

Demand of Long-Term Care and benefit eligibility across European countries

Ludovico Carrino^a, Cristina Elisa Orso^a, Giacomo Pasini^{a,b,1}

^a: Economics Department, Ca' Foscari University of Venice. Cannaregio 873, Fondamenta S.Giobbe, 30121 Venezia – Italy

^b: NETSPAR, Networks for Studies on Pensions, Aging and Retirement. Tilburg, the Netherlands

Abstract:

In order to design effective policies of formal elderly-care, it is crucial to understand how elderly individuals adjust their informal Long Term Care (LTC) utilization to changes in the provision of formal-care. Empirical evidence is scant, due to the lack of credible instruments to account for the endogeneity of formal-care. We propose a novel instrument, an index that captures individuals' eligibility status for the LTC programmes implemented in their own region. Our estimates, which are robust to a number of different specifications, point to the existence of a substantial unmet demand of care among the elderly.

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¹ Corresponding author. Email giacomo.pasini@unive.it; phone: (+39) 041 2349171, fax: (+39) 041 2349176. Emails of coauthors: Ludovico Carrino ludovico@unive.it; Cristina Elisa Orso cristina.orso@unive.it

1. INTRODUCTION

The demand of care by elderly Europeans is growing rapidly due to an unprecedented demographic transition fuelled by declining mortality and fertility rates. In order to design effective forms of social protection for the vulnerable elderly, it is crucial to understand how the targeted population might adjust the amount of care provided informally by relatives and friends (informal care) as a response to changes in the amount of care provided by public institutions (formal care). If total demand for care is satisfied, an increase in formal-assistance would reduce the burden of care on informal caregivers and the overall care-utilization would remain almost constant. Vice versa, economic theory predicts that if the amount of care provided formally and informally does not satisfy the total demand by the vulnerable elderly, increasing public provision may induce to increase informal care ([Stabile et al., 2006](#)).

Formal and informal care utilization are likely to be simultaneously determined. This implies the need of a source of exogenous variation of formal care in order to identify a causal effect on informal care. So far, most of the applied studies focused on the opposite direction of causality, i.e., the effect that a modification in the informal-care provision (usually, by children only) reflects in formal-care utilization ([Bolin et al., 2008](#); [Bonsang, 2009](#); [Van Houtven and Norton, 2004](#)). In this paper, we tackle directly the natural direction of causality: we exploit the variation in the way each country assesses elderly' vulnerability conditions and determines access to publicly provided home-care programmes to identify the causal relation between formal and informal care. Compared to the previous research, our approach has three main advantages: first, it does not rely on formal care price changes, allowing us to interpret results within the relevant theoretical literature. Second, using a new legislation-based index, we have an exogenous instrument with respect to individual decisions regarding informal care utilization. Third, identification relies on cross country, but also individual variation of the index arising from different health conditions across subjects and different eligibility assessments of the same health conditions across public LTC programmes.

We use comparative micro data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) and construct a dichotomous individual-specific variable that identifies elderly individuals who are eligible for public programmes (in-kind or in-cash) of formal home-care, based on individual health characteristics and on the respondents' own country and/or regional regulations. By introducing this eligibility indicator, we show that increasing formal home-care utilization by elderly adults positively and significantly affects informal home-care provision from family and friends. Interestingly, while formal-care proves to be endogenous with respect to the aggregate supply of assistance by respondents' children, relatives, friends and neighbours, this is not the case when the informal-care is narrowed to the assistance supplied by children only. This confirms the relevance of accounting for the interplays between all the informal care providers, as recently stressed by ([Kalwij et al., 2014](#)).

The paper is organised as follows. We first discuss the relationship between the formal and the informal provision of care and the identification strategy grounded in a novel instrumental variable based on eligibility frameworks in Europe. We then present the SHARE dataset and the variables that will be used in the empirical analysis as well as descriptive evidence on our instrument and on the population eligible for LTC (section 3).

Section 4 describes the two-part model adopted as main specification. Next, we present our results in section 5. Several robustness checks are performed in Section 6, while the last section offers some conclusions.

2. SIMULTANEITY OF FORMAL AND INFORMAL CARE

The OECD acknowledges that protecting the right to a life in dignity of frail older people is becoming a major policy challenge ([OECD \(2013\)](#), Foreword), and defines Long-Term Care (LTC) as a range of services required by persons with a reduced degree of functional capacity, either physical or cognitive, and who are consequently dependent for an extended period of time on help with basic activities of daily living (ADL). This personal care component is frequently provided in combination with help with basic medical services such as nursing care (help with wound dressing, pain management, medication, health monitoring), as well as prevention, rehabilitation or palliative care services. Long-term care services can also be combined with lower-level care related to domestic help or less demanding tasks. LTC can be provided at the recipient's own dwelling (*home-based care / domiciliary care*) rather than in nursing homes or residential care-facilities (*residential- / institutional care*).

It is common to differentiate LTC providers according to their (lack of) formalization, i.e., a contract or an official agreement between the care receiver and the caregiver. Indeed, *formal-care* includes all care services that are provided in the context of formal regulations, such as through contracted services, mostly by trained care workers, that can be paid out of pocket or through reimbursement by public (or, less often, by private) institutions. What characterizes formal care-provision is its acknowledgment by the Social or Health departments at the proper governmental level. *Informal-care* is, conversely, a term that refers to the unpaid assistance provided by partners, adult children and other relatives, friends or neighbours who hold a significant personal relationship with the care recipient.

Most of the empirical work has focused on how a change in the informal-care utilization can affect the probability and/or the intensity of receiving formal-care. [Van Houtven and Norton \(2004\)](#) modelled a family decision-making process where altruistic children choose the optimal provision of informal care to provide to their parents who, in turn, decide the optimal quantity of care to receive from formal-providers². [Kalwij et al. \(2014\)](#) adapted the model to allow for multiple caregiving sources (relatives, friends and neighbours, besides children). [Bonsang \(2009\)](#) conceptually disentangled formal-care in a skilled (personal/nursing care) and in a relatively unskilled part (domestic-help), arguing that the latter would have a higher degree of substitutability to informal care than the former. Typical findings are that informal home care substitutes for total – skilled and unskilled – formal home-care ([Bolin et al., 2008](#); [Van Houtven and Norton, 2004](#)). The substitution effect is stronger when recipient's vulnerability level is low, while a positive relationship exists for higher levels of

² As pointed out in the literature, the provision of informal-care could be also the result of a strategic game involving future bequests. Although this motivation is excluded in the models hereby mentioned, the hypothesis of pure altruism is hardly believable (see [Alessie et al. \(2014\)](#)). Nevertheless, no evidence has been provided for pure exchange-driven behaviour, either.

disability ([Bonsang, 2009](#)). A positive, though negligible, relation is also found restricting the analysis to skilled formal-care ([Balía and Brau, 2013](#); [Bonsang, 2009](#))

There are only a few examples in the literature looking at the causal effect of a change in the availability of formal care on the demand of informal care. [Stabile et al. \(2006\)](#) developed a model of household decision-making where care receivers and caregivers select the amount of formal and informal care in order to achieve the optimal level of health for the care receiver. Formal care can be bought from private providers (M2, at a price P), or from public sources (M1, at a unitary cost P-S, where S is subsidy). Publicly provided formal care is rationed: each individual can consume up to a maximum amount m . The household maximizes utility under a budget constraint (labour earnings can be allocated between expenditures in formal care and other consumption goods) and a time allocation constraint (time is divided between leisure, work and care-giving activities). Private and public formal care are assumed to be equally productive in care-provision and normal inputs in the care receiver health production function. The model delivers clear empirical implications for policy changes affecting the quantity of publicly provided care m holding prices constant (i.e., holding P , S and the market wage constant). If the household exhausts all the publicly provided care ($M1 = m$) and additionally buys private care ($M2 > 0$) ($M = m + M2$), then increasing m will increase the household non-wage income (the fraction of subsidized formal care increases), leading to an increase of informal care giving. If, conversely, the household consumes public-care at its limit ($M1 = m$), but does not purchase private-care ($M2 = 0$), increasing the generosity of the public home care programme will lead to a reduction of informal care provision.

The model implications are then tested estimating a demand equation for informal care:

$$(2.1) \quad TIHC_i = \gamma_0 + \gamma_1' HS_i + \gamma_2' CV + \gamma_3 FHC + \varepsilon_i$$

where $TIHC$ is the total amount of informal home-care, FHC is the total amount of formal home-care, HS is a set of health-variables and CV is a set of socio-economic control. $TIHC$ and FHC are both choice variables and are simultaneously determined: FHC need to be instrumented in order to obtain consistent estimates of the γ_k parameters.

The authors resort to data from Canada to validate the model, and use three macro-level exogenous variables as instruments for generosity of the public home care programme: the share of the population aged 65 and older in each province over time; the level of provincial spending on education in each province over time; and the provincial tax rate as a share of federal taxes in each province over time. [Golberstein et al. \(2009\)](#) rise doubts on the empirical analysis proposed by [Stabile et al. \(2006\)](#) in terms of data limitations (unavailability of data on amount of informal-care in Canada) and potential endogeneity of the public-care generosity measure, given the possibility that if there were fewer informal caregivers per province there might be pressure to expand publicly funded home care. Kim and Lim (2015) provides evidence on the short-run impact of government subsidies of long-term care (formal home and facility care) by applying a regression discontinuity design on administrative data from South Korea. They exploit the national assessment-of-need regulation to assign benefits, which is based on an assessment score made up of the sum of two components: a preliminary score and committee points. Long-term care benefits vary at different cutoffs of this score, allowing them to distinguish the impact of home and institutional care benefits. Their findings suggest that formal long-term care is a substitute for informal care only at the intensive margin. [Goltz and Arnault \(2014\)](#) estimate a bivariate-Tobit model and study whether or

not incentives to use more formal home care would relieve informal caregivers in France, on a sample of 1687 singles aged 60+, excluding all completely autonomous people. In order to build an instrument for weekly-hours of formal home-care by district, questionnaires were sent to each French Council District to obtain information about formal home-care prices. The authors use the answers to build a district-level variable related to average out-of-pocket expenses (of individuals) for formal-home care. Their results show that the burden of informal care would decrease if the elderly dependents were faced with lower formal home-care prices. Thus, subsidies reducing formal home-care prices would relieve informal caregivers. [Balía and Brau \(2013\)](#) elaborate on the difficulty of finding good instruments for formal-care utilisation. They propose a latent factor model that aims at correcting the endogeneity bias through the empirical specification without the need for an instrument. They also propose two individual variables (included in the SHARE data adopted in the study) as candidates for instruments, related to the occurrence of having foregone care because of excessive cost or unavailability. Unfortunately, the frequency of the responses to such questions in SHARE is quite low, and this, paired with the fact that the sample selection chosen by the authors limits the analysis to 1375 single individuals in 9 different European countries, constitutes a threat to the external validity of the results.

We follow a different approach, exploiting individual-specific information on eligibility status to local public programmes of home-based care. The estimation of causal effects through empirical strategies where the eligibility status is introduced to solve the endogeneity of the variable of interest has been presented in the economic literature (see, for instance, [Battistin et al. \(2009\)](#) and [Kim and Lim \(2015\)](#)) but not, to the best of our knowledge, in long-term care empirical applications, due to the substantial heterogeneity and – often – fragmentation of regulations. Using individual eligibility status with respect to local public programmes, we build an index with sufficient variability to avoid the well-known weak instrument problems of policy evaluations based on discrete policy variations affecting specific subgroups of a population. Moreover, the identification does not rely on matching estimation methods and is therefore applicable to any sampled population, strengthening its external validity.

Access to formal long-term home-care is by and large not discretionary for older adults in Europe. As discussed in [Carrino and Orso \(2014\)](#), every main public LTC programme across countries or regions performs an assessment-of-need in order to build a “vulnerability profile” of the elder applicant. Eligibility status is then determined by comparing the profile with a definition of “minimum objective vulnerability status”, set by eligibility rules in the legislation (this holds true also for the main private LTC insurance policies, which often borrow their eligibility criteria from public regulations). Relevant heterogeneity exists among countries (and even within countries, when multiple nationwide programmes are implemented) on the very issue of defining vulnerability. Even when restricting the perspective to a comprehensive set of functional (mostly ADL and iADL tasks) and cognitive limitations, it appears that there is almost no regulation that includes them altogether in the assessment-process. Moreover, health-outcomes are often unevenly weighted within an assessment-scale: some limitations are given more importance than others in determining eligibility, and there is legislation that characterizes some deficits as necessary and/or sufficient for eligibility. As a consequence, an individual with a given medical profile may well result eligible for LTC services under one legislative definition while being ineligible under others.

We construct an individual-specific dichotomous variable for eligibility status, which takes value 1 if the individual fulfils the minimum requirements of at least one LTC programme implemented in the region/country of residency (i.e., he/she is *eligible* for LTC home-care services) and 0 otherwise. It represents a non-linear combination of a set of health-status variables, which are based on regional or national long-term care regulations. This dummy variable will be used to instrument our potential endogenous regressors (annual hours of formal home-care utilization).

It is important to notice that we restrict the analysis to countries (and programmes within countries) where eligibility regulations are *carer-blind*, i.e., eligibility is need-tested (through validation of ADL- iADL- and cognitive limitations), while no role is played by other factors like informal-care availability, quality of family or neighbourhood environment, social-network of the patient ([Eleftheriades and Wittenberg, 2013](#)). Monetary resources are sometimes taken into account to determine the monetary amount of the benefits, but they do not have discriminatory power to define eligibility.

3. DATA, DESCRIPTIVE EVIDENCE AND SAMPLE SELECTION

We use data from the first and the second wave of SHARE (Survey on Health, Ageing and Retirement in Europe), a European multidisciplinary survey on individuals aged 50 or older and on their spouses. Data was collected in 2004 and 2006, and the original sample consists of 63,948 observations from 13 European countries, plus Israel. The design of SHARE is based on the Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA). We refer to [Börsch-Supan et al. \(2005\)](#) and [Börsch-Supan and Jürges \(2005\)](#) for a detailed review of the survey, its methodological details and the sampling procedures.

SHARE data is particularly useful to investigate individual choices on health-care utilization. The survey provides detailed information about respondents' morbidity and disability status, based on self-reports of objective limitations and health conditions. In particular, it contains a set of questions that allow us to build, for each individual, a simplified medical-profile comparable with the LTC regulations of the countries in our sample (see the Appendix for further details). Respondents are asked to report their dependency status in performing fourteen activities of daily living³, which conform to the ADL and iADL taxonomies by [Katz et al. \(1970\)](#) and [Lawton and Brody \(1969\)](#). Furthermore, the survey includes ten specific questions on *mobility limitations*⁴. All

³ These are: (i) dressing, including putting on shoes and socks; (ii) walking across a room; (iii) bathing or showering; (iv) eating, such as cutting up one's food; (v) getting in and out of bed; (vi) using the toilet, including getting up and down; (vii) using a map to determine how to get around in a strange place; (viii) preparing a hot meal; (ix) shopping or buying groceries; (x) making telephone calls; (xi) taking medicines, following medical prescriptions; (xii) doing work around the house or garden; and (xiii) managing money, such as paying bills and keeping track of expenses. An additional question covers the dependency over incontinence, or the involuntary loss of urine.

⁴ The tasks covered are: (i) walking 100 meters; (ii) sitting for about two hours; (iii) getting up from a chair after sitting for long periods; (iv) climbing several flights of stairs without resting; (v) climbing one flight of stairs without resting; (vi) stooping, kneeling, or crouching; (vii) reaching or extending your arms above shoulder level; (viii) pulling or pushing large objects like a living room chair; (ix) lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries 10; (x) picking up a small coin from a table.

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 sets of variables. First, the questionnaire assesses a set of 12 mood and behaviour-related conditions (pessimism, depressed mood, suicidal thoughts, guilt, trouble sleeping, loss of interest, irritability, fatigue, inability to concentrate, lack of appetite, incapacity of enjoyment, tearfulness), that are then summarized in the EURO-D scale ([Prince et al., 1999](#)), 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 ([Colombo et al., 2011](#)). Secondly, four questions on mental orientation and coherence ask respondents to report the current date, month, year and day of week; the number of correct answers is summarized in a generated variable (*orientation*) whose values range from 0 to 4 (the higher the better oriented). We choose to label as impaired (*orientation impairment*) those respondents who gave zero or one correct answer, following the approach suggested by [Verbeek-Oudijk et al. \(2014\)](#).

As for Long-term care (LTC) services, SHARE encompasses both formal and informal assistance performed at the patient's own dwelling. As regards formal home care, respondents are asked to report whether they made use of any of these three care-services in the last twelve months because of health problems. We limit our analysis to the skilled formal-care (*personal/nursing care*), which is the most demanding type of help and which is commonly regulated, through reimbursements or direct provision, by public health-care or social policy departments. In fact, domestic help may include some tasks not directly related to health care (like cooking, laundry, cleaning the house), usually performed by private domestic workers to seniors not in need of care. SHARE collects information about the number of weeks (per year) and the average number of hours (per week) of personal/nursing help care received, from which we build a continuous variable for the average annual number of hours of formal care received. Meals on wheels are measured in weeks of service per year: given the difficulties in aggregating the two types of formal care and its limited diffusion, we decided not to include it in the analysis.

Informal care is defined as unpaid help received from outside the household from any relative, friend or neighbour. Recipients indicate the nature of the relationship with the caregivers⁵, the frequency (daily, weekly, monthly or annual) and the average number of hours received. In this paper, we introduce two distinct classifications of informal care. The first (broad definition) concerns home assistance received from outside the household by children, relatives, friends and neighbours ([Kalwij et al., 2014](#)). The second (narrow definition) regards informal assistance provided by children, grandchildren and children-in-law. Consistently with the formal care definition, we build two continuous variables for the average annual hours of informal care received.⁶

⁵ A maximum of three caregivers can be named.

⁶ We follow [Bolin et al. \(2008\)](#) in the way we map SHARE questions about intensity of care into average annual hours.

The survey also includes information on chronic conditions and symptoms that the individual may suffer from,⁷ subjective well-being and life satisfaction as well as on other forms of health-care utilization (e.g., visiting the GPs or the dentist) and health-related behaviour (e.g., smoking, drinking, doing physical activities). Labour-market variables and economic variables are collected, e.g., details on current and past occupations, job opportunities in retirement age, sources and composition of income and wealth, as well as consumption and saving choices. Further socio-economic characteristics include education (both the ISCED classification – see [OECD \(1999\)](#) – and the number of years of completed education), involvement in social activities, as well as information on respondents' children.

Due to the high level of heterogeneity in defining eligibility criteria, among the European countries that have carer-blind home care programmes, we focus our attention on Austria, Belgium -Flanders, Wallonia and Brussels- Germany and France, whose public LTC regulations clearly identify a minimum level of need corresponding to a condition of “objective dependency” that entitles individuals to receive a public home-care service. Specific details on these LTC frameworks are included in the appendix. However, the main LTC programmes in Czech Republic, Spain and some Italian regions currently feature clearly cut assessment of need methods and carer blind eligibility rules. We excluded them from the analysis because their regulations were introduced after 2006 and information on formal care are not available in more recent waves of the SHARE survey.

Table 3-1 summarizes some descriptive statistics of our sample, which consists of non-institutionalised individuals aged 60 and older, having children, but not living with them (we use the same sample selection as in [Balía and Brau \(2013\)](#), [Bonsang \(2009\)](#), [Kalwij et al. \(2014\)](#)). SHARE does not include quantitative information about the assistance provided by any caregivers (spouse, children) from within the household. It is therefore hard to distinguish the way and the type of transfers that take place within a family in terms of informal care. The average sample age is 70.5 years old, with the 25-th percentile at 64 years old, the median age at 69 and the 75-th percentile at 75. The population aged 80+ accounts for 13.2% of the sample. Females account for 55.4% of the whole population, while retired individuals and homemakers are, respectively, 80% and 13%. A typical individual has 9.7 years of completed education and 2.4 children. As far as the health-conditions are concerned, on average 19.6% of the population have lost at least one iADL while 16.8% have at least one loss in ADL. Regarding mental limitations, the typical individual in the whole sample suffers from 2.3 mood- and behaviour-related conditions of the EURO-D scale, while 2.4% of the sample is labelled as cognitively impaired. Around 9.5% of the sample receive formal nursing/personal home-care, while almost 18.5% receive informal-care from

⁷ The chronic conditions should have previously been diagnosed to the respondent by a doctor. They include: (i) heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure; (ii) high blood pressure or hypertension; (iii) high blood cholesterol; (iv) stroke or cerebral vascular disease; (v) diabetes or high blood sugar; (vi) chronic lung disease such as chronic bronchitis or emphysema; (vii) asthma; (viii) arthritis, including osteoarthritis, or rheumatism; (ix) osteoporosis; (x) cancer or malignant tumor, including leukaemia or lymphoma, but excluding minor skin cancers; (xi) stomach or duodenal ulcer, peptic ulcer; (xii) Parkinson disease; (xiii) cataracts; (xiv) hip fracture or femoral fracture. Other reported symptoms (if they were present for the 6 months before the interview) include: (i) pain in the back, knees, hips or any other joint; (ii) heart trouble or angina, chest pain during exercise; (iii) breathlessness, difficulty breathing; (iv) persistent cough; (v) swollen legs; (vi) sleeping problems; (vii) falling down; (viii) fear of falling down; (ix) dizziness, faints or blackouts; (x) stomach or intestine problems, including constipation, air, diarrhea.

outside the household, by at least one provider among children, relatives, friends or neighbours. Assistance from children is an important share of the total informal-care provision: 14% of the sample receive assistance from their offspring. Statistics on formal- and informal-care utilization confirm previous findings (see, e.g., [Kalwij et al. \(2014\)](#)): the total number of hours of formal care is than the total hours of informal care (accounting both for incidence and hours of care). Moreover, the provision of formal-care increases with age among couples, and is generally higher for singles. Among those who receive informal assistance from children, 32% report having two and 11% report having three informal home-care providers. We also notice significant differences across European countries, both in terms of care-utilization incidence and of the number of annual hours received.

Table 3-1, Descriptive statistics

	Whole sample	Austria	Germany	France	Belgium Flanders	Belgium Wallonia
Observations	9342	1235	2746	2486	1961	915
Receiving formal personal/nursing care	9.5 %	3.6%	3%	16.5%	10.6%	15.4%
Receiving informal care from any provider	18.5%	20.6%	21.2%	14.4%	17.9%	19.9%
Receiving informal care from children	13.9%	15.7%	16.1%	10.8%	13.6%	13.9%
Annual hours formal personal/nursing home-care	9.6	19	7.3	7.6	10.9	6.1
Annual hours informal care (any provider)	77	80	90	68	78	57
Annual hours informal care from children	57	63	72	48	52	37
Age	70.5	70.1	69.6	71.2	70.7	71
Aged 80+	13.2%	11.6%	10%	16.6%	13.3%	15%
Females	55.4%	60.3%	51.6%	58.3%	53.9%	55.4%
Retired	79.9%	81.3%	79.2%	84.2%	74.6%	75.4%
Homemaker	13.1%	14.5%	9.7%	10.2%	19.5%	18%
Years of education	9.7	7.8	13	7.6	9.1	9.6

Number of children	2.4	2.29	2.22	2.469	2.509	2.56
Fraction of daughters	50.4%	50.3%	52.1%	49.6%	49.5%	49.6%
At least 1 ADL lost	16.8%	14.4%	13.9%	17.6%	16.3%	25.8%
At least 1 iADL lost	19.6%	20%	15.1%	21.3%	19%	28.3%
At least 1 ADL & 1 iADL lost	10%	9%	8%	10.6%	9.7%	16.1%
At least 2 ADL lost	6.3%	5.7%	6.2%	7.1%	6.6%	9.8%
# chronic conditions (out of 14)	1.8	1.57	1.76	1.86	1.76	2.19
# mobility deficits (out of 10)	1.7	1.77	1.75	1.81	1.49	2.24
Orientation impaired	2.4%	1%	2.4%	3.4%	2.3%	1.8%
EURO-D score	2.3	2	1.9	2.8	2	2.8
Bad subjective health	38.3%	32.5%	44.3%	42.1%	28.9%	38.2%

Data from SHARE waves 1&2 for Austria, Belgium, France, Germany. Sample selection: individuals older than 60, with children (no co-residence), not institutionalized.

3.1 THE ELIGIBLE POPULATION

The eligible population is determined on the basis of the rules adopted by LTC regulations to assess the degree of vulnerability of individuals and, consequently, to determine who is entitled to receive public home care services. Our aim is to implement countries' eligibility rules for public LTC programmes on our SHARE sample (details on the correspondence between SHARE and the LTC legislations are reported in Appendix) in order to obtain an exogenous eligibility indicator.

A comprehensive list of the health conditions included (to various extents) in each assessment scale includes ADL, iADL, additional mobility limitations, cognitive limitations, behavioural/depression status, as summarized in Table 3-2, summary of LTC assessment-of-need scales. Among the ADL set, we split the ambulation item in the "moving" and the "transferring" tasks (the latter being originally present in the ADL list), since they are often assessed separately in actual LTC regulations. Albeit the original ADL and iADL taxonomies, two additional categories are included, which are "behavioural / cognitive impairment" and "hygiene for post-surgery conditions or advanced medications". The former concerns patient's depression, mental stability and coherence, (coherence and mental impairment are included – to various extents – in a conspicuous number of regulations); the latter refers to those patients who have difficulties in performing advanced medications ("advanced" with respect to taking pills or following medical prescriptions) like enemas or maintenance of tubes/bags resulting from surgical operations. Furthermore, additional mobility limitations are included, such as crouching and walking down stairs.

Table 3-2, summary of LTC assessment-of-need scales

ADL	Non ADL
Bathing & hygiene ✓	Communication ✓
Dressing ✓	Shopping for groceries/medicines ✓
Using the toilet ✓	Cooking ✓
Transferring ✓	Housekeeping ✓
Continence ✓	Doing laundry ✓

Feeding ✓	Moving outdoor ✓
<u>Moving indoor</u> ✓	Responsibility for own medications ✓
<u>Hygiene for post-surgery conditions or advanced medications</u> ✘	Behavioral/Cognitive impairment ✓
	Other mobility limitations ✓

✓ = information available in SHARE; ✘ = information missing from SHARE
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.

In the SHARE micro-data, respondents provide self-reported information about the occurrence of each of these health-conditions. For a generic individual i living in country J , it is therefore possible to build a medical profile $\pi_{i,J}$.

We can define an “eligibility function” $f_{\tilde{J}} : \Pi \rightarrow \{0,1\}$, such that $f_{\tilde{J}}(\pi_{i,J}) = \begin{cases} 1 & \text{if } \pi_{i,J} \in \tilde{J} \\ 0 & \text{if } \pi_{i,J} \notin \tilde{J} \end{cases}$

where π_i is a generic medical-profile for the individual i , whose components are the limitations as of Table 3-2; and $\tilde{J} (\subset \Pi)$ is a subset of objectively vulnerable (eligible) medical-profiles among all the possible medical-profiles (set Π), determined by the eligibility rules for the LTC programmes in country J .

The function $f_{\tilde{J}}$ determines the eligibility status of an individual i (living in country J), according to the rules of all the LTC programmes implemented in country J . In other words, this stage determines whether the i -th individual is eligible to any LTC programmes in his/her nation/region.⁸

The function f is a highly non-linear combinations of health-indicators included both in the assessment of need scales and in our dataset. An example will help to clarify the nature of the f function: the Austrian national LTC programme (Pflegegeld) assesses individuals' on fourteen dimensions (items), between ADL, iADL and cognitive limitations (see the appendix for details). The need-of-care is defined nationwide in terms of care-time (hours per month) for each dimension. The regulation defines as eligible all the medical profiles that present an overall need-of-care of at least 50 hours per month (raised to 60h since 2011), but with at least one limitation in ADL and one in iADL.

It is worth highlighting that the “eligibility” status does not necessarily identify those individuals who are actually “treated” by public programmes; 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. As argued in Section 2, our eligibility variable can be interpreted as a requirement to obtain publicly funded long-term care through the surveyed programmes, i.e., a proxy for the country-specific perspectives on

⁸ We are implicitly assuming that the laws and the guidelines are carefully followed by the medical evaluators and by the medical-board that takes the final decision on eligibility. This is, admittedly, a simplifying assumption and yet, we believe, a necessary step in order to perform a comparative analysis.

the concept of vulnerability. It therefore allows us to account for the heterogeneities in both the assessment-of-need procedures and the eligibility rules in the countries included in our sample.

Descriptive statistics on care utilization by the eligible population are reported in Table 3.3, compared with three other benchmark-samples, namely: the sample of individuals with some functional limitations (at least one ADL, iADL), the whole sample and the sample of non-eligible elderly. A comparison between the first and second column shows how the eligibility status detects a peculiar subsample of the population and does not correspond to an arbitrary selection of “dependent” individuals. Indeed, the sample of eligible individuals, built according to country- or region- specific regulations, is notably different from the one that adopts an arbitrary and fixed-for-all definition of dependency.

Table 3-3, Care utilization among sub-samples

	Eligible	Individuals with 1+ ADL, 1+ iADL	Whole sample	Non-eligible
Observations	728	2461	9352	8624
<i>% individuals receiving:</i>				
formal-care	41.4%	19.8%	8.1%	5.9%
informal care from any provider	39.7%	32.5%	18.5%	16.1%
informal care from children	34.4%	25.9%	13.9%	11.6%
<i>Average annual hours of:</i>				
formal care	100	34.7	9.6	2
informal care	356	193	77	54
informal care from children	279	148	57	38
formal care (among receivers)	268	176	116	35
informal care from any provider (among receivers)	896	577	420	324
informal care from children (among receivers)	830	555	418	321
Age	77.3	74.2	70.5	70
Number of ADL lost	2.5	1.1	0.29	0.12
Number of iADL lost	2.8	1.5	0.38	0.20
EURO-D score	4.1	3.56	2.3	2.15
Orientation impaired	25.7%	5.7%	2.4%	0.46%

Data from SHARE waves 1&2 for Austria, Belgium, France, Germany. Sample selection: individuals older than 64, with children (up to 4; no co-residence), not institutionalized.

Formal-care users are nearly 40% among eligible individuals, while their percentages are 8.1% among the whole sample and 19.8% in the sample of functionally impaired (at least 1 ADL, 1 iADL). Moreover, in the eligible population, the incidence of formal-care provision is almost equal to that of informal-care, while it is substantially lower in the other samples (e.g., 8% versus 18% in the whole sample). When looking at the intensive margin of elderly-care utilization, the eligible sample received considerably larger amounts of hours of assistance, both informal and formal. Again, the ratio between the mean annual amounts of informal and formal-care narrows among objectively vulnerable elderly (896 hours vs 268 hours), with respect to the other benchmark samples. Indeed, this ratio peaks among the non-eligible (324 hours of informal care, 35 hours of formal-care). 5.9 percent of the non-eligible population report receiving formal care, with an average number of 2 hours per year of care received in the sample (compared to 100 hours per year in the eligible sample). There are at least two reasons, besides measurement error, for observing this pattern: first, formal care, as it is asked in SHARE, includes privately paid care not provided by a public authority. Second, our eligibility index is based on national and regional home care programmes, while we do not consider home care programmes run at municipal level, the reason being that we are not able to identify the exact municipality of residence in the data due to non-disclosure policies.

4. EMPIRICAL SPECIFICATION

In this section we empirically investigate the effect of receiving formal home care on the utilization of informal care, both at the extensive margin (i.e. the probability of receiving informal care) and at the intensive margin (i.e. the hours of informal care received). Similarly to previous studies ([Bolin et al., 2008](#); [Bonsang, 2009](#); [Duan et al., 1983](#); [Van Houtven and Norton, 2004](#)), we use a two-part model, which specifies the probability of receiving care and the quantity of care received as two different processes. The two-part model allows for the separation of the individual behaviour into two stages: first, a decision concerning receiving some care and second, a decision concerning the amount of care, conditional on receiving any. This kind of model is appropriate for estimating actual outcomes (or conditional outcomes), i.e. fully-observed variables. In our case, zero values for actual formal home care indicate that zero hours of care were received. We refer to these actual zero values as corner solutions, because individuals cannot receive a negative amount of hours of care.

The first part of the two-part model is a probit that models the probability of receiving informal care. Following (2.1), we assume that the parent's utilization of informal care ($TIHC_i$), is a function of hours of formal home care (FHC_i), health-status (HS_i), and a vector of socio-demographic covariates (CV_i). The second part is a linear regression where the dependent variable is a logarithm of hours of home care received, run on the conditional sample of home care receivers. Hours of formal home care are instrumented by the eligibility indicator, thus the first part of the model is estimated by IV probit and the second by Two-stage least squares. Consistency of our estimates hinges on two assumptions: the independence between the first and second stage, typical of a two-part model, and the validity of our instrument. Following [Dow and Norton \(2003\)](#) and [Duan et al., 1983](#), the two part model is often preferred to Tobit and Heckman selection models in the health economic literature. The reason is that despite the necessity to assume independence, the two part model does not impose any constraint on the coefficients, as in a Tobit model does, and at the same time does not rely on any exclusion restriction or functional form, as in a Heckman type of model.

Exogeneity of the new instrument proposed for hours of formal care comes from its legislation-based nature: the eligibility status is determined on the basis of the assessment-of-need scales used by different country legislations to assess the degree of vulnerability of individuals and, consequently, to determine who is entitled to receive public home care services. Besides being exogenous, the instrument must be informative, i.e. it must correlate with actual formal home care received. Eligibility clearly affects the probability of receiving care since it is a prerequisite to receive formal care provided by national or regional programmes. Still, it is not simply a different proxy for receiving formal care: it does not identify who are actually "treated" by formal home care programmes. As we documented in table 2.3, the sample includes both eligible individuals that do not receive any formal care, and individuals that are not eligible for a formal home care program, but do receive it.

The identification power of the eligibility instrument comes from the variation of the eligibility regulations across countries (or regions): similar individuals (in terms of health conditions) may be eligible or not eligible for public programmes according to the assessment criteria of their country (or region) of residence. In order to be sure that our instrument does not simply capture regional differences in the generosity of health care systems, we introduce a set of country- and region- fixed effects.

Another source of variation of our instrument is at the individual level, and relies on the different health status and level of vulnerability of respondents exposed to the same formal care programmes. Again, in order to rule out the possibility that our instrument simply proxies for individual health conditions, we introduce in the model as controls all the health variables used to build the eligibility indicator. Specifically, first we include a continuous variable that takes value 1 if the respondent has been diagnosed to suffer from at least one chronic condition. Second, we control for a measure taking value 1 if the respondent reports to suffer from some long-term illness, including mental health problems. Among the measures of physical dysfunctions, we include a binary variable that captures mobility limitations, the number of limitations in ADL as well as in iADL. Moreover, we add an interaction term between mobility and ADL as a further control in order to capture the combined effect between having at least one mobility limitation and the number of ADL limitations. As regards mental cognitive limitations, we include in our analysis a dummy variable assessing mathematical skills of elderly respondents (numeracy), and a binary indicator measuring the sense of orientation in space and time (orientation). Furthermore, we introduce a continuous variable based on EURO-D scale. Finally, in order to capture other non-observed health problems, we include a binary variable based on self-perceived health of individuals.⁹ The use of self-perceived health status (SPHS) is supported by evidence that shows a strong predictive relationship between individuals' self-rating of health and morbidity (Idler and Benyamini, 1997; Kennedy et al., 1998).

As regards socio-demographic covariates CV_i , we control for years of education, country-specific wealth quintiles, household income quintiles and residential area (whether he/she lives in a big city, in the suburbs of big city, large town and small town).¹⁰

5. RESULTS

5.1 INFORMAL CARE FROM CHILDREN, RELATIVES, FRIENDS (BROAD DEFINITION)

Table 5-1 reports the marginal effects for the determinants of informal home-care from children, relatives, friends and neighbours at the extensive margin. Each part of the model is first estimated by assuming the exogeneity of the variable of interest, formal home-care, on the utilization of informal-care, and then by adopting the instrumental variable approach.

Results from the probit model suggest that formal-care utilization increases the likelihood of receiving any informal home-care (p-value <0.001). A 10% increase (decrease) in the annual hours of personal/nursing domiciliary care leads to a 0.15 percentages point increase (decrease) in the probability of receiving assistance from one's own offspring, relatives, friends or neighbours. Given that the average annual hours of personal/nursing home-care provision is 9.6 among the whole sample, and that the average probability of

⁹ It assigns value 1 if the respondent reports a bad self-perceived health status ("fair", or "poor"), measured on a five-point scale from "excellent" (score 5) to "poor" (score 1).

¹⁰ We cannot use continuous measures of wealth and income since amounts are gross in wave 1 and net after taxes in wave 2.

receiving informal-care is 18.43%, an increase of average formal domiciliary assistance by 1 hour per year would lead to an 18.6% increase in the likelihood of informal-care use with respect to the mean.

As regards the IV-probit specification, the first-stage outcome of our empirical model for the extensive margin of informal-care utilization shows that, indeed, the individual’s eligibility status for public programmes of domiciliary assistance is a strong predictor for the log-hours of received formal home-care as defined in section 3. The estimated coefficient for eligibility is positive, as expected, statistically significant at the 1% level (p-value less than 0.001). The first-stage F-statistic, which tests the null hypothesis that the instrument is not informative, reports a value of 21.02 with a p-value less than 0.001.¹¹ However, the Wald test for exogeneity of formal-care cannot be rejected ($\chi^2=1.71$, p-value = 0.25). We therefore conclude that the un-instrumented probit specification (column “probit”) is appropriate for this part of the model.

Table 5-1: Two-part model for overall informal-care from outside the household: extensive margin

Dependent variable	first stage for formal-care utilization (annual log-hours)			any informal-care from any provider			
				probit		IV probit	
	coeff.		S.E.	marg. eff.	S.E.	marg. eff.	S.E.
Log-hours FHC	-			0.015 ***	0.004	0.069	0.043
Age	0.009 ***		0.002	0.005 ***	0.001	0.005 ***	0.001
Being retired	0.026		0.024	0.005	0.010	0.004	0.010
Female	0.031		0.020	-0.012	0.009	-0.014	0.009
Living with spouse	-0.091 ***		0.028	-0.222 ***	0.010	-0.215 ***	0.011
Years of education	0.005 **		0.002	-0.001	0.001	-0.001	0.001
Having l.t. illness	0.034 *		0.018	0.016 *	0.009	0.014	0.009
Euro-D score	0.008		0.006	0.007 ***	0.002	0.006 ***	0.002
Low numeracy-score	0.026		0.027	-0.019 **	0.010	-0.021 **	0.010
Low orientation-score	-0.279 *		0.145	-0.048 *	0.026	-0.040	0.027
Any mobility deficit	-0.039 ***		0.015	0.068 ***	0.009	0.070 ***	0.010
# ADL limitations	0.043		0.092	0.060 **	0.030	0.056 *	0.031
# iADL limitations	0.172 ***		0.026	0.024 ***	0.005	0.013	0.010
Mobility*ADL	0.134		0.097	-0.072 **	0.031	-0.081 ***	0.031
# Chronic dis.	0.017 *		0.009	0.004	0.003	0.004	0.003
Bad subjective health	0.040 *		0.021	0.021 **	0.009	0.019 *	0.009
<i>Living area (w.r.to rural area)</i>							
Big city	-0.057		0.036	-0.005	0.015	-0.003	0.016
Suburbs big city	-0.001		0.031	-0.001	0.013	-0.001	0.013
Large town	-0.042		0.033	-0.010	0.013	-0.008	0.014

¹¹ We perform the Kleibergen-Paap Wald statistic (see [Kleibergen and Paap \(2006\)](#)) in place of the Cragg-Donald’s one, since we adopt a heteroskedastic- and cluster- robust specification (see [Baum et al. \(2007\)](#)).

Small town	-0.005	0.026	-0.020 *	0.011	-0.021 *	0.011
Being eligible	0.492 ***	0.107				
Constant	-0.588 ***	0.163				
F-test excluded instrument	F(1, 6380)=21.02 ***					
Wald test of exogeneity	chi2(1) = 1.71					
Observations	9342	9342		9342		

Notes: formal home-care corresponds to nursing- and personal-care assistance at the patient's home. Informal home-care from outside the household by children, relatives, friends and neighbours corresponds to unpaid help with personal care, practical household tasks and paperwork.

Sample selection: individuals aged 60+ from waves 1&2 from SHARE, having children but not living with them.

Standard errors are robust to heteroskedasticity and clustered at the individual level.

Years of education based on ISCED codes.

**** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1*

The second part of the model – the intensive margin – is the equation for the yearly log-hours of informal-care received from any informal provider (conditional to receiving any), and is estimated both through OLS (assuming exogeneity of formal home-care use) and through 2SLS (where individuals' eligibility status is adopted as instrument). Conversely to what was found in the first part, the null hypothesis of the Wu-Hausman test for exogeneity of formal-care is now significantly rejected (F-stat= 4.90, p-value = 0.027), thus indicating that decisions about hours of formal assistance (conditional of receiving any) are endogenously determined with respect to the informal-care decision. The 2SLS specification is therefore the preferred specification. The first-stage of the 2SLS reports an F-statistics of 6.7 for the excluded instrument (dummy variable for eligibility status), which is strongly significant (p-value of 0.009).

Table 5-2, Two-part model for overall informal-care from outside the household: intensive margin

Dependent variable	first stage for formal-care utilization (annual log-hours)		annual log-hours of informal home-care from any provider, among receivers			
			OLS		2SLS	
	coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.
Log-hours FHC	-		0.059 ***	0.023	0.599 *	0.331
Age	0.141 ***	0.004	0.018 ***	0.005	0.010	0.007
Being retired	0.073	0.083	-0.121	0.081	-0.168 *	0.095
Female	0.001	0.076	0.070	0.080	0.076	0.091
Living with spouse	-0.126	0.082	-0.048	0.090	0.025	0.107
Years of education	0.024 *	0.009	-0.019 *	0.011	-0.031 **	0.014
Having 1.t. Illness	0.009	0.066	0.072	0.078	0.069	0.084
Euro-D score	0.031 *	0.017	0.030 *	0.016	0.012	0.022
Low numeracy-score	0.062	0.087	0.112	0.074	0.085	0.088
Low orientation-score	-0.256	0.279	0.484 ***	0.179	0.575 **	0.234
Any mobility deficit	-0.103 *	0.057	0.042	0.086	0.102	0.097
# ADL limitations	0.251	0.229	0.102	0.211	-0.040	0.282
# iADL limitations	0.194 ***	0.047	0.210 ***	0.033	0.086	0.086
Mobility*ADL	0.047	0.236	-0.068	0.212	-0.132	0.274
# Chronic dis.	0.015	0.026	-0.049 **	0.024	-0.059 **	0.027
Bad subjective health	0.001	0.068	0.144 *	0.076	0.139 *	0.081
<i>Living area (w.r.to rural area)</i>						
Big city	-0.226 **	0.112	-0.215 *	0.122	-0.100	0.150
Suburbs big city	-0.093	0.111	-0.025	0.107	0.027	0.125
Large town	-0.093	0.111	0.043	0.106	0.088	0.125
Small town	0.008	0.093	-0.070	0.086	-0.076	0.097
Being eligible	0.505 ***	0.195				
F-test excluded instrument	F(1,1468)=6.68***					
Wu-Hausman exogeneity test	F(1,1468) = 4.9016**					
Observations	1721		1721		1721	

Additional controls include dummies for country-, income-, wealth-, wave- effects.

Notes: formal home-care corresponds to nursing- and personal-care assistance at the patient's home. Informal home-care from outside the household by children, relatives, friends and neighbours corresponds to unpaid help with personal care, practical household tasks and paperwork.

Sample selection: individuals aged 60+ from waves 1&2 from SHARE, having children but not living with them.

Standard errors are robust to heteroskedasticity and clustered at the individual level.

Years of education based on ISCED codes.

*** p-value<0.01, ** p-value <0.05, * p-value <0.1

2SLS estimates for yearly log-hours of formal home-care (Table 5-2) confirm the lack of crowding out of informal- by the formal-care. Indeed, results suggest that an increase of 1% in the intensity of formal-care provision leads to an increase of 0.59% in the intensity of informal-care, among those who receive informal assistance. The positive effect is substantial, and it is better appreciated when computing the cross-elasticity between the two sources of care, evaluated at averages (420 yearly hours of informal-care, 30 hours of formal-care, both conditional to receiving informal-care from any provider). An increase of 1 hour per year in the formal-care provision leads to an increase of 8.26 hours in the overall informal-care from outside the household. According to [Stabile et al. \(2006\)](#), this result points to the existence of an unmet demand for public long term care services satisfied resorting to the private market: households exhaust all the available public formal care and given their budget and time constraints determine hours of informal care. Given that total demand of care is not satisfied, they resort to formal care bought on the market. An increase in public, subsidized formal care keeping input prices fixed (i.e., without changing market price for formal care, the unitary subsidy nor market wages) allows to substitute formal care paid out of pocket at price P with publicly provided subsidized formal care paid $P-S$, therefore reducing the average price for formal care. This substitution has the same effect as an increase in non-wage income: if total formal care and informal care giving time are normal goods, they will both increase at the new equilibrium.

As regards other covariates, being older significantly increases both the likelihood of receiving informal care from outside the household and the number of hours of care received. At the extensive margin, the dummy capturing the presence of a spouse in the household is characterized by a significant negative marginal coefficient, in line with the literature underlining the importance of informal assistance from the spouse (see, e.g., [Kalwij et al. \(2014\)](#) and [Motel-Klingebiel et al. \(2005\)](#)). The number of years spent in education is significantly negatively related to informal-care utilization at the intensive margin.¹² This effect (elsewhere found, e.g., in [Bonsang \(2009\)](#)), could depend either on cultural factors, or on the fact that higher educated individuals might tend to have weaker family ties ([Kalmijn, 2006](#)).

Individuals' medical conditions are important determinants of the informal-care provision at the extensive margin. In particular, results show significant positive effects for both functional limitations (limitations in ADL, iADL, or other mobility deficits) and disease-specific conditions (long-term illnesses). A similar effect appears for the Euro-D score, the "numeracy" and "orientation" dummies, as well as for subjective health. The interaction term between the dummy for mobility limitations and the number of ADL deficits takes a significant and negative value, suggesting that for those that have mobility limitations the marginal effect of a further loss in ADL is a lower than for less limited individuals.

Among those who already receive care, cognitive impairment, chronic conditions and bad subjective health still play a significant role in determining informal-care utilisation. Conversely, most of the coefficients for functional health-limitations (ADL, iADL, mobility) lose significance: increase in ADL or occurrence of mobility limitations do not have significant effects on the amount of care received. This result, which is in line

¹² We tried a modified specification with ISCED levels 0,1,2 and 3,4 and 5,6 being grouped together, respectively. The results hereby reported are confirmed, with a significant negative coefficient for the *low* education category.

with [Bonsang \(2009\)](#) suggests that informal care-giving is not going to fully intervene when vulnerability conditions reach levels that require a higher skilled care. Categorical variables for respondents' income and wealth were not significant. Additional controls include dummies for country and for waves.

5.2 INFORMAL CARE FROM CHILDREN (NARROW DEFINITION)

Our research question relies on identification of the effect of a variation in the provision of formal-care on the care-provision of the other sources of care (informal help from children, relatives, friends and neighbours). In order to offer comparable results with recent literature that mostly focused on informal-care from children¹³, we now adopt a narrower definition of informal-care, limiting our focus to the domiciliary assistance provided by respondent's offspring from outside the household. Table 5-3 reports the coefficients for the determinants of informal home-care from children, both at the extensive and at the intensive margin. As before, each part of the model is first estimated by assuming exogeneity of the variable of interest, formal home-care, on the utilization of informal-care, and then by adopting the instrumental variable approach.

At the extensive margin, results are similar to those found in the previous paragraph. The Wald test for exogeneity of formal-care in the first part of the model cannot be rejected ($\chi^2=0.63$, p-value = 0.42), and we therefore turn our attention on the simple probit specification (column "probit"). This result finds a correspondence in the paper by [Bonsang \(2009\)](#), who analyses the other direction of causality (i.e., the role of informal-care in determining formal-care utilization) using data from SHARE and a similar sample selection and finds that exogeneity of informal home-care from children on nursing/personal home-care cannot be rejected. Results from the probit model suggest that formal-care utilization increases the likelihood of receiving any informal home-care from children (p-value <0.001). A 10% increase in the annual hours of personal/nursing domiciliary care leads to a 0.09% point increase in the probability of receiving assistance from one's own offspring. Given that the average annual hours of personal/nursing home-care provision is 9.6 among the whole sample, and that the average probability of receiving informal-care from children is 13.8%, an increase of average formal domiciliary assistance by 1 hours per year would lead to a 13.9% increase in the likelihood of informal-care use with respect to the mean.

The second part of the model – the intensive margin – is the equation for the yearly log-hours of informal-care received from children (conditional to receiving any) and it is estimated both through OLS and through 2SLS. In this specification, the null hypothesis of the Wu-Hausman test for exogeneity of formal-care cannot be rejected (F-test=6.73, p-value = 0.30), thus indicating the OLS specification as the preferred specification. This results

¹³ This is also due to the fact that most literature treats informal-care as endogenous determinant of formal-care (the opposite direction of causality with respect to ours). Characteristics of respondents' offspring, usually included in health-surveys, have been found to be good instruments for the part of informal-care coming from children. Conversely, it is difficult to adopt plausible strong instruments for help by relatives, friends and neighbours, whose contributions as caregivers are, therefore, not included in the "informal-care" variable.

contrasts with the findings in Section 5.1, when the dependent variable included all the possible sources of informal care and where endogeneity was detected.¹⁴

OLS estimates for yearly log-hours of formal home-care confirm the lack of crowding out of informal- by formal-care: an increase of 1% in the intensity of formal-care provision leads to an increase of 0.064% in the intensity of informal-care from children, among recipients. At sample averages (418 yearly hours of informal-care, 37 hours of formal-care), an increase of 60 minutes per year in the formal-care provision leads to an increase of 43 minutes in the informal-care assistance from children living outside the household.

Table 5-3, Two-part model of informal home-care provision from children-only

Dependent variable	any informal-care from children				annual log-hours of informal home-care received from children, among receivers			
	Probit		IV probit		OLS		2SLS	
	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.
Log-hours FHC	0.009 ***	0.003	0.034	0.033	0.064 ***	0.023	0.390	0.269
F-test excluded instrument	F(1,6380)=21.02***				F(1,1101)=6.73***			
Wald test of exogeneity	chi2(1) = 0.63				-			
Wu-Hausman test of exogeneity	-				F(1,1101) = 2.029			
Observations	9334		9334		1283		1283	
Adjusted R ²	0.234				0.296		0.249	

Additional controls include dummies for country-, income-, wealth-, wave- effects.

Notes: formal home-care corresponds to nursing- and personal-care assistance at the patient's home. Informal home-care from children corresponds to unpaid help with personal care, practical household tasks and paperwork

Sample selection: individuals aged 60+ from waves 1&2 from SHARE, having children but not living with them.

Standard errors are robust to heteroskedasticity and clustered at the individual level.

Years of education based on ISCED codes.

**** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1*

Effects of covariates such as age, education, spousal support and health-conditions are consistent with the findings of the previous paragraph. Categorical variables for respondents' income and wealth were not significant. Additional controls include dummies for country and for waves.

Our findings, thus, highlight that there is no statistical evidence of endogeneity at the intensive margin, while the observed use of formal-care turns to be endogenous at the extensive margin only when the contributions of multiple informal providers are included in the analysis. The economic interpretation of this result is that conditional on receiving formal care, individuals simultaneously determine how many hours of formal and informal care to use they need to cover the total demand for care. Then, given the total number of hours of

¹⁴ Because of the reduced sample-size, the first-stage of the 2SLS reports a lower F-statistics for the excluded instrument (eligibility) of 7.1 and still strongly significant (p-value of 0.008). Results are available upon request.

informal care needed, households allocate them to the different potential informal care providers: [Kalwij et al. \(2014\)](#) show that the informal sources of care are substitute between each other. In order to test whether this result depends on the specific sample selection we choose, in the next section we will repeat the analysis under a number of different sample selections. Under the broad definition of informal care, exogeneity is rejected not only at the extensive margin, as in the baseline results discussed above, but also at the intensive margin for some alternative specifications. Vice versa, endogeneity is never detected when the dependent variable is narrowed to the assistance supplied by children only.

6. ROBUSTNESS

Our main specification includes both couples and single-living individuals (not living with their children). We account for the role of spousal support, for which we do not have quantitative information in SHARE, through a dummy variable that capture the presence of a spouse in the household (as in, e.g., [Bonsang \(2009\)](#), [Kalwij et al. \(2014\)](#), [Bakx et al. \(2014\)](#)). Other studies using SHARE proposed to restrict the focus to the single-only subsample, in order to avoid potential underestimation of informal caregivers ([Balía and Brau, 2013](#); [Bolin et al., 2008](#)). As a robustness, we replicate our model on the latter specification. The reduced dimensionality causes a drop in the performance of our instrument's relevance ($F(1, 1781) = 8.8$), although it remains strongly statistically significant (at 1%). The positive and significant marginal effect of formal or informal care is confirmed both at the extensive margin (where endogeneity is rejected) and at the intensive margin (where endogeneity is detected).

Table 6.1, Two-part model for the population of single-only

Dependent variable	any informal-care from children, relatives, friends				annual log-hours of informal home-care from children, relatives, friends (among receivers)			
	Probit		IV probit		OLS		2SLS	
	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.
Log-hours FHC	0.023 **	0.009	0.112	0.088	0.066 ***	0.025	0.794 *	0.433
Testing the null of formal-care exogeneity	chi2(1) = 0.90				F(1,880) = 7.889**			
First-stage weak-instrument test	F(1, 1781) = 8.8***				F(1, 880) = 5**			
Observations	2570		2570		1062		1062	

Standard errors are robust to heteroskedasticity and clustered at the individual level.

Notes: formal home-care corresponds to nursing- and personal-care assistance at the patient's home. Informal home-care from outside the household by children, relatives, friends and neighbours corresponds to unpaid help with personal care, practical household tasks and paperwork.

Sample selection: individuals aged 60+ from waves 1&2 from SHARE, having children but not living with them.

Standard errors are robust to heteroskedasticity and clustered at the individual level.

Years of education based on ISCED codes.

*** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1

Besides spouses, cohabiting children may also provide help and the way intergenerational households are treated in the estimation sample may affect the results. Our baseline specification excludes all the individuals living with at least one of their offspring, since SHARE data does not allow us to quantify the amount of care provided by household members. Following [Bonsang \(2009\)](#), we replicate our analysis by including in the sample selection all those individuals having at least one child living outside the household (thus not ruling out living arrangements that see children living with their parents). Co-residence is accounted for with a dummy indicating whether any of respondent’s children live in the same household. Results from this specification entirely confirm the positive relationship between formal and informal home-care previously reported. Endogeneity is detected at both hurdles of the two-part model.

Table 6.2, Two-part model for the population aged 60+, including households with cohabiting children.

Dependent variable	any informal-care from children, relatives, friends				annual log-hours of informal home-care from children, relatives, friends (among receivers)			
	Probit		IV probit		OLS		2SLS	
	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.
Log-hours FHC	0.013 ***	0.003	0.083 *	0.043	0.067 ***	0.021	0.593 *	0.325
Testing the null of formal-care exogeneity	chi2(1) = 2.78*				F(1,1578) = 4.80**			
First-stage weak-instrument test	F(1,6897) = 20.9***				F(1, 1578) = 6.56**			
Observations	10221		10221		1855		1855	

Standard errors are robust to heteroskedasticity and clustered at the individual level

Sample selection: individuals over 60 from waves 1&2 from SHARE, having children. At least one child lives outside the household.

*Health controls include: having long-term illnesses, Euro-D score, having cognitive limitations, having mobility limitations, # ADL limitations, # iADL limitations, interaction mobility*ADL limitations, # chronic diseases.*

Additional controls include: age, gender, marital status, education (years), country-, housing location-, income-, wealth-, wave- dummies.

Next, we test different age-selections proposed in the literature. Our main specification includes individuals aged 60 or older. We repeat the exercise for the population over 55 ([de Meijer et al., 2011](#)), 65 ([Bonsang, 2009](#)) and 70 ([Van Houtven and Norton, 2004](#)). Our instrument remains strongly relevant and all findings are confirmed. The results are available upon request. Furthermore, in order to rule out the possibility that the lack of crowding-out of informal-care by formal-care is driven by the oldest-old population, we repeat our analysis on the subsample of individuals aged 80+ (1232 observations). In this subsample, the eligible population is 23.3%; the incidence of formal home-care utilization is 21.2%. The eligibility variable is still a good instrument for annual hours of formal home-care (the weak-instrument test returns an F-statistic of 11.6 and 9.5 at the extensive and intensive margin, respectively), and it allows us to implement our two-part model of informal-care utilization. Both at the extensive and at the intensive margin the positive relation between formal and informal care is confirmed, though we find no statistical evidence of endogeneity. Still, in this case the reduced sample size may lead to a lack of power of the Hausman test.

Table 6.3, Two-part model for the oldest old (80+) population

Dependent variable	any informal-care from children, relatives, friends				annual log-hours of informal home-care from children, relatives, friends (among receivers)			
	Probit		IV probit		OLS		2SLS	
	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.	marg. coeff.	S.E.
Log-hours FHC	0.017 *	0.010	0.085	0.064	0.042	0.030	0.281	0.194
Testing the null of formal-care exogeneity	chi2(1) = 1				F(1,429) = 1.79			
First-stage weak-instrument test	F(1, 929) = 11.6***				F(1, 429) = 9.56***			
Observations	1232		1232		521		521	

Standard errors are robust to heteroskedasticity and clustered at the individual level

Sample selection: individuals over 80 from waves 1&2 from SHARE, having children but not living with them.

*Health controls include: having long-term illnesses, Euro-D score, having cognitive limitations, having mobility limitations, # ADL limitations, # iADL limitations, interaction mobility*ADL limitations, # chronic diseases.*

Additional controls include: age, gender, marital status, education (years), country-, housing location-, income-, wealth-, wave- dummies.

Next, we ran our model separately for wave 1 (4846 observations) and wave 2 (4499 observations) and fully confirm the results of a positive relationship between formal and informal care utilization (available upon request). As regards the econometric specification, results from a tobit and an IV tobit specification, available upon request, are in line with the two-part model not only in terms of sign and significance of the marginal effects, but also of magnitude: the implied elasticity of informal to formal care is very similar. Finally, as explained in Section 3, we built our dependent variable for annual hours of informal-care based on categorical questions concerning how often and for how many hours informal-care were received in the twelve months previous to the interview following the procedure proposed by (Bolin et al., 2008). This mechanism of building a continuous variable from an ordinal variable could raise some doubts on the accuracy of our adopted measure of informal-care. We then perform an ordered-probit analysis in place of the linear specification in the second part of our two-part model. Results confirm the results of the baseline model.

In our main empirical specification, we included information on several health outcomes as independent variables that could explain, alongside the individual eligibility status, the utilization of formal and informal care. In particular, our model imposes a linear relationship between the receipt of informal care (and of formal care, in the first-stage equation) and the number of ADL and iADL limitations. It is important to notice that different types of ADL and iADL limitations might have different effects on the health of the individuals (which drives the demand of both formal and informal care) and that the LTC regulations put different weights on specific ADL, iADL, cognitive/behavioural deficits. For such reasons we performed a robustness check on our instrument's validity by changing the way in which the health information enter the model.

At first, we implemented a specification where, instead of the number of ADL and iADL, a dummy for each limitation is considered. Indeed, such methodology turned out to be highly data demanding: the results are

confirmed at the extensive margin, while at the intensive margin the sample size is too small to obtain precise estimates. The second alternative specification follows a methodology frequently adopted in the recent literature, which consists in generating, at the individual level, a disability index that would substitute for the entire set of health information ([Kapteyn and Meijer, 2013](#); [Poterba et al., 2013](#)). In particular, we replicate the strategy introduced by [Bonsang \(2009\)](#), who follows Bound et al. (1999) by using objective health variables available in SHARE to predict self-reported measure of functional limitation. Adopting this disability index the results are strongly confirmed.

Table 6.4: alternative health measures

Marginal coefficients for yearly log-hours of formal home-care								
Dep. Variable:	Probit	IV probit	<i>F-test</i>	<i>Exogeneity</i>	OLS	2SLS	<i>F-test weak</i>	<i>Exogeneity</i>
informal care utilization	coeff	coeff	<i>weak instr.</i>	<i>Test</i>	coeff	coeff	<i>instr.</i>	<i>Test</i>
				$\chi^2(1)$				F(1,1468)
With disability index	0.01***	-0.01	110***	0.02	0.12***	0.49***	46.8***	33.1***
All health dummies	0.01***	0.06	9.21***	0.48	0.05**	0.91	1.9	4.25

*** *p-value* < 0.01, ** *p-value* < 0.05, * *p-value* < 0.1

The next robustness check regards the selected countries in our study. We chose four out of eleven SHARE countries participating in the first two waves of SHARE because all those countries have career-blind policies, with clear enough guidelines to be translated into an eligibility index without further assumptions needed by the researcher. Still, Austria LTC regulations (at 2004, 2006) was rather unclear on the boundaries to the discretionary use of the allowance and no clear obligation to pay for care or to use care services was identifiable. As highlighted in [Carrino and Orso \(2014\)](#), Austrian patients have a high degree of freedom in the use of the benefit for financing their formal-care services, although the allowance can be converted into an in-kind benefit in case of improper use of the money. After excluding Austria (1235 observations), the results are in general confirmed.

The last robustness check regards the external validity of our results: given that we cannot extend our result to other countries or broader samples, we decided to replicate the analysis of [Bonsang \(2009\)](#), where the author uses wave 1 SHARE data and looks at the opposite causal relation. Indeed, he estimates a two-part model to study the causal effect of informal care on formal care, using an instrumental variables approach (fraction of daughters in the household as instrument for informal care). We replicate his analysis on our sample, and obtain very similar results. The estimates for these last sets of robustness checks are available upon request.

7. CONCLUSIONS

This paper investigates the effects of a change in the formal home-care provision on the informal-care by children, relatives, friends and neighbours among elderly adults in Europe. We use data from SHARE wave 1 and wave 2, for Austria, Belgium, France and Germany. We concentrate on home-based services, as in Europe

they are now prioritized by policy makers with respect to residential/institutional care. This causal relationship has been less studied in the economic literature compared to the opposite one, due to the lack of an instrument to address the potential endogeneity of formal-care. We propose a novel instrumental variable approach that accounts for the role of national/regional eligibility rules to home LTC programmes. Our instrument is an individual-level dichotomous variable, which indicates whether the individual is eligible to receive public LTC benefits (in-kind or in-cash) and which is based on binding regulations at respondents' national or regional level. Adopting a two-part model for informal-care utilization, we show that an increase in formal-care use (nursing/personal assistance) among elderly Europeans has a positive and significant effect on the informal-care provided by family and friends. This result, which can be interpreted along the lines of the theoretical framework proposed by [Stabile et al. \(2006\)](#), points to the existence of an unmet residual demand for long-term care, as a result of an insufficient supply of public LTC. This shows that further social-protection is needed to address the LTC risk, both with public and private forms, enhancing the accessibility, affordability and effectiveness of care programmes.

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BIBLIOGRAPHY

- Alessie R, Angelini V, Pasini G. Is It True Love? Altruism Versus Exchange in Time and Money Transfers. *De Economist* 2014;162; 193-213. doi:10.1007/s10645-013-9221-5.
- Baker M, Stabile M, Deri C. What do self-reported, objective, measures of health measure? *Journal of Human Resources* 2004;39; 1067-1093. doi: 10.2307/3559039.
- Bakx P, Meijer C, Schut F, Doorslaer E. Going formal or informal, who cares? The influence of public long-term care insurance. *Health economics* 2014. doi: 10.1002/hec.3050.
- Balia S, Brau R. A country for old men? Long-term home care utilization in europe. *Health economics* 2013. doi: 10.1002/hec.2977.
- Battistin E, Brugiavini A, Rettore E, Weber G. The retirement consumption puzzle: evidence from a regression discontinuity approach. *The American Economic Review* 2009;99; 2209-2226. doi: 10.1257/aer.99.5.2209.
- Baum CF, Schaffer ME, Stillman S. ivreg2: Stata module for extended instrumental variables/2SLS, GMM and AC/HAC, LIML and k-class regression. 2007.
- BMASK. 2013. Ein : Blick 5. Pflege. Orientierungshilfe Zum Thema Behinderungen. (Ed)^(Eds). Bundesministerium für Arbeit, Soziales und Konsumentenschutz: Wien; 2013.
- Bolin K, Lindgren B, Lundborg P. Informal and formal care among single-living elderly in Europe. *Health economics* 2008;17; 393-409. doi: 10.1002/hec.1275.
- Bonsang E. Does informal care from children to their elderly parents substitute for formal care in Europe? *Journal of health economics* 2009;28; 143-154. doi:10.1016/j.jhealeco.2008.09.002.
- Börsch-Supan A, Brugiavini A, Jürges H, Mackenbach J, Siegrist J, Weber G. Health, ageing and retirement in Europe: first results from the Survey of Health, Ageing and Retirement in Europes. Mannheim Research Institute for the Economics of Aging (MEA) Mannheim; 2005.
- Börsch-Supan A, Jürges H. The Survey of Health, Ageing and Retirement in Europe—Methodology. MEA Eigenverlag, Mannheim. SHARE Codebook 2005;8.
- Bound J. Self-Reported Versus Objective Measures of Health in Retirement Models. *Journal of Human Resources* 1991; 106-138. doi: 10.2307/145718.
- Carrino L, Orso CE. Eligibility and inclusiveness of Long-Term Care Institutional frameworks in Europe: a cross-country comparison. Working Paper Series, Ca' Foscari University of Venice, 28/2014 2014.
- Chan KS, Kasper JD, Brandt J, Pezzin LE. Measurement Equivalence in ADL and IADL Difficulty Across International Surveys of Aging: Findings From the HRS, SHARE, and ELSA. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 2012;67B; 121-132. doi: 10.1093/geronb/gbr133.
- Colombo F, Llena-Nozal A, Mercier J, Tjadens F. OECD Health Policy Studies Help Wanted? Providing and Paying for Long-Term Care: Providing and Paying for Long-Term Cares. OECD Publishing; 2011. doi: 10.1787/9789264097759-en.
- de Meijer C, Koopmanschap M, d'Uva TB, van Doorslaer E. Determinants of long-term care spending: Age, time to death or disability? *Journal of Health Economics* 2011;30; 425-438. doi:10.1016/j.jhealeco.2010.12.010.
- Dewey ME, Prince MJ. 2005. Mental Health. In: Börsch-Supan A, Jürges H (Ed)^(Eds), Health, Ageing and Retirement in Europe - First Results from the Survey of Health, Ageing and Retirement in Europe, vol. SHARE Codebook 8. MEA Eigenverlag: Mannheim; 2005.
- Dow WH, Norton EC. Choosing between and interpreting the Heckit and two-part models for corner solutions. *Health Services and Outcomes Research Methodology* 2003;4; 5-18. doi:10.1023/A:1025827426320.
- Duan N, Manning WG, Morris CN, Newhouse JP. A comparison of alternative models for the demand for medical care. *Journal of business & economic statistics* 1983;1; 115-126. doi: 10.2307/1391852
- Dupourqué E, Schoonveld S, Bushey JB. AGGIR, the Work of Grids. *Long-term Care News* 2012;32.
- Dwyer DS, Mitchell OS. Health problems as determinants of retirement: Are self-rated measures endogenous? *Journal of health economics* 1999;18; 173-193. doi: 10.3386/w6503.
- Eleftheriades C, Wittenberg R. 2013. A critical review of international practice on assessment and eligibility in adult social care: Lessons for England. (Ed)^(Eds). Centre for Health Service Economics & Organisation (CHSEO): Oxford; 2013.
- Golberstein E, Grabowski DC, Langa KM, Chernew ME. Effect of Medicare home health care payment on informal care. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing* 2009;46; 58-71.

Goltz A, Arnault L. 2014. Can formal home care reduce the burden of informal care for elderly dependents? Evidence from France. (Ed)^(Eds). Paris Dauphine University; 2014.

Kalmijn M. Educational inequality and family relationships: Influences on contact and proximity. *European sociological review* 2006;22; 1-16. doi: 10.1093/esr/jci036.

Kalwij A, Pasini G, Wu M. Home care for the elderly: the role of relatives, friends and neighbors. *Review of Economics of the Household* 2014;12; 379-404. doi: 10.1007/s11150-012-9159-4.

Kapteyn A, Meijer E. 2013. A Comparison of Different Measures of Health and their Relation to Labor Force Transitions at Older Ages. (Ed)^(Eds), *Discoveries in the Economics of Aging*. University of Chicago Press; 2013.

Katz S, Downs TD, Cash HR, Grotz RC. Progress in development of the index of ADL. *The gerontologist* 1970;10; 20-30. doi: 10.1093/geront/10.1_Part_1.20.

Kleibergen F, Paap R. Generalized reduced rank tests using the singular value decomposition. *Journal of Econometrics* 2006;133; 97-126. doi:10.1016/j.jeconom.2005.02.011.

LaPlante MP. The classic measure of disability in activities of daily living is biased by age but an expanded IADL/ADL measure is not. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 2010;65; 720-732. doi: 10.1093/geronb/gbp129.

Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *The Gerontologist* 1969;9.

Motel-Klingebiel A, Tesch-Roemer C, Von Kondratowitz H-J. Welfare states do not crowd out the family: evidence for mixed responsibility from comparative analyses. *Ageing and Society* 2005;25; 863-882. doi: 10.1017/S0144686X05003971.

OECD. *Classifying educational programmes: Manual for ISCED-97 implementation in OECD countries*. OECD; 1999.

OECD. *A Good Life in Old Age?*s. OECD Publishing; 2013. doi: 10.1787/9789264194564-en.

Paaßen G. 2012. *Pflegereform 2012*. (Ed)^(Eds). *Pflegestufe.info*: Essen; 2012.

Poterba JM, Venti SF, Wise DA. 2013. Health, education, and the post-retirement evolution of household assets. (Ed)^(Eds). *National Bureau of Economic Research*; 2013.

Prince MJ, Reischies F, Beekman A, Fuhrer R, Jonker C, Kivela S-L, Lawlor B, Lobo A, Magnusson H, Fichter M. Development of the EURO-D scale--a European, Union initiative to compare symptoms of depression in 14 European centres. *The British Journal of Psychiatry* 1999;174; 330-338. doi: 10.1192/bjp.174.4.330.

Stabile M, Laporte A, Coyte PC. Household responses to public home care programs. *Journal of health economics* 2006;25; 674-701. doi: 10.1016/j.jhealeco.2005.03.009.

Van Houtven CH, Norton EC. Informal care and health care use of older adults. *Journal of health economics* 2004;23; 1159-1180. doi:10.1016/j.jhealeco.2004.04.008.

Verbeek-Oudijk D, Woittiez I, Eggink E, Putman L. 2014. *Who cares in Europe? A comparison of long-term care for the over 50s in sixteen European countries*. . (Ed)^(Eds). *Institute for Social Research: Den Haag (NL)*; 2014.

APPENDIX: IMPLEMENTING LTC ELIGIBILITY REGULATION IN SHARE

This appendix compares each ADL and iADL assessment-of-need scale with the information from the SHARE survey. Nearly all of the tasks included in the LTC regulations have a close correspondent in SHARE, yet some adjustments had to be made, as will be 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. Our goal is to implement legal benchmarks into our micro-data in a prudent and robust fashion, in order to identify a sub-population of “eligible individuals” 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.¹⁵

AUSTRIA – Pflegegeld

What follows is a summary of the assessment-of-need for the Austrian *Pflegegeld*, together with the corresponding information from SHARE.

Table A-1, Austrian Pflegegeld and SHARE

Core / Auxiliary	Limitation	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

¹⁵ Similar concerns are expressed by [Bonsang \(2009\)](#) and [Balía and Brau \(2013\)](#). Reliability of self-reported health-conditions is investigated in [Bound \(1991\)](#), [Baker et al. \(2004\)](#), [Dwyer and Mitchell \(1999\)](#), [LaPlante \(2010\)](#). A cross-survey comparison between HRS, SHARE and ELSA is performed in [Chan et al. \(2012\)](#).

c	<i>Mobility aid in the narrow sense</i>	15	Walking across a room <i>or</i> Getting in or out of bed
a	<i>Motivational talks</i>	10	EURO-D scale
a	<i>Emptying and cleaning the toilet chair</i>	10	-
a	<i>Procuring of food and medicines</i>	10	Shopping for groceries
a	<i>Cleaning the home and personal effects</i>	10	Doing work around the house
a	<i>Care of underwear and towels</i>	10	Doing work around the house
a	<i>Heating the living space (+procuring of fuel)</i>	10	Doing work around the house
a	<i>Mobility aid in a broader sense</i>	10	Using a map to figure out how to get around in a strange place
	<i>Cognitive impairment*</i>	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*

*Since January 1st, 2009.¹⁶

The care allowance is provided to individuals who present a decline in functional status that requires at least 60 hours of need-of-care per month (it was 50 hours before 2011). 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.¹⁷ Since January 1st 2009, people with mental illnesses, dementia or severe behavioural disorders are given a fixed supplementary amount of care-time in terms of 25 hours per month.¹⁸ Since our data was collected from 2004 to 2006, we cannot compute the additional 25-hours for cognitive impaired individuals; furthermore, we adopt the minimum threshold of 50-hours threshold when simulating the eligibility rules.

BELGIUM – Flanders supplementary LTC programme *Zorgverzekering*

The *BEL-foto* assessment-of-need adopts a four-step scale for each item (from 0 to 3), where 0 corresponds to full-autonomy and 3 corresponds to impossibility to perform the specific task. Since most of the health-conditions in SHARE are reported on a binary scale (yes/no)¹⁹, 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.

Table A-2, Belgium (Flanders) *Zorgverzekering* and SHARE

<i>Limitation</i>	<i>Value</i>	<i>SHARE tasks (binary: yes / no)</i>
<i>Household ADL</i>		
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

¹⁶ [BMASK \(2013\)](#)

¹⁷ [BMASK \(2013\)](#)

¹⁸ [BMASK \(2013\)](#)

¹⁹ SHARE respondents are asked not to report difficulties that are expected to last less than three months.

Meal preparation	2 out of 3	Preparing a hot meal
Housework planning	2 out of 3	Doing work around the house
<i>Physical ADL</i>		
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)
<i>Social ADL</i>		
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
<i>Mental Health</i>		
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 behaviour	2 out of 3	EURO-D scale = 4 or higher
Disruptive behaviour	2 out of 3	EURO-D scale = 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.

We followed a strict approach in defining the Mental Health conditions related to purposeless/disruptive behaviour, lack of initiative, depressed/anxious 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 [Dewey and Prince \(2005\)](#) (having at least 4 disturbances among a set of 12²⁰) as a more objective signal of latent psychological issues. In order to be eligible, a patient should score at least 35 on the BEL-scale.

BELGIUM – APA

²⁰ The 12 disturbances are pessimism, depressed mood, suicidal thoughts, guilt, trouble sleeping, loss of interest, irritability, fatigue, inability to concentrate, lack of appetite, incapacity of enjoyment, tearfulness.

The assessment process is performed through a scale (APA scale) which depicts vulnerability as determined by six items that are evaluated on a scale from 0 (no difficulties in performing the selected item) to 3 (impossibility in performing the selected item without help from others), and the overall profile of vulnerability is constructed by summing each item's scores. We chose to assign the score of 2 whenever a respondent reports to suffer from a limitation in the corresponding SHARE task.²¹

Table A-3, Belgian APA and SHARE

<i>Limitations</i>	<i>Value</i>	<i>SHARE tasks</i>
Moving and transferring around the house	2 out of 3	Walking across a room <i>or</i> Getting in or out of bed
Preparing meals and ingesting food	2 out of 3	Preparing a hot meal <i>or</i> Eating (+cutting up your food)
Performing body-care and being able to dress	2 out of 3	Bathing/showering <i>or</i> Dressing (+ putting on shoes and socks)
Taking care of own house and performing house-tasks	2 out of 3	Doing work around the house <i>or</i> 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

The minimum level of vulnerability corresponds to a score of 7 in the APA scale: all the applicants who get an overall index of less than 7 are not eligible to the monetary allowance. The minimum age requirement is 65 years old.

BELGIUM – nursing home-care by INAMI/RIZIV

The assessment-of-need for public home help adopts 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 task arises when the need-of-care is either severe (3) or full (4). We chose to assign the score of 3 whenever a respondent reports to suffer from a limitation in the specific task.²²

Table A-4, Belgian nursing home-care programme and SHARE

<i>Criteria</i>	<i>Value</i>	<i>SHARE tasks (binary: yes / no)</i>
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 <i>or</i> Getting in or out of bed
Using the toilet	3 out of 4	Using the toilet (+ getting up or down)
Continenence	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

²¹ SHARE respondents are asked not to report difficulties that are expected to last less than three months.

²² SHARE respondents are asked not to report difficulties that are expected to last less than three months.

The minimum level of vulnerability (category A) in order to be eligible corresponds to limitations in washing and dressing *or* to being disoriented in time and space (but physically independent).

FRANCE: APA and Aide Sociale

Each variable (item) in the French 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.²³ 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.²⁴

Table A-5, French AGGIR scale and SHARE

<i>Discriminatory variables</i>	<i>description</i>	<i>assigned value</i>	<i>SHARE tasks</i>
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	2 out of 3	
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 <i>or</i> 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

The APA regulation requires individuals to be at least 60 years old in order to make an application for the allowance. Moreover, the AGGIR categorization of dependency must correspond to, at least, GIR 4. We went through a rather complex algorithm²⁵ to divide the population into 6 ISO-groups. Individuals with difficulties in - roughly - at least two ADL's are categorized in GIR 4 regardless of their mental health status. This holds whenever the limitations are reported with at least a B (or, 2) intensity-score. It should be highlighted that being limited in "moving inside the house" is not a sufficient limitation for eligibility when the only other loss-of autonomy concerns the "transferring" task. When the "moving" limitation is selected, there should be at least one further difficulty among "using the toilet", "dressing", "eating" or "washing" in order to determine GIR 4.

²³ A: The individual performs the task spontaneously, habitually, completely and correctly alone. B: The individual can perform the task alone, yet not spontaneously, and/or correctly and/or habitually and/or completely. C: The individual cannot perform, requires assistance or must have someone else's help to do the activity.

²⁴ SHARE respondents are asked not to report difficulties that are expected to last less than three months.

²⁵ Details are available at [Dupourqué et al. \(2012\)](#). A free AGGIR simulator is available at <http://www.ibou.fr/aggir/>

Regardless to other functional deficits in ADL, those who have cognitive impairment are assigned to, at least, GIR 2.

In order to be eligible for the Social Assistance to seniors (*Aide Sociale*), three conditions must be met by the applicant, as the next table highlights: a minimum age-requirement of 65 years old; the presence of limitations in activities related to personal hygiene and to small acts of daily livings such as meals preparation and shopping for groceries (GIR 5 or GIR 6 classification); not being a beneficiary of the Personalized Autonomy Allowance (APA) programme. In order to simulate eligibility for Aide Sociale, we exploit the following SHARE information: “Bathing or showering”, “Preparing a hot meal” and “shopping for groceries”. In order to perform a prudent implementation of the regulation, we exclude the SHARE task “doing work around the house or garden”, as it seems too generic with respect to the Aide Sociale rationale.

Table A-6, French Aide Sociale eligibility rules

<i>Aide sociale eligibility criteria</i>	<i>Description</i>	<i>SHARE information</i>
<i>Age</i>	At least 65 years old	Age
<i>Vulnerability</i>	Needing assistance with personal hygiene / meals preparation / shopping for groceries	Bathing or Showering / Preparing a hot meal / Shopping for groceries
<i>Non-cumulation</i>	Not receiving APA allowance	-

GERMANY – Pflegeversicherung

The assessment-of-need for the German LTC Insurance programme shares some similarities with the Austrian one, in the extent to which they are both detailed and both assign to each task a measurement of need-of-care expressed in units of time. The time guidelines are not significantly different between Germany and Austria, although the former programme adopts a measurement in minutes/day while the latter’s measurement unit is in hours/month. Nevertheless, the German regulation does not fix time-guidelines for the iADL limitations (which mostly correspond to the so-called “non-basic activities” in the scale): indeed, Table shows how some limitations have an “unspecified” time-requirement in the “need-of-care” column. The term “unspecified” refers to the fact that the need-of-care should be assessed on an individual basis by the evaluation-team. In order to be able to implement the whole German legislation on SHARE data, we chose to fill the limitations having “unspecified” requirements with the corresponding guidelines coming from the Austrian *Pflegegeld* regulation (moving inside the house, leaving and returning home, shopping, cooking, doing housework). As an example, the “cooking” task has a time-requirement of 30 hours/month (1 hour per day) in Austria, which translates into 60 minutes per day in Germany.

Table A-7, German Pflegeversicherung and SHARE

<i>Basic care</i>	<i>Limitations</i>	<i>Need-of-care (minutes per task)</i>	<i>Assumed daily need</i>	<i>SHARE tasks (binary: yes / no)</i>
✓	Washing body (upper- lower- body, hands)	20-25	40'	Bathing or showering
✓	Dental care	5	10'	Bathing or showering
✓	Combing	1-3	-	Bathing or showering
✓	Shaving	5-10	-	Bathing or showering
✓	Taking a shower	15-20	6'	Bathing or showering

✓	Bathing	20-25		
✓	Defecation and urination	8	32'	Using the toilet (+ getting up or down)
	<i>If also dependent for: mobility inside the house</i>	8+2	40'	
✓	Maintenance of urinary drainage bag / ostomy bag	2-4 each	-	-
✓	Incontinence	11	44'	Incontinence or involuntary loss of urine
✓	Bite sized food preparation	2-3		
✓	Food in-take	15-20	51'	Eating (+cutting up your food)
✓	Moving in and out of bed / changing positions	1-3 each	4'	Getting in or out of bed
✓	Dressing-undressing (upper- lower body)	Unspecified	12'	Dressing (+ putting on shoes and socks)
✓	Moving inside house	Unspecified	(30')	Walking across a room
✓	Standing (transferring)	Unspecified	-	Getting in or out of bed
✓	Climbing stairs	Unspecified	-	Climbing one flight of stairs without resting
✓	Leaving and returning to house	Unspecified	(20')	Walking across a room
✗	Shopping	Unspecified	(20')	Shopping for groceries
✗	Cooking	Unspecified	(60')	Preparing a hot meal
✗	Cleaning dwelling	Unspecified		
✗	Washing dishes,	Unspecified		
✗	Washing and ironing clothes,	Unspecified	(60')	Doing work around the house
✗	Managing the heating	Unspecified		

Guidelines in brackets are taken from the Austrian legislation

The minimum requirements of daily care-needs in order to be eligible (*Pflegestufe I*) are an overall need for 90' of help, with at least 45' attributable to basic care tasks. Following the 2012 reform, individuals affected by cognitive impairment are given access to an additional allowance, irrespective of their functional disability status (even if they are classified as *Pflegestufe 0*).²⁶ The SHARE survey contains information that allows us to identify cognitive-impaired individuals, with the generated variable "Orientation in time (day, week, month, year)". In particular, cognitive deterioration is defined as not being able to answer correctly three (or more) out of the four questions (see Section 2.3 for details on SHARE data). Since our data was collected from 2004 to 2006, we do consider the 2012 reform and therefore we do not account for cognitive impairment in defining eligibility in Germany.

²⁶ [Paaßen \(2012\)](#)