Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics

Document de Treball 2018/24 1/42 pág.
Working Paper 2018/24 1/42 pág.

"Is Private Production of Hospital Services Cheaper than Public Production? A Meta-Regression of Public vs Private Costs and Efficiency for Hospitals"

Bel G & Esteve M

UB IREA
Institut de Recerca en Economia Aplicada | *Research Institute of Applied Economics*

Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics
Universitat de Barcelona
Av. Diagonal, 690 • 08034 Barcelona

WEBSITE: www.ub.edu/irea/ • CONTACT: irea@ub.edu

The Research Institute of Applied Economics (IREA) in Barcelona was founded in 2005, as a research institute in applied economics. Three consolidated research groups make up the institute: AQR, RISK and GiM, and a large number of members are involved in the Institute. IREA focuses on four priority lines of investigation: (i) the quantitative study of regional and urban economic activity and analysis of regional and local economic policies, (ii) study of public economic activity in markets, particularly in the fields of empirical evaluation of privatization, the regulation and competition in the markets of public services using state of industrial economy, (iii) risk analysis in finance and insurance, and (iv) the development of micro and macro econometrics applied for the analysis of economic activity, particularly for quantitative evaluation of public policies.

Abstract

The question of whether private organisations can outperform public ones in public service delivery has been a major topic of interest over the last few decades. However, empirical evidence does not systematically support the hypothesis of lower costs and higher efficiency when private organisations deliver public services. To better understand the cost and efficiency differences of public and private organisations, we conduct a meta-regression analysis of econometric studies relating to hospital ownership and performance. We analyse 61 estimations extracted from health studies using public versus private hospital costs and efficiency as an independent variable. Our analysis shows a genuine true effect in favour of public sector hospitals. We found evidence that public production of health services may be cheaper if this is provided by the public sector. However, the results show that when technical efficiency is considered, the private sector performs better than the public counterpart. And the opposite happens when instead of considering technical efficiency we consider financial costs. We discuss how the divergence in the results is affected by factors such as country, year, use of panel data in the study, whether performance is measured by examining financial costs, or if the study considers not-for-profit hospitals, among others.

JEL classification: L32, L33 I18

Keywords: Privatization, transaction costs, government regulation, meta- regression analysis

Germà Bel: Department of Econometrics, Statistics and Applied Economics & GiM-IREA University of Barcelona. C/ John Keynes 1-11, 08034 Barcelona. Tel: 34.93.4031131 Fax: 34.93.4024573 E-mail: gbel@ub.edu

Marc Esteve: University College London & ESADE. E-mail: marc.esteve@ucl.ac.uk

Acknowledgements

This research has enjoyed financial support from the Spanish Ministry of Economy and Competitiveness (ECO2016-76866-R) and the Government of Catalonia (2017 SGR644). No sponsor has been involved in the design and implementation of the research.

INTRODUCTION

How does ownership influence organisational performance? Academic interest in the study of public and private sector differences has been justified both as a means of exporting the most efficient management techniques from each sector to its counterpart (Box 1999; Boyne 2002), and more broadly to justify the participation of private organisations in the provision of public services (Hodge 2000). Stiglitz recalls that the distinction between the public and private sectors needs to be understood by differentiating who is responsible for the production, provision and, finally, payment of the service (2000). The underlying logic over recent decades has been that allowing private organisations to participate in the provision of public services would increase service performance (Boyne et al. 2003; Pollitt & Bouckaert 2011). Scholars have made multiple attempts to test this assumption and assess ownership effects over service performance (Boyne 1998, 2002; Hodge 2000; Bel & Warner 2008; Bel et al. 2010; Basu et al. 2012). However, as stated by Walker et al. (2013), empirical evidence regarding the performance differences of public versus private ownership remains ambivalent.

One of the main reasons why these comparisons have been so challenging is the very conceptualisation of the term performance. Walker et al. (2010) acknowledge the multidimensionality of performance and the resulting operationalisation challenges when this has to be measured. In their view, performance includes quality, efficiency, effectiveness, equity, probity, and responsiveness in delivering a public service. The literature has tried to overcome this challenge by focusing on cost savings when comparing the two sectors. This is the case, for example, of the descriptive meta-analyses provided by Boyne (1998), Hirsh (1995), and Hodge (2000), which failed to support the hypothesis that private sector provision of public services is cheaper. Bel et al. (2010) were able to perform a meta-

regression of costs and ownership for solid waste and water services at the municipal level. Interestingly, they did not find an empirical genuine effect of cost savings resulting from ownership, but did find important differences when comparing water and solid waste management. The authors argue that this could be explained by the degree of market competition. In the solid waste sector, potential for competition is relatively high, and studies use data on costs; on the contrary, competition is very weak in the urban water sector. The data available is more frequently related to technical inputs and outputs, rather than financial costs [data for level of competition in all sectors mentioned in this paragraph have been obtained from Hefetz and Warner (2012)]. Different from Bel et al. (2010), our study focuses only on one sector, health services, which is strongly regulated and is characterised by low potential for competition. But the fact that the empirical studies for this sector have used both financial and cost data together with technical data (and in each case, with a substantially large sample of studies) allows us to gain further insights to those already obtained from the existing literature.

A second major argument in favour of allowing the participation of the private sector in the delivery of public services is that it could increase service efficiency (Andrews & Entwistle 2013; Haque 2001). In other words, the issue is not only whether the service is cheaper, but if the result of dividing the inputs and outputs is more favourable when private actors provide the service. The economic theory of property rights offers a possible explanation: while in the private sector managers and owners have a direct financial incentive to increase efficiency, this is not the case in public organisations where property rights are not linked to the employee's salary (Andrews et al. 2011; Wamsley & Zald 1973).

While the literature is rich in analyses considering the relation between ownership and service costs (Boyne 1998; Hirsh 1995; Hodge 2000; Bel et al. 2010), there is a lack of

empirical evidence on the effects of ownership towards efficiency. This is important as in highly regulated sectors costs paid by users or governments do not necessary reflect technical efficiency (Vickers & Yarrow 1991). Andrews et al. (2011) provide an examination of the overall relation between publicness and performance and conclude that the evidence towards the effect of ownership on service efficiency is mixed, and call for future studies to further examine this topic. The present study answers this call and contributes to the literature comparing sector differences by assessing whether there are cost and efficiency differences among public and private organisations when providing public services. And if so, which factors can explain these differences? Hence, we move beyond the conceptualisation of performance as simply a function of savings, and include the concept of efficiency. We do so by analysing the reasons why certain studies have found different results when comparing service costs of public versus private hospitals. The empirical evidence is provided by means of a meta-regression analysis of all econometric studies of health service production costs. We analyse 61 estimations extracted from over 16 health studies using hospital costs as a dependent variable. Our analysis, thus, provides an explanation of the factors that drive the difference in results in the empirical literature regarding the costs of delivering health services via public vs private organisations.

THEORETICAL BACKGROUND TO THE RELATIONSHIP BETWEEN OWNERSHIP AND COSTS

The study of public and private sector differences has provided some compelling comparisons in both sectors (see, for example, the seminal work of Rainey, Backoff, & Levine 1976; Perry & Rainey 1988). However, defining public and private organisations has led to very different theoretical and epistemological approaches. The literature differentiates

three overarching points of view[1]: the generic approach, the core approach, and the dimensional or "publicness" approach (Bozeman & Bretschneider 1994; Scott & Falcone 1998).

The generic approach, acknowledges that although some differences can be found when comparing public and private sectors, they share a large degree of similarity when looking at the core dimensions of the management discipline: what managers have to do and how they have to do it (Murray 1975; Chandler 1991). It argues that it is not their publicness or privateness that affects the organisation, but rather other variables such as the organisational size, or the degree of centralisation and formalisation present in any given organisation (Scott & Falcone 1998). Because of that, the generic approach dismisses the classifications based on public-private differences, claiming that the notion that private sector organisations are mainly driven by monetary profit is too simplistic. This approach suggests that "management functions, organizational process, and managerial values are essentially identical across sectoral boundaries" (Ibid., p. 127).

By contrast, the core approach promotes a clear distinction between public and private organisations, focusing mainly on the legal distinction: publicly owned versus privately owned. This approach can be described from an economic perspective- differentiating between the state and the market- or from a political perspective –emphasising the political influences to which public organisations are subject (Pesch 2008). In this regard, ownership of the property rights on residual benefits of the activity becomes a key factor that can help to distinguish whether the organisation is public or private (Vickers & Yarrow 1988, 1991). Relatedly, public choice theorists (i.e. Niskanen 1971: Tullock 1965) have suggested that

[1] Note, for instance, that other authors have summarised five main approaches to the public and private distinction: generic, economist core, political core, normative, and dimensional (see Pesch 2008 for a full description).

public sector organisations operate with an absence of market pressures, and this means that they cannot benefit from the information provided by the market as an indicator of their performance. Instead, they rely on political will and budgetary changes to set their production levels. Despite being used largely in the public administration literature, some authors have stated that reality seems to overcome the basic distinction offered by the core approach, as there is a large array of hybrid organisations that lie in between the classic public and private distinction (Bozeman & Bretschneider 1994).

The third point of view, the dimensional or "publicness approach" (Bozeman 1987), builds upon the notion that "publicness is not a single, discrete attribute; rather, organizations (government, business, hybrid) are more or less public, depending on the extent to which externally imposed political authority affects them" (Bozeman & Bretschneider 1994). According to this perspective, the dichotomy of public and private ownership is not what differentiates organisations, but rather their interaction with a set of dimensions, such as funding, aim, or the final product or service provided by the organisation. One of the main theoretical precursors of the dimensional approach is the work by Wamsley and Zald (1973), which highlights the importance of considering public and private organisations as the result of two main variables: polity and economy. By polity, the authors refer to those activities and behaviours related to the development of agency purpose (such as force recruitment and socialisation, or monitoring the environment); while economy describes those actions that would help to effectively accomplish a particular task (such as resource allocation, or division of work). Accordingly, publicness is then seen as a continuum rather than a dichotomy (Bozeman 1987).

In an attempt to test the three approaches, Scott and Falcone (1998) verified their explanatory capacity and concluded that even though all of these can be adequate to explain

some organisational characteristics, the core approach and dimensional approach have a higher explanatory power than the generic approach. Their empirical evidence supports the idea that public and private organisations are different and, as the authors claim, justifies its study in relation to service performance (Scott & Falcone 1998).

Hence, given the long-standing discussion on the differences between public and private organisations, it is not surprising that several authors have focused on the study of whether public organisations can outperform their private counterparts, and vice versa (Andrews et al. 2011). As far as we know, the first empirical multivariate tests comparing public versus private organisations in public services was offered by Hirsch (1965) in the solid waste collection field, for which he did not find significant cost differences between public and private production. The model proposed by Hirsch (1965) was, with small modifications, followed in consequent studies by Kitchen (1976) in Canada, Kemper and Quigley (1976) and Collins and Downes (1977) in the USA, and Pommerehne and Frey (1977) in Switzerland. Except for the study by Collins and Downes (1977), all reported that private organisations outperformed their public counterparts. In a similar vein, Mann and Mikesell (1976) provide a multivariate empirical study comparing public and private performance in the water distribution sector, and found public production to be more efficient.

Interestingly, several years after these initial studies, two review studies [one a literary review (Bel & Warner 2008) and the other a meta-regression analysis (Bel et al. 2010)] assessed ownership effects on water and solid waste production. These authors found no systematic support for lower costs with private production; instead, they argue that performance differences are explained by the time period of the analysis, and contextual factors such as service characteristics and policy environment. In the same vein, Carvalho et

al. (2012) conducted a meta-regression comparing scale and scope economies between public and private production of public services. Furthermore, a recent comprehensive systematic review of the evidence of international literature on contracting out in technical and social services found no evidence of differing costs between public and private providers of social services, including healthcare (Petersen et al. 2018).

The differences stated above indicate that ownership does not have a clear effect over performance. Instead, as Andrews et al. (2012) warn, it is very much context dependent and should therefore be studied within a single service. With this in mind, the next section addresses the issue of public versus private performance in a particular service: public and private hospitals.

Assessing Public and Private Performance in the Health Sector

Over the last few decades, numerous studies have analysed performance differences in the healthcare sector among public and private hospitals. Campbell (1990) offered one of the most seminal works that began to address this research line. In her study of 224 US hospitals, she found that publicly-owned hospitals were significantly less efficient than those that were privately owned. A subsequent study by Chirikos and Sear (1994), again analysing US hospitals, refined the empirical approach by providing a DEA analysis that could account for six years of data (1982-1988). When comparing public versus private hospital performance, the authors found that private hospitals had a slightly higher technical efficiency. They argue that the net efficiency advantage of for-profit hospitals is very small and at the borderline of statistical significance (p = .06). Their results have been supported by other studies of US hospitals, showing public hospitals as being more inefficient than those that are for-profit (Vitaliano & Toren 1996).

Fournier and Mitchell (1997) claimed that ownership has little effect on performance. According to their results, what seems to have a strong effect on hospital efficiency is not its public or private status, but whether it is part of a large group of hospitals -what they call a multiservice system. Despite the initial agreement that public hospitals could be less efficient than those privately-owned, as more authors analysed the topic, different results began to emerge. Rosko (1999) provides a study with a very large *n* (3,262) of US hospitals. Challenging previous results, he found that for-profit hospitals tend to be less efficient than public ones. The author argues that this can be explained by the desire of private hospital directors to focus on value leadership, meaning the focus is on providing the best possible services regardless of cost (Ibid.). Far from showing a clear pattern, one of the latest studies of US hospital performance that included ownership as an explanatory variable again showed a very different picture. Using a stochastic frontier model of hospital technical efficiency, Brown (2003) reports higher inefficiencies within public versus private.

Although the literature on this topic is very heavily dominated by US studies, there have been a few attempts to address this issue in other national contexts. Other authors have also addressed the performance differences of public and private hospitals in other countries. Bosmans and Fecher (1995), for instance, provide a cross-sector analysis of Belgian hospitals. Interestingly, they found publicly-owned hospitals to be on average more efficient than their private counterparts. Two further studies have analysed European hospitals to disentangle the relationship between ownership and performance, finding different results. Herr's (2008) study of German hospitals provided empirical evidence suggesting that publicly-owned organisations are more efficient than those owned privately. However, a few years later, she developed a second study (also in Germany) which reported no significant differences in cost efficiency among public and privately-owned hospitals, but did show a higher profit efficiency in private hospitals (Herr et al. 2011). This research issue has also

been explored in the Asian context; this is the case, for example, in the study of Taiwanese hospitals developed by Lin et al. (2005). By analysing data from the Taiwan National Health Insurance Research, these authors conclude that publicly-owned hospitals experience higher costs per patient than those owned privately.

Interestingly, two meta-reviews focusing on ownership and performance obtained the opposite results despite being developed by the very same authors. Shen et al. (2007) reviewed those papers linking ownership and performance for the period between 1990 and 2004. In their results, the authors explain that ownership had a strong influence on performance, although they did not find that private hospitals performed better than their public counterparts. Furthermore, a comprehensive review conducted by the Australian Government Productivity Commission found no differences in costs between public and private hospitals (Productivity Commission 2009).

In a nutshell, there is a wide array of studies dedicated to the study of the relationship between ownership and hospital performance; however, their evidence points to mixed results, suggesting that it is not clear within the current literature how ownership influences performance. We argue that one of the reasons why the literature on organisational performance offers mixed results is the very definition of organisational performance. In this study, organisational performance considers both the costs that the service passes to the user, not for the organisation producing the service, and the efficiency of the hospital, which reflects the production costs of a particular service.

Theoretical Expectations

Nowadays there is no empirical consensus on whether publicly produced services perform better than private ones. A rather large number of studies find that private outperforms public, but there is a considerable number that report the opposite (see, for a review, Bel et al.

2010). Hence, we cannot provide an *a priory* proposition of whether the public sector will have lower or higher costs than its private counterparts when delivering health services.

The industrial organisation literature suggests considering the role of technical efficiency when analysing public and private delivery of public services. From this perspective, private service delivery should have lower costs as a result of the high management restrictions faced by public managers. In their seminal study of privatisation in the UK, Kay and Thomas (1986) argue that the main reason why it would be expected for private sector organisations to outperform their public counterparts is due to "the constraints and opportunities with which that management is faced" (Kay & Thomas 1986, p. 19). These authors state that with high regulation or lack of market competition this difference among public and private tends to diminish, because the private sector no longer can benefit from its managerial room of manoeuvre. In this line, Bel et al. (2010) draw on property rights theory to state that "ownership is an important factor because it confers the right to obtain the benefits from actions related to the assets, such as profit, as well as the benefits from innovation and efficiency gains. Bureaucrats have control rights under public ownership, but they do not enjoy property rights and thus cannot directly benefit from the profits generated by cost reduction" (Bel et al. 2010, p. 556).

Hence, from these theoretical perspectives we would expect that when technical efficiency is considered in the public vs private service delivery comparison, the private sector will tend to show better results than its public counterpart.

A second major issue when considering organisational performance is the concept of allocative efficiency. This refers to how the user can benefit from service efficiency. When cost is highly regulated by the government the user may not even notice the effects of an increase in efficiency. The service costs faced by the service user rarely reflect the real costs

incurred by the organisation producing it. Hence, while competitive markets tend to force the private sector to search for allocative efficiency (Kay & Thomas 1986), this may not be the case when a private organisation is producing a public service in a sector with low levels of competition and tight regulation. The reason for this is that the price of the service is decided by the contract with government. Thus, there is no incentive to transfer the increases in efficiency onto the user. Allocative efficiency is reflected in the financial costs of the service. This explains why in those cases in which private sector organisations have directly competed with public ones, such as in the American electric utilities field (Pescatrice & Trapani 1980) or German insurance companies in the 80s (Finsinger & Pauly 1985), studies have shown how the costs of the privately-owned organisations were significantly higher than those that were publicly-owned. Accordingly, the consideration of financial costs in the public vs private comparison should tend to favour the public sector to the detriment of their private counterpart.

A third and final variable that seems of particular importance when considering cost differences in service delivery is whether private not-for-profit organisations have been considered in the public vs private analysis. Not-for-profit organisations, instead of being owned by a group of shareholders or investors, are member-based institutions (Rosenau & Linder 2003). In practice, this means that they can belong to non-governmental organisations, specific communities or, in the case of hospitals, religious organisations and health authorities (Herrera et al. 2014). A major difference when compared to for-profit private organisations is that they do not distribute surplus to those who control the organisation; instead, this is either reinvested in the organisation or used to found other related institutions or projects. Arguably then, while for-profit organisations seek a high economic return when delivering a service, not-for-profit organisations intend to maintain economic sustainability to deliver the service (Gray 1986). From a theoretical point of view, it should be expected that

not-for-profit organisations delivering public services will present higher costs than their for-profit counterparts, as they do not have incentives to increase their economic benefits. Hence, when comparing public vs private service production, the inclusion of private organisations that are not-for-profit should diminish the cost differences between the public and private sector.

Summing up, the four main propositions derived from our theoretical expectations are: (1) We cannot provide a proposal for whether differences exist in terms of costs when comparing public versus private service delivery; (2) When technical efficiency is considered in the public vs private service delivery comparison, the private sector will tend to show better results (in comparison with the public sector) than when financial costs are considered. On the contrary, in this last case, the public sector will tend to show better (in comparison with the private sector) than when technical efficiency is considered; and (4) Studies that differentiate between private for-profit and private not-for-profit hospitals will find higher costs differences between public and private sector organisations.

THE META-SAMPLE

Table 1 provides the 21 studies used in the analysis, their number of estimators, and the number of observations each study contributes to the sample, country, and method. The final number of observations included in the analysis is 80. The studies we use in the analysis have been conducted for the USA, Germany, Taiwan, Belgium, Spain, and Italy. The final sample of studies included in the meta-regression analysis is the result of several review stages, following standard procedures in meta-regression studies (see, for example, Bel & Gradus 2016). The initial stage consisted of the identification of studies of interest by reviewing papers published in the fields of Public Administration, Public Policy, Economics, and Health. To identify potentially suitable studies, we used a combination of the key words

"hospital performance" or "hospital efficiency", and "ownership", "public" or "private" and searched for them in the publication abstracts. These journals were reviewed by analysing multiple databases, such as Science Direct, Pubmed, Proquest, and JStor.

In addition, we also reviewed unpublished works available in large working paper collections, such as EconLit, Social Science Network, and Repec-Ideas. Finally, this was completed by collecting papers from databases specialising in PhD theses, including OpenGrey, European Science Research Council (ESRC), E Thesis Online Service (ETHOS), US GAO, and The National Technical Information Service (NTIS). Arguably, at the end of this stage we had identified all those studies examining how ownership influences hospital performance. The database was built by the authors and the methodology is based on the MAER reporting guidelines in Stanley et al. (2013). The final search was concluded on July 27th of 2018 and returned a total number of 19,303 results.

-- Inster Table 1 about here --

After the first search, we look at each of the studies to identify which would be potentially suitable to build our database. We initially found 31 studies that seemed to be suitable to enter our meta-regression. The third and final stage consisted of carefully coding each identified paper to determine whether the author/s were empirically addressing ownership effects on hospital performance; this was achieved by distinguishing between public and private sectors, and the definition of hospital performance being used in each study. A fundamental characteristic of meta-regression studies is that the dependent variables of selected studies need to be very homogeneous to be compared; hence, we decided to exclude those articles that presented dependent variables that we consider to be too different to those included in the final sample, such as the performance of mental hospitals or dental care activities (i.e. Andersen Blegvad 2006; Jensen et al. 2009). Other studies were excluded

because they did not strictly compare public and private management, according to how the reference categories in their estimations were chosen (i.e. Thorpe et al. 2001; Lien et al. 2008; Czypionka et al. 2014; Cavallieri et al. 2018; Cho & Hong 2018). Similarly, in some cases studies had to be dropped because their authors did not provide sufficient statistical information for us to include them in the final database. Thus, those publications that did not provide information regarding the T-statistics or tandard errors (or the p-values) of their regressions could not be included in this study, as we did not have any possibility to compute the T-statistic (i.e. Goes & Zhan 1995; Ferrier & Valdmanis 1996; Connor, Feldman & Dowd 1998). In all, 10 studies were excluded.

THE META-REGRESSION

Our final sample is derived from the 21 studies identified as containing homogeneous estimates of the performance of private relative to public production of hospital services. These studies include a total of 96 estimations of hospital performance according to the production form. Of these 96 estimations, we can use the 80 that include all variables considered in our analysis, as well as the homogeneous definition of the production form variable, which allow us to obtain a t-value for the comparison between public and private production.

There are many reasons why t-values for the comparison between public and private production vary in empirical studies. Three categories of factors are suggested in Stanley and Jarrell (1989): (1) the fact that the data set employed in each study is unique; (2) model specification may induce biases; and (3) the statistical methods employed are different. We undertake a meta-regression analysis to explain diversity and the pattern of findings in the empirical studies. When constructing our data sample, we kept Stanley and Jarrell's (1989) points in mind. We provide some technical details on the structure of the meta-regression

model and the rationale to use t-values instead of coefficients as the dependent variable in the meta-regression.

Most studies included in our sample use data on hospital costs to compare financial performance of public and private hospitals. In several cases, data used is on the technical efficiency of public and private hospitals (i.e. Chirikos & Sear 1994; Sari 2003; Brown 2003; Tiemann & Schreyögg 2009). Whenever needed, we have transformed the T-statistics to ensure homogeneity and robustness of the dependent variable in our meta-regression estimation (i.e. Chirikos & Sear 1994).

We define several moderator variables for the database. First, we include a continuous variable, *YearData*, which reflects the year to which the data used in the study belongs (we take the average year when data was obtained for several years), to consider the possible existence of time trends affecting the comparative performance between public and private organisations. Using this moderator is usual in meta-regression analysis because it is intended to consider potential time effects. Some privatisation articles have observed that older studies tend to give higher performance ranking to public services provided by privately owned organisations, but this performance gap has been attenuated over the last few years (Bel et al. 2010).

Second, we include a set of moderator variables related to the characteristics of the model specification in each study. The second variable is the dummy variable, *panel*, which takes the value of one if a panel estimation method was used, and zero otherwise. This is intended to consider that panel estimations are richer in data and usually more robust than cross-section estimations. The third variable is the dummy variable *Individual*, which takes value one if the data collection took place at the individual (patient) level, and zero if the data

collection took place at organisational (hospital) level. This variable allows us to control for potential differences between microdata and organisational data.

Next, we include variables related to the exogenous characteristics of the study. Our fourth variable is a dummy variable, *USA*, which takes value one if the study was conducted in the USA, and zero otherwise; in this way, we consider that the USA does not have a universal system of health service provision as is the case for all other countries for which studies in the data sample have been conducted. Interestingly, there is some empirical evidence showing that the US has incurred higher costs when delivering health services than a comparable country with universal provision such as Canada (Woolhandler et al. 2003). Furthermore, it is worth noting that 65% of the studies in our meta-regression have been conducted for the US, so this variable helps to control for this fact. And we also include a dummy variable for *Germany*, which takes value one for Germany and zero otherwise, because four studies conducted with data from German hospitals provide more than 40% of the estimations we have been able to use. Together with this dummy, we use estimation techniques that expressly address the problem of correlation across observations.

Finally, we include our main independent variables. Our sixth variable is the dummy *Not-for-profit (NFP)*, which takes value one for those estimations where NFP were included, besides purely public and purely privately-managed hospitals, and zero otherwise. Our last variable is the dummy variable, *Cost*, which takes value one if the dependent variable in the estimation was cost-related, and value zero otherwise (generally in that case, technical efficiency-related indicators that considers which inputs are necessary to obtain a certain output). It is important to recall that costs and technical efficiency are not strictly related in weakly competitive and heavily regulated sectors, such as this one. As a result, it is possible that productive units can at the same time be more efficient and charge higher costs for

services (Vickers & Yarrow, 1988, 1991), as has been found in studies for public and private delivery of public services like solid waste collection (Bel & Miralles 2010). Because we have both types of dependent variable in the original estimations, and sometimes these present the opposite sign to indicate superior performance, we were careful in making signs homogeneous so that our meta-regression estimates are robust.

Table 2 summarises the dependent and independent variables used in this study, while table 3 depicts the descriptive statistics of these variables and the dependent variable in our meta-regression, and the variables used in the meta-regression tests.

-- Insert Table 2 about here –

-- Insert Table 3 about here --

In the meta-regression tests, in order to differentiate the *true empirical effect* from publication bias we also use the reported standard error and t-statistics associated with the coefficient of the variable indicating production form in the regression equations, and the degrees of freedom. Note that this information is not available in all of the studies. Whenever the t-statistics are given, the derivation of the standard error is a straightforward task. Degrees of freedom are given in the original studies or can be calculated from the descriptive data within the studies (i.e. by subtracting the number of regressors from the sample size). Finally, we have 80 observations for SE and their t-statistics.

The equation with which we estimate the influence of different study characteristics on the comparison between public and private performance can be stated as follows:

$$T_i = \alpha_0 + \alpha_1 \, YearData_i + \alpha_2 \, Panel_i + \alpha_3 \, Individual_i + \alpha_4 \, USA_i + \alpha_5 \, Germany_i + \alpha_6 \, NFP_i + \alpha_7 \, PCost_i + \varepsilon_i \quad (1)$$

where T_i is the t-value reported in each estimation for the coefficient of the production form. We have homogenised, when needed, the signs (according to the different specifications in the original models), and the higher the value the higher the cost (the lower the efficiency) of private production. The moderator variables are as defined in the previous section (see also Table 2). We tested formally for the presence of multicollinearity and obtained a mean value of 2.78 for the variance inflation factor (VIF). All coefficients were below 6, indicating that multicollinearity should not be a problem for the interpretation of the regression results (Damanpour & Schneider 2009; Hair et al. 2006).

RESULTS

We estimated different meta-regression models to obtain robust results. First, we estimated an ordinary least squares (OLS) regression. We tested for heteroscedasticity and did not reject the hypothesis of constant variance, as we found that the Breusch-Pagan/Cook-Weisberg test has a value of 0.10 for the chi-square statistic, with a p-value of 0.318. In addition, we include a robust OLS estimation to check the stability of our results. Results for both estimations are presented in table 4.

Our sample is formed with observations obtained from 21 studies, each containing a different number of estimations, which can lead to the problem of dependence across observations (Nelson & Kennedy 2009; Ringquist 2013). There may exist other potential sources of dependence across observations. A main one would be the use of common data sets in different studies – for example, as happens with the use of ICMA data in articles assessing the choice of production modes of local public services in the US. In this regard, it is worth noting that we do not have this problem in our analysis, as each database is unique to the study in which it was used. A second source of dependence across observations would be the fact that different studies may have been undertaken by the same research teams. In our

sample, two studies conducted for Germany were carried out by the same scholars. However, as we included a variable to control for studies conducted in Germany, this should not be a problem in our analysis.

To take full account of within-study autocorrelation, we followed the suggestion of Ringquist (2013, p. 218) and used generalised estimating equations (GEE) to estimate a random effects meta-regression model. By doing so, we cluster all estimations of each study to deal with dependence across observations. Another possible way of dealing with intra-study variability is to calculate a single average effect size from each original study, or select the best estimation from among all estimations in a single study. We disregarded both because that would result in an extremely small sample (16 estimations) for our meta-analysis, as warned by Nelson and Kennedy (2009), and – as suggested in Ringqvist (2013) - that would have implied discarding a large amount of information. It is worth noting that our robust GEE coefficients and signs are almost identical to those obtained when using a FGLS regression, and the Wald chi-squared statistics obtained with GEE and FGLS are similar, as can be seen in table 4, which shows the results from the estimation of the meta-regression equation (1).

-- Insert Table 4 about here --

Regarding the variable indicating potential time effects, all estimations show no significance for *YearData*, suggesting that the time for which the study was conducted does not affect the performance comparison between public and private production. Likewise, the variable *Individual* does not appear to be significant regarding the relative performance. On the contrary, the studies that use panel estimation -that is, the more robust studies- tend to

find better performance under public production, as indicated by the positive and highly significant (always at the one per cent level) sign for the variable *Panel*.

With respect to countries for which the study was conducted, all estimations show significance at the 5% level for the US for better performance in public production, with the exception of the OLS robust. Recall in this regard that our heteroscedasticity test suggests more robust results from OLS and GEE/GLS. In the same vein, the studies conducted for Germany tend to find a highly significant (always at the one per cent level, but OLS robust) better performance in public production, since private production appears to be associated with higher costs. We are not aware of specific data on cross-country differences in efficiency and productivity in the Health sector, which would indeed be useful to better understand these results. However, a possible explanation for these results can be found in looking at the overall performance levels of the public sector for each country, available at the Global Competitiveness Report (World Economic Forum), which evaluates and compares countries on (among many other issues) '(1.08) Efficiency of Government Spending' and '(1.09) Burden of Government Regulation'. In the last report published (2017-2018), Germany and the US rank similarly in both aspects, and are identified among the best countries in the world. On the contrary, Taiwan, and particularly Belgium, Spain, and Italy (the four remaining countries in our meta-regression) rank much worse on both factors. So, when our results show that the public sector in health in Germany and the US compares more favourably to the private sector than in the remaining countries in our study, this is consistent with comparative data available on the efficiency of the public sector overall for the countries included in our study.

Turning to the moderator variables related to theoretical insights, including not-for-profit management in the study does not have any significant relationship with the relative

performance of production forms, as *Not-for-Profit* coefficients do not have statistical significance. Instead, we find that studies that use financial data to analyse costs tend to find better performance within public production, as the sign for the variable *Cost* is positive and highly significant (always at the one per cent level).

Thus, overall, the meta-regression gives a strong indication that studies conducted for the USA and Germany - that use financial data and conduct panel estimation - provide better performance for public production.

Our meta-regression includes two articles (Augurzki et al. 2012, and Langaber et al. 2018) that analyse the effect of the production form on the probability of the hospital's financial default. As this might be not enough homogeneity with the dependent variables in the other 19 studies considered, we want to check the stability of our results. In this way, we have excluded these two articles, and have again obtained OLS, GEE and GLS estimates, this time with 19 studies including 76 raw estimations. The results are identical - signs and significance - for all variables in the model. These results are available upon request.

ROBUSTNESS TESTS

A major concern of any meta-regression model is the identification of any potential publication bias. Studies finding statistically significant relationships between the variables of interest are arguably more likely to be published in top academic outlets, which may lead to incorrect conclusions regarding the effectiveness of a hospital ownership type. A priori, we do not believe publication bias should be a serious problem in our analysis, mainly because there is no unanimously-established theoretical view on the relative performance between public and private production in the management of health services. Indeed, the studies analysed here typically deal with the dimension of the effect, rather than the existence of the effect itself.

Nonetheless, as publication bias could upwardly bias the effectiveness of the organisation's ownership, we believe it is important to deal with this potential problem. To identify and correct for possible publication bias, Stanley and Doucouliagos (2012) propose the funnel asymmetry tests (FATs). These tests estimate the relationship between a study's reported t-statistics on the one hand, and SE of its coefficients and Sample Size of the estimation on the other. Consequently, we estimate the following equations:

$$T_i = \beta_0 + \beta_1 \left(\frac{1}{SE_i}\right) + \varepsilon_i, \quad (2)$$

$$T_i = \beta_0 + \beta_1 SQR\_SampleSize\text{i} + \varepsilon_i \quad (3)$$

where *T* is a study's reported t-statistic, 1/SE is the inverse of the standard error (Inverse_StandardErrors), and SQR_SampleSize is the Square Root of the sample size. Evidence for publication bias will be found when $\beta_0 \neq 0$. Equations (2) and (3) are estimated in table 5.

Additionally, in line with Stanley (2008), to test the true empirical effect we also conduct a meta-significance test (MST) by estimating the following equation:

$$\log |T_i| = \gamma_0 + \gamma_1 \log(df_i) + \varepsilon_i, \quad (4)$$

where *df* are the degrees of freedom of the estimate reported [and log(df) is the logarithm of degrees of freedom]. The MST is based on the statistical property that the dimension of the t-statistic will vary systematically with the degrees of freedom if there is a genuine empirical effect (Stanley 2008). Therefore, Stanley (Ibid.) argues that if $\gamma_1 = 0$ the true effect is disputable. These results are included in Table 5.

-- Insert Table 5 about here --

It is important to note that the FAT estimates the relationship between a study's reported effect and its coefficients' standard errors, or sample size. Hence, evidence of publication bias is found when the intercept is significantly different from zero (Ibid.). The results of our FAT, presented in table 5, do not reject the hypothesis of no publication bias because the intercept is not statistically different from zero in any case.

We do not initially find evidence of the existence of a 'true' effect or genuine empirical effect in the FAT. However, the results of the MST show that the coefficient of *Logdf* is positive and highly statistically significant, which would indicate better performance with public production. Therefore, performance seems to be better in public hospitals according to the result of the MST, although some caution is needed because no true effect was obtained from the FAT.

CONCLUSION

Research comparing performance among public and private organisations has generated robust findings over the last few decades. Despite this, the results of this meta-regression offer some important insights for those interested in the costs and efficiency of public and private hospitals. First, those studies analysing German hospitals do find that private hospitals perform worse than their public counterparts; German hospitals tend to be more associated with better public performance when compared with studies elsewhere. Second, research using panel data approaches more frequently find that public hospitals outperform private ones. Arguably, when more robust methodologies are applied, such as panel data approaches, the results present a more favourable performance in terms of costs for public hospitals than when they rely on cross-sectional analysis. Third, using financial cost data in the studies tends to be associated with better performance by public hospitals. Finally, including not-for-profit hospitals when analysing public and private sector differences does

not seem to produce any effect. So, when we distinguish between private for-profit, and private not-for-profit in the public and private comparison, the results do not change.

Our results from the FATs estimations do not allow us to claim a true empirical effect of ownership over costs and efficiency, meaning that systematic differences do not exist between public and private production. However, it is worth noting that our MST suggests that public hospitals outperform private ones. Future research is needed to better understand if, when controlling for contextual and organisational variables, ownership has a true effect over organisational performance. In this sense, it is important to highlight that the present study is limited by the number of estimators contained in the literature on hospital performance. A common critique for meta-regression studies is that it does not allow for a fine comparison of how each dependent and independent variable of those studies included in the sample are measured (Borestein et al. 2009). While we have prioritised the use of similar measures over the *n* of our sample, future studies should also look at other performance information to enrich the knowledge on the effects of ownership over organisational outputs and outcomes.

To conclude, the evidence provided by this meta-regression lends some empirical support for the dimensional or "publicness approach" referred to by Bozeman and Bretschneider (1994), as it shows that the distinction between public and private does not explain clear performance differences per se; instead, we must consider a large array of environmental and organisational characteristics that could help us to understand the reasons behind performance differences across sectors. More than two decades ago, Perry and Rainey (1988) warned that the tendency in articles that address the public and private differentiation was to represent the distinction by a categorical variable of either public or private. After their revision of the literature, these authors propose a classification of the organisation type

according to the cross-classification of three variables: ownership, funding, and mode of social control. However, despite this classification attempt, most, if not all, research comparing public and private organisations has relied upon ownership to distinguish between public and private entities (Bozeman 1987; Perry & Rainey 1988; Boyne 2002). In this line, our analysis demonstrates that the comparison between public and private performance requires a broader theoretical framing that includes several moderating factors. Only by developing further research on these moderators of ownership and organisational performance will we be able to distinguish when and how private organisations could be a better option for the delivery of health services.

APPENDIX

The standard econometric model has the following structure:

$$Y = X\beta + \varepsilon \tag{A.1}$$

This allows for an explanation of the determinants of an event, and their magnitude and relevance. Now, in order to explain reported differences Jarrell and Stanley (1989) propose the following structure for a model to synthesise the various findings:

$$b_j = \beta + \sum_{k=1}^{K} \alpha_k Z_{jk} + e_j, \qquad (j = 1,2, \ldots L) \tag{2}$$

Where b_j (observed dependent variable) is the reported coefficient of the true effect - β from the jth study out of the set of estimations from the studies included in the data base. The right side of the equation displays the "meta-part". α_k stands for the meta-regression coefficients, Z_{jk} for meta-independent variables that capture systematic differences between observations, and e_j is the meta-regression disturbance term. In practice, for $b_{j,}$ it is customary to use the ratio between the coefficient and the standard error (the t-value) rather than the reported coefficients. The main reason for this is that in studies using different data sets, sample sizes

and specifications, the variances of the coefficients will tend to be different, which can make the meta-regression errors heteroscedastic.

REFERENCES

Andersen L. B. and Blegvad M. 2006. "Does Ownership Matter for the Delivery of Professionalized Public Services? Cost-Efficiency and Effectiveness in Private and Public Dental Care for Children in Denmark." *Public Administration* 84(1): 147–64.

Augurzky, B., Engel, D. Schmidt, C.M. and Schwierz, C. 2012. "Ownership and Financial Sustainability of German Acute Care Hospitals." *Health Economics* 21 (7): 811–824.

Andrews R., Boyne G. A., Meier K. J., O'Toole L. J. and Walker R. M. 2012. "Vertical Strategic Alignment and Public Service Performance." *Public Administration* 90(1): 77–98.

Andrews R., Boyne G. A. and Walker R. M. 2011. "Dimensions of Publicness and Organizational Performance: A Review of the Evidence." *Journal of Public Administration Research & Theory* 21(suppl_3): i301–i319.

Basu S., Andrews J., Kishore S., Panjabi R. and Stuckler D. 2012. "Comparative Performance of Private and Public Healthcare Systems in Low- and Middle-Income Countries: A Systematic Review." *PLoS Med* 9: e1001244.

Bel G., Fageda X. and Warner M. E. 2010. "Is Private Production of Public Services Cheaper Than Public Production? A Meta-Regression Analysis of Solid Waste and Water Services." *Journal of Policy Analysis and Management* 29(3): 553–577.

Bel G. and Gradus R. 2016. "Effects of Unit-Based Pricing on Household Waste Collection Demand: A Meta-regression Analysis." *Resource and Energy Economics* 44(1): 16–9182.

Bel, G. and Miralles A. 2010. “Choosing between service fees and budget funding to pay for local services: Empirical evidence from Spain.” *Environment and Planning C: Government & Policy* 28(1): 54–71.

Bel G. and Warner M. 2008. “Does Privatization of Solid Waste and Water Services Reduce Costs? A Review of Empirical Studies.” *Resources, Conservation and Recycling* 52(12):1337–1348.

Borenstein M., Hedges L. V., Higgins J. P. and Rothstein H. R. 2009. *Introduction to Meta-Analysis*. Chichester, UK: Wiley.

Bosmans N. and Fecher F. 1995. “Performance of Belgian Hospitals: A Frontier Approach.” *Health Economics* 4(5): 389–397.

Box R. C. 1999. “Running Government like a Business.” *American Review of Public Administration* 29(1): 1–19.

Boyne G. A. 1998. “Bureaucratic Theory Meets Reality: Public Choice and Service Contracting in US Local Government.” *Public Administration Review* 58(6): 474–484.

Boyne G. A. 2002. “Public and Private Management: What's the Difference?” *Journal of Management Studies* 39(1): 97–122.

Boyne, G. A., Farrell, C., Law, J., Powell, M. and Walker, R. M. 2003. *Evaluating Public Management Reforms: Principles and Practice*. Philadelphia and Buckingham: The Open University Press.

Bozeman, B. and Bretschneider S. 1994. “The `Publicness Puzzle' in Organization Theory: A Test of Alternative Explanations of Differences between Public and Private Organizations.” *Journal of Public Administration Research and Theory* 4(2): 197–224.

Brown H. S. 2003. “Managed Care and Technical Efficiency.” *Health Economics* 12(2): 149–158.

Campbell, E. S. 1990. “Hospital Efficiency and Indigent Care.” *Applied Economics* 22(11): 1597–1610.

Carey K. 1997. “A Panel Data Design for Estimation of Hospital Cost Functions.” *Review of Economics and Statistics* 79 (3): 443–453.

Carvalho P. R., Marques C. and Berg S. 2012. “A Meta-regression Analysis of Benchmarking Studies on Water Utilities Market Structure.” *Utilities Policy* 21(2): 40–49.

Cavalleri M., Guccio C., Lisi D. and Pignataro G. 2018. “Does the Extent of per Case Payment System Affect Hospital Efficiency? Evidence from the Italian NHS.” *Public Finance Review* 46(1): 117–149.

Chandler J. A. 1991. “Public Administration and Private Management. Is there a Difference?” *Public Administration* 69(3): 385–392.

Chirikos T. N. and Sear A. M. 1994. “Technical Efficiency and the Competitive Behaviour of Hospitals.” *Socio-Economic Planning* 28(4): 219–227.

Cho N. and Hong K. 2018. “A Kitchen with too Many Cooks: Factors Associated with Hospital Profitability.” *Sustainability* 10(2): 323.

Collins J. N. and Downes B. T. 1977. “The Effect of Size on Provision of Public Services the Case of Solid Waste Collection in Smaller Cities.” *Urban Affairs Quarterly* 12(3): 333–47.

Connor R. A., Feldman R. D. and Dowd B. E. 1998. “The Effects of Market Concentration and Horizontal Mergers on Hospital Costs and Prices.” *International Journal of the Economics of Business* 5(2): 159–180.

Czypionka T., Kraus M., Mayer S. and Röhrling G. 2014. "Efficiency, ownership, and financing of hospitals: The case of Austria." *Health Care Management Science* 17(4): 331–347.

Damanpour F. and Schneider M. 2009. "Characteristics of Innovation and Innovation Adoption in Public Organizations: Assessing the Role of Managers." *Journal of Public Administration Research and Theory* 19(3): 495–522.

Ding D. X. 2014. "The Effect of Experience, Ownership and Focus on Productive Efficiency: A Longitudinal Study of U.S. Hospitals." *Journal of Operations Management* 32(1-2): 1–14.

Fageda X. and Fiz E. 2011. *Ownership, Incentives and Hospitals*. Fundación de las Cajas de Ahorro. Documento de Trabajo nº 591/2011.

Ferrier G. D. and Valdmanis V. 1996. "Rural Hospital Performance and Its Correlates." *Journal of Productivity Analysis* 7(1): 63–88.

Finsinger J. and Pauly M. V. 1985. *The Economics of Insurance Regulation*: A Cross-National Study. London: Macmillan.

Fournier G. M. and Mitchell J. M. 1997. "New Evidence on the Performance Advantages of Multihospital Systems." *Review of Industrial Organisation* 12(5/6): 703–718.

Goes J. B. and Zhan C. 1995. "The Effects of Hospital-Physician Integration Strategies on Hospital Financial Performance." *HSR: Health Services Research* 30(4): 507–530.

Gray B. H. 1986. *For-Profit Enterprise in Health Care*. Institute of Medicine. National Academy Press, Washington DC.

Guerrini A., Romano G., Campedelli B., Moggi S. and Leardini C. 2018. "Public vs. Private in Hospital Efficiency: Exploring Determinants in a Competitive Environment." *International Journal of Public Administration*, 41(3): 181–189,

Hair J. F., Anderson E. R., Tatham R. L. and Black W. C. 2006. *Multivariate Data Analysis*. Upper Saddle River, N.J.: Prentice Hall.

Haque M. S. 2001. "The Diminishing Publicness of Public Service Under the Current Mode of Governance." *Public Administration Review*, 61: 65–82.

Hefetz A. and Warner M. E. 2012. "Contracting or Public Delivery? The Importance of Service, Market, and Management Characteristics." *Journal of Public Administration Research and Theory* 22(2): 289–317.

Herr A. 2008. "Cost and Technical Efficiency of German Hospitals: Does Ownership Matter?" *Health Economics* 17(9): 1057–1071.

Herr A., Schmitz H. and Augurzky B. 2011. "Profit Efficiency and Ownership of German Hospitals." *Health Economics* 20(6): 660–674.

Hirsch W. Z. 1995. "Contracting Out by Urban Governments: A Review." *Urban Affairs Review* 30(3): 458–472.

Hodge G. 2000. *Privatization: An International Review of Performance*. Boulder, CO: West-view Press.

Jensen P. H., Webster E. and Witt J. 2009. "Hospital Type and Patient Outcomes: An Empirical Examination Using AMI Readmission and Mortality Records." *Health Economics* 18(12): 1440–1460.

Jiang J. H., Friedman B. and Begun J. W. 2006. "Factors Associated with High-Quality/Low-Cost Hospital Performance." *Journal of Health Care Finance* 32(3): 39–52.

Kay J. A. and Thomas D. J. 1986. Privatization: A Policy in Search of a Rationale. *The Economic Journal,* 96: 18–32.

Kemper P. and Quigley J. 1976. *The Economics of Refuse Collection*. Cambridge (MA): Ballinger.

Kessler P. D. and McClellan M. B. 2002. "The Effects of Hospital Ownership on Medical Productivity." *The RAND Journal of Economics* 33(3): 488–506.

Kitchen H. M. 1976. "A Statistical Estimation of an Operating Cost Function for Municipal Refuse Collection." *Public Finance Quarterly* 4(1):56–76.

Langabeer II, J. R., Lalani K. H., Champagne-Langabeer T. and Helton J. R. 2018. "Predicting Financial Distress in Acute Care Hospitals." *Hospital Topics*, DOI: 10.1080/00185868.2018.1451262

Lien H. M., Chou, S. Y. and Liu, J. T. 2008. "Hospital ownership and performance: evidence from stroke and cardiac treatment in Taiwan." *Journal of Health Economics* 27/5: 1028–1223.

Lin H., Kao S., Wen H., Wu C. and Chung C. 2005. "Length of Stay and Costs for Asthma Patients by Hospital Characteristics—A Five-Year Population-Based Analysis." *Journal of Asthma* 42(7): 537–542.

Murray M. A. 1975. "Comparing Public and Private Management: An Exploratory Essay." *Public Administration Review* 35(4): 364–371.

Nelson J. P. and Kennedy P. E. 2009. "The Use (and Abuse) of Meta-analysis in Environmental and Natural Resource Economics: An Assessment." *Environmental and Resource Economics* 42(3): 345–377.

Nutt P. 1993. "Organizational Publicness and Its Implications for Strategic Management." *Journal of Public Administration Research and Theory* 3(2): 209–231.

Perry J. L. and Rainey H. G. 1988. “The Public-Private Distinction in Organization Theory: A Critique and Research Strategy.” *Academy of Management Review* 13(2): 182–201.

Pescatrice D. R. and Trapani J. M. 1980. “The performance and objectives of public and private utilities operating in the United States.” *Journal of Public Economics* 13: 259–76.

Pesch U. 2008. “The Publicness of Public Administration.” *Administration & Society* 40(2): 170–193.

Petersen O. H., Hjelmar U. and Vrangbæk K. 2018. “Is Contracting out of Public Services still the Great Panacea? A Systematic Review of Studies on Economic and Quality Effects from 2000 to 2014.” *Social Policy & Administration* 52(1): 130–157.

Pollitt C. and Bouckaert G. 2011. *Public Management Reform: A Comparative Analysis*. *New Public Management, Governance and the Neo-Weberian State*. Oxford: Oxford University Press.

Pommerehne W. W. and Frey B. 1977. “Public Versus Private Production Efficiency in Switzerland: A Theoretical and Empirical Comparison.” In: Ostrom V., Pendell R. B., editors. 1977. Comparing Urban Service Delivery Systems. *Urban Affairs Annual Review* 12: 221–41.

Productivity Commission 2009. *Public and Private Hospitals, Research Report*. Canberra: Australian Government Productivity Commission.

Ring P. S. and Perry J. L. 1985. “Strategic Management in Public and Private Organizations: Implications of Distinctive Contexts and Constraints.” *Academy of Management Review* 10(2): 276–286.

Ringquist E. J. 2013. *Meta-analysis for Public Management and Policy*. Jossey-Bass, Wiley & Sons. San Francisco, CA.

Rosenau P. V. and Linder S. H. 2003. "Two Decades of Research Comparing For-Profit and Nonprofit Health Provider Performance in the United States." *Social Science Quarterly* 84(2): 219–241.

Rosko M. D. 1999. "Impact of Internal and External Environmental Pressures on Hospital Inefficiency." *Health Care Management Science* 2(2): 63–74.

Rosko M. D. 2004. "Performance of U.S. Teaching Hospitals: A Panel Analysis of Cost Inefficiency." *Health Care Management Science* 7(1): 7–16.

Sari N. 2003. "Efficiency Outcomes of Market Concentration and Managed Care." *International Journal of Industrial Organization* 21(10): 1571–1589.

Scott P. G. and Falcone S. 1998. "Comparing Public and Private Organizations - An Exploratory Analysis of Three Frameworks." *American Review of Public Administration* 28(2): 126–145.

Stanley T. D. 2008. "Meta-Regression Methods for Detecting and Estimating Empirical Effect in the Presence of Publication Bias." *Oxford Bulletin of Economics and Statistics* 70(1): 103–127.

Stanley T. D. and Doucouliagos H. 2012. *Meta-Regression Analysis in Business and Economics*. Routledge Advance in Research Methods. Routledge, Oxon.

Stanley T. D., Doucouliagos H., Giles M., Heckemeyer J. H., Johnston R. J., Laroche P., Nelson J. P., Paldam M., Poot J., Pugh G., Rosenberger R. S. and Rost K. 2013. "Meta-

Analysis of Economics Research Reporting Guidelines." *Journal of Economic Surveys* 27(2): 390–394.

Stanley T. D. and Jarrell S. B. 1989. "Meta-regression Analysis: A Quantitative Method of Literature Surveys." *Journal of Economic Surveys* 3(2): 54–67.

Stiglitz J. E. 2000. *Economics of the Public Sector*. WW. Norton.

Tiemann O. and Schreyögg J. 2009. "Effects of Ownership on Hospital Efficiency in Germany." *Business Research* 2(2): 115–145.

Thorpe K. E., Seiber E. E. and Florence C. S. 2001. "The Impact of HMOs on Hospital-Based Uncompensated Care." *Journal of Health Politics, Policy and Law* 26(3): 543–555.

Vickers J. and Yarrow G. 1988. *Privatization: An Economic Analysis*. Cambridge, MA: MIT Press.

Vickers J. and Yarrow G. 1991. "Economic Perspectives on Privatization." *Journal of Economic Perspectives* 5(2): 111–132.

Vitalino T. F. and Toren M. 1996. "Hospital Cost and Efficiency in a Regime of Stringent Regulation." *Eastern Economic Journal* 22(2): 161–175.

Walker R. M., Brewer G. A., Bozeman B., Moon M. J. and Wu J. 2013. "An Experimental Assessment of Public Ownership and Performance." *Public Management Review* 15(8): 1208–1228.

Woolhandler S., Campbell T. and Himmelstein D. H. 2003. "Costs of Health Care Administration in the United States and Canada." *New England Journal of Medicine* 349(8): 768–775.

WEF. 2017. “The Global Competitiveness Report 2017–2018.” World Economic Forum, Geneva.

TABLES

Table 1. Main characteristics-multivariate studies on performance comparison between public and private production of health services

Authors	Number of Estimations	Year Sample	Sample	Country	Method*
Campbell (1990)	3	1986	224	USA	OLS
Chirikos & Sear (1994)	3	1989	189	USA	OLS
Bosmans & Fecher (1995)	1	1991	150	Belgium	OLS
Vitaliano & Toren (1996)	1	1991	219	USA	OLS
Fournier & Mitchell (1997)	1	1984-1986	534	USA	SUR
Carey (1997)	5	1987-1991	1733	USA	OLS
Rosko (1999)	3	1994	3262	USA	OLS
Kessler & McLellan (2002)	1	1985-1996	1661674	USA	OLS
Brown (2003)	5	1992-1996	1907	USA	OLS
Sari (2003)	5	1994-1998	876	USA	OLS & Panel
Rosko (2004)	2	1990-1999	407	USA	Panel
Lin et al. (2005)	1	1997-2001	139630	Taiwan	OLS
Jiang (2006)	2	1997-2001	1369	USA	Logistic
Herr (2008)	10	2001-2003	1665	Germany	OLS & Panel
Tiemann & Schreyögg (2009)	11	2002-2006	4902	Germany	Panel
Fageda & Fiz (2011)	2	1997 & 2007	1275	Spain	OLS
Herr, Schmitz & Augurzky (2011)	10	2002-2006	1579	Germany	OLS
Augurzki et al (2012)	3	2001-2005	962	Germany	OLS & PANEL
Ding (2014)	8	2003	50916	USA	OLS
Guerrini et al (2017)	2	2011-2012	142	Italy	Tobit & OLS
Langaber et al (2018)	1	2012-2015	1240	USA	OLS

* *OLS & Panel* indicates that some regressions use OLS and other Panel in the same study.

Table 2. Definition of variables

Dependent variable	
t-value	t-value of the production form in the estimations
Moderator variables	
Year Data	Continuous variable that reflects the year(s) for which the data was obtained
Panel	Dummy with one if the study used panel estimation method
Individual	Dummy with one if data is obtained for patients
USA	Dummy with one if the study was conducted in USA
Germany	Dummy with one if the study was conducted in Germany
Not-For-Profit	Dummy with one if the study included Not-For-Profit hospitals
Cost	Dummy with one if the study measured financial costs

Table 3. Descriptive statistics of variables used in meta-regression analysis and meta-regression tests

	Average	SD	Max	Min	Nº
t-Statistic	0.94	8.43	39.77	-38.40	80
Year Data	1999.08	6.54	2015	1984	80
Panel	0.35	0.48	1.00	0.00	80
Individual	0.01	0.11	1.00	0.00	80
USA	0.50	0.50	1.00	0.00	80
Germany	0.43	0.50	1.00	0.00	80
Not-for-Profit	0.70	0.46	1.00	0.00	80
Cost	0.63	0.49	1.00	0.00	80
Standard error	2.82	19.99	178.98	0.00	80
Degrees of freedom	29392	186019	1661669	135	80

Table 4. Meta-regression estimates (OLS, Robust OLS, GEE, and GLS)

	OLS	OLS	GEE	FGLS
Year Data	-0.134 (0.163)	-0.134 (0.117)	-0. 140 (0.174)	-0.134 (0.146)
Panel	9.288*** (2.221)	9.288*** (2.478)	8.492*** (2.330)	9.288*** (2.107)
Individual	-9.039 (5.242)	-9.039 (16.770)	-7.842 (5.187)	-9.039* (4.973)
USA	8.072** (3.744)	8.072 (5.298)	10.076** (3.979)	8.072** (3.551)
Germany	9.483*** (3.439)	9.483* (4.842)	11.206*** (3.971)	9.483*** (3.262)
Not-For-Profit	-0.181 (1.989)	-0.181 (2.038)	-1.894 (5.430)	-0.181 (1.887)
Cost	6.417*** (1.872)	6.417** (2.503)	5.804*** (2.090)	6.417*** (1.776)
Constant	254.683 (307.326)	254.683 (234.989)	255.577 (347.776)	254.683 (291.555)
N	80	80	80	80
F	7.96***	3.90***		
R2	0.4363	0.4363		
Breusch-Pagan/Cook-Weisberg test (p>chi2)	0.318			
VIF	2.78			
Wald(chi)2			46.82	61.92
Prob > chi2			0.000***	0.000***

*Level of significance: *=10 per cent; **=5 per cent; ***=1 per cent*

Table 5. Meta-regression tests: Funnel Asymmetry [FAT (1), FAT (2)(Robust)] and Meta-Significance [MST(Robust)]

Explanatory variables	FAT I test Dep. Variable t-Statistic	FAT II test Dep. Variable t-Statistic	MST: Dep. Variable: log (t-Statistic in Absolute Values)
Invers_StandardErrors	-0.0025 (0.0147)	---	---
SQR_SampleSize	---	0.004 (0.009)	
Log(DegreesFreedom)	---	---	0.332*** (0.117)
Constant	1.308 (0.956)	0.626 (0.939)	-0.932*** (0.428)
R^2	0.0364	0,0053	0.0902
F	2.95	0.20	8.06***
N	80	80	80

*Level of significance: **=5 per cent; ***=1 per cent*

UB IREA
Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics
Universitat de Barcelona
Av. Diagonal, 690 • 08034 Barcelona

WEBSITE: www.ub.edu/irea/ • **CONTACT:** irea@ub.edu