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Analysis of Commercial Automobile Insurance Operating Efficiency and Its Influence Factors of Chinese Property Insurance Companies

-- An Empirical Analysis Based on SBM-DEA Method and Tobit Model

Han Hong[1, a]

[1]University of Chinese Academy of Social Sciences, Beijing, China

[a]honghan516@163.com

Abstract

This paper selects the operation data of commercial car insurance of 25 companies in 2012-2016, and calculates the efficiency of commercial car insurance by using SBM-DEA model, also analyzes the main factors affecting the efficiency of commercial car insurance operation by using the Tobit panel data estimation model. The main conclusions are as follows: The overall efficiency value of the commercial insurance company is low, and only 2 of the 25 property insurance companies tested reached the effective frontier, there is still a large space for improvement, the redundancy of low efficiency companies is more serious; In the past three years, the technical efficiency value has remained stable and the upward trend is not obvious. Commercial car insurance premium income share, market share, cost rate, company asset size, all have different degrees of impact on the efficiency value of commercial car insurance.

Keywords

Commercial insurance efficiency; SBM-DEA model; Impact factors.

1. INTRODUCTION

Commercial car insurance usually refers to the insurance that the owner of the vehicle voluntarily insured after buying the traffic compulsory insurance.

After the reform and opening up, the rapid growth of economy in China has brought about the popularization of automobiles, and also create a huge space for the development of the car insurance. Since 2014, China has become the world's second largest car insurance market. The original premium income of China's insurance industry have reached 983.466 billion Yuan in 2017. And the premium income of car insurance have achieved to 752.107 billion Yuan, included ￥565.206 billion Yuan in commercial car insurance. And commercial car insurance premium income accounts for about 57.47% of the original premium income of the property insurance industry in China. With the rapid development of the industry, it is also accompanied by the mixed problems, One example is the high monopoly of the industry, According to the Yearbook of China's Insurance 2017, PICC earned 176.064 billion Yuan in commercial car insurance premium in 2016, accounting for 31.15% of the market; Ping An realized the commercial car insurance premium income of 114.375 billion Yuan, accounting for 20.24% of the market(see Table 1). The high degree of industry monopoly has become a very serious problem.

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The important position of commercial automobile insurance plays an important role in the development of insurance industry. In the face of fierce market competition, how the insurance company should improve the operating efficiency of commercial car insurance business and enhance competitiveness has become an urgent problem to be solved.

But there's very little research on commercial car insurance. Most scholars in China are mostly focused on traffic compulsory insurance in the study of the operational efficiency of insurance companies (Nan-Jun Zhu and Zhao-Jong Zhang, 2015; Ming-Lai Zhu and Yan Lu, 2011; Hong-Zhong Gao and Ze-tin Sun, 2010); Or focus on the overall efficiency of the insurance company (Wen-Ron Bing, 2015; Jing Lu, 2012; Chun-Hai Zhang, 2011). There is very little research on the efficiency of commercial car insurance operation. Firstly, there is many differences between commercial car insurance and traffic compulsory insurance in the scope of coverage, compensation scope, compensation limits and so on. Therefore, the study of traffic compulsory insurance cannot be equated with commercial car insurance. Secondly, commercial car insurance premium income accounts for more than 50% of the premium income of the property insurance company, so the operating efficiency of the insurance company is greatly affected by the business performance of commercial car insurance. Thus, we have to explore the operational efficiency of commercial car insurance alone.

As a result, for the first time, this study divests the traffic compulsory insurance, and take commercial car insurance as the main research object to analyze its operating efficiency and influencing factors, in order to fill the shortage of research in this area.

These are what this article is going to discuss, summed up with the following two points: (1) The operating efficiency of the commercial car insurance business of each property insurance company,(2) What is the degree of redundancy of inefficient corporate input elements ,and (3) The influencing factors of the operating efficiency of the commercial car insurance business.

The overall structure of this paper is as: Section 1 is the introduction; Section 2 is literature review; Section 3 are the SBM-DEA model and its results and analysis. Section 4 are Tobit model and its results and analysis; Section 5 is the conclusion and suggestion.

2. LITERATURE REVIEW

2.1. Research on the Operating Efficiency of the Insurance Industry

Since Charnes and Rhodes proposed data envelope analysis (DEA method) in 1978, it has been welcomed by many scholars because of its less restrictive conditions. The use of this method to measure efficiency is still very extensive until now. Cummins, Xie (2013) used DEA model and Malmquist Index analysis method to measure the operating efficiency of American financial insurance Company, as well as its productivity and economies of scale, the results showed that most small insurance companies showed increasing scale income while most large companies were decreasing. Yaisawarng, Saowaros (2014) used DEA method to estimate the operating efficiency of Thai property insurance Company in 2000-2007, the results showed that 74%-79% of non-life insurance companies in Thailand have efficiency, and there is economies of scale .Wei (2011) Selected DEA model to analyze the operating efficiency of Chinese and foreign insurance companies in China, He found that the operating efficiency of Chinese insurance companies is significantly higher than that of foreign insurance companies; Zhang (2011) used the DEA three-stage model to measure the operating efficiency of Chinese property insurance companies, and to analyze the economies of scale of each company, the results showed that most of companies are in the stage of increasing scale compensation, which can improve the scale efficiency by expanding the scale.

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2.2. Research on the Operating Efficiency of Automobile Insurance Business

Shao (2009) used DEA method to evaluate the operating efficiency of China's automobile insurance business before and after 2006, he found that the degree of automobile insurance control increased in 2006, which reduced the operating efficiency of the industry. Then he found out the factors that affect the efficiency through cross-sectional regression technology, the results showed that the cost rate had a very significant impact on the operation efficiency. Zhu, Lu (2011) compared the change of the cost rate of traffic compulsory insurance, and selected the earned premium, the payout rate and the comprehensive cost rate as the factors respectively, evaluated the operating condition of traffic compulsory insurance, and the motor vehicle ownership, highway mileage, income level, road freight volume and so on were taken as independent variables. The result showed that these independent variables have a significant correlation effect on the payout and operating cost of traffic compulsory insurance when considering the whole country, and the effect of these factors is not obvious when considering the specific scope of a province. From this, he concluded that the regional difference rate of carrying out traffic compulsory insurance is imminent. Zhu, Zhang (2015) selected operating expenses as input index, investment income and operating profit as output index, used DEA model to measure the operating efficiency of traffic compulsory insurance from the perspective of enterprise and society respectively, the results showed that the efficiency value calculated by the two perspectives is very different. At the same time, when choose Tobit panel data estimation model to study the influencing factors of enterprise and social efficiency, both urbanization rate and area have significant influence on them, so he suggested to increase urbanization rate and implement differentiated rates. Guo (2015) compared the relationship between the operating condition of commercial car insurance and the characteristics of property insurance company, studied the influence of property right nature, scale, operating years and other characteristics on the cost and expense index of commercial automobile insurance company. And the influence of the proportion of commercial car insurance business on the profit performance and risk performance of property insurance companies is studied by using regression model. The results showed that the proportion of commercial car insurance has a negative impact on the profits and risks of the insurance company, running a commercial car insurance business will reduce the profit level of the insurance companies.

On the one hand, scholars have abundant achievements in the study of the overall operating efficiency of the insurance industry, while there are few literatures to study the operating efficiency of specific insurance varieties. on the other hand, in the research on the Efficiency of automobile insurance management, most scholars focus on the study of traffic compulsory insurance, and there is little research on the efficiency of commercial car insurance operation. The purpose of this paper is to fill the gap in this research.

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3. OPERATIONAL EFFICIENCY OF COMMERCIAL CAR INSURANCE AND ITS CALCULATION

3.1. SBM-DEA Model

DEA is a non-parametric system method to deal with multi-input and multi-output decision-making problems. This method mainly establishes a decision unit (DMU)at first, then calculates the input-output ratio of the decision unit, and connects the outermost point to form an envelope line (an effective front surface), and the points on the effective front surface all realize the effective allocation of resources. In addition, the distance between other points to the cutting edge of production are calculated to judge the relative efficiency, and the main reasons for the inefficiency can be explored, so as to provide direction for the production and operation of the enterprise.

Traditional DEA models, such as CCR model and BCC model only evaluate efficiency from the ratio of input-output, the effect of relaxation variables on evaluation results is not taken into account. To correct the relaxation variable, K. Tone (2001) proposed the SBM model to peel off the influence of the relaxation variable. Assuming that each property company has m kinds of inputs, s kinds of outputs, x_{ij} is the amount of inputs, y_{ij} is the amount of outputs, s_i^- and s_r^+ represents relaxation variables for inputs and outputs, λ_j represents the weight, θ is the efficiency value. The model is shown below.

$$\begin{cases} \min\theta = \dfrac{1-(\frac{1}{m})\sum_{i=1}^{m}\frac{S_i^-}{X_{i0}}}{1+(\frac{1}{s})\sum_{r=1}^{s}\frac{S_r^+}{Y_{r0}}} \\ X_{i0}=\sum_{j=1}^{n} X_{ij}\lambda_j + S_i^- \\ Y_{r0}=\sum_{j=1}^{n} Y_{rj}\lambda_j - S_r^+ \\ \lambda \geq 0, S^- \geq 0, S^+ \geq 0 \end{cases}$$

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The input vector is $x=(x_1, x_2,\ldots,x_m)^T$, and the output vector is $y=(y_1,y_2,\ldots y_s)^T$, Now there are n property companies, means DMU_j $(1\le j\le n)$ equals to "n", The input-output vectors corresponding to the DMU_j are as follows:

$$\begin{cases} x_j = (x_{1j}, x_{2j}, \ldots, x_{mj})^T > 0, j=1,2,\ldots,n \\ y_j = (y_{1j}, y_{2j}, \ldots, y_{sj})^T > 0, j=1,2,\ldots,n \end{cases}$$
$$x_{ij}>0, y_{ij}>0, i=1,2,\ldots m; \quad j=1,2,\ldots,s$$

The efficiency values of each insurance company can be calculated through the SBM model, including technical efficiency, scale efficiency and pure technical efficiency, and technical efficiency = scale efficiency × pure technical efficiency. When the efficiency value is equal to 1, It means the evaluated DMU is on the effective front surface, the efficiency value is very high; and when the efficiency value is closer to 0, means the efficiency value of the evaluated DMU is very low.

3.2. Sample Selection

In order to comprehensively investigate the operating efficiency of commercial car insurance in various companies, this paper selects 25 representative insurance companies in the insurance market as the DMU of empirical research. The insurance companies selected in this paper account for more than 97% of the market share in the insurance market, so they are representative. Sample company name and basic information as shown in the following table.

Table 1. Basic situation table for sample companies

Company Name	Year of establishment	Market share
PICC	2003	34.26%
PAIC	1988	7.31%
CLPC	2006	22.27%
YGBX	2005	2.92%
TPBX	2001	2.05%
CPIC	2001	11.65%
CICP	2006	3.51%
CCIC	2003	3.41%
TAIC	1994	1.56%
HTIC	2011	0.61%
HAIC	1996	0.96%
ABIC	2004	0.72%
YAIC	1996	0.92%
AICS	2004	0.55%
BPIC	2005	0.34%
DBIC	2005	0.45%
MACN	2005	0.30%
CHIC	2006	0.06%
ACIC	2006	0.39%
YDCX	2008	0.62%
DHIC	2008	0.23%
ZKIC	2009	0.49%
ZSIC	2009	0.40%
XDCX	2009	0.31%
BOCI	2005	0.38%

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3.3. Input and Output Variables Selection and Definition

The choice of input-output is very important for the accurate evaluation of the operating efficiency of commercial insurance companies in the insurance company. Due to the fact that the insurance companies do not have much data on the separate disclosure of the auto car business. Therefore, this paper follows the principle of availability and representativeness of data. Select the number of employees, operating expenses and financial capital as the input variables of this paper. And Compensation expenditure for commercial car insurance and premium income as output variables. Variables are defined as follows:

Input variables

Number of employees: A total number of employees. Including marketing Staff, Executive Staff and so on. We use X1 to represent it.

Operating expenses: Embodying the cost control ability of the insurance company in the course of its operation. Including business and management costs. We use X2 to represent it.

Financial capital: financial capital= Paid-in capital+ additional paid-in capital. We use X3 to represent it.

Output variables

Premium income from commercial car insurance business: Premium income from commercial car insurance business= Premium Income from car insurance - Premium income from traffic compulsory insurance. We use Y1 to represent it.

Compensation expenditure for commercial car insurance: Compensation expenditure for commercial car insurance =Payment of expenses× Commercial Car Insurance Premium income÷ Total Premium Income. We use Y2 to represent it.

The data are derived from the 2013-2017< China Insurance Yearbook>, and Insurance association of China. The descriptive statistics of input-output indicators are shown in the following table.

Table 2. Descriptive statistics of input-output indicators

	Variables	Average	Maximum	Minimum	Std.
Output	Y1 (￥billion)	156.42	1760.64	1.56	323.95
	Y2 (￥billion)	84.03	913.89	0.73	177.23
Input	X1	13930	174545	310	26829
	X2 (￥billion)	90.78	973.58	1.73	180.40
	X3 (￥billion)	78.69	470.45	78.69	95.02

This paper used Pearson correlation coefficient to investigate the correlation between input and output variables, the results of which are shown in table 2, and it can be seen that the Pearson correlation coefficient between output and input index is more than 0.7, which has a high degree of correlation, and satisfies the "homogeneity" condition of input and output variables required by DEA model.

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Table 3. The Pearson correlation coefficient of input-output

Input indicators		Comprehensive cost	Number of employees	Financial capital
Output indicators	Payment of expenses	0.9869	0.8922	0.7181
	Premium income	0.9911	0.9106	0.713

3.4. Measurement Results and Analysis

Table 4 is the result of the measurement of the SBM-DEA model. Because of the large amount of data, this article only shows the technical efficiency values of the

Table 4. Technical Efficiency value of commercial car insurance

DMU	2012	2013	2014	2015	2016
PICC	1.00	1.00	1.00	1.00	1.00
PAIC	0.69	1.00	1.00	1.00	1.00
CLPC	0.85	0.62	1.00	1.00	1.00
YGBX	0.58	0.40	0.67	0.64	0.64
TPBX	0.49	0.35	0.54	1.00	1.00
CPIC	1.00	1.00	1.00	1.00	1.00
CICP	0.39	0.32	0.51	0.64	0.58
CCIC	0.46	0.40	0.62	0.66	0.53
TAIC	0.39	0.47	0.58	0.55	0.58
HTIC	0.37	0.27	0.40	0.47	0.49
HAIC	0.30	0.26	0.54	0.48	0.47
ABIC	1.00	0.26	1.00	0.57	0.39
YAIC	0.37	0.28	0.79	0.62	0.78
AICS	0.38	0.28	0.48	0.43	0.43
BPIC	0.22	0.21	0.45	0.49	0.55
DBIC	0.26	0.21	0.41	0.44	0.41
MACN	0.29	0.25	0.42	0.54	0.39
CHIC	0.17	0.16	0.33	0.33	0.33
ACIC	0.26	0.22	0.45	0.46	0.37
YDCX	0.33	0.30	0.48	0.51	0.56
DHIC	0.26	0.27	0.51	0.46	0.41
ZKIC	0.29	0.24	0.35	0.38	0.56
ZSIC	0.43	0.34	0.55	0.46	0.45
XDCX	0.22	0.21	0.32	0.28	0.45
BOCI	0.19	0.21	0.40	0.44	0.50
Average	0.447	0.382	0.592	0.594	0.594

As shown in table 4, the efficiency values of PICC and CPIC are the highest in all sample companies, almost all years have reached an effective frontier. In addition, the technical efficiency of PAIC, CLPC, TPBX and ABIC is relatively high, some years reach the frontier, and the efficiency value of the remaining years is much higher than the industry average. But in terms of the average value, the overall efficiency value of the industry is not high.

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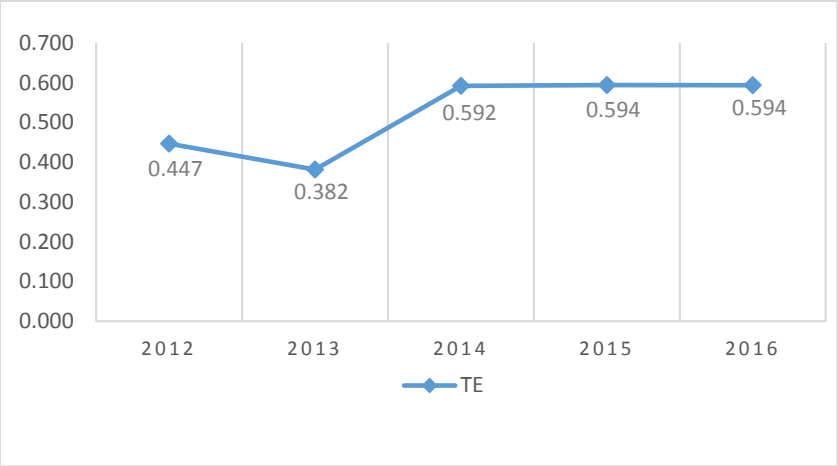

Figure 1. Change trend of commercial car insurance efficiency value in 2012-2016

As shown in Figure 1, the technical efficiency value (TE) declined in 2012-2013 and began to increase significantly in 2013-2014, with a smaller change in 2014-2016. The average level of technical efficiency values is not high. It means there's a lot of room for technical efficiency.

In order to further analyze the difference of technical efficiency value, this paper divides the insurance company according to its company characteristics. The results of the analysis are shown in the following table:

Table 5. Differences in TE values of companies with different characteristics

	Company features			Company features		
	Big	Small	Difference	Old	New	Difference
Maximum	1.00	0.45	0.55	1.00	0.89	0.106
Minimum	0.41	0.26	0.15	0.35	0.26	0.082
Average	0.67	0.36	0.30	0.58	0.43	0.150

As can be seen from the data in the table, the efficiency value of large companies is significantly higher than that of small insurance companies, and the difference is obvious. The efficiency of old companies is also significantly higher than that of new companies, but not as significant as the difference between big companies and small companies.

3.5. Improved Path to Efficiency Values

In this paper, several companies with low efficiency values are selected to analyze the redundancy of inputs through the input angle SBM model. And also analyses the improvement value and target value of each input index. Due to space constraints, this paper only selects the data of some inefficient companies in 2016 for example analysis.

According to table 5, the sample companies in the table all need to adjust the input variables in order to achieve an effective front surface. For example, To reach an effective front surface, HTIC needs to reduce operating costs by 20.346 ￥billion (target value of 10.784 ￥billion), 258 employees (target 2,474), and the financial capital of 23.769 ￥billion (target 6.231 ￥million).

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Table 6. Input relaxation variables for inefficient companies

DMU	Comprehensive cost (￥billion)		Number of employees		Financial capital (￥billion)	
	Improved values	Target value	Improved values	Target value	Improved values	Target value
HTIC	-20.346	10.784	-258	2474	-23.769	6.231
HAIC	-17.741	17.149	-2123	3868	-24.999	9.041
AICS	-7.537	8.733	-2994	3003	-18.493	5.817
BPIC	-2.354	6.046	-385	1385	-18.668	3.212
DBIC	-8.113	6.667	-1274	2240	-23.971	4.379
MACN	-5.304	5.206	-849	1219	-36.674	3.336
CHIC	-1.861	1.089	-188	246	-12.706	0.574
ACIC	-4.652	5.758	-2322	1980	-43.595	3.835
YDCX	-3.191	10.929	-988	2504	-25.292	5.808
DHIC	-1.635	3.345	-1254	1150	-27.952	2.228
ZKIC	-6.123	8.837	-229	1993	-21.091	4.659
ZSIC	-3.189	6.021	-2848	2070	-10.989	4.011
XDCX	-5.136	5.404	-521	1324	-32.842	4.238
BOCI	-3.392	6.718	-507	1561	-41.207	4.143

4. CALCULATION OF INFLUENCING FACTORS OF COMMERCIAL AUTOMOBILE INSURANCE MANAGEMENT EFFICIENCY

4.1. Variables and Descriptions

One of the shortcomings of the DEA model is that it is impossible to find the factors that affect the efficiency value, so this paper uses the Tobit regression model, takes the technical efficiency value as the interpreted variable, selects the proportion of commercial car insurance premium income, the cost rate, the market share and the total assets value as the explanatory variable, analyzes the relationship between the explanatory variable and the interpreted variable.

The proportion of commercial car insurance premium income= Premium income from commercial car insurance business÷Total premium income of the company.

The cost rate= Cost of commercial car insurance÷Commercial Car Insurance Premium income

The market share= Commercial car Insurance premium income for each sample company÷Commercial car Insurance premium income for all property insurance companies.

The total assets value=Ln (Assets of the sample company)

The data are derived from the 2013-2017 Yearbook of China's Insurance and the official website of the China Insurance Association.

4.2. Model

Based on the previous research conclusions, this paper establishes the regression

model of the influencing factors of the management performance of insurance companies, and uses the R language for Tobit regression, the concrete models are as follows:

$EFF_{it}=\beta_0+\beta_1 pro_{it}+\beta_2 exp_{it}+\beta_3 mar_{it}+\beta_4 LN(sca)_{it}++\varepsilon_{it}$

i and t represent the sample company and year respectively, β_0 is a constant entry, β_1 to β_4 is the coefficient value of each explanatory variable, pro represents the share of commercial car insurance premium income, exp represents the cost rate, mar represents the market share, LN(sca) represents the total asset after the logarithm, ε_{it} is the error. Descriptive statistics for each variable are shown in the following table.

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Table 7. Descriptive statistics of explanatory variables

Variable	Average	Std.	Maximum	Minimum
pro	0.525	0.106	0.78	0.033
exp	0.253	0.069	0.431	0.021
mar	0.046	0.095	0.4656	0.00
LN(sca)	5.102	1.499	8.981	1.837

4.3. Analysis of Regression Results

The regression results of the Tobit model are shown in table 8.

Table 8. Panel Tobit Model Regression results

Variable	Model 1	Model 2	Model 3	Model 4
Constant	-0.09276*** (0.0000)	0.35124*** (0.0000)	0.27863*** (0.0003)	-0.03057 (0.78968)
pro	1.17135*** (0.0000)	1.35228*** (0.0000)	1.07526*** (0.0000)	0.93074*** (0.0000)
exp		-2.12715*** (0.0000)	-1.45848*** (0.0000)	-0.88328*** (0.0007)
mar			1.0457*** (0.0000)	0.7364*** (0.0000)
LN(sca)				0.0492*** (0.0004)
Logarithmic likelihood value	11.75	46.72	65.36	71.26
Walt Inspection	39.07	162.1	261.9	300.2

Note: The values in parentheses are p test values, and ***, **, * and · represent significant levels at 0.1%, 1%, 5% and 10%, respectively.

Models 1, 2 or 3, and 4 in table 8 are the result of the gradual introduction of explanatory variables, based on the regression results, the relationship between the technical efficiency value and the influencing factors can be summarized as follows:

(1) The proportion of commercial car insurance premium income has a significant positive impact on technical efficiency values, the higher the proportion of commercial car insurance business, indicates that the higher the degree of specialization of commercial car insurance, and specialization can enable insurance companies to accumulate experience in the course of operation, so as to improve the operating efficiency of the insurance species.

(2) The cost rate also has a significant negative effect on technical efficiency. High cost rate means high operating costs, and high operating costs will drive down the profit margins of commercial car insurance, so that companies in the operation of commercial car insurance is very passive, seriously weakening the profitability of the commercial car insurance business of the insurance company, reduce its operating efficiency.

(3) The market share of commercial car insurance has a very significant positive impact on the efficiency value too. High market share means high premium income, which will bring about scale effect, and can establish a good image of large enterprises.

(4) The total assets value also has a very significant positive impact on the efficiency value. It shows that large insurance companies have obvious economies of scale in the operation of commercial car insurance, and also shows that large companies have the advantages of dispersing risk and reducing cost. Facing the high payout rate of car insurance, Companies with large assets have an advantage and are more able to win consumer trust.

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5. CONCLUSIONS AND RECOMMENDATIONS

Studying the operating efficiency of commercial car insurance business plays a very important role in the rational allocation of resources by insurance companies and the improvement of the overall operating efficiency and strength of the company. Using the SBM-DEA model, this paper calculates the efficiency value of the commercial car insurance business of 25 domestic insurance companies in 2012-2016, and analyzes the factors that affect the efficiency value of commercial car insurance technology by using the panel Tobit model. The results of the study are summarized as follows: (1) The efficiency value of commercial car insurance is generally low, there is a large improvement space. To solve the cost and other technical problems, expand the scale economy, are the fundamental way to improve the efficiency value for the property insurance companies;(2) According to the regression results of Tobit model in this paper, the proportion of commercial car insurance premium income, cost rate, market share and asset size all have a certain impact on the operating efficiency of commercial car insurance. In order to improve the operating efficiency of commercial car insurance business, it is necessary to reduce costs and expenses, improve the premium income and market share of commercial car insurance, expand the scale effect and so on.

This paper puts forward some suggestions based on the conclusions: First, improve cost control capacity and reduce the cost rate of commercial car insurance. At present, the main reason leading to the exorbitant cost of commercial car insurance in China is the narrow marketing channels and strong dependence on the channels of vehicle merchants. Property insurance companies can reduce the cost of expenditure by enrich marketing means, enhance initiative and give full play to the advantages of low cost of other channels; Second, to grasp the opportunity of commercial car insurance rate marketization reform in China, combined with their own advantages, reasonable expansion of commercial car insurance market share, increase the proportion of commercial car insurance premium income in total income, strengthen business quality control, improve service level, avoid product homogenization problems, Take advantage of product diversity and personalized service for customers to enhance their competitiveness to enhance market share gradually, but avoid blind expansion, and pay attention to cost and cost control at the same time.

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