Evaluation on the Implementation Effect of China's Basic Pension Insurance for Urban and Rural Residents

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***Abstract*—Accurate evaluation of the implementation effect of basic pension insurance for urban and rural residents(BPIURR) is an important means to realize effective supervision of pension insurance. From the perspective of fairness, efficiency and sustainability, the evaluation index system of the implementation effect of BPIURR was constructed in this article. Then by using the method of analytic Hierarchy Process and global entropy method, the implementation effect of BPIURR in 31 provinces from 2015 to 2019 was comprehensively evaluated in this article. The implementation effect of each kind of provinces was compared and analyzed by clustering analysis method. The results showed that the implementation effect of BPIURR in 31 provinces showed an increasing trend on the whole, but the comprehensive scores of all provinces were generally low. There were noticeable regional differences in the implementation effect of BPIURR.**

***Index Terms*—Basic pension insurance for urban and rural residents (BPIURR), Implementation effect evaluation, comprehensive weighting method, clustering analysis**

I. Introduction

General Secretary Xi Jinping pointed out that the management and supervision of the operation of the social security system should be strengthened. Accurate evaluation of basic pension insurance's implementation effect is an important means to realize effective supervision. In the past, domestic and foreign scholars mainly focused on the following aspects: First, put forward evaluation indicators. Previous scholars mostly focused on the dimensions of sustainability [1-3], fairness [2, 4], the expectation of residents [5], perceived quality [5], fund management [6], guarantee degree [2, 7], policy management [8], policy operation [8]. They tended to choose the maximum individual paying capacity [3], service attitude of the handling staff[5], policy mastery level of the handling staff [5], insurance participation rate [7], fund income growth rate [7], policy publicity effectiveness [8], pension receiving procedure [8], government management effectiveness [8], government management level [8], replacement rate[9], collection rate [9], old-age dependency ratio [10], old-age insurance socialized issuance rate [11] as evaluation indicators. Second, use evaluation method. Previous scholars used analytic hierarchy process [1, 2, 9], Delphi method [3], factor analysis method [5, 10, 11] and entropy method [8] to evaluate the implementation effect of BPIURR. Third, take

individual provinces and counties as evaluation objects. In the past, scholars often carried out regional evaluation (such as Shandong Province [7], Ningxia Province [12] and Anhua County [13]). Therefore, this article constructs a new evaluation index system from fairness, efficiency and sustainability. And this article comprehensively evaluates the implementation effect of basic pension insurance for urban and rural residents (BPIURR) in 31 provinces by using comprehensive weight method and cluster analysis method.

II. Implementation Effect Evaluation Index System Construction

A. Evaluation Index Selection

Existing literatures mostly construct the evaluation index system from the fairness and sustainability, while the evaluation of implementation effect of BPIURR needs to reflect the efficiency.Therefore, from fairness, efficiency and sustainability, this article constructs an evaluation index system, including 1 target layer, 3 criteria layer and 12 indicator layer (Table I).

B. Evaluation Index Weight Determination

After comprehensive weighting by analytic hierarchy Process and global entropy method, the weighting results of each indicator are shown in Table II.

III. Evaluation method

A. Comprehensive Weighting Method

The comprehensive weighting method combines analytic hierarchy process and global entropy method, which is used to determine the index weight. It overcomes the defects that analytic hierarchy process is influenced greatly by the personal preferences of experts and global entropy method requires too much data. It improves the scientificity of index weighting and makes the evaluation results more scientific, reasonable and accurate. The difference coefficient method is used to solve the weighting coefficient and the linear weighting model is used to combine the two weights:

$$w = \alpha w' + \beta w'' \quad (1)$$

In Eq. (1), w' and w'' represent the weight vectors of each index in the same index system; α represents the weighting coefficients of the analytic hierarchy process; β represents the weighting coefficients of the global entropy method. The weighting coefficient is solved by the difference coefficient method. The calculation formula can be expressed as follows:

TABLE I: EVALUATION INDEX SYSTEM OF IMPLEMENTATION EFFECT OF BPIURR

Target layer	Rule layer	Indicator layer	Index content
BPIURR	fairness	insurance participation rate	Number of people insured/number of people who should be insured
		Equity of participation[1]	Fairness of rights, opportunities and rules
	efficiency	Replacement rate	Average pension/average salary
		Pension level	Average pension
		Management service efficiency[1]	Service level of pension insurance management institutions
		Institutional liquidity[1]	Convenience of pension insurance's transfer and continuation in different places
	sustainability	Pension insurance coefficient	Fund expenditure/GDP
		Acceptance rate	Number of recipients/number of participants
		Fund balance ratio	Accumulated fund balance/Fund expenditure
		Current income and expenditure rate	Current fund income/current fund expenditure
		Fund income growth rate	Current fund income/previous fund income
		Old-age dependency ratio	The elderly population to be supported by every 100 working-age population

TABLE II: EVALUATION INDEX WEIGHT

Target layer	Rule layer	AHP weight	Global entropy method	Compre-hensive weight	Index layer	AHP weight	Global entropy method	Compre-hensive weight
BPIURR (weight 100)	fairness	0.59	0.13	0.43	insurance participation rate	0.40	0.03	0.27
					Equity of participation	0.20	0.10	0.16
	efficiency	0.28	0.61	0.39	Replacement rate	0.03	0.22	0.10
					Pension level	0.17	0.32	0.22
					Management service efficience	0.04	0.04	0.04
					Institutional liquidity	0.04	0.03	0.04
	Sustainability	0.13	0.26	0.18	Pension insurance coefficient	0.01	0.03	0.02
					Acceptance rate	0.01	0.02	0.02
					Fund balance ratio	0.04	0.08	0.05
					Current income and expenditure rate	0.01	0.06	0.03
					Fund income growth rate	0.03	0.03	0.03
					Old-age dependency ratio	0.02	0.04	0.03

$$\alpha = \frac{n}{n-1}\left[\frac{2}{n}\left(P_1 + 2P_2 + 3P_3 + \cdots + nP_n\right) - \frac{n+1}{n}\right] \quad (2)$$

$$\beta = 1 - \alpha \quad (3)$$

In Eq. (2-3), P_n represents the value of each index weight which is sorted from small to large in the weight $w^{'}$.

The comprehensive score of the implementation effect of BPIURR in the i-th province can be calculated as follows:

$$S_i = \sum_{j=1}^{k} u_j x_{ij}^{'} \quad (4)$$

In Eq. (4), u_i represents the comprehensive weight value and $x_{ij}^{'}$ represents the value after data processing. The larger the S_i, the better the implementation effect of BPIURR in

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[1] It indicates that the data were obtained by expert scoring method.

the province; the smaller the S_i, the worse the implementation effect of BPIURR in the province.

B. Cluster Analysis

Cluster analysis is based on the characteristics of different individuals and classifies individuals with similar properties into one category. This article carries out empirical analysis with SPSS 26.0, uses the inter-group connection method, calculates Euclidean distance and systematically clusters the comprehensive scores of various provinces. The cluster analysis can make a clearer observation of the implementation effect of BPIURR.

IV. DATA SOURCE AND EVALUATION RESULT ANALYSIS

A. Data Sources

This article selects 31 provinces in China as samples (excluding Hong Kong, Macao and Taiwan) to evaluate the effect of the implementation of BPIURR from 2015 to 2019. Most of the data involved in the article are derived from

"China Statistical Yearbook" , "China Labor Statistics Yearbook", "China Population and Employment Statistical Yearbook", statistical yearbook of 31 provinces, "Human Resources and Social Security Development Statistical Bulletin", the official website of the National Bureau of Statistics and the annual statistical bulletin of 31 provinces.The data of participation fairness, management service efficiency and institutional liquidity are obtained by expert scoring method..

B. Overall Evaluation

According to the comprehensive evaluation method, the comprehensive scores of 31 provinces are calculated (Table III).

TABLE III: COMPREHENSIVE SCORES OF 31 PROVINCES FROM 2015 TO 2019

Provinces	2015	2016	2017	2018	2019
Beijing	52.25	51.28	53.99	59.99	67.57
Tianjin	35.87	45.92	47.54	47.05	47.86
Hebei	38.22	39.12	39.81	41.51	42.34
Shanxi	37.53	38.24	39.77	39.92	41.15
Inner Mongolia	28.31	30.47	31.82	32.10	34.35
Liaoning	30.80	29.99	28.85	37.34	37.79
Jilin	27.80	27.34	29.90	30.42	32.61
Heilongjiang	26.11	25.06	29.94	31.41	38.83
Shanghai	45.29	47.24	49.00	51.14	51.78
Jiangsu	45.79	45.44	46.10	47.08	47.73
Zhejiang	43.35	42.36	42.57	43.84	43.63
Anhui	39.67	41.17	43.23	44.64	52.85
Fujian	35.42	41.24	42.80	50.02	50.98
Jiangxi	37.27	38.41	40.27	40.59	48.07
Shandong	40.29	41.13	44.38	48.41	48.21
Henan	39.53	40.52	41.34	49.55	50.32
Hubei	39.73	45.23	46.73	50.59	51.72
Hunan	44.47	44.08	46.75	54.82	56.80
Guangdong	47.67	47.69	47.07	46.23	45.69
Guangxi	29.18	30.54	33.25	32.64	35.51
Hainan	37.21	38.00	34.21	39.77	42.39
Chongqing	46.44	47.96	49.12	50.19	52.04
Sichuan	46.48	47.01	49.26	50.00	51.89
Guizhou	27.31	27.57	30.99	33.21	33.90
Yunnan	35.43	38.04	38.78	39.73	40.49
Tibet	30.17	32.92	41.44	41.42	38.44
Shaanxi	38.65	38.15	43.07	45.86	48.14
Gansu	34.78	34.91	40.32	41.88	43.09
Qinghai	30.89	32.63	35.23	36.11	40.20
Ningxia	30.67	32.03	33.23	34.40	37.13
Xinjiang	28.13	30.33	32.47	37.60	38.97
entire country	37.12	38.45	40.43	42.89	44.92

It can be seen from Table III:
1) The implementation effect of BPIURR in 31 provinces shows an overall upward trend. From Table III, it can be seen that the overall scores of various provinces have continued to increase. Only a few provinces have slightly declined in individual

years such as Liaoning, Heilongjiang, Jilin, Jiangsu, Zhejiang, Hunan and Tianjin, but the fluctuation range is relatively small. One of the most special provinces is Guangdong. Guangdong's comprehensive score increases slightly and then begins to decline from the initial 47.67 to 45.69.
2) The overall score of implementation effect of

BPIURR is relatively low. From Table III, it can be seen that the highest score is 67.57, which is the only score above the passing line. The other comprehensive scores have not reached the passing level and the lowest score is only 25.06. The national average score in 2015 is 37.12, the national average score in 2016 is 38.45, the national average score in 2017 is 40.43, the national average score in 2018 is 42.89 and the national average score in 2019 is 44.92. The national average score is at a low level, which shows that the effect of the implementation of BPIURR is still room for improvement.

3) The implementation effect of China's BPIURR has obvious regional and provincial difference. It can be seen from Table III that in 2015, Beijing has the highest comprehensive score of 52.25 and Heilongjiang has the lowest comprehensive score of 26.11. Beijing's comprehensive score is nearly twice that of Heilongjiang. In 2019, Beijing has the highest score of 67.57 and Jilin has the lowest comprehensive score of 32.61. The difference between these two provinces is 34.96. In the same year, the gap between the highest score and the lowest score is very large.

C. Cluster Analysis

The 31 provinces are divided into four categories by systematic cluster analysis (Fig. 1and Table IV).

The first category only includes Beijing. Beijing is a megacity in China and belongs to the eastern region. It has a high level of economic development. The participation rate of BPIURR in Beijing is very high. Its comprehensive score ranks first in the country for five consecutive years.

The second category includes Chongqing, Sichuan, Shanghai, Hubei, Jiangsu, Guangdong, Hunan, Fujian, Henan, Shandong, Shaanxi, Anhui and Tianjin, a total of 13 provinces. 6 provinces are located in the eastern region, 4 provinces are located in the central region and 3 provinces are located in the western region. In terms of comprehensive scores, these provinces rank in the forefront of the country. This shows that the implementation effect of BPIURR in such provinces is good.

The third category includes Shanxi, Hainan, Zhejiang, Yunnan, Hebei, Gansu, Jiangxi and Tibet, a total of 8 provinces, of which 3 are located in the eastern region, 2 are located in the central region and 3 are located in the western region. BPIURR's implementation effect in such provinces is average, especially in Zhejiang and Hainan. Although their economic development level is relatively high, but the implementation effect of BPIURR is not as good as the first two types of provinces. This shows that there are still a lot of problems in the implementation of BPIURR.

The fourth category includes Liaoning, Xinjiang, Qinghai, Jilin, Guizhou, Inner Mongolia, Guangxi, Ningxia and Heilongjiang, a total of 9 provinces, of which 1 is located in the eastern region, 2 are located in the central region and 6 are located in the western region. The characteristics of such provinces are their low level of economic development and serious population loss. These provinces have relatively low comprehensive score, which means the implementation of BPIURR in these provinces is poor.
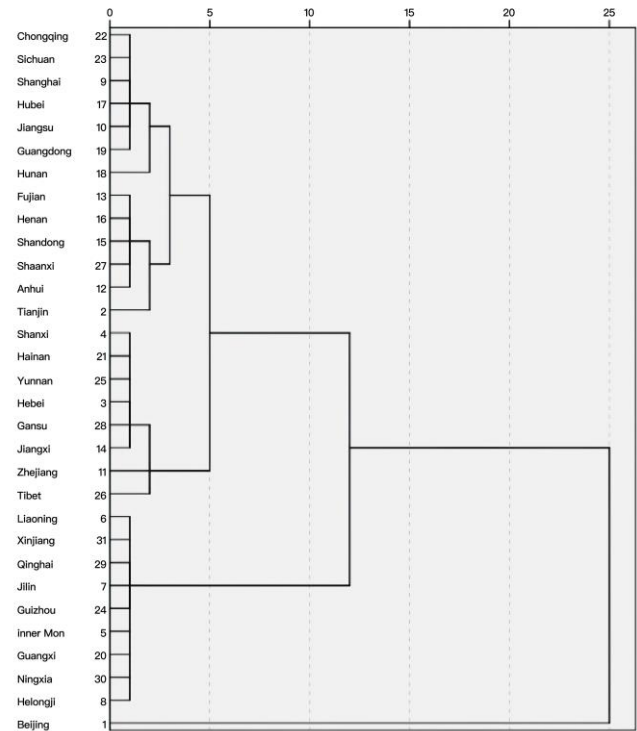

Fig. 1. Cluster diagram of the implementation effect of BPIURR in 31 provinces.

TABLE IV: CLUSTER ANALYSIS RESULTS OF THE IMPLEMENTATION EFFECT OF BPIURR IN 31 PROVINCES

Category	Province
The first category	Beijing
The second category	Chongqing, Sichuan, Shanghai, Jiangsu, Guangdong, Hunan, Shandong, Henan,
The third category	Hebei, Shanxi, Zhejiang, Yunnan, Gansu, Hainan, Jiangxi, Tibet
The fourth category	Liaoning, Xinjiang, Qinghai, Jilin, Guizhou, Inner Mongolia, Guangxi, Ningxia, Heilongjiang

V. CONCLUSION

Through the comprehensive evaluation of the implementation effect of BPIURR in 31 provinces, it can be seen that there are still some problems in the implementation of BPIURR. This also shows that the basic pension insurance policies in various provinces should make specific adjustments as actual conditions changes, so that the implementation effect of BPIURR will develop in a better direction.In order to further improve the implementation effect of BPIURR, the following suggestions are put forward:

1) The first and second kind of provinces should improve the sustainability of funds. These provinces should continue to promote the "full process" of pension insurance fund risk prevention and control [14]. In addition, they should improve the "four-in-one" fund management risk prevention and control system, which includes policy, management, information and supervision [14].

2) The third kind of provinces should implement a

universal participation plan, encourage flexible employees to actively participate in pension insurance, implement basic pension adjustment mechanism and raise the basic pension standard[14].

3) The fourth kind of provinces should optimize the inter-regional industrial structure and achieve regional cooperation. For provinces with low economic development, limited local government financial resources and greater pressure on pensions, different financial support will be adopted to ensure the steady development of BPIURR.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Zhang Ling conducted the research; Zhang Jiaxin analyzed the data; Zhang Ling and Zhang Jiaxin wrote the paper; all authors had approved the final version.

REFERENCES

[1] J. Y. Hang and X. L. Xue. "Research on the Evaluation of the Operation of New Rural Social pension insurance," *Population and Economy*, vol. 1, pp. 91-96, 2012.

[2] H. Ping and L. Dan. "The construction and empirical study of the integrated evaluation system of urban and rural social pension insurance — Taking Heyuan city, Guangdong province as an example," *Social Security Research*, vol. 3, pp. 9-16, 2016.

[3] L. Bing, "A macro-evaluation study on the development of the basic pension insurance system for urban and rural residents," *Theory and Reform*, vol. 1, pp. 55-58, 2015.

[4] X. Qiang. "The fairness evaluation and influencing factors of the basic pension insurance system," *Insurance Research*, vol. 5, pp. 104-112, 2013.

[5] Z. L. Xu and W. Bin, "Implementation performance evaluation of urban and rural social pension insurance system based on residents satisfaction: Taking Ningbo, Zhejiang as an example," *Rural Economy*, vol. 5, pp. 70-74, 2013.

[6] C. Chen and F. Jin, "Research on the Implementation of Pension Insurance Policies for Urban and Rural Residents — Taking Ningyang County as an Example," *Journal of Shanxi Agricultural University (Social Science Edition)*, vol. 15, pp. 95-99, 2016.

[7] X. L. Xue and Z. Yang, "Evaluation of the basic pension insurance protection level of urban and rural residents based on the principle of information entropy and ideal point: Taking Shandong Province as an example," *Journal of Hebei University of Economics and Trade*, vol. 41, pp. 92-99, 2020.

[8] L. Wei and Z. X. Peng, "Research on the implementation effect of the new rural insurance policy based on the entropy method," N*orthwest Population*, vol. 36, pp. 63-67+74, 2015.

[9] L. Min and C. Q. Wang, "Evaluation of the effectiveness of our countrys current basic pension insurance system — A study based on the analytic hierarchy process," *Guizhou Social Sciences*, vol. 7, pp. 64-70, 2008.

[10] G. L. Liu, "Research on the regional differences of the comprehensive level of our countrys pension insurance," *Modern Management Science*, vol. 11, pp. 84-86, 2014.

[11] C. S. Xu, "Performance evaluation of chinas pension insurance system — An empirical study based on factor analysis," *Economic Issues*, vol. 6, pp. 43-46, 2012.

[12] C. L. Yu, L. Si, and C. Leng, "Evaluation of the implementation effect of the social pension insurance system for urban and rural residents in Ningxia," *Ningxia Social Sciences*, vol. 5, pp. 52-55, 2013.

[13] W. J. Wang, "Problems and countermeasures in the implementation of the social pension insurance system for urban and rural residents — Taking Anhua County as an example," *Journal of Hunan Administration Institute*, vol. 2, pp. 16-19, 2015.

[14] Social protection platform. [Online]. Available: http://www.mohrss.gov.cn/syrlzyhshbzb/shehuibaozhang/zcwj/yangl ao/202108/t20210820_421166.html