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Technical Efficiency and Corporate Structure of Italian Private Hospitals: Evidence from One-step Stochastic Frontier Analysis

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Abstract

This paper aims to identify the relationship between the output-oriented technical efficiency of Italian private hospitals and their ownership structure. Using the one-step Stochastic Frontier Analysis technique, we explain technical efficiency throughout a set of variables capturing the firm's shareholder activity, ownership concentration, and managerial ownership. Results suggest that (1) technical efficiency is positively affected by managerial ownership, and (2) private hospitals are more efficient when ownership concentration is low.

Keywords: Technical Efficiency; Private Health System; Ownership; Stochastic Frontier.

JEL Classification: D24; L25; I10.

1. Introduction

In the last few decades, firms operating in Italy's health sector have experienced profound environmental and institutional change. Both the growth in demand for health care and the reduction of resources provided by governments have led to the rise and growth of private hospitals. Like public hospitals, these private firms must establish priorities in terms of improving efficiency, i.e., containing costs without affecting the quality of care. To address these challenges, a change in the organizational paradigm, including the ownership structure, could be appropriate.

Previous research has widely investigated the efficiency of the health industry (Valdmanis, 1990; Cavalieri *et al.*, 2017), mainly dealing with non-economic measures for both inputs (number of beds, physicians, nurses, etc.) and outputs (number of discharges, patients, etc.) of the production function. It has also exclusively focused on the efficiency of public hospitals, in which corporate governance issues take on specific features. However, little is known about the determinants of firm efficiency in the private health sector, and in particular about the impact of private hospitals' ownership structure on their technical efficiency.

Although firms operating in the private health system represent only a small (but growing) proportion of the whole supply of health services, we believe that investigating how ownership structure affects their relative efficiency is important, especially in Italy where patients usually turn to private hospitals to meet their health needs. Accordingly, we fill this gap in the literature by analyzing an unbalanced panel of Italian firms over the period 2007-2018. We rely on balance sheet data to overcome the problem of selecting reliable measures for inputs and outputs in private health services. Then, we exploit the panel structure of our data set and apply a Stochastic Frontier Approach, avoiding all the issues related to the implementation of Data Envelopment Analysis.

The paper is structured as follows. Sections 2 and 3 describe our methodology and data, respectively. In Section 4 we present the main findings, while Section 5 concludes the paper.

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2. Methodology

We measure the output-oriented technical efficiency of Italian private hospitals using a Stochastic Production Frontier approach for panel data, as proposed by Farrell (1957). We first apply a flexible translog production function (see Christensen *et al.*, 1973), in which the output and inputs are expressed in natural log values, as follows:

$$\ln(Y_{it}) = \beta_0 \ln(K_{it}) + \beta_1 \ln(L_{it}) + 0.5\left[\beta_2 \ln(K_{it})^2 + \beta_3 \ln(L_{it})^2\right] + \beta_4 \ln(K_{it}) \ln(L_{it}) + v_{it} - u_{it},$$

[1]

where v_{it} is the error term with zero mean and constant variance, and u_{it} is a non-negative one-sided inefficiency term which follows a half-normal distribution. All the parameters in Equation (1) are estimated by maximum likelihood. In addition, the technical efficiency (TE) scores for the private hospital i in year t are predicted as:

$$TE_{it} = \exp\{-u_{it}\}$$

[2]

Each TE score lies between zero and one. A value of one means full technical efficiency, whereas a score of less than one means that the private hospital is inefficient for the given technology.

Once TE scores are obtained using a translog production function, we apply a Stochastic Frontier Approach (Greene, 2005), specifically a true fixed effect model (TFE) as it has some advantages over other SFA models for panel data. First, it considers not only the technical inefficiency component, but also the fact that random shocks may affect the production frontier. Second, it allows us to control for heterogeneity, avoiding the strong assumption under which inefficiency is constant over time. In fact, a time-invariant inefficiency term leads to overestimated inefficiency and hence a downward bias of the estimated TE scores (Greene, 2005). Third, it permits the inclusion of the unobserved heterogeneity that is assumed to be correlated to the explanatory variables, allowing it to overcome the issues characterizing time-invariant efficiency panel data models (see Pit and Lee, 1981).

Finally, we include the efficiency determinants Z_k (i.e., nature of the ownership and of the board of directors, geographical area) as heteroscedastic variables in the inefficiency function u_{it}, directly parameterizing the variance of the inefficiency component (σ_u). This way, we are able to estimate the efficiency determinants along with the parameters of the stochastic production frontier by means of a one-stage approach. This procedure has an advantage over the alternative two-stage method, as it leads to unbiased estimators of the parameters for the deterministic part of the production frontier.

3. Data Description

The data was collected from the AIDA database provided by the Bureau van Dijk, containing detailed information on Italian listed companies in terms of balance sheet items, and ownership of Italian firms, divided into economic sector and geographical area. From the 99 sectors present in AIDA we chose sector *8610*, i.e. health and hospital services.

We estimate the technical (in)efficiency of private hospitals using an unbalanced panel of Italian firms over the period of 2008–2017. We end up with a sample of 3,725 observations (398 private hospitals).

Table 1 reports the descriptive statistics of the variables used in this empirical exercise. The output (Y) is measured by total annual revenues, labor input (L) is measured as the total labor cost including

wages, salaries, and social security charges paid at the end of the year, while capital stock (K) in a given year is proxied by the nominal value of tangible and intangible assets after depreciation. Both the output and inputs are expressed in natural log in our empirical analysis.

Table1: Descriptive Statistics

Variable	Mean	SD	Min	Max
Output[1] (Y)	21,317	40,041	33	637,066
Labor[1] (L)	6,803	13,406	5	221,755
Capital[1] (K)	31,216	53,941	110	676,866
Independence	0.12	0.32	0	1
Manager	0.20	0.40	0	1
Institutional	0.06	0.24	0	1
No_Profit	0.02	0.14	0	1
Private	0.31	0.46	0	1
Corporation	0.35	0.48	0	1
South	0.38	0.49	0	1
N	3,725			

1 in thousands Euros

Furthermore, among the environmental variables affecting the efficiency of Italian private hospitals, *Independence* takes 1 if the shareholders do not have more than 25% direct or total ownership, and 0 otherwise, and *Manager* takes the value of 1 if at least one managing director is also a shareholder and 0 otherwise. Roughly 20% of private hospitals have at least 1 manager who owns shares of the firm.

We also exploit information about the "ultimate owner," i.e. the shareholder with the highest percentage of ownership, then use some proxies of shareholders' activity. In particular, we add the dummies *Institutional* (1 if the ultimate shareholder is a mutual fund, bank, or insurance company), *No_Profit* (1 if the ultimate shareholder is the public authority or a research institute), *Private* (1 if the shareholder with the highest control of the private hospital is a household), and *Corporation* (1 if the ultimate shareholder is a company). Finally, 38% of private hospitals are located in the Center-South of Italy.[2]

4. Main Results

Table 2 reports the main results. The estimated output elasticities with respect to capital are always statistically significant at the 0.01 level and are stable across the five specifications. In addition, the change in revenues ranges between 0.96 to 1.27 percent given an increase of capital by 1 percent, and in each case it is greater than that obtained for the labor. Furthermore, the total elasticity of the scale goes from 0.97 to 1.13, suggesting that increasing all inputs by 1 percent would increase output by 0.97 to 1.13 percent.

In Column (1) we add among (in)efficiency determinants the variables *Independence* and *South* respectively. Findings highlight that private hospitals are more efficient if the ownership concentration is low (below 25 percent) and if they are located in the Center-South of Italy. This is in line with a branch of the finance literature stressing a negative correlation between ownership concentration and firm performance (see La Porta *et al.*, 2002), as a higher degree of ownership

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[2] Regions in the Center-South are Sicily, Sardinia, Calabria, Apulia, Basilicata, Campania, Molise, and Abruzzo.

concentration might be due to underdeveloped capital markets, where holding control as a disciplinary mechanism may be ineffective.

In Column (2) we also look at the variation in the technical efficiency of Italian private hospitals when owners are also managers, finding again a positive impact on the efficiency of firms under scrutiny. In fact, when shareholders operate as managers within private hospitals, both information asymmetry and interest misalignment (managerial opportunism, empire building) between the principal and the agent are minimized (Jensen and Meckling, 1976)

Table 2: One-Step Estimates for the Profit Efficiency

	(1)		(2)		(3)		(4)	
lnCapital (β_0)	1.2591***	(0.086)	1.2696***	(0.088)	0.9626***	(0.085)	0.9731***	(0.083)
lnLabor(β_1)	-0.1284*	(0.072)	-0.1719**	(0.071)	0.0081	(0.074)	-0.0447	(0.073)
1/2 lnLabor^2 (β_2)	0.1368***	(0.007)	0.1342***	(0.007)	0.1406**	(0.007)	0.1382***	(0.007)
1/2 Capital^2 (β_3)	-0.0889***	(0.014)	-0.0983***	(0.014)	-0.0419***	(0.014)	-0.0483***	(0.014)
lnLabor × lnCapital(β_4)	-0.0624***	(0.019)	-0.0471**	(0.019)	-0.0976***	(0.019)	-0.0830***	(0.019)
σ_u								
Independence	-2.0819***	(0.376)					-1.8939***	(0.328)
South	-0.6721***	(0.081)	-0.6927***	(0.075)	-0.6888***	(0.075)	-0.7033***	(0.082)
Manager					-0.6122***	(0.100)		
Institutional					-0.4760***	(0.178)	-0.8875***	(0.200)
NoProfit					-2.2291***	-0.754	-3.2662**	(1.589)
Private					0.7435***	(0.096)	0.4364***	(0.101)
Corporation					0.7458***	(0.096)	0.5025***	(0.100)
Constant	-2.5896***	(0.069)	-2.5962***	(0.073)	-3.1277***	(0.113)	-2.8621***	(0.107)
σ_v								
Constant	-5.3139***	(0.194)	-5.3690***	(0.207)	-5.5427***	(0.215)	-5.3588***	(0.175)
Efficiency								
(Mean)	0.8624		0.8588		0.8591		0.8646	
(SD)	0.0993		0.0975		0.1034		0.102	
(Minimun)	0.0707		0.0696		0.0655		0.0667	
(Maximun)	0.9922		0.9924		0.992		0.9913	
Returns to scale	1.1343		1.0977		0.9707		0.928	
N. obs. (groups)	3,725(398)		3,725(398)		3,725(398)		3,725(398)	

Standard errors in parentheses (* p < 0.1, ** p < 0.05, *** p < 0.01)

Moreover, in Column (3) we investigate whether the nature of the "ultimate shareholder" affects the output-oriented TE of private hospitals. We highlight how the nature of the ownership indeed matters in explaining the variation in our outcome variable. In particular, if the ultimate shareholder is a financial firm, a public authority, or a research institute, the efficiency increases by 0.47 and 2.23 percent respectively. Conversely, having a private company or a household as the "ultimate shareholder" negatively affects the outcome variable. Similar results are found when we add to the environmental variables not only the nature of corporate ownership but also the level of dependence of firms to shareholders, i.e. *Independence* (see Column 4).

5. Concluding Remarks

We assessed the relevance of shareholder activity, ownership concentration, and managerial ownership in explaining the (in)efficiency of Italian firms operating in the private health sector. Evaluating further features of ownership and board of directors in terms of technical efficiency is an excellent opportunity for future research.

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