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The effectiveness–efficiency trade-off in health care: The case of hospitals in Lombardy, Italy

Gianmaria Martini *, Paolo Berta, John Mullahy, Giorgio Vittadini

Department of Management Engineering, University of Bergamo, Viale Marconi, 5, 24044 Dalmine, BG, Italy

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ABSTRACT

We study the presence and the magnitudes of trade-offs between health outcomes and hospitals' efficiency using a data set from Lombardy, Italy, for the period 2008–2011. Our goal is to analyze whether the pressures for cost containment may affect hospital performance in terms of population health status. Unlike previous work in this area, we analyze hospitals at the ward level so comparisons can be made across more homogeneous treatments. We focus on two different health outcomes: mortality and readmission rates. We find that there is a trade-off between mortality rates and efficiency, as more efficient hospitals have higher mortality rates. We also find, however, that more efficient hospitals have lower readmission rates. Moreover, we show that focusing the analysis at the ward level is essential, since there is evidence of higher mortality rates in general medicine and surgery, while in oncology mortality is lower in more efficient hospitals. Furthermore, we find that consideration of spatial processes is important since mortality rates are higher for hospitals subject to high degree of horizontal competition, but lower for those hospitals having strong competition but high efficiency. This implies that the interplay of efficient resource allocation and hospital competition is important for the sustainability and effectiveness of regional health care systems.

1. Introduction

The recent worldwide growth of health care expenditures has raised strong concerns about cost containment. In the secondary care sector, the main attempts to achieve this goal have focused on health policies to increase the efficiency of hospitals' management and at eliminating possible waste of resources. One central feature of many such policies is the adoption of a prospective payment system (PPS), regulating hospitals' reimbursements for the treatments they provide. Under PPS, these reimbursements are classified according to DRG codes and have introduced strong incentives to reduce patients' Length of Stay (LOS). As a response to these incentives, hospitals' managers have adopted procedures and guidelines to increase labor and capital productivity, mainly through the increase of total discharges per bed and per unit of labor. These trends have raised concerns regarding the quality of care.[1] From this perspective, it becomes important to investigate whether there is in the hospital sector a trade-off between hospital efficiency and effectiveness in achieving health outcomes. The goal of this paper is to provide some new empirical evidence on this topic.

In dealing with this issue we introduce two factors that may lead to a better understanding of the impacts of pursuing efficiency in the realm of health outcomes: (1) the analysis is conducted at the hospital ward level and (2) the impacts of several spatial features of the hospitals' environment are considered. This analysis will be performed by applying a three-stage econometric model to a large administrative data set on all patients admitted in the hospitals of Lombardy, an Italian region with a population of approximately ten million, over four years from 2008 to 2011.

Focusing on the ward level should enhance the investigation of efficiency and effectiveness because, as noted by Carey and Burgess (1999), "the hospital level of analysis is too general to be capable of revealing variation in quality as measured by rate-based adverse events".[2] This suggests that hospital-level estimates may be too broad and incapable of describing the effectiveness achieved by the different structures operating within the same organization.[3] Hence, computing outcomes at the hospital level may lead to biased – or at least uninformative – estimates of the trade-offs' magnitudes and signs.

The analytical structure used in this paper is related to the earlier work of Carey and Burgess (1999), Deily and McKay (2006) and, most specifically, McKay and Deily (2008). Carey and Burgess (1999) study

* Corresponding author. Tel.: +39 0352052342.
E-mail address: gianmaria.martini@unibg.it (G. Martini).

[1] For instance Coulam and Gaumer (1991) show that in the US the introduction of PPS led to a reduction in patients' LOS, an indicator that may be regarded as a signal of the quality of care received during hospitalization.

[2] See Carey and Burgess (1999), p. 519.

[3] For instance, in the same hospital a ward (e.g., cardiology) may achieve very good performance, while another one (e.g., orthopedics) may perform badly.

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the relationship between cost and quality on a sample of US Department of Veterans Affairs hospitals during the period 1988–93. They show a positive trade-off between costs and quality. McKay and Deily (2008) examine in the context of U.S. acute care hospitals a variety of relationships involving cost inefficiency and health outcomes. The authors hypothesize that, holding constant other factors, cost inefficiency itself may be a determinant of health outcomes at the hospital level. Whereas costs per se may be positive contributors to good outcomes (working through higher levels of productive inputs, most obviously), cost inefficiency is unlikely to be productive of good health. The policy relevance of such a distinction is clear, since intervention efforts to control cost inefficiency may be very different in nature than interventions directed toward controlling the level of total costs associated with efficient use of inputs.[4] The authors find no consistently strong impacts of cost inefficiency on health outcomes, where the particular health outcomes of interest are inpatient mortality and inpatient complications.

While related in some ways to the Deily–McKay (DM) work, the analytical approach used in this paper is somewhat different. First, we estimate risk-adjusted measures of health outcomes starting from administrative data covering all the relevant population and not a sample of it. In contrast, DM employ estimates of health outcomes provided by a private health care information company, Solucient.[5] Second, DM do not utilize a multilevel model for estimating health outcomes and, hence, do not take into account the hierarchical structure of the data. Third, DM estimate both health outcomes and efficiency at the aggregate hospital level. Hence, they analyze each health organization without taking into account that this aggregate level is not able to provide a picture of the complexity of both health outcomes and efficiency scores within hospitals. Our data permit a more detailed analysis in which estimation is at the hospital ward level. Fourth, we estimate hospital efficiency through a production function and not a cost function. The latter may produce biased estimates to the extent that measured input prices do not reflect true prices (for DM, they are taken from balance accounts). Production function estimates are instead based on observed input data. Finally, our estimated trade-offs are able to control for the impacts of exogenous variables and ward effects.

In the first stage we estimate hospitals' effectiveness in achieving health outcomes. This means measuring changes in the patients' health status. In general, evaluating hospital performance in terms of effectiveness involves investigating improvements across a very broad range of indicators, varying from Quality Adjusted Life Years (QALY) to lower mortality rates. These improvements are achieved through the provision of health services (Donabedian, 1988) during hospitalization. Since patients' characteristics and hospitals' procedures may affect changes in the health status, risk-adjusted methods are widely adopted in the literature (Goldstein and Spiegelhalter, 1996). As shown by Goldstein (2003), in evaluating hospitals' effectiveness, multilevel models are more appropriate since patients are nested within health structures and the corresponding data have strong hierarchical relationships. We apply a multilevel model to individual data, and estimate hospitals' effectiveness at the ward level. We consider two indicators: mortality rate (MR) and readmission rate (RA).[6]

In the second stage we measure hospitals' efficiency. This means evaluating the performance of a productive unit, i.e., the ratio among outputs and inputs (or among costs and production). In this paper we focus on technical efficiency, i.e. a production function frontier. The latter is estimated using a stochastic frontier (SF) model (Aigner et al., 1977), whose estimates allow one to distinguish between failures in achieving the maximum feasible output level due to managerial inefficiency from those due to random shocks. SF models have been widely applied to measure hospitals' efficiency.[7] We apply a SF model to data on hospitals' inputs and outputs, and estimate hospitals' efficiency scores at the ward level. Furthermore, we analyze two output measures: (1) yearly number of discharges and (2) yearly revenues. In Lombardy, hospitals' revenues are given by the DRG tariff that the regional government sets at the beginning of each year for each discharge in a specific DRG. More complicated DRGs receive higher tariffs. Hence revenues take into account the differing complexity of treatments when assessing hospital technical efficiency.

Finally, in the third stage we provide some empirical evidence on the presence, the sign, and the magnitude of a trade-off between efficiency and effectiveness controlling for hospitals' characteristics (ownership, specialization, teaching), spatial variables, ward effects, and the interaction effects among these variables.

An important innovation of this paper is the inclusion of hospital competition in the analysis. Tay (2003) points out that the irrelevance of money prices in the choice of a specific hospital by a consumer (in Lombardy the consumer does not directly pay for a hospital treatment, since it is covered by the national health system) makes competition among hospitals mainly focused on location, i.e., horizontal product differentiation based on travel or time costs. Taking this perspective, Propper et al. (2004, 2008) have examined the impact of hospital competition on hospitals' mortality rates for patients with Acute Myocardial Infarction (AMI) in the UK in the 1990s. They find that competition has a negative impact on health outcomes measured by mortality rates. Kessler and McClellan (2000) also investigate patients affected by AMI in the US over the period 1985–1994 and find that hospital competition has instead a beneficial effect on mortality rates. These contributions measure competition through distance but they do not compute travel times. Unlike the present paper, these authors use fixed boundaries for the hospital's catchment areas and straight-line distances. Distances in our work are computed without imposing exogenous boundaries and are measured through the available road network; we believe that these more accurate travel times provide a more appropriate measure of hospitals' competition in the Lombardy context. Another dimension of hospitals' competition is through vertical product differentiation (quality), as suggested by Tay (2003): as a proxy for this variable we consider the percentage of patients admitted in regional hospitals but living outside the region, i.e., those patients who incur in higher mobility costs in their care seeking. The intuition is that the attraction of patients living at greater distances is a signal of hospital's reputation. Such measures have not been considered in previous studies.

The paper is organized as follows. In Section 2 we briefly describe the regional hospital sector in Lombardy and the main features of the regional DRG regime. In Section 3 we specify the empirical strategy, while the main features of the data set are described in Section 4. The empirical results are presented in Section 5, while the main conclusions are highlighted in Section 6.

2. The hospital sector in Lombardy

Major reforms affecting the hospitals operating in Lombardy were introduced in 1997. Since then, all hospitals satisfying some requirements compose the so-called mixed market hospital sector, including public, private not-for-profit and private for-profit hospitals. The organizations belonging to this mixed market receive a predetermined

[4] The authors utilize panel data from 1999 to 2001 on approximately 3000 hospitals to estimate what are, in essence, health production function models in which health outcomes are specified to depend on standard risk adjusters (e.g., severity, volume) as well as on a measure of cost inefficiency. The cost inefficiency measure is estimated using translog stochastic frontier cost function models.

[5] The latter collects data from patients covered by Medicare Cost Reports. Hence their measures of risk adjustment do not characterize the whole population.

[6] The literature emphasizes that health outcomes can be measured in different ways. At the hospital level, examples include in-hospital mortality rates, 30-day post-discharge mortality rates, complication rates, failure-to-rescue rates, post-surgical adverse events, and infection rates (Encinosa and Bernard, 2005; Kovner et al., 2002; Mukamel et al., 2001; Seshamani et al., 2006; Thornlow and Stukenborg, 2006). Another approach is to measure health outcomes such as mortality rates or complication rates for specific types of procedures or diagnoses (Birkmeyer et al., 2002; Needleman et al., 2002). We focus on total mortality rates, i.e., the sum of in-hospital and 30-day post-discharge mortality rates. Furthermore, we concentrate on post-surgical adverse events (i.e., readmissions).

[7] For reviews of studies using stochastic frontier analysis in the health care sector, see Hollingsworth (2003) and Rosko and Mutter (2008).

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