"Discrimination in Waiting Times by Insurance Type and Financial Soundness of German Acute Care Hospitals"

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Abstract. (68 words)

This paper shows that in German acute hospital care patients with private health insurance (PHI) have significantly shorter waiting times than patients with statutory health insurance (SHI). This preferential treatment may be driven by the higher expected profitability of benefiting PHI holders with relatively short waiting times. Consistently with this result we find that financially sound hospitals discriminate more between PHI and SHI holders than financially unsound hospitals.

1. Introduction

It is well documented that in many health systems medical services are rationed by waiting lists rather than

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prices (Lindsay and Feigenbaum 1984, Cullis and Jones 1986). In times of rationed medical supply, waiting lists discriminate between urgent and less urgent needs of treatment, but also between profitable and costly patients. Often holders of private health insurance (PHI) pay either more for equal services or have access to more innovative and costly treatments not available to holders of statutory health insurance (SHI) or those without any insurance (Lüngen et al. 2008, Krobot et al. 2004). Thus, discriminating between PHI and SHI patients is potentially profitable for providers of medical services. Indeed, empirical results show that private insurees benefit from better access to medical care including shorter waiting times (Asplin et al. 2005, Ward et al. 2008).The first objective of this paper is to determine theoretically and empirically whether discrimination of patients by insurance status occur within the German stationary acute care health sector. Second, we analyze whether discrimination is significantly associated with the financial soundness of hospitals.

More specifically, we first analyze hospitals supply of appointments within a dynamic model.[2] In our model hospitals are assumed to optimize waiting times such that the expected value of the associated profit function is maximized. The expected profitability of patients differs by the insurance type of the patients, who are either PHI or SHI holders. Patients decide on accepting the appointment or not based on the waiting time until appointment and their aversion towards high waiting times. The model basically shows that given an optimal

[2] Former models of waiting times follow two separate strands. In the statistical and operations research literature demand is modeled as random. The focus lies on the optimal distribution of queues from the point of view of the provider of services (Cox and Smith 1961, Cooper 1981). In welfare economics queuing is evaluated as an equilibrium device for demand and supply in elective care. The focus is on the Pareto-optimum distribution and allocation of resources.For a good overview of this literature see Siciliani (2006). We follow the statistical strand, as it is more appropriate to deal with our research question.

capacity hospitals reserve free capacity for PHI patients in order to attract these more profitable patients. This leads to a reduction of waiting times of PHI patients, but also an increase in waiting times of SHI patients and the maximation of expected profits. The model indicates that it pays-off for hospitals to discriminate in access to their medical services on the basis of the insurance type of patients.

Second, we test the theoretical prediction by applying the model to the German acute-care sector. For this purpose, we combine data on financial performance of hospitals with individual waiting times of patients who were given admission to these hospitals. Financial performance is measured by the one-year probability of default (PD). This is a comprehensive indicator of financial soundness often preferred by institutional creditors to measures of profitability or costs (Augurzky et al. 2008). With respect to waiting times we requested individual appointments from hospitals within an experimental study design, which allows for causal inferences of PHI versus SHI on waiting times (Asplin et al. 2005). The empirical analysis then focuses on two aspects: First, waiting times by insurance type and, second, the association between the hospitals`PDs and waiting lists by insurance type.

Empirical literature on the association between financial performance of providers of medical services and waiting times is scarce. Studies using US data found that a decrease in remuneration for the treatment of Medicare patients led to an increase of their waiting times (Resneck et al. 2004). Medicaid patients were shown to have higher waiting times than privately insured patients, who pay more for equal treatments (Asplin et al. 2005, MASG 1994). In German ambulatory care, where the remuneration for treating private policyholders is on average 20-35% higher than for treatments of statutory insurees, the difference in waiting time between these patient types amounts to 300% (Lüngen et al. 2008). These studies confirm that discrimination by insurance type occurs be it in ambulatory or stationary care, within different health system designs and different types of health insurances. Moreover, they indicate that this behavior is motivated by financial incentives. Our study provides first-time empirical evidence for the German acute-care hospital sector.

The paper is organized as follows. Section 2 presents key features of the regulatory framework of health insurance and its impact on patient selection within the German acute care health sector. Section 3 provides the theoretical model. Section 4 describes the data. Section 5 specifies the econometric models, while results are described in section 6. Section 7 concludes.

2. The role of health insurance in the German hospital sector

Before 2004 acute care hospitals in Germany acted under a cost-plus reimbursement system. This changed in 2004 after introduction of the Prospective Payment System (PPS), creating strong incentives for economic discipline in the hospital sector. Under PPS hospitals get a fixed payment for the treatment of each patient in a diagnosis-related group (DRG), regardless of the actual costs incurred by the care of the patient.[3] A large literature documents hospitals' responses in introducing cost-saving or reimbursement-increasing measures under PPS. These measures include decreases in the length of stay (Cutler 1995), selective reductions in expenditures for high-cost patients (Meltzer and Chung

[3] In reality prices are not 100% fix. Prices are fixed within an upper and lower boundary of the length of stay of the patient, in order to account for less (more) cost-intensive in-(out-)liers. Moreover, special compensation rules apply if hospitals exceed or fall below the number of patient cases that was agreed upon with insurance companies.

2002), upcoding[4] (Dafny 2005) and selection of profitable patients (Ellis 1998). Due to the regulatory framework of health insurance in Germany, the insurance status is a potential indicator for a profitable selection of patients. The main regulations shall be shortly described in the following.

In Germany, PHI is only available to some segments of society, namely civil-servants, self-employed and individuals with an annual income above 48.150 €. The rest of society is covered by compulsory SHI (Specke 2005). The cost of holding a PHI depends on morbidity and age. Therefore, one finds individuals with a lower morbidity rate to self-select into PHI and those with a higher morbidity rate to choose SHI which does not base premiums on the individual risk characteristics. Consequently, PHI holders are on average healthier and have a higher income than SHI holders (Kriwy and Mielck 2006). Moreover, with higher income private insurees are more sensitive towards high waiting times than SHI holders, because their opportunity cost of waiting (which may be foregone income or leisure time) is higher (Besley et al. 1999, Johannesson et al. 1998). In contrast, when given the choice between a high waiting time at a local hospital and a low waiting time at a more distant hospital, SHI holders often prefer the first option (Tai et al. 2004). The stronger preference of private insurees for low waiting times puts pressure on hospitals to lower their waiting times, in order not to loose them to competing hospitals.

Further, the treatment of PHI holders can generate additional remuneration not available in basic SHI.[5] These are hotel-benefits (private rooms), more costly treatment by the chief physician and access to innovative and costly treatment methods.[6] In addition, even

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[4] Upcoding refers to switching patients from appropriate lower-paying to higher-paying DRGs in order to inflate reimbursement.

[5] SHI holders can voluntarily purchase supplementary private insurance to cover additional hospital services. Currently 5.1 Million (7.1 %) of SHI-Insurees chose this option (Verband der privaten Krankenversicherung e.V. 2007).

[6] In 2006 the additional remuneration due to hotel benefits and treatment by the chief physician amounted to 2.5 bill. €, or 4% of

without coverage of additional hospital services, private insurees might generate lower costs of treatment given the same reimbursement due to their better health status and therefore probably faster recovery and shorter lengths of stay.

In short, there are arguments why positive discrimination of PHI versus SHI holders may pay-off for a hospital in Germany: the probability that PHI holders have low morbidity rates, additional income sources for treating PHI patients and the aversion of PHI patients towards high waiting times.

3. The model

3.1 Model specification

We assume that demand for a medical appointment at time t is given by $X(t)=X_P(t)+X_S(t)$, where $X_P(t)$ is the number of requests for appointments by private insurees and $X_S(t)$ the corresponding demand by SHI holders. It is natural to assume that $X_P(t)$ and $X_S(t)$ are independent Poisson-distributed random variables with intensity $\lambda_S t$ and $\lambda_P t$ implying that X(t) itself is Poisson distributed with intensity $(\lambda_S+\lambda_P)t$.

Replying to demand the hospital proposes waiting times until appointment. Each patient then either accepts the offer or not. This can be modelled by the sequence of independent random variables $Y_{S/P}(i)$, where $Y_{S/P}(i) = 1$ if the i-th demand accepted the offer given by the hospital and $Y_{S/P}(i) = 0$ otherwise. For short, one can say $Y_{S/P}(i)$ is Bernoulli- distributed $B(U_{S/P}(i))$ with parameter $U_{S/P}(i)$ $u_S=P(i)$, where $u_S=P(i)$ is the probability of accepting the offer. Hence the number of contracts (of the hospital) up to time t is given by

$$Z(t)=Z_S(t)+Z_P(t)$$

total hospital revenues. For a one-bed room the revenue amounted to 82,61 Euro per day, which is around 2.4% of average costs per patient in 2006 (GBE 2008).

with

$$Z_S(t) = \sum_{i=1}^{X_S(t)} Y_S(i), \quad Z_P(t) = \sum_{i=1}^{X_P(t)} Y_P(i) \qquad (1.1)$$

where $Z_S(t)$ is the number of contracts with SHI-holders and $Z_P(t)$ the number of PHI-holders. We assume that hospitals maximize profits PF:

$$PF = \int_0^{365} [(U_S(t+\tau) - U_S(t))F_S - C_S(U_S(t+\tau) - U_S(t))]e^{-r(t)}dt$$

$$+ \int_0^{365} [(U_P(t+\tau) - U_P(t))F_P - C_P(U_P(t+\tau) - U_P(t))]e^{-r(t)}dt \qquad (1.2)$$

$U_S(t)$ is the total number of SHI patients up to time t, $U_P(t)$ is the total number of PHI patients up to time t, τ is the patients length of stay in the hospital, the differences $U_S(t+\tau)-U_S(t)$ $(U_P(t+\tau)-U_P(t))$ count the number of SHI and PHI patients in the hospital at time t, r is the interest rate, F_S is the fixed flat rate payment for SHI-holders, F_P is the fixed flat rate payment for PHI-holders, it holds $F_P>F_S$ because of additional remuneration opportunities (private rooms, treatment by chief physician) treating PHI-holders, $C_S(U_S(t))$ are treatment costs for SHI-holders, $C_P(U_P(t))$ are treatment costs for PHI-holders and it holds $C_S(x)>C_P(x)$, $\forall x \in R_+$. The cost function C is assumed to fulfil the usual conditions, i.e.

$$C' > 0, \qquad (1.3)$$

Until now we did not restrict the hospitals capacities. We impose such a restriction by requiring that the total number of patients in the hospital is bounded by a number $N \in$ N for all t. In terms of U(t) this can be written as

$$U(t+\tau)-U(t)=U_S(t+\tau)-U_S(t)+U_P(t+\tau)-U_P(t) \leq N. \qquad (1.4)$$

In order to maximize the profit function (1.2) we have to replace $U_S(t)$ and $U_P(t)$ by the better known functions in (1.1) and (1.5). For this we need the following equations:

$$U_S(t)=Z_S(t)-W_S(t), U_P(t)=Z_P(t)-W_P(t), \qquad (1.5)$$

where $W_S(t)$ $(W_P(t))$ is the length of the waiting line of the SHI-holders (PHI-holders resp.). Inserting (1.5) into (1.2), we get

$$PF=\int_0^{365}[(Z_S(t+\tau)-Z_S(t))\cdot F_S-C_S(Z-W)_S(t+\tau)-(Z-W)_S(t)]e^{-r(t)}dt$$

$$-\int_0^{365}[(W_S(t+\tau)-W_S(t))F_S]e^{-r(t)}dt$$

$$+\int_0^{365}[(Z_P(t+\tau)-Z_P(t))\cdot F_P-C_P(Z-W)_P(t+\tau)-(Z-W)_P(t)]e^{-r(t)}dt$$

$$-\int_0^{365}[(W_P(t+\tau)-W_P(t))F_P]e^{-r(t)}dt\ . \qquad (1.6)$$

Note that PF is a random variable. Hence maximizing the profit means that the expectation of the profit variable E(PF)is maximized. Therefore, it is important to understand how a hospital`s management can steer profit and therefore its expectation. In the beginning of the model the Bernoulli-distributed random variables $Y_{S/P}(i)$ were introduced. The main point in this context are the Bernoulli-parameter $u_S^{(0)}(i)$ and $u_P^{(0)}(i)$, which can be considered as functions of the offered waiting time T_W, i.e.

$$u_S = u_S(T_W),\ u_P = u_P\ (T_W). \qquad (1.7)$$

We assume that the probability of accepting an offer $u_S(T_W)$ and $u_P\ (T_W)$ decreases strictly with increasing waiting times, because of aversion of patients towards high waiting times..

Before this background the question is: How can waiting times T_W be influenced by the management in order to maximize the expected profits? Let us first approach this question by intuitive deliberations: If the waiting list is empty, i.e. the capacity of a hospital is not exhausted, than it seems to be unreasonable to choose a waiting time T_W larger than zero for any patient requesting a medical appointment. But if the waiting list is not empty, it makes no sense to follow the usual law: first come – first serve, last come – last serve, since PHI-holders are more profitable patients. So one should leave gaps in the queue reserved for PHI-holders. Of course, these gaps should not be too large, since the demand for medical treatments is random and it may happen that in the latter case the capacities will not be exhausted. We check whether this intuition is verified by the model. For this reason we have to understand how a change in the probability of accepting an offer u_S and u_P changes the distribution of the number of contracts with SHI-holders Z_S and PHI-holders Z_P respectively. The first step in this direction is to determine the distribution of Z_S and Z_P if we leave u_S and u_P constant. This is done by the following theorem:

Theorem 1. Let $Z_S(t)$ and $Z_P(t)$as in 1.1 and let us fix u_S and u_P. Then the process $Z_S(t)$ and $Z_P(t)$ are again Poisson distributed with parameter $u_S\lambda_S t$ and $u_P\lambda_P t$ respectively.[7]

3.2 Interpretation: Capacity under-utilized

We discuss the case when capacity is not exhausted over the whole period of time under the assumption that T^S_W and T^P_W are fixed at the beginning of the year. In this case we can calculate the expectation of 1.6. Since $Z_S(t+\tau)-Z_S(t)$ and $Z_P(t+\tau)-Z_P(t)$ are still Poisson distributed with parameters $u_S(T^S_W)\lambda_S\tau$ and $u_P(T^P_W)\lambda_P\tau$ respectively (for a proof see Norris (1997)) and since by assumption $W_S(t)=0$ for all $t\in[0,365]$, we obtain by exchanging the integrations in this case

$$E(PF)=\int_0^{365}[(u_S(T^S_W)\lambda_S\tau\cdot F_S-E(C_S((Z-W)_S(t+\tau)-(Z-W)_S(t)))]e^{-r(t)}dt$$
$$+\int_0^{365}[(u_P(T^P_W)\lambda_P\tau\cdot F_P-E(C_P((Z-W)_P(t+\tau)-(Z-W)_P(t)))]e^{-r(t)}dt. \quad (2.1)$$

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[7] A proof of the theorem is presented in the appendix.

Since the processes $(Z-W)_S(t+\tau)-(Z-W)_S(t)$ and $(Z-W)_P(t+\tau)-(Z-W)_P(t)$ are stationary $E(C_S((Z-W)_S(t)))$ and $E(C_P((Z-W)_P(t)))$ are constant in t. Using the assumption on u_S and u_P above we obtain that (2.1) is monotonically decreasing in T^S_W and T^P_W . This is intuitive: If the capacities are not exhausted, the hospital should, if possible, decrease the waiting times for the patients and should offer the same waiting times for SHI and PHI-holders.

3.3 Interpretation: Capacity fully-utilized

The assumption made in section 3.2, that a hospital fixes the waiting times T^S_W and T^P_W before, is very demanding. Rather it is reasonable to assume that a hospital choose the parameters T^S_W and T^P_W at time t using the information given by $Z_S(v)$, $Z_P(v)$, $U_S(v)$, $U_P(v); v \leq t$. For example, if the waiting list $W(t)=Z(t)-U(t)$ is large, the hospital rather integrates gaps reserved for PHI-holders in the queue – in order to attract these more profitable patients – than in the case when W(t) is small or zero.

As shown in 3.2 the latter case of small Waiting lists is an indication of not exhausted capacities. Since non exhausted capacities cause additional costs, profit maximizing hospitals try to achieve fully utilized capacities.[8] If hospitals attain their goal of fully utilized capacities for most times $t \in [0, 365]$, we have that $W(t) > 0$. In this case it holds $U(t+\tau) - U(t) = N$ and (1.2) is approximated by:

$$\text{PF} \approx \int_0^{365} [(N - U_P(t+\tau) - U_P(t))F_S - C_S(U_S(t+\tau) - U_S(t)] \cdot e^{-r(t)} dt$$

$$+ \int_0^{365} [(U_P(t+\tau) - U_P(t))F_P - C_P(U_P(t+\tau) - U_P(t))] \cdot e^{-r(t)} dt . \quad (3.1)$$

[8] A more formal discussion of the question "What is the optimal capacity of a profit maximizing hospital?" can be found in Schwierz, Wübker, Wübker and Kuchinke (2008).

Let $\delta := F_P - F_G$, then (3.1) can be rewritten as

$$PF \approx \int_0^{365} [(N \cdot F_S) + \delta \cdot (U_P(t) - U_P(t-\tau))$$

$$-C_S(U_S(t+\tau)-U_S(t))-C_P(U_P(t+\tau)-U_P(t))]\, e^{-r(t)}dt. \qquad (3.2)$$

Getting

$$PF \approx \int_0^{365} [(N \cdot F_S - C_S(U_S(t+\tau)-U_S(t)) - C_P(U_P(t+\tau)-U_P(t))] \cdot e^{-r(t)}dt$$

$$+\delta \int_0^{365} (U_P(t+\tau)-U_P(t))\; e^{-r(t)}dt. \qquad (3.3)$$

Taking expectations we obtain

$$E(PF) \approx \int_0^{365} [(N \cdot F_S - E(C_S(U_S(t+\tau)-U_S(t)) - C_P(U_P(t+\tau)-U_P(t))] e^{-r(t)}dt$$

$$+\delta \int_0^{365} E((U_P(t+\tau)-U_P(t)))\quad e^{-r(t)}dt. \qquad (3.4)$$

Using this we can discuss what happens if we insert gaps reserved for PHI-holders in the queue. Since $C_P'<0$, $C_S'<0$ by assumption, the first integral increases if $T^P_W(t)$ decreases. Secondly, $E((U_P(t+)-U_P(t)))$ increases if $T^P_W(t)$ decreases. This implies that (3.4) increases if $T^P_W(t)$ decreases. In other words: Our model shows that given an optimal fully utilized capacity hospitals reserve free capacity for PHI patients in order to attract these more profitable patients. This leads to a reduction of waiting times of PHI patients, but also an increase in waiting times of SHI patients and the maximation of expected profits. Thus the model indicates that it pays-off for hospitals to discriminate in access to their medical services on the basis of the insurance type of patients. In the following, we test the theoretical prediction of the model with regard to the German acute-care sector. For this purpose, we combine data on financial performance of hospitals with individual waiting times of patients who were given admission to these hospitals.

4. Data

4.1 Probability of Default and Hospital characteristics

We use a densified measure of the financial performance of hospitals: the probability of default (PD) of an enterprise within one year. We use a rating tool to estimate the yearly PD for each hospital on the basis of balance sheets and profit and loss statements from acute care hospitals.[9] Our PDs are derived from 311 balance sheets from the years 2001 to 2005 and covering 435 or 24% of all hospitals situated in Germany in 2006. On average, the sample includes bigger hospitals, slightly overrepresents hospitals of private ownership and mirrors well the regional distribution of hospitals on the level of the German Federal States.[10] The total PD in our sample amounts to 1.31%. On average, public hospitals have a PD of 1.52%, private-not-for-profits 0.98% and private for-profits 1.47%. As a rough categorization creditors regard companies with a PD up to 1.00% as creditworthy. These companies are normally able to take up loans with relatively low costs. With a PD in the range of 1.00% - 2.60% obtaining a credit becomes more difficult and more costly, but is usually still possible. PDs above 2.60% suggest great difficulties up to the impossibility to borrow money.

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[9] The evaluation of the PD is based on key operating figures, such as liquidity, the debt to equity ratio or current assets. See Augurzky et al. (2008) for a more detailed description of the data and the model.

[10] The number of hospitals is higher than the number of balance sheets due to the inclusion of hospital chains. These provide only one balance sheet for all hospitals in a chain. We do not consider purely psychiatric hospitals in our sample. See also Augurzky et al. (2008).

We merge the yearly PD with hospital-level and regional-level data in order to control for observed heterogeneity across hospitals as well as for common market characteristics. On hospital-level these are the ownership form of the hospital (private for-profit, private not-for-profit, public), hospital size measured in the number of beds and the year of the balance sheet information. Regional-level data account for the levels of capacity utilization by ownership type and the amount of public subsidies in the hospital sector on the level of the German Federal States. Finally, we add a dummy distinguishing East from West German hospitals. The variables are described in the appendix in Table A1.

4.2 Waiting times

Data on waiting times for appointments at acute care hospitals in Germany was not available prior to this study. Therefore, it was collected following an experimental study design, as proposed by Asplin et al. (2005). Trained graduate students, who posed as patients, called hospitals using standard interview questions and data collection forms with the aim of obtaining an appointment for a doctoral consultation. During the call the interviewers had to make clear that they already went through a thorough medical check by an ambulatory doctor in short period before the request for appointment, such that their diagnosis was already established.[11] An important aspect of our experimental design of the study was to keep insurance status exogenous to waiting times. For this purpose the interviewers were told not to actively communicate their insurance type. Only upon request by the personnel of the hospital the interviewers presented themselves as SHI holders. Hospitals actively requesting the insurance type were then recalled for a second time within a few

[11] Usually patients obtain appointments through the ambulatory health sector. The gate-keeper, i.e. the house doctor, provides his patients with an appointment for a hospital stay. In order to directly obtain an appointment, our interviewers told the hospital personnel that they had to abstain from a routine referral by their doctors due to a recent tenancy changeover to a new hometown.

days after the first call.[12] During the second call the anonymous interviewer claimed to be privately insured. Hospitals not asking for the insurance type were not recalled. The interviewers obtained information on whether an appointment was consented to or refused, what the waiting time in days until the appointment was and on which day of the week the call was made. Upon attainment, all appointments were cancelled in order not to bind hospital capacity. The calls were randomly spanned over the weekdays (Monday to Friday) in 2007.

Three clinical conditions were selected by a medical practitioner before the interviews conditional on two attributes.[13] First, they should not be life-threatening or being declared as emergency cases, but should necessitate a medical treatment within short notice (maximum two weeks) in order not to result in otherwise avoidable detrimental health effects. Second, they should be treatable within the sample of hospitals for which data on hospital characteristics was readily available. The chosen conditions are Weber B Fracture, cervical conization and stenosis. Weber B Fracture is a fracture of the ankle joint treated operatively in surgical departments. Cervical conization is an operative treatment in gynecology departments, when cancer is suspected. Stenosis is a constriction of the coronary vessels treated by a stent implantation in cardiology departments.[14] Hospitals which had more than one of the departments in question, received calls to each of the departments.

[12] The average lag between first and second call was 7 days. The lag was meant to be kept short in order to minimize the risk that a sudden change in capacity utilization of a hospital significantly impacts on waiting times. Where possible, in order to prevent the interviewer from being re-identified by the personnel of the hospital, second calls were done, by different interviewers. Furthermore, caller identification for all outgoing calls was blocked.

[13] We thank Dr. med. Lüder Herzog from the Dresdner Hospital for his help in the selection of the appropriate clinical conditions.

[14] The four-digit codes within the International Classification of Diagnoses in its 10th-German Modification are “S82.6” for Weber B Fracture, “I25.1” for stenosis and “C53.9” for cervical conisation.

Table 1 presents descriptive statistics for the number of appointments acquired as well as the waiting times obtained by several subsamples. In the left part of the table, statistics for all appointments are shown. In the right part of the table, the subsample of all the remaining appointments after matching waiting times to hospital characteristics is presented. During the study period a total of 751 appointments from 531 hospitals was obtained. Matching waiting times with other observable characteristics of hospitals, such as their financial performance, leads to a reduction of the sample to 498 observations. Only 27 calls ended without successfully obtaining an appointment, either because the clinic did not provide treatment for the selected clinical condition or because the clinic did not answer the phone or because, in very few cases, the clinic did not provide an appointment because it was fully-booked for the next weeks to come.

Table 1
Number of appointments and waiting times

	All obtained appointments			**Remaining appointments with matched data**		
	Obs.	**Mean**	**SD**[1]	**Obs.**	**Mean**	**SD**
Total number of calls	751 (531)[2]	5.88	5.33	498 (326)	6.15	5.72
Calls with a successful appointment	724 (504)	5.88	5.33	498 (326)	6.15	5.72
Calls without a successful appointment	27 (27)	–	–	0 (0)	–	–
Insurance not asked for	398 (341)	5.76	4.61	248 (201)	5.26	6.25
Insurance asked for	326 (163)	6.55	5.52	250 (125)	7.04	5.32
PHI holder	163	5.10	5.14	125	5.69	4.33
SHI holder	163	8.00	5.90	125	8.39	5.87

Notes: [1] Standard deviation; [2] Numbers in parentheses indicate the number of hospitals; Authors' calculations.

A total of 163 times, i.e. in 29 percent of all cases, the interviewers were asked for their health insurance type, which ensued a follow-up call to each of these hospital to obtain waiting times for a PHI holder. Waiting times are lower if hospitals do not ask for the insurance type of the patient (Table 1). This hints at overall lower capacity utilization in these hospitals as compared to those which actively investigated the insurance type of the patient. Table 1 further shows that average waiting times clearly differ by the insurance type (Table 1). Private insurees wait on average 5.1 days, whereas SHI holders wait on average 2.9 days longer. Overall, the pattern of differences in waiting times, as described above, remains the same in the matched subsample: Hospitals which have investigated the insurance type of the patient have on average higher waiting times than those who were not interested in this type of information. Also, PHI holders have shorter waiting times than SHI holders.

Table 2 further decomposes waiting times by each clinical condition. Clearly, the propensity to ask for the insurance status or not depends on the clinical condition. Patients with Weber B Fracture are asked relatively seldom, patients with cervical conization are asked little more than half of the times and patients with stenosis are asked relatively often. Accordingly, waiting times increase in the same order of clinical conditions. Short waiting times in case of Weber B Fracture will be most probably related to the occurrence of acute pain that patients with this clinical condition have to endure. On the other hand, the relatively long waiting times for patients with stenosis and cervical conization may be explained by the lack of acute pain for these patients. The decomposition shows that within all diagnoses PHI patients have shorter average waiting times than SHI patients, once the hospitals ask for the insurance status.

Table 2

Number of appointments and waiting times by clinical condition

	All obtained appointments			**Remaining appointments with matched data**		
	Obs.	**Mean**	**SD**[1]	**Obs.**	**Mean**	**SD**
Weber B Fracture	213 (189)	1.77	3.08	133 (118)	2.09	3.32
Insurance not asked for	163 (163)	1.65	2.83	103 (103)	1.83	2.87
Insurance asked for	50 (25)	2.16	3.83	36 (18)	2.82	4.35
PHI holder	25	0.88	1.76	18	1.17	2.01
SHI holder	25	3.50	4.88	18	4.59	5.44
Stenosis	176 (114)	9.28	5.97	144 (92)	9.11	5.80
Insurance not asked for	51 (51)	9.55	5.83	37 (37)	10.30	5.70
Insurance asked for	126 (63)	9.18	6.06	104 (52)	8.71	5.81
PHI holder	63	7.60	5.08	52	7.05	4.56
SHI holder	63	10.80	6.57	52	10.41	6.48
Cervical Conization	335 (264)	6.70	4.37	221 (166)	6.72	4.46
Insurance not asked for	188 (188)	6.89	4.66	108 (108)	6.81	4.73
Insurance asked for	150 (75)	6.46	3.96	110 (55)	6.62	4.19
PHI holder	75	5.84	3.61	55	5.77	3.73
SHI holder	75	7.11	4.21	55	7.53	4.48

Notes: See notes to Table 1.

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We have estimated two simple models for the probability that a hospital asks for the patients' insurance status (Table 3). The results confirm the descriptive analysis that the probability of being asked is significantly decreased for the clinical condition Weber B Fracture and increased for calls on stenosis relative to the clinical condition of cervical conization. Further, calls later than Monday increase the probability of the outcome. In the subsample of hospitals with matched data the only additional significant determinant of the assessed probability is being geographically located in East Germany.

Table 3
Determinants of the probability to ask for the patients' insurance type

	All hospitals		Matched data	
Independent Variables	Marginal Effects	z-value	Marginal Effects	z-value
Probability of default	–	–	–0.012	(1.01)
For-profit hospital	–	–	0.690	(0.77)
Private non-profit hospital	–	–	0.012	(0.19)
#Beds	–	–	–0.004	(1.16)
#Beds²	–	–	0.004	(1.58)
Regional Capacity Utilization	–	–	0.157	(1.21)
Regional Capacity Utilization²	–	–	–0.001	(1.18)
East Germany	–	–	–0.251***	(3.68)
Public subsidies	–	–	0.005	(1.56)
Last PD before 2004	–	–	–0.069	(0.77)
Diagnosis: Fracture	–0.161***	(3.68)	–0.219***	(3.60)
Diagnosis: Stenosis	0.270***	(5.25)	0.232***	(3.55)
Tuesday	0.141**	(2.21)	0.135	(1.55)
Wednesday	0.149**	(2.23)	0.200**	(2.16)
Thursday	0.119*	(1.85)	0.111	(1.29)
Friday	0.217***	(2.78)	0.225**	(2.29)
Pseudo R²	0.11		0.18	
Chi²-test for joint significance of beds	–		3.52	
Chi²-test for joint significance of capacity utilization	–		1.61	
Observations	561		373	

Notes: Estimates from probit models; Constant included; Standard errors corrected for clustering of observations within hospitals; constant included; ***, **, * significant at 1%, 5% and 10% level respectively.

5. Estimation methods

We first estimate a number of hospital fixed-effects models using data on all obtained appointments. For the waiting time w_{ih} of patient *i* in hospital *h* we assume that:

$$w_{ih} = c + \alpha I_i + \gamma T_i + u_h + \varepsilon_{ih}, \qquad (1)$$

where *c* is a constant; I_i is a dummy for the insurance status of the patient, with 1 for a PHI and 0 for a SHI holder; T_i is a vector of dummies denoting the weekday of the call for appointment, u_h is a hospital fixed-effect and ε_{ih} is the random error. We are interested in the causal effect of insurance status on waiting times.

We provide results for two samples of hospitals. First, we assume that hospitals not asking for the insurance type of the patient would have offered identical waiting times to both PHI and SHI holders. Thus, for this subsample of appointments we duplicate the number of observations and assign one half of the observations to SHI and the other half to PHI patients. We then pool this data with appointments for hospitals who have asked for the insurance type and use all in one regression. The strategy basically imposes a no discrimination constraint between PHI and SHI holders for the subsample of hospitals who did not investigate the insurance type. Resulting estimates should therefore be regarded as conservative and could be, loosely speaking, a lower bound for the impact of insurance type on waiting times. We estimate a model without differentiation between the diagnoses as well as separate models for each diagnosis. Second, we restrict the data to only those hospitals who have asked for the insurance type of patients. In analogy to the pooled estimate above, this estimate will yield an upper bound of discrimination, because it focuses on the subsample of hospitals which have an obvious interest in the insurance type of their patients and can therefore discriminate easily. In both cases, we estimate a model without differentiation between the diagnoses as well as separate models for each diagnosis.

We then continue to assess whether waiting times are associated with the financial performance of the hospital as well as with other observable characteristics of hospitals within the sample of matched data. The model is then:

$$w_{ih} = \tilde{c} + \tilde{\alpha} I_i + \tilde{\gamma} T_i + \beta pd_h + \delta X_h + \lambda D_i + \tilde{\varepsilon}_{ih}, \quad (2)$$

where pd_h is the probability of default of hospital h of admittance; X_h is a vector of other observed hospital and regional attributes and D_i is a vector of dummies of the patient's clinical condition. Because hospital characteristics do not vary by the insurance type of patients, we have to forgo hospital fixed-effects in this model. Also, because of the small sample size we do not estimate separate models for each diagnosis.

Finally, we estimate how the financial performance as well as other observable characteristics of hospitals and patients are associated with differences in waiting times between PHI and SHI holders:

$$\Delta w_{ih} = \tilde{\tilde{c}} + \tilde{\beta} pd_h + \tilde{\delta} X_h + \tilde{\lambda} D_i + \mu_i W_i + \tilde{\tilde{\varepsilon}}_{ih}, \quad (3)$$

where Δ denotes the within-hospital difference in waiting times between PHI and SHI holders and W_i is a vector of variables denoting the difference between the weekday of a call for appointment for a PHI patient and the weekday of a call for a SHI patient by the weekdays of a SHI patient (So, e.g. the value is 3 if the call for a PHI patient was on a Friday and the call for a SHI patient was on a Tuesday.).

We estimate equations (1) and (2) by count models, because waiting times are measured in full days. In the final model specification the choice fell on a negative binomial model, as the LR-test has confirmed that waiting times are overdispersed. The standard errors were corrected for clustering of multiple observations within the same hospital. Model (3) was first estimated by ordinary least squares (OLS). However, tests indicating heteroscedasticity indicate that OLS is inefficient as compared to an estimation using a heteroscedasticity-consistent variance-covariance matrix of the error term. As the form of heteroscedasticity is unknown, we estimate the equation additionally by feasible generalized least squares (Wooldridge 2002). For this purpose we use the residuals ε_{ih} from equation (3) after estimation by OLS. We then regress the log of the squared residuals $\ln\left(\varepsilon_{ih}^2\right)$ on all explanatory variables by OLS, use the fitted values $\hat{g}_{ih} \equiv \ln\left(\hat{\varepsilon}_{ih}^2\right)$ from this regression and estimate (3) with weighted least squares and weights $w_{ih} = \exp(-\hat{g}_{ih})$.

6. Results

Table 4 presents the marginal effects of PHI versus SHI status as well as the levels of statistical significance as modeled in equation (1), i.e. after accounting for hospital fixed-effects and the days of the calls for appointment. In the left part of the table, the conservative estimates are presented, where it is assumed that hospitals not asking for the insurance type offer identical waiting times to PHI and SHI patients. The right part of the table shows estimates for the subsample of hospitals investigating the insurance status. For the sake of brevity the estimates of the other covariates are omitted.

First, in all estimation results PHI is related to shorter waiting times than SHI. Thus, clearly insurance status is a significant predictor of waiting times. The average effects vary between the conservative and non-conservative estimates as well as between diagnoses. The conservative estimate of -0.61 is more than 3 times lower than the estimate of -2.19 for the subsample of hospitals who have investigated the insurance status. This difference in estimates is mainly driven by the low propensity of hospitals to ask for the insurance status within the clinical condition of Weber B Fracture, such that the assumption of identical waiting times is reducing the overall effect of insurance status on waiting times.

Table 4

Marginal effect of PHI versus SHI on waiting times

Sample	All appointments[1]			Insurance type asked for[2]		
	Obs.	Marginal effect	z-value	Obs.	Marginal effect	z-value
All diagnoses	1122	–0.61***	(5.02)	326	–2.19***	(6.05)
Stenosis	212	–1.62***	(3.93)	128	–3.06***	(4.15)
Weber B Fracture	365	–0.30**	(2.04)	52	–2.91**	(2.16)
Cervical Conization	545	–0.38***	(3.32)	146	–1.43***	(3.48)

Notes: [1] All appointments and assuming identical waiting times for the subsample of hospitals not asking for the insurance type; [2] Subsample of hospitals asking for the insurance type; Poisson model including hospital fixed-effects, the weekday of the call for appointment and a constant; Standard errors corrected for clustering within hospitals; ***, **, * significant at 1%, 5% and 10% level respectively

Considering the magnitude of the effects, it is of course uncertain whether in the extreme case of a 3 day difference in waiting times, the relatively high waiting times for SHI patients would be detrimental to their health status. However, because in all clinical conditions patients get access to medical care mostly within the admissible range of waiting times, negative health effects are not very probable.

Table 5
Marginal effect of PHI versus SHI and hospital characteristics on waiting times

Independent Variables	All appointments[1]		Insurance type asked for[2]	
	Marg. Effect	**z-value**	**Marg. Effect**	**z-value**
PHI holder	-0.768***	(6.31)	-2.671***	(6.84)
Probability of default	0.093*	(1.82)	0.287**	(2.27)
For-profit hospital	0.753	(1.14)	-1.711	(1.17)
Private non-profit hospital	0.888*	(1.91)	0.057	(0.06)
#Beds	0.003	(1.21)	0.004	(0.92)
$\#Beds^2$	-0.003	(1.56)	-0.006*	(1.82)
Regional Capacity Utilization	-0.101	(0.13)	-3.107	(1.44)
Regional Capacity $Utilization^2$	7.0 E-04	(0.14)	0.019	(1.34)
East Germany	0.415	(0.83)	1.281	(1.04)
Public subsidies	0.004***	(2.62)	-0.027	(1.36)
Diagnosis: Fracture	-6.021***	(9.08)	-4.921***	(3.04)
Diagnosis: Stenosis	1.525***	(4.35)	2.280***	(3.57)
Last PD before 2004	0.767	(1.44)	0.496	(0.44)
Chi^2-test (whole model)	217.20***		169.80***	
F-test for joint significance of beds	3.69		14.26***	
F-test for joint significance of capacity utilization	0.03		5.13*	
Observations	746		250	

Notes: [1] Including only hospitals with waiting times for both PHI and SHI holders; Negative binomial model; Standard errors corrected for clustering of observations within hospitals; constant and differences in weekdays of calls between PHI and SHI patients included;***, **, * significant at 1%, 5% and 10% level respectively.

In Table 5, we investigate whether waiting times across hospitals can be significantly explained by their financial performance as well as by other observable attributes. As before, the insurance status is a strong predictor of waiting times. Moreover, the hospitals' PDs are positively related to waiting times. Out of the remaining explanatory variables only regional public subsidies, hospital size and the patients' diagnoses are significantly related to waiting times on the 5 percent significance level in either of the both estimates. Thus, overall there are few observable hospital characteristics that are significant predictors of individual waiting times.

Table 6
Marginal effects on the difference in waiting times between PHI and SHI holders

	All appointments[1]		**Insurance type asked for**[2]	
Independent Variables	Coeff.	t-value	Coeff.	t-value
Probability of default	0.064**	(2.13)	0.441***	(2.81)
For-profit hospital	-0.415	(1.24)	1.247	(1.64)
Private non-profit hospital	-0.119	(0.43)	0.078	(0.63)
#Beds	-0.001	(0.51)	-0.007**	(2.00)
#Beds²	0.001	(0.66)	0.006**	(2.20)
Regional Capacity Utilization	-0.604	(0.76)	-0.239	(0.08)
Regional Capacity Utilization²	0.004	(0.79)	0.004	(0.22)
East Germany	-2.578**	(2.14)	-4.582***	(2.66)
Public subsidies	0.001	(0.15)	0.037	(3.73)
Last PD before 2004	0.479	(1.42)	-2.134	(1.64)
Diagnosis: Fracture	0.076	(0.35)	-1.907	(1.34)
Diagnosis: Stenosis	-0.606	(1.09)	-0.363	(0.49)
F-test (whole model)	3.75**		4.14***	
F-test for joint significance of beds	0.64		4.97*	
F-test for joint significance of capacity utilization	1.01		7.79**	
Observations	373		125	

Notes: FGLS estimation results; Standard errors corrected for clustering within hospitals; constant included; tested for interactions between PHI and ownership form / hospital size / diagnoses; ***, **, * significant at 1%, 5% and 10% level respectively

Finally, Table 6 presents the results of estimates of the difference in waiting times between PHI and SHI holders as in equation (3). The results show that for high PDs this difference is more positive. In other words, hospitals with a bad financial performance do not benefit PHI holders with lower waiting times as compared to SHI holders.

To better understand the association between the PD on discrimination in waiting times between patient types, we graph the expected mean difference in waiting times for a range of values of the PD. To this end, following the estimation results of equation (5) we set the PD at a given value and, using simulated parameters values, we generate the average expected waiting time, as well as the 95 percent confidence interval at each value of the PD.[15] We draw 1,000 simulations of the estimated model parameters from their asymptotic sampling distributions. To generate the expected mean waiting times all variables other than the PD are set at their mean values.

Figure 1 presents the simulated expected values and the 95 percent confidence interval of waiting times for the range of values of the PD. The left panel of the figure shows the linear relationship between PD and the dependent variable for hypothetical values of the PD from zero to ten percent. The positive slope reveals that increasing values of the PD go along with relatively high waiting times of PHI as compared to SHI holders. Also the shape of the confidence interval illustrates that the degree of uncertainty regarding the simulated waiting times drastically increases once the difference in waiting times between PHI and SHI holders becomes positive. The right panel of the figure shows the difference in waiting times for the 1st to the 99th percentile of the actual PDs in the sample. The graph reveals that hospitals with a PD below one percent, which totals around 70 percent of all hospitals in our sample, tend to benefit PHI holders with relatively low waiting times. Discrimination decreases for hospitals with PDs above one percent.

These result are intuitive, as hospitals with high PDs will tend to have low rates of capacity utilization or will therefore not discriminate between patients but

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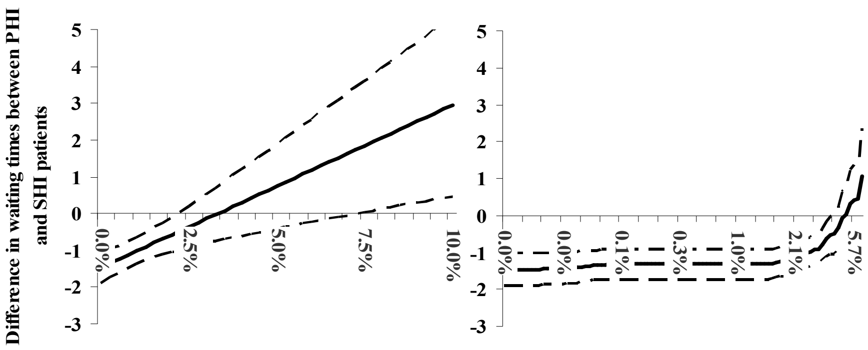
[15] We use CLARIFY, a STATA add-on, for this purpose (Tomz et al. (2001), King et al. (2001)).

rather give all of them equally fast access to their services. On the other hand, hospitals with a low PD will tend to utilize their capacity to a greater extent and will probably try to increase profits by discriminating between PHI and SHI holders. This may be achieved by a management system for waiting lines, where offers of waiting times are based on medical and profit considerations. Unfortunately, we do not observe whether actually discriminating hospitals have a waiting line management and whether this system drives the PD. Therefore, it is not possible to establish a causal link between the discrimination in waiting times and the PD in our study.

Figure 1

Simulated differences in waiting times between PHI and SHI holders by levels of the probability of default



7. Conclusion

The paper had two objectives. First, we assessed the causal impact of private (PHI) versus statutory health insurance (SHI) on waiting times until medical treatment in German acute care hospitals. Second, we explored whether financially sound hospitals discriminate more between these insurance groups than financially unsound hospitals. For this purpose we have developed a dynamic model, where hospitals allocate appointments according to the expected profitability which differs by the insurance type of their patients. Moreover, using data on financial performance of 435 German acute care hospitals and individual waiting times for medical treatments of privately and socially insured patients we investigated the objectives empirically.

Our dynamic model of waiting times predicted that profit-maximizing hospitals should grant generally profitable PHI patients lower waiting times relative to generally less profitable SHI patients. The preferential treatment of PHI holders may be explainable by profit and cost considerations. In Germany hospitals treating PHI holders profit from remuneration generated by additional services, which are often unavailable to SHI holders. Further, due to health insurance regulations, PHI holders tend to be a high income group, which is at lower risk of generating unremunerated costs for the hospital. Furthermore, PHI holders are more sensitive towards high waiting times than SHI holders. Overall, it makes sense to benefit PHI holders with shorter waiting times, as this ensures potentially more and more profitable patients.

The empirical results did not reject this prediction. First, the results show clear evidence of shorter waiting times for holders of PHI relatively to holders of SHI. Thus, access to medical stationary health care in Germany is asymmetrical w.r.t. the insurance status. Second, we find that more profitable hospitals discriminate more in waiting times than financial unsound hospitals. Hospitals which perform financially well will most probably have higher rates of capacity utilization and will therefore not be able to admit all patients requiring an appointment. Therefore, they will probably establish a management of waiting lines and admit patients based not only medical but also profit considerations. Because it is more profitable to benefit PHI holder with short waiting times, the association between the financial performance and discrimination in waiting times is intuitive. Unfortunately, we do not observe whether actually discriminating hospitals have a waiting line management and whether this system drives the PD. Therefore, it is not possible to establish a causal link between the discrimination in waiting times and the PD in our study.

While we could show that discrimination occurs and may be profitable, we do not know whether discrimination by insurance status in waiting times carries on to discrimination in the quality of treatment. This is an important issue, especially as so far there is very little transparency in quality of treatment in Germany. In the end, patients cannot judge in which hospital they are treated better. As long as quality remains intransparent, it is easier for hospitals to discriminate in the quality of treatment, e.g. by insurance status. This is an important subject for future research.

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Appendix

Proof: For the proof we use the method of generating functions (see e.g. (2)). Let v $\leq$ 1. Then

$$E\left(v^{Z_S(t)}\right) = E(v^{\sum_{i=1}^{X_S(t)} Y_S(i)}) = E(\prod_{i=1}^{X_S} v^{Y_S(i)}) = E(E(\prod_{i=1}^{X_S} v^{Y_S(i)} | X_S(t))$$

$$= \sum_{k=0}^{\infty} E(\prod_{i=1}^{k} v^{Y_S(i)} | X_S = k) P(X_S(t) = k) = \sum_{k=0}^{\infty} E(v^{Y_S(1)}))^k \cdot e^{-\lambda_S t} \frac{(\lambda_S t)^k}{k!}$$

$$= \sum_{k=1}^{\infty} e^{-\lambda_S t} e^{\lambda_S t \cdot v^{Y_S(1)}} = e^{\lambda_S t \cdot (u_S v + 1 - u_S - 1)} = e^{\lambda_S u_S t (v-1)}.$$

Table A1
Descriptive Statistics

Variable	Description	Mean	SD	Min	Max
Waiting time	Individual waiting time in days per patient until an appointment for a medical consultation.	6.15	5.35	0	25
Probability of default (PD)	One-year probability of default for each hospital based on logit scores.	1.28	2.12	2.8*E-4	14.31
Private non-profit hospital	1 if private not-for profit hospital , 0 otherwise	0.40	0.49	0	1
Private for-profit hospital	1 if private for profit hospital , 0 otherwise	0.19	0.39	0	1
Public hospital	1 if public hospital , 0 otherwise	0.41	0.49	0	1
Number of beds/100 (sq.)	Number of beds/100 (squared)	3.53	2.52	1.00	16.15
Regional Capacity Utilization	Regional capacity utilization on the level of the German Federal States by ownership type of the hospitals	76.29	3.64	54.40	84.70
East Germany	1 if hospital is situated in East Germany, 0	0.25	0.44	0	1

	otherwise				
Public subsidies	Ratio of the sum of public funds directed to basic reinvestment per bed in the Federal State related to the average value in East German as well as West German Federal States.	1.00	0.21	0.74	1.30
Diagnosis: Fracture	Weber B Fracture is the fracture of the ankle joint treated operatively in surgical departments.	0.27	0.45	0	1
Diagnosis: Stenosis	Constriction of the coronary vessels treated by a stent implantation in cardiology departments	0.29	0.46	0	1
Diagnosis: Cervical conization	Cervical conization is an operative treatment in gynaecology departments, when cancer is suspected	0.44	0.49	0	1
Last PD before 2004	1 if latest balance sheet data available before 2004, 0 otherwise	0.13	0.34	0	1

Notes: Authors' calculations; Statistics on variables which were dropped from the model due to their statistical insignificance are not shown for the sake of brevity.