



RUHR

ECONOMIC PAPERS

Adam Pilny
Magdalena A. Stroka

Choice of Received Long-term Care – Individual Responses to Regional Nursing Home Provisions



RUHR
UNIVERSITÄT
BOCHUM

RUB



#525

Imprint

Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstr. 150, 44801 Bochum, Germany

Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)
Hohenzollernstr. 1-3, 45128 Essen, Germany

Editors

Prof. Dr. Thomas K. Bauer
RUB, Department of Economics, Empirical Economics
Phone: +49 (0) 234/3 22 83 41, e-mail: thomas.bauer@rub.de

Prof. Dr. Wolfgang Leininger
Technische Universität Dortmund, Department of Economic and Social Sciences
Economics – Microeconomics
Phone: +49 (0) 231/7 55-3297, e-mail: W.Leininger@wiso.uni-dortmund.de

Prof. Dr. Volker Clausen
University of Duisburg-Essen, Department of Economics
International Economics
Phone: +49 (0) 201/1 83-3655, e-mail: vclausen@vwl.uni-due.de

Prof. Dr. Roland Döhrn, Prof. Dr. Manuel Frondel, Prof. Dr. Jochen Kluge
RWI, Phone: +49 (0) 201/81 49-213, e-mail: presse@rwi-essen.de

Editorial Office

Sabine Weiler
RWI, Phone: +49 (0) 201/81 49-213, e-mail: sabine.weiler@rwi-essen.de

Ruhr Economic Papers #525

Responsible Editor: Thomas Bauer

All rights reserved. Bochum, Dortmund, Duisburg, Essen, Germany, 2014

ISSN 1864-4872 (online) – ISBN 978-3-86788-600-0

The working papers published in the Series constitute work in progress circulated to stimulate discussion and critical comments. Views expressed represent exclusively the authors' own opinions and do not necessarily reflect those of the editors.

Ruhr Economic Papers #525

Adam Pilny and Magdalena A. Stroka

**Choice of Received Long-term Care –
Individual Responses to Regional
Nursing Home Provisions**



Bibliografische Informationen der Deutschen Nationalbibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über:
<http://dnb.d-nb.de> abrufbar.

<http://dx.doi.org/10.4419/86788600>

ISSN 1864-4872 (online)

ISBN 978-3-86788-600-0

Adam Pilny and Magdalena A. Stroka¹

Choice of Received Long-term Care – Individual Responses to Regional Nursing Home Provisions

Abstract

Existing literature analyzing the choice of received long-term care by frail elderly (65+ years) predominantly focuses on physical and psychological conditions of elderly people as factors that influence the decision for a particular type of care. Until now, however, the regional in-patient long-term care supply has been neglected as influential factor in the individual's decision-making process. In this study, we analyze the choice of received long-term care by explicitly taking the regional supply of nursing homes into account. When estimating a discrete choice model, we distinguish between four different types of formal and informal care provision. We find that the decision for long-term in-patient care is significantly correlated with the regional supply of nursing home places, while controlling for physical and psychological conditions of the individual.

JEL Classification: C35, D12, I11

Keywords: Informal care; formal care; choice of care; administrative data; nursing home supply

November 2014

¹ Adam Pilny, RWI, RGS Econ and Ruhr-Universität Bochum; Magdalena A. Stroka, Ruhr-Universität Bochum, RWI and WINEG. – We thank Thomas K. Bauer, Dörte Heger, Ingo Kolodziej, Sandra Schaffner and Ansgar Wübker for helpful comments and suggestions. We are grateful to our colleagues from the WINEG for the access to the data of the Techniker Krankenkasse. Financial support by the German Research Foundation (DFG) and the Ruhr Graduate School in Economics is gratefully acknowledged. – All correspondence to: Adam Pilny, RWI, Hohenzollernstr. 1-3, 45128 Essen, Germany, e-mail: adam.pilny@rwi-essen.de

1 Introduction

In developed economies, the number of individuals in need of care is expected to increase by 31% up to 2040, with this increase being smaller in Europe and Japan (up to 20%) and larger in North America as well as Australasia (about 60%) (Harwood et al., 2004). Since this process will certainly increase the demand for informal and formal care for the frail elderly, it imposes serious challenges, especially concerning the provision and financing of long-term care. In the context of a growing number of dependent individuals, it is not guaranteed that neither informal care nor formal care may meet the future needs to ensure an adequate provision of care. Therefore, understanding the determinants of the choice of received care gains importance in order to develop policies aiming at a demand-oriented supply of long-term care.

In Germany, the expenditures of care provision, adjusted for inflation, increased by about 41.2% from EUR 24.1 billion in 1995 to EUR 34.1 billion in 2012. The share of care provision expenditures to total health care expenditures increased in the same period from 8.6% in 1995 to 11.4% in 2012. Expenditures for in-patient care provision account for the majority of total care expenditures. In 17 years, in-patient care expenditures increased by 12.8% (EUR 20.3 billion in 1995, EUR 22.8 billion in 2012). In the same period, the magnitude of out-patient care expenditures increased considerably by 108.7% from EUR 5.4 billion in 1995 to EUR 11.3 billion in 2012 (Statistisches Bundesamt 2012, 2014a).¹ As the costs for the four general types of care provision in Germany, i.e. informal care, formal out-patient care, formal in-patient care and the combination of informal and formal out-patient care, vary considerably, especially policy makers as well as the long term-care and health insurance funds may have an interest in understanding the choice mechanisms for the received care services.² Considering the different types of care provision, this study addresses the determinants that influence the individual's choice of care by taking into account the regional in-patient care supply.

Empirical studies document that the decision for a particular type of care provision depends on socio-economic factors and mental or physical disorders (see e.g. Chiswick 1976; Coughlin et al. 1992; Headen Jr. 1993; Bauer 1996; Reschovsky 1996; Weaver et al. 2009; Balia and Brau 2011). However, a substantial part of the existing studies concentrates on the decisions made by caregivers, i.e. the adult children of frail elderly and their decision to provide informal care to their impaired parents. Evidence on the influence of the characteristics of dependent persons on the choice of received long-term care is predominantly provided by gerontological studies: The choice for a particular type of care is influenced by the inability to carry out activities of daily living (ADL), diagnostic reasons such as dementia, cancer or stroke, the individual's age, family structure, socio-economic status and prior institutionalization (see e.g. Arling et al. 1984; McAuley and Arling 1984; Wingard et al. 1990; Tennstedt et al. 1990; Thorslund et al.

¹For price adjustments, price indices for out-patient as well as in-patient health care services are considered using 2012 as base year (Statistisches Bundesamt, 2014b).

²A general overview on care provision and its taxonomy is provided by Norton (2000).

1991; Jette et al. 1992; Freedman 1996; Trydegard 1998; Tomiak et al. 2000). However, most of these studies are based on very small sample sizes and their empirical strategy is often limited to descriptive comparisons. Thus, so far, the knowledge about the decision-making process of elderly in need of care is limited.

We contribute to the literature by analyzing the choice from the perspective of the elderly and present evidence on the relationship between their choice of received care, their characteristics, and the regional supply of nursing homes. Furthermore, we analyze four types of care provision simultaneously. To the best of our knowledge, this is the first study analyzing the influence of regional and individual characteristics of elderlies on the individual choice of received care by considering all types of care provision that are offered in the German market for long-term care.

To estimate the factors that influence the decision, we apply a discrete choice model with a multinomial choice setting to distinguish between the driving factors of the four mentioned types of care provision. Our results show that the regional density of nursing homes increases the individual probability of choosing a nursing home. Moreover, the probability of choosing a nursing home rises with the care severity of the dependent person as well as with their mental diseases.

The paper is organized as follows: A description of the data is provided in Section 2. Section 3 explains the empirical model, while the results are presented in Section 4. Section 5 concludes.

2 Data

The empirical analysis employs data from two different sources. The main source is a resident-level administrative data set provided by the largest sickness fund in Germany, the *Techniker Krankenkasse*. Among others, it contains detailed information on personal characteristics and ascertained diagnoses. The diagnoses are documented using the International Classification of Diseases 10 (ICD-10). Our analysis is restricted to individuals aged 65 years and older, who are officially considered to be in need of care and assigned to one of three care levels by the independent Medical Review Board of the Statutory Health Insurance Funds.³ The data comprise 24,950 frail elderly who received one of the four possible types of care in the year 2009.

The individual-level data is merged to information on the county level provided by the Federal Institution for Research on Building (BBSR). These data include regional information on the number of nursing home places per dependent persons, the unemployment rate, the average household income, the female labor force participation rate, the share of elderly (65+) and the

³Care level 1 goes along with nursing needs of, on average, at least 90 minutes per day and care level 2 includes, on average, at least 180 minutes of daily nursing needs. Care level 3 is the highest one and covers, on average, over 300 minutes of daily care.

population density. As all records in our sample are of administrative nature, data coverage and completeness should be superior to survey data.⁴ Moreover, data reliability should be relatively high because most resident-level records are reported by experts such as physicians. This is particularly important for the present paper because home care dependent persons, who are often senile and who suffer from other severe diseases, or their relatives may not be able to answer questionnaires in a reliable way.

Sample means of the used variables are shown in Table 1.⁵ As shown in the bottom panel of Table 1, 21.7% of the individuals in the sample live in nursing homes, i.e. they have chosen in-patient care. The remaining 78.3% of the individuals receive out-patient care services. Out of these individuals, the majority is cared informally (48.2%), a high share receives the combination of informal and formal out-patient care (27.0%), while a small share receives out-patient care (3.1%) only. Looking at individual characteristics, Table 1 shows that females are over-represented in in-patient care with 64.3%. One explanation for this result might be that men have their spouse as a caregiver if compared to women who on average live longer as men (Wingard et al. 1990; Tennstedt et al. 1990). This hypothesis is confirmed by considering the variable *Living alone*, as 39.1% of the elderlies receiving in-patient care live alone, while informal care exhibits the lowest share of elderlies living alone (15.6%). Moreover, care seekers are cared informally on average at the age of 77.6 years, while elderlies choosing in-patient care are of higher age (82.9 years).

Sample means of the variables of mental and physical disorders indicate that individuals suffering from mental diseases choose in-patient care more often, while individuals suffering from physical diseases rather choose the other three types of care provision. The share of elderlies with mental disorders is high in in-patient care provision, e.g. 67.7% of all individuals in nursing homes suffer from dementia, 9.3% of them are schizophrenic and 8.6% suffer from other mental disorders.

The regional distribution of our variable of primary interest, the number of nursing home places per 100 care dependents, is presented in Figure 1. This figure documents that the provision of in-patient care differs strongly between regions. The highest density of nursing home places can be found in the western part of Germany. The high regional variation of the supply of nursing homes is used in our empirical analysis to identify individual responses to the regional nursing home provision.

⁴A comparison with data from the German Socio-Economic Panel (GSOEP) shows the representativeness of the underlying administrative data source (Schmitz and Stroka, 2013).

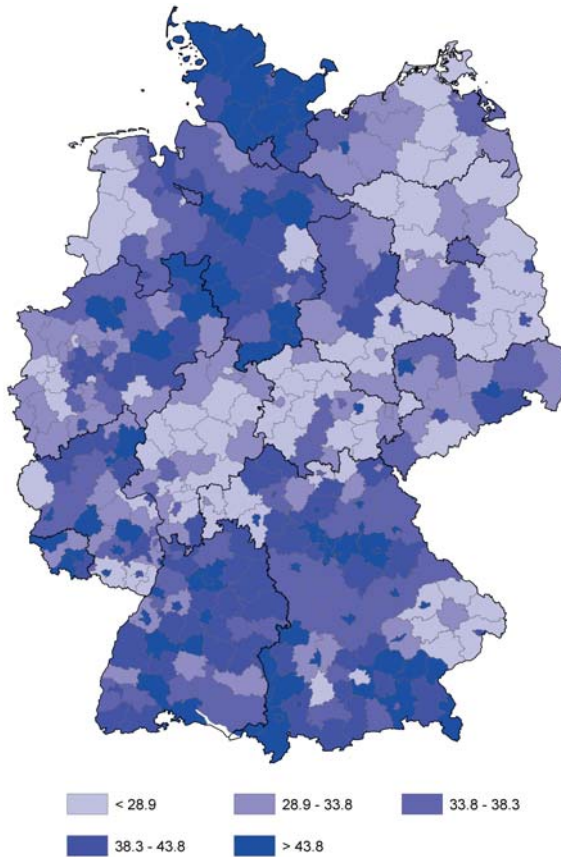
⁵Detailed definitions of the variables are provided in Table A1 in the Appendix.

Table 1: Descriptive statistics

Variable	Informal care		Out-patient care		Combination of informal & formal out-patient care		In-patient care	
	Mean	St. D.	Mean	St. D.	Mean	St. D.	Mean	St. D.
Individual characteristics								
Female	0.454	(0.498)	0.624	(0.485)	0.519	(0.500)	0.643	(0.479)
Age	77.596	(7.697)	80.899	(8.156)	80.439	(7.760)	82.902	(8.091)
Living alone	0.156	(0.362)	0.680	(0.467)	0.263	(0.440)	0.391	(0.488)
Care level 2	0.303	(0.460)	0.280	(0.449)	0.415	(0.493)	0.474	(0.499)
Care level 3	0.058	(0.234)	0.082	(0.275)	0.182	(0.386)	0.242	(0.428)
Number of consultations	32.248	(21.851)	30.684	(20.950)	30.862	(20.015)	37.196	(21.550)
Number of hospitalizations	1.052	(1.738)	1.119	(1.584)	1.137	(1.734)	0.982	(1.348)
Dementia	0.246	(0.430)	0.417	(0.493)	0.388	(0.487)	0.677	(0.468)
Mental disorders due to psychoactive substance	0.068	(0.252)	0.116	(0.321)	0.067	(0.249)	0.079	(0.270)
Schizophrenia	0.031	(0.175)	0.071	(0.256)	0.042	(0.202)	0.093	(0.291)
Depression	0.318	(0.466)	0.373	(0.484)	0.340	(0.474)	0.371	(0.483)
Other mental disorders	0.037	(0.189)	0.054	(0.225)	0.052	(0.222)	0.086	(0.280)
Parkinson's disease	0.142	(0.350)	0.128	(0.334)	0.171	(0.377)	0.186	(0.389)
Stroke	0.292	(0.455)	0.244	(0.430)	0.339	(0.473)	0.295	(0.456)
Cardiac infarction	0.092	(0.289)	0.075	(0.263)	0.080	(0.272)	0.063	(0.242)
Other diseases of the circulatory system	0.930	(0.256)	0.937	(0.243)	0.940	(0.238)	0.897	(0.304)
Invasive neoplasms	0.309	(0.462)	0.267	(0.443)	0.260	(0.439)	0.196	(0.397)
Diseases of the musculoskeletal system	0.748	(0.434)	0.699	(0.459)	0.712	(0.453)	0.629	(0.483)
Diseases of the genitourinary system	0.648	(0.478)	0.637	(0.481)	0.665	(0.472)	0.592	(0.492)
Injuries and poisoning	2.298	(3.920)	2.393	(4.176)	2.436	(3.880)	2.537	(3.967)
County characteristics								
Nursing home places per 100 care dependents _{t-2}	35.845	(7.377)	36.547	(7.128)	36.549	(7.514)	37.764	(7.692)
Share of elderly	0.206	(0.018)	0.205	(0.019)	0.205	(0.018)	0.205	(0.018)
Average household income	1.598	(0.206)	1.624	(0.232)	1.624	(0.207)	1.628	(0.207)
Unemployment rate	0.084	(0.032)	0.088	(0.032)	0.080	(0.030)	0.080	(0.030)
Female labor force participation rate	0.456	(0.042)	0.460	(0.040)	0.457	(0.040)	0.459	(0.039)
Population density	0.136	(0.219)	0.111	(0.207)	0.132	(0.213)	0.140	(0.218)
Federal state dummies								
East Germany	0.073	(0.261)	0.067	(0.250)	0.055	(0.228)	0.049	(0.217)
Bavaria	0.079	(0.270)	0.108	(0.311)	0.098	(0.297)	0.116	(0.321)
Baden-Wuerttemberg	0.102	(0.302)	0.089	(0.285)	0.129	(0.336)	0.134	(0.341)
Berlin	0.071	(0.257)	0.086	(0.281)	0.044	(0.206)	0.047	(0.211)
Brandenburg	0.022	(0.148)	0.017	(0.129)	0.014	(0.115)	0.018	(0.133)
Bremen	0.014	(0.116)	0.024	(0.152)	0.014	(0.115)	0.013	(0.113)
Hamburg	0.030	(0.172)	0.081	(0.273)	0.037	(0.190)	0.036	(0.186)
Hesse	0.113	(0.316)	0.089	(0.285)	0.102	(0.303)	0.101	(0.301)
Lower Saxony	0.123	(0.328)	0.112	(0.316)	0.114	(0.317)	0.121	(0.327)
Mecklenburg Western Pomerania	0.012	(0.109)	0.010	(0.102)	0.008	(0.091)	0.006	(0.075)
Rhineland Palatinate	0.044	(0.205)	0.026	(0.160)	0.043	(0.202)	0.044	(0.205)
Saarland	0.015	(0.120)	0.007	(0.081)	0.015	(0.122)	0.014	(0.119)
Saxony	0.016	(0.127)	0.008	(0.088)	0.014	(0.119)	0.011	(0.106)
Saxony-Anhalt	0.013	(0.113)	0.029	(0.167)	0.011	(0.106)	0.007	(0.083)
Schleswig-Holstein	0.037	(0.188)	0.063	(0.243)	0.038	(0.191)	0.060	(0.237)
Thuringia	0.009	(0.097)	0.003	(0.051)	0.008	(0.088)	0.007	(0.085)
Number of observations	12,032		765		6,736		5,417	
As % of the total sample	48.22%		3.07%		27.00%		21.71%	

Notes: The total number of observations is 24,950.

Figure 1: Nursing home places per 100 care dependents in 2007



Source: Federal Institution for Research on Building – BBSR (2011). Own illustration.

3 Model

An appropriate econometric setting for a multinomial choice model is provided by additive random utility models (ARUM). An ARUM specifies the utilities of m different alternatives $j \in \mathcal{J}$. The choice set \mathcal{J} includes, in our particular case, the alternatives (1) informal care, (2) out-patient care, (3) in-patient care and (4) the combination of informal and formal out-patient care. In a multinomial setting, the utility of individual i from choosing the j^{th} alternative is specified

as

$$U_{ij} = V_{ij} + \epsilon_{ij}, \quad j = 1, \dots, m \quad (1)$$

with the deterministic component V_{ij} and the stochastic component ϵ_{ij} . The deterministic component $V_{ij} = x_i' \beta_j$ covers the vector x_i with individual and regional characteristics and the parameter vector β_j . The individual is assumed to choose the alternative with the highest utility. Hence, the probability of choosing alternative j is denoted as

$$\begin{aligned} Pr[y_i = j] &= Pr[U_{ij} \geq U_{ik}] \\ &= Pr[U_{ik} - U_{ij} \leq 0] \\ &= Pr[\epsilon_{ik} - \epsilon_{ij} \leq V_{ij} - V_{ik}] \quad \forall k \neq j. \end{aligned} \quad (2)$$

We employ a multinomial probit model for our analysis, assuming the errors ϵ_j to be joint normally distributed with $\epsilon_j \sim \mathcal{N}[0, \Sigma]$. The specification of the covariance matrix Σ overcomes biased estimates that may occur due to the independence of irrelevant alternatives (IIA) assumption.⁶ The off-diagonals of Σ are not restricted to be zero. Hence, correlation across the error term is allowed and the IIA assumption does not represent a problem. The probabilities for choosing one of four alternatives in the choice set are specified as

$$\begin{aligned} Pr[y_i = 1] &= Pr[\tilde{\epsilon}_{21} \leq -\tilde{V}_{21}, \quad \tilde{\epsilon}_{31} \leq -\tilde{V}_{31}, \quad \tilde{\epsilon}_{41} \leq -\tilde{V}_{41}] \\ &= \int_{-\infty}^{-\tilde{V}_{41}} \int_{-\infty}^{-\tilde{V}_{31}} \int_{-\infty}^{-\tilde{V}_{21}} f(\tilde{\epsilon}_{21}, \tilde{\epsilon}_{31}, \tilde{\epsilon}_{41}) d\tilde{\epsilon}_{21} d\tilde{\epsilon}_{31} d\tilde{\epsilon}_{41} \end{aligned} \quad (3)$$

with $\tilde{V}_{\cdot 1} = V_{\cdot} - V_1$, $\tilde{\epsilon}_{\cdot 1} = \epsilon_{\cdot} - \epsilon_1$ and the probability density function of the multivariate normal distribution $f(\cdot)$. This trivariate normal integral can be evaluated numerically (Cameron and Trivedi, 2005). The parameters β_j and the variance matrix Σ are estimated with a maximum likelihood (ML) estimator. To interpret the results quantitatively, we calculate the average marginal effects of the covariates.

A potential limitation in our estimation strategy is endogeneity, which arises with respect to the demand and supply of formal care. As the implementation of instrumental variable estimation is not feasible in the context of a multinomial probit model, we use lagged data of the supply of nursing homes (i.e. data from the year 2007 instead of 2009) to overcome endogeneity, as the actual demand should have no influence on the past supply.

⁶As the four alternatives in our choice set are very likely to be close substitutes, an application of a multinomial logit model (MNL) is not appropriate. Several studies show that informal care and in-patient care are substitutes (see e.g. Pezzin et al. 1996; Sasso and Johnson 2002; Houtven and Norton 2004; Charles and Sevak 2005; Bolin et al. 2008; Bonsang 2009; Du 2012). Testing for the IIA property in our data reveals that an application of the MNL would result in biased estimates.

4 Results

The average marginal effects of the multinomial probit model are presented in Table 2. We estimate different model specifications with a varying number of covariates: Model specification 1 includes individual and regional characteristics, while model specification 2 includes additionally variables of mental and physical disorders.

As expected, the lagged number of nursing home places per 100 care dependents is associated with a higher probability of choosing in-patient care. In model specification 1, each additional nursing home place per 100 care dependents indicates an increase in the probability of choosing in-patient care by 0.5%-points. By including additional covariates in model specification 2 the effect decreases, but is still statistically significant. An inverse effect can be observed for informal care, i.e. each additional nursing home place per 100 care dependent persons is associated with a decrease in the likelihood of choosing informal care by 0.5–0.6%-points. Hence, the share of provided nursing home places in the region, where an individual lives, has a high impact on the choice for in-patient care.

Moreover, the marginal effect of the past nursing home supply on the choice of the combination of informal and formal out-patient care is also significantly positive. Each additional nursing home place increases the probability of choosing the combined type of care by about 0.1%-points. An explanation may be a high correlation between the supply of nursing homes and formal out-patient care. The effect of the past nursing home supply on the choice of formal out-patient care is quite small and statistically insignificant. This can be due to the small number of individuals who choose out-patient care in the sample (see Table 1).

Women have a 5.2%-points to 5.5%-points lower probability of choosing informal care. Though, they have a 5.5%-points to 5.9%-points higher probability of nursing home admission. This result confirms the findings by Tennstedt et al. (1990) and Wingard et al. (1990), who argue that women have a higher probability of nursing home admission than men, due to the fact that women are more often caregivers to their men than the other way around. The results also reveal that individuals who live alone have a 13.5%-points to 14.3%-points higher probability of choosing a nursing home. Hence, the absence of a caregiver in the household increases the likelihood of a nursing home admission. Living alone also increases the probability of choosing a formal out-patient care service. Consequently and as expected, individuals who live alone have a 25%-points lower probability of receiving informal care.⁷ The care level has also a high influence on the probability of choosing in-patient care. The higher the care level of an individual is, the more likely an individual chooses in-patient care. Dependent on the model specification,

⁷Intuitively, an interaction term of both dummy variables for women und living alone may be of interest. However, due to the non-linearity of the model an interaction term does not allow for correct inference about sign, magnitude or statistical significance of the estimated interaction effect as shown by Ai and Norton (2003). Therefore, we forgo including this interaction term in the model.

Table 2: Average marginal effects

	Model specification (1)				Model specification (2)			
	Inf.	Comb.	Out-p.	In-p.	Inf.	Comb.	Out-p.	In-p.
Nursing home places per 100 care dependents _{t-2} × 10 ⁻²	-0.558*** (0.049)	0.073* (0.043)	-0.002 (0.014)	0.487*** (0.038)	-0.499*** (0.050)	0.102** (0.044)	-0.002 (0.015)	0.399*** (0.037)
Share of elderly × 10 ⁻²	0.513** (0.217)	-0.259 (0.192)	-0.062 (0.064)	-0.193 (0.169)	0.341 (0.223)	-0.340* (0.198)	-0.067 (0.066)	0.067 (0.166)
Average household income × 10 ⁻³	-0.048** (0.024)	0.043** (0.021)	0.013** (0.007)	-0.009 (0.019)	-0.061** (0.025)	0.039* (0.022)	0.014** (0.007)	0.008 (0.018)
Unemployment rate × 10 ⁻²	0.558*** (0.175)	-0.666*** (0.154)	0.273*** (0.051)	-0.165 (0.138)	0.496*** (0.180)	-0.713*** (0.159)	0.291*** (0.052)	-0.075 (0.134)
Female labor force participation rate × 10 ⁻²	0.014 (0.132)	-0.392*** (0.115)	0.175*** (0.040)	0.203** (0.103)	0.040 (0.135)	-0.373*** (0.119)	0.188*** (0.042)	0.145 (0.100)
Population density × 10 ⁻²	0.010 (0.019)	-0.035** (0.017)	0.003 (0.006)	0.022 (0.015)	0.002 (0.020)	-0.036** (0.018)	0.005 (0.006)	0.030** (0.015)
Female	-0.052*** (0.007)	-0.008 (0.006)	0.000 (0.002)	0.059*** (0.006)	-0.055*** (0.008)	-0.002 (0.007)	0.002 (0.002)	0.055*** (0.006)
Age	-0.051*** (0.008)	0.044*** (0.007)	0.001 (0.002)	0.006 (0.006)	-0.040*** (0.008)	0.043*** (0.007)	0.001 (0.002)	-0.005 (0.006)
Age squared × 10 ⁻²	0.024*** (0.005)	-0.025*** (0.004)	-0.001 (0.001)	0.002 (0.004)	0.017*** (0.005)	-0.024*** (0.004)	-0.001 (0.001)	0.008** (0.004)
Living alone	-0.250*** (0.008)	0.036*** (0.007)	0.071*** (0.004)	0.143*** (0.007)	-0.253*** (0.008)	0.043*** (0.008)	0.074*** (0.005)	-0.135*** (0.007)
Care level 2	-0.267*** (0.007)	0.086*** (0.007)	-0.008*** (0.002)	0.189*** (0.006)	-0.230*** (0.007)	0.100*** (0.007)	-0.008*** (0.002)	-0.138*** (0.006)
Care level 3	-0.436*** (0.007)	0.116*** (0.010)	-0.011*** (0.002)	0.331*** (0.010)	-0.391*** (0.008)	0.181*** (0.011)	-0.010*** (0.003)	0.220*** (0.011)
East Germany	-0.063*** (0.023)	0.072*** (0.022)	-0.011** (0.005)	0.002 (0.019)	-0.060** (0.023)	0.068*** (0.023)	-0.012** (0.005)	0.004 (0.018)
Number of consultations × 10 ⁻²	-	-	-	-	-0.181*** (0.018)	-0.140*** (0.017)	-0.005 (0.006)	0.327*** (0.012)
Number of hospitalizations × 10 ⁻²	-	-	-	-	-0.094 (0.229)	0.983*** (0.197)	0.071 (0.066)	-0.960*** (0.196)
Dementia	-	-	-	-	-0.173*** (0.007)	-0.030*** (0.007)	0.009*** (0.002)	0.193*** (0.006)
Mental disorders due to psychoactive substance	-	-	-	-	-0.111*** (0.014)	0.002 (0.012)	0.013*** (0.005)	0.096*** (0.013)
Schizophrenia	-	-	-	-	-0.126*** (0.017)	-0.026* (0.015)	0.011** (0.005)	0.141*** (0.015)
Depression	-	-	-	-	-0.035*** (0.008)	0.012* (0.007)	0.002 (0.002)	0.020*** (0.006)
Other mental disorders	-	-	-	-	-0.050*** (0.017)	-0.005 (0.014)	0.000 (0.005)	0.055*** (0.013)
Parkinson's disease	-	-	-	-	-0.001 (0.010)	0.007 (0.009)	-0.002 (0.003)	-0.004 (0.007)
Stroke	-	-	-	-	-0.051*** (0.008)	0.038*** (0.007)	-0.003 (0.002)	0.017*** (0.006)
Cardiac infarction	-	-	-	-	0.036*** (0.013)	-0.013 (0.011)	-0.002 (0.004)	-0.021** (0.009)
Other diseases of the circulatory system	-	-	-	-	0.037*** (0.014)	0.053*** (0.012)	0.001 (0.004)	-0.091*** (0.012)
Invasive neoplasms	-	-	-	-	0.062*** (0.008)	-0.009 (0.007)	0.001 (0.002)	-0.055*** (0.006)
Diseases of the musculoskeletal system	-	-	-	-	0.082*** (0.008)	0.008 (0.007)	-0.006** (0.003)	-0.085*** (0.006)
Diseases of the genitourinary system	-	-	-	-	0.008 (0.008)	0.025*** (0.007)	0.004* (0.003)	-0.037*** (0.006)
Injuries and poisoning	-	-	-	-	-0.002** (0.001)	0.002** (0.001)	-0.000 (0.000)	0.001 (0.001)

Notes: The number of observations is 24,950. Cluster robust standard errors in parentheses. *Inf.* is informal care, *Comb.* is the combination of informal and formal out-patient care, *Out-p.* is out-patient care and *In-p.* is in-patient care. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

an individual with care level 2 has a 13.8%-points to 18.9%-points higher likelihood of nursing home admission compared to an individual with care level 1. Individuals with the highest care level 3 have even an up to 33.1%-points higher probability of choosing in-patient care compared to individuals with care level 1. Considering care level 2, the probability of receiving informal care decreases up to 26.7%-points compared to care level 1. For individuals with care level 3 this probability decreases even by up to 43.6%-points.

Individuals suffering from mental disorders, i.e. dementia, mental disorders due to psychoactive substance, schizophrenia, depression and other mental disorders, exhibit a significantly higher probability for a nursing home admission relative to individuals without mental disorders. The marginal effects of the variables for most of the included physical disorders have inverse signs. Hence, individuals suffering from cardiac infarction, other diseases of the circulatory system, invasive neoplasms, diseases of the musculoskeletal system and diseases of the genitourinary systems have a significantly lower probability for institutionalization than individuals without these physical diseases. When elderly are disabled in physical terms, informal caregivers seem to be able to cope with the care situation because the results considering these diseases are significantly positive in case of informal care. However, if the frail persons are suffering from mental disorders the burden for informal caregivers seems to be too large. As a consequence, elderlies with mental disorders have a higher probability of institutionalization and a lower probability of receiving informal care.

To test the sensitivity of the results, a robustness check has been applied by re-estimating model specification 2 with federal state dummies instead of the dummy variable for East Germany.⁸ The signs and the magnitude of the effects correspond, on the whole, to the main results.

5 Conclusion

This study contributes to the literature on the individual choice for long-term care and provides first evidence for Germany. Using a rich set of unique administrative data and estimating a discrete choice model, we show that the structure of the nursing home market is related to the individual choice of received care, i.e. the probability of receiving in-patient care increases with the number of provided nursing home places. We find significant results for individuals living alone, indicating a higher probability of receiving any type of formal care with the highest magnitude of the increase for in-patient care, while the probability of receiving informal care decreases for those individuals. Moreover, females have a significantly higher probability of receiving in-patient care and a significantly lower probability of receiving informal care. Another finding is that the probability of receiving in-patient care increases with the care severity and, hence, the care level of the dependent person. The results are robust to different model specifications.

⁸The average marginal effects for this model specification are provided in Table A2 in the Appendix.

While we take advantage of the large and very informative data set, our study comes along with some limitations. First, we only control for the supply of formal care and have no information on the potential supply of informal care within the family, e.g. the number of children. However, we include information on whether individuals live alone in our empirical models. Besides the missing information on the family structure, we have to deal with endogeneity of the demand for long term care services and the supply structure of the care market. Even though we consider the lagged supply of nursing homes in order to handle endogeneity, the reported effects in our analysis should be rather considered as correlations than causal effects.

Important policy implications arise from our results. It is appropriate to assume that with more flexible living arrangements, increasing female labor market participation and decreasing fertility rates informal care provision might become less available within families. Hence, a sufficient supply of formal care is necessary, especially as the choice of in-patient care is highly associated with the supply of nursing homes. In our analysis, we show that a higher supply of nursing home places per care dependent individual, and hence, an easier access to formal in-patient care is associated with an increase of the individual probability to be institutionalized. As Schmitz and Stroka (2014) show, care dependent individuals have a strong preference for low distances from their previous households to a nursing home and for lower nursing home prices. Thus, individuals living in regions with a higher density of nursing home places may have a higher probability to find a nursing home that fits their preferences and requirements. Moreover due to higher competition, nursing homes prices are expected to decrease in regions with a higher share of nursing homes.

Furthermore, a higher supply of nursing home beds might contribute to a solution considering the problem of the informal caregivers' burden. Today's informal caregivers bear the risk to become tomorrow's care recipients due to their burdensome task. Nevertheless, besides these expected positive aspects of an increase in nursing home supply open questions remain to be solved in the future, i.e. the funding of a sufficient provision of nursing home beds or the skill shortage in the nursing home sector. However, in face of the growing number of dependent individuals in forthcoming decades, it is not guaranteed that neither informal care nor formal care can meet the needs. Therefore, integrative models, i.e. concepts of linking informal and formal services, have to be considered and discussed in future research (Lyons and Zarit, 1999), since they may constitute a solution to overcome the challenges of the demographic change.

References

- Ai, C. and E. C. Norton (2003). Interaction terms in logit and probit models. *Economics Letters* 80(1), 123–129.
- Arling, G., E. B. Harkins, and M. Romaniuk (1984). Adult day care and the nursing home: The appropriateness of care in alternative settings. *Research on Aging* 6(2), 225–242.
- Balia, S. and R. Brau (2011). A country for old men? An analysis of the determinants of long-term home care in Europe. Working paper, Centre for North South Economic Research, University of Cagliari and Sassari, Sardinia.
- Bauer, E. J. (1996). Transitions from home to nursing home in a capitated long-term care program: The role of individual support systems. *Health Services Research* 31(3), 309–326.
- Bolin, K., B. Lindgren, and P. Lundborg (2008). Informal and formal care among single-living elderly in Europe. *Health Economics* 17(3), 393–409.
- Bonsang, E. (2009). Does informal care from children to their elderly parents substitute for formal care in Europe? *Journal of Health Economics* 28(1), 143–154.
- Cameron, A. C. and P. K. Trivedi (2005). *Microeconometrics - Methods and Applications*. Cambridge: Cambridge University Press.
- Charles, K. K. and P. Sevak (2005). Can family caregiving substitute for nursing home care? *Journal of Health Economics* 24(6), 1174–1190.
- Chiswick, B. R. (1976). The demand for nursing home care: An analysis of the substitution between institutional and noninstitutional care. *The Journal of Human Resources* 11(3), 295–316.
- Coughlin, T. A., T. D. McBride, M. Perozek, and K. Liu (1992). Home care for the disabled elderly: Predictors and expected costs. *Health Services Research* 27(4), 453–479.
- Du, J. (2012). Formal and informal care: An empirical Bayesian analysis using the two-part model. *Forum for Health Economics & Policy* 15(2).
- Freedman, V. A. (1996). Family structure and the risk of nursing home admission. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 51B(2), S61–S69.
- Harwood, R. H., A. A. Sayer, and M. Hirschfeld (2004). Current and future worldwide prevalence of dependency, its relationship to total population, and dependency ratios. *Bulletin of the World Health Organization* 82(4), 251–258.
- Headen Jr., A. E. (1993). Economic disability and health determinants of the hazard of nursing home entry. *The Journal of Human Resources* 28(1), 80–110.

- Houtven, C. H. V. and E. C. Norton (2004). Informal care and health care use of older adults. *Journal of Health Economics* 23(6), 1159–1180.
- Jette, A. M., L. G. Branch, L. A. Sleeper, H. Feldman, and L. M. Sullivan (1992). High-risk profiles for nursing home admission. *The Gerontologist* 32(5), 634–640.
- Lyons, K. S. and S. H. Zarit (1999). Formal and informal support: The great divide. *International Journal of Geriatric Psychiatry* 14(3), 183–192.
- McAuley, W. and G. Arling (1984). Use of in-home care by very old people. *Journal of Health and Social Behaviour* 25, 54–64.
- Norton, E. C. (2000). Long-term care. In A. J. Culyer and J. P. Newhouse (Eds.), *Handbook of Health Economics*, Volume 1 of *Handbook of Health Economics*, pp. 955–994. Elsevier.
- Pezzin, L. E., P. Kemper, and J. Reschovsky (1996). Does publicly provided home care substitute for family care? Experimental evidence with endogenous living arrangements. *The Journal of Human Resources* 31(3), 650–676.
- Reschovsky, J. D. (1996). Demand for and access to institutional long-term care: The role of Medicaid in nursing markets. *Inquiry* 33(1), 15–29.
- Sasso, A. T. L. and R. W. Johnson (2002). Does informal care from adult children reduce nursing home admissions for the elderly? *Inquiry* 39(3), 279–297.
- Schmitz, H. and M. A. Stroka (2013). Health and the double burden of full-time work and informal care provision – Evidence from administrative data. *Labour Economics* 24(0), 305–322.
- Schmitz, H. and M. A. Stroka (2014). Do elderly choose nursing homes by quality, price or location? *Ruhr Economic Papers* 495.
- Statistisches Bundesamt (2012). *Gesundheit – Ausgaben 1995 bis 2010*. Fachserie 12 – Reihe 7.1.2. Wiesbaden.
- Statistisches Bundesamt (2014a). *Gesundheit – Ausgaben 2012*. Fachserie 12 – Reihe 7.1.1. Wiesbaden.
- Statistisches Bundesamt (2014b). *Preise – Verbraucherpreisindizes für Deutschland – Jahresbericht 2013*. Wiesbaden.
- Tennstedt, S. L., L. M. Sullivan, J. B. McKinlay, and R. B. D’Agostino (1990). How important is functional status as a predictor of service use by older people? *Journal of Aging and Health* 2(4), 439–461.
- Thorslund, M., T. Norström, and K. Wernberg (1991). The utilization of home help in Sweden: A multivariate analysis. *The Gerontologist* 31(1), 116–119.

- Tomiak, M., J.-M. Berthelot, E. Guimond, and C. A. Mustard (2000). Factors associated with nursing-home entry for elders in Manitoba, Canada. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 55(5), M279–M287.
- Trydegard, G.-B. (1998). Public long term care in Sweden. *Journal of Gerontological Social Work* 29(4), 13–34.
- Weaver, F., S. C. Stearns, E. C. Norton, and W. Spector (2009). Proximity to death and participation in the long-term care market. *Health Economics* 18(8), 867–883.
- Wingard, D. L., D. Williams-Jones, J. McPhillips, R. M. Kaplan, and E. Barret-Connor (1990). Nursing home utilization in adults: A prospective population-based study. *Journal of Aging and Health* 2(2), 179–193.

Appendix

Table A1: Definition of variables

Variable	Definition
Individual characteristics	
In-patient care	1, if resident of a nursing home, 0 otherwise
Out-patient informal care	1, if received care is informal out-patient care, 0 otherwise
Out-patient formal care	1, if received care is formal out-patient care, 0 otherwise
Out-patient informal & formal care	1, if received care is a combination of informal and formal out-patient care, 0 otherwise
Female	1, if female, 0 otherwise
Age	Age of individual
Age squared	Age squared of individual
Living alone	1, if individual lives alone, 0 otherwise
Care level 2	1, if individual in care level 2, 0 otherwise (base group: care level 1)
Care level 3	1, if individual in care level 3, 0 otherwise (base group: care level 1)
Number of consultations	Number of consultations
Number of hospitalizations	Number of hospitalizations
Dementia	1, if dementia (ICD-10: F00-F03) was diagnosed, 0 otherwise
Mental disorders due to psychoactive substance	1, if mental disorders due to psychoactive substance (ICD10: F04-F06.2, F06.4-F09, F30, F39-F99) were diagnosed, 0 otherwise
Schizophrenia	1, if schizophrenia, or schizotypal and delusional disorders (ICD-10: F20-F29) were diagnosed, 0 otherwise
Depression	1, if depression or bipolar disorder (ICD-10: F31-F38, F06.3) were diagnosed, 0 otherwise
Other mental disorders	1, if other mental disorders (ICD10: F10-F19) were diagnosed, 0 otherwise
Parkinson's disease	1, if Parkinson's disease (ICD-10: G20-G22) was diagnosed, 0 otherwise
Stroke	1, if stroke (ICD10: I61, I63, I64) was diagnosed, 0 otherwise
Cardiac infarction	1, if cardiac infarction (ICD-10: I21-I22) was diagnosed, 0 otherwise
Other diseases of the circulatory system	1, if other diseases of the circulatory system (ICD-10: I00-I99 without I21-I22, I61, I63, I64) were diagnosed, 0 otherwise
Invasive neoplasms	1, if invasive neoplasms (ICD-10: C00-C97) were diagnosed, 0 otherwise
Diseases of the musculoskeletal system	1, if diseases of the musculoskeletal system (ICD-10: M00-M99) were diagnosed, 0 otherwise
Diseases of the genitourinary system	1, if diseases of the genitourinary system (ICD-10: N00-N99) were diagnosed, 0 otherwise
Injuries and poisoning	Number of injuries and poisonings (ICD-10: S00-T98) diagnosed
County characteristics	
Nursing home places per 100 care dependents _{t-2}	Number of nursing home places per 100 care dependent individuals in 2007
Share of elderly	Share of the population aged 65+ on the whole population
Average household income	Average available income of the private households per inhabitant
Unemployment rate	Unemployment rate of all persons capable for gainful employment
Female labor force participation rate	Share of labor force participation of women
Population density	Share of inhabitants in municipalities with a population density lower than 150 inhabitants per square kilometer at county level
Federal state dummies	
East Germany	1, if East Germany, 0 otherwise
Bavaria	1, if Bavaria, 0 otherwise
Baden-Wuerttemberg	1, if Baden-Wuerttemberg, 0 otherwise
Berlin	1, if Berlin, 0 otherwise
Brandenburg	1, if Brandenburg, 0 otherwise
Bremen	1, if Bremen, 0 otherwise
Hamburg	1, if Hamburg, 0 otherwise
Hesse	1, if Hesse, 0 otherwise
Lower Saxony	1, if Lower Saxony, 0 otherwise
Mecklenburg Western Pomerania	1, if Mecklenburg Western Pomerania, 0 otherwise
Rhineland Palatinate	1, if Rhineland Palatinate, 0 otherwise
Saarland	1, if Saarland, 0 otherwise
Saxony	1, if Saxony, 0 otherwise
Saxony-Anhalt	1, if Saxony-Anhalt, 0 otherwise
Schleswig-Holstein	1, if Schleswig-Holstein, 0 otherwise
Thuringia	1, if Thuringia, 0 otherwise

Table A2: Robustness check – Average marginal effects

	Inf.	Comb.	Out-p.	In-p.
Nursing home places per 100 care dependents _{t-2} × 10 ⁻²	-0.480*** (0.061)	0.045 (0.054)	-0.028 (0.017)	0.462*** (0.044)
Share of elderly × 10 ⁻²	0.444* (0.255)	-0.478** (0.226)	0.012 (0.077)	0.021 (0.186)
Average household income × 10 ⁻³	-0.048 (0.033)	0.003 (0.029)	0.010 (0.009)	0.035 (0.023)
Unemployment rate × 10 ⁻²	-0.180 (0.257)	-0.421* (0.227)	0.197*** (0.073)	0.404** (0.190)
Female labor force participation rate × 10 ⁻²	0.008 (0.173)	-0.073 (0.152)	0.074 (0.051)	-0.008 (0.126)
Population density × 10 ⁻²	-0.018 (0.022)	-0.015 (0.019)	-0.006 (0.006)	0.039** (0.016)
Female	-0.055*** (0.008)	-0.001 (0.007)	0.002 (0.002)	0.055*** (0.006)
Age	-0.040*** (0.008)	0.043*** (0.007)	0.001 (0.002)	-0.004 (0.006)
Age squared × 10 ⁻²	0.017*** (0.005)	-0.024*** (0.004)	-0.001 (0.001)	0.008** (0.004)
Living alone	-0.255*** (0.008)	0.044*** (0.008)	0.072*** (0.005)	0.139*** (0.007)
Care level 2	-0.231*** (0.007)	0.100*** (0.007)	-0.008*** (0.002)	0.139*** (0.006)
Care level 3	-0.393*** (0.008)	0.183*** (0.011)	-0.010*** (0.003)	0.220*** (0.011)
Number of consultations × 10 ⁻²	-0.183*** (0.018)	-0.139*** (0.017)	-0.008 (0.006)	0.330*** (0.013)
Number of hospitalizations × 10 ⁻²	-0.069 (0.228)	0.958*** (0.197)	0.076 (0.066)	-0.966*** (0.196)
Dementia	-0.172*** (0.007)	-0.030*** (0.007)	0.009*** (0.002)	0.193*** (0.006)
Mental disorders due to psychoactive substance	-0.111*** (0.014)	0.003 (0.013)	0.012*** (0.005)	0.096*** (0.013)
Schizophrenia	-0.125*** (0.017)	-0.026* (0.015)	0.011** (0.005)	0.140*** (0.015)
Depression	-0.035*** (0.008)	0.013* (0.007)	0.002 (0.002)	0.020*** (0.006)
Other mental disorders	-0.051*** (0.017)	-0.005 (0.014)	0.001 (0.005)	0.055*** (0.013)
Parkinson's disease	-0.001 (0.010)	0.006 (0.009)	-0.001 (0.003)	-0.004 (0.007)
Stroke	-0.051*** (0.008)	0.038*** (0.007)	-0.003 (0.002)	0.016*** (0.006)
Cardiac infarction	0.035*** (0.013)	-0.013 (0.011)	-0.002 (0.004)	-0.020** (0.009)
Other diseases of the circulatory system	0.037*** (0.014)	0.053*** (0.012)	0.001 (0.004)	-0.090*** (0.012)
Invasive neoplasms	0.062*** (0.008)	-0.009 (0.007)	0.002 (0.002)	-0.055*** (0.006)
Diseases of the musculoskeletal system	0.083*** (0.008)	0.009 (0.007)	-0.006** (0.003)	-0.086*** (0.006)
Diseases of the genitourinary system	0.009 (0.008)	0.025*** (0.007)	0.004** (0.002)	-0.038*** (0.006)
Injuries and poisoning	-0.002** (0.001)	0.002** (0.001)	-0.000 (0.000)	0.001 (0.001)
Federal state dummies	Yes	Yes	Yes	Yes

Notes: The number of observations is 24,950. Cluster robust standard errors in parentheses. *Inf.* is informal care, *Comb.* is the combination of informal and formal out-patient care, *Out-p.* is out-patient care and *In-p.* is in-patient care. The average marginal effects of the federal state dummies are available on request. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.