Three Essays on Empirical Industrial Organization

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To my parents

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Chapter 1

General Introduction

In this dissertation, I present three essays on empirical industrial organization. This field of economics concentrates on the structure of imperfectly competitive industries and on the behavior of firms and individuals in these industries (Einav and Levin, 2010). If markets fail to produce efficient outcomes, policy interventions need to minimize the impact of actions with significant negative spillovers (Stiglitz, 2009). Thus, the issues addressed by the empirical industrial organization are intimately related to broader public policy questions, such as the antitrust stance towards concentrated industries or the design of regulatory mechanisms for industries with information asymmetries (Einav and Levin, 2010). In order to develop and implement sound policy measures, it is essential to understand the behavior of consumers and their interaction with the firms. In light of this, I analyze competition and regulation in two separate industries. The first essay focuses on the EU telecommunications market, while the rest deals with the German market for long-term care.

The telecommunications industry is dynamic, with a rapidly expanding range of services and technologies. The national telecommunications sectors were monopolized until 1990s, when the liberalizaton attempts by US and EU regulatory authorities led to unbundling of incumbent carriers. The competition was further fostered by the spread of mobile telephony, various broadband technologies and voice over IP services. Yet, the telecommunications market remains highly concentrated. Majority of high developed countries have three to four mobile providers (Genakos et al., 2015), and 4-to-3 mergers took place in recent years in the Netherlands, Austria, Ireland, Germany, and Italy.[1] Moreover, the deployment and maintenance of high-speed broadband technologies are associated with high sunk costs, which creates entry barriers. Policy interventions must therefore reconcile the goal of economic efficiency on the one, and provide incentives for innovation and technological development on the other hand. In the first essay, I evaluate this issue in the context of telephony services.

The German long-term care market is rapidly expanding due to aging population and increasing prevalence of age-related disabilities. The care-dependent population increased from 2 million in 1999 to 2.6 million in 2013, and is projected to rise to 3.4 million in 2030 (Augurzky et al., 2015). Shortages of capital and qualified workforce pose substantial challenges for future care provision (Augurzky et al., 2013). At the same time, long-term care is a credence good. The choice of care

[1] See the European Commission merger cases Vodafone / Liberty Global, Hutchison 3G Austria / Orange Austria, Hutchison 3G UK / Telefonica Ireland, Telefonica Deutschland / E-Plus, and Hutchison / VimpelCom.

facilities is associated with *a priori* uncertain quality, which can have severe negative implications on consumer welfare. The success of policies designed to address these issues hinges upon understanding the care recipients' behavior. The German long-term care market is particularly suitable to explore it, due to a free choice between different long-term care forms and facilities. Thus, in the second and third essay, I focus on consumer choice and welfare in the long-term care market.

Chapter 2, under the title **Substitution Between Fixed, Mobile, and Voice over IP Telephony – Evidence from the European Union**, is co-authored by Mirjam R. J. Lange and published in *Telecommunications Policy* (Lange and Saric, 2016). This essay examines the regulation of EU market for telephony services in view of the changing industry landscape. The analysis of substitution between different types of telephony is the cornerstone of market definition and, therefore, of effective regulation. We explore the access substitution between fixed-lines, mobiles, and VoIP services in a unified EU cross-country framework. We employ a dataset for 20 EU countries for the 2008–2011 period, and apply dynamic panel data methods. We document a strong access substitution between fixed-lines and mobiles, and find indicative evidence of the substitution between fixed-lines and VoIP. Our results provide support for a joint market definition for the telephony services. This is in line with the European Commission's Recommendation on removal of access obligations from the market for fixed telephone networks (European Commission, 2014).

Chapter 3 is titled **The Welfare Effects of Single Rooms in German Nursing Homes: A Structural Approach**, and is co-authored by Annika Herr. In this essay, we explore the welfare effects of a single room policy in German nursing homes. This policy was promulgated in the federal state of Baden-Wuerttemberg in 2009 with the goal of enhancing the quality of life of nursing home residents. North Rhine-Westphalia followed suit with the provision that at least 80% of nursing home places must be provided in single rooms by 2018. We use a comprehensive dataset including all German nursing homes providing full-time inpatient care for elderly between 2007 and 2009. We estimate a one-level nested logit model of demand and, based on the model of bargaining between payers and providers, recover the marginal costs and markups. We then analyze a counterfactual market in which only single rooms are offered. Higher consumer welfare materializes only if the supply of nursing home places does not decline. Considering the costs of restructuring the existing nursing homes, it may be more welfare-enhancing to stimulate investment in new facilities which would be obliged to provide exclusively single rooms.

Chapter 4, with the title **Regional Variation in the Use of Inpatient Long-Term Care in Germany: A Spatial Approach**, explores county-level differences in the demand for nursing home care. The shares of county's care-dependent population in nursing homes varied between 49 and 175 percent of the national mean between 2007 and 2011.[2] Considering high public expenditures and shortage of a qualified workforce, regional variation could reflect broader problems in provision. For example, under-utilization due to long travel and waiting times indicates problems in access to nursing homes. Over-utilization, on the other hand, could indicate a lack of alternatives to nursing home care. I analyze this divergence using a rich dataset containing information on the entire German care-dependent population, supply of long-term care services, and structural characteristics of the counties. In order to account for regional spillovers in the demand for nursing home care, I apply a spatial autoregressive model with autoregressive disturbance terms. The main explanatory factors of the observed regional variation are the care recipients' age, existence of informal support, and density of nursing home places. Spatial dependencies play a relatively minor role.

Chapter 5 summarizes this dissertation and concludes.

[2] *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007-2011, own calculations.

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Chapter 2

Substitution Between Fixed, Mobile, and Voice over IP Telephony – Evidence from the European Union

Co–authored by Mirjam R. J. Lange

2.1 Introduction

The national telecommunication sectors have in the past operated as natural monopolies. State-owned carriers were in charge of maintaining and providing access to the national copper-based fixed telephone network.[1] The industry landscape changed in the 1990s, when mobile telephony became widespread due to the deployment of GSM technology. In the same period, fixed network incumbents began providing Internet services through the existing copper-based infrastructure. In one of the first liberalization attempts, the US Telecommunications Act of 1996 imposed access obligations on incumbent carriers to allow for network interconnection. The EU followed suit in 1998. Nowadays, wholesale access obligations still remain in place in most European countries (European Commission, 2014c). The incumbent carriers are required to lease the copper infrastructure to entrants at regulated (usually cost-based) access prices.

Recent developments in the EU telecommunications markets challenge the viability of the existing regulatory framework (Briglauer et al., 2011; Barth and Heimeshoff, 2014a,b). Fixed-line services have been in decline for many years. In contrast, staunch competition in the mobile sector and the resulting price drop have advanced the spread of mobile telephony (European Commission, 2013, p. 63). Broadband coverage is almost universal: at the end of 2013, more than 97% of all EU homes had access to fixed broadband, 62% of which were covered by ultra-fast broadband (European Commission, 2014a). The deployment and uptake of ultra-fast broadband provided an impetus for the expansion of VoIP telephony, since its quality critically depends on the underlying connection speed.[2] If an emerging communications service such as VoIP becomes a substitute for the existing ones, the

[1] The term fixed telephone network is equivalent to Public Switched Telephone Network (PSTN) and Plain Old Telephone Service (POTS). It refers to the international telephone system based on copper wires carrying voice data in the form of analog waves. Fixed telephony includes markets for access, call origination, and call termination on the public telephone network provided at a fixed location.

[2] VoIP, or broadly Internet telephony, is a methodology and a group of technologies that enables the usage of the Internet as the transmission medium for telephone calls. This type of telephony is digital, i.e., voice signals are translated into binary data instead of analog waves. The data packets are then transmitted via Internet Protocol (IP). VoIP can be unmanaged and managed. Unmanaged VoIP (also known as pure VoIP service, i.e., a peer-to-peer application) is based on a software developed by independent content providers and is not regulated. Typical examples include Skype and Viber. From the demand side, managed VoIP is nearly equivalent to the traditional fixed telephony. Consumers make and receive calls using a telephone gadget and are assigned a geographic or non-geographic number. Termination rates for calls to and from managed VoIP are regulated.

competitive boundaries might shift, which has to be considered in the regulatory decision-making.

The European Commission's 'Recommendation on relevant product and service markets within the electronic communications sectors has recently suggested that both markets for access (market 1/2007) and call origination (2/2007) on the public telephone network provided at a fixed location fail the Three criteria test and that, therefore, access obligations can be removed.[3] While the decision to discontinue the regulation was in the past based on meeting the test criteria, national regulators are nowadays obliged to provide evidence that a market has failed the test in order to retain the regulation. The burden of proof has thus been reversed.[4] The decision to deregulate is, inter alia, based on the degree of substitution between fixed-lines and other telephone services (European Commission, 2014c; FICORA, 2013). The Commission underlines that, although both mobiles and VoIP constrain the fixed incumbent carriers, only managed VoIP is a proper substitute for fixed-lines. This conclusion is based on the differences in features, contracts, and consumption patterns between mobile and fixed-line telephony.

Surprisingly, the empirical literature is almost silent with regard to VoIP telephony and its relationship with other communications services. Few existing studies on VoIP examine the traffic substitution and deal almost exclusively with unmanaged VoIP, i.e., peer-to-peer applications. However, analyzing managed VoIP, which is regarded as a possible substitute for fixed-lines due to their similarities from the demand side, is critical in the light of changed market conditions, and the necessity to redesign the existing regulatory framework. To the best of our knowledge, a coherent analysis of the access substitutability between fixed-line, mobile and managed VoIP telephony is absent from the literature. Our paper attempts to bridge this research gap. We address the following questions: (a) what is the extent of access substitution between fixed-lines and managed VoIP?, and (b) how is the demand for fixed-lines and managed VoIP affected by mobiles? We focus on access-

[3]Concerning the Three criteria test, the Commission first argues that entry barriers are no longer substantial, given that the market entry is possible on the basis of leasing the existing or deploying the own infrastructure. Second, VoIP telephony and mobiles constrain the market power of fixed-line incumbents, with the tendency towards more effective competition in the future. Finally, if *ex ante* access obligations are removed, competition law alone is sufficient to address the remaining market failures.

[4]Currently, markets 1/2007 and 2/2007 have been deregulated in only a few countries. *Ex ante* access obligations have been removed from the market 1/2007 in Finland, Lithuania, Romania, and Slovenia, and from the market 2/2007 in Finland and Romania only (European Commission, 2014c). The Netherlands and the UK impose limited remedies on the non-competitive segments (single calls and the ISDN2 and ISDN30 access markets, respectively) of the market 1/2007 (ECORYS, 2013, p.78).

instead of traffic-level substitution due to its relevance for the regulation, and a lack of empirical evidence on the issue.

We employ a dataset with a half-yearly frequency for 20 EU countries spanning the 2008–2011 period, and apply dynamic panel data methods. Our main interest is the estimation of own- and cross-price elasticities between fixed-lines, mobiles, and managed VoIP, which are indicative of the danger of market power abuse.[5] Our results indicate a strong access substitution between fixed-lines and mobiles, and provide vague evidence of their substitution with managed VoIP at the EU level. Second, bundling strategies are essential for maintaining the subscription base in the market for fixed-lines. Contrary to the Commission's appraisal, our findings indicate that fixed-lines and mobiles are likely part of the same market. Overall, we find evidence in favor of access substitution and, therefore, of a joint market definition. *Ex ante* access obligations previously imposed on copper-based incumbents are therefore redundant. However, in the short-run, national regulators might need to consider targeted remedies in order to protect the captive group. In this case, the regulatory framework should be redesigned in a way that is conducive to competition and innovation.

The paper is organized as follows. In Section 2.2, we summarize the relevant literature. Section 2.3 outlines the empirical strategy and describes our dataset. The results are presented in Section 2.4, before the discussion on policy implications in Section 2.5. Finally, Section 2.6 concludes.

2.2 Literature Review

A large body of the literature explores traffic and access substitution between fixed-lines and mobiles on both single- and cross-country levels. Studies on VoIP, on the other hand, are scarce and focus only on traffic-level substitution and unmanaged VoIP systems. A detailed literature overview is provided in Tables A2.1 and A2.2 in the Appendix.

[5]Market power abuse by the incumbent carriers in the case of deregulation could lead to unfavorable conditions for consumers (European Commission, 2014b, p.21; BEREC, 2014, pp.15-17; Vodafone, 2014, pp.4-7). This pertains primarily to the captive users, who cannot disconnect from the fixed-lines due to a lack of alternatives. The reasons for the captivity are twofold. First, fixed-lines provide access to services which are not compatible with either VoIP or mobiles, including fax, alarm systems, remote maintenance and monitoring applications. Second, for technical reasons, legacy copper-based equipment cannot always be operated by IP solutions, which induces high switching costs (BEREC, 2014, p.16).

One strand of literature analyzes the country-level substitution between fixed-lines and mobiles. In one of the pioneering works, Rodini et al. (2003) employ a binary logit model with a US household survey panel data from 2000–2001, documenting access substitution between mobiles and the second fixed-line. Ward and Woroch (2004) provide evidence of traffic-level substitution using an extended US households survey data for the 1999–2001 period. In a related study, Ward and Woroch (2010) employ the same dataset, and use a US price subsidy for fixed telephony as a natural experiment for their difference-in-differences analysis. Their results indicate modest access substitution between fixed-lines and mobiles. More recently, Ward and Zheng (2012) provided evidence of access substitution in China, using data from 1998–2007 and applying an Arellano-Bond linear dynamic panel model. Employing a logistic model with household survey data from 2004–2009, Suárez and García-Mariñoso (2013) deduce that access substitution between fixed-lines and mobiles in Spain is driven by the type of broadband access, network effects, age, household size and, to a lesser extent, price. Karacuka et al. (2011) analyze the demand for mobile telecommunications services in Turkey. Using operator-level panel data for the 2002–2006 period, the authors document strong evidence of traffic-level substitution. The substitution effect is stronger for pre-paid than for post-paid consumers. Briglauer et al. (2011) utilize a sample of Austrian market-level data from 2002–2007, and conclude that the demand for fixed-line access is inelastic, while the demand for fixed-line calls is elastic.

Another group of studies explore the relationship between fixed-lines and mobiles using aggregate cross-country data. Garbacz and Thompson (2007) estimate a fixed effects model using a sample of 53 less-developed countries (LDC) for the 1996 –2003 period. They find that fixed-lines are substitutes in the mobile market, while mobiles may be considered complements in the fixed-line market. Barth and Heimeshoff (2014a,b) employ a dynamic panel data approach on a sample of EU countries, documenting both access and traffic substitution. Other recent studies focus on the role of broadband technologies in fixed-mobile substitution. Using a dataset for 27 EU countries for the 2005–2010 and 2005–2011 periods, respectively, Grzybowski (2014) and Grzybowski and Verboven (2016) estimate a discrete choice model of household demand for 'fixed-line only', 'mobile only', and both 'fixed-line and mobile access'. Both studies provide evidence of fixed-mobile substitution. Furthermore, higher fixed broadband penetration is shown to increase the complementarity, while the spread of mobile broadband increases the substitutability between fixed-lines and mobiles. Grzybowski and Verboven (2016) also provide evidence of an incumbency advantage: a dominant position in the fixed-line market can be leveraged into the mobile market.

Several studies have focused on VoIP and its relationship with other telephony services. Most studies focus on individual countries and provide scant econometric evidence on intermodal traffic substitution. Cecere and Corrocher (2011) investigate the usage patterns of unmanaged VoIP services, such as Skype and MSN messenger, by estimating a probit model on a sample of UK consumer survey data from 2006.[6] The authors find that VoIP calls are made more regularly if a household is not subscribed to fixed-line, while the VoIP usage intensity is unaffected by the levels of mobile subscription. In contrast, Cecere and Corrocher (2012) use a sample of Italian consumers from 2006, and conclude that mobiles negatively affect the usage of unmanaged VoIP. The usage of other IP services (e.g., chat and mail applications), which is associated with deepened IT skills and higher perceived ease of use, slightly increases the probability of using VoIP applications. Unlike the two aforementioned studies, Kwak and Lee (2011) use time-series data for the 2006–2009 period, and employ an instrumental variable approach to analyze the traffic substitution between managed VoIP and other communications services in South Korea.[7] The authors conclude that the usage intensity of managed VoIP is driven by VoIP call rates, fixed-line call rates, and network effects, but is not affected by the pricing of mobile services.

Overall, the literature provides evidence of fixed-mobile substitution on both access- and traffic-level. On the other hand, the evidence of traffic substitution between VoIP and other communications services is inconclusive. The latter is partly due to relatively old datasets and short time-series. Against this backdrop, our study is the first to investigate the access-level substitution between VoIP, fixed-lines and mobiles.

[6] In their dataset, Skype is by far the most popular application with 67% of the respondents using it, followed by MSN (18%), BT/Yahoo! (16%), Tesco (6%), plus Orange (Wanadoo) and Google (both 4%).

[7] Note that the validity of instruments included in this study is questionable if the contract length exceeds one month.

2.3 Model Specification and Data

2.3.1 Empirical Strategy

A number of studies demonstrate that the subscription and usage patterns of telephony services are characterized by path dependence (Karacuka et al., 2011; Ward and Zheng, 2012; Barth and Heimeshoff, 2014a,b). The reasons for this are twofold. On the one hand, habits and routines thwart prompt adaptation of consumer behavior in the face of changed market conditions. On the other hand, most service contracts are not irrevocable at any time, which precludes their cancellation before the actual expiration date. Following Houthakker and Taylor (1970), we account for the demand persistence using the lagged values of the subscription levels. We further assume that the subscription volumes are driven by both current and lagged prices, since the cancellation and subscription decisions might not be immediate. We specify the demand function for technology $K = \{\mathit{fix,\ mob,\ voip}\}$ in period t as:

$$k_{sub_t} = f(k_{sub_{t-1}}, p_{k_t}, p_{k_{t-1}}, \mathbf{p}_{k_t}, \mathbf{p}_{k_{t-1}}, X_t),$$

where $k \in K$ denotes fixed, mobile or managed VoIP telephony, k_{sub} is the demand for k measured in terms of the subscription base, p_k is the price of service k, $\mathbf{p}_k = (p_l \mid \forall l \in K_{-k})$ is the price vector of all potential substitutes of k, and X_t is a vector of demand shifters which includes the number of broadband connections, the number of fixed incumbents' subscribers in the mobile market, and the monthly income per capita. Exploiting the panel structure of our dataset, we define the demand for service k in country i at time t as:

$$\begin{aligned} k_{sub_{it}} = \alpha + \beta_k k_{sub_{it-1}} + \sum_k \gamma_k p_{k_{it}} + \sum_k \delta_k p_{k_{it-1}} \\ + \sum_k \theta_k X_{k_{it}} + \eta_i + \nu_{it}, \end{aligned}$$

where η_i represents the time-constant country fixed effect and ν_{it} is an unobservable error term.

Considering that all contracts begin at different points in time and that contractual durations vary, we include the first lag of the dependent variable to capture the average demand persistence. Including a maximum of one lag is a compromise due to the degrees of freedom considerations. According to the economic theory of a downward sloping demand curve, the effect of own price on demand is negative. Concerning the prices of other services, a positive coefficient indicates substitutability, while a negative sign is indicative of a complementary relationship. The impact of fixed broadband is expected to differ across technologies. First, Grzybowski and Verboven (2016) show that more broadband connections lead to complementarities between fixed and mobile telephony, as incumbent carriers leverage their dominant position in the fixed-line network into the mobile market. Second, high-speed broadband ensures a higher quality of voice service, which provides an impetus for VoIP adoption. Additional bundling strategies and the strategic behavior of fixed-line incumbents are controlled for through their subscription base in the mobile market.[8] Carriers active in two or more markets are likely to behave strategically by maximizing their joint profits instead of pursuing profit-maximizing behavior in each market separately. This can influence contract features and, ultimately, the individual demand for services. Finally, higher incomes are likely to boost the demand for fixed, mobile, and VoIP telephony.

Given our dynamic setup, we apply the Arellano-Bond Generalized Method of Moments (GMM) estimator (Arellano and Bond, 1991), which is well-suited to address the unobserved heterogeneity and endogeneity issues. Due to the large cross-sectional but small time dimension of our dataset, we do not estimate a fixed effects model, as the demeaning transformation would produce inconsistent estimates (Nickell, 1981). The first-difference transformation of the difference GMM estimator, on the other hand, eliminates the time-constant country fixed effects, and therefore captures one source of endogeneity without leading to inconsistencies. We apply the difference GMM instead of the more efficient system GMM estimator, as the latter is consistent only under the assumption of zero correlation between explanatory variables and individual time-invariant effects (cf. Arellano and Bover, 1995; Blundell and Bond, 1998). Individual time-invariant effects capture a range of unobserved factors, including country-specific consumer preferences, geographic characteristics, and initial infrastructure stock. Each of these variables are correlated with prices and subscription levels. For instance, carriers are less able to exploit the economies of scale in countries with mountainous terrain, which affects the pricing of the telecommunications services. Furthermore, fixed infrastructure stocks in the 1990s differed substantially across EU countries, which determined future investment and consumption patterns (Grzybowski and Verboven, 2016; Grzybowski,

[8]Considering that fixed-line telephony is often bundled with copper-based broadband DSL, we separately control for an incumbent's number of DSL connections in a robustness check.

2014). The correlation between explanatory variables and individual time-invariant effects is therefore likely different from zero, which implies that the system GMM is inconsistent.

We estimate the demand using single equation techniques instead of simultaneous multiple equation estimators. The main advantage of system over equation-by-equation estimators is the efficiency. However, the system estimators are consistent only if all equations are specified correctly. The improved efficiency thus comes at a high cost, since the misspecification in one equation spills over to the estimates of all other equations. As the market of interest is fairly complex, with substantial differences in the underlying technologies, a single equation estimator is more likely to produce consistent demand estimates.

In our specification, the lagged dependent variable is correlated with the error term and, thus, clearly endogenous. Due to unobserved demand shocks, own prices and prices of substitutes are potentially endogenous, too (cf. Caves, 2011). In order to address this endogeneity problem, we use an instrumental variable approach. We employ two sets of instruments: (i) lagged levels for lagged dependent and price variables (Arellano and Bond, 1991), and (ii) cost shifters for price variables. The latter group of instruments is valid because the costs have no direct impact on subscription decisions, but influence the endogenous price variables. We use the termination rates as cost shifters, since they are directly incorporated into the calling prices and are the only observable cost shifters (cf. Barth and Heimeshoff, 2014a). Moreover, termination rates are set by the national regulators, and remain constant until the European Commission approves changes after a new round of regulation. Hence, they can be considered exogenous. In line with Briglauer et al. (2011), we include both fixed-to-fixed and fixed-to-mobile termination rates. Since the regulatory changes are likely to affect prices with some delay, we employ their lagged instead of current values.

In order to avoid spurious correlations, we test for the presence of a stochastic trend in each variable. The results of the panel unit root test are presented in Table A2.3. Fixed-line and mobile subscriptions are stationary in levels and in differences, whereas VoIP subscription is stationary in differences only. Since the Arellano-Bond GMM estimator is based on differences, our specification does not suffer from spurious correlation problem. Cointegration, i.e., long-term relationship between the variables, cannot be present either, given that the dependent and explanatory variables are integrated of different orders (Hamilton, 1994).

2.3.2 Data

Our dataset comprises 20 EU countries from the second quarter 2008 through the fourth quarter 2011 at six-month intervals.[9] Our main data sources are Analysys Mason and Eurostat. Data on the subscription levels, prices, number of broadband, DSL, cable, other fixed broadband lines and also mobile broadband connections are retrieved from Analysys Mason. GDP per capita and the consumer price index (CPI) are provided by Eurostat, while population density is retrieved from the World Bank. Information on fixed-to-fixed and fixed-to-mobile termination rates are from the 'Progress Reports on the Single European Electronic Communication Market', and are supplemented by data from the OECD and the national regulatory authorities where necessary. Table A2.5 provides a detailed description of our dataset.

The regression variables are defined as follows. Fixed-line demand represents the number of active analogue circuit-switched retail subscribers, measured as the number of active channels. Mobile demand is defined as the number of active individual mobile connections, including both pre-paid and post-paid users. Managed VoIP demand refers to the number of active channels of either paid-for native VoIP services that use a broadband access connection or VoIP services included in a paid-for bundle with broadband access. Thus, peer-to-peer applications are excluded. The fixed-line price is expressed as the sum of the access fee and calling price, both calculated as the average revenues per line. As is common in other studies, we proxy for the price of mobile telephony by the average revenue per user (cf., e.g., Ward and Zheng, 2012). The price of VoIP is calculated as the unweighted average price of all double-play contracts, which include both a broadband and a managed VoIP connection. The measure of the average VoIP price might therefore slightly overestimate the actual VoIP price.

In our regression equations, each variable is expressed in logarithms in order to be interpreted as elasticity. The price-related variables are measured in euros and deflated using the CPI with the year 2005 as the base period. Summary statistics are presented in Table 2.1 and the correlation matrix between the variables in Table A2.6.

[9] All countries included in this study are listed in Table A2.4 in the Appendix.

Table 2.1: Summary statistics

Variable	**Measured in**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
fix_{sub}	Channels [000]	6940	8383	315	29,097	160
mob_{sub}	Active subscribers [000]	27,849	29,826	1658	106,370	160
$voip_{sub}$	Channels [000]	2055	4064	11	20,618	160
p_{fix}	Euro	35.20	10.43	12.80	70.44	160
p_{mob}	Euro	23.94	7.99	9.41	47.54	160
p_{voip}	Euro	38.11	11.01	10.34	74.63	160
bb_{lines}	Channels [000]	5922	7248	299	26,902	160
inc_{mob}	Active subscribers [000]	6524	11,212	744	36,941	160
gdp_{pc}	Euro	6490	3139	1460	12,618	160
inc_{dsl}	Channels [000]	3086	3980	130	14,191	160
$cable/other_{bb}$	Channels [000]	1103	858	113	3864	160
$mobile_{bb}$	Active Subscribers [000]	1242	8884	13	39,116	160
pop_{dens}	Inhabitants per km^2	143.42	113.90	22.52	496.39	160
ftr	Euro cents	0.65	0.31	0.01	1.58	160
mtr	Euro cents	6.42	2.75	2	18.82	160

Note: All variables are expressed in levels.

2.4 Empirical Results

2.4.1 Main Results

The Arellano-Bond GMM estimator is sensitive to the lag structure (e.g., Arellano and Bover, 1995; Blundell and Bond, 1998). Therefore, we estimate two models with different sets of instruments. In Model A, we include the fourth lags of the subscription levels and prices. As our dataset is of half-yearly frequency and some contracts have a 24-months duration, this specification should not suffer from the endogeneity problem. Considering that most contracts are shorter than 24 months, Model B employs the second and the third lag of the dependent variable and the second lag of price variables as instruments.[10] Estimation results from our baseline specification are presented in Table 2.2.

Due to the first-difference transformation of the GMM estimator, the residuals have a moving average structure and are possibly first-order autocorrelated. Autocorrelation AR(s) of a higher-order would imply that the s-th lag of the dependent variable is endogenous, and consequently not a valid instrument. For Model A, the Arellano-Bond test indicates no presence of fourth-order autocorrelation. Hence,

[10] Our pricing data shows that, on average, 82% of all double-play offers with fixed-lines and broadband have a contract length up to 18 months and 72% up to 12 months. Concerning the double-play offers consisting of VoIP and broadband, 79% of contracts are up to 18 months long, while 72% are up to 12 months long. Concerning the mobile market, around 50% of subscribers use the prepaid services with no contractual obligations.

the instruments can be considered valid. For Model B, the test rejects the presence of autocorrelation of a higher-order except for the mobile market, implying second-order autocorrelation.[11] We further test for the exogeneity of the instruments by applying the Sargan-Hansen's J test. With p-values ranging from 0.33 to 0.68, the test statistics indicate that the null hypothesis of valid over-identifying restrictions cannot be rejected in either regression.

Table 2.2: Estimation results

	Model A			Model B		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable	$fix_{sub_{it}}$	$mob_{sub_{it}}$	$voip_{sub_{it}}$	$fix_{sub_{it}}$	$mob_{sub_{it}}$	$voip_{sub_{it}}$
$fix_{sub_{it-1}}$	0.777***			0.813***		
	(0.109)			(0.068)		
$mob_{sub_{it-1}}$		0.436**			0.516***	
		(0.195)			(0.161)	
$voip_{sub_{it-1}}$			0.940***			0.658***
			(0.071)			(0.084)
$p_{fix_{it}}$	-0.308*	0.151*	-0.197	-0.316***	0.140**	0.247
	(0.157)	(0.082)	(0.592)	(0.119)	(0.072)	(0.440)
$p_{fix_{it-1}}$	-0.246	0.146	-0.412	-0.220*	0.107	0.998**
	(0.172)	(0.113)	(0.404)	(0.127)	(0.104)	(0.497)
$p_{mob_{it}}$	0.268***	-0.220*	0.510	0.234***	-0.264**	-0.136
	(0.100)	(0.126)	(0.407)	(0.067)	(0.109)	(0.334)
$p_{mob_{it-1}}$	0.178*	-0.020	0.327	0.138*	0.074	-0.616
	(0.104)	(0.082)	(0.326)	(0.079)	(0.059)	(0.402)
$p_{voip_{it}}$	-0.018	-0.039*	-0.185***	-0.012	-0.033*	-0.241**
	(0.031)	(0.022)	(0.064)	(0.019)	(0.017)	(0.109)
$p_{voip_{it-1}}$	-0.031	0.008	0.081	-0.024	0.015	-0.039
	(0.019)	(0.020)	(0.116)	(0.019)	(0.023)	(0.087)
$bb_{lines_{it}}$	0.031	-0.020	0.222	0.016	-0.030	0.635**
	(0.111)	(0.088)	(0.245)	(0.107)	(0.078)	(0.305)
$inc_{mob_{it}}$	0.237**	0.067	0.650**	0.204**	0.069	-0.009
	(0.104)	(0.116)	(0.303)	(0.103)	(0.112)	(0.217)
$gdp_{pc_{it}}$	-0.014	0.140***	-0.240*	0.004	0.156***	-0.222
	(0.049)	(0.040)	(0.144)	(0.033)	(0.033)	(0.198)
N	120	120	120	120	120	120
Sargan Test (χ^2)	16.15	17.42	13.80	25.21	22.63	27.59
p-value	0.51	0.43	0.68	0.45	0.60	0.33
AR(2), Prob> z				0.77	0.01	0.42
AR(3), Prob> z				0.13	0.32	0.59
AR(4), Prob> z	0.28	0.15	0.79			

Sargan test H0: Overidentifying restrictions are valid, AR test H0: No autocorrelation.

The results of the fixed-line demand estimation are presented in column (1) for Model A and in column (4) for Model B. The lagged subscription volume has a

[11] Given that we apply an equation-by-equation estimation, the fixed-line and VoIP estimation are unaffected by this potential inconsistency in the mobile telephony equation. Note further that the estimation results also hold if only the third lag is included. Hence, the bias is probably small.

highly positive impact on contemporaneous demand, implying that a large share of current subscribers do not cancel their contracts in the following period. The demand for fixed-lines is therefore path-dependent. The current own-price elasticity is negative and within the inelastic range (-0.308 and -0.316). The lagged own-price elasticity is insignificant in Model A but significant in Model B, indicating some long-run price effect on the demand for fixed-line access. The current and the lagged mobile prices are positive and significant, implying a substitution from fixed-lines to mobiles. This result is in line with the existing literature and with the overall trends in telecommunications markets, which indicate an increasing importance of mobiles at the expense of fixed telephony. Surprisingly, the impact of VoIP prices on the demand for fixed-lines is insignificant at the aggregate EU level. Managed VoIP might nonetheless restrict the fixed-line carriers with the threat of potential market entry. This threat is credible due to an increasing availability of ultra-fast broadband, which fosters the transition from copper- to IP-based networks. We find a positive and significant effect of the number of fixed incumbents' subscribers in the mobile market. Bundles, therefore, constitute an important factor in maintaining the subscription base and, ultimately, in slowing down the decay of fixed telephony. The number of broadband lines and monthly income per capita are insignificant. The former might be due to the declining market shares of copper incumbents in the broadband market, while the latter suggests that the demand for fixed-lines is primarily determined by the development of a fixed-network infrastructure.

The results of mobile demand estimation are presented in columns (2) and (5). The lagged subscription volume has a positive and significant effect on the contemporaneous demand (+0.436 vs. +0.516). The current own-price elasticity is negative (-0.220 and -0.264), while the lagged own-price elasticity is insignificant. The current cross-price elasticities of mobiles with respect to fixed-lines are positive and significant in both models, providing evidence of fixed-mobile access substitution. A price increase of fixed-lines by 1% increases the demand for mobile telephony by 0.14-0.15%, implying that consumers respond to higher fixed-line prices by shifting away to mobiles. Mobile telephony therefore constrains the market power of fixed-line carriers. The current cross-price elasticity of mobiles with respect to VoIP is negative and significant (-0.039, -0.033), which is indicative of the complementarity between the technologies. The spread and higher affordability of VoIP might have increased the range of the communications options and slightly boosted the adoption of mobiles. However, given a high penetration and the affordability of mobiles in the EU, small price changes in VoIP services are unlikely to alter the mobile demand significantly. The variable number of broadband lines and the number of fixed incumbents' subscribers in the mobile market are insignificant, while the income per capita has a positive and significant effect on mobile demand.

Analogously to fixed-lines and mobiles, managed VoIP demand exhibits strong path dependence (columns 3 and 6). The own-price elasticity is negative (-0.185 and -0.241), while the lagged own-price elasticity is insignificant. The lagged cross-price elasticity of VoIP with respect to fixed-lines is positive and significant in Model B. Considering the strong advocacy of the European Commission for the joint market definition for VoIP and fixed-lines, substitutability between the two services should be expected. However, the evidence is not very robust. The cross-price elasticities of VoIP with respect to mobiles are insignificant, indicating a one-way complementary relationship. We find a positive effect of the number of fixed-broadband lines on the demand for VoIP access. This effect may be due to VoIP being provided as a cheap add-on to broadband connections. Furthermore, ultra-fast broadband increases voice quality, and thereby the attractiveness of IP-based communication services. Moreover, we document a positive impact of the incumbent's subscription base in the mobile market on VoIP access demand. Overall, our analysis provides evidence of incumbents' ability to leverage their dominant position in one market to another by offering bundles of fixed-mobile or VoIP-mobile telephony. This hints at the importance of bundling strategies in the telecommunications industry.

2.4.2 Robustness Checks

We assess the robustness of our results by employing two additional specifications.[12] The lag structure in both robustness checks is equivalent to Model A, since the corresponding specification in Model B might induce bias in mobile demand equation. The first specification (Model C) is in the spirit of Grzybowski (2014) and Grzybowski and Verboven (2016). We decompose the variable number of broadband lines into cable and other fixed broadband (including fibre), and mobile broadband. Additionally, we account for the effect of bundling the copper-based DSL broadband with fixed-lines by including the number of incumbents' active DSL lines. In the second specification (Model D), we interact the VoIP price with the number of broadband lines. Higher broadband penetration expands the potential VoIP market, thereby raising the demand for VoIP access. Considering a higher coverage and quality of fixed-line networks in developed and more densely populated countries,

[12] In another robustness check, we included a linear and a quadratic trend. Since both variables are insignificant, and the baseline results remain unchanged, we do not report the results.

along with a more intensive usage of telecommunications services, both specifications include GDP per capita and population density (cf., e.g., Caves, 2011; Barth and Heimeshoff, 2014a). The results of the robustness checks are presented in Table A2.7.

Both specifications confirm our main results. We document path dependencies in the subscription patterns for each telephony service and a strong substitution from fixed-lines to mobiles. Again, fixed-mobile substitution is weakened by bundling strategies: the presence of fixed-line carriers in the mobile market and increased number of incumbents' DSL subscribers in the broadband market help maintain the fixed-line subscription base. The results also confirm the complementarity between mobile and VoIP telephony, as well as the positive relationship between income and the adoption of mobiles. The current own-price elasticity of VoIP demand is significant. However, the same does not hold for cross-price elasticities.

Table 2.3: Short- and long-run own-price elasticities

		Model A			Model B		
		fix_{sub}	mob_{sub}	$voip_{sub}$	fix_{sub}	mob_{sub}	$voip_{sub}$
Short-run:	fix_{sub}	-0.308	0.268		-0.316	0.234	
	mob_{sub}	0.151	-0.220	-0.039	0.140	-0.264	-0.033
	$voip_{sub}$			-0.185			-0.241
Long-run:	fix_{sub}	-1.381	2.000		-2.866	1.989	
	mob_{sub}	0.268	-0.390	-0.069	0.289	-0.545	-0.068
	$voip_{sub}$			-3.083	2.918		-0.705

2.5 Policy Implications and Discussion

The main advantage of our estimation approach is the possibility to disentangle short- and long-run elasticities.[13] Table 2.3 presents own- and cross-price elasticities for fixed, mobile, and VoIP telephony. The estimated short-run elasticities are comparable in magnitude to those from other single- and cross-country studies. However, the long-run elasticities exceed previous estimates (Barth and Heimeshoff, 2014a; Karacuka et al., 2011; Briglauer et al., 2011). This is likely due to the structure of our dataset, which spans a relatively recent period and enables us to capture "the latest and arguably most dramatic developments" in the telecommunications sector (Vogelsang, 2010, p.14).

High long-run demand elasticities raise the question of market definition for voice services. A well-established market delineation approach is the SSNIP test, in

[13]In the Houthakker-Taylor model, the short-run elasticities are directly estimated as γ_k and the long-run elasticities are determined by $(\gamma_k + \delta_k)/(1 - \beta_k)$.

which the estimated long-run own-price elasticities are compared with the critical elasticity ϵ_c. The SSNIP test identifies the smallest relevant market within which a hypothetical monopolist could profitably raise its price while retaining the current subscription base. If the estimated own-price elasticity exceeds ϵ_c, a price increase would lead to lower profits, which indicates that the next best substitute has to be included in the market. In line with Vogelsang (2010) and Briglauer et al. (2011), we define the critical elasticity as $\epsilon_c = 1/[m+t]$, where $m = [p-c]/c$ is the price-cost margin, and t denotes a "small but significant non-transitory increase in prices", usually 5–10% during a period of 1–2 years. Assuming that the price-cost margin for fixed-line access is $m = 0.5$ (Stumpf, 2007), and that t takes the value of either 0.05 or 0.1, the critical elasticity falls within the range ϵ_c = [-1.82, -1.67]. The estimated fixed-line elasticity from Model A of -1.38 is below this threshold, while the elasticity from Model B is -2.87 and clearly exceeds ϵ_c. Estimates from the robustness checks are the closest to those from Model B, implying that the own-price elasticities are around 2 in absolute value. Fixed-line telephony can therefore be considered to be part of the same market as mobile and managed VoIP access services at the EU level. Cross-country estimates indicate that the competitive pressure from other services is sufficient to restrain the incumbent carriers, which supports the European Commission's decision to remove the *ex ante* access obligations from the markets 1/2007 and 2/2007.

Overall, our results provide evidence of the substitution from fixed-lines to mobiles and vice versa and are in line with the existing literature. Mobile operators exert competitive pressure on fixed-line carriers, which diminishes the danger of market power abuse. The magnitude of the long-run cross-price elasticities between fixed-lines and managed VoIP (+2.918) hints at access substitution toward VoIP, but this effect is not robust. However, considering that our dataset does not cover the post-2011 period, and that the access is generally less elastic than the usage, our result is in line with the existing literature on VoIP. Vague evidence of access substitution might be due to the fact that a bulk of subscribers do not switch because of price differences, but are automatically transferred from fixed to VoIP services with the provider's transition to an all IP-based network (ECORYS, 2013, p.195). The threat of potential market entry is nonetheless likely to constrain the price-setting behavior of fixed incumbent carriers. In contrast, the ability to offer service bundles is possible source of market power: if consumers perceive them as being superior to single services, carriers providing access to the latter may be in a disadvantageous position. Therefore, targeted access obligations might be necessary to ensure a level playing field for all operators in the market. Due to the differences in competitive conditions across the member states, this issue must be addressed by each national regulatory authority separately.

Another relevant issue for future regulation is the role of unmanaged VoIP. Most national regulators do not consider this service to be a substitute for managed VoIP, which is due to differences in features and consumption patterns. However, an increased usage of unmanaged VoIP might diminish the relevance of other communications services. Future market definition will consequently depend on a range of factors, including (ultra-)fast broadband penetration, quality of service, pricing, and the possibility of receiving calls according to domestic or international numbering plans (European Commission, 2014b). On the other hand, providers might block or degrade the over-the-top (OTT) applications which have the potential to erode their revenues. Yet, a blockage is likely to be limited in scope, due to the large countervailing power of major OTT applications such as Skype, Facebook, and Viber. Therefore, instead of full-scale *ex ante* regulation, this issue could be addressed under competition law (ECORYS, 2013, p.153).

2.6 Conclusion

In this paper, we estimate the degree of access substitution between fixed, mobile, and managed VoIP telephony. Our study is the first to investigate the interdependencies between all three types of voice services in a coherent cross-country framework. We use a sample of 20 EU countries for the 2008–2011 period, and apply dynamic panel data techniques to estimate the own- and the cross-price elasticities. In order to address the endogeneity of the lagged subscription base and price variables, we apply an instrumental variable approach.

We document strong access substitution between fixed-lines and mobiles, and find evidence of the long-run substitution from fixed-lines to managed VoIP telephony. Hence, both telephone services likely constrain the market power of fixed incumbent carriers. On the other hand, bundling raises the demand for fixed-lines. While the substitutability indicates that *ex ante* access obligations imposed on fixed incumbents might be redundant, bundling strategies as a source of market power hint at their necessity. At the EU level, we find evidence in favor of joint market definition and, therefore, of discontinuing the regulation. However, due to different competitive environments across the member states, this issue must be addressed by the individual national regulators. Thus, the question of whether the threat of market power abuse by the fixed incumbents still exists is not answered conclusively. Targeted access obligations might be one of the solutions to protect the captive group of users and ensure a level playing field for all operators active in the market. In this case, national regulators must redesign the regulatory frameworks in a way that does not stifle competition and innovation.

In the explanatory note on the deregulation of markets for access and call origination on the public fixed network, the European Commission underlines that (managed) VoIP, and not mobile, is a proper substitute for fixed-lines. Our results, in contrast, indicate a stronger substitutability between fixed-lines and mobiles than between fixed-lines and VoIP telephony. The Commission anticipates, however, that fixed-lines and VoIP will become effective substitutes within the validity period of the Recommendation. Considering the existence of various "white" and "grey spots" in the EU countries with limited ultra-fast broadband coverage, and the fact that its adoption is path-dependent and somewhat sluggish, this assessment might be too optimistic. Therefore, further research on the substitutability between telephony services with more recent data is needed to evaluate the effects of regulatory changes. As several fixed incumbent carriers have announced a full-IP transition in upcoming years, this matter might be resolved in the near future.

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Appendix

Table A2.1: Fixed-mobile substitution studies

Author	Country & Period	Method	Main results
Rodini et al. (2003)	US, 2000–2001	Logit	Moderate access substitution between the second fixed-line and mobile, cross-price elasticity 0.13–0.18.
Ward and Woroch (2004)	US, 1999–2001	LA/AIDS	Moderate fixed-mobile traffic substitution, cross-price elasticity 0.22–0.33.
Ward and Woroch (2010)	US, 1999–2001	Probit/diff-in-diff	Access substitution between the first fixed-line and mobile, cross-price elasticity 0.25–0.31.
Ward and Zheng (2012)	China, 1998–2007	Dynamic panel	Strong fixed-mobile access substitution (FMAS).
Karacuka et al. (2011)	Turkey, 2002–2006	Dynamic panel	Fixed-to-mobile traffic substitution.
Suárez and García-Mariñoso (2013)	Spain, 2004–2009	Logit	Low FMAS. Substitution driven by the broadband connection and socio-demographic characteristics.
Briglauer et al. (2011)	Austria, 2002–2007	Error correction model	Fixed-to-mobile traffic substitution, long-run cross-price elasticity 0.45.
Garbacz and Thompson (2007)	53 LDC, 1996–2003	Fixed effects	Fixed-lines are substitutes in the mobile market, but mobiles are complements to fixed-lines.
Barth and Heimeshoff (2014a)	EU-27, 2003–2009	Dynamic panel	FMAS, cross-price elasticity 0.18.
Barth and Heimeshoff (2014b)	EU-16, 2004–2010	Dynamic panel	Fixed-to-mobile traffic substitution, cross-price elasticity 0.12.
Grzybowski (2014)	EU, 2005–2010	Discrete choice	FMAS reduced by higher broadband penetration and boosted by the spread of cable and 3G broadband.
Grzybowski and Verboven (2016)	EU, 2005–2011	Discrete choice	FMAS; incumbency advantage in the mobile market; broadband Internet (mainly DSL) reduces substitutability.

Table A2.2: VoIP studies

Author	Country & Period	Method	Main results
Cecere and Corrocher (2011)	UK, 2006	Probit	Traffic substitution between (mainly) unmanaged VoIP and fixed-line. No relationship between mobile and VoIP usage.
Cecere and Corrocher (2012)	Italy, 2006	Probit	Traffic substitution between mobile and unmanaged VoIP. Use of other IP services increases VoIP usage.
Kwak and Lee (2011)	South Korea, 2006–2009	Static panel	Traffic substitution between fixed-lines and managed VoIP, cross-price elasticity 10.07. Mobile-VoIP traffic substitution insignificant.

Table A2.3: Maddala-Wu unit root tests

	Levels		Differences	
	χ^2	$\chi^2 > p$	χ^2	$\chi^2 > p$
fix_{sub}	58.889	0.027	58.398	0.030
mob_{sub}	53.976	0.069	62.191	0.014
$voip_{sub}$	45.219	0.263	66.987	0.005
p_{fix}	87.787	0.000	88.058	0.000
p_{mob}	82.628	0.000	62.259	0.014
p_{voip}	120.055	0.000	74.645	0.001
bb_{lines}	269.162	0.000	31.668	0.824
inc_{mob}	93.855	0.000	53.346	0.077
gdp_{pc}	22.544	0.988	64.218	0.009
inc_{dsl}	267.227	0.000	98.737	0.000
$cable/other_{bb}$	36.206	0.642	64.756	0.008
$mobile_{bb}$	26.654	0.948	35.874	0.657
pop_{dens}	44.469	0.2891	68.105	0.004
mtr	106.982	0.000	179.420	0.000
ftr	117.979	0.000	114.546	0.000

H0: unit root

Table A2.4: Countries

Austria	Ireland	Sweden	Latvia
Belgium	Italy	UK	Poland
Denmark	Netherlands	Bulgaria	Romania
France	Portugal	Estonia	Slovakia
Germany	Spain	Hungary	Slovenia

Table A2.5: Variables description and source

Variable	Description	Source
fix_{sub}	Number of active circuit-switched retail subscribers.	Analysys Mason*
mob_{sub}	Number of mobile (pre-paid and post-paid) subscribers.	Analysys Mason
$voip_{sub}$	Number of active users of either paid-for native VoIP subscribers or VoIP services included in a paid-for bundle with broadband access; excluding peer-to-peer applications.	Analysys Mason
p_{fix}	Average revenue (subscription + traffic) per fixed-line in euro PPP.	Analysys Mason
p_{mob}	Average revenue per mobile subscriber in euro PPP.	Analysys Mason
p_{voip}	Average price of broadband contracts bundled with VoIP in euro PPP.	Analysys Mason ('Triple-play pricing study')
bb_{lines}	Number of active broadband lines.	Analysys Mason
inc_{mob}	Fixed-line incumbent's share in mobile market (in terms of subscribers).	Analysys Mason
gdp_{pc}	Monthly real GDP per capita in euro PPP.	Eurostat
inc_{dsl}	Incumbent's number of DSL broadband subscribers (including ADSL, SDSL and VDSL).	Analysys Mason
$cable/other_{bb}$	Sum of cable and other fixed broadband subscribers (including cable, FTTB, FWA and all other fixed broadband connections).	Analysys Mason
$mobile_{bb}$	Number of mobile broadband PC or laptop connections via a USB modem or datacard. Excludes handset access or use of the handset as a modem.	Analysys Mason
pop_{dens}	Population density. Inhabitants per sq. km of land area.	World Bank
ftr	Fixed-to-fixed termination rates in euro PPP.	Progress Reports on Single European Electronic Communications Markets
mtr	Fixed-to-mobile termination rates in euro PPP.	Progress Reports on Single European Electronic Communications Markets

*If not otherwise indicated, data is from 'Telecoms Market Matrix'.

Table A2.6: Cross-correlation table

Variables	fix_{sub}	mob_{sub}	$voip_{sub}$	p_{fix}	p_{mob}	p_{voip}	bb_{lines}	inc_{mob}
fix_{sub}	1.000							
mob_{sub}	0.911*	1.000						
$voip_{sub}$	0.479*	0.542*	1.000					
p_{fix}	-0.139*	-0.094	-0.010	1.000				
p_{mob}	0.187*	0.014	0.205*	0.498*	1.000			
p_{voip}	0.006	0.027	0.063	0.473*	0.587*	1.000		
bb_{lines}	0.872*	0.924*	0.743*	-0.085	0.149*	0.058	1.000	
inc_{mob}	0.892*	0.971*	0.628*	-0.047	0.105	0.118	0.913*	1.000
gdp_{pc}	0.214*	0.191*	0.267*	0.434*	0.755*	0.557*	0.321*	0.245*
inc_{dsl}	0.890*	0.947*	0.728*	-0.056	0.176*	0.114	0.978*	0.953*
$cable/other_{bb}$	0.205*	0.368*	0.299*	0.058	-0.148*	0.045	0.408*	0.348*
$mobile_{bb}$	0.627*	0.766*	0.459*	-0.118	-0.038	0.077	0.754*	0.726*
pop_{dens}	0.260*	0.316*	0.183*	0.392*	0.237*	0.389*	0.365*	0.315*
ftr	-0.413*	-0.400*	-0.271*	-0.038	-0.179*	-0.041	-0.406*	-0.396*
mtr	-0.063	-0.147*	-0.218*	0.043	0.167*	-0.032	-0.221*	-0.105

	gdp_{pc}	inc_{dsl}	$cable/other_{bb}$	$mobile_{bb}$	pop_{dens}	ftr	mtr
gdp_{pc}	1.000						
inc_{dsl}	0.323*	1.000					
$cable/other_{bb}$	0.157*	0.327*	1.000				
$mobile_{bb}$	0.270*	0.710*	0.379*	1.000			
pop_{dens}	0.376*	0.348*	0.448*	0.169*	1.000		
ftr	-0.283*	-0.390*	-0.164*	-0.384*	-0.142	1.000	
mtr	-0.185*	-0.147*	-0.364*	-0.410*	-0.010	0.284	1.000

*: Significant at 5% level or higher

Table A2.7: Robustness checks

	Model C			Model D		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable	$fix_{sub_{it}}$	$mob_{sub_{it}}$	$voip_{sub_{it}}$	$fix_{sub_{it}}$	$mob_{sub_{it}}$	$voip_{sub_{it}}$
$fix_{sub_{it-1}}$	0.737***			0.790***		
	(0.103)			(0.105)		
$mob_{sub_{it-1}}$		0.581***			0.370**	
		(0.208)			(0.183)	
$voip_{sub_{it-1}}$			1.016***			0.977***
			(0.102)			(0.080)
$p_{fix_{it}}$	-0.203*	0.129	0.141	-0.277*	0.129*	-0.121
	(0.122)	(0.089)	(0.711)	(0.156)	(0.078)	(0.692)
$p_{fix_{it-1}}$	-0.270**	0.081	-0.682	-0.276**	0.106	-0.340
	(0.132)	(0.096)	(0.578)	(0.139)	(0.096)	(0.538)
$p_{mob_{it}}$	0.206**	-0.156*	0.546	0.303**	-0.343***	0.720
	(0.100)	(0.084)	(0.524)	(0.121)	(0.091)	(0.449)
$p_{mob_{it-1}}$	0.201**	-0.015	0.424	0.161**	0.032	0.268
	(0.084)	(0.068)	(0.333)	(0.064)	(0.077)	(0.323)
$p_{voip_{it}}$	-0.017	-0.043***	-0.170**	-0.226	-0.356	0.375
	(0.025)	(0.015)	(0.082)	(0.414)	(0.318)	(0.871)
$p_{voip_{it-1}}$	-0.028	0.018	0.192	-0.039	0.011	0.105
	(0.025)	(0.020)	(0.190)	(0.030)	(0.029)	(0.154)
$inc_{dsl_{it}}$	0.128**	-0.078	-0.045			
	(0.061)	(0.049)	(0.255)			
$cable/other_{bb_{it}}$	-0.052	0.022	-0.023			
	(0.038)	(0.026)	(0.166)			
$mobile_{bb_{it}}$	0.004	-0.013	0.007			
	(0.010)	(0.015)	(0.071)			
$p_{voip_{it}}\#bb_{lines_{it}}$				-0.018	0.025	-0.334
				(0.030)	(0.023)	(0.064)
$bb_{lines_{it}}$				0.117	-0.155	0.334
				(0.206)	(0.155)	(0.438)
$inc_{mob_{it}}$	0.163*	0.119**	0.625*	0.250***	0.069	0.685**
	(0.090)	(0.058)	(0.360)	(0.097)	(0.090)	(0.319)
$gdp_{pc_{it}}$	0.013	0.130***	-0.210	-0.027	0.191***	-0.309
	(0.047)	(0.028)	(0.187)	(0.025)	(0.036)	(0.199)
$pop_{dens_{it}}$	-0.001*	0.001	-0.010	0.000	0.001	-0.006***
	(0.002)	(0.003)	(0.009)	(0.002)	(0.004)	(0.008)
N	120	120	120	120	120	120
Sargan Test (χ^2)	19.05	17.33	11.16	16.23	19.31	14.06
p-value	0.33	0.43	0.85	0.70	0.50	0.83
AR(4), Prob> z	0.11	0.17	0.56	0.31	0.03	0.52

Sargan test H0: Overidentifying restrictions are valid. AR test H0: No autocorrelation.

Declaration of Contribution

Hereby I, Amela Saric, declare that the chapter "Substitution Between Fixed, Mobile, and Voice over IP Telephony – Evidence from the European Union" is co-authored by Mirjam R. J. Lange. My contributions to the chapter are as follows:

- I have contributed in equal parts to the data gathering, preparation, and evaluation process
- I have contributed to the Introduction and Literature Review
- I have written major parts of the Empirical Model
- I have written minor parts of the Results section
- I have contributed to the Discussion and Conclusion

Signature of co-author (Mirjam R. J. Lange): M. Lange

Chapter 3

The Welfare Effects of Single Rooms in German Nursing Homes: A Structural Approach

Co–authored by Annika Herr

3.1 Introduction

Nursing homes and other forms of long-term care have been subject to much attention in recent years, both from the public and from researchers alike.[1] The main reason behind the increased focus on long-term care is a rise in demand due to population aging and limited availability of informal caregivers. For example, the size of the care-dependent population in Germany is projected to increase from 2.6 million in 2013 to 3 million in 2020 and to 3.5 million in 2030 (Augurzky et al., 2013). The same projection for the US foresees an increase from 12 million in 2010 to 27 million in 2050 (Commission on Long-Term Care, 2013). Since the nursing homes provide support for chronic care needs, the duration of stays is longer than for hospitals and varies from months to years. For example, the estimate of an average length of nursing home stay in the US between 1992 and 2006 was 13.7 months (Kelly et al., 2010), while the corresponding estimate for the UK between 2008 and 2010 was 26.3 months (Forder and Fernandez, 2011). In this context, the issues of well-being and life quality of nursing home residents take precedence.

The emerging concept of long-term care is a person-centered care (Calkins and Cassella, 2007). This concept affirms the rights to autonomy, privacy, and dignity and reiterates the importance of a self-directed care and flexible forms of living. The relevance of a person-centered care for the well-being of care recipients was acknowledged by the German federal state of Baden-Wuerttemberg, in which a single room policy in nursing homes is to be implemented by 2019.[2] The federal state of North Rhine-Westphalia has followed suit, with the regulation that at least 80% of nursing home places must be provided in single rooms by 2018.[3] However, the providers warn of the detriments of this legislation, which include a deteriorated financial position and, possibly, a market exit.[4]

[1]Long-term care refers to services aimed at providing assistance to individuals who, owing to a physical, psychological, mental disease or handicap, require a significant amount of support to carry out the recurring activities of everyday life for a minimum of six months (SGB XI §14).

[2]This measure applies to full-time inpatient care only, and excludes residential units with outpatient care. Source: Einzelzimmervorgabe bei Pflegeheimen bleibt, Press release of the state of Baden-Wuerttemberg, `http://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/einzelzimmervorgabe-bei-pflegeheimen-bleibt-1/`, accessed on February 10, 2016.

[3]Source: Fragen und Antworten zum GEPA NRW, Ministerium für Gesundheit, Emanzipation, Pflege und Alter des Landes Nordrhein-Westfalen, `http://www.mgepa.nrw.de/pflege/rechtsgrundlagen_2014/FAQ_GEPA/index.php`, accessed on February 12, 2016.

[4]Source: Neues Alten- und Pflegeegsetz beschlossen, Caritas in NRW, `http://www.caritas-nrw.de/themendossiers/altenhilfeundpflege/neues-alten-und-pflegegesetz-beschlossen`, accessed on February 10, 2016.

The policy mandating exclusively single rooms is controversial as, though it produces benefits to nursing home residents, there are also substantial implementation costs to providers. On the one hand, living in a single room is associated with a higher well-being, satisfaction, and a range of health benefits. Available studies suggest that single rooms are among the most desired characteristics of a nursing home (Lawton and Bader, 1970; Mosher-Ashley and Lemay, 2001; Calkins and Cassella, 2007). As implied by the research into acute care settings, residents living in a single room have undisturbed communication with staff and visitors (Chaudhury et al., 2005), and tend to express high satisfaction with their current living arrangement (Pinquart and Burmedi, 2004). The key clinical benefits of single rooms include a lower prevalence of infections (Drinka et al., 2003; Coleman, 2004), and less negative sleep patterns (Schnelle et al., 1999). Yet, transforming doubles into single rooms implies high costs and potential capacity reductions. This might in turn jeopardize the quality and provision of care. Moreover, the inability to recoup investments increases the danger of a market exit.[5] The evaluation of welfare effects of a single room policy is therefore an empirical issue.

In addition to single rooms, the literature on long-term care explores the effects of assisted living concepts (Shura et al., 2010; Corazzini et al., 2015), and the excessive use of medications (Hughes and Lapane, 2005; Alanen et al., 2006; Stroka, 2015) on the welfare of the nursing home residents. Yet, these studies are descriptive and/or are based on anecdotal evidence. Other questions on the research agenda include the impact of public quality evaluations and staffing standards on the long-term care quality (Mukamel et al., 2008; Park and Stearns, 2009; Grabowski and Town, 2011; Mukamel et al., 2012; Lin, 2014; Herr et al., 2016), demand (Grabowski and Town, 2011; Werner et al., 2012), and the relationship between quality, prices, and competition (Grabowski, 2004; Forder and Allan, 2014; Mennicken et al., 2014; Herr and Hottenrott, 2016). However, these studies consider neither the welfare of the nursing home residents, nor the overall welfare implications of the regulatory interventions.

[5] In their communication notes, both federal states emphasize their intention to grant investment subsidies and allow for deadline extensions in order to prevent market exists. Source: Häufig gestellte Fragen zur Einzelzimmervorgabe in der Landesheimbauverordnung, `https://sozialministerium.baden-wuerttemberg.de/fileadmin/redaktion/m-sm/intern/downloads/Publikationen/FAQ_Einzelzimmervorgabe_Heimbauverordnung_2015.pdf`, accessed on February 15, 2017, and Fragen und Antworten zum GEPA NRW, `https://www.mgepa.nrw.de/mediapool/pdf/pflege/FAQ_GEPA_NRW.pdf`, accessed on February 15, 2017.

This paper seeks to evaluate the welfare effects of a policy mandating exclusively single rooms in nursing homes. We evaluate the welfare in a counterfactual market in which only single rooms are offered, and compare it with the status quo market.[6] We contribute to the sparse literature on the value of privacy in nursing homes and to a broader strand of literature on choice and welfare in the long-term care market. We are the first to estimate a structural model of demand and supply for the inpatient long-term care using data on all German nursing homes for the years 2007 and 2009. This issue is relevant for two reasons. First, long-term care is the fastest growing segment of the German health care sector, with an average annual volume growth rate of 2.8% between 1999 and 2011, and with substantial public and private expenditures (Augurzky et al., 2015). Second, evidence on the market behavior of care recipients in Germany is sparse. This obscures the impact of regulatory interventions, such as public quality evaluations and staffing standards, whose goal is to foster competition and enhance consumer welfare in the long-term care market. Our study aims to fill this literature gap.

Our methodological approach is based on Berry (1994) and builds on recent empirical studies modeling individual behavior in the health care markets (Bundorf et al., 2009; Varkevisser et al., 2012; Werner et al., 2012; Gowrisankaran et al., 2015). These studies employ structural econometric models, which are better-suited to capture various market complexities. Yet, in contrast to them, we circumvent the usage of arbitrary quality criteria, such as staff-to-residents ratios or measures defined by the regulatory authorities. Instead, we take a more direct approach by exploring the welfare effects of a change in one crucial dimension of a nursing home. Care-dependency needs are evaluated based on a uniform procedure, which enables the comparison between the care recipients. Therefore, we are able to determine the potential market size. We recover the marginal costs and markups using a model of bargaining between providers and payers, which is more illustrative of the real price-setting mechanism and, unlike the Nash-Bertrand competition model, generates positive marginal costs (Gowrisankaran et al., 2015). Finally, our dataset is a comprehensive sample of all German nursing homes over the two years, which enables us to a) exploit the time-variation in demand to identify consumer preferences; b) address the endogeneity of prices; and c) gain additional insights into the functioning of a large and growing, but relatively unresearched market.

[6]The extent of subsidies and the exact implementation costs are still unknown. Therefore, our analysis is limited to a counterfactual market (where all parameters, except of the share of single rooms, remain unchanged) and focused on changes in the welfare of consumers, who are the primary target of this policy change.

Our dataset (Pflegestatistik) is provided by the Statistical Offices of the German federal states and used on-site at the Research Data Centre Duesseldorf. We observe a range of individual nursing home characteristics, including prices, capacity, number of residents, staffing, room configuration, and ownership. We apply a one-level nested logit model of demand and use the ownership type as nesting criteria, distinguishing between for-profit and non-profit facilities. This grouping structure reflects the individual heterogeneity of preferences. Potential market comprises the entire care-dependent population in a county. The outside option includes ambulatory and informal long-term care. In the first stage, we estimate the mean own-price elasticity of demand at -0.752, and the cross-price elasticities in the range 0.004–0.046. In the second stage, we recover the marginal costs and markups using the Nash model of bargaining between providers and payers, the latter including long-term care and social insurance funds. We use these marginal cost estimates to calculate the price elasticities of demand under the hypothetical scenario of full out-of-pocket payments. The mean estimate of -1.404 lies above the actual own-price elasticity, implying that the long-term care insurance reduces the price sensitivity of care recipients. Next, we estimate the price elasticities of demand under the hypothetical scenario of Bertrand-Nash competition and the current level of out-of-pocket payments. The mean price elasticity of -2.552 indicates that the existing price level could be attained only under substantially higher price elasticities of demand. Therefore, price negotiations counter the market power of nursing home providers facing price-inelastic consumers. Using the estimated demand and supply parameters of our preferred model, we simulate the equilibrium prices and market shares in a counterfactual market with single rooms only. Based on the new equilibrium values, we evaluate the welfare effects of a single room policy by estimating changes in consumer surplus and providers' variable profits.

The average share of nursing home places provided in single rooms in the period 2007 to 2009 was 0.58.[7] Increasing this share to 1 has different welfare effects, which depend on the corresponding capacity changes. Assuming a symmetric bargaining power between providers and payers, we explore three implementation scenarios: a) constant capacities, which are secured either by expanding the facilities or, if possible, by splitting doubles into single rooms; b) reduced capacities, whereby doubles are transformed into single rooms without being divided; c) reduced capacities, whereby 50% of doubles are transformed into single rooms by being divided and 50%

[7]Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2013, own calculations. Figure A3.2 illustrates the regional distribution of single rooms.

without being divided. In addition, we evaluate scenario d), which is equivalent to c), but with the payers' bargaining power of 2/3. Single room policy increases the attractiveness of nursing homes relative to other forms of long-term care. Yet, due to the corresponding capacity changes, the actual utilization of inpatient care increases only under scenario a). In this case, the average share of outside option declines from 71.1% to 69.2%, whereby consumer surplus increases by 1.8% and providers' variable profits by 5.1%. Capacity reductions under scenario b) raise the average market share of outside option to 75%. Consumer surplus diminishes by 6.6% and providers' variable profits by 16.2%, implying that the negative welfare effects of lower capacities outweigh the positive welfare effects of single rooms. Under scenario c), the average share of outside option increases to 72%, which leads to a decline in consumer surplus of 2.6% and in providers' variable profits of 5.5%. Finally, under scenario d), a decline in consumer surplus is 2.4% and 35.1% in providers' variable profits. Hence, assuming symmetric bargaining powers, the policy mandating exclusively single rooms is welfare-enhancing for both consumers and providers only if the supply of nursing home places remains unchanged. Welfare effects for providers are pronouncedly negative if their bargaining power is low.

In section 2, we describe the institutional characteristics of the German long-term care market. Section 3 describes our model and the identification strategy. In section 4, we present the descriptive statistics and in section 5 discuss the results. Finally, section 6 concludes.

3.2 The German Long-Term Care Market

The German long-term care system is organized around the principle "Prevention and rehabilitation before care, outpatient care before inpatient care, and short-term care before full-time inpatient care" (SGB XI §3), in an effort to enable the care recipients to remain in their familiar environment for as long as possible. Inpatient care comprises short- and long-term nursing home care, whereby short stays are limited to a period of four weeks per year.[8] Therefore, nursing home entry is supposed to take place only after all other care options had been exhausted. As of 2013, 30.6% of the care-dependent population were receiving full-time inpatient care, while 23.9% used the outpatient care services (Augurzky et al., 2015). Care-dependency

[8] Care recipients are entitled to short-term nursing home stays when the outpatient care becomes insufficient or unavailable for a period of time. This is usually the case during the postoperative recovery, caregivers' vacation or search for a nursing home place for a long-term stay.

needs are externally evaluated by the Medical Review Board of the Statutory Health Insurance based on the assistance necessary to perform the activities of daily living (ADL) (Table A3.2). An individual is classified as care-dependent if she requires assistance with at least two basic ADL, which include personal hygiene, feeding and mobility, and one instrumental ADL, which is related to household chores.

Long-term care insurance (LTCI) in Germany is mandatory since 1995 and follows the health insurance. Members of the public health insurance schemes are automatically enrolled into public LTCI, and those privately insured are obliged to purchase private LTCI offering the same set of benefits. In 2013, public LTCI included 86% of the population, while the rest were privately insured.[9] In the event of care-dependency, LTCI beneficiaries are entitled to a lump-sum allowance, which varies depending on the form of care and the level of care-dependency.[10] The LTCI allowance for inpatient care usually covers only a fraction of total price. If neither the care recipients nor their families are able to bear the entire amount of out-of-pocket payments, social insurance funds step in.[11]

Prices for inpatient and outpatient long-term care are negotiated between providers and payers on behalf of LTCI beneficiaries (SGB XI §85). Payers are organized at the federal state-level and include social insurance and LTCI funds. Other parties may include state-level associations of nursing home owners (for example, Red Cross, Caritas, Diakonie), representatives of the local authority districts, and private health insurance funds. Prices are negotiated for a certain period in advance, with a minimum of one year. Negotiations are initiated following the disclosure of the past, current, and projected costs, and are carried out for each provider separately. Social insurance funds have a veto right over the final decision, and the power to restart the negotiations. If the price cannot be agreed upon within six weeks, an independent arbitration board determines it. Prices for inpatient care include expenses for: a) nursing care, which vary across the levels of care-dependency and cover assistance with the basic and instrumental ADL; b) room and board; and c) investment, which are based on the room type (single- vs. multiple-bed), and cover the costs of facility maintenance and repair.

[9] Source: Gesetzliche Krankenversicherung – Mitglieder, mitversicherte Angehörige und Krankenstand, Jahresdurchschnitt 2013, Bundesministerium für Gesundheit, http://www.bmg.bund.de/fileadmin/dateien/Downloads/Statistiken/GKV/Mitglieder_Versicherte/KM1_JD_2013.pdf, accessed on September 19, 2016.

[10] Private LTCI funds must provide at least the same set of benefits as the public ones. Supplementary LTCI is voluntary and relatively uncommon. Detailed data on public LTCI allowances are presented in the Appendix to the next chapter.

[11] Social insurance funds bore 42% of the total expenses for inpatient care in 2013 and 50% in 2011 (Augurzky et al., 2015).

3.3 Empirical Strategy

To evaluate the welfare effects of a single room policy in German nursing homes, we a) estimate the structural model of demand for inpatient care; b) recover the marginal costs and markups; and c) simulate the prices and market shares under the given counterfactual scenario. We focus on nursing homes providing full-time inpatient care for elderly (aged 65+), and exclude specialized facilities for care recipients with psychological and mental disorders and hospices, as well as residential units with outpatient care.

3.3.1 Demand Model

We observe $m = 1,.., 429$ geographic markets in year $t = 2007$ and $m = 1,.., 412$ in $t = 2009$. Potential market (M) corresponds with the size of care-dependent population in county m.[12] Consumer choice set consists of a) $j = 1, .., J$ nursing homes located in m and b) outside option, which includes short-term nursing home stays and outpatient care. At the beginning of period t, each of the $i = 1,.., M$ care recipients chooses one form of care. We model the choice as a utility-maximization problem of a representative consumer and approximate it by a one-level nested logit model (Berry et al., 1995; Verboven, 1996; Slade, 2004), which allows us to account for the correlation of preferences across the nursing homes.

The agent i's indirect utility from choosing a nursing home j in period t is:

$$u_{ijt} = \delta_{jt} + v_{ijt},$$

where δ_{jt} represents the mean utility of care recipients in j, and v_{ijt} is the individual-specific deviation from the mean. The latter term allows for the correlation of preferences across nursing homes with similar characteristics. We define δ_{jt} as:

$$\delta_{jt} = \beta x_{jt} - \alpha p_{jt} + \xi_{jt}, \tag{3.1}$$

[12] Lower m in 2009 is due to administrative reforms in Saxony (2008) and Aachen (2009). Broader market definition (municipality or federal state) would not be appropriate for our analysis, considering that care recipients tend to choose nursing homes in the proximity of their residences. Several studies provide empirical evidence on this issue (Varkevisser et al., 2012; Stroka and Schmitz, 2014; Gowrisankaran et al., 2015). Yet, a care recipient might enter a nursing home in another county – for example, in order to stay closer to their family or to receive a higher quality care. We give this issue a due attention in the construction of price instruments.

where the vector x_{jt} includes the nursing home size, attached facilities (residential units, hospitals) and the share of single rooms, p_{jt} is the price, and ξ_{jt} the unobservable characteristics. Our implicit assumption is that prospective residents have a preference for single rooms and, therefore, for nursing homes providing a higher share thereof.[13] The utility from the outside option is normalized to zero ($u_{0t} = 0$).

Nursing homes are grouped based on the similarity of their structural characteristics. This grouping structure is captured by the term v_{ijt}, which is defined as:

$$v_{ijt} = \epsilon_{igt} + (1 - \sigma)\epsilon_{ijgt},$$

where σ measures the correlation of preferences for nursing homes within the same group, and parameters ϵ_{igt} and $\epsilon_{igt}+(1-\sigma)\epsilon_{ijgt}$ are Type-I extreme value distributed. At $\sigma = 1$, preferences for facilities within the same group are perfectly correlated, while $\sigma = 0$ implies no correlation of preferences. In the latter case, $\epsilon_{igt}+(1-\sigma)\epsilon_{ijgt}$ is i.i.d. and nested logit reduces to a standard logit model. In line with a random utility maximization, we assume $0 < \sigma < 1$, which implies a higher degree of substitution within than between the groups. This property of nested logit remedies for the shortcomings of a standard logit model, where the substitution between the products does not depend on their characteristics, but only on their respective market shares.

The market share of nursing home j is calculated as the probability of choosing j conditional on choosing the group g:

$$Pr_j = Pr_{j|g,t} \cdot Pr_g.$$

This expression is the basis for nested logit demand equation, which links market shares to prices, nursing home characteristics, and within-group shares (Berry, 1994):

$$ln(s_{jt}) - ln(s_{0t}) = \beta x_{jt} - \alpha p_{jt} + \sigma ln(s_{j|gt}) + \xi_{jt}. \tag{3.2}$$

3.3.2 Nesting Structure

Our nesting criteria is the ownership type. We distinguish between for-profit and non-profit facilities, whereby the objectives of the latter are not limited to profit-maximization. For example, Red Cross defines its mission as to "protect life and health and to ensure respect for the human being," Caritas shares the mission of

[13]Note that we abstract from residential units with outpatient care, whose residents may prefer double rooms in order to live with their spouses.

a "Catholic Church to serve the poor and to promote charity and justice," while Diakonie strives to "address the wants and needs of others based on the Christian view of a mankind." Our nesting structure is motivated by the possible quality disparities between for-profit and non-profit facilities. In markets with information asymmetries, product quality is *a priori* uncertain. If the contractual compliance cannot be fully monitored, for-profit organizations might provide suboptimal quality on imperfectly observable product dimensions. Non-profits, on the other hand, are subject to the non-distribution constraint, which prohibits the payment of profits to owners and employers (the Arrow-Hansmann hypothesis).[14] This softens the non-compliance incentive and increases the likelihood of having the optimal quality delivered. Thus, care recipients with a higher information cost might prefer the non-profit facilities due to their implicit quality assurance.

The existing literature provides ample evidence on the relationship between ownership and quality. In a seminal study, Arrow (1963) demonstrates that the dominance of non-profit sector in the health care markets is due to the contradiction between the profit motive and the trustworthiness necessary to provide a high quality. Grabowski et al. (2013) account for the endogeneity of ownership status and find that non-profit facilities deliver better care quality. Chou (2002) documents quality disparities between for-profit and non-profit nursing homes under the information asymmetries, which vanish if the care recipients are well-informed.[15] Grabowski and Hirth (2003) find positive competitive spillovers from non-profit to for-profit nursing homes. If the non-profits dominate the market, for-profits are chosen primarily by the well-informed. This leads to a better care quality in the latter, which is consistent with the hypothesis that non-profit ownership serves as a low-cost signal for quality.

The German long-term care market is dominated by the non-profit nursing homes, although the for-profits are gaining an increasingly important role.[16] Non-profits are dominant in North Rhine-Westphalia, Thuringia and in some areas of Bavaria and Baden-Wuerttemberg (Figure A3.3), although a majority of counties display a relatively balanced mix of for-profits and non-profits. Thus, prospective

[14] According to the German tax code, non-profit organizations may use their profits only for the purpose of fostering their primary activity (Abgabenordnung, §52 Gemeinnützige Zwecke). Thus, profit payouts to owners and employers are ruled out.

[15] Information asymmetries in this study are proxied by the frequency of family visits. Regular visits are assumed to imply a consistent monitoring of the care quality.

[16] As of 2013, market shares of for-profit and non-profit nursing homes were 36.4% and 63.6%, respectively, while the corresponding shares in 1999 were 25.4% and 74.6%. During this period, the number of places increased by 105% in for-profit, and by 25% in non-profit facilities (Augurzky et al., 2015).

residents should not face major restrictions in their choice of a particular ownership type.

3.3.3 Identification

The structural error term ξ in equation (3.2) encapsulates a range of unobservable factors, such as care quality, staff attentiveness, location and reputation, which are systematically correlated with the explanatory variables. For example, nursing homes with an excellent reputation or a location in an urban area are not only likely to face higher demand and higher market shares, but also to set higher prices. Unobservable factors induce simultaneity bias, which affects the consistency of OLS estimates of price and within-group share coefficients.[17] In order to identify the true effects of endogenous variables, we combine the fixed-effects with the instrumental variable approach. Fixed-effects net out all the correlation between the time-invariant unobserved factors and explanatory variables. Instrumental variable approach eliminates simultaneity from the regression equation through instruments for endogenous variables, which are uncorrelated with the error term. Our identifying assumption is therefore $E[p_{jt}, s_{j|gt}|\xi_{jt}] = 0$.

We instrument for the price variable by the average prices for comparable nursing homes. Comparability is established if a) the difference in capacity is not more than 20 places; b) staff-to-resident ratios do not deviate by more than 10%. We employ the prices for five most similar facilities as instruments. In a robustness check, we lower the number of instruments to two. Our instrument set includes nursing homes located in the same federal state, but outside the county of interest. In order to ensure that the identification condition is met, we exclude nursing homes located in immediately neighboring, and in counties whose centroids are less than 60 kilometers distance from a centroid of a county of interest.[18] Our choice of instruments is based on the following considerations. First, capacity and staff employed are the major cost determinants for a nursing home provider. Facilities similar across these two dimensions are likely to have a comparable cost structure and, therefore, correlated prices (Hausman et al., 1994). Second, prices for similar facilities serve as a reference point in price negotiations (SGB XI §84). Third, all providers within a federal state negotiate with the same group of payers, which implies a uniform price-setting

[17] Other nursing home characteristics, such as size and ownership, are chosen before the market entry and, therefore, likely exogenous.

[18] Distances are calculated based on the centroid coordinates provided by the German Office for Cartography and Geodesy (BKG), publicly availabile at `http://www.geodatenzentrum.de/auftrag1/archiv/vektor/vg2500/`.

mechanism. Fourth, the prices for nursing homes in neighboring counties could be correlated due to unobserved demand shocks. As an instrument for within-group market share, we employ the number of facilities in the same ownership group.[19] Entry in a nursing home market entails high sunk costs and extensive preparations. Thus, the short-term demand shifts are unlikely to alter the number of providers, and the identification condition is fulfilled.

Several institutional characteristics of the long-term care market could confound our empirical estimates. First, the choice set of social assistance beneficiaries may be initially restricted. However, they are allowed to move into their preferred facility if the costs are not disproportionate, and the choice can be soundly justified, for example through an offer of a particular religious service or proximity to the family (SGB XII §9). Our model assumption is that the payers (including social insurance funds) negotiate on behalf of nursing home residents, maximizing their utility (see Section 3.3.5). Second, the nursing home choice may be restricted through capacity constraints. Yet, in emergency case, prospective residents are entitled to short-term nursing home stays until an adequate facility is found (SGB XI §42). Figure A3.4 indicates a relatively small share of nursing homes operating at full capacity. Thus, the observed choice might not always be the most preferred, but it should largely reflect consumer preferences.[20]

3.3.4 Elasticities

For a clear interpretation of the estimated price coefficients, we calculate the price elasticities of demand. The own-price elasticity measures the responsiveness of the demand for nursing home j to changes in its own price and is expressed as (Berry, 1994):

$$\eta_{jjt} = \alpha p_{jt} \left(s_{jt} - \frac{1}{1-\sigma} + \frac{\sigma}{1-\sigma} s_{j|gt} \right). \tag{3.3}$$

Cross-price elasticities capture the effect of changes in prices for homes k on the demand for j. Due to different degrees of substitution, we distinguish between homes within the same ownership group ($j \in g$, $k \in g$) and within different groups ($j \in g$, $k \notin g$, $k \in h$). Based on this distinction, we calculate within- and between-group cross-price elasticities as:

[19] Within-group share instruments are inverted and log-linearized in order to ensure a positive correlation with the instrumented variable.

[20] Due to the above issues, we cannot uncover the extent of rationing by distinguishing between the care recipients based on their entitlement to social assistance in the spirit of Ching et al. (2015).

$$\eta_{jkt} = \begin{cases} \alpha p_{jt}\left(\frac{\sigma}{1-\sigma} s_{j|gt} + s_{jt}\right), & j \in g, k \in g \\ \alpha p_{jt} s_{jt}, & j \in g, k \notin g, k \in h. \end{cases} \tag{3.4}$$

3.3.5 Supply Side

We estimate the supply side using a model of oligopolistic competition with differentiated products (Berry et al., 1995; Verboven, 1996; Slade, 2004). Nursing homes are assumed to operate as single-product firms and differ across multiple dimensions. The produced long-term care is a vector of characteristics which reflect distinctive features of a nursing home. Typically, the differentiation stems from physical location, ownership, size, and quality of care. Hence, we assume that all nursing homes within the relevant market are to some degree substitutable. We recover the extent of substitution based on the estimates of cross-price elasticities from equation (3.4). Our supply side model is based on the assumption of bargaining between providers and payers. We build upon a classic bargaining model by Horn and Wolinsky (1988) and the models of bargaining in the health care markets (Grennan, 2013; Gowrisankaran et al., 2015).

Negotiations are carried out between the individual nursing homes and payers, which include the long-term care funds, social insurance funds, and several smaller players.[21] We assume that payers negotiate on behalf of nursing home residents and maximize their utility with respect to observable facility characteristics.[22] Hence, the objective utility functions of payers and nursing home residents are assumed equivalent. This assumption subsumes the main objectives of the negotiating parties. Long-term care insurance funds have initiated a system of public quality reporting and are therefore likely concerned about the welfare of nursing home residents. On the other hand, social insurance funds have an incentive to negotiate lower prices in order to minimize the share of care recipients entitled to social assistance. Price sensitivities of the self-paying nursing home residents and social insurance funds, who cover the out-of-pocket payments of social assistance beneficiaries, may nonetheless differ. However, as we have no information on the shares of care recipients entitled

[21] In the German long-term care market, nursing home chains are relatively common. Hence, one provider might negotiate on behalf of multiple facilities. Yet, the prices should be independent of each other, irrespective of the chain membership (SGB XI §85).

[22] As the long-term care is a credence good, this assumption does not rule out the necessity of a regulatory intervention. For example, staff engagement and attentiveness influence the care quality, but are unobservable by the payers and, hence, not a subject of negotiations. In this context, the aim of public quality reporting is to provide information on the unobserved aspects of care quality to prospective nursing home residents.

to social assistance, the estimation of separate price coefficients is beyond the scope of this paper. The objective utility function of a nursing home is assumed to depend on its profit motive. The for-profits pursue a profit-maximization strategy, while the non-profits maximize a weighted combination of profit and output (Gaynor and Vogt, 2003; Lakdawalla and Philipson, 2006).

The outcome of negotiations is a solution to a Nash bargaining problem, which takes the following form:

$$NB^{jt,s} = (U_{jt} - U_{0t})^{\gamma_j}(V_{jt} - V_{0t})^{\gamma_s}, \tag{3.5}$$

where U_{jt} and V_{jt} are the payoffs from an agreement to a nursing home j and payer s in period t, respectively, U_{0t} and V_{0t} are the payoffs without an agreement, and γ_j and γ_s are the respective bargaining powers. Without loss of generality, we assume that $\gamma_j + \gamma_s = 1$, and denote the bargaining powers as $\gamma_j = \gamma$ and $\gamma_s = 1 - \gamma$. If the negotiations fail and nursing home rejects the price set by an independent arbitration board, it exits the market. Therefore, the payoff from a disagreement is zero, $U_{0t} = V_{0t} = 0$. Equation (3.5) can be rearranged to obtain:

$$NB^{jt,s} = [\underbrace{(\beta x_{jt} - \alpha p_{jt} + \xi_{jt})}_{\delta_{jt}} q_{jt}]^{\gamma} \left[\theta_\pi(p_{jt} + l_{jt} - c_{jt})q_{jt} + \theta_q q_{jt}\right]^{1-\gamma}, \tag{3.6}$$

where δ_{jt} captures the mean utility derived from a nursing home j in period t, q_{jt} is its occupancy rate, and p_{jt}, l_{jt} and c_{jt} denote the out-of-pocket payments, LTCI entitlements of publicly insured nursing home residents, and the estimated marginal costs, respectively. θ_π and θ_q capture the relative weights placed on profits and outputs by nursing home providers, whereby $\theta_\pi + \theta_q = 1$. Since the output does not enter the objective utility function of for-profit providers, we assume that $\theta_q = 0$. Optimizing equation (3.6) with respect to price gives the following marginal cost expression:

$$MC_{jt} = \underbrace{c_{jt}}_{\substack{\text{“true”} \\ \text{MC}}} - \underbrace{\frac{\theta_q}{\theta_\pi}}_{\text{MRS}} = p_{jt} + l_{jt} - \frac{\delta_{jt}(1-\gamma)}{\alpha\gamma - \delta_{jt}\frac{\eta_{jjt}}{p_{jt}}}, \tag{3.7}$$

which is equal to the difference between the “true” marginal cost (c_{jt}) and the marginal rate of substitution (MRS) between profit and output. The terms c_{jt} and MRS cannot be identified separately from our data. We therefore estimate the "behavioral" marginal cost, which is equal to $c_{jt} - \frac{\theta_q}{\theta_\pi}$ for non-profit, and c_{jt} for for-profit nursing homes (Gaynor and Vogt, 2003).

Marginal costs cannot be estimated analytically because the expression (3.7) is non-linear. Thus, we assume that the bargaining powers are symmetric ($\gamma = \frac{1}{2}$). First, if the bargaining parties fail to agree and the price set by an independent arbitration board is rejected, nursing home exits the market. The treatment of the current residents therefore needs to be discontinued, which is an outcome with serious negative welfare implications. Hence, the payers are unlikely to exert their bargaining power to a degree which stymies profitable operations of a nursing home. Second, payers and providers are in a repeated interaction with each other, which entails similar discount factors (Rubinstein, 1982). Third, symmetric bargaining powers are roughly in line with the estimates from the empirical literature (Crawford and Yurukoglu, 2012; Gowrisankaran et al., 2015). Finally, if the bargaining power were concentrated at the payers' side, prices would be set at the level close to marginal costs. Under this scenario, policy changes would have a negligible impact on prices, which is unrealistic. Yet, in order to assess the robustness of our results, we allow for asymmetric bargaining powers and assume $\gamma = \frac{2}{3}$.

In our framework, bargaining model has two key advantages over the Nash-Bertrand competition, where the price is set as a strategic variable. First, it better approximates the price-setting mechanism in the German long-term care market. Second, it generates more reasonable marginal cost estimates. Since the out-of-pocket payments for nursing home stays are below the actual prices, the estimated elasticities are lower than under the full co-payment scheme. In a Nash-Bertrand setting, providers might exploit lower elasticities to set higher prices. Thus, applying this competition model would result in unrealistically low marginal cost estimates (Gowrisankaran et al., 2015).

3.3.6 Simulation

We evaluate the welfare effects of a policy mandating exclusively single rooms by comparing the status quo with the counterfactual market values. The basis for our welfare analysis are the changes in the utility of consumers and providers induced by a) higher availability of single rooms; b) costs of facility rebuilding; c) potential capacity reductions. Assuming symmetric bargaining powers, we evaluate three implementation scenarios: a) constant capacities, whereby facilities are either expanded or double rooms are split into singles in order to retain the same number of places; b) reduced capacities, whereby double rooms are transformed into singles without being divided; c) reduced capacities, whereby 50% of shared rooms are transformed into singles by being divided and 50% without being divided. In addition, we also explore the scenario d), which is equivalent to c), but with the payers' bargaining power of 2/3. In a counterfactual market, consumer valuation of observable nursing home characteristics, price sensitivity, and marginal costs (MC) remain constant. The ratio of single rooms to total available places increases to 1, while the nursing home capacities change under each scenario. We define the nested logit demand function as:

$$\ln(s_{jt}(\mathbf{p}_t^{sim}, \delta_{jt})) - \ln(s_{0t}(\mathbf{p}_t^{sim}, \delta_{jt})) = \hat{\beta} x_{jt} - \hat{\alpha} p_{jt}^{sim} + \hat{\sigma} \ln(s_{j|gt}(\mathbf{p}_t^{sim}, \delta_{jt})) + \xi_{jt}, \quad (3.8)$$

where the coefficients $\hat{\alpha}$, $\hat{\beta}$ and $\hat{\sigma}$ are estimated from equation (3.2). Based on the expression for marginal costs (3.7), we specify the first-order condition as:

$$p_{jt}^{sim} + l_{jt} - \widehat{MC}_{jt} - \frac{\delta_{jt}(1-\gamma)}{\hat{\alpha}\gamma - \delta_{jt} \frac{\eta_{jjt}(p_{jt}^{sim}, s_{jt}(\mathbf{p}_t^{sim}, \delta_{jt}))}{p_{jt}^{sim}}} = 0. \quad (3.9)$$

We determine the new equilibrium values of prices p_{jt}^{sim}, market shares $s_{jt}(\mathbf{p}_t^{sim}, \delta_{jt})$ and within-group shares $s_{j|gt}(\mathbf{p}_t^{sim}, \delta_{jt})$ by applying the Newton-Raphson algorithm on equations (3.8) and (3.9). Based on the simulated values of prices and market shares, and estimates $\hat{\alpha}$, $\hat{\beta}$ and $\hat{\sigma}$, we calculate the consumer surplus as follows (Ivaldi and Verboven, 2005):

$$CS(\mathbf{p}_t^{sim}) = \frac{1}{\hat{\alpha}} M \ln(1 + \sum_{g=1}^{G} D_{gt}^{1-\hat{\sigma}}), \quad (3.10)$$

where $D_{gt} = \sum_{j \in G} \exp(\frac{\delta_{jt}}{1-\hat{\sigma}})$. Providers' variable profits are expressed as:

$$\Pi(\mathbf{p}_t^{sim}) = (p_{jt}^{sim} - \widehat{MC}_{jt}) q_{jt}(\mathbf{p}_t^{sim}), \quad (3.11)$$

where $\widehat{MC}_{jt}$ is the marginal cost estimate, and q_{jt} the demand for nursing home j under the prices $\mathbf{p}_t^{sim}$. However, the magnitude of fixed costs associated with policy implementation is unknown. Our evaluation of the welfare effects is therefore limited to the comparison of status quo and counterfactual values of consumer surplus and providers' variable profits.

3.4 Dataset and Descriptive Statistics

Our dataset is provided by the Statistical Offices of the German federal states and used on-site at the Research Data Centre Duesseldorf. We observe all nursing homes offering full-time inpatient care for the elderly in 2007 and 2009.[23] The dataset includes information on nursing homes' capacities, occupancy rates, ownership, associated facilities (hospitals, ambulatory services, residential units), and prices for each care level. The share of for-profit nursing homes in the sample is 40.1%. Non-profit facilities are on average more expensive, have a higher capacity, more associated facilities, and provide a higher average share of single rooms. We also observe the care recipients using the informal care (either alone or combined with the outpatient care), which is our outside option. The total market size (M) is defined as a number of care recipients in a county. Since the care-dependency needs are evaluated based on a standardized procedure developed by the long-term care insurance funds, market conditions across the counties are homogenous. This ensures a consistent estimate of the market size. Detailed summary statistics are presented in Table 4.1.

We calculate the out-of-pocket payment for nursing home j as the total price for each care level net of the respective public LTCI allowances. Our price measure is a weighted average of out-of-pocket payments across the three care levels. We employ the ratios of the respective LTCI allowances to the aggregate LTCI allowance as weights:

$$w_i = \frac{LTCI_i}{\sum_{i=1}^{3} LTCI_i},$$

where i denotes the care level.[24] We do not observe the out-of-pocket payments of privately insured and social assistance beneficiaries. However, this issue is not of a major concern for two reasons. First, the share of privately insured care recipients is low (14% as of 2013). Second, our price coefficient captures the price sensitivity of both the nursing home residents and social insurance funds, which cover part of the long-term care expenses. Although distinguishing between the two would be helpful, our analysis is concerned with the aggregate welfare effects and, therefore, with average price sensitivities.

[23] Data aggregated at the federal state level is publicly available at https://www.destatis.de/DE/Publikationen/Thematisch/Gesundheit/Pflege/LaenderPflegeheime.html.

[24] Public LTCI allowances in 2007 were €1,023 for care level 1, €1,279 for care level 2, and €1,432 for care level 3. In 2009, the allowance for care level 3 increased to €1,470. The respective weights are therefore 0.27, 0.34 and 0.39. Our dataset does not provide information on prices for dementia and hardship cases.

3.5 Results

3.5.1 Demand- and Supply-side Estimation

The results of our demand estimation are presented in Table 3.2. The first two columns display the coefficient estimates from OLS and FE specifications, which do not account for the potential endogeneity of prices and within-group shares. The third column presents the results from our preferred FE.IV specification, which addresses the endogeneity problem by instrumenting prices and within-group shares. Both FE and FE.IV specifications include facility and year fixed-effects.

Table 3.1: Summary statistics

	Total		**For-profit**		**Non-profit**	
	mean	s.d.	mean	s.d.	mean	s.d.
Market shares						
s_j [$s_j \cdot 10$]	0.013	0.013	0.010	0.010	0.015	0.014
$s_{j\|g}$	0.093	0.104	0.112	0.139	0.080	0.070
s_0	0.711	0.067	0.706	0.071	0.714	0.065
Size	81.19	48.28	71.38	49.19	87.74	46.52
Extra facilities	0.30	0.46	0.25	0.43	0.33	0.47
Single rooms [share]	0.58	0.28	0.48	0.28	0.64	0.25
Weighted average price* [EUR]	1,477.32	435.23	1,402.13	429.23	1,527.86	431.94
Price per care level*						
Care level 1	1,258.15	398.62	1,219.60	412.00	1,284.06	387.24
Care level 2	1,416.95	435.73	1,347.32	430.48	1,463.76	432.99
Care level 3	1,685.05	477.83	1,579.15	456.67	1,756.23	478.57
Instruments, price* [EUR]						
Price, comparable home 1	1,479.00	435.35	1,449.94	431.54	1,497.02	436.90
Price, comparable home 2	1,473.86	440.78	1,447.14	438.13	1,491.81	441.67
Price, comparable home 3	1,466.99	429.25	1,437.74	417.08	1,486.65	436.15
Price, comparable home 4	1,468.83	436.48	1,436.91	425.82	1,490.28	442.23
Price, comparable home 5	1,472.32	434.62	1,441.55	422.30	1,492.99	441.52
Instruments, within-group share						
Number of homes, same group	18.38	18.31	18.21	20.33	18.49	16.82

We report the descriptive statistics for all German nursing homes providing the long-term inpatient care for elderly for 2007 and 2009. *Price variables refer to out-of-pocket payments, i.e., the prices negotiated for each nursing home net of the LTCI allowance. Group g is defined based on the ownership type of a provider. Market size corresponds with the size of care-dependent population in a county. s_j is the overall market share of nursing home j in a county, $s_{j|g}$ within-group share, and s_0 the share of the outside option. All prices are expressed in EUR.
Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

The coefficient σ measures the correlation of preferences for nursing homes with the same ownership type. An estimated value of σ is in line with random utility maximization ($0 < \sigma < 1$) and is positive and significant across all specifications.[25] This confirms the importance of controlling for the heterogeneity of individual preferences. As expected, instrumental variable estimation results in higher (absolute) price and lower within-group share coefficient. The effect of price is negative and significant. Facility size is positively valued, which is likely due to the fact that larger nursing homes can offer a place to prospective residents more quickly. The coefficient on the variable association with another facility is not significantly different from zero. Finally, the coefficient on the variable share of single rooms to total available places is positive, implying a higher valuation of nursing homes offering more privacy and independence. This estimate is the basis for our simulation of the effects of a single room policy.

To evaluate the robustness of our coefficient estimates, we introduce three additional specifications. First, since the reference point in price negotiations are the most similar facilities, we restrict the number of price instruments from five to two. Second, we employ the variable nursing home capacities as an instrument for within-group market share. The identification requirement in this case is likely fulfilled, as the capacity is generally chosen before the market entry and not in response to short-term demand shocks. At the same time, total supply of nursing home places of a particular ownership type should be highly correlated with within-group market shares. Finally, in the third specification, we allow for different correlations of individual preferences across the ownership types. This modeling assumption is based on a finding that better informed care recipients tend to choose for-profit nursing homes (discussed in section 3.3.2), which might result in a higher substitutability within this ownership group. Results in Table A4.5 demonstrate that our baseline coefficient estimates are robust to different specifications. Moreover, regression (3) indicates a higher correlation of preferences within the for-profit group, which is the result in line with the existing literature.

For a more precise interpretation of the estimated price coefficient, we calculate the price elasticities of demand. The results are presented in Table 3.3. The mean own-price elasticity is -0.752 and is slightly larger for non-profit nursing homes, which is mostly driven by higher average prices in this group. The average within- and between-group cross-price elasticities are estimated at 0.041 and 0.005, respectively. Considering that changing a nursing home might be financially and emotionally burdening, low cross-price elasticities are likely due to a high cost of moving and

[25] The specification with federal state as a relevant market did not yield significant within-group share coefficient.

Table 3.2: Estimation results

$\mathrm{ls}_j = lns_j - lns_0$	**OLS**	**FE**	**FE.IV**
σ [ownership]	0.68531***	0.58355***	0.50969***
	(0.00498)	(0.00721)	(0.01189)
Price	-0.00006***	-0.00003***	-0.00026***
	(0.00000)	(0.00000)	(0.00006)
Size	0.00543***	0.00422***	0.00451***
	(0.00013)	(0.00032)	(0.00035)
Extra facility	0.05869***	-0.00076	0.00169
	(0.00897)	(0.00558)	(0.00605)
Single rooms	0.15987***	0.02075	0.07401**
	(0.01487)	(0.02660)	(0.03169)
Constant	-2.78668***	-2.92495***	-2.85108***
	(0.02290)	(0.03799)	(0.06855)
Observations	14,205	14,205	14,205
Facility FE	no	yes	yes
Time FE	no	yes	yes
IV (σ)	no	no	yes
IV (price)	no	no	yes
Adjusted R-squared	0.70	0.70	0.68
Underidentification test			121.59
			(0.00)
Weak ID test			20.66
Sargan test			3.00
			(0.56)

The dependent variable is $ls_j = lns_j - lns_0$, where s_j = total number of care recipients in facility j/total market size, s_0 = market share of outside option/total market size. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

Table 3.3: Facility-level price elasticities

	Total		**For-profit**		**Non-profit**	
	mean	s.d.	mean	s.d.	mean	s.d.
Own, actual	-0.752	0.240	-0.706	0.267	-0.783	0.237
Cross-within	0.041	0.045	0.046	0.058	0.038	0.033
Cross-between	0.005	0.005	0.004	0.004	0.006	0.005
Own, no LTCI	-1.405	0.255	-1.352	0.257	-1.439	0.248
Own, effective	-2.552	0.483	-2.457	0.489	-2.614	0.469

Elasticities are calculated using the equations (3.3) and (3.4), while the effective own-price elasticity is expressed as $\epsilon = (\frac{p-MC}{p})^{-1}$. Our price measure is the actual out-of-pocket payment. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007-2009, own calculations.

adapting to a new environment. In the second step, we recover the marginal costs and markups for individual nursing homes based on equation (3.7). The average values for the two years in our sample are presented in Table 3.4. The average ratio of marginal costs to prices is 0.593, and is higher for for-profit than for non-profit nursing homes (0.604 vs. 0.576).

Table 3.4: Marginal costs and markups

	Total		**For-profit**		**Non-profit**	
	mean	s.d.	mean	s.d.	mean	s.d.
Marginal cost [EUR]	1,658.52	475.42	1,566.49	479.94	1,719.56	462.42
Markup	0.407	0.084	0.424	0.093	0.396	0.076
Marginal cost (% of price)	0.593	0.084	0.576	0.093	0.604	0.076

Marginal costs are calculated using the expression (3.7), while the markups are expressed as $\frac{p-MC}{p}$. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

Long-term care allowances decrease the out-of-pocket payments, dampening the responsiveness of care recipients to price changes. Abolishing the price negotiations would allow the nursing homes to exploit diminished price sensitivity and set higher prices. Using our marginal cost estimates, we explore the price effects of the hypothetical Bertrand-Nash competition scenario. We calculate the demand elasticities necessary to produce the current price level using the formula $\epsilon = (\frac{p-MC}{p})^{-1}$, which we refer to as effective elasticities (Gowrisankaran et al., 2015). The gap between the actual and the effective elasticities describes the level of price increases which the negotiations hinder. The mean estimate of -2.552 in Table 3.3 is significantly larger in magnitude than the actual elasticity of -0.752. Therefore, under the current long-term care insurance scheme, Bertrand-Nash competition would result in higher prices. Next, we evaluate the impact of long-term care insurance on the average price level under the price negotiations. Assuming that the long-term care insurance rates drop to zero, the mean own-price elasticity increases in magnitude to -1.405, which results in lower negotiated prices. Under the scenario of zero out-of-pocket payments, the demand becomes price insensitive. Long-term care insurance rates therefore need to be adjusted considering their impact on the negotiated price level.

3.5.2 Simulation

In the final step of our analysis, we simulate the equilibrium prices and market shares in a counterfactual market with single rooms only. We then evaluate the welfare effects of a single room policy by comparing the status quo and the counterfactual values of consumer surplus and providers' variable profits.

Table 3.5: Mean prices and market shares in a counterfactual market with single rooms only

	a)		**b)**		**c)**		**d)**	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
price	1,459.29	465.06	1,451.65	468.61	1,454.35	468.55	1,449.51	450.49
sj $[s_j \cdot 10]$	0.013	0.011	0.011	0.009	0.012	0.009	0.012	0.009
sjg	0.089	0.100	0.089	0.097	0.093	0.105	0.093	0.104
s_0	0.692	0.067	0.750	0.053	0.720	0.060	0.719	0.059

Scenarios: Symmetric bargaining power ($\gamma = \frac{1}{2}$) and a) constant capacities; b) reduced capacities, whereby doubles are transformed into single rooms without being divided; c) reduced capacities, whereby 50% of doubles are transformed into single rooms by being divided and 50% without being divided. Scenario d) is equivalent to c), with the payers' bargaining power of $\gamma = \frac{2}{3}$. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

The new equilibrium values of prices and market shares are presented in Table 3.5. The average prices decline under each scenario, although by a relatively low amount.[26] Considering that care recipients value the single rooms positively (Table 3.2), the implementation of this policy raises the attractiveness of nursing home care. Yet, due to the resulting capacity changes, the actual number of care recipients in nursing homes increases only under scenario a). Price decline in this case is likely due to a fiercer competition between the providers. Under the remaining implementation scenarios, the total supply of nursing home places shrinks. This raises the average market share of the outside option and reduces the total number of care recipients in nursing homes. Payers' utility declines due to lower capacities and occupancy rates, which likely leads to a lower negotiated price.

Table 3.6 presents the aggregate changes in consumer surplus and providers' variable profits in a counterfactual market with single rooms only. The welfare changes are largely determined by the capacity changes. Under scenario a), transforming all double rooms into singles leads to a total increase in consumer surplus of 1.8% and 5.1% in providers' variable profits. Aggregate consumer welfare improves

[26]Note that our counterfactual scenarios are "static" in a sense that no market entry/exit with potential price effects takes place. Furthermore, we abstract from policy implementation costs, which are likely to spill over to the prices.

Table 3.6: Aggregate consumer surplus (CS) and providers' variable profits (PS) in a counterfactual market with single rooms only (€000,000)

	status quo	**a)**	**b)**	**c)**	**d)**
CS	37,500	38,100	35,000	36,500	36,600
PS	6,770	7,120	5,670	6,390	4,390
ΔCS		0.018	-0.066	-0.026	-0.024
ΔPS		0.051	-0.162	-0.055	-0.351

Consumer surplus and providers' variable profits are calculated using the expressions (3.10) and (3.11) and aggregated at the level of Germany. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

both because of a higher utility derived from individual nursing homes, and a larger share of care recipients in nursing homes. Providers' variable profits increase despite lower prices, which is due to a higher utilization of nursing home capacities. Under scenario b), the negative welfare effects of reduced capacities clearly outweigh the positive welfare effects of single rooms, which leads to a 6.6% decrease in consumer surplus and 16.2% in providers' variable profits. Under scenario c), the negative welfare effects of reduced capacities prevail, due to which consumer surplus diminishes by 2.6% and providers' variable profits by 5.5%. Finally, under scenario d), the assumption of asymmetric bargaining powers produces a decline in consumer surplus by 2.4% and 35.1% in providers' variable profits. The payers have a higher bargaining power and are thus able to negotiate lower prices; yet, consumer surplus declines as a result of reduced supply of nursing home places. Lower prices have a pronouncedly negative impact on providers, who incur substantial losses. Therefore, under the assumption of symmetric bargaining powers, the effects of a single room policy are welfare-enhancing only if the nursing home capacities remain unchanged. The welfare effects of the most realistic implementation scenario c) are negative, and become even more so if the bargaining power is actually asymmetric.

3.6 Conclusion

The right to privacy is one of the central tenets of long-term care. Living in a single room is therefore crucial for the well-being of nursing home residents. Yet, the implementation of a single room policy raises the issues of nursing home capacities and financial position of providers. Our paper evaluates the welfare implications of a single room policy in German nursing homes. To this end, we a) estimate a structural model of demand for inpatient long-term care; b) estimate a model of bargaining between providers and payers; and c) quantify the welfare effects of a single room policy under various implementation scenarios. We use a panel dataset of all German nursing homes for elderly (aged 65+) for 2007 and 2009, and apply an instrumental variable approach with fixed-effects.

We find that the care recipients positively value nursing home size and single rooms, but significantly dislike higher prices. The demand for nursing home care is price inelastic. We show that the current price level would materialize under the scenario of Bertrand-Nash competition only if the mean own-price elasticity increases approximately 3.5 times in magnitude. Abolishing the system of price negotiations would therefore result in significant price increases. We also find that higher long-term care insurance rates dampen the price sensitivity of demand, resulting in higher negotiated prices. Changes in the long-term care allowances thus need to be implemented with regard to their impact on the negotiated prices. Based on the estimated demand and supply parameters, we simulate the welfare changes in a counterfactual market for nursing homes with single rooms only. We evaluate four implementation scenarios, with different assumptions on capacity changes and the distribution of bargaining powers. Although the prices decline under each scenario, the welfare implications are predominantly negative due to a reduced supply of nursing home places. A single room policy is welfare-enhancing for both consumers and providers only under the assumption of symmetric bargaining powers and unchanged nursing home capacities. In the remaining scenarios, the share of care recipients in inpatient care diminishes due to lower capacities, reducing both consumer surplus and providers' variable profits. Providers incur particularly high losses if their bargaining power is low.

Single room policy enhances the well-being of individual nursing home residents; however, the welfare implications hinge upon its implementation. Retaining constant capacities enhances consumer welfare, although the costs of implementation are high. Thus, restructuring the nursing homes in order to provide exclusively single rooms will almost certainly result in reduced capacities and negative welfare effects. If the recent policy change in Baden-Wuerttemberg and North Rhine-Westphalia is to be adopted as a model for future interventions, regulators need to secure the supply of nursing home places. In a more recent period, which is beyond the scope of our analysis, there was a marked increase in the average ratio of single rooms to total nursing home places (Figure A3.2). Yet, this increase can be largely attributed to new entrants, which provide a larger share of single rooms on average (Figure A3.6). Existing facilities are slow to restructure, in spite of the potential competitive advantages (Figure A3.5). This might be indicative of the expenses associated with facility rebuilding. Therefore, instead of imposing strict regulatory requirements on nursing homes which are already present in the market, it may be more welfare-enhancing to stimulate investment in new facilities which would be obliged to provide exclusively single rooms.

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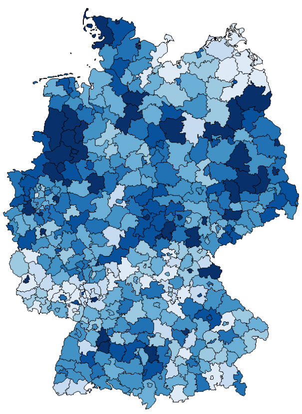
Appendix

Figure A3.2: Ratio nursing home places in single rooms-to-total available places, 2007–2013, county level



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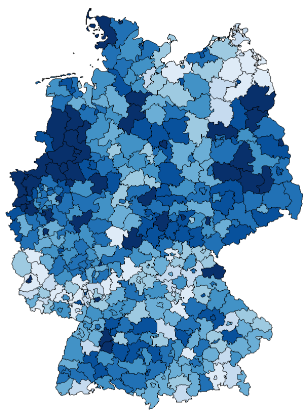

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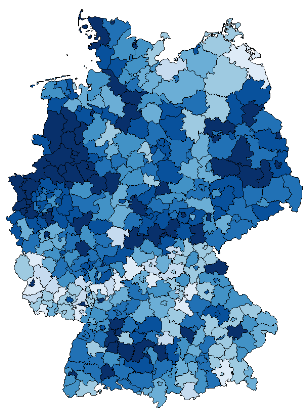
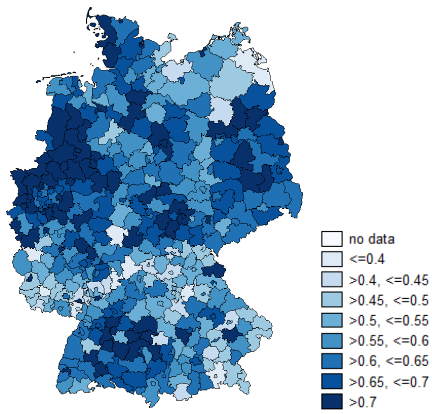


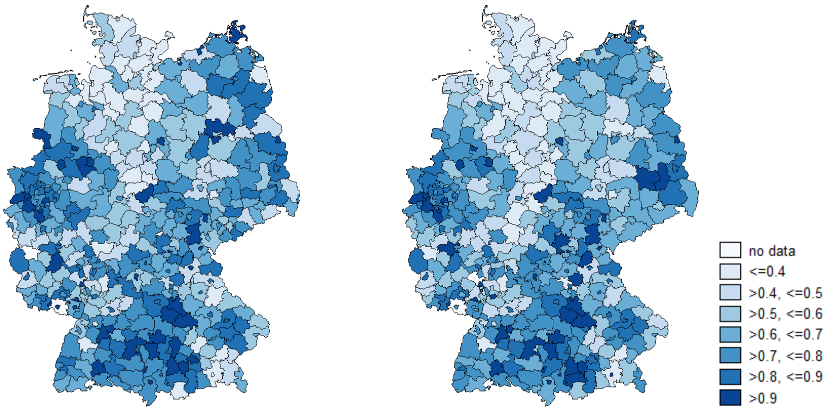
(c) 2011



(d) 2013

Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2013, own calculations.

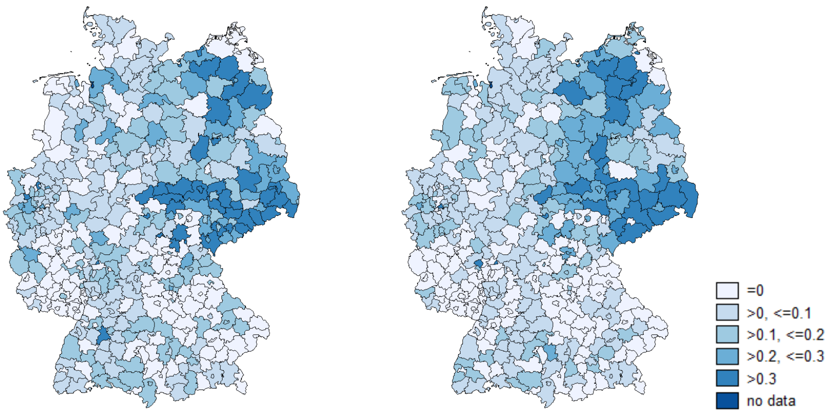
Figure A3.3: Ratio nursing home places in non-profit ownership-to-total available places, 2007–2009, county level



(a) 2007 (b) 2009

Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2009, own calculations.

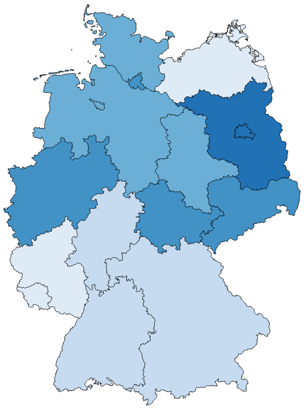
Figure A3.4: Share of nursing homes operating at full capacity, 2007–2009, county level



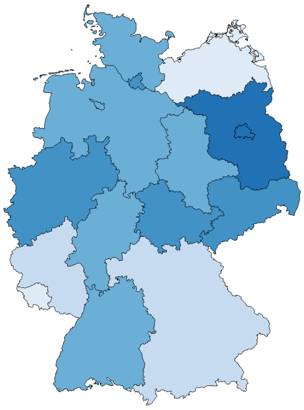
(a) 2007 (b) 2009

Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2009, own calculations.

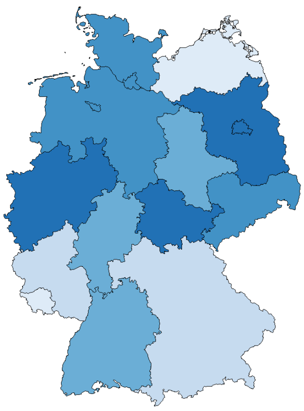
Figure A3.5: Ratio nursing home places in single rooms-to-total available places, facility-level averages for nursing homes which entered before 2008, federal state level



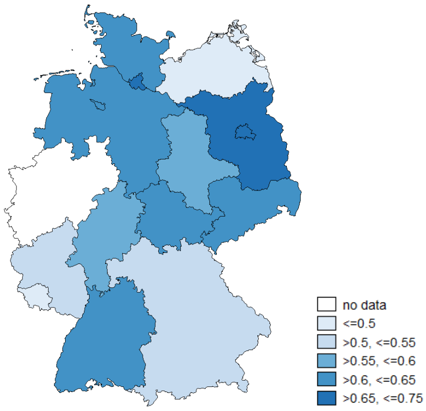
(a) 2007



(b) 2009



(c) 2011



(d) 2013

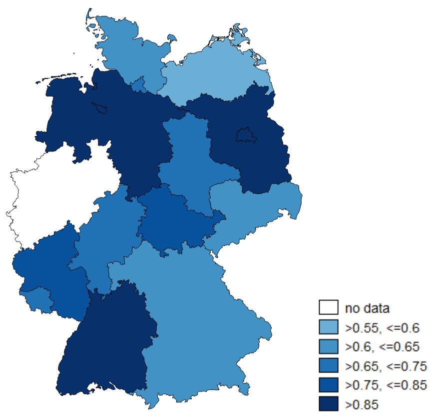
Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2013, own calculations.

Table A3.2: Daily caregiving needs through care levels

	Basic care	Total care
Care level 0[b]	–	–
Care level I	46	90
Care level II	120*	180
Care level III	240**	300
Hardship case	360***	–

We present the minimum daily needs for assistance in performing the activities of daily living (ADL) at different care-dependency levels. Basic care includes all recurring activities related to personal hygiene, feeding and mobility. Total care encompasses both basic care and assistance with household activities, such as cooking, cleaning and grocery shopping. The minimum daily needs are expressed in minutes and refer to years prior to 2016, when the definitions were changed. [a]Individuals with dementia in each care-dependency level are eligible for higher allowances. However, our dataset does not provide information on this specific condition. From 2017, rule "+1" applies to each care level above, whereby hardship cases are classified as level V. [b]Care-dependency level 0 applies to individuals whose daily caregiving needs are significant, but below those necessary for level 1. *At least 3 times a day at different hours **Round the clock ***At least 3 times during the night or with more than one caregivers, round the clock.

Figure A3.6: Ratio nursing home places in single rooms-to-total available places, facility-level averages for nursing homes which entered in 2012–2013, federal state level



Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2013, own calculations.

Table A3.3: Robustness checks

$\text{ls}_j = lns_j - lns_0$	**(1)**	**(2)**	**(3)**
σ [ownership]	0.50617***	0.44954***	
	(0.01574)	(0.01134)	
σ_1 [non-profit]			0.49982***
			(0.01151)
σ_2 [profit]			0.53498***
			(0.01372)
Price	-0.00029***	-0.00030***	-0.00026***
	(0.00009)	(0.00006)	(0.00006)
Size	0.00451***	0.00491***	0.00449***
	(0.00036)	(0.00036)	(0.00035)
Extra facility	0.00192	0.00247	0.00146
	(0.00618)	(0.00627)	(0.00602)
Single rooms [%]	0.07985**	0.08089**	0.08095**
	(0.03666)	(0.03279)	(0.03142)
Constant	-2.82872***	-2.99902***	-2.84403***
	(0.09787)	(0.07244)	(0.06803)
Observations	14,205	14,205	14,205
Facility FE	yes	yes	yes
Time FE	yes	yes	yes
IV (σ)	yes	yes	yes
IV (price)	yes	yes	yes
Adjusted R-squared	0.68	0.67	0.70
Underidentification test	46.16	124.26	121.47
	(0.00)	(0.00)	(0.00)
Weak ID test	15.49	21.13	17.69
Sargan test	0.11	3.64	3.28
	(0.74)	(0.46)	(0.51)

The dependent variable is $ls_j = lns_j - lns_0$, where s_j = total number of care-dependent in facility j/total market size, s_0 = market share of outside option/total market size. Comparison to the baseline scenario: (1) two instead of five price instruments; (2) number of places in nursing homes of the same ownership type as within-group share instrument; (3) separate dummies for the correlation of preferences for non-profit and for-profit nursing homes. Underidentification test H0: Instruments are irrelevant, Weak ID test: rule of thumb – instruments are weak if $F < 14$, Sargan test H0: Overidentifying restrictions are valid. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

Table A3.4: Consumer surplus and providers' variable profits in a status quo market, federal state level

	status quo	
Federal state	**CS**	**PS**
Schleswig-Holstein	3010	405
Lower Saxony	3460	772
Bremen	487	49.7
North Rhine-Westphalia	6660	1410
Hesse	2250	438
Rheinland-Palatinate	1010	343
Baden-Wuerttemberg	2960	760
Bavaria	3340	1060
Saarland	353	86.6
Brandenburg	9550	449
Mecklenburg-West Pomerania	542	162
Saxony	2090	404
Saxony-Anhalt	1060	220
Thuringia	702	205

Values of consumer and producer surplus are expressed in €000,000. Scenarios: Symmetric bargaining power ($\gamma = \frac{1}{2}$) and a) constant capacities; b) reduced capacities, whereby double rooms are transformed into singles without being divided; c) reduced capacities, whereby 50% of double rooms are transformed into singles by being divided and 50% without being divided; d) equivalent to scenario c), with the payers' bargaining power of $\gamma = \frac{2}{3}$. Due to the organization of the long-term insurance funds, Hamburg is merged with Schleswig-Holstein and Berlin with Brandenburg. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

Table A3.5: Consumer surplus in a counterfactual market and changes with respect to status quo market, federal state level

Federal state	**a)**	**b)**	**c)**	**d)**	**Δ a)**	**Δ b)**	**Δ c)**	**Δ d)**
Schleswig-Holstein	2850	2700	2770	2830	-0.052	-0.105	-0.079	-0.060
Lower Saxony	3550	3320	3430	3450	0.024	-0.405	-0.009	-0.003
Bremen	497	464	479	480	0.020	-0.047	-0.016	-0.014
North Rhine-Westphalia	6810	6280	6530	6530	0.022	-0.058	-0.020	-0.020
Hesse	2300	2110	2200	2200	0.024	-0.062	-0.020	-0.020
Rheinland-Palatinate	1040	941	989	989	0.031	-0.067	-0.020	-0.020
Baden-Wuerttemberg	3020	2780	2900	2,900	0.018	-0.061	-0.023	-0.023
Bavaria	3440	3110	3200	3290	0.030	-0.069	-0.022	-0.015
Saarland	366	328	346	346	0.036	-0.073	-0.021	-0.021
Brandenburg	9710	8710	9190	9200	0.013	-0.086	-0.038	-0.037
Mecklenburg-West Pomerania	556	508	531	535	0.026	-0.063	-0.020	-0.013
Saxony	2200	2040	2120	2,050	0.056	-0.020	0.020	-0.019
Saxony-Anhalt	1090	1010	1050	1050	0.025	-0.049	-0.014	-0.014
Thuringia	717	672	695	696	0.020	-0.043	-0.011	-0.008

The values of consumer surplus are expressed in €000,000. Scenarios: Symmetric bargaining power ($\gamma = \frac{1}{2}$) and a) constant capacities; b) reduced capacities, whereby double rooms are transformed into singles without being divided; c) reduced capacities, whereby 50% of double rooms are transformed into singles by being divided and 50% without being divided; d) equivalent to scenario c), with the payers' bargaining power of $\gamma = \frac{2}{3}$. Due to the organization of the long-term insurance funds, Hamburg is merged with Schleswig-Holstein and Berlin with Brandenburg. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

Table A3.6: Providers' variable profits in a counterfactual market and changes with respect to status quo market, federal state level

Federal state	**a)**	**b)**	**c)**	**d)**	**Δ a)**	**Δ b)**	**Δ c)**	**Δ d)**
Schleswig-Holstein	459	370	416	280	0.131	-0.088	0.026	-0.309
Lower Saxony	839	685	763	502	0.085	-0.113	-0.011	-0.350
Bremen	56.0	45.1	50.6	34.9	0.127	-0.090	0.018	-0.300
North Rhine-Westphalia	1550	1260	1410	969	0.099	-0.110	-0.005	-0.313
Hesse	490	376	432	283	0.119	-0.141	-0.012	-0.353
Rheinland-Palatinate	343	273	309	214	-0.000	-0.205	-0.099	-0.376
Baden-Wuerttemberg	786	624	706	494	0.034	-0.179	-0.071	-0.350
Bavaria	993	795	895	595	-0.063	-0.250	-0.155	-0.439
Saarland	96.9	71.7	84.6	58.5	0.119	-0.172	-0.024	-0.324
Brandenburg	529	417	473	326	0.179	-0.071	0.053	-0.274
Mecklenburg-West Pomerania	163	123	144	97.7	0.005	-0.239	-0.114	-0.397
Saxony	373	283	321	267	-0.078	-0.300	-0.208	-0.339
Saxony-Anhalt	235	181	208	144	0.067	-0.177	-0.055	-0.345
Thuringia	202	169	185	127	-0.015	-0.174	-0.097	-0.380

The values of providers' variable profits are expressed in €000,000. Scenarios: Symmetric bargaining power ($\gamma = \frac{1}{2}$) and a) constant capacities; b) reduced capacities, whereby double rooms are transformed into singles without being divided; c) reduced capacities, whereby 50% of double rooms are transformed into singles by being divided and 50% without being divided; d) equivalent to scenario c), with the payers' bargaining power of $\gamma = \frac{2}{3}$. Due to the organization of the long-term insurance funds, Hamburg is merged with Schleswig-Holstein and Berlin with Brandenburg. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2009, own calculations.

Declaration of Contribution

Hereby I, Amela Saric, declare that the chapter "The Welfare Effects of Single Rooms in German Nursing Homes: A Structural Approach" is co-authored by Jun.-Prof. Dr. Annika Herr. My contributions to the chapter are as follows:

- I have contributed to develop the idea and methodological approach
- I have contributed to the data collection and preparation process
- I have carried out the data evaluation process
- I have contributed to write the sections 3.1 and 3.6
- I have written the sections 3.2–3.5

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Chapter 4

Regional Variation in the Use of Inpatient Long-Term Care in Germany: A Spatial Approach

4.1 Introduction

The German long-term care system is designed to encourage caregiving in domestic surroundings.[1] Informal care has precedence over formal care, as does outpatient care through ambulatory services over inpatient care in nursing homes (SGB XI §3). The primary aim of this organizational principle is to enable the care recipients to remain in their familiar environment for as long as possible. Institutionalization is thus seen as a last step. Yet, we observe striking differences in the shares of the elderly (aged 65+) care recipients in nursing homes across Germany. The unadjusted mean varies in a range of 49 to 175% of the national mean at county-level (Figure 4.1). Considering decentralized regulation of nursing homes, high public expenditures, and a shortage of a qualified labor force (Augurzky et al., 2013), regional variation could reflect broader problems in provision, for example, insufficient supply in rural areas or a lack of informal support. Thus, there is a need to understand sources of these differences.

Due to population aging and rising demand, long-term care is currently one of the central public policy issues in Germany.[2] The care-dependent population is projected to increase from 2 million in 1999 and 2.6 million in 2013 to 3.4 million in 2030. Between 1999 and 2013, public expenditures on long-term care increased from €16.8 billion to €40 billion, which amounts to a rise from 8.6% to 12.7% of the total health expenditures (Augurzky et al., 2015). In order to meet the projected demand, investment volume in nursing homes is estimated at €58–80 billion by 2030, with an additional 128.000–245.000 of full-time employed (Augurzky et al., 2015). Yet, even if these resources were made available, the existing regional variation indicates potential issues in the future care provision. Under-utilization due to long travel and waiting times implies that the access problem could become more acute. Over-utilization due to a lack of informal support or other care alternatives suggests that the individual preferences of care recipients are unmet, and that public resources are suboptimally employed. The issue of regional variation is therefore essential for the creation of future long-term care policies.

The German long-term care system is primarily financed through insurance. Families are financially responsible for their relatives in need, and social assistance

[1] The need for caregiving arises if individuals require assistance with the activities of daily living due to advanced age, health- or mental-related problems for a minimum of six months (SGB XI §14).

[2] See Pflegestärkungsgesetz I, II and III.

is granted only if they lack sufficient resources.[3] The aforementioned principle of precedence of informal over formal care is strictly enforced if social assistance is required. Thus, there is essentially a free choice between different forms of long-term care and providers. The entitlement to an allowance from the long-term care insurance (LTCI) funds is based on the care-dependency level and independent of income and availability of informal care.[4] Informal caregivers are entitled to both cash and non-cash benefits.[5] LTCI allowance usually covers only a fraction of the total price and out-of-pocket payments are substantial.[6]

The most obvious source of regional variation in the use of nursing home care is the extent of caregiving needs, which depends on functional and cognitive impairment, chronic diseases, and self-rated health status (Geerlings et al., 2005; Luppa et al., 2010; Laferrère et al., 2013). Second, individuals provided with more family- or community-based support are shown to enter the nursing homes later and to a lesser extent (Larsson and Thorslund, 2002; Van Houtven and Norton, 2004; Charles and Sevak, 2005; Mor et al., 2007; Bonsang, 2009; Litwin and Attias-Donfut, 2009; Geerts and Van den Bosch, 2012). Third, the use of inpatient care is higher in areas with a greater density of nursing home places (Kenney and Dubay, 1992; Laferrère et al., 2013), which is partly related to shorter travel times (Kenney, 1993; McAuley et al., 2009). Fourth, the decision to enter a nursing home is affected by income and housing shortage (Sarma and Simpson, 2007; Goda et al., 2011; Alders et al., 2015). Studies with a focus on cultural factors are mostly based on cross-country comparisons, which suggest that national long-term care policies reflect social preferences on family and governmental involvement. Hence, inpatient care dominates in the Scandinavian countries and the Netherlands, where government is deemed responsible for the provision of long-term care (Bolin et al., 2008; Bakx et al., 2015). In contrast, it plays a lesser role in Germany, where families are legally obliged to care for their aged relatives (Alders et al., 2015).

[3]Esping-Andersen (1990) characterizes this arrangement as conservative-corporate. It is distinguished by the benefits which are earnings-related and administered through employers, and financial responsibility of the families. In social democratic countries, such as Denmark and Sweden, the state provides comprehensive payments and support to care recipients, and finances the long-term care through taxes. In contrast, liberal welfare countries, such as United States and United Kingdom make comparatively small public transfers.

[4]Details on care levels and care-dependency evaluation procedure are presented in Chapter 3 of this dissertation (Table A3.2).

[5]In this context, Pflegestärkungsgesetz attempts to stimulate informal caregiving by reducing the double burden of work and caring. Detailed information on changes concerning the care-dependency evaluation procedure and entitlements of care recipients and caregivers are available at `http://www.pflegestaerkungsgesetz.de`, accessed on February 13, 2017.

[6]See Table 4.1 and A4.2 for data on prices and LTCI allowances.

Our paper is the first to analyze regional variation in the utilization of inpatient long-term care. We do so in reference to a range of factors, including caregiving needs, availability of alternative forms of care, sociodemographic and supply factors, but also spatial dependencies in utilization and regional shock spillovers. We use a rich dataset comprising the entire German care-dependent population, long-term care facilities, and structural and demographic characteristics of the counties for the years 2007, 2009 and 2011, and apply a spatial autoregressive model. Our methodological approach follows the small area variation studies by Cutler and Shiner (1999) on health expenditures, Augurzky et al. (2013), Kopetsch and Schmitz (2014), and Ozegowski and Sundmacher (2014) on hospital and ambulatory services, and accounts for potential price endogeneity. Local use of inpatient care and shocks are assumed to have spillover effects on nearby counties. We are able to establish the main sources of the variation, identify areas with below- and above-average adjusted utilization, and uncover the extent of regional interdependencies. For comparison, we estimate the specifications excluding the spatial dimension. Most studies cited in the previous paragraph are based on survey data, which are representative samples of care recipients. Two notable exceptions are Kenney and Dubay (1992) and Mor et al. (2007), who analyze the US long-term care market using comprehensive datasets on Medicare/Medicaid claimants. Due to their limited scope, survey data provide little evidence on spatial patterns in utilization. Moreover, no regional variation study has addressed the use of long-term care services. Finally, even though the German long-term care market is large and growing, little is known about the behavior of care recipients. Our paper aims to close this research gap.

The characteristics of our dataset enable us to exclude the variation which may confound our empirical findings. First, our analysis is not truncated because we observe not only the nursing home residents, but the entire care-dependent population. Second, we are able to identify elderly care recipients using full-time inpatient care, which is the primary focus of our analysis. Third, we can infer the average out-of-pocket payments for nursing home services, because: a) the allowances paid by the public long-term care insurance funds are not mean-tested, but are based on caregiving needs, and b) long-term care insurance is mandatory. Finally, the LTCI allowances and the care-dependency evaluation procedure are uniform nation-wide, while the regulation of nursing homes is delegated to federal states. This rules out potential variation due to county-level differences in the long-term care policies.

We find that the care recipients' age and an informal network of support explain 45.1% of the variation. Supply of long-term care facilities captures up to 27.1%, while income, rurality, and price for nursing home services account for a maximum of 13.5%. We find a small but significant presence of regional shock spillovers. Overall, our model achieves a relatively good measure of fit, with an R^2 of 62.4%. These findings have important policy implications. In particular, they demonstrate that the degree of informal support has a profound impact on the demand for inpatient care. Thus, the policy-makers need to stimulate informal caregiving in some areas by reducing the double burden of work and caring. Furthermore, higher subsidies for the expansion of nursing home capacities in low-use areas may be necessary to secure access to an adequate care.

This paper is structured as follows. In section 2, we discuss the idea of spatial dependencies and apply them to the long-term care market. Section 3 outlines our model and econometric specification. In section 4, we provide dataset description and variable definitions. Section 5 presents the results. Finally, Section 6 discusses policy implications and concludes.

4.2 Spatial Dependencies

The idea of spatial dependencies originates from the interaction-based models, in which collective behaviors and aggregate patterns emerge from the interaction of agents across social, economic and geographic dimensions (Brock and Durlauf, 2000; Manski, 2000; Anselin, 2002). Interaction can be a) endogenous, if the group behavior causally influences individual behavior, b) exogenous, wherein individual behavior varies with exogenous characteristics of the group, c) correlated, in which similar behaviors are due to similar individual characteristics and institutional environments (Manski, 2000). The underlying idea is that actions chosen by one individual influence the constraints, expectations, and preferences in her reference group (Revelli, 2006). Endogenous interaction in the long-term care market may arise from cultural factors. For example, high use of inpatient care in a particular area may increase its broader societal acceptance. In our context, exogenous interaction can be attributed to a wider effect of local developments. For example, the closure of a large nursing home in one county is likely to boost the demand for inpatient care in neighboring counties. Negative economic shocks will increase the unemployment and outflow of the workforce, which could lower the degree of informal support. Correlated interaction results from factors which cannot be observed by an econometrician. Examples include a high prevalence of conditions which often precede a nursing home entry, such as mental diseases and strokes, or a good quality of care in a particular region.

To our knowledge, only Kopetsch and Schmitz (2014) explicitly consider spatial dependencies in the use of medical services. The bulk of empirical evidence on spatial interactions among economic agents comes from the public economics literature. Positive spatial dependencies are documented in the US state government per capita expenditures (Case et al., 1993), and medical spending (Baicker, 2005), UK local government expenditures on personal social services (Revelli, 2002, 2006), mental health (Moscone and Knapp, 2005; Moscone et al., 2007), and long-term care (Fernandez and Forder, 2015). Spatial dependencies in public expenditures are usually explained through a) welfare competition argument, i.e., the aim to not become a "welfare magnet" by providing a higher level of social services than the neighboring counties, and b) preferences of imperfectly informed voters, who benchmark against the performance of neighboring authorities (Revelli, 2006). These findings suggest that the spatial dimension might deserve more attention in the regional variation literature. We therefore proceed to set up a model which accounts for both spatial dependencies in the demand for long-term care services and regional shock spillovers, and apply spatial econometric methods.

4.3 Empirical Framework

Our model formalizes the ideas that the use of inpatient care in nearby counties is simultaneously determined and that shocks are spatially correlated. In the rest of this section, we discuss the model of health services utilization, the econometric framework, and some identification issues.

4.3.1 Econometric Specification

Considering $i = 1, .., I$ counties observed over $t = 1, .., T$ time periods, we assume that the use of inpatient care follows the spatial autoregressive process with spatial autoregressive disturbances (SARAR) (Anselin, 2001):

$$\mathbf{y} = \lambda \mathbf{W} \mathbf{y} + \mathbf{X_x} \beta + \mathbf{X_n} \gamma + \mathbf{u} \tag{4.1}$$

$$\mathbf{u} = \rho \mathbf{W} \mathbf{u} + \epsilon, \tag{4.2}$$

where $\mathbf{y}$ is $(I \cdot T) \times 1$ vector of observations of the shares of care recipients in nursing homes, $\mathbf{X_x}$ is $(I \cdot T) \times K$ matrix of observations of $k = 1, .., K$ exogenous covariates, $\mathbf{X_n}$ is $(I \cdot T) \times N$ matrix of observations of $n = 1, .., N$ endogenous covariates, $\mathbf{W}$ is $I \times I$ spatial contiguity weight matrix, and $\mathbf{u}$ and ϵ are $(I \cdot T) \times 1$ vectors of spatially correlated residuals and IID disturbances, whereby $\epsilon \sim N(0, \sigma^2\mathbf{I})$. We denote $\mathbf{Wy}$ and $\mathbf{Wu}$ as spatial lags of the dependent variable and regression residuals, respectively. The spatial contiguity weight matrix $\mathbf{W}$ parametarizes the interaction between the counties. The element w_{ij} captures the influence of the use of inpatient care in county j on county i. We adopt a geographical contiguity criterion and assign $w_{ij} = 1$ if counties share a common border, or if the distance between their centroids is less than 60 kilometers, and 0 otherwise (Moscone et al., 2007).[7] Coefficient λ captures the relationship between the use of inpatient care in nearby counties, conditional on explanatory variables. Coefficient ρ captures the combined effect of demand shocks and unobservables. The spatial contiguity weight matrix is generated using the `spmat` command in Stata 12 (Drukker et al., 2013a).

The OLS estimator applied on equations (4.1) and (4.2) is inconsistent because the term Wy is endogenous.[8] We therefore follow Kelejian and Prucha (1998, 1999, 2010), Kelejian et al. (2004), and Arraiz et al. (2010) and apply a generalized spatial two-stage least-squares estimator with instrumental variables. We employ a matrix of instruments $\mathbf{H} = [\mathbf{X}, \mathbf{WX}, \mathbf{W^2X}]$, where $\mathbf{X} = [\mathbf{X_x}, \mathbf{Z}]$, and $\mathbf{Z}$ is a matrix of instruments for endogenous covariates $\mathbf{X_n}$. Considering that the majority of regulations are delegated to federal states, we include a vector of federal state dummies $\mathbf{D}$.[9] In addition, we capture potential time effects through year dummies $\mathbf{T}$. Our working equation is therefore:

$$\mathbf{y} = \lambda\mathbf{Wy} + \mathbf{X_x}\beta + \mathbf{X_n}\gamma + \mathbf{D} + \mathbf{T} + \rho\mathbf{Wu} + \epsilon. \tag{4.3}$$

For comparison purposes, we estimate equation (4.3) without spatial dependencies:

$$\mathbf{y} = \mathbf{X_x}\beta + \mathbf{X_n}\gamma + \mathbf{D} + \mathbf{T} + \epsilon. \tag{4.4}$$

Equation (4.3) was estimated using the `spreg` and `spivreg` commands in Stata 12 (Drukker et al., 2013c,b).

[7] Distances are calculated based on centroid coordinates provided by the German Office for Cartography and Geodesy (BKG), publicly availabile at `http://www.geodatenzentrum.de/auftrag1/archiv/vektor/vg2500/`. In a robustness check, we restrict the distance to 30 kilometers.

[8] See Appendix for a detailed proof.

[9] An overview of federal state regulations is available under `http://www.biva.de/gesetze/laender-heimgesetze/`, accessed on February 3, 2017.

4.3.2 A Model of Health Services Utilization

We analyze the regional variation in the use of inpatient care based on a modified Andersen-Newman model of medical care utilization (Andersen and Newman, 2005). This model distinguishes between a) individual, b) health services system, and c) societal determinants of utilization. Individual determinants include three broad groups of personal characteristics: i) illness, ii) predisposing, and iii) enabling factors. Illness is measured in terms of disability, symptoms, and diagnoses. Predisposing variables capture the propensity to use the health services regardless of one's health status, and typically include age, gender, marital status, support from children or any other relatives, employment, and education. For example, older age is not a reason *per se* to seek medical treatment, but health needs and patterns of medical care use differ according to age (Andersen and Newman, 2005). Education and employment may reflect individual beliefs related to the use of health services, such as awareness of preventive care. Enabling variables describe the accessibility of health services and include health insurance coverage, income, prices, travel, and waiting times. Health services system determinants refer to resources and organization of health care delivery. This category comprises personnel, equipment and materials employed, geographic distribution of the resources, and procedures used once the patient is admitted into the system. Finally, societal determinants include the technology available to physicians and behavioral norms related to utilization.

We adapt the Andersen-Newman model to the long-term care market and include the extent of caregiving needs as a measure of illness (McAuley et al., 2009). Our proxy for caregiving needs is a share of the care recipients in a county in care levels 2 and 3 (the latter of whom also includes hardship cases), who are disproportionately represented in the German nursing homes (Schulz, 2012).[10] We account for the share of the oldest old (aged 85+) among care recipients, who are shown to use the nursing home services more frequently than their younger peers (Pickard, 2012; Schulz, 2012; Laferrère et al., 2013). Our proxies for the existence of informal support include shares of female care recipients, men and women in the active workforce, and population in the age group 50–65. A higher share of women among care recipients could be indicative of less informal support. Women are widowed more often than men, which deprives them of the key source of informal care, and increases the probability of nursing home entry.[11] The effect of employment on the type of

[10] See Table A3.2 for the exact definition of care levels.

[11] Women have a higher life expectancy and are therefore widowed more often than men. For example, the remaining life expectancy of 60-year old women in Germany in the period 2011–2013

care chosen could be ambiguous. Employment does reduce the capacity to provide informal care; yet, flexible work arrangements (part-time, mini-jobs) can help reconcile work and care duties (Haberkern and Szydlik, 2010; Alders et al., 2015). The propensity of daughters to provide informal care is generally higher than that of sons (Freedman, 1996; Wolf et al., 1997; Van Houtven and Norton, 2004; Charles and Sevak, 2005). We expect that a higher share of women in the active workforce is associated with a higher use of inpatient care, while the effect of men's participation is not clear *a priori*. For example, women could partly substitute work by caregiving, while their spouses compensate for the earnings foregone by working more.[12] Finally, we employ the variable share of population aged between 50 and 65, since the majority of caregiving relatives (children and their spouses) are expected to be at this age.[13]

Our enabling variables include the average price for inpatient care, income, rurality, and measures of supply of long-term care services. Assuming that nursing home care is a normal good, the demand for it is affected negatively by higher prices, and positively by income. Nursing homes are relatively expensive, costing on average €1448.7 per month (Table 4.1). Thus, higher income could lead to their greater use. In this vein, Bakx et al. (2015) report that being in the bottom income quartiles in Germany decreases the probability of using any formal long-term care. Similarly, Augurzky et al. (2013) and Eibich and Ziebarth (2014) find that higher income boosts the use of hospital and ambulatory services. Next, we employ rurality as a proxy for travel times, since the distance influences the choice of facility (Kenney and Dubay, 1992; McAuley et al., 2009; Augurzky et al., 2013). Our data shows that nursing home services in Germany are used more intensively in urban areas (Figure 4.1).

Supply of long-term care services is expressed as a ratio of nursing home places and ambulatory facilities to care-dependent population in a catchment area. We choose this particular spatial unit because a choice set of care recipients might include nursing homes beyond one's county of residence. For example, in the highly urbanized state of North Rhine-Westphalia, care recipients may consider nursing

was 25.3, and that of men 21.7 years. *Source*: INKAR Database of the Federal Office for Building and Regional Planning (BBR), accessed on February 6, 2017.

[12] 15.8% of women in the active workforce in the period 2007–2011 were part-time employed, while the corresponding share of men was only 2.7%. *Source*: INKAR Database of the Federal Office for Building and Regional Planning (BBR), accessed on February 11, 2017.

[13] Augurzky et al. (2013) and a study by the Robert Koch Institut (2014) suggest that most informal caregivers are between 55 and 69 years of age. Since our dataset does not provide information on this particular age group, 50–65 is used as an approximation.

homes not only in their home county, but in the whole conglomerate, because they are almost all within equally easy reach (Kopetsch and Schmitz, 2014). Similar to the spatial contiguity weight matrix defined above, our catchment area comprises all immediately neighboring counties and counties whose centroids are at a distance of less than 60 kilometers from the centroids of the county of interest. The long-term care literature reports a positive association between utilization and supply (Kenney and Dubay, 1992; McAuley et al., 2009; Haberkern and Szydlik, 2010; Alders et al., 2015). This may be due to shorter travel and waiting times, or may be the effect of stronger competition and lower prices (Forder and Allan, 2014; Herr and Hottenrott, 2016). Furthermore, inpatient and outpatient care services could be partly substitutable. Unadjusted German data indicate that the use of inpatient care is higher in areas with more nursing home places (Figure A4.2), and lower where the outpatient care is more intensively used (Figure A4.3). Since our data is aggregated at a county level, supply measures are also used as proxies for the health service system factors. Societal determinants of utilization are generally not observed by an econometrician (McAuley et al., 2009). Hence, we assume that the spatial autocorrelations and federal state dummies capture the regional differences in technology and behavioral norms. Detailed variable descriptions are provided in section 4.

4.3.3 Estimation and Identification

Our estimation approach follows Cutler and Shiner (1999), Augurzky et al. (2013) and Kopetsch and Schmitz (2014), and allows us to net out the variation which is due to systematic differences between the counties. We successively add groups of explanatory variables to the regression and infer their explanatory power from the changes in goodness-of-fit measures. Our preferred order of inclusion reflects the relevance of each group for the decision to enter a nursing home. We start off with caregiving needs and subsequently include predisposing and enabling variables. Finally, we add federal state and time dummies to account for any unobservable state- and time-specific effect. Since the explanatory power of individual variable blocks varies, based on their order of inclusion, we evaluate it by specifying alternative sequences (see Table A4.6 in the Appendix).

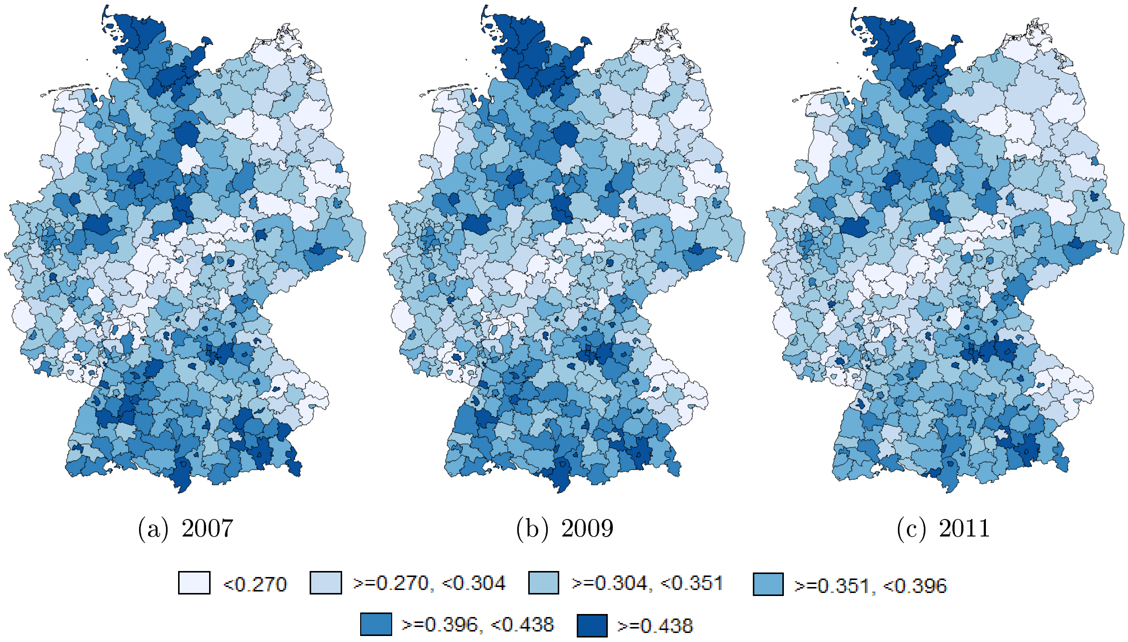
To account for a possible endogeneity problem, we instrument for the price of nursing home care using the gross hourly wage of public service employers and average land price. Land price should be positively related to the cost of building and operating a nursing home, as more popular areas are generally more expensive and more attractive (Herr and Hottenrott, 2016). Wages are one of the major cost items of nursing home providers (Mennicken et al., 2014). Both variables are strongly correlated with the prices (Table A4.4), but should have no direct effect on the choice of long-term care form. The identification condition is, therefore, likely fulfilled. Proxies for the availability of informal support and supply measures are also endogenous. For example, the decision as to whether to provide informal care to parents or to use the nursing home services are made simultaneously (Van Houtven and Norton, 2004). Furthermore, nursing homes are more likely to be built in areas where the propensity to use them is higher, which induces reverse causality. Unfortunately, we do not have convincing instruments in this case. Our coefficient estimates should therefore be interpreted not as causal effects, but as correlations. This, however, does not invalidate our approach, as our primary interest is to net out the observed variation.

4.4 Dataset and Descriptive Statistics

Our dataset includes the long-term care statistics and data on wages and income provided by the Statistical Offices of the German federal states, and regional data from the INKAR database of the Federal Office for Building and Regional Planning (BBR). The data was used on-site at the Research Data Centre Duesseldorf. The long-term care statistics include individual data on all care recipients entitled to public or private long-term care insurance allowances. Furthermore, we observe all German nursing homes, and ambulatory facilities. The remaining data are provided at county or federal state level. As we are primarily interested in regional variation and not in individual determinants of nursing home entry, we aggregate the long-term statistics at county level. Our dataset spans the years 2007, 2009 and 2011. Summary statistics are presented in Table 4.1.

We observe a range of regional heterogeneities in the use of inpatient care (Figure 4.1). On average, 35.6% elderly care recipients received full-time care in nursing homes. Regionally, this share varied between 17.5% and 61.5%. There is a negative, although not unambiguous relationship, between the use of inpatient and outpatient care, which hints at weak substitutability. The use of inpatient care is highly correlated with the supply of nursing home places (Figure A4.2). Moran-I coefficient rejects the null hypothesis of zero spatial autocorrelation in the levels of utilization

Figure 4.1: Shares of care recipients in nursing homes, 2007–2011, county level



(a) 2007 (b) 2009 (c) 2011

Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2011, own calculations.

of inpatient care between different counties.[14] Figures A4.4 and A4.5 illustrate the direction of spatial autocorrelation.

Our variables are defined as follows. The dependent variable measures the share of elderly (aged 65+) care recipients in a county using full-time inpatient care. As proxies for the level of caregiving needs, we use the shares of care-dependent population in care levels 2 and 3. In a robustness check, we replace these proxies with the weighted average care-dependency level in a county:

$$care\_level\_mean = share\_level1 + 2 \cdot share\_level2 + 3 \cdot share\_level3,$$

where *share_level1*, *share_level2* and *share_level3* denote the shares of care recipients (%) in the respective care levels. Predisposing variables include shares of the oldest old (aged 85+) and women among care recipients, labor force participation of men and women, and share of population in the age group 50–65 at county level.

[14] Moran-I coefficient is calculated as $I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij}(X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2}$, where N is the number of spatial units, w_{ij} is an element of spatial contiguity weight matrix, X is the vector of observations on the variable of interest, and $\bar{X}$ the mean of X (Anselin, 1995). The value $I = 0.274$ ($p = 0.001$) suggests that null hypothesis of zero spatial autocorrelation can be rejected.

In a robustness check, we replace the last variable with the age group 35–65. Labor force participation is defined as the share of men (or women) between 15 and 65 years of age in the active workforce.[15] The price variable is defined as the average price for nursing home services. Prices for individual nursing homes are calculated as weighted averages across the care levels. The weights employed are:

$$w_i = \frac{LTCI_i}{\sum_{i=1}^{3} LTCI_i},$$

where $LTCI_i$ denotes the maximum monthly allowance paid by the public long-term care insurance funds for the care level i.[16] Rurality is measured as the share of the county's population in municipalities with a population density of less than 150 residents per square kilometer. GDP per capita is used as a proxy for income and is expressed in euros. Our supply measures are calculated as ratios of nursing home places and ambulatory facilities to care-dependent population in a catchment area. Finally, land price refers to an average price for land for construction per square meter. Both this and the variable gross hourly wage are expressed in euros.

4.5 Results

Our main estimation results are presented in Table 4.2. We include blocks of explanatory variables following the sequence described in section 3.2. The explanatory power of each block is measured by the change in the adjusted R^2 coefficient, which expresses the proportion of explained variation in the dependent variable (Wooldridge, 2008). Standard errors are robust to heteroskedasticity and are clustered at a county level. We find that the proxies for caregiving needs have a low explanatory power, capturing only 1% of the variation. Including predisposing variables raises this proportion to 46%. Enabling factors excluding the supply add relatively little to the explanatory power of our model, increasing R^2 to 47.4%. With measures of supply, the explained proportion increases to 55%. Finally, a model with federal state and time dummies leads to the adjusted R^2 of 62.4%. Figure A4.6 illustrates the relationship between the observed and the predicted values of the use of nursing home care from the last specification.

[15] Unfortunately, we do not observe the actual working arrangements (full-time, part-time, mini jobs) or the registered job seekers.

[16] Our dataset does not provide price information for hardship and dementia cases. We therefore include only prices for care levels 1–3 and the corresponding LTCI allowances.

Table 4.1: Summary statistics

Variable	mean	s.d.	min	p50	max
Dependent variable					
Care recipients in nursing homes, share	0.356	0.071	0.175	0.355	0.625
Caregiving needs					
Care recipients, share					
in care level 2	0.343	0.021	0.277	0.342	0.413
in care level 3	0.120	0.026	0.053	0.118	0.230
Care-dependency, weighted average level	0.810	0.031	0.721	0.809	0.946
Predisposing					
Care recipients, share					
aged 85+	0.425	0.043	0.291	0.428	0.567
female	0.704	0.016	0.657	0.704	0.762
Labor force participation, share*					
female	0.747	0.039	0.565	0.748	0.839
male	0.827	0.043	0.605	0.832	0.919
Total population, share					
age group 50–65	0.199	0.018	0.152	0.196	0.264
age group 35–65	0.485	0.015	0.441	0.485	0.537
Enabling					
GDP per capita [000 EUR]	28.166	11.351	13.3	25.15	107.6
Rurality**	0.297	0.301	0.0	0.229	1.0
Weighted average price, inpatient care [EUR]***	1448.7	337.9	576.4	1470.4	2353.6
Care level 1	1245.4	296.1	415.4	1294.7	2054.7
Care level 2	1393.8	341.0	462.1	1425.4	2291.9
Care level 3	1638.8	380.1	785.6	1638.2	2603.2
Supply					
Catchment area, ratios					
Nursing home places-to-care recipients	0.393	0.055	0.254	0.391	0.586
Ambulatory facilities-to-care recipients	0.006	0.001	0.004	0.006	0.01
Instruments					
Land price [EUR/m^2]	126.6	118.3	4.8	89.2	1135.9
Gross hourly wage, public service providers [EUR]	24.8	2.2	18.6	25.3	29.0

We report descriptive statistics for all German elderly care-dependent individuals (aged 65+) entitled to public and private long-term care insurance allowances, and counties for the years 2007, 2009 and 2011. Averages are expressed at county level. *Labor force participation is a share of males/females in the age group 15–65 in the active workforce. **Rurality is defined as a share of county's population living in municipalities with population density lower than 150 residents per km^2. ***Price for inpatient care refers to a price negotiated for each nursing home net of the long-term care allowance. It is expressed as a weighted average of prices for different care levels. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2011, own calculations; INKAR database of the Federal Office for Building and Regional Planning (BBR).

As an alternative measure of goodness-of-fit, we split the counties into quintiles based on shares of care recipients in nursing homes, and calculate the ratio of mean observed-to-mean predicted values in each quintile (Göpffarth et al., 2016). The results are presented in Figure 4.2. The unadjusted ratio is by 55% higher in the uppermost than in the lowermost quantile. After adjusting for all explanatory variables and dummies, this difference drops to 18%. The adjusted ratios for each quintile converge with the inclusion of additional blocks of explanatory variables. Furthermore, the relative ranking of quintiles from the unadjusted case remains unchanged in all further specifications.

We can reject the null hypothesis of zero spatial autocorrelation in residuals from the last specification (Moran-I = 0.067, p = 0.000). Thus, we account for spatial dependencies in utilization and spatial correlation of shocks by estimating our working equation (4.4).[17] Controlling for other factors, both proxies for the extent of caregiving needs are insignificant. This is a surprising result, considering that several studies find that the decision to enter a nursing home is largely driven by this factor. Yet, our proxies capture only a daily amount of required care, without providing information about the actual types of impairments. Some of them may be more strongly associated with the use of inpatient care than others. For example, cognitive disabilities, dementia, and malignant tumors are found to be consistent predictors of nursing home entry (Luppa et al., 2010; Laferrère et al., 2013; Schulz, 2012). Informally caring for people with these types of disorders may be more difficult than for those with physical impairments, irrespective of their care-dependency level.

Concerning the predisposing variables, we find that higher share of female care recipients is not associated with significantly higher use of inpatient care. On the other hand, there is a positive and statistically significant relationship with share of the oldest old (aged 85+). Controlling for other factors, inpatient care is used more intensively in counties with a higher female labor participation and more population in the age group 50–65. The relationship with male labor force participation is negative. The most likely explanation for this result is that higher male employment enables women to take on more flexible work arrangements and combine them with the caregiving. Furthermore, we find that the use of inpatient care is lower in more rural counties, which indicates a negative impact of travel times on the propensity to enter a nursing home. As expected, the association with income is positive, and with price, negative.

[17]The goodness-of-fit measure from this specification is pseudo-R^2, which is not comparable to the adjusted R^2. Therefore, we use the adjusted R^2 from specification (5) as our main goodness-of-fit measure.

Table 4.2: Estimation results

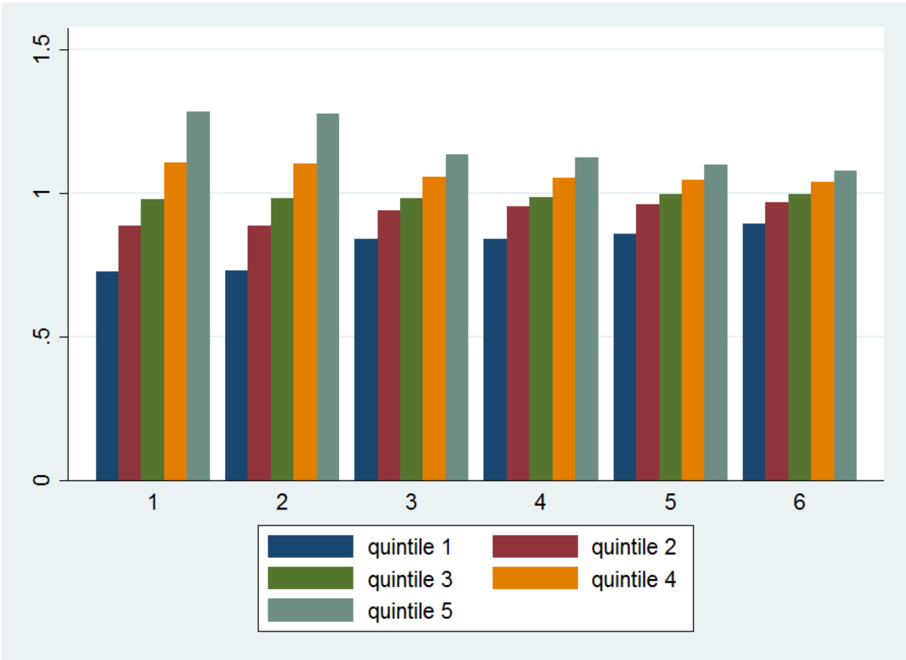
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Caregiving needs						
share_level2	-0.176	-0.380***	-0.318***	-0.156	-0.060	-0.021
	(0.132)	(0.115)	(0.112)	(0.108)	(0.111)	(0.082)
share_level3	0.239*	-0.090	-0.089	-0.030	0.062	0.051
	(0.146)	(0.095)	(0.098)	(0.084)	(0.104)	(0.076)
Predisposing						
age85		0.915***	0.991***	0.739***	0.999***	1.057***
		(0.060)	(0.069)	(0.071)	(0.096)	(0.061)
female		0.494***	0.078	0.107	0.122	0.103
		(0.138)	(0.162)	(0.148)	(0.157)	(0.117)
labor_f		0.431***	0.179	0.149	0.200*	0.225***
		(0.082)	(0.119)	(0.117)	(0.113)	(0.078)
labor_m		-0.150**	-0.034	-0.179**	-0.132*	-0.173***
		(0.063)	(0.073)	(0.072)	(0.076)	(0.054)
pop50_65		-1.136***	-1.204***	-0.629***	-0.452**	-0.627***
		(0.156)	(0.152)	(0.150)	(0.225)	(0.160)
Enabling						
gdp			0.286	0.648**	0.849***	0.982***
			(0.266)	(0.266)	(0.282)	(0.176)
rurality			-0.318***	-0.419***	-0.456***	-0.466***
			(0.086)	(0.077)	(0.074)	(0.058)
price			-0.007***	-0.007***	-0.015**	-0.021***
			(0.001)	(0.002)	(0.007)	(0.003)
nh_places				0.448***	0.258***	0.209***
				(0.050)	(0.060)	(0.043)
amb_facilities				-1.419	-0.195	-0.026
				(2.500)	(2.839)	(1.845)
constant	0.388***	-0.212	0.230	0.109	-0.044	-
	(0.049)	(0.135)	(0.172)	(0.162)	(0.171)	
Spatial coefficients						
λ (dep. variable)						0.007***
						(0.002)
ρ (error term)						0.034***
						(0.010)
Observations	1226	1226	1226	1226	1226	1226
Adjusted R-squared	0.009	0.460	0.474	0.550	0.624	-
Federal state FE	no	no	no	no	yes	yes
Year FE	no	no	no	no	yes	yes
IV (Price)	no	no	yes	yes	yes	yes

Specifications: (1) caregiving needs; (2) + predisposing; (3) + enabling (without supply); (4) + enabling (with supply); (5) federal state and year dummies; (6) spatial dimension. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2011, own calculations; INKAR database of the Federal Office for Building and Regional Planning (BBR).

Other factors remaining constant, the use of inpatient care is significantly higher in counties located in catchment areas with a higher density of nursing home places. The coefficient on the supply of outpatient services is insignificant. Considering that outpatient care is usually combined with informal support by the relatives, its effect might already be captured by the predisposing variables. Federal state and time dummies have a relatively large explanatory power, which implies that care recipients in certain areas have a higher propensity to use the inpatient care. This may be traced back to the influence of culture, better quality of care, and other unobserved state-specific factors, or time effects. Coefficients on spatial dependencies in the utilization and correlation of shocks are small, although highly significant. For comparison, we estimate equation (4.4) without federal state and time dummies. The results are presented in column (1) in Table A4.5. Spatial correlation in error terms is considerably larger in magnitude, while spatial dependencies in utilization are insignificant. Thus, it is likely that the estimated spatial coefficients pick up some of the unobserved regional characteristics. Without further controls, we cannot make a precise statement on the degree of spatial dependencies in the use of inpatient care, but they are likely minor.

In order to test for the robustness of our results, we introduce three alternative specifications. In the first one, we replace the shares of care recipients in levels 2 and 3 by the average care-dependency level in a county. Second, we replace the share of population in the age group 50–65 with the age group 35–65. This allows us to consider a broader group of potential informal caregivers. Finally, the third specification is identical to the baseline, but with the catchment area restricted to counties whose centroids lie at most 30 kilometers away from the county of interest. Our baseline results remain unchanged in each specification. The explanatory power of individual variable blocks may also change depending on their order of inclusion. To test for this, we try a range of alternative sequences (Table A4.6). Although the respective explanatory powers change, our main findings are confirmed. Explanatory power of predisposing variables is in the interval 13.4–45.1%. Enabling variables explain 1.4–13.6% of the variation, while supply variables capture 6.4–27.2%. Thus, on average, predisposing variables explain the highest proportion of the variation, followed by the density of nursing home places.

Figure 4.2: Mean observed-to-mean predicted values of the county-level shares of care recipients in nursing homes



We divide the counties in quintiles based on the unadjusted shares of care recipients in nursing homes. Specifications: 1. unadjusted; 2. adjusted for need; 3. + predisposing; 4. + enabling (without supply); 5. + enabling (with supply); 6. + federal state and time dummies. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2011, own calculations.

4.6 Conclusion

There is a clear regional variation in the use of inpatient long-term care in Germany. We analyze the county-level differences using data on the care-dependent population, the supply of long-term care services, and sociodemographic characteristics. Age and the presence of an informal network of support are found to explain by far the most variation. The supply of nursing home places also plays an important, albeit lesser role, while income, price, and rurality explain a relatively small part. The supply of outpatient services is insignificant. Without observing more detailed health characteristics, and in particular without distinguishing between physical and cognitive impairments, we cannot make any clear statement on the role of caregiving needs.

The hypothesis of no spatial autocorrelation in the use of inpatient care is rejected. However, estimates from a model with and without spatial dimensions are similar, while spatial coefficients are rather low in magnitude. Thus, spatial dependencies do not seem to play a major role in the long-term care market. Our model achieves a relatively good measure of fit, with an adjusted R^2 of 62.4%. Unexplained variation could possibly be attributed to unobserved determinants of nursing home entry, such as cultural differences, individual health characteristics, different types of working arrangements, family structure, and population flows.

Our results have important policy implications. In particular, the negative association between the use of inpatient care and the existence of informal support implies that the role of informal caregiving is critical. In light of the growing care-dependent population, and a high need for capital and a qualified workforce, informal caregivers need to be adequately supported and compensated for their efforts. In this respect, a recent regulatory change (Pflegestärkungsgesetze) aims to help reconcile work and care duties. A positive relationship between the density of nursing home places and the use of inpatient care suggests that subsidizing the expansion of nursing home places in low-supply areas may be necessary to secure an adequate care for the population in need.

Yet, more support for informal caregivers and a better supply of nursing home places in some areas are unlikely to solve the problems of care provision alone. Future challenges must be addressed through innovative long-term care concepts. Nursing home entries take place for various reasons, including a lack of adequate caregiving in domestic surroundings, inability to do household chores, and a lack of social contacts. Long-term care arrangements targeting each of these dimensions separately could be a promising future course. Abandoning the strict distinction between inpatient and outpatient care, as well as the concept of a nursing home as a "last resort", could help better organize the provision and meet individual preferences. For example, more household support and an emphasis on the social dimension of care could keep people in their domestic surroundings for longer. Assisted living facilities could facilitate the transition from one's residence to nursing home and offer a more personalized care. Long-term care arrangements incorporating all these dimensions would be beneficial not only for consumers, but could also help counter the rising costs and secure an adequate care provision in the future.

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Appendix

A Digression on the Inconsistency of the OLS Estimator

Consider our equations (4.1) and (4.2) from section 4.3.1:

$$\mathbf{y} = \lambda\mathbf{W}\mathbf{y} + \mathbf{X_x}\beta + \mathbf{X_n}\gamma + \mathbf{u}$$

$$\mathbf{u} = \rho\mathbf{W}\mathbf{u} + \epsilon.$$

The expression for the error term can be rearranged as follows:

$$\mathbf{u} = (\mathbf{I} - \rho\mathbf{W})^{-\mathbf{1}}\epsilon.$$

Spatial correlation among the errors is by definition non-zero:

$$\mathbf{\Omega_u} = \mathbf{E}[\mathbf{u}\mathbf{u}'] = \sigma^{\mathbf{2}}(\mathbf{I} - \rho\mathbf{W})^{-\mathbf{1}}(\mathbf{I} - \rho\mathbf{W}')^{-\mathbf{1}}.$$

The initial system of equations can be rearranged to obtain a reduced form model:

$$\mathbf{y} = (\mathbf{I} - \lambda\mathbf{W})^{-\mathbf{1}}(\mathbf{X_x}\beta + \mathbf{X_n}\gamma) + (\mathbf{I} - \lambda\mathbf{W})^{-\mathbf{1}}(\mathbf{I} - \rho\mathbf{W})^{-\mathbf{1}}\epsilon.$$

which can be used to show that the term Wy is endogenous:

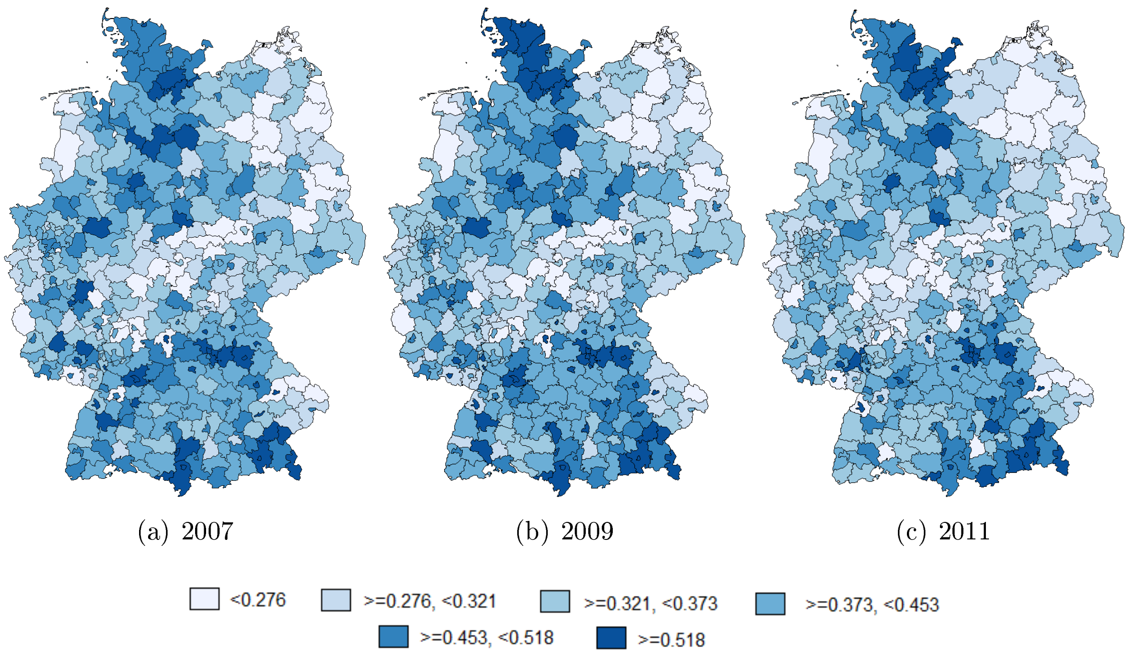
$$\mathbf{E}\Big[\big(\mathbf{W}\mathbf{y}\big)\mathbf{u}'\Big] = \mathbf{E}\Big[\mathbf{W}\big(\mathbf{I} - \lambda\mathbf{W}\big)^{-\mathbf{1}}\big[\mathbf{X_x}\beta + \mathbf{X_n}\gamma + \big(\mathbf{I} - \rho\mathbf{W}\big)^{-\mathbf{1}}\epsilon\big]\big(\mathbf{I} - \rho\mathbf{W}'\big)^{-\mathbf{1}}\epsilon\Big]$$

$$= \mathbf{E}\Big[\mathbf{W}\big(\mathbf{I} - \lambda\mathbf{W}\big)^{-\mathbf{1}}\big(\mathbf{I} - \rho\mathbf{W}\big)^{-\mathbf{1}}\epsilon\big(\mathbf{I} - \rho\mathbf{W}'\big)^{-\mathbf{1}}\epsilon\Big]$$

$$= \mathbf{W}\big(\mathbf{I} - \lambda\mathbf{W}\big)^{-\mathbf{1}}\sigma^{\mathbf{2}}\big(\mathbf{I} - \rho\mathbf{W}\big)^{-\mathbf{1}}\big(\mathbf{I} - \rho\mathbf{W}'\big)^{-\mathbf{1}}$$

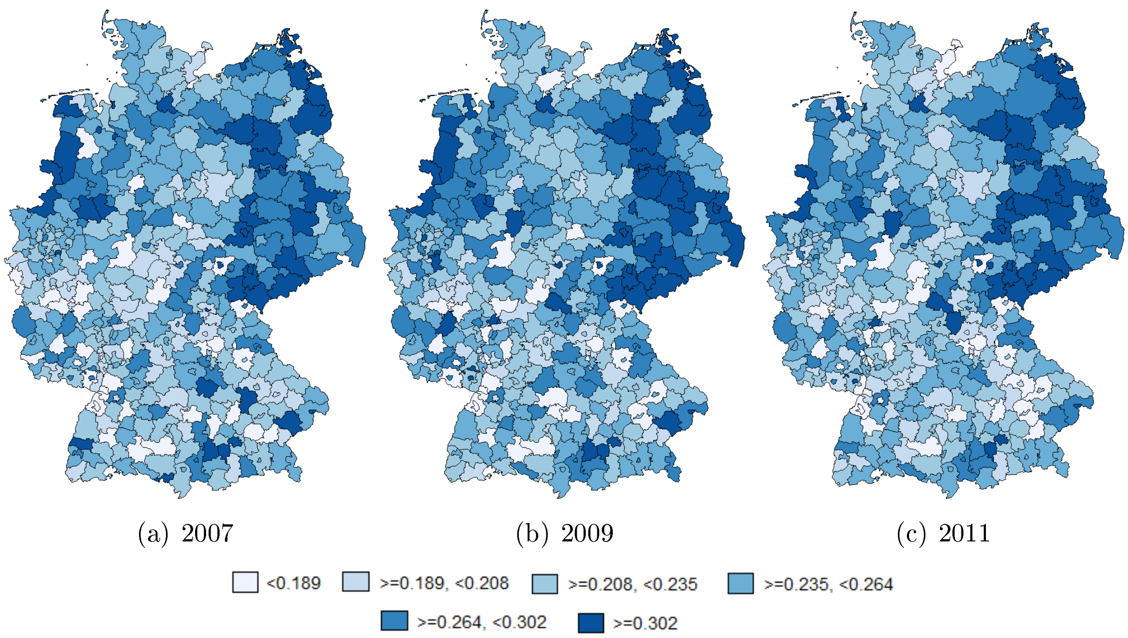
$$= \mathbf{W}\big(\mathbf{I} - \lambda\mathbf{W}\big)^{-\mathbf{1}}\mathbf{\Omega_u} \neq \mathbf{0}.$$

Figure A4.2: Ratio nursing home places-to-care-dependent population, 2007–2011, county level



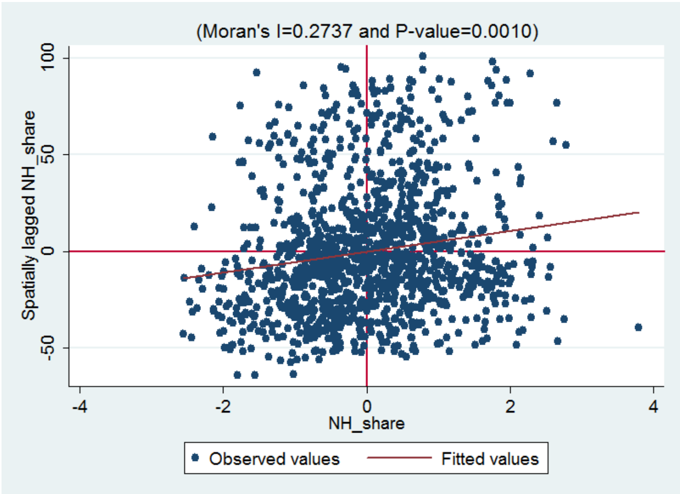
Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2011, own calculations.

Figure A4.3: Shares of care recipients in outpatient care, 2007–2011, county level



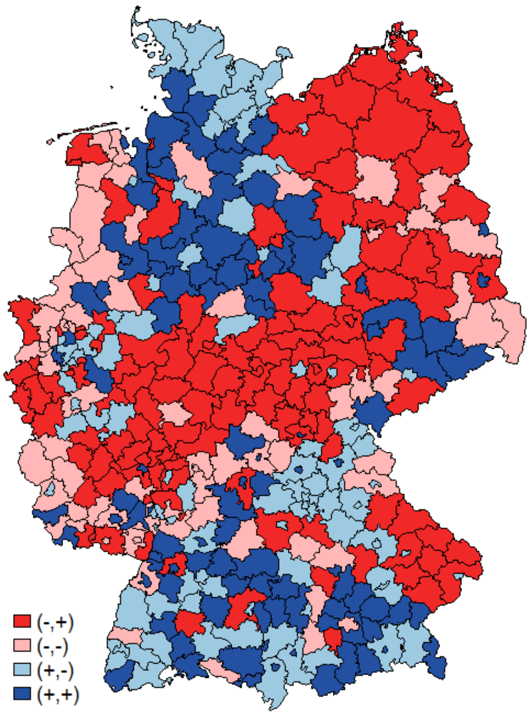
Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2011, own calculations.

Figure A4.4: Moran scatter plot



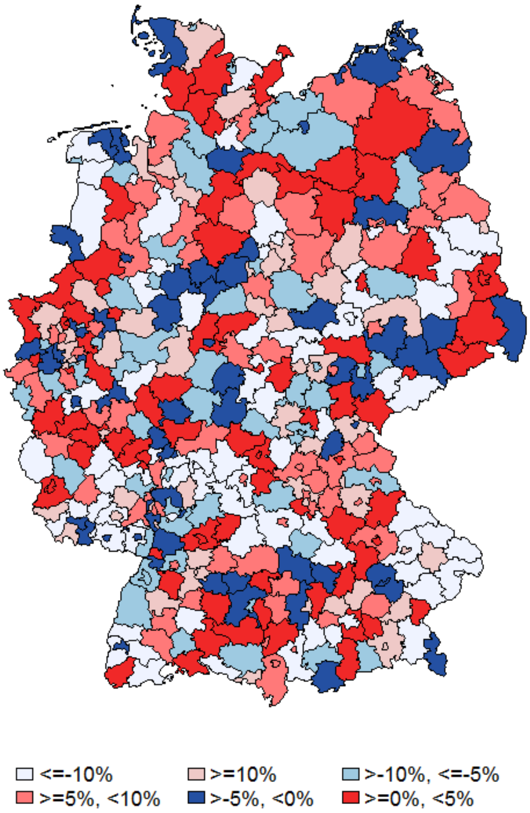
Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2011, own calculations.

Figure A4.5: Shares of care recipients in inpatient care and spatial dependence



We present the average shares of care recipients in nursing homes for the years 2007–2011 in a county as above or below national average and the sign of its spatial dependence. (-,+) utilization below mean, positive spatial dependence; (-,-) utilization below mean, negative spatial dependence; (+,-) utilization above mean, negative spatial dependence; (+,+) utilization above mean, positive spatial dependence. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2011, own calculations.

Figure A4.6: Deviation of predicted from observed values (%), county level



We present the deviation of the actual shares of care recipients in nursing homes from the shares predicted by the specification including federal state and time dummies (specification (5) in Table 4.2). The deviation is expressed as a percentage of the observed value. Values predicted by the specification including the spatial dimension (specification (6) in Table 4.2) are almost identical and are available upon request. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik 2007–2011, own calculations.

Table A4.2: Long-term care insurance funds' allowances

	2007	2008	2010	2012	2013	2015	2017
Informal care only*							
Care level 0	–	–	–	–	120	123	316
Care level I	205	215	225	235	235	244	316
Care level II	410	420	430	440	440	458	545
Care level III	665	675	685	700	700	728	728
with dementia*							
Care level I	–	–	–	–	305	316	545
Care level II	–	–	–	–	525	545	728
Care level III	–	–	–	–	700	728	901
Outpatient care**							
Care level 0	–	–	–	–	225	231	689
Care level I	384	420	440	450	450	468	689
Care level II	921	980	1040	1100	1100	1144	1298
Care level III	1432	1470	1510	1550	1550	1612	1612
Hardship case	1918	1918	1918	1918	1918	1995	1995
**with dementia							
Care level I	–	–	–	–	665	689	1289
Care level II	–	–	–	–	1250	1298	1612
Care level III	–	–	–	–	1550	1612	1995
Hardship case	–	–	–	–	1918	1995	1995
Inpatient care***							
Care level 0	–	–	–	–	–	–	770
Care level I	1023	1023	1023	1023	1023	1064	770
Care level II	1279	1279	1279	1279	1279	1330	1262
Care level III	1432	1470	1510	1550	1550	1612	1775
Hardship case	1688	1750	1825	1918	1918	1995	2005
***with dementia							
Care level I	–	–	–	–	1023	1064	1262
Care level II	–	–	–	–	1279	1330	1775
Care level III	–	–	–	–	1550	1612	2005
Hardship case	–	–	–	–	1918	1995	2005

We present the maximum monthly allowances (€) paid by the German public long-term care insurance funds for home care, outpatient, and inpatient care. Depending on their contributions, care recipients with private insurance are entitled to higher allowances. *Source*: `http://pflegestaerkungsgesetz.de`, accessed on February 1, 2017.

Table A4.3: Variable labels

Variable	Label
Dependent variable	
Care recipients in nursing homes, share	*NH_share*
Caregiving needs	
Care recipients, share	
in care level 2	*share_level2*
in care level 3	*share_level3*
Care-dependency, weighted average	*care_level_mean*
Predisposing	
Care recipients, share	
aged 85+	*age85*
female	*female*
Labor force participation, share	
female	*labor_f*
male	*labor_m*
Total population, share	
age group 50–65	*pop50_65*
age group 35–65	*pop35_65*
Enabling	
GDP per capita [000 EUR]	*gdp*
Rurality	*rurality*
Weighted average price, inpatient care [EUR]	*price*
Supply	
Catchment area, ratios	
Nursing home places-to-care recipients	*nh_places*
Ambulatory facilities-to-care recipients	*amb_facilities*
Instruments	
Land price [EUR/m^2]	*land_price*
Gross hourly wage, public service providers [EUR]	*wage*

Table A4.4: Cross-correlation table

Variable	*NH_share*	*share_level2*	*share_level3*	*care_level_mean*	*age85*	*female*	*labor_f*	*labor_m*
NH_share	1.000							
share_level2	-0.059*	1.000						
share_level3	0.091*	-0.076*	1.000					
care_level_mean	0.068*	0.267*	0.941*	1.000				
age85	0.623*	-0.066*	0.126*	0.099*	1.000			
female	0.174*	0.153*	-0.067*	-0.013	0.040	1.000		
labor_f	-0.087*	0.182*	-0.016	0.047	-0.173*	-0.097*	1.000	
labor_m	-0.123*	0.085*	0.164*	0.188*	-0.103*	-0.235*	0.502*	1.000
pop50_65	-0.360*	-0.127*	-0.251*	-0.285*	-0.318*	-0.191*	0.513*	0.171*
pop35_65	-0.358*	-0.002	-0.061*	-0.060*	-0.346*	-0.079*	0.364*	0.065*
gdp	0.339*	-0.165*	0.134*	0.074*	0.426*	0.061*	-0.326*	-0.155*
rurality	-0.281*	0.120*	0.121*	0.157*	-0.280*	-0.199*	0.366*	0.157*
price	0.132*	-0.126*	0.062*	0.017	0.385*	-0.195*	-0.546*	-0.032
land_price	0.265*	-0.104*	0.049	0.013	0.463*	0.078*	-0.364*	-0.244*
wage	0.119*	-0.325*	0.209*	0.092*	0.461*	-0.438*	-0.356*	0.145*
nh_places	0.524*	-0.041	0.142*	0.123*	0.436*	-0.027	-0.025	1.842*
amb_facilities	0.054	0.023	-0.054	-0.045	-0.075*	0.196*	0.375*	-0.065*

Variable	*pop50_65*	*pop35_65*	*gdp*	*rurality*	*price*	*land_price*	*wage*	*nh_places*	*amb_facilities*
pop50_65	1.000								
pop35_65	0.573*	1.000							
gdp	-0.387*	-0.252*	1.000						
rurality	0.306*	0.272*	-0.395*	1.000					
price	-0.429*	-0.243*	0.378*	-0.389*	1.000				
land_price	-0.412*	0.112	0.578*	-0.416*	0.523*	1.000			
wage	-0.141*	-0.188*	0.318*	-0.213*	0.749*	0.354*	1.000		
nh_places	-0.353*	-0.232*	0.090*	-0.020	0.206*	0.162*	0.221*	1.000	
amb_facilities	0.148*	-0.159*	-0.159*	0.183*	-0.496*	-0.060*	-0.453*	-0.043	1.000

*Significant at 5% level or higher.

Table A4.5: Robustness checks

Variable	**(1)**	**(2)**	**(3)**	**(4)**
share_level2	0.044		0.001	-0.024
	(0.075)		(0.082)	(0.084)
share_level3	0.240***		0.082	0.039
	(0.069)		(0.076)	(0.081)
care_level_mean		0.031		
		(0.061)		
age85	0.976***	1.062***	1.027***	1.074***
	(0.052)	(0.061)	(0.061)	(0.065)
female	0.157	0.102	0.085	0.155
	(0.112)	(0.118)	(0.117)	(0.120)
labor_f	0.250***	0.222***	0.222***	0.222***
	(0.082)	(0.079)	(0.077)	(0.081)
labor_m	-0.084	-0.174	-0.223***	-0163***
	(0.052)	(0.054)	(0.055)	(0.056)
pop50_65	-0.722***	-0.638***		-0.707***
	(0.130)	(0.161)		(0.160)
pop35_65			-0.415***	
			(0.110)	
gdp	0.645***	0.999***	1.097***	1.020***
	(0.145)	(0.176)	(0.180)	(0.177)
rurality	-0.344***	-0.471***	-0.467***	-0.466***
	(0.058)	(0.058)	(0.058)	(0.060)
price	-0.004***	-0.021***	-0.019***	-0.024***
	(0.001)	(0.003)	(0.003)	(0.003)
nh_places	-0.022	0.206***	0.232***	0.133***
	(0.043)	(0.043)	(0.042)	(0.036)
amb_facilities	1.236	-0.074	-0.437	1.324
	(2.041)	(1.842)	(1.819)	(1.706)
constant	-0.124	0.081	-	0.137
	(0.109)			
λ (dep. variable)	0.003	0.007***	0.009***	0.007***
	(0.003)	(0.002)	(0.002)	(0.002)
ρ (error term)	0.105***	0.035***	0.034***	0.027***
	(0.005)	(0.010)	(0.011)	(0.011)
Observations	1226	1226	1226	1226
Adjusted R-squared	-	-	-	
Federal state FE	no	yes	yes	yes
Year FE	no	yes	yes	yes
IV (Price)	yes	yes	yes	yes

Robustness checks: (1) federal state and year dummies excluded, (2) caregiving needs calculated as weighted average care-dependency level in a county, (3) *pop50_65* replaced with *pop35_65*, (4) catchment area restricted to counties which share a border or whose centroids lie a maximum 30 kilometers away. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2011, own calculations; INKAR database of the Federal Office for Building and Regional Planning (BBR).

Table A4.6: Reduction of the variation, baseline vs alternative ordering

	R^2	Δ
Baseline specification		
Need	0.009	–
+ Predisposing	0.460	0.451
+ Enabling (no supply)	0.474	0.014
+ Enabling (incl. supply)	0.550	0.076
Basic model		
Need	0.009	–
Alternative ordering 1		
+ Enabling (no supply)	0.144	0.135
+ Enabling (incl. supply)	0.416	0.272
+ Predisposing	0.550	0.134
Alternative ordering 2		
+ Enabling (only supply)	0.280	0.271
+ Enabling (rest)	0.416	0.136
+ Predisposing	0.550	0.134
Alternative ordering 3		
+ Enabling (no supply)	0.144	0.135
+ Predisposing	0.474	0.330
+ Enabling (incl. supply)	0.550	0.076
Alternative ordering 4		
+ Predisposing	0.460	0.451
+ Enabling (only supply)	0.524	0.064
+ Enabling (rest)	0.550	0.026
Alternative ordering 5		
+ Enabling (only supply)	0.280	0.271
+ Predisposing	0.524	0.244
+ Enabling (rest)	0.550	0.026

We report changes in adjusted R^2 from the inclusion of blocks of explanatory variables in different sequences.
Source: FDZ der Statistischen Ämter des Bundes und der Länder, Pflegestatistik, 2007–2011, own calculations.

Chapter 5

General Conclusion

In this dissertation, I explore consumer choices, interaction between consumers and firms, and regulatory issues in the markets for telecommunications and long-term care.

The first essay investigates the substitution between fixed, mobile and voice over IP (VoIP) telephony services. We use a sample of 20 EU countries for the 2008–2011 period, and apply dynamic panel data techniques to estimate the own- and the cross-price elasticities. Our results suggest a strong access substitution between fixed-lines and mobiles, and provide indicative evidence of the substitution between fixed-lines and VoIP. Market power of fixed incumbent carriers is therefore likely constrained. At the EU level, we find evidence in favor of joint market definition and, therefore, of discontinuing the regulation. However, due to different competitive environments across the member states, this issue must be addressed by the national regulators. Targeted access obligations might be one of the solutions to protect the captive group of users without stifling the competition.

In the second essay, we evaluate the aggregate welfare effects of a single room policy in German nursing homes. This regulatory measure is designed to enhance the life quality of nursing home residents, but raises important issues about capacities and financial position of providers. We a) estimate a structural model of demand for inpatient long-term care; b) estimate a model of bargaining between providers and payers; c) quantify the welfare effects of a single room policy under different implementation scenarios based on capacity changes. We use a panel dataset of all German nursing homes providing full-time care for elderly (aged 65+) between 2007 and 2009, and apply an instrumental variable approach. Our results indicate that the aggregate welfare effects are positive only if the overall nursing home capacities do not decline. Due to the costs of facility restructuring, a more promising policy course could be to stimulate investment in new facilities, which would be obliged to provide exclusively single rooms.

In the third essay, I examine the regional variation in the demand for nursing home care among elderly care recipients (aged 65+) in Germany. Large differences in the shares of county's care-dependent population in nursing homes could reflect problems in access or insufficient informal support in some areas. I investigate this issue using a comprehensive dataset on the entire German care-dependent population, supply of long-term care facilities, and structural characteristics of the counties for 2007, 2009 and 2011. Methodologically, I apply spatial autoregressive methods to account for demand spillovers. The main explanatory factors of regional differences are the care recipients' age, informal support, and supply of nursing home places. Regional spillovers do not play a significant role. In light of the growing care-dependent population and a high need for capital and workforce, our results indicate that informal caregiving needs to be stimulated further. The expansion of nursing home places in low-supply areas may be necessary to secure an adequate care for the population in need.

To conclude, my dissertation provides an in-depth analysis of consumer choices and the interaction between consumers and firms in the markets for telecommunications and long-term care. The results underscore a range of issues relevant for the creation of efficient regulation.

Eidesstattliche Versicherung

Ich versichere an Eides statt, dass die vorliegende Dissertation von mir selbstständig und ohne unzulässige fremde Hilfe unter Beachtung der „Grundsätze zur Sicherung guter wissenschaftlicher Praxis an der Heinrich–Heine–Universität Düsseldorf" erstellt worden ist. Die Arbeit wurde bisher in gleicher oder ähnlicher Form keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht.

Düsseldorf, im März 2017

Amela Saric-Babin