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To Evaluate the Efficiency of Medical and Health Expenditure in 21 Cities of Guangdong Province

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Abstract

Great achievements have been made in China's economic development. While the people's living standards have been greatly improved, people's livelihood issues have also drawn increasing attention, especially the issue of medical care and health security, which is related to the people's well-being. In this paper, DEA-Malmquist model is used to calculate the efficiency of health financial expenditure in 21 prefecal-level cities of Guangdong Province in China. The results show that the efficiency of medical financial expenditure of all cities in Guangdong province has not reached the effective level, and the efficiency gap is small.But thanks to new health reform policies since 2009, all cities have improved the efficiency of medical and health expenditure.

Keywords

Medical and health expenditure, DEA-Malmquist model, efficiency, public sector.

1. Introduction

As China's population aging trend is strengthening and the economic level is improving day by day, people have put forward higher requirements for the level of medical and health services. Since the reform of the medical and health system was launched in 1985, the central and local governments have increased their financial investment in the medical and health system in China. For Guangdong province, from the new medical reform in 2009 to 2017, the new medical reform fiscal health care spending rose from 25.285 billion yuan to 140.751 billion yuan, the proportion of expenditure in the general budget expenditure of Guangdong Province increased from 4.9% to 8.9%. However, even though the scale of expenditure keeps rising, the phenomenon of "difficult and expensive medical treatment" is still prominent, and the efficiency of medical and health expenditure of all regions in Guangdong province needs to be improved. In addition, from the perspective of distribution, the scale and efficiency of the government's medical and health expenditure vary greatly among regions.

In the international context, China's reform and opening up have been deepening, and people's cross-border exchanges have become more frequent, posing greater challenges to the prevention and effective control of infectious diseases. From the outbreak of SARS in 2003 to the COVID-19 in 2020, the public health crisis has seriously jeopardized the physical and mental health of the people and caused huge economic losses. As the frontier platform of China's opening up and exchange, Guangdong province is facing a more serious situation.

Therefore, it is very important to analyze the financial expenditure efficiency of medical and health care in 21 prefecture-level cities of Guangdong province and put forward suggestions accordingly. To this end, this paper attempts to use the Malmquist productivity change index model method to study the panel data of 20 prefectural cities in Guangdong province from 2009 to 2018 to test the efficiency of medical and health expenditure in Guangdong province, so as to gain an in-depth understanding of the efficiency and existing problems of medical and health expenditure in Guangdong province and provide reference and basis for further improving the efficiency level.

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2. Literature Review

2.1. English Idioms

As for the research on the efficiency of medical and health expenditure, parametric and nonparametric analysis methods are relatively mature in english idioms.

Representative, Kim et al. (2013) calculated the impact of government health expenditure on the level of health represented by infant mortality and life expectancy at birth in 17 OECD countries from 1973 to 2000. Sanjeev Gupta and Marijn Verhoeven(2001) used the borderless analysis (FDH) in the non-parametric method to calculate the efficiency of government health expenditure in 37 African countries from 1984 to 1995. Foreign medical and health research attaches importance to the efficiency of results--the efficiency of output, which is mainly expressed by the level of health, and measured by life expectancy, infant mortality rate, the incidence of infectious diseases legally reported in Category A and B. The research conclusions generally indicate that the efficiency of government expenditure varies significantly among countries.

2.2. Chinese Idioms

In China, non-parametric data envelopment (DEA) is mostly used for research, and there are mainly two methods for the selection of output input indicators.

One is to take the local government's medical and health expenditure as the only input, and take the number of beds, health technicians and health institutions as the output indicators, such as Zhang Shuo (2014), Li Yufang(2015), et al.

The other is to take the medical and health resources, such as the number of medical institutions, the number of health technicians and the number of beds, as input indicators, and the utilization rate of medical resources, such as the use of hospital beds, outpatient visits and the number of discharged patients, as output results. (Niu Shuai et al., 2016;Li Wenhui et al., 2011;Jin Rongxue et al., 2012).

According to the research results, there is a consensus that there are significant regional differences in the efficiency of health expenditure of local governments in China (Chen Shiyi et al., 2008;Zhang Zhongfang, et al., 2013), but there is no consistent conclusion on the efficiency of the central, eastern and western regions.

3. Methodology

3.1. Basic Content of the DEA-Malmquist Model

DEA method was proposed by Charnes et al., a famous American operational research scientist, in 1978. It is a nonparametric research method to evaluate the relative effectiveness of decision making units (DMU) with multiple inputs and multiple outputs. Malmquist index was first put forward by Malmquist in 1953. It was introduced into the field of productivity research by caves et al., and then further developed by far and used with DEA model. DEA-Malmquist model index is generally used for the production and operation performance of decision-making units with multiple inputs and outputs, and mainly reveals the productivity changes through the changes of Effch index and Techch index. This method can use the following gradient model to calculate the efficiency :

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$$M(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{E^{tU(t+1)}(x^{t+1}, y^{t+1})}{E^{tU(t+1)}(x^t, y^t)} = \frac{E^{t+1}(x^{t+1}, y^{t+1})}{E^t(x^t, y^t)}\left(\frac{E^{tU(t+1)}(x^{t+1}, y^{t+1})}{E^{t+1}(x^{t+1}, y^{t+1})} * \frac{E^t(x^t, y^t)}{E^{tU(t+1)}(x^t, y^t)}\right) = EC * TC \quad (1)$$

As shown in formula 1, (x^t, y^t) and (x^{t+1}, y^{t+1}) are the input-output relationship of stage t and stage t+1 respectively, EC is the efficiency change, and TC is the technology change. In this paper, the efficiency of medical and health financial expenditure in 21 cities of Guangdong province was calculated by DEAP2.1 software.

In summary, the result after the decomposition of Malmquist index is expressed by formula as: Tfpch=Techch* Effch= Techch *Sech* Pech. When the result of Tfpch index is greater than or equal to 1, it indicates that the government's medical and health expenditure is effective and the overall level of government's medical and health investment performance is high; on the contrary, when the result of Tfpch index is less than 1, it indicates that the government's medical and health expenditure is invalid and the overall level of government's medical and health investment performance is low.

3.2. Data and Indicator Descriptions

In this paper, the input and output indicators used are shown in the table 1. The data are from Statistical Almanac of Guangdong Province and Health Statistical Almanac of Guangdong Province from 2009 to 2019.

Table 1: Input and output indicators data

Indicator categories	Selected indicator
Input indicators	Medical and health expenditure
Output indicators	Number of hospital beds per thousand
	Health technicians per thousand
	Number of medical and health institutions
	Major infectious diseases rate
	Maternal mortality rate

4. Conclusion

4.1. Static Analysis of DEA-Malmquist Model Results

This paper calculates the financial expenditure efficiency of medical and health expenditure in 20 cities in Guangdong province from 2009 to 2018 through the DEAP2.1 software.

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Table 2: The average M index and its decomposition in 20 cities from 2010 to 2018

Area	City	Effch	Techch	Pech	Sech	Tfpch
Middle	Guangzhou	1.043	0.859	1	1.043	0.896
	Zhuhai	1	0.86	1	1	0.86
	Foshan	0.98	0.869	0.988	0.992	0.852
	Shaoguan	0.987	0.876	1	0.987	0.865
	Dongguan	0.949	0.849	1	0.949	0.806
	Zhongshan	1	0.866	1	1	0.866
East	Shantou	1.031	0.903	0.997	1.035	0.931
	Heyuan	1.023	0.857	1.016	1.006	0.876
	Meizhou	0.97	0.851	0.99	0.98	0.826
	Huizhou	0.961	0.885	1	0.961	0.851
	Shanwei	0.996	0.825	1	0.996	0.822
	Chaozhou	1	0.854	1	1	0.854
	Jieyang	0.984	0.856	0.981	1.003	0.843
West	Jiangmen	1.023	0.846	1.02	1.004	0.866
	Yangjiang	1.003	0.877	1.003	1.001	0.88
	Zhanjiang	1.024	0.857	0.992	1.032	0.878
	Maoming	1.007	0.852	1	1.007	0.859
	Zhaoqing	1.009	0.857	1.001	1.008	0.864
	Qingyuan	1.026	0.862	1.007	1.019	0.884
	Yunfu	0.992	0.864	1.003	0.989	0.857

From the perspective of the whole province, the average annual malmquist index of all cities is lower than 1, and the average is 0.862, indicating that the government's medical and health expenditure has not reached the effective state. The gap of total factor productivity among cities is small, so the medical and health expenditure generally has low efficiency. It can be seen from the table 2 that this is mainly reason the low value of Techch index, but from the regional perspective, the reasons for the low value of technical efficiency vary from regions.

In the central region, the economy of each city is relatively developed, and the financial investment in medical and health care is large and growing constantly, and the scale effect is decreasing. In addition, the emphasis on distribution and the neglect of management leads to the low utilization of medical financial expenditure. However, east and west of Guangdong are economically underdeveloped, and capital utilization efficiency is low due to the shortage of capital and talent shortage due to geographical location and economic conditions.

4.2. Dynamic Analysis of DEA-Malmquist Model Results

We can get the 2010-2018 M-index trend of 20 cities in Guangdong province through Stata software.

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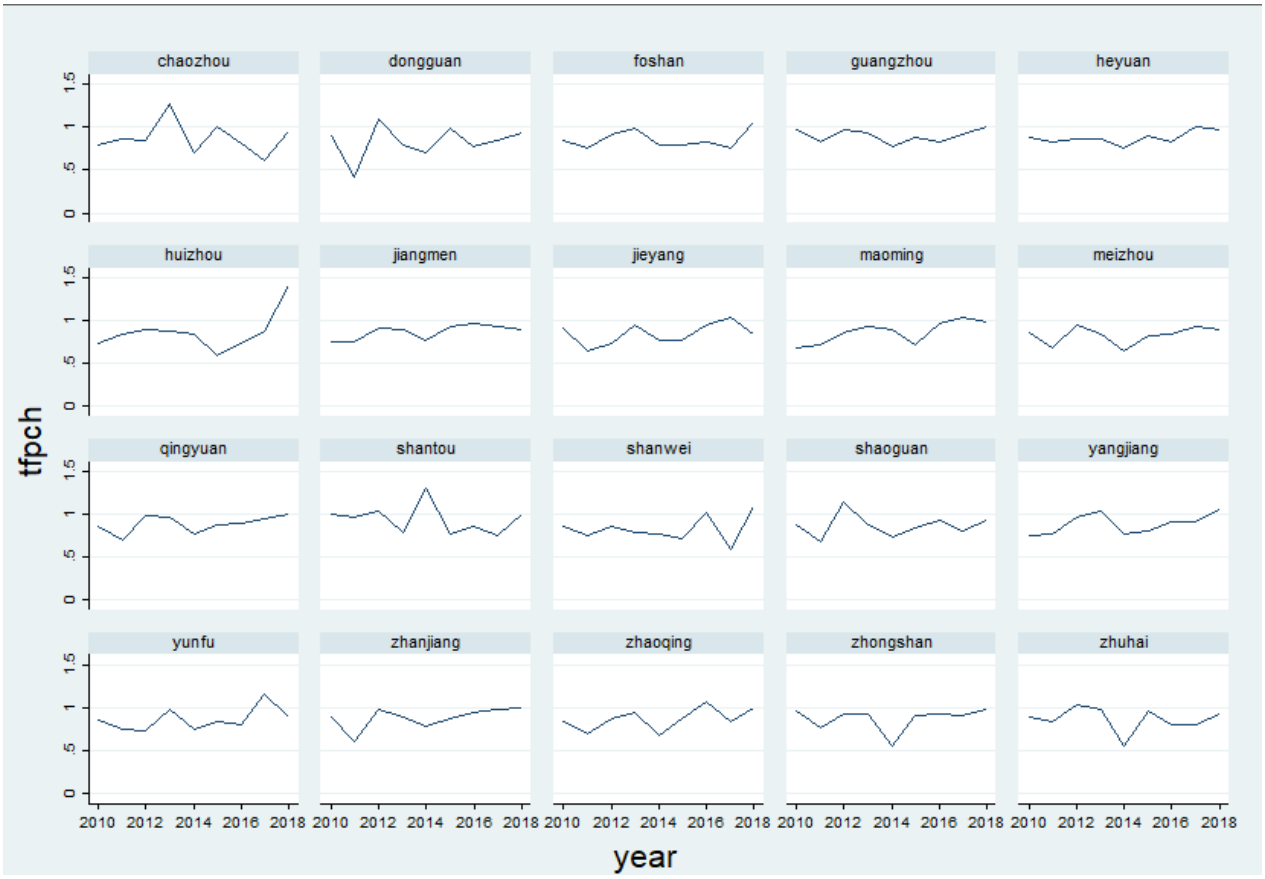

Figure 1: The trend of M-index's changing in 20 cities of Guangdong Province from 2010 to 2018

As shown in the figure1, Foshan, Guangzhou, Heyuan, Jiangmen, Jieyang, Maoming, Meizhou, Qingyuan, Yangjiang, Zhangjiang, the changes of these ten cities are relatively gentle from 2010 to 2018. The Malmquist index of the ten cities, Chaozhou, Dongguang, Huizhou, Shanwei, Shaoguan, Yunfu, Zhaoqing, Zhongshan and Zhouhai, has a large change range in each year.

Except Shantou, Zhuhai and Zhongshan, the Malmquist index of other cities is on the rise. This is mainly reason that the new medical reform plan has been well implemented since 2009. For the first time, the basic medical and health system was provided as a public product, which greatly alleviated the problem of people's "difficult and expensive to see a doctor". Otherwise the main theme of the medical reform in 2014 was mainly focused on the compensation mechanism, medical service price adjustment, and profit seeking behavior of medical institutions, which was committed to improving the quality of medical and health services. Practice has proved that a series of medical reform programs from 2009 to 2018 have achieved good results in practical application.

5. Conclusion

Either the weak financial input or the neglect of the management of medical financial funds, the efficiency of medical financial expenditure of all cities in Guangdong Province has not reached an effective state, and the efficiency gap among the central, western and eastern regions is small. However, thanks to the new medical reform policy since 2009, the efficiency of medical and health expenditure in all cities has improved. Therefore, Guangdong Province should continue to strengthen innovation and promote medical reform. The low value of the Techch index indicates that its technological innovation level is relatively backward and there is a large room for improvement. In addition, we should pay attention to the balance of medical and health

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expenditure among regions, enhance the marginal effect of medical and health expenditure, and promote the equalization of basic public services.

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