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Austria 2025:

Informal, Formal, or Both?

Assessing the Drivers of Home Care Utilisation in Austria Using a Simultaneous Decision Framework

Matthias Firgo, Klaus Nowotny, Alexander Braun

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Informal, formal, or both? Assessing the drivers of home care utilization in Austria using a simultaneous decision framework*

Matthias Firgo†, Klaus Nowotny‡ and Alexander Braun§

May 31, 2017

Abstract

Understanding the relation between different types of long-term care (LTC) and the determinants of individual choice of LTC types is fundamental for efficient policy making in times of aging societies. However, empirical research on this issue has revealed both national and methodological factors as crucial for the policy conclusions drawn. Thus, the purpose of the present paper is twofold: First, at least to our knowledge, it is the first comprehensive assessment of this kind for Austria. Second, it extends the scarce literature explicitly focusing on the combined use of informal and formal care in addition to the exclusive use of these services based on an econometric framework accounting for the simultaneity and interdependencies in these types of LTC. Our results provide strong evidence for a task-specific and complementary relation of formal and informal home care in Austria, with the health status and functional limitations as the main determinants of individual choice.

Keywords: long-term care, formal, informal, bivariate probit, SHARE, Austria.

JEL Classification: C35, H44, I11, I12, J14.

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1 Introduction

The efficacy and efficiency of present and future long term care (LTC) systems becomes increasingly important in the context of "double aging" societies. The number of people above 65 years of age will increase rapidly with the baby-boomer-generation born between the mid 1950s and early 1970s. This cohort will reach the age of retirement in the upcoming decades. This will lead to a sharp increase in demand and expenditures for LTC across Western societies (for the EU countries see European Commission, 2015) irrespective of whether healthy life expectancy increases ("compression of morbidity"; Fries, 1980) or not (cf. Zweifel et al., 1999). In this context a sound understanding of the (structural as well as socio-economic) factors that determine the utilization of LTC and the choice between informal care (provided by family, friends or neighbors) and formal care (provided by professionals) becomes particularly important.

Analyzing this choice is especially important as policies across many European countries are based on increasing the supply of formal home care services. This is supposed to improve the personal satisfaction of care dependent individuals and to control the increase in public expenditures for LTC by enabling people to live at home longer rather than in expensive nursing homes. However, the efficacy of such policies and the implications for informal care givers are still not well understood. If informal and formal home care are substitutes, then an extension of formal home care supply will compensate for the decreasing potential in informal care due to smaller household sizes, fewer children, and higher employment and mobility rates among these children. It will also support labor market policy goals on female employment rates given that the majority of informal care is still provided by women. However, if informal and formal home care are complements, to be successful policies prioritizing formal home over institutional care have to be accompanied by policies increasing the incentives for informal care provision such as (full) financial and social security compensation for informal care givers.

A number of recent papers focused on the determinants of individual choice of and/or on the relation between different types of LTC. Empirical results on the former typically highlight the importance of the individual state of health as well as family characteristics but the results tend to differ depending on the (set of) countries analyzed and on the econometric framework chosen. Evidence on the latter has been highly inconclusive, with the results again depending on the econometric models employed and on the (groups of) countries analyzed (see, for instance, Gannon and Davin, 2010). This stems from the fact that large differences in institutional design (such as capacity planning, quality insurance, stakeholder influence, entitlement, and monetary benefits or obligations for in-

formal carers) as well as in cultural aspects—for instance social preferences for institutional (nursing home and/or institutional care) versus formal versus informal home care—exist across the countries of Europe (Österle, 2001; Da Roit and Le Bihan, 2010; Kraus et al., 2010; Riedel and Kraus, 2011, 2016; Geerts and Van den Bosch, 2012; Riedel et al., 2016). These differences not only affect the utilization rates of different types of LTC but also the factors that determine the individual choice in LTC and to some degree the substitutability of different LTC modes. Two recent papers explicitly highlight the differences in determinants for LTC utilization (Bakx et al., 2015) and in the relation between LTC services (Bolin et al., 2008) even between countries with similar LTC systems. In addition Suanet et al. (2012) highlight the effects of country specific societal determinants such as pension generosity or legal obligation to care for relatives both directly on the probability to receive formal or informal care, and indirectly via influencing the effects of the health status of the care dependent on the choice in LTC.

Against this background the purpose of the present paper is twofold: First, to the best of our knowledge, we provide first comprehensive evidence on the drivers for the individual utilization of informal and/orr formal home care and on the relation between these types of LTC in Austria.[1] Second, we add to the scarce literature that explicitly models the determinants of LTC utilization in an econometric framework that goes beyond simple (multinomial) probit/logit models.

With respect to the former purpose (evidence on Austria), the in total rather inconclusive previous results found in cross-country studies as well as in analyses for individual countries call for further country specific analyses to inform national and local policy makers about the actual determinants of LTC utilization in their country and given the country-specific institutional setting: In Austria, until the mid 1990s LTC was largely viewed as the responsibility of the family by the population as well as by fragmented policy approaches (Da Roit et al., 2007). In 1993 a reform program was introduced that included comprehensive cash benefit legislation. This granted cash-for-care (*"Pflegegeld"*) on a needs- but not means-tested basis. While there is a legal entitlement to this care allowance there is no such entitlement to LTC services. The system is characterized by both central and non-central decision making and capacity planning (see Riedel et al., 2016, among others, for details). While *Pflegegeld* is based on a national law and funded by the national government, LTC services—including decision making, capacity planning and funding—are are organized by the in-

[1]Multivariate analyses on Austria are limited to the role of the socioeconomic status on LTC utilization in the capital Vienna (Schmidt, 2017). This metropolitan area, however, is characterized by sociodemographic and socioeconomic conditions that are very different from the rest of the country.

dividual federal states of Austria. The introduction of *Pflegegeld* has helped to support informal and formal arrangements and was evaluated positively by informal carers (Badelt et al., 1997). However, families and particularly female family members still provide the majority of LTC, and home care prevails as the dominant mode of LTC in Austria. This also stems from the legal fact that institutional care has to be paid by using the (financial and real) property of the care-dependent—and thereby capital that would be otherwise inherited—if (pension) income and *Pflegegeld* do not cover the high costs of institutional care. Recent reforms have again given home care priority over institutional care but due to a lack of micro data little is known about the relation between LTC modes and the choice determinants. The current paper seeks to shed light on this relation and the determinants for the choice between informal and/or formal home care.

With respect to the latter purpose (econometric framework), formal and/or informal care utilization is likely to be the result of a joint decision among the care dependent and potential informal care givers. To the best of our knowledge, however, only Jiménez-Martín and Prieto (2012) have explicitly modeled the determinants for the combined use of formal and informal home care (FIC) in addition to the exclusive use of formal care (FC) or informal care (FC) in an econometric framework that addresses the simultaneous nature of care decisions as well as any interdependencies between IC and FC. Given the growing number of recent papers finding a (task specific) complementarity of IC and FC (Bonsang, 2009; Jiménez-Martín and Prieto, 2012; Balia and Brau, 2014; De Meijer et al., 2015), proper econometric modeling for the determinants of FIC in comparison to FC and IC clearly is of high relevance for policy makers.[2]

2 Related literature

The relationship between formal LTC services and informal care has been a subject of the literature for many years. Despite a substantial number of empirical contributions, however, evidence has remained mixed. A number of early papers for the United States found evidence for substitution between informal and formal home (Van Houtven and Norton, 2004, 2008) and institutional (Lo Sasso and Johnson, 2002; Charles and Sevak, 2005) care. Bolin et al. (2008) draw a similar conclusion on home care also for the EU but acknowledge different patterns in different EU countries—with a north-south gradient showing stronger substitution in Southern Europe—as well as relatively small substitution effects. In addition, Gannon and Davin (2010) find rather substitutive than

[2]Balia and Brau (2014) and Bruni and Ugolini (2016) estimate simultaneous models but do not model the determinants for cases of FIC.

complementary relations between IC and FC for France and Ireland and illustrate that results highly depend on the specific econometric frameworks chosen.

Substitution patterns between LTC modes are confirmed for the United States also in more recent contributions (Li and Jensen, 2011; Guo et al., 2015).[3] Recent studies on European countries—with a study on Germany (Pilny and Stroka, 2016) as an exemption—identify rather different patterns: For a number of EU countries Geerts and Van den Bosch (2012) find a complementary more often than a substitutive relation between IC and FC. A complementary relation is also found for Spain by Jiménez-Martín and Prieto (2012). Other recent papers for Europe since Bonsang (2009) have pointed out task specific relations of substitution and complementarity, respectively, with FC serving as a substitute (complement) for IC in basic activities (more complex tasks). Task specific substitutive/complementary relations for Europe were confirmed by Balia and Brau (2014) who at the same time emphasize the small scale of the effects. Jiménez-Martín and Prieto (2012) confirm task specificity patterns between informal and formal home care in Spain. De Meijer et al. (2015) conclude for the Netherlands that the substitutability between institutional and home care decreases with the disability level of the care dependent.

A number of papers have been dedicated to the identification of drivers for the utilization of home care services and informal care. A common finding is that the individual health conditions as well as family characteristics of the care dependent are the main factors determining the choice in type of LTC. Apart from these, individual studies uncover a number of interesting additional factors. Mellor (2001) concludes that current and future availability of IC has no effect on the probability for insurance coverage for LTC services. Lo Sasso and Johnson (2002) show that informal support in basic activities of daily living (ADLs) reduces entry into institutional care but informal support has no effect on entry probability if also instrumental activities in daily living (iADLs) are considered.[4] Using Italian data Bruni and Ugolini (2016) conclude that disability related variables rather than family characteristics determine utilization of institutional care while household and socioeconomic factors are found to be more influential in explaining the choice between IC and FC.

Using data on 10 EU countries, Bonsang (2007) focuses on the substitution between time and money in relation to geographical distance of potential IC giving children. He identifies gender, age, employment status, geographical

[3] Additionally, there are two papers (Mellor, 2001; McMaughan Moudouni et al., 2012) on the United States concluding that IC and FC are neither substitutes nor complements.

[4] ADLs include self-care tasks such as functional mobility (walking, getting out of bed, etc.), bathing and showering, dressing, self-feeding, personal and toilet hygiene. iADLs include housekeeping and laundry, preparing meals, taking medications as prescribed, managing money, shopping, use of telephone or other form of communication, transportation within the community.

distance of the child as well as age and health/disability of the parent as the determinants for the amount of IC provided while expected inheritance and money received from parents turned out to be insignificant. For a similar set of countries Balia and Brau (2014) confirm age and disability levels as important predictors for the choice in LTC but augment the set of main drivers by proximity to death, which is found to significantly affect the use of paid domestic help and IC. For the case of Spain Jiménez-Martín and Prieto (2012) find that the choice of the LTC type crucially depends on age, gender, and the marital status of the care dependent person but also on the availability of FC services. In line with the latter Paraponaris et al. (2012) and Bakx et al. (2015) conclude that low socioeconomic status increases difficulties in accessing FC. While finding a complementary relation more often than a substitutive relation between IC and FC, Geerts and Van den Bosch (2012) conclude that among Scandinavian countries and continental European countries with needs-based entitlements, the transition to FC strongly depends on the availability of IC.

Despite different FC utilization rates Geerts and Van den Bosch (2012) find little evidence for country differences in the effect of health variables in the transition to FC. Conversely, Suanet et al. (2012) illustrate that in European countries with legal obligations to (finance) care for relatives older adults with many functional limitations are less likely to receive FC both exclusively and in addition to IC. Bakx et al. (2015) also illustrate that—despite universal public LTC insurance—differences in system features such as eligibility rules, coverage generosity and social preferences lead to differences in the choice between IC and FC in Germany and the Netherlands. The importance of institutional factors is also corroborated in De Meijer et al. (2015) who find that changes in formal home care utilization rates in the Netherlands over time can be explained by changes in institutional factors rather than by shifts in the disability distribution of the population. In a nutshell, empirical analyses seeking to identify the drivers for choice in LTC across countries may suffer from identification problems due to potential differences in the effects for individual variables between countries.

Despite the common conclusions of the high relevance of health and family characteristics, methodological considerations might also have affected the results of some the previous publications. Gannon and Davin (2010) and Charles and Sevak (2005) clearly illustrate the potential bias when not accounting properly for the simultaneous nature of LTC utilization decisions and the potential interdependencies between IC and FC. However, many of the papers focusing on the determinants for choice in LTC cited in the previous paragraphs are based on econometric models ignoring such simultaneity and interdependencies. Geerts and Van den Bosch (2012) estimate hierarchical logistic regression models while others chose multinomial probit (Paraponaris et al., 2012; Bakx et al., 2015) or

multinomial logit (De Meijer et al., 2015) models. Suanet et al. (2012) even estimated separate (binary) logit models for informal care, formal care and mixed care utilization. Among those papers that analyze the predictors for exclusively using informal (IC) or formal care (FC) and for using both (FIC), respectively, only Jiménez-Martín and Prieto (2012) estimate models accounting for simultaneity and interdependencies between different LTC types. Such a framework is also chosen by Balia and Brau (2014) and Bruni and Ugolini (2016) who, however, do not model instances of FIC. The consideration of simultaneous decision processes in our empirical framework will be described in section 4 below.

3 Data

We use the fifth wave of the Survey of Health, Ageing, and Retirement in Europe (SHARE, see Börsch-Supan, 2015, for details) for our microeconometric analysis. SHARE is a panel dataset that includes micro data from 20 European countries and more than 220,500 individuals. The data set allows a joint analysis of health issues, sociodemographic factors and individual income levels.[5] The fifth wave used in this paper was collected in 2013 and published in 2015.[6]

For Austria, Wave 5 includes 4,385 individuals. The analysis focuses on those 3,217 individuals which are 60 years of age or older. Taking into account missing information for the dependent and explanatory variables (see below) and focusing only on individuals living in private households slightly decreases the final sample size to 3,125 individuals. The set of dependent and explanatory variables used in the analysis is illustrated in Table 1.

[Table 1 about here.]

In the empirical analysis we estimate two models (see Section 4). In the first model we investigate the determinants explaining whether individuals that are not living in an institutional care facility utilize any form of home care (IC, FC or FIC) or not, using a probit specification. The second model analyzes the choice between IC, FC, FIC or no care in a bivariate probit model.[7] The share

[5] Missing values, especially those related to income, were imputed from the EU Statistics on Income and Living Conditions (EU-SILC) before the release of the data (see Malter and Börsch-Supan, 2015).

[6] Wave 5 is used because it is the first wave that allows us to define formal and informal home care for Austrian respondents in the way described below using a sufficient sample size.

[7] Informal care is defined using two questions. The first question ("SP002_HelpFrom" in the SHARE wave 5 questionnaire) asks: "Thinking about the last twelve months has any family member from outside the household, any friend or neighbour given you personal care or practical household help?" Respondents were shown a card that defined "personal care" as "dressing, bathing or showering, eating, getting in or out of bed, using the toilet" and "practical household help" as help "with home repairs, gardening, transportation, shopping, household chores or help with paperwork, such as filling out forms, settling financial or legal matters."

of people receiving any type of LTC in the sample is 26.4 % (824 individuals). Out of those 404 (166) individuals receive only IC (FC), and 254 people a combination of both (FIC) types of LTC. The remaining 2,301 people did not receive any form of LTC by the time the data were collected.[8]

As independent variables we include a number of socioeconomic and structural factors as potential determinants for the choice of LTC. The group of socioeconomic variables comprises household income and size, children, marital status, and the educational level. The mean income per capita at the household level is an aggregation of self-reported net income components per annum. Little surprising the mean income is higher than the sample mean of € 17,103 for those using FC (€ 18,314) and lower than the sample mean for those using IC (€ 16,053) or FIC (€ 16,148).[9]

The mean household size is 1.90 with most individuals living in two-person households (57.7 % of the sample). The share of one-person households is at 30.1 % (the sample maximum is 8 people). Household size averages are slightly lower among LTC users (1.73) than among Non-LTC users (1.96). In addition to household size we include a dummy variable equal to one if an individual identifies as "Single". The total share of single individuals in the sample is 36.4 % and is again higher among LTC users than among Non-LTC users.

Besides partners, children are the most important source for IC. The literature typically finds a large impact of the gender of children on their willingness to provide IC. Thus, we include separate dummy variables on the existence of a daughter (share of 45.6 %) and a son (share of 46.1 %), with the share of individuals without children at 38.7 %. As expected Table 1 reveals that for both daughters and sons the ratio of individuals having a child of this sex is the highest (lowest) for the group of care dependent using IC (FC).

The second question ("SP020_RecHelpPersCareInHH") asks: "And is there someone living in this household who has helped you regularly during the last twelve months with personal care, such as washing, dressing? By regularly we mean daily or almost daily during at least three months. We do not want to capture help during short-term sickness." Respondents were coded as receiving informal care if they affirmed any of these two questions. Furthermore, they were coded as receiving formal care if they affirmed question "HC127_AtHomeCare" in the SHARE wave 5 questionnaire: "We already talked about the difficulties you may have with various activities because of a health problem. Please look at Card 40. During the last twelve months, did you receive in your own home any professional or paid services listed on this card due to a physical, mental, emotional or memory problem?". The services listed on Card 40 include "help with personal care (e. g. getting in and out of bed, dressing, bathing and showering)", "help with domestic tasks (e. g. cleaning, ironing, cooking)", "meals-on-wheels (i. e. ready made meals provided by a municipality or a private provider)" and "help with other activities".

[8] When constructing our dependent variables, i. e. binary variables on utilization of (different types of) LTC, we make the implicit assumption that all individuals who are in need for home care select themselves into one the three LTC groups (IC, FC, FIC) and that none of the individuals (irrespective of whether they receive care or not) have unmet needs.

[9] A very small number of 13 respondents reported an income of zero. Since this is only 0.4 % of the total sample we ignore these missing values in the remaining analysis.

To control for education, which might influence both the likelihood for becoming care dependent because of differences in occupational distributions and the choice of LTC, we include a dummy variable that is equal to one in case an individual obtained an education level beyond compulsory education (ISCED > 2 according to the ISCED 1997 classification). The share of individuals with higher than compulsory education is significantly higher in the group of Non-LTC users compared to LTC users. On the one hand this could indeed indicate a lower risk for care dependence associated with higher education due to better health conditions. On the other hand this could also mean that people with higher education choose institutional care over home care more often if they become care dependent and are thus not part of the sample.

As structural independent variables we include gender, age, place of residence with respect to urbanization, limitations in the instrumental activities of daily living (Lawton, 1969), chronic conditions, and the subjective health status reported. Among these variables we expect a major impact from age on both care dependency and the choice of LTC. The mean sample age is 71.0 and little surprising is the lowest among Non-LTC users (69.5 years, compared to 75.4 amont LTC recipients) and the highest (78.7) in the FIC group. This, together with a lower mean age (72.8) among IC users than among FC recipients (76.7) suggests a chronological and thus task specific to complementary relation between IC and FC.

In this respect also the health related variables show a coherent distribution between LTC user groups. The mean number of limitations in the instrumental activities of daily living (iADL) are higher in the IC group than among those not receiving care and peaks in the FIC group (with a mean of 2.8 iADL limitations). Also, the average number of chronic conditions[10] is highest (lowest) and the subjective health status[11] is poorest (best) in the group of FIC users (Non-LTC users) and generally lower for Non-LTC users than for LTC recipients. Similar patterns are found for the number of chronic diseases at the LTC group aggregates. Still it is worth mentioning that there is substantial correlation between self-reported health status and the number of conditions at the individual level (with a coefficient of correlation of 0.48). For this reason we will use the subjective health status only as a variable to check the robustness of the results with respect to the inclusion of an additional health variable. For limitations in iADL we generate dummy variables for 1–2 (iADL1-2) or three or more (iADL3+) limitations (with zero iADL limitations serving as a reference)

[10]This includes positive observations of the question: 'doctor told you had:...' (heart attack, high blood pressure, cataract, COPD, diabetes, ulcer, cancer, Parkinson disease, Alzheimer, rheumatic arthritis, osteoarthritis, hip fracture, affective disorder, or other).

[11]This variable is a self rated 5-point Likert-scaled classification of subjective health satisfaction with 1 being "excellent" and 5 being "poor".

because of rather homogeneous shares in LTC types among individuals with 1-2 and among individuals with 3 or more iADL limitations, respectively. In the absence of such similarities we introduce separate dummy variables ("Multimorbidity") for individuals with 2, 3 or 4 chronical conditions and only combine 0-1 conditions (as a reference group) and ≥ 5 conditions as dummy "Multimorbidity (5+)" because of the small fraction of individuals with no or more than five conditions.

For differences by gender, we include a dummy variable that is equal to one for females. Women account for 54.1 % of the non-LTC recpipients but for 64.2 % of all LTC users. In the latter group the share of women is especially high among formal care recipients (71.7 %). Females account for 76.4 % of all singles in the sample but the number of female singles is slightly below that of women in a relationship. Conversely, 80.1 % of all men in the sample are in a relationship. These differences reflect the higher life expectancy of females in these age-cohorts, implying that men are more likely to have died before their female partners in relationships among individuals of similar age. To control for potential heterogeneity between males and females, we will also include an interaction term of sex and marital status.

Differences in the choice of LTC might also be driven by factors of agglomeration. The percentage of people who live in a "large city"[12] is 23.1 % in the full sample with similar shares found for all groups except for FC (37.0 %). Thus, via smaller household size, higher employment rates (especially among females) and smaller informal networks a higher share of FC only users are found in urban areas.

We restrict our analysis to the choice of home care modes because SHARE wave 5 for Austria contains only very few individuals who were living in a nursing home at the time of the interview. Also, while recent SHARE waves have substantially increased the Austrian sample, the number of observations providing information on the amount of care (the number of hours by LTC mode) used is still too small to analyze the intensive margin of LTC utilization. Thus, our analysis focuses on explaining the determinants of LTC utilization at the extensive margin.

4 Econometric model

The empirical analysis utilizes two econometric models. In a first step, we utilize a probit model to estimate the effect of the explanatory variables X_i on a binary

[12] Whether a city is "large" or not is assessed by the interviewers.

dependent variable ($Care_i$) which takes on a value of one if respondent i received either formal care (FC_i) and/or informal care (IC_i) and is zero otherwise:

$$\Pr(Care_i = 1|X_i) = \Pr(\varepsilon_i > -X_i\beta|X_i) = \Phi(X_i\beta)$$

where X_i is a matrix of explanatory variables, β is a parameter vector to be estimated and ε_i is an i. i. d. error term, $\varepsilon \sim N(0, 1)$. From this model we can calculate the impact of the explanatory variables on the probability of receiving any type of care.

Since we are also interested in the differences of the determinants of formal and informal care, probit models could be estimated for both care types:

$$\Pr(FC_i = 1|X_{1i}) = \Pr(u_i > -X_{1i}\gamma|X_{1i}) = \Phi(X_{1i}\gamma) \quad (1)$$

$$\Pr(IC_i = 1|X_{2i}) = \Pr(v_i > -X_{2i}\delta|X_{2i}) = \Phi(X_{2i}\delta) \quad (2)$$

Estimating the two probits (1) and (2) separately would, however, ignore the often simultaneous nature of the care decision as well as any interdependencies between formal and informal care. For example, if there are unobserved effects that affect the probability of receiving formal care, it can be expected that these factors also affect the probability of receiving informal care which would lead to a correlation of the error terms u_i and v_i.

We therefore estimate a bivariate probit model as a second step (see Greene, 2011, p. 738 or Cameron and Trivedi, 2005, p. 522) which estimates both equations jointly using maximum likelihood. In the bivariate probit model, the error terms u_i and v_i are assumed to follow a joint normal distribution with zero mean and correlation coefficient ρ, which can be estimated along with the parameter vectors γ and δ:

$$\begin{pmatrix} u_i \\ v_i \end{pmatrix} |X_{1i}, X_{2i} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right]$$

If $\rho = 0$, the bivariate probit collapses to two separate probits; whether this is the case can be tested empirically using a LR or Wald test. The bivariate probit thus models the probabilities of receiving formal and informal care as separate but not independent decisions and encompasses the situation with two separate probits as a special case. The lists of regressors X_1 and X_2 can but do not have to include the same set of variables.

We further consider a recursive (triangular) simultaneous equations model (Greene, 2011, p. 746) as an extension of the bivariate probit. In a recursive model, the dummy dependent variable of one probit enters the second probit equation as an endogenous covariate. It however requires the assumption that

there is no simultaneity, i.e. that only one of the two dependent variables is endogenous. Following Balia and Brau (2014) we assume that IC is endogenous and affects FC, but that FC has no effect on IC.[13] This is the case if, for example, informal care by the respondent's children is driven by motives other than health status, such as bequest motives or reciprocity, and thus independent of formal care provision. Another rationale for this assumption is that formal care is a complementary "addition" to informal care rather than a substitute (which is supported by the findings in a number of recent papers, see Section 2) and that formal care might reduce the amount of informal care (the intensive margin), but not the probability that it is provided at all (the extensive margin) so that the probability of receiving informal care is independent of receiving formal care.

As noted by Greene (2011, p. 476) the endogenous nature of the IC dummy variable can be ignored when formulating the log-likelihood of this model, and estimates of γ and δ can be obtained in a seemingly unrelated regressions (SUR) model without taking special care of the endogenous nature of IC. As noted by Knapp and Seaks (1998), a test for $\rho = 0$ in the recursive model can be interpreted as a test for the exogeneity of the IC dummy variable in the formal care equation (cf. Li and Jensen, 2011).

From the bivariate probit model several partial effects can be derived. Our two binary dependent variables allow us to capture all four possible outcomes: (i) neither formal nor informal care ($FC_i = IC_i = 0$), (ii) formal care only ($FC_i = 1, IC_i = 0$), (iii) informal care only ($FC_i = 0, IC_i = 1$) and (iv) both formal and informal care ($FC_i = IC_i = 1 = FIC_i$). For each of these outcomes we can calculate the marginal effects of the explanatory variables on the probabilities of observing these outcomes. Furthermore, we can calculate the effects on the marginal probabilities $\Pr(FC_i = 1)$ and $\Pr(IC_i = 1)$, i. e. the probability that person i receives formal (informal) care irrespective of whether she also receives informal (formal) care.

5 Estimation results

5.1 Binary probit model: care vs. no care

Table 2 illustrates the regression results for the explanatory variables from Section 3 on a binary dependent variable $Care_i$ which takes on a value of 1

[13] Balia and Brau (2014) also estimate a simultaneous equations model with four equations where they jointly model the probabilities of receiving FC or IC (extensive margin) as well as the amount of formal and informal care received (intensive margin) using SHARE data. However, they find that formal care does not directly influence the probability of receiving informal care and vice versa. Given this result and the difficulties with finding credible exclusion restrictions to identify such models (see the discussion in Balia and Brau, 2014) we do not estimate a simultaneous equations model.

if the respondent received formal and/or informal care at the time of the survey (zero else). The corresponding marginal effects (at the means of the independent variables) are shown in Table 3. Columns (1) and (2) contain only the structural and socio-economic determinants of care, respectively.

Focusing first on the structural determinants, as shown in column (1) of Table 3 age and being female have significantly positive marginal effects on the probability of receiving care. At the mean, each year increases the probability of receiving care by 0.9 percentage points (pp), and women's care propensity is 5.9 pp higher than men's. The most important determinants for the LTC propensity are, however, the number of limitations in instrumental activities of daily living (iADL) and the number of chronic diseases ("multimorbidity"). Respondents with one or two iADL limitations have a 32.9 pp higher probability of receiving formal and/or informal care, and this effect doubles if respondents have three or more limitations (+65.7 pp).

The number of chronic diseases also increases the probability of utilizing care services, but the coefficients and marginal effects are only significant for three or more chronic diseases: respondents with three chronic diseases have an 8.5 pp, respondents with four chronic diseases a 13.8 pp, and respondents with five or more chronic conditions a 22.4 pp higher probability of receiving care.

[Table 2 about here.]

[Table 3 about here.]

Among the socio-economic determinants only the coefficients and marginal effects of marital status, having a daughter and education are statistically significant, while household size and income play no role in determining the probability of receiving LTC. Those who are single have a higher demand for care services because they lack the support of a spouse or partner. Correspondingly, being single increases the probability of receiving care by 21.0 pp.

Concerning the effect of having children, the regression shows that having a son has no effect on the probability of receiving home care. Conversely, we find that respondents' usage of care services increases by 6.7 pp if they have a daughter. This finding necessitates an explanation given the assumption that there are no unmet needs. One possible explanation is that the (potential of) higher LTC supply by daughters evokes needs that respondents without daughters do not have, so that an increased supply is met by an increase in demand. Another possible explanation is that respondents with unmet care demands that have no daughter have already moved to nursing homes, so that the positive coefficient of having a daughter reflects a selection on observables.

Finally, those with middle or higher education (ISCED > 2) have a 11.0 pp lower probability of receiving care if only the socio-economic characteristics are

included in the regression. One possible explanation for this is that higher education is correlated with better health,[14] creating a downward bias on the education variable if health status is not included.

Indeed, once both structural and socio-economic variables are jointly included in our preferred specification (see column (3) of Tables 2 and 3), the education dummy is no longer significant. Gender is also no longer significant, which suggests that the positive effect of being female was due to a correlation with being single.[15] This hypothesis is supported by the lower coefficient of single once both groups of explanatory variables are included. The probit regression in column (3) also contains an interaction term of being single and being female to capture differences in the effect of gender by marital status (and differences in the effect of marital status by gender). But the interaction term and the "female" dummy are neither individually nor jointly ($\chi^2(2) = 0.69$, $p = 0.708$) significant.

All other marginal effects retain their statistical significance. If both the structural and socio-economic independent variables are included, the most important determinants of care provision are the health variables (iADL limitations and chronic diseases) as well as being single and having a daughter.

Columns (4) and (5) extend the specification by including a dummy variable for living in a large city and subjective health status, respectively.[16] Respondents in the sample living in a large city are no more likely to receive any form of home care than those living in smaller cities or rural areas. Subjective health has a significantly positive effect on the probability of receiving care services. At the same time however, the effects of having three or four chronic diseases are no longer statistically significant, most probably because these are correlated with the subjective health: Spearman's rank correlation coefficient between the number of chronic diseases and the (ordinal) subjective health status is $\rho = 0.490$. Since we are more interested in the effects of the number of chronic diseases, the model of column (3) remains our preferred specification for the bivariate probit.

[14] The share of respondents with two iADL limitations is significantly higher among those with low education (21.7 %) than among those with higher education (10.2 %, test statistic for difference being zero: $z = 8.299$). The same holds true for the share of respondents with three iADL limitations (14.9 % vs. 4.0 %, $z = 10.581$). Furthermore, low-education respondents have a significantly higher average number of chronic diseases (1.97) than higher-education respondents (1.64, $t = 5.325$).

[15] The share of singles is much higher among women in the sample (48.9 %) than among men (19.8 %, test statistic for difference being zero: $z = 16.7$), which may be due to women having a longer life expectancy. This can have contributed to an upward bias of being female in the regression of column (1) focusing only on structural determinants.

[16] Since the dummy variable for living in a large city has many missing values, the number of observations is considerably smaller in column (4) and (5).

5.2 Bivariate probit: formal and/or informal care?

The bivariate probit results in Table 4 show that there is a significantly positive correlation between the error terms of the formal and informal care decisions ($\rho = 0.338$): Unobserved factors that increase the probability of receiving formal care also raise the probability of receiving informal care and vice versa. The correlation is not only economically, but also statistically significant (Wald test for $\rho = 0$: $\chi^2(1) = 48.891$, critical value: 3.841) which justifies the use of a bivariate probit model that jointly estimates equations (1) and (2). In addition to the regression coefficients, Table 5 again shows the marginal effects on the probabilities of receiving no care ($FC_i = IC_i = 0$), formal care only ($FC_i = 1, IC_i = 0$), informal care only ($FC_i = 0, IC_i = 1$) and both formal and informal care ($FC_i = IC_i = 1$) as well as on the marginal probabilities $\Pr(FC = 1)$ and $\Pr(IC = 1)$.

[Table 4 about here.]

[Table 5 about here.]

Neither the linear nor the quadratic effect of age are significant in Table 4. But the marginal effect of age is significant (see Table 5) and the predicted probabilities exhibit a distinct pattern over the observed range of the variable (60–99 years of age, see Figure 1). While the predicted probability of receiving neither formal nor informal care ceteris paribus declines with age (from 85.8 % at age 60 to 45.0 % at age 99), the probabilities of receiving formal care alone or formal care together with informal care steadily increase as respondents get older. The probability of receiving informal care alone on the other hand is initially higher than the probabilities of receiving only formal care or both formal and informal care and increasing in age. It however peaks out at around 81 (17.1 %, compared to 10.5 % at age 60 and 9.7 % at age 99), after which it decreases as age advances. This suggests that at around 80 years of age the care requirements exceed the capacity of informal care providers, so that informal care is supplemented or replaced by formal care.

[Figure 1 about here.]

As in the probit model we find almost no effect of gender after controlling for the socio-economic variables. Being female has a statistically significant effect on the probability of receiving only formal care, but the effect on $\Pr(FC = 1, IC = 0)$ is economically insignificant (+1.7 pp).

The number of limitations with instrumental activities of daily living on the other hand has a substantial effect, especially on the probability of using

formal care alone or together with informal care. The probability of receiving only informal care on the other hand is higher for respondents with 1–2 iADL limitations (+9.1 pp), but there is no significant difference for persons with 3 or more limitations compared to those with no limitations. The number of chronic conditions also has no significant effect on the probability of receiving informal care only (at the 5 % level of significance), while $\Pr(FC = IC = 1)$ is significantly higher for persons with three or more conditions. Together, these results imply that limitations with instrumental activities of daily living and chronic diseases mainly affect formal care provision (either as the only LTC mode or in combination with informal care) while informal care rather plays a supplemental role in the LTC mix.

While all marginal effects of household size are insignificant, being single has a significantly positive effect on both types of LTC, especially on the probability of receiving only informal care (+7.0 pp). Again, we cannot rule out that the presence of (and some of the tasks performed by) a partner are not perceived as care by the respondents. The bivariate probit regression in Table 4 shows that having a son or daughter has no significant effect on receiving formal care at the 5 % level: Both dummy variables are individually as well as jointly ($\chi^2(2) = 0.225$, p-value: 0.894) insignificant. Conversely, and in line with the previous literature, we find that having a daughter increases the probability of receiving informal care, but only if it is the only LTC mode (see Table 5): Having children has no significant effect on the probabilities of utilizing formal care or both formal and informal care at the 5 % level of significance. Again, given the assumption that there are no unmet needs the positive effect on IC (that is not offset by a negative effect on FC) may be due to a higher demand for informal care as a response to an increased supply of LTC or reflect a selection effect.[17]

Household income significantly increases the probability of formal care utilization if it is used as the only LTC mode. But even then, the effect is rather small: The probability of using only formal care is 3.2 % for a household at the first quartile of the income distribution (about € 10,600) and 4.0 % for a household at the third quartile (about € 21,400), a modest (and insignificant) increase by 0.8 pp. Having secondary or higher education also increases $\Pr(FC = 1, IC = 0)$, but again only by a small amount (+1.8 pp).[18]

[17] We also estimated a model that included a dummy variable for the proximity of children (= 1 if at least one child lived in the same household or at most 1 km away, zero else). The proximity dummy was, however, not statistically significant for either LTC mode, while all other effects remained practically unchanged. The results are available from the authors upon request.

[18] This is most likely due to the fact that education is a determinant of household income: As expected, the average income of respondents with secondary or tertiary education is signifi-

To sum up, the results of Tables 4 and 5 show that the use of FC as the only mode of LTC is mostly driven by old age, health status (measured by the numbers of iADL limitations and chronic diseases), being single and household income. While the probability of using informal care also depends on age, the use of IC as the only mode of LTC declines with old age while it is positively affected by being single and having a daughter. Limitations with instrumental activities of daily living also increase the probability of only using IC, but only if the number of limitations is small. The combined use of both informal and formal care is most affected by iADL limitations in addition to age, chronic diseases and being single. In general, most variables affect both types of LTC, except for having a daughter—which increases $\Pr(IC = 1)$ only—and household income/education, which only increases $\Pr(FC = 1)$.

5.3 Bivariate probit: robustness

To evaluate the robustness of the bivariate probit regression, columns (1) and (2) of Table 6 report the results of a model that adds a dummy variable for living in a large city, while columns (3) and (4) control for the (self-reported) subjective health status.

[Table 6 about here.]

Compared to Table 4, the results of the regression hardly change if a dummy variable for residing in an urban environment is included. The dummy variable itself is not statistically significant. Some of the coefficients seem to be estimated with lower precision once we control for living in a large city, but this is most likely due to the decrease in the number of observations (from 3,125 to 2,112) because the dummy variable is not observed for every individual in the sample.[19]

As in the probit model (see Table 2), including the self-reported subjective health status decreases the statistical significance of the dummy variables for chronic diseases because the subjective health status is correlated with the latter. All other effects are, however, highly robust to the inclusion of subjective health status.

[Table 7 about here.]

cantly higher (about € 18,700) than the average income of respondents with primary education (about € 12,560; $t = 16.105$).

[19] The most pronounced difference in statistical significance can be observed for the education variable in the formal care equation. This is probably due to large differences in educational attainment between the residents of urban and rural environment: While 31.8 % of the rural residents have ISCED education levels of 2 or below, this share is only 9.0 % among urban residents. Correspondingly, 28.6 % of those with higher education levels live in urban environments, compared to only 7.9 % of those with lower education levels.

Table 7 shows the results of the recursive ("triangular") bivariate probit regressions where the equation for formal care includes a dummy variable for informal care. Two recursive models were estimated: For the first model in columns (1) and (2), the dummy variables for having a son or a daughter—which were insignificant in the equations for $FC = 1$ in Tables 4 and 6—were used as exclusion restrictions and included only in the informal care equation. As mentioned above, both variables are individually and jointly insignificant in the formal care equation of Table 4, but highly significant in the informal care equation.[20] The second model in columns (3) and (4) was estimated using the same explanatory variables for both $FC = 1$ and $IC = 1$ and is thus identified only by functional form.

In both models, receiving informal care appears with a negative sign in the formal care equations, which suggests that informal care recipients are less likely to receive formal care. However, as in Balia and Brau (2014), the coefficient of informal care is not significantly different from zero. This holds irrespective of whether an exclusion restriction is imposed or not. [21] The hypothesis that receiving informal care has no effect on receiving formal care can thus not be rejected.

As mentioned in Section 4, a test for $\rho = 0$ in the recursive model can be interpreted as a test for the exogeneity of the IC dummy variable in the formal care equation (see Knapp and Seaks, 1998; Li and Jensen, 2011). Since Wald tests cannot reject the null hypotheses that $\rho = 0$ for both models, there is no evidence against the hypothesis that receiving informal care is indeed exogenous to the formal care decision. Furthermore, the results of the recursive model support the robustness of the regressions in Section 5.2: The results are practically the same as in Table 4, only the dummy variable for higher education (ISCED > 2) is no longer significant at the 5 % level in the formal care equation of the recursive models.

6 Discussion and conclusions

This paper is the first empirical assessment on the determinants of individual long term home care utilization for Austria. We estimated bivariate probit

[20] A joint test for significance in the informal care equation of the recursive model with exclusion restrictions (column (2) of Table 7) reveals a test statistic of $\chi^2(2) = 50.327$ (p-value: 0.000).

[21] Although we do not find a significant effect on on the extensive margin, we cannot exclude that there may be effects on the intensive margins of formal and informal care provision. For example, Balia and Brau (2014) find that—although the effects on the extensive margins are insignificant—the number of hours of IC provided does have a positive effect (significant at the 10 % level) on the number of hours of FC provided, and that the number of hours of FC has a significantly negative effect on the number of hours of IC provided.

models to account for the statistically significant simultaneity in the decision between informal (IC) and/or formal home care. Our results identify the individual health status and limitations in the instrumental activities of daily living as the main drivers for choice of LTC modes. In line with recent papers on other European countries such as Spain and the Netherlands our results point towards a task specific, complementary relation between informal and formal home care rather than a substitutive relation. This conclusion is supported by a number of results obtained.

First, compared to individuals with no functional limitations, the probability of exclusively receiving informal care only increases for individuals with few functional impairments but not for individuals with many impairments. Conversely, the probability of using formal care alone and especially together with informal care increases substantially as the number of functional limitations in the activities of daily living increases. Thus, our results reveal that beyond a certain level of functional impairments informal care primarily supplements formal home care.

Second, in line with previous studies we find that having a daughter (but not having a son) increases the probability for informal care only if it is used as the only mode of LTC. On the other hand neither having a daughter nor a son influences the probability for formal care (both when used exclusively and if combined with informal care). Thus, relying on formal care services seems to be independent from informal care provided by daughters. This again points towards complementary tasks performed by children and professional care givers and may be related to the loss of income for working-age individuals in the absence of financial compensation for providing informal LTC.

Third, household income only significantly increases the probability of formal care utilization. This again points toward the supplementary nature of informal care which—unlike formal care—is not affected by income.

Fourth, most variables that turn out to be significant influence both types of LTC, except for having a daughter and for household income/education. Thus, most structural variables on health affect probabilities for both LTC types in the same direction. This again serves as an argument for complementarity between informal and formal care.

Finally, in a triangular model we find no statistical evidence that receiving IC reduces the probability for receiving formal care, ceteris paribus. This holds irrespective of whether formal care is used exclusively or in addition to informal care. In addition, statistical tests cannot reject the exogeneity of IC for the decision to use or not to use formal care.

These findings have important policy implications for the planning of LTC systems in Austria. Home care is dominating institutional care by far in Austria

and the majority of home care is provided by informal care givers. This is due to strong social preferences for informal care and acceptable legal and social protection for informal care givers compared to many other countries of Europe. It can, however, be expected that population aging will increase the demand for formal home care services in the upcoming decades: According to our results, the predicted utilization of IC peaks at around 80 years of age, followed by a sharp increase in the predicted use of formal and combined informal/formal care for octogenarians. The demand for formal care will thus quite likely increase with a rising number of persons age 80 or older, which must be met by an increased supply of affordable formal care services.

For example, an average 75 year old single woman that has a daughter, 0.47 iADL limitations and 1.95 chronic conditions has a 6.8 % probability of receiving formal care only and a 7.3 % probability of receiving both formal and informal care, which adds up to a 14.1 % total probability of receiving formal care (table 8, scenario [1]).[22] Ceteris paribus, at age 85 the same person would have a 12.3 % probability of receiving formal care only and a 13.8 % probability of receiving both formal and informal care (total probability of receiving formal care: 26.1 %, see table 8, scenario [2]). Taking into account that health and the ability to perform instrumental activities of daily living deteriorate with age—the average 85 year old respondent in our sample has 1.56 iADL limitations and 2.41 chronic conditions—these probabilities would even increase to 17.7 % and 32.2 %, respectively, raising the total probability of receiving formal care to 49.9 % (scenario [3]). [23]

[Table 8 about here.]

This increase in the demand for formal care services will persist even if possible advances in geriatric medicine are taken into account: Even if, for example, the share of persons with three or more iADL limitations could be decreased by 10 percentage points and the shares of persons with 4 or 5+ chronic conditions by 5 percentage points each, the probability of receiving formal care at age 85 for our representative single woman would ceteris paribus decrease by only 3.5 percentage points to 46.4 % if these changes are offset by corresponding increases in the shares of persons with 1–2 iADL limitations and 2 or 3 chronic conditions (scenario [4]). Although this decrease is statistically significant, it is rather modest.

[22] The average values for iADL limitations and chronic conditions for a 75 year old person are based on the average values for the 343 respondents in our sample who are between 74 and 76 years of age. Mean values are used for all other explanatory variables.

[23] Again, these average values are computed from the 128 respondents in our sample who are between 84 and 86 years of age.

On the other hand, the number of iADL limitations (which includes activities such as grocery shopping or making a telephone call) can be expected to decrease as more technology-oriented generations enter retirement that are, for example, accustomed to buy things online or using a smartphone or computer. In addition, the number of iADL limitations could be reduced by advances in household robotics that further simplify household tasks. If, for example, the share of persons with 1–2 iADL limitations at age 85 could be limited to 20 % and the share of persons with three or more limitations to 15 % (which is about halfway between the shares for the 75 and 85 year olds, see table 8) the probability of receiving formal care would decrease significantly and substantially by 12.5 percentage points to 37.4 % compared to the status quo (scenario [5]). Furthermore, the probability of receiving informal care would decrease by 8.8 percentage points, and the overall probability of requiring neither formal nor informal care would increase by 11.1 percentage points to 39.8 %. The effect of population aging may thus be moderated by higher levels of technology competence and/or advances in household robotics.

Given these results a successful policy prioritizing formal home care over residential care to flatten the impending increases in public expenditures for LTC induced by the aging population has to acknowledge that the extension of formal home care services has to be accompanied by policies increasing the incentives for family members and relatives to provide complementary informal care. Such incentives include (full) financial compensation and social security coverage for informal care givers. Also policies supporting innovation and dissemination activities of modern ICT devices compensating for existing instrumental limitations seem to be promising in substituting informal as well as formal LTC.

Our analysis, of course, is also associated with a number of limitations. First, as is a common problem in empirical research using SHARE data, we have only very limited information on (the determinants for) people in nursing homes. Also, while SHARE wave 4 brought a substantial increase in the sample for Austria, the sample size is still relatively small. For this reason we also refrained from estimating the determinants for the intensive margin of LTC use, i.e. the numbers of hours of IC and FC provided. The number of observations on the amount of care used was still too small for the Austrian sample in SHARE wave 5. Thus, future research on Austria should include the intensive margin in the framework once the database necessary is available.

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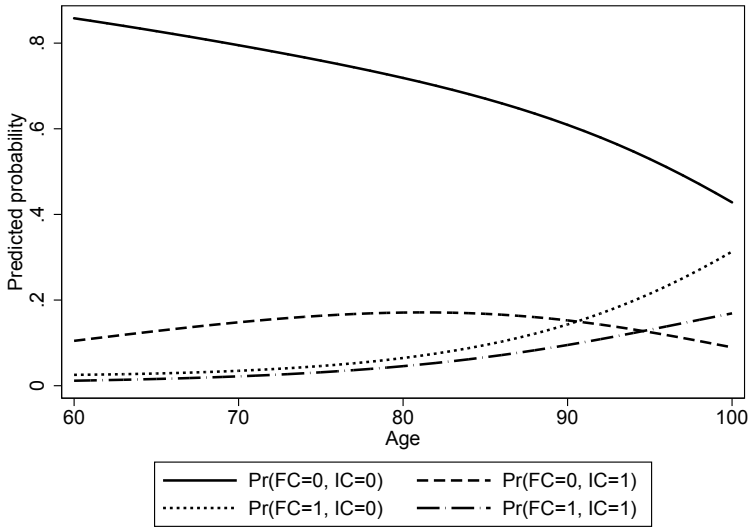

Figure 1: Predicted probabilities at various levels of age while keeping all other variables at their mean. Predictions based on regression results from Table 4. FC: formal care; IC: informal care.

Variable	Total sample Mean	SD	Non-LTC Mean	LTC Mean	IC Mean	FC Mean	FIC Mean
Age	71.031	7.728	69.467	75.398	72.807	76.693	78.673
Female	0.568	0.495	0.541	0.642	0.611	0.717	0.642
iADL 0	0.801	0.399	0.918	0.475	0.696	0.367	0.193
iADL 1-2	0.131	0.338	0.074	0.291	0.218	0.398	0.339
iADL 3+	0.068	0.252	0.008	0.234	0.087	0.235	0.469
Multimorbidity (0-1)	0.215	0.411	0.256	0.101	0.149	0.072	0.043
Multimorbidity (2)	0.304	0.460	0.332	0.225	0.267	0.193	0.177
Multimorbidity (3)	0.227	0.419	0.225	0.233	0.252	0.181	0.236
Multimorbidity (4)	0.139	0.346	0.118	0.195	0.161	0.223	0.232
Multimorbidity (5+)	0.115	0.319	0.068	0.246	0.171	0.331	0.311
Household size	1.900	0.872	1.961	1.728	1.772	1.693	1.681
Single	0.364	0.481	0.293	0.559	0.510	0.578	0.626
Has son	0.461	0.499	0.441	0.518	0.569	0.428	0.496
Has daughter	0.456	0.498	0.421	0.553	0.629	0.440	0.508
Household income	17.103	10.938	17.305	16.538	16.053	18.314	16.148
Educ. (ISCED $>$ 2)	0.745	0.436	0.782	0.641	0.668	0.693	0.563
Large city	0.231	0.422	0.226	0.243	0.211	0.370	0.223
Subjective health	3.084	1.047	2.852	3.732	3.438	3.771	4.173
Observations	3,125		2,301	824	404	166	254

Table 1: Descriptive statistics by type of long-time care (LTC) users. †Number of observations: 2,112. Data source: SHARE Wave 5, Austria. SD: standard deviation; iADL: instrumental activities of daily living; IC: informal care; FC: formal care; FIC: formal and informal care. Household income measured in € 1,000.

	Dependent variable: $Care_i = 1$				
	(1)	(2)	(3)	(4)	(5)
Age	−0.120*		−0.105	−0.137*	−0.121
	(0.060)		(0.061)	(0.067)	(0.068)
Age^2	0.001*		0.001*	0.001*	0.001*
	(0.000)		(0.000)	(0.000)	(0.000)
Female	0.202***		0.062	0.054	0.041
	(0.056)		(0.075)	(0.096)	(0.097)
iADL 1-2	0.934***		0.992***	0.812***	0.708***
	(0.075)		(0.078)	(0.090)	(0.092)
iADL 3+	1.896***		2.030***	1.681***	1.522***
	(0.136)		(0.147)	(0.173)	(0.177)
Multimorbidity (2)	0.099		0.086	0.074	−0.052
	(0.083)		(0.084)	(0.094)	(0.098)
Multimorbidity (3)	0.274**		0.292***	0.252*	0.056
	(0.087)		(0.088)	(0.099)	(0.106)
Multimorbidity (4)	0.423***		0.458***	0.375***	0.133
	(0.095)		(0.098)	(0.112)	(0.117)
Multimorbidity (5+)	0.656***		0.690***	0.692***	0.370**
	(0.105)		(0.108)	(0.122)	(0.130)
Household size		0.032	−0.001	0.016	0.016
		(0.036)	(0.040)	(0.047)	(0.048)
Single		0.633***	0.528***	0.394**	0.373**
		(0.065)	(0.113)	(0.122)	(0.124)
Has son		−0.009	0.069	−0.062	−0.042
		(0.054)	(0.062)	(0.068)	(0.069)
Has daughter		0.210***	0.322***	0.163*	0.164*
		(0.054)	(0.062)	(0.068)	(0.068)
Household income		0.001	0.005	0.004	0.009**
		(0.002)	(0.003)	(0.003)	(0.003)
Education (ISCED > 2)		−0.331***	0.091	0.032	0.066
		(0.057)	(0.069)	(0.080)	(0.081)
Single × female			−0.071	−0.056	−0.015
			(0.128)	(0.140)	(0.142)
Large city				0.049	0.047
				(0.078)	(0.079)
Subjective health					0.264***
					(0.040)
Constant	1.841	−0.819***	1.069	2.600	1.330
	(2.179)	(0.116)	(2.232)	(2.461)	(2.484)
Log-likelihood	-1341.341	-1684.486	-1281.757	-1026.881	-1003.492
Observations	3125	3125	3125	2112	2112

Table 2: Probit regression of $Care_i = 1$. Data source: SHARE Wave 5, Austria. iADL: instrumental activities of daily living. *** significant at 1 %, ** significant at 5 %, * significant at 10 % level.

	Marginal effects on Pr($Care_i$)				
	(1)	(2)	(3)	(4)	(5)
Age	0.009***		0.007***	0.008***	0.007***
	(0.001)		(0.001)	(0.002)	(0.002)
Female	0.059***		0.011	0.008	0.011
	(0.016)		(0.018)	(0.024)	(0.024)
iADL 1-2	0.329***		0.348***	0.301***	0.260***
	(0.029)		(0.030)	(0.035)	(0.036)
iADL 3+	0.657***		0.689***	0.596***	0.553***
	(0.033)		(0.033)	(0.043)	(0.051)
Multimorbidity (2)	0.030		0.025	0.025	−0.017
	(0.025)		(0.025)	(0.032)	(0.032)
Multimorbidity (3)	0.085**		0.089**	0.087*	0.019
	(0.028)		(0.028)	(0.035)	(0.035)
Multimorbidity (4)	0.138***		0.148***	0.133**	0.045
	(0.033)		(0.034)	(0.042)	(0.041)
Multimorbidity (5+)	0.224***		0.235***	0.256***	0.131**
	(0.039)		(0.041)	(0.047)	(0.049)
Household size		0.010	−0.000	0.005	0.005
		(0.011)	(0.012)	(0.016)	(0.016)
Single		0.210***	0.148***	0.119***	0.120***
		(0.022)	(0.024)	(0.028)	(0.028)
Has son		−0.003	0.020	−0.021	−0.014
		(0.017)	(0.018)	(0.023)	(0.023)
Has daughter		0.067***	0.094***	0.053*	0.053*
		(0.017)	(0.018)	(0.022)	(0.022)
Household income		0.000	0.001	0.001	0.003**
		(0.001)	(0.001)	(0.001)	(0.001)
Education (ISCED > 2)		−0.110***	0.026	0.010	0.022
		(0.020)	(0.019)	(0.026)	(0.026)
Large city				0.016	0.016
				(0.026)	(0.027)
Subjective health					0.087***
					(0.013)
Observations	3125	3125	3125	2112	2112

Table 3: Marginal effects on Pr($Care_i = 1$) at the means of the independent variables calculated from probit regression. iADL: instrumental activities of daily living. Data source: SHARE Wave 5, Austria. ***significant at 1 %, **significant at 5 %, *significant at 10 % level.

	Dependent variable:	
	$FC = 1$	$IC = 1$
	(1)	(2)
Age	−0.080	0.068
	(0.074)	(0.060)
Age^2	0.001	−0.000
	(0.000)	(0.000)
Female	0.318**	−0.082
	(0.107)	(0.076)
iADL 1-2	1.168***	0.742***
	(0.089)	(0.078)
iADL 3+	2.043***	1.449***
	(0.123)	(0.116)
Multimorbidity (2)	0.150	0.080
	(0.130)	(0.085)
Multimorbidity (3)	0.314*	0.275**
	(0.132)	(0.089)
Multimorbidity (4)	0.612***	0.340***
	(0.135)	(0.099)
Multimorbidity (5+)	0.741***	0.434***
	(0.142)	(0.107)
Household size	−0.001	−0.024
	(0.054)	(0.040)
Single	0.680***	0.374***
	(0.144)	(0.112)
Has son	−0.026	0.117
	(0.078)	(0.062)
Has daughter	−0.016	0.349***
	(0.077)	(0.062)
Household income	0.010***	−0.001
	(0.003)	(0.003)
Education (ISCED > 2)	0.241**	−0.010
	(0.089)	(0.068)
Single × female	−0.327*	0.023
	(0.161)	(0.128)
Constant	−1.026	−4.674*
	(2.762)	(2.197)
ρ	0.338	
Wald test of $\rho = 0$	48.891***	
Log-likelihood	−1997.798	
Observations	3125	

Table 4: Bivariate probit regression of $FC_i = 1$ and $IC_i = 1$. Data source: SHARE Wave 5, Austria. FC: formal care; IC: informal care; iADL: instrumental activities of daily living. *** significant at 1 %, ** significant at 5 %, * significant at 10 % level.

	Marginal effects on:					
	Pr($FC = 0$, $IC = 0$)	Pr($FC = 0$, $IC = 1$)	Pr($FC = 1$, $IC = 0$)	Pr($FC = 1$, $IC = 1$)	Pr($FC = 1$)	Pr($IC = 1$)
	(1)	(2)	(3)	(4)	(5)	(6)
Age	−0.007***	0.003**	0.002***	0.002***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Female	0.002	−0.025	0.017**	0.006	0.023*	−0.019
	(0.017)	(0.014)	(0.006)	(0.004)	(0.010)	(0.016)
iADL 1-2	−0.342***	0.091***	0.107***	0.144***	0.251***	0.235***
	(0.028)	(0.022)	(0.017)	(0.018)	(0.028)	(0.029)
iADL 3+	−0.649***	0.057	0.139***	0.453***	0.592***	0.511***
	(0.027)	(0.031)	(0.028)	(0.041)	(0.045)	(0.042)
Multimorbidity (2)	−0.031	0.012	0.010	0.008	0.019	0.021
	(0.024)	(0.020)	(0.011)	(0.006)	(0.017)	(0.023)
Multimorbidity (3)	−0.095***	0.053*	0.020	0.023**	0.043*	0.076**
	(0.027)	(0.023)	(0.013)	(0.009)	(0.020)	(0.026)
Multimorbidity (4)	−0.150***	0.048	0.052**	0.049***	0.102***	0.098**
	(0.033)	(0.026)	(0.018)	(0.013)	(0.028)	(0.031)
Multimorbidity (5+)	−0.195***	0.060*	0.066**	0.068***	0.134***	0.129***
	(0.037)	(0.029)	(0.021)	(0.017)	(0.034)	(0.035)
Household size	0.006	−0.006	0.001	−0.001	−0.000	−0.006
	(0.011)	(0.009)	(0.004)	(0.002)	(0.007)	(0.010)
Single	−0.137***	0.070***	0.032***	0.034***	0.066***	0.105***
	(0.023)	(0.019)	(0.010)	(0.007)	(0.015)	(0.022)
Has son	−0.025	0.028*	−0.005	0.002	−0.003	0.030
	(0.017)	(0.014)	(0.006)	(0.004)	(0.009)	(0.016)
Has daughter	−0.082***	0.084***	−0.010	0.008*	−0.002	0.091***
	(0.017)	(0.015)	(0.006)	(0.004)	(0.009)	(0.017)
Household income	−0.001	−0.001	0.001***	0.000*	0.001***	−0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Education (ISCED > 2)	−0.015	−0.011	0.018**	0.009*	0.026**	−0.003
	(0.018)	(0.016)	(0.006)	(0.004)	(0.009)	(0.018)
Observations	3125					

Table 5: Marginal effects at the means of the independent variables calculated from probit regression. FC: formal care; IC: informal care; iADL: instrumental activities of daily living. Data source: SHARE Wave 5, Austria. ***significant at 1 %, **significant at 5 %, *significant at 10 % level.

	Dependent variable:			
	$FC = 1$	$IC = 1$	$FC = 1$	$IC = 1$
	(1)	(2)	(3)	(4)
Age	−0.108	0.035	−0.084	0.050
	(0.084)	(0.065)	(0.084)	(0.066)
Age^2	0.001	−0.000	0.001	−0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Female	0.442**	−0.068	0.456**	−0.081
	(0.149)	(0.096)	(0.152)	(0.096)
iADL 1-2	1.075***	0.552***	0.971***	0.449***
	(0.104)	(0.090)	(0.105)	(0.091)
iADL 3+	1.944***	1.180***	1.778***	1.012***
	(0.154)	(0.140)	(0.160)	(0.143)
Multimorbidity (2)	0.023	0.077	−0.124	−0.039
	(0.144)	(0.095)	(0.144)	(0.098)
Multimorbidity (3)	0.222	0.257*	0.027	0.079
	(0.146)	(0.100)	(0.152)	(0.105)
Multimorbidity (4)	0.467**	0.323**	0.228	0.101
	(0.152)	(0.112)	(0.156)	(0.118)
Multimorbidity (5+)	0.673***	0.475***	0.363*	0.183
	(0.159)	(0.120)	(0.165)	(0.130)
Household size	0.030	0.006	0.027	0.007
	(0.067)	(0.046)	(0.067)	(0.046)
Single	0.790***	0.293*	0.777***	0.270*
	(0.172)	(0.121)	(0.176)	(0.122)
Has son	−0.018	−0.028	0.008	−0.010
	(0.090)	(0.067)	(0.091)	(0.068)
Has daughter	−0.054	0.191**	−0.061	0.192**
	(0.088)	(0.068)	(0.089)	(0.068)
Household income	0.011**	0.001	0.015***	0.004
	(0.004)	(0.003)	(0.004)	(0.003)
Education (ISCED > 2)	0.192	−0.038	0.219*	−0.013
	(0.102)	(0.079)	(0.103)	(0.079)
Single × female	−0.485*	0.004	−0.478*	0.044
	(0.193)	(0.140)	(0.196)	(0.142)
Large city	0.172	−0.052	0.173	−0.056
	(0.097)	(0.080)	(0.098)	(0.081)
Subjective health			0.256***	0.239***
			(0.055)	(0.040)
Constant	−0.113	−3.136	−1.693	−4.301
	(3.128)	(2.400)	(3.110)	(2.432)
ρ	0.348		0.320	
Wald test of $\rho = 0$	40.469		33.346	
Log-likelihood	−1563.834		−1536.504	
Observations	2112		2112	

Table 6: Bivariate probit regressions of $FC_i = 1$ and $IC_i = 1$. Data source: SHARE Wave 5, Austria. FC: formal care; IC: informal care; iADL: instrumental activities of daily living. *** significant at 1 %, ** significant at 5 %, * significant at 10 % level.

	Dependent variable:			
	$FC = 1$	$IC = 1$	$FC = 1$	$IC = 1$
	(1)	(2)	(3)	(4)
$IC = 1$	−0.204		−0.307	
	(0.364)		(0.468)	
Age	−0.072	0.067	−0.067	0.066
	(0.074)	(0.060)	(0.079)	(0.060)
Age^2	0.001	−0.000	0.001	−0.000
	(0.000)	(0.000)	(0.001)	(0.000)
Female	0.301**	−0.082	0.291*	−0.082
	(0.109)	(0.076)	(0.114)	(0.076)
iADL 1-2	1.190***	0.743***	1.198***	0.742***
	(0.093)	(0.078)	(0.091)	(0.078)
iADL 3+	2.096***	1.450***	2.115***	1.450***
	(0.137)	(0.115)	(0.139)	(0.115)
Multimorbidity (2)	0.153	0.078	0.153	0.078
	(0.127)	(0.085)	(0.125)	(0.086)
Multimorbidity (3)	0.325*	0.274**	0.331*	0.273**
	(0.130)	(0.089)	(0.129)	(0.090)
Multimorbidity (4)	0.620***	0.340***	0.622***	0.340***
	(0.132)	(0.099)	(0.130)	(0.099)
Multimorbidity (5+)	0.751***	0.434***	0.755***	0.434***
	(0.139)	(0.107)	(0.137)	(0.107)
Household size	−0.003	−0.025	−0.004	−0.025
	(0.053)	(0.040)	(0.052)	(0.040)
Single	0.686***	0.373***	0.690***	0.373***
	(0.142)	(0.112)	(0.140)	(0.112)
Has son		0.120*	−0.011	0.117
		(0.060)	(0.077)	(0.062)
Has daughter		0.347***	0.028	0.349***
		(0.062)	(0.106)	(0.062)
Household income	0.010**	−0.001	0.010**	−0.001
	(0.003)	(0.003)	(0.003)	(0.003)
Education (ISCED > 2)	0.232*	−0.010	0.226*	−0.010
	(0.091)	(0.068)	(0.091)	(0.068)
Single × female	−0.314	0.023	−0.308	0.023
	(0.160)	(0.128)	(0.160)	(0.128)
Constant	−1.295	−4.620*	−1.415	−4.594*
	(2.736)	(2.195)	(2.846)	(2.221)
ρ	0.454		0.513	
Wald test of $\rho = 0$	3.463		2.458	
Log-likelihood	−1997.785		−1997.751	
Observations	3125		3125	

Table 7: Recursive bivariate probit regressions of $FC_i = 1$ and $IC_i = 1$. Data source: SHARE Wave 5, Austria. FC: formal care; IC: informal care; iADL: instrumental activities of daily living. *** significant at 1 %, ** significant at 5 %, * significant at 10 % level.

	Scenario				
	(1)	(2)	(3)	(4)	(5)
Age	75.000	85.000	85.000	85.000	85.000
Female	1.000	1.000	1.000	1.000	1.000
Single	1.000	1.000	1.000	1.000	1.000
Has son	0.000	0.000	0.000	0.000	0.000
Has daughter	1.000	1.000	1.000	1.000	1.000
iADL 1-2	0.140	0.140	0.258	0.308	0.200
iADL 3+	0.061	0.061	0.273	0.223	0.150
Multimorbidity (2)	0.297	0.297	0.250	0.300	0.250
Multimorbidity (3)	0.210	0.210	0.273	0.323	0.273
Multimorbidity (4)	0.204	0.204	0.156	0.106	0.156
Multimorbidity (5+)	0.122	0.122	0.234	0.184	0.234
$\Pr(FC = 1, IC = 0)$	0.068	0.123	0.177	0.171	0.155
$\Pr(FC = 1, IC = 1)$	0.073	0.138	0.322	0.293	0.219
$\Pr(FC = 1)$	0.141	0.261	0.499	0.464	0.374

Table 8: Parameter values for simulation scenarios. All other variables are held at their mean (see table 1). Probabilities predicted using bivariate probit regression of table 4. Data source: SHARE Wave 5, Austria. FC: formal care; IC: informal care; iADL: instrumental activities of daily living.