Competition and quality in German ambulatory long-term care: Where labour supply matters more than prices

Annika Herr[1,2,3*] Olena Izhak[3†] Maximilian Lückemann[1,2‡]

[1] Institute of Health Economics (IHE), Leibniz Universität Hannover

[2] CINCH, Universit´at Duisburg-Essen

[3]D´usseldorf Institute for Competition Economics (DICE), Heinrich-Heine-Universit´at

June 1, 2022

Preliminary. Please do not cite.

Abstract

This paper analyses the effect of competition on the quality of ambulatory long-term care (LTC) services in Germany, which supported 24 percent of the 4.1 million care dependent people in 2019 (21 percent received stationary care, 55 percent informal care). Ambulatory care is politically and individually preferred over stationary care and there are low barriers to entry, while there is little evidence on the effects of competition in this market. In this study, We challenge the theoretical prediction that competition increases quality when prices are regulated. This adds to previous research on UK nursing homes that identified price competition as the relevant mechanism. We use four waves of publicly available quality data of 14,000 ambulatory care units in Germany, reported between 2011 and 2019. To examine causal effects, we apply an instrumental variable approach and look at different quality and competition measures. We show that quality decreases in competition despite the fact that ambulatory care prices are regulated. That is why we examine a new mechanism in a second step and show that nursing staff shortage is correlated with competition and lower quality in German ambulatory LTC. Introducing competition should therefore be accompanied by respective support for more qualified nursing personnel to circumvent adverse quality effects.

JEL Classification: C90, I10, I11

Keywords: long-term care, competition, quality, prices, nursing staff

*Email: annika.herr@ihe.uni-hannover.de; Address: Leibniz Universität Hannover, Institute of Health Economics (IHE),Otto-Brenner-Straße 7, 30159 Hannover, Germany

†Email: izhak@dice.hhu.de; Address: Universit´at D´usseldorf, D´usseldorf Institute for Competition Economics (DICE), Universit´atsstrasse 1, 40225 D´usseldorf, Germany

‡Email: maximilian.lueckemann@ihe.uni-hannover.de; Address: Leibniz Universität Hannover, Institute of Health Economics (IHE),Otto-Brenner-Straße 7, 30159 Hannover, Germany

1 Introduction

Ambulatory long-term care (LTC) aims at supporting a self-determined life for elderly people by providing medical care and support for basic daily life at home. Demographic trends towards an ageing population result in a growing interest in ambulatory LTC. In Germany, outpatient long-term care is also crucial to satisfy the overall demand for LTC (Blümel et al. 2021). Therefore, Germany promotes the supply of care services by keeping market entry barriers low (Schürmann 2016). A market-opening clause (§72 SGB XI) forces long-term care insurances to offer supplier contracts to all market entrants who fulfill minimum staffing requirements (Schürmann 2016). However, only a high-quality ambulatory LTC provision can significantly delay transition to stationary nursing home care, increase patient satisfaction and finally reduce the long-run costs for complex care treatment (Pick and Brüggemann 2016). Since one side-effect of German regulation is promoting competition through low entry barriers and long-term care insurance, it is relevant to understand the effect of competition on the quality of ambulatory LTC.

Simple micro-economic models of market competition and quality predict higher quality in more competitive areas when prices are regulated and when they are above marginal costs (Bardey and Siciliani 2021; Gaynor and Town 2011; Brekke, Siciliani, and Straume 2010; Brekke, Nuscheler, and Straume 2007; Karlsson 2007; Beitia 2003; Nuscheler 2003; Gravelle and Masiero 2000). On the other hand, theoretical models expect mixed results in unregulated markets. Here, competition may also reduce both prices and quality depending on consumer preferences (Spence 1975; Kranton 2003; Allard, Léger, and Rochaix 2009).

While theory provides unambiguous expectations of the real world if prices are regulated, the empirical literature indicates mixed results for the related hospital sector. Gaynor and Town (2011) conclude in a review of the empirical evidence: If prices are regulated, services will compete on non-price dimensions to attract consumers in order to gain market shares, for instance by offering higher quality.

Prominent literature considers the American Medicare programme and the British NHS. For Medicare (fixed hospital prices), Shen (2003), Tay (2003), and Kessler

and McClellan (2000) find that competition leads to an increase in quality, while Gowrisankaran and Town (2003), Volpp et al. (2003), and Mukamel and Spector (2002) present a negative or no significant effect. Moreover, Kessler and Geppert (2005) find mixed evidence, depending on the respective quality outcome. In the NHS, hospital prices are fixed. Brekke et al. (2021), Moscelli et al. (2018), Bloom et al. (2015), Gaynor, Moreno-Serra, and Propper (2013), and Cooper et al. (2011) present quality improvements due to more competition. Moscelli et al. (2018) examine a competition promoting reform in the NHS and confirm quality improving effects (emergency quality indicators). However, applying other quality indicators, (non-emergency quality indicators) Moscelli, Gravelle, and Siciliani (2021) present quality decreases, which highlights the importance of being able to choose specific quality indicators.

While the economic literature has addressed quality effects extensively in the related hospital setting, LTC research concerning competition is scarce. Zinn (1994) finds first evidence of a negative relationship between market concentration and quality indicators in the LTC market. Forder and Allan (2014) examine the British nursing home sector with prices set by providers. They show that competition decreases quality due to increased price pressure, using an instrumental variable approach with regional instruments in a cross-sectional setting. Jung and Polsky (2014) are the first to analyse the effect of competition on the quality of ambulatory care services in the United States. Results reveal a nonlinear relation that differs in the quality indicators and the degree of competition.

In this paper, we examine the German ambulatory LTC market. We can characterise this market by the quality disclosures, secret price negotiations between the mostly small services and the insurance funds, and low barriers to market entry. Because ambulatory LTC services deliver care in the homes of people in need of care instead of providing care in own facilities, the fixed costs of entering the market are limited, which makes providers more flexible (Jung and Polsky 2014). This market structure hampers a transfer of results from other countries or the stationary setting to German outpatient LTC.

With this research, we contribute to the literature in several ways. First, we are the

first to analyse ambulatory LTC competition in Germany. This paper is also the first to use the German ambulatory care quality report cards. Second, our results contradict the theoretical prediction that competition will increases the quality in price-regulated health care markets. Third, we point out the relevance of sufficient qualified nursing staff, which has not been part of theoretical and empirical approaches so far.

In our analyses, we exploit variation in the market structure of outpatient care services. Since quality and market concentration are likely to be endogenously related, we apply an instrumental variable approach, instrumenting the ambulatory LTC competition by the regional stationary LTC market concentration. Care dependents are free to choose a service, however, long travel time is inefficient for the providers. Thus, we apply a 10-kilometre radius around the ambulatory care service to investigate the market concentration.

We conduct repeated pooled cross-sectional analyses using a unique set of quality report cards published between 2011 and 2019. To measure LTC quality, we construct indices based on selected relevant indicators.

Our results reveal, counter-intuitively, that competition decreases ambulatory LTC quality. Since we do not find any significant correlations between prices and competition, we suggest a (qualified) nursing shortage as a channel for the quality deteriorating effect. To pursue this hypothesis, we use data from the German employment agency (IAB) and find an increase in job offers and vacancies in more competitive areas. The shortage of qualified nursing personnel in turn is associated with low quality. We conclude that the nursing shortage reverses the quality increasing effects of competition in a regulated price setting.

2 Background

The Medical Review Board of German Statutory Health Insurance (MRB) classifies people in need of care into five levels of care dependency (§15 SGB XI).[1] Level one

1. The MRB is a non-profit organisation providing socio-medical specialist advice to the German Statutory Health and Nursing Care Insurances.

implies minor physical and cognitive constraints, while level five points to severe cognitive and physical limitations. German statutory LTC insurance contributes a lump-sum premium according to the degree of care for professional care services or primary cash benefits for informal care while care recipients pay the remaining costs as a private contribution (§4 SGB XI).

Ambulatory LTC services negotiate prices with the insurance funds. Due to price negotiations, providers cannot set their own prices, nor may they offer services in addition to the agreed ones (Heiber 2019). Prices are negotiated between the LTC insurance and the provider based on §89 SGB XI. The negotiated prices shall allow for economically managing the service, e.g. prices are higher when the pay for nursing personnel is based on union tariffs or employing higher qualified staff. However, these regulations do not allow for price adjustments with respect to market concentration. LTC insurance would not agree to prices that are decoupled from remuneration tariffs or average costs. Therefore, we consider the ambulatory LTC prices as regulated.

To shed light on the provided LTC quality, the MRB regularly inspects the quality of nursing homes and ambulatory LTC services. The latter are evaluated based on 46 criteria, aggregated into four broad categories: nursing services, medical services, organisation and customer satisfaction. These categories measure the outcome quality of care, the quality of medically indicated procedures, the corresponding quality of organisational and contractual arrangements as well as the quality based on a customer survey, respectively (Hasseler and Wolf-Ostermann 2010). The MRB assesses ambulatory care services based on audits and surveying of the care recipients. Therefore, monitoring personnel select and interview up to nine patients regarding each service to ensure the inspection criteria are being met (Sünderkamp, Weiß, and Rothgang 2014).

Insurance companies publish summarised results of the MRB inspections and price information online on public comparison engines (AOK's www.pflege-navigator.de or BKK's https://pflegefinder.bkk-dachverband.de/). The primary purpose of these engines is to enhance the transparency of the care market and to help seniors and their relatives make better choices of care providers. The report cards also provide

all reported quality criteria. We provide an example of an English translation of the quality report cards and the 46 quality criteria in Appendix A.

3 Theoretical considerations

We assume ambulatory LTC services produce a single differentiated good: the provision of care services, with higher quality being strictly preferred (Tirole, Jean, and Bonin 1988). As explained above, we consider the negotiated prices as regulated for ambulatory LTC in Germany.

Our theoretical considerations are inspired by Gaynor and Town (2011) and Brekke et al. (2021). We describe the demand for service i as a function of market share (s_i) and market demand (D):

$$q_i = s_i(z_i, \mathbf{z_{-i}})D(\overline{p_i}, z_i, \mathbf{z_{-i}}) \tag{1}$$

Firm i's quantity (q_i) is increasing in its quality (z_i) and decreasing in the competitors' quality ($\mathbf{z_{-i}}$). Market demand (D) decreases in regulated prices ($\overline{p}$), and increases in quality. All firms use the same resources and have the same input prices. Thus, firms face the same cost function:

$$c_i = c(q_i, z_i) + F \tag{2}$$

consisting of variable costs and a fixed cost component. The variable costs depend on the number of treatments (q_i) and the level of quality (z_i). Following §72 SGB XI, there is free entry and exit as long as the minimum quality standards are met. All firms earn zero profits in equilibrium. Assuming Nash behaviour and profit maximisation, the equilibrium profit equation is:

$$\pi_i = \overline{p} \cdot q_i - c_i = 0 \tag{3}$$

Maximising profits with respect to quality results in the following first derivative:

$$\frac{\partial \pi_i}{\partial z_i} = [\overline{p_i} - \frac{\partial c_i}{\partial q_i}]\{\frac{\partial s_i}{\partial z_i} D(\cdot) + s_i \frac{\partial D(\cdot)}{\partial z_i}\} - \frac{\partial c_i}{\partial z_i} = 0 \tag{4}$$

Gaynor and Town rearrange equation (4) by extending the expression to obtain elasticities and implicitly explain quality. Now, quality increases in price, the quality elasticity of market share η_z^s and demand η_z^D. On the other hand, quality is decreasing in the marginal costs of quantity (c_q) and quality (c_z):

$$z_i = \frac{(\overline{p_i} - c_q)[\eta_z^s + \eta_z^D](s_i \cdot D)}{c_z} \tag{5}$$

Originally, demand elasticity for quality increases with the number of alternatives in a market. Following this, an increase in firms is accompanied by an increase in equilibrium quality (Gaynor and Town 2011). However, Brekke et al. (2021) state: "If competition has an effect on cost [...], it always goes in the same direction as the effect of quality."

The costs for quality are predominantly determined by the share of qualified nursing personnel who provide a quality level between the minimum requirements ($\underline{z}$) and a maximum quality ($\overline{z}$: perfect mix of professionals and assistants). We assume that the staff is differentiated in their qualification and motivation, i.e. the services can pick personnel from a distribution and prefer higher qualified staff to lower qualified staff since prices are related to actual personnel costs.

$$c_z = c_z(z, \theta) \qquad , where\, \underline{z} \leq z \leq \overline{z} \tag{6}$$

However, Germany is dealing with a serious nursing personnel shortage. Due to this shortage, firms compete not only for patients, but also for a limited pool of qualified nursing personnel to maintain a high level of LTC quality. Transferring Gaynor and Town into the German LTC market, we highlight that costs for retaining or recruiting skilled personnel play an important role, especially in low concentration and contested markets. Costs for skilled personnel increase disproportionately in quantities, while price adjustments are inertial. In Equation (6), θ describes the in-

tensity of competition that increases costs for skilled personnel ($\partial c_z/\partial\theta) > 0$). Thus, marginal costs for quality in highly competitive markets are higher, which results in a lower quality in equilibrium (see Equation (5)). Another quality decreasing side-effect follows if assistant nurses or unskilled staff serve as a substitute for the lack of skilled nursing personnel. In contrast to Gaynor and Town (2011), we focus on a situation of limited resources. Thus, when discussing the mechanisms, we test whether the lack of skilled nursing personnel reverses the original quality enhancing competition effect. We postulate that quality decreases in competition if there is a lack of qualified staff.

4 Estimation strategy

We estimate a multivariate linear model with repeated cross-sections and regional and time fixed effects. This model has been widely used to estimate the effects of hospital competition (Gaynor and Town 2011) and is also part of the Jung and Polsky (2014) study, which is related to our framework.

Equation (7) presents our empirical model for service i in year t, where disclosed quality z_{it} varies between 0 and 100.

$$z_{it} = \beta_0 + \beta_1 CI_{irt} + \beta_2 \mathbf{DS}_{ct} + \beta_3 \mathbf{CS}_{it} + \gamma \overline{p}^{nh}_{mt} + F_f + T_t + \varepsilon_{it} \tag{7}$$

We use three different market concentration indicators CI_{irt} at a 10-kilometre radius r around the location of the ambulatory care service. We also apply other radii, such as 20 kilometres, or use the municipality borders to examine competition of different market sizes as robustness checks. However, we expect a radius larger than 10 kilometres to be unlikely after discussions with ambulatory care providers. Nurses would have to spend too much time travelling, which is inefficient and unprofitable for a provider.

We also include a vector of regional socio-economic characteristics to approximate demand characteristics at the county level (DS_{ct}). Basically, we sort the regional characteristics into five categories: age-specific factors, wealth, settlement structure,

supply of and demand for medical infrastructure. We provide further details about the controls in Appendix A.3. Additionally, we include provider size quartiles with respect to the number of care dependent people being treated by the service, which allows us to control for different cost structures (CS_{it}). We face many missing values regarding ambulatory care prices in our data, except for the 2019 wave. While earlier studies omit price information in their model (Gaynor and Town 2011), we use the municipality's average nursing homes' out-of-pocket contribution per month as a proxy for the regulated regional price level ($\bar{p}^{nh}_{mt}$). Nursing home price regulation deviates from the ambulatory care regulation. However, the stationary care prices correlate with the ambulatory care price level in a region. We also add federal state (F_f) and time (T_t) fixed effects to control for state policies and audit wave-specific properties. We cluster standard errors at month and location of the quality-assessing MRB ($federal\,state \cdot assessment\,month \cdot year$).

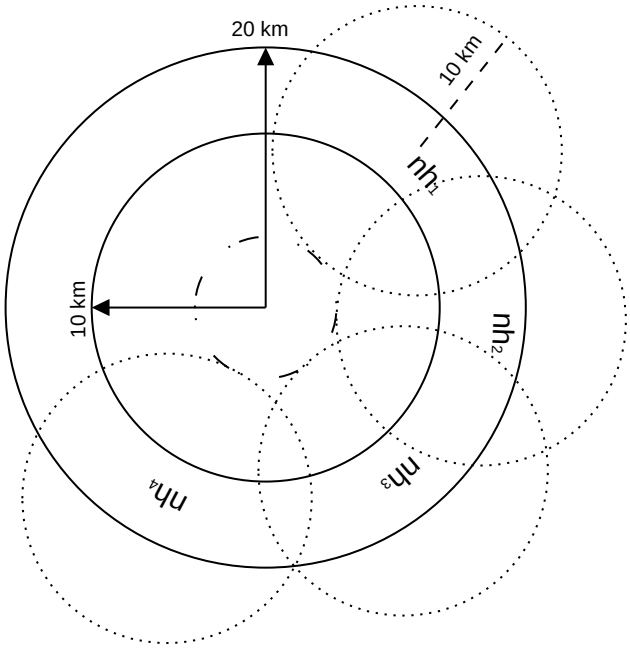
We expect the market structure to be endogenous to quality, e.g. due to reverse causality or omitted variable bias (Yang, Yong, and Scott 2021) and therefore to bias the competition variable's point estimates in Equation (7). We assume that the source of endogeneity is driven by the demand side. Options and preferences for informal care by relatives or friends are unobservable and depend on cultural background, income, family structures, flexible work arrangements or the opportunity cost of providing informal care (Plöthner et al. 2019). Although we control for some of these factors, there is still variation left to bias our results.

Ambulatory care providers and informal care arrangements are substitutes for care dependants with moderate care needs (Care level 1–3). We expect ambulatory care concentration to increase with a higher supply of informal care. Furthermore, we postulate higher quality in more concentrated markets for two reasons. First, lower demand relaxes the time pressure for nursing staff and allow more time per service provided. Second, in regions with a high motivation for informal care, for example, due to cultural background, we expect nurses and also nursing assistants to be more used to LTC and thus to be more experienced than in other regions. Furthermore, relatives may set and request higher standards. We therefore expect our OLS results

to be underestimated and downward biased.

To eliminate the endogeneity in this relation, we instrument the ambulatory LTC market concentration with the respective average 10 km competition indicator of nursing homes that are located 15 to 20 km around the ambulatory care unit. Figure 1 illustrates the idea. The nursing home competition is exogenous to the ambulatory and informal care demand since the stationary and the outpatient LTC sector serve different consumer groups. The literature indicates that the elderly prefer to receive LTC at home for as long as they can (Karsch-Völk et al. 2012; Plöthner et al. 2019). This is in line with the regulatory suggestion:"ambulatory care preferred to stationary care" (§3 SGB XI), since ambulatory care is less resource-intensive than stationary care. Moreover, once transferred to stationary LTC, people are unlikely to recover and return to ambulatory care.

Figure 1: Competition instrument: graphical explanation



Another endogeneity concern could lie in the poaching of nursing staff and substitution of ambulatory and stationary care workers. To minimise this factor, our instrument includes nursing homes that are located at least 15 km away from the service. This is driven by the idea, that care workers (often with part-time jobs) are unlikely to respond to job offers outside their catchment area.

We expect ambulatory and stationary market concentration to be positively correlated (no substitutes). Regions that are attractive to ambulatory LTC are also favoured by stationary care providers. This is triggered by regional conditions such as population density or income levels. Regional policies in favour of LTC could also stimulate this positive correlation.

Equations (8) and (9) provide our two-stage least squares model, including the instrumented competition measure.

First stage:

$$CI_{rt}^{amb} = \alpha_0 + \gamma_1 CI_{rt}^{stat} + \alpha_1 \mathbf{DS}_{ct} + \alpha_2 \mathbf{CS}_{it} + \alpha_3 \overline{p}_{mt}^{nh} + F_f + T_t + v_{it} \tag{8}$$

Second stage:

$$Z_{it} = \beta_0 + \beta_1 \widehat{CI_{rt}^{amb}} + \gamma_1 \mathbf{DS}_{ct} + \gamma_2 \mathbf{CS}_{it} + \gamma_3 \overline{p}_{mt}^{nh} + F_f + T_t + u_{it} \tag{9}$$

We will formulate our model in terms of concentration instead of competition since the applied competition measures decrease in competition and increase in concentration, which makes interpretations easier. The ambulatory care market is characterised by many small firms (low concentration). Potential providers observe price levels and demand to decide on the entry and size of their services. Adjustments for general price increases are captured by time fixed effects. All providers then decide on quantities, which define the market concentration. As a last step, they decide on the quality given the competition.

5 Data

We include two data sets in our analyses. The MRB quality report cards provide individual information for all ambulatory and stationary LTC providers. Data from "Indicators and Maps of Regional and Urban Development" (BBR[2]) comprise socio-economic and demographic indicators at municipality and county levels.

Our facility data covers four waves, corresponding to the biannual rhythm of the

2. German: "Indikatoren und Karten zur Raum- und Stadtentwicklung."

German care statistic in 2011, 2013, 2015 and 2019. The transparency reports contain detailed quality information, the number of customers on the day of inspection and prices for stationary care (for ambulatory care in wave 2019 only). Since our data provides information about nearly every LTC service in Germany, we are able to derive market concentration estimates based on the number of customers within a specific radius, for both stationary and ambulatory LTC.

5.1 Quality measures

Besides aggregated quality categories (compare Appendix A), the quality reports provide detailed information on 46 different indicators of ambulatory LTC. Following Hasseler and Wolf-Ostermann (2010), the report cards' indicators need to be treated carefully since not all of them provide valid information on the actual quality. This is why we choose a subsample of relevant questions identified in interviews with nursing practitioners. We distinguish between criteria regarding the patients' documented nursing care (commonly published as"completely fulfilled with n out of N persons in need of care") and yes-no questions referring to a facility's organisational structure.

We allocate the indicators from the MRB report to three categories and call them nursing quality, medical quality, and organisational quality.

The nursing quality indicator captures the quality provided by nurses following the protocol and fulfilling the contractual agreements. For medical quality, we investigate the share of care recipients for whom the medication provided by the ambulatory care provider corresponds to the doctor's prescription.

Questions regarding organisational quality provide information about responsibilities and training sessions for the nursing team, which is associated with smooth processes and higher qualifications. We construct a broad and a narrow organisational quality index, where the latter focuses on the distribution of responsibilities within the nursing service. In Appendix A.2, we list the corresponding single quality questions. As provided in Equation (10), for each criterion, we assign the value of 100 if it is met for all inspected residents and zero otherwise following Herr, Nguyen, and Schmitz (2016). Subsequently, we construct our indices (Z_i) as averages over all

the respectively selected criteria (z_i) and obtain values from zero to one hundred.

$$Z_i = \frac{1}{n} \sum_{i=1}^{N} z_i \quad i = 1, \ldots, n \tag{10}$$

5.2 Market concentration measures

Competing ambulatory LTC services are located within a fixed regional market area (§72 SGB XI). To quantify the intensity of competition, we use three indicators. Besides the inverse number of services ($1/N$) located in the relevant area (10 km or 20 km radius or municipality), we apply two indicators including market shares: the two-firm concentration ratio (CR(2)) and the Herfindahl-Hirschman Index (HHI) (Cheung and Shen 2017).

The Herfindahl-Hirschman index is defined as the sum of the squared market shares of all suppliers within a defined market and takes values between close to zero and one hundred percent ($HHI_{rt} = \sum_{i=1}^{N} s_{it}^2$), where s_{it} is the market share of an ambulatory care service i, i.e. the proportion of all ambulatory care recipients within radius r served by the service i. A value of one hundred corresponds to a monopoly market (Hirschman 1980). These competition measures are widely applied in the hospital competition research (Gaynor and Town 2011). Among others, Jung and Polsky (2014) and Forder and Allan (2014) made use of this index in the context of LTC.

The two-firm concentration ratio $CR(2)$ is given by the sum of market shares of the two largest players in the ambulatory care market. A value tending towards 0 indicates a low concentrated market density since the number of companies in the market tends toward infinity while the respective market shares are negligibly small. If the top two services supply the whole market the value is equal to one hundred percent (Perloff, Karp, and Golan 2007). The CR(2) formula is given as $CR(2)_{rt} = \sum_{i=1}^{2} s_{it}$. To ease interpretation, we formulate the results section in terms of concentration (negative competition).

Table 1: Descriptive Statistics

Variable	2011		2013		2015		2019		2011-2019			
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	min	max
Quality indicators												
Nursing care quality	65.27	29.06	73.05	27.16	78.84	25.64	80.23	27.88	74.41	28.11	0	100
Medication as prescribed	69.64	45.98	74.85	43.39	78.59	41.02	80.75	39.43	75.95	42.74	0	100
Nursing and housekeeping organiz. quality	96.49	15.77	98.03	11.36	98.46	10.26	100	0	98.29	10.93	0	100
Broad organizational quality	93.42	13.47	95.39	10.73	94.25	11.54	97.39	8.018	95.18	11.14	0	100
Competition measures												
Ambulatory facility size	85.3	65.84	89.08	65.66	93.02	68.81	110.2	85.87	94.07	72.88	4	501
10 km radius												
Herfindahl Index (HHI)	13.53	13.76	13.46	13.55	13.71	13.72	12.53	13.07	13.28	13.52	.7546	97.24
Concentration ratio (CR(2))	34.85	23.91	34.66	23.76	35.04	23.73	32.93	23.12	34.33	23.63	4.424	100
No. amb. facilities	32.64	35.06	31.73	34.71	29.64	32.51	37.34	43.26	32.98	36.95	2	231
20 km radius												
Herfindahl Index (HHI)	4.355	4.354	4.266	4.246	4.303	4.178	3.864	3.789	4.187	4.143	.3826	58.93
Concentration ratio (CR(2))	15.93	11.77	15.73	11.3	15.78	11.16	14.58	10.55	15.48	11.2	2.184	89.81
No. amb. facilities	88.81	83.28	87.91	83.17	80.33	72.9	101.9	100.4	90.13	86.4	3	458
Municipality level												
Herfindahl Index (HHI)	35.27	32.03	35.65	32.13	36.02	32.1	33.7	31.3	35.12	31.88	1.086	100
Concentration ratio (CR(2))	59.33	33.38	59.71	33.37	60.26	33.15	57.92	33	59.26	33.23	5.881	100
No. amb. facilities	19.26	30.26	18.39	29.96	17.84	29.13	21.41	35.86	19.29	31.59	1	185
Instruments												
Stationary competition 10 km radius												
Herfindahl Index (HHI)	15.2	12.59	14.45	11.73	14.5	11.72	15.15	12.55	14.84	12.17	1.754	92.97
Concentration ratio (CR(2))	35.09	20.21	33.76	19.79	33.94	19.85	34.53	20.37	34.34	20.07	5.78	100
No. stat. facilities	18.95	14.62	19.83	15.33	19.92	15.84	19.47	15.88	19.54	15.44	1.25	73.77
Stationary competition municipality level												
Herfindahl Index (HHI)	37.15	34.1	37.25	34.25	37.44	34.19	37.01	34.04	37.21	34.14	1.441	100
Concentration ratio (CR(2))	95.28	12.46	95.07	12.74	94.69	13.43	95.14	12.83	95.05	12.87	43.69	100
No. stat. facilities	12.67	17.76	12.82	17.97	13.16	18.78	12.94	18.26	12.9	18.19	1	83
Observations	9549		9646		9269		10612		39076			

Sources: Transparency Reports (facility-level) and indicators and maps of regional and urban development (BBR). 39,076 observations (amb. ltc facilities): [four waves] 2011 (9,549 obs.), 2013 (9,646 obs.), 2015 (9,269 obs.), 2019 (10,612 obs.). Quality indicators: nursing care quality (indic. 1, 10, 11, 12, 13, 14), medical quality (indic. 19), narrow organisational quality (indic. 17, 26), broad organisational quality (indic. 17, 26, 29, 32, 33) formular: $Z_i = \frac{1}{n}\sum_{i=1}^{N} z_i$. Competition measures: Herfindahl index (sum of squared market shares at 10km, 20km and municipality level) $HHI_{rt} = \sum_{i=1}^{N} s_{it}^2$; concentration-ratio(2) (sum of market shares of the two largest facilities at 10km, 20km and municipality level) $CR(2)_{rt} = \sum_{i=1}^{2} s_{it}$; Inverse number of facilities $1/N$. Instruments: corresponding stationary competition indicators and regional demand shifters: Income tax per inhabitant and population density (both on municipality level).

5.3 Descriptive statistics

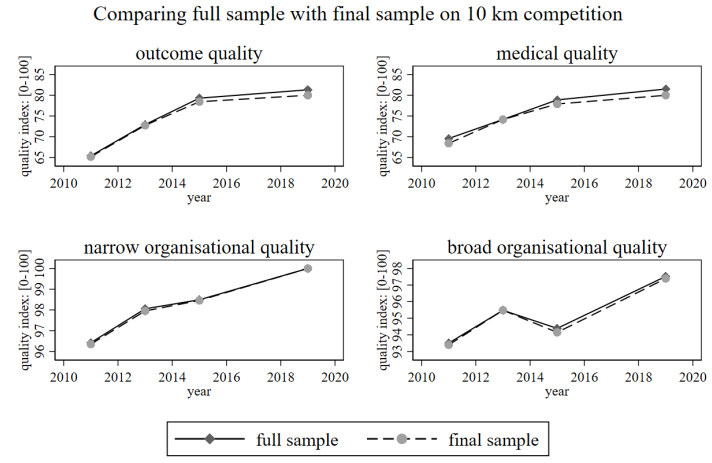
The four transparency-report waves comprise $47,788$ observations in total. For our analyses, we exclude outliers with respect to the density of suppliers. This includes three German cities: Hamburg, Berlin and Munich ($4,214$ obs.) as well as nursing services representing a monopoly (i.e. we observe a single service within a 10 or 20 km radius) in the respective competition area (appr. $3,500$ observations). Furthermore, we lose some observations due to missing information (appr. 500 obs.). Our final sample represents approximately 10,000 outpatient LTC services per wave and results in 39,076 observations in total.

In Table 1, we present our sample summary statistics. On average, services offer fair nursing care quality regarding a mean of 74.41 and a corresponding standard deviation of around 28.11, which is relatively constant over time. The single item

indicator for medical-care quality increases from 70 percent in 2011 to 81 percent in 2019. This means that around 80 percent of the services dispensed the medication as prescribed to all customers who had been inspected for the report by the MRB in 2019. We find close to excellent organisational quality paired with low variation across the sample. Therefore, we focus on nursing and medical quality. However, we apply organisational quality in robustness checks. Figure 2 indicates a quality increase over time. Here, we compare the final sample and the total sample to show that our sample is representative.

In our analyses, we focus on the 10 km radius market definition. The Herfindahl-Hirschman Index for the 10 km radius is 13, on average, with a standard deviation of 13.5, which reveals a moderately concentrated market with high variation across Germany. We also observe a small decrease towards less concentrated markets over time. The same is true for the concentration ratio of the largest two competitors within the market (mean 34, s.d. 24). On average, within a 10-kilometre radius, we observe 33 ambulatory care services. However, this number varies a lot, from 2 to 231 (s.d. 37). The capacity ranges from 4 to 501 people receiving LTC. Below the

Figure 2: Reported quality over time



Source: MRB ltc quality report cards 2011-2019
Observation number full sample: 47,788; final sample: 38,389
Excluded observations: monopoly regions and mega cities: Hamburg, Munich and Berlin

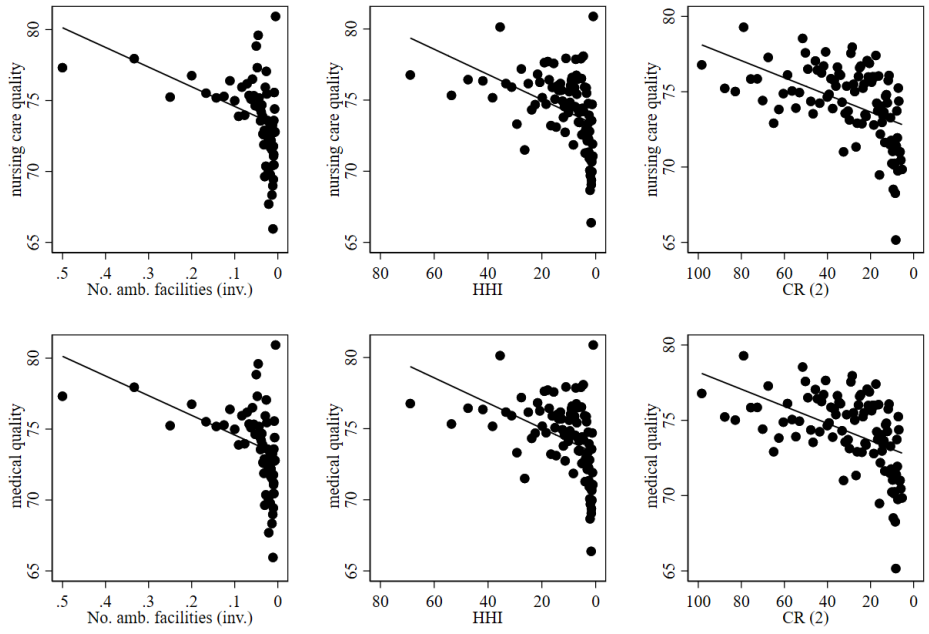
ambulatory competition indicators, we present those for the stationary market in a 10 km radius, which we use as instruments for ambulatory care competition. We find a comparable concentrated market in the stationary sector. The Herfindahl-Hirschman index is 15 (s.d. 12). However, we observe fewer suppliers in the respective

regions (20 stationary versus 33 ambulatory providers). On average, the largest two nursing homes serve 34 percent of the market's demand. Following Ching, Hayashi, and Wang (2015), this structure resembles an oligopoly market with few big players claiming the majority of the market shares. Here, we observe an average of 13 up to 83 nursing homes on the municipality level. Additional information regarding the control variables included in the estimation models is presented in Appendix A.3.

6 Results

Descriptive results in Figure 3 suggest a negative correlation between all three concentration measures and both nursing care quality (upper part) and medical quality (lower part). We estimate the effect of concentration on quality based on our em-

Figure 3: Scatter plot: quality and concentration



Source: MRB ltc quality report cards 2011-2019

pirical model provided in Section 3. The first two columns in Table 2 present the potentially biased ordinary least squares coefficients (OLS) while the latter (IV) presents the instrumental variable estimation results.

In the first line, we see the Herfindahl-Hirschman point estimates, followed by the

concentration ratio and the inverse number of ambulatory care services. The sample size differs slightly across the quality indicators since medical quality indicators are missing for a number of observations. We present more detailed results in Appendix A.4.

Table 2: Nursing and Medical amb. ltc Quality in 2011-19, 10km radius

	Nursing Quality								
	OLS	OLS	IV	OLS	OLS	IV	OLS	OLS	IV
HHI	.0236**	.0071	.3329***						
	(.0116)	(.0145)	(.0588)						
CR (2)				.0189***	.0136	.1988***			
				(.0068)	(.0094)	(.031)			
No. of amb. facilities, inv.							4.12***	1.68	40.33***
							(1.533)	(1.826)	(7.983)
Regional characteristics		×	×		×	×		×	×
Size FE		×	×		×	×		×	×
Wave FE	×	×	×	×	×	×	×	×	×
Federal State FE	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.409	74.409	74.409	74.409	74.409	74.409	74.409	74.409	74.409
first-stage excl. F-statistic			673.687			1463.284			720.857
F-statistic		78.473	78.197		78.314	78.510		78.193	77.932
R2		0.104			0.104			0.104	
N		38890	38890		38890	38890		38890	38890
	Medical Quality								
	OLS	OLS	IV	OLS	OLS	IV	OLS	OLS	IV
HHI	.0793***	.0435**	.1429						
	(.0189)	(.0219)	(.0999)						
CR (2)				0539***	.0352**	.0888*			
				(.0111)	(.0139)	(.052)			
No. of amb. facilities , inv.							11.77***	6.291**	2.221
							(2.57)	(2.968)	(13.55)
Regional characteristics		×	×		×	×		×	×
Size FE		×	×		×	×		×	×
Wave FE	×	×	×	×	×	×	×	×	×
Federal State FE	×	×	×	×	×	×	×	×	×
Mean depend. variable	75.953	75.953	75.953	75.953	75.953	75.953	75.953	75.953	75.953
first-stage excl. F-statisti			604.359			1256.602			605.265
F-statistic		28.274	28.065		28.266	28.157		28.458	28.323
R2		0.058			0.058			0.058	
N		34906	34906		34906	34906		34906	34906

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$; Standard errors clustered on zip-code level in parenthesis.
Sources: Transparency Reports (on facility-level) and indicators and maps of regional and urban development on county level, . Four waves: 2011, 2013, 2015, 2019: in total 39,453 observations. We face missing values for nursing care quality (38,890) and medical quality (34,906). Estimation strategy: $Q_{it} = \beta_0 + \beta_1 \widehat{CI_{rt}} + \beta_2 \mathbf{DS}_{mt} + \beta_3 \mathbf{CS}_{it} + \gamma P_{mt} + F_f + T_t + u_{imt}$ Dependant variable: nursing care quality $\in (0, 1/6, \ldots, 1)$ and medical quality $\in (0, 1)$; Competition variable: inverse number of amb. facilities, municip. $1/N$, HHI amb. care, municip. and CR(2) amb. care, municip. (For this table, we present the inverse of Log(no. of Facilities) $(*(-1))$.) Regional control variables on county level are provided in the Appendix in Table 6. Fixed effects: capacity dummies (class1 [0-40 residents], class2 [41 - 75 residents], class3 [76 - 120 residents], class4 [121 - 400 residents]), wave fixed effects and federal state fixed effects. Instruments: nursing home competition measures on 10km radius level.

Most of our coefficients are highly significant and show the same signs across our models. This also holds for the broad and narrow organisational quality indicators (see Appendix A.4). We expected our OLS results to be downward biased and find our hypotheses supported by the instrumental regression results exceeding the biased OLS point estimates ten-fold. Our instrument appears to be strong, as the first-stage F-statistics of the excluded coefficients are well over 100 (Staiger and

Stock 1997). In the first stage, we see our assumptions confirmed that higher ambulatory competition is associated with higher stationary competition (see Table 10). At the top of Table 2, we present the effect of the HHI on nursing care quality. The point estimate equals 0.33 in column IV. Thus, the market concentration development (HHI decreases by seven percent from 13.53 in 2011 to 12.53 in 2019, see Table 1) implies a quality decrease of 0.33 points, which corresponds to a drop of 0.5 percent of the average nursing care quality. If the HHI decreases by one standard deviation (12.17, on average), quality decreases by $12.17 \cdot .33 = 4$ or 6 percent.

We find similar results for the second competition indicator $CR(2)$. The IV coefficient equals 0.2 and is significant at the 1 percent level. A decline in market share of the largest two players by about 23 percentage points (one s.d.), results in a 4.6-point lower nursing quality.

The last competition measure refers to the inverse number of competitors. Again, we find concentration to increase quality. In the lower panel of Table 2, we report the medical quality results. Medical quality is a binary indicator available for $34,906$ observations, which either is one (fulfilled for everybody) or zero (not fulfilled for at least one inspected person). We estimate a linear probability model. The OLS results show an increase in medical quality (4.3 and 3.5 percentage points for HHI and CR(2), resp.) for a one unit (7 and 3 percent, resp.) increase in concentration. The CR(2) IV point estimate of 0.9 is significant at the 10 percent level and also indicates a quality deteriorating relationship. However, the IV estimates for the HHI and the inverse number of competitors turn out to be less precisely estimated, although they indicate a positive effect and exceed the OLS results (as expected). The effects we find are small, but robust and significant across most competition measures.

6.1 Robustness checks

For our main analyses, we define a 10 km radius as the market size of ambulatory care services. We find a robust quality deteriorating effect across all quality and competition indicators. Since the organisational quality measure provides little

variation, we use these measures preferably as robustness results rather than main results. We also vary the size of the respective competition region. Hence, we determine competition on a 20 km radius and on the municipality level.

We also applied a second demand-side instrument on the municipality level to support the results of our main instrument. Namely, we include regional demand shift proxies, such as population density and average income tax. Here, we follow Forder and Allan (2014) who utilise regional indicators as average house prices, the deprivation score and the percentage of long-term ill on the UK-specific Middle Layer Super Output Area (MSOA-level). We assume that regions with a higher population density attract more care services regardless of the quality level. On average, higher income tax characterises a more wealthy region, capable of paying ambulatory services. These are two factors contributing to lower market concentration. Our regional instruments have no direct connection with the disclosed quality. We argue that population density and income tax are more likely to result from economic growth or attractive infrastructure rather than high ambulatory LTC quality.

Table 3: Overview results of robustness checks

10km radius									
		HHI			**CR (2)**			**Inv. no. amb. fac.**	
Instrument Setting	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Nursing quality	.0071	.3329***	.1934***	.0136	.1988***	.1006***	1.68	40.33***	25.72***
Medical quality	.0435**	.1429	.2996***	.0352**	.0888*	.1577***	6.291**	2.221	39.84***
Narrow organ. quality	.0103*	.0371*	.0514**	.0079**	.0223*	.0272**	1.214*	4.667*	6.835**
Broad organ. quality	.0165***	.1074***	.0514**	.0117***	.0647***	.0272**	2.679***	14.32***	6.835***
20km radius									
		HHI			**CR (2)**			**Inv. no. amb. fac.**	
Instrument Setting	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Nursing quality	.0857**	.4308***	.8342***	.0388**	.1998***	.3067***	11.14*	53.36***	129.3***
Medical quality	.0704	.0861	1.196***	.0527*	.0682	.444***	4.672	-15.74	186.1***
Narrow organ. quality	.0122	.0353	.1914**	.0083	.0188	.0711**	1.75	3.283	29.51**
Broad organ. quality	.0351**	.1218***	.1914**	.0134*	.0601***	.0711**	5.926**	15.16**	29.51**
Municipality level									
		HHI			**CR (2)**			**Inv. no. amb. fac.**	
Instrument Setting	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Nursing quality	.0222*	.082***	.1522***	.0314***	.0576***	.0958***	4.023**	8.781***	17.9***
Medical quality	.018	.0359	.2463***	.0316**	.0316	.1551***	3.887	6.214	28.99***
Narrow organ. quality	8.0e-04	-.0028	.0405**	.0013	4.8e-04	.0253**	.0985	-.2487	4.776**
Broad organ. quality	.0078	.0213**	.0405**	.0087**	.0182***	.0253**	1.78***	2.684**	4.776**

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$; Standard errors clustered on federal state*assessment month level in parenthesis.
Market concentration measures: Herfindahl Hirschman Index (HHI), concentration ratio of the two most powerful firms (CR2) and inverse number of facilities (inv. no. amb. fac.)

The results in Table 3 support our main insights in the third column (IV^{Reg}) or in more detail in the appendices A.4 and A.5 (first-stage estimates). The point estimates for the 20 km radius market are, on average, higher than for the 10 km

radius. The significance and directions remain the same. We find similar results on the municipality level. However, this market definition is the least precise, since we do not include the specific location of the service. In every specification, our instruments meet the relevance criterion.

The vast majority of these models presented in Table 3 illustrate a statistically significant negative relationship between quality and competition.

7 Exploring the channels of competition

In this section, we take a closer look at two prominent indicators which may influence the quality through the market concentration level.

7.1 Price level

Recent literature finds that quality increases with higher prices Herr, Nguyen, and Schmitz (2016) and Reichert and Stroka (2018). Moreover, Forder and Allan (2014) explained how price competition has a deteriorating effect on the quality of nursing homes. However, German LTC prices are negotiated and, therefore, we assume LTC prices to be regulated and to directly affect quality. This would mean that we do not expect any indirect price effect on quality via competition. In this section, we nevertheless show that the individual price has no effect on competition and thus we show that our hypothesis of regulated prices is applicable.

We observe negotiated ambulatory prices at the service level for $5,875$ ambulatory services in 2019. This allows us to estimate a cross-sectional model at the service level:

$$p_i^{amb} = \beta_0 + \beta_1 CI_{ir}^{amb} + (\gamma\, \overline{p_{m,t-1}^{amb}}) + X_c + S_s + F_f + \epsilon_{i,c} \tag{11}$$

where p_i^{amb} indicates individual comparable prices for 2019 and CI_{ir}^{amb} provides competition measures on a 10 km radius. We include controls on county level, size and federal state fixed effects. Moreover, to control for the variation of earlier negotiations, we include average municipality lagged prices (for own contribution and average total costs).

Results for competition turn out to be insignificant across all specifications. This

supports our hypothesis that ambulatory LTC price negotiations are not affected by competition.

Table 4: Channel competition and LTC prices

	Stat. own contribution			**Stat.** avg. total costs			**Amb.** indiv. prices		
	OOP costs	OOP costs	OOP costs	Total costs	Total costs	Total costs	Point value	Point value	Point value
HHI Gemeindeebene von $0-100$	-.4018			-.3195			-4.0e-06		
	(.3389)			(.2169)			(5.9e-06)		
CR(2) Gemeindeebene in %		-.2176			-.1661			4.4e-06	
		(.2213)			(.141)			(3.9e-06)	
No. facilities $1/N$			-.9871			-.675			-5.5e-04
			(.6916)			(.4531)			(7.0e-04)
lagged own contribution	.8139***	.8134***	.8127***						
	(.038)	(.0378)	(.0379)						
lagged total costs				.8564***	.856***	.8556***			
				(.0284)	(.0282)	(.0283)			
Controls	×	×	×	×	×	×	×	×	×
Size FE							×	×	×
Wave FE	×	×	×	×	×	×			
Federal State FE	×	×	×	×	×	×	×	×	×
Observations	2893.000	2893.000	2893.000	2893.000	2893.000	2893.000	5875.000	5875.000	5875.000
F-statistic	167	169	168	311	310	315	195.278	195.321	195.285
R2	0.848	0.848	0.848	0.836	0.836	0.836	0.649	0.649	0.649

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$; Standard errors clustered on county level in parenthesis.
Sources: Transparency Reports (on facility-level) and indicators and maps of regional and urban development on county level. Four waves: 2011, 2013, 2015, 2019: in total 2,893 municipalities. Dependant variable: Average own contribution and avg. total costs for nursing homes (1-6), Negotiated point values for 2019 (7-9), Lagged price information of t-1 (three periods). Competition variable: inverse number of amb. facilities, municip. $1/N$, HHI amb. care, municip. and CR(2) amb. care, municip. (For this table, we present the inverse of No. of Facilities $(*(-1))$.) Regional control variables on county level provided in Table 6. Fixed effects: capacity dummies (class1 [0-40 residents], class2 [41 - 75 residents], class3 [76 - 120 residents], class4 [121 - 400 residents]), wave fixed effects and federal state fixed effects.

7.2 Labour shortage

Instead, we newly propose that the channel may lie in labour force shortages. LTC services compete for the qualified nursing personnel. Following Foster and Lee (2015) this is essential for maintaining a high level of quality. Besides little room for substitution of capital for qualified labour in LTC services, there is a severe shortage of nursing personnel in Germany (Büscher, A., Schröder, D., & Gruber, E. M. 2022; Bonacker and Geiger 2022). If demand for qualified personnel cannot be satisfied due to labour shortage, ambulatory services recruit more unskilled staff. This can be a severe concern in areas facing higher competition compared to other regions. A long list of literature provides evidence showing that employing unqualified staff in nursing homes is likely to result in lower care quality (Konetzka, Stearns, and Park 2008; Castle and Anderson 2011; Lee, Blegen, and Harrington 2014; Lin 2014). We match our data with nursing job vacancies at the county level published by the Federal Employment Agency. To estimate the correlation of competition and the

number of job vacancies, we estimate a linear regression (Equation (12)).

$$V_{ct} = \beta_0 + \beta_1 CI_{ct} + X_{ct} + F_f + T_t + u_{ct} \tag{12}$$

We explain the number of vacancies V in county c at time t with the respective competition indicators, control variables at county level X_{ct} as well as federal state F_f and wave fixed effects T_t. In this regression, we look at 30,486 observations over a time horizon of three waves (2011, 2013, 2015).

Table 5: Channel competition and nursing personnel

	Job offers geriatric care, in total			Job offers geriatric care, trained nurses			Job offers geriatric care, assistants		
HHI, 10km	-.1937***			-.1925**			-27.42***		
	(.0734)			(.0814)			(8.366)		
CR(2), 10km		-.1315***			-.128**			-18.59***	
		(.0495)			(.0553)			(5.609)	
Inv. no. of amb. facilities			-.0606**			-.0626**			-8.648***
			(.0246)			(.0263)			(2.823)
Controls	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×
Federal State FE	×	×	×	×	×	×	×	×	×
Observations	30486.000	30486.000	30486.000	30486.000	30486.000	30486.000	30486.000	30486.000	30486.000
F-statistic	11	9	14	11	9	14	11	9	14
R2	0.496	0.456	0.546	0.497	0.457	0.547	0.496	0.456	0.547

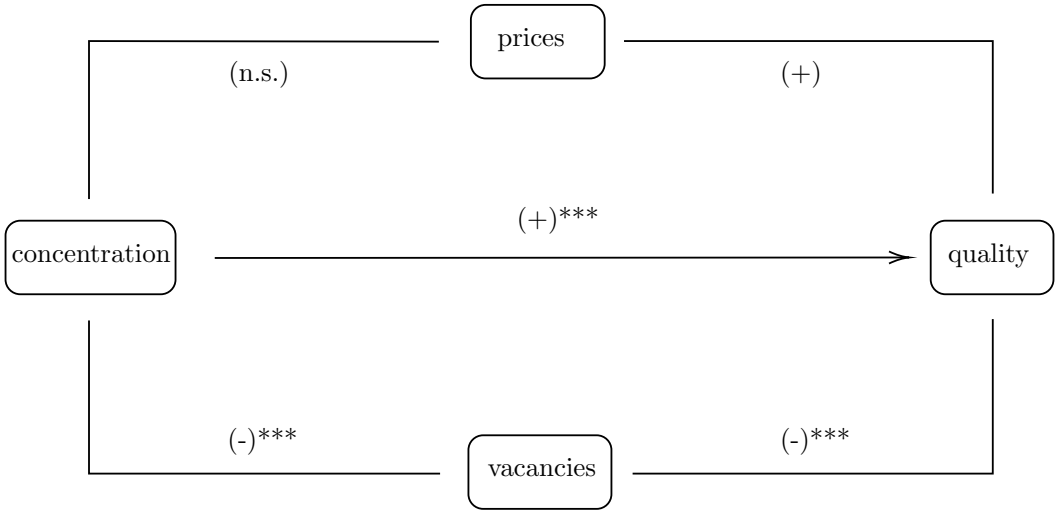
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; standard errors in parenthesis
Sources: Transparency reports (on facility-level) and indicators and maps of regional and urban development on county levels for 2011 2013 2015, Observations: 30,489 ambulatory facilities. Dependant variable: Nurses vacancies on county level (total, trained, assistants). Regional control variables on county level provided in Table 6. Fixed effects: federal state and time fixed fixed effects.

Table 5 confirms a robust significant negative correlation between job offers for different qualification levels and all three market concentration measures. Results suggest that the demand for personnel increases in competition. It is very likely that the costs for personnel is higher in these markets. Firms will then either skimp on assistant nurses or reduce the number of qualified nurses so as to remain profitable. This in turn, results in lower quality, which we can show in a simple model (see Table 11).

However, equation (12) is a simple linear regression framework and point estimates could be biased. Moreover, we do not observe the service specific numbers of qualified and assistant nurses. Nevertheless, the results support our hypothesis regarding a negative correlation between market concentration and a sufficiently qualified care team, which likely deteriorates ambulatory LTC quality.

Figure 7.2 summarises the results regarding the potential channels explaining the positive relation between concentration and quality.

Figure 4: Potential mechanisms influencing quality via market concentration in ambulatory LTC



8 Discussion and conclusion

In this study, we investigate the effect of competition on quality in ambulatory LTC. This is not only a fundamental empirical question but may also provide recommendations for the German regulation that supports a low concentrated ambulatory care market.

We use the German publicly available transparency reports, a rich data set of four waves collected between 2011 and 2019. Our empirical model contains about 10,000 ambulatory care services per wave. Since the aggregated quality grades are subject to criticism from German experts, we create quality indices based on specific relevant quality items also provided in the reports. To quantify competition, we apply three different measures on a 10 km radius, 20 km radius and on a municipality level, respectively.

Our empirical strategy is related to the theoretical suggestions of Gaynor and Town (2011). We estimate a repeated cross-sectional model with regional socio-economic control variables and include size-, time- and federal state fixed effects.

Since we lack information on ownership type (Grabowski et al. 2013; Jones, Propper, and Smith 2017) or detailed information on the nurses (Lin 2014), there is still some quality variation we cannot explain in our model. However, our interest lies

specifically in the effects of the competitive structure on LTC quality. To be able to make causal statements, we apply a two-stage least squares framework. Here, we instrument the ambulatory market concentration by the corresponding nursing home concentration outside of the relevant radius that we assume does not depend on ambulatory care demand. Compared to the IV estimates, our OLS estimates are downward biased, which implies that the competition effect is greater than estimated in the OLS models. Regarding the channels, Forder and Allan (2014) argue that fiercer price competition explains the lower quality in markets with unregulated prices. We can exclude this channel since there is no correlation between competition and prices in Germany. However, we are the first to consider the nursing staff shortages and problems of finding well-trained nurses as a channel that may explain the negative effect of competition on quality. In regions with a higher service density and lower market concentration, providers are expected to skimp on nursing assistants rather than on rare professional nurses, i.e. they need to move down the qualification distribution to satisfy the demand. Results suggest that less concentrated ambulatory care markets are associated with a higher demand for nursing personnel (i.e. more open positions). Providers face large personnel shortages, while the number of vacancies increases, which in turn leads to a lower quality of care. Lack of qualified personnel is not an exclusive problem for Germany and that is why we postulate that our results can be transferred to other countries (Zallman et al. 2019). Our results identify the need to invest in the supply of well-trained nursing staff more strongly. Since market concentration is low, and due to the regulatory framework and demand increases, this should be a first step to enabling quality competition in LTC markets.

9 Acknowledgements

The authors thank seminar participants at Essen, Hannover and iHEA 2021 for their helpful comments and remarks. (planned: EuHEA Conference 2022, EARIE 2022, EuHEA PhD Workshop 2022, IZA-CINCH-Workshop). The authors gratefully acknowledge funding by the Federal Ministry of Education and Research (FKZ:

01EH1602B) and the German Research Foundation (DFG), Germany.

References

Allard, Marie, Pierre Thomas Léger, and Lise Rochaix. 2009. "Provider Competition in a Dynamic Setting." *Journal of Economics & Management Strategy* 18 (2): 457–486. ISSN: 1530-9134. https://doi.org/10.1111/j.1530-9134.2009.00220.x.

Bardey, David, and Luigi Siciliani. 2021. "Nursing-homes' competition and distributional implications when the market is two-sided." *Journal of Economics & Management Strategy* 30 (2): 472–500. ISSN: 1530-9134. https://doi.org/10.1111/jems.12415.

Beitia, Arantza. 2003. "Hospital quality choice and market structure in a regulated duopoly." *Journal of Health Economics* 22 (6): 1011–1036. ISSN: 0167-6296. https://doi.org/10.1016/s0167-6296(03)00049-3.

Bloom, Nicholas, Carol Propper, Stephan Seiler, and John van Reenen. 2015. "The Impact of Competition on Management Quality: Evidence from Public Hospitals." *The Review of Economic Studies* 82 (2): 457–489. ISSN: 0034-6527. https://doi.org/10.1093/restud/rdu045.

Blümel, Spranger, A., Achstetter, K., Maresso, A., and Busse, R. 2021. *Germany: Health system review.* https://apps.who.int/iris/bitstream/handle/10665/341674/hit-22-6-2020-eng.pdf?sequence=1.

Bonacker, Marco, and Gunter Geiger. 2022. *Pflege in Zeiten der Pandemie: Wie sich Pflege durch Corona verändert hat.* Verlag Barbara Budrich. ISBN: 9783847417378.

Brekke, Kurt R., Chiara Canta, Luigi Siciliani, and Odd Rune Straume. 2021. "Hospital competition in a national health service: Evidence from a patient choice reform." *Journal of Health Economics* 79:102509. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2021.102509.

Brekke, Kurt R., Robert Nuscheler, and Odd Rune Straume. 2007. "Gatekeeping in health care." *Journal of Health Economics* 26 (1): 149–170. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2006.04.004.

Brekke, Kurt R., Luigi Siciliani, and Odd Rune Straume. 2010. "Price and quality in spatial competition." *Regional Science and Urban Economics* 40 (6): 471–480. ISSN: 0166-0462. https://doi.org/10.1016/j.regsciurbeco.2010.06.003. https://www.sciencedirect.com/science/article/pii/S0166046210000475.

Büscher, A., Schröder, D., & Gruber, E. M. 2022. "Die Personalsituation in der ambulanten Pflege: Eine qualitative Studie zu aktuellen und zukünftigen Herausforderungen: The Staffing Situation in Outpatient Care: A Qualitative Study on Current and Future Challenges." *Pflege,* ISSN: 1664-283X.

Castle, Nicholas G., and Ruth A. Anderson. 2011. "Caregiver Staffing in Nursing Homes and Their Influence on Quality of Care: Using Dynamic Panel Estimation Methods." *Medical Care* 49 (6): 545–552. ISSN: 0025-7079. http://www.jstor.org/stable/23053761.

Cheung, Sai On, and Lu Shen. 2017. "Concentration analysis to measure competition in megaprojects." *Journal of Management in Engineering* 33 (1): 1–11. ISSN: 0742-597X. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000464.

Ching, Andrew T., Fumiko Hayashi, and Hui Wang. 2015. "Quantifying the impacts of limited supply: The case of nursing homes." *International Economic Review* 56 (4): 1291–1322. ISSN: 0020-6598. https://doi.org/10.1111/iere.12138.

Cooper, Zack, Stephen Gibbons, Simon Jones, and Alistair McGuire. 2011. "Does Hospital Competition Save Lives? Evidence from the English NHS Patient Choice Reforms." *The Economic Journal* 121 (554): F228–F260. https://doi.org/10.1111/j.1468-0297.2011.02449.x.

Forder, Julien, and Stephen Allan. 2014. "The impact of competition on quality and prices in the English care homes market." *Journal of Health Economics* 34:73–83. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2013.11.010.

Foster, Andrew D., and Yong Suk Lee. 2015. "Staffing subsidies and the quality of care in nursing homes." *Journal of Health Economics* 41:133–147. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2015.02.002.

Gaynor, Martin, Rodrigo Moreno-Serra, and Carol Propper. 2013. "Death by Market Power: Reform, Competition, and Patient Outcomes in the National Health Service." *American Economic Journal: Economic Policy* 5 (4): 134–166. ISSN: 1945-7731. https://doi.org/10.1257/pol.5.4.134.

Gaynor, Martin, and Robert J. Town. 2011. "Competition in health care markets." *National Bureau of Economic Research* 2:499–637. https://doi.org/10.1016/B978-0-444-53592-4.00009-8.

Gowrisankaran, Gautam, and Robert J. Town. 2003. "Competition, payers, and hospital quality." *Health Services Research* 38 (6 Pt 1): 1403–1421. ISSN: 1475-6773. https://doi.org/10.1111/j.1475-6773.2003.00185.x.

Grabowski, David C., Zhanlian Feng, Richard Hirth, Momotazur Rahman, and Vincent Mor. 2013. "Effect of nursing home ownership on the quality of post-acute care: An instrumental variables approach." *Journal of Health Economics* 32 (1): 12–21. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2012.08.007.

Gravelle, Hugh, and Giuliano Masiero. 2000. "Quality incentives in a regulated market with imperfect information and switching costs: capitation in general practice." *Journal of Health Economics* 19 (6): 1067–1088. ISSN: 0167-6296. https://doi.org/10.1016/s0167-6296(00)00060-6.

Hasseler, Martina, and Karin Wolf-Ostermann. 2010. *Wissenschaftliche Evaluation zur Beurteilung der Pflege-Transparenzvereinbarungen für den ambulanten (PTVA) und stationären (PTVS) Bereich.* https://bagues.de/spur-download/sht/48_10an1.pdf.

Heiber, Andreas. 2019. *Leistungskataloge und Vergütungen SGB XI 2018: Ein bundesweiter Vergleich-Studie.* Vincentz Network GmbH & Co. KG. ISBN: 9783866307391.

Herr, Annika, Thu-Van Nguyen, and Hendrik Schmitz. 2016. "Public reporting and the quality of care of German nursing homes." *Health Policy* 120 (10): 1162–1170. ISSN: 0168-8510. https://doi.org/10.1016/j.healthpol.2016.09.004. http://www.sciencedirect.com/science/article/pii/S0168851016302342.

Hirschman, Albert O. 1980. *National power and the structure of foreign trade.* Expanded ed. Vol. 1. Studies in international political economy. Berkely: Univ. of California Press. ISBN: 0520040821. https://archive.org/details/nationalpowerst00hirs.

Jones, Daniel B., Carol Propper, and Sarah Smith. 2017. "Wolves in sheep's clothing: Is non-profit status used to signal quality?" *Journal of Health Economics* 55:108–120. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2017.06.011.

Jung, Kyoungrae, and Daniel Polsky. 2014. "Competition and quality in home health care markets." *Health Economics* 23 (3): 298–313. ISSN: 1057-9230. https://doi.org/10.1002/hec.2938.

Karlsson, Martin. 2007. "Quality incentives for GPs in a regulated market." *Journal of Health Economics* 26 (4): 699–720. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2006.12.001.

Karsch-Völk, M., P. Landendörfer, K. Linde, A. Egermann, G. Troeger-Weiß, and A. Schneider. 2012. "Medizinische und kommunale Herausforderungen einer alternden Gesellschaft im ländlichen Bereich." *Gesundheitswesen (Bundesverband der Arzte des Offentlichen Gesundheitsdienstes (Germany))* 74 (7): 410–415. https://doi.org/10.1055/s-0031-1286272.

Kessler, D. P., and M. B. McClellan. 2000. "Is Hospital Competition Socially Wasteful?" *The Quarterly Journal of Economics* 115 (2): 577–615. ISSN: 0033-5533. https://doi.org/10.1162/003355300554863.

Kessler, Daniel P., and Jeffrey J. Geppert. 2005. "The Effects of Competition on Variation in the Quality and Cost of Medical Care." *Journal of Economics & Management Strategy* 14 (3): 575–589. ISSN: 1530-9134. https://doi.org/10.1111/j.1530-9134.2005.00074.x.

Konetzka, R. Tamara, Sally C. Stearns, and Jeongyoung Park. 2008. "The staffing-outcomes relationship in nursing homes." *Health Services Research* 43 (3): 1025–1042. ISSN: 1475-6773. https://doi.org/10.1111/j.1475-6773.2007.00803.x.

Kranton, Rachel E. 2003. "Competition and the Incentive to Produce High Quality." *Economica* 70 (279): 385–404. ISSN: 00130427. https://doi.org/10.1111/1468-0335.t01-1-00289.

Lee, Hyang Yuol, Mary A. Blegen, and Charlene Harrington. 2014. "The effects of RN staffing hours on nursing home quality: A two-stage model." *International Journal of Nursing Studies* 51 (3): 409–417. ISSN: 0020-7489. https://doi.org/10.1016/j.ijnurstu.2013.10.007.

Lin, Haizhen. 2014. "Revisiting the relationship between nurse staffing and quality of care in nursing homes: An instrumental variables approach." *Journal of Health Economics* 37:13–24. ISSN: 0167-6296. https://doi.org/10.1016/j.jhealeco.2014.04.007.

Moscelli, Giuseppe, Hugh Gravelle, and Luigi Siciliani. 2021. "Hospital competition and quality for non–emergency patients in the English NHS." *The RAND Journal of Economics* 52 (2): 382–414. ISSN: 0741-6261. https://doi.org/10.1111/1756-2171.12373.

Moscelli, Giuseppe, Hugh Gravelle, Luigi Siciliani, and Rita Santos. 2018. "Heterogeneous effects of patient choice and hospital competition on mortality." *Social Science & Medicine* 216:50–58. ISSN: 0277-9536. https://doi.org/10.1016/j.socscimed.2018.09.009.

Mukamel, Dana B., and William D. Spector. 2002. "The competitive nature of the nursing home industry: price mark ups and demand elasticities." *Applied Economics* 34 (4): 413–420. ISSN: 0003-6846. https://doi.org/10.1080/00036840110044199.

Nuscheler, Robert. 2003. "Physician Reimbursement, Time Consistency, and the Quality of Care." *Journal of Institutional and Theoretical Economics* 159 (2): 302. ISSN: 0932-4569. https://doi.org/10.1628/093245603297485 3.

Perloff, Jeffrey M., Larry S. Karp, and Amos Golan. 2007. *Estimating Market Power and Strategies.* Cambridge University Press. ISBN: 9781139463560. https://books.google.de/books?id=hbJWL2Tcx5sC.

Pick, Peter, and Jürgen Brüggemann. 2016. "Qualität Der Pflege: Fast Am Ziel Oder Halbe Strecke?" *Gesundheits-und Sozialpolitik* 70 (1): 25–31. https://www.jstor.org/stable/26766179.

Plöthner, M., K. Schmidt, L. de Jong, J. Zeidler, and K. Damm. 2019. "Needs and preferences of informal caregivers regarding outpatient care for the elderly: a systematic literature review." *BMC Geriatrics* 19 (1): 1–22. ISSN: 1471-2318. https://doi.org/10.1186/s12877-019-1068-4. https://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-019-1068-4.

Reichert, Arndt R., and Magdalena A. Stroka. 2018. "Nursing home prices and quality of care - Evidence from administrative data." *Health Economics* 27 (1): 129–140. ISSN: 1057-9230. https://doi.org/10.1002/hec.3518.

Schürmann, Lena. 2016. "Unternehmerische Akteure auf Wohlfahrtsmärkten: private ambulante Pflegedienste im Spannungsfeld zwischen Fürsorge und Wettbewerb." *AIS-Studien* 9 (2): 75–95. ISSN: 1866-9549. https://doi.org/10.21241/ssoar.64833.

Shen, Yu-Chu. 2003. "The effect of financial pressure on the quality of care in hospitals." *Journal of Health Economics* 22 (2): 243–269. ISSN: 0167-6296. https://doi.org/10.1016/s0167-6296(02)00124-8.

Spence, A. Michael. 1975. "Monopoly, Quality, and Regulation." *The Bell Journal of Economics* 6 (2): 417–429. ISSN: 0361915X. https://doi.org/10.2307/3003237.

Staiger, Douglas, and James H. Stock. 1997. "Instrumental Variables Regression with Weak Instruments." *Econometrica* 65 (3): 557–586. ISSN: 00129682. https://doi.org/10.2307/2171753. http://www.jstor.org/stable/2171753.

Sünderkamp, Susanne, Christian Weiß, and Heinz Rothgang. 2014. "Analyse der ambulanten und stationären Pflegenoten hinsichtlich der Nützlichkeit für den Verbraucher." *Pflege* 27 (5): 325–336. ISSN: 1664-283X. https://doi.org/10.1024/1012-5302/a000379.

Tay, Abigail. 2003. "Assessing Competition in Hospital Care Markets: The Importance of Accounting for Quality Differentiation." *The RAND Journal of Economics* 34 (4): 786. ISSN: 0741-6261. https://doi.org/10.2307/1593788.

Tirole, Jean, T. Jean, and J. Bonin. 1988. *The Theory of Industrial Organization.* The MIT Press. ISBN: 9780262200714.

Volpp, Kevin G. M., Sankey V. Williams, Joel Waldfogel, Jeffrey H. Silber, J. Sanford Schwartz, and Mark V. Pauly. 2003. "Market Reform in New Jersey and the Effect on Mortality from Acute Myocardial Infarction." *Health Services Research* 38 (2): 515–533. ISSN: 1475-6773. https://doi.org/10.1111/1475-6773.00131.

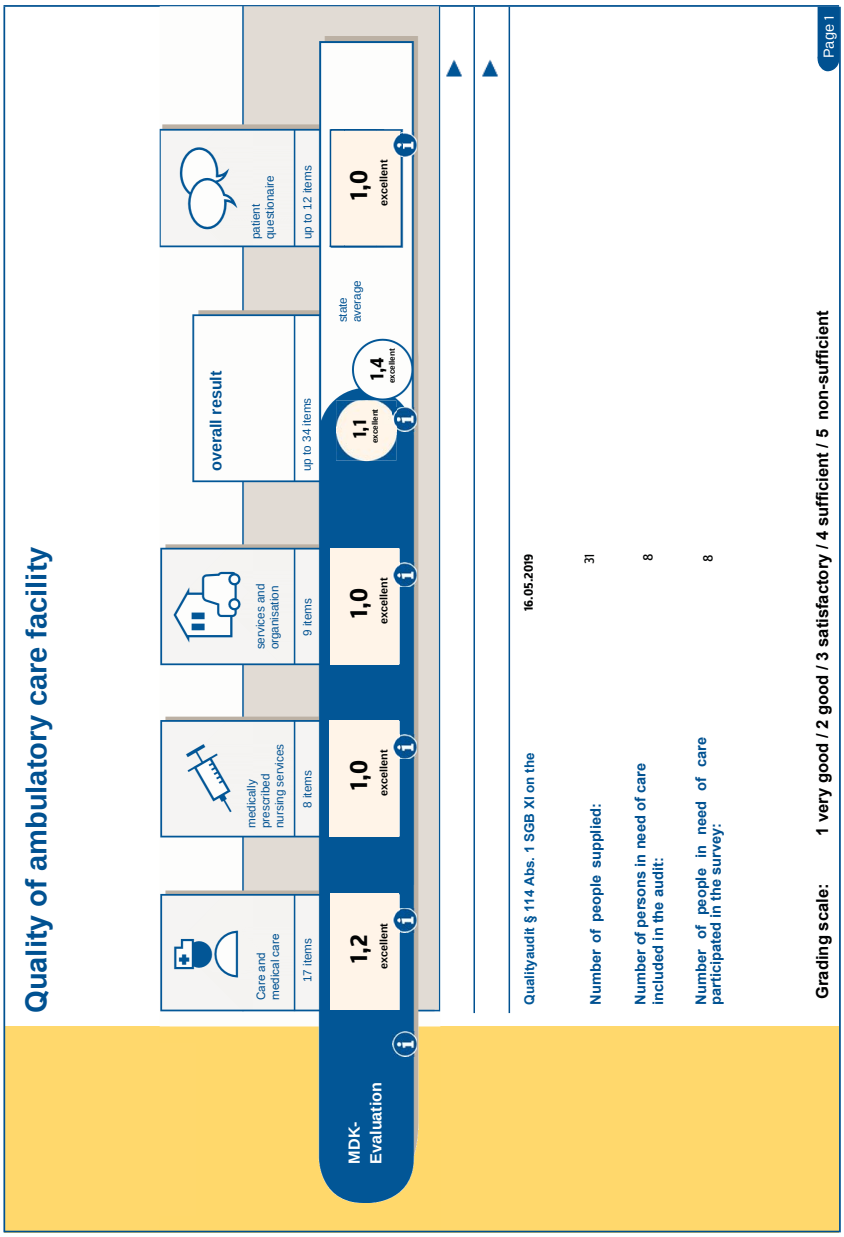
Yang, Ou, Jongsay Yong, and Anthony Scott. 2021. "Nursing Home Competition, Prices, and Quality: A Scoping Review and Policy Lessons." *The Gerontologist,* https://doi.org/10.1093/geront/gnab050. https://academic.oup.com/gerontologist/advance-article/doi/10.1093/geront/gnab050/6225846?login=true.

Zallman, L., K. E. Finnegan, D. U. Himmelstein, S. Touw, and S. Woolhandler. 2019. "Care For America's Elderly And Disabled People Relies On Immigrant Labor." *Health Affairs* 38:919–926. ISSN: 1544-5208. https://doi.org/10.1377/hlthaff.2018.05514.

Zinn, Jacqueline S. 1994. "Market competition and the quality of nursing home care." *Journal of Health Politics, Policy and Law* 19 (3): 555–582. ISSN: 0361-6878.

A Appendices

Figure 5: Example of first page of a transparency report



A.1 Ambulatory care quality items/criteria translated into English

Item 1 – 17 Nursing Services

Response: "Completely fulfilled for x out of X persons in need of care"

Item 1 – 17 Nursing Services

Response:"Completely fulfilled for x out of X persons in need of care"

1 Are the individual wishes regarding personal hygiene taken into account within the framework of the agreed service provision?

2 Is personal hygiene within the scope of the agreed service provision appropriate within the possibilities of influence of the care facility?

3 Are the individual wishes for food and drink within the framework of the agreed service provision considered?

4 Has the agreed liquid supply service been carried out in a comprehensible manner?

5 Are the individual risks associated with the supply of liquids recorded if benefits are agreed for this area?

6 Has the person in need of care or his or her relative been informed of any identified risks of liquid supply in the context of agreed body-related care measures of personal hygiene, nutrition or liquid supply?

7 Was the agreed food intake service carried out in a comprehensible manner?

8 Are individual nutritional risks recorded if benefits have been agreed?

9 Has the person in need of care or a relative been informed in the context of agreed body-related care measures of personal hygiene, nutrition or liquid supply in case of identifiable risks in the area of nutrition?

10 Are individual resources and risks associated with segregation recorded if services have been agreed?

11 Does the agreed service support excretion/incontinence care performed in a comprehensive manner?

12 If an individual decubitus risk of a care dependent is recognised decubitus during the provision of agreed services, is this then recorded?

13 Are the individual risks relating to the contractures taken into account when the agreed services are provided?

14 Are the agreed mobility services and their development carried out in a comprehensible manner?

15 Are biographical and other characteristics of people with dementia taken into account in the provision of services?

16 Are relatives informed about how to interact with people with dementia who need long-term care in the context of service provision?

17 Is it clear from the nursing documentation that an initial consultation was held?

Item 18 – 25 Medically indicated Nursing Services

Response:"Completely fulfilled for x out of X persons in need of care"

18 Are the nursing measures for the treatment of chronic wounds or pressure sores based on the current state of the art?

19 Does the medication correspond to the medical prescription?

20 Does the medical treatment meet the medical prescription?

21 Is the blood pressure measurement carried out and evaluated according to the doctor's prescription and are the necessary consequences drawn from this?

22 Is the blood sugar measurement carried out and evaluated according to the doctor's prescription and are the necessary consequences drawn from this?

23 Is the injection carried out in accordance with the doctor's prescription in a comprehensible manner, documented and, in case of complications, the doctor informed?

24 Are compression stockings/bandages properly applied?

25 Is active communication with the doctor comprehensible in the event of a need for treatment care?

Item 26 - 34 Service and Organisation

Response:"Yes / No"

26 Will the nursing service provide a cost estimate of the expected costs before the start of the contract?

27 Are there effective rules within the care service to ensure that data protection is guaranteed?

28 Are there written procedural instructions on the behaviour of carers in emergency situations with people in need of care?

29 Are employees regularly trained in first aid and emergency procedures?

30 Is there a written policy on dealing with complaints?

31 Is there a plan for further training to ensure that all staff working in the care sector are involved in the training?

32 Is the area of responsibility/the tasks for the senior nurse specified?

33 Is the area of responsibility/the tasks for the housekeeping employees specified?

34 Is the constant availability and operational readiness of the care service with regard to the agreed services guaranteed?

35 - 46 Customer Survey

Response:"Completely fulfilled for x out of X persons in need of care"

35 Has a written care contract been concluded with you?

36 Were you been informed by the nursing service before the start of the service about the costs you expect to incur or have to take over yourselves?

37 Have the times of the care services been coordinated with you?

38 Do the nursing staff ask you what clothing you want to wear?

39 Does a group of nursing staff visit you in a manageable size?

40 Are the nursing services available and ready for action if required?

41 Are you supported/motivated by the nursing staff to wash partially or completely by yourself?

42 Do the staff give you tips and advice (information) on care?

43 Has anything changed for the better after a complaint?

44 Do the nursing staff respect your privacy?

45 Are the employees polite and friendly?

46 Are you satisfied with the domestic services of the nursing service?

A.2 Quality categories

1. Nursing Quality

Nursing quality is related to the outcome quality. This sort of quality is difficult to measure in the LTC context regarding customer's high age and the low survival rate. That's why we look at the quality provided by nurses in terms of following the protocol and fulfilling contractual agreements.

1. Are the individual wishes regarding personal hygiene taken into account within the framework of the agreed service provision?

10. Are individual resources and risks associated with segregation recorded if services have been agreed?

11. Does the agreed service support excretion/incontinence care performed in a comprehensive manner?

12. If an individual decubitus risk of a care dependent is recognised decubitus during the provision of agreed services, is this then recorded?

13. Are the individual risks relating to the contractures taken into account when the agreed services are provided?

14. Are the agreed mobility services and their development carried out in a comprehensible manner?

2. Medical Care Quality

This measure is based on how well the medication provided by the ambulatory care provider compares to the doctor's prescription:

19. Does the medication correspond to the medical prescription?

3. Organisational Quality

Questions regarding organisational quality are not directly related to the outcomes of a nursing service. Nevertheless, this indicator provides important information about the contractual arrangements, areas of responsibility and training within the nursing

service. We construct a broad and narrow organisational quality index, where the latter sets a focus on the distribution of responsibility within the nursing facility. Narrow organisation quality represents a subsample of the broad index based on the following questions:

17. Is it clear from the nursing documentation that an initial consultation was held?

26. Will the nursing service provide a cost estimate of the expected costs before the start of the contract?

29. Are employees regularly trained in first aid and emergency procedures?

32. Is the area of responsibility/the tasks for the senior nurse specified? [narrow measure]

33. Is the area of responsibility/the tasks for the housekeeping employees specified? [narrow measure]

A.3 Summary statistics

Table 6: Summary statistics for included control variables

Variable	**2011-2019**			
	mean	sd	min	max
Regional characteristics				
Nursing home specific point value: cent amount per point	.052	.0064	.0372	.0683
Avg. monthly contribution of care recipients (excl. investment costs)	1556	708.5	6.288	5304
Number of people supplied	94.13	72.9	4	501
Land price	154.8	175.6	6.1	1390
No. fem. population from 65 to under 75 years as proportion of population	52.83	1.244	48.3	57.3
No. fem. population from 75 to under 85 years as proportion of population	71.85	25.77	52.9	126.8
Avg. age, fem. population in ages	45.72	2.223	40.5	52.7
Avg. age, male population in ages	42.97	1.856	38.2	48.8
Monthly gross earnings of employees in Euro	2552	419.6	1708	4424
Avg. no. overnight stays in tourist accommodation	2.532	.8442	1.491	6.042
Foreign guests in overnight guest stays (%)	14.83	9.568	.4815	50.71
Population per km^2	681.6	799	35.6	3074
Care recipients per 10,000 inhabitants	385.3	115.3	166.6	952.2
Proportion of care recipients in outpatient care in total care	23.99	4.71	10.9	50.9
Proportion of care recipients in stat. care in total care	26.27	6.635	8.6	48.4
Proportion of care allowance recipients in total care recipients	48.91	7.309	26.1	72.4
Nursing home staff per 10,000 inhabitants	91.78	21.41	41.7	194.9
Care services staff per 10,000 inhabitants	44.38	17.72	8.8	168.9
Places available in nursing homes per 10,000 inhabitants	109.5	26.3	48.7	238.6
Class of average offer rent	4.049	1.928	1	13
Overnight stays in guests accomodations per inhabtitant	20.21	31.18	0	355.6
Beds in guests accomodations per 1,000 inhabitants	156.4	247	0	3306
GDP per inhabitant	3.5e+04	1.5e+04	1.5e+04	2.4e+05
Working people per 100 employed population	81.75	3.929	59.7	95.7
Proportion of population 65 years and older of total population	21.75	2.812	15.3	33.9
Proportion of population 75 years and older of total population	11.02	1.779	6.6	17.5
Proportion of population 85 years and older of total population	2.737	.4183	1.7	4.2
Proportion fem. population 75 years and older of total population	60.82	1.944	55.8	66.5
Proportion fem. population 85 years and older of total population	70.3	2.878	60.4	79.4
Remaining life expectancy of 60 years old females	25.35	.6096	23.15	27.43
Remaining life expectancy of 60 years old males	21.76	.8061	19.24	24.54
Proportion of unemployed women in the female civilian labor force	6.276	2.831	1.3	17.1
Proportion of unemployed men in the male civilian labor force	6.576	2.911	1.2	16.2
Unemployeed 55 years and older per 1,000 inhabitants from 55 to below?	49.67	18.9	12.5	126.8
Proportion social insuranced employeed worker to all workers	60.86	4.418	39.2	70.6
Proportion of social insured employeed at working place in 3rd sector (WZ?	67.61	10.71	35	92.8
Proportion of employeed in in person service profession	22.84	4.218	10.13	43.8
Proportion unemployeed level skilled workers on total unemployeed	40.44	5.507	12.9	57.5
Proportion foreign on inhabitants in (%)	9.061	5.843	.7	36.4
Disposable income of private households	1769	241.4	1275	3385
Trade tax in Euro per inhabitant	548.4	349.3	7	2412
Municipal debt in Euro per inhabitant	1715	1426	0	1.0e+04
Proportion of population with basic insurances	23.68	16.62	1.8	84.3
General practitioners per 100,000 inhabitants	54.42	17.39	7.43	218.4
Avg. age of population in years	44.37	2.031	39.4	50.8
Proportion of inhabitants in communities with population density < 1	22.9	26.53	0	111.6
Observations	39076			

A.4 Detailed regression result tables

Table 7: Quality and Herdindahl-Hirschman Index: regression results 2011-2019

10 km radius	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Herfindahl-Hirschman Index $(0-100)$	.0071	.3329***	.1934***	.0435**	.1429	.2996***	.0103*	.0371*	.0514**	.0165***	.1074***	.0514**
	(.0145)	(.0588)	(.0506)	(.0219)	(.0999)	(.0816)	(.0053)	(.0213)	(.0203)	(.0058)	(.0238)	(.0203)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.409	74.409	74.409	75.953	75.953	75.953	98.286	98.286	95.184	95.184	95.184	95.184
Observations	38890	38890	38890	34906	34906	34906	39350	39350	39314	39314	39314	39314
1st stage excl. F-statistic		673.687	1103.957		604.359	1010.619		678.378	1080.732		678.448	1080.732
F-statistic	78.473	78.197	77.622	28.274	28.065	28.454	19.421	19.936	18.837	18.729	18.735	18.837
R2	0.104	0.091	0.100	0.058	0.058	0.055	0.026	0.026	0.048	0.049	0.042	0.048

20 km radius	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Herfindahl Index $(0-100)$	.0857**	.4308***	.8342***	.0704	.0861	1.196***	.0122	.0353	.1914**	.0351**	.1218***	.1914**
	(.0435)	(.0897)	(.229)	(.0659)	(.1604)	(.3524)	(.0151)	(.0322)	(.088)	(.0166)	(.0388)	(.088)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.489	74.489	74.489	75.955	75.955	75.955	98.289	98.289	95.199	95.199	95.199	95.199
Observations	39537	39537	39537	35488	35488	35488	40003	40003	39967	39967	39967	39967
1st stage excl. F-statistic		885.899	532.056		821.395	510.363		899.423	528.563		888.712	528.563
F-statistic	79.194	79.166	77.917	29.964	29.551	29.457	21.167	20.677	19.536	19.405	19.386	19.536
R2	0.105	0.104	0.098	0.058	0.058	0.051	0.026	0.026	0.047	0.049	0.048	0.047

municipality level	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Herfindahl Index $(0-100)$	.0222*	.082***	.1522***	.018	.0359	.2463***	8.0e-04	-.0028	.0405**	.0078	.0213**	.0405**
	(.0126)	(.0242)	(.0397)	(.0186)	(.037)	(.067)	(.0049)	(.0092)	(.0165)	(.0048)	(.0093)	(.0165)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.018	74.018	74.018	74.502	74.502	74.502	98.169	98.169	95.160	95.160	95.160	95.160
Observations	29796	29796	29796	27053	27053	27053	30169	30169	30123	30123	30123	30123
1st stage excl. F-statistic		3713.438	706.972		3474.167	630.190		3730.480	715.926		3660.966	715.926
F-statistic	77.620	78.035	78.884	22.458	22.420	22.152	16.901	16.869	18.303	18.136	18.183	18.303
R2	0.109	0.108	0.105	0.059	0.059	0.054	0.028	0.028	0.051	0.052	0.052	0.051

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$; Standard errors clustered on federal state*assessment month*year level in parenthesis.
Sources: Transparency Reports (on facility-level) and indicators and maps of regional and urban development on county level. Four waves: 2011, 2013, 2015, 2019: in total 39,076 observations, nursing care quality (38,890), medical quality (34,906), narrow organisation quality (39,350), broad organisation quality (39,314). Estimation strategy: $Zit = \beta_0 + \beta_1 \widehat{CI}_{rt} + \beta_2 \mathbf{DS}_{mt} + \beta_3 \mathbf{CS}_{it} + \gamma P_{mt} + F_f + T_t + u_{imt}$ Dependant variable: nursing care quality $\in (0, 100/6, \ldots, 100)$, medical quality $\in (0, 100)$, narrow organ. quality $\in (0, 100/2, 100)$ broach organ. quality $(\in (0, 100/5 \ldots, 1)$; Market concentration indicator: Herfindahl-Hirschman Index (HHI) of amb. care (10 km radius, 20 km radius and municipality level), Regional control variables on county level provided in Table 6. Fixed effects: capacity dummies (class1 [0-40 residents], class2 [41 - 75 residents], class3 [76 - 120 residents], class4 [121 - 400 residents]), wave fixed effects and federal state fixed effects. Instruments: IV_{CI}^{stat}: nursing home competition measures on 10 km radius level; IV^{Reg}: populations density and income tax on municipality level.

Table 8: Quality and Market concentration ratio of largest two firms: regression results 2011-2019

10 km radius	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}
Concentration ratio (2)	.0136	.1988***	.1006***	.0352**	.0888*	.1577***	.0079**	.0223*	.0272**	.0117***	.0647***	.0272**
	(.0094)	(.031)	(.0264)	(.0139)	(.052)	(.0424)	(.0033)	(.0115)	(.0106)	(.0036)	(.012)	(.0106)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.409	74.409	74.409	75.953	75.953	75.953	98.286	98.286	95.184	95.184	95.184	95.184
Observations	38890	38890	38890	34906	34906	34906	39350	39350	39314	39314	39314	39314
1st stage excl. F-statistic		1463.284	1709.388		1256.602	1562.377		1464.946	1648.719		1464.240	1648.719
F-statistic	78.314	78.510	78.055	28.266	28.157	28.712	19.391	19.570	18.855	18.874	19.023	18.855
R2	0.104	0.094	0.102	0.058	0.058	0.056	0.026	0.026	0.048	0.049	0.043	0.048

20 km radius	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}
Concentration ratio (2)	.0388**	.1998***	.3067***	.0527*	.0682	.444***	.0083	.0188	.0711**	.0134*	.0601***	.0711**
	(.0187)	(.0323)	(.0838)	(.0287)	(.0542)	(.129)	(.0062)	(.0118)	(.0323)	(.0071)	(.013)	(.0323)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.489	74.489	74.489	75.955	75.955	75.955	98.289	98.289	95.199	95.199	95.199	95.199
Observations	39537	39537	39537	35488	35488	35488	40003	40003	39967	39967	39967	39967
1st stage excl. F-statistic		2878.589	617.860		2676.085	605.176		2936.247	604.406		2926.089	604.406
F-statistic	79.007	79.014	78.323	29.705	29.505	29.843	20.727	20.410	19.377	19.469	19.448	19.377
R2	0.105	0.103	0.100	0.058	0.058	0.053	0.026	0.026	0.047	0.049	0.047	0.047

municipality level	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}	OLS	IV^{stat}_{CI}	IV^{Reg}
Concentration ratio (2)	.0314***	.0576***	.0958***	.0316**	.0316	.1551***	.0013	4.8e-04	.0253**	.0087**	.0182***	.0253**
	(.0096)	(.0153)	(.0249)	(.0143)	(.0241)	(.0416)	(.0036)	(.006)	(.0103)	(.0035)	(.0057)	(.0103)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.018	74.018	74.018	74.502	74.502	74.502	98.169	98.169	95.160	95.160	95.160	95.160
Observations	29796	29796	29796	27053	27053	27053	30169	30169	30123	30123	30123	30123
1st stage excl. F-statistic		5461.058	733.025		5440.971	644.838		5412.331	734.672		5381.039	734.672
F-statistic	77.925	78.844	79.893	22.483	22.481	22.661	16.906	16.938	18.122	18.082	18.142	18.122
R2	0.109	0.109	0.107	0.059	0.059	0.056	0.028	0.028	0.051	0.052	0.052	0.051

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Standard errors clustered on federal state*assessment month*year level in parenthesis.
Sources: Transparency Reports (on facility-level) and indicators and maps of regional and urban development on county level. Four waves: 2011, 2013, 2015, 2019: in total 39,076 observations, nursing care quality (38,890), medical quality (34,906), narrow organisation quality (39,350), broad organisation quality (39,314). Estimation strategy: $Zit = \beta_0 + \beta_1 \widehat{CI}_{rt} + \beta_2 \mathbf{DS}_{mt} + \beta_3 \mathbf{CS}_{it} + \gamma P_{mt} + F_f + T_t + u_{imt}$ Dependant variable: nursing care quality $\in (0, 100/6, \ldots, 100)$, medical quality $\in (0, 100)$, narrow organ. quality $\in (0, 100/2, 100)$ broach organ. quality ($\in (0, 100/5 \ldots, 1)$; Market concentration indicator: Market concentretaion of largest two firms (CR2) of amb. care (10 km radius, 20 km radius and municipality level), Regional control variables on county level provided in Table 6. Fixed effects: capacity dummies (class1 [0-40 residents], class2 [41 - 75 residents], class3 [76 - 120 residents], class4 [121 - 400 residents]), wave fixed effects and federal state fixed effects. Instruments: IV^{stat}_{CI}: nursing home competition measures on 10 km radius level; IV^{Reg}: populations density and income tax on municipality level.

Table 9: Quality and Market concentration ratio as inverse number of competitors: regression results 2011-2019

10 km radius	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Inv. no. amb. facilities	1.68	40.33***	25.72***	6.291**	2.221	39.84***	1.214*	4.667*	6.835**	2.679***	14.32***	6.835**
	(1.826)	(7.983)	(6.73)	(2.968)	(13.55)	(10.85)	(.6893)	(2.8)	(2.698)	(.7376)	(3.286)	(2.698)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.409	74.409	74.409	75.953	75.953	75.953	98.286	98.286	95.184	95.184	95.184	95.184
Observations	38890	38890	38890	34906	34906	34906	39350	39350	39314	39314	39314	39314
1st stage excl. F-statistic		720.857	986.517		605.265	918.689		709.002	951.149		712.583	951.149
F-statistic	78.193	77.932	77.693	28.458	28.323	28.485	19.466	20.118	18.869	18.740	18.854	18.869
R2	0.104	0.094	0.100	0.058	0.058	0.055	0.026	0.026	0.048	0.049	0.043	0.048

20 km radius	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Inv. no. amb. facilities	11.14*	53.36***	129.3***	4.672	-15.74	186.1***	1.75	3.283	29.51**	5.926**	15.16**	29.51**
	(6.56)	(13.56)	(35.55)	(10.69)	(25.59)	(55.08)	(2.257)	(4.961)	(13.67)	(2.623)	(6.141)	(13.67)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.489	74.489	74.489	75.955	75.955	75.955	98.289	98.289	95.199	95.199	95.199	95.199
Observations	39537	39537	39537	35488	35488	35488	40003	40003	39967	39967	39967	39967
1st stage excl. F-statistic		620.400	584.237		564.891	557.650		623.838	581.473		611.836	581.473
F-statistic	79.059	79.075	78.757	29.588	29.755	29.121	20.978	20.525	19.507	19.339	19.345	19.507
R2	0.105	0.104	0.098	0.058	0.058	0.051	0.026	0.026	0.047	0.049	0.048	0.047

municipality level	Nursing Quality			Medical Quality			Narrow Organ. Quality			Broad Organ. Quality		
	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}	OLS	IV_{CI}^{stat}	IV^{Reg}
Inv. no. amb. facilities	4.023**	8.781***	17.9***	3.887	6.214	28.99***	.0985	-.2487	4.776**	1.78***	2.684**	4.776**
	(1.572)	(2.914)	(4.638)	(2.497)	(4.356)	(7.879)	(.6134)	(1.083)	(1.938)	(.5764)	(1.127)	(1.938)
Controls	×	×	×	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×	×	×	×
Federal-State FE	×	×	×	×	×	×	×	×	×	×	×	×
Mean depend. variable	74.018	74.018	74.018	74.502	74.502	74.502	98.169	98.169	95.160	95.160	95.160	95.160
Observations	29796	29796	29796	27053	27053	27053	30169	30169	30123	30123	30123	30123
1st stage excl. F-statistic		4787.542	813.648		4506.835	708.699		4784.273	818.351		4754.468	818.351
F-statistic	77.661	78.022	78.941	22.437	22.398	22.312	16.983	16.910	18.115	18.091	18.119	18.115
R2	0.109	0.108	0.106	0.059	0.059	0.055	0.028	0.028	0.051	0.052	0.052	0.051

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Standard errors clustered on federal state*assessment month*year level in parenthesis.
Sources: Transparency Reports (on facility-level) and indicators and maps of regional and urban development on county level. Four waves: 2011, 2013, 2015, 2019: in total 39,076 observations, nursing care quality (38,890), medical quality (34,906), narrow organisation quality (39,350), broad organisation quality (39,314). Estimation strategy: $Zit = \beta_0 + \beta_1 \widehat{CI}_{rt} + \beta_2 \mathbf{DS}_{mt} + \beta_3 \mathbf{CS}_{it} + \gamma P_{mt} + F_f + T_t + u_{imt}$ Dependant variable: nursing care quality $\in (0, 100/6, \ldots, 100)$, medical quality $\in (0, 100)$, narrow organ. quality $\in (0, 100/2, 100)$ broach organ. quality ($\in (0, 100/5 \ldots, 1)$; Market concentration indicator:Inverse number of ambulatory facilities (10 km radius, 20 km radius and municipality level), Regional control variables on county level provided in Table 6. Fixed effects: capacity dummies (class1 [0-40 residents], class2 [41 - 75 residents], class3 [76 - 120 residents], class4 [121 - 400 residents]), wave fixed effects and federal state fixed effects. Instruments: IV_{CI}^{stat}: nursing home competition measures on 10 km radius level; IV^{Reg}: populations density and income tax on municipality level.

A.5 First-stage regression results

Table 10: First-stage Estimations

10 **km radius**	amb. HHI		amb. CR (2)		Inv. no. amb. facilities	
Stat. HHI	.2771***					
	(.0107)					
Stat. CR (2)			.3705***			
			(.0097)			
Inv. no. stat. facilities					.2564***	
					(.0096)	
Income tax		-.0157***		-.027***		-1.2e-04***
		(.0032)		(.0057)		(2.7e-05)
Population density		-.0086***		-.0168***		-6.5e-05***
		(1.8e-04)		(2.9e-04)		(1.5e-06)
Controls	×	×	×	×	×	×
Size FE	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×
Fed. State FE	×	×	×	×	×	×
excl. F-statistic	673.687	1103.957	1463.28	1709.38	720.857	986.517
Observations	38890	38890	38890	38890	38890	38890

20 **km radius**	amb. HHI		amb. CR (2)		Inv. no. amb. facilities	
Stat. HHI	.146***					
	(.0049)					
Stat. CR (2)			.3347***			
			(.0065)			
No. stat. facilities					.1009***	
					(.0041)	
Income tax		-.0057***		-.0152***		-3.7e-05***
		(.0011)		(.0029)		(7.0e-06)
Population density		-.0016***		-.0046***		-1.0e-05***
		(5.1e-05)		(1.3e-04)		(3.1e-07)
Controls	×	×	×	×	×	×
Size FE	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×
Fed. State FE	×	×	×	×	×	×
excl. F-statistic	885.90	532.06	2878.59	617.86	620.40	584.24
Observations	39537	39537	39537	39537	39537	39537

municipality level	amb. HHI		amb. CR (2)		Inv. no. amb. facilities	
Stat. HHI	.5487***					
	(.009)					
Stat. CR (2)			.5691***			
			(.0077)			
No. stat. facilities					.5197***	
					(.0075)	
Income tax		.0077***		.0088***		6.3e-05***
		(.0019)		(.0026)		(1.5e-05)
Population density		-.0127***		-.0205***		-1.1e-04***
		(3.4e-04)		(5.4e-04)		(2.7e-06)
Controls	×	×	×	×	×	×
Size FE	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×
Fed. State FE	×	×	×	×	×	×
excl. F-statistic	3713.44	706.97	5461.05	733.03	4787.54	813.65
Observations	29796	29796	29796	29796	29796	29796

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$; Standard errors clustered on federal state*assessment month*year level in parenthesis. Sources: Transparency Reports (on facility-level) and indicators and maps of regional and urban development on county level. Four waves: 2011, 2013, 2015, 2019: in total 39,076 observations, nursing care quality (38,890), medical quality (34,906), narrow organisation quality (39,350), broad organisation quality (39,314). Estimation strategy: $Z_{it} = \beta_0 + \beta_1 \widehat{CI}_{rt} + \beta_2 \mathbf{DS}_{mt} + \beta_3 \mathbf{CS}_{it} + \gamma P_{mt} + F_f + T_t + u_{imt}$ Dependant variable: Dependant variable: nursing care quality $\in (0, 100/6, \ldots, 100)$, medical quality $\in (0, 100)$, narrow organ. quality $\in (0, 100/2, 100)$ broach organ. quality ($\in (0, 100/5 \ldots, 1)$; Competition variable: inverse number of amb. facilities $1/N$ (10 km radius, 20 km radius and municipality level), HHI amb. care $HHI_{rt} = \sum_{i=1}^{N} s_{it}^2$ (10 km radius, 20 km radius and municipality level) and CR(2) amb. care $CR(2)_{rt} = \sum_{i=1}^{2} s_{it}$ (10 km radius, 20 km radius and municipality level). Fixed effects: capacity dummies (class1 [0 − 40 residents], class2 [41 − 75 residents], class3 [76 − 120 residents], class4 [121 − 400 residents]), wave fixed effects and federal state fixed effects. Instruments: IV_{CI}^{stat}: nursing home competition measures on 10 km radius level; IV^{Reg}: regional characteristics on municip. level (populations density, income tax)

A.6 Quality and vacancies

Table 11: Relationship of nurse vacancies and quality

	Nursing quality			Medical quality			Organisational quality		
Vacancies total	-.0256***			-.0234***			-.0063***		
	(.0053)			(.0061)			(.0013)		
Vacancies trained nurses		-.0362***			-.0341***			-.0092***	
		(.0076)			(.0085)			(.002)	
Vacancies assistants			-.0744***			-.0647***			-.0174***
			(.0156)			(.0197)			(.0038)
Controls	×	×	×	×	×	×	×	×	×
Size FE	×	×	×	×	×	×	×	×	×
Wave FE	×	×	×	×	×	×	×	×	×
Federal State FE	×	×	×	×	×	×	×	×	×
Observations	31323	31323	31323	28419	28419	28419	31670	31670	31670
F-statistic	66	65	66	24	25	24	18	18	18
R2	0.109	0.109	0.109	0.057	0.057	0.057	0.052	0.052	0.052

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$; robust standard errors

Sources: Transparency Reports (on facility-level) and indicators and maps of regional and urban development on county levels for 2011 2013 2015, Observations: $28419 - 31323$ ambulatory facilities.Model: $Z_{ct} = \beta_0 + \beta_1 V_{ct} + \beta_2 \mathbf{X_{ct}} + S_s + F_f + T_t$ Dependant variable: nursing care quality $\in (0, 1/6, \ldots, 1)$ and medical quality $\in (0, 1)$ $[Z_{tc}]$; Variable of interest: average number of job offers for nurses (total, trained, assistants) per county $[V_{ct}]$; Regional control variables on county level provided in Table 6. Fixed effects: capacity dummies (class1 [0-40 residents], class2 [41 - 75 residents], class3 [76 - 120 residents], class4 [121 - 400 residents]) $[S_s]$, federal state and time fixed effects $[F_f + T_t]$.