RESEARCH ON EFFICIENCY OF PRIMARY HEALTHCARE SERVICE OF SHANGHAI IN CHINA

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Abstract

Object: The article researches on efficiency of Shanghai Community Health Service (SCHS) and establishes production function of SCHS.
Method: Establishing the production function of SCHS by Weighted Least Squares Estimation .
Result: 1. Formulating the reasonable production function of SCHs based on Cobb: Douglas (C-D) function. 2. The article reveals SCHS production function with constant returns to scale.
Conclusion: 1. Increasing human resource investment is a key factor for raising SCHS.2.Strenghten management and explore an efficient service model will improve SCHS level.

Keywords: Community health service, Production function, Economic efficiency

Introduction

Over the years, the organization of primary in China has changed considerably. As part of the development of health care, the 1997 reforms of health introduced the community health center (CHC). Primary care is considered the most innovative health care sector as a whole in China. By the beginning of 1998, the government encouraged communities to establish their own public health networks. In 2006, the State Council declared new guidelines in order to promote the development of the CHCs by enforcing more public involvement in their function. Meanwhile China government

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publicized 8 detailed policy amendments to support the function and performance of the CHCs which included their management, standards, human resource construction, and hospital support. The proposal to rebuild a good primary health-care system occupies a central role in China's health-care reform, which was announced in 2009. In the planned model, the functions of primary-care centres will include medical care, disease prevention, health promotion and education, birth control, and rehabilitation in the community. the separate roles of primary-care institutions and of secondary and tertiary hospitals will be clarified, and mechanisms for bidirectional referral between them will be established (Xu XH 2010). At the same time , CHCs will also take on a gate-keeping role to reduce the cost burden arising from uncontrolled and inappropriate use of expensive hospital services. By 2009, the total number of CHCs across China (including 31 provinces and autonomous regions and 4 municipalities—Shanghai, Beijing, Chongqing, and Tianjin) reached 4434. (China Health Statistical Yearbook, 2010).

A key element of public policy is promoting good health to attain broad based economic growth. In China the path to health reform has been a long and arduous road. In 2009, an additional investment of CNY 850 billion (US$127 billion) to develop infrastructure and human resources in thousands of clinics at county, town, and village levels in rural areas, and community health center and stations in cities (Qian Liu, B.Wang 2011). Government programs have made the efficient use of budgetary commitments a priority. In 2009 the Chinese State Council issued an official document entitled "Deepening Medical and Health Reform and the Health Reform Program (2009-2011)" requiring medical institutions to pay close attention to efficient use of resources and establishing efficiency as one of the major criteria for determining whether medical reform was successful or not. New medical reforms introduced a basic medical and health system that has gradually increased the equity of health services provided, but efficiency in the health department is still not optimal. Medical services remain difficult to access and costly and the best way to allocate scarce resources efficiently has been controversial.

Our work is situated in China that an emerging powerful economic developing country which is still facing with many challenges, following the collapse of the commune system, in providing basic medical coverage to its whole population. In narrowing our study to a manageable scale, we have chosen the City of Shanghai, one of megalopolises in China, and have selected community health centers as the basic health care setting that this paper will examine. Shanghai has 17 districts and covers an area 6340 squarekilos and has a population of over 23 million by 2011. Since1997 health reform beginning , Shanghai has finished CHCS standardization

construction and invested 1.86 billion yuan . By 2011, there are 241 CHCs and 670 community health stations. We shall explore efficiency of the Shanghai community health service (SCHS) in the City of n delivering services to their residents subsequent to the health care sector since reform policy.

Literature Review and Theoretical Framework

Literature Review

The first systematic study of efficiency theory was published in 1957 by MJ Farrell from the University of Cambridge. He concluded that technical efficiency reflected the maximum output capacity from an established set of input parameters, what he called the production possibility frontier(Farrell 1957). He defined technical efficiency as: "Technical efficiency refers to produce a certain amount of products required minimum cost percentage in accordance with the established inputs proportion under the same production technology and market price". Alternate definitions of technical efficiency approach the field from the perspective of output by an economic body, or decision unit.

The majority of the published literature on health care efficiency has been related to the production of hospital care. In a systematic review of existing efficiency measures between 1990 and 2008, 265 efficiency measures were used in 172 articles (Hussey et al. 2009). Of the 172 articles, 162 (61.1 percent) measured the efficiency of hospitals. Studies of physician efficiency were the second most common (Hussey et al. 2009). Almost half of the measures in the published literature were specified as ratios, using single metrics for inputs and outputs. The rest of the measures in the published literature (147 measures, 55.5 percent) used econometric or mathematical programming. Two approaches were most common: data envelopment analysis (DEA) and stochastic frontier analysis (SFA) methodologies.

Only a few studies have examined the efficiency in the provision of primary care in China. The traditional method to assess performance in the health services is ratio analysis. Using the DEA model，Javier Salinas-Ji ménez and Peter Smith(1996) assessed UK National Health Service primary care performance. In this study , population characteristics and quality were taken as outputs indicators and Gross expenditure on General Medical Services per head of resident was taken as input indications. Antonio Giuffrida (1998) used Data Envelopment Analysis to measure Malmquist indices of productivity changes, which are then decomposed into indices of pure technical efficiency change, scale efficiency change and technological change. The analysis indicates a small improvement in the productivity over Ihe period considered. Athanasios I. Zavras (2002) used DEA to evaluate efficiency of Greek national primary

health care network. In this paper input variables included the number of personnel stratified in different categories (medical, nursing, paramedical, and administrative), and the number of people covered by each health center. The total number of annual visits was output .

Fewer researchers measured efficiency of primary care service using production function method. Furthermore Chinese CHCs functions have unique characters from other country's . CHCs in China were established in order to provide accessible, affordable and high-quality health care for all. Measurement of outcome and assessment of efficiency are considered as crucial parameters in the process of functions evaluation, especially in the public sector, where scarcity of resources is apparent .This study attempts to establish the reasonable production function of SCHS. Efficiency of CHCs were evaluated based on the production function .

Theoretical Framework

Efficiency is usually analyzed using Parametric and nonparametric method or a deterministic or stochastic approach(Coelli et al., 1998; Kumbhakar and Lovell, 2000; Grosskopf et al., 2006; Jacobs et al., 2006; Spinks and Hollingsworth, 2009).A deterministic and parametric approach is applied in this paper.

Production function is defined as maximum output under certain inputs in a given technology. The basic model is:

$$y_i = f(x_i;\beta) \quad i = 1,2,3,\cdots,I。 \tag{1}$$

y_i stands for actual output vector of i unit, x_i stands for input vector of unit i , β stands for parameter vector for estimation , f stands for production function,

Aigner et al.（1977）、Meeusen and Vanden（1977）pointed that output would be affected in production process by non-human factors such as natural disasters, random effects, climate, geography and so on. So random error should be combined with random errors (μ_i).

Thus the production function of decision unit is random rather than certainty. According (1), the stochastic frontier production function is

$$y_i = f(x_i;\beta)\cdot \exp\{\mu_i\} \quad i = 1,2,3,\cdots,I。 \tag{2}$$

If taking Cobb-Douglas production function, we get model

$$Y = AL^{\alpha}K^{\beta}e^{\mu}$$

Taking logarithm linearization both sides, we get

$$\ln Y = \ln A + \alpha \ln L + \beta LnK + \mu \tag{3}$$

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 capital investment, 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, capital investment 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 efficiency.

Empirical Model

In this study the model involving the main variables are input indicators and output indicators. Input indicators include capital investment and labor (shown figure 1). The labor input includes the number of medical staffs. The capital investment include public expenditure, subsidies for community public health expenditure and prepaid medical insurance expense.

Figure 1. CHCs input indicators

Labor	I .Medical staffs
	I .Public expenditure
Capital	II .Subsidies
	III .Prepaid insurance expense

The outcome of the primary care provided is the health improvement of the population served, measured, for instance, in quality adjusted life years. Unfortunately this outcome is not available and we have to rely on intermediate outcomes which are related to health improvement. Chinese CHCs have six main functions by providing basic clinical services, prevention, health education, women and children's care, elderly care, immunizations and physical rehabilitation. As noted above, the output variables reflecting CHCs outcome are underlined as follows:

i. Numbers of outpatient service
ii. Numbers of inpatient service
iii. Numbers of management of chronic diseases
iv. Numbers of preventive health care
v. Numbers of community health education
vi. Numbers of service for childhood immunization
vii. Numbers of service for preparental instruction

Primary health service activities are difference from the service technical content, labor intensity and the service risk. For instance, the

workload between outpatient and inpatient has a significant difference. To accurately calculating the amount of health services, the standard health service unit was applied in this paper. One standard health service is that a qualified doctor or assistant doctor provides a fifteen minutes and satisfied service for a patient. According to PENG Ying-chun (2011) calculation method , we get the catalog of health services workload, such as outpatient has one service unit and out-call emergency has 2 service unit and so on (shown figure 2 and figure 3). So we can calculate the whole CHC amounts of workload by this method. Actually CHCs activities are divided two class, one is medical health services another is public health services .

Figure 2. Classification and quantification of CHC medical health services

CHC medical health services		Service unit
basic clinical services	Outpatient service	1.00
	Emergency case	3.00
	Home visit	4.00
	Hospitalization day	8.00
	Outpatient rehabilitation	2.00
Care services	Intramuscular injection	0.40
	Venous transfusion	0.80
	Intravenous injection	0.63
	Catheterization	1.70
Pharmaceutical services	Dispensing	0.33
	Herbal prescription	1.33
	Decoction prescription	4.00
Accessory examination services	Fast blood glucose analysis	0.30
	urine and stool analysis	0.60
	Biochemical Assay	2.00
	electrocardiographic examination	0.67
	B-ultrasonography	1.33

Figure 3. Classification and quantification of CHC public health services

CHC public health services	Service unit
Intervention management on Hypertension patients (one year)	10.33
Intervention Management on Diabetic patients (one year)	10.00
Intervention Management on patient with coronary heart disease(one year)	12.67
Intervention management on patients with stroke (one year)	10.80
Childhood immunization	1.33
Health management on 0～3 child (one year)	13.04
Health management on pregnant women(one year)	16.33
Health management on seniors (one year)	3.77
Health management on patients with mental disorders(one year)	29.33

Result

In empirical analysis, we use data of 97 CHCs from 2011 Shanghai health Statistical Yearbook. We set up production function and study the relation between outputs and inputs. The data is conducted by EVIEWS6.0 statistics software.

Establish the production function of SCHS

According $\ln Y = \ln A + \alpha \ln L + \beta LnK + \mu$, we analyze through Weigh Least Squares (WLS) and the result is shown in the following figure 4.

Figure 4 WLS estimation on production function of SCHS

Variable	Coefficient	SD	T-value	P-value
C	0.750	0.073	10.297	0.0000
LnL	0.596	0.015	40.963	0.0000
LnK	0.239	0.006	38.006	0.0000
R-squared	0.988	Mean dependent var		6.053
Adjusted R-squared	0.987	S.D. dependent var		10.928
F-statistic	3761.929	Durbin-Watson stat		1.752
Prob(F-statistic)	0.000000			

As result shown , Adjusted R-squared is 0.987 implying function fitting well.

The coefficients of LnL and LnK have been tested by t-test. So the production function of SCHCs is

$$LnY = 0.75 + 0.596LnL + 0.239LnK + \mu \quad (4)$$

The production function shows labor marginal effect is 0.596. It means increasing one unit labor the output will increase 59.6%. At the same way, increasing one unit capital the output will increase 23.9%.

The returns to scale of SCHS

From the function (4), we derive the coefficient $\alpha+\beta=0.596+0.239=0.835$. As we mention above, C-D production function types due to whether $\alpha+\beta$ equal one or not , Hence ,Wald method is used to test the hypothesis:

$$H_0: \alpha+\beta \geq 1 \quad H_1: \alpha+\beta < 1$$

The statistical results show that $F=159.3866$, $P=0.000$. which do not meet the 0.05 criteria for significance, the hypothesis H_0 can be rejected, indicating that the economic characteristic of Shanghai primary healthcare services is decreasing returns to scale.

Discussion and policy suggestions

Labor and Capital's effect on Chinese medical services

As mention above, labor marginal effect is more higher than capital's. Production function shows that labor is the dominant factor for output .This is mainly because the medical health services are a labor-intensive service and extensive professional knowledge is critical. Therefore, investment in medical human resources is a appropriate way to improve SCHS output.

Enhance CHCs capacity development

Enhance CHCs capacity will helpful to relieve the pressure for large hospital. The habit of patients is to seek help from large hospitals. This behavior is partly caused by a lack of public confidence in the quality of care provided in primary-care facilities. Improved training of general practitioners will be essential to modify this attitude. The challenge is the serious shortage of trained general practitioners in the country. In response to this, in April, 2010, six relevant ministries jointly issued a plan for capacity development. The objectives include: to develop general practice as an academic discipline in universities; to establish a system for postgraduate training that includes hospital rotation for young medical graduates, and special programs for more experienced doctors who wish to become general practitioners; and to strengthen continuing professional development for doctors in post already. Additionally, remuneration, prospects for promotion, and working conditions of general practitioners will be improved, to retain those who have been trained. With target figures of 60 000 and 300 000 general practitioners to be trained within 3 years and 10 years, respectively, the plan is ambitious but essential in view of the population's size(The State Commission Office for Public Sector Reform 2010).

Returns to scale of CHS

According to function(4), we get that the returns to scale of SCHS is decreasing. This means under present situation when labor input and capital investment and to extend the one time, and output is less than one time. It also implies the SCHS' efficiency of health service is low. Under present situation, output is shrinking with increasing labor and capital input. Invest on labor and capital can not improve SCHS efficiency. It will not increase by expanding the scale except for by improving the technology efficiency (TE). In order to improve (TE), the health administration department should enhance medical health interior management level, by constructing institution mechanism and appropriate operation model. At present China has explored family practice systems and innovate the service contents so as to improve efficiency of primary healthcare service.

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