



# Analysis of hospital technical efficiency in China: Effect of health insurance reform

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## ABSTRACT

This paper investigates the regional hospital efficiency in China during the 2002–2008 period, especially for how the health insurance reform of New Rural Cooperative Medical System (NRCMS) impacts on efficiency. Adopting the non-parametric technique of data envelopment analysis (DEA) to handle the feature of multiple outputs and undesirable outputs in the hospital industry, empirical estimates indicate that hospital efficiency is moderate that increased slightly from 0.6777 to 0.8098 during the sample period. However, it ranges widely from 0.396 to 1 across provinces. The regression analysis on examining determinants of efficiency suggests that a higher proportion of for-profit hospital and high quality hospital is helpful to enhance technical efficiency. We find a negative relationship between government subsidy and efficiency for coastal regions. While technical efficiency varies considerable across provinces, there is no significant difference between coastal and non-coastal regions being found, after controlling for other variables. Crucially, the medical reform of NRCMS overall has a significant efficiency-enhancing effect, particularly for non-coastal regions, *ceteris paribus*. It highlights the effectiveness of NRCMS on promoting medical service accessibility for rural residents.

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## 1. Introduction

The goal of a medical service system is improving the health and alleviating the inequality of medical resources across regions. As countries allocate more resources toward medical service, health policy authorities are becoming increasingly concerned with the performance of medical services. This issue is particularly relevant to China, which is one of the largest economies in the world in terms of area and population. After implementing the open policy in the early 1980s, China has experienced spectacular and persistent economic growth, leading to a significant improvement in the living standards and average income. It consequently induces increased demand for medical services. Therefore, hospitals, which are the main providers of medical service, are facing immense pressure for improving the quality and efficiency of service.

One of the prerequisites for implementing any medical system and effectively utilizing medical resources is to determine the “technical efficiency” (TE). Existing hospitals can aim to improve their TE by achieving better results (outputs) with minimal costs (inputs). In 2002, the Chinese government spent only 5.42% of the GDP on healthcare, which was lower than that of other developing countries with the same per capita GDP, while it increased the funding for medical care by as much as 1–1.5% of the GDP in the consequent years. However, the medical resources were not evenly distributed between the coastal and non-coastal regions of China. How vastly does the relative efficiency of the medical system differ across regions, and what causes this difference? It is important to evaluate the hospital efficiency in each region so that the government can modify the medical care

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program accordingly to increase hospital efficiency and sustainability. However, to our best knowledge, few studies have evaluated the TE of China's regional hospital industry, inspiring the main concern of this study that analyzes the TE and its determinants of the regional hospital sector in China.

Corresponding to the transition of the economic system, China has reformed the social security system several times to reduce the inequality between urban and rural areas, aiming to provide a healthy medical system for the rural population (Bloom & Gu, 1997). As a part of the evolution of the healthcare system during the past three decades, one major reform was the initiation of the New Rural Cooperative Medical System (NRCMS) in 2003, which aims to provide healthcare to the low-income people, especially to those who live in rural areas and cannot afford high medical costs. If this reform can effectively grant more rural residents access to hospital services, more patients can obtain appropriate medical treatments with the existing medical facilities and physical technicians, thus increasing the hospital efficiency in each region. It is important to evaluate whether this reform significantly contributes to improving hospital efficiency. Specifically, this reform rendered provincial and county governments responsible for providing medical care and provided basic salaries for medical personnel. Therefore, understanding the evolution of hospital efficiency and its determinants is particularly crucial for provincial governments from the perspectives of health and fiscal policies.

Data envelopment analysis (DEA), the non-parametric programming method introduced by Charnes, Cooper, and Rhodes (1978), is a useful and appropriate tool and has been used to estimate hospital efficiency, because it has some key advantages compared with the parametric technique.<sup>1</sup> It can handle not only multi-outputs and multi-inputs production frontier, but also be free of behavioral assumption of profit maximization and/or cost minimization. Most hospitals in China are state-run that are required to achieve particular social ends, such as increasing the number of served patients and life expectancy, and decreasing the number of deaths caused by disease. As the hospital industry is an application field with a specific context and characteristics such as health outcomes (health improvement) are hard to directly measure<sup>2</sup>; in this study, multiple outputs DEA has been used to evaluate the relative efficiency of hospital operation across regions. However, are more outputs (such as outpatients and inpatients) really better? The expansion of hospital outputs, such as admissions of outpatient visits and utilization of circulating beds, may luster the efficiency score, but it is probably driven by the supply side moral hazard. Therefore, a growing line of studies on evaluating hospital efficiency has taken this problem into account, e.g. Clement, Valdmanis, Bazzoli, Zhao, and Chukmaitov (2008) and Hollingsworth (2008). In China, most hospitals are non-for-profit hospitals and they are required to serve patients as more as possible. The expansion of hospital outputs may be accompanied by an undesirable output – patient mortality. That is, there is undesirable output in the hospital production function. A high rate of patient mortality not only signals a bad reputation and low medical quality, but also is apt to cause medical disputes and litigations. Moreover, it is unacceptable by people to see their families pass away in hospitals since life is invaluable to everyone. Specifically, in Chinese tradition, the belief of “treating patients as families” was taught as one of essential ethics in medical education, leading to the fact that most doctors regard rescuing patients from fatal injury or disease as their primary mission. Thus, hospitals dislike patients to pass away in hospitals, suggesting that patient mortality can be treated as an undesirable output caused by moral hazard.

This paper aims to evaluate the hospital efficiency in 30 province-level units in China during 2002–2008, attempting to contribute to the existing literature by providing the following four distinct types of empirical evidence. This is one of the first studies to evaluate the efficiency of China's regional hospital sector. Recently, the demand for medical services kept surging, and provincial governments managed and subsidized medical services; therefore, this province-level analysis can provide a complete picture on the relative hospital efficiency across regions. Further, the empirical analysis on the determinants of efficiency can lend insightful implications for health authorities. Second, previous studies on evaluating China's regional medical service efficiency adopt production function considering only one output, preventing them to fully characterize the multiple dimensions of human health. The analysis is based on the DEA approach to incorporate multiple outputs and considers for the undesirable output in hospital operation. Empirical results facilitate a better understanding of the relative technical efficiency score in the regional hospital sector. Third, dynamics of the regional hospital efficiency score drawn from this study can be used to evaluate the effectiveness of the medical care system reform implemented in 2003. The inequality of medical sources between the coastal and non-coastal regions of China is a topical and serious social problem that arises from the previous development strategy that favored the coastal regions. This study also evaluates the relative effectiveness of NRCMS between coastal and non-coastal regions. Finally, this study compares the hospital efficiency between coastal and non-coastal regions and evaluates the dynamics of their relative efficiency.

The remainder of this paper is organized as follows: Section 2 briefly introduces the development of the regional health system in China and reviews related literature. Section 3 discusses the methodology of DEA that includes the undesirable output, followed by the dataset used in this study. The empirical estimates of TE are presented and discussed in Section 4. In Section 5, we examine the influences of environmental factors on the efficiency of the regional hospital sector, especially on the impact of NRCMS. Then, we proceed with a comparative analysis on potential differences in determinants of hospital efficiency between coastal and non-coastal regions in Section 6. Concluding remarks and policy implications are summarized in the final section.

<sup>1</sup> Emrouznejad, Parker, and Tavares (2008) provided an extensive review on studies using DEA, including evaluating hospital efficiency, over the 1978–2007 period.

<sup>2</sup> Dlouhy (2009) pointed out that the causality between the input and output of healthcare is not always certain. More importantly, in addition to the efficiency of healthcare, equity and morality are 2 additional concerns of the government and the residents.

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