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Japanese surgeons' productivity change after the revision of surgical fee schedule[☆]

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HIGHLIGHTS

- This is the first study that evaluated the surgeons' productivity change using the Malmquist model before and after the revision of surgical fee schedule in Japan.
- Surgeons maintained their productivity before and after the revision of fee schedule implemented on April 1, 2014.
- Surgeons' percent change of efficiency was significantly positive while that of technique was significantly negative.
- These results suggest that surgeons performed surgery more efficiently to compensate for their reduced reimbursements.

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ABSTRACT

The goal of this study is to evaluate Japanese surgeons' productivity change before and after the revision of fee schedule.

We focused on the revision of fee schedule that was implemented on April 1, 2014. We analyzed all the surgical procedures performed from April 1 through September 30 in 2013 and 2014 at Teikyo University Hospital. Non-radial and non-oriented Malmquist model under the constant returns-to-scale assumptions was employed. Inputs were defined as the number of medical doctors who assisted surgery, and the time of surgical operation from skin incision to skin closure. The output was defined as the surgical fee for each surgery. We computed each surgeon's natural logarithms of Malmquist index, efficiency change and technical change.

We analyzed 5,315 surgical procedures performed by 108 surgeons. The productivity change was not significantly different from 0 ($p = 0.230$). However, the efficiency change was significantly positive ($p = 0.041$) while the technical change was significantly negative ($p < 0.0001$).

Surgeons' productivity did not significantly change after the revision of fee schedule because surgeons performed surgery more efficiently to compensate for their reduced reimbursements.

1. Introduction

The Japanese health care system has had universal health insurance for more than half a century. Most health care providers are reimbursed on a fee-for-service basis according to the fee schedule that set prices uniformly at the national level. The same fee schedule is enforced for all plans and almost all health care providers. The services covered and the fees set for physicians and hospitals have been uniform across nation since 1959 [1]. This nation-wide uniform fee schedule has been revised every

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two years at Central Social Insurance Medical Council. Japan ranks third in the world in gross domestic product only after the United States and China [2], and is the largest economy in the world with the nation-wide controlled price system for health care which the United States and China do not have. Although the revision of its fee schedule has an enormous impact on daily clinical practices throughout Japan, there have been no studies that quantitatively evaluated clinical productivity change before and after the revision.

Malmquist index (MI) represents productivity change of a decision making unit (DMU) between two time periods under dynamic situation, and is an example of comparative statics analysis [3,4]. It is based on data envelopment analysis (DEA), which evaluates relative efficiency of DMUs against the efficient frontier under static conditions in a single period. By comparing DEA results between two time periods, MI can divide productivity change into two components, one measuring efficiency change (EC) and the other measuring technical change (TC) [5]. The MI models have been used to assess productivity change in a variety of sectors such as agriculture, airlines, banking, electric utilities, insurance companies, public sectors and health care [4,5]. The goal of this study is to compute surgeons' productivity change before and after the revision of surgical fee schedule, and to evaluate the impact of the revision on their productivity.

2. Material and methods

The Teikyo University Institutional Review Board approved our study.

2.1. Data

Teikyo University Hospital is located in metropolitan Tokyo, Japan, serving a population of ∼1000,000. It has 1152 beds and has a surgical volume of approximately 9000 cases annually. It has thirteen surgical specialty departments. We collected data from all the surgical procedures performed in the main operating rooms of Teikyo University Hospital from April 1 through September 30, 2013 (Period 1) and those from April 1 through September 30, 2014 (Period 2). We extracted the necessary information from surgical records in the Teikyo University Hospital electronic medical record system.

Exclusion criteria for surgery were as follows. First, surgical procedures performed under local anesthesia by surgeons were excluded. Oral, dermatologic and ophthalmologic surgical procedures were excluded because most of their cases were minor surgeries performed under local anesthesia without anesthesiologists' involvement, and those under general anesthesia do not represent the activity of their surgeons. Second, the surgical procedures were excluded if the patients die within one month after surgery to maintain a constant quality outcome of surgery. Third, the surgical procedures which were not reimbursed under the surgical payment system in 2013 and 2014 were excluded. Fourth, the surgical procedures were excluded if their records were incomplete for any reason.

2.2. Analysis framework

We employed non-radial and non-oriented Malmquist model under the constant returns-to-scale assumptions, which was particularly relevant because of its ability to employ multiple inputs and outputs simultaneously [6]. In this analysis, we focused on the surgeons' activities and their clinical decisions. We defined the DMU as a surgeon with the highest academic rank that scrubbed in the surgery. All the inputs and outputs are under the control of a DMU. Inputs were defined as (1) the number of medical doctors who assisted surgery (assistants), and (2) the time of surgical operation from skin incision to skin closure (surgical time). The output was defined as the surgical fee for each surgery. It is classified as K000–K915 in the Japanese surgical fee schedule and is called "K codes". Each surgical procedure is assigned to one of the K codes which correspond with surgical fees. The fee is identical regardless of who (a senior surgeon or a surgical trainee) performs surgery as long as they have medical licensure, how many assistants they use, or how long it takes to complete surgery [7,8]. Other fees for blood transfusion, medications, special insurance medical materials and anesthesia were excluded. The monetary values of surgical fees were originally expressed in the Japanese yen, and were converted to U.S. dollars at $1 = 100 yen to facilitate understanding by international readers.

We focused on the revision of fee schedule that was implemented on April 1, 2014 [7,8]. In this revision, emergency surgery that was performed out of regular hospital hours and on holidays and late nights was more highly reimbursed than in 2013. However, the fees for surgeries such as Caesarean section and thoracoscopic partial resection for lung malignant tumor were reduced in 2014. Coincidentally, the Japanese government increased consumer tax from 5% to 8% on the same day. This tax increase does not influence either the reimbursements from Health Insurance Claims Review & Reimbursement Services to the hospital or patients' out-of-pocket payments. However, it affects the prices paid by the hospital to purchase medical supplies, pharmaceuticals and so on. The overall effects of this revision of fee schedule are unknown [9]. Therefore, we studied in the following two periods; April–September, 2013 (Period 1) and April–September, 2014 (Period 2).

We added all the inputs and outputs of the surgical procedures for each DMU during these study periods, and computed his/her Malmquist Index (MI), efficiency change (EC) and technical change (TC) using DEA-Solver-Pro Software (Saitech, Inc., Tokyo, Japan) [4]. All the surgeons in the sample were given an MI, EC and TC for each [10]. In order to more easily interpret these results, we took the natural logarithms of the MI, EC and TC, which allow us to interpret them as percent changes [11]. The natural logarithm of MI >0 indicates progress in productivity of the DMU from Period 1 to 2, while that of MI $=0$ and MI <0 respectively indicate the status quo and deterioration in the productivity. Similarly, a natural logarithm for EC and TC measure of greater than 0 implies that there is efficiency progress and frontier technology progress, respectively. The natural logarithm of MI equals the sum of natural logarithm of TC and that of EC [11].

All the surgeons analyzed were employees of Teikyo University, and were salaried according to their ranks and experiences. The hospital charges surgeons' surgical fees to Health Insurance Claims Review & Reimbursement Services, and the reimbursement becomes the revenue of the hospital [7,8]. It pays to surgeons their salary from this revenue. The surgeons analyzed in this study belong to one of the following ten surgical specialty departments; cardiovascular surgery, emergency surgery, general surgery, neurosurgery, obstetrics & gynecology, orthopedics, otolaryngology, plastic surgery, thoracic surgery and urology. We compiled their natural logarithms of MIs, ECs and TCs in their surgical specialties, and calculated their means and standard deviations. We excluded from our analysis the surgeons who performed surgery in only one of these two periods.

3. Theory/calculation

3.1. Malmquist index

Malmquist Index (MI) is defined as the product of EC and TC terms. The EC term relates to the degree to which a DMU improves