2020 4th International Conference on Modelling, Simulation and Applied Mathematics (MSAM 2020)
ISBN: 978-1-60595-674-9

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

Rong PENG, Qing-kang CHEN, Xin LI and Kai-xin CHEN

National Economics Research Center, Guangdong University of Finance & Economics, Guangzhou, China

Keywords: Policy evaluation, PMC index model, Long-term care insurance.

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 X1:3	innovation guidance	X1:2 X1:4	supervision support
X2	policy evaluation	X2:1 X2:3	well-founded clear objective	X2:2 X2:4	scientific protocol talent training
X3	insured population	X3:1 X3:3	urban employees urban and rural residents	X3:2 X3:4	urban residents urban and rural elderly
X4	funding source	X4:1 X4:3 X4:5	medical insurance fund financial subsidy social organization donations	X4:2 X4:4 X4:6	individual payment with employer's subsidy personal donation
X5	care form	X5:1 X5:3	clinical care community care	X5:2 X5:4	institutional care home care
X6	care content	X6:1 X6:3 X6:5 X6:7	medical care preventive care psychological counseling Others	X6:2 X6:4 X6:6	daily-life care rehabilitation care hospice care
X7	care organization	X7:1 X7:3 X7:5	medical organization care service organization day care organization	X7:2 X7:4 X7:6	endowment institution community health service center others
X8	insurance level	X8:1 X8:3 X8:5	fixed payment paid daily others	X8:2 X8:4	paid proportionally from the fund paid monthly
X9	insurance qualification	X9:1 X9:3	disability classification evaluation Barthel index	X9:2 X9:4	dementia evaluation medical institution certificate
X10	policy disclosure				

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.

Table 2. The multi-input-output table.

X1					X2				X3			
X1:1	X1:2	X1:3	X1:4		X2:1	X2:3	X2:4		X3:1	X3:2	X3:3	X3:4
X4							X5					
X4:1	X4:2	X4:3	X4:4	X4:5	X4:6		X5:1	X5:2	X5:3	X5:4		
X6							X7					
X6:1	X6:2	X6:3	X6:4	X6:5	X6:6		X7:1	X7:2	X7:3	X7:4	X7:5	X7:6
X8										X10		
X8:1	X8:2	X8:3	X8:4	X8:5		X9:2	X9:3	X9:4		X10		

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.

$$X_t\left(\sum_{i=1}^{n}\frac{X_{ti}}{T(X_{ti})}\right), t = 1,2,3\cdots \tag{1}$$

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

$$PMC = \left[\begin{array}{l} X_1\left(\sum_{a=1}^{4}\frac{X_{1a}}{4}\right)+X_2\left(\sum_{s=1}^{4}\frac{X_{1s}}{4}\right)+X_3\left(\sum_{d=1}^{4}\frac{X_{1d}}{4}\right) \\ +X_4\left(\sum_{f=1}^{6}\frac{X_{1f}}{6}\right)+X_5\left(\sum_{g=1}^{4}\frac{X_{1g}}{4}\right)+X_6\left(\sum_{h=1}^{7}\frac{X_{1h}}{7}\right) \\ +X_7\left(\sum_{i=1}^{6}\frac{X_{1j}}{6}\right)+X_8\left(\sum_{i=1}^{5}\frac{X_{1k}}{5}\right)+X_9\left(\sum_{i=1}^{4}\frac{X_{1l}}{4}\right)+X_{10} \end{array}\right] \tag{2}$$

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.

Table 3. Evaluation criteria of PMC index.

The Total PMC Index	0-4.99	5.00-6.99	7.00-8.99	9.00-10
Level	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
Qiqihaer	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	1.00	0.83	0.75	0.71	0.83	0.80	0.75	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	12
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.

Acknowledgment

This work was supported by the National Natural Science Foundation of China (71503054) and Scientific Research Project of the Education Department of Guangdong Province (2018WZDXM004).

References

[1] R. Jing, H. Zhang and H. Fang, Implications of international experience for building China's long-term care insurance system, Chinese Health Economics, 2017, pp. 89-93.

[2] Y. Zhu and A. Österle, "China's policy experimentation on long-term care insurance: Implications for access," The International Journal of Health Planning and Management, 2019, pp. 1-14.

[3] Q. Wang, M. Tang, and H. Cao. Comparative study on the long-term nursing insurance pilot service projects in China. Health Economics Research, 2018, pp. 38-42.

[4] Y. Zhang and H. Qie, Quantitative evaluation innovation policies of the state council: based on the PMC-Index model, Science & Technology Progress and Policy, 2017, pp. 127-136.

[5] Y. Zhang and Y. Zhou, Policy instrument mining and quantitative evaluation of new energy vehicles subsidies, China population，resources and environment, 2017, pp. 188-197.

[6] MAR. Estrada, Policy modeling: definition, classification and evaluation. Journal of Policy Modeling, 2011, pp. 523-536.

[7] MAR. Estrada and Yap S F, Nagaraj. Beyond the ceteris paribus assumption: modeling demand and supply assuming omnia mobilis. Internationl Journal of Economics Research, 2008(2): 185-194.