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# Efficiency Change of China's Primary Health Care Institution and Influencing Factor Analysis

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Abstract: By using the data of China's primary health care institutions from 30 provinces in 2006~2012, this paper calculated their efficiency level by way of the DEA-Malmquist productivity index model, and summarized the changing patterns according to the regional classification. At last, the paper cited the Tobit model to analyze the influence factors of China's primary health care institutions. The result indicated that there is no significant increase in total factor productivity of China's primary health care institutions, with the exception only in Beijing and Ningxia which showed dramatic growth, the changes of total factor productivity (TFP) from eastern, central and western regions are all in accordance to the results. Moreover, the study also showed that per capita beds is the most significant cause affecting the rate of total factor productivity and technology progress.

Keywords: primary health care institution, total factor productivity, Tobit model; influencing factors

## 1 Introduction

China's primary health care institution, as broadly defined especially by the Chinese government in 2011, refers to the county level medical institution and small community health clinics (or medical assistance centers). It is roughly located in the county hospital as its primary institution, towns and townships as the backbone, and the village clinics as a basis. It is aimed to provide public health and common disease prevention, as well as frequently-occurring disease diagnosis for people to solve the contradictions between tremendous population size and the relative shortage of medical health resources. In the past years, it has been done well. The authors of this study want to use the method of health care evaluation to judge the state of China's primary health care institution.

Abramovitz study of the American economy in 1869~1878, found that besides the inputs growth in TFP, there are other contributing factors of output growth[1].Lately, R. Solow asserted that TFP growth is the main source of American economic growth[2] in a constant scale reward, hicks- neutral and profit maximization conditions. In 1967, Jorgenson and Griliches took the super logarithmic function to measure total factor growth rate from the department and the total amount [3];

In 1968, Aigner and Chu proposed the deterministic production frontier and he divided the total factor productivity into Technology and Technical Efficiency Change [4]. Meeusen and Broeck put forward the Stochastic Frontier Analysis method in 1977 [5]. In 1984, R.D. Banker, A. Charnes and W.W. Cooper put forward the method of data envelopment analysis (DEA), then the DEA method is widely applied to evaluate organization efficiency, whose input and output relationship looks more complex, e.g.: hospitals, schools, banks and the public sector [6]. In 1994, Fare et al. came up with non-parametric Malmquist index of the total factor productivity growth rate based on DEA [7].

In the evaluation of efficiency in the medical institution, H. David Sherman was the first one to apply the DEA method to analyze the efficiency of medical institutions in 1984 [8]. Tobit model was initially created by James Tobin [9] but he didn't get the specific model. Michael D. Rosko used the two-stage SFA-Tobit model in analyzing inefficiency influence factors in 3,262 US medical institutions in 1999, and found non-profit hospitals[10]. In 2003, Hollingsworth account 188 pieces of literature that CHS adopted to advance efficiency on the health care sector during 1983~2002, and found that more than 50% of evaluations use the DEA method, and more than 10% of evaluations used the Malmquist productivity index method, which is based on the DEA method[11]. Otero L.D. used the DEA-Tobit method to regress the standard which leads software engineering organizations to gain insights regarding the role of various types of technical experience [12].

But relative research on TFP was comparatively late in China. Zheng Yu-xin and Zhang Xiao analyzed the devotion of technology efficiency and technology progress based on the survey about Chinese coastal business [13]. Yan Peng-fei and Wang Bing (2004) measured the TFP growth, technical efficiency and technological progress of China's 30 provinces from 1978 to 2001[14]. Guo Qing-wang and Jia Jun-xue comprehensively used Solow residual method (2005),



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contact variable method and the potential output method to evaluate technological progress efficiency and TFP growth in China from 1979 to 2004[15]; Wang Zhi-gang, Chen Yu-yu (2006) evaluated the compositions (production efficiency, scale efficiency change and the technological progress) of total productive progress growth about Chinese 28 provinces in 1978 ~ 2003[16];

The research about TFP in the medical and health appeared in recent years, Zhang Lu-lu original analysis the efficient of medical institution by SFA, which calculate and measure the supplies technical efficiency of Chinese hospitals [17]. Pan Zhi-ming (2007) analyzed the relative efficiency of CHS in Fujian province, but he didn't involve in the analysis the factors affecting efficiency [18].In recent research, Zhang Zhe calculated the relative efficiency goals of CHS institutions in 2009 by super efficiency DEA model and compared the regional relative efficiency [19]; Liu Hai-ying and Zhang Chun-hong measured the health efficiency of China's urban and rural medical institutions using Three-stage DEA method. The result showed that the medical and health efficiency of rural areas is greater than the urban areas [20].

Tu Jun and Wu Gui-sheng used the Two-stage DEA-Tobit model to compare the innovation efficiency of China's agricultural sector and then multiplied linear regression model according to the results of the evaluation to analyze the influence factor on innovation efficiency[21]. Chang Shuo evaluated the efficiency of China's postal industry by DEA. Furthermore, he analyzed TFP value, technical efficiency and scale efficiency value by Tobit model [22].

Through these literatures we know that the data envelopment analysis method and Malmquist productivity index method based on DEA are widely-used by experts in the area of health efficiency evaluation. The Tobit two-step method based on DEA aimed at analyzing the influence factor of the TFP has also been used in some areas. But there were little research focused on the combination of the dynamic analysis on primary health care institution efficiency index and the influence factor about the TFP decomposing. This paper will apply the combination of Malmquist Productivity index based on DEA and the Tobit model, studying the dynamic efficiency of China's primary health care institution.

## 2 Data and method

### 2.1 The research methods

2.1.1 Data envelopment analysis (DEA)

The Malmquist productivity index could be introduced through the distance function $C^2R$ model of DEA model.

According to Shephard (1970), the output function which represents production set $S^t$ from (t) to (t+1) period is defined as [23]:

$$S^t = \{(x, y) | \text{in t period}\} \tag{1}$$

For input $x \in R_+^N$, output $y \in R_+^N$ the t production possibility set $S^t$ is defined as:

$$D_0^t(x^t, y^t) = \inf\{\theta | (x^t, y^t/\theta) \in S^{t+1}\}$$
$$= \left(\sup\{z | (x^t, zy^t) \in S^t\}\right)^{-1} \tag{2}$$

In this article, we mainly from the perspective of input and output research on the total factor productivity changes in China's primary health care information service industry. First, hypothesize that the k ($k = 1, ..., K$) province use the n ($n = 1, ..., N$) kinds of input $x_{k,n}^t$, get the m ($m = 1, ..., M$) kinds of output $y_{k,m}^t$ in each t ($t = 1, ..., T$) period. Under the observable decisional unit, the possible productivity set of constant returns to scale (CRS) is defined as:

$$S^t(C) = \left\{(x^t, y^t) / x^t \geq \sum_{k=1}^{k} \lambda^{k,t} x^{k,t}; y^t \leq \sum_{k=1}^{k} \lambda^{k,t} y^{k,t}; \lambda^{k,t} \geq 0, k = 1, \cdots, K\right\} \tag{3}$$

Lovell called forefront technology of CRS possible productivity set as benchmark TC which provides the reference calculating TFP [24]. Fare (1997) obtained Malmquist productivity index expression above the benchmark technology [25].

2.1.2 Malmquist productivity index (MPI)

Because the productive possible set of DEA is a closed set, the input and output indicators can adjust appropriately. In order to get the index of Malmquist production rate, this paper makes the following assumptions:

Assumption 1: The doctors and nurses can take the place of human resource input .That method had been used in the article of Afonso and Aubyn (2006) [26].

Assumption 2: Suppose beds can substitute for the medical equipment inventory. As the number of sanitation equipment in China's primary health care institution is combinative and split by government in recent years, this paper use the beds data instead.

Assumption 3: Suppose hospital visits as the standard for the output of China's primary health care institution. The output of medical institutions is hard to quantify, so this paper adopts the method used by Afonso and Aubyn

Malmquist function can process input and output flexibly and measure the dynamic trend of institution efficiency objectively, so the paper measures the efficiency of China's primary health care institutions and decomposes it into technology efficiency change and technological progress by DEA-Malmquist.

According to the Caves: When there are only one input and output, the Malmquist productivity index of technology base on the output index variables from t to t+1 period is as follows[27]:

$$M_0^t = \frac{d_0^t(x^{t+1}, y^{t+1})}{d_0^t(x^t, y^t)}$$
$$M_0^{t+1} = \frac{d_0^{t+1}(x^{t+}1, y^{t+1})}{d_0^{t+1}(x^t, y^t)} \tag{4}$$

In formula (4), $d_0^t(x^t, y^t)$ and $d_0^{t+1}(x^{t+1}, y^{t+1})$ mean the output distance function compare the production point in the same period (t and t+1) with frontier technology according to the production point, while $d_0^t(x^{t+1}, y^{t+1})$ and $d_0^{t+1}(x^t, y^t)$ mean the function during the mixing period.

According to Fare (1994), the change of productivity can be calculated by two geometric average of Malmquist productivity index. It was equivalent to [8]:

$$M_0(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{d_0^t(x^{t+1}, y^{t+1})}{d_0^t(x^t, y^t)} \times \sqrt{\frac{d_0^t(x^{t+1}, y^{t+1})}{d_0^{t+1}(x^{t+1}, y^{t+1})} \times \frac{d_0^t(x^t, y^t)}{d_0^{t+1}(x^t, y^t)}} \quad (5)$$

Malmquist productivity index is divided into technical efficiency change (EC) and technological change (TE), the technical efficiency change also can be decomposed into pure technical efficiency change (PC) and scale efficiency (SC) two parts. It was as the following:

$$M_0(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{s_0^t(x^t, y^t)}{s_0^t(x^{t+1}, y^{t+1})} \times \frac{d_0^t(x^{t+1}, y^{t+1}/VRS)}{d_0^t(x^t, y^t/VRS)} \times \sqrt{\frac{d_0^t(x^{t+1}, y^{t+1})}{d_0^{t+1}(x^{t+1}, y^{t+1})} \times \frac{d_0^t(x^t, y^t)}{d_0^{t+1}(x^t, y^t)}} = SC \times PC \times TP \quad (6)$$

In the analysis of TFP (the total factor productivity) changes, the SC (scale efficiency) was more than 1 means that as the increase of inputs, the production efficiency was improved, the scale economies has been achieved. The PC (pure technical efficiency) is more than 1 means that better management improves efficiency. If the TE\` (change of technology) is more than 1, it implies the implement of technology progress which improves the TFP (total factor productivity). If the index of TFP above 1, it means the productivity improved when that the corresponding efficiency move towards the opposite direction.

2.1.3 Two-stage method and Tobit model

The efficiency of DMU which is obtained by the Malmquist productivity index is affected by not only the index of input and output, but by other factors .Such as macro-economic factors, policy factors and DMU itself. In order to study these factors and its degree of influence, some research using Ordinary Least Squares method is needed to estimate the parameter of the model. But these will lead to biased and inconsistent [28]. This paper tried DEA two-stage method which evaluated the DUM efficiency value first, and then regressed by Tobit model.

According to the method of two-stage, Tobit model set up as is followed [29]:

$$Z_{it} = \begin{cases} Cx' + \varepsilon_{it}, & Cx_i + \varepsilon_{it} > 0 \\ 0, & Cx_i + \varepsilon_{it} < 0 \\ \varepsilon_{it} \sim N(0, \sigma^2) \end{cases} \quad (7)$$

$Z_{it}$ means efficiency measurements of provinces, $X_{it}$ is the influence factors, C means coefficient which is to be coefficient. When $Z_{it}>0$, the actual observed value is to be taken. When $Z_{it}<=0$, the actual observed value is zero. By the Maximum Likelihood method, it can be improved that c and sigma of Tobit model was the consistent estimator.

Because TE and EC are both important to TFP, the paper takes TFP, TE, EC as the dependent variable, influence factors as the independent variable. Due to the multifarious influence factors of China's primary health care institution, we make assumptions are as followed:

Assumption 4: Assume that there were positive correlation between the China's primary health care institution and regional economic level.

Assumption 5: Assume the education level has a positive effect on efficiency of China's primary health care institution. The higher education people receive, the higher level of medical care can be.

Assumption 6: Assume input of region public health can affect the China's primary health care institution. Health input could improve the configuration of medical institution and personal quality.

H7: Density of primary health institution is positively correlated with primary health institution efficiency. Bigger density of institution can promote the technology and information exchange.

H8: Per capita beds which represent infrastructure has positive role on TFP. Better infrastructure can bring nice environment and then improve efficiency.

According to the influence factors, this paper set up specific Tobit model as followed[30]:

$$TFP_{it} = C_0 + C_1 * PGDP_{it} + C_2 * P.H.Inp_{it} + C_3 * I.D._{it} + C_4 \cdot EDU_{it} + C_5 * PerBed + \varepsilon_{it} \quad (8)$$

$$TE_{it} = C_0 + C_1 * PGDP_{it} + C_2 * P.H.Inp_{it} + C_3 * I.D._{it} + C_4 \cdot EDU_{it} + C_5 * PerBed + \varepsilon_{it} \quad (9)$$

$$EC_{it} = C_0 + C_1 * PGDP_{it} + C_2 * P.H.Inp_{it} + C_3 * I.D._{it} + C_4 \cdot EDU_{it} + C_5 * PerBed + \varepsilon_{it} \quad (10)$$

Among them, PGDP, P.H.Inp, I.D., EDU and Per.Bed respectively as the influence factor of economical level, public health investment and the density of primary health care institution, education level and per capita beds. The subscript i, t means t year.$C_0$ is the constant term of the model. $C_1$, $C_2$, $C_3$, $C_4$ and $C_5$ are the regression coefficient of variables.

2.2.1 Data source

In this paper, the relevant data for the period 2006~2012 is from China Health Statistics Yearbook and China's National Bureau of Statistics. Based on the explicit concept in 2011, this paper collected data that included: town and townships, village clinics, community health centers, and health clinic nursing stations.

Tab.1 Influence factor and its definition

| Influence factor | Various definition |
|---|---|
| Economical level | (Regional GDP)/Population |
| Education level | (Education input)/Population |
| Public health input | (Health input)/Population |
| The density of Primary health care institution | (The number of China’s primary health care institution)/Population |
| The per capita beds | (The beds of China’s primary health care institution)/Population |

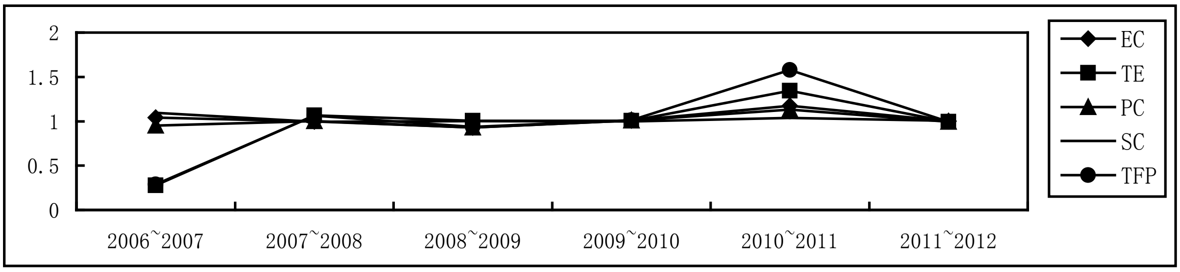


**Fig.1 Malmquist productivity and it’s decomposition of China’s primary health care institution in 2006~2012 institution**

2.2.2 The selection of input and output indicators and processing

Considering the index assumptions of input-output and characteristics of China’s primary health care institution in the Malmquist index, this paper chose two output indicators and three input indicators. Input indicators included the number of doctors, nurses and beds of China’s primary health care institution. Output indicators included the number of visits and hospitalization. For some statistical reason, the paper processed the data as follows:

The health works in the village clinics instead of the nurses, beds in streets, village and towns replace all bed in primary health care institution in 2006. The number of visit and hospitalization in towns and townships replace the number of primary health care for the period 2006~2012.

2.2.3 The selection of influence factors indicators and processing

This paper chose five influence factors according to the assumptions of the Tobit model. Influence factors and the definitions are shown in Tab.1.

## 3 Results and analysis

### 3.1 The TFP of China’s primary health care institution

From a longitudinal comparison: there are three years that gained TFP growth: 2007~2008, 2009~2010, 2010~2011. The highest rating was 2010~2011, with a growth rate of 57.8%. In the other three years in which the TFP wasn’t improved, the lowest period was 2006~2007 with a Malmquist index of 0.28.

The trend of SC, PC and EC is distributed smoothly and they change consistently. While TFP and TE changed greatly. In 2007~2008, TFP and TE annual growth was quite substantial while it began to decline after the peak in 2010~2011. The value of TFP and TE are on the same trend except in 2010~2011. Therefore, it can be said that the change of TFP is mainly due to technological progress.

For the horizontal comparison from Tab.2: (1) The value of PC increased in Shandong, Hubei, Yunnan etc. the highest of which is in Shandong, increasing by 5.5%. (2)The SC all increased except for Fujian, Jiangxi, Shandong, Henan and Sichuan. The outstanding province is Jilin (8.9%); (3) The mean value of EC is 1.023 and its average growth rate is 2.3%; (4) The TE of all provinces is below 1, while the capital Beijing is 1.075. The lowest one is in Hubei with a TE value of 0.764; (5) The Beijing and Ningxia provinces of TFP is more than 1, its efficiency value increased by 10.7% and 3.8% respectively.

From China’s provinces Malmquist productivity index it can be seen that TFP changes are affected by technical efficiency and technical progress, and the most important factor is technological progress, only Beijing and Ningxia achieved the efficiency growth of primary health care institution.

In order to describe the efficiency of China’s primary health care institution clearly from a general view, the paper divided China into eastern, central and western regions and calculated the changes of TFP regarding them as decision-making units. Through Tab.3: we learn that the TFP of three regions are all low in 2006~2007, the average rate is 0.326. This is because the development of China’s primary health care institution is at the nascent stage.

In 2007~2008, the growth rate of TFP reached 248%, because China’s government adopted a series of policies to support primary health care institutions at that time. It also leads to rapid service efficiency

**Tab.2 Malmquist production and it's decomposition of China's primary health care institution in 30 provinces**

| Firm | EC | TE | PC | SC | TFP | Firm | EC | TE | PC | SC | TFP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beijing | 1.029 | 1.075 | 1.000 | 1.029 | 1.107 | Hubei | 1.076 | 0.764 | 1.042 | 1.032 | 0.823 |
| Tianjin | 1.044 | 0.933 | 1.006 | 1.037 | 0.974 | Hunan | 1.012 | 0.789 | 1.01 | 1.002 | 0.799 |
| Hebei | 1.000 | 0.877 | 1.000 | 1.000 | 0.877 | Guangdong | 1.000 | 0.821 | 1.000 | 1.000 | 0.821 |
| Shanxi | 1.088 | 0.886 | 1.011 | 1.076 | 0.964 | Guangxi | 1.001 | 0.789 | 1.000 | 1.001 | 0.79 |
| Henan | 0.983 | 0.794 | 1.000 | 0.983 | 0.781 | Hainan | 0.997 | 0.998 | 0.99 | 1.007 | 0.995 |
| LiaoNing | 1.040 | 0.86 | 1.021 | 1.019 | 0.895 | Chongqing | 0.99 | 0.855 | 0.986 | 1.005 | 0.846 |
| Jilin | 1.086 | 0.833 | 0.997 | 1.089 | 0.905 | Sichuan | 0.998 | 0.791 | 1.000 | 0.998 | 0.79 |
| Shanghai | 0.992 | 0.955 | 0.995 | 0.997 | 0.947 | Guizhou | 1.087 | 0.843 | 1.000 | 1.087 | 0.916 |
| Jiangsu | 0.986 | 0.823 | 0.98 | 1.005 | 0.811 | Yunnan | 1.086 | 0.839 | 1.049 | 1.035 | 0.912 |
| Zhejiang | 1.000 | 0.835 | 1.000 | 1.000 | 0.835 | Shaanxi | 1.055 | 0.877 | 1.018 | 1.037 | 0.925 |
| Anhui | 0.962 | 0.823 | 0.959 | 1.003 | 0.792 | Gansu | 1.049 | 0.872 | 1.015 | 1.033 | 0.915 |
| Fujian | 0.981 | 0.82 | 0.983 | 0.998 | 0.804 | Qinghai | 1.009 | 0.936 | 0.994 | 1.015 | 0.945 |
| Jiangxi | 0.989 | 0.778 | 0.997 | 0.992 | 0.770 | Ningxia | 1.118 | 0.928 | 1.000 | 1.118 | 1.038 |
| Shandong | 1.044 | 0.799 | 1.055 | 0.99 | 0.834 | Xinjiang | 1.019 | 0.885 | 1.022 | 0.997 | 0.902 |
| Heilongjiang | 1.036 | 0.83 | 0.954 | 1.087 | 0.861 | Inner Mongolia | 0.964 | 0.909 | 0.952 | 1.014 | 0.877 |
| China | 1.023 | 0.858 | 1.001 | 1.022 | 0.878 | | | | | | |

Note: According to the calculation of DEAP2.1

improvements. While the following year, efficiency values all decreased below 1. In 2009~2010, efficiency of regions improved except the central area.

In 2010~2011, the Malmquist values of three regions appeared to peak, the highest one is on the eastern region which indicated a higher efficiency level eastern primary health care institutions. In 2011~2012, TFP values declined but tended to be equal to 1, which showed a brilliant promotional prospect on the efficiency of China's primary health care institution.

### 3.2 Empirical analysis of Malmquist productivity

From China's provincial Malmquist result in 2006~2012, we learned that there were many differences among provinces. In order to interpret the cause of such differences, we chose Tobit regression model to analyze the influence of various factors on productivity. We use STATA 12.0 to regress the model of TFP, TE and SC. The result is as followed:

**Tab.3 Regions TFP of China's primary health care institution**

| Year | Eastern | Central | Western | Average |
|---|---|---|---|---|
| 2006~2007 | 0.311 | 0.255 | 1.000 | 0.326 |
| 2007~2008 | 1.083 | 1.047 | 1.060 | 1.063 |
| 2008~2009 | 0.954 | 0.930 | 0.940 | 0.941 |
| 2009~2010 | 1.059 | 0.960 | 1.015 | 1.011 |
| 2010~2011 | 1.623 | 1.622 | 1.619 | 1.621 |
| 2011~2012 | 0.999 | 1.000 | 0.986 | 0.955 |

From Tab.4, it can be seen that the change of TFP is highly influenced by TE from the perspective of the estimated coefficient and its significance. It showed that the change of TFP is primarily caused by TE.

Economical levels don't significantly affect TFP growth. The economic level isn't necessarily congruent with TFP growth.

The coefficient of institutions' density is 0.0000147 under the 20% significance level. It means the density of institution has a positive but slight influence on TFP. It is because the layout of China's primary health care institution hasn't reached the best scale.

Education level has active impact on TFP of China's primary health care institution and its coefficient is 0.000347. So every 1 percent increase in education level, the TFP value has 0.0347% increment.

The negative role of health input indicated that China's investment in primary health care institution is used ineffectively.

### 3.3 Discussion

Through vertical and horizontal change of TFP and Tobit model analysis about TFP change, we concluded that:

(1) Total factor productivity growth of China's primary health care institution is mainly derived from technological progress, which means the growth is sustainable. That the economic development level has insignificant effects on TFP of China's basic medical institution meant that TFP is not subject to resource constraints.

(2) From the regional side, TFP change of primary health care institution in eastern, central and western is consistent. The TFP of eastern is higher than the other two, which is mainly caused by the relative facilities configuration and education level.

(3) From Tobit model, we know that the most influential factor is per capita beds, education level is secondary, and institution density is minimal, while public health has a negative effect. Per capita beds are the representation of infrastructures for primary health

**Tab.4 Regression model of Tobit**

| MODEL | TFP | | TE | | EC | |
|---|---|---|---|---|---|---|
| para | Cons | Std. Err. | Coef. | Std. Err | Coef. | Std. Err. |
| Cons | 0.2876354* (2.57) | 0.1117803 | 0.3423712* (3.95) | 0.0866771 | 1.020394 (19.74) | 0.0516934 |
| PGDP | 0.0003816 (1.13) | 0.0003369 | 0.0002424 (0.93) | 0.0002611 | -2.14e-07 (-0.14) | 1.56e-06 |
| I.D. | 0.0000147*** (1.11) | 0.0000133 | 0.0000145*** (1.40) | 0.0000103 | -1.61e-06 ( -0.26) | 6.15e-06 |
| EDU | 0.000374* (4.43) | 0.0000845 | 0.0002928* (4.47) | 0.0000655 | 0.000056*** (1.43) | 0.0000391 |
| P.H.Inp | -0.0002323* (-2.93) | 0.0000792 | -0.0001508* (-2.46) | 0.0000614 | -0.0000376 (-1.03) | 0.0000366 |
| Per.Bed | 0.0356968* (3.14) | 0.0113786 | 0.0323386* (3.67) | 0.0088215 | -0.0016613 (-0.32) | 0.0052628 |
| LR chi2(6) | 50.13 | | 58.16 | | 2.60 | |
| Log likelihood | -73.868302 | | -28.347487 | | 64.129696 | |
| Porb>chi2 | 0.0000 | | 0.0000 | | 0.7614 | |
| Sigma | 0.0192056 | | 0.0148909 | | 0.0088836 | |
| Number of obs | 180 | | 180 | | 180 | |

Note: The "*", "**", "***", means that the confidence coefficience is respectively 1%, 10%, 20%.

care institution. Complete infrastructure can attract more patients, make full use of resources and improve the efficiency. The higher the education level, the more health knowledge gets to the people; they may see doctors voluntarily at primary health care institutions, so education level can affect efficiency positively. The intensity of institution density will bring competitiveness among institutions; competition can promote the technical progress and then change the efficiency. In terms of public investment, there shows negative role because TFP growth is sustainability and unconstrained by resource [31].

## 4 Conclusion

With china's 30 provinces panel data in 2006~2012, the paper estimated the efficiency change of China's Primary Health Care Institution by using the Malmquist Productivity index. Through the Tobit model, the article analyzed the growth of TFP, and drew conclusions:

At present, the TFP growth of China's primary health care institution is not significant. The main reason for growth is technological progress. The development of China's primary health care service is on the elementary stage and endogenous growth has potential, the efficiency growth is not constrained by resource, so the growth is sustainable. In terms of Chinese health authorities, they could strengthen general practitioners team construction, improve the diagnosis and treatment technology, guide residents' medical behaviors, and improve the efficiency of primary health institution[32].

Through the influence factors analysis of China's primary health care institution TFP, we concluded that the basic infrastructure has great effect on TFP, while education and density has insignificant effects. So the authorities should specify the function of China's primary health care institution, optimize the configuration of basic medical devices and drugs, and explore efficient medical service modes, so as to satisfy the basic health needs of the people[33].

## References


[1]Abramovitz, Resource and output trends in the United Stated since 1870. *American Economics Association,* 1956(5): 5-23.

[2]R Solow. A contribution to the theory of economic growth in 1956. Advanced Macroeconomics, Y Zhi-gang, Fudan University Press, 2004. (in Chinese)

[3]Jorgensen Dale, Z Griliches, The explanation of productivity change. *Review of Economic Studies,* 1967(34): 249-283.

[4]S F Aigner, J Chu, On Estimating the industry production function. *American Economic Review,* 1968(13): 568-598.

[5]W Meeusen, J Broeck den Van. Efficiency estimation from cobb-douglas production functions with composed error. *International Economic Review,* 1977(18): 435-444.

[6]R D Banker, A Charnes, W W Cooper. Some models for estimating technical and scale inefficiencies in date envelopment analysis. *Management Science,* 1978(30): 1078-1092.

[7]R Fare, S Grosskopf. Malmquist productivity indexes and fisher ideal indexes. *The Economic Journal,* 1994(102): 158-160.

[8]Sherman H D. Hospital efficiency measurement and evaluation: Empirical test of a new technique. *Medical Care*, 1984: 922-938.

[9]J Tobin. Estimation of relationships for limited dependent variables. *Econometrica,* 1958, 26: 24-36.

[10]M D Rosko. Impact of internal and external environmental pressures on hospital inefficiency. *Health Care Management Science*, 1999, 2(2):63-74.

[11]Hollingsworth B. Non-parametric and parametric applications measuring efficiency in health care. *Health Care Management Science,* 2003, 6(4): 203-218

[12]L D Otero, G Centeno, C E Otero, Reeves K A. DEA-Tobit Analysis to understand the role of experience and task factors in the efficiency of software engineers. IEEE. *Transactions on Engineering Management,* 2012, 59(3): 391-400.

[13]Z Yu-xin, Z Xiao, Z Si-qi. Technical efficiency, technological progress and its contribution to the productivity: The coastal industrial enterprises preliminary analysis of the investigation. *The Journal of Quantitative & Technical Economics,* 1995(12): 20-27. (in Chinese)

[14]Y Peng-fei, W Bing, Technical efficiency, technological progress and productivity growth: The empirical analysis based on DEA. *Economic Research Journal,* 2004(12): 55-65. (in Chinese)

[15]G Qingwang, J Junxue. The effects of active fiscal policy on regional economic growth and disparity. *China Soft Science,* 2005(7): 46-53. (in Chinese)

[16]W Zhi-gang, G Liu-tang, C Yu-yu, Production efficiency and total factor productivity growth rate between regions (1978-2003). *Social Sciences in China,* 2006(2): 55-66. (in Chinese)

[17]Z Lu-lu, H Shan-lian, W Ying, F Zheng, Z Luo-man. Hospital medical service supply summary of empirical research in economics. *Chinese Journal of Hospital Administration,* 2000, 16(5): 5-7. (in Chinese)

[18]P Zhi-ming, Z Zhen-quan, W Xi-ying, DEA method is applied to evaluate of community health service center of relative efficiency. *Chinese Journal of Health Statistics,* 2007, 24(4):383-385. (in Chinese)

[19]Z Zhe. Based on super efficiency DEA efficiency evaluation of community medical services. *Journal of Shandong University: Health Sciences,* 2011(10): 148-152. (in Chinese)

[20]L Hai-ying, Z Chun-hong. China's rural medical institutions service efficiency is lower than city really: Based on the three stage DEA output measure the radial expansion after adjusting the efficiency of the new evidence. *China Rural Survey*, 2011(10): 86-95. (in Chinese)

[21]T Jun, W Gui-sheng. Based on DEA-Tobit two-step evaluation and analysis of regional agricultural innovation system. *The Journal of Quantitative & Technical Economics,* 2006, 23(4): 136-145. (in Chinese)

[22]C Shuo. Chinese telecom access price and connectivity analysis. *Journal of Shijiazhuang University of Economics,* 2011(5): 27-31. (in Chinese)

[23]R W Shephard. *Theory of cost and production functions*. Princeton University Press, 1970.

[24]Lovell C A K. The decomposition of Malmquist productivity index. *Productivity Analysis Journal*, 2003(20): 437-458.

[25]R Fare, S Grosskopf, M Norris, Z Zhang, Productivity growth, technical progress and efficiency change in industrialized countries. *American Economic Review,* 1994(87): 1033-1039.

[26]Afonso A, Aubyn M S. Relative efficiency of health provision: A DEA approach with non-discretionary input. ISEG-UTL Economics Working Paper, 2006, 33: 2006.

[27]D W Caves, L R Christensen, W E Diewert, The economic theory of index numbers and the measurement of input and output and productivity. *Econometrica,* 50: 1393-1414.

[28]H Zhi-ning, *STATA and eviews economitrics analysis*. Chinese Renmin University Press. (in Chinese)

[29]C Qiang. *Advanced econometric and stata applications.* Beijing: Higher Level Press. (in Chinese)

[30]L Zi-nai, P Wen-qing. *Economics.* Beijing: Higher Level Press. (in Chinese)

[31]W Qun-yong. *Stata tutorials and application cases* China Financial Economic Press. (in Chinese)

[32]Z Jing. The primary health service in Hong Kong and its reference and enlightenment for the mainland. *Chinese General Practice,* 2014, 17(23): 2667-2671. (in Chinese)

[33]L Meng, L Li-hang, W Xiao-wan, Analysis on the efficiency of 29 community health service centers in Hunan province based on DEA model. *Chinese Health Economics,* 2013, 32(4): 47-50. (in Chinese)

[34]W Gao-ling, T Da-jiang, Evaluation of service efficiency of community health service institutions in China based on super-efficiency DEA. *Chinese General Practice,* 2014, 17(28): 3296-3300. (in Chinese)