International Tax and Public Finance, 7, 503–519, 2000.

Competition and Efficiency in Health Care: An Analysis of the Italian Case

ROBERTO CELLINI cellini@mbox.unict.it
Universitá di Catania, Dipartimento di Economia e Metodi Quantitativi, Corso Italia 55, 95129 Catania, Italy

GIACOMO PIGNATARO Ecommo1@mbox.unict.it
Universitá di Catania, Dipartimento di Economia e Metodi Quantitativi, Corso Italia 55, 95129 Catania, Italy

ILDE RIZZO rizzor@mbox.unict.it
Universitá di Catania, Dipartimento di Economia e Metodi Quantitativi, Corso Italia 55, 95129 Catania, Italy

Abstract

In this paper we look at the Italian National Health System as a case study, in order to investigate whether competition exerts positive effects on the efficiency of hospitals. Using the DEA technique we measure the efficiency of Italian hospital production; secondly, we take a regression analysis approach to analyse its determinants. A general conclusion stemming out of the analysis is that competition is not a value per se and that its effects on hospitals' performance are affected by the rules governing the health system.

Keywords: competition, efficiency, health care, DEA

JEL Code: I–11

1. Introduction

The issue of the efficiency of the National Health System (NHS) is highly debated at the moment in Italy. Very recently, the Government has reformed relevant features of the system, with the aim of improving its *value for money*. A detailed analysis of the Italian NHS is outside the scope of this paper; however some of its main features will be outlined to analyse how competition in the health sector affects the performance of hospitals.

In this paper we try to point out that competition is not a "value" *per se*, and that its effects on efficiency are affected by the rules governing the system. The analysis is organised in two steps: firstly, we measure the efficiency of hospital production in Italy, using Data Envelopment Analysis (DEA), and secondly, we analyse some of its determinants, taking a cross section regression analysis approach. We reach the conclusion that, given the existing rules, competition does not enhance efficiency in a relevant way.

The analysis goes as follows: in section 2 the main institutional features of the Italian NHS are analysed and the specific characteristics of competition are examined. In section 3 measures of efficiency are computed and discussed; in section 4 the results of regression analysis are presented and in section 5 some comments and concluding remarks are offered.

2. The Italian National Health System: Institutional Features and Economic Implications

2.1 In the last two decades, the Italian NHS has been subjected to three different reforms.[1] According to the main objectives of the paper, attention will be focused on the rules governing hospitals, trying to bring out the real content of competition in this segment of the Italian NHS.[2]

The essential objectives inspiring the creation of the Italian NHS in 1978 were planning of health care, equality of treatment, public provision, decentralisation, democratisation, and the coverage of health expenditure out of general revenues.[3] The system did not prove effective in many respects such as preventive care, planning of health services, providers accountability. Management decentralisation without effective financial responsibility for decisions[4] was frequently responsible for low *value for money*.

The system was again reformed in 1992 leading to:

- cost sharing, as a means of reducing patients' demand, by making patients more "cost conscious";
- managerial changes in the structure of Local Health Authorities (ASL);
- partial split between providers and purchasers, with the creation of independent hospitals, i.e., Hospital Trusts, bearing full responsibility for their own budgets, management and technical functioning; however, the ASLs still maintain the management of Local Public Hospitals.
- enhancement of *competition* through the drawing up of identical technical, functional and qualitative criteria for all providers;
- freedom for patients to choose any accredited hospital (i.e. public and private hospitals which provide services paid for by NHS) for the provision of health services;
- more responsibilities to Regional governments;[5]
- a system of payment per case for hospitals, where fees are set prospectively according to diagnosed medical conditions and standardised treatment costs, on the basis of "Diagnosis Related Groups" (DRG).

More adequate forms of control, at different management levels, were introduced, involving substantive quality control rather than formal legal checks. For instance, the National Health Plan, which is an instrument for the central regulation of services, must quantify its objectives through indicators which measure results in terms of health care costs and benefits.

2.2 Italian NHS has achieved significant positive accomplishments but it still suffers from serious shortcomings. Among the accomplishments it is possible to include universal comprehensive health care, linked to the concept of *minimum standard* of care, and equitable access to a wide range of health services. There is, however, a great deal of room for

improvement of hospitals efficiency—as Section 3 and 4 show—and for the containment of hospital, diagnostics, and pharmaceutical costs. At the same time, the *yardstick competition* introduced by the DRG payment system can induce a decline in quality and an increase in the overall amount of service.

The evolution of the system is marked by the idea of implementing "quasi markets", i.e. a system where NHS is publicly financed[6] but where: the share of public production decreases, competition among producers is increased and the freedom of choice of citizens is enhanced, allowing for the choice between public and private accredited producers.[7] Contracting out is one of the tools for maintaining competition in the system. This is in line with the reforms carried out by many OECD countries (see, Kalish, Aman, Buchele, 1998), even if competition retains some special features.

2.3 Competition is used by many OECD countries as a means for improving the quality and efficiency of health care services. Most of the competition initiatives have been focused on the split between purchasers (both public and private insurers) and providers.

From a theoretical point of view, however, the issue of whether competition is beneficial in terms of efficiency is, indeed, controversial. In the literature,[8] there is some support for the hypothesis that, because of asymmetrical information, providers may be able to induce private demand. If this is the case, competition, rather than lowering prices, may have the effect of increasing them. Such a negative impact of quasi-markets on efficiency, however, is likely to be reduced if a managed care scheme is adopted, i.e., if demand is exerted at an aggregate level, rather than at the level of individual patients. This allows insurance companies and/or public purchasers to select providers that offer a good range of services at an affordable price, and effectively sets up competition amongst providers.[9] A somehow different approach has been recently enacted in the United Kingdom: even if the 1997 reforms preserve the purchaser/provider split established in 1991, the focus is now on co-operation among providers rather than on competition, in the interest of equity, continuity of care and reduced transaction costs.

The evolution of the Italian NHS has been towards increased competition, but with some distinctive characteristics. Two different types of competitors can be distinguished: the accredited and the non-accredited producers. The former group includes public and private hospitals that sell their services to Regions and are reimbursed on a DRG basis. The second group is composed by all private hospitals that sell their services to private clients and are financed by direct payments or reimbursement from private insurers.

Both groups compete with each other and the degree of effective competition varies according to the development of private insurance: the more widespread the use of private schemes, the greater the degree of competition is likely to be. At the moment, the alternative to the public scheme is rather weak. According to some empirical evidence, private insurance companies are not yet specialised in the field and do not offer specific products. Most of them provide coverage mainly for hospital benefits and only very few contract on a general basis with private hospitals.[10] Given the lack of any risk-pooling system, the market is highly segmented and cream skimming is likely to arise.

As a consequence, in Italy, private schemes only complement public schemes at the margin. The "pure" private health sector is still small, financed partly by direct payments and partly by private insurance under the reimbursement model.[11] Unlike other countries,

where opting out for private insurance is allowed,[12] in Italy such a choice is not possible on a general basis.

Moreover, competition between public accredited hospitals and private non-accredited hospitals is affected by the fact that physicians working for the former are allowed to offer their services also to the latter.[13] Given the crucial role that doctors play in inducing demand, this may lead them to "compete with themselves". This is especially true for those covering top positions within public hospitals and, as a consequence, perverse effects are likely to arise. In fact, given the ineffective system of rewards and penalties existing within public hospitals, physicians will have strong incentives to invest effort in the private sector activities. In doing so, public hospitals' performance is likely to be severely penalised. In other words, with the existing rules,[14] competition between the public and the private sector is distorted. As a consequence, if the private sector grows because of the development of the insurance market, this is likely to exert a negative impact on the performance of the public sector and of the system as a whole.

Even among the accredited hospitals the forms of competition are rather unusual. First, it should be noticed that the separation between providers and purchasers is only partially enacted. The ASLs still manage minor hospitals and provide services.[15] Secondly, private accredited hospitals may be able to practise cream skimming on a generalised basis, since the volumes of activities are not contracted. Broadly speaking, the competition implemented in the system does not seem to offer powerful incentives to stimulate the performance of the system itself; this point is clearly supported by the evidence provided in the following empirical analysis.

Summing up, competition within the Italian NHS is rather limited: opting out is constrained, distortions are introduced by the co-existence, for physicians, of public and private roles, and the market is highly segmented within the accredited sector, giving rise to cream skimming. In such a framework, any attempt to enhance the role of private producers, both accredited and non-accredited is likely to exert a negative effect on the performance of the system, as it will be shown in the following sections.

2.4 On the grounds of the major shortcomings of the present system, the Government in 1999 passed a new reform, aiming at:

- enlarging the autonomy of accredited public hospitals;
- controlling costs and decreasing supply of unnecessary services;[16]
- introducing new constraints and incentives for physicians working in public hospitals.[17]

Such an Act is too recent to allow any comment about its impact, and intense debate is ongoing: the empirical analysis carried out in the following sections, investigating the effects of competition on the performance of hospitals, will also allow evaluation of the soundness of the new principles introduced in the system.

3. The Efficiency of Production of Hospital Services

3.1 In this section, we measure technical efficiency of hospital production in Italy. The reason why we concentrate on technical efficiency is that it can be regarded as an "in-

trinsic" objective of any organisation, either public or private. Therefore, it is a sensible measure for comparing the performance of public and private hospitals. Moreover, the pursuit of technical efficiency has its own relevance in the public sector, since it implies that the (scarce) resources employed in the production of health services yield the maximum "output". The main implication is that any gain in technical efficiency allows for treating an increasing number of patients, giving effectiveness to the principle of universality of service, which can be regarded as a founding principle of many National Health Services.

3.2 The data used in the subsequent estimation of technical efficiency are drawn from official records kept by hospitals and transmitted to the Ministry for Health, for the year 1996, and regard a very large sample of Italian hospitals, made up of 1,183 hospitals over a total of 1,789.[18] The sample, therefore, contains about two thirds of the overall population of hospitals. Our sample is mainly constituted by the so called "accredited" hospitals, that is the public and private hospitals which provide services paid for by NHS.[19] The sample is also representative with respect to the geographical distribution of hospitals.

3.3 The measurement of technical efficiency is carried out through DEA. As it is well-known, DEA is a non-parametric technique, very useful for estimating efficiency in a multiple-output multiple-input context, like the provision of health services. It measures the potential maximum radial reduction in inputs, achievable to keep production levels unchanged, or, conversely, the potential maximum radial expansion of outputs, achievable with the available inputs. The measures are computed by the solution of a linear programming problem, under the hypotheses of constant returns to scale (CRS) or variable returns to scale (VRS). The use of DEA for measuring technical efficiency in the health sector is quite widespread. Sherman (1984) and Ehreth (1994) have also shown that the applications of DEA to the hospital sector give better results than other techniques.

The application of DEA requires, first of all, the definition of outputs and inputs. Hospital activity in Italy is classified according to the DRG system, which includes 492 categories. For each DRG, we have information on the number of discharged patients, in-patient days, and day cases. Since there is no widespread consensus on which is the best measure of output for hospitals, we try different specifications of outputs[20] (see Table 3.1): number of discharged patients[21] (models 1 and 2), number of in-patient days[22] (models 5 and 6) and both measures (models 7 and 8). In all models we have also included, as a different output, day cases. These outputs have been aggregated into broader composite outputs, medical and surgical activities. As aggregation weights, we use the relative cost per discharged patient for aggregating the number of discharged patients, the cost per in-patient day for in-patient days, and the cost per day case for day cases.[23] In fact, as Gerdtham, Lothgren, Tambour, Rehnberg (1998) put it, "due to severity of illness the amount of inputs required to produce services for a patient ready for discharge can vary considerably."

It is possible to argue that the above measures of hospital production represent just intermediate outputs, while the final output is related to the improvement in the health of discharged patients. Health improvement is in fact partially correlated to the quality of care delivered by hospitals, which is very difficult to measure. Following Giuffrida,

Table 3.1. Inputs and outputs for computations of alternative efficiency indices.

	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Orientation of DEA model								
Input	♦		♦		♦		♦	
Output		♦		♦		♦		♦
Inputs								
Physicians	♦	♦	♦	♦	♦	♦	♦	♦
Nurses	♦	♦	♦	♦	♦	♦	♦	♦
Other personnel	♦	♦	♦	♦	♦	♦	♦	♦
Beds	♦	♦	♦	♦	♦	♦	♦	♦
Discharged patients			♦	♦				
Outputs								
Medical discharged patients	♦	♦	♦	♦			♦	♦
Surgical discharged patients	♦	♦	♦	♦			♦	♦
Medical day cases	♦	♦	♦	♦	♦	♦	♦	♦
Surgical day cases	♦	♦	♦	♦	♦	♦	♦	♦
Medical in-patient days					♦	♦	♦	♦
Surgical in-patient days					♦	♦	♦	♦
Patients discharged alive			♦	♦				

Lapecorella and Pignataro (1999), we have used mortality rates of hospitals as a proxy for the quality of care. To avoid technical problems connected to the use of a variable ranging from 0 to 1 in DEA, we include the total number of discharged patients among the inputs of hospitals, and the number of patients discharged alive among the outputs in models 3 and 4.

As far as inputs are concerned, we use the number of physicians, the number of nurses, the number of other personnel and the number of beds, the latter as a proxy of capital used in the hospital production.

As it can be seen from Table 3.1, all the different specifications of the production function have been estimated according to both an input orientation procedure, aimed at minimising the inputs used in the production of output, and an output orientation procedure, aimed at maximising the amount of output produced.[24] Table 3.2 shows some descriptive statistics for the inputs and outputs.

3.3 Table 3.3 shows the main results from the application of DEA to the data depicted in the previous section. The efficiency scores have been computed using the DEAP 2.1 package.[25] It is possible to interpret[26] efficiency values estimated under the CRS hypoth-

Table 3.2. Description of data.

	Mean	**Std dev**	**Min**	**Max**
Inputs				
Physicians	87.322	149.19	1	1657
Nurses	214.97	336.55	1	2827
Other personnel	136.41	220.26	0	2332
Beds	251.74	312.56	10	3055
Discharged patients	7227.703	9875.929	46	102476
Outputs				
Medical discharged patients	5037.856	6828.153	16	78550
Surgical discharged patients	2189.87	3262.92	0	26734
Medical day cases	6379.392	12246.688	0	92952
Surgical day cases	665.215	1368.438	0	11571
Medical in-patient days	42258.36	50798.47	55	416911
Surgical in-patient days	20113.06	32223.96	2	282749
Patients discharged alive	7054.03	9635.771	27	101078

esis as a measure of overall technical efficiency, which can be broken up into scale efficiency and pure technical efficiency, where the latter is the value estimated under the VRS hypothesis.

First of all, it is possible to note that the efficiency values of models 3 and 4, including the "quality" variable, are very high and very much different from all the scores computed for the other models. The reason is relatively simple. In the computation of the efficiency score, the technique aggregates the different outputs and inputs, assigning weights to each output and input which "favour" those segments of production more efficiently carried out by the hospitals. Since the mortality rate is, on average, very low, all the hospitals in the sample benefit in the computation of their efficiency from being especially "efficient" in discharging patients alive. Of course, this reduces the significance of the estimation of efficiency, when this quality variable is incorporated into the analysis. More generally, caution is needed in the attempt to measure efficiency, taking account of quality differences among hospitals. It is quite difficult, indeed, to find a suitable measure of quality of care delivered by hospitals, which is under their complete control. Mortality rates, for instance, depend not only on the quality of hospital care, but on a lot of other factors, totally out of the control of those providing care in a hospital. One could also question the methodological appropriateness of trying to "correct" the measures of efficiency with measure of effectiveness, against the alternative of keeping these two measures separate.

Table 3.3. Description of efficiency indices.

Model	Type of efficiency	Mean	Std dev.
1 & 2	Overall	0.470	0.178
1	Pure technical	0.562	0.180
1	Scale	0.839	0.201
2	Pure technical	0.533	0.217
2	Scale	0.901	0.124
3 & 4	Overall	0.977	0.036
3	Pure technical	0.980	0.032
3	Scale	0.997	0.015
4	Pure technical	0.980	0.032
4	Scale	0.997	0.015
5 & 6	Overall	0.373	0.152
5	Pure technical	0.481	0.194
5	Scale	0.804	0.204
6	Pure technical	0.475	0.216
6	Scale	0.826	0.175
7 & 8	Overall	0.575	0.163
7	Pure technical	0.647	0.172
7	Scale	0.892	0.142
8	Pure technical	0.639	0.194
8	Scale	0.911	0.105

For all these reasons, we decided to disregard the efficiency scores computed under models 3 and 4.

As far as the other efficiency measures are concerned, the computation of correlation indices shows that there is quite a high correlation among these values and, above all, between those values under model 7 and 8 and the others. Moreover, the efficiency frontier in the different models contains mainly the same hospitals.[27]

Since the different specifications of outputs tend to generate similar efficiency frontiers and efficiency values, in what follows we concentrate on the efficiency scores computed under model 7, including all the three relevant measures of output (discharged patients, in-patient days and day cases) and input oriented.

The efficiency results show that there is a very high degree of technical inefficiency, of about 42.5%.[28] Table 3.4 also shows that only 44 hospitals (3.72% of the sample) are on the efficiency frontier.

Table 3.4. Distribution of efficiency values.

Efficiency	Overall efficiency		Pure efficiency		Scale efficiency	
values	Number	%	Number	%	Number	%
0–0.249	43	3.6	14	1.2	4	0.03
0.250–0.499	303	25.6	222	18.8	31	2.6
0.500–0.599	331	27.9	257	21.8	19	1.6
0.600–0.699	286	24.2	286	24.2	58	4.8
0.700–0.799	119	10.1	183	15.5	107	9.0
0.800–0.899	42	3.6	94	7.9	196	16.6
0.900–0.999	15	1.3	44	3.7	711	60.1
1.000	44	3.7	93	7.9	57	4.8

Table 3.5. Distribution of efficiency indices for the main hospital types and geographical areas.

Hospital type	Overall efficiency	Pure efficiency	Scale efficiency
Hospital Trusts	0.631	0.818	0.787
Local Public Hospitals	0.562	0.612	0.924
Teaching Hospitals	0.483	0.662	0.741
Private accredited hosp.	0.574	0.667	0.852
Private non accredited h.	0.741	0.759	0.973
Geographical areas			
North	0.589	0.648	0.915
Center	0.571	0.663	0.863
South	0.561	0.627	0.896

The major reason for this poor performance is related to the pure component of technical efficiency. Pure technical inefficiency is on average 35%, while scale inefficiency is, on average, about 11%. Only 57 hospitals work at an efficient scale, while inefficiency of scale is related, in a slight majority of cases, to the small dimension of hospitals (613 hospitals show increasing returns to scale), while still a lot of hospitals suffer from a very large dimension (503 hospitals show decreasing returns to scale).

Finally, we show the distribution of efficiency scores for the different types of hospitals and the main geographical areas.

It is worth noting how efficiency is not strictly related to ownership, since private hospitals behave differently, according to whether they operate within NHS or not, and public hospitals' performance is different for different types of organisations. Also, the overall efficiency frontier is mostly made up by private accredited hospitals (32 over 44) and by a very few public hospitals (6 local public hospitals and 1 hospital trust). However, when one considers the pure efficiency frontier, the presence of private and public hospitals is more balanced, suggesting that the latter face problems related to the rigidity of their structures, and to the "obligation" of operating either at a wide scale or at a small local scale. Their efficiency in using their resources, when one takes out this scale effect, is comparable to that of their private counterparts.

As far as the distribution of efficiency scores among the main geographical areas of the country is concerned, there is no noticeable difference. The three areas are also evenly represented on the pure efficiency frontier (27 hospitals in the North, 36 in the Center, and 31 in the South are on the pure efficiency frontier). With respect to the latter, however, it is interesting to note that most of the southern hospitals on the frontier are private, while the opposite is true for northern hospitals.

These few comments on the efficiency scores computed for the Italian hospitals suggest how the analysis of their determinants is quite complex, and has to contemplate a wide set of factors.

4. Regression Analysis

4.1. In this section we analyse some determinants of the efficiency of hospitals. The dependent variable is the index of efficiency, computed according to model 7 (see Table 3.1).

The explanatory factors may be listed in three groups. The first group includes the features of any single hospital: its type (public hospital, hospital trust, accredited or non accredited private hospital, etc.) and its share in the regional market. The latter is computed with respect to discharges, but results do not change if the shares of beds are taken into account.[29] The second group concerns the structure of health care markets at the regional level. It includes the total number of hospitals (normalised with respect to population), the mix of accredited and private hospitals, the composition of accredited hospitals, and the Herfindahl index computed at the regional level on the basis of discharges.[30] The third group includes macroeconomic and demographic variables referring to the region where each hospital is located; specifically, GDP per capita and the share of population aged over 65. These variables aim at capturing some aspects of the demand for health care services.

All variables are listed in Table 4.1.[31]

It is worth stressing some general features of the regression analysis. First, as to the specification, we will adopt the procedure "from general to particular": we start by considering a large group of explanatory factors, and then proceed to omit the non-significant ones.

Secondly, since the dependent variable is an index, ranging from 0 to 1, it has to be expected the R^2-statistics will be rather low. Given the data at hand, it would be meaningless to perform all usual diagnostic tests about correct specification, and we will comment upon the sign and significance of the coefficients of explanatory factors.

Table 4.1. Variables.

Dependent variable
EFFOTE = index of overall technical efficiency
EFFPTE = index of pure technical efficiency
EFFSC = index of scale efficiency
Explanatory factors
DUHT = dummy variable for Hospital Trusts
DULPH = dummy variable for Local Public Hospitals
DUTEA = dummy variable for Teaching Hospitals
DUSR = dummy variable for Scientific Research Hospitals (Law 833/78, Art. 42)
DURSI = dummy variable for residual special institutions (Law 833/78, Art. 41)
DUAPH = dummy for Accredited Private Hospitals
DUNAPH = dummy for Non-Accredited Private Hospitals
DUPSH = dummy for (formally abolished) Psychiatric Hospitals
DULPH = dummy for particular private institutions considered Local Public Hospitals.
SHARER= share of discharges of the hospital in the region
HTOTPOP = total number of hospitals for 1000 inhabitants in the region
HPRNPU= ratio between non accredited private and public hospitals in the region
BEDPRIVPU = ratio between beds in private and public hospitals in the region
HERFR = Herfindahl index in the region (computed on the basis of discharges)
*POP65 = share of population aged over 65
*GDPPC = GDP per capita

Note: (*) Source: ISTAT (1996, 1999); otherwise, data are from Health Ministry. All series are available from Authors upon request.

Table 4.2 reports the results for the final specification of regression analysis, in the case of OLS estimates. As already mentioned, we follow the procedure from general to particular: we start by including all regressors listed in Table 4.1, and then proceed to delete the variables that are totally insignificant (Student t lower than 1.00 in absolute value). In any case, appropriate deletion tests support our choices. Further details are given below.

4.2. As far as the effects of the characteristics of hospitals are concerned, all dummy variables for the type of hospitals are significant. All tests reject the null hypothesis of equality of the coefficients of the dummies, and thus support the specifications printed in Columns (1), (3), (4) of Table 4.2. However, regressions considering only a constant term, instead of the vector of dummy variables, replicate the same qualitative results for the remaining regressors (see Column (2)).

The values of the dummies' coefficients in Table 4.2 may be interpreted as indicators of efficiency of the different types of hospitals (see Islam, 1995, for a similar interpretation of fixed effect coefficients in panel regressions). Local Public Hospitals and Teaching Hospitals have the lowest coefficients for overall efficiency; this "under-performance" is not surprising for the Teaching Hospitals, since there are other two outputs, teaching and research, which are not taken into account by our measure of efficiency. As to the Local Public Hospitals, the low dummy coefficient is a signal of the existence of some room for improving efficiency.[32] On the contrary, Hospital Trusts have a relatively large coefficient of fixed effect; loosely speaking, this can be seen as a good outcome of the split between

Table 4.2. Final specifications for OLS estimation.

	(1)	(2)	(3)	(4)
Dependent Variable	EFFOTE	EFFOTE	EFFPTE	EFFSC
DUHT [or #Constant]	.52 (9.74)	#.47 (9.75)	.70 (15.98)	.77 (18.47)
DULPH	.46 (9.51)		.51 (13.54)	.92 (23.84)
DUTEA	.40 (4.76)		.58 (7.05)	.75 (11.19)
DUSR	.55 (10.18)		.60 (12.82)	.93 (21.55)
DURSI	.52 (9.50)		.55 (11.80)	.94 (21.78)
DUAPH	.48 (9.66)		.57 (14.63)	.85 (21.72)
DUNAPH	.63 (7.25)		.65 (7.90)	.96 (14.05)
DUPSH	.64 (3.62)		.90 (5.04)	.73 (5.20)
DULPH	.51 (6.95)		.54 (7.78)	.94 (16.24)
SHARER	.33 (1.43)	.40 (1.68)	.52 (2.17)	−.17(−1.31)
HERFR	−.22(−1.32)	−.29(−1.72)	−.25(−1.48)	Omitted
HPOPTOT	−3.31(−3.28)	−3.41(−3.36)	−2.59(−2.90)	−1.95(−2.56)
BEDPRIVPU	.14 (3.00)	.14 (3.04)	.08 (1.92)	.10 (2.81)
HPRNPU	−.12(−1.86)	−.11(−1.73)	Omitted	−.16(−3.00)
POP65	.012 (5.23)	.012 (5.41)	.011 (5.06)	.004 (2.07)
R^2	.069	.048	.10	.13
F	5.46 [.000]	9.90 [.000]	10.40 [.000]	13.38 [.000]

Note: Student t in parenthesis; p-value in brackets.

providers and purchasers, introduced by the 1992 Reform. Note also the good result for non-accredited private hospitals, while evidence on accredited private hospitals is mixed (we do not comment upon psychiatric hospitals, given the very limited presence of these hospitals in the sample).

As an additional exercise on this point, we evaluate the significance of any single dummy, added one by one, in the specification with the constant term; results are in Table 4.3. The above comments are totally confirmed. In particular, it is worth noticing that the dummy referring to public hospitals is significant and negative, while dummies referring to Hospital Trusts and non-accredited private hospitals are positive and significant at the 94% and 97% level, respectively.

As a general conclusion on this point, the intuition presented at the end of Section 3.3 that ownership *per se* is not relevant, is confirmed. Hospital Trusts have the same performance as Private Accredited Hospitals. Local Public Hospitals, still incorporated into purchasing Authorities and suffering from the lack of managerial autonomy, score worse than their public and private counterparts.

The effect of the individual market share upon the efficiency is positive and significant when we evaluate the pure technical efficiency, while it is not highly significant upon the overall efficiency.[33]

4.3. The structure of the regional market seems to play a relevant role. The negative effect of the density of hospitals is a very robust result. This can be due, at least partially, to the

Table 4.3. Dummy variable for type of hospitals.

DUMMY	Value, (t statistics)	F test
DUHT	.04 (1.95)	.051
DULPH	−.03(−2.87)	.004
DUTEA	−.07(−1.08)	.279
DUSR	.08 (2.94)	.003
DURSI	.04 (1.59)	.112
DUAPH	.04 (.03)	.969
DUNAPH	.15 (2.19)	.029
DUPSH	.17 (1.02)	.306

Note: Dummy variables are added, one by one, in specification of Column (2) of Table 4.2. F is the appropriate statistics F(1,1185) for the test on zero restriction on the coefficient of additional variable.

fact that the higher the number of hospitals, the lower the demand met by each hospital, and the lower its efficiency. An immediate policy implication is that competition, as measured by the number of hospitals, does not increase efficiency; on the contrary, it has a detrimental effect.

At this stage, the Herfindahl index is negative, but not very significant. In different specifications (e.g. a logit estimation—see note 35) we would find a negative and significant effect. This means that concentration in the regional market has a "negative" impact on efficiency. Note that this result is not at odds with the negative effect of the density: since we have controlled for the number of firms, Herfindahl index measures the "non-competitiveness" of the market in which each hospital operates. This appears to have a negative external effect on hospitals' behaviour.

The evidence on the effects of the public-private mix in each region on hospitals' efficiency is not clear-cut. Private hospitals' share of the market has a positive effect when it is measured with respect to beds, while it has a negative effect when measured with respect to the number of hospitals. We also find a non-significant effect of the presence of private hospitals (independent of the way it is measured) upon the efficiency of public hospitals.

Competition, then, seems to have a positive impact on efficiency of hospitals when it is interpreted in terms of market concentration and therefore in terms of existence of competitive "tension" among hospitals. The creation of competition through an enlargement of markets, increasing the number of hospitals or the presence of private hospitals, has an insignificant, if not negative, impact on efficiency.

4.4. Variables capturing the demand for health services are important in shaping the efficiency of hospitals. In fact, it is widely known that the expenditure for health care services increases with the level of GDP, both at the individual level (health services are sometimes regarded as luxuries), and at the aggregate level. On the other hand, health care demand is driven by needs, and the share of old population is likely to represent a good proxy for such need. Specifically, we considered the GDP per capita, and the share of population aged over 65. Both variables turned out to have a positive impact on the

efficiency. They are highly statistically significant when considered one-by-one in separate regressions, while statistical significance shrinks when they are considered together in the same regression. This is consistent with our point that both variables are related to the dimension of demand. In our final specification we keep the share of population aged over 65.[34] Obviously, the conclusion is that a larger demand leads to a higher efficiency. This is also due to the definition of efficiency, which is strictly connected to the amount of services provided.

Different econometric checks support the robustness of results.[35]

5. Conclusions

In this paper, looking at the Italian NHS as a case study, we have tried to investigate the effects of competition and ownership on the efficiency of hospitals. Using DEA, the efficiency of hospital production has been measured and, in a subsequent regression analysis, some of its determinants have been analysed.

Overall, evidence and observations lead to conclude that competition does not necessarily play a role in enhancing efficiency of hospital production. The negative impact of the density of hospitals upon the efficiency indexes is a robust result (it holds also when we consider the accredited hospitals alone). We believe that the result is not surprising: the number of providers describes how strong is competition in a market of a "standard good". In the case of health care services the number of providers does not capture the true essence of competition. The main policy implication is that an enlargement of the number of providers will not improve *per se* the efficiency of hospital care. Therefore, we cannot agree with the conclusions of different available analyses. For instance, Dalmau-Matarrodona and Puig-Junoy (1998) analyse the determinants of technical efficiency of hospitals in Catalonia, and show that "the presence of competitors in the local market, independently of their market share, improves technical efficiency". Apart from the obvious institutional differences between Italy and Catalonia and the differences in the samples' size, their analysis does not control for the size of demand and, therefore, the coefficient relative to the number of competitors may capture the positive effect of demand on competition.

Furthermore, an enlargement of the market aiming at increasing the share of private producers has no significant positive effect on efficiency. Ownership does not play a significant role in explaining differences in hospitals' efficiency, as well as the share of private producers in the supply of hospital services. Non-accredited private hospitals and public Hospital Trusts perform better than the other types of hospitals, *ceteris paribus*. This confirms that the rules governing the behaviour of hospitals matter more than private or public ownership.

As far as the latter point is concerned, this paper shows that competition can enhance efficiency when it is referred to the "competitive tension" within the market, which, in turn, is related to its concentration. The implication here is that, since the purchase of services is publicly controlled, the purchasing authorities should develop contractual relations with producers such that concentration of production should be avoided. Therefore, the opening-up of the market can be beneficial only if it is necessary to avoid concentration.

Finally, as already mentioned, competition in Italy is not really sound: often physicians in public hospitals also work in private hospitals. Our results may represent good evidence in favour of the proposals to forbid physicians to cumulate public and private jobs, in order to enhance the efficiency of the public system, currently supported by the Italian government.

Acknowledgments

We wish to thank M. Alfò and M. Spizzichino (Ministry for Health), A. Giuffrida, M. Guagnini, V. Guardabasso, C. Guccio and L. Siciliani for useful comments and help in finding the data. Section 2 has been written by I. Rizzo, Section 3 by G. Pignataro and Section 4 by R. Cellini.

Notes

1. The Italian NHS was created in 1978, with the aim of providing universal, comprehensive health services to all citizens; with the Legislative Decrees 502/1992 and 517/1993 "the reform of the reform" has been launched to introduce efficiency and reducing public spending; in 1999 a new reform is enlarging the autonomy of accredited public hospitals.
2. Hospital care represents a quite large share of health expenditures in Italy (46,7%), as well as in other European countries (the OECD European countries' average is 46,1%). On the relevance of hospital care, and on the features of the Italian NHS, see Dirindin, Vineis (1999).
3. According to Artoni (1999), the reform achieved some relevant results with respect to the reduction of territorial disparities: in 1977 the Region with the highest expenditure was above the average of 24% while in 1993–95 such a percentage decreased to 14%. The same reduction of disparities occurred for those Regions below the average.
4. The system of payment for hospitals was characterised by a per in-patient day basis.
5. The regions must fund any overspending by the ASLs out of their own resources. Moreover, the regions must finance additional expenditure by scaling back exemptions from prescription charges or by increasing the percentage of costs covered by patients contributions or, in part, raising the rate of existing regional health contributions.
6. According to Mapelli (1999), among the OECD countries, the Italian system exhibits the highest percentage of private financing (30%).
7. Private production in 1995 accounted for 52.9% of total production: the 28% was privately financed, while the 25% was publicly financed (Mapelli, 1999).
8. For a survey, see Belli (1996).
9. One example of this is the 1995 reform in Australia, which allowed private health insurance companies to negotiate contracts with individual hospitals, ambulatory care clinics, and health care providers regarding fees charged and services offered. This will enable them to offer better benefits packages to their consumers.
10. 133 insurance companies operate in the health sector and 20% of them raise the 80% of the overall amount of premia. Only 5 contract on a general basis with private hospitals (Nuti, 1998).
11. Supplementary insurance is available from private insurers for better physical surroundings (private rooms) and for care of private providers.
12. For instance, Germany and the Netherlands offer some freedom of choice for consumers. In Germany, people may change funds if the contribution rate is increased; in the Netherlands, people may change funds once every six months. The possibility of opting out can be different for different social groups.
13. They are prevented from doing so in the accredited private hospitals.
14. This aspect has been taken into account in the reform just approved.
15. From this point of view, the system is an hybrid because two models—integrated and contractual—coexist; however, regional differences do exist with this respect.
16. A new payment system for providers will be introduced, based on the negotiation of volumes of services.

17. Physicians, working in public hospitals, are penalised if they sell their services in the private sector: those offering *extra-moenia* services will not be allowed to cover positions within the public accredited hospitals. At the same time, top positions will be assigned on a 5 years base and performance will be monitored.
18. This is the number of hospitals recorded by the Ministry for Health.
19. As to accredited hospitals, the sample includes 59 Hospital Trusts, 613 Local Public Hospitals and 415 Private Accredited Hospitals. It does not include all the accredited hospitals, since the data set provided by the Ministry of Health misses all the data, relative to the variables used in the measurement of technical efficiency, for one region, Sicily. A few observations also had to be dropped out of the sample because the relative data were incomplete or manifestly inconsistent. Moreover, only 6 out of 152 non-accredited private hospitals are included in our sample, since they have no obligation to transmit information on the services they produce to the Ministry for Health, as they are not reimbursed by the NHS.
20. This is also a test for the robustness of DEA results, as minor changes in the variables used in the analysis should not significantly change the efficiency values.
21. Among the studies which use such definition of output, see Zwanziger, Melnick (1988), Burgess, Wilson (1996), Gerdtham, Lothgren (1998), Gerdtham, Lothgren, Tambour, Rehnberg (1998), Giuffrida, Lapecorella, Pignataro (1999), Fabbri (1999). The latter two papers present empirical analysis on Italian hospitals.
22. See Galizzi, Novara, Vassallo (1999) who study efficiency of regional hospital production, measured as *non-weighted* number of patient days.
23. The costs used in the analysis are the officials ones, attached to each DRG, published in the Gazzetta Ufficiale, D.M. 30.06.1997.
24. As we will see later, the two models provide the same result when constant returns to scale (CRS) are assumed, while they differ under the assumption of variable returns to scale (VRS). As Coelli (1996) points out: "Given that linear programming cannot suffer from such statistical problems as simultaneous equation bias, the choice of an appropriate orientation is not as crucial as in the econometric estimaton case".
25. See Coelli (1996).
26. See Banker, Charnes and Cooper (1984).
27. A test conducted on the correlation values shows that correlation among the indexes is significantly different from zero.
28. On average, Italian hospitals use 42.5% more inputs than necessary.
29. The correlation between the two series is .989.
30. Given the available data, Herfindahl index has been constructed, on the basis of the "supply side" of the market.
31. Starred variables come from Italy's National Statistical Institute, ISTAT (1998, 1999), and refer to 1995—the last available data. However, the cross-region variation is rather stable over time, so that we do not believe that modifications would emerge if more recent data were used.
32. This result is in line with Giuffrida, Lapecorella, Pignataro (1999).
33. This result is not surprising, because almost 50% of hospitals in our sample operate under decreasing returns to scale.
34. We choose to take the variable that performs better, on the basis of statistical criteria. However, results would not change if we considered the other variable, or even alternative economic variables (for instance, family consumption per capita, or the families' average propensity to savings, which are positively correlated with GDP per capita). It is Cor (GDPPC, POP65)=.55; Cor (GDPPC, consumption per capita)=.93.
35. In order to check the robustness of our results, we have repeated the regression analysis, by assuming a logarithmic specification, and—alternatively—by using logit/probit models. In both cases, the evidence on the sign and significance of regressors is—broadly speaking—the same as in the OLS estimation. In particular, market concentration (and the density of hospitals per inhabitants) has negative *and significant* effects on the overall efficiency of single hospitals, the presence of private hospitals does not contribute to enhance hospitals' efficiency; the demand plays a positive role. A further check for the robustness of results has been carried out using aggregate regional data (partly borrowed from Cellini, Pignataro and Rizzo, 1999). The resulting sample was constituted by 20 observations, corresponding to the 20 Italian regions. The analysis of simple correlation, as well as the multiple regression analysis, is totally consistent with all points made in Section 4. The above mentioned evidence is available upon request.

References

Artoni, R. (1999). *Lezioni di Scienza delle Finanze*, Il Mulino, Bologna.

Banker, R. D., H. Charnes, and W. W. Cooper, (1984). "Some Models for Estimating Technical and Scale Inefficiency in Data Envelopment Analysis." *Management Science* 30, 1078–1092.

Belli, P. (1996). "L'effetto della Riforma dei Quasi-mercati sulla Concorrenza fra Fornitori di Servizi Sanitari." *Econpubblica*, Working Paper n. 38.

Burgess, J. F. and P. W. Wilson, (1996). "Hospital Ownership and Technical Efficiency." *Management Science* 42(1), 110–123.

Cellini, R., G. Pignataro, and I. Rizzo, "Competition and Efficiency in Health Care: An Analysis of the Italian Regions." w.p. 354 Università di Bologna (http://www.dse.unibo.it).

Coelli, T. (1996). "A guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program." *CEPA Working Paper* 96/08.

Dalmau-Matarrodona, E. and J. Puig-Junoy, (1998). "Market Structure and Hospital Efficiency: Evaluating Potential Effects of the Regulation in a National Health Service." *Review of Industrial Economics* 13(4), 447–466.

Dirindin, N. and P. Vineis, (1999). *Elementi di Economia Sanitaria*, Il Mulino, Bologna.

Ehreth, J. L. (1994). "The Development and Evaluation of Hospital Performance Measures for Policy Analysis." *Medical Care* 32, 568–587.

Galizzi, B., M. Novara, and E. Vassallo, (1999). "Efficienza dell'Assistenza Ospedaliera Italiana in un'Analisi Territoriale." *Economia Pubblica* 29(3), 37–73.

Gerdtham, U-G. and M. Lothgren, (1998). "Health Care System Effects on Cost Efficiency in the OECD Countries." *Stockholm School of Economics*, Working Paper series in economics and finance, No. 247.

Gerdtham, U-G., M. Lothgren, M. Tambour, and C. Rehnberg, (1998). "Internal Markets and Health Care Efficiency: A Multiple-output Stochastic Frontier Analysis." *Stockholm School of Economics*, Working Paper series in economics and finance, No. 222.

Giuffrida, A., F. Lapecorella, and G. Pignataro, (1999). "Efficiency of Health Care Production in Different Hierarchically Structured Hospitals." *CHE Technical Paper*, 14.

Kalisch, D. W., T. Aman, and L. A. Buchele, (1998). *Social and Health Policies in OECD Countries: A Survey of Current Programmes and Recent Developments*. OECD- Occasional Paper, n. 33, Paris.

Islam, N. "Growth Empirics: A Panel Data Approach." *Quarterly Journal of Economics* 110, 1127–1170.

Istat (1998). *Annuario di Statistiche Sanitarie*. Istat, Roma.

Istat (1999). *Contabilità Regionale*. Electronic Database. Istat, Roma.

Mapelli, V. (1999). *Il Sistema Sanitario Italiano*, il Mulino, Bologna.

Nuti, F. (1998). *Introduzione all'Economia Sanitaria e alla Valutazione Economica delle Decisioni Sanitarie*, Giappichelli, Torino.

Sherman, H. D. (1984). "Hospital Efficiency Measurement and Evaluation." *Medical Care* 22, 922–938.

Ugolini, C. and D. Fabbri, (1998). "Mobilità Sanitaria ed Indici di Entropia." *Mecosan* 7(26), 9–24.

Zwazinger, J. and G. Melnick, (1988). "The Effects of Hospital Competition and the Medicare PPS Program on Hospital Cost Behavior in California." *Journal of Health Economics* 7, 301–320.