



Based on the Entropy Topsis Model in Urban and Rural Endowment Service Supply Level Evaluation Method Innovation Research

In field data in Henan, Jiangxi and Ningxia as an example

Shujing Li ^{1a*}, Ziqian Fu ^{2b}

Beijing Normal University, Beijing, China

^{a*}sherleen_9@163.com

^b15079481559@163.com

Abstract

In the context of population aging furtherly deepening in China, it's an effective way to evaluate the actual pension demand of urban and rural residents and the demand for real pension endowment service by constructing quantitative index models. Also, reasonable policies combined with the advantages of different entities in the aging service can play a role in improving and increasing effective supply around the endowment service. From the perspectives of material, spiritual, economic income and spending, this paper builds factors in aspects of residents' endowment actual demand, the condition of old-age security and satisfaction and evaluates the effective supply of pension services in each region based on the results of the questionnaire surveys in Henan Province, Jiangxi Province and Ningxia Hui Autonomous Region, using the entropy-containing Topsis. The results show that the satisfaction level of the residents in these three provinces is at a moderately low level, while the residents' demand for elderly care services is at a high level. In detail, the demand for the aging service and the satisfaction level of the elderly care in Jiangxi Province is at a high level, whereas the satisfaction level of elderly care in Henan Province is low and the residents' demand is high, and the demand and satisfaction level of the elderly care in Ningxia Hui Autonomous Region are both low. Based on this, relevant countermeasure suggestions are put forward.

Keywords- *Residents endowment service satisfaction; effective supply; AHP; Entropy weight method; Topsis comprehensive evaluation model*

1. INTRODUCTION

Nowadays, the increasingly high proportion of elderly people (13.5% in 2020, up 5.44% compared with 2010) in China has shown continuing pressure of long-term balanced population development for some time to come. Although the government has been making policy adjustments in urban and rural old-age insurance and old age service systems [1], obvious differences in the supply and demand of elderly care services still can be seen across localities and there is a clear mismatch between supply and demand and an imbalance between supply and demand of services in less developed regions [2]. Therefore, in the context of China's imminent entry into a deeply aging society, it is crucial to improve the effective supply of elderly services to alleviate the

problems of mismatch and imbalance between supply and demand.

The overall supply of elderly care services in China is not optimistic. Family retirement is still the main choice for most senior citizens, but the quality of life of the elderly is often difficult to guarantee as their children also face financial and life care pressures [3]. Besides, Lin Bao found that the actual usage of elderly care services provided by organizations like institutions and communities was low and showed an oversupply in terms of quantity and a clear structural decoupling between supply and demand [4]. From the demand side, the thematic needs of the elderly groups are expressed in terms of basic living care, medical protection, and spiritual comfort, and different elderly groups also show differentiated characteristics. For example, compared to

non-empty nesters, empty nesters are more inclined towards daily care and spiritual comfort; elderly people living alone are more in need of daycare and rehabilitation care services than those who do not live alone [5]. However, Qiao points out that the huge and diverse demand for elderly care often stays at the level of need in the economic sense, and factors such as the weak affordability of the elderly and differentiated personal preferences make the actual demand insufficient [6].

At present, most studies have discussed and evaluated the supply of elderly services from a theoretical perspective, and the development of the elderly service industry is generally plagued by difficulties such as insufficient market competitiveness and government "overstepping". In terms of quantitative evaluation, fuzzy comprehensive evaluation and AHP are often used in studies [7]. Most of them are based on the perspective of the elderly's needs, and different indicators are established to conduct quantitative analysis. The most concerned one is the satisfaction with elderly services, which constructs indicators by extracting individual characteristics to quantitatively analyze the satisfaction with elderly services. Su Baozhong et al. showed that rural residents' willingness to purchase rural socialized pensions are generally influenced by family status, insurance coverage, self-care ability, and the number of people living in the same village, with the first two significantly contributing to the willingness to purchase pension services and the latter two the other way around [8].

In summary, the existing studies have carried out detailed discussions and theoretical evaluations on the current supply situation of elderly care in China in terms of types of supply and geographical areas, and many empirical articles have also analyzed and evaluated the service quality and efficiency of elderly care institutions, which is of great significance for understanding the basic supply situation of the elderly care services in China. However, there are still some shortcomings: firstly, the existing evaluation of the level of elderly services in China mostly uses a single indicator, such as the basic pension, which is mostly used to measure the old-age protection in urban and rural areas, while the supply of elderly services is often measured by the number of elderly institutions and beds, which seems rather thin in the evaluation process; secondly, in most of the studies on the supply and demand of elderly services, most of them are based on the degree of change in aging and the quantity of supply of urban and rural elderly service institutions, but there is a lack of real evaluation of the effective supply of elderly services from the perspective of the actual needs of individuals; thirdly, most studies have used macro-level data to construct indicators for analysis, but in practice, the evaluation of the quality and effectiveness of the supply of elderly services has to be made from the perspective

of individuals. Based on this, this study designs a research questionnaire to conduct field research and collects information on individual needs for elderly care from multiple perspectives such as material, spiritual, economic security levels, and expenditure. In addition, we construct a reasonable model of effective supply of elderly care services at three levels: total, quality, and structure of elderly care supply, and use the entropy-based Topsis model to evaluate the level of effective supply of elderly care services in each region comprehensively.

2. THEORETICAL BASIS AND CONCEPT DEFINITION

2.1 Concept definitions

The supply of elderly services involves clothing, food, housing, and transportation, as well as living and medical care, and its subjects include the government, enterprises and institutions, social organizations, etc., with significant public welfare characteristics [9]. At the same time, the supply of elderly services is manifested in diverse elderly care models, including family, social, community, and institutional, and new elderly care models such as "Internet+" elderly care and PPP elderly care have gradually emerged with the advancement of the Internet.

Despite the rapid development of the elderly care service industry, it has not solved the long-standing problem of oversupply and imbalance between supply and demand in the elderly care service industry, and the "effectiveness" of the supply level is worrying. Whether the existing supply of elderly services can be effectively supplied, allocated and utilized, and whether the supply and demand of elderly services are applicable, matched, and coordinated are issues that need to be addressed at this stage.

2.2 Theoretical basis

2.2.1 Hierarchical Theory of Needs

Abraham Maslow progressively divided human needs into five levels from low to high: physiological, security, social needs, respect, and self-worth. The progressive relationship shows that only when the lower-level needs can be satisfied will higher-level needs be pursued. His theory also provides a direction for upgrading the supply of elderly services—analyze the effectiveness of elderly services demands from all levels of needs according to the heterogeneity of elderly needs.

2.2.2 Welfare Pluralism

The core idea of welfare pluralism, which originated

in the 1970s, lies in the plurality of welfare providers, i.e., the welfare provider changes from the original single government to a pluralistic model of provision in which government, social organizations, and families are the main actors. The early theoretical dissection originated from the welfare trichotomy [10], which later evolved into the quadratic and quintuplet approaches. All of these approaches go beyond the traditional binary system (government and market) and all cover the characteristics of - decentralization (central and local, social and market) and participation (pluralistic participating agents). The perspective of diversified supply subjects has significant implications for the improvement of the supply structure of the aging industry in China [11].

According to Maslow's Hierarchy of Needs theory, individuals will pursue higher-level social needs such as social identity and self-worth realization after satisfying basic material needs. Therefore, the needs of the elderly are heterogeneous at different levels. For the lower levels of needs, the supply of elderly care should be concentrated on the basic needs of the elderly, while for the higher needs, the supply should be implemented at the high-end service level above the basic needs.

Based on the original theoretical analysis, the higher the level of supply, the higher the degree of satisfaction of the elderly needs at the same level of demand, so the empirical model should support this theory and serve as the basic theory to support the subsequent hypothesis.

3. IRSEARCH DESIGN

3.1 Index Selection and Data Sources

The questionnaire survey of three provinces-Henan, Jiangxi and Ningxia found that the elderly pension demands are at different levels. The demand for lower levels endowment supply should be implemented in the basic demand side, for higher levels of pension, supply should be implemented in basic requirements. According to different needs of the elderly has put forward a more effective comprehensive pension service model.

In accordance with the above theoretical analysis, the survey and index have been designed to reflect local endowment service supply level and the elderly endowment demand. Comprehensive well-being index for the aged (CFAI) from the aspects of micro main body defines old-age service level of effective supply, and demand for different levels of levels, the greater the effective supply level, the higher the value of CFAI.

3.1.1 Individual Supply Side Satisfaction Selection Principle

A reasonable degree of satisfaction index system should be able to adequately measure vital practical needs of the elderly. Liu Yimei thinks a reasonable social endowment service system is the package. From the supply side view, building the index system should be able to reflect the current social endowment system in the real implementation of older people.

TABLE 1. SATISFACTION INDEX SYSTEM

Primary Index	Secondary Index
Material	Basic Needs Life Care (Pension) Health Care
	Social Relations Spiritual Comfort leisure Entertainment
Spiritual	

3.1.2 Demand Side Selection Principle

According to Maslow's demand theory analysis, measuring requirements of the individual needs to take into account the different levels of demand and the important influence factors on any account, in the basic personal lives..

TABLE 2. RESIDENTS ENDOWMENT DEMAND

Primary Index	Secondary Index	Tertiary indicators
Material	Basic Needs	1.Foods 2.Clothes 3.House
	Life Care (Pension)	1.Take Care of Yourself 2.Children Care 3.Neighborhood Help 4. Community 5. Government Care
	Health Care	1.Near the Institutes 2. Their Children Care 3.Providing Health Care services 4. Other Nursing Home
Spiritual	Social Relations	1.Children Relatives together 2.Acquaintances Neighbors 3.Endowment Busy
	Spiritual Comfort	1.Children Filial Piety 2. Neighborhood Relations 3.Other Old People' s Chat 4. Television Time
	Leisure	1.TV 2.Cards 3.Traveling 4.Dancing
Old-age security	Insurance	1.New Rural Insurance 2.Town Worker Insurance

Expenses	Living Expenses	3.the Authority Institution
	Medical Expenses	1.Medical Expenses 2.Reimbursement Ratio 3.Number of Illness

3.2 Data Resource

In this paper, data from field visit in Henan Jiangxi and Ningxia, adopt open mode sampling survey, and via mobile phone recording and on-the-spot interviews collected more than 600 copies of questionnaires. Every questionnaire had detailed measures about the actual status of the residents' endowment, pension, raising demand.

3.3 Model Architecture and Descriptive Statistics

Through architecture residents demand side, the old-age security end and pension satisfaction index comprehensive evaluation system and by the method based on Entropy Weight Topsis for composite scores.

3.3.1 AHP for preference weight

For a time order of multiple choice, choose set a certain people to have an option. Indicators were chosen, and will be importance index according to the personal willingness, Order value with said

$$i = 1, 2, \dots, n$$

The smaller the sorting ryoma then the options to the respondents, the more important. Thus the choice of the respondents selected vector can be expressed as

$$(v_1, v_2, \dots, v_n)^T$$

The angle of standard for the order value, v for the i on the corresponding option order value, and its size of the reaction strength demand of endowment. The measure index quantitative score for:

$$score = (w_1, w_2, \dots, w_n) \times (v_1, v_2, \dots, v_n)^T \tag{1}$$

Fristly, build scoring matrix.

TABLE 3. SCORING MATRIX

R	r ₁	r ₂	...	r _j
r ₁	r ₁₁	r ₁₂	...	r _{1j}
r ₂	r ₂₁	r ₂₂	...	r _{2j}
...
r _i	r _{i1}	r _{i2}	...	r _{ij}

According to the scores of subjective weights, λ_j are calculated,

$$\lambda_j = \sqrt{\sum_{j=1}^n R_{ij}} \tag{2}$$

The biggest characteristic root for the matrix is:

$$\lambda_{max} = \frac{1}{n} / \sum_{j=1}^n \frac{R \times \lambda_j}{\lambda_j} \tag{3}$$

In addition to the subjective evaluation weight Table 3 consistency inspection, the formula is:

$$CI = \frac{\lambda_{max} - n}{n - 1}, \quad CR = \frac{CI}{RI} \tag{4}$$

Consistency inspection according to the above formula, the RI is the mean random consistency index, its value is related to value table.

3.3.2 Entropy Topsis evaluation model

First, through the data collecting:

Then the various indexes are treated by X:

$$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{bmatrix};$$

To standardize X processing for Z

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}}$$

Probability matrix P, the calculated standardized data for each elements is

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^n z_{ij}};$$

Calculate the information entropy e_j and information utility value d_j , and calculation of entropy:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n p_{ij} \ln(p_{ij}), \quad d_j = 1 - e_j, \quad w_j = d_j / \sum_{j=1}^m d_j \tag{5}$$

Then construct weighted matrix

$$C = (c_{ij})_{m \times n}, \quad c_{ij} = z_{ij} \times w_j;$$

Then calculate the positive ideal solution and negative ideal solution, and then calculate the distance.

Object i to the positive ideal solution is

$$s_i^0 = \sqrt{\sum_{j=1}^8 (c_{ij} - c_j^0)^2}, \quad i = 1, 2, 3, 4, 5;$$

Object i to the negative ideal solution is

$$s_i^1 = \sqrt{\sum_{j=1}^8 (c_{ij} - c_j^1)^2}, \quad i = 1, 2, 3, 4, 5 \tag{6}$$

Finally, to calculate the index of all the schemes sorting value, and carries on the sorting:

$$f_i = s_i^0/s_i^1 + s_i^0, i = 1, 2, 3, 4, 5 \quad (7)$$

3.4 Descriptive statistics of questionnaire indicators

TABLE 4. BASIC INFORMATION QUESTIONNAIRE

Province	Sex	Age(year)	Family numbers above 60 years old	Living expenses (Ten thousand yuan)
Henan	Male : 51% Female : 49%	0-30 : 12%	0 : 20%	0-1 : 8%
		30-40 : 15.5%	1 : 18%	1-2 : 16%
		40-50 : 17%	2 : 54%	2-3 : 15.5%
		50-60 : 30%	3 : 3%	3-4 : 15.5%
		>60 : 25.5%	4 : 3.5%	4-5 : 16%
			5 : 1.5%	5 以上 : 28.5%
Jiangxi	Male : 60.6% Female:39.4%	0-30 : 17.2%	0 : 14.4%	0-1 : 0%
		30-40 : 6.1%	1 : 20%	1-2 : 15%
		40-50 : 11.7%	2 : 41.7%	2-3 : 43.3%
		50-60 : 23.3%	3 : 23.9%	3-4 : 23.9%
		>60 : 41.7%	4 : 0	4-5 : 13.9%
		5 : 0	5 以上 : 3.9%	
Ningxia	Male : 54.5% Female:45.5%	0-30 : 13.5%	0 : 6%	0-1 : 15%
		30-40 : 14%	1 : 34%	1-2 : 30.5%
		40-50 : 14%	2 : 52.5%	2-3 : 21.5%
		50-60 : 13.5%	3 : 3.5%	3-4 : 13.5%
		>60 : 45%	4 : 4%	4-5 : 3%
		5 : 0	5 以上 : 16.5%	

4. THE THREE PROVINCES OF ENDOWMENT EFFECTIVE SUPPLY EVALUATION RESULTS

4.1 indicators determination

All kinds of indexes of the entropy weight method is adopted to lower weighting, and adopts weighted average method.

$$A_i = \sum \alpha X_i \quad (8)$$

4.1.1 The provincial residents endowment satisfaction (effective supply) determination

TABLE 5. SATISFACTION EVALUATION INDEX WEIGHT

Province	Basic needs	Life Care (Pension)	Health Care	Social	Spiritual Comfort	leisure
Henan	0.120	0.124	0.153	0.085	0.099	0.419
Jiangxi	0.120	0.224	0.201	0.038	0.215	0.202
Ningxia	0.443	0.136	0.132	0.093	0.084	0.112

TABLE 6. PROVINCES SATISFACTION DESCRIPTIVE STATISTICS

Province	Obs	Min	Max	Mean	Std.Dev.
Henan	200	1.2004	4.0908	2.360928	0.5902113
Jiangxi	180	0.1956	4.2803	2.625014	0.8816627

Ningxia 200 1.4202 20.5145 2.941884 1.3989737

This table can be seen that, by comparison, Ningxia residents endowment service satisfaction is highest, and the evaluation of a small number of extremely high phenomenon; and on average, residents in Henan province pension satisfaction, the lowest in the three provinces of Jiangxi province.

4.1.2 Residents Endowment Needs Assessment to Determine

TABLE 7. PENSION DEMAND EVALUATION INDEX WEIGHT

Province/Wight	Basic needs	Life Care (Pension)	Health Care	Social
Henan	0.110	0.069	0.043	0.031
Jiangxi	0.051	0.031	0.059	0.052
Ningxia	0.053	0.027	0.035	0.059

Province/Wight	Leisure	Insurance	Living Expenses	Medical Expenses
Henan	0.078	0.119	0.248	0.302
Jiangxi	0.071	0.121	0.109	0.507
Ningxia	0.063	0.126	0.410	0.227

TABLE 8. PROVINCES RESIDENTS DESCRIPTIVE STATISTICS

Province	Obs	Min	Max	Mean	Std.Dev.
Henan	200	0.6053	2.5332	1.238554	0.3284933
Jiangxi	180	0.7117	2.8706	1.332957	0.4883419
Ningxia	200	0.6093	2.9839	1.042667	0.3302749

Evaluation according to the requirements of residents endowment composite scores can be seen that, taken together, residents in Jiangxi province, one of the highest demand for pension services; Henan times; while Ningxia endowment demand the lowest in the three provinces.

4.2 The provincial pension service level evaluation of the effective supply and ranking

Analysis of the three provinces of pension service demand evaluation and individual residents satisfaction evaluation can be found that the average satisfaction of three provinces are still in the medium level, and Ningxia is medium. And from the point of demand, Ningxia is low, in Henan province and Jiangxi province for the high level of demand.

TABLE 9. THE RESULT OF EFFECTIVE SUPPLY LEVEL

Province/Wight Satisfaction	Demand	Effective supply level	
Henan	low	hierarchy	Low
Jiangxi	Low	Mid-high	Low
Ningxia	hierarchy	Mid-low	hierarchy

TABLE 10.ENTROPY TOPSIS MODEL SCORE

Province	Satisfaction	Demand	Old-age Security	Health Care	Scores	Rank
Henan	2.3609	2.5332	0.4758	3.5770	0.490	2
Jiangxi	2.6250	2.8706	0.9775	1.7998	0.508	1
Ningxia	2.9419	2.9839	0.6930	2.7482	0.477	3

4.3 Determination of relationship

According to the results of the score, in order to further explore and analysis, resident service supply satisfaction and explore the relationship between the pension service.

$$Degree_{satisfaction} = \beta_0 + \beta_1 Dregree_{demand} + \beta_2 Contorls_i + \varepsilon_i \tag{9}$$

TABLE 11.RESULT THE CORRELATION OF MODEL

type	Full sample	Full sample	Henan	Jiangxi	Ningxia
D_demand	0.113 (0.108)	-0.495*** (0.170)	-0.116* (0.161)	-0.616* (0.512)	-0.023 (0.503)
Control	NO	YES	YES	YES	YES
Fee		0.008 (0.163)	0.031 (0.029)	-0.227** (0.090)	-0.009 (0.029)
Life		0.006 (0.195)	-0.019 (0.039)	0.083 (0.121)	-0.016 (0.034)
medical		0.042*** (0.008)	0.019** (0.008)	0.0691 (0.027)	0.025 (0.019)
cons	2.508*** (0.136)	2.920*** (0.159)	2.33*** (0.174)	3.337*** (0.447)	2.875*** (0.420)
N	580	580	200	180	200
R ²	0.002	0.050	0.051	0.126	0.013

Note: *, **, *** indicate significant at the 10%, 5% and 1% levels respectively, with standard errors in parentheses.

From the point of the whole sample, residents have a negative correlation relationship between demand and satisfaction degree, that under the current supply, the higher the residents' demand, the less satisfaction. Provincial points, the relationship between Henan and Jiangxi negative correlation, and no obvious correlation between Ningxia.

5. CONCLUSION

5.1 Conclusion

According to the residents in this paper, the three provinces endowment satisfaction and demand such as comprehensive evaluation can be seen, the three provinces residents' satisfaction with the status of old-age service is low. So now the provinces of pension

service still have insufficient effective supply. Effective supply in Jiangxi province level the highest in the three provinces, Henan province times, Ningxia is lowest.

5.2 Suggestions

From the point of three provinces in the overall situation, the effective supply of endowment service are also insufficient, there is a lot of room to improve. Mainly reflected in the health care and spiritual consolation in full. Each region should increase the elderly medical fast-track, elderly make a diagnosis and give treatment, to provide more targeted to increase beds. For spiritual comfort, with most old people rely on children, and only children family is very difficult to do in real life, the government should set up public welfare and community.

The low satisfaction mainly embodied in the most populous province of Henan province, the per capita pension institutions and inadequate health care per capita, most people experience is poor. The endowment and yearning for the high quality and demand, the local government can adjust measures to local conditions, to carry out flexible "community endowment + medical", flexible, high quality. Ningxia demand for pension service level is not high, but the satisfaction is low, local can promote the quality of original endowment service, realize the facilities.

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