-adjusted (standardised) inclusiveness rates

6.3.1 Fixing the population

As discussed in the Introduction, cross-country differences in care-utilisation are determined by a combination of eligibility rules, determining the objectively vulnerable profiles of individuals in need-of-care, and epidemiological characteristics, which are specific to each country-population.

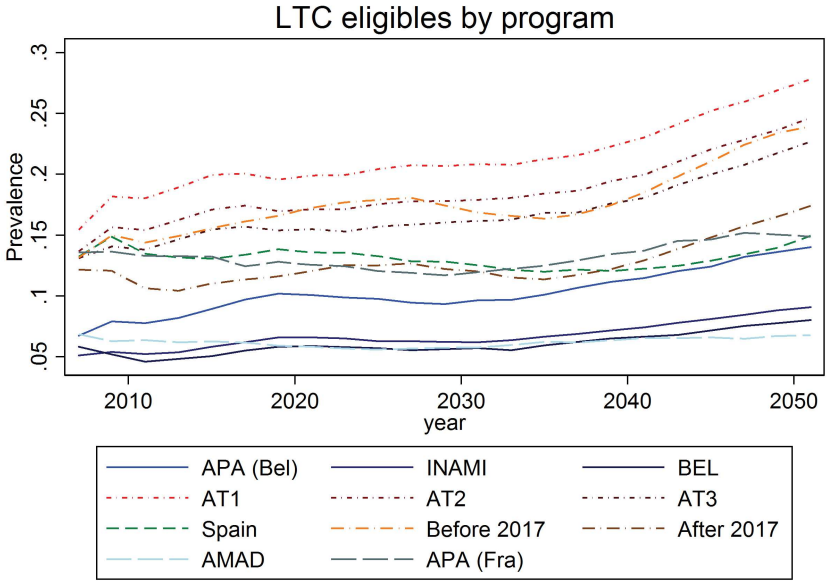
Through the adoption of the directly-adjusted method discussed in Section 3.2, we are able to estimate how the eligibility rates change across countries and over time, only due to differences in the legal definition of vulnerability. The rates reported in Table 10 and in Figure 3 should be interpreted as the forecasted percentage of a standardised population that would be defined as eligible under a specific program of care.[15] For Belgium and French programs we report both the program-specific rates, i.e., the share of individuals that would be eligible under a specific program, and the overall rates, i.e., the share of individuals eligible to at least one program in the country.

Significant differences emerge from the eligibility rates of the French system (APA or Aide Sociale), the Austrian Pflegegeld and the Belgian system (APA, INAMI's home-care, and the Flemish program). Around 20% of the standard population would receive care under the French bundle between the 2010s and the 2030s, while this prevalence reaches 25% in 2051. At program level, the APA coverage ranges between 13% and 14% until the 2040s, when it rises up to 18%. On the contrary, the Aide ménagère

[15] In our context the standardised population has been obtained by pooling the populations of the 10 countries in EuFEM.

rates range around 6% until 2040, to reach 7% in 2051. The Austrian rules (in their 2017 version, with the monthly threshold set at 65 hours-of-need, i.e. AT3) would cover around 14% of the population in the 2010s-2030s, to reach 18% in 2051. Under the Belgian rules altogether less than 10% of the standard population would be eligible for care, with this percentage rising to 12% in the latest forecasted years. The Spanish and the new German regulations (post 2017) result in similar coverage rates, ranging from 11%-12% in the early years to 15%-16% in 2051.

Figure 2: Eligibility rates



As final evidence, Figures 4 and 5 reports the same results disaggregated by level of education and by gender. As we can clearly see, low educated individuals share a common higher level of vulnerability and, therefore, a higher eligibility. Interestingly, the model predict that the share of eligible low dedicated individuals will reach a top around 2035 and then will start to decline, mainly because the share of low educated individuals will start declining. On the contrary, the share of highly educated people show a rising trend, but still below the current values observed for low-educated individuals. In terms of gender differences, women show higher levels of eligibility compared to men, which is mostly driven by their longer life expectancy. For both men and woman after 2035 the model predict an increase in eligibility rates.

Table 10: Direct adjustment rates by program (EU 10) - Standardised population and varying rules

		Belgium			Austria		Spain	Germany		France	
Year	APA	INAMI	BEL	AT1	AT2	AT3		Before 2017	After 2017	AMAD	APA
2007	8.623	6.985	7.060	16.231	14.616	13.759	11.734	14.528	13.050	4.267	13.174
2009	9.020	6.116	5.689	17.818	15.556	14.354	12.792	15.627	12.880	5.266	14.562
2011	7.882	4.962	4.538	17.450	14.883	13.507	11.899	14.913	11.509	5.831	13.782
2013	7.626	4.706	4.324	17.502	14.871	13.487	11.826	14.914	11.217	6.026	13.707
2015	7.884	4.934	4.460	17.855	15.231	13.854	12.135	15.159	11.346	6.017	13.930
2017	8.034	4.982	4.515	17.901	15.311	13.896	12.094	15.250	11.409	6.152	13.883
2019	8.203	5.118	4.626	18.119	15.462	14.047	12.286	15.428	11.507	6.109	14.136
2021	8.262	5.163	4.714	18.235	15.566	14.152	12.440	15.504	11.665	6.136	14.220
2023	8.282	5.147	4.688	18.195	15.604	14.212	12.469	15.544	11.713	6.094	14.285
2025	8.306	5.184	4.699	18.194	15.560	14.157	12.368	15.477	11.581	6.134	14.147
2027	8.218	5.138	4.630	18.006	15.463	14.081	12.324	15.345	11.544	6.035	14.063
2029	8.057	4.993	4.534	17.730	15.173	13.820	12.142	15.172	11.307	5.891	13.888
2031	8.003	4.962	4.503	17.601	15.027	13.637	12.046	15.045	11.210	5.878	13.796
2033	7.987	4.891	4.421	17.504	14.953	13.545	11.926	15.013	11.073	5.933	13.715
2035	7.877	4.848	4.427	17.615	15.005	13.610	11.877	15.027	11.067	6.037	13.700
2037	7.938	4.908	4.483	17.948	15.271	13.817	12.116	15.323	11.363	6.166	13.962
2039	8.263	5.073	4.595	18.535	15.829	14.325	12.587	15.832	11.631	6.263	14.403
2041	8.556	5.210	4.739	19.160	16.391	14.864	12.999	16.275	12.061	6.462	14.844
2043	9.130	5.536	5.054	20.094	17.227	15.641	13.684	17.055	12.654	6.579	15.573
2045	9.580	5.866	5.258	20.713	17.888	16.314	14.264	17.713	13.214	6.770	16.134
2047	10.237	6.211	5.638	21.623	18.701	17.127	14.962	18.532	13.780	6.867	16.894
2049	10.760	6.474	5.891	22.328	19.417	17.796	15.464	19.144	14.236	7.036	17.389
2051	11.224	6.806	6.140	22.966	19.999	18.372	16.017	19.718	14.780	7.055	17.967

Figure 3: Eligibility rates - standardised population and varying rules

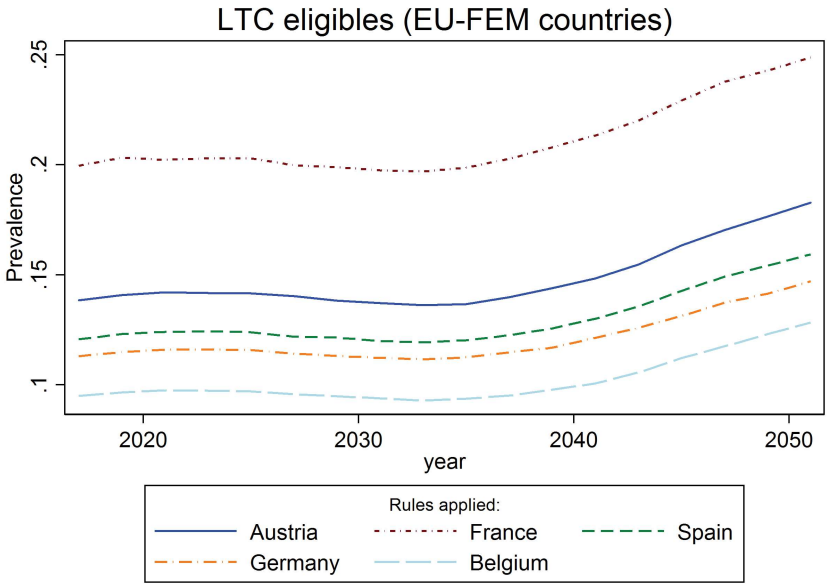


Figure 4: Eligibility rates by education level - standardised population and varying rules

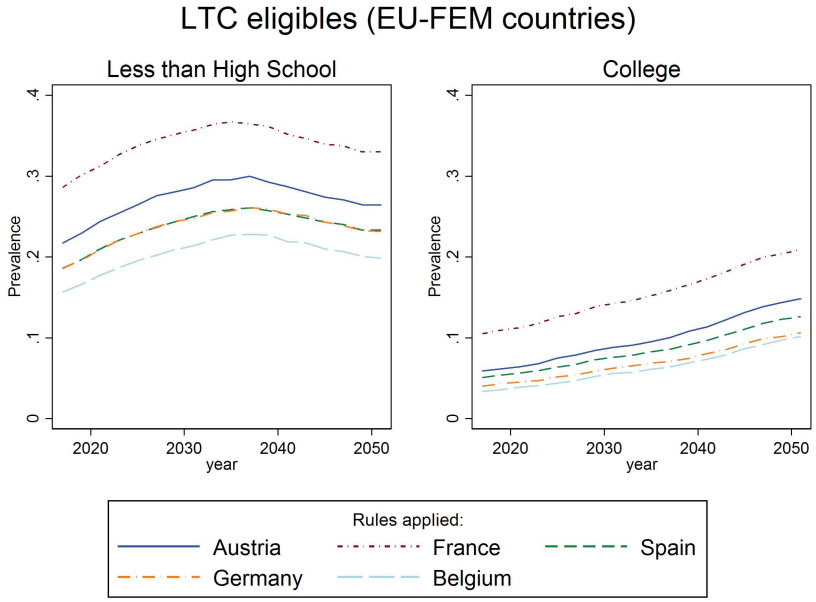
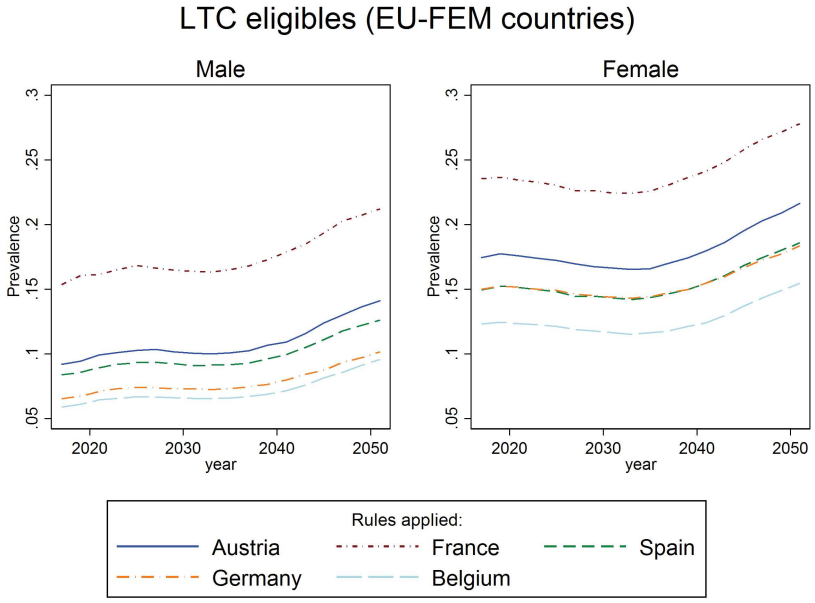


Figure 5: Eligibility rates by gender - standardised population and varying rules



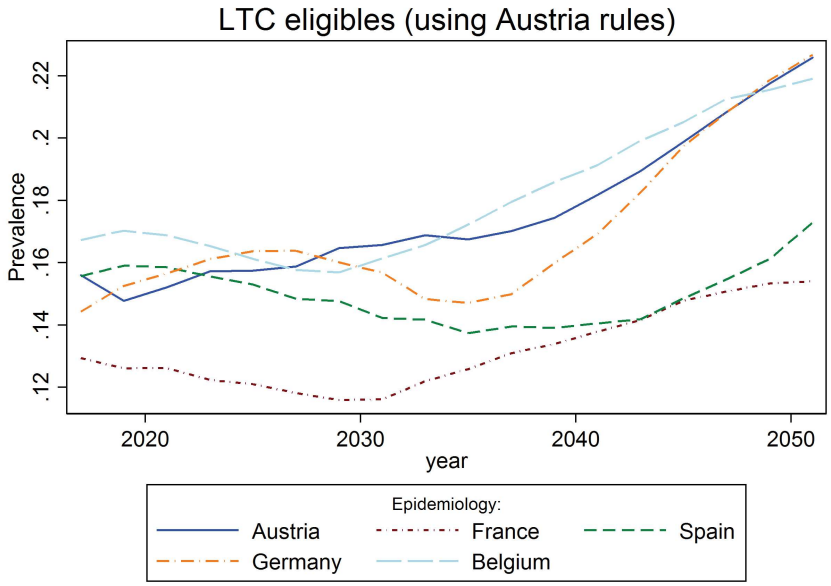
6.3.2 Fixing the eligibility rules

While the previous results illustrate the differences in coverage rates embedded in the programs' regulations, in this section we discuss the forecasted trends in utilisation due only to changes in the epidemiological status across countries and over time. To do so, we arbitrarily choose one among the reviewed LTC regulations, namely the Austrian regulation post 2016, and use it to evaluate the prevalence of objective vulnerability within each country population throughout the selected time-span.[16] Therefore, the French value in, say, 2030, represents the share of French 65+ population in 2030 that would be classified as objectively vulnerable according to the Austrian rules. Given that the definition of vulnerability is fixed across countries and time, the differences in eligibility rates are attributable to differences in the (predicted) health characteristics of the populations. Results show significantly different patterns of eligibility rates with respect to those analyzed so far: the Belgian population is the one with the highest prevalence of eligible individuals throughout most of the time-span, while the French have the lowest rates. Vulnerability prevalence for Austria and Germany is close to Belgium's in the 2020s and after 2045, while being lower in the early years of the simulation as well as in the 2030s (especially for Germany). The Spanish population exhibits rates close to those of Austria and Germany in the early

[16](Figure **??** to **??** in Appendix B reports the results of this exercise when selecting other regulations and confirm the main conclusions reached so far.

simulated years, while levelling with the French ones in the latest decade. Trends of vulnerability are always increasing for the Austrians, while for Belgium and France they are slightly decreasing until 2030, when a strong upward pattern starts. Rates for the German population are first increasing (until mid-2020s) and then decreasing (until mid-2030s), only to exhibit a rapid increase in the last 15 years of the simulation. Spain's rates of vulnerability are constantly decreasing until past 2040, when an upward trend emerges.

Figure 6: Eligibility rates - Varying population and fixed rule (Austria)



6.4 Discussion

The possibility of exploiting program-specific information on the eligibility rules for publicly subsidized Long-Term Care allows us to offer comparable information on programs' potential coverage, as well as to disentangle the joint role of populations' health-characteristics and programs' inclusiveness in determining such coverage.

When looking at potential coverage, Table 10 highlights that, in general, programs that account more heavily for iADL limitations, as the Austrian Pflegegeld, are more inclusive than those focused on ADLs only, as the Belgian home-care program, given the higher frequency of the former in the older population. Moreover, the reason for the high coverage attributed to the French system is the combination of a main program targeting higher levels of vulnerability (the French APA) and a subsidiary one for individuals who

do not have access to the APA while still suffering from some limitations in daily activities. Nevertheless, not all programs including iADL limitations have similar coverage rates: e.g., the Belgian APA evaluates a subset of both ADLs and iADLs, yet it sets a higher minimum eligibility threshold than the Austrian program.

Such differences in potential coverage rates help to explain why the pictures emerging from Figure 2 and Figure 6 appear to be substantially different. As already stated, while Figure 6 gives us a proxy on the country-specific prevalence of functional and cognitive limitations, it does not account for the difference in vulnerability evaluation rules across programs. Conversely, Figure 2 exhibits crude rates which are the result of both population characteristics and programs' inclusiveness. Figure 3 allows to disentangle such effects, since it provides comparable measures of eligibility rates, and highlights the importance of accounting for the nature of the assessment of need procedures that define access-to-care. As an example, when the definition of need-of-care is fixed across countries (specifically, it corresponds to Austrian rules in Figure 6), the French population has the lowest levels of vulnerability among the included countries, while Belgium having the highest rates. Such positions are basically reversed when looking at crude-rates in Figure 2, and the cause for such a rank reversal is due to the fact that the French system as a whole (APA and Aide Sociale) has a much higher coverage rate than the Belgian (APA and Home-care and Flemish LTCI), as visible from Figure 3. Alternatively stated, if Belgians and French 65+ individuals would be subject to the same regulation, the former population would exhibit a higher prevalence of vulnerability than the latter.

7 Conclusion

While the existing literature has highlighted that differences in institutional frameworks must be accounted for while comparing or forecasting care-utilisation rates no empirical evidence has been proposed so far. The evidence presented in this work, to the best of our knowledge, represent the first attempt to offer a comparable measure of the extent to which the target populations of LTC programs differ in the current implemented laws, and what effects such differences will make in the forthcoming decades. For example, if Germany and Spain would adopt a definition of objective vulnerability as in the Austrian program, their forecasted LTC coverage in 2050 (on their own 65+ population) would be much higher than with their original programs (22% versus 15%), while the opposite would happen for France, whose 65+ population would be less covered (15% versus 20%).

Although we are fully aware that our model may represent a highly simplified version of real life events, these results produced interesting "status quo" projections, which could allow policy makers to

take more informed decision to implement LTC policies and, eventually, render the system equitable and sustainable over time.

A Appendix - LTC regulations and SHARE

This appendix compares the assessment-of-need scales of the reviewed LTC regulations with the information available from the SHARE survey. Nearly all of the tasks included in the regulations have a close correspondent in SHARE, yet some adjustments had to be made, as described hereafter. The aim of this correspondence exercise is not to replace or mimic the work and the expertise of the trained professionals who actually conduct the assessments in the field. Rather, we implement legal benchmarks into our micro-data in a prudent and robust fashion, in order to identify a sub-population of "eligible individual" out of the total sample. Three major issues must be acknowledged when comparing actual legislations with micro-data information. First, as already mentioned, the correspondence between each assessment-of-need and the SHARE survey is not perfect: some information is not available in our data, and some medical definitions may differ slightly. Secondly, most of the evaluations of functional limitations in SHARE are scored dichotomously (0 or 1), i.e., a limitation can either occur or fail to occur, but no intensity is measured. Although this is consistent with Katz et al. (1970) ADL and Lawton and Brody (1969), iADL original design, some comparability issues arise with respect to those LTC assessment-of-need adopting a multi-step scale evaluation, i.e., requiring information about the degree of the potential loss-of-autonomy. Nevertheless, it should be highlighted that, regarding ADL, iADL and mobility limitations, SHARE respondents are asked not to report difficulties that are expected to last less than three months. Lastly, the information collected in SHARE is self-reported, even though the interviewer is able to signal unreliable answers. Respondent subjectivity is, therefore, a potential issue that also affects information on the health-status, e.g., the occurrence of ADL or iADL limitations.[17] A detailed description of the included LTC programmes' regulations is available in Carrino and Orso (2014).

A.1 Austria - *Pflegegeld*

Eligibility: the Austrian care allowance *Pflegegeld* is provided to individuals who present a decline in functional status that currently requires at least 65 hours of need-of-care per month; the threshold was at 60 hours before 2016, and at 50 hours before 2011 (BMASK (2013, 2015)). The decline is expected to last for at least 6 months due to a physical, mental or emotional disability or sensory impairment in at least one core activity and at least one auxiliary activity.

Assessment: Table 11 describes the assessment-of-need dashboard, which covers a wide number of potential functioning and cognitive limitations, split between core and an auxiliary, together with a

[17] Similar concerns are expressed by Bonsang (2009) and Balia and Brau (2013). Reliability of self-reported health-conditions is investigated in Bound (1991), Baker et al. (2003), Dwyer and Mitchell (1999), LaPlante (2010). A cross-survey comparison between HRS, SHARE and ELSA is performed in Chan et al. (2012).

Table 11: Austrian *Pflegegeld* and SHARE

Core / Auxiliary	Limitation (yes/no)	Fixed need-of-care (hours/month)	SHARE tasks (binary: yes / no)
c	Daily body care	25	Bathing or showering
c	Preparation of meals	30	Preparing a hot meal
c	Taking meals	30	Eating (+cutting up your food)
c	Defecation	30	Using the toilet (+ getting up or down)
c	Dressing and undressing	20	Dressing (+ putting on shoes and socks)
c	Cleaning for incontinence sufferers	20	Incontinence or involuntary loss of urine
c	Colostomy care	7.5	-
c	Care cannula tube care	5	-
c	Catheter care	5	-
c	Enemas	15	-
c	Taking medication	3	Taking medications
c	Mobility aid in the narrow sense	15	Walking across a room or Getting in or out of bed
a	Motivational talks	10	EURO-D scale
a	Emptying and cleaning the toilet chair	10	-
a	Procuring of food and medicines	10	Shopping for groceries
a	Cleaning the home and personal effects	10	Doing work around the house
a	Care of underwear and towels	10	Doing work around the house
a	Heating the living space (+procuring of fuel)	10	Doing work around the house
a	Mobility aid in a broader sense	10	Using a map to figure out how to get around in a strange place
	Cognitive impairment	25	Orientation in time (day, week, month, year): cannot answer three or more

Source: Gesamte Rechtsvorschrift für Einstufungsverordnung zum Bundespflegegeldgesetz, BGBl. II Nr. 37/1999, BGBl. II Nr. 453/2011

specific formalization of a potential need-of-care for post-surgery conditions or complex auto-medication. The vulnerability assessment converts each limitation in a specific amount of time (hours per month), representing the minimum amount of care that - the law assumes - should be needed by a patient suffering from that deficit. Since January 1st 2009, people with mental illnesses, dementia or severe behavioral disorders are given a fixed supplementary amount of care-time in terms of 25 hours per month.

A.2 Belgium

A.2.1 Flanders supplementary LTC program *Zorgverzekering*

The Belgian Flemish region provides its vulnerable elderly with a care-allowance that is part of a separate LTC insurance scheme (*Zorgverzekering* / Care Insurance) with respect to the nationwide APA and the in-kind federal home-care programme.

Eligibility: the allowance is limited to Flemish and Brussels citizens, it is not age- or income-related and it requires a minimum score of 35 in the assessment evaluation of vulnerability. The cash benefit has a fixed amount of €130.

Assessment: vulnerability is assessed on a detailed evaluation scale (BEL scale BEL-profielschaal), which embeds 27 vulnerability outcomes (Table 12), split in four domains (household, physical, social and mental), to be evaluated on a four-step scale (from 0 to 3), where 0 corresponds to full-autonomy and 3 corresponds to impossibility to perform the specific task. The sum of each task' score provides the patient?s dependency index. Since most of the health-conditions in SHARE are reported on a binary scale, we prudently chose to assign a score of 2 in the BEL-scale to each activity that respondents report to be limited in, instead of assigning the full score of 3. We followed a strict approach in defining the Mental Health conditions related to purposeless/disruptive behavior, lack of initiative, depressed/anxious

Table 12: Flanders supplementary LTC program *Zorgverzekering* and SHARE

Limitation	Value	SHARE tasks (binary: yes / no)
Household ADL		
House-holding	2 out of 3	Doing work around the house
Laundry	2 out of 3	Doing work around the house
Ironing	2 out of 3	Doing work around the house
Shopping	2 out of 3	Shopping for groceries
Meal preparation	2 out of 3	Preparing a hot meal
Housework planning	2 out of 3	Doing work around the house
Physical ADL		
Bathing and showering	2 out of 3	Bathing or showering
Dressing	2 out of 3	Dressing (+ putting on shoes and socks)
Functional mobility	2 out of 3	Getting in or out of bed
Using the toilet	2 out of 3	Using the toilet (+ getting up or down)
Incontinence	2 out of 3	Incontinence or involuntary loss of urine
Feeding	2 out of 3	Eating (+cutting up your food)
Social ADL		
Social loss	2 out of 3	EURO-D scale = 4 or higher
Commitment to therapy and medical rules	2 out of 3	Taking medications
Safety inside/outside the house	2 out of 3	Doing work around the house or garden
Administration	2 out of 3	Managing money, such as paying bills and keeping track of expenses
Financial operations	2 out of 3	Managing money, such as paying bills and keeping track of expenses
Mental Health		
Orientation in time	2 out of 3	Orientation in time (day, week, month, year): cannot answer three or more
Orientation in space	2 out of 3	Orientation in time (day, week, month, year): cannot answer three or more
Orientation in persons		-
Purposeless behavior	2 out of 3	EURO-D score = 4 or higher
Disruptive behavior	2 out of 3	EURO-D score = 4 or higher
Lack of initiative	2 out of 3	EURO-D scale = 4 or higher
Depressed mood	2 out of 3	EURO-D scale = 4 or higher
Anxious mood	2 out of 3	EURO-D scale = 4 or higher

Source: Second Annex to the Ministerial Decree of 6 January 2006 regulating the determination of the severity and duration of the reduced autonomy on the basis of the BEL-profielschaal under the Flemish care insurance

mood. In principle, a direct correspondence could be established between the items in the BEL-scale and the questions in SHARE ("In the last month, have you been sad or depressed", "Have you been irritable recently?", etc.); nevertheless, given the potential inherent subjective interpretation of the questions by the respondents, we felt more comfortable with adopting the EURO-D measure and threshold proposed by Börsch-Supan and Jürges (2005) (having at least 4 disturbances among a set of 12) as a more accurate predictor of latent psychological issues.

A.2.2 *APA*

Eligibility: the eligibility to the Belgian LTC cash benefit of Assistance to Elderly People (APA: Aide à la Personne âgée) is primarily based on a vulnerability-evaluation , as well as on socio-demographic criteria including age, marital status and family composition. Moreover, the programme is means-tested since household income is taken into account in determining the monetary amount of the benefit. Until the end of 2016 the APA was managed at the federal level for all Belgians, regardless of their region. Since 1 January 2017, the competence of the APA for Flanders has been transferred to the Flemish Community.
Assessment: the assessment process is performed through a scale (APA scale) with six activities that are evaluated on a scale from 0 (no difficulties) to 3 (impossibility to perform the selected item without help), and the overall vulnerability score is constructed by summing each item' values. We chose to assign the score of 2 whenever a respondent reports to suffer from a limitation in the corresponding SHARE

Table 13: Belgian APA and SHARE

Limitation	Value	SHARE tasks (binary: yes / no)
Moving and transferring around the house	2 out of 3	Walking across a room or Getting in or out of bed
Preparing meals and ingesting food	2 out of 3	Preparing a hot meal or Eating (+cutting up your food)
Performing body-care and being able to dress	2 out of 3	Bathing/showering or Dressing (+ putting on shoes and socks)
Taking care of own house and performing house-tasks	2 out of 3	Doing work around the house or Managing money, such as paying bills and keeping track of expenses
Communication: being able to have contacts with others	2 out of 3	Making telephone calls
Need of supervision. Being able to assess and avoid dangerous situations	2 out of 3	Orientation in time (day, week, month, year): cannot answer three or more

Table 14: Belgian nursing home-care by INAMI/RIZIV and SHARE

Criteria	Value	SHARE tasks (binary: yes / no)
Washing	3 out of 4	Bathing or showering
Dressing	3 out of 4	Dressing (+ putting on shoes and socks)
Moving and transferring	3 out of 4	Walking across a room or Getting in or out of bed
Using the toilet	3 out of 4	Using the toilet (+ getting up or down)
Continence	3 out of 4	Incontinence or involuntary loss of urine
Eating	3 out of 4	Eating (+cutting up your food)
Orientation in time	3 out of 4	Orientation in time (day, week, month, year): cannot answer three or more
Orientation in space	3 out of 4	Orientation in time (day, week, month, year): cannot answer three or more

task:

The minimum required score in the APA scale to be eligible to the monetary allowance is 7, while the minimum age requirement is 65 years old.

A.2.3 nursing home-care by *INAMI/RIZIV*

Eligibility: federal-level home nursing-care in Belgium is provided by the National Institute for Sickness and Disability Insurance (Institut National d'Assurance Maladie-Invalidité / Rijksinstituut voor Zieke en Invaliditeitsverzekering - INAMI/RIZIV) irrespectively of patients' age or income, yet the degree of reimbursement and the method of payment (fee-for-service or lump-sum payment) depends on the applicant's degree of dependency. The minimum eligible level of vulnerability corresponds to level B of the adopted vulnerability scale, and refers to two profiles: (i) being limited in washing and dressing and in moving or going to the toilet; (ii) being disoriented in time and space and being limited in washing and dressing (INAMI (2016); Karakaya (2009); Sermeus et al. (2010)).

Assessment: NIHDI adopted an ADL scale (Table 14), slightly adapted from Katz et al. (1970), which includes six items on functioning and two on mental coherence and orientation. Patient's dependency or need-of-care for each item is scored on a four-step scale for each item (from 1 to 4), where 0 corresponds to full-autonomy and 4 corresponds to impossibility to perform the specific task. Dependency-status on a single item arises when the need-of-care is either severe (3) or full (4). We chose to assign the score of 3 whenever a SHARE-respondent reports to suffer from a limitation in the specific task.

Three main categories of dependency are established by the NIHDI (the minimum category for eligibility is B), defined as follows:

Table 15: Belgian eligibility rules for home nursing-care

Category	Physical dependence		Mental dependence
O	No dependence	AND	No dependence
A	Dependent in washing and dressing	OR	Disoriented in time and space (but physically independent)
B	Dependent in washing and dressing, AND dependent for moving and/or going to the toilet	OR	Disoriented in time and space, AND dependent in washing and/or dressing
C	Dependent in washing and dressing, AND dependent for moving and going to the toilet AND dependent for incontinence and/or eating	AND	No dependence
Cdement	As in category C	AND	Disoriented in time and space

A.3 France - *APA and Aide ménagère à domicile*

There are three main public sources of long-term care services in France: the sickness insurance scheme which covers some expenditures for health care, the retirement insurance scheme which finances forms of domestic assistance (Aide sociale aux personnes âgées: aide ménagère à domicile (AMAD)) and the Personalised Allowance of Autonomy (APA, Allocation Personnalisée d'Autonomie). The latter constitutes the main national programme for tackling dependency among the 60+ population. These LTC programmes target different profiles of vulnerable individuals, yet adopting a unique evaluation-scale to assess their dependency condition: the AGGIR scale, which we will describe hereafter.

Eligibility: the APA is available to individuals aged 60 or older, with a AGGIR score of, at least, GIR 4. The Aide ménagère à domicile targets older individuals with some degree of dependency yet not eligible for APA. It requires a minimum age of 65 years old; the presence of limitations in daily activities related to personal hygiene and to small acts of daily livings (e.g., laundry- and home-care, meals preparation and shopping for groceries) classifiable as GIR 5 or GIR 6; not being a beneficiary of the APA nor eligible to it; having a monthly income up to €801 for singles or €1243 for couples. It cannot be combined with APA. In implementing the eligibility rules for the Aide ménagère in SHARE, we classified as eligible those 65+ individuals with GIR 5 classification in the AGGIR scale (thus not eligible for APA) who have at least one further limitation in either house-tasks, meals preparation or shopping for groceries. Basing on the available legislation and on-line resources, we decided not to include other iADLs in the eligibility algorithm (e.g., using the telephone, managing money, taking medications), in order to perform a prudent implementation of the regulation. For the same reason we excluded from the eligible population those with GIR 6 dependency score (roughly no ADL loss), as it seems too broad a category to be led back to the Aide ménagère rationale, given the information available in SHARE.

Assessment: the AGGIR scale (Autonomie Géontologique - Groupes Iso-Ressources) is a national standardized assessment-of-need tool that helps to determine an individual's vulnerability status. The scale, introduced in 1997 and modified in 2001, 2004 and 2008, evaluates limitations in ADL and iADL and generates an index-measure from 1 to 6 that represents a patient's vulnerability classification. Each

Table 16: French AGGIR scale and SHARE

Discriminatory variables	description	assigned value	SHARE tasks
coherence	converse or behave in a logical and sensible manner	2 out of 3	Orientation in time (day, week, month, year): cannot answer three or more
orientation	locates oneself in time and space		
toileting	upper and lower body hygiene	2 out of 3	Bathing or showering
dressing	upper, middle and lower body dressing	2 out of 3	Dressing (+ putting on shoes and socks)
alimentation	serving and eating	2 out of 3	Eating (+cutting up your food)
evacuation	using the toilet for urine/faecal evacuations	2 out of 3	Using the toilet (+ getting up or down)
transfers	lying down, sitting down, getting up	2 out of 3	Getting in or out of bed
indoor movement	with or without technical assistance	2 out of 3	Walking across a room
outdoor movement	same as above, but outdoors	2 out of 3	Walking across a room or Using a map to figure out how to get around in a strange place
distant communication	using the phone and tele-alarm	2 out of 3	Making telephone calls

Table 17: France AGGIR vulnerability categorization

GIR group	Description
GIR 1	Bedridden or confined to an armchair, with seriously impaired mental functions
GIR 2	Those confined to bed, needing assistance for most ADL (typically toileting, dressing, elimination, alimentation), with mental functions not entirely compromised. Those with severe mental deficits but with no serious limitations in mobility and personal care functions.
GIR 3	Those with no serious mental and mobility limitations, who need help several times a day for ADL (typically for hygiene and elimination tasks) while not requiring constant monitoring.
GIR 4	Those who have transferring limitation, but once up can move around indoors. They sometimes need help with washing and dressing, and most of them can eat without assistance. Alternatively, those with no mobility or transferring limitations, but who need help to perform other ADL, including eating.
GIR 5	Those who can move around inside their home without assistance, and can eat and dress themselves alone. They require occasional help with washing, preparing meals and doing housework.
GIR 6	Those who have not lost their autonomy for daily living activities.

category, or Group Iso-Resources (GIR), gathers individuals with similar loss of autonomy and equivalent need-of-care. GIR 1 represents the hardship case (0 percent of autonomy), while GIR 6 corresponds to the non-vulnerable level (93% of autonomy, or higher). The AGGIR assessment is a compound of two groups of variables: (i) ten "discriminatory" variables, six of which are related to difficulties in ADL, two cover psychical deficits (coherence and orientation) and two relate to iADL (outdoor movement, distant communication), but do not concur in determining the final AGGIR score; (ii) seven "illustrative" contextual variables, mainly related to iADL tasks, which do not influence the AGGIR score. Each variable (item) in the AGGIR scale is evaluated on a three-step scale (A, B, C or 1, 2, 3), depending on the degree of limitation experienced by the patient in the specific task. Since we do not have information on the intensity of the limitations reported by the SHARE respondent, we chose to prudently assign the label B (the intermediate level) whenever a respondent reports a limitation in a specific task.

Through a rather complex algorithm, AGGIR splits the population into 6 iso-groups, a rough description of which is available in Table 17

A.4 Germany - *Pflegeversicherung*

The Long-term care Insurance (*Pflegeversicherung*) provides German citizens as an additional pillar of the national Welfare State, through benefits in cash and/or in kind, aimed at easing the costs of residential-assistance or, to a greater extent, home-care. From a financial point of view, the LTC Insurance is not a full insurance, since it still requires the individuals to contribute to the care-expenditure, depending on their level of vulnerability. Cash benefits are paid directly from the insurance-fund to the dependent person who can use them at his/her discretion to compensate a self-procured caregiver; the benefits are

not treated as income and thus are tax-free. Benefits in kind (community care) consist in personal-care and domestic-help service provided by professional carers, usually a licensed home care service which can be both for-profit or non-profit (professional help is considerably more expensive than private aid, hence, the budget of in-kind benefits is considerably higher than for the cash-programmes). In 2017, both eligibility criteria and assessment of need regulations have been substantially modified, thus resulting in a new definition of vulnerability and need-of-care (Bäcker (2016); BMG (2015); Kalwitzki et al. (2015)).

Eligibility: It is based on five-step categorization based on an overall vulnerability score (from 0 to 100) assigned to the claimant with the new assessment of need process. The minimum score granting access to the in-cash or in-kind benefits is 27

Assessment: the process of assessing individuals' vulnerability is developed in six modules: Mobility, Cognitive abilities (mostly related to orientation, understanding and memory), Behavior and mental problems, Limitations in ADL, Coping with illness and therapy, and Social participation. Two additional modules, Performing activities outside the house, and Limitations in iADL are assessed but do not contribute to the overall score nor to the eligibility decision. Each module includes several outcomes which are valued on a scale taking any integer between 0 and 3 (sometimes different scales are used, such as 0-2-4-6), with higher numbers meaning higher dependency. Table 18 summarizes the outcomes included in the assessment, together with the link we established with the SHARE data. Since we do not have information on the intensity of the limitations reported by the SHARE respondent, we chose to prudently assign the "mostly dependen" level (e.g., 2 out of 3) whenever a respondent reports a limitation in a specific task. Within the Mobility module, a close correspondence can be established. The Cognitive module involves several outcomes on orientation or understanding ability; since an outcome-specific link could be established only for some SHARE items, we chose to evaluate this module as a whole by using the "orientation" index (not being able to answer three or more questions on time, i.e., day, week, month, year) and the "recal" variable (recalling less than three words out of ten). We thus aim to reduce the effect of self-report bias and inaccuracy potentially embedded in specific respondents' answers, and to effectively identify serious cognitive conditions through the most "objective" outcomes (orientation and recall) adopted by the literature in this field (Castro-Costa et al. (2007)). A similar approach is followed for the Psychological section, where, as explained for the Belgian Flanders scheme, given the potential inherent subjective interpretation of the single SHARE questions on the topic, we adopt the widely adopted EURO-D threshold of 4 points (or higher) as a more accurate predictor of latent psychological

Table 18: German *Pflegeversicherung* and SHARE

Limitation	Assigned Value	SHARE tasks (binary: yes / no)
1. Mobility		
Change of position in bed	2 out of 3	Getting in or out of bed
Hold the stable seating position	2 out of 3	Sitting for about two hours
Standing up / sitting down	2 out of 3	Getting up from a chair after sitting for long periods
Move within the living area	2 out of 3	Walking across a room
Stair climbing	2 out of 3	Climbing one flight of stairs without resting
2. Cognitive and communicative skills †	Valued as a whole in the vulnerability scale	Orientation in time (day, week, month, year): cannot answer three or more Recall: less than 30% words
3. Behavioral and psychological problems ⋆	Valued as a whole in the vulnerability scale	EURO-D score 4+
4. Dependency in ADL		
Wash the front upper body	2 out of 3	Bathing or showering
Combing, dental care / prosthesis cleaning, shaving	-	Bathing or showering
Wash the intimate area	2 out of 3	Bathing or showering
Showers or bathing	2 out of 3	Bathing or showering
Fitting and lining the upper and lower body	4 out of 6	Dressing (+ putting on shoes and socks)
Cutting-up the food, pouring beverages	2 out of 3	Eating (+ cutting up your food)
Eating	6 out of 9	Eating (+cutting up your food)
Drinking	-	-
Use the toilet / toilet-chair	4 out of 6	Using the toilet (+ getting up or down)
Consequences of urinary incontinence, dealing with permanent catheter / urostoma	2 out of 3	Incontinence or involuntary loss of urine
Consequences of a faecal incontinence, dealing with stoma	-	-
5. Dealing with illness and therapy-related requirements and stress		-
6. Designing everyday life and social contacts		
In control for planning routines and activities	-	-
Resting and sleeping	2 out of 3	Having had trouble sleeping recently
To keep oneself busy performing enjoyable activities	2 out of 3	"What have you enjoyed doing recently"- Fails to mention any enjoyable activity
Plan for the future (longer periods of time, make weekly or monthly schedule)	-	-
Interaction with people in direct contact	-	-
Contact management to persons outside the direct environment	2 out of 3	No activity performed in the last month OR Unable to use the telephone
NOT CONSIDERED FOR ELIGIBILITY		
7. Out-of-home activities (iADL tasks)		
8. Household management ∘		

† Identify people from the surrounding area; Local orientation; Time orientation; Memory; Perform multi-step daily operations; Making decisions in everyday life; Understanding facts and information; Identify risks and hazards; Communication of elementary needs; Understanding of Prompts; Participation in a conversation the data, including whatever notes are needed.
⋆ Motorized behavioral problems; Nocturnal restlessness; Self-injurious and autoaggressive behaviour; Damage to objects; Physically aggressive behavior towards other people; Verbal aggression; Other vocal abnormalities; Defence or other supportive measures; Delusions, misunderstandings; fears; Impotence, depressive mood; Social inadequate behaviour; Other inadequate actions
∘ Shopping for daily needs; Preparation of simple meals; Easy (clean) cleaning and cleaning; Elaborate (heavy) clearing and cleaning; Use of services; Settlement of financial matters; Regulation of administrative matters

issues. The fourth module largely resembles the ADL-items covered in SHARE, except for "drinking" and "faecal incontinence", which cannot be matched. The fifth module is primarily concerned with assessing whether the individual can cope independently with simple or elaborate illness-related requirements (e.g., taking medications, insulin injections, therapeutic activity, stoma-care routine). Each outcome is evaluated in terms of the frequency of assistance required by the applicant (daily, weekly, monthly). Since SHARE only covers the "taking medication" outcome, and no information can be retrieved on the frequency of assistance needed, this module can not be matched with the micro-data. Finally, in the module on Everyday Life we are able to match three outcomes out of six.

The sum of the outcomes' values is then converted in an overall module-specific score, following guidelines and grids summarized in Table 19

The sum of the modules eligibility scores constitutes the individual's vulnerability score, which is then used for eligibility purposes. In order to get access to the LTC benefits, a minimum score of 27 is required.

Table 19: German *Pflegeversicherung* Level of dependency

	Level of dependency				
	0	1	2	3	4
	None	Low	Considerable	Severe	Harderst
Module					
1 Mobility (sum of outcomes values)	0 - 1	2 - 3	4 - 5	6 - 9	10 - 15
MODULE 1 ELIGIBILITY SCORE	0	2,5	5	7,5	10
2 Cognitive (sum of outcomes values)	0 -1	2 - 5	6 - 10	11 - 16	17 - 33
Matching with SHARE variables				Orientation in time	Orientation in time and recall less than 30%
3 Depression (sum of outcomes values)	0	1 - 2	3 - 4	5- 6	7 - 65
Matching with SHARE variables				EURO-D ≥ 4	
MODULES 2, 3 ELIGIBILITY SCORE (the highest is considered)	0	3,75	7,5	11,25	15
4 Dependency in ADL (sum of outcomes values)	0 - 2	3 - 7	8 - 18	19 - 36	37 - 54
MODULE 4 ELIGIBILITY SCORE	0	10	20	30	40
5 Therapy-related requirements	-	-	-	-	-
MODULE 5 ELIGIBILITY SCORE	0	5	10	15	20
6 Everyday life (sum of outcomes values)	0	1 -3	4 - 6	7 - 11	12 - 18
MODULE 6 ELIGIBILITY SCORE	0	3,75	7,5	11,256	15

Source: SGB XI (Buch des Sozialgesetzbuches)

A.5 Spain - *Ley de Dependencia*

In 2006, the Spanish government enacted the Ley de Dependencia (Dependency Law - Act 39/2006, of 14th December, on the Promotion of Personal Autonomy and Care for Dependent persons) whose aim was to "configure a network for public use that integrated on a coordinated basis, both public and private centres and services" (Jiménez-Martín and Prieto, 2012), and to harmonize the previously highly decentralized system. Eligible individuals may receive both in-kind and in-cash benefits for home-care (the latter are available also for caregivers). All cash allowances are means-tested and depend on cost (or on hours of care for the caregivers-allowance).

Eligibility: the minimum level of vulnerability corresponds to a final score of 25 in the assessment-scale (Moderate dependence level). There are no age requirements.

Assessment: the evaluation process is standardised throughout the whole country, through an assessment scale (Table 20), approved by the Territorial Council of the System for Autonomy and Care for Dependency, involving 10 Activities. Each activity carries a weight and comprises several tasks, which in turn are characterized by a coefficient (bounded between 0 and 1), representing the share of the Activity?s weight carried by that task (e.g., Cutting up food has the 20% of the Eating and drinking weight). For mentally impaired individuals, a further activity is considered ("Making decision"), while the remaining ten are assigned new weights (in parenthesis in the Table). E.g., for a mentally impaired individual the weight of the Activity Eating and drinking is 10. Since some of the tasks included in the Spanish assessment do not have a perfect match in the SHARE dataset, we opted for the most coherent and prudent choice. As an example, with regards to the task of moving outdoor (which is an iADL), for which we

lack a specific information in SHARE, we looked at the respondents' ability to move indoor (which is an ADL). We want to avoid the risk of labelling someone as non-autonomous in a task when he is in-fact able to do it. In this case, moving indoor clearly represents a prudent choice, since it is arguable that an individual who cannot move inside her house will not able to walk outdoor, while the vice-versa is not necessarily true.

The Spanish legislation allows for different degrees of loss-of-autonomy for each of the aforementioned tasks. The need-of-support can be special, full or partial, to which is assigned a coefficient of 1, 0.95 or 0.9 respectively. These support coefficients must be multiplied to the coefficient of the task in which the limitations is experienced. E.g., if an individual has full limitations in cooking, she will be assigned a score of 0.45*0.95 within the dimension Housekeeping. Since in SHARE we do not have information about the intensity of occurring limitations, we prudently chose to always assign a need-of-support of 0.9. The final score, between 0 and 100, is the sum of the weights of the tasks for which the individual has difficulty, multiplied by the degree of supervision required and the weight assigned to that activity.

Table 20: Assessment of need in the Spanish *Ley de Dependencia*

Activities - tasks	Weight	SHARE tasks
Eating and drinking	16.8 (10)	Eating (+cutting up your food)
Recognize e/o reach the food served	0.25	—
Cutting up food	0.2	—
Using cutlery	0.3	—
Putting a glass to mouth	0.25	—
Control of physical needs	14.8 (7)	Using the toilet (+ getting up or down)
Go to the appropriate place	0.2	—
Dressing and undressing	0.15	—
Adopting the right posture	0.3	—
Cleaning oneself	0.35	—
Washing	8.8 (8)	Bathing or showering
Turning on and turning off taps	0.15	—
Washing hands	0.2	—
Using shower or bath tub	0.15	—
Washing lower part of the body	0.25	—
Washing upper part of the body	0.25	—
Other personal tasks	2.9 (2)	Bathing or showering
Combing hair	0.3	—
Cutting nails	0.15	—
Washing hair	0.25	—
Brushing teeth	0.3	—
Dressing	11.9 (11.6)	Dressing (+ putting on shoes and socks)
Recognize e/o reach clothes and shoes	0.15	—
Putting on shoes	0.1	—
Doing up buttons	0.15	—
Dressing upper part of the body	0.3	—
Dressing lower part of the body	0.3	—
Maintaining health	2.9 (11)	
Request therapeutic assistance	0.15	Taking medications
Applying therapeutic measures	0.1	Taking medications
Avoiding indoor risks	0.25	Walking across a room
Avoiding outdoor risks	0.25	Walking across a room
Distress call	0.25	Making telephone calls
Maintaining health 2	9.4 (2)	-
Changing position from lying to sitting on the bed	0.1	Getting in or out of bed
Sitting	0.15	Sitting for about two hours
Getting up from a chair	0.1	Getting up from a chair after sitting for long periods
Standing up	0.15	Getting in or out of bed
Sitting down on a chair	0.1	Getting in or out of bed
Changing posture from a sitting position	0.1	Getting in or out of bed
Changing posture from bed	0.1	Getting in or out of bed
Changing centre of gravity of body in the bed	0.2	Getting in or out of bed
Moving inside home	12.3 (12.1)	-
Movements related dressing	0.25	Dressing (+ putting on shoes and socks)
Movements related eating	0.15	Eating (+cutting up your food)
Movements related washing	0.1	Bathing or showering
Movements not related to self-care	0.25	Walking across a room
Access to all settings of the rooms	0.1	Walking across a room
Access to all rooms	0.15	Walking across a room
Moving outside home	12.2 (12.9)	-
Going out	0.25	Walking across a room
Walking around the house/buiding	0.25	Walking across a room
Walking short distances in known places	0.2	Walking across a room
Walking short distances in unknown places	0.15	Walking across a room or Using a map to figure out how to get around in a strange place
Walking long distances in known places	0.1	Walking across a room
Walking long distances in unknown places	0.05	Walking across a room or Using a map to figure out how to get around in a strange place
Housekeeping	8 (8)	
Cooking	0.45	Preparing a hot meal
Shopping (for food)	0.25	Shopping for groceries
Cleaning the house	0.2	Doing work around the house or garden
Washing clothes	0.1	Doing work around the house or garden
Only for patients with a mental illness or cognitive impairment:		
Making decisions	(15.4)	Orientation in time (day, week, month, year): cannot answer three or more

Source: Real Decreto 174/2011, Ministerio de Sanidad, Politica Social e Igualdad "BOE", num.42, 18/02/2011

B Appendix

B.1 Transition models

Regression tables have been made using Jann (2007)

Table 21: Transition model - Disability outcomes

	Sitting 2h	Getting up	Climbing stairs	Dressing	Walking	Bathing	Eating	Getting in bed
Austria	-0.049	0.111***	-0.024	-0.008	-0.151*	-0.053	0.061	0.011
Germany	0.098*	0.137***	-0.297***	0.124**	-0.035	0.173**	0.127	0.015
Sweden	-0.096**	-0.076*	-0.472***	0.009	-0.147*	-0.318***	-0.020	-0.137*
Netherlands	-0.236***	-0.065*	-0.234***	-0.297***	-0.447***	-0.254***	-0.187*	-0.229***
Spain	-0.145***	0.023	0.015	-0.011	-0.050	-0.040	-0.010	0.072
France	-0.123***	-0.064*	-0.246***	0.087*	-0.198**	-0.041	-0.205**	-0.145**
Denmark	-0.142***	-0.163***	-0.185***	-0.019	-0.269***	-0.177**	-0.160*	-0.233***
Switzerland	-0.191***	-0.127***	-0.527***	-0.085	-0.270**	-0.164**	-0.176*	-0.236***
Belgium	-0.000	0.067*	-0.200***	0.087*	-0.264***	0.158***	-0.133*	-0.026
Up to low secondary education	0.043	0.036	0.154***	0.047	0.007	0.172***	0.036	0.019
Associates degree or more	-0.107***	-0.091***	-0.087**	-0.111***	-0.057	-0.075*	-0.079	-0.126**
Male	-0.075**	-0.167***	-0.135***	0.162***	0.031	-0.013	0.021	-0.005
Male AND Up to low secondary education	0.005	-0.022	-0.012	-0.063	-0.008	-0.066	-0.079	0.005
Min(63, two-year lag of age)	0.000	0.012***	0.017***	0.012***	0.000	0.024***	0.017**	-0.003
Min(Max(0, two-year lag age - 63), 73 - 63)	0.009**	0.020***	0.030***	0.023***	0.041***	0.033***	0.030***	0.019***
Max(0, two-year lag age - 73)	0.001	0.029***	0.042***	0.027***	0.034***	0.049***	0.022***	0.028***
lag of Heart disease	0.039	0.011	0.200***	0.081**	0.063	0.100**	0.020	0.062
lag of Stroke	0.038	0.156***	0.102*	0.135**	0.163**	0.219***	0.185**	0.081
lag of Cancer	-0.025	-0.014	0.079*	0.036	0.017	0.033	-0.035	0.018
lag of Hypertension	0.043*	0.043*	0.054**	0.010	-0.062	-0.035	-0.074	-0.039
lag of Diabetes	0.056*	0.098***	0.142***	0.058	0.095*	0.130***	0.081	0.158***
lag of R bothered by incontinence	0.078*	0.151***	0.089**	0.189***	0.053	0.186***	0.096	0.095*
lag of eurod score	0.167***	0.201***	0.186***	0.183***	0.110**	0.134***	0.153***	0.149***
lag of no activity	0.180***	0.113***	0.164***	0.083*	0.130*	0.140**	0.148**	0.137**
lag of Resting and sleeping	0.125***	0.070***	0.021	0.033	-0.084*	0.010	-0.020	0.038
lag of Enjoyable activities	0.016	0.009	0.053*	-0.021	0.046	0.044	-0.020	0.024
lag of sitting two hours	0.764***	0.318***	0.062*	0.106***	-0.115*	0.033	-0.018	0.161***
lag of getting up from chair	0.363***	0.734***	0.261***	0.264***	0.179***	0.167***	0.136***	0.276***
lag of climbing one flight of stairs	0.150***	0.239***	0.747***	0.227***	0.408***	0.311***	0.205***	0.213***
lag of dressing, including shoes and socks	0.169***	0.204***	0.122***	0.880***	0.200***	0.226***	0.276***	0.347***
lag of walking across a room	-0.190**	0.082	0.274***	-0.039	0.759***	0.122	-0.168	0.198**
lag of bathing or showering	-0.044	0.059	0.166***	0.280***	0.224***	0.845***	0.125*	0.164**
lag of eating, cutting up food	-0.044	-0.120	-0.095	0.053	0.118	0.003	0.916***	0.043
lag of getting in or out of bed	0.164**	0.186***	0.020	0.183***	0.154*	0.131*	0.149*	0.582***
lag of using the toilet, incl getting up or down	-0.051	-0.071	0.059	-0.158*	-0.084	-0.169*	-0.264**	-0.186*
lag of using a map in a strange place	0.080*	0.026	0.051	-0.024	0.071	0.115**	0.119*	0.037
lag of preparing a hot meal	-0.133*	-0.030	0.073	0.127*	0.117	0.210***	0.284***	0.210**
lag of shopping for groceries	0.062	0.117**	0.253***	0.139**	0.312***	0.325***	0.175**	0.147**
lag of telephone calls	0.065	-0.061	-0.137	-0.010	0.050	-0.145	0.204*	0.029
lag of taking medications	-0.001	-0.161	-0.158	-0.150	-0.179	-0.322***	-0.173	-0.087
lag of doing work around the house or garden	0.176***	0.263***	0.304***	0.235***	0.212***	0.310***	0.103*	0.156***
lag of managing money	-0.064	-0.014	0.064	0.166**	-0.005	0.232***	0.199**	0.068
lag of Orientation = 1	0.065	0.284**	0.227*	0.502***	0.353**	0.560***	0.625***	0.558***
lag of Orientation = 2	0.204	0.212*	0.146	0.235*	0.422**	0.359**	0.355**	0.522***
lag of Orientation = 3	-0.052	0.022	0.109	0.113	0.145	0.251***	0.227**	0.247***
lag of Orientation = 4	-0.000	-0.001	0.048	0.061*	0.044	0.054	0.051	0.069
lag of Bmi $\leq$ log(30)	0.006	0.675***	0.482***	0.403***	-0.300*	-0.300**	-0.742***	-0.307**
lag of Bmi > log(30)	0.319*	1.102***	1.436***	1.162***	0.941***	1.182***	0.366	0.691***
Splined init of BMI age 50 $\leq$ log(30)	0.070	0.084	0.028	-0.050	0.285*	0.036	0.003	0.302**
Splined init of BMI age 50 > log(30)	-0.131	0.005	-0.083	-0.040	-0.077	0.190	-0.055	-0.226
Heart problem status at age 50 (1/0)-imputed	0.112*	0.175***	0.114*	0.058	0.159*	0.051	0.183*	0.083
Stroke status at age 50 (1/0)-imputed	0.050	-0.140	0.089	-0.023	0.206	0.027	0.134	0.045
Cancer status at age 50 (1/0)-imputed	0.214**	0.095	-0.006	-0.059	0.091	0.043	0.013	0.088
High blood pressure status at age 50 (1/0)-imputed	0.018	0.040	0.038	0.040	0.091	0.095*	0.054	0.062
Diabetes status at age 50 (imputed)	0.031	-0.017	0.070	0.021	0.146	0.107	0.100	-0.083
Lung disease status at age 50 (1/0)-imputed	0.165***	0.126**	0.339***	0.145**	0.151*	0.131*	0.168*	0.138*
Ever Smoked at age 50 - imputed	-0.004	-0.029	-0.021	0.028	-0.011	0.005	0.024	-0.053
Smoking status at age 50 (imputed)	0.060**	0.024	0.115***	0.107***	0.065	0.144***	0.078*	0.065*
Single at age 50 - imputed	0.001	0.019	0.053	-0.007	-0.028	0.062	0.030	-0.028
Widowed at age 50 - imputed	-0.032	-0.047*	0.005	-0.001	-0.033	0.038	-0.159***	-0.079*
Log of years between current interview and previous	0.079***	0.182***	0.173***	0.190***	0.231***	0.227***	0.137**	0.088*
Costant	-2.009***	-4.802***	-4.696***	-4.276***	-2.872***	-3.335***	-1.367*	-2.288***

Table 22: Transition model - Disability Outcomes

	Toilet	Map	Meal	Shopping	Phone	Medications	Housework	Money
Austria	0.015	0.162***	0.171**	-0.023	-0.207**	-0.122	0.296***	0.124*
Germany	0.162*	-0.035	0.192**	0.058	-0.058	0.116	0.228***	0.040
Sweden	-0.105	-0.247***	-0.020	-0.152**	-0.171*	-0.258***	0.135**	-0.062
Netherlands	-0.304***	-0.166***	0.079	-0.187***	-0.203**	-0.375***	0.187***	-0.147*
Spain	0.121*	0.186***	0.087	-0.117*	0.015	-0.013	0.112**	-0.065
France	-0.166**	-0.163***	-0.125*	0.006	-0.139*	-0.174**	0.179***	-0.052
Denmark	-0.179*	-0.101*	0.099	-0.016	-0.245**	-0.054	0.158***	0.066
Switzerland	-0.198*	-0.184***	-0.155*	-0.176**	-0.284**	-0.295**	-0.002	-0.189**
Belgium	-0.266***	-0.122**	0.090	0.042	-0.156*	-0.278***	0.301***	-0.001
Up to low secondary education	0.062	0.208***	0.060	0.138***	0.091	0.140*	0.053*	0.227***
Associates degree or more	-0.062	-0.164***	-0.092*	-0.066	-0.088	-0.052	-0.030	-0.115*
Male	0.029	-0.245***	0.238***	-0.061	0.265***	0.159**	-0.129***	0.129**
Male AND Up to low secondary education	-0.061	-0.007	0.024	-0.072	-0.067	-0.023	0.005	-0.100
Min(63, two-year lag of age)	0.010	0.007*	0.010	0.010*	0.006	0.004	0.007*	-0.001
Min(Max(0, two-year lag age - 63), 73 - 63)	0.021***	0.032***	0.044***	0.037***	0.039***	0.041***	0.036***	0.041***
Max(0, two-year lag age - 73)	0.031***	0.038***	0.049***	0.060***	0.038***	0.041***	0.047***	0.048***
lag of Heart disease	-0.004	0.085**	0.096**	0.130***	-0.034	0.074	0.145***	0.017
lag of Stroke	0.186**	0.172***	0.276***	0.267***	0.104	0.257***	0.169***	0.212***
lag of Cancer	-0.027	-0.025	-0.011	-0.034	-0.019	-0.009	0.046	-0.082
lag of Hypertension	-0.038	0.028	-0.055	-0.021	-0.047	-0.027	0.012	-0.017
lag of Diabetes	0.109*	0.162***	0.112**	0.161***	0.144**	0.246***	0.166***	0.180***
lag of R bothered by incontinence	0.147**	0.098**	0.140**	0.079*	0.148**	0.072	0.146***	0.120**
lag of eurod score	0.169***	0.227***	0.158***	0.212***	0.134**	0.133**	0.191***	0.245***
lag of no activity	0.158**	0.212***	0.229***	0.134**	0.202***	0.212***	0.149***	0.151**
lag of Resting and sleeping	-0.004	-0.017	-0.083**	-0.009	-0.043	0.007	0.074***	-0.054
lag of Enjoyable activities	0.026	0.015	-0.001	0.046	-0.034	-0.023	0.027	0.020
lag of sitting two hours	0.024	0.016	-0.043	-0.009	-0.025	0.023	0.117***	0.014
lag of getting up from chair	0.226***	0.115***	0.133***	0.173***	0.032	0.059	0.284***	0.078*
lag of climbing one flight of stairs	0.239***	0.149***	0.222***	0.316***	0.070	0.117*	0.347***	0.139***
lag of dressing, including shoes and socks	0.293***	0.033	0.132**	0.175***	0.134*	0.210***	0.191***	0.087
lag of walking across a room	0.231**	-0.121	0.003	0.073	-0.030	-0.026	-0.011	-0.044
lag of bathing or showering	0.189**	0.178***	0.262***	0.303***	0.231***	0.107	0.286***	0.221***
lag of eating, cutting up food	0.027	0.053	0.070	0.116	-0.086	0.094	-0.068	0.004
lag of getting in or out of bed	0.247***	0.022	0.033	-0.015	0.051	0.126	0.041	0.031
lag of using the toilet, incl getting up or down	0.330***	-0.178*	-0.196*	-0.247**	-0.213*	-0.354***	-0.195**	-0.193*
lag of using a map in a strange place	0.061	0.808***	0.101*	0.149***	0.243***	0.221***	0.043	0.272***
lag of preparing a hot meal	0.208**	0.080	0.741***	0.175**	0.195*	0.275***	0.129*	0.161*
lag of shopping for groceries	0.193**	0.142**	0.384***	0.832***	0.188**	0.223***	0.367***	0.183***
lag of telephone calls	0.041	0.325***	0.035	0.021	1.151***	0.319***	0.022	0.272**
lag of taking medications	-0.136	-0.171*	0.070	-0.302***	-0.100	0.461***	-0.320***	-0.031
lag of doing work around the house or garden	0.130**	0.169***	0.264***	0.391***	0.068	0.069	0.806***	0.201***
lag of managing money	0.092	0.315***	0.258***	0.221***	0.278***	0.290***	0.104	0.904***
lag of Orientation = 1	0.590***	0.582***	0.708***	0.533***	0.735***	0.763***	0.446***	0.794***
lag of Orientation = 2	0.341*	0.281**	0.325**	0.308**	0.645***	0.565***	0.275*	0.329**
lag of Orientation = 3	0.166*	0.230***	0.288***	0.353***	0.321***	0.370***	0.185**	0.315***
lag of Orientation = 4	0.050	0.094**	0.052	0.029	0.122**	0.111*	0.001	0.061
lag of Bmi $\leq$ log(30)	-0.359**	-0.231**	-0.594***	-0.459***	-0.651***	-0.663***	0.001	-0.549***
lag of Bmi $>$ log(30)	0.766**	0.315	0.932***	1.053***	0.245	0.413	1.032***	0.728***
Splined init of BMI age 50 $\leq$ log(30)	0.226	0.099	0.130	0.090	0.246	0.167	0.078	0.080
Splined init of BMI age 50 $>$ log(30)	-0.112	-0.063	0.160	0.030	-0.065	0.172	0.107	0.006
Heart problem status at age 50 (1/0)-imputed	0.005	0.004	0.038	0.070	-0.022	-0.022	0.055	0.068
Stroke status at age 50 (1/0)-imputed	0.078	0.043	-0.035	-0.061	0.027	-0.013	0.008	0.224
Cancer status at age 50 (1/0)-imputed	0.136	0.093	0.122	-0.074	0.092	-0.004	0.039	0.116
High blood preasure status at age 50 (1/0)-imputed	0.009	-0.011	0.068	0.019	0.015	0.039	0.035	-0.009
Diabetes status at age 50 (imputed)	0.026	0.101	0.177*	0.102	0.008	0.001	0.012	0.140
Lung disease status at age 50 (1/0)-imputed	0.099	0.101	0.218***	0.227***	-0.015	-0.015	0.274***	0.081
Ever Smoked at age 50 - imputed	-0.023	-0.080*	-0.026	-0.049	-0.087	-0.033	-0.039	-0.046
Smoking status at age 50 (imputed)	0.105**	-0.005	0.069*	0.105***	-0.003	0.018	0.110***	0.013
Single at age 50 - imputed	0.014	-0.026	0.084	0.048	-0.034	-0.046	0.076*	0.016
Widowed at age 50 - imputed	-0.063	-0.010	-0.027	0.001	-0.136**	-0.161***	0.049*	-0.030
Log of years between current interview and previous	0.170***	0.126***	0.225***	0.231***	0.177***	0.202***	0.142***	0.189***
Costant	-2.987***	-2.172***	-2.151***	-2.100***	-1.928**	-1.646*	-3.003***	-1.282*

Table 23: Transition model - Disability Outcomes

	Resting and sleeping	Enjoyable activities	Orientation	Eurod score
Austria	0.042	-0.191***	0.063*	-0.342***
Germany	0.162***	-0.214***	0.034	-0.215***
Sweden	-0.025	-0.301***	0.072*	-0.372***
Netherlands	-0.120***	-0.431***	-0.026	-0.383***
Spain	0.027	-0.399***	-0.041	-0.132***
France	0.116***	-0.357***	-0.010	-0.023
Denmark	-0.002	-0.507***	-0.024	-0.342***
Switzerland	-0.007	-0.624***	-0.006	-0.317***
Belgium	0.054*	-0.422***	-0.017	-0.155***
Up to low secondary education	0.001	0.145***	-0.059**	0.087***
Associates degree or more	-0.030	-0.061**	0.020	-0.047*
Male	-0.280***	0.071**	-0.081***	-0.264***
Male AND Up to low secondary education	0.009	-0.049	0.072**	-0.041
Min(63, two-year lag of age)	-0.005**	0.003	-0.015***	-0.014***
Min(Max(0, two-year lag age - 63), 73 - 63)	0.005*	0.006*	-0.031***	0.016***
Max(0, two-year lag age - 73)	-0.004	0.009**	-0.048***	0.005
lag of Heart disease	0.078***	0.048	0.008	0.146***
lag of Stroke	-0.007	0.059	-0.041	0.047
lag of Cancer	0.024	-0.019	0.035	0.064*
lag of Hypertension	0.056***	-0.024	-0.006	0.000
lag of Diabetes	0.009	0.059*	-0.015	0.075**
lag of R bothered by incontinence	0.069*	-0.035		0.150***
lag of eurod score	0.198***	0.199***		0.807***
lag of no activity	0.056*	0.145***		0.060*
lag of Resting and sleeping	0.954***	-0.004		0.270***
lag of Enjoyable activities	0.019	0.403***		0.062**
lag of sitting two hours	0.139***	0.005		0.137***
lag of getting up from chair	0.056**	0.117***		0.147***
lag of climbing one flight of stairs	0.013	0.087**		0.117***
lag of dressing, including shoes and socks	0.028	0.034		0.097**
lag of walking across a room	-0.048	-0.020		-0.103
lag of bathing or showering	-0.041	0.024		0.004
lag of eating, cutting up food	0.037	-0.031		0.002
lag of getting in or out of bed	0.122*	-0.054		0.080
lag of using the toilet, incl getting up or down	0.123	-0.052		-0.047
lag of using a map in a strange place	0.003	0.070*		0.126***
lag of preparing a hot meal	-0.049	0.047		-0.072
lag of shopping for groceries	-0.053	0.117**		-0.004
lag of telephone calls	-0.147*	0.012		-0.140
lag of taking medications	-0.066	-0.078		-0.147
lag of doing work around the house or garden	0.071**	0.031		0.095***
lag of managing money	-0.085	0.084		0.158**
lag of Orientation = 1	0.038	0.036		0.225*
lag of Orientation = 2	-0.079	0.052	-0.004	-0.011
lag of Orientation = 3	0.074	0.167**	-0.051	0.182***
lag of Orientation = 4	0.047*	0.013	0.139	0.046*
lag of Bmi $\leq$ log(30)	-0.056	-0.009	0.088	-0.001
lag of Bmi $>$ log(30)	0.220	0.182	0.009	0.235
Splined init of BMI age 50 $\leq$ log(30)	0.024	-0.006	-0.031	0.074
Splined init of BMI age 50 $>$ log(30)	-0.108	0.057	0.149	0.007
Heart problem status at age 50 (1/0)-imputed	0.099*	-0.054	-0.007	0.069
Stroke status at age 50 (1/0)-imputed	-0.052	-0.096	0.037	-0.021
Cancer status at age 50 (1/0)-imputed	0.123*	0.059	-0.081	0.115*
High blood preasure status at age 50 (1/0)-imputed	-0.025	0.005	0.014	0.015
Diabetes status at age 50 (imputed)	0.019	0.119*	-0.029	0.067
Lung disease status at age 50 (1/0)-imputed	0.155***	0.035	-0.104**	0.120**
Ever Smoked at age 50 - imputed	0.004	-0.060**	0.009	-0.033
Smoking status at age 50 (imputed)	-0.005	0.036*	0.032	0.085***
Single at age 50 - imputed	0.000	0.064*	0.016	0.013
Widowed at age 50 - imputed	-0.012	0.064**	0.004	0.041*
Log of years between current interview and previous	0.010	0.101***	-0.074***	0.137***
Costant	-0.475*	-1.429***		-0.550*
lag of Has exactly 1 IADL			-0.112*	
lag of Has 2 or more IADLs			-0.028	
lag of Has exactly 1 ADL			-0.024	
lag of Has exactly 2 ADLs			-0.076	
lag of Has 3 or more ADLs			-0.031	
lag of Orientation = 5			0.284**	
lag of Widowed			0.012	
lag of Current smoking			-0.057*	
Cut 1			-3.324***	
Cut 2			-3.115***	
Cut 3			-2.694***	
Cut 4			-1.885***	

Table 24: Transition model - Health Outcomes 1

	Mortality	Cancer	Diabetes	Hearth Disease	Hypertension	Lung Disease	Stroke
Austria	0.048	0.102	0.094	0.062	0.047	0.063	0.343***
Germany	-0.017	0.199**	-0.025	0.081	0.018	0.116*	0.144*
Sweden	-0.017	0.234***	-0.070	0.111*	-0.162***	-0.280***	0.137*
Netherlands	-0.043	0.191***	-0.060	0.001	-0.309***	-0.013	0.081
Spain	0.102*	0.043	0.175***	0.012	-0.042	0.008	-0.014
France	-0.077	0.113*	-0.083	0.084*	-0.333***	0.019	0.036
Denmark	0.124*	0.049	-0.272***	0.004	-0.194***	0.075	0.057
Switzerland	-0.103	0.145*	-0.267***	-0.165**	-0.363***	-0.112*	-0.180*
Belgium	-0.126**	0.084	-0.046	0.061	-0.178***	-0.066	0.089
Up to low secondary education	-0.006	-0.137***	0.117**	0.100**	0.120***	0.084*	0.120**
Associates degree or more	-0.110**	-0.055	-0.094**	-0.046	-0.101***	-0.052	-0.035
Male	0.228***	0.059	0.163***	0.192***	0.028	-0.026	0.175***
Male AND Up to low secondary education	0.060	0.092	-0.133**	-0.128**	-0.049	0.088	-0.061
Min(63, two-year lag of age)	0.039***	0.030***	0.019***	0.030***	0.022***	0.011**	0.017***
Min(Max(0, two-year lag age - 63), 73 - 63)	0.025***	0.018***	0.011**	0.033***	0.020***	0.019***	0.027***
Max(0, two-year lag age - 73)	0.063***	-0.005	0.002	0.018***	0.001	0.006	0.022***
lag of Heart disease	0.136***						0.253***
lag of Stroke	0.069						
lag of Cancer	0.535***						-0.020
lag of Hypertension	-0.018			0.104***			0.090**
lag of Diabetes	0.154***			0.071	0.186***		0.157***
lag of Lung disease	0.287***						
lag of Has exactly 1 IADL	0.364***						
lag of Has 2 or more IADLs	0.571***						
lag of Has exactly 1 ADL	0.231***						
lag of Has exactly 2 ADLs	0.354***						
lag of Has 3 or more ADLs	0.614***						
lag of Widowed	0.012	0.010	0.018	-0.000	0.022	-0.029	-0.048
lag of Current smoking	0.248***	0.095*	0.061	0.083*	-0.014	0.134***	0.094
Heart problem status at age 50 (1/0)-imputed	0.021	0.243***	0.191***		0.253***	0.249***	0.115
Stroke status at age 50 (1/0)-imputed	-0.194	-0.113	0.044	0.188	0.369***	0.070	
Cancer status at age 50 (1/0)-imputed	0.073		-0.084	0.184*	0.010	0.007	0.369**
High blood preasure status at age 50 (1/0)-imputed	0.070	-0.007	0.157***	0.078*		0.003	0.070
Diabetes status at age 50 (imputed)	0.110	0.101		0.183**	0.076	0.221***	0.109
Lung disease status at age 50 (1/0)-imputed	-0.044	0.185**	0.130*	0.012	-0.041		0.312***
Ever Smoked at age 50 - imputed	0.016	-0.004	0.022	-0.019	-0.034	0.044	-0.044
Smoking status at age 50 (imputed)	0.086**	0.041	0.068*	0.022	0.024	0.234***	0.007
Log of years between current interview and previous	0.591***	0.171***	0.251***	0.202***	0.198***	0.184***	0.165***
Costant	-5.468***	-4.262***	-8.124***	-5.138***	-6.524***	-3.230***	-3.533***
lag of Orientation = 2		0.252	0.366	-0.380	-0.074	-0.450	-0.299
lag of Orientation = 3		0.243	0.229	-0.131	0.047	-0.095	-0.345*
lag of Orientation = 4		0.178	0.193	-0.195	0.035	-0.152	-0.533***
lag of Orientation = 5		0.129	0.124	-0.242	0.029	-0.185	-0.529***
lag of Bmi $\leq$ log(30)		0.005	1.436***	0.306**	1.223***	-0.091	0.052
lag of Bmi > log(30)		0.405	1.585***	0.680***	0.720***	1.341***	0.450
Splined init of BMI age 50 $\leq$ log(30)		-0.026	-0.035	0.092	-0.013	0.220*	0.023
Splined init of BMI age 50 > log(30)		0.024	0.443*	-0.182	0.370*	-0.198	0.111
Single at age 50 - imputed		0.010	0.038	-0.016	-0.003	0.023	0.008
Widowed at age 50 - imputed		-0.057	-0.019	0.060	0.050	0.042	0.029

Table 25: Transition model - Health Outcomes 2

	ADL	IADL	Pain	Cognitive Status	Depression	Smoking	BMI (log)	Nursing Home
Austria	-0.021	0.007	-0.187***	0.441***	-0.412***	-0.042	0.006***	0.106
Germany	0.072	-0.003	0.053*	0.404***	-0.294***	0.034	0.006***	-0.116
Sweden	-0.124***	-0.214***	-0.076***	0.744***	-0.591***	0.246***	0.001	0.457**
Netherlands	-0.286***	-0.206***	-0.303***	0.571***	-0.433***	0.343***	0.002	0.213
Spain	-0.013	-0.028	0.093***	-0.104	0.007	-0.161***	0.008***	-0.184
France	-0.004	-0.083	0.137***	0.390***	-0.137***	0.049*	0.005***	-0.049
Denmark	-0.142***	-0.039	-0.155***	0.584***	-0.609***	0.237***	0.001	0.276
Switzerland	-0.205***	-0.281***	-0.304***	0.565***	-0.617***	0.214***	0.004*	0.060
Belgium	0.077*	-0.089*	0.178***	0.571***	-0.257***	0.095***	0.003	0.166
Up to low secondary education	0.117***	0.243***	0.081***	-0.286***	0.216***	-0.266***	0.004***	0.165
Associates degree or more	-0.110***	-0.099*	-0.103***	0.209***	-0.078**	-0.022	-0.003***	-0.264
Male	-0.019	0.135***	-0.307***	-0.005	-0.203***	0.382***	0.003**	0.008
Male AND Up to low secondary education	-0.092**	-0.110*	-0.042*	0.035	-0.103**	0.377***	-0.004*	-0.134
Min(63, two-year lag of age)	0.012***	0.001	-0.001	5.056*	-0.009***	-0.007***	-0.001***	-0.016
Min(Max(0, two-year lag age - 63), 73 - 63)	0.029***	0.042***	0.016***	-0.027***	0.018***	-0.014***	-0.001***	0.026
Max(0, two-year lag age - 73)	0.045***	0.054***	0.002	-0.037***	0.020***	-0.005*	-0.002***	0.038***
lag of Heart disease	0.147***	0.067*	0.171***	-0.066		0.074***	0.001	-0.039
lag of Stroke	0.236***	0.282***	0.075*	-0.009		0.068*	0.002	0.306*
lag of Cancer	0.075*	-0.024	0.049*	-0.090		0.079**	0.001	-0.199
lag of Hypertension	0.022	0.006	0.040**	-0.022		0.024	0.004***	-0.099
lag of Diabetes	0.152***	0.223***	0.048*	-0.097		0.062**	0.002	0.133
lag of Has exactly 1 IADL	0.417***	1.022***	0.148***	-0.307***	0.405***	-0.106*	0.005*	0.025
lag of Has 2 or more IADLs	0.329***	1.398***	-0.104	-0.448*	0.547***	-0.180*	-0.002	0.745***
lag of Has exactly 1 ADL	0.961***	0.353***	0.473***	-0.158*	0.354***	0.050	0.004*	0.404**
lag of Has exactly 2 ADLs	1.417***	0.622***	0.641***	-0.219*	0.662***	0.101*	0.000	0.149
lag of Has 3 or more ADLs	1.922***	0.748***	0.524***	-0.199	0.576***	-0.063	-0.001	0.454*
lag of Orientation = 2	-0.030	-0.380**	0.042		0.117	0.030	0.021*	
lag of Orientation = 3	-0.266*	-0.433***	-0.010		0.235	0.128	0.009	
lag of Orientation = 4	-0.410***	-0.694***	0.039		0.082	0.150	0.011	
lag of Orientation = 5	-0.504***	-0.814***	-0.017		-0.054	0.156	0.012*	
lag of Widowed	0.015	-0.027	0.028	-0.052	-0.186***	-0.083**	0.006***	-0.244
lag of Current smoking	0.110***	0.184***	0.031	-0.055	0.121***	2.674***	-0.006***	
lag of Bmi $\leq$ log(30)	0.148*	-0.512***	0.665***	-0.108	-0.172*	0.055	0.886***	
lag of Bmi $>$ log(30)	1.353***	0.725***	0.590***	-0.103	0.591***	0.373**	0.810***	
Splined init of BMI age 50 $\leq$ log(30)	0.085	0.126	0.044	0.238	0.129	0.086	0.014***	
Splined init of BMI age 50 $>$ log(30)	0.005	0.006	-0.130	-0.326	-0.095	-0.200	0.023**	
Heart problem status at age 50 (1/0)-imputed	0.128**	0.062	0.056	-0.192	0.188***	0.023	0.001	0.244
Stroke status at age 50 (1/0)-imputed	0.039	0.131	0.061	0.234	0.257**	0.076	0.002	0.077
Cancer status at age 50 (1/0)-imputed	0.002	0.058	0.088	0.054	0.106	0.116*	-0.007*	0.525
High blood preasure status at age 50 (1/0)-imputed	0.058*	0.003	0.056**	0.012	0.047	-0.059**	0.002	0.107
Diabetes status at age 50 (imputed)	0.053	0.150*	0.112**	0.082	0.319***	0.020	0.002	0.000
Lung disease status at age 50 (1/0)-imputed	0.271***	0.122*	0.139***	0.095	0.353***	-0.038	0.002	-0.012
Ever Smoked at age 50 - imputed	0.011	-0.064	0.031*		-0.091***		0.001	0.071
Smoking status at age 50 (imputed)	0.065**	-0.077*	0.028	-0.082	0.018		0.002*	0.200*
Single at age 50 - imputed	0.035	0.017	0.002	0.085	0.019	-0.000	-0.002	0.030
Widowed at age 50 - imputed	0.012	-0.039	0.057*	0.055	0.241***	0.022	-0.004*	0.167
Log of years between current interview and previous	0.165***	0.169***	0.647***	0.074	0.024	-0.015	-0.001	0.837***
lag of Lung disease			0.195***	-0.179*		0.251***	-0.004	-0.102
lag of demented				-1.680***				
lag of CIND				-0.916***				
Poland				0.000				
Init. of Ever smoked				0.135**				
Costant					-0.645		1.258***	-3.037***
Init. of							-0.000**	
lag of Non-pension wlth(hatota) not zero								-0.636*
lag of (IHT of hh wlth in 1000s if positive)/100 zero otherwise								2.534
Cut point 1	3.009***							
Cut		0.603	2.937***	316.946*		0.644**		
Cut point 2	3.606***							
Cut		1.167*	3.465***	318.281*		2.288***		
Cut point 3	4.005***							
Cut			4.867***					

Table 26: Transition model - Economic Outcomes

	HH wealth	HH Capital Income	HH Cap Inc non zero	Claim Pension	Wealth is non zero	Work
Austria	-18.588***	-903.852	0.374***	0.362***	0.389***	0.040
Germany	-15.645***	1571.573	0.559***	0.255***	0.275**	0.292***
Sweden	-2.544**	826.364	0.895***	0.837***	0.565***	0.381***
Netherlands	-9.627***	207.197	0.860***	0.095*	0.765***	0.107*
Spain	-0.270	-200.134	-0.089**	-0.148**	0.340***	-0.085
France	-2.609***	4727.941**	0.545***	0.170***	0.785***	0.133***
Denmark	-2.904***	1102.420	0.783***	0.393***	0.537***	0.121**
Switzerland	8.773***	7421.815***	0.618***	0.605***	0.128	0.230***
Belgium	1.813**	-90.367	0.986***	-0.101*	0.590***	0.068
Up to low secondary education	-6.788***	-510.843	-0.122***	-0.184***	-0.226**	-0.116***
Associates degree or more	8.630***	2782.146**	0.120***	-0.014	0.000	0.162***
Male	1.384**	351.093	0.011	0.290***	0.109	0.089***
Male AND Up to low secondary education	0.312	-864.806	-0.030	0.308***	-0.015	0.091*
lag of age at the interview < 58	0.402***	88.756	0.008*		-0.022	
lag of age at the interview >= 58 and <73	-0.266***	-222.501*	0.004		-0.002	
lag of age at the interview >= 73	-0.259***	2.696	0.007**		-0.011	
lag of Heart disease	-2.154***	143.889	-0.077**	0.029	0.043	-0.034
lag of Stroke	-0.856	-634.227	-0.006	-0.157*	-0.031	-0.194*
lag of Cancer	0.947	-1102.859	0.057	0.025	-0.026	-0.142**
lag of Hypertension	-0.743	-561.164	-0.035	0.065*	-0.066	-0.070**
lag of Diabetes	-3.308***	-937.128	-0.123***	-0.006	-0.079	-0.037
lag of Lung disease	-2.776**	-1112.053	-0.054	-0.057	-0.167	-0.113
lag of Has exactly 1 IADL	-1.469	-722.500	-0.054	-0.070	-0.229*	-0.159
lag of Has 2 or more IADLs	3.436	-1632.884	-0.038	-0.217	-0.386**	-0.051
lag of Has exactly 1 ADL	-3.012***	-1096.935	-0.103**	-0.041	-0.078	-0.088
lag of Has exactly 2 ADLs	-2.852*	257.804	0.065	-0.028	0.148	-0.425***
lag of Has 3 or more ADLs	-5.359***	-701.565	-0.195***	-0.043	-0.089	-0.604***
lag of Orientation = 2	-9.364*	-2015.364	0.020	0.206	0.543	-0.012
lag of Orientation = 3	-3.747	18241.560*	0.043	0.199	-0.132	0.292
lag of Orientation = 4	-3.586	-2104.934	0.159	0.205	0.101	0.294
lag of Orientation = 5	-3.763	-2100.071	0.152	0.223	0.021	0.281
lag of Widowed	-4.639***	-876.106	-0.114***	0.522***	-0.233**	0.051
lag of R working for pay	1.273	3983.632**	0.101***	-0.303***	0.097	1.604***
lag of (IHT of hh wlth in 1000s if positive)/100 zero otherwise	1456.879***	119331.858***	13.931***	1.187*	18.027***	0.373
Wave 2	1.332**	-401.008	0.121***		-0.320***	
Wave 4	-3.151**	917.609	0.847***		-0.352*	
Heart problem status at age 50 (1/0)-imputed	-0.306	7321.032**	-0.037	0.090	0.015	-0.028
Stroke status at age 50 (1/0)-imputed	-3.191	-1882.810	0.022	0.277*	-0.000	0.035
Cancer status at age 50 (1/0)-imputed	-1.913	3422.472	-0.118	-0.080	0.122	0.015
High blood preasure status at age 50 (1/0)-imputed	-1.799**	1206.762	0.041	-0.037	0.018	-0.001
Diabetes status at age 50 (imputed)	-1.064	-692.349	0.022	-0.038	0.209	-0.000
Lung disease status at age 50 (1/0)-imputed	1.894	11932.051***	-0.084	0.007	0.190	-0.019
Ever Smoked at age 50 - imputed	0.177	-1.479	0.044*	0.038	0.200*	-0.011
Smoking status at age 50 (imputed)	-4.325***	1817.208*	-0.056***	0.072**	0.022	-0.056**
Single at age 50 - imputed	-5.999***	-319.826	0.002	0.048	-0.303***	0.066*
Widowed at age 50 - imputed	-3.991***	-61.606	0.005	0.631***	-0.036	0.030
Log of years between current interview and previous	3.473**	-2872.740	0.060	0.298***	0.222	-0.226***
lag of (IHT of earnings in 1000s)/100 if working,zero otherwise	73.800***				10.586**	
Costant	6.243	294.690	-1.345***	-1.082***	2.780**	-1.629***
lag of (IHT of earnings in 1000s)/100 if working zero otherwise		-58093.938	2.694***	-0.234		13.514***
lag of Non-pension wlth(hatota) not zero		-4544.417	0.099	0.070		0.153
lag of Claiming OASI		493.843	0.112***			-0.256***
Age at Average Effective Retirement Age				-0.465***		0.066*
Years before Average Effective Retirement Age				-0.301***		0.121***
Years after Average Effective Retirement Age				0.020***		-0.040***
Seasonally Adjusted Unemployment Rate						-0.008*

B.1.1 VCV

Table 27: Incoming Cohorts VC Matrix -1

	hypertension	diabetes	weight	orientation	incontinence	eurod_score	sitting	getting_up	climbing_stairs	dressing	walking	bathing	eating	getting_in	toilet	map	meal	shopping	telephone	medications	housework	money	work
hypertension	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
diabetes	0.405	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
weight	0.349	0.350	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
orientation	-0.004	0.032	-0.009	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
incontinence	0.160	0.241	0.158	-0.154	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
eurod_score	0.159	0.188	0.092	-0.127	0.258	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
sitting	0.134	0.188	0.071	-0.127	0.292	0.380	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
getting_up	0.177	0.183	0.202	-0.112	0.375	0.368	0.711	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
climbing_stairs	0.237	0.288	0.205	-0.123	0.314	0.374	0.526	0.594	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.
dressing	0.156	0.181	0.193	-0.089	0.364	0.364	0.571	0.630	0.595	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.
walking	0.145	0.171	0.033	-0.113	0.402	0.326	0.539	0.633	0.810	0.816	1.000	.	.	.	.	.	.	.	.	.	.	.	.
bathing	0.180	0.216	0.112	-0.082	0.377	0.407	0.549	0.607	0.681	0.837	0.881	1.000	.	.	.	.	.	.	.	.	.	.	.
eating	0.123	0.131	0.006	-0.116	0.389	0.344	0.485	0.549	0.624	0.746	0.866	0.784	1.000	.	.	.	.	.	.	.	.	.	.
getting_in	0.161	0.215	0.107	-0.164	0.336	0.397	0.619	0.704	0.625	0.802	0.805	0.806	0.716	1.000	.	.	.	.	.	.	.	.	.
toilet	0.152	0.156	0.100	-0.090	0.249	0.353	0.544	0.645	0.712	0.820	0.897	0.858	0.811	0.837	1.000	.	.	.	.	.	.	.	.
map	0.113	0.203	0.073	-0.206	0.334	0.340	0.410	0.398	0.482	0.484	0.601	0.542	0.587	0.465	0.582	1.000	.	.	.	.	.	.	.
meal	0.125	0.131	0.033	-0.092	0.339	0.375	0.490	0.531	0.649	0.702	0.855	0.803	0.886	0.705	0.838	0.640	1.000	.	.	.	.	.	.
shopping	0.163	0.213	0.068	-0.138	0.374	0.430	0.556	0.609	0.696	0.733	0.833	0.818	0.800	0.705	0.821	0.582	0.876	1.000	.	.	.	.	.
telephone	0.094	0.123	-0.008	-0.196	0.370	0.352	0.470	0.497	0.588	0.690	0.821	0.727	0.793	0.702	0.799	0.710	0.838	0.771	1.000	.	.	.	.
medications	0.152	0.177	0.043	-0.097	0.435	0.378	0.500	0.537	0.576	0.684	0.805	0.747	0.809	0.722	0.810	0.708	0.843	0.781	0.913	1.000	.	.	.
housework	0.146	0.220	0.121	-0.148	0.360	0.419	0.622	0.620	0.664	0.722	0.823	0.784	0.744	0.724	0.757	0.520	0.776	0.853	0.634	0.675	1.000	.	.
money	0.088	0.219	0.107	-0.213	0.328	0.396	0.350	0.384	0.504	0.548	0.693	0.593	0.680	0.553	0.609	0.705	0.750	0.654	0.778	0.772	0.589	1.000	.
work	-0.090	-0.265	-0.087	0.140	-0.225	-0.276	-0.320	-0.294	-0.447	-0.361	-0.480	-0.497	-0.419	-0.338	-0.428	-0.301	-0.480	-0.510	-0.372	-0.378	-0.492	-0.407	1.000

Table 28: Incoming Cohorts VC Matrix - 2

	hypertension	diabetes	weight	orientation	incontinence	eurod_score	sitting	getting_up	climbing_stairs	enjoyable_activities	resting_sleeping	housework	no_activity	work
hypertension	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.
diabetes	0.405	1.000	.	.	.	.	.	.	.	.	.	.	.	.
weight	0.349	0.350	1.000	.	.	.	.	.	.	.	.	.	.	.
orientation	-0.004	0.032	-0.009	1.000	.	.	.	.	.	.	.	.	.	.
incontinence	0.160	0.241	0.158	-0.154	1.000	.	.	.	.	.	.	.	.	.
eurod_score	0.159	0.188	0.092	-0.127	0.258	1.000	.	.	.	.	.	.	.	.
sitting	0.134	0.188	0.071	-0.127	0.292	0.380	1.000	.	.	.	.	.	.	.
getting_up	0.177	0.183	0.202	-0.112	0.375	0.368	0.711	1.000	.	.	.	.	.	.
climbing_stairs	0.237	0.288	0.205	-0.123	0.314	0.374	0.526	0.594	1.000	.	.	.	.	.
enjoyable_activities	0.030	0.084	0.028	-0.083	0.104	0.254	0.082	0.114	0.190	1.000	.	.	.	.
resting_sleeping	0.147	0.133	0.064	-0.099	0.227	0.726	0.328	0.318	0.277	0.174	1.000	.	.	.
housework	0.146	0.220	0.121	-0.148	0.360	0.419	0.622	0.620	0.664	0.157	0.344	1.000	.	.
no_activity	0.013	0.056	0.036	-0.046	-0.076	0.120	0.043	0.066	0.191	0.199	0.035	0.115	1.000	.
work	-0.090	-0.265	-0.087	0.140	-0.225	-0.276	-0.320	-0.294	-0.447	-0.132	-0.189	-0.492	-0.158	1.000

B.2 Crude rates

Table 29: Crude rates by program - Male

	Belgium			Austria			Spain	Germany		France	
Year	APA	INAMI	BEL	AT1	AT2	AT3		Before 2017	After 2017	AMAD	APA
2007	4.112	4.057	2.627	13.907	13.907	12.643	11.457	9.810	10.678	4.154	11.295
2009	3.733	2.859	2.003	12.831	10.859	9.559	10.960	12.089	9.001	4.254	10.637
2011	4.520	3.033	1.847	13.110	11.043	9.452	9.622	10.653	6.587	4.680	9.385
2013	5.440	3.330	2.262	13.758	11.374	9.911	9.399	10.614	6.010	4.527	9.170
2015	6.291	3.981	2.463	14.819	12.215	10.582	9.521	11.094	6.253	4.867	9.433
2017	7.123	4.361	3.015	14.819	12.501	10.758	9.383	11.801	6.456	4.974	9.110
2019	7.340	4.672	3.047	13.978	11.747	10.296	9.667	12.736	7.017	5.254	9.300
2021	7.204	4.589	3.083	14.845	12.321	10.796	9.554	13.574	7.787	5.132	9.571
2023	6.972	4.514	3.001	15.266	12.699	10.995	9.784	14.253	8.186	5.301	9.478
2025	6.762	4.275	2.921	15.686	13.085	11.227	9.463	14.694	8.726	4.891	9.408
2027	6.551	4.319	2.799	16.008	13.250	11.357	9.301	14.680	8.619	5.000	9.173
2029	6.481	4.191	2.785	15.958	13.204	11.456	8.898	14.146	8.400	5.208	9.017
2031	6.827	4.237	2.913	16.427	13.564	11.937	8.696	14.196	8.369	5.120	9.590
2033	7.078	4.433	2.819	16.163	13.772	12.229	8.348	13.173	8.015	5.466	9.773
2035	7.729	4.863	3.372	16.903	14.078	12.419	8.216	13.131	7.867	5.519	10.122
2037	8.363	5.229	3.625	18.000	15.090	13.186	8.311	13.351	7.845	5.294	10.228
2039	8.918	5.479	3.907	18.580	15.871	13.924	8.424	14.106	8.077	5.534	10.755
2041	9.166	5.746	3.986	18.922	15.989	13.862	8.396	14.839	8.755	5.579	10.973
2043	9.737	6.048	3.965	19.728	16.864	14.964	8.759	16.076	9.592	5.894	11.632
2045	9.877	6.298	4.233	20.687	17.551	15.577	9.217	17.178	10.193	5.961	11.836
2047	10.713	6.653	4.624	21.521	18.566	16.306	9.933	18.113	10.858	5.831	12.232
2049	10.979	6.814	4.820	22.570	19.286	17.372	10.314	19.062	11.670	6.142	12.190
2051	11.218	7.125	4.964	23.350	20.088	18.088	10.997	19.782	12.154	6.277	11.930

Table 30: Crude rates by program - Female

		Belgium			Austria		Spain	Germany		France	
Year	APA	INAMI	BEL	AT1	AT2	AT3		Before 2017	After 2017	AMAD	APA
2007	8.769	5.933	8.263	16.474	13.504	13.429	14.614	15.601	13.258	8.762	15.184
2009	10.986	7.297	7.562	21.955	19.053	17.275	17.848	17.345	13.886	7.709	15.752
2011	10.256	6.910	6.679	21.650	18.630	17.029	16.389	17.786	13.555	7.587	16.074
2013	10.351	6.983	6.827	22.806	19.912	18.227	16.001	18.145	13.980	7.395	16.266
2015	11.054	7.305	7.102	23.866	20.824	19.203	15.730	19.263	14.867	7.309	16.062
2017	11.782	7.690	7.532	24.114	21.251	19.516	16.364	19.639	14.906	7.099	14.958
2019	12.505	8.131	8.064	24.624	21.695	19.994	16.953	19.825	15.352	6.413	15.505
2021	12.428	8.214	8.147	24.085	21.078	19.374	16.616	20.071	15.229	6.374	14.876
2023	12.261	8.143	8.101	23.647	20.665	18.710	16.380	20.318	15.498	6.003	14.793
2025	12.247	7.977	8.037	24.218	21.109	19.257	16.134	20.319	15.634	6.155	14.102
2027	11.847	7.919	7.818	24.547	21.429	19.490	15.552	20.112	15.347	6.222	14.051
2029	11.758	7.935	8.029	24.481	21.500	19.743	15.828	19.938	15.382	6.182	13.818
2031	12.007	7.861	8.070	24.363	21.385	19.564	15.514	19.666	14.972	6.284	13.837
2033	11.891	7.990	7.862	24.546	21.544	19.533	15.126	18.710	14.493	6.386	14.171
2035	12.100	8.142	8.124	24.778	21.949	20.414	15.019	18.942	14.517	6.794	14.366
2037	12.592	8.254	8.429	24.446	21.505	19.822	15.266	19.440	14.803	6.893	15.047
2039	13.006	8.572	8.663	25.252	22.307	20.559	15.042	20.452	15.345	7.034	15.566
2041	13.399	8.828	8.839	26.296	23.134	21.377	15.397	21.661	16.468	7.319	15.902
2043	13.952	9.210	9.133	27.594	24.338	22.432	15.547	22.757	17.220	7.053	16.803
2045	14.510	9.608	9.539	28.797	25.588	23.469	15.976	24.727	18.798	7.102	16.875
2047	15.239	9.919	9.898	29.450	26.220	24.300	16.359	25.720	19.954	7.002	17.534
2049	15.751	10.426	10.133	30.295	27.053	25.169	16.995	26.678	20.597	7.161	17.325
2051	16.236	10.629	10.496	31.294	28.170	26.270	18.227	27.309	21.249	7.170	17.220

Table 31: Crude rates by program - Aged 85 or more

	Belgium			Austria			Spain	Germany		France	
Year	APA	INAMI	BEL	AT1	AT2	AT3		Before 2017	After 2017	AMAD	APA
2007	22.776	13.858	18.729	36.203	28.518	28.518	38.067	47.072	42.363	17.101	36.002
2009	29.218	20.543	19.539	48.914	44.293	40.964	45.911	57.310	46.329	15.255	42.482
2011	32.374	21.548	18.724	59.730	55.078	51.815	45.894	56.301	43.052	15.304	42.364
2013	34.635	22.331	19.996	62.993	58.587	55.510	48.182	56.812	42.371	14.794	44.995
2015	38.807	24.523	21.355	65.873	61.324	58.483	48.673	57.428	42.778	15.969	46.500
2017	41.072	25.501	23.070	66.894	62.360	59.539	50.607	58.751	42.898	16.790	45.541
2019	43.491	27.722	24.366	69.592	65.304	62.339	52.165	59.380	44.317	15.254	46.865
2021	43.836	28.364	25.281	70.501	66.452	63.395	52.427	58.413	43.338	15.109	47.876
2023	45.243	29.088	26.137	69.050	64.706	61.983	54.349	56.850	42.187	14.826	47.615
2025	45.881	29.122	26.699	68.759	65.104	61.980	54.910	56.385	41.521	14.971	48.626
2027	46.625	30.840	27.224	68.549	63.762	60.967	55.586	57.185	42.055	15.095	49.470
2029	47.200	31.284	27.810	66.471	61.692	58.804	56.477	59.258	43.729	14.585	48.947
2031	46.496	29.757	27.344	68.840	64.720	61.903	57.049	61.755	45.877	13.921	47.874
2033	43.155	28.415	24.849	70.547	66.141	63.304	55.601	62.265	46.820	14.406	45.199
2035	43.767	28.457	25.912	72.061	68.003	65.735	55.723	61.144	46.327	14.772	44.569
2037	45.117	28.812	26.249	71.068	67.334	64.817	56.048	59.942	44.298	14.740	44.044
2039	45.610	29.346	26.295	68.949	65.145	62.305	55.851	58.017	42.897	15.484	45.561
2041	45.609	29.361	26.489	70.125	66.284	63.421	54.670	58.015	42.603	15.295	45.134
2043	44.854	28.911	25.116	72.515	68.607	66.225	55.241	58.628	43.160	14.484	46.533
2045	44.639	29.179	25.698	73.022	69.006	66.744	55.302	60.851	44.927	14.776	46.224
2047	46.456	29.836	26.652	71.950	68.162	65.617	55.649	60.944	45.300	14.248	47.511
2049	47.348	30.461	26.958	72.741	68.704	66.410	55.589	61.556	46.120	14.553	46.994
2051	47.979	31.032	27.481	72.961	69.285	66.924	56.579	62.273	46.906	14.735	46.297

B.3 Fixing the eligibility rules

Figure 7: Eligibility rates - Varying population and fixed rule (Belgium)

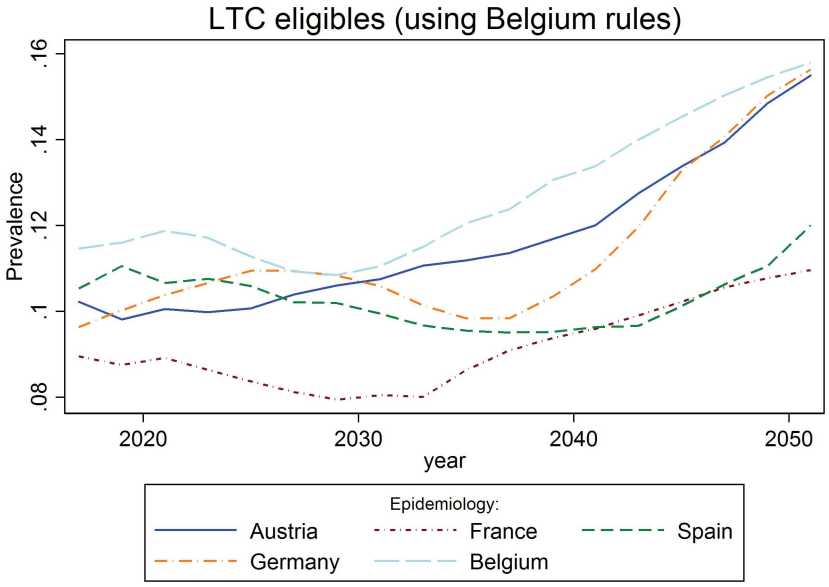


Figure 8: Eligibility rates - Varying population and fixed rule (Germany)

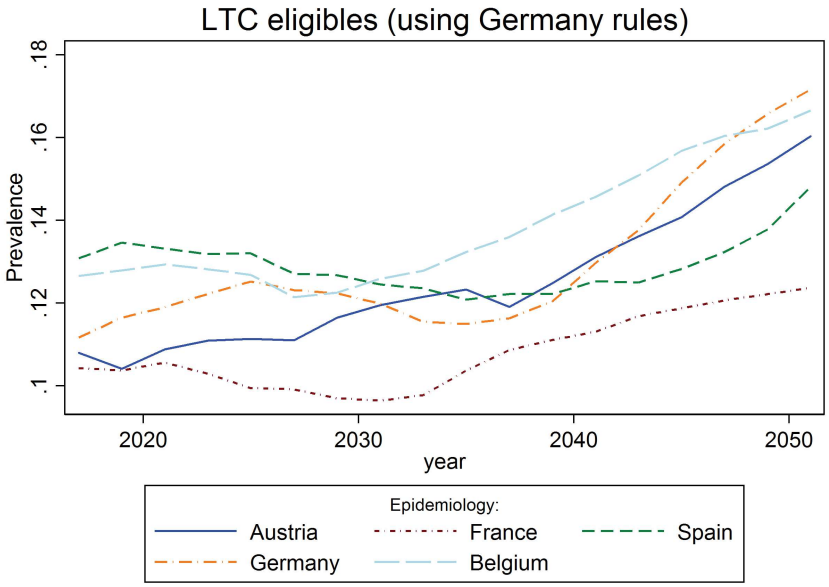


Figure 9: Eligibility rates - Varying population and fixed rule (Spain)

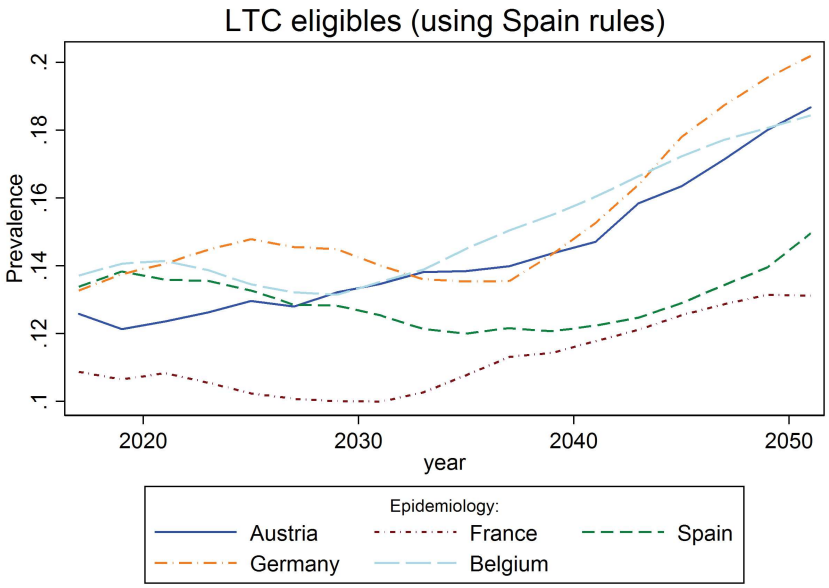
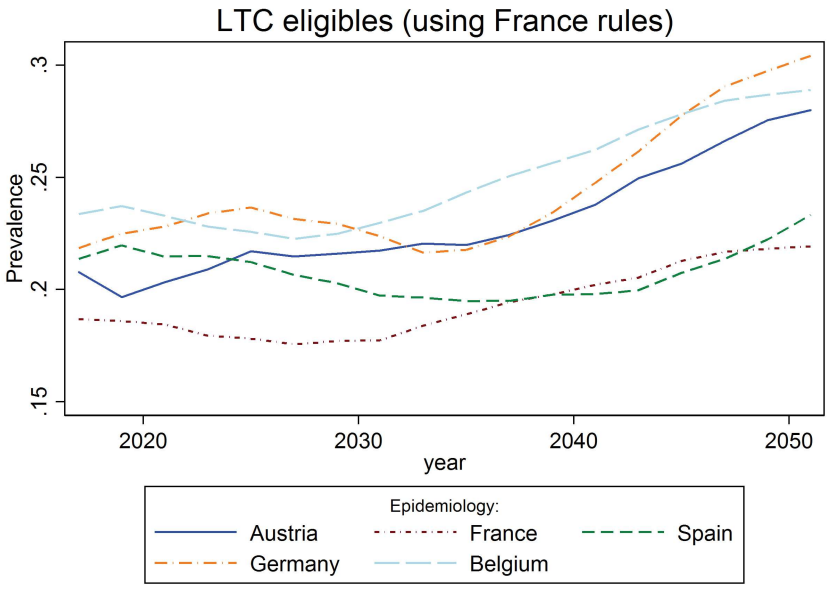


Figure 10: Eligibility rates - Varying population and fixed rule (France)



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