THE IMPACT OF NEW PUBLIC MANAGEMENT ON EFFICIENCY: AN ANALYSIS OF MADRID'S HOSPITALS

COCOPS Working Paper No. 12

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October 2013

This Project is funded by the European Union under the 7th Framework Programme

About COCOPS

The COCOPS project (Coordinating for Cohesion in the Public Sector of the Future) seeks to comparatively and quantitatively assess the impact of New Public Management-style reforms in European countries, drawing on a team of European public administration scholars from 11 universities in 10 countries. It will analyse the impact of reforms in public management and public services that address citizens' service needs and social cohesion in Europe. Evaluating the extent and consequences of NPM's alleged fragmenting tendencies and the resulting need for coordination is a key part of assessing these impacts. It is funded under the European Commission's 7th Framework Programme as a Small or Medium-Scale Focused Research Project (2011-2014).

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This paper was presented at the XV World Economy Meeting, Santander 5-7 June 2013. The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement No. 266887 (Project COCOPS), Socio-economic Sciences and Humanities".

ISSN 2211-2006

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Abstract

Madrid has emerged at the vanguard of public healthcare reform in the European Union. Despite the fact that the introduction of New Public Management (NPM) into Madrid hospitals has gone further than elsewhere in the EU – sparking controversy — 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, not the management model.

Keywords: New Public Management, Efficiency, Healthcare, Hospital performance, Madrid

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1. Introduction

New Public Management (NPM) policies have been introduced 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 (Acerete et al. 2011; Simonet, 2013). 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) (Petmesidou and Guillén, 2008). Since then, regional governments in Spain have increasingly introduced NPM reforms into healthcare, particularly in Catalonia and, at an accelerated rate, in Madrid (Gallo and Gené-Badia, 2013). We argue Madrid is now positioning itself at the vanguard of NPM healthcare implementation in the context of the European Union.

This paper focuses on the reform of hospitals belonging to the Madrid Regional Health Service (SERMAS). After first emulating healthcare reforms in the UK, Madrid has now overtaken the British model, particularly as regards 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 have gained increased traction during the ongoing economic and financial crises. Nevertheless, the implementation of healthcare reform has been controversial and witnessed widespread protest by citizens and professionals. In particular, the ongoing attempt to contract out clinical services delivery in six public hospitals has sparked popular criticism (Legido-Quigley *et al.,* 2013). 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, but, despite the massive popular opposition, the contracting out plan is still going ahead (Garcia Rada, 2013).

[1] Decentralization took place during the 1980s and 1990s, transferring powers in healthcare management gradually across the different Spanish regions, firstly to Catalonia (1981), Andalucia (1984), the Basque Country and Valencia (1987), Galicia and Navarra (1990) and the Canary Islands (1993). The healthcare decentralization process ended in January 2002, in which the devolution of autonomy and power from the central government to all regional governments was completed (Petmesidou and Guillen, 2008).

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 (Mayston, 1999). In the Spanish context, policymakers have used repeatedly the efficiency improvement argument to introduce new management formulas in healthcare delivery (Garcia Rada, 2011).

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 Andrews, 2013). However, the benefits of NPM-related tools in healthcare delivery have been already questioned from an international perspective (see, for example, Ferrari, 2006; Pollock *et al.,* 2011; Acerete *et al*., 2012; Barlow *et al.,* 2013). 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.

To avoid ideological positions by turning to empirical evidence, 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 anonymised, 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 the *Data and Methodology* section).

[2] For an overview about the empirical evidence as regards the use of new management formulas in the Spanish NHS, see Sanchez *et al*. (2013).

The rest of the paper is organized as follows. The second section 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

In 1996, the government of the ruling conservative Popular Party (*Partido Popular*) approved Royal Decree 10/1996[3] allowing 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". Soon afterwards, Law 15/1997 — the result of the parliamentary processing of Royal Decree 10/1996 — stated that provision and management of health services could be carried out also through agreements or contracts with public or private entities. This allowed for the entry of private providers into public healthcare delivery.

As a consequence, the process of introduction of NPM-related policies in public healthcare services began across Spanish regions. By 2002, when powers in healthcare management were fully transferred to all Spanish regions, Madrid had emerged at the vanguard of NPM implementation in healthcare[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 greater autonomy, their own legal status and, in competition with other hospitals, similar to the UK's hospital trusts (Bayle and Beiras, 2001:141) 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.

[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 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 — of 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 (Martin, 2003). *Non-direct management* formulas include contracting with private companies and different forms of PPP. 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 (Hellowell and Pollock, 2009; Acerete *et al*., 2011). The "*Alzira*" model is a PPP model which goes further, since the private sector finances, constructs and operates the physical hospital infrastructure, but also is in charge of clinical services delivery (Acerete *et al.* 2011).

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

Notes: *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

In the Spanish context, the use of these new management models aimed to increase the health system efficiency. This would occur firstly by solving the perceived problems caused by public law and statutory personnel regime (Martin, 2003). 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 (*Informe Abril,* 1991*)*. 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 (Street, 1994) and the introduction of contracts (Gallego, 2000). 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 (Andrews, 2013). 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 (Clifton *et al*, 2006). 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 may generate benefits (Shleifer and Vishny, 1994).

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? To answer this question, we turn now to the data and methodology of our study.

3. Data and methodology

The data

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 anonymised 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. It 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 analysis. The final sample consists of 25 public hospitals, including 14 operating under a traditional ADM model and 11 considered NMM.

Measuring technical efficiency and 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 (Andrews, 2013). 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 (1957): 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*. (1978) - and extended by Banker (1984) and Banker *et al*. (1984) - to assess the relative

[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

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 (Hollingsworth 2003, 2008).

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 the 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 (Tiemann and Schreyögg, 2009).

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 (Arocena and Garcia-Prado, 2007). Following O'Neill *et al.* (2008), hospital managers and policymakers have, in general, greater control over the level of inputs than output. O `Neill *et al*. (2008) 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 it is not feasible to assume that all DMUs are operating at an optimal scale (Banker *et al*, 1984). Following Jacobs et al. (2006) and Tiemann and Schreyögg (2009), 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.

Another concern when selecting our model is that 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

[8] Following Cooper *et al*. (2007:116) a rough "rule of thumb" is to keep the number of DMUs equal to or greater than max$\{I x O,\ 3x\ I + O\ \}$.

variable selection was based on previous studies (see O'Neill *et al*., 2008). 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, Bilsel and Davutyan, 2011; Arocena and Prado, 2007; Sahin and Ozcan, 2000). 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 and their measurement is provided in Table A1 while Table A2 reports descriptive statistics for those variables. 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. Following Hua and Bian (2007), when modeling undesirable outputs the choice between strong and weak disposability of undesirable outputs has an important effect on DMU's efficiency. Briefly, strong disposability assumes that undesirable outputs are freely disposable, i.e., it is possible to reduce undesirable output without any cost, in terms of reducing also desirable outputs. On the contrary, weak disposability refers to those situations when a reduction of undesirable output forces a lower production of desirable one, i.e., reducing undesirable output is only possible at some cost, in terms of desirable output (for a comprehensive overview on this topic see Färe and Grosskopf, 2004). Here, since we consider undesirable outputs also as a proxy for service quality, we assume strong disposability of undesirable outputs because intra-hospital mortality rates and re-admission ratios could be reduced just by improving service quality and not necessarily at the cost of reducing desirable outputs.

Under strong disposability of undesirable outputs, different approaches to deal with those outputs have been proposed in the efficiency literature; these approaches have been usually classified into direct and indirect ones (Bilsef and Davutyan, 2011). Indirect approaches transform the values of undesirable outputs by a linear monotone decreasing transformation, thus transformed undesirable outputs can be treated as desirable (Hua and Bian, 2007). Based on the translation invariance property of Banker, Charnes and Cooper (BCC) (1984) models, Seiford and Zhu (2002) suggested multiplying each undesirable output (uo_i) by (-1) and then use a translation vector to convert negative data into non-negative. Mathematically, $uo_i = -uo_i + c \geq 0$ where *v* is the translation vector which makes $uo_i > 0$.

Direct approaches avoid data transformation and use the original data. Liu *et al.* (2010) argued that under strong disposability assumptions there is no need to transform the data and, it is enough to consider undesirable outputs as desirable inputs. Liu *et al*. (2010:178) consider this approach very effective because of its "simplicity" and "elegance", although they recognize that it may not reflect the true production process since it changes the input-output relationship. Because of the lack of consensus in the efficiency literature about the most appropriated approach to deal with undesirable factors, under strong disposability of undesirable outputs, we define seven different DEA-BCC 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 A3 reports the seven different models.

Dealing with undesirable outputs is not our only concern; Simar and Wilson (1998, 2000) proved that standard DEA estimates may be biased upwards, because of sampling noise ignoring issues. To overcome this problem, we employ the DEA homogeneous bootstrap methods described in Simar and Wilson (1998, 2000).

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.

4. Results

Table 2 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

[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 (2008). Bootstrapped efficiency scores obtained through 10000 replications.

estimates (*bias* β_i). Table A4 reports also estimated standard deviations for each hospital (σ). Following Simar and Wilson (2000: 790), bias-correction should not be used unless $(\sigma)^2 < \frac{1}{3}(\,bias\ \beta i)^2$, i.e., when the bias-corrected estimator has a lower mean square error than the ordinary or standard estimate. To check this, second column of Table A4 shows the ratio $r_i = \frac{1}{3}(\,bias\ \beta i)^2/(\sigma)^2$, and columns three and four report the estimated 95% confidence intervals.

Because in all cases the mean square error test was passed, we discuss only those results related to bias-corrected efficiency scores. 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 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, the model known as "*Alzira* model" (DMU number 22) — characterized by a private management of clinic and non-clinic services— is not in any of the estimated models among the "top three" efficient hospitals, which may call into question the often-repeated superiority — in terms of efficiency — of this model.

Table 3 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 in any case. 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 A2 (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

[11] Efficiency confidence intervals computed with the FEAR package developed by Wilson (2008). Individual confidence intervals are reported in Table A4.

traditionally managed hospitals and those using new management formulas. Moreover, 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.

Table 2. DEA-BCC models results

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
DMU	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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

Table 3. Average bootstrap-DEA results and Mann-Whitney test results

		Mean Score	95 % bootstrapped C.I.		U test[a]
Model 1	ADM	.8160214	.7671357	.8804786	-1.134 (.189)
	NMM	.8582273	.8052545	.9227273	
Model 2	ADM	.8496071	.7948	.9077714	-.931 (.352)
	NMM	.8922	.8340818	.9503182	
Model 3	ADM	.8337286	.7776071	.8978286	-.1095 (.273)
	NMM	.8790364	.8162364	.9448182	
Model 4	ADM	.8352357	.7804571	.9010429	-.766 (.443)
	NMM	.8718091	.8169818	.9317273	
Model 5	ADM	.8270357	.7683286	.8962429	-.876 (.381)
	NMM	.8627909	.8078909	.9254364	
Model 6	ADM	.8516429	.7957929	.9115143	-1.204 (.228)
	NMM	.8942545	.8363182	.9509727	
Model 7	ADM	.8308286	.7696429	.8988143	-1.396 (1.63)
	NMM	.8788273	.8165364	.9449091	

Note: [a] Z values for Mann-Whitney test. Test significance in parenthesis.

Conclusions

As a consequence of rising healthcare expenditures and the ongoing economic crisis, the issue of public healthcare sector efficiency is once again on 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.

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.

What policy lessons can be extracted from our findings? Firstly, since we do not find any evidence of efficiency gains by adopting NPM-related policies in Madrid's public hospitals, we suggest that, policymakers should be extremely cautious when adopting these policies, particularly those involving the private sector, such as different forms of PPPs. If a private firm does not generate profits by improving the efficiency, profit maximization incentives may have a downward effect on service quality, especially when service quality is difficult to measure (Hart *et al*., 1997). Moreover, in a non-efficiency gains scenario, private firms may have strong 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 already needed a government bailout (Sanchez *et al*., 2013). Then, in 2011, *El País* (10 May 2011) 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 about the collapse of all seven PFI hospitals due to unforeseen events, such as the application of a new Accountability Plan in 2011.

In this light, two questions arise: which are the real drivers of healthcare reforms in Madrid? Is the goal of healthcare reform to improve the efficiency of Madrid public healthcare, rather than being motivated by "regulatory capture" issues? Following Laffont and Tirole (1991:1091), regulators — in our context policymakers — may be "captured" or influenced by interest groups hoping for future employment within the regulated firms, effect known as the "revolving door". In this sense, there is clear evidence of "revolving doors" in the SERMAS (see *El País*, 10 December 2012). Also, in June 2013, a Court from Madrid has opened an investigation to clarify whether the existence of "revolving doors" may have influenced the adoption of measures in favor of some private healthcare companies (*Juzgado de Instrucción nº4 de Madrid- Diligencias previas 2052/2013*). Movements between the private and public sector do not have to be necessarily harmful when done in a transparent way without conflict of interest, but this 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 (Pollock *et al*., 2006).

Finally, though we have presented efficiency estimates for the sample of Madrid hospitals and health policy implications, these conclusions must be interpreted with caution in view of some limitations of this study such as sample size and data limitations. Small sample size prevented

[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 (Jensen and Stonecash, 2005)

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. Next steps for future research include overcome some of these limitations by employing additional years as soon as new data is available. It would be of interest also to answer one of the questions raised from this study; the drivers of healthcare reform implementation in Spain, with a particular focus on the following issue: is there any correlation between the "revolving door" effect and the adoption of contracting out policies in healthcare?

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Appendix A: Supplementary tables

Table A1. Variable definitions and explanations

Variable	Definition and explanations
Inputs	
Beds	Total number of hospitals' beds
Physicians	Total number of physicians who are full time employees plus total number of physicians who are part time employees weighted by 0.5
Nursing staff	Total number of nursing staff who are full time employees plus total number of nursing staff who are part time employees weighted by 0.5
Desirable Outputs	
Discharges	Total number of case-mix adjusted recovery discharges
Outpatient visits	Total number of case-mix adjusted outpatient visits, including emergencies
Undesirable outputs	
Mortality rate	Share of total number of in-hospital dead patients to total number of case-mix adjusted admissions
Readmissions rate	Share of total number of one-year readmissions to total number of case mix adjusted discharges.

Table A2. Descriptive statistics

		Mean	Std. Deviation	Min	Max
Beds	Total	455.88	414.6714	77	1453
	ADM	607.6429	486.5422	77	1453
	NMM	262.7273	177.9377	83	569
Physicians	Total	403.44	297.3928	74	1079
	ADM	496.8214	351.6871	74	1079
	NMM	284.5909	154.0365	137.5	592
Nursing staff	Total	727.9	636.148	126	2387
	ADM	939.75	763.2871	126	2387
	NMM	458.2727	266.5548	212.5	1114
Discharges	Total	32212.52	27892.4	4348.72	98043.78
	ADM	41286.08	32793.16	4348.72	98043.78
	NMM	20664.35	14394.44	6926.37	48761.76
Outpatient visits	Total	521288.3	392398	89865.92	1368891
	ADM	551617	419789.2	89865.92	1238626
	NMM	482688.2	370845.5	193354	1368891
Mortality rate	Total	2.06428	.5240246	1.179493	3.433322
	ADM	1.979494	.4911567	1.179493	2.780687
	NMM	2.172189	.567949	1.413293	3.433322
Readmissions rate	Total	5.174021	1.215448	1.936325	6.586897
	ADM	4.929406	1.572037	1.936325	6.586897
	NMM	5.48535	.3774613	4.888784	6.116265

Notes: ADM- Traditional administrative direct management. NMM-New management models

Table A3. Different DEA-BCC 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 A4. Efficiency scores' standard deviations and confidence intervals

	Model 1				Model 2				Model 3				Model 4			
DMU	σ_i	r_i	LowCI	HighCI	σ_i	r_i	LowCI	HighCI	σ_i	r_i	LowCI	HighCI	σ_i	r_i	LowCI	HighCI
1	0.0032	166.88	0.7279	0.8627	0.0023	206.17	0.7449	0.8635	0.0026	189.55	0.7401	0.8631	0.0026	198.83	0.7376	0.8631
2	0.0018	481.33	0.6806	0.7679	0.002	288.12	0.7442	0.8577	0.003	186.70	0.6746	0.7865	0.0023	307.00	0.6857	0.7823
3	0.0058	109.04	0.7849	0.9957	0.0044	126.16	0.8071	0.9969	0.0054	103.82	0.792	0.9959	0.0051	115.17	0.7956	0.9965
4	0.0013	775.40	0.6831	0.7545	0.0013	707.69	0.6903	0.7626	0.0011	920.34	0.6877	0.7551	0.0011	1008.33	0.6896	0.7591
5	0.0016	738.29	0.8662	0.9957	0.0015	643.38	0.8746	0.9969	0.0017	592.95	0.8692	0.9962	0.0016	660.08	0.8706	0.9962
6	0.0058	108.83	0.7866	0.9958	0.0044	126.45	0.8066	0.9968	0.0053	105.08	0.7913	0.9966	0.0052	113.85	0.7931	0.9962
7	0.0003	4485.33	0.8811	0.9442	0.0004	3657.52	0.8759	0.947	0.0006	2124.45	0.8632	0.9463	0.0003	5015.70	0.8817	0.9445
8	0.0016	433.50	0.7957	0.9046	0.0011	632.07	0.8088	0.9062	0.0013	519.07	0.8036	0.9053	0.0014	486.78	0.8033	0.9085
9	0.0006	1933.79	0.7597	0.8234	0.0005	2028.00	0.7688	0.8254	0.0005	2374.45	0.7649	0.8238	0.0006	1993.48	0.7652	0.8264
10	0.0018	410.93	0.7368	0.8316	0.0013	523.13	0.7469	0.8336	0.0016	421.56	0.7406	0.8324	0.0016	550.13	0.7764	0.8808
11	0.0027	341.33	0.8392	0.9958	0.0023	334.87	0.8522	0.9971	0.0026	321.13	0.8433	0.9964	0.0024	364.84	0.8474	0.9965
12	0.0004	2715.02	0.6833	0.7207	0.0008	1402.92	0.7034	0.7606	0.0006	2169.04	0.6748	0.7233	0.0004	3417.19	0.6892	0.7291
13	0.0013	920.10	0.7632	0.8512	0.0009	1249.39	0.7997	0.8775	0.0012	951.11	0.7733	0.8619	0.0013	867.00	0.7638	0.8512
14	0.0005	2511.41	0.8273	0.8905	0.0005	2784.65	0.8371	0.9061	0.0006	2232.23	0.8302	0.9026	0.0005	2748.21	0.8277	0.893
15	0.0018	509.89	0.6741	0.7581	0.0017	453.44	0.7119	0.804	0.0019	384.14	0.6893	0.7808	0.0021	388.58	0.6937	0.7906
16	0.0007	1797.25	0.8567	0.938	0.0009	1258.47	0.8958	0.9967	0.002	472.51	0.861	0.9968	0.0005	2796.85	0.8754	0.9523
17	0.0003	4934.26	0.9219	0.9868	0.0017	557.12	0.8756	0.9969	0.0023	395.25	0.8561	0.996	0.0004	3040.08	0.9177	0.9874
18	0.001	1102.08	0.806	0.8932	0.0006	2036.68	0.8707	0.9516	0.0008	1569.80	0.8496	0.9418	0.001	1056.56	0.807	0.8961
19	0.0015	503.54	0.7747	0.8729	0.0015	563.98	0.8678	0.9967	0.002	424.83	0.8468	0.9964	0.0036	200.08	0.8197	0.9965
20	0.0019	458.93	0.7951	0.9155	0.001	979.21	0.8881	0.9968	0.0012	915.84	0.8785	0.9959	0.0018	528.90	0.8653	0.9962
21	0.0015	653.18	0.7893	0.8978	0.0007	1414.53	0.8769	0.965	0.001	986.45	0.8574	0.9588	0.0009	1125.63	0.8322	0.9258
22	0.0057	112.68	0.7884	0.9954	0.0043	130.86	0.808	0.9968	0.0052	110.09	0.7914	0.9963	0.005	117.06	0.7955	0.9961
23	0.0032	253.23	0.818	0.9952	0.0043	131.48	0.8078	0.9967	0.0054	103.82	0.7906	0.9963	0.0052	113.37	0.7933	0.9963
24	0.0022	368.02	0.7726	0.894	0.0012	675.00	0.8313	0.9363	0.0017	453.44	0.8054	0.9216	0.0017	468.02	0.7938	0.9065

25	0.0058	109.04	0.7853	0.9955	0.0043	127.81	0.8077	0.9969	0.0054	104.04	0.7902	0.9965	0.0052	111.72	0.7927	0.9964

Table A4. Efficiency scores' standard deviations and confidence intervals (continued)

	Model 5				Model 6				Model 7			
DMU	σ_i	r_i	LowCI	HighCI	σ_i	r_i	LowCI	HighCI	σ_i	r_i	LowCI	HighCI
1	0.003	167.75	0.7315	0.8631	0.002	245.71	0.752	0.8635	0.0026	185.29	0.738	0.8633
2	0.0017	505.47	0.6833	0.7685	0.0019	307.41	0.7487	0.8575	0.0028	209.53	0.6764	0.7864
3	0.0056	107.57	0.7874	0.9961	0.0042	131.12	0.8085	0.9972	0.0052	108.46	0.7926	0.9964
4	0.0011	945.99	0.6861	0.7546	0.0012	803.06	0.6915	0.763	0.001	1125.20	0.6889	0.7549
5	0.0035	219.92	0.823	0.9964	0.0016	558.63	0.8748	0.9971	0.0033	224.28	0.8285	0.9964
6	0.0055	109.53	0.7875	0.9958	0.0042	130.49	0.8077	0.997	0.0052	108.46	0.7919	0.9966
7	0.0003	4485.33	0.8834	0.9442	0.0005	2431.05	0.8749	0.9472	0.0006	2106.75	0.8637	0.9465
8	0.0015	472.93	0.7972	0.9046	0.0011	611.13	0.8143	0.9092	0.0013	551.95	0.8023	0.9052
9	0.0006	1776.33	0.7633	0.8235	0.0005	2453.88	0.7697	0.827	0.0005	2431.05	0.7655	0.824
10	0.0022	315.65	0.7358	0.8456	0.0013	638.58	0.7883	0.8815	0.002	332.85	0.7404	0.8458
11	0.0026	334.80	0.8435	0.9966	0.0022	349.14	0.855	0.9969	0.0026	314.79	0.8446	0.9963
12	0.0003	4988.48	0.6833	0.7206	0.0007	1804.25	0.7068	0.7621	0.0006	2196.01	0.6753	0.7237
13	0.0013	885.40	0.7632	0.8513	0.0008	1558.38	0.8012	0.8773	0.0012	954.08	0.7752	0.8615
14	0.0004	3960.33	0.8281	0.8911	0.0005	2652.21	0.8413	0.91	0.0006	2287.12	0.8303	0.9029
15	0.002	417.72	0.6771	0.7675	0.0017	443.37	0.7126	0.8038	0.0019	402.22	0.6872	0.7807
16	0.0007	1804.25	0.8591	0.9416	0.0009	1240.33	0.898	0.9969	0.002	472.51	0.8626	0.9964
17	0.0003	5208.33	0.9194	0.9873	0.0017	534.90	0.8768	0.997	0.0023	396.25	0.8566	0.9966
18	0.0011	913.98	0.8032	0.8942	0.0006	1950.75	0.8723	0.9512	0.0009	1222.33	0.849	0.9421
19	0.0055	111.74	0.7874	0.9958	0.0032	199.57	0.8322	0.9972	0.0053	106.87	0.7913	0.9962
20	0.0022	454.09	0.8523	0.9953	0.0015	606.81	0.8749	0.9971	0.0021	430.86	0.8554	0.9961
21	0.0012	819.50	0.8089	0.9104	0.0007	1305.06	0.8788	0.9656	0.001	979.21	0.8585	0.9589
22	0.0056	105.66	0.7878	0.9965	0.0042	132.38	0.8075	0.9965	0.0052	111.72	0.7921	0.9964
23	0.0056	109.07	0.7874	0.9962	0.0042	126.75	0.8089	0.9968	0.0053	106.42	0.7927	0.9962

24	0.0021	358.82	0.775	0.8942	0.0011	739.18	0.8352	0.9366	0.0016	510.26	0.8068	0.9219
25	0.0055	110.63	0.7892	0.9962	0.0041	137.26	0.8087	0.9967	0.0054	104.26	0.7911	0.996

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