Application of Computer Technology in Efficiency Analysis of China Life Insurance Company

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***Abstract*—During the recent 100 years, the third technological revolution has promoted the development of computer technology dramatically, which thus has brought a great change in the economic society of human beings such as economics structure, employment direction, the form of international economic and the form of business. Besides, new concepts and ideas have been brought into the mode of production and life style of human beings. By the instrumentality of LINDO soft ware and SAS system, this research was conducted to evaluate the super efficiency, technical efficiency, pure technical efficiency and scale efficiency of life insurance companies of China in recent years by using the method of DEA and to analyze and find out the main and secondary factors that influenced the operational efficiency of insurance companies by using the measurement method. On this basis, it was concluded that efficiency of life insurance companies in our country could be enhanced by increasing underwriting quality, strengthening service awareness and optimizing business structure, etc.**

***Index Terms*—DEA model; efficiency; Life Insurance Company; insurance market; software LINDO; SAS system**

I. INTRODUCTION

Application of computer technology and computer programs pervades every field of human life and production and also alters the development mode of human economic society. For example, in recent years, Lindo and Lingo are widely used in the fields of economic management and empirical analysis. Software of Lindo and Lingo which were developed by American Lindo System Company are computer programs to solve the problem of optimization. The basic function of Lindo is to solve problems of linear programming and quadratic programming. Furthermore, Lingo not only has all the functions of Lindo but also can solve the problem of nonlinear programming and Lingo can be used in the solution of linear and nonlinear equations. In the practical process of application, we find that the most significant feature of Lindo and Lingo is that an integer acting as a decision variable is available (integer programming) and the execution speed of these two kinds of software is much faster.

In fact, Lingo is a modeling language of the problem of optimization, which includes many common functions of mathematics, economics and management and it is available for users' fitting the optimization model and it can supply interfaces of other data files such as text files, excel, database files and so on and it is very convenient, fast and simple for inputting, solving and analyzing spacious problems of optimization.

Maybe thanks to these characteristics, Lindo and Lingo's solving programs of linear, nonlinear and integer programming are used to analyze maximizing profits and minimizing costs by the broad masses of theory researchers and practical managers and the programs can be used in various fields and have been proved to be playing a significant role in commercial, industry, research and government including affairs of production distribution, ingredient mixing, arrangement between production and personal affairs, inventory management etc and especially the field of finance and insurance.

SAS is a large-scale integrated computer software system in which a set of computer programs worked together. The SAS users can make reasonable choices according to their demands. Since SAS is a kind of integrated system, it has complete functions of data access, data management, data analysis, data report and so on. This computer system was promoted by American SAS Software Research Institution in 1976, and now has been adopted by 120 countries and 30,000 departments in the world. SAS when running under WINDOWS environment can fully utilize the eminent graphical interface of WINDOWS operating system and good connectivity with other system and data, which brings a lot of convenience on program editing and data manipulation and management. The operation of SAS system is flexible and functional; furthermore, its language is a powerful programming designing language and it integrates a variety of high-level language features and flexible format. It is an integration of data

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progressing and statistical analysis and also has a strong scalability. Therefore, the system is widely used by lots of general theory researchers and practical managers.

Since 1980 when the domestic business was restored, the insurance industry of China has developed rapidly. The total volume of premium income was 1,600,000,000 yuan in 1980, and an increase to 139,322,000,000 yuan (life insurance premium income was 87, 210,000,000 yuan), and an increase to 978,400,000,000 yuan (life insurance premium income was 744, 738,000,000 yuan). The total volume of premium income in 2008 was increased by 6 times that in 1998 and life insurance premium income was increased 7.5 times. The capital of insurance increased from 260,409,000,000 yuan in 1999 to 3,341,844,000,000 yuan in 2008, an increase of 11.8 times. The total investment of insurance increased from 89,142,000,000 yuan in 1999 to 2,246,522,000,000 yuan in 2008, an increase of 24.2 times. The insurance density increased from 110 yuan per person in 1999 to 736.74 yuan per person in 2008, and the insurance density was increased. As a result, insurance is playing a more and more important role in the development of economics of the society. On aspect of attracting foreign investment: there were 18 overseas-funded enterprises of all insurance companies in China in 2000, and this number increased to 89 in 2009. The increase of insurance companies especially on overseas-funded enterprises will lead to an increased competition in the insurance market. The financial strength, product development technology, development of industry approach and the business management level of foreign insurance companies are obviously better than those of domestic insurance companies. And because of the better salary, higher strategy on investment and management, a large number of excellent talents of management will be attracted by foreign insurance companies and this is a huge pressure for domestic insurance companies. Insurance companies of China always pay attention to underwriting income and scale of growth, and ignore claims service, efficiency and investing management and emphasize the premium income, thus under the macroeconomic environment that large numbers of foreign insurance companies flush into the market of insurance of China, the efficiency of insurance companies is becoming a focus in this field.

With the linear, nonlinear and quadratic solution programs of Lindo and through the method of Date Envelopment Analysis (DAE), this research is conducted to evaluate values of super efficiency, comprehensive efficiency, pure efficiency and scale efficiency, and analyze changes of efficiency of different insurance companies, and establish relevant econometric model to analyze the key factors affecting the efficiency of insurance companies, and make appropriate comments and suggestions on enhancing the efficiency of insurance companies. Related researches in China only measured the efficiency of a certain value; however, this paper especially estimates the super efficiency of insurance companies to compare the pros and cons between insurance companies of which technology are effective and at last it analyzes the influencing factors on corresponding values of efficiency.

II. Introduction Evalutaion Of The Efficiency Of Insurance Companies Of China

A. Sample Selection

According to the principle of availability and comparability on data, 22 life insurance companies in 2003-2008 were selected as the research samples. While newly established insurance companies that have been operated for 10 months and the premium income of which was in the forefront of all newly established insurance companies were also selected, and at last, 22 companies in 2003, 25 companies in 2004, 29 companies in 2005, 33companies in 2006, 35 companies in 2007, and 39companies in 2008 were chosen. In the data of sampling companies, because PICC (People's Life Insurance Company of China) was establish on 6.30. 2003, and inherited relevant insurance business of CICL (China Life Insurance Company Limited), the increase of reserve fund of PICC in 2003 is presented as the product of total increase reserve fund of CICL*(premium income of PICC / premium income of CICL), and compensation duty and profit margin are instead according CICL, others are instead according to data of PICC. Relevant data come from the "China Insurance Yearbook" and relevant documents.

B. Variable Selection and Comparison

Efficiency is a reflection of result on microscopic behavior of enterprises, and it specially presents relationship between input and output or costs and benefits of insurance companies. According to the definitions given by Charnes and Coopers, the most important characteristics of input and output are that the increase of output and the decrease of input are the fundamental approach of pursuing aim and improving efficiency level of a production decision-making unit. There are three main methods to define input and output of a financial institution, namely intermediate approach, cost approach and added value. Financial institutions are generally calculated as a pure financial intermediary financial institution in the intermediate approach, that is, financial institution only earns the differences of interests through borrowing funds and transforming funds into assets. Obviously, this method is not proper for insurance companies. It is determined by the contribution to the income of financial institutions that whether a financial product can be acted as an input or output. If the proceed of the asset is greater than the opportunity cost of assets , or liabilities of the financing cost is less than the opportunity cost, then the product can be considered to be financial outputs; otherwise that is input. This approach is theoretically feasible; however, it is not practically available because it needs accurate data of product benefits and opportunity costs which are difficult to estimate. Berger& Humphery(1997) considered that added value was an appropriate method to measure the output in researches on the efficiency of insurance

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companies, and this method can bring significant added value factors as output variables and the value reduction factors as input variables. There is basic agreement on the selection of input variables in China and the variables are mainly labor investment, capital investment (including forms of physical assets, paid-in capital, total capital and etc.) and operating costs (including forms of claim amounts and operating expenses etc.); however, there is a big difference on output variables. Zhao Xu (2003) adopted profits as the variable, while Hui min and Li Xin dan (2003) the asset profit margin and business income, Hou jing and Zhu lei (2004) the actual expected loss and investment income, Yao Shu jie et. (2005) premium income and investment income, Sun lin and Li Guang jin (2005) per capita profit and asset margin and He jing and Li Cunpu (2005) premium income. Insurance companies are different from general companies. It is clearly inappropriate to measure the operating efficiency by using a particular index of profits, profit margin or the premium income, such as premium income, and per capita premium is a quantitative measurement of operating results, and it is difficult to evaluate the income and risk status objectively only by considering the premium income. The reserve fund is a indicator of measuring business risk of insurance companies. The more adequate reserve fund the stronger ability of insurance companies resisting risks, and profits and profit margins are profitability indicators of insurance companies, and the higher profit margin, the greater development potential of companies. The amount of investment income presents the management and investment competence of companies. Modern insurance companies should not only pursue profits and investment income but also carry out their social duties, thus it is a key to measure the performance of insurance companies that considers premium income, profits, changes in the insurance reserve and investment income comprehensively.

In summary, we adopt added value approach on input and output. Total fixed assets (equal to half of total fixed assets in early and the fixed assets at the end), total cost (including fees, commission costs and operating expenses), net amount of compensation payout (including direct insurance and reinsurance claims net of compensation), and total number of employees are selected as the input indicators. Premium income (equal to the direct insurance and reinsurance premium income), total profits, the amount of reserve growth (the amount of preparation for the end of the year - the early mount of preparation) and the amount of investment income are selected as output indicators.

C. Selection of Model

Estimating efficiency of insurance companies using DEA linear model includes: 1.Measure the technical efficiency value by using C2R model, thus in order to compare the comprehensive efficiency of insurance companies; 2. Measure the pure efficiency value by using BC2 model and compare efficiency of insurance companies after removing the scale factor; 3. Measure the super efficiency value by using super efficiency model and thus in order to compare and distinguish the achievements and failures among insurance companies; 4. Measure the returns to scale changes by NIRS model, when the technical efficiency value in NIRS model is not equal to that in BC2 model that TENIRS ≠ TE BC2 ,it means the unit being evaluated is in the increase region of returns to scale, and the scale invalid is due to the small size and that means companies can increase efficiency through the expansion of scale. When TENIRS = TE BC2 ,it means unit being evaluated is in the decrease region of returns to scale, and the scale invalid is due to the overlarge size of decision-making unit, and that means companies can increase efficiency through narrowing the scale. In this paper, origin and evolution of the models are omitted, and the returns to scale status of companies are not listed in this paper.

(a) C^2R Model

$$\rho = \min[\theta - \varepsilon(l_1^T s^- + l_2^T s^+)]$$
$$s.t. \quad \sum_{i=1}^{n} \lambda_i x_i + s^- = \theta x_k;$$
$$\sum_{i=1}^{n} \lambda_i y_i + s^+ = \theta y_k;$$

(b) BC2 Model

$$\rho = \min[\theta - \varepsilon(l_1^T s^- + l_2^T s^+)]$$
$$s.t. \quad \sum_{i=1}^{n} \lambda_i x_i + s^- = \theta x_k;$$
$$\sum_{i=1}^{n} \lambda_i y_i - s^+ = y_k;$$
$$\sum_{i=1}^{n} \lambda_i = 1$$

(c) "Super Efficiency" Model

$$\rho = \min[\theta - \varepsilon(l_1^T s^- + l_2^T s^+)]$$
$$s.t. \quad \sum_{i=1, j\neq k}^{n} \lambda_i x_i + s^- = \theta x_k;$$
$$\sum_{i=1, j\neq k}^{n} \lambda_i y_i - s^+ = y_k;$$

(d) NIRS Model

$$\rho = \min[\theta - \varepsilon(l_1^T s^- + l_2^T s^+)]$$
$$s.t. \quad \sum_{i=1}^{n} \lambda_i x_i + s^- = \theta x_k;$$
$$\sum_{i=1}^{n} \lambda_i y_i - s^+ = y_k;$$
$$\sum_{i=1}^{n} \lambda_i \leq 1$$

In the model, $\lambda_i, S^+, S^- \geq 0; \varepsilon$ are non-archimedean infinitesimal, and λ_i is the weight of DMU decision-

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making unit, and $x_i = (x_{1i}, x_{2i}, \cdots, x_{mi})$ is the input variable of DMU decision-making unit, and $y_i = (y_{1i}, y_{2i}, \cdots, y_{si})$ is the output variable of f DMU decision-making unit, and S^+, S^- is the slack variable, and S^- is the m-dimensional column vector variable, and S^+ the s-dimensional column vector variable, and ρ is the ration of narrowing input. If $\rho = 1$, $S^+ = S^- = 0$ DMU_i decision-making unit is DAE effective, and if $\rho = 1$ and there is non-zero value in S+, S- , DMU_i decision-making unit is DAE weekly effective, and if $\rho \prec 1$, DMU_i decision-making unit is DAE invalid. ρ is the index of relative efficiency, and in $l_1 = (1,1,...,1)^T_{1\times m}, l_2 = (1,1,...,1)^T_{1\times s}$, s is the output variable and m is the input variable.

D. Selection and Application of Software

(a) Characteristics and Application of LINDO Software.

LINDO was developed by the Linnus Schrage and is a kind of software package that specially used to solve the mathematical programming problem. The software package contained a complete series since its inception including LINDO, GINO, LINGO and LINGO NL. As mentioned above, LINDO is mainly used to solve linear programming, integer programming and quadratic programming problems, and GINO can be used to solve nonlinear programming problem, and to solve linear and nonlinear equations, inequalities and the roots of algebraic equations, besides, GINO includes certain finance, probability and trigonometric functions and a variety of common mathematical functions which is available for user to invoke when creating the problem model, and LINGO can be used in solving linear and integer programming problem, and LINGO NL can be used for solving linear, nonlinear and integer programming problems.

Because LINDO's high speed on implementation and the convenience on inputting, solving and analyzing mathematical programming problems, LINDO is widely used in the fields of mathematics, scientific research and industry and LINDO has been developed several versions. Current versions of LINDO are powerful and are mainly used in solving linear, quadratic and integer programming problems. Interactive environment is available for beginners to set up and solve the optimization problem easily. On the other hand, it can also be used to solve some complex quadratic integer programming problems practically. Like on the large-scale machine, it can be used to solve large-scale complex problems with more than 50,000 constraints and 2,000,000,000 variables. Using LINDO software, this paper gets the value of DEA value of several insurance companies through selecting input and output variables.

Entering the following procedure in LINDO6.1 window, the technical efficiency value of the insurance company Pacific-Antai Life Insurance Company Limited (PALIC) is obtained, and the procedures of other efficiency values of insurance companies are similar, and they are omitted. Here just presents the following procedure in LINDO6.1 window:

```
MINX26
ST
2)149987.00X1+54876.91X2+34618.16X3+18820.71X4
+17674.05X5+6607.45X6+1245.22X7+4758.05X8+597.
6X9+617.36X10+188.26X11+174.88X12+50.32X13+65
0.98X14+75.69X15+333.9X16+213.04X17+116.74X18+
1206.1X19+120.13X20+83.48X21+3.66X22+53.59X23+
292.22X24+21.56X25>21.56
3)3157X1+2384.7X2-1602.29X3-360.57X4+110.68X5-
570.52X6-126.35X7-37.93X8-1.5X9-72.95X10-
40.63X11-54.35X12-10.39X13-131.33X14-22.85X15-
60.73X16-80.38X17-54.61X18-126.54X19-40.52X20-
56.45X21-26.43X22-72.15X23+25.23X24-19.48X25>-
19.48
4)93294X1+34412.44X2+25341.38X3+14419.62X4+126
50.46X5+5774.42X6+1213.97X7+3348.81X8+321.27X9
+360.1X10+131.36X11+78.43X12+34.56X13+282.75X1
4+43.62X15+281.293X16+113.75X17+82.08X18+1035.
6X19+132.88X20+64.5X21+2.2X22+42.76X23+291.73
X24+7.54X25>7.54
5)3669X1+2848.06X2+1288.79X3+453.59X4+710.95X5
+164.01X6+18.73X7+369.49X8+28.93X9+16.74X10+11
.41X11+5.04X12+1.65X13-
5.88X14+3.28X15+5.14X16+6.33X17+5.21X18+48.82X
19+3.59X20+2.56X21+1.96X22-
0.6X23+14.88X24+3.51X25>3.51
6)12773.5X1+4331.735X2+1418.055X3+929.485X4+57
5.3X5+240.775X6+54.58X7+127.4X8+25.27X9+21.57X
10+10.79X11+10.43X12+0.6X13+13.5X14+5.955X15+7
.622X16+22.89X17+14.695X18+36.97X19+17.99X20+1
4.945X21+5.095X22+12.16X23+10.81X24+2.845X25-
2.845X26<0
7)21872X1+8626.62X2+3459.92X3+2491.03X4+2796.7
8X5+1101.39X6+209.19X7+1275.09X8+213.86X9+293.
16X10+71X11+105.5X12+21.92X13+363.38X14+49.09
X15+115.52X16+126.81X17+22.27X18+264.24X19+71.
57X20+97.62X21+32.89X22+82.36X23+4.52X24+33.64
X25-33.64X26<0
8)6065X1+1206.12X2+824.46X3+142.75X4+436.06X5
+51.01X6+0.19X7+167.58X8+14.42X9+6.4X10+1.57X1
1+4.01X12-
0.11X13+0.9X14+0.21X15+3.5X16+0.19X17+0.08X18+
1.62X19+0.76X20+0.4X21+0.00X22+0.1X23+0X24+0.2
3X25-0.23X26<0
9)75437X1+39564X2+20644X3+6573X4+8387X5+479
8X6+822X7+1974X8+277X9+518X10+186X11+229X1
2+91X13+696X14+109X15+189X16+226X17+215X18
+1007X19+237X20+266X21+93X22+303X23+167X24
+173X25-173X26<0
END
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(b) Characteristics and Application of SAS Software

SAS (STATISTICAL ANALYSIS SYSTEM) was a kind of statistical analysis system which was developed

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by COROLINA STATE UNIVERSICIY in 1966. The SAS INSTITUTE INC was established in 1976 and since then began the work of maintenance, development, marketing and training of SAS system. During the period, SAS had gone through many versions, and after several years' improvement and development, SAS system has been valued as the international standard statistical analysis software and is widely used in various fields. SAS is a modular, integrated large-scale application software system. It consists of dozens of specialized modules and its functions include data access, data storage and management, application development, graphics processing, data analysis, report preparation, operation research approach, econometrics and forecasting etc.

On one hand, SAS has characteristics of powerful functions and its statistical methods are abundant and new. SAS provides not only basic statistics calculation but also variance analysis, correlation and regression analysis and multivariate analysis of various statistical analysis processes of various experimental designs, and its technology of analysis is advanced and reliable. The analysis method is realized through the process call. Many processes also provide a variety of algorithms and options. For example, in the analysis of variance of multiple comparisons, more than 10 kinds of methods including LSD, DUNCAN, and TUKEY are provided. A choice of 9 various methods (such as STEPWISE, BACKWARD, FORWARD, RSQUARE etc) is provided in regression analysis. In the regression model, users can choose whether to include the intercept and can also pre-designate some independent variable word groups (SUBSET) in the model. For the intermediate results, those can be all output, not output or selecting output and can also be stored to a file for further analysis procedure call. On the other hand, SAS is easy to use and flexible to operate. It yields data sets through a common data (DATA) and later complete various data analysis through different procedure calls. Its programming statements are concise and short, and generally a number of complex operations with satisfactory results can be completed by a only a few statements. Results are presented by concise English prompt, and statistical terminology is standard and easily understand, and it is available for preliminary English and statistical basis. Users just tell SAS what to do without telling how to do. Design of SAS make users do not have to tell SAS something that can be "guessed" by SAS (that is without setting), and SAS also can correct some minor errors automatically. Besides, SAS can give reasons and correction method of running-time errors. As a result, SAS organically combines the scientific, precise and accurate of statistics and the feature of easily use together, which greatly facilitates the users.

In SAS9.0 window, entering the following procedure, main factors influencing technical efficiency value of insurance companies can be obtained. Procedure as followed: data A2;set A1;run;proc reg; model Y1=X1-X8/selection=stepwise sls=0.05 sle=0.2 r;run; A1: data files imported in SAS software, including the 8 assumptive influencing factors and specific values of various efficiency, and other efficiency values are regression similar, and they are omitted in this paper.

E. Efficiency Value and Evaluations of Company

Table 1 shows us the super efficiency technical efficiency, pure technical efficiency and scale efficiency of different insurance companies. The top five insurance companies of super efficiency are Zhaoshangxinruo company, Ruitai life insurance company, Zhongbaokanglian v, PICC, Yangguang life insurance company, and the last five companies are Changcheng life insurance company, Hezhong life insurance company, Haier –NewYork company, Haikang life insurance company and Guangdianrisheng company, short term and long term companies are both include, and at the forefront only PICC is large scale company, while others are all small companies. The top five insurance companies of technical companies are Zhongbaokanglian company, Yangguang life insurance company, Yingdataihe company, Xingfu life insurance company and PICC, and the last five companies are Yingzhong life insurance company, Hezhong life insurance company, Haier-NewYork company, and Guangdianrensheng company. Pure technical efficiency and scale efficiency are similar, and this is because total value of technical efficiency is determined by pure technical efficiency and scale efficiency.

TABLE1. EFFICIENCY OF VARIOUS DIFFERENT INSURANCE COMPANIES[1]

Company	Number	Average value				Operating time: year
		Super efficiency	Technical efficiency	Pure technical efficiency	Scale efficiency	
China Life Insurance	1	1.8363	0.9771	1.0000	0.9771	2003-2008
Ping An Life Insurance	2	1.2635	0.9468	1.0000	0.9468	2003-2008
Pacific Life Insurance	3	1.0985	0.9571	1.0000	0.9571	2003-2008
Xinhua Life Insurance	4	1.3150	0.9307	1.0000	0.9307	2003-2008
Taikang Life Insurance	5	1.1445	0.9576	0.9933	0.9628	2003-2008
Tai Ping Life Insurance	6	0.9604	0.7162	0.7979	0.8889	2003-2008
Sino-Life Insurance	7	0.9095	0.6306	0.7971	0.7546	2003-2008
AIA	8	1.0822	0.7964	0.9755	0.8200	2003-2008

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Zhonghong Life Insurance	9	1.4103	0.7883	0.8849	0.8417	2003-2008
Pacific-Aetna Life Insurance	10	0.7050	0.5844	0.6307	0.8633	2003-2008
Allianz Dazhong Life Insurance	11	0.5566	0.5566	0.8155	0.6497	2003-2008
AXA-Minmetals Assurance	12	0.5001	0.4769	0.5607	0.7727	2003-2008
China Life CMG	13	1.9438	1.0000	1.0000	1.0000	2003-2008
Prudential Life Insurance	14	0.6829	0.5793	0.6557	0.7623	2003-2008
John Hancock Tianan Life Insurance	15	0.5597	0.4378	0.8528	0.5012	2003-2008
Generali China Life Insurance	16	1.3654	0.9032	0.9162	0.9738	2003-2008
Sun Life Everbright	17	0.5754	0.5163	0.6188	0.8224	2003-2008
Haier New York Life	18	0.2565	0.2565	0.4327	0.5969	2003-2008
Minsheng Life Insurance	19	0.6306	0.5326	0.6680	0.8020	2003-2008
ING Insurance Company	20	0.8471	0.4018	0.5179	0.7364	2003-2008
Sino-British Life Insurance	21	0.3992	0.3702	0.6227	0.5745	2003-2008
Nissay-SVA Life Insurance Company	22	0.1805	0.1805	0.9527	0.1915	2003-2008
AEGON-CNOOC Insurance	23	0.2391	0.2391	0.4533	0.5286	2004-2008
Heng An Standard Life Insurance	24	0.5092	0.5092	0.7096	0.7587	2004-2008
CIGNA and CMC Life Insurance	25	3.4377	0.6899	0.8611	0.7781	2004-2008
China. MetLife	26	0.4016	0.3857	0.4340	0.6718	2005-2008
Greatwall Life Insurance	27	0.3815	0.3815	0.6035	0.6295	2005-2008
Cathay Life Insurance	28	0.4200	0.4200	0.6235	0.6692	2005-2008
Winterthur Life	29	3.3269	0.7500	1.0000	0.7500	2006-2008
United Metlife Insurance	30	0.6844	0.6492	0.7818	0.7918	2006-2008
Union Life Insurance	31	0.2996	0.2996	0.4014	0.7529	2006-2008
Huatai Life Insurance	32	0.6042	0.4977	0.7045	0.6348	2006-2008
Jiahe Life Insurance	33	1.1850	0.6497	0.9100	0.6976	2007-2008
Dragon Life Insurance	34	1.3203	0.6618	0.8649	0.8818	2007-2008
Huaxia Life Insurance	35	0.6755	0.6755	0.8041	0.7096	2007-2008
Sinatay Life Insurance	36	0.5879	0.5879	0.7880	0.7461	2008
YingDaTaiHe Life Insurance	37	1.5471	1.0000	1.0000	1.0000	2008
Happy Insurance	38	1.0442	1.0000	1.0000	1.0000	2008
Sunshine Life Iunsurance	39	1.5893	1.0000	1.0000	1.0000	2008

[1]Data from the "China insurance Yearbook" from 2003 to 2008 and other relevant documents

III. Analysis of Facorsiy of Influencing Efficiency of Insurance Company

A. Theory Analysis of Factors Influencing Efficiency of Insurance Company

According to current domestic research on the efficiency of insurance companies, it is considered that size, ownership structure, human capital, proprietorship structure, operating time and business scope of insurance companies will affect the efficiency of insurance companies. Based on the domestic researches' conclusions, this paper assumed the following factors influencing efficiency of insurance companies and did tests accordingly.

a) X1Factor of the Capacity of Insurance Services:

A key function of contracted business of insurance company is risking-sharing, and when insurers suffer losses, timely payments by insurance companies is one of the keys that insurance companies can get businesses. Therefore, the loss ratio is measured as an index of service competency of insurance companies. Low loss ratio will not only improve operational efficiency, but rather be in a disadvantage situation because of lack of appeal in the fierce competition. Insurance companies always pay attention to premium income but ignore the claims, and when the overall loss ratio is low, it is assumed that the higher the loss ratio is, the more premium and the better operating efficiency the insurance companies get. Loss ratio = current total amount of claim/current total amount of premium.

b) X 2 Factor of Asset Scale:

Insurance companies are enterprises operating risk business, and larger-scale insurance companies have higher ability of acceptance of risk, and small-scale insurance companies are disadvantage on both credibility

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and popularity, and insurance industry in China is in the stage that development and improvement of competitiveness are relying on the growth of scale, so natural logarithm of asset amount of an insurance company is selected to present the scale of an insurance company.

c) X 3Factor of Human Capital:

Human resources play an important role in the development and competition of modern enterprise. An insurance company is composed of stuffs with different levels. It is generally believed that higher educated employees with stronger professional knowledge are good for the development of an insurance company. Therefore the ratio of well-educated stuff (number of employees who are undergraduate and over / total number of employees) is adopted as the human capital.

d) X4 Factor of Productivity Per Labor Unit:

Premium income per person is to measure the operating efficiency of an insurance company through the production efficiency per labor unit. Higher production efficiency per labor unit can produce better benefits and efficiency in an insurance company. Higher premium income per capita induces higher operating efficiency in a insurance company and vice versa. Premium income per capita = total premium income / total number of employees.

e) X5 Factor of Operating Time of a Company:

It takes a long time to manifest the operating performance of an insurance company, and companies of short operating time are at a disadvantage on business network, reputation and scale while companies of long operating time are at an advantage on business network, reputation and scale. Therefore, it is assumed that longer operating time, better operating efficiency.

f) X6 Factor of Insurance Type:

Business of life insurance companies can be divided into group insurance and individual insurance. Group insurance is better than individual insurance at terms of size and quality, so a higher proportion of individual insurance in the premium income of an insurance means lower operating efficiency and vice versa. The type of an insurance business is account to the individual proportion, and an individual proportion = an individual premium/ total amount of premium income.

g) X7 Factor of Underwriting Quality:

For an insurance company, more surrender will bring negative effects on normal operation and development. High surrender ratio stands for low efficiency in an insurance company. Surrender ratio = amount of surrender/ total amount of premium income.

h) X8 Factor of Competence of Investment and Management:

When an insurance company develops to a certain stage, the underwriting profit generally is low because competition increases. The insurance company enhances its competitiveness and developing ability mainly relying on high investment rate and good risk management. The insurance market is developing gradually, and the investment scope is expanding, and the investment risk is also expanding, and the rate of return on investment (ROI) influences greatly on the operating efficiency in an insurance company. Therefore, in this paper it is assumed that the higher rate of ORI the higher efficiency of an insurance company. ROI = net investment income/ total amount asset of the insurance company.

B. Establishment of model

The macroeconomic environment that influences the super efficiency, technical efficiency, pure technical efficiency, scale efficiency value of an insurance company includes insurance regulatory policy, macroeconomic conditions, as well as the operation situation of the enterprise itself such as ROI and premiums per capita. The enterprise can not alter the external factors like macroeconomic policy; however, the only changes that can be done by enterprise are to strengthen their management, improve operational efficiency. Coelli et al. (1998) proposed the famous "two-stage" method, and its main thought is first calculates the efficiency value by DEA model, and then selecting appropriate environment variables to do regression analysis and then make sure of the factors influencing efficiency. In China, least squares regression and Tobit models are always used to estimate the influencing factors, and because the efficiency value of former model has a restrict range between 0-1, parameter estimation is biased and non-consistent. The technical efficiency value determined by DEA method can not distinguish the advantages and disadvantages among companies, and efficiency values of effective companies are all 1, and the restrict range of efficiency value which between 0-1 make the Tobit model no longer available in this situation. According to Hardwicketal's method (2003), this paper did regression analysis on super efficiency and when did regression on technical efficiency, pure technical efficiency and scale efficiency value, convertible regression of efficiency value is adopted. Transform form is as below:

$$Y_i = Ln(TE_i / 1 - TE_i)$$

TE_i is technical efficiency, pure technical efficiency and scale efficiency value calculated in the DEA model, and the rang is 0-1, and Ln is natural logarithm, and in order to convert conveniently, all the efficiency value minus 0.0005, and regression model is established:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon_i$$

After that, we can adopt the least squares method to do stepwise regression on dependent variable Y at different influencing factors and investigate the factors that have significant effect on the efficiency of insurance industry.

C. Empirical Results Analysis

From the regression results, we can find that the factors affecting the efficiency of an insurance company are loss ratio, human capital, premium income per capita and proportion of individual insurance and operating time. Loss ratio and proportion of individual insurance show significant difference at the level of 5% in t-test and others show significant difference at the level of 1% in t-test. Loss ratio, surrender rate, premium income per

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capita and company scale plays a significant effect on influencing efficiency of an insurance company. Of these four factors, surrender rate shows significant difference at the level of 5% in t-test and the other three show significant difference at the level of 1%. Details are shown in Table 2.

TABLE 2. REGRESSION RESULTS OF FACTORS INFLUENCING EFFICIENCY OF LIFE INSURANCE COMPANIES OF CHINA

Variable	Model 1	Model 2	Model 3
Constant		-2.0209（4.18）**	
Loss ratio	7.4912（4.33）**		7.3445（5.86）**
Human capital	5.8667（6.89）***		
Surrender ratio			6.2194（8.67）***
Company scale		0.7632（41.7）***	0.2844（44.82）***
Premium per capita	0.2209（11.39）***		0.1706（8.12）***
Individual insurance[1]	-0.3144（4.46）**		
Operating time	0.1923（18.34）***		
Adjusted R	0.4795	0.1873	0.6231
F statistics	32.79***	41.70***	73.99***
Number of observation	183	183	183

***、**means difference at level of 1 and 5%，T statistics are in brackets.

[1]Propotion of individual insurance

Models are obtained according the results of regression (Y_1, Y_2, Y_3 are technical efficiency, pure technical efficiency, scale efficiency value separately)

Model1

$$Y_1 = 7.4912X_1 + 5.8667X_3 + 0.2209X_4 + 0.1923X_5 - 0.3144X_6$$

Model 2

$$Y_2 = -2.0209 + 0.7632X_2$$

Model3

$$Y_3 = 7.3445X_1 + 0.2844X_2 + 0.1706X_4 + 6.2194X_7$$

In model 1, the loss ratio, human capital, premium income per capita, company operating time is positively correlated with technical efficiency, and as loss ratio increased by 1 percentage, technical efficiency increases 7.4912 percents, and this shows that insurance companies of China should strengthen management on claims and improve the function on claims and security. As human capital increases 1%, technical efficiency increases 5.8667%. Human capital generally does not show significant difference in the previous researches and thus it is often removed. However, this paper shows that human capital begins to play an important role on efficiency of insurance companies according to the last 6 years data, and it is inseparable from the practical environment that Chinese insurance industry has fully opened to foreign countries and insurance companies has enhanced competition and talents have began to play a great role on the development of insurance companies since 2003. Premiums per capita and established time have a positive impact on the technical efficiency of insurance companies, and this is consistent with previous analysis, and it means that the established time of the insurance company has a certain impact on efficiency of the insurance company, and this is mainly related to with the marketing channels of the insurance company. Newly established insurance companies are poor at brand influence and marketing networks, and as time goes on, these will be improved. There is no doubt that premium per capita is the index of output per unit, and low output unit will never bring high operational efficiency, thus as premium per capita increases 1%, technical efficiency increases 0.2209%. Compared with other indexes, the impact of premium per capita is less, and it is relative to with that insurance marketing of China only seeks the expanding in scale a few years ago, and it means that it is not feasible that insurance companies of China increases efficiency by expanding scale. Proportion of individual insurance and technical efficiency are negatively correlated, and 1% increase in proportion of individual insurance and 0.3144% decrease in technical efficiency and this is consistent with the current situation in China. China's insurance market is relatively underdevelopment, and compared with individual insurance, group insurance has superiority on scale and quality. If the individual insurance proportion is high in the business of insurance companies, operating efficiency will be relatively low. Therefore, it is a better choice to increase the proportion of group insurance in the business of insurance companies.

In model 2, scale of insurance companies affects the pure technical efficiency of insurance companies. If the scale of the company increases 1%, pure technical efficiency increases 0.7632%. Overall, compares with other factors, scale of companies has a lower influence on efficiency of insurance companies.

In model 3, loss ratio, surrender rate, premium income per capita and company scale affect the scale efficiency of insurance companies. These four factors are positive correlation. Loss ratio increases 1%, and the scale efficiency increases 7.3445%. This is basically consistent with model 1. This means that loss ratio influences technical efficiency of the company through influencing scale efficiency. Increase of loss ratio contributes to the increase of scale, thus increase scale efficiency, and the increasing scale efficiency can help improving the technical efficiency. 1% decrease of surrender rate contributes 6.2194% increase of scale efficiency and

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which may be related to China's current surrender terms and that insured is in a weak position compares with insurance company. In other words, the insurance company constrains the insured through a relatively harsh terms of surrender, so the insured once surrenders, the insurance companies benefit. A 1 % increase of company scale and the premium per capita followed a crease of 0.2844%, 0.1706% scale efficiency separately. As can be seen, it is very weak that insurance companies enhance technical efficiency through increasing scale efficiency.

Overall, factors influencing technical efficiency of insurance companies include loss ratio, surrender rate, premiums per capita, company scale, company operating time and proportion of personal insurance in companies' business. On the aspect of impact that ROI affects the operating efficiency, because significant issues in the regression analysis have been removed, and this is the disadvantage of the paper and it may be due to that when determining the DEA efficiency, return on investment is taken as the output item and thus make DEA efficiency highly related to ROI.

IV. Conclusion and Suggestion

Statistical economics is playing a more and more important role in the modern society of economics and life. In order to grasp the pulse of the economy, government and enterprise collect and release large amounts of digital information every year, and in order to constitute the developing plan of society economy, several order differential equations, hundreds of simultaneous linear equations and solving large-scale matrix are processed, and it is inconceivable without the help of computer. The actual shapes of various curves in economics mainly come from the analysis of statistical data and knowledge of database, procedures, and systems etc. are needed in computer application science. It is not only because that economics gives us inspires to understand the complex economical society, but also that it makes the market economy go through smoothly and get better control. To accurately grasp the subtleties of economic and social development, we consider that we should first combine mathematics, economics and computer organically. Since we are familiar with our research object: the efficiency of life insurance companies, we should have a mathematical basis meanwhile we should also have to grasp the application of computer programs in some extent: LINDO software and SAS software, so we combine the two and carry out the thought of this article.

In this paper, by the means of the software of LINDO and SAS, efficiency values of different insurance companies are fast calculated and it supplies a scientific tool for comparing business efficiency of each insurance company and it promotes the application of LINDO and SAS in the field of economic management. The appearance of LINDO and SAS well solve the shortcoming of lack of tools in the field of economic analysis. Especially in the problem of linear programming, LINDO software is simple, fast, and convenient to operate, and it is suitable for the users in the field of economic analysis.

A. Improve the Underwriting Quality of Insurance Companies

To the newly established insurance companies, it is pivotal that how to improve their popularity and get customers' recognition, and only with the appropriate market scale, newly established companies can compete with the old famous state insurance companies; otherwise, everything is impossible. For the large scale insurance companies like PICC, it is an important issue to handle the relationship between scale and quality correctly. At the time of expanding scale, underwriting quality should be improved, and avoid ignoring underwrite quality because of the expansion of scale.

B. Greatly Improve Loss Ratio and Service Quality of Insurance

The appropriate loss ratio is a key indicator to attract interests of insured and is a basic function of insurance companies. Some insurance companies attempt to improve profits by deliberately suppressing loss ratio, set barriers of coverage and claims; however, these measures will not enhance the profitability, operating efficiency and competitiveness of insurance companies but will make themselves in a vicious circle and make themselves in a disadvantage situation in the competition of insurance. Appropriately increasing loss ratio will stimulate the enthusiasm of insured and also is conductive to the growth and maturity of the insurance market, and insurance companies also can deconcentrate the risk through the advantage of scale.

C. Optimize Insurance Structure and Speed Up the Development of Insurance Products.

In the current insurance market of China, group insurance is better than individual insurance on scale and quality; therefore, insurance companies should pay attention on promoting group insurance, increase the proportion of group insurance, and insurance companies should speed up the development of insurance products depending on the development of group insurance and especially focus on the market of individual insurance and promote various kinds of products to meet different individual need. As the development of economy, the individual insurance market will gradually develop and mature, and insurance companies will have a great space in developing individual insurance market.

D. Improve the Investment and Management Capabilities of Insurance Companies and ROI, and Provide Supports For the Development of Insurance Companies.

Modern insurance companies obtain a large number of insurance funds relying on the insurance market and then get high returns depending on the excellent operating on investment and management and thus it will support the development of insurance business. The traditional situation of getting profits relying on the underwriting are not existed anymore, and the fierce competition make the underwriting profits of insurance companies become

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smaller and smaller, or even loss, so it is the inevitable choice for the insurance companies to improve the ROI.

Facing the situation that foreign large insurance companies have joined the Chinese insurance market and the competition is increasing day by day, it is greatly effective to improve the insurance companies' efficiency through strengthening the claim service, increasing the loss ratio, improving insurance structure, especially raising the proportion of group insurance.

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