

<http://ansinet.com/itj>

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Index System Construction and Efficiency Evaluation Research on Equalization of Public Service

^{1,2}Qingyuan Zhou and ³Jianjian Luo

¹Center for Rural Development, Sichuan University, China

²School of Political Science, Sichuan University, China

³Changzhou College of Information Technology, China

Abstract: Equalization of public service is an important issue needed to be pursued by modern government and its index evaluation research has import value. Input and output equalization of public service is established by using Data Envelopment Theory (DEA) theory and conducts confirmatory analysis on data of Jiangsu Province from 2003 to 2008. The results show that the method is feasible and has high reliability. Its policy implication lies in that efficiency of equal input and output of public service does not become higher as time goes by and influencing factors are needed to be specifically analyzed so as to further improve equalization of public service.

Key words: Equalization of public service, index construction, DEA theory, efficiency evaluation

INTRODUCTION

There is no united concept or understanding of public service at present. This study argues that public services refer to those services established on the basis of a certain social consensus and shared impartially and generally by all citizens, regardless of race, income, status and region. And also according to this study, equalization of basic public service indicates that services shared by all citizens of a country must be about the same.

At the present time, researches about equalization index and evaluation of basic public service are focusing on the following aspects: (1) evaluating the current situation of our public service in education by efficiency coefficient method (Guo, 2007), (2) evaluating the index system of equalization of basic public service in urban area and merit rating by regional differences analyzing tools and the improved TOPSIS method (Wang, 2010) and (3) establishing the index system from various aspects and conducting qualitative analysis (Zhang, 2009; Chen, 2010; Chen and Cai, 2010).

Through analyzing the present situation of study, it is difficult to evaluate quantitatively because statistical criteria of public service equalization index are different in various regions. Thus, researches about public service equalization still remain at qualitative analysis of definition and index.

This study gives an analytical evaluation on the longitudinal historical statistics of a region from the

perspective of acquiring the optimum equalization efficiency of both public service input and output, so as to guide the improvement of public service equalization in this region. In light of the above, this study establishes the index system of public service based on DEA theory and gives evaluation on the input and output index of public service equalization in Jiangsu Province.

CONSTRUCTION OF INDEX SYSTEM OF PUBLIC SERVICE EQUALIZATION BASED ON DEA THEORY

DEA theory: Data Envelopment Analysis (DEA) is an effective method which evaluates the relative efficiency and benefit of several decision making units of the same type that possess multiple inputs and outputs (Li and Chen, 2003).

Suppose the number of decision making unit is n and each decision making unit DMU_j ($j = 1, 2, \dots, n$) has m kinds of input and s kinds of output, represented respectively by input x_{ij} and output y_{rj} , $i = 1, 2, \dots, m$, $r = 1, 2, \dots, s$.

The benefit evaluation index of each decision making unit is:

$$h_j = \frac{\sum_{r=1}^s \mu_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \quad (1)$$

Appropriately select μ and v and make them meet the condition $h_j \leq 1$. Now conduct benefit evaluation on the

decision making unit of No. J_0 , aiming at its benefit index and being restricted by benefit index of all decision making units, so as to get the optimum model as follow:

$$(P) \begin{cases} \max \frac{\mu^T Y_0}{v^T X_j}, j=1,2,\dots,n \\ \frac{\mu^T Y_j}{v^T X_j} \leq 1, \\ v \geq 0, \mu \geq 0 \end{cases} \quad (2)$$

The above formula is a fractional program. In addition, let $X_0 = X_{j_0}$, $Y_0 = Y_{j_0}$ and convert it by Charnes-Cooper. And simplify the formula as a linear programming problem by dual change:

$$(D_{C^2R}) \begin{cases} \min \theta \\ \sum_{j=1}^n \omega_j X_j \leq \theta X_0 \\ \sum_{j=1}^n \omega_j Y_j \geq Y_0 \\ \omega_j \geq 0, j=1,2,\dots,n \end{cases} \quad (3)$$

The meaning of the above model C^2R is obvious: seek for a certain combination of m DMU and make its output as less as possible on the premise that the output is no less than that of DMU of No. j_0 . This is the research of the input effectiveness under the condition of constant output. Similarly, the output effectiveness can be analyzed on the premise of constant input.

Introduce the positive and the negative deviation variables $S^+ = (s_1^+, s_2^+, \dots, s_s^+)^T$ and $S^- = (s_1^-, s_2^-, \dots, s_s^-)^T$, convert constraint conditions into equations and get the linear programming:

$$(D_{C^2R}) \begin{cases} \min \theta \\ \sum_{j=1}^n \omega_j X_j + S^- = \theta X_0 \\ \sum_{j=1}^n \omega_j Y_j - S^+ = Y_0 \\ \omega_j \geq 0, j=1,2,\dots,n \\ S^- \geq 0, S^+ \geq 0 \end{cases} \quad (4)$$

In the formula (4), when optimum solutions are ω^* , θ^* , s_i^{-*} , s_r^{+*} , $i = 1, 2, \dots, m$, $r = 1, 2, \dots, s$, so:

- If $\theta^* = 1$, $s_i^{-*} = 0$ and $s_r^{+*} = 0$, the decision making unit j_0 is effective for DEA. Meanwhile this unit is constant in scale merit and optimum in technical

benefit, namely the output y_0 is optimal on the basis of the original input x_0 in the economic system composed of n decision making units

- If $\theta^* = 1$ yet , s_i^{-*} and s_r^{+*} are not all zero, the decision making unit j_0 is less effective for DEA, which means the unit is not simultaneously constant in technical benefit and scale merit. That is to say input x_0 can be reduced by s_i^{-*} in order to retain the original output y_0 or the output be increased by s_r^{+*} under the condition of constant input
- If $\theta^* < 1$, or $s_i^{-*} \neq 0$ and $s_r^{+*} \neq 0$, the decision making unit j_0 is not effective for DEA, which means the input of this unit is not appropriate. Although the input is reduced from x_0 to $\theta^* x_0$, the output can be still y_0 . And now the decision making unit j_0 is not effective for DEA

Construction of input and output index system of public service equalization: This index system is established on the basis of relatively fair input and equal output, following principles of systematicness, emphasizing major points, combining science and operability public-oriented and so on.

CASE STUDY

Analyze both public service input (Fig. 1) and output (Fig. 2) of Jiangsu Province from 2003 to 2008 (Table 1, 2), so as to verify the effectiveness of this model.

Conduct analytical calculation on the data above by MyDEA1.0.5 developed by the Health Policy and Management Department of the School of Public Health in Peking University. Results are shown in Table 3.

Through analyzing the efficiency of equalized input and output of public service in Jiangsu Province from 2003 to 2008, it can be concluded that the public service equalization is not optimal within the relative time, which means the public service equalization needs to be further improved. Major conclusions are as follows:

- Analyze from the perspective of basic education, input and output efficiencies of each year from 2003 to 2008 are the same and the scale efficiency has taken shape. Instead of increasing input and output efficiency, the adding of input can only generate scale merits. Therefore, it is necessary to increase input constantly and pay attention to regional balance so that equalization of education can be fairer

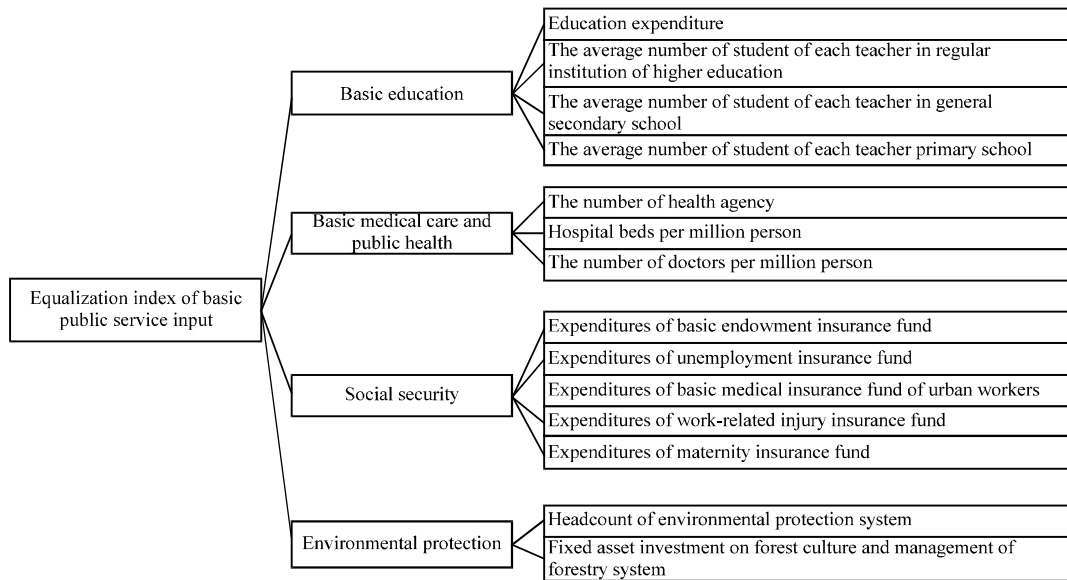


Fig. 1: Equalization of basic public service input

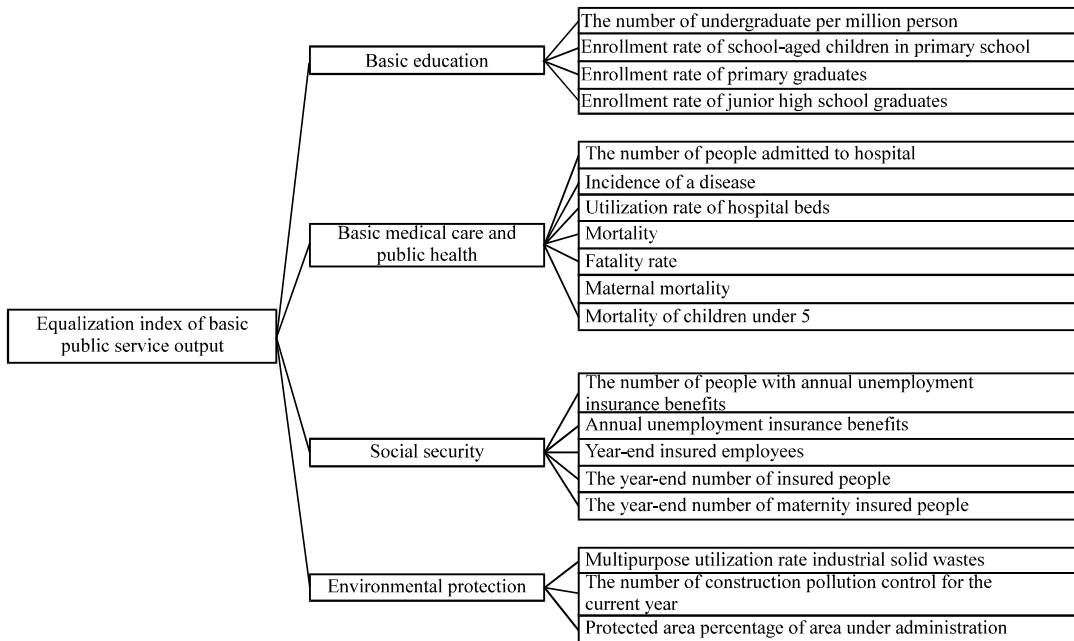


Fig. 2: Equalization of basic public service output

- Analyze from the perspective of basic medical care and public health, input and output efficiencies of 2003, 2004, 2007 and 2008 are optimal, while those of 2005 and 2006 are relatively poor, showing that part of the population are not equally access to public medical care service for the current year of which input and output are disproportionate. Basic medical care and public health service equalization should be deeply analyzed in terms of input and output efficiency
- Analyze from the perspective of social security, input and output efficiencies from 2003 to 2007 are higher than that of 2008. Thus, in 2009, it is necessary to learn from experiences of 2008

Table 1: Equalization index of basic public service input

Types of basic public service	Equalization index of input	2003	2004	2005	2006	2007	2008
Basic education	Education expenditure (yuan per person)	11295	11716	13145	14720	19314	24167
	The average number of student of each teacher in Regular Institution of Higher Education (person)	18.3	18	18.38	17.8	17.7	17.4
	The average number of student of each teacher in General Secondary School (person)	19.6	19.58	19.04	18.3	17.5	16.47
	The average number of student of each teacher in primary school (person)	21.6	19.94	18.56	17.49	16.6	16.02
Basic medical care and public health	The number of health agency (per unit)	12733	14447	15324	17143	19129	13451
	Hospital beds per million person(per unit)	24	24.6	25.6	26.8	27.8	28.8
	The number of doctors per million person (person)	14.5	14.7	15	15.7	16.1	15.6
Social security	Expenditures of basic endowment insurance fund (a hundred million yuan)	207.41	243.75	281.85	355.28	419.36	524.33
	Expenditures of unemployment insurance fund (a hundred million yuan)	22.05	21.13	20.22	20.06	19.81	31.00
	Expenditures of basic medical insurance fund of urban workers (a hundred million yuan)	55.55	69.35	90.6	107.73	133.83	178.56
	Expenditures of work-related injury insurance fund (a hundred million yuan)	2.8	2.82	4.01	5.41	7.05	9.85
	Expenditures of maternity insurance fund (a hundred million yuan)	2.15	2.92	4.34	4.96	6.93	8.17
Environmental protection	Headcount of environmental protection system (person)	9074	8463	8631	9239	8829	9872
	Fixed asset investment on forest culture and management of forestry system (a hundred million yuan)	1.61	2.28	1.25	1.45	0.5	0.312

Table 2: Equalization index of basic public service output

Types of basic public service	Equalization index of output	2003	2004	2005	2006	2007	2008
Basic education	The number of undergraduate per million person (person)	116.1	133.8	155.2	173.0	193.10119	204.8589852
	Enrollment rate of school-aged children in primary school (%)	99.6	99.7	99.8	99.9	99.55	99.9
	Enrollment rate of primary school graduates (%)	98.7	98.8	99.8	100	100	100
	Enrollment rate of junior high school graduates (%)	83.2	84.8	89.6	93.5	95.72	96
	The number of people admitted to hospital (10000 each time)	349.8	410.0	444.3	480.0	549.8	620.1877
Basic medical care and public health	Incidence of a disease (1/100000)	14.8	17.5	11.58	10.34	9.58	9.22
	Utilization rate of hospital beds (%)	64.1	69.0	70.85	71.93	77.03	78.52
	Mortality(1/100000)	0.2	1.3	0.1227	0.061	0.0529	0.0431
	Fatality rate (%)	20.75	16.3	9.47	9.74	17.29	9.9
	Maternal mortality(1/100000)	23.12	20.74	18.56	11.47	11.37	10.76
	Mortality of children under 5(‰)	11.25	10.14	8.56	7.62	6.94	6.53
Social security	The number of people with annual unemployment insurance benefits (10000 people)	88.25	85.98	67.02	51.63	48.65	48.83
	Annual unemployment insurance benefits (a hundred million Yuan)	13.92	14.73	12.03	9.36	9.37	11.57
	Year-end insured employees (10000 people)	608.41	715.11	821.07	935.77	1070.34	1213.90
	The year-end number of insured people (10000 people)	503.02	577.20	680.21	812.69	920.98	1055.71
	The year-end number of maternity insured people (10000 people)	504.06	552.68	630.92	711.49	794.11	907.23
Environmental protection	Multipurpose utilization rate of industrial solid wastes (%)	91.69	92.3	94.85	94.07	96.1	98.7
	The number of construction pollution control for the current year (per unit)	1973	814	782	642	788	830
	Protected area percentage of area under administration (%)	7.0	6	6.8	6.9	6.0	5.5

Table 3: Output efficiency of basic public service

Types	2003	2004	2005	2006	2007	2008
Basic education	1	1	1	1	1	1
Basic medical care and public health	1	1	0.993	0.964	1	1
Social security	1	1	1	1	1	0.872
Environmental protection	1	0.996	1	0.948	1	1

that further analyze equalization and make sure whether there are people who are not benefited

- Analyze from the perspective of environmental protection, input and output efficiencies of 2004 and

2006 are lower than those of other years. Environmental administration should conduct technical and economic analysis on input and output to realize higher efficiency, so as to achieve the purpose of lower input and higher output

CONCLUSION

This study establishes index systems of input and output equalization of public service by DEA theory. The system analyses part indexes of public service equalization and conducts model verification with data of

Jiangsu Province from 2003 to 2008. The results show that this method is practical.

It is impossible to collect data of other provinces because statistical criteria of all provinces are different. Therefore, this paper analyses the data of Jiangsu Province in longitudinal temporal series. On the other hand, the index system should be further studied in order to cover statistic data of provinces as many as possible. Accordingly, lateral comparisons can be carried out among data of all provinces, aiming at guiding the development of public service equalization.

ACKNOWLEDGMENT

Project supported by Educational Commission of Jiangsu Province of China: Research on Mechanism and Policy of Achieving the Equalization of Basic Public Services in Urban and Rural Areas in Jiangsu Province (2010SJB790008).

REFERENCES

Chen, J. and S.Q. Cai, 2010. Road traffic supply based on public service equality. *Technoeco. Manage. Res.*, 1: 18-21.

Chen, Y.Z., 2010. Local public finance system reform from the angle of public service equalization in urban and rural areas. *Finance Econ.*, 1: 43-44.

Guo, H., 2007. Evaluation of public service equity by efficiency coefficient from the perspective of public finance-an example of education equity. *Finance Trade Econ.*, 13: 42-46.

Li, M. and G.H. Chen, 2003. Research and application of Data Envelopment Analysis (DEA). *Chin. Eng. Sci.*, 6: 80-80.

Wang, Y.R., 2010. Appraisal of equalization and ability to urban basic public services in China. *Urban Prob.*, 8: 9-16.

Zhang, Q., 2009. To promote the building of service-oriented government and the equalization of basic public service. *Chin. Public Admin.*, 4: 13-17.