Long-Term Care Across Europe and the U.S.: The Role of Informal and Formal Care

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Large cross-country variation in long-term-care (LTC) policy in conjunction with household-level data on caregiving provides a valuable laboratory for policy analysis. However, comprehensive cross-country data on how care is provided are lacking, especially for informal care. We close this gap by drawing on data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) and the Health and Retirement Study (HRS) in the U.S. We propose solutions to overcome several challenges, which make a comprehensive analysis of LTC possible. We quantify the importance of various care sources. We find that co-residing caregivers provide two-thirds of informal-care hours – a care arrangement that has been somewhat neglected by the literature. Informal-care provision in Europe follows a steep North-South gradient, the U.S. falling in between Central-European and Southern-European countries. This gradient is among the strongest predictors of care arrangements, suggesting that policy plays a crucial role in determining care decisions.

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1 Introduction

The provision of long-term care (LTC) to disabled elderly people is a pressing policy issue. Some countries, such as Sweden and the Netherlands, already spend around 4% of GDP on LTC, and the trend is rising. There have been LTC policy reforms in several countries, e.g. Germany and Spain, and there is a lively debate in many others on how the problem of increasing care needs should be addressed. The rising female labor-force participation may well shift Southern-European countries, which have so far relied heavily on family-provided care, towards care in nursing homes. This will only intensify the debate on if and how formal caregiving should be subsidized by governments.

In general, care can be provided in different settings: informally by family members or friends (*informal care*, IC) or formally. Formal care is again sub-divided in care given by paid helpers in the elderly's home (*formal home care*, FHC) and care given in nursing homes (NH). There is evidence that countries differ widely in how much they make use of different care forms, but it is hard to come by statistics on precisely by *how much* they differ, see the literature review below. The goal of this paper is to provide a big picture of how LTC is provided across Europe and the U.S, in all of its forms.

We combine data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) with the Health and Retirement Study (HRS) from the U.S., which has a structure very similar but not identical to SHARE. We take into account all of the following: care received in nursing homes, all forms of formal home care (including meals-on-wheels and private domestic help), informal care from household members, and informal care from persons residing outside the household. We correct for the under-sampling of nursing-home residents that we document in SHARE (but not in the HRS) constructing sampling weights that bring SHARE in line with government-provided OECD data on institutional care. Since our approach encompasses *all* forms of informal care, our results are valuable not only for the literature on LTC but also for the literature on home production in general since we provide hours data for an important component of home production across countries.

We also have to overcome additional challenges to make the data in SHARE and the HRS comparable. For example, SHARE provides data for some care forms only on the household level, we bring these data down to the individual level by exploiting the information on disability of household members. Furthermore, SHARE does not ask for hours of care provided when it comes to care provided by household members. However, these data are essential in order to obtain a complete picture of care provision that takes into account the intensity of care.

We address this shortcoming by imputing the care need from the HRS, where there is complete hours data for all forms of care.

We document the following facts. Despite having a younger population than the European countries, the U.S. has similar care needs. This is due to the earlier onset of disability at relatively low age in the U.S. (and despite the fact that the U.S. has the lowest care need among the oldest old). Southern Europe displays slightly lower disability rates than countries in the North and the center of Europe. We document a strong North-South gradient in the utilization of informal care. In *Northern* countries with high public spending on LTC (Sweden, Denmark, Netherlands, Belgium) informal care accounts for only 28% of all care hours. This number rises to 49% in *Middle* countries (Germany, France, Austria), which exhibit medium-sized public spending on LTC, the *Southern* European countries (Spain, Italy), in which the government spends least on LTC, have the highest percentage of informal-care hours: 85%. The U.S., also a low public spender on LTC, falls between Middle and South with an informal-care share of 64%.[1] This strong gradient persist, also quantitatively, once we control for individual characteristics of families. Indeed, the region dummies are as powerful as the strongest individual predictors for the informal-care decision (the level of disability and the presence of a partner). This indicates that LTC policies play a crucial role in determining families' care decisions.

This North-South gradient is even stronger among singles: IC contributes only 16% of all hours of care to singles in the North, 35% in the Middle, 50% in the U.S., and a whopping 82% in the South.[2] As for the elderly who co-reside with a partner, the vast majority of care hours is given to them by the partner at home; an exception to this rule are the Northern countries, in which nursing homes are an important provider of care also for those with a partner. In all regions, we find that informal care towards coupled persons almost always comes from the spouse; informal care towards single persons is predominantly provided by children of the elderly, who are usually female and of working age.

Informal caregivers and nursing homes are the most important sources of care in all regions. Formal home care (FHC) plays a minor role; even in the Middle, which has the highest prevalence, only 14% of all care hours are from FHC. Furthermore, we find that individuals who live at home tend to concentrate all their care on one form of care. Among informal caregivers, we also find that care tends to be concentrated on a single caregiver.

As for determinants of the choice between formal and informal care, we find that the degree of disability and the availability of a spouse matter most. In all regions, the probability of

[1] See Figure 4 for the data we used to calculate these percentages.

[2] See Figure 8 for the precise hours data.

receiving informal care decreases strongly in disability. In the U.S. this effect is strongest: The proportion of individuals who receives informal care as the primary source of care drops from 90% for the lowest disability level down to 22% for the highest level.

Finally, we find that economic characteristics of families correlate with care choices. In all regions, informal-care recipients have higher wealth; in the U.S. and the North they are also more likely to own homes. A potential reason is the high financial burden that nursing homes impose. Having children with higher education is associated with lower use of informal care in the U.S. and in the South, indicating that opportunity costs of caregivers matter a lot in countries where public LTC provision is low.

We now turn to a review of the literature. A comprehensive overview of how care in all its forms is provided across countries is clearly important for policy makers and economists wanting to study the nexus between policy, economic variables, and care provision. However, to the best of our knowledge, there is no such comprehensive overview so far. We will organize our discussion of the related literature around Table 1. The table presents a non-exhaustive list of articles with cross-country evidence on LTC, showing which sources of care these studies have taken into account. The upshot is that currently no single study has accounted for all forms of care.

First, there are studies drawing on government-provided data (OECD/EU, 2013 and the European Commission, Lipszyc, Sail, Xavier et al., 2012). These provide excellent aggregate data on formal-care provision across countries, both for nursing homes and care at home. However, these data sets lack aggregate data on informal care. We use the data provided by the OECD on the number of nursing-home residents to correct for the under-sampling of nursing-home residents in SHARE that we document at the country level.

Second, there is a literature on informal caregiving that draws on SHARE's Waves 1 and 2. However, this literature does not consider informal care provided inside the household and care provided by spouses, both of which we find to be very important sources of care. It also restricts itself to formal care at home and omits nursing-home care entirely. Qualitatively these omissions likely do not matter for their results, but quantitatively probably they do. For example, Bolin, Lindgren & Lundborg (2008*a*), Bonsang (2009), and Balia & Brau (2014) study whether informal care from children and formal home care are substitutes or complements, and whether the institutional framework matters for this relationship. They find that informal care at home and formal care at home are rather substitutes than complements. If taking informal care provided by a spouse and nursing-home care into account, their findings would presumably be strengthened: The spouse is a plausible substitute for formal home care; formal care in

Table 1: Sources of care studied

Paper	Data source	IC from someone:		FC at:		IC provided by:	
		inside HH	outside HH	home	NH	child	spouse
Our paper (2018)	SHARE W1-6, HRS, gov'ts	✓ (35.3%)	✓ (22.4%)	✓ (12.1%)	✓ (30.1%)	✓	✓
OECD (2013, 2015)	Governments			✓	✓		
Eur. Comm. (2012)	Governments			✓	✓		
Bolin, Lindgren & Lundborg (2008)	SHARE W1		✓	✓		✓	
Bonsang (2009)	SHARE W1		✓	✓		✓	
Balia & Brau (2014)	SHARE W1		✓	✓		✓	
Crespo & Mira (2014)	SHARE W1,W2	✓*	✓			✓	

This table is a non-exhaustive but representative list of articles that provide cross-country evidence on LTC and take into account various forms of care. *Informal care (IC) from someone inside the household (HH)* means informal care provided from someone living in the same household as the elderly in need of care. *IC from someone outside HH* means informal care provided from someone living in a different household than the care recipient. *Formal care (FC) at home* is care provided by a formal (paid) caregiver at the home of the elderly. *FC at NH* is care in a nursing home. In brackets in second row: percentage of hours in different care forms based on our calculations using waves one and two of SHARE. *In Crespo & Mira (2014)'s sample, co-residency is extremely rare and there is no imputation of hours for co-residing caregivers. They rely on the daily-help filter in the survey design and infer from it that intensive care is provided.

a nursing home is a clear substitute for intensive informal care. The results from this literature are in line with our finding that mixing of formal and informal care is rather limited.[3]

A third strand of the literature uses SHARE to study how labor-market outcomes of children who provide informal care are affected and how this trade-off differs across countries. Again, these studies all leave aside spousal care and nursing-home care, which are key for providing a big picture of the care situation and need to be taken into account to assess all relevant margins especially when considering policy experiments. Bolin, Lindgren & Lundborg (2008*b*) find that informal caregiving comes with large costs in term of losing employment opportunities especially in central Europe; in contrast, Crespo & Mira (2014) do not find such an effect in central European countries but rather in southern European countries. In the United States the literature has found that informal caregiving does come with adverse consequences on labor-market outcomes. We find that higher education among children is associated with lower use of informal care in the United States and southern Europe while this effect is small in central and northern Europe.

[3]The substitutability between informal and formal care has also been found in the United States by, for example, Van Houtven and Norton (2004) and Charles and Sevak (2005).

Finally, Table 1 shows that none of the studies considers caregiving by spouses. One reason for this is data availability: SHARE does not ask for hours of caregiving of spouses. Another reason is that spouses are usually already retired when their partner becomes disabled and that thus they do not face the tough trade-off between caregiving and market work that the children of the disabled are typically confronted with. We provide imputations for care hours from spouses that can be used to address this problem. Similarly, caregiving in nursing homes has not been considered in most studies, most likely because not enough time has passed to make SHARE representative of the nursing-home population. Again, the re-weighting scheme that we propose using the OECD data could be a way to address this issue.

The article is structured as follows. Section 2 provides a short description of SHARE and the HRS. In Section 3 we describe the key challenges that must be overcome in order to provide a comprehensive overview of LTC across Europe and our methodology to do so (the exact methodology is relegated to Appendix). Section 4 contains the empirical results, and Section 5 concludes.

2 HRS and SHARE

The Health and Retirement Study (HRS) is a panel study of bi-yearly frequency conducted by the University of Michigan. It began in 1992, and became representative of the U.S. population of ages 50 and above as of 1998. A cohort initially sampled consists of only non-institutionalized individuals and thus excludes the nursing-home population. However, respondents who subsequently move to nursing homes are retained in the study and interviewed whenever possible, often through a proxy respondent. In order to ensure the representativeness of the nursing-home sample the HRS provides sampling weights which are currently available for the years 2000-2012.[4] Our sample consists of data collected for the years 2000-2012 (six surveys).

The HRS obtains detailed information about care obtained from others due to functional limitations with regards to activities of daily living (ADL: dressing, bathing, going to bed, eating, walking across a room) and instrumental activities of daily living (IADL: shop for groceries, prepare meals, take medication, manage money, use phone). Respondents are asked about the helpers with the various (I)ADLs declared and how many hours each helper provides.[5] An important caveat is that no hours of care are collected for nursing home residents.

[4]Below we will see that the fraction of the nursing-home population in the HRS is almost identical to OECD data.

[5]Whenever possible we use the cleaned-up data versions provided by the RAND Corporation. Note that the

For these we impute care hours by making use of care hours from community residents and indicators of frailty in order to capture how many care hours an institutionalized individual *would* require were she at home.

The Survey of Health, Ageing, and Retirement in Europe (SHARE) is a panel of bi-yearly frequency of the population aged 50 and above. SHARE was modeled after the Health and Retirement Study (HRS) in the U.S. which makes a comparison between the two possible. SHARE was introduced in 2004 and has currently the following waves available: Wave 1 (2004/05), Wave 2 (2006/07), Wave 3 (2008/09), Wave 4 (2010/11), Wave 5 (2013), and Wave 6 (2015). Wave 3 (SHARELIFE) is special in that it is retrospective: It focuses on respondents' life histories. As of 2015, SHARE covers 27 European countries and Israel. We restrict attention to European countries that are in SHARE since Wave 1, which are: Austria, Belgium, Switzerland, Germany, Denmark, Spain, France, Greece, Italy, Israel, Netherlands, and Sweden. We drop Greece and Switzerland. Greece did not conduct surveys in Waves 4 and 5 and some authors report problems with data collection there (see Balia & Brau, 2014 and Bolin et al., 2008*a*). In Switzerland, there were problems in the data collection on caregiving, which is also noted by Bolin et al., 2008; Bonsang, 2009; and others.

3 Methodology

A comprehensive overview of LTC needs to account for informal and formal-care arrangements both at home and in long-term-care institutions. In order to provide such an overview, we have to overcome several challenges. In the following we lay out the most significant issues that need to be addressed and describe briefly how we tackle each of them. The appendix contains the details.[6]

3.1 Non-representativeness of nursing-home population in SHARE

Both SHARE and HRS aim to be representative of the entire population aged 50 and above. Consequently, both surveys make an effort to follow up on respondents moving to nursing homes. However, we find that SHARE is not (yet) representative of the nursing-home population. This is obviously a key concern when trying to establish the relative importance of nursing

RAND family file does not include information on helpers other than children. Thus, to find out about the importance of, for example, the spouse in providing informal care we use the original HRS data.

[6]Codes for the procedures described in this section and the resulting data tables are available on request from the authors and will be made publicly available upon publication.

Table 2: Nursing-home population as of 2015

Country	NH sampled by SHARE (HRS)?	% in NH over 65: in OECD	% in NH over 65: in SHARE (HRS)	Ratio OECD-SHARE (HRS) weighted	Ratio OECD-SHARE (HRS) unweighted
Sweden	yes	4.5	2.6	1.8	2.5
Netherlands	yes	5.3	4.2	1.5	2.0
Denmark	yes	3.9	2.9	1.3	1.5
Belgium	no	8.8	4.3	2.0	2.0
Austria	no	–	2.2	–	–
Germany	yes	4.1	1.6	2.6	3.3
France	no	4.3	2.3	1.9	1.7
Spain	yes	1.8	1.3	1.3	1.2
Italy	no	–	1.1	–	–
U.S.	yes	3.3	2.9	1.1	0.8

Column *NH sampled by survey?*: says if nursing-home residents were eligible in SHARE's baseline and refreshment samples according to Ch. 5 of Börsch-Supan & Jürges, 2005 and Ch. 8 of Malter & Börsch-Supan, 2013. *% in NH over 65*: Proportion of nursing-home residents among population that is above age 65 from: (i) *OECD* statistics from year 2015 (2014 for the Netherlands, Denmark, and Belgium for which 2015 was not available), (ii) our own calculations in *SHARE* using Wave 6 using the calibrated cross-sectional household weights. *Ratio OECD-SHARE*: Gives (i) ratio of two preceding columns (*weighted*) and (ii) the same ratio when not using household weights. The last row shows data for the U.S. from 2011 (no OECD data available after 2011); the *SHARE* columns for the U.S. are from our own calculations using the 2012 HRS RAND files, using household weights where appropriate.

homes for care provision. Table 2 shows that SHARE's fraction of the NH population is about one-half of that in the OECD data, which draws on aggregate data reported by governments, whereas the HRS is almost spot on. Furthermore, Table 10 in the appendix shows NH fractions of SHARE and the HRS over time to see whether these converge to aggregate data reported by the OECD. Convergence would be suggestive that the surveys successfully retain respondents who move to a NH. Indeed, in the initial waves of SHARE the fraction of NH residents increases as SHARE follows up with them but this fraction does not converge to that reported by the OECD. In contrast, the HRS NH population coincides almost exactly with the numbers reported by the OECD.

We also find evidence that under-sampling in SHARE is due to lower retention rates for NH residents: in SHARE, NH residents are substantially more likely to attrite (36%) than community residents (25%). This difference persists when controlling for disability, age, and other characteristics.[7]

To correct for the under-sampling of NH residents, we adjust the SHARE-provided sampling weights upward so that the implied proportion of elderly above 65 in NH matches the OECD numbers for each country in each wave. Obviously, capturing merely the right fraction

[7]Sampling problems, such as these, are pervasive in surveys with elderly subjects due to *gatekeeping* problems, see Kars, van Thiel, van der Graaf, Moors, de Graeff & van Delden (2016). Gatekeeping refers to the fact that health-care professionals or nursing-home staff prevent eligible subjects from being sampled in studies.

of the NH population is insufficient to claim that the results we obtain are representative of this group. What we also need is that conditional on NH residency attrition is independent of other respondent characteristics. We find that this condition is not rejected by our data: When we regress an attrition dummy on a set of observables (age, gender, the disability index d, education etc.) of NH residents, none of the coefficients is significant.[8]

Quantitatively, our adjustment matters a great deal on how important NH care is. For example, when using our adjusted weights, the average daily hours of care that an over-65-year-old in SHARE obtains from NH are 0.210, while it is only 0.077 when using the original SHARE weights – a drop of 63%.

3.2 Determining care needs when hours of care are missing

Moreover, several challenges arise from how care is measured in SHARE but less so in the HRS. Some questions concerning caregiving were only asked in particular waves. Also, within waves the structure of questions differed across different forms of care. Table 3 gives an overview on SHARE's care measures across waves that the reader may find useful for the ensuing discussion.

Table 3: Overview of care data in SHARE

Type of care	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Level
nursing home (NHC)	dummy	dummy	dummy	dummy	dummy	dummy	indiv.
formal home care (FHC)	hours	hours	–	–	dummy	dummy	indiv.
informal from outside hh. (OIC)	hours	hours	–	freq.	freq.	freq.	hh.
informal from inside hh. (IIC)	dummy	dummy	–	dummy	dummy	dummy	indiv.

Table shows which information on care received is available in SHARE for different forms of care (rows) in the different waves (columns). *dummy*: Question(s) available *if* this form of care was received. *freq.*: Question available if this type of care was received daily, weekly, monthly, or less often. *hours*: Question(s) available on hours of care received of this form of care. *Remark:* For IIC, question only asks for care that was given on daily or almost daily basis; for nursing-home care, we only consider survey information on permanent nursing-home residency (but not short-term stays for rehabilitative purposes). Last column (*Level*) shows if information for a care form is available on the individual level (*indiv.*) or on the household level (*hh*). All information is taken from the SHARE questionnaires.

The most basic challenge that we face here is that data on hours of care is not always available. Since the intensity of care needs varies widely among the disabled, hours measures are essential for an accurate picture of how care is delivered. The missing-hours problem is especially relevant for IIC (informal care from someone who lives in the same household) because co-residing caregivers often give the most intensive care (see, for example, Barczyk &

[8]It is harder to test if there is non-random attrition at the point where individuals leave the community and *enter* a nursing home. The problem is that for a community resident who attrites we do not observe whether she enters a NH in the moment she disappears from the sample or leaves the sample for any other reason.

Kredler, forthcoming). For this category hours information is lacking in all SHARE waves.[9] The HRS collects hours of IC provided irrespectively of where caregivers reside.

In general, our strategy to close the missing-hours gap is the following. We use respondents for which we have complete hours information (usually from the HRS, in some cases also from SHARE) to predict *total hours of care* that an individual receives (the sum of hours of care received in all categories) as a function of (I)ADLs, dementia, and age. The regressions are reported in Table 11 in the appendix. The predicted values from these regressions are our preferred measure of *care need*, which we denote by d, measured in daily hours of care. We use d both as a care-needs index and to impute total hours of care for individuals for whom care hours are incomplete.

More specifically, depending on the population of interest we use a different sample to impute total hours of care. There are three such categories:

1. **Missing hours for IIC**. SHARE asks *if* a respondent receives IIC, but not *how many hours* the respondent receives. In order to impute total hours of care for this group, we use a comparable group of respondents: the sample of HRS community residents who receives care from somebody living inside the household.[10] We use the predicted values from this regression to impute total hours of care that IIC recipients in SHARE obtain. Note that here we implicitly assume that a person's care need depends on the disabilities and age but not on the country a person lives in.[11] Next, if a respondent receives all care from IIC sources (about half of all cases), we assign all hours of care to IIC. If a respondent also receives OIC or FHC, we subtract the OIC and FHC hours from total hours to obtain IIC hours.

2. **Missing hours data for NH**. Neither SHARE nor the HRS collects information on hours of care that NH residents receive. However, to ascertain which fraction of care needs is met by NH relative to other sources of care (IC, FHC) we need to take into account the intensity of care needs covered by NH. Note that we are not so much concerned with how many hours of care NH staff is really attending to, but rather *how many hours of care that*

[9] Presumably due to this data structure, there is so far very little research in SHARE on care from this important group of caregivers.

[10] Note that the fact that a disabled person co-resides with a caregiver may correlate with severe disability. For example, a child may move in with his mother once her disability becomes severe enough that she cannot be left alone at night any more.

[11] Note that we *do not* assume how this care need (i.e. total hours of care) is met; depending on the policies in different countries, this may well differ. For example, Northerners may cover a larger fraction of their care need by FHC if it is more readily available or receives higher subsidies than in the South.

person would have needed from IC or FHC when living at home. In other words, we want to make the numbers for NH and community care comparable.[12] In order to do so, we impute hours of care received in NH from a sample of community residents in the HRS and SHARE for whom we have complete hours information.

3. **Individual-level versus household-level questions**. SHARE usually asks a respondent if she (as an individual) has received a certain kind of care; this is the case for NH, FHC, and IIC. However, SHARE does not follow this rule when it comes to OIC (informal care received from persons who reside *outside* the household). For OIC, SHARE asks the respondent about care that all members of the respondent's household received together. Since our analysis is at the individual level, we have to make assumptions on how to assign the care received to one (or both) of the partners in a respondent household if this household is a couple. We use the information on both partners' limitations with ADLs and IADLs. In more than three-fourths of the cases, this assignment is unproblematic since only one of the partners has limitations. In these cases, we assign all care hours to the partner with limitations. If, however, both partners report limitations, we assume that both partners received OIC and split the care hours received proportionally using our care-needs index.

3.3 Other issues

Additionally, there are some other more minor challenges in SHARE that are worthwhile to point out. Firstly, for co-residing couples answers to the question on who received care from whom are often contradictory. In order to resolve this inconsistency, we use data on (I)ADL limitations to determine the recipient; this is straightforward in the large majority of cases. Secondly, using HRS data we impute hours for meals-on-wheels (food delivered to the elderly at home by organizations). Finally, wherever possible we use imputed total hours to determine hours in unknown care categories residually.

4 Empirical results

For our empirical analysis we always use as many waves as possible as long as this allows us to obtain consistent estimates for a given question. For statistics on care hours, for example, this

[12] Most likely, nursing homes need fewer man-hours to meet care needs than community care does due to scale economies. Estimating this comparative advantage is of interest, but not the objective of the exercise at hand.

means that we typically have to restrict the sample to Waves 1 and 2 since only these waves have sufficient information to infer the distribution of hours.[13] For several other questions, however, we are also able to use later waves.[14]

4.1 Demographics, disability rates, and policy

We first present an overview of the demographic situation, disability rates, and public LTC policy across the countries in our sample. Table 4 summarizes the results. We group countries into four regions by their LTC policies. We define the U.S. as one region since its LTC policy and other economic features make it very different from the European countries. As for the European countries, we divide them into three groups based on their public spending on LTC. *North* comprises countries whose public spending on LTC exceeds 2% of GDP; these countries are in Scandinavia and the Benelux. *Middle* countries are defined as those with public LTC spending between 1% and 2% of GDP and are all found in the center of Europe. The remaining countries comprise the region *South* and have public LTC spending below 1% of GDP. We note that our categorization of countries is very much in line with the classification of the European Commission (2015); their classification is based on qualitative features of countries' policies, which makes us confident that our classification is reasonable.

The first data column of Table 4 shows the ratio of the retired population (above 65 years old) over the working-age population (20 to 65 years old). We see that there are no systematic differences between countries in Europe, but that the U.S. has a substantially lower dependency rate. The second column shows that the fraction of over-65-year-olds who suffer from severe disability, defined as those with $d \geq 3$ (i.e. in need of 3 hours of daily care or more) again shows little variation across countries. If anything, the Northern and Middle countries have slightly lower care needs, although their governments spend more on LTC. The U.S. is quite similar to Europe in its disability rate and spends little. We summarize the above in the following fact:

Fact 1 *European countries are similar to each other in demographics and disability rates; the U.S. population is younger but has a similar disability rate. However, there is large variation in government LTC spending.*

[13] Our imputations give us hours information for many respondents also in Waves 4 through 6, but the sample of such respondents is likely biased towards respondents who receive only one category of care.

[14] Wave 3 has no information on current care arrangements for respondents residing at home; we only use Wave 3 when it comes to nursing home status but exclude it for all other exercises. Wave 4 contains no information on formal home care; we thus exclude Wave 4 when calculating any statistics involving formal home care but use it when it comes to statistics on informal care.

The fact that the U.S. has a similar disability ratio as the European countries but is younger stems from an onset of heavy LTC needs at younger ages. Figure 1 displays our disability ratio by age groups. Among 65 to 69-year-old the disability ratio in the U.S. is largest and about twice as high as for the Middle region. Interestingly, European countries catch up and surpass the U.S. in the oldest age category. Thus, the similar disability rates for *all* above-65-year-olds mask substantial heterogeneity when it comes down to age groups.

Table 4: Demographics, disability, and government spending in 2012

Region	Country	Dependency ratio in % (65+/20-65)	Disability ratio (% of 65+ with $d \geq 3$)	Gov't LTC spending/GDP
North:	Netherlands	30.2	8.5	3.7
	Sweden	33.8	9.4	3.2
	Denmark	33.0	8.5	2.5
	Belgium	30.6	12.6	2.3
Middle:	Austria	30.5	8.8	1.2
	France	33.3	10.0	1.7
	Germany	34.8	10.0	1.3
South:	Spain	30.6	13.8	0.8
	Italy	37.8	10.4	0.7
U.S.:	U.S.	24.6	10.9	0.5

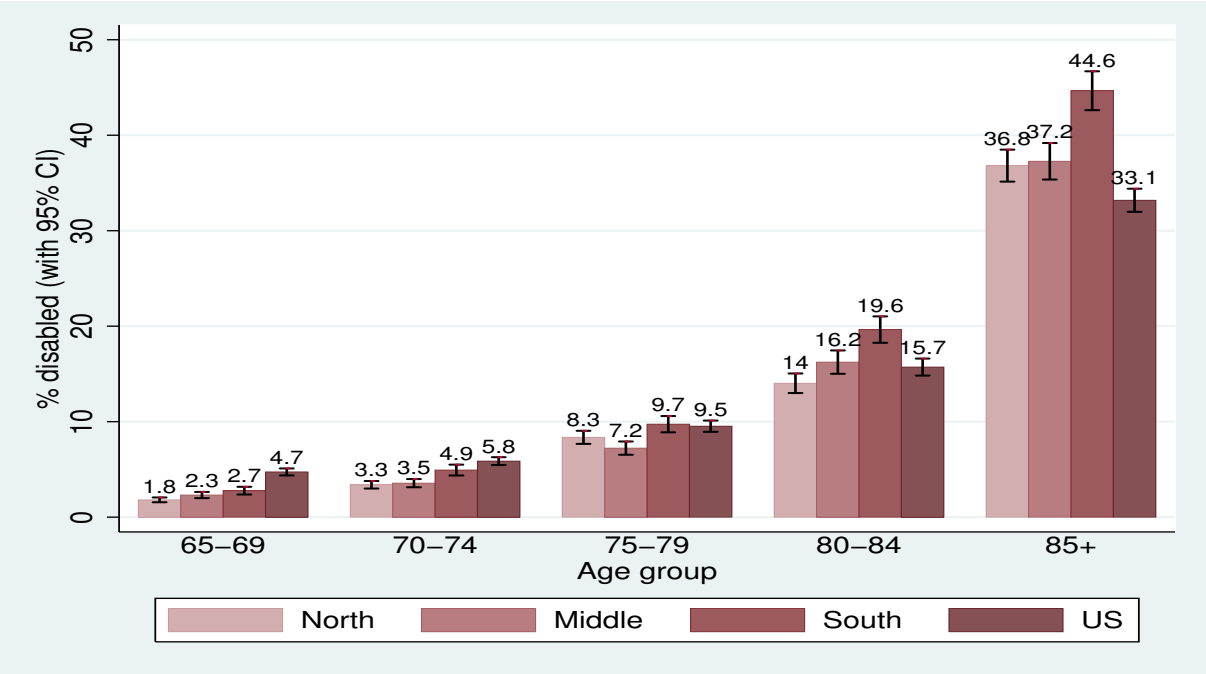
Dependency ratio is taken from United Nations (2017), LTC spending ratio from OECD (2017). Dependency is for the year 2015, LTC spending ratio is for the year 2015 (or nearest year available) and includes both health LTC spending (mainly ADL-related) and social LTC spending (mainly IADL-related). The disability ratio is obtained pooling all waves in SHARE but Wave 3 (no disability data); for the U.S. we pooled all waves after 2003 from the HRS. The disability ratio is calculated as the fraction of individuals aged 65 years and above who have a disability score d (daily care need in hours) of at least 3.

Fact 2 *The U.S. displays higher disability rates than Europe below age 75, but lower rates above age 85. Within Europe, the South has higher disability rates at all ages than North and Middle, the latter being very similar to each other in the disability patterns.*

We now ask in how far individuals use private markets to insure against LTC risk. Figure 2 shows that very few people take up private LTC insurance unless they are forced to do so (which is the case in some countries). Only Belgium, France, and the Netherlands show substantial sign-up rates, but even in these countries fewer than one-fourth of over-65-year olds has voluntary LTC insurance. There is no evidence that people use private insurance markets more in countries in which the government spends little on LTC (such as the South and the U.S.). We will later see that the shortfall in government spending is rather compensated by informal caregiving.

Fact 3 *Voluntary uptake of LTC insurance is low in all countries without systematic variation across countries.*

Figure 1: Cross-region disability ratio by age group



The disability ratio is calculated as the fraction of individuals per age group within a region who have a disability score d (daily care need in hours) greater or equal to 3. For North, Middle, and South we use all waves in SHARE but Wave 3 (no disability data); for the U.S. we use all waves from the HRS after 2003. The error bars are 95-percent confidence intervals.

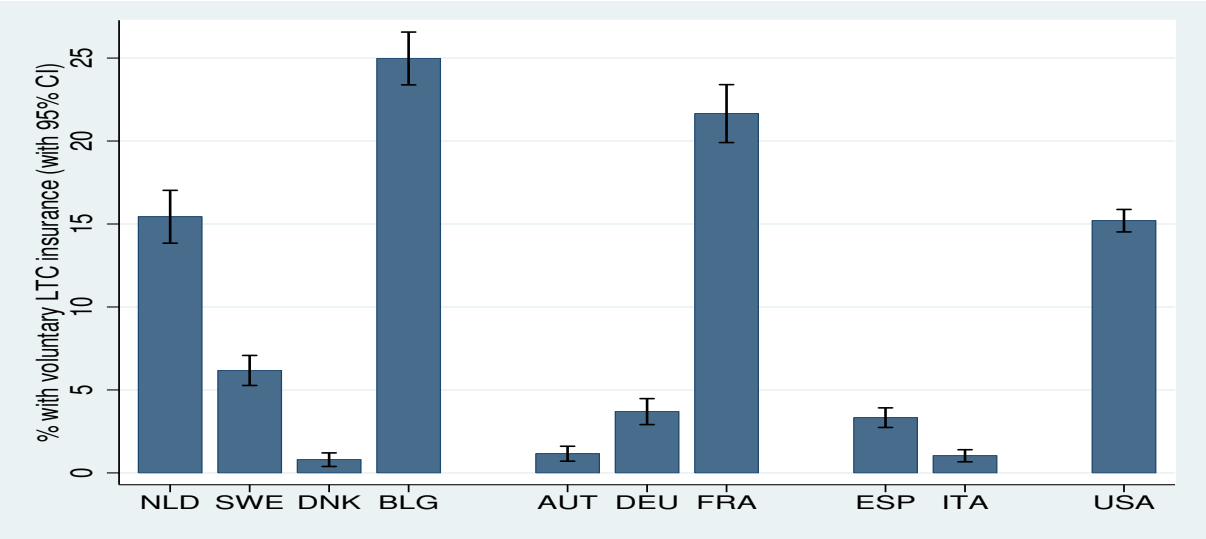
4.2 Care arrangements

In how far does the variation in LTC policy across countries translate into differences in care arrangements? Table 5 aims to shed light on this question; it shows which percentage of the frail elderly are taken care of informally by family members or friends (IC), which percentage receives formal home care (FHC), and which percentage resides in a nursing home (NH). We also report the percentage of individuals who say they receive care from both informal and formal caregivers in the column *IC-FHC*.

We see that care arrangements are rather homogeneous inside regions and that most variation in care arrangements is across regions. This hints at the importance of policies for determining care choices. The differences between the Northern and Middle countries are especially noteworthy as these countries share similar cultural backgrounds and so differences are likely due to policy. As for care choices, the main fact we can glean from Table 5 is the following:

Fact 4 *There is a strong North-South gradient in the utilization of informal care: Southerners use IC most and Northerners least, the U.S. being most similar to the South.*

Figure 2: Voluntary LTC insurance uptake as of 2015



Sample: all respondents aged 65 and above. SHARE: Wave 6 (Netherlands: Wave 5)[15]; HRS: Wave 11 (2012). Weights are used.

Table 5: Care arrangements across countries (in % of cases)

Region	Country	Informal care (IC)	Mix IC-FHC	Formal home care (FHC)	Nursing home (NH)
North:	Netherlands	14	28	17	42
	Sweden	27	27	11	35
	Denmark	21	37	15	27
	Belgium	20	35	14	31
	Total	20	32	14	34
Middle:	Austria	36	38	12	15
	France	24	42	14	20
	Germany	36	35	7	21
	Total	31	38	11	20
South:	Spain	57	26	8	8
	Italy	62	22	8	7
	Total	60	24	8	8
U.S.:	U.S.	64	12	5	19

Sample: All respondents aged 65 and above who receive care. SHARE: Waves 1, 2, 5, and 6. HRS: Waves 5-11. Weights are used.

The gradient in nursing-home (NH) and FHC utilization is exactly the opposite, although the U.S. is closer to the Middle than to the South in NH utilization. Since care arrangements are rather similar within regions, we will in the following report all statistics on the region level and not by countries. This is preferable since it increases the sample size once we zoom in on smaller subsamples.

One striking feature that emerges from Table 5 is that there is a substantial number of elderly who live at home and make use of both informal and formal care in all countries. This seems to suggest that combining the two care forms is an attractive option. However, we will now see that such mixing is almost always heavily tilted towards one form of care. Figure 3 shows that the vast majority of IC-FHC mixers receive more than 80% of hours from either IC or FHC. The tilting is strongly towards IC in the South and the U.S., balanced in the Middle, and towards formal care in the North, in line with the general tendency in the regions that we identified in Table 5. This finding is in line with the bulk of the literature which has found that informal and formal care are substitutes, not complements.[16]

Fact 5 *There is no substantial mixing of formal and informal care at the individual level.*

The case counts presented in Table 5 seem to suggest that care given at home, namely IC and FHC, are more important than NH care. However, the case counts certainly overstate the importance of care at home since individuals with the highest levels of disability often opt for nursing homes. We now correct for care intensity by measuring the average daily hours of care that an individual above 65 years receives in the four regions.

Figure 4 shows the results. We see that the importance of NH increases dramatically using the hours measure, especially in the North and in the Middle. FHC loses some importance, but IC is still prominent, indicating that it is also used in cases of severe disability. Finally, the North-South gradient becomes, if anything, stronger when accounting for the intensity of care. The U.S. is now positioned between the South and the Middle, but still far away from the North.

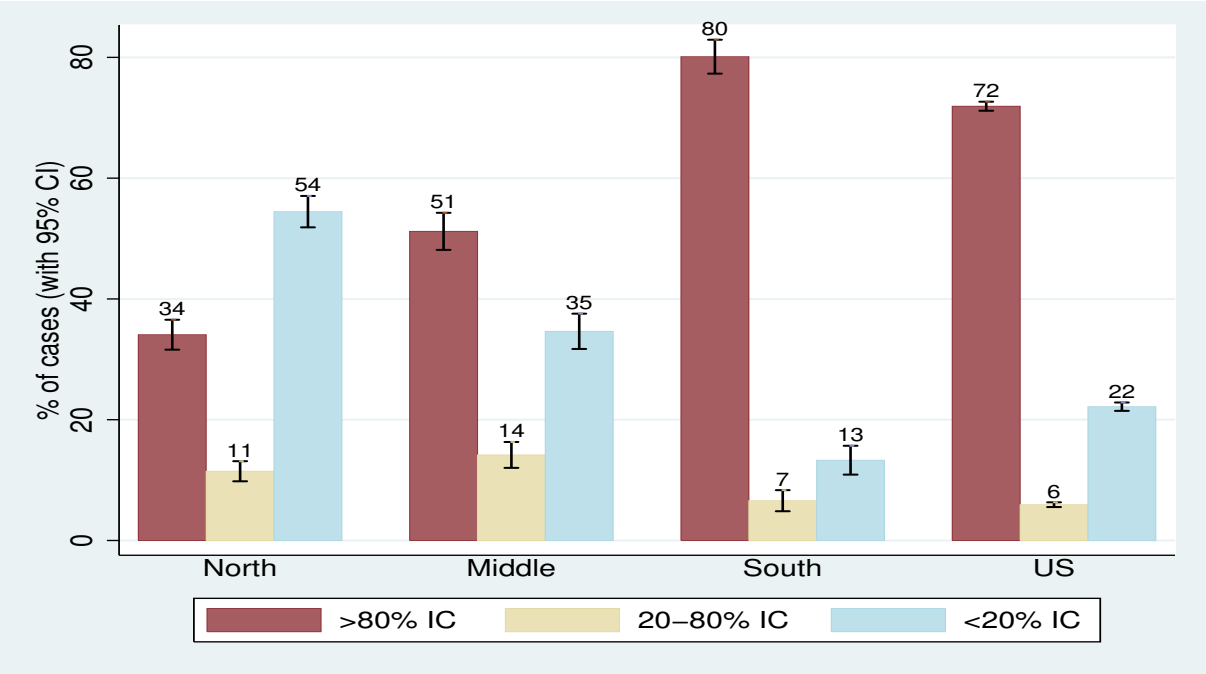
Fact 6 *When accounting for the time intensity of care, IC and NH emerge as the most important care forms. The North-South gradient in IC stays very strong, the U.S. falling between the European Middle and South.*

4.2.1 Severity of disability and the care choice

We now study in more detail how the severity of disability influences the care choice. Figure 5 plots the main source of care (IC, FHC, or NH) against our preferred disability index, d. The following fact emerges:

[16]Note that this result does not hinge on the imputation of hours for IIC. As a robustness check, we computed the same statistics as in Figure 3 for the sample to those who did not receive IIC. The percentage of those receiving between 20 and 80% IC stayed within a range of 3 percentage points compared to the results show in Figure 3.

Figure 3: Choices of IC-FHC mixers



Sample: All respondents aged 65 and above who received both IC and FHC. SHARE: Waves 1-2. HRS: Waves 5-11. Weights are used.

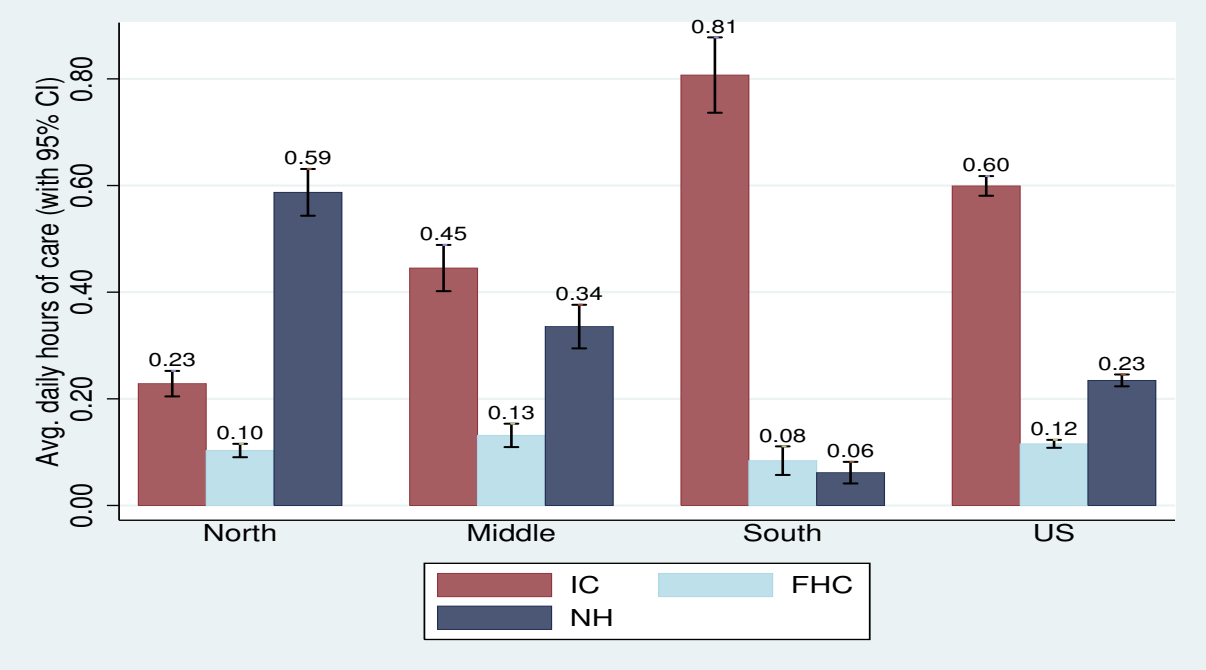
Fact 7 *In all regions, IC use decreases and NH use increases with the severity of disability. This disability-IC gradient is strongest in the U.S. and weakest in the Middle and the South.*

Now, it is natural to ask: How many individuals are there in each disability category? For which proportion of all care hours does each category account for? Figure 6 answers these questions by plotting the *Lorenz Curve* of care. Each point on the curve corresponds to one point on the cumulative distribution function (cdf) of care hours. The point marked with $d = 2$, for example, indicates that 51% of individuals have care needs of 2 hours and below (the x-component) and that these individuals account for 11% of all hours of care (the y-component). The following fact emerges:

Fact 8 *Care hours are concentrated. The "impaired" (those with a care need d below 3 hours) account for 61% of all respondents with limitations, but only 18% of all care hours. The "disabled" (care need of 3 hours and above) represent 39% of all respondents with limitations, but obtain 82% of care hours.*

From now on, we will often focus our analysis on the sample of *disabled* which is responsible for most of the care need in the population.

Figure 4: Hours of care in different care forms



Sample: All respondents aged 65 and above. SHARE: Waves 1-2. HRS: Waves 5-11. Weights are used.

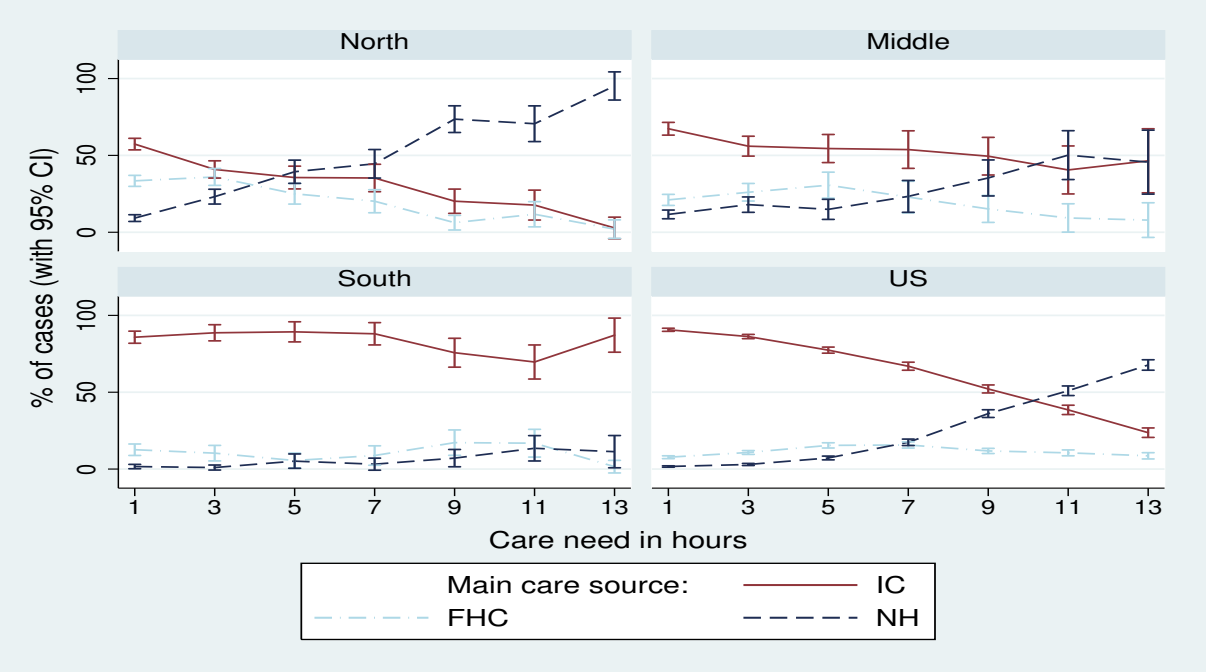
4.2.2 Time trends

SHARE and the HRS by now have sufficiently many waves so that we can learn something about time trends in the provision of care. Figure 7 shows the percentage of the (main) sources of care for the four regions over time.

Fact 9 *In Europe, IC use has decreased at the expense of NH. This trend was strongest in the Middle and South. In the U.S., however, there was a weak trend in the opposite direction.*

Presumably, the trend towards NH would have been even stronger in the South had the economic crisis not hit these countries with exceptional power. High unemployment lowered the opportunity cost of IC substantially in the South for many families in the last ten years. Nevertheless, the data show that there was a 10-percentage-point decrease in IC over our sample period. This seems to indicate that other trends (such as the incorporation of more women into the labor force) were apparently stronger than the crisis effect in driving care choices. In sum, Spain and Italy have converged somewhat in their care choices towards the countries in the Middle and North.

Figure 5: Care choice by disability level



Sample: All respondents aged 65 and above who received care. SHARE: Waves 1-2. HRS: Waves 5-11. Weights are used. Bins for care need d in daily hours: (0,2], (2-4], ..., > 12.

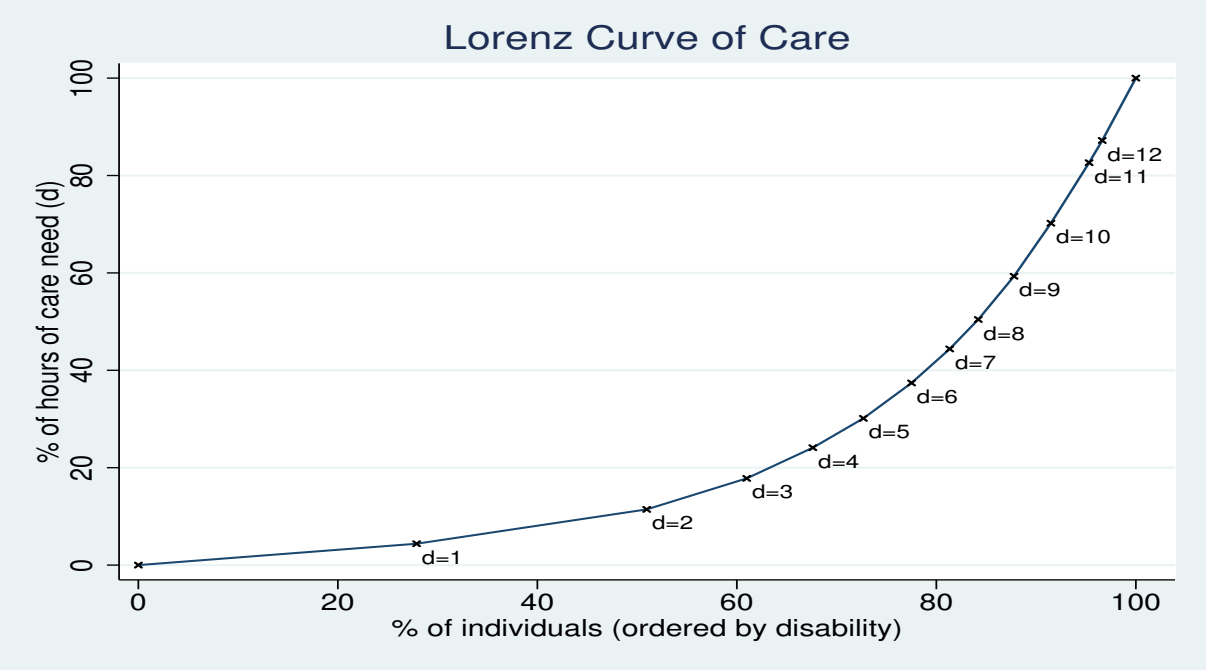
4.3 Informal caregivers: The role of spouses and children

Beyond the level of disability and time trends, another crucial dimension along which care arrangements vary is the marital status of the disabled. Figure 8 shows which care arrangements disabled people choose, distinguishing if they are single or coupled. Coupled individuals are predominantly taken care of informally in all countries, although there is a substantial NH population among the coupled in the North. For singles, IC is still the predominant care form in the South and the US, whereas in the Middle and North IC is eclipsed by nursing homes.

Who are these informal caregivers? Figure 9 splits up IC hours into where they came from: if from a working-age caregiver in the family (*young*, mostly children of the elderly), a retirement-age caregiver in the family (*old*, mostly spouses), or other friends and relatives (*other*) for whom age is unknown. We see that in all regions, single elderly receive care mainly from young caregivers. Among these, we find that it is mostly daughters who take on the task of caregiving (more on this below). As for coupled elderly, almost all care is given by old caregivers; these are almost always spouses.

Fact 10 *The coupled elderly are predominantly cared for by their spouse at home in the Middle,*

Figure 6: Lorenz Curve of Care



For integer values of d (point markers), graph shows % of individuals with care need of d and below on the x-axis and the fraction of total care needs in the population as measured by d on the y-axis. We use care need and not reported care hours since care hours are not reported by NH residents. Sample: All respondents aged 65 and above with limitations ($d > 0$), all waves from SHARE and HRS. Weights are used. Labels give disability score pertaining to point on the curve.

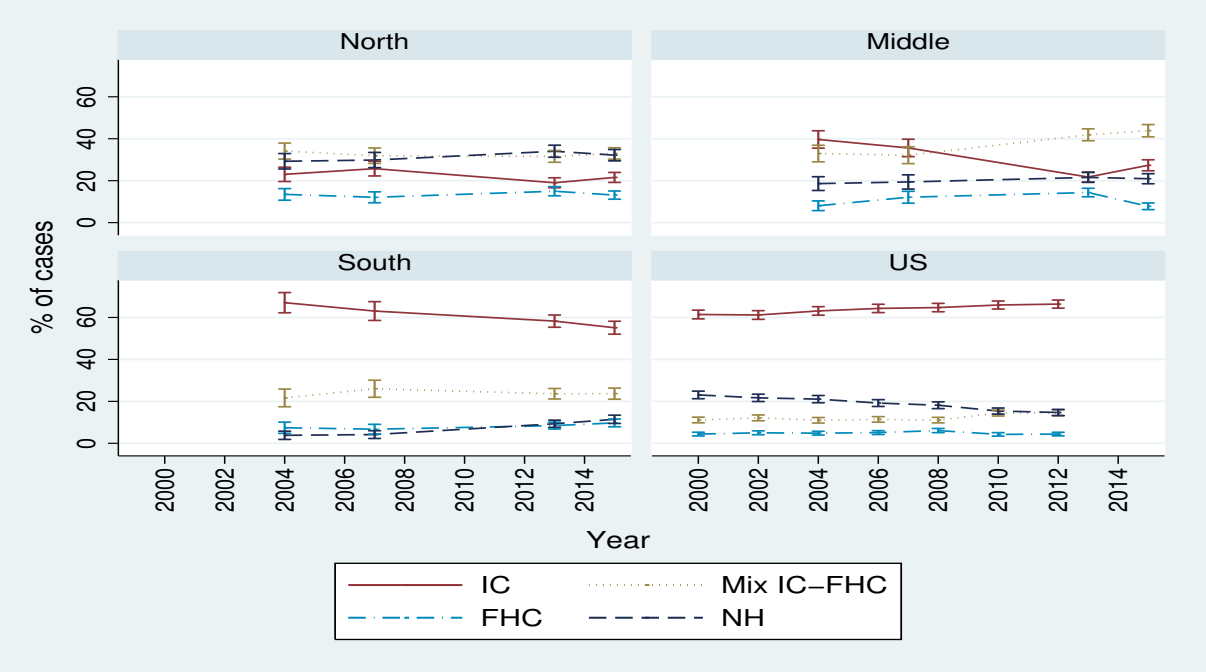
South, and U.S., but in the North formal care is as important as care from the spouse for this group. Among singles, there is more variation in care arrangements: nursing homes are most prevalent in North and Middle, whereas IC is most common in South and U.S.

Our data also allow us to determine whether a caregiver co-resides with the elderly in need or not. Especially for the most disabled, it is often necessary that a caregiver is at reach around the clock, so that we expect a large number of hours to come from co-residing caregivers. Figure 10 splits all IC hours into those provided by a co-resident (split again into partners and children – others are negligible) and those provided by caregivers from outside the household (most often children). Indeed, the following fact emerges:

Fact 11 *Co-resident caregivers give about two-thirds of all IC hours, in all regions. Even for single elderly, co-resident caregivers are as important as outside-household caregivers in the U.S. and the South.*

As we saw above, many disabled persons receive IC hours that amount easily to a part-time or full-time job. However, if the care burden were shared among many family members, this

Figure 7: Time trends by region



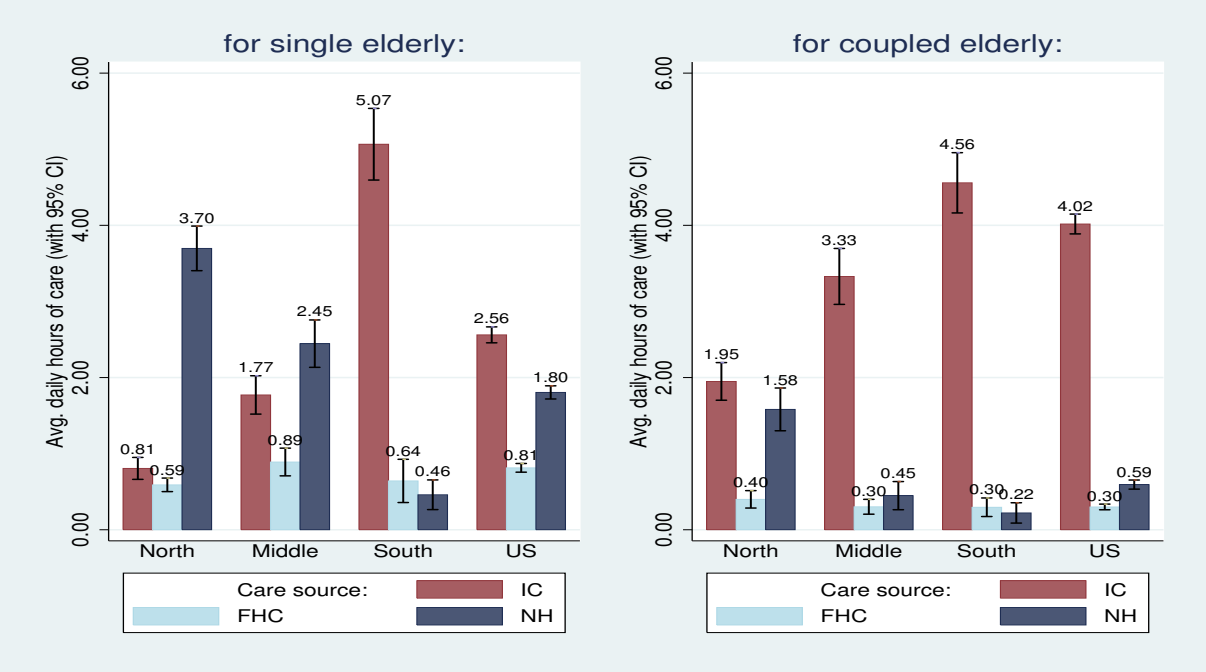
Sample: All respondents aged 65 and above who received care. SHARE: Waves 1, 2, 5, and 6. HRS: Waves 5-11. Weights are used. North excludes Netherlands (no data in Wave 6).

need not imply a large individual burden on each caregiver. But we find the opposite: Work is usually concentrated on one person. We calculated the share of hours that the main informal caregiver (the one with most hours) contributes to all IC hours that a person receives. Figure 11 shows the distribution of this share for the disabled (above 3 hours of care needs per day) who receive their care mainly from informal sources. We see that even for singles, where one might conjecture that the children share the caregiving burden, it is usually one person who contributes more than 80% of the IC hours (the right-most bar of the histograms). In less than 20% of cases (most in the U.S. and the South), the main caregiver contributes 60% or less. For the coupled, the pattern is even more extreme.

Fact 12 *In all regions, IC tends to be concentrated on one helper. 50% of the disabled (care need $d \geq 3$) have only one helper, 28% have two helpers. Among the impaired ($0 < d < 3$), care is even more concentrated.*

We now ask who the persons are who provide the lion's share of IC. We define a *heavy helper* (HH) as an informal caregiver who gives 3 or more daily hours of care (amounting to

Figure 8: Care choice by coupledness status



Sample: all respondents who received care. SHARE: Waves 1-2. HRS: Waves 5-11. Weights are used.

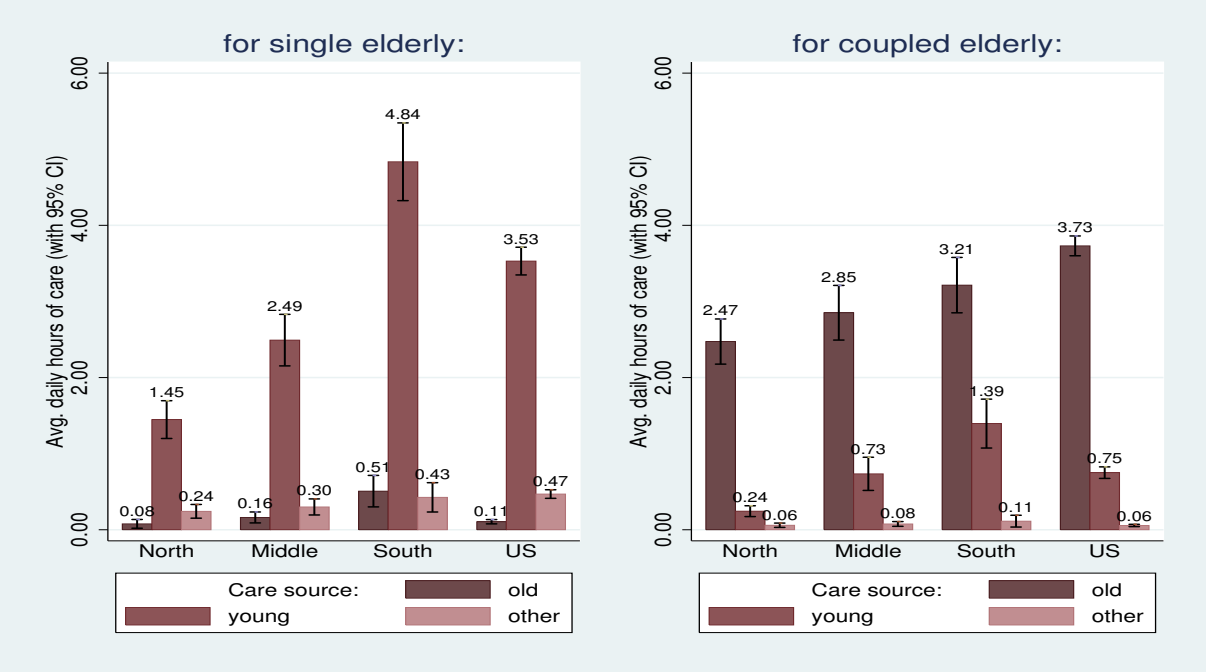
21 hours or more per week, i.e. a part-time job). Table 6 shows characteristics of heavy helpers and compares them to other (comparable) children.

Heavy-helping (HH) spouses are more likely to be female in all regions. This reflects two facts: First, women tend to become disabled and die later than men. Second, women tend to be married to older men, which makes it likely that the husband experiences disability earlier. HH spouses are usually in retirement age, such that few conflicts with labor-market activities are expected.

Among HH *children*, even more are female: About three-quarters or more of heavy helpers are daughters. HH spouses and children in the U.S. are substantially younger than their counterparts in Europe, presumably reflecting the earlier onset of severe disability and earlier childbearing in the U.S.

As may be expected, physical proximity between HH children and their frail parents plays an important role. Co-residence rates between HH children and their parents are impressively high in the South and the U.S., highlighting an interaction that presumably runs both ways: intense caregiving requires physical proximity, and being physically close makes a child more likely to become a heavy helper. Co-residence rates are a lot higher for HH children than for other children. In the South, almost all HH children live within a few kilometers of their parents.

Figure 9: Source of informal-care hours



Sample: All respondents who received IC. SHARE: Waves 1-2, HRS: Waves 5-11. Weights are used.

Among non-HH children, this is not the case, and less so in North, Middle, and the U.S.

HH children appear to have slightly fewer competing time demands from their own families. They are less likely to be married and have fewer children than comparable non-HH children.

In terms of labor-market characteristics we observe that the vast majority of HH children are still of working age and so caregiving bears potentially high opportunity costs in terms of forgone labor income. HH children hold full-time jobs less often than non-HH children, especially in the U.S. However, there is still a quite large number of HH children who are working alongside their heavy caregiving activity, again especially so in the U.S.

Fact 13 *Heavy helping children tend to be female and of working age. They live close to their parents or co-reside and are less active in the labor market than comparable children.*

4.3.1 Who opts for informal care?

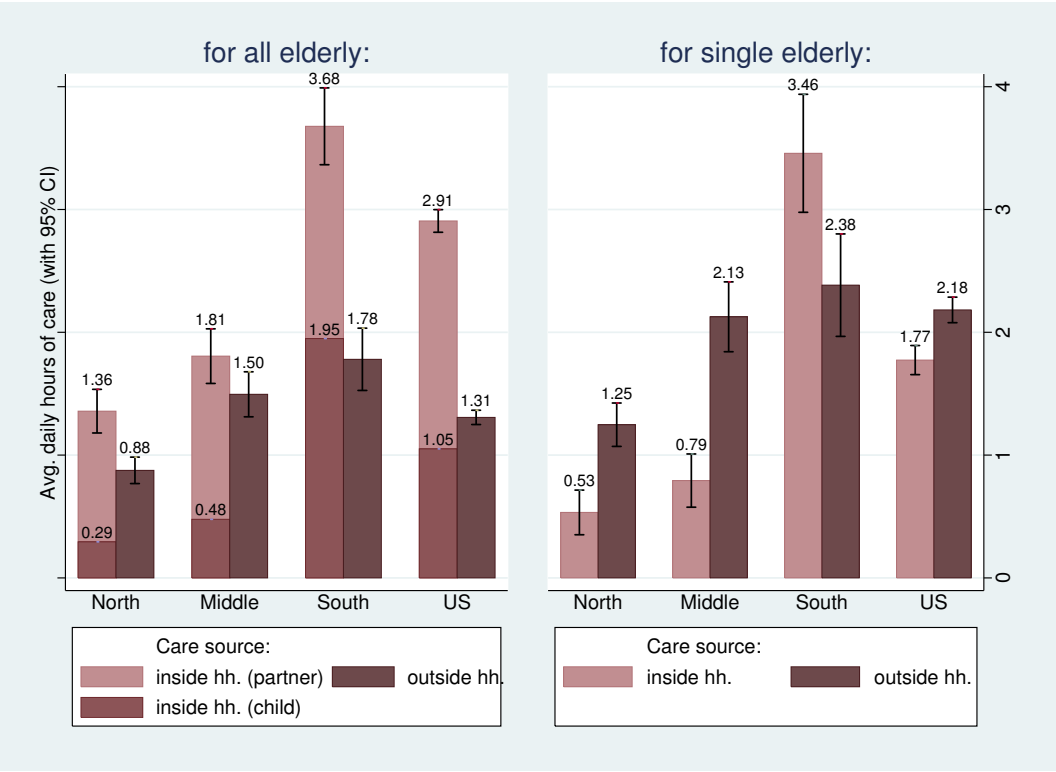
We have seen that disability and marital status play an important role in determining if a disabled person receives IC or not. But how important are economic circumstances in determining the care choice when compared to health? And how much does the importance of such eco-

Table 6: Characteristics of heavy-helping (HH) spouses, HH kids and comparable non-HH kids

Variable	Group	North	Middle	South	U.S.
female	HH spouses	0.57	0.71	0.64	0.54
	HH kids	0.85	0.72	0.81	0.74
	Non-HH kids	0.51	0.53	0.49	0.50
average age	HH spouses	75.2	74.9	74.1	68.5
	HH kids	56.1	55.0	54.0	48.6
	Non-HH kids	56.4	56.5	55.1	52.4
co-residing	HH kids	0.51	0.35	0.69	0.62
	Non-HH kids	0.03	0.07	0.16	0.06
same building	HH kids	0.54	0.53	0.76	–
	Non-HH kids	0.03	0.12	0.23	–
< 5 km	HH kids	0.82	0.77	0.95	0.67
	Non-HH kids	0.40	0.39	0.62	0.33
married	HH kids	0.58	0.48	0.68	0.45
	Non-HH kids	0.71	0.63	0.76	0.69
# children	HH kids	1.69	1.54	1.28	1.92
	Non-HH kids	1.80	1.65	1.72	2.23
≥ 65 years	HH kids	0.21	0.16	0.12	0.10
	Non-HH kids	0.20	0.21	0.19	0.16
≥ 62 years	HH kids	0.27	0.26	0.20	0.16
	Non-HH kids	0.31	0.32	0.29	0.25
Full-time	HH kids	0.20	0.23	0.26	0.39
	Non-HH kids	0.44	0.40	0.43	0.63
Part-time	HH kids	0.17	0.18	0.08	0.12
	Non-HH kids	0.10	0.08	0.03	0.09
Self-empl.	HH kids	0.13	0.09	0.03	–
	Non-HH kids	0.06	0.09	0.05	–
retired	HH kids	0.28	0.23	0.14	–
	Non-HH kids	0.22	0.29	0.16	–
inactive	HH kids	0.22	0.28	0.48	0.48
	Non-HH kids	0.17	0.13	0.32	0.28
educ. Yrs.	HH kids	11.98	11.21	8.84	12.8
	Non-HH kids	11.68	11.57	8.75	13.2
N	HH spouses	217	220	268	2,912
	HH kids	58	95	274	2,951
	Non-HH kids	2,774	2,282	2,736	9,011

Table shows means of female dummy, age, and a coresidence dummy for spouses and children who are heavy helpers (primary informal caregiver who provides 3 or more hours of daily care). SHARE: Waves 1, 2, 5, and 6 (only use helpers for whom hours can be determined in Waves 5-6.). HRS: Waves 5-11. Weights are used.

Figure 10: Inside-household versus outside-household informal care

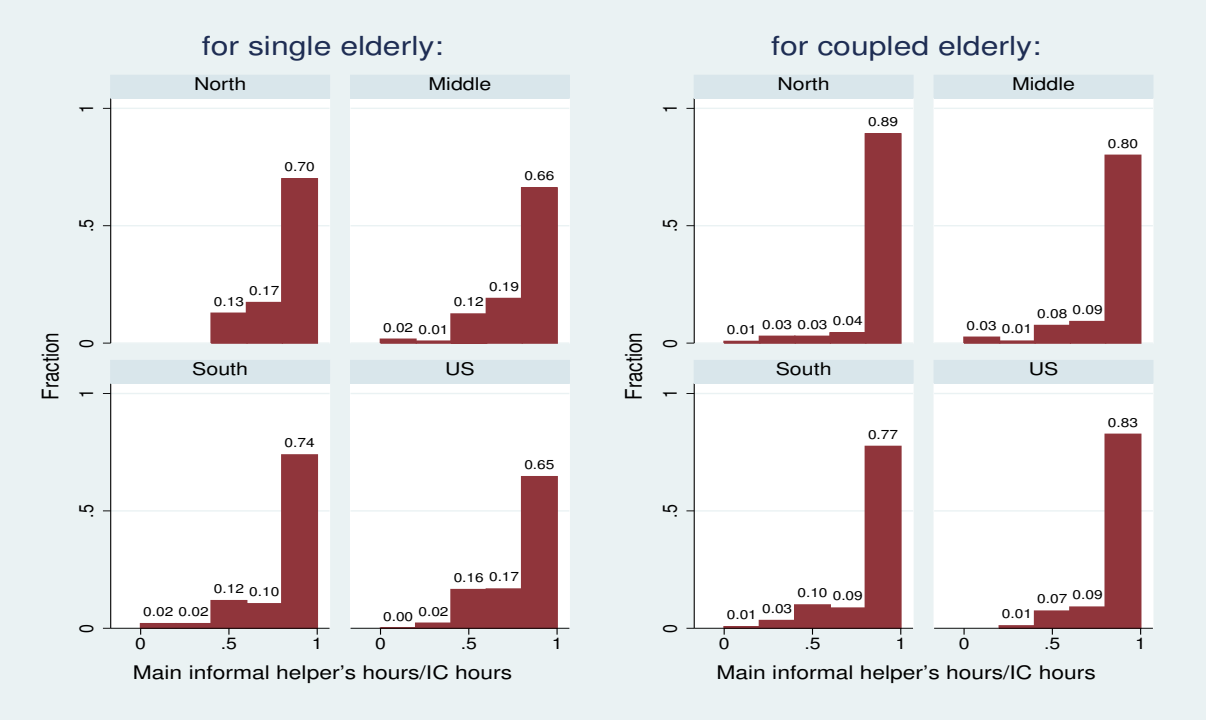


Sample: All respondents who received IC. SHARE: Waves 1-2, HRS: Waves 5-11. Weights are used.

nomic factors differ across regions? One would expect that in countries with high public LTC provision economic circumstances of the family matter less than countries with low public LTC provision. In the U.S., for example, the rich may be more likely to end up in a nursing home since they can afford it, whereas the poor may be induced to use more IC. In the North, however, families have the option to choose cheap government-provided care, in which case their economic means should matter less for their choice whether to enter a nursing home or not.

In order to address these questions we estimate a linear probability model using the sample of respondents with care needs. The dependent variable is an IC indicator which equals one if a person receives the majority of care from informal sources and is otherwise zero. Table 7 shows the estimation results from regressing the IC dummy on economic characteristics of families and controls that were previously discussed. To assess the importance of family ties we include *all* (with care needs), which refers to whether or not an individual is single, coupled, has children or is childless. Table 8 then zooms in on single elderly – for these the IC decision is of special interest since we expect this group to be most responsive to government policy. In

Figure 11: Concentration of informal caregiving on one caregiver



Sample: All respondents aged 65 and above who are disabled ($d \geq 3$) and receive more than half of their hours of care from informal sources. SHARE: Waves 1-2; HRS: Waves 5-11. Weights are used.

order to learn more about the effects of children's characteristics on the IC choice we also add age and education of children to the set of covariates.

In the first regression we pool all regions. This has the advantage that we can estimate the effect a certain region has, which captures to some extent the influence of a region-specific policy regime, on the likelihood of IC when also controlling for individual characteristics. Tables 7 and 8 show that the coefficients associated with these regional dummies are highly significant. Indeed, their magnitude is very similar to the raw (unconditional) differences in care arrangements across regions from Table 5.

Fact 14 *The region (North, Middle, South, US) where a person lives has a strong effect on the IC decision; in fact, this effect is as strong as the strongest individual-level predictors, disability and coupledness.*[17]

[17]To compare the coefficients of the dummy variables to the coefficients of the continuous variables, it is important to take into account the amount of variation in the continuous variables. Disability (measured by daily care need d) varies between 0 and 12.4 and has a standard deviation of 3.47 in the sample used in Table 7's pooled regression. The standard deviations of the other continuous variables are as follows: age (8.10), time (4.62) log

It is worthwhile to point out that Fact 14 is a priori not to be taken for granted. In many other contexts, such as when it comes to determination of wages or educational attainment, variation on the individual level within countries is so large that it dwarfs cross-country variation (at least this is the case among rich countries). For LTC, however, we find that regional differences are among the most powerful predictors. This strongly indicates that government LTC policies play a large role in determining care decisions.

We now turn to a discussion of the region-specific regressions presented in Tables 7 and 8. First, we observe that many results from the unconditional statistics we presented before are corroborated here. The disability-IC gradient is steepest in the U.S. and flattest in the South. Coupledness remains an important predictor for the care choice for all regions except for the South. Having a daughter matters in all regions but the North and is more important than the number of children in general, reflecting the large share of women among heavy-helping children.

For the time trends, however, the partial correlations in the regressions differ from the picture obtained from the raw correlations we presented in Figure 1. The time trend towards formal care is strongest in the North and Middle, but is insignificant or weak in the South and in the U.S. once we control for other observable characteristics of families. In the North and Middle, the probability that a single person with fixed characteristics receives IC has decreased by about two percentage points per year, which is substantial. In the South, the decrease in IC over the sample period, however, can largely be accounted for by changes in other covariates.

As for the socio-economic variables, we have opted to include only covariates in the regressions that can reasonably be assumed to be pre-determined when the care decision is made: Education and household income (pension income is determined almost exclusively by earnings in working age). This facilitates the interpretation of the results, although we do not claim to uncover a causal relationship. Other economic variables, however, are clearly determined jointly with the care arrangement. For example, we would expect NH residents to spend down their wealth faster than IC recipients and to be more likely to sell their home. We thus omit wealth and home ownership from the regressions and report instead correlations for these variables separately. For socio-economic variables we will focus our discussion on singles with children who face trade-offs which are most relevant when evaluating policy options.

One would expect that children with higher opportunity costs in the labor market should be less likely to give IC. Since our data has good information on children's education but not wages we use education as a proxy for these opportunity costs. Specifically, for respondents

income (1.16), education years (4.22).

with multiple children we use the average years of education over all children. Our finding is summarized by the following fact:

Fact 15 *Having children with higher education is associated with lower use of IC, ceteris paribus, in the U.S. and, somewhat less so, in the South. This effect is small and not significant in Middle and North.*

We now present evidence on how the use of IC co-varies with wealth measures and some other variables. Economic theory predicts that this correlation should be positive for two reasons. First, IC slows down the spend-down in assets because it saves on expensive NH expenditures. This effect would make us expect an especially high correlation in the U.S. and the South. Second, richer individuals should have more bargaining power with their children when it comes to the IC decision. Indeed, Table 9 shows that elderly who have wealth are by up to 20 percentage points more likely to receive IC. This effect is strongest in the South and weakest in the U.S. (maybe surprisingly so) and the Middle.

Also, one would expect to find a strong positive association of home ownership with the IC choice. After all, it seems to make sense to sell one's house when entering a NH. However, our data show a significant relationship only in the North and the U.S. This is puzzling, since Northerners face the lowest financial burden from NH entry.

Fact 16 *Ceteris paribus, elderly who receive IC are more likely to hold wealth in all regions, most so in the South. Use of IC is positively correlated with home ownership in the North and the U.S., but no such effect is found for South and Middle.*

Finally, it is interesting to observe whether the gender of the elderly matters for the care decision. It is well-known that most NH residents are women. This is also the case in our data: Pooling all regions together, we find that 23% of disabled women live in nursing homes, but only 17% of men do so; this pattern is similar within all regions. However, this pattern turns around once we focus on singles: Table 9 shows that single women are more likely to receive IC than men. When controlling for other characteristics in the regressions in Table 8, the coefficients on the female dummy become, if anything, even larger. This leads us to our final fact:

Fact 17 *Unconditionally, women are less likely to receive IC than men. However, this is mainly driven by the fact that women tend to outlive their husbands and are thus more often single when they become disabled. When controlling for partnership status, women are actually more likely to receive IC than men.*

Table 7: Linear probability model for IC choice: all

	Pooled	North	Middle	South	US
North	-0.147***				
	(0.0142)				
South	0.264***				
	(0.0104)				
US	0.222***				
	(0.00851)				
age	-0.00438***	-0.00733***	-0.00863***	-0.00235	-0.00279***
	(0.000401)	(0.00119)	(0.00136)	(0.00120)	(0.000461)
time	-0.00321***	-0.0138***	-0.0130***	-0.00572**	0.00239**
	(0.000710)	(0.00193)	(0.00215)	(0.00188)	(0.000883)
disability	-0.0385***	-0.0335***	-0.0281***	-0.0149***	-0.0500***
	(0.000843)	(0.00231)	(0.00274)	(0.00219)	(0.00102)
female	-0.00909	0.00388	-0.0690**	-0.0184	0.0168*
	(0.00688)	(0.0192)	(0.0233)	(0.0198)	(0.00806)
coupled	0.187***	0.200***	0.250***	0.00993	0.195***
	(0.00842)	(0.0300)	(0.0365)	(0.0293)	(0.00887)
educ. yrs.	-0.00869***	0.00159	-0.00964***	-0.0150***	-0.00912***
	(0.000827)	(0.00251)	(0.00258)	(0.00223)	(0.00107)
log income	0.0126***	0.0210*	0.0181	0.0367***	-0.00107
	(0.00369)	(0.0103)	(0.0135)	(0.0102)	(0.00501)
nr. kids	0.0108***	0.0117*	0.0169*	0.0192***	0.00885***
	(0.00159)	(0.00540)	(0.00677)	(0.00521)	(0.00170)
has daughter	0.0752***	0.0141	0.0745**	0.0826***	0.0669***
	(0.00757)	(0.0200)	(0.0232)	(0.0205)	(0.00957)
Constant	7.307***	28.47***	27.26***	12.16**	-3.645*
	(1.427)	(3.879)	(4.316)	(3.783)	(1.771)
Observations	18749	2819	2193	2222	11515
R^2	0.267	0.238	0.263	0.107	0.273

Linear regression with IC dummy as dependent variable. IC dummy is 1 iff individual received more than half of care hours from informal sources. Income is on household level in 2010 Euros, adjusted by PPP for the U.S. First column pooled over regions, other columns by region (including country fixed effects – not reported). Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Sample: All respondents aged 65 and above who received care and for whom the main source of care can be determined. SHARE: Waves 1, 2, 5, 6; HRS: 5-11. *disability*: daily care need d in hours. Weights are used.

Table 8: IC choice of singles with kids

	Pooled	North	Middle	South	US
North	-0.128***				
	(0.0221)				
South	0.340***				
	(0.0174)				
US	0.243***				
	(0.0158)				
age	-0.00528***	-0.00270	-0.0182***	-0.0115**	-0.00121
	(0.00100)	(0.00295)	(0.00376)	(0.00368)	(0.00113)
time	-0.00277*	-0.0180***	-0.0186***	-0.000907	0.00377**
	(0.00113)	(0.00289)	(0.00358)	(0.00366)	(0.00137)
disability	-0.0473***	-0.0372***	-0.0376***	-0.0173***	-0.0567***
	(0.00130)	(0.00321)	(0.00435)	(0.00412)	(0.00156)
female	0.0636***	0.0950**	-0.0325	0.0101	0.0791***
	(0.0133)	(0.0336)	(0.0492)	(0.0557)	(0.0150)
educ. yrs.	-0.0136***	-0.00593	-0.0206***	-0.0174***	-0.00878***
	(0.00139)	(0.00415)	(0.00443)	(0.00475)	(0.00183)
log income	0.0168**	0.0463**	0.0324	0.0483*	-0.00261
	(0.00631)	(0.0153)	(0.0220)	(0.0198)	(0.00777)
nr. kids	0.0104***	-0.00166	0.00918	0.0318**	0.00693*
	(0.00252)	(0.0102)	(0.0145)	(0.0104)	(0.00269)
has daughter	0.0916***	0.0230	0.139***	0.0961*	0.0696***
	(0.0126)	(0.0304)	(0.0376)	(0.0405)	(0.0157)
kid avg. age	0.000565	-0.00266	0.00294	0.00944**	-0.000866
	(0.000940)	(0.00270)	(0.00337)	(0.00316)	(0.00108)
kid avg. educ. yrs.	-0.00189**	0.000761	-0.00130	-0.00381*	-0.0169***
	(0.000581)	(0.00117)	(0.00154)	(0.00154)	(0.00316)
Constant	6.474**	36.40***	39.12***	2.693	-6.258*
	(2.265)	(5.803)	(7.228)	(7.394)	(2.752)
Observations	8785	1249	896	658	5982
R^2	0.240	0.194	0.239	0.119	0.222

Identical to regressions from Table 7, but sample is restricted to singles with children.

Table 9: Unconditional IC gradients

	Pooled	North	Middle	South	US
some wealth	0.152***	0.154***	0.121***	0.198***	0.110***
	(0.00869)	(0.0203)	(0.0272)	(0.0269)	(0.0105)
owns home	0.0928***	0.173***	0.0374	-0.0313	0.0525***
	(0.0104)	(0.0275)	(0.0315)	(0.0259)	(0.0133)
female	0.0377**	0.0646*	0.0260	0.0906*	0.0425**
	(0.0115)	(0.0271)	(0.0404)	(0.0385)	(0.0132)
has child	0.197***	0.107***	0.180***	0.188***	0.191***
	(0.0121)	(0.0261)	(0.0327)	(0.0323)	(0.0162)
disabled	-0.234***	-0.251***	-0.279***	-0.144***	-0.304***
	(0.00945)	(0.0200)	(0.0260)	(0.0263)	(0.0119)

Table gives coefficients from regressions of the IC dummy on the dummy given in the first column (constant term not reported). Sample restricted to singles of age 65 and above who report care. SHARE: Waves 1, 2, 5, 6; HRS: 5-11. Weights are used. *some wealth*: net worth greater than 25,000 Euros (2010 Euros, adjusted by PPP for the U.S.). *disabled*: care need of $d \geq 3$h per day.

5 Conclusions

This paper presents a big picture of the provision of long-term care across Europe and the U.S., using data from SHARE and the HRS. We find a strong North-South gradient in the use of informal care in Europe, the U.S. being closest to Southern European countries. This indicates that policies are very important in shaping care decisions since informal care is used most in countries with low public LTC spending. However, this crowding-out pattern is not observed for private LTC insurance: Uptake of such insurance is low in all countries and does not vary systematically with government LTC provision. On the individual level, we find that a low degree of disability and the presence of a spouse are the strongest predictors for the use of informal care. Most informal care is given by individuals who co-reside with the care recipient, usually a spouse or a daughter. Households that use informal care hold higher wealth than those using formal care, most likely reflecting the high cost of nursing homes. High-education children make formal care more likely in the U.S. and Southern Europe, but not so in Central and Northern Europe. This indicates that economic factors matter more for the care decision in countries with low public LTC provision.

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A Appendix

A.1 Sampling, retention, and weights

When SHARE first contacts households the response rate is between 43% to 68%, varying by country. Inside each household, 89% of eligible individuals in the households respond. Like any panel, SHARE suffers from attrition through mortality and respondents withdrawal. The retention rates of alive individuals in SHARE are lower than in the HRS. Malter & Börsch-Supan (2013) document in their Chapter 10 that the probability of household response in SHARE's Wave 4 conditional on response in Wave 3 was around 80%, whereas it is above 90% for the HRS. In the long run, the retention rates for households first contacted in Wave 1 and who are still in Wave 4 drops to around 70%. Between countries, it varies from below 60% (Austria, Germany, Netherlands) to 90% (Switzerland). Retention at the *individual* level, however, is unproblematic: Conditional on a household being retained, all individuals in the household are almost certain to respond again. When a person dies, SHARE attempts to locate a proxy

respondent (typically a close relative of the deceased) to carry out an *end-of-life interview* in order to learn about the circumstances of the deceased at and before death.

SHARE provides sampling-design weights to compensate for unequal selection probabilities of households/individuals and for non-response of sample units; whenever appropriate, we use the "calibrated cross-sectional household weights" (`cchw_w#`) in order to obtain unbiased population statistics, following the recommendation of Malter & Börsch-Supan (2013) (see Ch. 8). For the HRS, we use the weights provided by RAND (`RwWTCRNH`) which include the nursing-home weights.

A.2 Evolution of nursing-home population in SHARE and HRS

Table 10 shows the evolution of the nursing-home population in SHARE and the HRS across waves and compares it to the numbers provided by the OECD.

Table 10: Percentage of over-65-year-olds in nursing homes over time

Country	Source	2004	2007	2009	2011	2013	2015
Sweden	SHARE	1.9	4.2	3.4	2.8	2	2.6
	OECD	6.8	6	5.8	5.2	4.9	4.5
Netherlands	SHARE	4.1	4.4	3.5	3	4.2	–
	OECD	7.3	6.9	6.7	6.5	5.6	5.3
Denmark	SHARE	4.2	4.2	3.6	3.4	3.7	2.9
	OECD	–	5.1	4.7	4.4	4	3.9
Belgium	SHARE	0.3	1.8	2.9	4	4	4.3
	OECD	6.4	6.6	6.7	6.7	8.8	8.8
Austria	SHARE	1.3	1.6	2.1	2.9	2.3	2.2
	OECD	–	–	–	–	–	–
Germany	SHARE	1.3	2.5	2.3	2	2.4	1.6
	OECD	3.8	3.8	3.8	4	4.1	4.1
France	SHARE	0.7	1.8	1.9	1.5	1.7	2.3
	OECD	3.7	4	4.2	4.4	4.4	4.2
Spain	SHARE	0.6	1.2	1.4	1.2	1.5	1.3
	OECD	–	–	1.3	1.7	1.8	1.8
Italy	SHARE	0.5	0.3	0.1	0.5	0.9	1.1
	OECD	–	–	–	–	–	–
U.S.	HRS	4.1	4.0	3.5	3.1	2.9	
	OECD	3.9	3.7	3.4	3.3	–	–

OECD data are from `http://stats.oecd.org`, Section *Long-Term Care Resources and Utilisation*; if data were not available for a year in question we took data (i) from the subsequent year and, if that was not available, (ii) from the year before; if neither (i) nor (ii) was available we report "–" (no data available). SHARE and HRS statistics are computed using the nursing-home dummy and weights.

A.3 Excluding help to healthy respondents

In general, we set care dummies and care hours to zero for all care categories if respondents did not report any (I)ADL limitations. We do this since LTC is defined as help with (I)ADLs, so any positive care hours reported by respondents without limitations are not consistent with this definition. Respondents sometimes seemed to declare help by cleaning ladies, home aides, and regular help by family members as care; we want to exclude such help from our measure of care.

A.4 Informal care (IC)

In all waves but Wave 3, SHARE asked about IC. In Waves 1,2 and 5, all information about IC is contained in the Social-Support Module. Waves 4 and 6 are special: We had to merge the Social-Support Module with the Social-Networks Module in order to determine the identity of some caregivers (see questions `sp003` and `sp021` as described in Release 1.1.1 of Wave 4, p. 11-13 and Release 6.0.0 of Wave 6, p. 28-30.) Unlike the HRS, SHARE has different sets of questions on IC coming from caregivers who live *inside* the respondent's household (often spouses) and caregivers who live *outside* the respondent's household (often children).

1. *IC from persons outside the household (outside-household informal care, OIC):* Inside each household, SHARE asks one person (the so-called *family respondent*) if anybody in the household is receiving help from family members or friends who live outside the household (questions `sp002` and following) and who these helpers are. In Waves 1 and 2, there is also a question on how frequently such help was received from each helper (`sp005`: daily, weekly, monthly, or less), and how many hours of care were received on a typical day/week/month/in the last year (`sp006`). However, Waves 4, 5 and 6 do not contain information on hours but only on frequency (daily, weekly, monthly, or less). What complicates matters for us is that the question on hours received in Waves 1 and 2 asks about the hours of care received *altogether by all members of the household.* Since we are after hours at the individual and not the household level, we proceed as follows to split up hours between couples:[18]

[18] Although it is not foreseen by the SHARE manuals, the question on informal care from persons outside the household was answered separately by inhabitants of the same household in many cases. The separate answers look plausible if interpreted as referring to care that the respondent received him/herself; in such cases we thus determine care hours separately from each partner's answer.

(a) *one partner in nursing home (less than 1% of cases)*: If one member of the couple resides in a nursing home, we assign all OIC hours to the household member at home and none to the nursing-home resident.

(b) *only one partner disabled (about 75% of cases):* If one of the partners reported at least one (I)ADL limitation but the other partner reported zero limitations (or the (I)ADL information was missing), we assign all OIC hours of care to the household member with limitations and zero to the one without limitations.

(c) *both partners disabled (remaining cases):* If both partners had at least one (I)ADL limitation, then we split the OIC hours between them. The split is proportional to a weighted sum of their (I)ADL limitations; we weigh the (I)ADLs since we find that each of them necessitates different amounts of care. The weights are taken from Regression (1) in Table 11, which regresses daily hours of care received by HRS respondents (for which we know care hours on an individual basis) on the (I)ADL dummies and a dementia dummy, omitting the constant term.

2. *IC from persons inside the household (inside-household informal care, IIC):* In households consisting of more than one person, SHARE asks each survey-eligible person both if she or he (i) gave personal care to or (ii) received personal care from other persons in the same household. *Personal care* is defined by the question as help with ADLs such as washing, dressing, getting out of bed that occurred on a daily or almost daily basis. A problem we encountered with inside-household help was that within couples the answers on who gave care to whom was often contradictory. For example, in some cases the husband reported to have received care from his wife, but the wife said she did not give help to her husband. This might be due to true disagreement between the partners; for example, the disabled partner may not want to admit that he was being helped. However, our analysis of the data rather suggests that these inconsistencies are due to data-entry errors. Consistent with this hypothesis, we find that disagreement between the partners' answers is a lot more likely when a proxy answered the questions about caregiving for the respondent. This proxy is almost always the spouse him/herself – in this case, there is obviously no room for disagreement, since one person answered for both partners. We conclude that most likely the interviewer and respondent were not careful when going over the questions about caregiving to the partner a second time (in the case of proxy interviews) or when spouses answered the survey together and had to answer the same questions from the perspective of both sides. We adopt the following strategy to address

this issue: Whenever there is contradictory information inside a couple or when the partners claimed that they were giving care to each other, we check if both members of the couple are actually disabled. We assume (i) that non-disabled persons do not receive care, (ii) that couples with a similar level of disability really provide care to each other (they may have problems with different activities, making this possible), and (iii) that care goes from the healthier to the more disabled person in case of large differences in disability. As a *large difference*, we define a difference of 3 or higher in the count of the 6 ADL limitations (note that the question explicitly referred to help with these ADLs).

A.5 Formal home care (FHC)

SHARE Waves 1, 2, 5 and 6 collected information on formal home care (FHC); Waves 3 and 4 did not ask about FHC. Questions on FHC were asked on the *individual* level, meaning that we have separate information on each household member. SHARE divides the question on FHC into three categories: (i) *nursing/personal care*, (ii) *private domestic help*, and (iii) *meals-on-wheels*. Nursing/personal care explicitly refers to activities that fall strictly under LTC: help with dressing, bathing, showering, going to bed etc. Private domestic help includes typical household tasks like cleaning, cooking, and shopping.[19] Meals-on-wheels refers to ready-made meals provided by an organization or company to the respondent. In Waves 1 and 2, SHARE asks precisely for how many weeks in the last year and how many hours per week each of the three types of formal home care was received (however, hours are not asked for when it comes to meals-one-wheels). In Waves 5 and 6, there is only information *if* the respondent received each type of care, but not on the frequency nor on hours. Whenever the information is available, we compute the hours of care for each type of FHC as follows. We multiply the number of weeks in which care was received in the last year (questions `hc033`, `hc035`, `hc037`) by the number of weekly hours (questions `hc034`, `hc035`). For meals-on-wheels, there is no information on weekly hours; we impute 1.852 hours per day. We obtain this number from the following regression: We regress the total daily hours of care received on 11 dummies for the (I)ADLs and a dummy for memory limitations, omitting the constant term. The sample for this regression are non-nursing-home residents in the HRS. The coefficient on the IADL dummy *preparing*

[19]The explanatory text to the question on paid domestic help makes it clear (in all waves) that the question refers only to help that was received because the respondent had health problems that made the task difficult to perform for the respondent herself. Thus, in theory, cleaning ladies hired by perfectly healthy respondents should not be reported here. However, the data indicate that the question was not always understood this way by respondents. Out of the roughly 6,200 respondents who said they received help with domestic tasks, about 750 reported that they had no mobility limitations. We did not consider help to these apparently healthy respondents as care.

meals is 1.852, which has the interpretation as the daily time need of preparing meals for a caregiver at home.

A.6 Dealing with missing care hours

Apart from imputing hours for meals-on-wheels in the category FHC, data on hours of care are incomplete in many cases, especially in SHARE. We separate the missing-hours problem into the following four issues:

1. SHARE only reports hours of OIC on the household level, but not the individual level (this concerns Waves 1 and 2).
2. SHARE does not ask about OIC and FHC hours from Wave 4 through 6.
3. SHARE does not ask about IIC hours.
4. Neither SHARE nor the HRS ask about care hours received by nursing-home residents.

Note that in Points 2 and 3, we deal with OIC and IIC separately. We do this since the mere fact of having an inside-household helper likely contains information on care needs that go beyond the observables in our data. Co-residing with a helper makes it more likely that the frail elderly has heavy care needs and the presence of a helper is needed around the clock; Barczyk & Kredler (forthcoming) document that co-residency between children and parents is frequently associated with heavy care needs.

Formally, our imputation strategy is based on the following assumption:

A1 $\mathbb{E}[h_i^{tot}|lim_i, cores_i] = \mathbb{E}[h_i^{tot}|lim_i, cores_i, country_i]$: Conditional on their limitations and co-residence of a helper, community residents in all countries receive the same *total* number of hours of care.

Note that we make no assumption on the *source* of care (i.e. we do not impute hours received as IC, FHC etc.), but only the *total number of hours of care* an individual receives. The source of care is then determined entirely from the data.

We now briefly discuss Assumption A1. The assumption may fail if individuals with the same set of limitations demand more care in a country that subsidizes care more generously. But this should be a problem mainly for FHC, which accounts for only a small fraction of care hours. Similarly, informal caregivers may spend more hours in some countries when dealing

with the same set of limitations, maybe because their opportunity cost of time differs. However, since our goal is to find out how a given set of care needs are met across (and not so much how care varies in intensity), it is actually appropriate for our purposes to assign the same number of hours to individuals with the same set of limitations. The most serious concern is probably the differential selection of severely-disabled respondents in IIC and NH across regions. We would expect that in the South, many severely-disabled individuals stay at home and receive IIC while individuals with the same limitations would already have entered a nursing home in the other regions. The (I)ADL, memory, and age variable in the regressions should capture most of this differential selection. However, any unobservable characteristics that predict care needs and nursing-home entry simultaneously will lead to biases. Specifically, we would expect an under-estimation of IIC hours in the South since we impute care hours for them from a sample of less-disabled elderly.

For nursing-home residents (Category 4), the goal of our imputation is not to predict the hours of care that these individuals receive from nursing-home employees. Rather, the imputation aims to answer the following question: How many hours of care would the individual require if being cared for at home? As argued in the main text, this is in line with our objective to calculate which fraction of care needs in a country is met by the different categories of care.

Table 11 shows the regressions we use for the imputations in the fours cases (numbering of regressions identical to the listing above). The left-hand side of the regression is always the total number of hours of care received (from all sources); we include only observations where the total number is known. The right-hand side includes a set of dummies for 11 (I)ADLs, a dummy for dementia, and the respondent's age.[20] In the following, we describe the imputation regressions for cases 1-4 in detail:

1. **Split hours inside SHARE couples who are both disabled**: Here, our goal is to obtain a measure of how important each (I)ADL is in determining care needs. We regress the total hours of care on 11 (I)ADL dummies and the dementia dummy, omitting the constant term. The sample of the regression consists of HRS and SHARE community residents for whom the total hours of care are known (for SHARE, we can only take singles and couples who answered separately to the question at this point). The results from the regression are shown in Column 1 in Table 11. The coefficients, which turn out

[20]We omitted age squared and gender; both were insignificant and failed to improve the fit of the regressions. We deliberately do not include other health markers in our regression. These other health markers are highly correlated with the (I)ADL dummies, leading to collinearity. We prefer the (I)ADL measures to other health and mobility measures since they were specifically designed to measure care needs. We make an exception for dementia since dementia obviously increases the need for supervision even when the elderly is not physically frail.

to be all positive, are assigned as the weights to the (I)ADLs and the dementia dummy. OIC hours of care at the household level (in SHARE's Waves 1 and 2) are then divided among household members proportionally to the sum of weights over (I)ADLs that each household member has.

2. **Impute hours for non-IIC community residents with incomplete hours information** (more precisely: for community residents in SHARE and HRS who do not receive IIC and for whom we know *that* they received OIC and/or FHC, but for whom information is lacking on *hours* of OIC and/or *hours* of FHC; most of these cases like come from Waves 5 and 6 in SHARE in which hours were not asked): We impute total hours for these individuals from the sample of HRS and SHARE community residents who do not receive any care from inside the household and for whom total hours are known. Here, we include information from couples in SHARE for whom we assigned hours in Point 1.

3. **Impute hours for IIC recipients in SHARE** (more precisely: for all SHARE respondents who received some IIC, but also HRS community residents who received some IIC but for whom hours information is incomplete): We impute total hours of care for these individuals from the sample of HRS community residents who receive care from at least one member of the same household and for whom we have precise hours information. At this stage, we do *not* use the imputed values from Point 2 since these are not original information.

4. **Impute hours for nursing-home residents in SHARE and HRS**: For all individuals residing in nursing homes we impute hours of care from the sample of HRS community residents and SHARE community residents for whom we have precise information on total care hours. Note that in SHARE, these must be respondents who received only OIC and/or FHC in Waves 1 and 2. Again, we do *not* use imputed values from Points 2 and 3 in the regression since these are not original information.

A.7 Assigning hours to care categories

Once we have imputed total hours of care, we assign them to the different care categories (IIC, OIC, FHC) in case that this information is missing. For nursing-home residents, we assume that they did not receive any informal care. Let h_{tot} be total hours of care. We proceed as follows:

1. If there is only one type of care reported, all hours are assigned to this type of care.

Table 11: Imputation regressions

	(1)	(2)	(3)	(4)
covariate	daily hours	daily hours	daily hours	daily hours
dementia	1.689***	1.401***	1.482***	1.644***
	(0.130)	(0.166)	(0.189)	(0.127)
dress	0.511***	0.601***	0.460***	0.568***
	(0.0881)	(0.119)	(0.136)	(0.0922)
walk	0.996***	0.645***	1.183***	1.027***
	(0.103)	(0.132)	(0.147)	(0.101)
bath	0.994***	0.769***	1.227***	0.819***
	(0.0984)	(0.119)	(0.156)	(0.0977)
eat	1.180***	1.090***	1.092***	1.174***
	(0.126)	(0.162)	(0.181)	(0.124)
bed	0.294**	0.364*	0.622***	0.491***
	(0.106)	(0.142)	(0.150)	(0.106)
toilet	0.246*	0.348*	0.200	0.284*
	(0.114)	(0.148)	(0.162)	(0.112)
meals	1.922***	1.416***	1.997***	1.874***
	(0.101)	(0.127)	(0.147)	(0.0987)
shop	0.919***	0.568***	1.174***	0.835***
	(0.0791)	(0.115)	(0.137)	(0.0911)
phone	1.139***	0.784***	0.690***	0.957***
	(0.112)	(0.149)	(0.161)	(0.111)
meds	1.531***	1.609***	1.553***	1.564***
	(0.123)	(0.166)	(0.170)	(0.121)
money	1.075***	0.751***	1.343***	0.991***
	(0.0915)	(0.117)	(0.147)	(0.0945)
age		0.0436***	0.0796***	0.0424***
		(0.00444)	(0.00565)	(0.00349)
constant		0.327**	1.166***	0.444***
		(0.109)	(0.144)	(0.0888)
N	12406	6337	6311	12648
R^2	0.519	0.266	0.346	0.301

Regression of daily hours of care on dementia and (I)ADL dummies and age. Samples 1-4 are defined in text. Weights are used. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2. If exactly two types of care are reported (e.g. IIC and FHC) and...

   (a) ...hours are known for none of them: We code hours in the two categories as missing.

   (b) ...hours are known for exactly one type of care. Say h_i hours are known for care category i. We assign $\min\{h_i, 0.9\times h_{tot}\}$ to category i, and $\max\{h_{tot}-h_i, 0.1\times h_{tot}\}$ to the other care category. This means that we assign at least 10% of care hours to the smaller category in case the subtraction yields a value below 10%, which avoids negative hours.

   (c) (...hours known for both: No need to impute)

3. If the respondent reports all three types or care and...

   (a) ...hours are known for none of them: Code hours in all three categories missing.

   (b) ...hours are known for exactly one category. Say h_i hours are known for care category i: We then assign $\min\{h_i, 0.9 \times h_{tot}\}$ to category i and assign missing values to hours in the other two categories.

   (c) ...hours are known for exactly two care categories, say h_i and h_j:

      i. If $h_i+h_j \leq 0.9\times h_{tot}$, we assign h_i and h_j to categories i and j and $h_{tot}-h_i-h_j$ to the remaining category.

      ii. If $h_i + h_j > 0.9 \times h_{tot}$, we assign $\frac{h_i}{h_i+h_j}0.9 \times h_{tot}$ to i, $\frac{h_j}{h_i+h_j}0.9 \times h_{tot}$ to j, and $0.1 \times h_{tot}$ to the third category.

   (d) (...hours known for all categories: No need to impute)

A.8 Data availability

Codes for the above imputations and the resulting data tables are available on request from the authors. They will be made publicly available upon publication.