Advances in Social Sciences Research Journal – Vol.3, No.2
Publication Date: Feb. 25, 2016
DoI:10.14738/assrj.32.1818.
Wang, D. (2016). Research on Internet Insurance Performance Efficiency of Life Insurande Company in China Using Data Envelopment Analysis. *Advances in Social Sciences Research Journal,* 3*(2)* 58-69.

Research on Internet Insurance Performance Efficiency of Life Insurance Company in China Using Data Envelopment Analysis

Da Wang
School of Insurance
Central University of Finance and Economics

Abstract

In these years, the revenue of premium from the Internet is increasing constantly and the Internet Insurance is developing at an amazing speed. However, how about the operation efficiency of Internet Insurance? Basing on the situation of revenue of premium from the Internet, this paper selects the top 10 Life Insurance Companies in China as the research samples. Using Data Envelopment Analysis and choosing both financial and non-financial variables, this paper makes a research on the Internet Insurance performance efficiency of Life Insurance Companies. The results show that in the early development period, the performance efficiency of Internet Insurance is normally low and the input of fixed assets does less to the performance efficiency than other two inputs. And this paper put forwards that insurance companies should take use of the official website to improve the performance efficiency of the Internet.

Key words: Internet Insurance；DEA；Performance Efficiency

INTRODUCTION

With the further development of Internet technology, people have cultivated the habit of shopping online. The Internet is influencing people's lifestyle at an unprecedented speed. Since the concept "Internet Plus" is came up with, industries in different areas start to combine the Internet with the traditional industry to promote the innovation. Furthermore, Internet Finance is the most popular topic in China recently.

From the E-business of insurance in the past to Internet Insurance nowadays, research and application of Internet about insurance has a more than 20 years' process. Until recently, with the promotion and the development of the macro environment, Internet Insurance in China has made a great progress. According to the statistics from Insurance Association of China, there are 28 insurance companies operating the business of Internet Insurance in 2011 and the total amount of the Internet premium is 3.199 billion Yuan; In 2012 there are 34 insurers having this business and the Internet premium arrives to 10.624 billion Yuan which is 2.3 times more than previous year; In 2013, the number of the insurers is 60 and the Internet premium is 29.115 billion Yuan; As for the year of 2014, the total Internet premium is 85.89 billion Yuan coming from 85 insurance companies. In the short 4 years, the growth of the Internet premium is up to 2585%.

In the early period, insurance companies just regarded the Internet as a distribution channel. Recently, with the founding of Internet Insurance companies (Zhong'an Online and Taikang Online), the Internet is no longer just a way selling insurance products. The Internet plays an important role on the whole chain of the insurance industry.

The low cost and transparent information are the advantages of the Internet, which bring wide development space to the traditional insurance industry. However, how about the Internet performance efficiency of the insurances? Which factors are the primary factors that will improve the Internet performance efficiency? Basing on the thought to questions above, this paper uses the model of DEA (Data Envelopment Analysis) to study the Internet performance efficiency of the insurance companies in China. This paper analyzes the influence factors to the performance efficiency and comes up with the operation strategies to the development of the Internet Insurance.

The arrangement of other parts of this paper is as follows: the second part is the Literature Review. This part introduces some research methods about operation efficiency and the research situations of the scholars in the operation efficiency of the traditional insurance companies. The third part introduces the DEA as well as the input and output indexes this paper selects. The fourth part is the analysis of the empirical results. This analysis includes two sections: one is about the result of the DEA and the other is the principal component analysis basing on the calculation of DEA. The last part is the conclusion of this paper and the further research in this area.

LITERATURE REVIEW

The research methods of the operation efficiency are as follows:（1）the Data Envelopment Analysis represented by Sherman and Gold (1985); (2) the Free Disposal Hull represented by Berger and Humphrey; (3) the Stochastic Frontier represented by Hasan and Marton; (4) the Thick Frontier represented by Berge and Humphrey (1997); (5) the Distribution Free Method represented by Berger (1993) and Weil (2004).

Basing on the research above, scholars in the area of insurers' operation efficiency make a large amount of research. Sun (2008) uses the DEA to analyze the operation efficiency of life insurance companies in China and aboard. The author calculates the technical efficiency as well as pure technical efficiency and then reckons the scale efficiency. According to the results, the paper makes a comparison about the operation efficiency of China's life insurance companies and foreign life insurance. The conclusion is that the operation efficiency of China's life insurance companies ranks in front of the foreign life insurance companies because of the large scale of China's insurers. He and Yan (2010) estimate the production efficiency of gross premium, standard premium as well as premium from different distribution channels respectively using the DEA and SFA. They consider that the operation efficiency of the branch companies in some large and middle-sized cities is not optimistic. It is apparent that these companies facilitate the development of their business through the capital and they should improve their business performance. Ye and Chen (2012) use the SFA to make a research about the operation efficiency of China's listed insurers. They think that executive compensation has a negative influence on the profit efficiency and no effect on the cost efficiency. Zhang (2009) uses the DEA to make an empirical research about the property insurance companies in China. The paper focuses on the effect of the micro factors and makes liner analysis as well as summarizes the factors of macro economic. It turns out to be that the scale of the companies and the qualities of the staff are referred as the most important endogenous factors.

There are also some papers related to the operation efficiency of Internet finance (bank and insurance). Guan, Zhang and Yang（2014） use the DEA to calculate the operation efficiency of 11 listed commercial banks. It analyzes the influence of the Internet finance on the overall efficiency，scale efficiency as well as pure technical efficiency. It turns out to be that the Internet finance has a positive influence on the overall efficiency and pure technical efficiency.

Liu (2015) selects 7 property insurance companies and 7 life insurance companies as the research sample basing on the $w \geq 0, \mu \geq 0$ rank of the Internet business. The paper uses the SFA to analyze the influence of the Internet Insurance on the operation efficiency of insurance industry. The result turns to be out that the development of the Internet Insurance has a positive effect on the cost efficiency and profit efficiency，meanwhile this influence is of direction.

As for this paper, it uses the DEA to make a research about 10 China's life insurance companies whose Internet insurance premiums rank top ten in the year of 2014. When it comes to the input and output variables，this paper selects both financial indexes and the indexes which can reflect the character of Internet such as the click rate of the insurers' websites.

RESEARCH METHOD AND DATA SELECTION

Research Method

This paper uses the DEA (Data Envelopment Analysis), which was first came up with by Charnes, Cooper and Rhodes in the year of 1978, to study the operation efficiency of the Internet Insurance companies in China. This method utilizes the model of linear programming to build the frontier of Pareto Optimal, which is the classic non-parametric approach. In the method of DEA, the mathematical function relationship is not a necessity between input index and output index, which is useful to avoid the subjective factors. Moreover, it is flexible to select the input index and output index. At last, DEA does better in dealing with the problem of multiple input indexes and output indexes. Basing on the advantages referring to above as well as the purpose of this paper, the methodology of DEA is selected as the research method.

In the model of DEA, let's assume there are n units, which are referred as Decision Making Units (DMU) and every unit has m input factors and s output factors. The index of input is represented by $X_j = \left(x_{1j},...,x_{mj}\right)^T$ (j=1,..., n) in which x_{ij} represents the input "i" of DMU "j". Likewise, the index of output is represented by $Y_j = \left(y_{1j},...,y_{sj}\right)^T$ (j=1,...,n) in which y_{rj} represents the output "r" of DMU "j". Furthermore, the weights of input and output are represented by $u = \left(u_1,...,u_s\right)^T$ and $u = \left(u_1,...,u_s\right)^T$ respectively. As for every DMU, the index of the efficiency is $h_j = \frac{u^T Y_j}{v^T X_j}$ j=1,2…n. And we have the following mathematical programming problem:

$$\max h_0 = \frac{u^T Y_0}{v^T X_0}$$

$$h_j = \frac{u^T Y_j}{v^T X_j} \leq 1, j = 1,2,...n \qquad (1)$$

$$v \geq 0, u \geq 0$$

The model above is not a linear programming, and we use the transfer of Charnes-Cooper to adjust it. We impose the constraint $t = 1/v^T X_0$ and w=tv, μ=tu, then we get the following model:

$$\max \mu^T Y_0$$

$$w^T X_j - \mu^T Y_j \geq 0, j = 1,2,...n \qquad (2)$$

$$w^T X_0 = 1$$

We add two slack variables s^+ and s^- into the formula (2), then we get the dual linear programming model:

$$\begin{aligned} &\min h_j = \theta \\ &\sum_{j=1}^{m} X_j \lambda_j + s^- = \theta X_0 \\ &\sum_{j=1}^{m} Y_j \lambda_j + s^+ = Y_0 \\ &\lambda_j \geq 0, j = 1,2,...n; s^+ \geq 0; s^- \geq 0 \end{aligned} \tag{3}$$

In the model, h_j is the efficiency index of the DMU, representing the value of technical efficiency. And λ_j is the weight of the DMU.

Selection of Samples and the Indexes

Selection of Samples

As for the research objectives, this paper selects 10 life insurance companies which are the top 10 in the rank of Internet Insurance Premium in 2014. The 10 life insurance companies are Sun Life Everbright Life, ICBC-AXA，Foresea Life，Funde Sino Life，Pr Life, Kunlun Health，CCB-Life，Guohua Life，Sunshine Life and Taikang Life. 10 companies' Internet Insurance premium and the market shares are in the following table.

Table 1: Related Data of Top Ten Life Insurance Companies' Internet Insurance Business

Rank	Life Insurance Company	Number of Internet Insurance Policy（Thousand）	Premium of Internet Insurance（Billion Yuan）	Share of Internet Life Insurance Market（%）
1	Everbright Life	163.1	6.101	17.27
2	ICBC-AXA	144	4.594	13.01
3	Foresea Life	219.3	3.946	11.17
4	Funde Sino Life	309.8	3.287	9.31
5	Pr Life	164.7	3.207	9.08
6	Kunlun Health	261.8	2.465	6.98
7	CCB-Life	64.4	2.32	6.57
8	Guohua Life	1282.4	1.793	5.08
9	Sunshine Life	34297.3	1.344	3.81
10	Taikang Life	18630.4	1.071	3.03
	Sum	55537.2	30.128	85.30

Data Resource:《Report of the Industry of Internet Insurance in 2014》

The total revenue of the Internet Insurance premium of the 10 life insurance companies occupies 85.3% of the whole Internet life insurance market, so the research samples are representative.

Although the 10 life insurance companies are of small size in China compared to other life insurance companies like China Life and so on, the 10 life insurance companies do well in the Internet insurance business. Making a research in their operation efficiency of Internet Insurance will be meaningful to development of the whole Internet Insurance market.

Selection of the Indexes of Input and Output

Referring to the scholars' research in the operation efficiency of insurance companies, they choose "capital", "operation cost", "population of staff", "fixed asset" and so on as the input indexes. Also, they choose "revenue of premium", "compensation expenses", "profit of investment" and so on as the output indexes. We summarize these indexes in the following table.

Table 2 Input and Output Indexes Selected by Scholars in Recent Researches

Author	Input Index	Output Index	Research Object	Time of Publication
Yuanxian Liu	Labor Force, Financial Capital, Physical Capital	Payment of Insurance Claims	Property &Life Insurance	2015
Ran Zhang	Labor Force, Equity Capital, Expenses	Payment of Insurance Claims, Profit of Investment, Net Profit	Property Insurance	2012
Jiadong Zhang	Population of Staff, Operation Cost, Equity Capital	Payment, Reserve Fund, Profit of Investment	Life Insurance	2014
Xufeng Sun	Population of Staff, Operation Cost, Fixed Assets	Expenses of Payment, Reserve Fund, Profit of Investment	Life Insurance	2008
Chunhai Zhang	Fixed Assets, Operation Cost, Population of Staff	Revenue of Premium, Profit of Investment	Property Insurance	2011
Qiang Bai	Financial Capital, Population of Staff, Expenses	Revenue of Premium, Profit of Investment	Group of Insurance	2014

Theory of Production is the paper's foundation in selecting input and output indexes，for instance, the life insurance companies input human resources, material resources as well as financial capacity to create the revenue of premium and profit of investment. This paper aims at the research of Internet operation efficiency of life insurance companies, when it comes to the selection of the indexes, we consider both financial indexes and Internet indexes.

Basing on the summarization and the analysis above, this paper selects the "fixed asset", "operation cost" as well as "population of the staff" as the input indexes. Also, we select "revenue of premium from Internet" and "click rate of the official website" as the output indexes.

The fixed asset, which is referred as the index of input of capital, represents the input in the area of material input of life insurance company; Operation cost represents the financial input of life insurance company in the real operation; The population of staff stands for the input of labor force of life insurance company. Since this paper studies the Internet operation efficiency of life insurance company, we select premium from the Internet which reflects the character of

Internet Insurance and the click rate which is a proper output index especially in estimating the appearance of operation efficiency of Internet Insurance business (Floros, 2008).

Data of fixed asset and operation cost can be got from "Annual report of 2014". The data of revenue of premium from Internet can be got from "Report of the Industry of Internet Insurance in 2014";.The population of staff can be got from"Insurance Yearbook of 2014".And the click rate of official website can be got from the database of Alexa.com.

Table 3 Data of Input and Output Indexes of 10 Life Insurance Companies

Life Insurance Company	Fixed Asset (Million Yuan)	Operation Cost (Million Yuan)	Population of Staff (people)	Premium from Internet (Million Yuan)	Click Rate (%)
Everbright Life	57.674	1048.456	2824	6101	0.00006
ICBC-AXA	40.524	855.609	7538	4594	0.00005
Foresea Life	1019.627	1815.62	5694	3946	0.00015
Funde Sino	1680.038	5417.522	94827	3287	0.00024
Pr Life	11.007	306.317	1043	3207	0.00008
Kunlun Health	7.91	177.649	1160	2465	0.000007
CCB-Life	354.303	1146.756	3014	2320	0.00009
Guohua Life	210.51	918.429	7067	1793	0.00011
Sunshine Life	1410.194	3081.01	17145	1344	0.0023
Taikang Life	1708.449	10349.124	10743	1071	0.0461

We use "Input 1", "Input 2" and "Input 3" to represent the "fixed asset", "operation cost" and "population of staff" respectively. Also, we use "Output 1" and "Output 2" to represent the "premium from Internet" and "click rate". Therefore, we can use ABC12 to represent the model. Since the model used in our paper includes three inputs and two outputs, this particular model will have 21 possible combinations and generates 21 results based on the DEA such as A1, AB2, BC12, ABC12 and so on. Testing all possible 21 combinations will help us to better identify the weak and strong aspects of the analyzed life insurance companies. This methodology has been used by Ovidiu Stoica when he made a research in the effect of the Internet Banks on the operation efficiency of Romania's banks in 2013.

EMPIRICAL RESULTS

Results of DEA

Using the software of DEAP 2.1 and the data in Table3, we get the results of DEA in the following table.

Table 4 Results of Model ABC12

	A1	B1	C1	AB1	AC1	BC1	ABC1
Everbright Life	0.339	0.419	0.703	0.419	0.703	0.703	0.703
ICBC-AXA	0.364	0.387	0.198	0.387	0.364	0.387	0.387
Foresea Life	0.012	0.157	0.225	0.157	0.225	0.225	0.225
Funde Sino	0.006	0.044	0.011	0.044	0.011	0.044	0.044
Pr Life	0.935	0.755	1.000	0.935	1.000	1.000	1.000
Kunlun Health	1.000	1.000	0.691	1.000	1.000	1.000	1.000
CCB-Life	0.021	0.146	0.250	0.146	0.025	0.250	0.250
Guohua Life	0.027	0.141	0.083	0.141	0.083	0.141	0.141

Sunshine Life	0.003	0.031	0.025	0.031	0.025	0.034	0.034
Taikang Life	0.002	0.007	0.032	0.007	0.032	0.032	0.032
Mean	0.271	0.309	0.322	0.327	0.347	0.382	0.382
	A2	B2	C2	AB2	AC2	BC2	ABC2
Everbright Life	0.039	0.013	0.005	0.039	0.039	0.013	0.039
ICBC-AXA	0.046	0.013	0.002	0.046	0.046	0.013	0.046
Foresea Life	0.005	0.019	0.006	0.019	0.006	0.019	0.019
Funde Sino	0.005	0.010	0.001	0.010	0.005	0.010	0.010
Pr Life	0.269	0.059	0.018	0.269	0.269	0.059	0.269
Kunlun Health	0.033	0.009	0.001	0.033	0.033	0.009	0.033
CCB-Life	0.009	0.018	0.007	0.018	0.009	0.018	0.018
Guohua Life	0.019	0.027	0.004	0.027	0.019	0.027	0.027
Sunshine Life	0.060	0.168	0.031	0.168	0.060	0.168	0.168
Taikang Life	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Mean	0.149	0.134	0.108	0.163	0.149	0.134	0.163
	A12	B12	C12	AB12	AC12	BC12	ABC12
Everbright Life	0.347	0.428	0.703	0.428	0.703	0.703	0.703
ICBC-AXA	0.373	0.397	0.198	0.397	0.373	0.397	0.397
Foresea Life	0.015	0.174	0.227	0.174	0.227	0.227	0.227
Funde Sino	0.010	0.053	0.012	0.053	0.012	0.053	0.053
Pr Life	1.000	0.806	1.000	1.000	1.000	1.000	1.000
Kunlun Health	1.000	1.000	0.691	1.000	1.000	1.000	1.000
CCB-Life	0.026	0.162	0.253	0.162	0.253	0.253	0.253
Guohua Life	0.041	0.166	0.085	0.166	0.085	0.166	0.166
Sunshine Life	0.063	0.198	0.055	0.198	0.063	0.198	0.198
Taikang Life	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Mean	0.388	0.438	0.422	0.458	0.472	0.500	0.500

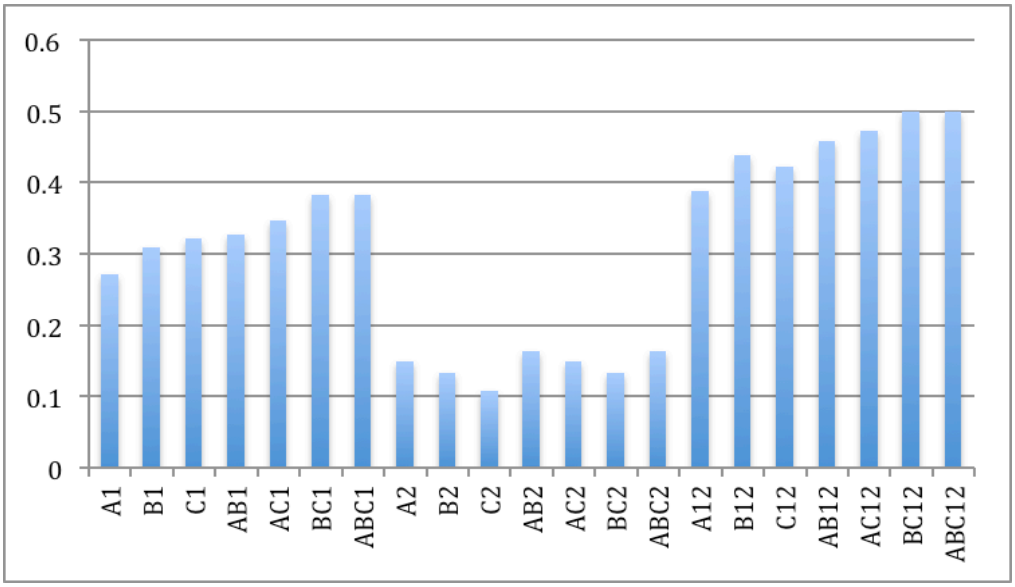

Chart 1 Mean Value of the 21 Combinations

According to the results of DEA above, we have the following analyses:

1. Through observation, we can see that the mean values of these 21 combinations are not high universally even if the ABC12 (the score is only 50%) which has all inputs and

outputs. The low mean values state that the Internet operation efficiency of the 10 life insurance companies is not high. On one side, the Internet Insurance is in the early period of its development, so the low efficiency conforms to the law of nature. On the other side, this paper selects the premium from the Internet instead of the whole premium as one of the outputs. The Internet is one of premium channels, which is far less than the whole premium.

2. The combination BC12 and combination ABC12 have the highest scores, which are both 50%. The combination ABC12 includes all the inputs and outputs while the combination BC12 doesn't have the input A. This states that the input A, that is the fixed asset, has less effect on the Internet operation efficiency comparing to other two inputs. We can consider that operation cost and population of staff play an important role on the Internet operation efficiency of these 10 life insurance companies and insurers should input more of these two factors.
3. In the combination ABC12 which includes all inputs and outputs，Pr Life, Kunlun Health and Taikang Life all get the score of 100% followed by Everlight Life whose score is 70.3%. The high efficiency of these four life insurance companies states that these companies have high input-output ratio and the inputs of material capital, human resources and financial capacity have been transferred into to outputs successfully.
4. In the chart 1, the 21 combinations are divided into 3 parts according to their mean values. The left part is the combination, which only includes output 1, the middle part, is the combination, which only includes output 2, and the right part is the combination includes both output 1 and output 2. The combinations including both output 1 and output 2 have higher score and the combinations only including the output 2 have lower score. The deep implication will be explained in the Principal Component Analysis later.
5. We can also see from the table 4 that some life insurance companies may get high scores in some combinations while getting low scores in other combinations. Taking Taikang Life as an example, in the combinations of A2, B2, C2, AB2, BC2, AB2, ABC2, A12, B12, AB12, BC12, A12 and ABC12, the scores are all 100%. However, in the combinations of A1, B1, C1, AB1, BC1, AC1 and ABC1, the scores are low universally even the highest score is just 38.2%. Likewise，this phenomenon exits in other life insurance companies which is related to the different channels of Internet insurance premium. Also this phenomenon will be explained in the later part of this paper.

The Principal Component Analysis

In order to take use of the results of DEA and explain some analyses above, this paper uses the Principal Component Analysis to analyze the results of the 21 combinations. PCA is a multidimensional reduction process that facilitates the analysis and simplification of data. Comparing with other linear transformation techniques, PCA has the advantage of not having a fix set of base vectors that depend on what is similar and what is different in various models. In addition, PCA compounds all possible combinations and the entirety of decision-making unites in a robust way in order to identify the similarities, the differences and the inconsistent components. There are four steps in this process: Step 1: we calculate the sample mean vector X and covariance matrix S. Step 2: we estimate the sample correlation matrix R. Step 3: we solve the following equaition:

$$\left|R-\lambda I_2\right|=0 \tag{4}$$

Therefore, we obtain the ordered 2 characteristic roots $\lambda_1 \geq \lambda_2$ with $\sum \lambda_k = 2$ （ k=1

，2）and the related 2 characteristic vectors（l_{m1}，l_{m2}）（m=1,2）.These characteristic vectors compose the principal components Y_m. The components in eigenvectors are, respectively, the coefficients in each corresponding Y_m:

$$Y_m = \sum_{m=1}^{2} l_m \lambda_n \text{，} \quad \text{m=1,2 n=1,2,...,N} \tag{5}$$

Step 4: we compute the weights（w_k）of the principal components and PCA scores（z_n）for each model（n=1，2，...,N）:

$$z_n = \sum_{k=1}^{2} w_k Y_k \text{ ,n=1,2,...,N} \tag{6}$$

We use principal components analysis to extract relevant data and eliminate redundant information to make a deeper analysis of the Internet operation efficiency of the 10 life insurance companies.

Using the software of spss 20.0 and the data in the table 4, we get the total variance of PCA. The accumulated total variance of the first principal component is 57.364% and the accumulated total variance of the second principal component is 40.099%. So the total number is 97.463%, which is high enough. We just consider the first and second principal component. The results of PCA are in the following table.

Table 5 The PCA results of DEA

Component	PC1	PC2	Component	PC1	PC2	Component	PC1	PC2
A1	.745	-.632	A2	.579	.808	A12	.982	.061
B1	.681	-.707	B2	.417	.906	B12	.971	.116
C1	.682	-.651	C2	.441	.890	C12	.954	.116
AB1	.704	-.693	AB2	.544	.832	AB12	.987	.064
AC1	.729	-.668	AC2	.579	.809	AC12	.991	.001
BC1	.698	-.711	BC2	.417	.906	BC12	.995	0.13
ABC1	.698	-.711	ABC2	.544	.832	ABC12	.995	0.14

According to the results above, we have the analyses as follows:

1. In the table 5, the first principal components of all the 21 combinations are positive. Meanwhile, combinations of ABC12 (0.995), BC12 (0.995) and AC12 (0.991) have the highest scores. Since combination BC12 and combination ABC12 have the same score, we can consider that input A (fixed asset) makes less contribution to the Internet operation efficiency, which is in accordance with the conclusion in the early analysis of this paper.
2. The results of the second principle components can explain the meaning of the model better. Combinations can be divided into two categories according to the results whether they are positive or negative. There are 7 combinations (A1, B1, C1, AB1, AC1, BC1, and ABC1) having the negative results and the other 14 combinations have the positive scores. The 7 combinations with negative scores all have the output 1 (premium from the Internet). Then we can put the other 14 combinations into 2 parts. Scores of combinations (A2, B2, C2, AB2, AC2, BC2, and ABC2) are much higher than the other 7 combinations. These 7 combinations all include output 2 (click rate of the

official website). The 21 combinations are divided into 3 areas, which is in accordance with the results of DEA.

3. Combining the results of the second principle components and the results of DEA, we analyze the combinations just including one output (either output 1 or output 2). The combinations only including output 2 (the click rate of official website) have higher scores while the combinations only including output 1 (premium from the Internet) have lower scores. We can consider that life insurances with high score in the combination only including the output 2 get premium mainly from the official websites. While the others get the premium from the third parties' platform.

Through calculating the total scores of the ten life insurance companies in the 7 combinations, which only include output 2, we can see that Taikang Life has the highest score which is much higher than the other 9 life insurance companies. According to the conclusion above, we can consider that Internet premium of Taikang Life mainly comes from its own official website while Internet premium of the other 9 come mainly from the third parties' Internet platform. This conclusion is in accordance with the information published by the Insurance Association of China that Internet premium of life insurance companies mainly come from the third parties' Internet platform, however, Internet premium of property insurance companies mainly come from the official websites. And Taikang Life has the most insurance policies from the official website. Although, the market share of Taikang Life is the last one in the 10 companies, it takes use of the advantages of official website to attract consumers and improve the Internet operation efficiency.

CONCLUSIONS

Basing on the real situation of the market of Internet Insurance, this paper focuses on the empirical research of Internet operation efficiency. According to the situation of the Internet premium in the year of 2014 and the availability of other data, this paper selects the top 10 life insurance companies in the business of Internet Insurance as the research objectives. Using the model of DEA and selecting the inputs and outputs, this paper calculates the Internet operation efficiency of the 10 life insurance companies. On the basis of the results of DEA, we use PCA to make a deeper analysis, and get the conclusions as follows:

1. The low Internet operation efficiency of the Internet Insurance is related to the period of the development of Internet Insurance. Although Internet Insurance in China is in the early period of the development, the Internet operation efficiency will improve faster and faster according to the high speed of the Internet premium as well as the attention industry and government pays to.
2. As for the 10 life insurance companies in this paper, input "fixed asset" makes less contribution to the Internet operation efficiency comparing to the other two inputs (operation cost and population of staff). The life insurance companies should input more in the factors of operation cost and population of staff, that is to enhance the ability of management.
3. The results of this paper verify that Internet premium of life insurance companies mainly come from the third parties' Internet platform while Taikang Life has the higher operation efficiency whose Internet premium comes mainly from its own official website. This conclusion states that improving the operation ability of the official website is useful to improve the Internet operation efficiency. The life insurance companies should pay more attention to the building and maintenance of the official websites to improve the loyalty of customers and the brand image.

The improvement of the operation efficiency of the Internet Insurance is useful to improve the operation efficiency of the whole insurance industry and has positive effect on the insurance industry. Researches in this area mainly focus the theory research such as the business model and marketing. However, there are fewer researches in the empirical analysis in the Internet Insurance. This paper is intended to offer some reference in the related area and more research will be made in the future to enrich the study.

Reference

1. Sheman, H. D. and Gold F., 1985. Bank Branch Operating Efficiency: Evaluation with Data Envelopment Analysis. Journal of Banking and Finance 9,2, pp.297-316.
2. Berger, A.N. and Humphrey, D.B., 1992. Measurement and Efficiency Issues in Commercial Banking. In: Griliches Z, editor. "Output measurement in the service sectors", NBER studies in income and wealth, The University of Chicago Press, Chicago, pp.245-300.
3. Hasan, I. and Marton, K., 2003. Development and Efficiency of the Banking Sector in a Transition: an Application of Data Envelopment Analysis. IMF Working Paper 146,2.
4. Berger, A.N. and Humphrey, D.B., 1997. Efficiency of Financial Institution: International Survey and Directions for Future Research. European Journal of Operational Research 98,pp. 175-212.
5. Weill, L., 2004. The Evolution of Efficiency in Europe: with Special Reference to Kosovo. Working Paper 4, Central Bank of Kosovo.
6. Sun X F. Empirical Study about the Efficiency of Life Insurance Company Based DEA.[D] Shandong：Ocean University of China, 2008
7. He H，Yan B. Empirical Study on the Efficiency of Life Insurance Company Based on DEA and SFA. [J] Shanghai Finance. 2009(2): 17-24.
8. Ye C H, Chen X A. The impact of manager's payoff to the efficiency of China's Listed Insurance Companies—Basing on the SFA.[J] Insurance Studies. 2012(8): 23-33
9. Zhang R. Empirical Study on the Efficiency of China and Foreign Property Insurance Company Basing on the DEA [D]. Shanxi: Shanxi Normal University, 2012.
10. Guan R R, Zhang W S, Yang P J. A Study of Effects of Internet Finance on China's Banks Operation Efficiency and Possible Solution to Existing Problems [J]. Journal of Yunnan Normal University.2014 (11): 56-64.
11. Liu Y X. An Exponential Analysis of the Impacts of Internet Insurance Development on Operational Efficiency of Insurance Companies [J] Insurance Studies. 2015(9): 104-116.
12. Charnes A, Cooper WW, Rhodes EL. Measuring the Efficiency of Decision Making Units. European Journal of Operational Research 1978; 2(6): 429–44.
13. Zhang J D. Based on DEA Method to Assess the Efficiency of China's Life Insurance Companies [D]. Sichuan: Southwestern University of Finance and Economics, 2014.
14. Zhang C H. Empirical Study on the Efficiency of China's Property Insurance Company Basing on the Three-stage DEA [J]. Insurance Studies. 2011(10): 22-29.
15. Bai Q. Study on the Efficiency of China's Insurance Conglomerate: Based on the Three Stage DEA [D]. Shandong：Ocean University of China，2014.
16. Floros, C., 2008. Internet Banking Websites Performance in Greece. Journal of Internet Banking and Commerce 13, 3, pp. 1-8.
17. Ovidiu, S., 2013. The Impact of Internet Banking on the Performance of Romanian Banks: DEA and PCA Approach. Procedia Economics and Finance 20(2015): 610-622.

