RESEARCH ON EFFICIENCY OF CHINESE MEDICAL HEALTH SERVICES – BASED ON ANALYSIS OF C-D PRODUCTION FUNCTION

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Abstract

The article analyzes Chinese medical health service efficiency based on Cobb - Douglas production function to establish Chinese medical health services production function. Then the article reveals Characterization of Chinese health services and analyzes technology efficiency of Chinese 31 provinces and cities. After that, the article puts forward relevant policy suggestions.

Keywords: Health Service, C-D Production Function, Efficiency

Introduction

A key element of public policy is the promotion of good health in order to attain broad based economic growth. Base on this paradigm, many countries devote huge budgetary allocation to health, but in most developing countries especially, this huge health expenditure failed to translate into better health status.

China's health reforms has lead a through and arduous road For decades. From 2005 to 2009, state financial input has increased by a substantial margin from 468.56 billion yuan to 155.25 billion yuan , accounting for the proportion of total health expenses also rising from 17.93% to 27.23%.But the problems of difficult access to and costly medical services are still outstanding. How to use scarce medical resource to play a greater efficiency is always a hot issue in the society. With the new medical reform policy introduced, basic medical and health system is established, the equity of health service has gradually increased, and the medical and health service efficiency has been plagued by health departments. In 2009 the Chinese

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council has issued files *deepening medical and health reform* and *the health reform program (2009-2011)*. In these files government requires medical and health institutions to pay close attention to efficiency, this means that the government has regarded efficiency as one of the major criteria for medical reform success or not. The article has taken advantage of Cobb - Douglas production function to explore China's medical service efficiency and characteristics. Some researchers have carried out studies on efficiency of medical services. For instance ,Ersoy(1997), Zhang Lulu(2000), Vivian Valdmains(2004), Miika Linna, et al(2005),Retzlaff-Roberts(2004), Ningyan and Renran (2005) , more recently Zhang Ruihua et al(2011). Most of these studies focus efficiency of hospitals. Those on medical services of state have carried out based on data envelopment analysis or other models, neglecting C-D production Function.

Literature Review and Theoretical Framework

Literature Review

Theory of Efficiency

The first systematic study of technical efficiency theory is a British economist Farrell of the University of Cambridge (1957).He pointed that technical efficiency reflected maximum output capacity under the established input, namely the production possibility frontier. So he defined technical efficiency definition: " Technical efficiency refers to produce a certain amount of products required minimum cost percentage in accordance with the established factor input proportion under the same production technology and market price ". Leibenstein (1966) defined technical efficiency from the perspective of outputs. He pointed that technical efficiency was the percentage of actual output accounting for maximum output under the same investment and market. Whitesell (1994) noted that economic efficiency was an economic body productive capacity under the established production goal.

Efficiency of medical health services

Some researchers have defined efficiency of medical health service. Li Shaodong (2006) noted medical service efficiency was effectiveness of resources in the field of medical services, which were investment from society resources. Wang Yun (2007) believed that medical health service efficiency was health service system optimization of output, under the limited health resources. While some other researchers have carried out studies on hospital efficiency. Donald (1987) has taken a research on 166 hospitals having 23 to 1070 beds in New York in 1981,in order to investigated the economics scale of hospitals. Chirikos (1999) has taken advantage of the stochastic frontier cost functions to analyze 186 hospitals productivity efficiency in Florida from 1952 to 1993 years, the result showing the 15%.hospital inefficiency. Bryce and Engherg (2000) have made the use of the stochastic frontier cost model to analyze hospital efficiency and result has indicated that some differences value between the different models due to different distribution , but their rank are essentially the same. So Bryce and Engherg drew a conclusion that when assessing the efficiency of hospitals, the result were essential same although different model. Although in most of the studies hospitals efficiency are concerned , they have failed to analyze the national health service efficiency .

Theoretical Framework

Cobb - Douglas production function is proposed by mathematician Cobb and Douglas in the nineteen thirties. Cob Douglas production function is considered to be a very useful production function, because this function to its simple form with what economists care about nature, which will have certain significance in the economic theory analysis and application. The function is used to predicting production and development of national and regional systems or large industrial enterprises .Its basic form is

$$Y = AL^{\alpha} K^{\beta} \mu \qquad (1)$$

Y stands for total output, A is a Technical Efficiency (TE), L is the number of input labor , K is the capital generally referring to the net value of Fixed Assets, α is labor output elastic coefficient, β is capital output elastic coefficient, μ is random disturbance. From this model, the main factors are labor resource investment, Fixed Assets and integrated technology level (including the management level, the quality of the labor resource, the introduction of advanced technology). According to the α and β combination condition, C-D production function has three types:①α+β >1, known as increasing returns, it is advantageous to increase output according to the existing technology with the expansion of production scale ②α+β <1, called diminishing returns, it is the loss outweighs the gain according to the existing technology expanding the production scale to increase the output ③α+β= 1, known as the constant return type, show that the production efficiency and not with the expansion of production scale and improve, only to improve the technical level can raise economic benefits.

Taking the logs of equation(1), we have the linear form of (1) as equation (2) below:

$$\ln Y = \ln A + \alpha \ln L + \beta LnK + \mu \qquad (2)$$

Empirical Model

In this study a model involving the main variables are input indicators and output indicators. Input indicators include capital investment and labor. Capital indicator mainly selects medical institution Fixed Assets. Labor indicator selects the number of medical staffs.

Because medical health services in China is emphasized as public welfare, we select the quantities of medical services as output indicator rather than the business income, including numbers of outpatients and inpatients and quantities of family health services.

Based on the model in equation (2), we estimate the following equation:

$$LNHSO = LNA + \alpha LNHI + \beta LNHS + \mu \qquad (3)$$

Where HSO is health service output, which in this study is represented by total numbers outpatients , inpatients and services for Family Bed. A is medical health service synthesis technology efficiency. HI is capital investment to medical health service which is represented by Fixed Assets . HS is medical staffs andμ is error term.

Sources of Data

In the empirical analysis, we use data from 2010 China Health Statistical Yearbook, which represents as follow table 1.We set up production function and study the relation between output and input. The data is conducted by EVIEWS6.0 statistics software.

Table 1 China Medical Health Services Input-Output

Area	Total staffs(million)	Number of medical staffs （thousand）	Fixed assets （billion yuan）	Service numbers （million）
Beijing	211.714	161.1	48.816	13.4789
Tianjing	93.366	67.9	17.559	6.6121
Hebei	407.351	268	42.615	30.27199
Shangxi	264.352	186.3	46.155	10.88343
Inner Mongolia	177.697	135	17.357	8.19574
Lianning	310.007	226.4	39.512	14.5574
Jiling	180.775	132.6	18.874	8.4955
Heilongjiang	242.973	175.3	26.337	10.0086
Shanghai	169.506	132.8	43.330	18.7332
Jiangsu	437.008	309	80.595	37.1879
Zhejiang	327.014	266	70.311	34.1877
Anhui	305.499	208.6	29.500	19.988
Fujiang	184.866	131	101.037	16.0565
Jianxi	223.480	151	22.162	15.8404
Shangdong	602.143	415	70.899	46.103
Henan	572.773	359.9	43.429	40.0078
Hebei	337.113	247	39.294	22.5219
Hunan	351.160	253.5	52.242	20.2623
Guangdong	555.799	421.3	102.577	56.4785
Guangxi	245.611	172.9	25.469	19.1138
Hunan	49.898	37.9	5.950	3.1912
Chongqing	146033	100	170.50	11.5891
Sichuan	437760	303.1	418.41	36.3285
Guizhou	143868	96.8	105.91	10.0968
Yunnan	196796	135.2	248.83	17.0667
Xizang	16040	10.1	21.35	1.0329

Shangxi	245352	171.8	241.42	14.0075
Gansu	126388	91.3	367.81	9.3529
Qinghai	34429	24	4.95	1.8532
Ninxia	37734	28	53.73	2.5245
Xinjiang	146943	116	224.89	7.7084

Empirical Result

Establishment of China's medical health services production function

Equation 3 was estimated with the ordinary least squares (OLS) techniques.

The results are shown in table 2:

Table 2 China's Medical Health Cobb Douglas Function Regression Results

Dependent Variable: LNSHO
Method: Least Squares
Sample: 1 31
Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.398558	0.261981	24.42377	0.0000
LNHI	0.907685	0.110653	8.202963	0.0000
LNHS	0.125753	0.084476	1.488614	0.1478

R-squared	0.929448	Mean dependent var	9.475399
Adjusted R-squared	0.924409	S.D. dependent var	0.935492
S.E. of regression	0.257203	Akaike info criterion	0.213861
Sum squared resid	1.852290	Schwarz criterion	0.352634
Log likelihood	-0.314845	Hannan-Quinn criter.	0.259097
F-statistic	184.4362	Prob(F-statistic)	0.000000

So, China's medical health service C-D production function follows as below:

$$LNHSO = 6.398558 + 0.907685LNHS + 0.125753LNHI$$
$$s = (0.261981) \quad (0.110653) \quad (0.084476)$$
$$t = (24.42377) \quad (8.202963) \quad (1.488614)$$
$$R^2 = 0.929448 \quad \overline{R^2} = 0.924409 \quad F = 184.4362$$

Adjust R^2 is 0.924409, it indicates the two input variables (health investment and medical staff) can explain about 93% reasons for health services output.

Characterization of China's medical health services scale

To study China’s medical health services scale ,we analyze the relation betweenαandβ.As table 2 displays: α+β =0.907685+0.125753=1.055201,we want to confirm whether α+β=1 has statistically significant. So we will test the following assumptions :

i Hypothesis H_0 : α+β =1

ii Hypothesis H_1 : α+β ＞1

we take Wald test and result is shown in table 3:

Table 3 China's Medical Health Services Scale Coefficient Test

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	0.355417	(1, 28)	0.5559
Chi-square	0.355417	1	0.5511

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
-1 + C(2) + C(3)	0.033438	0.056088

Wald (Wald) examination shows that α+β =1 and the hypothesis H_0 is proved.

Discussion and policy suggestions

Labor and Capital's effect for Chinese medical health services

According to C-D production function estimation results, the coefficient of LNHS is 0.907685 representing output on labor supply elasticity, that is to say, inputs indicator increase one percent, the output will increase about by 0.91% , under the capital investment remaining constant. Similarly, if the labor input remains unchanged, capital inputs increase one percent, the outputs will increase on about by 0.13%. This is mainly because of the medical health is labor-intensive. The professional knowledge is critical. Therefore, strengthening medical staffs training will greatly benefit medical health services output.

Recently Chinese Health Minister has carried out "health and medicine long-term talent development plan (2011 -2020)" , pointing out the number of medical staffs will reach 9,530,000 by 2015 , growing 1,750,000 than 2009 and the number will reach to 12,550,000 by 2020.At that time ,Chinese medical staffs scale will basically meet the demand of society.

6.2 Characterization of Chinese medical health services is constant returning to scale.

The study results provide view for the government making medical health services development policy. In this study, the sum the model of two elastic coefficient is 1, reflecting constant returning to scale(α+β =1), this is to say that if labor inputs and capital inputs enlarged 1 time, then the outputs is also enlarged 1 time. The efficiency of the medical health services will not increase through scale expanding except for improving the Technical Efficiency. In order to improve the Efficiency of Chinese medical health services, health administration department should enhance medical health interior management level, such as constructing effect mechanism and appropriate operation mode. Only increasing capital investment is not a good way for medical health development.

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