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Who gets the Credit? Determinants of the Probability of Default in the German Hospital Sector

Abstract
Huge underinvestment increases the need for private borrowing in the German hospital sector, the access to which is partly determined by the probability of default (PD) of individual hospitals. Using ordinary least squares and quantile regression techniques this paper provides first empirical evidence of its kind to evaluate the PD in the hospital sector and its constituent determinants. Based on annual account and medical data from 17% of all German hospitals we find that the current average probability of default amounts to approximately 1.7%, which is slightly higher than the average probability for all German firms. Among other determinants, we find that public ownership significantly increases the risk of default, while private for-profit and private not-for-profit hospitals do not differ. Moreover, demographic change in the form of population growth is confirmed to be relevant for the PD.

JEL-Classification: I11, L31.

Keywords: Hospital profitability, quantile regression, probability of default, ownership type theories

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1. Introduction

The risk of default is gaining considerable attention in the German hospital sector. Traditionally, German hospitals had only few incentives for achieving financial soundness. The full-cost cover principle perfectly insured hospitals against the risk of default. Moreover, with the majority of hospitals being not-for-profit providers, the canonical aim of profit maximization was largely irrelevant. However, reforms have introduced financial pressure into the sector and thus the need to improve financial outcomes.[1] Moreover, public funds directed to basic reinvestment in the hospital sector decrease steadily and substantially, albeit a need for reinvestment.[2] For many hospitals, closure or merger with a partner in private ownership is the only way out of default. Already, closures and mergers have reduced the number of hospitals by 10% from 2 411 in 1991 to 2 166 in 2004 (Source: German Statistical Office).

As a consequence, hospitals have to rely increasingly on external capital such as bank loans or on their own cash flow generated by daily business (Augurzky et al. 2005). Against the background of the new financial regulation Basle II which raises credit costs for borrowers with high risk of default and reduces credit costs for borrowers with low risk of default we expect higher risk premiums for financially instable hospitals. Yet, many not-for-profit hospitals still dispose of guarantees by their owners, e.g. local authorities or churches, which reduce their default risk. However, owners – themselves facing financial difficulties – try to get rid of these guarantees. They establish independent legal entities of their hospitals or even sell them to private investors. As such, the probability of default (PD) becomes a key variable determining which hospitals will stay in the market and which will not.

In this paper we evaluate the PD in the hospital sector and its constituent determinants. Former research has focused on profitability and cost measures only (Eggleston et al. 2005), However, the PD seems to be a more comprehensive and a more preferred indicator of financial soundness by institutional creditors. Our data set contains annual balance sheet data and medical performance characteristics of 347 hospitals – 17% of all German hospitals. The calculation of the PD is based on Moody's KMV RiskCalcTM – a rating tool often used by institutional creditors.

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1 The shifting from the full-cost cover to performance related case fees based on *diagnosis-related groups* (DRG) reinforces this process as hospitals get a per-case payment irrespective of their actual expenses.

2 Investments by the German Federal States amounted to € 2.7 bn. in 2005 (Mörsch 2006), a large decline of 25% in nominal and even more so in real terms since 1991. Daily business is paid for by the patients' health insurers which amount to roughly € 60 bn. per year (Arbeitsgemeinschaft 2004). Our estimates suggest that due to the decline in investment funds we face reinvestment needs of up to € 12 bn. other sources even speak about € 30 bn. or more (Deutsche Krankenhausgesellschaft 2006).

Efforts to increase the efficiency of the value chain of hospitals, namely trends in privatization, the formation of hospital alliances, and changing market concentrations raise the question of how these changes are related to the PD.[3] Theories of ownership type, hospital alliances, or market power predict increasingly favorable financial performance due to these developments. However, empirical results are mixed and generalizations are difficult. As most of the empirical studies deal with the US hospital market, results for Germany are lacking so far. Thus, we test for the significance of these theories, as outlined in section two, in the German hospital market.

Concerning demographic change in Europe, we further estimate the impact of demographic change on hospitals' financial soundness. Demographic change is expected to have substantial impacts on the hospital sector, especially in terms of demand for services. While the ageing of the German population will increase demand for hospital services, decline of population will counteract this development. We exploit the regional variation in past population structure and growth to determine its impact on individual PDs.

The paper is organized as follows: Section 2 presents hypotheses to explain the variation in a hospital's PD. Section 3 describes the methodology of our empirical analysis and the data set. The empirical results are discussed in section 4. The paper ends with a conclusion in section 5.

2. Prior Research: Theory and Empirical Findings

A rich body of literature analyzed the role of ownership and market power to explain hospital's differences in profitability and cost measures (see Eggleston et al. 2005 for an overview). Related to that we shortly introduce the main hypotheses and findings in the literature regarding ownership form, hospital alliances, competition, and demography.

Ownership form is mostly analyzed in theories of property rights and asymmetric information. These predict better financial outcomes of for-profit than of not-for-profit hospitals (*Hypothesis 1*) for three reasons. First, in contrast to not-for-profits organizations for-profit owners participate in residual gains (Furubotn, Petrovich 1972; Danzon 1982). Second, for-profits might have higher incentives to offer a lower quality of services due to asymmetric information (Easley, O'Hara 1983; Hansmann 1987, 1980). Third, ownership may also reflect unobservable entrepreneurial abilities of management. Many

[3] Privatization, growth of hospital chains, and changing market concentrations might go on or even intensify. Between 1991 and 2003 the share of private-for-profit hospitals increased from 14.8% to 24.8%. In 2004 every 5th hospital was considering changes in ownership form and/or a merger to be a future option with every 20th hospital realizing this option in 2004 already (Arbeitsgemeinschaft 2004). As such the German hospital market follows the American merger wave where approximately every 6th hospital merged during the past 15 years (Gaynor, Vogt 2003).

public hospitals managers have previously been employed in public institutions or have been politicians. The managerial behaviour of some of them follows partly the logic of public institutions and thus, is partly incompatible with the profit-oriented thinking of private firms.

A higher *market power* is favorable from the perspective of a supplier, as he can more easily increase prices, reduce costs through a reduction of the quality of services, or even lower input prices because of the market power he exercises over pre-suppliers. We use the Herfindahl-Hirschman-Index (HHI) to approximate market power. Higher values of HHI correspond to higher levels of market power and better financial performance compared to those with low levels of HHI (*Hypothesis 2*).

Next, *hospital alliances* are supposed to be financially superior to individual hospitals. They can benefit from economies of scale and synergy effects, adjustments in the product mix, and the bundling of sufficient funds for profitable investments (Krishnan et al. 2004; McCue, Furst 1986). Thus, we expect hospital alliances to show lower PDs than individual hospitals (*Hypothesis 3*).

The final hypotheses are based on *demographic characteristics*. In less than perfectly competitive markets, such as the hospital sector, increases in demand lead to higher prices and/or decreasing average costs through higher "plant utilization". Past local population growth may be an adequate approximation for the change in demand. Thus, past population growth might be associated with better financial outcomes and lower PD (*Hypothesis 4*). The age structure of the population seems to be relevant, too. On the one hand older people demand more health services than younger people. But the treatment of diseased old people is also more cost intensive, as older people are often confronted with higher degrees of comorbidity and complications. The DRG compensation might be insufficient to carry all the costs of such a treatment. It is, thus, unclear in what way the changing share of elderly in the population affects the PD. A priori, we have no assumption on the sign of the effect (*Hypothesis 5*).

Empirical results are mixed. A recent survey of this literature for US hospitals finds that on average for-profit hospitals generate more revenue and greater profits than not-for-profit hospitals, although the difference is very modest (Eggleston et al. 2005). Some authors find that a higher market concentration reduces costs or improves profits (Dranove, Ludwick 1999; Sari 2002; Town, Vistnes 2001) while others find the opposite (Connor et al. 1998; Propper et al. 2004). Hospital alliances generate higher net revenues (Clement et al. 1997), lower costs (Menke 1997; Sloan, Vraciu 1983), or have no effect at all (Lawrence 1990; Vita 1990). This rather unsatisfying bulk of evidence is the result of different study designs, especially differences in the data, but also in model assumptions. Studies that control for more confounding effects find a

smaller effect of ownership and larger confidence intervals. There is little evidence on the effects of demographic characteristics. Local population density is found to be negatively related to average revenue levels (Wilcox-Gök 2002). A higher population share of elderly decreases the cash-flow per bed (Clement et al. 1997). This highlights the cost-intensiveness of older patients. It does not show, however, whether their treatment is unprofitable.

3. Data and Estimation Strategy

We use data from several sources. First, we use a unique, representative sample of hospital data including 253 balance sheets from 347 hospitals and encompassing also other hospital characteristics such as the ownership form, the number of beds and whether it is part of a hospital alliance or not.[4] We identify hospital alliances by reviewing published reports of mergers, acquisitions, and joint ventures and using information from internet based research. Thus, in this paper we refer to hospital alliances as loosely (several ownerships) or tightly (one ownership) associated hospitals that compete against other providers in the market. We measure market power by the Herfindahl-Hirschman Index (HHI), which is defined as the sum of the squared market shares of a hospital based on 16 different fields of medicine (ophthalmology, surgery etc.). The hospital's local market is defined as the sum of beds in maximum distance of 50 kilometres. The HHI ranges between 0.00002 and 5.3 and reaches 0.18 on average. We capture possible economies of scale by measuring the number of beds in each hospital.

The second source comprises population data from the German Federal Office for Building and Regional Planning (BBR). We construct a measure for the local population change between 1991 and 2000 and the local share of people aged 60 or older in the year 2000 for the hospital's vicinity. Relevant information is available on the level of county as smallest regional unit. Applying a zip-code county identifier we merge the data of the BBR to our hospital data.

We have information on public subsidies for hospitals on the level of the German Federal States. These are defined as the sum of all public funds directed to basic reinvestment per bed in the Federal State related to the average value for East German as well as West German Federal States. Due to the specific situation in East Germany after re-unification, namely the lack of modern medical care in the early 90's, the level of public support differs remarkably between East and West Germany.

[4] The difference between the number of balance sheets and hospitals is explained by the existence of hospital chains which only provide one aggregated balance sheet for the whole chain. For details see Augurzky et al. (2005).

Furthermore, we know the current price level of each hospital, the so-called *DRG base rate*. Currently, the base rate differs between hospitals. However, it will converge to the average of the Federal State until 2009.[5] Hospitals with a currently high base rate will lose revenues; those with a low rate will gain revenues. A currently high base rate can be a sign of both successful budget negotiation between health insurers and the hospital in the past or high per-case costs and thus probably of a relative inefficiency. – Definitions and descriptive statistics of the variables are depicted in Tables 4 and 5 in the appendix.

To test our hypotheses we first estimate the one-year PD for each hospital based on the given accounting data. Then the PD becomes the dependent variable in the regression framework, as described below. Building a model to predict the PD is a difficult undertaking if the data set of companies is small and comprises only few defaults. In the case of hospital data in this paper it is even impossible. In the past there have been only very few defaults for political reasons – and even if we assumed an average default of 1.5% per year we might expect to find only around 5 defaults in our data set. Given this data restriction we are not able to build an own hospital rating. Therefore, we rely on existing quantitative rating tools for small and medium sized enterprises to benchmark hospitals according to their financial soundness.

We apply *Moody's KMV RiskCalc*™ to estimate PDs. This rating tool has been developed for Germany on the basis of 11 400 balance sheets spanning over more than 4 400 German enterprises. It is widely used by financial service providers. The explaining variables are presented in the appendix in Table 6. Hospitals might differ from usual small and medium sized enterprises (SME): they operate in a regulated market; local political authorities partly control the management of public hospitals and sometimes subsidizes "their" hospitals with public funds. In the past, hospitals close to default often obtained help by the local authorities and were able to survive somehow. However, scarcer resources in the future will prevent politicians to continue to subsidize their hospitals. Even today they sell public hospitals to private hospital chains to get rid of financial commitments. We thus aim at calculating a stand-alone PD of a hospital that cannot resort to external aid.

Given the estimated PD we rely on ordinary least squares and quantile regression techniques to explain variation in the PDs. Quantile regression was introduced by Koenker/Bassett (1978) and has since then found its way into empirical applications in many different fields of research (Koenker 2005). Quantile regression aims at analyzing the effect of the explanatory variables on the entire conditional distribution of the dependent variable. In classical

[5] We excluded two hospital chains, which have hospitals in several Federal States. As we have only one balance sheet for all hospitals belonging to the chain, we cannot relate the individual DRG base rate to the DRG base rate of the Federal State.

linear regression the focus is only on the mean of the conditional distribution. Quantile regression models quantiles of the conditional distribution, e.g. median regression. It gives a more complete picture provided the relevant quantiles exist. As the sample median or an arbitrary sample quantile is more robust to outliers, quantile regression is more robust than OLS.

4. Results

The average PD in our data set amounts to 1.63%. For comparison: 142 of 10,000 firms in the German health sector (NACE code 80) filed for bankruptcy in 2004 (Destatis 2006). Around 20% of the hospitals have a PD above 2.6%. Many banks are reluctant to allow a credit at PDs as high as this. On average, municipality-owned hospitals exhibit the highest average PDs of 2.0% and privately owned the lowest of 0.8% (Table 2). Also, privately owned hospitals exhibit lower costs and higher profits. Thus, ownership form seems to be a good predictor for financial soundness. Multivariate regression results for the log PD are reported in Table 1. Regressions with the profit margin as the dependent variable are reported in Table 2.

Ownership: We find that hospitals owned by municipalities have a significantly higher PD than for-profit hospitals. Based on the mean regression their PD is 64% above the estimated PD of for-profits. This effect increases over the quantiles. However, our results suggest that there is no significant difference between private not-for profit and private for-profit hospitals. This indicates that it might not be profit-orientation alone that seems to have a positive effect on financial outcomes, but private ownership irrespective of its profit orientation.

Market power: Higher market power corresponds to a higher PD, although this effect is decreasing over the quantiles. This contradicts our initial *Hypothesis 2*. For market power to take its positive impact on financial soundness, it may be of importance in which geographic area market power is built up. High market power can result from being the only provider in a rural area. In that case the lack of competitors may lead to inefficient production and worse financial outcomes. In urban areas with multiple providers it may reflect a successfully built up market dominance and better financial soundness. To test this we interact the agglomeration dummy with HHI. Indeed, the coefficient of the interaction term for municipality-owned hospitals is negative. Yet, it is not large enough to change the sign of the coefficient of HHI. Moreover, we find that market power does not increase the PD for private-not-for-profit hospitals. Thus, the PD of a private not-for-profit hospital with above average HHI is significantly lower than the PD of an average for-profit hospital. The same is true for public hospitals although at the lower quantile only. Probably,

market dominance can make up for the negative impact of non-profit orientation on the PD.

Hospital alliances: In contrast to our expectations, neither do we find an impact of being member of a hospital alliance on the PD. Note that our data do not contain the large German hospital alliances, but only small alliances up to 5 members. It is unclear under what circumstances the hospitals have built up an alliance. There might be political reasons: alliances are built to integrate hospitals with financial problems in order to prevent insolvency. The interaction between ownership form and hospital alliance is not significant, too. It does not seem that allied private not-for-profit or allied public hospitals can generate lower risks of default than individual for-profit hospitals.

Demographic characteristics: Higher past population growth in the hospital's region is linked with a lower PD. This is consistent with *Hypothesis* 4. Results from quantile regressions suggest that the impact of population growth on the risk of default rises along the quantiles. This suggests that population shrinking hits those hospitals more which are already in a financially less solid position. In numbers, a 1% increase in the population size over the period of 1991 to 2000 is roughly equivalent to a 2.3% decrease in the average PD. The coefficient of the share of elderly people in the hospital's region is negative in all specifications but significant only in the median regression. Tentatively, this result does not contradict the view that a higher share of elderly in the population affects positively the financial soundness of hospitals. As discussed before, the positive effect on demand seems to dominate slightly the negative effect due to higher costs of treating diseased old people.

In our sample, there is no difference in population growth or the share of the elderly between hospitals of different ownership type (Table 2). One reason for this may be that hospitals did not account for these variables in the past. Nevertheless, in the future hospitals may bear these factors more strongly in mind. Demographic forecasts show a widening gap in county level population size changes over the next 15 years (Augurzky et al. 2006). At the extreme, until 2020 some counties might lose more than 20% and others might gain more than 30% of inhabitants relative to the year 2005. Given the estimated coefficients, this would *ceteris paribus* translate into changes in PD between –50% and +70%. As a consequence, we expect local demographic changes to become more important for the financial constitution of a hospital market than in the past. Similarly, forecasts on the share of the population above the age of 59 show changes on the demand side, although far less relevant.

Geographical location: The average PD for hospitals in East Germany is significantly lower than for hospitals in West Germany (with varying impact over the quantiles). The recent modernization of East German hospitals after German unification seems to put have them in a comparatively good financial

Table 1

Determinants of the Probabilities of Default of German Hospitals

Explanatory variables	WLS[1]	t-value	25% Quantile	t-value	Median	t-value	75% Quantile	t-value
Private not-for-profit	–0.07	(0.23)	0.15	(0.64)	–0.04	(0.12)	0.02	(0.06)
Municipality-owned	0.64*	(1.97)	0.61*	(2.53)	0.63	(1.48)	0.83*	(2.51)
Allied	–0.02	(0.06)	0.08	(0.29)	0.33	(0.70)	0.15	(0.39)
Market power (HHI)	0.79*	(2.03)	1.23**	(7.04)	0.79**	(2.87)	0.68*	(2.09)
Allied private not-for-profit	0.18	(0.42)	0.08	(0.23)	–0.26	(0.46)	0.09	(0.19)
Allied municipality-owned	0.13	(0.30)	0.04	(0.11)	0.21	(0.38)	-0.17	(0.38)
Municipality-owned *HHI	–0.28	(0.67)	–0.77**	(3.63)	0.17	(0.50)	0.06	(0.14)
Private not-for-profit*HHI	–0.88*	(2.26)	–1.23**	(6.98)	–0.90**	(3.29)	–0.57~	(1.82)
Agglomeration*HHI	–0.47~	(1.94)	–0.19	(0.92)	–0.53*	(1.99)	–0.57*	(2.54)
Population growth 1991–2000	–2.28~	(1.85)	–0.96	(0.79)	–2.22	(1.06)	–3.46~	(1.65)
Share of elderly*100	–5.58	(1.28)	–2.26	(0.87)	–14.82*	(2.17)	–7.13~	(1.70)
Number of beds*1 000	–0.74**	(2.89)	–0.47	(1.24)	–0.84*	(2.26)	–1.6**	(3.90)
Number of beds sq.*100 000	0.17**	(3.98)	0.14**	(2.78)	0.17**	(2.67)	0.30**	(4.46)
Year of balance sheet	–0.26**	(4.51)	–0.15**	(3.89)	–0.31**	(4.17)	–0.28**	(3.96)
Public subsidies	1.11*	(2.33)	0.50	(1.33)	0.56	(0.89)	2.34**	(4.75)
Relative DRG base rate	–0.85	(1.25)	–1.36**	(2.75)	–0.04	(0.05)	–0.05	(0.06)
West Germany	0.75**	(3.88)	0.57**	(3.58)	0.55*	(2.18)	1.08**	(5.10)
South Germany	–0.25	(1.56)	–0.26~	(1.86)	–0.37~	(1.65)	–0.06	(0.30)
Agglomeration	0.37*	(2.39)	0.25~	(1.95)	0.48*	(2.28)	0.50**	(2.73)
Constant	515.26**	(4.55)	302.74**	(3.90)	625.31**	(4.21)	564.49**	(4.00)
R^2	0.49		–		–		–	

Source: Own data, own calculations; Number of observations 254. – [1]Homoscedasticity and normality of the residuals are achieved by weighting the observations by the number of beds by using the logarithm of PD as the dependent variable; See Appendix Table 4 for a description of the variables; Significance levels: ~ : 10%; *: 5%; ** : 1%.

robustness. There is also a slight South-North wedge, although it is not statistically significant. Moreover, hospitals in urban areas exhibit higher PDs than those in rural once. If HHI does not fully capture local competition this finding might be explained by higher competitiveness in urban areas compared to rural regions.

Size: Bigger hospitals in terms of bed capacity have lower PDs. Given the estimated coefficients, the PD of a hospital with e.g. 800 beds is *ceteris paribus* roughly 25% lower than that of a hospital with 400 beds. This indicates economies of scale in the hospital sector.

Public subsidies: Hospitals located in regions with a higher level of public subsidies have higher PDs. This is surprising, as more financial support should ease the financial burden of a hospital. Note however, that we measure the variable *public subsidies* at the level of the German Federal States and not, as we would like, at the level of each hospital. This might make this variable less reliable. An explanation for this finding might be that subsidies were targeted at financially "crippled" hospitals without aiming at efficiency increases or that hospitals with high subsidies lose incentives to save costs.

DRG base rate: A high current DRG base rate lowers the PD. Yet, this effect is significant only for hospitals at the 25% quantile. The value of the current base rate is calculated based on the revenues negotiated between the hospital and the health insurances. Good negotiation increased profits. The positive sign of the coefficient might reflect this. However, this relation will change as currently high base rates converge to the mean base rate of the respective Federal State until 2009. In the end, we expect PDs of hospitals with a high current base rate to worsen until 2009.

Up-to-dateness: Hospitals with up-to-date balance sheets have a significantly lower PD. The impact varies over the quantiles. We assume that outward transparency correlates with inward transparency and that a lack of it negatively affects financial outcomes. It may also be that hospitals with worse financial outcomes have an inclination not to publish their balance sheet quickly.

So far we have chosen the PD as the dependent variable. Tables 2 and 3 additionally report regression results for the *profitability* as the dependent variable. The signs of the estimated coefficients of this additional model are in line with those of the PD model. Yet, as to the significance of the effects there are differences noteworthy. Except for the 75%-quantile, we do not find significant ownership type effects. Profits are found to be lower only for municipality-owned hospitals, a finding similar to the PD results. For the 75%-quantile, we find a significantly positive effect of being member of a hospital alliance on profits, consistent with *Hypothesis* 3. Interaction effects seem to be more important for profits than for PDs.

Table 2

Determinants of the Logarithm of Profitability of German Hospitals

Explanatory variables	WLSa	t-value	25% Quantile	t-value	Median	t-value	75% Quantile	t-value
Private not-for-profit	–3.1 E-03	(0.21)	2.0 E-03	(0.12)	3.2 E-03	(0.20)	–0.01	(1.17)
Municipality-owned	–0.02	(1.65)	–0.02	(0.84)	–0.02	(1.10)	–0.02*	(2.08)
Allied	–0.01	(0.62)	–0.01	(0.51)	1.6 E-0.3	(0.08)	0.03**	(2.76)
Market power (HHI)	–0.02	(1.22)	–0.02	(1.28)	–0.04*	(2.09)	–0.04**	(4.21)
Allied private not-for-profit	0.01	(0.41)	0.01	(0.40)	–2.4 E-03	(0.10)	–0.03~	(1.85)
Allied municipality-owned	1.1 E-03	(0.06)	1.1 E-03	(0.05)	–0.01	(0.59)	–0.04**	(2.94)
Municipality-owned * HHI	0.01	(0.56)	0.01	(0.71)	0.03	(1.30)	0.03**	(2.99)
Private not-for-profit* HHI	0.03	(1.38)	0.02	(1.23)	0.05*	(2.36)	0.04**	(4.16)
Agglomeration* HHI	5.4 E-03	(0.50)	3.2 E-03	(0.28)	5.6 E-03	(0.79)	5.4 E-03	(0.69)
Population growth 1991–2000	0.04	(0.49)	0.17	(1.56)	0.04	(0.48)	–0.05	(1.04)
Share of elderly*100	2.27	(1.11)	4.08	(1.19)	1.71	(0.73)	–1.71	(0.42)
Number of beds*1000	2.5 E-03	(0.18)	2.0 E-02	(0.96)	6.3 E-03	(0.34)	9.3 E-03	(0.08)
Number of beds sq.*100000	–3.4 E-03	(1.59)	–5.7 E-03~	(1.71)	–3.7 E-03	(1.30)	–3.9 E-03*	(2.19)
Year of balance sheet	0.01**	(4.88)	0.01**	(3.59)	0.01**	(3.20)	0.01**	(3.79)
Public subsidies	–0.03	(1.51)	–0.05~	(1.69)	–0.03	(1.20)	–0.03*	(2.11)
Relative DRG base rate	0.08*	(2.43)	0.08	(1.63)	0.03	(0.96)	0.05**	(2.67)
West Germany	–0.04**	(4.43)	–0.04**	(3.43)	–0.03**	(2.70)	–0.03**	(5.19)
South Germany	0.01	(1.25)	0.01	(0.64)	0.01	(1.25)	0.01*	(2.30)
Agglomeration	–0.01	(0.81)	3.6 E-04	(0.04)	–4.3 E-03	(0.51)	–1.3 E-03	(0.26)
Constant	–25.66**	(4.91)	–28.25**	(3.63)	–20.31**	(3.22)	–13.26**	(3.78)
R^2	0.52		–		–		–	

Source: Own data, own calculations; Number of observations 254; a Homoscedasticity and normality of the residuals are achieved by weighting the observations by the number of beds; See Table 4 for a description of the variables; Significance levels: ~ : 10%; *: 5%; **: 1%

Table 3

25–75 Interquartile Differences for Indicators of Financial Soundness

	Probability of default	t-value	Profit margin	t-value
Private not-for-profit	–0.13	(0.29)	–0.01	(0.42)
Municipality-owned	0.23	(0.47)	–0.01	(0.17)
Allied	0.06	(0.10)	0.04	(0.83)
Market power	–0.55	(0.07)	–0.02	(0.18)
Allied private not-for-profit	0.01	(0.01)	–0.04	(0.69)
Allied municipality-owned	–0.21	(0.29)	–0.04	(0.76)
Municipality-owned *market power	0.83	(0.10)	0.02	(0.19)
Private not-for-profit*market power	0.67	(0.08)	0.02	(0.19)
Agglomeration*market power	–0.38	(0.54)	2.2 E-03	(0.06)
Regional population growth 1991–2000	–2.51	(0.91)	–0.22*	(2.10)
Share of elderly	–0.06	(0.77)	–0.01	(1.36)
Number of beds*1000	–0.92	(1.33)	–0.21	(0.51)
Number of beds sq.*100000	0.12	(0.34)	2.12 E-03	(0.09)
Year of balance sheet	–0.13	(1.16)	–0.01~	(0.44)
Public subsidies	1.84~	(1.85)	0.01	(0.44)
Relative DRG base rate	1.32	(0.97)	–0.03	(0.82)
West Germany	0.51	(0.60)	0.01	(0.64)
South Germany	0.20	(0.60)	0.01	(0.49)
Agglomeration	–0.26	(0.91)	–1.0 E-03	(0.09)
Constant	261.75	(1.17)	14.99	(1.60)

Source: Own data, own calculations; See Appendix Table 4 for a description of the variables; Significance levels: ~: 10%; *: 5%; **: 1%.

The differences in the results of the two models indicate that theories on ownership type and hospital alliance cannot be easily confirmed by sticking to one specific financial indicator. A priori profitability seems to be the most important indicator for financial soundness. Only a profitable firm is able to accumulate capital on the long run and invest in new technologies. However, profitability varies considerably over time. The indicator PD is more stable in time since it additionally considers – among other things – equity and debts accumulated in the past, the liquidity situation and cash flow. In our view, therefore, it is the preferable indicator.

Finally, we have a look at differences between the coefficients of the quantile regressions. There are no statistically significant differences in the coefficients neither between the 25% and 50% quantiles nor between the 50% and 75% quantiles. Table 3 reports results for the 25% to 75% interquartile differences in the coefficients for the two models. We find statistically significant effects for regional population growth and the level of public subsidies and the publication year of the balance sheet data. In our data, there is some variation in the determinants of hospital profitability and PD over the quantiles.

5. Conclusion

Reforms of the health system curbing expenditure growth and the retreat of public funding increase the financial pressure on German hospitals. As a consequence, hospitals have to rely increasingly on external capital to satisfy their basic reinvestment needs. The access to the capital markets and to bank loans strongly depends on the individual creditworthiness defined by the PD. The Basle Committee's new framework on banking supervision (BIS 2004) becoming effective in 2007 accelerates this development. Thus, creditworthiness is becoming a key variable also in the German hospital market.

This paper estimates the average current PD of German hospitals based on a widely used rating tool: Moody's KMV RiskCalc™. Using OLS and quantile regression it analyzes possible determinants of the PD, such as ownership type, membership in a hospital alliance, market power, and demographic change. The data basis includes 253 balance sheets from 347 hospitals supplemented by further hospital characteristics and information about the local environment of the hospitals.

The average PD amounts to approximately 1.6% – i.e. non-investment grade in the financial sector. We find substantial differences among hospitals. As such, public ownership appears to be conflicting with financial soundness. Municipality-owned hospitals exhibit a PD significantly above average. They also show a higher cost ratio and lower profitability than both private-for-profit and private-not-for-profit hospitals. However, the financial robustness of private not-for-profit compared to for-profit hospitals indicates that even in a more competitive environment not-for-profit hospitals have a good chance to keep their market share. Probably, municipality-owned hospitals have on average lower levels of entrepreneurial orientation which might affect the financial soundness of hospitals.

Furthermore, the PD seems to be lower for hospitals in regions with past population growth. With respect to the ongoing demographic change in Europe future variation of population growth on the county-level might become increasingly relevant for the financial soundness of hospitals. Alas, the share of elderly in the hospital's region has a negligible effect on the PD. Apparently higher health demand by elderly people comes along with higher treatment costs.

Finally, the results suggest positive (but diminishing) economies of scale. Hospital alliances do not exhibit a lower PD than single hospitals. The reason for this is unclear. Hospitals in rural areas seem to have a lower average PD than those in agglomerations. From this we conclude that the supply of in-patient services is not very much at danger in rural areas if hospital closures strongly follow financial robustness.

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Table 4

Definitions of Variables

Dependent	
Probability of default	One-year probability of default (PD) for each hospital based on Moody's KMV RiskCalc^{TM} rating tool
Profit margin	Annual profit divided by total turnover
Independent	
Private not-for-profit	1 private not-for profit , 0 otherwise
Municipality-owned	1 if municipality-owned, 0 otherwise
Allied	1 if belonging to a hospital alliance, 0 otherwise
Market-power (HHI)	Herfindahl-Hirschman-Index defined as the sum of the squared market shares of a hospital based on 16 different fields of medicine (ophthalmology, surgery etc.). The hospital's local market is defined as the sum of beds in maximum distance of 50 kilometres
Regional population growth 1991–2000[1]	Population change in the hospital's county between 1991 and 2000 (in %)
Regional share of elderly[1]	Share of people aged 60 or older in the year 2000 in the hospital's county
Number of beds	Number of beds
Number of beds sq.	Number of beds^2
Year of balance sheet	Year of publication of newest balance sheet results
Public subsidies	Sum of public funds on the level of the German Länder directed to basic reinvestment per bed in the Federal State divided by the average value for East German as well as West German Länder
DRG base rate	Current price level of each hospital
West Germany	1 if hospital is situated in West Germany, 0 otherwise
South Germany	1 if hospital is situated in South Germany, 0 otherwise
Aglommeration	1 if hospital situated in urban area, 0 otherwise
Allied private not-for-profit	1 if private not-for profit belonging to hospital alliance, 0 otherwise
Allied municipalicty-owned	1 if municipality-owned belonging to hospital alliance, 0 otherwise
Municipalicty-owned *HHI	HHI if municipality-owned, 0 otherwise
Private not-for-profit *HHI	HHI if private not-for profit, 0 otherwise
Agglomeration*HHI	HHI if situated in urban area, 0 otherwise

Number of observations 254; Data sources: Own data, own calculations. – [1]Population data from the German Federal Office for Building and Regional Planning.

Table 5

Descpritive Statistics by Ownership Type

	For-profit (N=35)		Municipality-owned (N=107)		Private not-for-profit (N=112)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Probability of default in %	0.83	1.42	2.03	2.74	1.50	2.09
Profit margin	0.02	0.07	-0.02	0.05	-0.00	.054
Share of hospital alliances	0.49	0.51	0.41	0.49	0.30	0.46
Market power (HHI)	0.13	0.40	0.25	0.75	0.16	0.40
Number of beds	311.5	268.4	564.6	619.4	377.6	300.0
Public subsidies	0.97	0.16	1.04	0.21	0.92	0.15
Relative DRG base rate	1.03	0.12	0.98	0.09	0.97	0.12
Regional population growth 1991–2000	1.00	0.09	1.01	0.06	1.01	0.06
Regional share of elderly[1]	24.2	2.3	24.3	1.9	23.7	1.8
Share of hospitals in						
west Germany	0.43	0.50	0.68	0.47	0.80	0.40
south Germany	0.63	0.49	0.64	0.48	0.28	0.45
agglomeration	0.51	0.51	0.43	0.50	0.70	0.46

Source: Own data, own calculations. – [1]Population data from the German Federal Office for Building and Regional Planning

Table 6

Balance Sheet Data Used in Moody's RiskCalc to Determine the Individual Probability of DefaultD

Financial field	Weighting (in %)	Figure	Expected impact on probability of default
Capital commitment	10	Duration of capital commitment	–
Debt	38	Outside capital structure Net debt rate Equity rate	–+
Financial power	9	Financial power	+
Return	25	Return on investment Turnover return	++
Productivity	11	Personnel expense rate	–
Growth	7	Turnover growth	changing

Own analysis based on *Moody's KMV RiskCalc*™ rating tool. – [1]A Up to a growth rate of 25% the impact is positive and then it turns around.