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The impact of New Public Management on efficiency: An analysis of Madrid's hospitals

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ABSTRACT

Madrid has recently become the site of one of the most controversial cases of public healthcare reform in the European Union. Despite the fact that the introduction of New Public Management (NPM) into Madrid hospitals has been vigorous, little scholarship has been done to test whether NPM actually led to technical efficiency. This paper is one of the first attempts to do so. We deploy a bootstrapped data envelopment analysis to compare efficiency scores in traditionally managed hospitals and those operating with new management formulas. We do not find evidence that NPM hospitals are more efficient than traditionally managed ones. Moreover, our results suggest that what actually matters may be the management itself, rather than the management model.

1. Introduction

New Public Management (NPM) policies have been introduced into public healthcare across most OECD countries from the 1980s, in response to concerns about rising healthcare expenditures, fueled by technological and medical advances in treatment, as well as an aging population [1,2]. In Spain, NPM reforms were first introduced into the healthcare system from the early 1980s, in parallel with political decentralization.[1] Decentralization allowed Spain's 17 regional governments to gain autonomy as regards decisions to introduce or reinforce NPM into healthcare, including the adaptation of new hospital management models, such as different forms of public private partnership (PPP) [3]. Since then, regional governments in Spain have increasingly introduced NPM reforms into healthcare, particularly in Catalonia and Madrid [4]. However, vigorous NPM-related reform of the Madrid healthcare system has been highly controversial.

This paper focuses on the reform of hospitals belonging to the Madrid Regional Health Service (henceforth, SERMAS). Emulating healthcare reforms in the UK, Madrid vigorously implemented the use of new hospital management formulas, through the implementation of purchaser/provider split, use of PPPs, contracting out and the introduction of competition between hospitals. Moreover, reforms in Madrid gained increased traction during

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[1] Decentralization took place during the 1980s and 1990s, transferring powers in healthcare management gradually across the different Spanish regions, firstly to Catalonia (1981), Andalusia (1984), the Basque Country and Valencia (1987), Galicia and Navarra (1990) and the Canary Islands (1993). The healthcare decentralization process ended in January 2002, when the devolution of autonomy and power from the central government to all regional governments was completed [3].

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the ongoing economic and financial crises. Nevertheless, the implementation of healthcare reform has proved controversial and witnessed widespread protest by citizens and healthcare professionals. In particular, the attempt to contract out clinical services delivery in six public hospitals sparked popular criticism [5]. A popular movement formed by doctors, nursing staff and citizens – the so-called "white tide" – took the streets in Madrid several times from November 2012 [48]. Despite this massive popular opposition, the contracting out bidding process went ahead. However, in January 2014, the regional government abruptly declared it would halt the contracting out plan, soon after the Madrid High Court suspended the process [6].

Policy-makers and scholars have argued that NPM techniques would increase efficiency in the health care sector, by introducing criteria from private sector management into traditional methods of public administration [7]. In the Spanish context, policymakers have used repeatedly the efficiency improvement argument to introduce new management formulas in healthcare delivery [8].

Theory suggests that NPM-related policies may enhance the efficiency of public service delivery, such as healthcare provision (for a comprehensive overview of NPM and efficiency, see [9]). However, the benefits of NPM-related tools in healthcare delivery have been already questioned from an international perspective (see, for example, [10–13]). Moreover, there is no clear evidence supporting efficiency gains as regards the use of new management formulas in Spain,[2] which is adding fuel to an already heated debate in relation to the pros and cons of introducing new management formulas in public hospitals.

The central aim of this paper is to evaluate whether the NPM reforms implemented in the SERMAS hospitals' network are indeed associated with efficiency gains. To do so, this paper carries out a comparative analysis of the performance of traditionally managed hospitals and those adopting new management formulas, for hospitals belonging to the SERMAS in the year 2009. We assess the relative hospitals' efficiency by means of standard data envelopment analysis (DEA) techniques and a DEA-bootstrap approach, followed by a second-stage consisting of a statistical analysis to assess differences in efficiency scores between the two groups by means of a Mann–Whitney *U* test and an analysis of DEA bootstrapped confidence intervals.

To the best of our knowledge, this is the first study to analyze efficiency differences between traditionally managed hospitals and those ones operating under new management formulas in Madrid. Thus, this paper sheds new light on the current debate about the use of new forms of public hospitals' management in Spain. One reason for this lack of empirical evidence may be the opacity of the Spanish NHS; although there is a considerable amount of information on Spanish hospitals in public databases, data is anonymized, making it difficult to identify hospitals and thus, to identify the management model. To overcome this problem, we crossed two different databases to extract individual hospital information (for a detailed explanation see Section 3.2).

The rest of the paper is organized as follows. Section 2 synthesizes the main NPM-style policies implemented in Spanish hospitals, with a particular focus on Madrid. Section 3 describes the data and the methodology used for inference. Section 4 reports the analysis results and interprets them. Section 5 concludes, summarizing our findings, their policy implications and possible directions for further research.

2. New hospital management models

Though the Spanish public health system had contracted out some services to private hospitals for decades [15], the legislation passed during the second half of the 1990s introduced new managerial formulas to govern publicly owned hospitals, significantly reshaping the healthcare landscape. At the central government level, Law 15/1997 was particularly important, since it enabled the implementation of a wide array of new hospital management models. Previously, during the first half of the 1990s, the ruling Socialist party had already passed legislation aimed at introducing more efficient and flexible organizational formulas, such as Law 30/1992, which regulated, among other things, the so-called "*consorcios*" (consortia), and Law 30/1994, which first regulated the foundations model. When the conservative Popular Party (*Partido Popular*) gained power from 1996, it approved Royal Decree 10/1996,[3] which allowed for the use of new hospital management models, with the explicit aim of "introducing more flexible organizational formulas, in order to meet the demands of efficiency and social profitability of public resources [*sic*]". Most importantly, Law 15/1997 – the result of the parliamentary processing of Royal Decree 10/1996 – enabled at the national level the implementation of new managerial formulas to govern public hospitals, and also contemplated private sector involvement in the delivery and management of public healthcare services. With this, the entry of private providers into public healthcare delivery was facilitated further (for a comprehensive overview of the legislative framework behind the adoption of new hospital governance formulas in Spain, see Álvarez and Durán [16]).

As a consequence of these changes to the legislative framework, the introduction of NPM-related policies to the public healthcare services increased across Spanish regions. By 2002, when powers in healthcare management had been fully transferred to all Spanish regions, Madrid emerged as one of Spain's most active sites of healthcare reform.[4] Here, two main actions were taken as regards hospital management: (i) introduction of market-driven mechanisms through the separation of purchaser and provider, with the aim of transforming the public hospital network into a large number of smaller firms, with

[2] For an overview about the empirical evidence as regards the use of new management formulas in the Spanish NHS, see [14].

[3] Royal Decree 10/1996 about new management formulas of the Spanish NHS.

[4] Through the implementation of Law on Health Organization of the Community of Madrid (LOSCAM-Law 12/2001).

Table 1
Main characteristics of SERMAS hospitals.

Type of model	Name	Service delivery	Legal subjection	Staff management
Administrative direct management	Clinic unit with no legal status (traditional managed hospital)	Public (direct)	Public law	Statutory regime
New management model	Public enterprise	Public (direct)	Private law	Labor legislation**
New management model	Foundation	Public (direct)	Private law	Labor legislation
New management model	Contracting	Private (indirect)	Private law	Labor legislation
New management model	PFI	Mixed* (indirect)	Private law	Labor legislation
New management model	"*Alzira*" model	Private (indirect)	Private law	Labor legislation

* Private sector delivers non-clinic services while public sector delivers clinic services through a public enterprise.
** Subject to labor legislation except if reflected on its statutes subjection to statutory regime.

greater autonomy, their own legal status and, in competition with other hospitals, similar to the UK's hospital trusts [17] and (ii) contracting out some or all hospital services, including clinic services. As a result, there are currently five different new management models in the SERMAS hospitals, including private or semi-private formulas, in addition to the so-called *traditional direct management* (ADM) model: public enterprises; foundations; PFI models with a public enterprise managing clinic services and outsourced non-clinic services to private companies; PPP models with full private management; and contracts with privately owned hospitals.

Table 1 summarizes the different management models coexisting in Madrid and their main characteristics. Briefly, ADM hospitals are directly managed by regional governments; they do not enjoy – usually – their own legal status and they are ruled by public law. In addition to this model, there are the so-called *new management models* (NMM), including both forms of direct (public) and non-direct (private) service delivery. Within the first (*direct management*), we have public enterprises and foundations. They are configured as organizations with legal personality, ruled by private law and may be subject – if reflected in their statutes – to labor legislation to manage their staff, considered as key features to increase flexibility and autonomy [18]. *Non-direct management* formulas include contracting with private companies and different forms of PPP. For a critique of PPP see [49]. As regards the first formula, healthcare contracting consists of an administrative contract whereby healthcare services are provided through privately owned facilities. Regarding the different forms of PPPs, in Madrid there are two models; the UK's PFI model and an *indigenous* version, the so-called "*Alzira*" model. PFI models involve long-term arrangements between the public and private sectors, whereby the private sector finances the hospital building and then delivers non-clinical services over a period of around 30 years [1,19]. The "*Alzira*" model is a PPP model which goes further, since the private sector finances, constructs and operates the physical hospital infrastructure, and also is in charge of clinical services delivery [1].

In the Spanish context, the use of these new management models aimed to increase the efficiency of the health system. This would occur in two ways. Firstly, it would solve the perceived problems caused by public law and statutory personnel regime [18]. Public law and civil servant statutory regime were considered two key obstacles to achieve efficiency gains, since it was believed that public law was too rigid to promote the system dynamism and statutory regime prevented to incorporate productivity and efficiency tools, such as performance related pay, into personnel management [20]. Secondly, the separation of purchaser and provider aimed to promote the creation of an internal market and the disaggregation of public sector units. It has been suggested that the separation purchaser/provider helps to improve efficiency, by introducing market incentives into the public healthcare sector management [21] and the introduction of contracts [22]. Moreover, disaggregation of public sector units is considered a fundamental tool to make former monolithic and over-bureaucratized organizations become more flexible, controllable and manageable by professional managers [9].

In addition, allowing the entry of private providers was supposed to have positive effects as regards efficiency improvements because of the relatively superior efficiency of the private sector over the public one, a view which justified much of the privatization movement [23]. A key argument when explaining the perceived superior efficiency of the private sector is the view that private firms may have more incentives to innovate because, unlike the public sector, innovations can generate benefits [24].

Based on these arguments, this paper will focus on the following research question: are new management formulas more efficient than traditional ones as regards hospital management? We turn now to the data and methodology of our study.

3. Materials and methods

3.1. Methodology

When talking about public sector efficiency, and thus public healthcare efficiency, one may distinguish three dimensions of efficiency; allocative, distributive and productive or technical [9]. Clearly, a full-scale, comprehensive evaluation of the efficiency of new management formulas in the healthcare system would require evaluation of all three efficiency dimensions but, because of lack of reliable data, we focus only in one of those dimensions for which we have enough data; productive or technical efficiency. The concept of technical efficiency reflects the seminal notion of efficiency by Farrell [25]: input oriented efficiency indicates the ability of each decision making unit (DMU) (in our case hospitals) to minimize input consumption for a given level of output, while – alternatively – output oriented efficiency indicates the ability of each DMU to maximize the output within a certain fixed level of inputs. In this paper, we propose to apply the DEA methodology initially developed by Charnes et al. [26] – and extended by Banker [27] and Banker et al. [28] – to assess the relative technical efficiency of the sample of 25 hospitals belonging to the *SERMAS*. In the hospital sector, DEA methods have been the most common approach when measuring technical efficiency [29,30].

Briefly, the DEA methodology is an extension of linear programming which allows us to develop an efficient frontier for each DMU. The DEA estimation procedure consists of solving for each DMU an optimization problem via linear programming. The efficient frontier is represented by convex combinations of efficient DMUs. The rest of inefficient firms or DMUs are "wrapped" by the efficient frontier considering that deviations from the efficient frontier are due to technical inefficiency. One of the main advantages of DEA methodology is that it allows considering multiple inputs and outputs simultaneously, which makes it particularly attractive in the case of hospitals. Additionally, it requires no assumptions about the functional form of the production frontier, which reduces the theoretical needs when specifying the model [31].

The first question that arises when selecting the model is its orientation, in the sense that either the inputs or outputs are considered exogenous and beyond the control of hospital management [32]. Following O'Neill et al. [33], hospital managers and policymakers have, in general, greater control over the level of inputs than output. O'Neill et al. [33] also argued that, in most countries, the emphasis is more on controlling costs rather than on increasing demand of health services, which seems to be the case of Madrid. Based on these arguments we consider that an input orientation is the most suitable for our study.

A second question of interest when formulating the model is the returns to scale assumption. In this paper, we assume variable returns to scale (VRS), which seems appropriate when we cannot assume that all DMUs are operating at an optimal scale [28]. Following Jacobs et al. [34] and Tiemann and Schreyögg [31], in the hospital sector issues such as imperfect competition, budgetary constraints and/or regulatory constraints may result in DMUs operating at an inefficient scale size, thus assuming constant returns to scale may be a strong assumption.

A third question to deal with is that DEA efficiency scores have been subject of criticism because of their lack of statistical basis [35]. Also, Simar and Wilson [36] proved that standard DEA estimates may be biased upwards. To overcome these problems, we employ the DEA homogeneous bootstrap methods described in Simar and Wilson [36,37]. Briefly, bootstrapping allows deriving statistical properties of efficiency scores through resampling, by estimating bias, variance and constructing confidence intervals [35].

Once we get the DEA efficiency scores for the SERMAS general hospitals, we analyze the differences in technical efficiency between traditional and new managed hospitals by means of two different methodologies; a non-parametric Mann–Whitney *U* test and an analysis of bootstrapped average efficiency confidence intervals computed on the previous stage.

3.2. Data and variables

The data used in this study was obtained from the Spanish Hospital Survey (ESRI[5]) for the year 2009, and data provided by the Ministry of Health of the Community of Madrid.[6] Because ESRI files are anonymized micro-data, we obtained hospital names by contrasting resources data from the ESRI with the Spanish National Catalogue of Hospitals.[7] We have considered only year 2009 because it was the first with fully available information for all PFI models. This was also the last year available when writing this paper.

In 2009, there were 33 hospitals belonging to the SERMAS. From the initial sample of 33 hospitals, we excluded psychiatric, children, geriatrics and long stay hospitals, in order to work with a relatively homogeneous sample, which is crucial in a DEA. The final sample consists of 25 public hospitals, including 14 operating under a traditional ADM model and 11 considered NMM.

As regards the variables employed, DEA models require a careful selection of inputs and outputs, so the selection of variables is another crucial step when implementing DEA methods. The selection of inputs and outputs has been conditioned by our sample size,[8] and variable selection was based on previous studies (see [33]). As inputs, we have used the *number of beds*, *number of full-time employed physicians* and the *number of full-time nursing staff*. The number of beds is a proxy for hospital size and capital investment and has been the most widely used input in hospital efficiency studies. The number of physicians and nursing staff are proxies for hospitals' labor and human capital.

As outputs, we have considered the *number of discharges* and the *number of outpatient visits*. However, in a production process not every output may be classified as desirable, and the inclusion of only desirable outputs may not reflect the true technical efficiency of a DMU. In the case of hospital efficiency, two clear examples of undesirable outputs are the death of a patient during treatment and readmission of patients, both outputs used in some studies as proxies for quality of outcome (see, for example, [32,39,40]).

5 Retrieved from: http://www.msssi.gob.es/estadisticas/microdatos.do.
6 Retrieved from: http://cmbd.sanidadmadrid.org/.
7 Retrieved from: http://www.msssi.gob.es/estadisticas/microdatos.do.
8 Following Cooper et al. [38] a rough "rule of thumb" is to keep the number of DMUs equal to or greater than max $\{Ix0, 3x(I+0)\}$.

Table 2
Different DEA models.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Inputs							
Beds	x	x	x	x	x	x	x
Doctors	x	x	x	x	x	x	x
Nursing	x	x	x	x	x	x	x
Outputs							
Discharges	x	x	x	x	x	x	x
Outpatients	x	x	x	x	x	x	x
Undesirable outputs							
Mortality rate		x	x			x	x
Readmission rate				x	x	x	x

Notes: Model 1 ignores undesirable outputs. Models 2, 4 and 6 treat undesirable outputs as normal inputs. Models 3, 5 and 7 use a linear transformation to deal with undesirable outputs.

Table 3
DEA efficiency scores.

DMU	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	β_i	bias β_i	β_i	bias β_i	β_i	bias β_i	β_i	bias β_i	β_i	bias β_i	β_i	bias β_i	β_i	bias β_i
1(a)	0.8657	0.7940	0.8657	0.8084	0.8657	0.8037	0.8657	0.8022	0.8657	0.7983	0.8657	0.8114	0.8657	0.8043
2(a)	0.7711	0.7027	0.8599	0.8011	0.7893	0.7183	0.7849	0.7150	0.7711	0.7049	0.8599	0.8022	0.7893	0.7190
3(a)	1.0000	0.8950	1.0000	0.9143	1.0000	0.9046	1.0000	0.9051	1.0000	0.8993	1.0000	0.9166	1.0000	0.9061
4(a)	0.7576	0.6949	0.7648	0.7049	0.7576	0.6998	0.7620	0.7014	0.7576	0.6990	0.7656	0.7067	0.7576	0.6994
5(a)	1.0000	0.9246	1.0000	0.9340	1.0000	0.9282	1.0000	0.9287	1.0000	0.9100	1.0000	0.9344	1.0000	0.9143
6(b)	1.0000	0.8951	1.0000	0.9142	1.0000	0.9058	1.0000	0.9038	1.0000	0.9002	1.0000	0.9168	1.0000	0.9061
7(a)	0.9479	0.9131	0.9500	0.9080	0.9498	0.9018	0.9479	0.9110	0.9479	0.9131	0.9500	0.9072	0.9498	0.9020
8(c)	0.9081	0.8504	0.9088	0.8608	0.9085	0.8571	0.9118	0.8582	0.9081	0.8516	0.9119	0.8648	0.9085	0.8556
9(a)	0.8269	0.7812	0.8280	0.7890	0.8271	0.7849	0.8296	0.7831	0.8269	0.7831	0.8296	0.7866	0.8271	0.7844
10(a)	0.8353	0.7720	0.8361	0.7845	0.8353	0.7783	0.8841	0.8191	0.8488	0.7810	0.8841	0.8271	0.8488	0.7855
11(d)	1.0000	0.9135	1.0000	0.9270	1.0000	0.9192	1.0000	0.9205	1.0000	0.9175	1.0000	0.9287	1.0000	0.9200
12(a)	0.7232	0.6871	0.7628	0.7109	0.7259	0.6774	0.7316	0.6911	0.7232	0.6864	0.7646	0.7130	0.7259	0.6771
13(a)	0.8543	0.7860	0.8804	0.8253	0.8648	0.8006	0.8543	0.7880	0.8543	0.7872	0.8804	0.8256	0.8648	0.8005
14(e)	0.8942	0.8507	0.9091	0.8633	0.9060	0.8568	0.8964	0.8510	0.8942	0.8505	0.9130	0.8684	0.9060	0.8563
15(c)	0.7612	0.6907	0.8063	0.7435	0.7836	0.7190	0.7937	0.7219	0.7710	0.7001	0.8063	0.7442	0.7836	0.7176
16(c)	0.9420	0.8906	1.0000	0.9446	1.0000	0.9246	0.9555	0.9097	0.9458	0.8942	1.0000	0.9450	1.0000	0.9246
17(c)	0.9912	0.9547	1.0000	0.9304	1.0000	0.9207	0.9912	0.9530	0.9912	0.9537	1.0000	0.9318	1.0000	0.9206
18(c)	0.8974	0.8398	0.9545	0.9075	0.9456	0.8907	0.8991	0.8427	0.8974	0.8397	0.9545	0.9086	0.9456	0.8911
19(a)	0.8763	0.8180	1.0000	0.9382	1.0000	0.9285	1.0000	0.9117	1.0000	0.8992	1.0000	0.9216	1.0000	0.9050
20(a)	0.9196	0.8490	1.0000	0.9457	1.0000	0.9370	1.0000	0.9282	1.0000	0.9187	1.0000	0.9359	1.0000	0.9244
21(c)	0.9017	0.8353	0.9683	0.9226	0.9623	0.9078	0.9291	0.8768	0.9138	0.8542	0.9683	0.9245	0.9623	0.9080
22(f)	1.0000	0.8951	1.0000	0.9147	1.0000	0.9054	1.0000	0.9062	1.0000	0.9002	1.0000	0.9162	1.0000	0.9047
23(a)	1.0000	0.9117	1.0000	0.9145	1.0000	0.9046	1.0000	0.9040	1.0000	0.8986	1.0000	0.9180	1.0000	0.9052
24(c)	0.8978	0.8246	0.9396	0.8856	0.9251	0.8623	0.9099	0.8461	0.8978	0.8288	0.9396	0.8878	0.9251	0.8625
25(a)	1.0000	0.8950	1.0000	0.9157	1.0000	0.9045	1.0000	0.9047	1.0000	0.8997	1.0000	0.9167	1.0000	0.9044

Notes: (a) ADM model; (b) contracted private hospital; (c) PFI model; (d) foundation; (e) public enterprise; (f) PPP – "Alzira" model.

In this study, we have included in our model those two undesirable outputs; *in-hospital mortality rate* and the ratio between *patient readmissions* and discharges. Further, the four outputs (desirables and undesirables) are case-mix adjusted to control for complexity differences between hospitals, using hospitals' average weights based upon the diagnosis related group (DRG) system. A summary of variable definitions, measurement and descriptive statistics are provided as Supplementary data in Tables S1 and S2. Hospitals are grouped into ADM or NMM according to their management formula.

Modeling undesirable outputs has been object of considerable discussion in the efficiency literature (see Supplementary data; Box 1). Because of the lack of consensus about the most appropriated approach to deal with undesirable factors, under strong disposability of undesirable outputs, we define seven different DEA models, by maintaining all inputs and desirable outputs fixed in all models, and combining different approaches to deal with undesirable outputs and the number of undesirable outputs.[9] Table 2 reports the seven different models.

4. Results and discussion

Table 3 shows results for the standard and bootstrapped DEA models.[10] For each model the first column shows the estimates of the relative efficiency scores without bias correction for each hospital (β_i), while the second column shows bootstrap bias-corrected efficiency scores estimates

[9] Including in our model 3 inputs and 4 outputs may be too close to the so-called "rule of thumb", so we defined also alternative models ignoring undesirable outputs or including just one.

[10] DEA models computed with the FEAR package developed by Wilson [41]. Bootstrapped efficiency scores obtained through 10,000 replications.

Table 4
Average bootstrap-DEA confidence intervals and Mann–Whitney tests.

		Mean score	95% bootstrapped C.I.		*U* test[a]
Model 1	ADM	0.8160214	0.7671357	0.8804786	−1.314 (0.189)
	NMM	0.8582273	0.8052545	0.9227273	
Model 2	ADM	0.8496071	0.7948	0.9077714	−0.931 (0.352)
	NMM	0.8922	0.8340818	0.9503182	
Model 3	ADM	0.8337286	0.7776071	0.8978286	−0.1095 (0.273)
	NMM	0.8790364	0.8162364	0.9448182	
Model 4	ADM	0.8352357	0.7804571	0.9010429	−0.766 (0.443)
	NMM	0.8718091	0.8169818	0.9317273	
Model 5	ADM	0.8270357	0.7683286	0.8962429	−0.876 (0.381)
	NMM	0.8627909	0.8078909	0.9254364	
Model 6	ADM	0.8516429	0.7957929	0.9115143	−1.204 (0.228)
	NMM	0.8942545	0.8363182	0.9509727	
Model 7	ADM	0.8308286	0.7696429	0.8988143	−1.396 (0.163)
	NMM	0.8788273	0.8165364	0.9449091	

[a] *Z* values for Mann–Whitney test. Test significance in parenthesis.

($bias\ \beta_i$). Table S3 (provided as Supplementary data) reports estimated standard deviations for each hospital ($\hat{\sigma}$). Following Simar and Wilson [37], bias-correction should not be used unless $(\hat{\sigma})^2 < 1/3(bias\ \beta_i)^2$, i.e., when the bias-corrected estimator has a lower mean square error than the ordinary or standard estimate. We checked this: column two in Table S3 shows the ratio $r_i = 1/3(bias\ \beta_i)^2/(\hat{\sigma})^2$ and columns three and four report the estimated 95% confidence intervals. Our results show that the "mean square error test" is consistently passed, so we discuss only bias-corrected results.

A first look at the results does not reveal any clear pattern regarding the existence of a relationship between new management formulas and improved technical efficiency; in all the models analyzed we found among the "top three" efficient hospitals both ADM and NMM hospitals. On average, and considering only models including undesirable outputs, the most efficient units are hospitals (DMUs) 17, 20 and 5. DMU 17 is a PFI model with a public enterprise managing clinic services and outsourced non-clinic services while DMUs 20 and 5 are ADM hospitals. The same applies for the less efficient units; on average the less efficient units are DMUs 12, 4 and 15. DMUs 12 and 4 are ADM hospitals while DMU 15 is a PFI model similar to DMU 17. Interestingly, our results suggest that the two hospitals characterized by full private management of clinic and non-clinic services – DMUs 6 and 22 – are not in any of the estimated models among the "top three" efficient hospitals, which may cast some doubt on the often-repeated superiority of the private sector over the public in terms of efficiency.

Table 4 compares the average scores of ADM hospitals with NMM hospitals. The average efficiency scores show a slightly better performance of NMM hospitals for the seven models defined, but that difference does not seem to be statistically significant anyway. We cannot reject the null hypothesis that both populations are the same when performing the Mann–Whitney test in all models. Moreover, average bootstrapped confidence intervals for the efficiency of the two groups under analysis overlap to a large degree,[11] thus we do not have evidence that the two groups are significantly different as regards technical efficiency. Interestingly, a closer look at Table S2 (descriptive statistics) indicates that NMM hospitals are much smaller and homogeneous than their ADM counterparts, thus, in principle, more manageable and controllable but, this important feature does not seem to make NMM hospitals more efficient than their ADM counterparts.

In sum, the results of all seven DEA-bootstrap models and all statistical analysis comparing both groups of hospitals do not reveal any statistical significant different in efficiency between traditionally managed hospitals and those using new management formulas. The fact that we find different management models (both ADM and NMM) among hospitals with higher – and lower – efficiency scores may suggest that what really matters is the individual hospital management, not the management model itself.

What policy lessons can be extracted from our findings? Firstly, the finding that new hospital management models do not seem to be necessarily better or worse – in terms of technical efficiency – than traditional management models, may help to support the view that it is more worthwhile to focus on improving the good governance of public health services as a whole, rather than simply focusing on switching management model [6].

Secondly, due to the potential lack of efficiency gains derived from the implementation of NPM-related policies in Madrid's public hospitals, a number of undesirable problems may emerge, adding more uncertainty to the decision-making process, particularly as regards the implementation of those managerial formulas involving the private sector, such as different forms of PPPs. In this regard, the theory of incomplete contracts advanced by Hart et al. [42] suggests that if a private firm does not generate profits by improving efficiency, profit maximization incentives

[11] Efficiency confidence intervals computed with the FEAR package developed by Wilson [41]. Individual confidence intervals are reported in Table S3 (provided as Supplementary data).

may have a downward effect on service quality, especially when service quality is difficult to measure. Moreover, in a non-efficiency gains scenario, private firms may have significant incentives to raise the prices charged to governments when renegotiating contracts (the so-called "hold up" effect[12]) and/or contracts may become, financially speaking, unviable, leading to government bailouts. This is already happening: first, in 2010, the PFI hospitals from Madrid requested a government bailout [14]. Next, in 2011, *El País* [44] published a letter addressed to the Madrid's health commissioner, in which the private firms operating the seven PFI hospitals from Madrid attempted to renegotiate their contracts, warning of the collapse of all seven PFI hospitals due to unforeseen events, such as the application of a new Accountability Plan in 2011.

Finally, though we have presented efficiency estimates for the sample of Madrid hospitals and health policy implications, these results must be interpreted with caution in view of some limitations of this study such as sample size and data limitations. Small sample size prevented us from including additional input and output measures which may better reflect the true hospital production process. In addition, the cross-section nature of the data does not permit us to analyze efficiency changes over time which may of interest when analyzing healthcare reform effects.

5. Conclusions

As a consequence of rising healthcare expenditures and the ongoing economic crisis, the issue of public healthcare sector efficiency is once again at the top of the policy agenda across many regional governments in Spain. Despite of the lack of conclusive empirical evidence, the adoption of NPM-related policies in healthcare management is still on the rise, particularly in regions such as Madrid, which underwent deep reform of its public healthcare services from the 2000s.

This paper sought to assess whether the use of new managerial tools led to improvements in technical efficiency for a sample of 25 hospitals belonging to the SERMAS. Our results suggest that there is no difference in terms of technical efficiency between traditionally managed hospitals and those adopting new management formulas and, there are always different management models among the more – and less – efficient hospitals. These findings remained unchanged when using different DEA models and different statistics analysis, calling into question if what actually matters is the management model or, on the contrary, particular managers' practices. Moreover, our results suggest that there is no clear evidence to support the idea that the public sector is inherently less efficient than the private in this case/sector.

This absence of evidence about efficiency gains derived from implementing new management formulas in Madrid hospitals, along with the scarcity of additional empirical evidence on this topic in Spain, may open the door to other considerations which could be the object of future research; which/what are the real drivers of healthcare reforms in Madrid? Is healthcare reform motivated ideologically, by politicians who believe that NPM-related mechanisms will bring about better solutions for patients? The conservative Madrid's regional government has been characterized since the 2000s by a strong NPM vocation [12], which may have influenced its adoption of marketization policies in the SERMAS. Or is healthcare reform explained by "regulatory capture"? Laffont and Tirole [45] showed that regulators – in our context policymakers – may be "captured" or influenced by interest groups hoping for future employment within the regulated firms, an effect known as the "revolving door". To date, evidence is emerging about "revolving doors" in the SERMAS [46]. Though movements between the private and public sector are not necessarily harmful, and indeed, may be beneficial, when done in a transparent way without conflict of interest, they may have negative consequences, in terms of social welfare, if policies are motivated by the hope of future personal gains instead of the optimum outcome for the general interest [47].

Next steps for future research include overcoming some of the limitations of this study by using additional data on more years as soon as this is available; and to answer some of the questions raised by this research, such as identifying the drivers of healthcare reform implementation in Spain. Research evaluating healthcare policy in Spain would be considerably facilitated if data on the Spanish NHS was rendered more transparent.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.healthpol.2014.12.001.

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[12] When contracts are highly complex or incomplete, governments may need to renegotiate the contract in the case of an unforeseen problem or event. This not only has costs, it also gives the private firm – with its incentives to maximize profits – to raise the prices charged to governments [43].

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