Evaluating the Consistency of Long-term Care Insurance Policy Using PMC Index Model

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Abstract. The pilot of long-term care insurance (LTCI) system is an important step for constructing a national wide LTCI system in China. Based on the 57 LTCI policies developed in 15 pilot areas in China, this paper evaluated the LTCI policies by building a PMC index model with 10 primary variables and 44 two-level variables. The results showed that the PMC index valued between 6.00 and 9.22. Qingdao city was the only area which had the highest level of policy strength among the pilot areas. The main policy inconsistency related to the following six aspects: the security population, the financing source, the care services, the security level and the conditions of security.

Introduction

The establishment of a long-term care insurance (LTCI) system has assumed vital strategic importance for facing the challenges of population aging in China [1]. Since the Chinese government’s pilot LTCI policy was introduced in 2016, attention has been increasingly paid to the implementation and operational effects of LTCI. Current studies consist chiefly of design and policy comparisons of the LTCI system across the pilot areas, and including the following dimensions of insured participants, fund-raising, provision of services and benefits payments [2-3]. These researches are largely based on LTCI system pilot-area programmatic documents, and are generally of qualitative nature. Accordingly, there has been relative neglect both of system policy-support documents, and of a quantitative approach to the evaluation of LTCI policies. This study aims to address this imbalance by constructing a policy evaluation index system and using all LTCI policy documents issued in the pilot areas up to the end of July, 2019. Quantitative analyses was performed to examine the consistency of these LTCI policies.

Data Source and Method

The materials we investigated are publicly available from the government website. These include relevant policy documents on LTCI pilot as issued by authorities (such as the General Offices of the People’s Governments, as well as the Human Resources and Social Security Bureau in 15 pilot cities). Note that expired policy documents were excluded, leaving us with 57 in total. These documents were all issued between 2015 and 2019, and include the guidelines, trial measures, and detailed rules of the LTCI system. Notably, Nantong issued the largest number of policies (10), followed by Shanghai, Qingdao, and Suzhou (between 5 and 8), with Chongqing being the least prolific (1 document only).

The Policy Modeling Consistency (PMC) index model was used to evaluate the internal consistency of policies. This is achieved by calculating a PMC index [4]. Three primary steps are involved in constructing the PMC index model. Firstly, variables are specified and value rules are set up. This is followed by the establishment of multi-input-output tables, and the calculation of the PMC index. Due to its superior features relative to traditional models (the BP artificial neural network model, the gray relational model, the analytic hierarchy model, and the fuzzy comprehensive evaluation model), the PMC index model has been extensively employed in the field of policy evaluation [5-6].
Construction of PMC Index Model

Specification on Model Variables and Value Rules

Our study employs NLPIR data processing software to process word segmentation and word frequency of policy texts—and then to collect high-frequency words, and to set up model variables in combination with the main dimensions of LTCI policy design in the literature. Table 1 lists the 10 constructed primary variables and the 44 secondary variables. For example, policy property (X1) indicates the objective and effect of policy implementation, including four secondary variables such as innovation, supervision, guidance, and support.

Table 1. Variables for evaluating long-term care insurance policies.

| Number | Primary Variable       | Number | Secondary Variable     | Number | Secondary Variable     |
|--------|------------------------|--------|------------------------|--------|------------------------|
| X1     | policy property        | X1:1   | innovation             | X1:2   | supervision            |
|        |                        | X1:3   | guidance               | X1:4   | support                |
| X2     | policy evaluation      | X2:1   | well-founded           | X2:2   | scientific protocol    |
|        |                        | X2:3   | clear objective        | X2:4   | talent training        |
| X3     | insured population     | X3:1   | urban employees        | X3:2   | urban residents        |
|        |                        | X3:3   | urban and rural residents | X3:4 | urban and rural elderly |
| X4     | funding source         | X4:1   | medical insurance fund | X4:2   | individual payment     |
|        |                        | X4:3   | financial subsidy      | X4:4   | with employer’s subsidy|
|        |                        | X4:5   | social organization    | X4:6   | personal donation      |
|        |                        | X4:7   | donations              |        |                        |
| X5     | care form              | X5:1   | clinical care          | X5:2   | institutional care     |
|        |                        | X5:3   | community care         | X5:4   | home care              |
| X6     | care content           | X6:1   | medical care           | X6:2   | daily-life care        |
|        |                        | X6:3   | preventive care        | X6:4   | rehabilitation care    |
|        |                        | X6:5   | psychological counseling| X6:6  | hospice care           |
|        |                        | X6:7   | Others                 |        |                        |
| X7     | care organization      | X7:1   | medical organization   | X7:2   | endowment institution  |
|        |                        | X7:3   | care service organization | X7:4 | community health service center |
|        |                        | X7:5   | organization           | X7:6   | others                 |
|        |                        |        | day care organization  |        |                        |
| X8     | insurance level        | X8:1   | fixed payment          | X8:2   | paid proportionally from the fund |
|        |                        | X8:3   | paid daily             | X8:4   | paid monthly           |
|        |                        | X8:5   | others                 |        |                        |
| X9     | insurance qualification| X9:1   | disability classification| X9:2 | dementia evaluation    |
|        |                        | X9:3   | evaluation             | X9:4   | medical institution certificate |
|        |                        |        | Barthe index           |        |                        |

After determining primary and secondary variables, the following rule was adopted to calculate the values of the variables: all secondary variables are expressed in binary form. This gives each secondary variable relatively equivalent weight, so that each variable plays an equally important role. In other words, if the policy contains the corresponding secondary variable, the value of the secondary variable is 1; otherwise it is 0.

Construction of Multi-Input-Output Table

The multi-input-output table is a set of data analysis framework which can store a large volume of data to calculate any individual variable. Establishment of a multi-input-output table is the basis for primary-variable calculation. Each primary variable includes several secondary variables which, as explained above, are all of equal importance. The multi-input-output table is constructed as shown in Table 2 according to the index system established in Table 1.
PMC Index Calculation

Following Ruiz Estrada [4], the primary and secondary variables are entered into the multi-input-output table to calculate the PMC index of the primary variable and the total PMC index of policy according to formula (1) and formula (2), respectively.

\[
X_t \left( \sum_{i=1}^{n} \frac{X_i}{T(X_i)} \right), t = 1,2,3 \ldots
\]

(1)

In formula (1), T is the number of secondary variables. The subscript t means the primary variable. The subscript i means the secondary variable.

\[
PMC = X_1 \left( \sum_{a=1}^{4} \frac{X_{1a}}{4} \right) + X_2 \left( \sum_{s=1}^{4} \frac{X_{2s}}{4} \right) + X_3 \left( \sum_{d=1}^{4} \frac{X_{3d}}{4} \right)
\]

\[
+ X_4 \left( \sum_{j=1}^{6} \frac{X_{4j}}{6} \right) + X_5 \left( \sum_{g=1}^{7} \frac{X_{5g}}{4} \right) + X_6 \left( \sum_{h=1}^{7} \frac{X_{6h}}{7} \right)
\]

\[
+ X_7 \left( \sum_{i=1}^{8} \frac{X_{7i}}{6} \right) + X_8 \left( \sum_{i=1}^{9} \frac{X_{8i}}{5} \right) + X_9 \left( \sum_{i=1}^{10} \frac{X_{9i}}{4} \right) + X_{10}
\]

(2)

In terms of the calculated PMC index the policies can be classified into several levels. This allows a level evaluation of the long-term care policy by pilot areas, which in turn helps to identify policy weaknesses. Evaluation criteria adopted from reference [7] are shown in Table 3.

| Level          | The Total PMC Index | The PMC Index of Primary Variables |
|----------------|---------------------|-----------------------------------|
|                | 0-4.99             | 5.00-6.99                         | 7.00-8.99 | 9.00-10 |
| The Total PMC Index | weak    | medium | relative strong | strong |
| The PMC Index of Primary Variables | 0-0.49 | 0.5-0.69 | 0.7-0.89 | 0.90-1 |
| Level          | weak    | medium | relative strong | strong |

Policy Evaluation Results and Analysis

PMC Index and Ranking

The PMC index and ranking LTCI policies in 15 pilot areas are shown in Table 4. It can be seen that the PMC indices are from 6.00 to 9.22, with an average value of 7.26. The three regions with the highest PMC indices are Qingdao, Nantong, and Jingmen; the lowest three are Anqing, Chongqing, and Qiqihar. Note that there are 5 pilot areas with PMC indices higher than the average value, the remaining 10 are lower than the average. In terms of the mean value of the PMC index of
primary variables, five of them including X3, X4, X6, X8 and X9 are lower than the total mean value (0.726). In particular, the mean values of X3 and X9 are substantially lower than the total mean value, indicating that the 15 pilot areas have weak policy both in terms of insured population and insurance qualification.

Table 4. PMC index and ranking of 15 pilot areas.

| Areas   | X1   | X2   | X3   | X4   | X5   | X6   | X7   | X8   | X9   | X10  | PMC index | Ranking |
|---------|------|------|------|------|------|------|------|------|------|------|-----------|---------|
| Chengde | 1.00 | 1.00 | 0.25 | 0.83 | 1.00 | 0.71 | 0.67 | 0.60 | 0.50 | 1.00 | 7.56      | 5       |
| Changchun | 1.00 | 0.50 | 0.50 | 0.33 | 1.00 | 0.43 | 0.67 | 0.60 | 0.75 | 1.00 | 6.78      | 11      |
| Qiqihar | 1.00 | 1.00 | 0.25 | 0.67 | 0.75 | 0.43 | 0.67 | 0.40 | 0.50 | 1.00 | 6.66      | 13      |
| Shanghai | 1.00 | 1.00 | 0.50 | 0.33 | 1.00 | 0.71 | 1.00 | 0.60 | 0.50 | 1.00 | 7.65      | 4       |
| Nantong | 1.00 | 1.00 | 0.83 | 0.75 | 0.71 | 0.83 | 0.80 | 0.75 | 1.00 | 1.00 | 8.68      | 2       |
| Suzhou  | 1.00 | 0.75 | 1.00 | 0.50 | 0.75 | 0.71 | 0.83 | 0.40 | 0.25 | 1.00 | 7.20      | 7       |
| Ningbo  | 1.00 | 1.00 | 0.25 | 0.17 | 1.00 | 0.71 | 0.67 | 0.20 | 0.75 | 1.00 | 6.75      | 11      |
| Anqing  | 1.00 | 0.50 | 0.25 | 0.50 | 0.75 | 0.29 | 0.67 | 0.80 | 0.25 | 1.00 | 6.00      | 15      |
| Shangrao | 1.00 | 0.75 | 1.00 | 0.83 | 0.75 | 0.29 | 0.67 | 0.40 | 0.50 | 1.00 | 7.19      | 8       |
| Qingdao | 1.00 | 1.00 | 1.00 | 0.67 | 1.00 | 1.00 | 1.00 | 0.80 | 0.75 | 1.00 | 9.22      | 1       |
| Jingmen | 1.00 | 1.00 | 0.50 | 0.83 | 0.75 | 1.00 | 0.83 | 0.60 | 0.25 | 1.00 | 7.77      | 3       |
| Guangzhou | 1.00 | 1.00 | 0.25 | 0.17 | 1.00 | 0.86 | 0.83 | 0.60 | 0.50 | 1.00 | 7.21      | 6       |
| Chongqing | 1.00 | 0.75 | 0.25 | 0.83 | 1.00 | 0.43 | 0.50 | 0.20 | 0.25 | 1.00 | 6.21      | 14      |
| Chengdu | 1.00 | 1.00 | 0.25 | 0.33 | 0.75 | 0.86 | 0.83 | 0.40 | 0.50 | 1.00 | 6.92      | 10      |
| Shihezi | 1.00 | 0.75 | 0.50 | 0.83 | 0.75 | 0.71 | 0.50 | 0.80 | 0.25 | 1.00 | 7.10      | 9       |

| AVE     | 1.00 | 0.87 | 0.52 | 0.58 | 0.87 | 0.66 | 0.74 | 0.55 | 0.48 | 1.00 | 7.26      | —       |
| SV      | 0.00 | 0.21 | 0.60 | 0.43 | 0.14 | 0.34 | 0.20 | 0.37 | 0.40 | 0.00 | 0.11      | —       |

Note: The AVE is mean value; The SV is dispersion coefficient

Further, the range of the PMC index is 3.22, and the dispersion coefficient is 0.11, which together indicate great variation in the PMC index across the 15 regions. With regard to the dispersion coefficient, the values of X3, X4, and X9 are no less than 0.4, and the values of X6 and X8 are between 0.3 and 0.4. This points to highly significant differences in the insured population, funding sources, care contents, insurance level, and insurance qualifications of the 15 pilot areas.

**Policy Strength Level and Policy Weaknesses**

Policy strength levels in the pilot areas are divided according to the PMC index ranking criteria in Table 3; the results are given in Table 5. We observe that Qingdao is the sole pilot area with a “strong” policy level. Eight pilot areas achieve a “relative strong” policy score; these include Nantong, Jingmen, Shanghai, Chengde, Guangzhou, Suzhou, Shangrao, and Shihezi. There are six pilot areas with a “medium” policy level, namely Chengdu, Changchun, Ningbo, Qiqihar, Chongqing, and Anqing. Note that none of the 15 areas recorded a “weak” policy level.
Table 5. Policy strength level and policy weaknesses in 15 pilot areas.

| Areas    | PMC Index | Policy Strength Level | Policy Weaknesses |
|----------|-----------|-----------------------|-------------------|
| Qingdao  | 9.22      | strong                | none              |
| Nantong  | 8.68      | relative strong       | none              |
| Jingmen  | 7.77      | relative strong       | X9                |
| Shanghai | 7.65      | relative strong       | X4                |
| Chengde  | 7.56      | relative strong       | X3                |
| Guangzhou| 7.21      | relative strong       | X3, X4            |
| Suzhou   | 7.20      | relative strong       | X8, X9            |
| Shangrao | 7.19      | relative strong       | X6, X8            |
| Shihezi  | 7.10      | relative strong       | X9                |
| Chengdu  | 6.92      | medium                | X3, X4, X8        |
| Changchun| 6.78      | medium                | X4, X6            |
| Ningbo   | 6.75      | medium                | X3, X4, X8        |
| Qiqihaer | 6.66      | medium                | X3, X6, X8        |
| Chongqing| 6.21      | medium                | X3, X6, X8, X9    |
| Anqing   | 6.00      | medium                | X3, X6, X9        |

In terms of the primary variable of policy strength in each region, Qingdao and Nantong have no policy weaknesses, while the policy weaknesses in the other regions are mainly X3 (insured population), X4 (funding source), X6 (nursing content), X8 (insurance level), and X9 (insurance qualification). The number of policy weaknesses in those regions with a “relatively strong” policy is 0 to 2. Within this group, Jingmen, Shanghai, Chengde, and Shihezi have but one policy weakness, (X9 (insurance qualification), X4 (funding source), X3 (insured population) and X9 (insurance qualification), respectively). In areas recording a “medium” policy-strength level, the number of weaknesses ranges up to and including 4.

Conclusion

A PMC index model consisting of 10 primary variables and 44 secondary variables was constructed to evaluate the consistency of LTCI policies in 15 pilot areas in China. The results showed variation in both policies and implementation schemes as formulated in the pilot areas. These differences are primarily within the following five domains: insured population, funding source, nursing content, insurance level and insurance qualification. We suggest that pilot areas should improve the consistency of LTCI policies to build Chinese national LTCI system by perfecting the LTCI policy text, as well as improving the policy weakness and innovating the supply of care services.

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