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Efficiency of Fiscal Expenditure for Social Security based on DEA-Malmquist

-An Empirical Study Based on Provincial Panel Data from 2012 to 2016

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***Abstract*—Since the Party's 19th CPC National Congress report, the unbalanced development of regional social security has become the main contradiction in the construction of China's social security system. Based on the DEA-Malmquist index method, this paper analyzes the social security expenditure efficiency of 30 provinces (cities) from 2012 to 2016 with static and dynamic dual measures. Efficiency of fiscal expenditure for social security and local economic development level are not consistent. From the dynamic point of view, the decline of technological progress is the main reason for the decline of total factor productivity of fiscal expenditure for social security. Although the growth of scale efficiency leads to the improvement of technical efficiency, it does not bring about the improvement of total factor productivity.**

Keywords—Social security; Fiscal expenditure efficiency; DEA-Malmquist; Regional development imbalance

I. INTRODUCTION

The party's 19th CPC National Congress report points out that "the basic contradiction of socialism in China has been transformed into a contradiction between the growing need for a better life and the imbalance of the people." Zheng Gongcheng (2017) holds that this contradiction is especially obvious in the field of social security, and the transformation of the basic contradiction of society in the new era has objectively decided the development direction of the construction of social security system. At the same time, the problem of fairness and efficiency is always the most core content in the social security theory system. The balanced development of regional social security includes both the balance of regional financial social security input and the balance of the efficiency of regional financial social security expenditure.

Wang Xiaojun, Qian Zhenzhang (2009) used cross-sectional data to study the efficiency of financial social security expenditure in various provinces. It is concluded that the efficiency of financial social security implementation is affected by the level of regional economic development and the efficiency varies greatly between provinces. Jiang Baoyu(2012)analyzes the efficiency of social security expenditure in China from 2001 to 2009 from the perspective of sustainable development, and concludes that the sustainable development efficiency of social security in China has maintained a good level since 2005.In the research on the efficiency of social security expenditure by using panel data in China, Li Shenghui, Xiong Cangwei (2016) used panel data from 2010 to 2013 to study the efficiency and satisfaction of social security expenditure in prefectural cities of Guangdong Province.Xia Jun, Li Chungen 2018) made a static and dynamic analysis of the rural minimum living security expenditure efficiency based on the provincial panel data from 2008 to 2013.

With the reform of China's social security system, the development of regional social security is also facing the problem of uneven and inadequate development. The transformation of social contradictions in China by 19th CPC National Congress makes the social security system under the new background of the times. It is necessary to use panel data to re-analyze the efficiency of regional social security expenditure in order to judge whether the development of regional social security is balanced or not. Therefore, this paper uses panel data from 2012 to 2016 to evaluate the efficiency of China's inter-provincial social security expenditure, and compares and analyzes whether the efficiency of China's social security expenditure is balanced at the provincial level from an empirical point of view.

II. RESEARCH MODEL AND INDEX SELECTION

A. Data envelopment analysis

Data Envelopment Analysis (DEA) is a mathematical programming method to determine the relative validity of homogeneous decision making unit (DMUs). The multidimensional data can be integrated into a comprehensive index, and then a linear optimization performance analysis method with the direction of system improvement is proposed. Under the assumption of variable scale compensation, BC2 model is used to analyze:

Assume that the input and output data corresponding to the n decision units are：

$$x_j = \left(x_{1j}, x_{2j}, x_{3j} \dots, x_{mj}\right)^T, j = 1,2, \dots, n, \quad (1)$$

$$y_j = \left(y_{1j}, y_{2j}, y_{3j} \dots, y_{sj}\right)^T, j = 1,2, \dots, n, \quad (2)$$

$x_j \in E^m$, $y_j \in E^s$, $x_j > 0$, $y_j > 0 (j = 1,2,3, \dots, n)$, The BC^2model is:

$$(P_{BC^2})\begin{cases} max(\mu^T y_{j0} + \mu_0) = V^P \\ s.t.\ \omega^T x_j - \mu^T y_j - \mu_0 \geq 0, j = 1,2,3,\dots,n, \\ \omega^T x_{j0} = 1 \\ \omega \geq 0, \mu \geq 0 \end{cases} \quad (3)$$

B. Malmquist exponential analysis

Malmquist method was proposed by Malmquist in 1953, and Fare developed and improved the Malmquist method to measure the dynamic Malmquist exponents across time.

$$M_0(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)}\right)\left(\frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)}\right)\right]^{1/2} \quad (4)$$

Where, $D_0^t(x^t, y^t)$, $D_0^t(x^{t+1}, y^{t+1})$ and $D_0^{t+1}(x^{t+1}, y^{t+1})$, $D_0^{t+1}(x^t, y^t)$ respectively are the output distance functions of t time and t +1 moment frontier technology as reference

The Malmquist index can be decomposed into two parts: technical efficiency and technological progress. Among them, technical efficiency can be decomposed into scale efficiency and pure technical efficiency:

$$M_0(x^{t+1}, y^{t+1}, x^t, y^t) = EC \times TC = PEC \times SEC \times TC \quad (5)$$

Among them, EC indicated technical efficiency and TC indicated technological progress and PEC was pure technical efficiency and SEC indicated scale efficiency.

C. Selection of indicators and data sources

In order to verify the rationality of the selection of input and output indicators, the selected index values are tested with Pearson correlation coefficient, and the results are shown in Table 1.

Table 1 shows that there is a negative correlation between the pension participation rate of the output index and the per capita social security expenditure of the input index at the significant level of 5%, which is contrary to the principle of homogeneity of DEA analysis. There was a negative correlation between number of beneficiaries per 10,000 population and the countdown of Engel coefficient of the output index at the significant level of 1%.It also violates the principle of homogeneity of DEA analysis, so the pension insurance rate and number of beneficiaries per 10,000 population are excluded. The final selection indicators are shown in Table 2. The data used herein are derived from the Yearbook of the Statistical Yearbook of the People's Republic of China and the Yearbook of the Chinese Civil Administration Statistical Yearbook.

TABLE I PEARSON CORRELATION COEFFICIENT TEST FOR INPUT AND OUTPUT INDICATORS

	Pension insurance participation rate	Number of social services and facilities	Elderly population pension beds	Hospital beds	Engel coefficient	Per capita social security expenditure	Number of beneficiaries per 10,000 population
Pension insurance participation rate	1.0000						
Number of social services and facilities	0.3891* (0.0000)	1.0000					
Elderly population pension beds	0.3171* (0.0001)	0.4774* (0.0000)	1.0000				
Hospital beds	0.0446 (0.5881)	0.2830* (0.0005)	0.2692* (0.0009)	1.0000			
Engel coefficient	0.0104 (0.8994)	0.3036* (0.0002)	0.3334* (0.0000)	0.5827* (0.0000)	1.0000		
Per capita social security expenditure	-0.1618* (0.0479)	0.0631 (0.4429)	0.1805* (0.0271)	0.4485* (0.0000)	0.4082* (0.0000)	1.0000	
Number of beneficiaries per 10,000 population	0.4698* (0.0000)	0.0355 (0.6661)	-0.0076 (0.9262)	0.0216 (0.7929)	-0.2198* (0.0069)	-0.5461* (0.0000)	1.0000

TABLE II EVALUATION INDICATORS OF THE EFFICIENCY OF FISCAL SOCIAL SECURITY EXPENDITURE

Input index	Per capita social security expenditure X_1	Reflect the intensity of investment in social security
Output index	Number of social services and facilitiesX_2	Reflect the objective outcome of social welfare
	Elderly population pension beds X_3	Reflect the result of the objective output of the old-age service
	Hospital beds X_4	Reflect the objective output of medical services
	Engel coefficient X_5	Reflect the degree of improvement in rural family life

III. AN EMPIRICAL ANALYSIS ON THE EFFICIENCY OF FISCAL AND SOCIAL SECURITY EXPENDITURE IN 30 PROVINCES OF CHINA

A. Static efficiency analysis

In this paper, we use deap2.1 software to measure the efficiency scores of 30 provinces' expenditure on financial social security from 2012 to 2016. The results are shown in Table 3.

TABLE III DEA SCORES OF FISCAL SOCIAL SECURITY EXPENDITURE IN 30 PROVINCES OF CHINA

area	overall efficiency	pure technical efficiency	Scale efficiency	return of scale
Beijing	0.322	1.000	0.322	drs
Tianjin	0.420	0.880	0.477	drs
Hebei	0.995	1.000	0.995	drs
Shanxi	0.666	0.965	0.690	drs
Nei Monggol	0.399	1.000	0.399	drs
Liaoning	0.435	1.000	0.435	drs
Jilin	0.561	0.943	0.595	drs
Heilongjiang	0.519	0.967	0.536	drs
Shanghai	0.315	0.904	0.348	drs
Jiangsu	0.910	1.000	0.910	drs
Zhejiang	1.000	1.000	1.000	-
Anhui	0.725	0.863	0.840	drs
Fujian	0.904	1.000	0.904	irs
Jiangxi	0.675	0.809	0.834	drs
Shandong	1.000	1.000	1.000	-
Henan	0.939	0.996	0.943	drs
Hubei	0.666	0.965	0.690	drs
Hunan	0.800	0.954	0.838	drs
Guangdong	0.739	0.742	0.996	drs
Guangxi	0.802	0.831	0.965	drs
Hainan	0.380	0.728	0.522	drs
Chongqing	0.493	0.960	0.514	drs
Sichuan	0.732	1.000	0.732	drs
Guizhou	0.926	0.971	0.954	drs
Yunnan	0.609	0.812	0.750	drs
Shaanxi	0.607	1.000	0.607	drs
Gansu	0.537	0.950	0.566	drs
Qinghai	0.281	1.000	0.281	drs
Ningxia	0.454	0.965	0.471	drs
Xinjiang	0.676	1.000	0.676	drs
Average value	0.650	0.940	0.693	drs

According to the results of DEA static analysis, the overall efficiency of China's financial social security expenditure is not high, the national average score is only 0.650.Financial social security expenditure to achieve comprehensive efficiency and effectiveness of the provinces only Zhejiang and Shandong provinces. The distribution of the scale and efficiency of financial social security expenditure in various provinces is obviously uneven. However, the pure technical efficiency of financial social security expenditure in each province is at a higher level, and the distribution is relatively balanced. Therefore, it can be seen that the imbalance of expenditure efficiency of provincial finance social security is mainly due to the imbalance of scale efficiency.

This paper combines the efficiency value of financial social security expenditure of each province in Table 3 with the average social security expenditure per capita in 2012-2016, and makes a comparative analysis of the national average level from the two dimensions of input and efficiency. And the provincial social security expenditure-efficiency model is divided into four categories, the specific classification results are shown in figure 1

Fig. 1 four categories of Social Security Expenditure-efficiency in China

From figure 1, it can be seen that 13 provinces are distributed in the "high input-low efficiency" zone, and 14 provinces are in the "low input-high efficiency" interval, which shows that the input-efficiency distribution of the financial social security expenditure in each province is obviously uneven. The provinces with high investment in social security have not brought the corresponding efficient output, while the provinces with lower per capita social security expenditure have higher efficiency of fiscal social security expenditure. This shows that the allocation and utilization of public service resources in each province is obviously unbalanced

In addition, the efficiency of social security expenditure is also inconsistent with regional economic development, that is, the social security expenditure efficiency of economically developed provinces is not necessarily high. It can been seen that financial social security expenditure efficiency and local economic development level is not consistent.

B. Dynamic efficiency analysis

This paper uses panel data from 30 provinces in 2012-2016 to further evaluate the dynamic trend of China's fiscal social security expenditure by using the output-oriented DEA-Malmquist method. The analysis results are shown in Table 4.

Overall, the total factor productivity of China's financial social security expenditure has dropped 1.5 percent, the technical efficiency and scale efficiency are in a state of growth, while the change of technological progress has dropped by 11.8.In the whole country, the average growth rate of the technical efficiency of the financial social security expenditure is 1.17. Under the condition of the increase of the technical efficiency, the decline of the technological progress is the main reason for the decline of the total factor productivity. However, since the change of pure technical efficiency is very lightl, the increase of technological efficiency is due to the growth of scale efficiency. At the provincial level, the total factor productivity (TFP) has increased to varying degrees in 16 provinces throughout the country, while the remaining 14 provinces have shown a downward trend. The growth rate of TFP in Shanxi is the fastest. The increase was 20 %, while total factor productivity in Henan province fell the most, to 29. 9%. In addition, technological progress of 30 provinces shows a decline. Among the provinces with lower total factor productivity, Zhejiang, Anhui, Fujian, Henan, Hubei, Hunan, Guangdong and Guangxi are all declining their technical efficiency and technological progress. Although technical efficiency has been improved in Jiangxi, Shandong, Hainan, Sichuan, Guizhou and Yunnan provinces, the downward trend of technological progress is far greater than that of technological efficiency, which has resulted in the decline of total factor productivity (TFP).

TABLE IV CHANGES IN THE EFFICIENCY OF FISCAL SOCIAL SECURITY EXPENDITURE IN 30 PROVINCES OF CHINA FROM 2012 TO 2016

area	technical efficiency	technical progress	pure technical efficiency	Scale efficiency	Total factor productivity
Beijing	1.183	0.947	1.007	1.175	1.120
Tianjin	1.172	0.938	0.937	1.250	1.099
Hebei	1.158	0.930	0.940	1.232	1.077
Shanxi	1.335	0.899	0.963	1.386	1.200
NeiMonggol	1.324	0.890	0.969	1.367	1.179
Liaoning	1.226	0.904	1.028	1.193	1.108
Jilin	1.208	0.889	1.028	1.175	1.074
Heilongjiang	1.218	0.879	1.028	1.185	1.070
Shanghai	1.254	0.868	1.028	1.220	1.088
Jiangsu	1.307	0.876	1.028	1.272	1.145
Zhejiang	0.984	0.874	0.986	0.998	0.860
Anhui	0.982	0.872	0.986	0.996	0.856
Fujian	0.995	0.868	0.987	1.008	0.864
Jiangxi	1.061	0.885	1.000	1.061	0.939
Shandong	1.075	0.886	1.000	1.075	0.952
Henan	0.838	0.837	0.994	0.843	0.701
Hubei	0.895	0.841	0.997	0.898	0.753
Hunan	0.971	0.866	0.999	0.972	0.840
Guangdong	0.973	0.860	1.004	0.969	0.836
Guangxi	0.994	0.867	1.003	0.991	0.862
Hainan	1.161	0.858	1.013	1.147	0.996
Chongqing	1.137	0.882	1.012	1.124	1.003
Sichuan	1.085	0.890	0.998	1.087	0.966
Guizhou	1.122	0.872	0.994	1.128	0.978
Yunnan	1.157	0.858	1.000	1.157	0.993
Shaanxi	1.173	0.910	1.004	1.169	1.068
Gansu	1.167	0.908	1.003	1.163	1.059
Qinghai	1.207	0.886	1.002	1.205	1.069
Ningxia	1.201	0.865	1.001	1.200	1.038
Xinjiang	1.154	0.868	1.000	1.154	1.002
average value	1.117	0.882	0.998	1.119	0.985

TABLE V CHANGES IN MALMQUIST INDEX OF FISCAL SOCIAL SECURITY EXPENDITURE IN CHINA 2012-2016

years	technical efficiency	technical progress	Pure technical efficiency	Scale efficiency	Total factor productivity
2012—2013	1.257	1.064	0.988	1.273	1.338
2013—2014	1.122	1.123	0.973	1.153	1.260
2014—2015	1.046	0.732	1.022	1.023	0.765
2015—2016	1.055	0.692	1.009	1.045	0.730
average value	1.117	0.882	0.998	1.119	0.985

Compared with the vertical level, it is concluded from Table 6 that the total factor productivity of China's financial social security expenditure is rising first and then decreasing. The average annual decline was 1.5%; in 2013, the growth rate was 33.8 %in 2014, and 26% in 2015.There was a more serious downward trend in 2016, with a drop of 23.5% and 27%, respectively. According to the decomposition efficiency of total elements, the technical efficiency of financial social security expenditure in our country shows an increasing state, and the technical efficiency growth rate is 25.7%, 12.2%, 4.5% and 5.5% respectively. The change of technological progress is consistent with the change direction of total factor productivity (TFP).In 2015 and 2016, the change of technological progress fell 26.8%, 30.8% respectively. In the case of lightly increase in technological efficiency, the change of technological progress largely determined the change of total factor productivity (TFP).At the same time, the year of total factor productivity growth, technical efficiency and technological progress have played a role in promoting its role. The decline of total factor growth rate is the main reason for the decline of total factor productivity. Although the increase of scale efficiency leads to the improvement of technical efficiency, it does not bring about the increase of total factor productivity.

IV. CONCLUSIONS AND SUGGESTIONS

This paper uses DEA-Malmquist method to measure and evaluate the static and dynamic changes of the expenditure efficiency of fiscal social security in 30 provinces of China from 2012 to 2016. The conclusions are as follows:

(1)From the static efficiency analysis, the comprehensive efficiency level of China's financial social security expenditure is not high, and the decline of scale efficiency level is the main reason for the reduction of comprehensive efficiency. In addition, the input-efficiency distribution of financial and social security expenditure is in an unbalanced state, and the high input in nearly half of the provinces does not bring the corresponding efficient output. Social security expenditure efficiency also presents imbalance with regional economic development. This indicates that there is irrationality in the structure of input and output of interprovincial social security expenditure in China. When the government allocates the public service resources, it should meet the real needs of the people.

(2)From the dynamic efficiency analysis, the total factor productivity of China's financial social security expenditure shows a trend of first rising and then decreasing. In the years of total factor productivity growth, both technological efficiency and technological progress have played a catalytic role. In the year of total factor productivity decline, the decline in technological progress is the main reason for its decline. It indicates that the increase of technical efficiency and technological progress brought by the improvement of management level and optimization of scale are the main factors of the increase of total factor productivity, and the stagnation of technological progress is the main reason for its decline.

REFERENCES:

[1] Zheng Gongcheng. Comprehensive understanding of the Party's 19th CPC National Congress report and the construction of social security system with Chinese characteristics [J]. Journal of Chinese Academy of Governance, 2017, 6: 8-17. (In Chinese)

[2] Li Shenghui, Xiong can. Research on the efficiency and satisfaction of Local Government's Social Security Fiscal Expenditure [J]. Administration of China, 2016. (In Chinese)

[3] Jiang Baoyu. An empirical analysis of social security efficiency in China under the view of sustainable development. Academic exploration, 2012 (8) : 43 – 45. (In Chinese)

[4] Xia Jun, Li Chungen. The static state and dynamic change of the efficiency of the rural minimum living security financial expenditure -- Based on the empirical analysis of the interprovincial panel data from 2008 to 2013 [J]. Journal of Huazhong Agricultural University (SOCIAL SCIENCE EDITION), 2018 (2): 79-87. (In Chinese).

[5] Wang Xiaojun, Qian Zhen. Analysis on the efficiency of Fiscal and Social Security Expenditure in China [J]. Fujian Forum (Humanities and Social Sciences Edition, 2009 / 5: 4-7). (In Chinese)

[6] Qiu Xiaojie, Wen Zhenhua. Analysis on the efficiency of China's Rural Social Security Fiscal Expenditure [J]. Economic issues, 2012: 74-78. (In Chinese)