OWNERSHIP, INCENTIVES AND HOSPITALS

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Abstract:

This article analyzes hospital privatization by comparing costs and quality between different ownership forms. We put the attention on the distinction between public hospitals and private hospitals with public funding. Using information about Spanish hospitals in the period 1997-2007, we have found that private hospitals provide services at a lower cost at expenses of lower quality. The way that Heath Authorities finance publicly funded hospitals may be responsible for the differences in incentives between public and private centers. Cost reimbursement contracts are used to finance public hospitals while prospective payment is used to finance private hospitals. We argue that the trade-off between costs and quality could be minimized by designing financing contracts with fixed and variable components.

Key words: Hospitals, Privatization, Cost Reimbursement, Prospective Payment.

JEL codes: I11; L15; L33

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I. INTRODUCTION

Public health expenditure has increased notably in recent decades. Technological change, the ageing of the population, the increase in public health coverage and the presence of more chronic diseases are the main factors explaining this phenomenon. Since *per capita* expenditure for healthcare grew at an annual rate of 6%[1] on average in OECD countries between 1990 and 2007, debates about healthcare systems arose in the nineties and have resulted in reforms in most OECD countries.

In Europe, where the majority of healthcare systems are publicly funded, reforms were designed to pursue two objectives: cost-containment and the introduction of internal market competition. In order to achieve these goals health authorities delegated some of their responsibilities to the private sector[2]. As a result of these reforms healthcare markets are characterized by the simultaneous existence of public and private providers. Here we focus on the comparison of public hospitals and private hospitals with public funding, using data from Spanish hospitals from 1997 and 2007.

Privatization may lead to cost savings if it introduces competition or if private firms can take better advantage of the economies of scale and scope than their public counterparts. However, such factors are not applicable in publicly funded healthcare systems. Thus, the cost differences between ownership forms should be found in the managers' incentives. In a context of assymetric information between the provider (health authorities) and the producer (hospitals), we claim that the attention should be put on payment systems.

The prospective system implies that the payment to hospitals is based on a fixed price per discharge. The US medicare programme and the contracting system in the British National Health Service (NHS) apply a prospective system in which the payment is mainly based on a fixed price for each treatment falling within a specific group. In Spain, the payment of private hospitals with public funding is also of a prospective type.

In contrast, the cost reimbursement system implies that the hospitals recover all the costs that must incur in their activities. This is the system generally used in financing public hospitals in Spain.

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[1] Source: Organization for Economic Cooperation and Development (OECD) Databases.
[2] Italy, United Kingdom, Switzerland, Germany and Spain are some examples of countries that applied such reforms during the nineties.

Under the prospective system, the managers of the hospital may have strong incentives to reduce the costs of treatment because they will retain all the cost savings. These cost savings could be achieved by refusing high-cost patients or reducing quality. Under the cost reinbursement system, the hospital does not internalize costs that are fully bear by the provider. In this latter system, the hospital does not have necessarily incentives to reduce quality.[3]

Overall, it is possible that a tradeoff between cost and quality reduction could arise from hospital privatization when it goes together with a different payment system. A crucial point here is to find an appropriate measure of quality.

In this paper, we undertake an empirical analysis to examine whether hospital privatization in Spain has led to cost savings at the expense of quality. Results of this analysis may provide evidence of the different incentives that can be expected between different payment systems.

We estimate cost and quality equations but our aim is not to examine the determinants of hospital performance. The focus of the paper is on the comparison between public and privated production in a context of public funding taking into account the typical control variables used on related previous studies.

The paper is organized as follows. Section 2 reviews both the theoretical and empirical literature about ownership, payment systems and performance focusing on the hospital market. Section 3 deals with the data while giving an overview of the scope of privatization in the Spanish hospital market. Section 4 explains the empirical strategy and results. Section 5 gives the conclusions.

II. LITERATURE REVIEW

In this section we review economic theories amd empirical studies related to ownership, incentives and performance in the hospital market.

2.1. Theoretical framework

Different economic theories agree on the idea that if privatization results in an increase in market competition then cost savings will be incurred. This reasoning may be taken from the typical Structure-Conduct-Performance paradigm in industrial organization. Additionally, Public choice theories believes that public agents are not benevolent as private agents in private markets. Hence, public choice theories also

[3] Note that differences between cost reimbursement and prospective payment systems can be considered to be similar to differences between rate-of return regulation and price-cap regulation (Ma, 1994).

claim that if competition in the provision of public services is introduced, then public agents will not have enough power to achieve their own objectives.

Introducing competition is a difficult task in publicly funded healthcare systems. Indeed, health authorities normally plans healthcare services and patients are distributed among centers according to their location. For this reason, there is almost no opportunity for publicly funded centers to compete for patients.

Privatization may also lead to costs savings if private firms can take better advantage of economies of scale and scope than their public counterparts. However, hospitals are isolated productive unities, and private firms do not have better opportunities than public entities to exploit economies of scale. In addition, private hospitals are normally smaller than public hospitals, at least in our context. It has to be noted that private hospitals normally offer a lower variety of healthcare services, so taking advantage of the economies of scope is also unlikely in the private healthcare sector.

Martimort (2006) examines the costs and benefits of privatization considering an scenario where the State (the principal) delegates the production of public services to the private sector (the agent). In a context of assymetric information, he argues that the key trade-off of governments is between efficiency and limiting the costly information rents that private firms may obtain. This trade-off will be affected by several contractual incompleteness.

When studying healthcare delivery it is important to keep in mind that we are dealing with a complex market in which it will be likely to find contractual incompleteness. Arrow (1963) claimed the predominance of *uncertainty* in both healthcare demand and treatment effectiveness, which means that hospitals find it difficult to predict their costs. Moreover, the presence of *asymmetric information* gives the practitioner a key role in the market, so their incentives would determine market results. In addition, healthcare can be defined as a *credence good*, which means that the consumer is often not well informed about the quality of the service provided and cannot experience the quality of the good. In summary, as healthcare is a *complex product*, contracting out public healthcare services is associated with high transaction costs.

Transaction costs theories states that factors such as asset specificity, uncertainty (Brown and Potosky, 2003) or monitoring and control (Sappinton and Stiglitz, 1987) determine the potential problems and risks of contracting public services, because these features increase the complexity of the contracts for public service delivery. Following Hart and Moore (2008) and Williamson (1975), complex contracts could lead to undesirable contractor behavior because it is difficult to monitor their acts.

Based on the idea that different organizational forms have distinct objectives, the *property rights theory* analyzes the economic incentives of public and private firms by studying who has the residual control rights of non-human assets. Hart, Shleifer and Vishny (1997) claimed that private firms have strong incentives to invest in innovations because they have well defined control rights, but as they would gain more benefit from cost reduction, private providers may over-invest in cost-cutting at the expense of quality. The authors assumed the presence of asymmetric information, and the idea behind their findings is based on the fact that private deliverers ignore the adverse effects of non-contractible quality.

In a similar vein, Levaggi (2007) claims that privatization implies a loss of information on the relationship between cost and quality. This loss of information may be generally compensated by competition. However, competition is not feasible in the hospital care because consumers do not have enough information and usually they do not pay for the services received.

In a context of lack of competition and assymetric information, it is clear that hospitals that are financed through contracts with public adminsitrations may face a trade-off between costs and quality. To this point, it is needed to put the attention on the differences in the payment systems to public or private producers. In our context of public funding, prospective systems are used for private hospitals and cost reimbursement is used for public hospitals. It is clear that in the trade off between costs and quality, cost reimbursement contracts provides better incentives to enhance quality while prospective contracts provides better incentives to save costs.

Ma (1994) develops a theoretical analysis to examine the different incentives associated with cost reimbursement and prospective payment systems of hospitals. If the hospital can only choose between cost reduction and quality enhancement, he shows that prospective contracts are superior to cost reimbursement contracts because in the latter case is possible to set a price in which the hospital fully internalize the costs and also the benefits of quality. Results of the comparison are more ambigous when the activity of the hospital is more complex (if they may refuse high-cost patients or may use different quality levels to discriminate patients whith different costs).

Chalkley and Malcomson (2002) argues that prospective systems in comparison to cost reimbursement allows the hospital to save costs but the providers does not benefit from these lower costs. Cost sharing contracts between the provider and the producer could be advantageous for the provider if monitoring costs are not high.

Finally, Ellis and Macguire (1986) show that a mixed payment system that combines elements of cost reimbursement and prospective systems may lead to an effficient quantiy of services. Indeed, prospective payment may lead to provide too few services while cost reimbursement may lead to provide too many services. In addition, a mixed system provides the appropiate incentives in relation to admissions of low-cost cases and discouragement of treatment of high-cost patients.

2.2. Empirical studies

Table 1 summarizes the empirical studies about hospital privatization and performance[4]. The vast majority of empirical literature analyzing the effect of hospital privatization does it by relating hospital ownership and costs. As can be seen in Table 1, there is no systematic relationship between hospital ownership and costs or efficiency.

It is worth noting that the majority of studies analyzing the US hospital market found that private for-profit hospitals were more costly than not-for-profit and public entities (Granneman et al., 1986; Ozcan et al., 1992). However, most of the analyses carried out for European countries showed the opposite (Barbetta et al., 2007; López-Casasnovas and Wagstaff, 1997). Note that while in Europe the majority of private hospitals receive public funds, in US private hospitals are basically financed by their consumers.

The empirical relationship between ownership behavior and hospital quality has been less well analyzed. It is worth noting that almost all studies concern the US hospital market. The relationship between hospital ownership and quality is not clear either. Although some studies found private hospitals to offer a lower quality of services (Mark, 1996), the opposite is also true (Keeler et al., 1992). As Table 1 shows, the results differ depending on the definition of quality used and the sample included in the analysis.

To our knowledge all studies analyzing hospital quality have used partial indicators for rating hospitals. Eggleston et al. (2008) provides a systematic review of the different measures of quality used in the analysis of health care delivery.

[4] See Malani et al. (2003) and Sloan (2000) for a theoretical and empirical review of hospital ownership and performance.

Table 1. Empirical Literature about Hospital Privatization, Costs and Quality

	Ownership forms included	Sample	Methodology Quality variable	Results
Hospital ownership and costs				
Becker & Sloan (1985)	PUB, PFP, PNP	USA. 1900 hospitals. 1979.	Cost Regression	Inconsistent Results
Granneman et al. (1986)	PUB, PFP, PNP	USA. 867 hospitals.	Cost Regression	PFP more costly than PNP and PUB
Ozcan et al. (1992)	PUB, PFP, PNP	USA. 3000 hospitals. 1987	DEA	PUB more efficient
Herr (2008)	PUB, PFP, PNP	Germany 1556-1635 hospitals. 2000-2003	SF	PUB more efficient
Barbetta et al. (2007)	PUB, PNP	Italy. 531 hospitals. 1995-2000	DEA	PNP more efficient
Daidone and Amico (2009)	PUB, PFP, PNP	Italy. 625 hospitals. 2000-2005	SF	PUB and PNP more efficient
Farsi and Filippini (2008)	PUB, PFP, PNP	Switzerland. 150 hospitals. 1998-2003	SF	No differences
Piror & Solà (1993)	PUB, PFP	Spain. Catalonia. 169 hospitals. 1989	DEA	No differences
López-Casasnovas & Wagstaff (1997)	PUB, PFP	Spain. Catalonia. 43 hospitals. 1988-1991	DEA	PFP more efficient
Dalmau-Matarrodona & Puig-Junoy (1998)	PUB, PFP	Spain. Catalonia. 94 hospitals. 1990	DEA	No differences
Hospital ownership and quality				
Keeler et al. (1992)	PUB, PFP, PNP	USA. 14.008 elderly patients. 297 hospitals. 1981-1982 & 1985-1986	Diagnosis and treatments. Doctor's opinion.	PUB offer lower quality. No differences between private types.
Brennan, et al. (1991)	PUB, PFP, PNP	USA. New York. 31.000 patients. 51 hospitals. 1984	Adverse Rates	No differences
Shortell & Hughes (1988)	PFP, PNP	USA. 214.839 patients. 981 hospitals. 1983-1984	Mortality Rates	No differences
Mark (1996)	PFP, PNP	USA. 286 hospitals. 1984-1989	Third-party Assessment	PFP lower quality
Hospital ownership, costs and quality				
Herzlinger & Krasker (1987)	PUB, PFP, PNP	USA. 563 hospitals. 1982	Cost, Pair Comparison Quality, Third-party Assessment	No differences
Sloan et al. (2001)	PUB, PFP, PNP	USA. 8.404 medical cases. 1982-1995	Quality, Mortality Rates Logit Estimation	PFP more costly. No quality differences.
Lien et al. (2008)	PFP, PNP	Taiwan. 127.623-149.160 cases. 480-515 hospitals. 1997-2000	OLS and IV Estimation	No costs differences PNP higher quality

Note, Public (PUB) Private for-profit (PFP) and not-for-profit (PNP). Data Envelopment Analysis (DEA) Stochastic Frontier (SF)

We believe that it is convenient to construct an index that combines all quality dimensions that can be found in a hospital. In this way it would be possible to compare public and private for-profit and not-for-profit hospitals from a broader perspective.

Very few studies have examined hospital costs and quality at the same time and those that have did so by comparing the costs and quality of treating specific diseases. As far as we know, three studies have undertaken this kind of analysis. Herzlinger and Krasker (1987) found no differences in the costs and quality between US public, private for-profit and not-for-profit hospitals. Sloan et al. (2001) found US for-profit hospitals to be more expensive, but they found differences in quality offered. Finally, Lien et al. (2008), who studied the Taiwanese hospital market, claimed that there were no differences in medical expenditure between ownership forms, but they detected differences in quality. In particular, not-for-profit firms offered a higher quality than their for-profit counterparts.

The studies that examine the impact of ownership on costs and quality do not link such impact with the different payment systems in place. Note that this link is relevant when analyzing public funded systems. Our empirical analysis focuses on the relationship between ownership, costs and quality. We argue that in a context of assymetric information and lack of competition, differences in the performance of public and private hospitals should be related to the different payment systems for these two type of producers.

III. DATA FROM THE SPANISH HOSPITAL SECTOR

The data used in this study were extracted from the *Estadística de Establecimientos Sanitarios con Régimen de Internado* (EESRI), a survey that is carried out annually by the Spanish Ministry of Health and Social Affairs, for the years 1997 and 2007. All Spanish hospitals and their dependent centers are obliged to provide the information requested in the survey. Note that many of the variables used in the empirical analysis do not vary in the considered period. Hence, we think it is not useful to construct a panel for each year of the whole period with data available.

The EESRI provides census information about hospital resources, healthcare and economic activity as well as who is paying each patient's costs. Note that this survey is protected by the Statistical Secrecy Law 12/1989, which protects all kinds of personal data. For this reason, we were unable to determine the precise location of each hospital in our database. In particular we only had information about the region in which each hospital was found.

In Spain hospitals are registered in the *Catálogo Nacional de Hospitales* (CNH). In 1997, 895 hospitals were registered in the CNH while in 2007 there were 916. The EESRI provided information about 789 hospitals for 1997 and 764 for 2007, which represents 88.15% and 83.4% of the centers registered in the hospital census. Of these hospitals we had to eliminate 18 observations because the data they provided was confusing. We worked with a sample of 1535 observations, 783 from 1997 and 752 from 2007.

As we were working with economic data from different years we deflated all monetary variables in order to convert all data to constant 2007 prices. We used the Consumer Price Inflation provided by the Spanish National Statistics.

To construct the quality index we used data from the *Barómetro Sanitario*, a statistical report produced annually by the Spanish Ministry of Health and Social Affairs.

Healthcare delivery in Spain is carried out by three types of center: public hospitals in which the Public Administration directly provides healthcare services, private centers that are publicly funded and private entities in which the users pay for the services received.

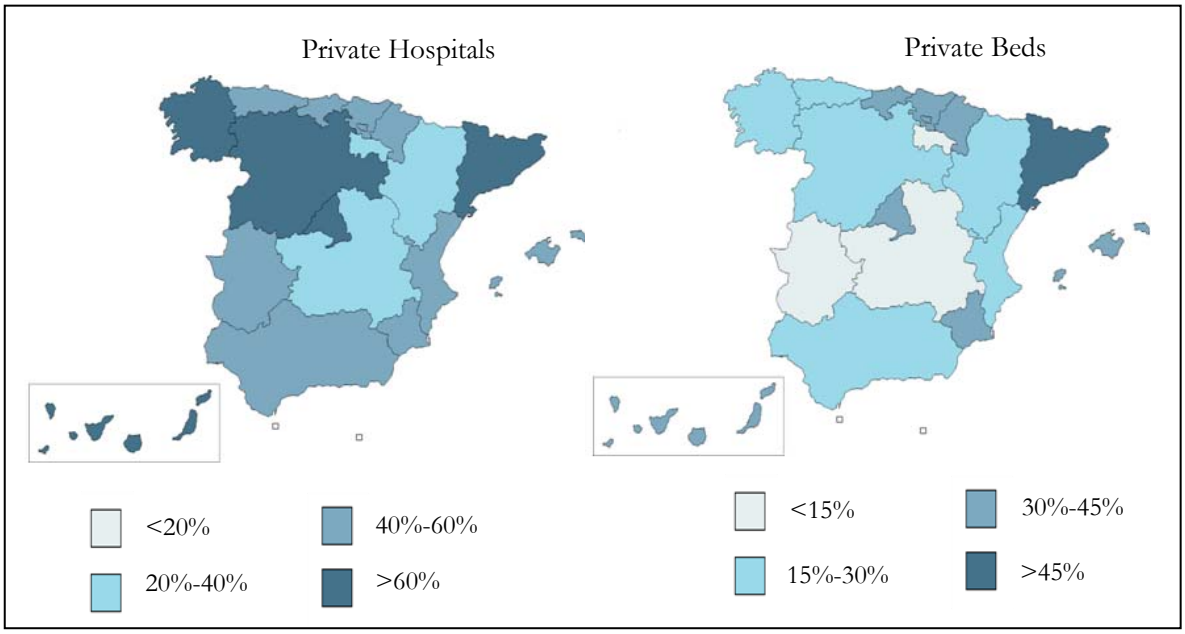
The mechanism of finance of each kind of managerial form remains a key element to understand the different incentives of the agents. Public hospitals are financed by a global budget, which theoretically is based on cost reimbursement payments. This means that hospitals agree on an *ex-ante* budget with the Health Authorities. When the agreed budget is not sufficient to cover public hospitals costs, an extra budgetary subsidy is transferred to finance the hospital costs (López-Casasnovas, 2001). For this reason, it can be said that the expenses of public Spanish hospitals are guaranteed to be covered.

On the other hand, the relationship between the Public Administration and private providers (both profit and not-for profit entities) is defined by a contract. Resources are allocated to service providers in one single package, as in a capitation formula, and private managers decide how to use these resources. This means that private hospitals that deliver public healthcare services have a fixed budget with which to carry out their activities. This resembles a prospective payment system

The diversity of healthcare management in the different regions explains the heterogeneity of hospital ownership that can be found in Spain. In particular, 39.29% and 40.69% of Spanish hospitals were publicly managed in 2007 and 1997 respectively, 45.11% and 42.36% were run by private for-profit entities respectively,

and 16.94% and 16.94% by private not-for-profit firms. As Figure 1 shows, the importance of being private for profit and not-for-profit hospitals varies between regions.

Figure 1. Proportion of private hospitals and beds in the Spanish hospital market. 2007.



Source: Estadística de Establecimientos Sanitarios con Régimen de Internado - EESRI (Ministry of Health and Social Affairs).

The proportion of private for-profit installed beds increased from 18.21% in 1997 to 21.61% ten years later. On the other hand, public and private not-for-profit beds decreased from 67.83% to 65.93% and from 13.29% to 12.46% respectively. The proportion of private beds also varies between regions.

From Figure 1 it is worth noting that the proportion of private hospitals is higher than the proportion of private beds. This reflects the fact that at least for the Spanish hospital sector, private hospitals are smaller than their public counterparts.

It is interesting to examine the scope of public funds in private hospitals in order to gain an overview of the importance of the private sector in the Spanish National Health System, and as a consequence in terms of public expenditure. In particular, almost 50% of private hospitals finance more than half of their patients with public funds. The scope for public funds in private hospitals is even higher in not-for-profit centers.

Public hospitals are on average more costly than their private counterparts. At first glance this could be explained in several ways. First, public hospitals are, on average, bigger than private centers. Second, public entities receive, on average, more complex

patients than private for-profit hospitals. And finally, the quality offered by public centers is, on average, higher than that offered by their private counterparts.

IV. EMPIRICAL STRATEGY

Our empirical strategy relies on estimating equations that account for the most revelant determinants of costs and quality. Recall that the focus of the paper is on the comparison between public and privated production in a context of public funding taking into account the typical control variables used on related previous studies.

4.1. Description of the variables

While it is easy to define and control for hospital inputs, outputs are not easy to characterize. Hospitals produce a wide range of heterogeneous services, so defining hospital production is a complex task (Pinto et al., 2008). For that reason hospital cost studies have used intermediate outputs as a measure of hospital activity. Table 2 describes and summarizes the variables used in the analysis.

Table 2. Definition of the variables, descriptive statistics and data sources

Variable	Description	Mean (S.D.)	Max (Min)	Hypothesis*	
				Cost	Quality
Ownership variables					
Private-profit$_{it}$	Dummy variable which takes value 1 if the hospital is managed privately.	0.43 (0.49)	1 (0)	-	-
Private-not-for-profit$_{it}$	Dummy variable which takes value 1 if the hospital is managed by a not-for-profit firm.	0.16 (0.36)	1 (0)	-	-
Privately-funded$_{it}$	Dummy variable which takes value 1 if the hospital finances more than a 10% of their patients with private funds.	0.18 (0.39)	1 (0)	+	+
Dependent variables					
Ln total average expenditure$_{it}$	Natural logarithm of total average expenditure deflated into 2007 prices per discharged patients.	7.86 (1.47)	13.43 (4.12)	--	--
Quality$_{it}$	Quality Index which accounts for, hospital adaptability, scientific-technical quality and consumer satisfaction.	2.57 (1.52)	6 (0)	--	--
Intermediate outputs					
Ln discharged$_{it}$	Natural logarithm of the number of discharged patients in hospital i during the year t.	7.55 (1.93)	11.12 (0)	-	Not clear
Ln Case-mix$_{it}$	Natural logarithm of the Case-mix index following Roemer (1968)	2.46 (2.02)	9.08 (-4.97)	+	Not clear
Ln Rotation Index$_{it}$	Natural logarithm of the number of discharged patients per installed beds	5.36 (0.62)	5.92 (-0.20)	Not clear	Not clear
Input variables					
Ln Installed beds$_{it}$	Natural logarithm of the number of installed beds in each hospital i and time t.	4.78 (1.08)	7.56 (1.38)	+	Not clear
Ln Average Wage$_{it}$	Natural logarithm of total personal expenditure per number of employees deflated in 2007 prices.	9.00 (1.09)	11.13 (5.21)	+	+
Emergency room$_{it}$	Dummy variable which takes value 1 if the hospital offers emergency room services.	0.73 (0.44)	1 (0)	+	Not clear
Ln investment$_{it}$	Natural logarithm of total investment in fixed assets per installed bed deflated in 2007 prices.	7.13 (1.94)	12.78 (-1.17)	--	+
Control Variables					
Surgical$_{it}$	Dummy variable which takes value 1 if the observation is a surgical hospital	0.07 (0.25)	1 (0)	--	--
Other acute$_{it}$	Dummy variable which takes value 1 if the observation is an other acute hospital	0.07 (0.26)	1 (0)	--	--
Psychiatric$_{it}$	Dummy variable which takes value 1 if the observation is a psychiatric hospital	0.10 (0.31)	1 (0)	--	--
Long stay$_{it}$	Dummy variable which takes value 1 if the observation is a long stay hospital	0.14 (0.35)	1 (0)	--	--
Y07	Dummy variable which takes value 1 if the observation is from 2007			--	--

Dependent variables

For the cost equation we used the total deflated average expenditure as a dependent variable. This reflects the total disbursement made by the hospital in assets or services required for developing its activity, the most outstanding being labor expenditure, pharmaceutical and material goods. With the objective of having a comparable

measure of hospital costs we deflated 1997 total expenditure into 2007 prices and obtained average costs by dividing the total deflated expenditure by the number of discharged patients.

Health outcomes depend on the quality of care received. Some forms of hospital quality may easily be observed by patients, such as food or the size of the room, but other forms are more difficult for patients to gauge, for example, the quality of the personnel (Sloan et al., 2001). One of the main difficulties for the analysis arises in establishing a satisfactory operational definition of quality. Following Vuori (1988) we constructed a quality index that takes into account different dimensions of quality and provides an acceptable overview of each hospital standard.

On the basis that hospital quality is not a one-dimensional attribute, Vuori (1988) defined quality in healthcare services as a combination of three different outcomes: adaptability, scientific/technical quality and degree of consumer and professional satisfaction. *Adaptability* understood as the balance between the needs and expectations of the public, *scientific/technical* quality means that the services and techniques provided should be in accordance with the level of current scientific/technical knowledge, and *consumer and professional satisfaction* refers on one hand, to satisfying the needs and expectations of clients, and on the other hand the conditions and expectations of health personnel (Solà and Prior, 2001).

In order to obtain an accurate relation between ownership and hospital quality we constructed a quality index that takes into account these three dimensions of hospital quality. As it was not obvious how to find variables that exactly measure each of the quality definitions listed above, we used proxies to represent them. Table 3 gives a summary of all variables included, their source and summary statistics.

As proxies for *adaptability* we included the number of nurses per installed bed and the number of pieces of hospital equipment, such as incubators or surgical rooms, per installed bed. Although using physical labor or capital intensity as quality variables has its limitations, they have been used in recent empirical literature. Farsi and Filippini (2008), for example, used a hospital's nurse per bed ratio to represent the quality of nursing care.

In order to approximate *scientific/technical* quality we included the hospital mortality rate, the technological equipment such as X-ray or hemodynamic rooms per installed bed and a variable defining whether a hospital served as a medical school for graduates. In Spain not all hospitals are authorized to train graduates. To open training vacancies hospitals must fulfil certain requirements. For this reason, we assumed that

the fact that a hospital has postgraduate positions may be a sign of hospital quality. Previous studies such as those of Aletras (1999) and Farsi and Filippini (2008) also used a variable representing hospital training as a proxy for hospital quality.

Table 3. Variables included in the quality index

	Definition	Average (observations above)	
Adaptability		**1997**	**2007**
-Nurses per installed bed	Hospital's nurse per bed ratio	0.45 (327)	0.71 (347)
-Physical equipment per installed bed	Number of physical equipment which includes incubators, surgical rooms and birthing rooms per installed bed	0.05 (294)	0.06 (316)
Scientific-Technical			
-Mortality rate	Number of hospital deaths per admitted patients.	0.09 (637)	0.08 (627)
-Technological equipment per installed bed	Sum of technological equipment available in the hospital which includes X-ray rooms, X-ray computed tomography, Magnetic Resonance, renal litroticia equipment, Hemodynamic Rooms, Digital Angiography, Gamma Camera, Megavoltage x-Rays and Hemodialysis technology per installed beds.	0.04 (279)	0.05 (274)
-Medical School for graduates	Dummy variable which take value one if the hospital accepts Medical School graduate students.	0.26 (205)	0.29 (224)
Consumer satisfaction degree			
-Health Care System evaluation	Average opinion of the Spanish Health Care Sysrem per CA.	6.78 (269)	6.99 (177)

*EESRI. Estadística de Establecimientos Sanitarios con Régimen de Internado. Ministry of Health and Social Affairs.
**Barómetro Sanitario. Ministry of Health and Social Affairs.
***INE. Instituto Nacional de estadística. Spanish Nacional Statistics.

To capture *consumer satisfaction* we included a variable representing a consumer satisfaction survey carried out by the Spanish Ministry of Health and Social Affairs.[6] In particular, we rated the second question of the survey in which citizens were asked about their overall opinion of the healthcare system in their region.[7]

To construct our quality index we gave a point for each category that a hospital *i* was above average during time *t*, except for the mortality rate which we consigned a point if the hospital mortality rate was below average, and for the medical school variable which took a value of one if the hospital had postgraduate students. Ultimately we

[6] We were unable to include the degree of professional satisfaction because the sources available from the Spanish Ministry for Labor and Immigration do not provide concrete information for the healthcare sector.
[7] Unfortunately, the dataset used in the study does not provide information about patient satisfaction with each particular hospital.

obtained an ordinal variable that ranked hospital quality from 0 to 6, where 0 was the lowest possible hospital quality and 6 the highest.

Ownership variables

In order to evaluate the effect of privatization on hospital costs and quality we included in our estimations two dummy variables, one representing private for-profit hospitals and the other representing private not-for-profit centers. In this way we took public hospitals as the reference type.

We used the definition in the EESRI to classify hospitals into different ownership types. In particular, we considered as a public hospital all entities that are legally dependent on the Spanish National Public Health System. With regard to private not-for-profit hospitals we included all organizations that do not distribute their surplus to owners or stakeholders, such as Church Hospitals or Foundations. Finally, we considered those centers that are managed by private firms to be private for-profit hospitals.

Although the aim of our study was to analyze the provision of publicly financed healthcare services, we included a dummy variable to control for those private hospitals that are financed with private funds. We believe that such centers would not behave like private hospitals that depend on public funds.

Hospital output variables

O'Neill et al. (2008) found that the empirical literature on hospital efficiency used a wide variety of hospital intermediate inputs. In our analysis we used the number of *discharged patients* as a measure of hospital activity, as suggested in several studies (Barbetta, 2007; Ozcan, 1992; O'Neill, 2008).[8]

One of the main features of the healthcare market is the uncertainty of both the demand for and the effectiveness of the treatments. For this reason a hospital may encounter a wide variety of cases that may be more or less complex depending on multiple unpredictable factors. To control for both the complexity and severity of illness we constructed a *case-mix index*, as defined by Roemer (1968) and used by Aletras (1999).

The index adjusts a hospital's average length of stay by its occupancy rate in order to exclude the influences of exogenous supply and demand, which also affect the

[8] A discharged patient is normally defined as a case who has previously been admitted into the hospital (Redrado, 2007).

length of stay (Aletras, 1999). The formula applied in our database is expressed in equation (1):

$$CM_{it} = ALOS_{it} * (OCC_{it}/OCC_{t}) \quad (1)$$

where $ALOS_{it}$ = $Inpatient\_days_{it}/Discharged\_Patients_{it}$ and OCC_{it} =$Inpatient\_days_{it}/(Installed\_beds_{it}*360$. $ALOS_{it}$ is the average length of stay in hospital i during the period t, OCC_{it} is the occupancy rate of hospital i during t, and OCC_t is the mean occupancy of all sample hospitals in t. This formula weights the average length of stay by the proportion with which a hospital's occupancy rate differs from the mean occupancy of the sample in each period.

We also included a *rotation index* that captures the marginal effect that an increase in hospital activity could have on hospital performance. We defined our index following Redrado (2007) through this expression:

$$RI_{it} = discharged\_patients_{it}/installed\_beds_{it} \quad (2)$$

Hospital input variables

We included different variables in order to represent hospital inputs. As in the previously published hospital cost literature (Aletras, 1999; Sloan et al., 2001), we used the *number of installed beds* to represent hospital size as a proxy for capital assets. Hospital size is a particularly important control variable given the notable differences in input and output mixes that exist between large and small hospitals (Ozcan, 1992).

It is important to note that about two-thirds of hospital costs are due to payroll expenses, so including labor inputs in a hospital cost equation is indispensable. We introduced the *average wage*, calculated from the total personal expenditure divided by the number of employees in the hospital.

In line with Farsi and Filippinni (2008) we also included a dummy variable for the *emergency room* in order to capture those hospitals that are usually involved in severe cases.

Finally, a variable reflecting *hospital investment* was also incorporated. We used the total deflated investment in fixed assets per discharged patient.

Control variables

In order to control for unobserved differences between hospitals we included dummies for hospital type and time.[9]

With regard to hospital type, we used the hospital classification used by the EESRI. This statistic classifies hospitals into five types: general, surgical, other acute, psychiatric and long term. We considered general hospitals as the reference case so we included four dummies to represent the other hospital types.

As we were working with data from two different years, 1997 and 2007, we introduced a dummy variable for all 2007 observations. In this way we were able to capture the overall technological progress and the variation in unobserved variables such as potential differences in data collection from one year to another. However, results do not vary substantially when we just use the sample of 2007 in the regression analysis.

4.2. The empirical model

- Determinants of hospital costs

The equation used to examine the determinants of costs is as follows:

$$ln\_average\_cost_{it} = \beta_0 + \beta_1 Private\_profit_{it} + \beta_2 Private\text{-}non\_profit_{it} + \beta_3 Privatelly\_funded_{it} + \beta_4 Indischarged_{it} + \beta_5 ln\_case\_mix_{it} + \beta_6 ln\_rotation\_index_{it} + \beta_7 ln\_average\_wa_{it} + + \beta_8 Emergency\_room_{it} + \beta_9 ln\_investment_{it} + \beta_{10} Surgical_{it} + \beta_{11} Other\text{-}acute_{it} + \beta_{12} Psychatric_{it} + \beta_{13} Long\_stay_{it} + \beta_{14} Y07 + \varepsilon_i \quad (3)$$

where i represents each hospital and t the period of time analyzed. The explanatory variables are defined in the previous section and summarized in Table 2. Note that the continuous variables are expressed in logarithms.

As we saw in Section 2 economic theories about ownership and performance provide different explanations for the potential cost savings of privatization. Private hospitals may incur lower costs than their public counterparts, but this could be associated with the provision of lower quality healthcare services.

On the contrary, we expect privately funded hospitals to behave differently from publicly supported centers. In particular, we believe that completely private entities should incur higher costs than public centers and may offer a higher quality of services.

[9] We estimated our cost and quality equations including regional dummies but this incurred multicollinearity problems without improving our results. For this reason, we decided not to include them in the analysis.

Note that in privately funded hospitals patients pay for the treatments received, so in order to capture clients, private hospitals might offer a higher quality of services that would lead to higher costs.

The effect of discharged patients on hospital costs will depend on how the economies of scale affect the hospital cost structure. If, on average, Spanish hospitals benefit from economies of scale we could expect discharged patients to have a negative effect. This would mean that an increase in hospital activity reduces average costs, and thus having more patients would improve hospital efficiency. If, on the contrary, Spanish hospitals suffer diseconomies of scale, then additional fixed costs would have a greater impact than lower variable costs per patient, and thus an increase in activity would lead to a rise in average costs. For this reason we were unable to determine a priori the relation between discharged patients and average costs.

In relation to the case-mix index we could expect to find a positive relationship with hospital average costs. The more complex the patients that the hospital receives, the more costly it would be to treat them. Furthermore, a previous report found a positive relationship between costs and the case-mix index (Aletras, 1999).

As explained earlier, we also included a rotation index to capture the marginal effect of hospital activity on hospital costs. The relationship between the rotation index and our dependent variable is not certain and would depend on how discharged patients and the number of installed beds influence hospital costs.

The empirical literature on hospital costs is clear about the effect of hospital capacity on costs. Among others, Aletras (1999) and Sloan et al. (2001) found that hospital capacity has a positive relationship with costs. The idea behind this result is that an increment in installed beds represents a rise in hospital fixed capital, which is related to an increase in hospital costs. For this reason we could expect a positive relationship between the number of installed beds and hospital average costs.

Another variable that we would expect to have a positive relationship with average costs is the average salary. It is clear that an increase in personnel costs will lead to a rise in average costs.

Based on the same idea as that for the case-mix variable, we could expect to find a positive relationship between average hospital costs and the emergency room variable. The availability of an emergency room attracts more severely ill patients into the hospital, thus leading to higher costs. Previous studies, such as that by Farsi and Filippini (2008), have corroborated this idea.

Regarding the investment in fixed assets we would expect it to have a positive relationship with average costs. Investment in fixed assets represents an increase in hospital fixed capital, thus we should find the same relationship as with the number of installed beds. In addition, any expenditure would yield a rise in average costs.

- **Determinants of hospital quality**

The empirical expression used in the analysis of the determinants of quality can be seen in equation (4):

$$Quality_{it} = \beta_0 + \beta_1 Private\_profit_{it} + \beta_2 Private\text{-}non\_profit_{it} + \beta_3 Privatelly\_funded_{it} + \beta_4 Indischarged_{it} + \beta_5 ln\_case\_mix_{it} + \beta_6 ln\_rotation\_index_{it} + \beta_7 ln\_average\_wa_{it} + \beta_8 Emergency\_room_{it} + \beta_9 ln\_investment_{it} + \beta_{10} Surgical_{it} + \beta_{11} Other\text{-}acute_{it} + \beta_{12} Psychatric_{it} + \beta_{13} Long\_stay_{it} + \beta_{14} Y07 + \varepsilon_{it} \quad (4)$$

where i represents each hospital and t the period of time analyzed. All variables used in the cost equation were also used for regressing hospital quality. Note also that the continuous variables are expressed in logarithms

As mentioned above, it is expected that private hospitals with public funding may have lower costs at the expense of lower quality. On the contrary, privately funded hospitals should provide healthcare services of a higher quality in order to capture more clients.

The effect of discharged patients on quality is not clear. In fact all variables accounting for hospital activity could affect hospital quality in two different ways: the learning effect and congestion effect. The former would improve hospital quality while the latter would have the opposite effect.

The fact that a hospital has a large number of discharged patients per year may improve hospital quality because of the learning effect. Hospital personnel would have more experience and thus could offer better services. In contrast, receiving many patients may reflect a situation of hospital congestion. If a hospital is congested quality may be eroded because patients would have to register on waiting lists and practitioners would have to treat more patients and the time per patient would thus decrease. Taking all this into consideration, it is not clear what effect the number of discharged patients would have on hospital quality.

The effect of the case-mix index on hospital quality is also ambiguous because receiving complex cases could be related to quality in different ways. Higher quality might result because complex cases require more sophisticated techniques and thus the hospital would display higher levels of scientific/technical quality, but lower quality

might result because complex cases present more uncertainty and thus patients might have a lower probability of recovery.

The effect of the rotation index would depend on the variables constructing the quality index. At the same time the controversy between learning and congestion is also applicable.

The relationship between hospital size and quality is not simple either. On the one hand, a larger hospital could capture variations in healthcare demand to a better extent, and so it would present higher levels of adaptability. But holding other inputs constant, this could also mean offering a lower quality of attention to patients because it would mean attending more patients with the same personnel.

The variable capturing personnel salaries is the only one in the quality analysis for which we could define a clear relationship with the dependent variable. In particular, we would expect to find a positive relation between salaries and quality because it is accepted worldwide that increasing salaries is an effective mechanism for improving service quality.

Regarding the emergency room variable we were unable to predict a priori the results that we would find. On the one hand, having an emergency room could positively affect quality because such hospitals would show higher levels of adaptability and because they are normally equipped with high levels of technology, and thus would present high levels of scientific/technical quality. On the other hand, it could mean that resources are channeled through the emergency room such that the rest of the services have tighter budgets, which could be reflected in the provision of lower quality healthcare.

In relation to investment in fixed assets we expected it to have a positive relationship with quality. The idea of introducing this variable was to capture the intention of a hospital to improve the quality of healthcare, such that the more a hospital invests, the higher quality it will provide.

4.2. Estimation and results

We performed the regressions for the complete sample and just for general hospitals. In both cases we analyzed on one hand all centers and on the other hand only publicly funded hospitals. We considered publicly funded entities those hospitals that finance more than 90% of their patients with public funds.

First, we performed the regressions for the complete sample; second, we analyzed only those entities that were financing more than 90% of their patients with public

funds; then we studied general hospitals; and finally, we included only publicly funded general hospitals.

Recall that we estimated hospital costs and quality equations in their reduced form so that each equation had the same explanatory variables. As our quality index is a censored variable we could not apply a Seemingly Unrelated Regression Equations (SURE) estimation. For these reasons, we estimated the cost and quality equations separately.

- Determinants of hospital costs

We estimated equation (3) using the Ordinary Least Square (OLS) methodology for all cost estimations. Table 4 shows the results for each regression. The estimated coefficients are mostly significant and generally have the expected sign.

Private for-profit and not-for-profit hospitals presented lower costs per discharged patient than their public counterparts. As Table 4 shows, the ownership variables are significant at 1% and have negative signs. Moreover, these results hold for all our regressions. Even though not-for-profit entities may be considered as benevolent producers (Chalkley and Malcomson, 1998), we do not find substantial differences in the cost incentives of private for-profit and not-for-profit firms.

We found that private for-profit hospitals with public funds expended, on average, 3,111.5 € less per patient than public centers. In the same way, the average expenditure in private not-for-profit hospitals was, on average, 3,791.5 € less than in their public counterparts. We should be careful when analyzing these results because the estimated coefficients are never totally precise. In our case, we may have captured differences between case severity within ownership types. The differences were smaller when the estimation focused on general hospitals. In particular, private for-profit (not-for-profit) general hospitals spent 1,327.7 € (1,459.1 €) less per patient than public entities. So, when comparing hospitals of the same type the cost differences between public and private hospitals were not as large.

The opposite was found for *privately funded* hospitals. From our estimates we can state that privately funded hospitals are more costly than their public counterparts. In particular, privately funded hospitals spent, on average, 824.2 € more per patient than publicly funded centers. These differences were also reduced when focusing on general hospitals. Specifically, privately funded general hospitals cost 452.2 € more per patient than public centers. These results are consistent with studies from the US mentioned above.

Table 4. Cost equation estimates

Ln total average expenditure	All hospitals		General hospitals	
	Ownership	Publicly founded	Ownership	Publicly founded
Private-profit$_{it}$	-0.302***	-0.278***	-0.364***	-0.278***
	(0.035)	(0.045)	(0.044)	(0.055)
Private-not-for-profit$_{it}$	-0.368***	-0.297***	-0.400***	-0.236***
	(0.039)	(0.053)	(0.052)	(0.074)
Privately-funded$_{it}$	0.080**	--	0.124***	--
	(0.037)		(0.047)	
Ln discharged$_{it}$	-0.722***	-0.784***	-0.474***	-0.510***
	(0.018)	(0.029)	(0.037)	(0.066)
Ln Case-mix$_{it}$	0.017**	-0.002	0.015	0.008
	(0.008)	(0.014)	(0.013)	(0.015)
Ln Rotation Index$_{it}$	-0.018	-0.012	-0.190***	-0.311***
	(0.034)	(0.082)	(0.057)	(0.116)
Ln Installed beds$_{it}$	0.647***	0.746***	0.481***	0.577***
	(0.022)	(0.031)	(0.037)	(0.062)
Ln Average Wage$_{it}$	0.584***	0.676***	0.525***	0.641***
	(0.034)	(0.057)	(0.042)	(0.069)
Emergency room$_{it}$	0.093**	0.136**	0.074	0.356
	(0.043)	(0.062)	(0.081)	(0.095)
Ln Investment	0.087***	0.057***	0.063***	0.034***
	(0.010)	(0.011)	(0.012)	(0.010)
Surgical$_{it}$	-0.066	0.027	--	--
	(0.058)	(0.132)		
Other acute$_{it}$	-0.013	-0.042	--	--
	(0.055)	(0.071)		
Psychiatric$_{it}$	-0.382***	-0.454***	--	--
	(0.066)	(0.090)		
Long stay$_{it}$	-0.285***	-0.352***	--	--
	(0.057)	(0.074)		
y07	0.857***	0.787***	0.989***	0.874
	(0.067)	(0.100)	(0.082)	(0.123)
constant	4.178***	3.513***	4.482***	3.830***
	(0.279)	(0.536)	(0.327)	(0.690)
Number of observations	1275	690	789	454
Prob>F	0.000	0.000	0.000	0.000
R^2	0.93	0.94	0.92	0.95

Robust Standard Errors in parenthesis. ***p<0.01; **p<0.05; *p<0.1. Baseline, Public and publicly funded hospitals.

The effect of *Ln_discharged* on hospital costs was negative and significant at 1%. We found that this relationship was maintained for all estimates. Based on our results we can say that, on average, Spanish hospitals enjoy economies of scale. Publicly funded hospitals enjoy the largest benefits with a 7.5% reduction for each 10% rise in the number of discharged patients.

The *Ln_Rotation Index* had a negative effect on per patient costs. This variable was just significant at 1% for general hospitals. These results may be explained by the fact that different hospital types were being considered in the other estimates. As different

hospitals might be experiencing different cost responses to hospital activity, the average effect is unclear.

As expected, hospital inputs affected average expenditure positively. *Ln_installed_beds, Ln_average_wage* and *Ln_investment* were statistically significant at 1% in all estimates. The same results were found for the variable accounting for whether the hospital has an emergency room, but were just significant at 5% when we used the whole sample and not significant when including just general hospitals.

In relation to the case-mix variable we had expected to find a positive relationship with hospital average expenditure, but we only found a significant relationship when including the whole sample. It is possible that the case-mix index that we constructed does not properly reflect the patients' complexity and severity of illness. We believe that information about the exact diagnoses treated in each hospital would provide better information with which to construct a case-mix index than a weighted average length of stay.

- Determinants of hospital quality

As explained above, we constructed a quality index in order to capture different dimensions of hospital quality. Our quality index used ranks from 0 to 6, and thus we estimated our equation (4) using an Ordered Logistic regression. Table 5 shows the results for each regression.

Our estimates indicate that private for-profit and not-for-profit hospitals provide a lower quality of services than their public counterparts. Table 5 shows that both ownership variables were negative and significant at 1%. These results are robust because they hold for the four estimates. Thus, it seems that private hospitals are less costly than public centers because private managers tend to reduce the quality of the services provided. Again, we do not find substantial differences in the cost incentives of private for-profit and not-for-profit firms.

We also found that the variable for privately funded hospitals was positive but not statistically significant. Although privately funded hospitals try to attract patients by offering more expensive services, it is not clear that the quality offered is higher than in public centers.

Our estimates suggest that learning effects predominate in the Spanish hospital market. We found *Ln_discharged* to be positive and significant at 1% for all our estimates. In contrast, the congestion effect appeared when analyzing hospital capacity and rotation. In particular, *Ln_installed_beds* was negative and statistically significant

at 1% in all estimates and *Ln_Rotation-Index* was negative and significant for all estimates except for publicly funded hospitals.

Table 5. Quality equation estimates

	All hospitals		General hospitals	
Quality	**Ownership**	**Publicly funded**	**Ownership**	**Publicly funded**
Private-profit$_{it}$	-1.729***	-1.789***	-2.369***	-2.506***
	(0.178)	(0.276)	(0.241)	(0.410)
Private-not-for-profit$_{it}$	-1.801***	-1.440***	-2.919***	-2.512***
	(0.213)	(0.280)	(0.303)	(0.377)
Privately-funded$_{it}$	0.095	--	0.042	--
	(0.147)		(0.220)	
Ln discharged$_{it}$	0.875***	0.971***	1.928***	2.629***
	(0.100)	(0.162)	(0.251)	(0.482)
Ln Case-mix$_{it}$	-0.034	-0.046	0.004	-0.0002
	(0.036)	(0.058)	(0.046)	(0.082)
Ln Rotation Index$_{it}$	-0.356**	-0.293	-0.942***	-1.400***
	(0.138)	(0.291)	(0.259)	(0.485)
Ln Installed beds$_{it}$	-0.881***	-0.708***	-1.704***	-2.023***
	(0.106)	(0.164)	(0.215)	(0.158)
Ln Average Wage$_{it}$	0.089	0.589	-0.062	0.729
	(0.140)	(0.377)	(0.178)	(0.516)
Emergency room$_{it}$	0.398**	0.643**	0.496	1.140
	(0.183)	(0.329)	(0.345)	(0.722)
Ln Investment	0.133***	0.141***	0.126**	0.153**
	(0.037)	(0.067)	(0.049)	(0.077)
Surgical$_{it}$	-0.261	-0.173	--	--
	(0.188)	(0.464)		
Other acute$_{it}$	-0.538**	-0.663**	--	--
	(0.231)	(0.331)		
Psychiatric$_{it}$	0.309	0.709	--	--
	(0.364)	(0.565)		
Long stay$_{it}$	-2.756***	-2.705***	--	--
	(0.352)	(0.489)		
y07	-0.665**	-1.528**	-0.496	-1.979
	(0.284)	(0.691)	(0.362)	(0.948)
Number of observations	1275	1275	789	454
Prob>χ^2	0.000	0.000	0.000	0.000
Pseudo R^2	0.24	0.29	0.14	0.15

Robust Standard Errors in parenthesis. ***p<0.01; **p<0.05; *p<0.1. Baseline, Public and publicly funded hospitals.

Hospital quality increases when the investment in fixed assets increases (*Ln_Investment*) and when there is an emergency room (*Emergency_room*). *Ln_Case-mix* and the average salary did not have any impact on hospital quality. It should be noted that in the majority of hospitals all personnel have regulated salaries, so hospital managers cannot use salaries as an incentive. It is preferable to think that they use non-monetary elements, like flexibility or fewer medical guards, as an incentive mechanism.

V. CONCLUDING REMARKS

Healthcare is a complex market with high transaction costs. Furthermore, the effect of privatization on cost savings cannot be explained by the introduction of competition and/or by the fact that private firms take better advantage of economies of scale and scope. The explanation of cost differences between ownership forms should be found in managers' incentives. In particular, private firms are more prone to engage in cost reductions at the expense of quality.

Our empirical analysis showed that private for-profit and not-for-profit hospitals incur lower per patient expenditure than their public counterparts. Moreover, we can confirm that those differences are partially explained by the fact that private hospitals provide a lower quality of service. The way that Heath Authorities finance publicly funded hospitals may be responsible for the differences in incentives between public and private centers. Private hospitals are normally paid by a prospective system, so their managers would have incentives to engage in cost reduction at the expense of quality. Public centers do not have such economic restrictions because the payment is based on a cost reimbursement contract. Hence, the incentive for reducing costs would be less strong.

When analyzing private hospitals offering private healthcare services the results are different. We found that privately funded centers do not offer services at lower costs although the quality offered is no higher than in public centers. Note that privately funded hospitals may need to provide better services in order to attract new clients.

Health Authorities face a trade-off between costs and quality when choosing private hospitals as providers of public healthcare services. Private hospitals with public funding may provide health services at lower costs that public entities. Under a context of fiscal restrictions privatization could be a reasonable solution because it could represent a notable reduction in public expenditure by guaranteeing a minimum of quality.

If governments give priority to quality of health services, private production could not be an appropriate solution. In this regard, private hospitals with public funding may provide health services at lower quality that public entities.

This trade-off could be minimized by designing contracts and finance mechanisms that redirect private incentives. If Health Authorities finance public producers with cost reimbursement contracts, hospital managers will have incentives to over expend in the provision of their services. If private centers are financed by a prospective system, which means that hospitals receive a fix amount per patient attended, managers will

have incentives to save costs. Following our results this cost reduction would be accompanied by a decrease of the quality offered.

We believe that a financing contract that includes fixed and variable payments could minimize the trade off. In this regard, neither pure cost reimbursement contracts nor pure prospective contracts should be the appropriate solution to finance hospital care. Keeping a fixed part the Health Authority can ensure that the hospital receive a minimum of income and that have incentives to save costs. In addition, the introduction of a variable payment based on the severity of illnesses treated and a quality indicator could reinforce the maintenance of a minimum of quality. Hence, private hospitals could take into account the adverse effect that cost reduction has on hospital quality. The optimal combination of the fixed and variable parts in the financing contract of hospitals could be the subject of future research.

Once again the need of a proper definition of hospital quality arises as a potential limitation in order to maximize the benefits of a mixed reimbursement method. We have presented a first draw of what we believe that a complete quality indicator would be, but further research should be done to find a better approach for constructing a quality index.

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