ISCTE IUL
Instituto Universitário de Lisboa

China's Insurance Companies' Efficiency：

An Empirical Study

Jiayan ZHU

Thesis submitted as partial requirement for the conferral of the degree of

Doctor of Management

Supervisor:

Prof. Álvaro Rosa, Associate Professor, ISCTE University Institute of Lisbon

Co-supervisor:

Prof. Liping, Full Professor, University of Electronic Science and Technology of China, School of Management and Economics

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Abstract

Great achievements have been seen in China’s insurance industry in the past 20 years, however, inefficiency problems were prevailing as many insurance company only pursuing the expansion of the quantity, but not the increase of their key competitiveness. How to improve the core competitiveness of China's insurance industry, especially the efficiency of Chinese-funded insurance companies, has always been an important issue that the Chinese government, regulators and insurance institutions have been paying attention to and exploring for a long time.

This thesis uses the most advanced efficiency evaluation model——three-stage DEA method and a samples of 43 property insurance companies and 53 life insurance companies to calculate the technical efficiency, pure technical efficiency and scale efficiency from 2008 to 2011. The research results show that China’s insurance industry has high technical efficiency and pure technical efficiency, while its scale efficiency is low and its scale is still in an expanding stage from 2008 to 2011. In order to compete with foreign insurance companies, Chinese insurance companies must upgrade their key competitiveness and pure technical efficiency as soon as possible. Through more rational allocation of resources and more refined management, China's insurance industry can achieve its development goals.

According to Empirical research, the main reason for the weak core competitiveness of Chinese small and medium-sized insurance companies is the imbalance of inputs and outputs. Therefore, through rational allocation of resources, optimization of business strategies, and control of costs, the efficiency of companies can be improved.

By studying the factors affecting the efficiency of Chinese insurance companies, the conclusion shows that the expansion of asset size will significantly increase the technical efficiency and scale efficiency of life insurance companies and property insurance companies. Moreover, all efficiency of foreign property insurance companies outperform Chinese-funded ones, while technical efficiency of Chinese-funded life insurance companies outperform foreign ones.

Key words: Three-stage DEA, insurance industry, efficiency, China

JEL: C14；G22

Resumo

Tem-se assistido nos últimos 20 anos um desenvolvimento extraordinário da indústria de seguros na China, contudo, o problema da ineficiência continua a ser um problema grave porquanto que a indústria de seguros na China caracteriza-se no essencial pela expansão em dimensão e não nos fatores de competitividade. A necessidade de melhoria da capacidade competitiva da indústria chinesa de seguros e, em especial, a eficiência de seguradoras de capital chinês tem sido uma preocupação importante para o governo chinês, para os reguladores e para as próprias instituições seguradoras.

Este trabalho, utilizando o método de eficiência DEA de três estádios e uma amostra composta por 43 seguradoras de seguros imobiliários e 53 outras do ramo vida, computou a eficiência técnica, eficiência técnica pura e a escala de eficiência no período de 2008 e 2011. Os resultados da investigação mostram que a indústria seguradora da China tem uma elevada eficiência técnica e técnica pura, enquanto que a escala de eficiência é baixa e demonstramos que se encontrava numa fase de desenvolvimento no período de 2008 e 2011.

De acordo com a nossa investigação empírica, a razão principal da fraca competitividade das seguradoras chinesas de pequena e média dimensão é o desequilíbrio entre «inputs» e «outputs». Com uma afetação racional de recursos, otimização de estratégias de mercados e controlo de custos, a eficiência das seguradoras poderia ser melhorada.

Na análise de fatores que afetam a eficiência das empresas chinesas de seguros, o nosso estudo mostra que o reforço de ativos contribuirá para a melhoria da eficiência técnica e da escala de eficiência de seguradoras tanto do ramo vida como do ramo imobiliário. Concluímos ainda que as seguradoras estrangeiras têm melhor eficiência do que as congéneres chinesas, mas avaliando pela ótica de eficiência técnica, as seguradoras chinesas têm melhor desempenho que as seguradoras estrangeiras.

Palavras-chave: DEA de três estádios, seguros, eficiência, China.

JEL: C14; G22

摘　要

近二十年来，中国保险业虽然取得了举世瞩目的发展成果，但大多数保险公司只关注保费增量而不关注核心竞争能力的提升，普遍存在效率低下的问题。如何提高中国保险业的核心竞争能力，特别是中资保险公司的效率，一直是中国政府、监管机构、保险机构长期关注和探索的重要问题。

本文运用目前最先进的效率评价模型——三阶段 DEA 方法，采用 2008 年～2011 年 43 家财险公司和 53 家寿险公司在内的 96 个样本企业，测算中国保险公司的技术效率、纯技术效率和规模效率。研究结果表明，2008 至 2011 年间中国保险业的技术效率、纯技术效率均已经达较高水平，但是规模效率仍然处于较低水平，但整个保险业的规模仍处于不断扩大的阶段。中资保险公司要与国外保险公司竞争，就必须尽快提升核心竞争力的技术水平、提高纯技术效率。通过更合理资源配置和更精细化的经营管理，实现中国保险业的发展目标。

通过实证分析，本文认为中国中小保险企业核心竞争力较弱的主要原因是投入和产出不均衡。国内中小保险企业应通过资源的合理分配、优化经营策略，控制费用和成本，以提升保险公司效率。

通过对中国保险公司效率的影响因素研究，本文结论资产规模的提升会显著增加寿险和财险公司的技术效率和规模效率。外资财险的所有效率比中资均有优势，而中资寿险在技术效率有优势。

关键词：三阶段 DEA、保险业、效率、影响因素

JEL: C14 数理数量：半参数和非参数方法；G22 保险；保险公司.

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The five years of doctoral study, which was the most precious period of my life. I am really lucky meet many good teachers, relatives and classmates'great encouragement and support.

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"There is no shortcut to the mountain of books, and there is no end for the sea of knowledge by Painful voyage." (This Chinese verse means: only the diligent will be rewarded by God in their pursuit for knowledge.)

This thesis explores the significant further analysis of Chinese insurance industry efficiency theoretical principle and evaluation method. This thesis not only means the doctoral education achievements, but also for my new field of academic research for over 10 years experience of insurance industry and capital management field. From now on, I will reward my teachers, friends and relatives by hard work and diligent learning.

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攻读博士的五年，是我人生最宝贵的一段成长历程。我感到非常幸运，能得到师长、亲人和同学给予我巨大的鼓励和支持。

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“书山有路勤为径，学海无涯苦作舟。”本论文在中国保险业效率分析和评价等方面做出了较有意义的探索。本论文不仅意味着博士求学的阶段性成果，同时也是我长达 10 多年在保险行业和资管行业学术研究的阶段性总结。在日后的工作、生活中，学生唯有勤奋努力、刻苦专研，才能回报支持我的师长、亲人和朋友。

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Chapter 1: Introduction

1.1 Research Background

Although the new China has been established for 70 years, the Chinese modern enterprises really integrate into the market or the world economy only after the Chinese reform and opening up since thirty years ago, the historical development rhythm of China's insurance companies are basically in line with this environment.

From 1949 to 80s, there was only one insurance company in China, namely the Chinese people's life-insurance company (PICC), which later divided into property insurance and life insurance business, the establishment of independent PICC Property Insurance Company and China Life Insurance Company. At the same time, Pingan Insurance Company and China Pacific Insurance Company (CPIC) emerged in succession. In the 90s of last century, Xinhua insurance company and Taikang Insurance company emerged again.

While China entered the WTO, the insurance industry was deemed as an open industry as well. Therefore, after 2004, China has witnessed the emergence of quite a few joint insurance companies with powerful foreign insurance companies as shareholders, as well as the rapid appearance of many shareholding and private insurance companies. Confronted with the sudden increase of micro business entities in the market, established insurance companies have no choice but to turn to transformation, and what new insurance companies should do is to achieve acclimatization. Therefore, the insurance market has experienced substantial innovation in products and marketing ways. Correspondingly, the study on the effective operation of insurance companies in China, a special market environment, has left some aspects untouched.

In 1992, AIA (American International Assurance) was approved to do business in China and thus turned out to be the first wholly foreign-owned insurance company in China. Later on, foreign-funded companies had their business scope and operating area further expanded, and an increasing number of foreign-funded insurance companies successively obtained the license

of entering the Chinese market. Among the 46 insurance companies entering *Fortune* Global Top 500, so far, 37 companies therein have set a joint venture in China. The admission of foreign-funded insurance companies into China not only enhances the market competition, but also delivers advanced management and technology experience to us. Given that joint insurance companies have accumulated abundant experience in product design, service quality, compliance and prudent operation, they are capable of facilitating the overall development of the Chinese insurance industry. In addition to introducing foreign capital, Chinese-funded insurance companies have quickened their reform of reaching out. In 2003, PICC took the lead to realize the overseas listing in Hong Kong Exchanges and Clearing Limited, after which China Life and Ping An Insurance have been successively listed in New York and Hong Kong. As a result, the Chinese insurance industry has integrated into the international capital market in a deeper manner, and had its integrated competitive power and capital strength improved.

The total premium income of China's insurance industry increased 70 times from 52.1billion in 1997 to 3.8 trillion in 2017. In the first twenty years of the 21st century, the average annual growth rate of the Chinese insurance industry was more than 30%. The period was called "the Golden Decade" for the industry because of fast growth. According to statistics from the CIRC website, by the end of 2018, there were 179 insurance companies in China, including 88 property insurance companies and 91 life insurance companies, 88 property insurance companies, including 66 Chinese and 22 joint venture insurance companies. 91 life insurance companies include 63 Chinese and 28 joint venture insurance companies. According to the CIRC website, the original premium income in 2018 was 3.801662 trillion yuan, including 2.626087 trillion yuan for personal insurance companies and 1.175569 trillion yuan for property insurance companies. China emerged as an emerging insurance giant.

The pace and progress of Chinese insurance companies' business history is identical with the broad environment, and confused by similar problems. In the meantime, the industry development issue also exists.

1.2 Research dilemma

After 68 years of development, with the ups and downs of the industry, which went through business suspense, reopen, seperation and mixed operation, Chinese insurance industry experienced a development process from weak to strong. Since 1999, the premium income of China insurance industry grew nearly 9 times, but high growth is only a superficial prosperity, in fact the mainstream insurance products in market are short-term financial products of high cost rather than insurance products with high intrinsic value, so the scale of China's insurance market is difficult to achieve sustainable growth in current mode.

Especially after 2011, the domestic insurance industry began to face a double bottleneck of premium growth and sustainable profitability. It is difficult to maintain sustained growth in premium income for domestic insurance companies, and even some life insurance companies appear negative growth in premium income and rare insurance companies continue to have two-digit growth rate. In the process of reform and transformation of China insurance industry, the performance of some insurance companies shows that the growth of premium is weak, the rate of return on investment is not high, and the overall operating capacity of insurance companies is poor, these are significant difficulties of the current Chinese insurance industry. The state-owned insurance companies faced with the change from the former monopoly to the market competition. Chinese-funded companies are facing the challenges of the foreign capital and advanced technology brought by the gradual opening of the market.

Facing the increasingly fierce competition, Chinese-funded insurance companies must improve their competitiveness by changing their operational model. The core connotation of the competitiveness of insurance companies is the promotion of efficiency. Only by constantly enhancing their own cost control and profit creation abilities can they survive and develop in a highly competitive market environment.

1.3 Research Questions

(I) To study the competitiveness of Chinese insurance companies from an efficiency perspective:

China’s insurance industry development is mainly rely on premium scale expansion. Most insurance companies only rely on the substantial expansion of premium scale to occupy market share, and there are some main problems, such as low efficiency. With the end of the transition period of China's entry into WTO, Chinese insurance institutions are facing more fierce market competition. Some insurance companies can no longer occupy market share and survive only by increasing the scale of premiums, the key to the survival and development of China's insurance industry is to improve the efficiency of insurance companies. Therefore, it is very important and urgent to carry out the research on the efficiency of insurance companies.

(II) The Significance of Studying the Efficiency of Insurance Companies

1. Macroscopic Aspect

Proceeding from the economic perspective, insurance is a compensation system for sharing losses and offering economic guarantee. From the risk management perspective, it is a kind of risk aversion mechanism. Therefore, insurance is closely related to a country’s economic development and social stability. At the earliest, insurance was born in seaborne trade as a product of market economy development. Before the reform and opening-up and during the planned economy period, the insurance industry in China was on the verge of disappearance. On the transformation of market economy, however, it reappeared as a result of incomplete factors in such systems as social security, public assistance and disaster compensation. It is proved by both historical and realistic factors that insurance, particularly commercial insurance, is inseparable for the market economy. Even Sun and Zheng (2009) put forward "the imperfect market economy of the insurance industry is not a perfect market economy". Moreover, in recent years, our government has taken the advancement of the insurance industry as one of the key reforms. Therefore, this thesis believes that the improvement of insurance companies’

efficiency ranks to be the fundamental starting point for the development of the insurance industry in addition to external institutional factors or institutional efficiency like industry supervision.

2. Microcosmic Aspect

When a country recovers the development of an industry, the phenomenon of not observing objective disciplines or following outdated management method at the new development stage is common. In earlier years, some established insurance companies in China were also trapped in this phenomenon. In the past two or three years, however, due to the earning pressure and the investment restriction imposed by the government on insurance companies, this phenomenon has become more serious rather than disappeared with the development of the insurance industry at certain times or in some regions for both established Chinese-funded companies with listing pressure and share-holding companies responsible for shareholders. Apart from disturbing the market order, it also leaves hidden trouble for its own operation. Due to the fierce competition at present, it is unpractical for some companies to maintain its survival and occupy market share by applying extensive sales based on the corporate scale. Thus, the proper management of the relationship among premium amount and operating cost, handling charge and compensation amount is of utmost significance for securing efficient operation despite the fact of serious product homogeneity and numerous substitute goods.

(III) Realistic Problems Left over by History

In China, the history of modern enterprises with genuine operational significance is only over 100 years. Since 1949, the integration of modern business enterprises into the real market or the world economy has only occurred in the past 20 or 30 years. The pace and progress of Chinese insurance companies' business history is consistent with the broad environment, and problems confused are also similar. But at the same time, the industry development issue also exists.

1. Time Opportunity Related to the Insurance Industry

From 1949 to 1980s, there was only one insurance company in China, namely, PICC Life Insurance Company Limited, which later divided into independent PICC and China Life as a result of business delineation of property insurance and life insurance. At the same time, Ping An Insurance and China Pacific Insurance emerged in succession. In the 90s of last century, New China Insurance and Taikang Insurance emerged. While China entered the WTO, the insurance industry was also an open industry. Therefore, after 2004, China has witnessed the emergence of quite a few joint insurance companies with powerful foreign insurance companies as shareholders, as well as the rapid appearance of many shareholding and private insurance companies. Facing the sudden increase of micro business entities in the market, established insurance companies have no choice but to turn to transformation, and new insurance companies also need to achieve acclimatization. As a result, the insurance market has experienced substantial innovation in products and marketing ways. Correspondingly, the study on the effective operation of insurance companies in China, a special market environment, has left some aspects untouched.

2. **Competitiveness of China's Insurance Industr**y

In 1992, AIA, an American insurance company, has been approved to operate in China, becoming the first wholly foreign-owned insurance company in China. Later, the business scope and business area of foreign companies were further expanded, and foreign insurance companies successively obtained the license to enter the Chinese market. According to the CIRC website, there are 50 foreign insurance companies had set up joint ventures in China by the end of 2018.The entry of foreign-invested insurance companies into China not only increased market competition, but also provided us with advanced management and technical experience. The joint venture insurance companies have rich experience in product design, service quality, compliance and prudent operation, which has promoted the overall development of China's insurance industry. At the same time of the introduction of foreign capital, Chinese-funded insurance companies have also accelerated the pace of reform to go global. According to Hao Lina pointed out that PICC P&C first listed in the Hong Kong Exchange to achieve overseas listing in 2003, then China Life Insurance Company and Ping An Insurance Company listed in New York and Hong Kong successively, which enabled China's insurance industry to more deeply integrate into the international capital market, thus

promoting and enhancing the overall competitiveness and capital strength of China's insurance industry. In addition to going out for financing, the real realization of the connection between the domestic insurance market and the global insurance market is that after introducing foreign insurance enterprises and their management experience for a certain period of time, they must invest overseas and establish overseas insurance institutions at the same time.

(Ⅳ) Micro-matters Reflected by Realistic Problems

1. Research on Corporation Efficiency

(1) Foreign research. The research on the efficiency of financial institutions abroad originates from the merger of financial institutions since 1980s. The restrictions of cross-border and separate operations have been broken and the wave of financial business integration has been broken. Most of the early research subjects were commercial banks, and most of the research results came from professors from American and European business schools. In the early days, the study objects were commercial banks, and most research results came from professors of American and European business colleges. From the 1990s, Weiss, a professor from The Wharton School and other personnel initiated the study of insurance companies' efficiency, and gave priority to insurance institutions in developed countries such as Europe and America. Although the history of studying the efficiency of insurance companies worldwide is about 20 years only, study objects and investigators have experienced rapid expansion on a global scale, and the study method is increasingly perfect.

(2) Domestic research. Domestic scholars Yun, and Li (2003), and others used economics and econometric models to study the efficiency of insurance companies began about 2003, and the research progress is rapid. In the first published literature, such as Li (2005), Yao (2005) and so on, creative empirical research results have appeared after 2005. It not only includes the discussion about quantitative study method used, but also covers the verification performed by very few people for the

combination of existing method results with practice. Most of the existing results are concentrated in production technology, equity or organizational form and industry. In the meantime, the research achievements of cost efficiency and profit efficiency etc. mentioned by some new economic theories emerging in recent years worldwide have started to appear. In spite of the restriction of historical and present data, if any insurance company can give full play to those research methods keeping abreast of the times and utilizing its own historical data for measurement, it will be very beneficial for Chinese insurance companies during the transformation period in terms of operating principle and system.

2. Historical sample data is distorted or missing

According to the empirical Analysis of Insurance Company efficiency and Marketing decision published by Yu (2011) , it is pointed out that it is necessary to point out that most of the data before 2000 exist data distortion, and the research conclusions based on those relevant data are also worthy of discussing. In fact, before 2000, most insurance products failed to reflect the customer's real needs, such as high-interest insurance, compulsory supplementary medical insurance, mandatory policy insurance, which can not provide real market information to insurance companies or regulatory authorities. At the same time, as the imperfect regulatory mechanism or defective department responsibilities and regulation rules of insurance companies, only a small amount of valuable data, due to long time or unpublicized information, have no longer been available. In the early years, the industry standard and the enterprise accounting standards make the statements retained at that time hardly to see detailed classification of business costs such as business payments and commissions. However, with the entry of foreign insurance companies into China and the attendant influences, Chinese insurance companies no longer use high interest rates, new products, old products delisting and other means to promote the premium growth, but expand output by improving product and management. At the same time, Chinese-fund insurance companies began to pay attention to profit assessment, and tried to control costs through a variety of management methods, no longer just stared at premium rankings or market share. Some companies have made it clear that the sales department's assessment has changed from a single premium indicator to

comprehensive assessment including insurance premium, business activity rate, business promotion fees, intermediary fees, the compensation amount, withdrawal of outstanding deposit and other indicators.

1.4 Research goals and significance

1. Research goals

(1) A reasonable model and calculation method for measuring the efficiency of Chinese insurance companies:

Based on the above thoughts that limited the development of the insurance companies, the purpose of this dissertation is focusing on the low efficiency problem in the Chinese insurance industry, and help the industry achieve a healthier and stable development. The thesis has carried out a study of efficiency of the insurance industry. On top of the China’s insurance buiness system changes and the law of insurance business review and summarize, the study will attempt to analysis the development issues that China’s insurance industry is facing, using the three stage DEA method to measure the development trend of China’s insurance industry efficiency, also provide the important decision-making basis to improve the efficiency of China’s insurance indurstry.

By using the models and principles of econometrics and mathematical statistics, the research problems are modeled and rigorous results are obtained. In view of the qualitative analysis of the efficiency of China's insurance industry in the past, this thesis makes a more in-depth study on the efficiency of the insurance industry. The thesis is now going to focus on the quantitative analysis.The data has covered the whole industry in recent years, by using the statistics and econometrics methods for empirical analysis and aiming to get a more objective conclusion.

(2) Analysis of some significant factors affecting the efficiency of insurance companies:

After measuring China’s insurance companies’ efficiency with three period DEA method, there is a deficiency about the DEA method to meaure the efficiency that is unable to find the factors that influence efficiency of decvision making units. Therefore, when study the factors affecting the efficiency of the insurance companies in China.

Taking the overall scale, ownership structure, organizational form, investment level, marketing channel mode, product richness and human capital of insurance company as explanatory variables, this thesis analyzes the microcosmic factors that affect the efficiency of insurance company by constructing multiple regression model, and explains the influence mode and degree of these factors, so as to provide scientific theoretical basis for improving the efficiency level of insurance company.

In summary, this thesis attempts to use industry data in 2008-2011 years, first of all, to measure the efficiency of China's insurance companies, including technical efficiency, pure technical efficiency, scale efficiency and other indicators of efficiency. Furthermore, the factors that affect the efficiency of insurance companies are compared and analyzed, including macroeconomic factors, industry factors, and basic characteristics of insurance companies and so on. The ultimate goal of this thesis is to discriminate the problems existing in the development of China insurance industry and analyze the efficiency development trend of China insurance industry on the basis of researching and summarizing system changes and business regularities of China insurance industry, to improve the efficiency of China's insurance industry to provide decision-making gauge.

2. This thesis has the following theoretical significance and realistic meaning:

Empirical research is mainly divided into two aspects: first, the theoretical improvement of empirical analysis methods; second, in the empirical analysis to test the theory. In this thesis, the method used to measure production efficiency is applied to the sales department of an enterprise, because of the particularity of the products of an insurance company, its production and sales departments can be regarded as the same department. Insurance companies produce through sales of salespeople, while insurance companies hardly have to pay large amounts of fixed assets for it. Therefore, this thesis takes the estimation of the production efficiency of insurance companies as

the starting point, and provides some ideas and solutions for those salespeople who want to complete the sales task with high efficiency and high quality. At the same time, combined with the profit efficiency in the new economic theory, this thesis analyzes the marketing decision, hoping to achieve:

(1) Empower each insurance company to judge its capacity status in the industry. Given that scale is beneficial for the production efficiency to some extent and Chinese insurance companies always take the law of large number as the marketing principle, it's important for insurance companies to figure out factors influencing capacity and methods for improvement or raising due attention. After China joining the WTO, the quantity of Chinese insurance companies has surged. In addition, foreign-funded insurance companies also bring about quite a few new business ideas. For instance, the hook of business promotion fee and the paid-up premiums and the outsourcing of salesmen control the cost in production management at great length, to which established Chinese-funded insurance companies shall refer.

(2) Production management methods can be improved by virtue of efficiency estimation. After confirming factors related to premium income via empirical analysis, utilize these relations to formulate the sales assessment methods applicable for corresponding development stages of insurance companies, or analyze whether the marketing strategy of each stage is really beneficial for corresponding companies, and then develop dynamic marketing evaluation and assessment system.

1.5 Research Framework and Main Contents

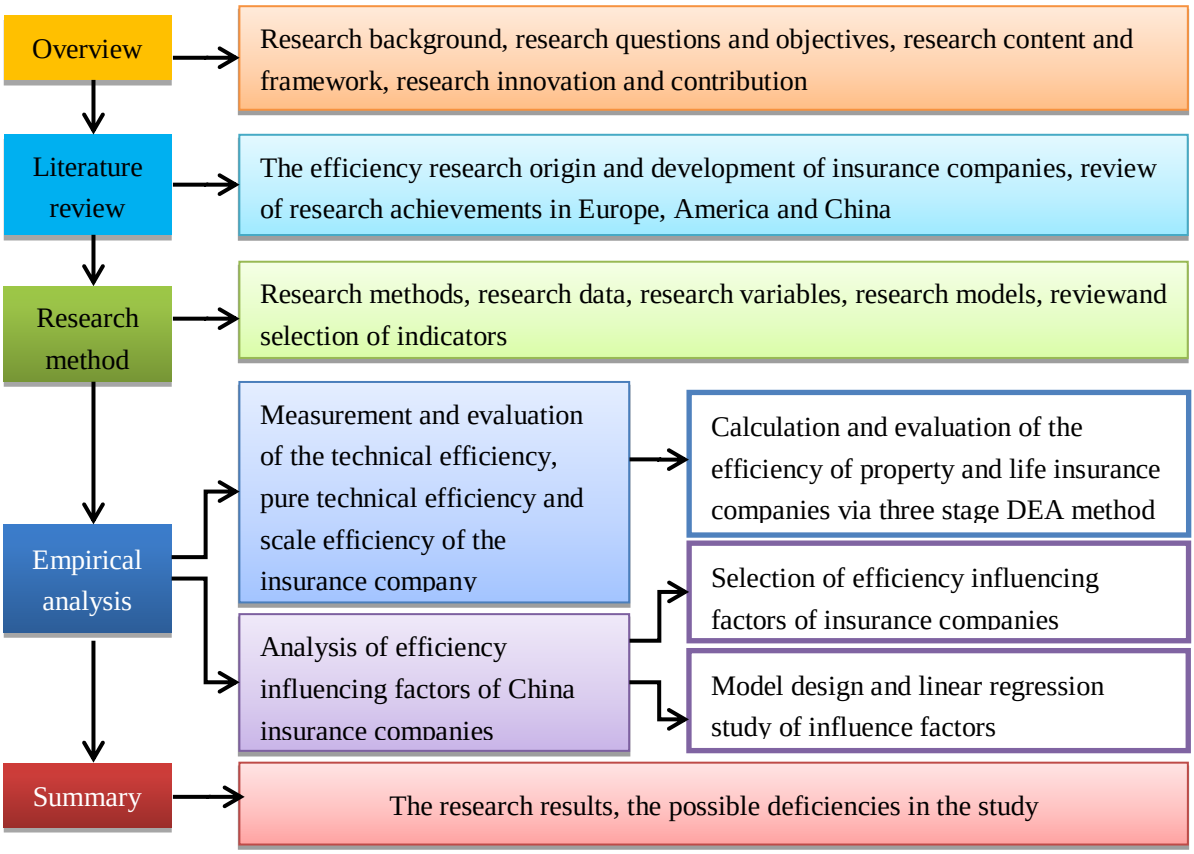

Figure 1-1 Research Framework

The first chapter is introduction. The thesis expounded the significance of studying the efficiency of insurance companies from the development history of China insurance industry and analysis of the realistic and micro problems faced by China insurance industry in the further development. This chapter briefly described the research background, research questions and objectives, research content and framework, research innovation and contribution.

The second chapter is literature review. This chapter expounded the origin and development of the efficiency research of insurance companies in detail, from the efficiency theory, the efficiency research of commercial banks and gradually to the efficiency research of insurance companies and from the efficiency research of insurance companies based on financial data to the efficiency research of quantitative methods such as DEA, SFA and three-stage DEA. It also reviewed and summarized the achievements of efficiency research of insurance companies in Europe, America and China.

The third chapter first reviewed the research methods in detail, including the connotation and evolution of efficiency theory, the comparison of DEA, SFA and the three-stage DEA methods, and then selected the research method -- the three-stage DEA. The chapter also reviewed and summarized the foreign and domestic research data and variables in detail and then selected research data, research variables, models and indicators.

The fourth chapter used the three-stage DEA method to calculate and evaluate the technical efficiency, pure technical efficiency and scale efficiency of China property insurance and life insurance companies.

The fifth chapter analyzed the impact factors of China insurance company efficiency, and made the Tobit regression analysis of impact factors of technology, pure technology and scale efficiency of insurance companies. This thesis selected the variables closely related to the operation of the insurance company, including the company size, accident insurance premium income, profit income ratio, marketing model, market share, capital usage, the nature of capital and other indicators. Based on the analysis of factors affecting the efficiency of insurance companies, the chapter conducted the empirical study of the efficiency of insurance institutions to find the way of improving the efficiency of insurance companies.

The sixth chapter is the conclusion and discussion. The chapter summarized the research conclusions and pointed out the possible deficiencies in the study.

1.6 Research Contribution

The main contributions of this thesis are as follows:

1. This thesis enriched the theory on quantitative research on efficiency of China insurance industry. Previous studies on the efficiency of China insurance industry often focus on practice, while theoretical achievements are inadequate and qualitative research is more than quantitative research, which was also lack of systematic analysis of internal mechanism and external environment of China insurance industry and lack of countermeasures discussion on China insurance industry problems. This thesis used theories and methods of econometrics and insurance science to analyze the efficiency measurement methods of China's insurance industry,

the factors and mechanisms affecting efficiency, and the countermeasures to improve efficiency in depth.

2. The thesis compared and updated the existing research methods. Previous studies on the efficiency of China insurance industry mostly are based on the use of nonparametric method DEA, and less are based on the use of parameter method SFA, and the two-stage DEA method. However, the three-stage DEA method, which is the most advanced efficiency evaluation model, no one has studied the efficiency of the whole insurance industry in China (including life insurance companies and property insurance companies).

3. Sample data are the most widely selected and studied and relatively new in China. In recent years, a few empirical researchers used the data from 1999 to 2006 when they tried to use quantitative methods, which was very weak for the actual guidance to China insurance industry which was fully opened in 2007.This thesis used a sample of 96 companies from 2008 to 2011 including 43 property insurance companies and 53 life insurance companies, using the three-stage DEA method to measure the efficiency of sample insurance companies, and on this basis, using econometric method to analyze the factors that influence the efficiency of insurance companies in China.

4. This thesis accurately solved existing problems of the Chinese insurance institutions in optimizing the production capacity (technical efficiency), pure technical efficiency, scale expansion (scale efficiency). In addition, this thesis found the factors related to the efficiency of the insurance company. Therefore, it provides an important reference basis for improving the overall efficiency of China's insurance industry and contributes to the sustainable development of China's insurance industry.

Charpter 2: Literature review

2.1The Origin and Development of Efficiency Research

2.1.1 Efficiency Theory, production efficiency and Efficiency of enterprise

1. Definition of efficiency

There are different types of efficiencies, such as Pareto-efficiency, technical-efficiency, allocation-efficiency, exchange-efficiency, X-efficiency and market-efficiency. Although these terms are defined differently, they are all measures for achieved results when scarce resource is used. Efficiency, usually expressed as a percentage, is often used to compare the economic activities of enterprises in the same conditions. A high percentage indicates high efficiency. In economics, efficiency can usually be classified into production efficiency in microeconomics and system efficiency (or resource allocation efficiency) in macroeconomics.

2. Production Efficiency in Microeconomics

Basing on different research objects, the efficiency in economics is generally classified into the production efficiency in microeconomics and the "system efficiency" (also known as the "resource allocation efficiency") in macroeconomics.

(1) Production Efficiency

The "production efficiency" is defined as the proportion of the maximum output available to be achieved by a rational production unit for inputting given quantity/ratio of factors under the environment of resource scarcity to the optimal output. The efficiency value is between 0 and 1. The closer the value approaches to 1, it means more approximate to the optimal boundary and higher efficiency.

(2) Production Function

The "production function" means the relationship between the quantity of diversified factors applied for production on the premise of invariable technological level and the maximum output available to be manufactured over a period of time. Premise: manufacturers

pursue for the maximum profits. It focuses on the relationship between element quantity and capacity quantity. In the equation **Q= f(L, K, N, E)**, variables represent output, input labor, capital, land and entrepreneurial ability respectively, where N is fixed and E is hardly to be measured. Therefore, the equation is generally simplified to be Q=f(L, K). In addition to the linear equation, common production equations also cover Cobb-Douglas production function **($Q = AK^{\beta}L^{1-\beta}$)**.

3. Enterprise Efficiency in X-efficiency Theory

In 1986, the American economist Harvey (1986) put forward a theory that the input of quantifiable production elements cannot completely determine the output, and output also hinges on a kind of unknown non-resource distribution efficiency in addition to production elements. Harvey and his followers or followers of X theory attribute all factors causing non-allocation (low) efficiency to X. For a ball game team, for example, such unknown X-efficiency may refer to the solidarity and cooperation degree of team members, or individual skills thereof.

2.1.2 Research on the Efficiency of insurance company

Professor Weiss, who come from Wharton school, began to study the efficiency of the insurance company in the 1990s and it mainly focus on the insurance institutionsof Europe and the United States. Although international research on the efficiency of the insurance company is only 20 years, the research object and researchers has rapidly expanded to the world, and the methods are more and more perfect.

2.1.3 Research on the efficiency of Insurance Company based on financial data

Early theoretical researches on efficiency of insurance industry was mainly conducted from the financial perspective. Financial ratios, such as return on assets, profitability, loss ratio, , were used to compare efficiency levels of different insurance companies. With the rapid development of the insurance industry, information from simple ratio comparison has been unable to meet the needs of efficiency studies.

2.1.4 Marginal efficiency method

In the 1990s, Chinese scholars Yao Shujie began to use marginal efficiency method to study efficiency of the insurance industry. This approach uses the knowledge of operations research, mathematical economics, and management to rank the efficiency levels of insurance companies, quantify the strengths of various impacting factors on efficiency, and provide suggestions for improvement. Marginal efficiency method has been widely used in insurance research and a large body of literature and findings with referential and practical value has been produced.

2.1.5 Frontier efficiency method

Farrell (1957) first put forward the "analysis methods" frontier efficiency, the starting point is based on the known input and output a set of observations, define and construct all possible combinations of input and output (efficiency frontier, or efficiency boundary) calculated by comparing the efficiency of each institution and the efficiency frontier in the distance, then this method is widely used in the research of western scholars' efficiency.

2.1.6 Parametric methods

Parametric methods (econometric methods) are mainly classified into stochastic frontier approach, free distribution method and thick frontier approach, among which stochastic frontier approach (SFA) has been a widely recognized method to measure technical efficiency and the latter two being the transformation of SFA.

In 1977, Aigner, Lovell, Schmidt, Meeusen, and Breoeck (1977) published the research achievements of SFA. SFA assumes the form of production function in accordance with the different demands of input, output and other environmental factors, estimates the value of each parameter by virtue of multivariate statistical techniques, and then confirms the stochastic frontier of production. Error terms are taken into consideration at the same time. The error terms of such function is designed into the composite structure, including inefficient items and stochastic error terms available to influence stochastic frontier. The most advantage thereof lies in that the input-output process is described via estimated output function, and then the efficiency estimation of input-output be controlled. Generally, it comprises two stages, namely, the estimation of production function form through least square method and the verification of

error terms.

Currently, such function forms as linear production function, Cobb-Douglass production function, Leontief production function and trans-log production function are available to be used by SFA, among which trans-log production function features extensive application in SFA research as a result of its estimability, inclusiveness and interactivity. Particularly, investigators in countries with developed commercial banks, insurance companies and financial market, represented by European and America, have utilized abundant data in the mature market to establish some widely applied efficiency models based on trans-log production function, so as to measure the production (cost) efficiency and profit efficiency of financial institutions.

Cost efficiency model expression:

$$\ln C_{st} = [\alpha_0 + \sum_{i=1}^{n} a_{yi} \ln y_{sit} + \frac{1}{2}\sum_{i=1}^{N}\sum_{k=1}^{N} \alpha_{yik} \ln y_{sit} \ln y_{sit} + \sum_{j=1}^{M} \alpha_{wj} \ln W_{sjt} + \frac{1}{2}\sum_{J=1}^{M}\sum_{f=1}^{M} a_{wjf} \ln W_{sjt} \ln W_{sft} + \sum_{i=1}^{N}\sum_{J=1}^{m} a_{yiwj} \ln y_{sit} \ln w_{sjt}] + \varepsilon_{st} \quad (2.1)$$

C, Y, W and t represent total enterprise cost, output quantity, input price and time respectively. S={1,…， S}, i={1,…， N} and j={1,…， M} means enterprises, output and input respectively in samples. C_{st} represents the total cost of enterprise s in year t, Y_{sjt} the output i of enterprise s in year t, and W_{sjt} the input j of enterprise s in year t.

Among all the profit efficiency models, after 2000, international investigators prefer to use the non-standard profit efficiency model with expression as:

$$\ln(\pi_{st}) = [\alpha_0 + \sum_{i=1}^{N} \alpha_{yi} \ln y_{sit} + \frac{1}{2}\sum_{i=1}^{N}\sum_{k=1}^{N} \alpha_{yik} \ln y_{sit} \ln y_{skt} + \sum_{j=1}^{M} \alpha_{wj} \ln W_{sjt} + \frac{1}{2}\sum_{j=1}^{M}\sum_{f=1}^{M} \alpha_{wjf} \ln W_{sjt} \ln W_{sft} + \sum_{i=1}^{N}\sum_{J=1}^{M} \alpha_{yiwj} \ln y_{sit} \ln W_{sjt}] + u_{st} + v_{st}$$

（2.2）

Y represents the output quantity, W the price of input quantity and t the time. In addition, Y_{sjt} means the quantity of output i of enterprise s in year t, and W_{sjt} the price of input j of enterprise s in year t. π_{st} refers to the profit value of enterprise s in year t, U_{st} the composite function composed of inefficiency error with efficiency affected, and V_{st} the random error.

Regarding the aforesaid two models emerging by the end of 1990s, it is widely believed that, however, investigators hold different opinions on and conclusions of the layout of inefficient (low efficient) items. While investigators from different countries applying data of local commercial banks and insurance companies to measure cost efficiency and profit efficiency, they assumed that, inefficient items obey half-normal distribution, truncated normal distribution and gamma distribution, and then concluded different statistical value in significance. Currently, no uniform conclusion thereabout has been developed. Furthermore, that whether such transcendental logarithmic function setting higher requirements for sample data quality can be applied for the financial market at different development periods is to be verified by time and statistics.

2.1.7 Study on using non-parametric methods

Non-parametric Method (Mathematical Programming Approach): The method most commonly used for calculation is a non-parametric frontier efficiency analysis method, i.e. data envelopment analysis ("DEA" for short). DEA method adopts the linear programming technique to calculate the relative efficiency value of multiple decision-making units in given samples, compare the input and output of each sample with the optimal decision-making unit of samples upon weighted average, and then distinguish samples featuring effective operation from those of ineffective operation. Generally, DEA models are classified into the input type and the output type. The input type refers to the linear programming of the minimum input on the premise of fixed output, while the output type refers to the linear programming of the maximum output on the premise of fixed input.

These methods do not require constructing the concrete forms of production functions. Rather, researchers can use special mathematical methods to construct the production frontier.

Two non-parametric methods, Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH) are often used.

For the life insurance companies, premium, occurred insurance payment, and the change of the amount of reserve are often used as output indicators. For the property insurance companies, the value of loss or damage is often used as an output indicator. The influencing factors of insurance company efficiency mainly focus on the equity form, company size and regulatory policy of the company.

2.1.8 Combination of the two methods and compared of advantages and disadvantages

1.DEA--Nonparametric method (mathematical programming method)

Either at home or abroad, the most commonly used measure for efficiency is the non-parametric frontier efficiency, namely Data Envelopment Analysis (DEA). This study will use the linear programming technology, on the basis of relative efficiency, to evaluate the performance of the same type of insurance companies. This analysis contains two steps: 1, defining efficiency frontier; 2, comparing each point in the sample with the efficiency frontier.

2. SFA--Parametric method (econometric method).

The widely accepted method to measure technical efficiency is the Farrell's Stochastic Frontier Approach (SFA), which is through the early frontier production function of the parameters to determine the production frontier to measure the factors that affect the production efficiency. It needs to set an input-output function first, and then to the project design of the error of the output function into composite structure (the structure contains the measured input and output efficiency of random items), and according to the distribution of error term different assumptions, corresponding technical methods to estimate the parameters of the production function, to calculate the input-output efficiency. The biggest advantage is that the estimated output function of input and output of the process are described, so that the estimation on the efficiency of input and output under control. It is due to the separation of the inefficient and the random error term ensuring the efficiency of be estimated effective and consistent, and considering the random error term impact on the efficiency of the individual subsequent thick frontier approach (TFA), free distribution method (DFA) is its deformation later the researchers on the basis of the development of this method, to measuring mechanism of cost efficiency and

profit efficiency significantly. It is often divided into two stages: 1, using OLS to estimate production function form 2, test of error term.

There are 3 advantages of DEA method: 1, the relative volume; 2, easy observation; 3, handling multiple. But the disadvantages are: 1, the deviation is big, we can't explain the random error. 2, we cannot explain inefficiency.

The advantages of SFA method: 1, Targeted, not easy to interference by abnormal points. 2, precise separation of random error and the inefficiency point 3, good elasticity. But the disadvantages are: 1, looking for large and more sample data; 2, not appropriate functional form or error distribution assumption instead affects accuracy.

Berger, Cummins, and Weiss (2000) made analysis of 16 about insurance agency efficiency of research methods and conclusions among five countries such as America's. The report shows that 5 kinds of model using frontier efficiency analysis technology: 2 kinds of model using DEA method of analysis technique and unbounded FDH method; 3 kinds of model using SFA, DFA and TFA method.

The existence of the optimal frontier efficiency analysis method is still no consensus, there are more debates in view of the disadvantages of various methods (Humphrey, 1997) : (1) the major advantages of the SFA method is that it will seperate pure random error and non-efficiency value, While the disadvantage is that inappropriate functional form or the distribution of error term assumption will potentially will confuse the default error with efficiency estimation. (2) the main advantage of the nonparametric method is set to avoid the error, because it does not need to specify the functional form or distribution hypothesis. But this method can not seperate the random error because any deviation from boundary are measured as non-efficiency.

2.1.9 Three phase DEA method

Fried, Lovell, Schmidt, and Yaisawarng (2002) proposed a new efficiency evaluation model - the three phase DEA method. Its feature is can remove the non-operating factors (external environment and random error) on the efficiency of the impact, so that the calculated

efficiency value can more truly reflect the level of company's management lever.

Its basic idea and theoretical logic are: Apply the input-output items into traditional DEA model at the first stage, get input-output items difference in amount value of each sample business enterprise.The second stage apply the difference value and the chosen environment changes. Through the method of stochastic cost frontier to adjust the devotion item input of sample business enterprise to expel the influence of environment and random error margin factor before passing random cost; Third stage is devotion item after adjusting and originality of produce an item(or adjust behind of produce the devotion item of item and originality) again apply go into DEA model, the efficiency value that gets at this time is to pick and get rid of the production of business enterprise that the environment factor influences with random error margin to conduct an efficiency value.

The specific steps are as follows:

The first stage: In the traditional data envelopment analysis, the BCC model (The BCC model assumes that DMU is in the case of variable scale compensation and is used to measure pure technology and scale efficiency) can hypothetically convert the regular compensation of CCR model (The CCR model assumes that DMU is in the case of fixed scale compensation and is used to measure total efficiency) into variable compensation. In other words, the technical efficiency is decomposed into the pure technical efficiency and the scale efficiency.

Technical Efficiency = Pure Technical Efficiency * Scale Efficiency

The "input-orientation" means the minimization of the quantity of elements input and the negative output in certain output conditions. It is assumed that there are w decision-making units (namely, DMU), and for insurance enterprises, each decision-making unit has the input of n and the output of p. Under the BCC model, the operation efficiency is as follows:

$$\mathbf{Max}(\boldsymbol{m_k})$$

$$\boldsymbol{m_k} = \sum_{\boldsymbol{r=1}}^{\boldsymbol{p}} \boldsymbol{u_r y_{rk}} - \boldsymbol{U_k}$$

Therein, $\sum_{i=1}^{n} v_i x_{ik} = 1$ （2.3）

$$\sum_{r=1}^{p} u_r y_{rk} - \sum_{i=1}^{n} v_i x_{ik} - U_k \leq 0$$

$u_r \geq \varepsilon > 0$; $v_i \geq \varepsilon > 0$; i=1,2,3，…， p； r=1,2,3,…,p; k=1,2,3,…, w

In this model, x_{ik} refers to the input of item i of decision-making unit k, y_{rk} is the output of item r of decision-making unit k, v_i is the input of item i, and u_r is the weight coefficient of item r; ξ is set as any round number to secure that all the input and output items are positive weight items; U_k represents the index of scale return, and h_k represents the efficiency of decision-making unit k between 0 and 1.

The second stage: The SFA method is used to decompose the relaxation variables in the first stage. Because the first stage DEA method can not eliminate the influence of error and environmental factors on the efficiency value. In the second stage, the error, environmental factors and internal management are taken as independent variables, and the input relaxation variables of each decision making unit in the first stage are taken as dependent variables. SFA method is used to decompose the relaxation variables, and the reasons for the different relaxation variables of each insurance company are analyzed. Suppose w DUM, has n input variables per DUM and q environment variables affect relaxation variables. Establish the following equations:

$$p_{kr}=f^k(z_r,\beta^k)+v_{kr}+u_{kr}$$

k=1,2,…,n; r=1,2,3,…,w （2.4）

p_{kr} represents the slack variable input by item r of decision-making unit k; $z_r=(z_{1r},z_{2r},...,z_{pr})$ represents q environment variables, and β^k are unknown parameters to be estimated; $f^k(z_r,\beta^k)$ represents the influence way of environment variables for slack variables, generally being $f_k(z_r,\beta_k)=z_r\beta_k$; v_{kr} is generally deemed as a random disturbance

term, namely, $v_{kr} \sim N(0,\sigma_{2\_kr})$; u_{kr} is generally deemed as a nonnegative random variable, so as to interpret low management efficiency; and it is assumed that the truncation is normally distributed, namely, $u_{kr} \sim N(0,\sigma_{2\_kr})$, where u_{kr} and v_{kr} are mutually independent.

In Phase II, the regression result of SFA method shall be utilized to adjust the input item of each DMU. Based on the most efficient decision-making unit, the input thereof shall be deemed as the benchmark and have the following adjustment performed:

$$\boldsymbol{x_{kr}^{A}=x_{kr}+[max_r(z_r\hat{\beta}^k)-z_r\hat{\beta}^k]+[\ max_r(\hat{v}_{kr})-\hat{v}_{kr}]}$$

$$\textbf{i=1,2,…,n;}\quad \textbf{k=1,2,…,w} \qquad (2.5)$$

x_{kr} represents the input item of DMU r prior to adjustment, and x_{kr}^{A} is the input item of DMU r after adjustment; $\hat{\beta}^k$ is the parameter estimation of environment variable, and $\hat{v}_{kr}$ is the parameter estimation of random disturbance term. All the DMUs are adjusted to the same environment via difference value of first bracket, and all the DMUs are adjusted to the same random error level via difference value of second bracket.

The Third stage: the revised DEA model. Substitute the input value x_{kr}^{A} of each DMU after adjustment through SFA method into the BCC model of Phase I to calculate efficiency, and the result obtained is the efficiency value after eliminating the influence of random error and environment factor.

2.2 Europe and America research findings

2.2.1 The principal academic representatives with non-parametric method used are as follows:

Charnes, Cooper, and Rhodes (1978) and others used DEA and other methods to study the efficiency of insurance institutions. The first step: defining the frontier of efficiency. It is found that the optimal decision point, the linear combination of the same or higher output decision points, or the linear point requires the same or different output in the input combination, using the best company or the best combination; the second step: on the basis of

the sample, each company sample is compared with the sample of the best company or the best combination (efficiency frontier), we can know which companies are effective or invalid.

Fukuyama (1997) studied 25 mutual or stock insurance companies in Japan from 1988 to 1993. The results show that there is no significant difference in operating efficiency between the two types of companies. However, because mutual shareholding companies are mainly affected by technology, while joint-stock companies are mainly affected by the size of enterprises, there are significant differences in technical efficiency.

Cummins (1998) studied the efficiency of American life insurance companies as samples from 1988 to 1995, who analyzed the relationship between mergers and acquisitions, using the DEA method and the efficiency of scale economy. The results show that capital operations such as M & A and reorganization can improve the operating efficiency of life insurance companies.

Cummins, Tennyson and Weiss (1999) analyzed 1988-1995 sampled data from US life insurance companies. They used DEA method to examine the relationship between acquisitions, enterprise scale, and efficiency. The results showed that mergers and acquisitions improved management and profitability, and therefore achieved higher efficiency.

Boonyasai, Grace, and Skipper (1999) studied the impact of liberalization and deregulation of insurance companies on efficiency in South Korea, Taiwan, Tailand, and the Philippines. The improvement of efficiency in the Philippines reached the highest level due to the simultaneous operation of market liberalization and deregulation. South Korea achieved higher efficiency by liberalizing its market as the first step and then gradually deregulating it. Comparatively, Taiwan and Tailand achieved almost no improvement due to the long lag for deregulation after the market liberalization.

Adams and Hardwick (2003) used DEA to analyze the sampled data from some EU life insurance companies. They found that there was a convex relationship between cost efficiency and the company size. Particularly, efficiency was positively correlated with the existence of auditing committee, and negatively correlated with the separation of external board members, CEOs, and chairmen.

Barros, Barroso, and Borges (2005) used DEA research method to analyze the technical efficiency of Portuguese insurance companies from 1995 to 2001, and concluded that enhancing corporate governance ability, effectively controlling human cost and reducing channel agency and individual agency and other marketing channels are conducive to promoting the improvement of efficiency.

Alhabsh (2011) focused on the impact of deregulation on insurance efficiency, involving South Korea and Southeast Asia. The results of the study are as follows: liberalization and deregulation of the Philippine insurance market occur together, and the overall efficiency return performance of the life insurance market is better than that of other countries after the liberalization of the market; South Korea's insurance industry has liberalized the market before deregulation, and efficiency levels have improved significantly; however, it took Taiwan and Thailand a long time to relax regulation, so it is inefficient.

2.2.2 The principal academic representatives with parametric method used are as follows:

In 1977, Aigner et al (1977) put forward with a parametric method using stochastic frontier model to measure insurance institutions’ efficiency, which comprises two steps: The first step uses metering methods (i.e. ordinary least square, nonlinear least square method or maximum likelihood method) to estimate the optimal production function. The second step decomposes regression error items, and is generally divided into the non-efficient part of one-sided distribution and the random error part of symmetric distribution.

Yuengert (1993) studied the efficiency of 757 American insurance and group insurance companies in 1989. The conclusion was that all 757 Sample Firms have scope economy, and large insurance companies have scopeefficiency. In the same year, Gardner and Grace (1993) adopted DFA to verify the alteration in the X-efficiency of 561 American insurance companies from 1985 to 1990. The result showed that the average efficiency during the duration of six (6) years was about 0.45.

In 2009, Paul Fenn, Dev Vencappa and Stephen Diacon collected 1995-2001 financial data from 14 European insurance companies. They constructed frontier cost functions respectively for life insurance companies, non-life insurance companies, and mixed business companies. The results showed that companies that had larger scale and larger market share tended to have lower efficiency. These studies show that parametric methods are often used to examine the cost effectiveness, and economists have been trying to identify those major factors influencing efficiency.

2.2.3 The main academic representatives using a variety of research methods:

Regarding comparative studies using different methods in efficiency studies, Rai (1996) studied 106 global insurance companies in 1988 - 1992 using SFA and DEA methods. The conclusion was that large companies had higher cost efficiency compared to small companies; insurance companies specializing in property insurance or life insurance had higher cost efficiency. The lowest X-efficiency value was France insurance companies, the highest X-efficiency value was Finland and British insurance companies.

In 1997, European scholars Fecher, Perelman, Kessler and Pestieau used DEA and SFA methods to analyze the efficiency of insurance companies in France, Italy and Spain. The results show that the results of the two methods are consistent.

Cummins and Zi (1998) used SFA, DFA, DEA, FDH and other methods to compare the efficiency of 445 life insurance companies in the United States in 1988 - 1995. The conclusion was that the efficiency value calculated using the SFA method and FDH method was obviously higher than the efficiency value calculated by DFA and DAE; both the share life insurance company and the Mutual Insurance Companies had the scale. The conclusions of SFA and DFA are consistent. The conclusions of DEA and FDH are consistent.

Another study realized by Brockett, Cooper, Golden, Rousseau, and Wang (2005) used two research methods of DEA and SFA to analyze the efficiency of a total of 1,524 property insurance companies in the United States. They conducted an analogy analysis of the property insurance companies focusing on the solvency, different marketing channels, as well as the

types of companies with different organizational forms, such as shareholding system and co-insurance, and concluded that the solvency of American property insurance companies has little impact on the development of the property insurance industry.

More recently, Elin and Lunen (2009) applied DEA and SFA to analyze the technical efficiency and the cost efficiency of 6,462 insurance companies in 36 countries from 2002 to 2006, and obtained the conclusion that insurance companies in Denmark and Japan possess the highest efficiency.

2.3 China Research Review

Chinese researchers study the operating efficiency of China's insurance industry, mainly in the following two aspects. One is to calculate and compare the operating efficiency of Chinese insurance companies. The second is the research on the influencing factors of the operating efficiency of Chinese insurance companies.

2.3.1 Calculation and comparative study on the operating efficiency of Chinese insurance companies

The efficiency of Chinese insurance enterprises starts relatively late. Different from the efficiency of insurance institutions studied abroad, China mainly focuses on the production and technical efficiency of the industry. In foreign countries, probably because the development of insurance industry is relatively mature and the data are relatively rich and complete, its research is basically based on econometric methods to estimate scale efficiency, range efficiency, allocation efficiency, technical efficiency. Cost efficiency and profit efficiency in X efficiency. However, China's insurance industry is in a period of open transformation after a long period of closure. In addition to the reasons for the lack of data, it is of great significance to study the basic production efficiency, cost and profit efficiency for the contradictions in the actual operation of insurance companies. However, we must deal with the congenital and acquired defects in all kinds of data of insurance companies in our country at the same time, such as the huge scale difference in cross section data, and the vast majority of operating profits and net

profits of insurance companies are negative. The classification of statistical reports for a long time is rough and so on.

According to the different input, output index and research subject, the main conclusions of Chinese scholars are summarized as follows:

Yun and Li (2003) used the data envelopment analysis model. Because the data are relatively limited, they only studied the efficiency of the Top 9 major insurance companies in China in 1999, and selected the number of personnel, expenses and physical assets as input indicators, the profit rate and premium income as the output indexes. It is concluded that the insurance industry in China is in the primary stage of operation and management, the overall efficiency of the insurance industry in China is on the low side, and the operating efficiency of the Chinese insurance companies is lower than that of the foreign insurance companies. Because the business expenditure is too high, the cost control is weak, the asset profit margin is low, the investment way is narrower, and after comparing with the foreign insurance company, the concrete solution to improve the efficiency is given.

Zhao (2003) also adopted the DEA model to study the pure technical efficiency of 13 Chinese-funded insurance companies from 1997 to 2001, select the human capital, the total assets, the owner's equity as the investment index, and select the profit as the output index. The efficiency of the old-brand insurance company and the newly-established insurance company is compared. The efficiency of the state-owned and mixed-ownership insurance company is compared. The efficiency of the newly-established insurance company is higher, and the efficiency of the joint-stock insurance company is higher than that of the state-owned insurance company. In turn, the influence factors of the insurance efficiency are studied by the Tobit model, and the size and the market share of the insurance company's assets are obtained, and the effect on the efficiency of the insurance company is not significant. The conclusion also confirms that the efficiency is the main index to measure the operating condition of the Chinese insurance company.

On the other hand, Hou and Zhu (2004) used DEA model to study the efficiency of Chinese property insurance companies from 2000 to 2002. Total capital, total cost and number of

personnel are selected as input variables, and reserves, indemnities and investment returns are selected as output variables. The conclusions of the study are as follows: the efficiency of Chinese property insurance companies is lower and the effect of scale is lower; Then, the influencing factors of the efficiency of the insurance company are studied, the input value / the actual input factor value on the production front is selected as the input index, and the asset profit rate is selected as the output index. It is also the first time to choose asset profit margin as an index to measure the profitability of insurance companies. The conclusion drawn from the study is that the main reason for the inefficiency of Chinese property insurance companies is the management problem, and there is a significant positive correlation between the input index and the output index, that is, when excessive investment, it will lead to the management ability of the insurance company. Low profitability.

Other autors specifically did studies in the area of life insurance such as Li (2005) who has used DEA model to study the operating efficiency of 13 Chinese life insurance companies from 1999 to 2002. fixed assets and total expenses were selected as input variables, and life insurance premium income and short-term insurance premium income were selected. Health insurance premium income and investment income as output variables. Through the analysis and calculation of technical efficiency and scale efficiency, the conclusion is drawn: improving scale efficiency can improve technical efficiency. The Malmquist index model is used to analyze and study the total factor productivity of China's insurance industry. It is found that the total factor productivity of China's insurance industry is growing, but the effect of scale has not yet appeared.

About the determination of optimal boundary of insurance business, we have found the work of Wu, Li, and He (2005) having selected the data of 31 insurance companies as samples, and used envelope analysis DEA to determine that the optimal point of insurance business in China will improve the efficiency of the company. Since then, DEA method has been widely used in the study of technical efficiency of insurance companies. However, in addition to a large number of studies on the efficiency of insurance companies, in addition to the technical efficiency, the limitations of DEA method lead us to see only the distance ratio of each company

relative to the optimal boundary. Or the relative value of the distance between any several families in the optimal boundary, that is, the relative efficiency. Moreover, except that the factors that affect these relative efficiency can not be explained, all the factors that are not considered on the optimal boundary are regarded as inefficient. Chen (2005) analyzed the technical efficiency of 23 insurance companies in China from 1999 to 2003. The number of employees, the total cost and the paid-in capital were selected as the input index, the insurance indemnity, the sum of reserve and investment income as the output index. The results show that the fluctuation of the efficiency of these insurance companies is the main reason caused by the changing value of scale efficiency.

He and Li (2005) also selected 31 insurance companies' data, and first applied the SFA to study the technical efficiency of the insurance company. After that, not only the results of the efficiency of the insurance company are studied by the SFA method, but also the research on the efficiency of the insurance company has gradually expanded to the aspects of scale efficiency, cost efficiency and so on. Although it is not comparable to the research results of the SFA method in the banking industry, the extension of the efficiency research method of the insurance company is very fast.

Cao (2006) studied the efficiency of 12 insurance companies in China from 1999 to 2003. Human capital, total assets, total expenses and compensation were selected as input variables, and premium income and net profit were selected as output variables. Analyze total factor productivity, including cutting-edge technology, pure technical efficiency and scale efficiency. It is concluded that the technical efficiency of Chinese insurance companies is decreasing year by year and the gap between them is gradually increasing. The gap of technical efficiency is caused by the difference of scale efficiency, and the scale reward is increasing year by year. Total factor productivity is also the conclusion of increasing year by year.

Huang (2006—2008) used the complete DEA, SFA method to study the technical efficiency, scale efficiency, cost efficiency and profit efficiency of domestic insurance companies. Through SFA method, we try to embed risk in cost function, foreign capital competition and other factors, establish a variety of profit measurement models and measure

the profit efficiency of many companies in different years. It also analyzes the efficiency change value of each company, and the factors that affect the efficiency and its change, including the stock form of the company, the size of the company, and the diversification of products and so on.

Sun and Chen (2007) adopted DEA method to study the overall efficiency, technical efficiency and scale efficiency of a life insurance company in 2001-2003. The capital investment, manpower cost and operating expenses are selected as input targets, and premium income, investment income and profit are selected as output indicators. The results of the research show that the change of the input and output items has little effect on the efficiency, and the size of the company and the company's nature have a great effect on the efficiency.The entry of foreign capital, extensive operation and low investment income are the main reasons for the inefficiency of Chinese insurance companies.

Shi and Li (2007) selected the number of personnel, fixed assets, owner's equity, fixed assets as input indicators, and selected the sum of reserves and insurance claims as output indicators. The technical efficiency, pure technical efficiency, scale efficiency, cost efficiency and allocation efficiency of Chinese insurance companies from 1999 to 2005 are studied. The relationship between profit margin and scale efficiency and technical efficiency of property insurance and life insurance companies is compared and analyzed.

Zhang and Hou (2008) used DEA method, while the number of employees, fixed assets and total cost were selected as input indicators, and premium income, net profit and insurance compensation were selected as output indicators. This thesis compares the operating efficiency of domestic and foreign insurance companies in China. The results show that there is a great difference in the efficiency value between Chinese and foreign companies, and some suggestions are given to improve the efficiency of domestic and foreign insurance companies.

Hao (2009) studied the technical efficiency and scale efficiency of 23 Chinese property insurance companies from 1999 to 2003. The input index selected the paid-in capital, the number of employees, the cost, and the output index to choose compensation. The results show

that the scale efficiency is the main reason that affects the sawtooth fluctuation of the total efficiency.

Liang (2010) used pure econometric economic law and the sales data of Ping an Insurance Company Hubei Branch for the first time to establish three major sales channels of insurance companies (agent sales channels, bank insurance simultaneous business channels. The linear model of group insurance sales channel) performance marketing, and how to build measurement model, test and so on. And analyzes the factors that affect the premium income of sales channels. Although it provides a good idea, it is very difficult to achieve this accurate measurement of the sales department of every insurance company in the market.

Sun and Lu (2010), using the two-stage DEA method, selected the data of 22 Chinese property insurance companies in 2007, and analyzed their operating efficiency. This thesis compares the efficiency values of state-owned insurance companies and state-owned insurance companies, and concludes that the overall efficiency of Chinese property insurance companies is generally low, and the gap between the efficiency values of joint-stock insurance companies is obvious. However, the difference in efficiency between state-owned insurance companies is not large.

Xu and Li (2010) used DEA method to select the data of 26 China Life Insurance companies in 2005 and 2006, and concluded that the overall operating efficiency is on the rise year by year. The technical efficiency of life insurance companies plays a significant role in the change of overall efficiency.

Liang and Liang (2011) used SFA method to study the operating efficiency of insurance companies, selected the cost efficiency, profit efficiency and development trend of 29 insurance companies from 2001 to 2006. The conclusion is that the efficiency of foreign insurance companies is higher than that of Chinese joint-stock insurance companies, while the efficiency of Chinese joint-stock insurance companies is higher than that of state-owned insurance companies, and the cost efficiency of domestic insurance companies is higher than that of state-owned insurance companies. The cost efficiency of property insurance companies is higher than

that of life insurance companies, but the profit efficiency of property insurance companies is lower than that of life insurance companies.

AI (2011) used DEA method to study the efficiency of liability insurance business for the first time in 15 Chinese property insurance companies from 2007 to 2009. The conclusion is that the technical efficiency of liability insurance business of these 15 property insurance companies is on the low side as a whole, and the difference of efficiency value among insurance companies is large.

Huang (2011) used the three-stage DEA model to be the first Chinese scholar to apply the external environmental factors to the research system of insurance efficiency in China. Thirdly, the technical efficiency, pure technical efficiency and scale efficiency of 284 insurance companies in the industry from 1999 to 2006 are studied and analyzed. The conclusion is that the external environmental factors interfere greatly with the estimation of efficiency, especially the efficiency of Chinese insurance is far overestimated because of the advantages of external environmental factors. The adjusted efficiency value is obviously lower than that before adjustment, and it is concluded that the main reason for the overall low efficiency of China's insurance industry is the low pure technology, that is to say, it should be through technological innovation. The improvement of management level to improve the overall efficiency of the insurance industry. Huang (2007) also used the three-stage DEA model to apply the risk factors to the research system of insurance efficiency in China. The conclusion is that the risk factors have a greater and greater impact on the efficiency of insurance companies. That is, the risk management ability of insurance companies significantly affects the estimation of efficiency. Through further analogy between equity structure and domestic and foreign insurance formula, it is found that the efficiency of the adjusted joint-stock insurance companies, Compared with large state-owned insurance companies, the efficiency of large state-owned insurance companies has been significantly reduced. And the efficiency of the adjusted foreign insurance companies, compared with the efficiency of Chinese insurance companies has been significantly improved.

Zhang (2011) used three-stage DEA method to select the data of 46 property insurance

companies in 2009 to study the operational efficiency. The research conclusion is that the technical efficiency of property insurance companies is not high, and the pure technical efficiency is not high. The efficiency of domestic insurance companies is lower than that of foreign insurance companies, but the scale efficiency of most property insurance companies in China is higher, and the scale reward is increasing, which can improve the scale efficiency by improving the management ability and market size of enterprises. Other authors like Wang and Zhao (2010) used the three-stage DEA model to eliminate the influence of external environment and random interference factors on efficiency, and selected the data of 39 property insurance companies in 2007 to study the operational efficiency. The conclusion is that the overall operating efficiency of insurance companies is low, and the overall efficiency of domestic insurance companies is lower than that of foreign insurance companies. Consistent with Huang Wei's research conclusion in 2011, their research conclusion is that the pure technical efficiency of domestic insurance companies is low, that is, the overall efficiency of insurance industry should be improved by improving management, decision-making level and technological innovation.

Shen (2012) used three-stage DEA method to select the data of 27 life insurance companies from 2005 to 2010, calculate the efficiency value of insurance companies for 6 years, and find out the main factors that affect the efficiency through comparative analysis. The conclusion is that the overall operating efficiency of Chinese life insurance companies in the past five years is not high, and the technical efficiency shows an upward and downward trend. Most of the life insurance companies in China are in a low level of efficiency, mainly because they are in a poor external environment; Market share has a great influence on pure technical efficiency and scale efficiency, and the influence of operating years and number of branches on scale efficiency is more important.

Liu and Yang (2012) used DEA method to empirically analyze the data of 21 property insurance companies from 2000 to 2010, and selected premium income, total assets and expenses as input indicators. The insurance indemnity is selected as the output index, in addition, the annual input and output of the insurance company are regarded as a decision-making unit, and the relatively accurate insurance efficiency is obtained. The conclusion: in 2000 and 2008,

the overall efficiency of domestic property insurance companies is the highest, from 2000 to 2005, and then from the lowest point in 2005 to the peak in 2008, and then decreased. Then the Tobit regression model is used to do linear regression between input and output, and there is an obvious negative correlation between the efficiency of insurance companies and macroeconomic growth rate, which further confirms the conclusion of DEA method.

In a recent study, Liu and Zhang (2013) used the three-stage DEA method to study the operating efficiency of 16 property insurance companies from 2007 to 2010. The conclusion is that the state-owned insurance companies are better than the joint-stock insurance companies. The cost efficiency of foreign insurance companies is high; by comparing the profit efficiency of large insurance companies, it is concluded that the profit efficiency of several listed insurance companies and insurance companies with high market share is higher than that of other companies.

However, in a restricted study regarding only property insurance industry, Bai (2015), He (2015). used DEA-Malmquist method to study the operating efficiency of 36 property insurance companies from 2008 to 2011. The conclusion is that the overall efficiency of Chinese property insurance enterprises is generally not high. And the gap between the families is small. Therefore, the improvement of technical efficiency is the main factor to improve the overall efficiency. Through the study, there were only 5 in 2008, 9 insurance companies achieved technical efficiency in 2009, 2010, 2011. After that, through Tobit model, the author obtains the analysis of influencing factors: the management ability of insurance company is positively correlated with the efficiency of insurance company, the scale of capital is negatively correlated with efficiency, human capital, and cost expenditure, and there is no significant correlation between solvency and efficiency of insurance companies.

Tang (2015) applied the modified three-stage DEA and Malmquist exponential model to study the technical efficiency, pure technical efficiency, scale efficiency and Malmquist productivity index of 39 property insurance companies and 43 life insurance companies in China from 2007 to 2012. According to the research conclusion, the technical efficiency of life insurance companies is higher than that of property insurance companies; that of foreign-funded insurance companies is higher than that of Chinese-funded insurance companies; and that of

established insurance companies is higher than that of newly-established insurance companies. Proceeding from Malmquist productivity index, the alteration in the pure technical efficiency is not obvious, while the improvement of technical efficiency is mainly achieved by enhancing the scale efficiency. Therefore, it can be observed that the technical progress can improve insurance companies’ total factor productivity.

2.3.2 Research on the influencing factors of operating efficiency of Chinese Insurance companies

The main factors that affect the efficiency changes of insurance companies are summarized, as follows:

(1) Macroeconomic factors, such as inflation rate, GDP, interest rate, exchange rate, economic sentiment index and so on;

(2) Industry factors, including: the market structure of China's insurance industry, the degree of market competition, the supervision of insurance regulatory departments, and so on;

(3) The basic situation of insurance companies, including: organizational structure, capital scale, profit margin, market share, human capital, expenses, marketing channels.

(4) Other factors, such as the whole financial market structure, institutional evolution and so on. From the analysis of the decisive factors of insurance efficiency by Chinese scholars, it mainly focuses on the industry factors and the basic situation of insurance companies.

The following is a summary of the main literature on the influencing factors of the efficiency of China's insurance industry:

Yao et al (2005) and others used DEA method to study 22 Chinese insurance companies from 1999 to 2002. It is concluded that the main reason for the low overall operating efficiency of insurance companies is the low scale efficiency. And the scale reward of most insurance companies shows a decreasing trend. Then the Tobit model is used to analyze the influencing factors of the efficiency of insurance companies, Human capital, capital investment and indemnity were selected as input indicators, premium income and investment

income as output indicators. The results show that human capital, stock form, capital scale and sales channel have significant positive correlation with the operating efficiency of insurance company, which are the main reasons that affect the efficiency. Compared with the two main sales channels of direct marketing and agency marketing, it is concluded that direct marketing has a more significant impact on efficiency than direct marketing.

Gan and Hu (2007) used DEA method to study the operating efficiency of Chinese life insurance companies from 2004 to 2005. The conclusion is that the overall efficiency of Chinese life insurance companies is not high. Then the Tobit model is used to study the influencing factors of the operating efficiency of life insurance companies. It is found that the market share of life insurance companies, the proportion of premium income in bank agency marketing channels, and the product concentration have a very significant impact on the efficiency of insurance companies.

Hu and Ye (2008) used DEA method to study the efficiency of Chinese insurance companies from 2002 to 2005. Human capital, paid-in capital, indemnity and expenses were selected as input indicators, and premium income was selected. As an output index, the sum of reserves and profits shows that the efficiency of foreign property insurance companies is better than that of Chinese property insurance companies, but the efficiency of Chinese life insurance companies is ahead of that of foreign life insurance companies, and economies of scale generally exist in Chinese insurance companies. However, excluding the influence of scale factors, the efficiency of Chinese life insurance companies is lower than that of foreign life insurance companies. Then the regression analysis method is used to analyze the factors that affect the efficiency of insurance companies, and the main factors that affect the efficiency are personnel quality, organizational form of the company, the size of the company, the level of corporate governance and so on.

Lu (2010) used the data of Chinese insurance companies from 1999 to 2006 to find that the overall technical efficiency of Chinese insurance companies is low, and there is a continuous downward trend, but the overall scale efficiency is higher. After that, the main factors affecting efficiency, including human capital, company size, solvency, management level and other external factors, such as macroeconomic situation and industrial structure, are studied. The

conclusion is that the solvency and operating status of insurance companies have a positive and significant impact on the technical efficiency, pure technical efficiency and scale efficiency of insurance companies. Human capital refers to the quality, education and ability of personnel, which has no correlation with technical efficiency and pure technical efficiency, but has a negative correlation with scale efficiency. The management level has a negative correlation with the technical efficiency and pure technical efficiency of insurance companies. Scale efficiency has a negative and significant impact.

Zhu and Li (2012) used DEA method to study the operating efficiency of 138 Sino-foreign joint venture property insurance companies and 218 Sino-foreign joint venture life insurance companies in China from 2000 to 2010. The conclusion is that there is an obvious positive correlation between human capital and the efficiency of insurance companies. China's entry into WTO has no obvious influence on the efficiency of Sino-foreign joint venture property insurance companies, but has obvious negative influence on the efficiency of Sino-foreign joint venture life insurance companies.

Zhu and Zhang (2015) used DEA method to study the operating efficiency of 24 insurance companies from 2008 to 2013. The conclusion is that the more provincial branches and county-level companies set up by insurance companies, the higher the operating efficiency of insurance companies, but the lower the social efficiency; The technical efficiency of the insurance company and the insurance capital management company of the insurance company has obvious positive influence on the social efficiency.

Liu (2015) applied the SFA method to perform empirical analysis for the top 7 property insurance companies and the top 7 life insurance companies operating Internet insurance business in 2014. According to the research conclusion, both property insurance and life insurance companies, The development of Internet insurance business has a significant positive impact on the profit efficiency and cost efficiency of insurance companies.

Song (2016) studied the operating efficiency of 24 Chinese property insurance companies from 2010 to 2014 by using the three-stage DEA method, and then used the malmquist index model to carry on the in-depth study. The conclusion is that there is still room to improve the

overall operating efficiency of China's property insurance industry, and some suggestions are given.

2.3.3 Summary and comment on the efficiency Research of Insurance Industry in Foreign countries and China

The first two chapters summarize the main representative literature on the efficiency research of insurance companies in china and abroad, and analyze in two parts: according to the selection of different input, output index, to study different efficiency; through different factors to study the degree of influence on efficiency.

In addition, in the evolution of research methods: from the literature review, we can find that in the past research, scholars can be divided into two categories: nonparametric research methods and parametric research methods. In the traditional nonparametric analysis method, most scholars use the classical DEA method in their research, and this method has more and more exposed some disadvantages in practical application. First, on the basis of DEA method, scholars upgrade and modify the DEA model.

In 1978, Charnes, Cooper, and Rhodes extended the DEA model and put forward with the CCR model; in 1984, Banker, Charnes, and Cooper (1984) softened the assumed conditions of the CCR model, and designed the BBC model featuring variable scale return. However, both CCR model and BCC model based on efficiency measure do not consider the radial and linear piecewise metric theory of relaxation effect, which can easily lead to the error of efficiency measurement. The traditional DEA method does not take into account the external environment of each object and the efficiency value calculated by random error, which can not completely reflect the efficiency of the insurance company. Secondly, most scholars use the two-stage Tobit regression model or the ordinary least square regression model to analyze the factors that affect the efficiency. Fried et al (2002) think that the inefficiency of the enterprise may be due to the influence of the external environment and random errors on the management. Because the two-stage method can not remove the interference of error and environmental factors on the calculation of efficiency value, the obtained efficiency value can not be true, which fully reflects

the actual operating efficiency of the company.

Secondly, most research made use of two-stage Tobit regression model or ordinary-least squares regression model to analyze the influencing factors of efficiency. Fried et al (2002) point out that the low business efficiency may have been caused by the internal poor management or the impact of external environments and random errors. The former factor is endogenous, and the latter two factors are exogenous. The two-stage method can not remove the impact of external environments and random errors, therefore the efficiency value obtained does not fully reflect the management efficiency of enterprises. For this reason, Fried et al (2002) proposeda new efficiency evaluation model, the three-stage DEA method. The biggest characteristic of this method is to remove from the effect of non-operating factors (external environments and random errors) on efficiency, thus the efficiency value obtained can more truly reflect the managerial and administrative level of enterprises.

The basic idea of three-stage DEA method is as follows: in the first stage, the input and output values are replaced by DEA, to obtain the initial value and input (or output) difference of the efficiency of insurance companies; In the second stage, SFA is used to sort out the input and output value, which will eliminate the influence of external environment and random error factors. In the third stage, the efficiency values obtained by replacing the adjusted input and output values with DEA, are the efficiency values that eliminate the external environmental factors and random error factors.

The research on the operating efficiency of insurance companies abroad began in the 1990s, while the domestic research on the insurance industry started relatively backward, but the depth and breadth of the research in the past 10 years has developed rapidly. The foreign research on the insurance industry is mainly based on the quantitative analysis of modeling, while the early research on the insurance industry in China is mainly qualitative analysis. It was not until 2003 that Chinese scholars began to use economics and econometric models to study the efficiency of insurance companies, and it was not until 2005 that the corresponding empirical research appeared. The main research results in China mainly focus on the discussion of metrological research methods, and a small number of literatures are empirical analysis of the combination

of theoretical and practical metrological research methods. From the content point of view, most of the existing domestic achievements are concentrated in production technology, equity or organizational form, including the industry. Although trapped by historical and current data problems, these research methods in keeping pace with the times are generally valued and used by industry regulators and insurance companies. It is very beneficial for Chinese insurance companies to use sufficient historical data to establish appropriate measurement models and get the corresponding results, which is very beneficial to the insurance companies in our country who are in the process of changing their business philosophy and system.

Among the scholars who study the efficiency of insurance industry in China, Huang Wei first used the three-stage DEA model in 2011, and the literature using the latest three-stage DEA in the past five years has gradually increased. Moreover, there are great differences in business characteristics, market environment and business model between property insurance companies and life insurance companies. There are not many literatures that can be studied separately and then compared. Moreover, there are few factors that affect efficiency by literature analysis and test. Therefore, the analysis of the operating efficiency of China's insurance industry behind the influencing factors need to be further explored. Based on the existing literature research fields and results, I choose the full data of the industry in the past four years, distinguish property insurance from life insurance, distinguish domestic capital from foreign capital, and use the most advanced three-stage DEA method to measure the more accurate efficiency value. On this basis, the influencing factors of efficiency are analyzed, and finally some effective suggestions are put forward.

Chapter 3 Chinese Insurance Companies' Efficiency Measurement

3.1 Selection of research methods

According to the literature review and summary and analysis of the second chapter, in order to accurately compare and evaluate the efficiency level of insurance companies in China, it is necessary to control or eliminate the impact of unknown or uncontrollable variables such as external environmental factors and random error factors. The efficiency of the company needs to be measured and evaluated in a comparable caliber. The three-stage DEA model proposed by Fried, Schmidt, and Yaisawarng (1999). The model can eliminate random errors and environmental factors, and can objectively evaluate the operating efficiency of Chinese insurance companies.

3.2 Selection of models, variables, indexes and data for efficiency study

3.2.1 Model selection——three-stage DEA method

Fried et al (1999) found that the traditional DEA model did not consider the influence of external environmental factors on the efficiency. Initially, he came up with the four-stage of DEA method, but this method was unable to adjust the effect of random errors. Fried (2002) further optimized of the four-stage DEA method into the three-stage DEA method, and at the same time adjusted the effects factors such as environmental variables and random errors. However, Fried et al (1999) proposed the first-stage initial efficiency and the calculation of last-stage adjustment efficiency value based on BBC model, and the BCC model is a classical DEA model, which abandoned the slack variable (difference value) while doing the efficiency estimation. This might cause the large errors of the efficiency measure. Tone (2001) proposed a DEA model based on slack measure (measure slack-based), and introduced the relaxation quantity into the objective function. The problem of the traditional model ignoring the slack information that causes errors has been well solved.

The calculation of the first stage initial efficiency and the late adjustment efficiency of the three-stage DEA method is based on the BCC model of the traditional DEA method, and no relaxation variable (difference) is used to estimate the efficiency. Tone put forward a new innovation in 2001, which introduced relaxation quantity into objective function, and solved the problem of neglecting the information of relaxation quantity in traditional DEA model.

Upon consideration of the influence of slack variables on efficiency, this thesis adopts the three-stage DEA method already improved as it may evaluate the operating efficiency of insurance companies in a more accurate manner, and remove the influence of external environment and random error on efficiency.

3.2.2. The Selection of Environment Variables

The second stage of three-stage DEA method is to use SFA method to eliminate external environmental factors. The efficiency of DMU is obtained more accurately by eliminating environmental factors. External factors include: macroeconomic, established years, market size and government supervision and so on. The external environment variables selected in this thesis consider the quantification and availability of the data, including the number of years of establishment of the insurance company, the nature of the enterprise (0 for the foreign company and 1 for the Chinese company) and the market share.

1. The nature of the enterprise is able to affect the operating efficiency of the insurance company. On the one hand, the Chinese financial industry hás only been opening to outside world since the last decade, and the insurance industry followed much behind. Chinese traditional state-owned insurance companies often have a strong administrative monopoly power and market share as well as their own branches and employees all over the country, therefore taking a leading position in the competition with foreign capitals and the newly established insurance companies. On the other hand, the traditional Chinese insurance companies trend to have an issue of waste of resources, corporate governance structure defects such as rigid infrastruture. Comparatively, foreign insurance companies trend to have a keen

insight into the market、excellent innovation ability and excellent corporate governance structure. Therefore, the impact of the insurance company's properties on its efficiency is uncertain.

2. The length of existence of a company can reflect its basic survival ability. On the one hand, an old and famous company trends to be unique in business management and product quality. It can more easily gain consumers' trust. This is also true for a property insurance company or a life insurance company. The longer the company hás been established, the better reputation the property insurance company will typically have, making it to have more customers and better performance. On the other hand, with a long history, with persistent good reputation of the property insurance and life insurance companies are more able to attract good employees to join, so as to further improve the efficiency of the company's operation. However, the long established companies may also be in the rapid development of the market because of the old concept, organizational structure and management system, such as the reasons for the rigidity of the new moon in the different market to maintain consistent competitiveness (However, the long established company may suffer from inconsistency competitiveness as the situation of old concepts, ossification of both organization structure and management system due to the rapid market development, and the issue will be enlarged in the rapid changed market) , it will incur the decline of the company's operating ability and the overall efficiency. No matter what the situation is, the length of existence will affect the efficiency of the insurance company, so this thesis will set up the number of years as an environmental variable for this study.

3. Market share is the most important index to reflect a property insurance company's market share and the company's competitiveness. A companies with a large market share rate tends to have a better product quality and service level with the awareness of how to enhance the effectiveness and efficiency of company according to market changes and customer feedback. Comparatively, a company with a small market share may sacrifice part of efficiency in order to pursue the market share. Indeed, a company with a large market share may face greater moral hazard and adverse selection problems in a complex and volatile market. A company with a small market share, however, has small pressure. Therefore, market share may

also have the impact on the a potential positive or a negative efficiency of property insurance company. This thesis will make market share as one environment variable. Market share is expressed by the company's premium income accounted for the proportion of the total premium income of the insurance market.

3.2.3. The selection of input and output index

When using the three stage DEA model to study the efficiency of insurance companies, the selection of input and output index is very important, because it directly affects the efficiency value of DMU. In this thesis, input and output index were selected based on the 'Cost Approach' (in case of constant production, reducing cost to the largest extent).

1. Input index

Insurance companies are part of the financial services industry. The competitiveness of financial services industry should be measured by the quality and quantity of service. In the existing research literature, due to the data availability and other objective factors, scholars, such as Han (2009), Huang (2008a), Wang (2010) and others, prefer using fixed assets as asset type input variable on the selection of the input index.

This thesis will continue this traditional approach, using the amount of fixed assets owned by the insurance company as one of the index to measure inputs. In this thesis, current cost, the total premium paid as the explicit cost by the insurance company, was selected as the second variable. The explicit cost is the fees and commissions. Insurance companies must assume a certain degree of labor or intermediary services, which is the explicit cost, in order to obtain premium income. This cost is an important index to evaluate the relative efficiency of insurance companies. This means, in order to obtain a certain amount of premium income, the less cost a company pays, the higher the efficiency would be. This is consistent with index selection criteria of the 'cost method'.

In addition to fixed assets, labor is another important input. in this aspect, almost all of the insurance companies in the literature used the number of employees for this input level no matter what kind of research methods or perspectives were adopted. Some examples of such

studies were conducted by Huang (2009), Zhao (2003) and other scholars. On this basis, and in order to ensure consistency and comparability of research results, this study also used the "employee number" to measure the level of labor input of different insurance companies.

2. Output index

In the existing literature of measuring the efficiency of insurance companies, the selection of output index is based on a particular perspective or purpose of research. The representative output index mainly include total investment assets (Huang 2009), premium income, and investment income (Zhang, 2011; Zhao & Wu, 2010). The purpose of this research is to measure and analyze the operating efficiency of different property and life insurance companies and the industry as a whole in China, rather than the efficiency of one or a few insurance groups, It is questionable to use investment income as output index and therefore it was not included in the selection of output index. However, in the cross-section data, the total invested assets should be used as input index in the efficiency analysis. In summary, based on the purpose of this particular study, total premium throughout the year was selected as a measurement of output. Premium income is the return of insurance companies to provide insurance services, which reflects the level of internal governance and the quality and quantity of services and the market share, as time goes on. The stability of premium income will be gradually transformed into an insurance company profits, reflecting the company's long-term competitiveness.

3.2.4 The Selection of Samples and Data

China's insurance market and the entire industry have been in rapid development. More and more Chinese, foreign, and joint venture insurance companies have been newly established in recent years. Therefore, when researching the efficiency of insurance companies, it’s difficult to select samples. Fewer samples can guarantee the completeness of data, but they are hard to represent the scale and efficiency of the entire industry. Ideally we should select as many samples as possible to represent all the insurance companies. However, it is difficult to get the operating data of all the insurance companies. This dilemma has been perplexing the comprehensive and standardized research on the operational efficiency of insurance companies

and the insurance industry in our country. In this study, in the process of sampling, we balanced the sample's representation and data completeness. This study used the four year (2008-2011) sampled data from China Year Book by selecting 53 domestic life insurance companies and 43 property insurance companies respectively that have started operation in recent years.

The Chinese researchers usually select 20-30 insurance companies that have relatively large market shares to measure efficiency. This sampling method will lead to biased conclusions when many newly established small-sized companies have become strong competitors because of their advantages in prices and services and the effect of brands from those established companies is subsiding. Therefore, this study will select a sample of four years cross-sectional data and use the third period DEA to measure efficiency and analyze the impacting factors.

3.3 Empirical Analysis

In the empirical analysis, the author used FRONTIER4.1, DEAP2.1 and STATA to calculate the external environmental factors in the three stages and second stages of 43 property insurance companies and 53 life insurance companies in the four years from 2008 to 2011.

3.3.1 DEA First Stage Results: Based on DEA Empirical Analysis

3.3.1.1 The analysis of technical efficiency of property insurance companies

In the first phase of DEA analysis, the sample data of 43 property insurance companies in China are placed at the same efficiency frontier. According to BCC model, the technical efficiency, pure technical efficiency and scale efficiency of insurance companies are analyzed.

In the end of this thesis, the attached Table 1 is the essential data, **Table 3-1** is the technical efficiency, **Table 3-2** is the empirical result of pure technical efficiency, and **Table 3-3** is the empirical result of scale efficiency and scale remuneration.

Table 3-1 Technical Eficiency of propert 1nsurance Companies from 2008 to 2011

Technical Eficiency（TE）						
Nature of company	Company name	2008	2009	2010	2011	mean value
Domestic	PICC	1	1	1	1	1
	chinalife	0.871	0.709	1	1	0.895
	CCIC	0.822	0.547	0.719	0.787	0.718
	China Taiping	0.76	0.449	0.642	0.737	0.647
	Sunshine Ins	0.659	0.461	0.652	0.859	0.657
	CUPI	0.655	0.978	0.894	0.856	0.845
	CPI	1	1	0.861	0.931	0.948
	PingAn Propert	0.806	0.621	0.992	0.994	0.853
	Huatai	0.471	0.722	0.407	0.613	0.553
	TiananProperty	0.815	0.604	0.853	0.622	0.723
	STARR	1	0.433	0.619	0.538	0.647
	SINOSAFE	0.911	0.987	0.891	1	0.947
	YAIC	0.776	0.613	0.794	0.913	0.774
	Alltrust	0.432	0.501	0.714	0.695	0.585
	AAIC	0.513	0.611	0.516	0.357	0.499
	Anbang	0.998	0.988	1	1	0.996
	AnhuaAgri	0.519	0.672	0.651	0.419	0.565
	Auto Company	0.567	0.982	0.671	0.69	0.727
	SUNLIGHT INS	0.256	0.225	0.426	0.46	0.342
	BOHAI INS	0.566	0.632	0.424	0.469	0.523
	DUBON INS	0.721	0.421	0.583	0.611	0.584
	CHIC	0.325	0.381	0.266	0.224	0.299
	CAS PICC	0.272	0.321	0.407	0.605	0.401
	ANCHENG	0.345	0.477	0.566	0.293	0.42
	BOC INS	0.245	0.536	0.345	0.27	0.349
	YING DA	0.256	0.692	0.562	0.553	0.516
	Changan Property	0.266	0.291	0.724	0.834	0.529
	gynybx	0.983	1	0.994	0.837	0.954

Foreign capital (joint venture)	generali-china	0.772	0.422	0.623	1	0.704
	AIG	0.595	0.49	0.43	0.498	0.503
	MARINE	0.906	0.645	0.935	0.956	0.861
	Fengtai Shanghai	0.406	0.678	0.941	0.622	0.739
	Sun Alliance	0.678	0.271	0.631	0.377	0.489
	Hillock	0.689	0.156	0.633	1	0.619
	Sumitomo Mitsui	0.597	0.557	0.893	0.979	0.757
	SAMSUNG	1	0.95	0.675	0.679	0.826
	Allianz	0.753	0.42	0.742	0.381	0.574
	Sompo Japan	0.69	0.708	0.871	0.675	0.736
	Liberty	0.254	0.271	0.5813	0.425	0.383
	UNITA Ins	0.242	0.264	0.245	0.803	0.389
	Zurich Beijing	0.245	0.119	0.215	0.294	0.218
	Hyundai Ins	0.256	0.382	0.356	0.389	0.346
	Aioi	0.547	0.312	0.624	0.389	0.468

As can be seen from Table-3-1, the average technical efficiency of Chinese property insurance companies from 2008 to 2011 is 0.615, 0.577, 0.664 and 0.666, respectively. The average technical efficiency of the whole property insurance company over the past four years is 0.631. The total number of samples selected was 43, including 28 property insurance companies and 15 foreign property insurance companies.

From 2008 to 2011, the total number of more than the average number was 22, 20, 20, 22, 21 respectively. Among them, the number of Chinese capital exceeding the average is 15, 16, 14, 15, 15 respectively; the number of external (joint) capital exceeding the average is 7, 4, 6, 7, 6 respectively, and the minimum values from 2008 to 2011 are 0.245, 0.119, 0.27, 0.218 respectively, and the maximum mean value is 1.

Therefore, from 2008 to 2011, the technical efficiency of China's property insurance company is relatively low compared with Europe and the United states. The technical efficiency of PICC, China Life Insurance, China United, CPIC, Ping An Insurance, Huaan Insurance,

Anbang Insurance, Guo Yuan Agricultural Insurance, Marine Nichido is above the average level; the technical efficiency of PICC Insurance for each year is at the forefront; Ping An Insurance, Ampang Insurance is close to the forefront; but the technical efficiencies of the Sun Agricultural Insurance, Mingan Insurance, BOC INS, UNITA Ins, Zurich (Beijing) are much lower than the average, which indicated that the overall business proficiency of staff members of these companies needs to be improved; the technical efficiency of Huanong Property Insurance, Sun Alliance Insurance, Samsung Insurance has increased in four years; the technical efficiency of YIN DA, Changan, Sumitomo Mitsui , BOHAI Ins, Allianz Insurance has declined in four years; the technical efficiency of Changan Property, Sun Alliance, Hillock, ANCHENG Insurance, UNITA Insurance, Aioi didn't have significant changes.

Thus, for the property Insurance companies in China, in terms of technical efficiency, a hierarchical distribution is quite obvious. The longer the operating time that a company has, the higher the technical efficiency would be, which is in line with the positive impact of innovating ideas. The technical efficiency of some small companies with short-time operation has much space for improvement.

3.3.1.2 Analysis of pure technical efficiency of property insurance companies

Table 3-2 Pure Technical Eficiency of property Insurance Companies from 2008 to 2011

Pure Technical Eficiency（PTE）						
Nature of company	**Company name**	**2008**	**2009**	**2010**	**2011**	**mean value**
Domestic	PICC	1	1	1	1	1
	chinalife	0.994	0.712	0.743	0.874	0.851
	CCIC	0.993	0.677	0.778	0.592	0.601
	China Taiping	0.859	0.481	0.578	0.694	0.653
	Sunshine Ins	0.714	0.521	0.714	0.941	0.673
	CUPI	0.712	1	1	1	0.928
	CPI	1	1	1	1	1

Pure Technical Eficiency（PTE）						
Nature of company	**Company name**	**2008**	**2009**	**2010**	**2011**	**mean value**
Domestic	PingAn Propert	0.811	0.933	1	0.913	0.914
	Huatai	0.621	0.743	0.913	0.625	0.718
	TiananProperty	0.882	0.641	0.853	0.633	0.502
	STARR	1	0.45	0.873	0.548	0.718
	SINOSAFE	0.991	0.991	1	1	0.993
	YAIC	0.842	0.689	0.813	0.829	0.793
	Alltrust	0.991	0.762	1	0.791	0.886
	AAIC	0.845	0.755	0.692	0.432	0.681
	Anbang	1	1	1	1	1
	AnhuaAgri	0.679	0.754	0.845	0.438	0.679
	Auto Company	0.627	0.991	0.891	0.763	0.818
	SUNLIGHT INS	0.614	0.255	0.561	0.497	0.482
	BOHAI INS	0.656	0.641	0.613	0.924	0.709
	DUBON INS	0.882	0.511	0.672	1	0.616
	CHIC	0.743	0.512	0.363	0.425	0.461
	CAS PICC	0.301	0.325	0.494	0.637	0.439
	ANCHENG	0.672	0.491	0.724	0.311	0.549
	BOC INS	0.772	0.556	0.724	0.579	0.658
	YING DA	0.676	0.732	0.689	0.562	0.665
	ChanganProperty	0.677	0.299	0.733	0.848	0.614
	gynybx	1	1	0.998	0.47	0.757
Foreign capital (joint venture)	generali-china	0.841	0.654	0.677	1	0.743
	AIG	0.608	0.501	0.451	0.552	0.478
	MARINE	0.964	0.768	0.993	0.883	0.882
	Fengtai Shanghai	0.498	0.702	0.991	0.843	0.733
	Sun Alliance	0.678	0.566	0.976	0.662	0.721
	Hillock	0.865	0.414	0.816	1	0.775
	Sumitomo Mitsui	0.701	0.688	0.983	0.434	0.652
	SAMSUNG	1	1	1	0.463	0.866
	Allianz	0.894	0.852	0.888	0.892	0.882
	Sompo Japan	0.716	0.731	0.994	0.416	0.489
	Liberty	0.981	0.431	0.641	0.479	0.558
	UNITA Ins	0.893	0.914	0.874	0.393	0.769
	Zurich Beijing	0.699	0.711	0.678	0.62	0.677
	Hyundai Ins	0.881	0.991	0.968	0.843	0.921
	Aioi	0.772	0.913	0.788	0.715	0.797

Pure technical efficiency value represents the management and decision-making level within the insurance company, which is the external reflection of a company's internal governance and decision-making ability. Table 3-2 shows that the pure technical efficiency average value of our insurance companies from 2008 to 2011 were 0.754, 0.686, 0.823 and 0.776.

Descriptive statistics are as follows: the total number of samples selected is 43, including 28 property insurance companies and 15 foreign property insurance companies. From 2008 to 2011, the total number of more than the average number was 25, 25, 22, 19, 17, respectively. Among them, the number of Chinese capital exceeding the average is 16, 15, 13, 13, 10; the number of external (joint) capital exceeding the average is 9, 10, 9, 6, 7 respectively, and the minimum values from 2008 to 2011 are 0.301, 0.299, 0.393, 0.393, 0.439, respectively, and the maximum mean value is 1.

In those four years, the overall average of the pure technical efficiency value was 0.766. It can be seen that the pure technical efficiency of China's insurance companies was higher than the technical level. It can be known that the main restricting factor for the overall efficiency of insurance companies in our country is the low level of technical efficiency, which means that comparing with the insurance companies’ internal management and operation decision-making, the insurance company's business proficiency and efforts to improve the efficiency of insurance companies are more important.

The pure technical efficiency values of PICC, China Life property Insurance, CPI, Ping An Insurance, SINOSAFE, YAIC Insurance, Anbang property Insurance, Marine Insurance, Samsung Insurance and Allianz general Insurance were much higher than the average level. And the pure technical efficiency values of PICC, Pacific Property Insurance and Anbang Property Insurance were in the forefront, suggesting that over the past few years the companies had good internal governance mechanisms and ability to make right and forward-looking decisions. The pure technical efficiency values of Tian An Insurance, Sunshine agricultural Insurance, Huanong Property Insurance, the CAS Insurance, AIU Insurance, and Japanese Insurance were far lower than the industry average, suggesting that these companies still need to optimize the internal governance structure and improve the decision-making ability. Among

them, Yongcheng Property, Anxin Insurance, Anwar Insurance, Bohai Property Insurance, CAS Property Insurance, Changan Responsibility, Sino Italian Insurance and Feng Tai Shanghai increased significantly. The pure technical efficiency values of CCIC, Tianping Auto, Huanong Property Insurance, Hyder Insurance, Bank of China Insurance, AIU Insurance, Mitsui, Japanese Insurance and UNITA Insurance declined. The pure technical efficiency values of Chubb Insurance and Du Bang Insurance was unstable and volatile.

3.3.1.3 Analysis of Scale Efficiency and Scale Return of Property Insurance Companies

The scale return is an important concept in economics, which measures the multiple of the output increase when all the input variables are doubled. When the output is increased by more than 1, the company should expand the scale of production, because the new input of production factors is in the marginal productivity. At this time the company will increase the size of output and profit; when the output is less than 1, rational manufacturers should reduce the production scale and reduce the input of production factors, and when the ratio is equal to 1, the scale efficiency of the company is the same, which means the size of the company is suitable, and it is not appropriate to expand or shrink. The scale efficiency is an important index to measure the overall investment and output of a company.

Table 3-3 Insurance Companies' scale-efficiency and return of scale in 2008-2011

	2008		2009		2010		2011		mean
PICC	1	drs	1	drs	1	drs	1	drs	1
chinalife	0.876	irs	0.996	drs	1	-	1	drs	0.968
CCIC	0.828	irs	0.808	drs	0.968	drs	0.994	drs	0.9
China Taiping	0.885	drs	0.933	drs	0.825	irs	0.928	irs	0.892
Sunshine Ins	0.923	drs	0.885	drs	0.913	drs	0.913	irs	0.909
CUPI	0.92	drs	0.978	drs	0.894	irs	0.856	irs	0.912
CPI	1	irs	1	-	0.861	irs	0.931	irs	0.948
PingAn Propert	0.994	drs	0.666	irs	0.992	irs	0.994	irs	0.912
ehuatai	0.758	irs	0.972	drs	0.446	drs	0.981	drs	0.789
TiananProperty	0.924	drs	0.942	irs	1	-	0.983	drs	0.962
STARR	1	irs	0.962	irs	0.709	irs	0.982	irs	0.913
SINOSAFE	0.919	drs	0.996	irs	0.891	irs	1	irs	0.952
YAIC	0.922	irs	0.89	irs	0.977	irs	0.983	irs	0.943

	2008		2009		2010		2011		mean
Alltrust	0.436	irs	0.657	irs	0.714	irs	0.879	drs	0.672
AAIC	0.607	irs	0.809	irs	0.746	irs	0.826	irs	0.747
Anbang	0.998	irs	0.988	irs	1	irs	1	irs	0.997
AnhuaAgri	0.764	irs	0.891	drs	0.771	drs	0.957	drs	0.846
AutoCompany	0.904	irs	0.991	-	0.753	irs	0.904	irs	0.888
SUNLIGHT INS	0.417	irs	0.882	irs	0.759	irs	0.926	irs	0.746
BOHAI INS	0.863	irs	0.986	irs	0.691	irs	0.508	irs	0.762
DUBON INS	0.817	drs	0.824	drs	0.867	drs	0.611	drs	0.779
CHIC	0.437	irs	0.744	irs	0.733	irs	0.527	irs	0.611
CAS PICC	0.904	drs	0.988	-	0.824	drs	0.95	drs	0.917
ANCHENG	0.513	drs	0.972	drs	0.782	drs	0.942	drs	0.802
BOC INS	0.317	drs	0.964	irs	0.476	drs	0.466	drs	0.556
YING DA	0.378	irs	0.945	irs	0.816	irs	0.984	irs	0.781
Changan Property	0.393	irs	0.973	irs	0.988	irs	0.983	irs	0.834
gynybx	0.983	irs	1	-	0.996	irs	0.962	-	0.986
generali-china	0.918	irs	0.645	irs	0.921	irs	1	-	0.871
AIG	0.978	irs	0.978	-	0.953	irs	0.902	irs	0.953
MARINE	0.94	irs	0.84	irs	0.942	irs	0.973	irs	0.924
Fengtai Shanghai	0.815	irs	0.979	irs	0.951	irs	0.738	irs	0.871
Sun Alliance	1	irs	0.479	irs	0.647	irs	0.57	irs	0.674
Hillock	0.797	irs	0.377	irs	0.776	irs	1	irs	0.738
Sumitomo Mitsui	0.852	irs	0.81	irs	0.908	irs	0.995	irs	0.891
SAMSUNG	1	irs	0.95	irs	0.675	irs	0.89	irs	0.879
Allianz	0.847	irs	0.493	irs	0.836	irs	0.427	irs	0.651
Sompo Japan	0.964	irs	0.969	-	0.876	irs	0.827	irs	0.909
Liberty	0.259	irs	0.629	irs	0.907	irs	0.887	irs	0.671
UNITA Ins	0.271	irs	0.289	irs	0.28	irs	0.899	irs	0.435
Zurich Beijing	0.351	irs	0.167	irs	0.317	irs	0.474	irs	0.327
Hyundai Ins	0.291	irs	0.385	irs	0.368	irs	0.461	irs	0.376
Aioi	0.709	irs	0.342	irs	0.792	irs	0.544	irs	0.597
Mean	0.76	——	0.813	——	0.803	——	0.85	——	0.807

Note: SE means "scale efficiency" ,TE=PTE*SE；“-”means scale returns are constant; drs means "scale returns

are decreasing"; irs means "scale returns are increasing".

Table 3-3 shows from 2008 to 2011, the average scale efficiency of property insurance companies of our country are 0.760, 0.813, 0.803 and 0.850, and the overall average scale efficiency is 0.807. China property insurance company's overall scale efficiency is higher than pure technical efficiency and technical efficiency at the same period. Therefore, the main problem that restricts the efficiency of the property insurance companies are the two aspects of the insurance companies’ internal governance and employees’ proficiency and their level of efforts. On average, the scale efficiency of PICC, China Life Insurance, CCIC, sunshine insurance, CPIC, Ping An insurance, public insurance, Huaan insurance, Yongan property insurance, Anbang insurance, CAS property insurance, the yuan agricultural insurance, Generali-China, AIU Insurance and Japanese insurance has reached more than 0.9; the highest scale efficiency is PICC, China Life Insurance and the Anbang property insurance, which respectively reached 1.000, 0.968 and 0.997. The scale efficiency value of Permanent Prudential insurance, Huanong property insurance, Bank of China Insurance, Sun Alliance, Allianz Insurance, UNITA insurance, Zurich (Beijing), Modern insurance and Aioi is low, which is below 0.7. And the lowest is UNITA insurance, Zurich (Beijing) and Modern insurance which are 0.435, 0.327, and 0.376.

From the perspective of returns to scale, in the period of sample study, most insurance companies were still in the stage of increasing returns to scale. Therefore, market demand for insurance companies market was large. These Insurance companies will remain expanding in the next period of time. PICC, State Property Insurance and Hyder Insurance in the period of decreasing returns to scale, therefore, these companies should not blindly pursue scale expansion, and should optimize the internal governance structure, and improve the quality of employees, and strive to achieve more output with existing input, or should streamline bloated personnel and institutions, so as to improve the ratio of input and output. and the Earth Insurance, Sunshine Insurance, Huatai Insurance, Bank Insurance were in the stage of decreasing returns to scale of the three years, therefore, these insurance companies should not blindly expand the scale, but refine their own development strategies according to their different situations so that they can come back to the increasing stage of scale efficiency. China Life Insurance, China

Pacific Insurance, Property Insurance, Auto Balance, Tian An China, CAS PICC Yuan Agricultural Insurance, Italian Insurance, AIU Insurance, Japanese Insurance in the four years have reached a constant returns to scale stage. Thus, these insurance companies' investment and returns to scale were at the critical point. Their increasing or decreasing of returns to scale may be affected by market environment, company internal management, enterprise culture and other factors.

3.3.1.4 Analysis of Life Insurances Companies' Technical-Efficiency

Table 3-4 Life Insurances Companies' Tech-Efficiency in 2008-2011

	Technical-Efficiency（TE）				
Year	**2008**	**2009**	**2010**	**2011**	**value**
PICC	1	0.796	1	1	0.949
CHINA-LIFE	0.894	0.783	0.742	0.788	0.802
Taiping-life	0.998	1	0.963	1	0.991
Mingsheng	0.647	0.712	0.688	0.861	0.727
Sunshine-life	0.977	0.689	0.586	0.954	0.801
Pacific Insurance	1	0.745	0.867	1	0.903
Pingan-life	0.979	0.983	0.821	0.865	0.912
Huatai-life	0.901	0.841	0.691	0.827	0.815
Xinhua-life	0.636	0.638	0.835	0.746	0.714
Taikang-life	1	0.601	0.716	0.994	0.828
Sino-life	0.961	1	0.696	0.979	0.909
unionlife	0.419	0.712	0.789	0.977	0.777
greatlife	0.442	0.741	0.899	0.718	0.7
ABC LIFE	0.611	0.899	0.583	0.69	0.721
Kunlun health	0.233	0.311	0.412	0.242	0.3
hexiehealth	0.123	0.177	0.412	0.322	0.259
Zhengde-life	0.223	0.331	0.381	0.493	0.357
Xintai-life	0.918	0.871	0.729	0.789	0.827
ydthlife	0.678	0.879	0.976	0.678	0.803
Guohua-life	1	0.624	0.593	0.664	0.725
happyinsurance	0.674	0.876	0.774	0.971	0.855
Zhonghong	0.892	0.615	0.774	0.971	0.909
Jianxin life	0.598	0.483	0.724	0.956	0.751
Allianz	1	0.612	0.671	0.891	0.915
AXA life	0.998	0.899	0.876	0.889	0.916

	Technical-Efficiency（TE）				
Year	**2008**	**2009**	**2010**	**2011**	**value**
Paul in CMG	0.345	0.445	0.446	0.564	0.451
Xincheng-life	0.356	0.566	0.433	0.544	0.475
Zhongyi-life	0.822	0.363	0.506	0.714	0.601
Everybright	0.931	0.988	1	1	0.98
BOB-CARDIF Life	1	0.414	1	0.991	0.851
Haier Life	0.949	0.868	0.818	1	0.909
aviva-cofco Life	0.789	0.674	0.775	0.677	0.729
Aegon-Cnooc Life	0.791	0.581	0.604	0.788	0.691
Cignacmb Life	0.893	0.789	0.982	0.724	0.847
Prime-care Life	0.708	0.208	0.418	0.816	0.538
HengAn standard	0.831	0.882	0.412	0.421	0.636
RuiTai Life	0.412	0.124	0.451	0.542	0.382
Met Life	0.768	0.677	0.564	0.345	0.589
Cathaylife	0.911	0.672	0.768	0.912	0.816
AVIC Samsung	0.596	0.772	0.957	1	0.831
Sino-French Life	0.452	0.515	0.612	0.782	0.59
Great Eastern	0.526	0.23	0.627	0.662	0.511

Table 3-4 shows that the average technical efficiency of China's life insurance companies in 2008 to 2011 were 0.737, 0.671, 0.717 and 0.772, the average technical efficiency of the entire industry for four years was 0.723.

Further descriptive statistics: 46 samples were selected, including 27 Sino-funded insurance companies and 19 foreign-funded (joint) life insurance companies. From 2008 to 2011, the total exceeding average number was 24, 27, 22, 21, and 29. Among them, the number of Chinese capital exceeding the average is 12,16,14,16,19;The number of foreign capital exceeding the average value is 12,11,8,5,10;The minimum values from 2008 to 2011 were 0.223,

0.124, 0.381, 0.345, 0.357, and the maximum values were 1 each year.

China's life insurance companies' technology efficiency values were higher than the corresponding values of the property insurance companies. It was obvious that levels of familiarity and proficiency with business as well as work effort of practitioners of life insurance companies were higher than that of property insurance company employees. That is to say, with the same labor input, the output of a life insurance company was higher than a property insurance company. In the four years, the technical efficiency of China Life Shares, Sun Life, CPIC Life Insurance, Taikang Life, Happy Life, CCB Life Insurance, Allianz, the Dutch Life, Italian Life were the highest, above 0.9. The technical efficiency values of the Best Italian Life, Life PICC, Life Insurance Shares, were 0.980, 0.991 and 0.949. The technical efficiency values of Jiahe Life, Kunlun Health, Harmonious Health, AXA Life, CMG were 0.3, 0.259, 0.357, 0.451, 0.475, under 0.5. Obviously, it is the top priority for these insurance companies to improve their business management ability and staff proficiency.

3.3.1.5 Anaylsis of Life Insurance Companies' Pure Tech-Efficiency

Table 3-5 Life Insurances Companies' Pure Tech-Efficiency in 2008-2011

	Pure Technical-Efficiency（PTE）				
Year	**2008**	**2009**	**2010**	**2011**	**value**
PICC	1	1	1	1	1
CHINA-LIFE	0.983	0.899	0.887	0.991	0.94
Taiping-life	1	1	1	1	1
Mingsheng	0.723	0.818	0.92	0.911	0.843
Sunshine-life	0.991	0.704	0.591	0.954	0.81
Huatai-life	0.972	0.841	0.731	0.836	0.845
Xinhua-life	0.637	0.644	0.845	0.749	0.719
Taikang-life	1	0.792	0.858	1	0.915
Sino-life	0.962	1	0.833	1	0.949
unionlife	0.421	0.717	0.956	1	0.728
greatlife	0.554	0.824	0.913	0.844	0.784
ABC LIFE	0.611	0.978	0.587	0.707	0.721
Kunlun health	0.442	0.551	0.788	0.542	0.581
hexiehealth	0.413	0.421	0.543	0.643	0.505
Zhengde-life	0.543	0.543	0.543	0.584	0.553

	Pure Technical-Efficiency（PTE）				
Year	**2008**	**2009**	**2010**	**2011**	**value**
Huaxia Life	0.611	0.745	0.837	0.782	0.744
Xintai-life	0.998	0.876	0.745	0.899	0.88
ydthlife	0.899	0.987	0.999	0.981	0.966
Guohua-life	1	0.628	0.607	0.666	0.725
happyinsurance	0.781	0.988	0.892	0.987	0.912
Zhonghong	0.907	0.738	0.775	0.972	0.848
Jianxin life	0.598	0.498	0.824	0.972	0.676
Allianz	1	0.679	0.717	0.913	0.802
AXA life	1	0.991	0.995	0.992	0.994
Xincheng-life	0.893	0.744	0.655	0.677	0.742
Zhongyi-life	0.833	0.368	0.516	0.715	0.608
Everybright	0.998	1	1	1	0.999
Bob-cardif	1	0.479	1	0.994	0.868
Haier-life	0.952	0.869	0.841	1	0.915
Aviva-cofco	0.888	0.785	0.893	0.879	0.861
aegon-cnooc	0.811	0.581	0.605	0.951	0.737
cgnacmb	0.991	0.889	1	0.873	0.938
changsheng	0.992	0.892	0.782	0.887	0.888
hengan	1	0.632	0.843	0.986	0.865
Ruitai Life	0.981	0.892	0.788	0.678	0.835
METLIFE	0.789	0.456	0.613	0.873	0.683
CathayLujiazui	0.899	0.788	0.678	0.673	0.76
SSAC	0.928	0.741	0.831	0.971	0.868
SFLI	0.941	1	1	1	0.985
zhongxin	0.633	0.662	0.783	0.899	0.744
Alic	1	0.695	0.943	0.951	0.897

The average pure technical efficiency of life insurance companies in China from 2008 to 2011 is 0.718, 0.767, 0.815 and 0.874, which has been increasing year by year. The average pure technical efficiency of the whole industry in four years is 0.823.

Further descriptive statistics: the total number of samples selected was 46, including 27 foreign life insurance companies and 19 foreign (joint) life insurance companies. From 2008 to 2011, the total number of more than the average number was 33, 22, 29, 27, 25, respectively. Among them, the number of Chinese capital exceeding the average is 15, 13, 16, 14, 13; the

number of external (joint) capital exceeding the average is 18, 9, 13, 13, 12 respectively; the minimum values from 2008 to 2011 are 0.413, 0.368, 0.516, 0.542, 0.505, respectively, and the maximum mean value is 1.

The average pure technical efficiency value of life insurance companies is higher than that of property insurance companies. Thus it can be seen that the internal governance structure and management level of China's life insurance companies are better than the business proficiency level of the employees of property insurance companies. Therefore, in order to improve the overall efficiency of life insurance companies, it is more effective to improve the professional quality and proficiency level of employees in life insurance companies than to improve the internal governance structure and level of life insurance companies.

There are 46 life insurance companies in the total sample, including 27 Chinese-funded companies and 19 foreign-funded companies. The number of foreign-funded companies exceeding the mean value is relatively higher than that of Chinese-funded companies, which indicates that foreign-funded companies have higher pure technical efficiency and more perfect corporate governance structure and operation and management level.

The average pure technical efficiency values of PICC Life, PICC Health, China Life Shares, Sun Life, CPIC Life Insurance, Xinhua Life Insurance, Taikang Life, Nobuyasu Life, China Life Insurance, Allianz, Italian Life, Life in the Netherlands, Aegon-Cnooc, AVIC Samsung were high, above 0.9. Among them, the average pure efficiency values of PICC Life, PICC Health and the Italian Life were 1, 1, and 0.999, and they almost reached the forefront of pure technical efficiency. This shows that the three life Insurance companies have a good internal governance structure and excellent management team. The pure technical efficiency values of Jiahe Life, Kunlun Health, and Harmonious Health were the lowest, 0.581, 0.505 and 0.553, respectively. The low values of the pure technical efficiency were the main reason for restricting the efficiency of the three life insurance companies.

3.3.1.6 Analysis of LifeInsurance Companies' Scale-Efficiency and Return of Scale

Table 3-6 Life Insurance Companies' Scale-Efficiency and Return of Scale in 2008-2011

	2008		**2009**		**2010**		**2011**		**mean**
PICC	1	drs	0.796	drs	1	drs	1	drs	0.949
PICC-health	0.91	drs	0.871	drs	0.837	drs	0.796	drs	0.854
CHINA-LIFE	0.998	drs	1	drs	0.963	drs	1	drs	0.991
Taiping-life	0.895	drs	0.871	drs	0.748	drs	0.946	drs	0.865
Mingsheng-life	0.986	drs	0.979	drs	0.992	drs	1	drs	0.99
Sunshine-life	1	drs	1	drs	0.985	drs	1	drs	0.997
Pacific Insurance	0.979	-	0.983	-	0.876	-	0.992	-	0.958
Pingan-life	0.927	irs	1	irs	0.946	irs	0.99	irs	0.966
Huatai-life	0.999	drs	0.991	drs	0.989	drs	0.996	drs	0.994
Xinhua-life	1	irs	0.759	irs	0.835	irs	0.994	irs	0.897
Taikang-life	0.999	irs	1	irs	0.836	irs	0.979	irs	0.954
Sino-life	0.996	irs	0.994	irs	0.826	irs	0.977	irs	0.949
unionlife	0.798	irs	0.9	irs	0.985	irs	0.851	irs	0.884
greatlife	1	irs	0.92	irs	0.994	irs	0.976	irs	0.973
ABC LIFE	0.528	irs	0.565	irs	0.523	irs	0.447	irs	0.516
Kunlun health	0.298	irs	0.421	irs	0.759	irs	0.501	irs	0.495
hexiehealth	0.411	drs	0.61	drs	0.702	drs	0.845	drs	0.642
Zhengde-life	0.747	-	0.905	-	0.623	-	0.529	-	0.701
Huaxia-life	0.92	irs	0.995	irs	0.979	irs	0.878	irs	0.943
Xintai-life	0.755	irs	0.891	irs	0.977	irs	0.692	irs	0.829
ydthlife	1	drs	0.994	drs	0.977	drs	0.997	drs	0.992
Guohua-life	0.863	irs	0.887	irs	0.868	irs	0.984	irs	0.901
happyinsurance	0.984	-	0.834	-	0.999	-	0.999	-	0.954
Zhonghong	1	drs	0.97	drs	0.879	drs	0.989	drs	0.96
Jianxin life	1	irs	0.902	irs	0.936	irs	0.976	irs	0.954
Allianz	0.998	irs	0.908	irs	0.881	irs	0.897	irs	0.921
AXA life	0.498	irs	0.662	irs	0.505	irs	0.839	irs	0.626
Paul in CMG	0.399	-	0.761	-	0.662	-	0.804	-	0.657
Xincheng-life	0.987	irs	0.987	irs	0.981	irs	0.999	irs	0.989
Zhongyi-life	0.933	-	0.988	-	1	-	1	-	0.981
Everybright	1	irs	0.865	irs	1	irs	0.997	irs	0.966

	2008		2009		2010		2011		mean
Bob-cardif	0.997	irs	0.999	irs	0.973	irs	1	irs	0.993
Haier-life	0.889	irs	0.859	irs	0.868	irs	0.771	irs	0.847
Aviva-cofco	0.976	irs	1	irs	0.999	irs	0.829	irs	0.951
aegon-CNOOC	0.902	irs	0.888	irs	0.982	irs	0.83	irs	0.901
cgnacmb	0.828	irs	0.984	irs	0.86	irs	0.634	irs	0.827
changsheng	0.708	irs	0.33	irs	0.496	irs	0.828	irs	0.591
hengansl	0.848	-	0.989	-	0.523	-	0.621	-	0.746
Oldmutual	0.523	irs	0.272	irs	0.736	irs	0.621	irs	0.538
METLIFE	0.855	irs	0.86	irs	0.832	irs	0.513	irs	0.765
CathayLujiazui	0.982	irs	0.907	irs	0.925	irs	0.94	irs	0.939
SSAC	0.634	irs	0.772	irs	0.957	irs	1	irs	0.841
SFLI	0.715	irs	0.778	irs	0.782	irs	0.87	irs	0.787
zhongxin	0.526	irs	0.331	irs	0.665	irs	0.697	irs	0.555
Alic	0.97	irs	0.884	irs	0.977	irs	0.85	irs	0.921
mean	0.883	—	0.9	——	0.881	——	0.895	——	0.89

Note:SE is scale efficiency, TE=PTE*SE；"-" means "scale returns are unchanged ", "**drs**" means "scale returns decline" and "**irs**" means scale returns are increasing.

From Table 3-6, the average scale efficiency of life insurance companies in China from 2008 to 2011 is 0.883, 0.900, 0.881, 0.895, and the average scale efficiency of each life insurance company in four years is 0.890.

The average scale efficiency of Chinese life insurance companies and foreign life insurance from 2008 to 2011 is calculated respectively, and the changing trend can be seen: the average value of Chinese life insurance is 0.880,0.882,0.881, 0.893, Chinese is relatively stable from 2008 to 2010, and has increased in 2011; the average value of foreign life insurance is 0.808, 0.801, 0.830, 0.827, it can be seen that there was a slight decrease in 2009, but a significant increase in 2010.

All in all, we come to the conclusion,the overall scale efficiency of China's life insurance companies was higher than the technical efficiency and the pure technical efficiency of the same period.

The main problems restricting the efficiency of life insurance companies were the internal governance of the insurance companies and the employees' proficiency and effort. On average, 25 life insurance companies, such as PICC life, China Life, Mingsheng Life, Sunshine Life, Taibao Life, Ping An Life, and AIA Life, all achieved scale efficiencies of more than 0.9. The highest scale efficiency values were for Huatai Life, Sunshine Life and China Life, They respectively reached 0. 994, 0. 997, and 0. 991. The scale efficiency values of eight life insurance companies such as Jiahe Life, Kunlun Health, and Harmonious Health were lower than 0.7, in which Kunlun Health, Jiahe Life and Ruitai Life have the lowest scale efficiency values, which were 0.495, 0.516, and 0.538.

Further descriptive statistics: the total number of samples selected was 46, including 27 foreign life insurance companies and 19 foreign (joint) life insurance companies. From 2008 to 2011, the total number of more than the average number was 28, 23, 24, 24, 25, respectively. Among them, the number of Chinese capital exceeding the average is 18, 15, 13, 17, 16; the number of external (joint) capital exceeding the average is 10, 8, 11, 7, respectively; the minimum values from 2008 to 2011 are 0.298, 0.272, 0.496, 0.447, 0.495, respectively.

It is concluded that the minimum value of scale efficiency is increasing year by year, and the speed is fast. In 2008, the minimum value is Kunlun Health, the minimum value in 2009 is Ruitai Life, in 2010, the minimum value is Changsheng Life, and in 2011, the minimum value is Jiahe Life. The four insurers are small, but in the midst of increasing returns.

From the perspective of scale return, during the period of sample study, most insurance companies were still in the increasing stage. It can be seen that the market demand of China life insurance is large. These insurance companies with increasing returns of scale will still be expanding in the future. However, many companies such as Sinochem Life, Ying Da Life, PICC-Life, PICC-Health were in the state of diminishing. Therefore, these insurance companies should not blindly pursue the expansion of scale. Rather, they should optimize the internal governance structure of the companies, improve the quality of the employees, so that more outputs can be gained with existing inputs. They should also streamline the staff and organizations and increase the output input ratio. Hengan Standard, ZBKL, Zhengde Life, Happiness Life and many other companies have reached the stage of constant scale reward in

the four years. It can be seen that the input and output of these insurance companies were at the critical point of scale reward. This may have been the result of many factors such as market environment, corporate internal governance, and corporate culture.

3.3.2 Second stage of DEA: Empirical analysis results based on SFA

Schmidt (2002) points out that the efficiency of the enterprise is affected by both internal and external environment and random errors. Internal management is an internal variable, and the external environment and random error are exogenous variables. The traditional stage DEA model does not rule out the possibility of external environment and random error factors on the efficiency of insurance companies operating value influence. Therefore, the numerical form can not reflect the technical efficiency of each property insurance and life insurance companies, pure technical efficiency and scale efficiency. Therefore, this thesis considers to enter the second stage of the DEA model, using the SFA model to separate the environmental factors and random error factors.

Table 3-7 Analysis based on Second-Stage of SFA

	Staffs Number	Costs	Asset Input
C	-47.6514**	-25.6615	375.3516***
	-6.7207	（-0.2671）	-49.6173
enterprise nature	18.3562**	156.2561**	56.1515**
	（-7.1957）	-24.1671	（-12.7719）
the establishment of a number of years	-105.6517**	-94.1561**	-195.2515***
	-4.9142	-5.8975	-31.6194
market share	-15.5729***	-79.8185***	-234.9516***
	-25.9151	-14.9534	-53.4261
σ^2	32.9517***	127.5719***	171.3517***
	-81.9235	-67.2357	-51.6214
γ	0.6014***	0.5156***	0.7153***
	-10.2351	-9.2615	-13.1466
Log-likelihood	-342.72	-250.95	741.62
LR	20.18***	18.93***	28.16***

t statistics in parentheses:*p< 0.1, **p< 0.05, ***p< 0.01

From table 3-7, we can see that the likelihood ratio of each item in the model has passed $p < 0.05$ significance test, which indicates that there is a statistically significant relationship between the slack variables and environmental variables. Therefore, it is necessary to eliminate the influence of environmental variables based on SFA stochastic frontier analysis to study the efficiency of insurance companies. In the model, the ratio of variance to the total variance is indicated. In the second stage DEA, the gamma value of the regression analysis was more than 50%, and the significant level was 1%, which indicated that the total variance of the management has a large proportion in the total variance, and that the analysis based on SFA stochastic frontier was necessary.

From table 3-7, we can draw the following conclusions:

(1) The nature of the Enterprise. There is a positive correlation between the nature of the enterprise and the number of employees, the cost, the input relaxation variables of the asset input, and there is a significant correlation between them. The nature variable of the enterprise is set to 1 for the Chinese enterprise and 0 for the foreign enterprise, so the relaxation variable value of the three investment of the Chinese enterprise is larger than that of the foreign enterprise.

(2) The established years. Because all the data in the table are negative, and ** indicates significant, there is a negative correlation between the established years and the three input relaxation variables, which indicates that the longer the company is established, the smaller the relaxation variable value of each input element is, and the lower the waste degree of the corresponding input element is.

(3) Market share. Because all the data in the table are negative, and *** indicates highly significant, there is a negative correlation between market share and three input relaxation variables. This indicates that the larger the market share of the insurance company, the smaller the relaxation variable of the three inputs and the less the waste of the corresponding input resources. Specifically, in terms of the number of employees and cost inputs, the coefficient of market share variable was negative, which indicated that the growth of market share is beneficial to the savings of staff and cost.In terms of the amount of capital investment, the

coefficient of market share variable was negative, which shows that increasing market share can reduce the inefficient use of capital investment.

3.3.3 DEA Third Stage: Results of Empirical Analysis after Excluding Environmental Variables

1. Analysing after adjustment of Property insurancers' TE

Table 3-8 After adjustment of Property insurancers from 2008 to 2011 the status of technical efficiency

Technical-Efficiency					
	2008	**2009**	**2010**	**2011**	**mean value**
PICC	1	1	1	1	1
chinalife	0.672	0.571	0.922	1	0.792
CCIC	0.543	0.945	0.899	0.983	0.843
China Taiping	0.451	0.642	0.788	0.691	0.643
Sunshine Ins	1	1	0.988	0.912	0.975
CUPI	1	1	1	1	1
CPI	1	0.984	1	1	0.996
PingAn Propert	0.983	0.941	1	0.954	0.97
ehuatai	0.941	0.559	0.731	0.834	0.767
TiananProperty	1	1	1	1	1
STARR	0.834	0.544	0.534	0.353	0.567
SINOSAFE	0.641	0.764	0.983	0.891	0.82
YAIC	0.687	0.489	0.987	0.941	0.776
Alltrust	0.214	0.382	0.495	0.801	0.473
AAIC	0.411	0.259	0.412	0.523	0.402
Anbang	0.977	1	0.988	0.789	0.939
AnhuaAgri	0.421	1	0.412	0.511	0.586
Auto Company	0.451	0.893	0.421	0.513	0.57
SUNLIGHT INS	0.284	0.119	0.241	0.245	0.223
BOHAI INS	0.513	0.794	0.632	0.415	0.589
DUBON INS	0.852	0.766	0.521	0.567	0.677
CHIC	0.342	0.187	0.121	0.135	0.197

Technical-Efficiency					
	2008	**2009**	**2010**	**2011**	**mean value**
CAS PICC	0.511	0.512	0.613	0.643	0.57
ANCHENG	0.531	0.578	0.427	0.523	0.515
BOC INS	0.647	0.449	0.628	0.682	0.602
YING DA	0.341	0.355	0.513	0.413	0.406
Changan Property	0.782	1	0.514	0.452	0.687
gynybx	0.515	0.258	0.341	0.412	0.382
AIG	0.422	0.117	0.413	0.513	0.367
MARINE	0.445	0.217	0.516	0.553	0.433
Fengtai SH	0.234	0.358	0.541	0.565	0.425
Sun Alliance	0.213	0.131	0.325	0.513	0.296
Hillock	0.133	0.062	0.234	0.153	0.146
Sumitomo Mitsui	0.472	0.268	0.533	0.641	0.479
SAMSUNG	0.235	0.31	0.135	0.331	0.253
Allianz	0.234	0.157	0.341	0.113	0.212
Sompo Japan	0.414	0.148	0.563	0.562	0.422
Liberty	0.504	0.14	0.531	0.351	0.382
UNITA Ins	0.627	0.543	0.513	0.413	0.524
Zurich Beijing	0.149	0.042	0.141	0.452	0.196
Hyundai Ins	0.421	0.229	0.145	0.513	0.327
Aioi	0.223	0.146	0.441	0.234	0.261
Mean	0.551	0.515	0.582	0.595	0.561

Comparing the technical efficiency before and after adjustment, from Table 3-1 we know that the average technical efficiency of China property insurance companies is 0.615, 0.577, 0.664 and 0.666 from 2008 to 2011 respectively, and the overall average technical efficiency is 0.631. From Table 3-8, the adjusted average technical efficiency is 0.551, 0.515, 0.582, 0.595 from 2008 to 2011, and the overall average technical efficiency is 0.561. After the adjustment of the overall technical efficiency slightly reduced.

We can draw Table 3-9 from tables 3-1 and 3-8, Compared to before and after adjustment of the mean value technical efficiency of property insurance companies.

Table 3-9 Pre-adjested & adjested mean value Technical-Efficiency of Property Insurance

	Pre-adjusted mean value	adjusted mean value
PICC	1	1
chinalife	0.895	0.792
CCIC	0.718	0.843
China Taiping	0.647	0.643
Sunshine Ins	0.657	0.975
CUPI	0.845	1
CPI	0.948	0.996
PingAn Propert	0.853	0.97
ehuatai	0.553	0.767
TiananProperty	0.723	1
STARR	0.647	0.567
SINOSAFE	0.947	0.82
YAIC	0.774	0.776
Alltrust	0.585	0.473
AAIC	0.499	0.402
Anbang	0.996	0.939
AnhuaAgri	0.565	0.586
Auto Company	0.727	0.57
SUNLIGHT INS	0.342	0.223
BOHAI INS	0.523	0.589
DUBON INS	0.584	0.677
CHIC	0.299	0.197
CAS PICC	0.401	0.57
ANCHENG	0.42	0.515
BOC INS	0.349	0.602
YING DA	0.516	0.406
Changan Property	0.529	0.687
gynybx	0.954	0.382
generali-china	0.704	0.41
AIG	0.503	0.367
MARINE	0.861	0.433
Fengtai SH	0.739	0.425
Sun Alliance	0.489	0.296
Hillock	0.619	0.146
Sumitomo Mitsui	0.757	0.479
SAMSUNG	0.826	0.253
Allianz	0.574	0.212
Sompo Japan	0.736	0.422
Liberty	0.383	0.382
UNITA Ins	0.389	0.524
Zurich Beijing	0.218	0.196

	Pre- adjusted mean value	adjusted mean value
Hyundai Ins	0.346	0.327
Aioi	0.468	0.261

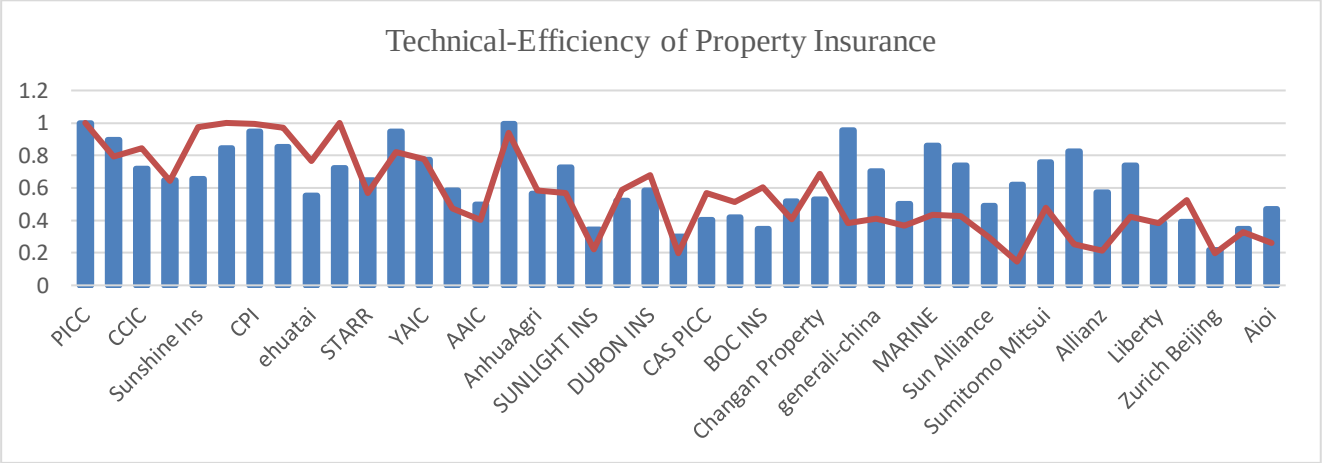

Figure 3-1 Compared to before and after adjustment of the average technical efficiency of property insurance companies

By comparing the technical efficiency of each property insurance company after adjustment by three-stage DEA method, before the adjustment of the technical efficiency of the Chinese property insurance company, the difference after the adjustment is not big, and the adjustment is slightly improved; However, the technical efficiency of foreign property insurance companies before the adjustment, after a large gap, after the adjustment of a large decline. After removing interference, the average technical efficiency of domestic property insurance companies is generally higher than that of foreign property insurance companies. This shows that the Proficiency and effort in the work of employees of domestic property insurance companies is generally higher than that of foreign property insurance companies.

The descriptive statistics of adjusted property insurance technical efficiency (TE) were further analyzed: the total number of samples selected was 46, including 27 property insurance companies and 19 foreign property insurance companies. From 2008 to 2011, the total number of property insurance companies exceeded the average number was 16, 19, 16, 17 and 20, respectively. Among them, the number of Chinese capital exceeding the average is 15, 19, 16, 16, 20; the number of external (joint) capital exceeding the average is 1, 0, 0, 0, respectively, and the minimum value from 2008 to 2011 is 0. 133, 0. 02, 0. 123, 0. 113, 0. 146, respectively,

and the maximum mean value is 1.

From the descriptive statistics, it can be seen that the gap between the minimum value and the maximum value of each property insurance technical efficiency is very large. The number of foreign property insurance companies exceeding the average value is only 1 or 0, and the number of Chinese property insurance companies exceeding the average value is much larger than that of foreign property insurance companies. It is concluded that the technical efficiency of Chinese property insurance companies is much higher than that of foreign property insurance companies, and the gap between the technical efficiency values of each property insurance company is huge. It is also proved that the proficiency and effort of the employees of domestic property insurance companies are generally higher than those of foreign property insurance companies.

2. Analysing after adjustment of Property insurancers' PTE

Table 3-10 After adjustment of Property insurancers from 2008 to 2011 the status of pure technical efficiency (PTE)

	2008	**2009**	**2010**	**2011**	**mean value**
PICC	1	1	1	1	1
chinalife	0.782	0.738	1	1	0.88
CCIC	0.925	1	1	0.977	0.976
China Taiping	0.788	0.413	0.992	0.822	0.754
Sunshine Ins	1	1	1	0.978	0.995
CUPI	1	1	1	1	1
CPI	1	0.614	1	1	0.904
PingAn Propert	1	1	1	1	1
ehuatai	1	0.563	0.872	0.924	0.84
TiananProperty	1	1	1	1	1
STARR	0.955	0.712	0.673	0.899	0.81
SINOSAFE	1	1	1	1	1
Alltrust	0.456	0.389	0.689	0.988	0.631
AAIC	0.644	0.501	0.544	0.789	0.62
Anbang	1	1	1	0.978	0.995

	2008	2009	2010	2011	mean value
AnhuaAgri	0.875	1	0.632	0.576	0.771
Auto Company	0.541	1	0.851	0.827	0.805
SUNLIGHT INS	0.421	0.143	0.451	0.532	0.387
BOHAI INS	0.642	1	0.784	0.753	0.795
DUBON INS	0.923	0.779	0.753	0.672	0.782
CHIC	0.552	0.378	0.521	0.235	0.422
CAS PICC	0.647	0.549	0.744	0.714	0.664
ANCHENG	0.672	0.712	0.572	0.748	0.676
BOC INS	0.783	0.469	0.893	0.893	0.76
YING DA	0.561	0.657	0.677	0.744	0.66
Changan Property	0.899	1	0.764	0.784	0.862
gynybx	0.673	0.374	0.551	0.782	0.595
generali-china	0.617	0.746	0.768	0.782	0.729
AIG	0.776	0.201	0.674	0.877	0.632
MARINE	0.778	0.487	0.785	0.855	0.727
Fengtai SH	0.565	0.546	0.875	0.857	0.711
Sun Alliance	0.415	0.699	0.634	0.874	0.656
Hillock	0.513	0.503	0.683	0.253	0.488
Sumitomo Mitsui	0.543	0.55	0.741	0.893	0.682
SAMSUNG	0.546	0.628	0.423	0.677	0.569
Allianz	0.455	0.678	0.566	0.421	0.53
Sompo Japan	0.554	0.464	0.689	0.874	0.646
Liberty	0.653	0.491	0.654	0.566	0.591
UNITA Ins	0.744	0.89	0.788	0.677	0.775
Zurich Beijing	0.642	0.703	0.523	0.677	0.637
Hyundai Ins	0.677	0.918	0.673	0.677	0.737
Aioi	0.934	0.862	0.571	0.671	0.76
Mean	0.748	0.7	0.768	0.797	0.753

Table 3-11 Comparison of Pre-adjested and Pre-adjested mean value of Pure Technical efficiency of each property Insurance Companies

	Pre-adjusted mean value	Adjested mean value
PICC	1	1
chinalife	0.851	0.88
CCIC	0.601	0.976
China Taiping	0.653	0.754
Sunshine Ins	0.673	0.995
CUPI	0.928	1
CPI	1	0.904
PingAn Propert	0.914	1
ehuatai	0.718	0.84
TiananProperty	0.502	1
STARR	0.718	0.81
SINOSAFE	0.993	1
YAIC	0.793	0.93
Alltrust	0.886	0.631
AAIC	0.681	0.62
Anbang	1	0.995
AnhuaAgri	0.679	0.771
Auto Company	0.818	0.805
SUNLIGHT INS	0.482	0.387
BOHAI INS	0.709	0.795
DUBON INS	0.616	0.782
CHIC	0.461	0.422
CAS PICC	0.439	0.664
ANCHENG	0.549	0.676
BOC INS	0.658	0.76
YING DA	0.665	0.66
Changan Property	0.614	0.862
gynybx	0.757	0.595
generali-china	0.743	0.729
AIG	0.478	0.632
MARINE	0.882	0.727
Fengtai SH	0.733	0.711
Sun Alliance	0.721	0.656
Hillock	0.775	0.488
Sumitomo Mitsui	0.652	0.682
SAMSUNG	0.866	0.569
Allianz	0.882	0.53
Sompo Japan	0.489	0.646

	Pre-adjusted mean value	Adjusted mean value
Liberty	0.558	0.591
UNITA Ins	0.769	0.775
Zurich Beijing	0.677	0.637
Hyundai Ins	0.921	0.737
Aioi	0.797	0.76

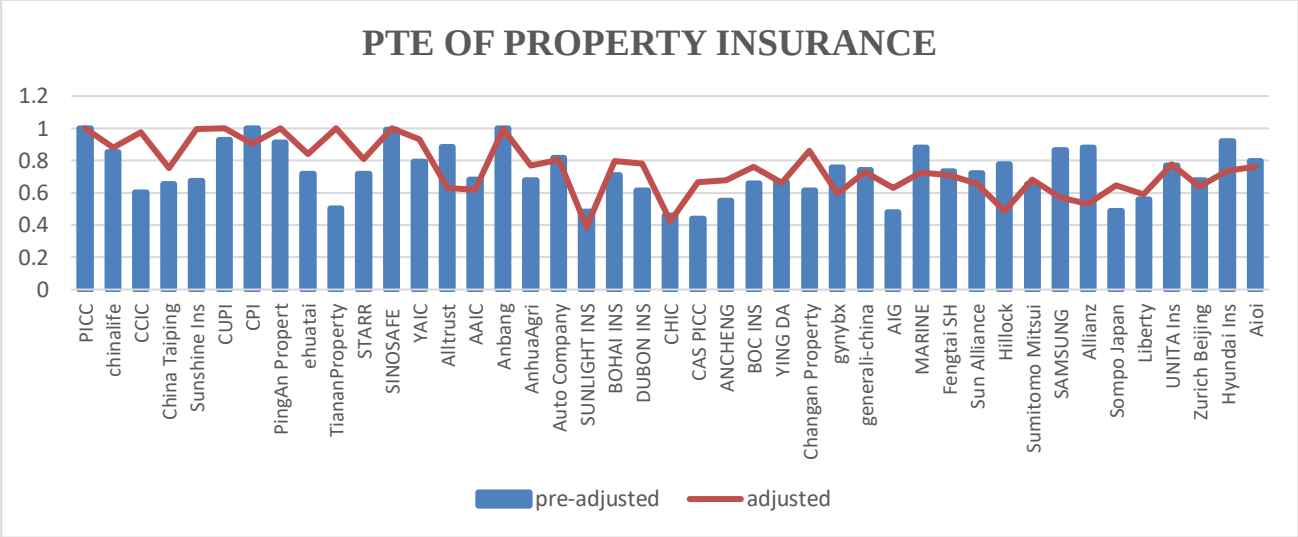

Figure 3-2 Compared to before and after adjustment of the mean value pure-technical efficiency of property insurance companies

According to the above figure, the average pure technical efficiency of each property insurance company adjusted by the three-stage DEA method property is compared. Before the adjustment of the technical efficiency of China domestic property insurance company, the difference is not big, but the adjustment is slightly improved. However, the technical efficiency of foreign insurance companies before adjustment, after the difference is not big, the adjustment curve is smoother. After removing interference terms, the average pure technical efficiency of domestic property insurance companies is generally higher than that of foreign property insurance companies. That means: the internal governance structure and management level of domestic property insurance companies are generally higher than that of foreign property insurance companies.

From Table 3-9, the adjusted average technical efficiency is 0.551, 0.515, 0.582, 0.595 from 2008 to 2011, and the overall average technical efficiency is 0.561.

From Table 3-10, the adjusted average pure technical efficiency is 0.748,0.700,0.768,0.797 from 2008 to 2011, and the overall average technical efficiency is 0.753. Therefore, it is concluded that the pure technical efficiency of property insurance companies is higher than that of technical efficiency.

From the descriptive statistics, we can see that the difference between the minimum and maximum value of the pure technical efficiency of each property insurance is not too big, and it can be seen that the pure technical efficiency of the Chinese property insurance company is slightly higher than that of the foreign property insurance company. As domestic property insurance companies gradually improve their internal governance structure and management level, Chinese property insurance companies have surpassed foreign property insurance companies in recent years.

3. Analyzing the scale efficiency of each property insurance company before and after the adjustment

Table 3-12 Changes in scale efficiency and scale returns of property insurance companies from 2008 to 2011 after excluding environmental variables

Scale -Efficiency of Property Insurance

	2008		**2009**		**2010**		**2011**		**Mean Value**
PICC	1	drs	1	drs	1	drs	1	drs	1
chinalife	0.86	drs	0.774	drs	0.922	drs	1	drs	0.889
CCIC	0.588	drs	0.945	drs	0.899	drs	1.007	drs	0.86
China Taiping	0.573	drs	1.555	drs	0.795	drs	0.841	drs	0.941
Sunshine Ins	1	drs	1	drs	0.988	drs	0.933	drs	0.981
CUPI	1	drs	1	drs	1	drs	1	drs	1
CPI	1	-	1.603	-	1	-	1	-	1.151
PingAn Propert	0.983	irs	0.941	irs	1	irs	0.954	irs	0.97
huatai	0.941	drs	0.993	drs	0.839	drs	0.903	drs	0.919

Scale -Efficiency of Property Insurance									
	2008		**2009**		**2010**		**2011**		**Mean Value**
TiananProperty	1	irs	1	irs	1	irs	1	irs	1
STARR	0.874	irs	0.765	irs	0.794	irs	0.393	irs	0.707
SINOSAFE	0.641	irs	0.764	irs	0.983	irs	0.891	irs	0.82
YAIC	0.687	irs	0.681	irs	0.987	irs	0.941	irs	0.824
Alltrust	0.47	irs	0.983	irs	0.719	irs	0.811	irs	0.746
AAIC	0.639	irs	0.517	irs	0.758	irs	0.663	irs	0.645
Anbang	0.977	irs	1	irs	0.988	irs	0.807	irs	0.943
Anhua	0.482	drs	1	drs	0.652	drs	0.888	drs	0.756
Auto Company	0.834	-	0.893	-	0.495	-	0.621	-	0.711
SUNLIGHT	0.675	irs	0.833	irs	0.535	irs	0.461	irs	0.626
BOHAI INS	0.8	irs	0.794	irs	0.807	irs	0.552	irs	0.739
DUBON INS	0.924	drs	0.984	drs	0.692	drs	0.844	drs	0.861
CHIC	0.62	irs	0.495	irs	0.233	irs	0.575	irs	0.481
CAS PICC	0.79	-	0.933	-	0.824	-	0.901	-	0.862
ANCHENG	0.791	drs	0.812	drs	0.747	drs	0.7	drs	0.763
BOC INS	0.827	irs	0.958	irs	0.704	irs	0.764	irs	0.814
YING DA	0.608	irs	0.541	irs	0.758	irs	0.556	irs	0.616
Changan Property	0.87	irs	1	irs	0.673	irs	0.577	irs	0.78
gynybx	0.766	-	0.69	-	0.619	-	0.527	-	0.651
generali-china	0.67	irs	0.348	irs	0.668	irs	0.582	irs	0.567
AIG	0.544	-	0.583	-	0.613	-	0.585	-	0.582
MARINE &NICHIDO	0.572	irs	0.446	irs	0.658	irs	0.647	irs	0.581
Fengtai Shanghai	0.415	irs	0.656	irs	0.619	irs	0.66	irs	0.588
Sun Alliance	0.514	irs	0.188	irs	0.513	irs	0.587	irs	0.451
Hillock	0.26	irs	0.124	irs	0.343	irs	0.605	irs	0.333
Sumitomo	0.87	irs	0.488	irs	0.72	irs	0.718	irs	0.699
SAMSUNG	0.431	irs	0.494	irs	0.32	irs	0.489	irs	0.434
Allianz	0.515	irs	0.232	irs	0.603	irs	0.269	irs	0.405

Scale -Efficiency of Property Insurance									
	2008		**2009**		**2010**		**2011**		**Mean Value**
Sompo Japan	0.748	-	0.319	-	0.818	-	0.644	-	0.633
Liberty	0.772	irs	0.286	irs	0.812	irs	0.621	irs	0.623
UNITA Ins	0.843	irs	0.611	irs	0.652	irs	0.611	irs	0.68
Zurich Beijing	0.233	irs	0.06	irs	0.27	irs	0.668	irs	0.308
Hyundai Ins	0.622	irs	0.25	irs	0.216	irs	0.758	irs	0.462
Aioi	0.239	irs	0.17	irs	0.773	irs	0.349	irs	0.383
Mean	0.737	irs	0.736	irs	0.758	irs	0.747	irs	0.745

Table 3-13 Compare Pre-adjested mean value with adjested mean value of Scale Efficiency of Property Insurance:

Scale Efficiency of Property Insurance		
	Pre-adjested mean value	**adjested mean value**
PICC	1	1
chinalife	0.968	0.889
CCIC	0.9	0.86
China Taiping	0.892	0.941
Sunshine Ins	0.909	0.981
CUPI	0.912	1
CPI	0.948	1.151
PingAn Propert	0.912	0.97
huatai	0.789	0.919
TiananProperty	0.962	1
STARR	0.913	0.707
SINOSAFE	0.952	0.82
YAIC	0.943	0.824
Alltrust	0.672	0.746
AAIC	0.747	0.645
Anbang	0.997	0.943
Anhua	0.846	0.756
Auto Company	0.888	0.711
SUNLIGHT	0.746	0.626
BOHAI INS	0.762	0.739

Scale Efficiency of Property Insurance		
	Pre-adjested mean value	**adjested mean value**
DUBON INS	0.779	0.861
CHIC	0.611	0.481
CAS PICC	0.917	0.862
ANCHENG	0.802	0.763
BOC INS	0.556	0.814
YING DA	0.781	0.616
Changan Property	0.834	0.78
gynybx	0.986	0.651
generali-china	0.871	0.567
AIG	0.953	0.582
MARINE &NICHIDO	0.924	0.581
Fengtai Shanghai	0.871	0.588
Sun Alliance	0.674	0.451
Hillock	0.738	0.333
Sumitomo	0.891	0.699
SAMSUNG	0.879	0.434
Allianz	0.651	0.405
Sompo Japan	0.909	0.633
Liberty	0.671	0.623
UNITA Ins	0.435	0.68
Zurich Beijing	0.327	0.308
Hyundai Ins	0.376	0.462
Aioi	0.597	0.383

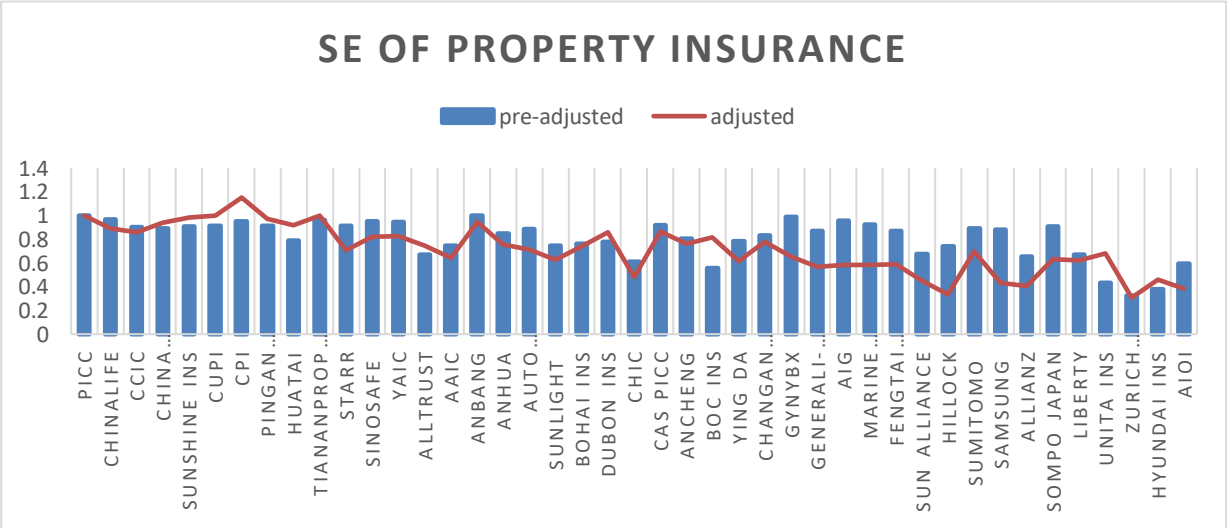

Figure 3-3 Comparison of before and after adjustment mean value scale efficiency of property insurance companies

In summary, from Table 3-13, we can see that the average scale efficiency after adjustment of property insurance is 0.737, 0.736,0.758,0.747, and the overall average technical efficiency is 0.745. It is concluded that the scale efficiency of property insurance company is slightly lower than that of pure technical efficiency. The pure technical efficiency is much higher than the technical efficiency. Therefore, the influence of property insurance company efficiency is mainly due to the technical efficiency is too low. It plays an absolute key role of improve the efficiency, which is insurance company employees' business proficiency and the degree of effort.

4. Analysis of life insurance companies' TE

Based on the 2008-2011 technical efficiency (TE) data of life insurance companies in Table 3-4, the technical efficiency data of life insurance companies in 2008-2011 were obtained after excluding environmental variables in Table 3-14.

Table 3-14 Technical efficiency of life insurance companies after adjustment from 2008 to 2011

	Technical Efficiency				
	2008	**2009**	**2010**	**2011**	**Mean**
PICC	1	0.777	0.779	0.731	0.822
PICC Health	0.892	0.783	0.678	0.978	0.833
China Life shares	0.82	0.775	0.779	0.731	0.777
TAIPING LIFE	0.234	0.463	0.484	0.724	0.477
MINSHENG LIFE	0.135	0.101	0.112	0.242	0.148
SUM LIFE	1	0.088	0.259	1	0.587
CPIC life insurance	0.825	0.638	1	1	0.866
PingAn Life	1	1	1	1	1
HuaTai Life	0.056	0.072	0.105	0.078	0.078

Technical Efficiency					
	2008	**2009**	**2010**	**2011**	**Mean**
Xinhua Life	0.637	0.972	1	0.075	0.671
Taikang Life	0.925	0.756	0.718	0.599	0.75
FUDE Sino Life	0.101	0.215	0.779	0.499	0.399
HeZhong Life	0.134	0.244	0.341	0.413	0.283
GREAT LIFE	0.034	0.566	0.046	0.091	0.185
Jiahe Life	0.134	0.223	0.241	0.314	0.228
Kunlun health	0.232	0.513	0.241	0.345	0.333
Hexie health	0.513	0.214	0.454	0.513	0.424
Zhengde life	0.425	0.324	0.423	0.432	0.401
Hua life	0.642	0.526	0.452	0.524	0.536
Xintai life	1	0.015	0.039	0.621	0.419
ydthlife	1	0.026	0.027	0.037	0.273
Kuo hua life	0.021	1	1	0.028	0.513
Happy insurance	0.026	1	0.089	0.142	0.315
Manulife	0.021	0.031	0.919	1	0.493
CCB Life	0.467	0.014	0.016	0.031	0.132
allianz	0.242	0.411	0.133	0.156	0.236
Cngold life	0.122	0.144	0.213	0.433	0.228
PICC Kanglian Life	0.886	0.737	1	1	0.906
Citic-prudential Life	0.049	0.052	0.061	0.077	0.06
Generali China	0.313	0.433	0.432	0.234	0.353
Sunlife Everbright Life	0.291	0.033	0.144	0.084	0.138

	Technical Efficiency				
	2008	**2009**	**2010**	**2011**	**Mean**
BOB-CARDIF Life	0.041	0.021	0.024	0.606	0.173
Haier Life	0.231	0.441	0.312	0.413	0.35
aviva-cofco Life	0.055	0.071	0.051	0.076	0.064
Aegon-Cnooc Life	0.338	0.451	0.536	0.145	0.368
Cignacmb Life	0.113	0.013	0.413	0.523	0.266
Prime-care Life	0.472	0.002	0.003	0.007	0.121
HengAn standard	0.034	0.133	0.134	0.516	0.205
RuiTai Life	0.526	0.672	0.422	0.413	0.509
Met Life	0.234	0.342	0.324	0.132	0.258
Cathaylife	0.013	0.011	0.014	0.012	0.013
AVIC Samsung	0.003	0.581	0.951	1	0.634
Sino-French Life	0.183	0.133	0.341	0.313	0.243
Great Eastern	0.288	0.004	0.008	0.007	0.077
AIA life	0.059	0.211	0.159	0.211	0.16
Mean	0.373	0.361	0.412	0.412	0.389

Table 3-15 Compare Pre-adjested mean value with adjested mean value of Technical Efficiency of Life Insurance

Technical-Efficiency of Life Insurance		
	Pre-adjested mean value	**adjested mean value**
PICC	0.949	0.822
China Life shares	0.991	0.777

Technical-Efficiency of Life Insurance

	Pre-adjested mean value	adjested mean value
TAIPING LIFE	0.727	0.477
MINSHENG LIFE	0.801	0.148
SUM LIFE	0.903	0.587
CPIC life insurance	0.912	0.866
PingAn Life	0.815	1
HuaTai Life	0.714	0.078
Xinhua Life	0.828	0.671
Taikang Life	0.909	0.75
FUDE Sino Life	0.777	0.399
HeZhong Life	0.7	0.283
GREAT LIFE	0.721	0.185
Jiahe Life	0.3	0.228
Kunlun health	0.259	0.333
Hexie health	0.357	0.424
Zhengde life	0.516	0.401
Xintai life	0.827	0.419
ydthlife	0.803	0.273
Kuo hua life	0.725	0.513
Happy insurance	0.855	0.315
Manulife	0.909	0.493
CCB Life	0.751	0.132
allianz	0.915	0.236
Cngold life	0.916	0.228
PICC Kanglian Life	0.451	0.906
Citic-prudential Life	0.475	0.06
Generali China	0.601	0.353
Sunlife Everbright Life	0.98	0.138
BOB-CARDIF Life	0.851	0.173
aviva-cofco Life	0.729	0.064
Aegon-Cnooc Life	0.691	0.368
Cignacmb Life	0.847	0.266
Prime-care Life	0.733	0.121
HengAn standard	0.538	0.205
Met Life	0.636	0.258

Technical-Efficiency of Life Insurance

	Pre-adjested mean value	adjested mean value
Cathaylife	0.382	0.013
AVIC Samsung	0.589	0.634
Sino-French Life	0.816	0.243
Great Eastern	0.59	0.077
AIA life	0.511	0.16

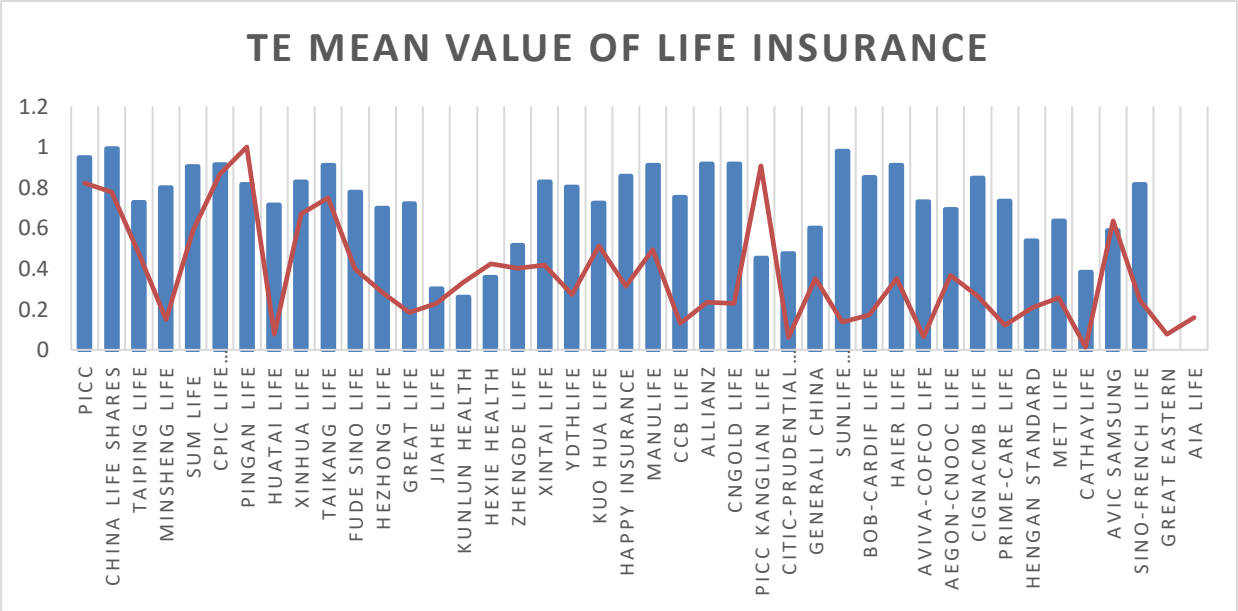

Figure 3-4 Comparison of average TE of Life Insurance companies before and after Adjustment

As we can be seen from Table 3-15 and Figure 3-4, the adjusted average technical efficiency from 2008 to 2011 is 0.373, 0.361, 0.412 and 0.412, and the overall average technical efficiency is 0.389. Compared with property insurance, the average technical efficiency of life insurance is much lower than that of property insurance and there is a significant decline after adjusting without considering environmental factors, indicating that the constraint to the efficiency of life insurance industry in China mainly lies in the business proficiency of employees (measured by TE).

Further descriptive statistics on the technical efficiency of life insurance (TE) show that the total number of samples selected by life insurance is 45, including 25 property insurance companies and 20 foreign property insurance companies. From 2008 to 2011, the total number of exceeded the average number was 17, 22, 20, 24 and 19, respectively. Among them, the

number of Chinese capital exceeding the average is 14, 12, 14, 15, 16; the number of external (joint) capital exceeding the average is 3, 10, 6, 9, 3 respectively; the minimum values from 2008 to 2011 are 0.003, 0.002, 0.003, 0.007, 0.013, respectively, and the maximum mean value is 1.

It can be seen from descriptive statistics that there is a huge gap between the minimum and maximum technical efficiency of each life insurance, and the minimum value is very small. And we can see that the technical efficiency of Chinese life insurance companies is far more than that of foreign life insurance companies. This is very different from the technical efficiency of property insurance, which shows that life insurance companies in China are more suitable for the development of local insurance industry in China, while the technical proficiency and marketization of foreign life insurance companies are much lower than those of Chinese life insurance companies.

5. Analysis of the Pure Technical Efficiency of the Life Insurance Companies after Adjustment

According to the pure technical efficiency data in Table 3-5, the pure technical efficiency data of life insurance companies from 2008 to 2011 in Table 3-16 are obtained without considering environmental variables.

Table 3-16 excluding environmental variables, life insurance companies' pure technical efficiency (PTE) 2008-2011

	Life insurance companies' PTE				
	2008	**2009**	**2010**	**2011**	**Mean Value**
PICC Health	0.988	0.889	0.788	1	0.917
China Life shares	1	1	1	1	1
TAIPING LIFE	0.304	0.476	0.487	0.748	0.504
MINSHENG LIFE	0.151	0.104	0.125	0.254	0.159
SUM LIFE	1	0.091	0.266	1	0.59

	Life insurance companies' PTE				
	2008	**2009**	**2010**	**2011**	**Mean Value**
CPIC life insurance	0.856	0.671	1	1	0.882
PingAn Life	1	1	1	1	1
HuaTai Life	0.058	0.074	0.119	0.091	0.086
Xinhua Life	0.637	1	1	0.831	0.867
Taikang Life	1	0.841	0.719	0.601	0.791
FUDE Sino Life	0.124	0.202	0.823	0.511	0.415
HeZhong Life	0.413	0.789	0.888	0.495	0.647
GREAT LIFE	0.035	0.636	0.057	0.096	0.206
Jiahe Life	0.431	0.441	0.542	0.662	0.519
Kunlun health	0.513	0.784	0.543	0.655	0.624
Hexie health	0.793	0.783	0.554	0.899	0.758
Zhengde life	0.784	0.874	0.778	0.866	0.826
Hua life	0.899	0.894	0.784	0.874	0.863
Xintai life	1	0.021	0.052	0.783	0.464
ydthlife	1	0.031	0.033	0.051	0.279
Kuo hua life	0.023	1	1	0.039	0.516
Happy insurance	0.027	1	0.097	0.153	0.32
Manulife	0.023	0.034	1	1	0.515
CCB Life	0.495	0.023	0.261	0.039	0.205
allianz	0.455	0.598	0.466	0.233	0.438
Cngold life	0.456	0.324	0.542	0.879	0.551
PICC Kanglian Life	1	1	1	1	1
Citic-prudential Life	0.051	0.053	0.071	0.089	0.066

	Life insurance companies' PTE				
	2008	**2009**	**2010**	**2011**	**Mean Value**
Generali China	0.564	0.758	0.684	0.721	0.682
Sunlife Everbright Life	0.911	0.112	0.217	0.224	0.366
BOB-CARDIF Life	0.042	0.028	0.034	0.062	0.042
Haier Life	0.345	0.513	0.783	0.892	0.634
aviva-cofco Life	0.055	0.072	0.059	0.083	0.068
Aegon-Cnooc Life	0.567	0.741	0.822	0.423	0.639
Cignacmb Life	0.433	0.067	0.563	0.673	0.434
Prime-care Life	1	0.011	0.016	0.024	0.263
HengAn standard	0.083	0.314	0.431	0.789	0.405
RuiTai Life	0.893	0.783	0.845	0.873	0.849
Met Life	0.637	0.763	0.873	0.783	0.764
Cathaylife	0.016	0.018	0.021	0.029	0.021
AVIC Samsung	0.008	1	1	1	0.752
Sino-French Life	0.782	0.413	0.782	0.789	0.692
Great Eastern	1	0.011	0.021	0.023	0.264
AIA life	0.061	0.211	0.159	0.201	0.158
Mean Vaule	0.512	0.497	0.536	0.561	0.527

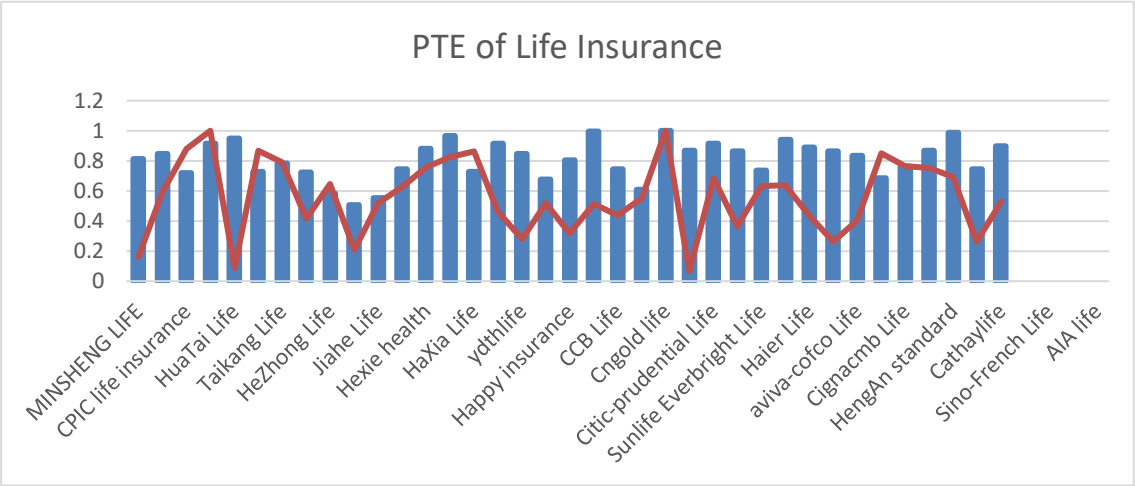

Figure 3-5 Compare with Pre-adjested and adjested life insurance companies' pure technical efficiency (PTE) 2008-2011

As can be seen from Table 3-16 and Figure 3-5, the adjusted average pure technical efficiency is 0.512, 0.497, 0.536 and 0.561, and the overall average technical efficiency is 0.527. The data after adjustment is much different from that before adjustment. Compared with property insurance, the average pure technical efficiency of life insurance is much lower than that of property insurance and there is a significant decline after adjusting without considering environmental factors, indicating that the constraint to the efficiency of life insurance industry in China mainly lies in the two aspects of internal corporate governance and comprehensive management level (measured by PTE).

Further, the descriptive statistics of pure technical efficiency (PTE) of life insurance were further conducted. The total number of samples selected for life insurance was 45, including 25 of which were from China Finance Insurance and 20 foreign (joint) capital insurance companies. From 2008 to 2011, the total exceeding average number was 23,23,26,26,22. Among them, the number of Chinese capital exceeding the average is 14,15,16,16,13;The number of foreign capital exceeding the average value is 9,8,10,10,9 respectively;The minimum values from 2008 to 2011 are 0.008, 0.011, 0.016, 0.023, 0.021 respectively, and the maximum value is 1 each year.

Therefore, the conclusion can be drawn: From descriptive statistics, it can be seen that there is a huge gap between the minimum and maximum value of the pure technical efficiency of life insurance companies, but the minimum value is very small, which indicates that in

addition to the technical proficiency of personnel and marketization degree, the internal governance and comprehensive management also restrict the development of China's life insurance industry.

As domestic property insurance companies gradually improve their internal governance structure and management level, some Chinese property insurance companies have exceeded foreign property insurance companies in recent years. The difference between the pure technical efficiency of Chinese life insurance companies and the proportion of foreign life insurance companies exceeding the average is not large, while the proportion of Chinese life insurance companies is slightly lower, indicating that Chinese life insurance companies still need to learn from foreign companies with perfect internal governance structure and high comprehensive management level.

6. Analysis of the Scale Efficiency of the Life Insurance Companies after Adjustment

Table 3-17 From 2008 to 2011 after adjustment of changes in scale efficiency and scale returns for life insurance companies

	2008		2009		2010		2011		Mean
PICC	1	drs	0.777	drs	0.779	drs	0.731	drs	0.822
PICC Health	0.903	drs	0.881	drs	0.861	drs	0.978	drs	0.906
China Life shares	0.82	drs	0.775	drs	0.779	drs	0.731	drs	0.777
TAIPING LIFE	0.77	drs	0.973	drs	0.994	drs	0.968	drs	0.927
MINSHENG LIFE	0.895	drs	0.972	drs	0.896	drs	0.953	drs	0.929
SUM LIFE	1	drs	0.968	drs	0.974	drs	1	drs	0.986
CPIC life insurance	0.964	-	0.951	-	1	-	1	-	0.979
PingAn Life	1	irs	1	irs	1	irs	1	irs	1
HuaTai Life	0.966	drs	0.973	drs	0.883	drs	0.858	drs	0.92
Xinhua Life	1	irs	0.972	irs	1	irs	0.091	irs	0.766

	2008		2009		2010		2011		Mean
Taikang Life	0.925	irs	0.899	irs	0.999	irs	0.997	irs	0.955
FUDE Sino Life	0.815	irs	1.065	irs	0.947	irs	0.977	irs	0.951
HeZhong Life	0.325	irs	0.31	irs	0.385	irs	0.835	irs	0.464
GREAT LIFE	0.972	irs	0.89	irs	0.808	irs	0.948	irs	0.905
Jiahe Life	0.311	irs	0.506	irs	0.445	irs	0.475	irs	0.435
Kunlun health	0.453	irs	0.655	irs	0.444	irs	0.527	irs	0.52
Hexie health	0.647	drs	0.274	drs	0.82	drs	0.571	drs	0.578
Zhengde life	0.543	-	0.371	-	0.544	-	0.499	-	0.49
Hua life	0.715	irs	0.589	irs	0.577	irs	0.6	irs	0.621
Xintai life	1	irs	0.715	irs	0.75	irs	0.794	irs	0.815
ydthlife	1	drs	0.839	drs	0.819	drs	0.726	drs	0.846
Kuo hua life	0.914	irs	1	irs	1	irs	0.718	irs	0.908
Happy insurance	0.963	-	1	-	0.918	-	0.929	-	0.953
Manulife	0.914	drs	0.912	drs	0.919	drs	1	drs	0.937
CCB Life	0.944	irs	0.609	irs	0.062	irs	0.795	irs	0.603
allianz	0.532	irs	0.688	irs	0.286	irs	0.67	irs	0.544
Cngold life	0.268	irs	0.445	irs	0.393	irs	0.493	irs	0.4
PICC Kanglian Life	0.886	-	0.737	-	1	-	1	-	0.906
Citic-prudential Life	0.961	irs	0.982	irs	0.86	irs	0.866	irs	0.918
Generali China	0.555	-	0.572	-	0.632	-	0.325	-	0.521
Sunlife Everbright Life	0.319	irs	0.295	irs	0.664	irs	0.375	irs	0.414
BOB-CARDIF Life	0.977	irs	0.75	irs	0.706	irs	0.775	irs	0.802
Haier Life	0.67	irs	0.86	irs	0.399	irs	0.464	irs	0.599

	2008		2009		2010		2011		Mean
aviva-cofco Life	1	irs	0.987	irs	0.865	irs	0.916	irs	0.942
Aegon-Cnooc Life	0.597	irs	0.609	irs	0.653	irs	0.343	irs	0.551
Cignacmb Life	0.261	irs	0.195	irs	0.734	irs	0.778	irs	0.492
Prime-care Life	0.472	irs	0.182	irs	0.188	irs	0.292	irs	0.284
HengAn standard	0.41	-	0.424	-	0.311	-	0.654	-	0.45
RuiTai Life	0.59	irs	0.859	irs	0.5	irs	0.474	irs	0.606
Met Life	0.368	irs	0.449	irs	0.372	irs	0.169	irs	0.34
Cathaylife	0.813	irs	0.612	irs	0.667	irs	0.414	irs	0.627
AVIC Samsung	0.375	irs	0.581	irs	0.951	irs	1	irs	0.727
Sino-French Life	0.235	irs	0.323	irs	0.437	irs	0.397	irs	0.348
Great Eastern	0.288	irs	0.364	irs	0.381	irs	0.305	irs	0.335
AIA life	0.968	irs	1	irs	1	irs	1.05	irs	1.005
mean	0.729		0.727		0.768		0.734		0.74

As can be seen from Table 3-17 above, the adjusted average scale efficiency is 0.729, 0.727, 0.768 and 0.734, and the overall average technical efficiency is 0.74. Therefore, the conclusion can be drawn: The average scale efficiency of life insurance companies is 0.74, which is slightly lower than that of property insurance companies of 0.745. Most life insurance companies are in the stage of increasing returns to scale, while joint-venture or newly established life insurance companies are in the state of diminishing returns to scale.

AppendixTable-4 is derived from the average scale efficiency before the life insurance is adjusted in Table 3-6 and the average scale efficiency after the life insurance is adjusted in Table 3-17.

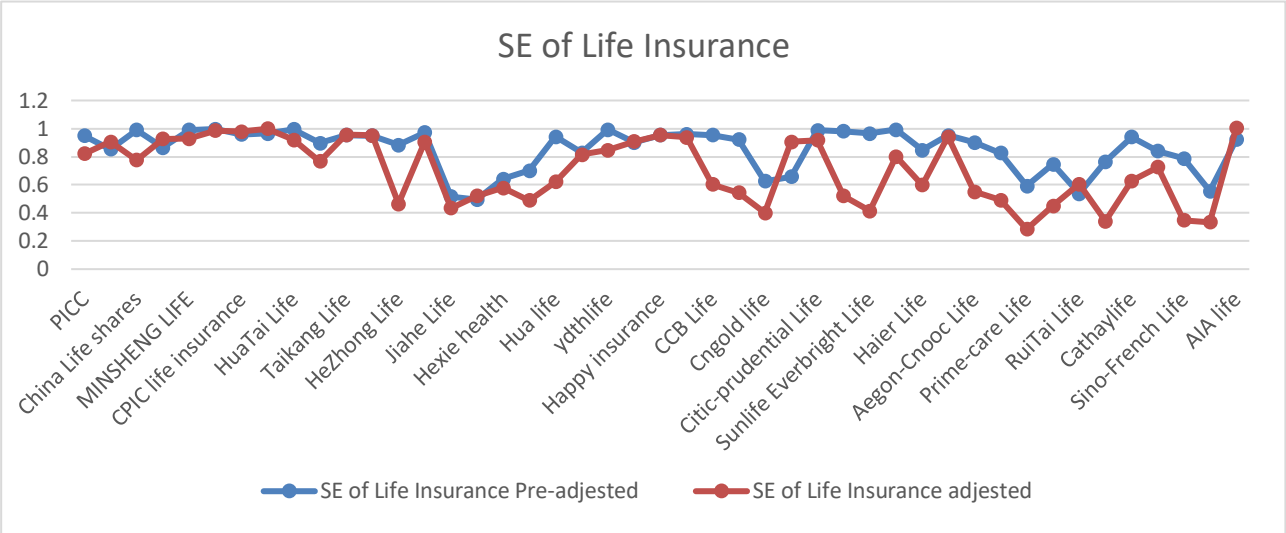

Figure 3-6 Compared to before and after adjustment of the Scal efficiency of life insurance companies

3.4 An Empirical Analysis of the Core Competence of Small and Medium-sized Insurance Enterprises by Three-stage DEA Method

Since China's accession to the WTO, the pattern of China's economic competition has been affected by globalization, and since then great changes have taken place. As foreign-funded insurance companies with strong financial strength, long history and perfect corporate governance structure gradually enter the Chinese market, the competition in China's insurance market is increasingly fierce, showing a development trend of survival of the fittest, which poses great challenges to the survival and development of China's insurance companies. Therefore, in the current white-hot competitive market environment, Chinese insurance companies need to accurately understand their position and the value they can create in the future insurance market, and find out their advantages and disadvantages compared with foreign insurance companies. Similarly, by combining economics with management, and applying statistical method to quantitatively analyze the competitiveness of China's insurance industry, we can obtain valuable research conclusions. At present, the evaluation of the competitiveness of China's insurance industry is receiving more and more attention from the academic community.

Literature on the competitiveness of the insurance industry and foreign literature: There is

no new theoretical structure, mainly the research based on the existing competitiveness research theory. Generally speaking, it is analyzed through three levels: macro, middle and micro. The representative work of the macro-level study is David Cummins' *International Analysis of Insurance Industry Competitiveness* (1999). This thesis analyzes various factors influencing the competitiveness of the insurance industry from the international macro perspective, and makes a comprehensive analysis and elaboration on the competitiveness of the insurance industry. The analysis on the medium level is to study insurance competitiveness from the perspective of the industry. Finally, the representative study of insurance companies through the micro level is Scott E. Harrington's *Solvency and Competitiveness* in 2002, which analyzed the competitiveness of insurance companies from the perspective of solvency.

China's research on insurance competitiveness is based on foreign research. It is mainly the middle and micro level analysis. The first is the middle level analysis, which studies the insurance competitiveness from the perspective of the industry and takes the industry as the research object. The second is to study the core competitiveness of insurance companies through micro level, taking the company as the research object.

The representative work on insurance competitiveness from the perspective of industry includes: Pei Guang's *A Study on the Competitiveness Of China's Insurance Industry* published in 2002, analyzing the innovation of insurance business, the innovation of regulatory system, and the innovation of mixed operation of property insurance and life insurance from the perspective of China's macro-economy and the development pattern of the world's insurance industry.

The representative works on the study of the core competitiveness of various insurance companies through micro level include: In 2002, Tang came to the conclusion that adjusting the structure of China's insurance industry and implementing the talent strategy is a key factor in improving the competitiveness of China's insurance industry. In 2002, QIAN concluded that the competitiveness of China's insurance industry can be improved through four aspects: market access ability, reputation, function and the reliable guarantee ability of insurance companies. In 2005, Xu Wenhu studied how to improve the core competitiveness of Chinese insurance companies from the perspective of maximum integrity. In 2005, Fang (2005)

published an analysis of the opening and core competitiveness of China's insurance industry, analyzing and evaluating the core competitiveness of China's insurance industry based on the international and domestic insurance industry. In 2007, LIU Maoshan concluded that the innovation of thinking ability is the core competitiveness of the insurance industry.

(I) Selection of Decision-making Units

This thesis takes insurance companies with total assets below RMB50 million as the standard for small and medium-sized insurance companies in China, including Chinese-funded, Sino-foreign joint ventures and foreign-owned small and medium-sized insurance companies, therefore this thesis selects 27 small and medium-sized property insurance companies such as Dazhong Property Insurance Company, Alltrust Property Insurance and AAIC and 11 small and medium-sized life insurance companies such as Kunlun Health, Hexie Health and AXA-Minmetals as decision-making units.

(II) Selection of Input and Output Indicators

It is very important to select input and output indicators in the three-stage DEA model analysis. The selection principles of the indicators are as follows: (1) according to the business characteristics of China's small and medium-sized insurance companies, the core competitiveness of the research objects can be analyzed and reflected; (2) the selection of input and output indicators should be representative and easy to obtain; (3) avoid selecting input and output indicators with strong linear relationship.

According to the existing literature, the most representative of the input and output indicators is to select "fixed assets" as the input indicator of capital, and select the "number of employees" as the input indicator of labor.

The selection of "premium income" is often used to measure the competitiveness of insurance companies. Based on the specific research purpose of this thesis, the annual insured gross premiums collected are selected as the measurement indicator of output. Premium income is the main income source of insurance company, reflecting the level of governance within the insurance company and the quality and quantity of services provided, as well as the market share, and as time goes by, stable premium income can be transformed into insurance company

profit gradually, which reflects the company's long-term competition ability.

The "loss ration" is often used to measure the operating capacity of an insurance company, because as an insurance company, the business is to carry out the dispersion and transfer of risks. In particular, the special nature of small and medium-sized insurance companies is to mitigate the impact of uncertain risks on people's lives, and to convert uncertain risk losses into defined expenditures. Therefore, the "loss ration" is used as the output indicator.

The "profit rate" is commonly used to measure the profitability of an insurance company, especially to measure the short-term profitability of an insurance company. This indicator is calculated as the ratio of annual net profit to total revenue. Taking the "profit-to-income ratio" as an output indicator can reflect the business objectives of small and medium-sized insurance companies in pursuit of profit maximization, and can solve the difficult problem of measuring the service quality and risk of small and medium-sized insurance companies.

(III) Data Sources and Processing

This chapter makes a horizontal comparative evaluation of the core competitiveness of China's small and medium-sized insurance companies. Therefore, a time-section data is selected for a comparative analysis of China's small and medium-sized insurance companies. The original data of insurance companies from 2008 to 2011 is from *China Insurance Yearbook from 2009 to 2012*. The sample size of the analysis was 41, including 27 small and medium property insurance companies and 14 small and medium life insurance companies. There are two input indicators and three output indicators, and the sample size is greater than the number of indicators. The decision-making units are the insurance companies of the same type, meeting the requirements of DEA model. The original data are shown in Appendix Table 1 and Table 2.

(IV) Selection of DEA Model

In this thesis, the basic model of C^2R model of the DEA method is adapted. Suppose there are n departments or decision-making units (DMUs), and each DMU has m kinds of inputs and s kinds of outputs, the input and output vectors are:

$X_j=(X_{1j},X_{2j},\ldots\ldots,X_{mj})^T>0$, $Y_j=(Y_{1j},Y_{2j},\ldots\ldots,Y_{mj})^T>0$, X_{ij}=DMU-j. For the input of the i-th

type, Y_{rj}=the output of the DMU-j to the r-th output (j=1,2,....,n; i=1,2,.....,m; r=1,2,....,s). For the sake of simplicity, we directly convert C^2R into an equivalent linear programming:

$$\boldsymbol{min\theta s.t}\sum_{j=1}^{n}\boldsymbol{y_{rj}}\lambda_j-\boldsymbol{d_r^+}=\boldsymbol{y_{rjo}}$$

$$\textbf{(r=1,…,s)} \qquad (3.1)$$

$$\sum_{j=1}^{n}\boldsymbol{x_{rj}}\ \lambda_j+\boldsymbol{d_i^-}=\boldsymbol{\theta x_{rj0}}$$

$$\textbf{(i=1,…,m)} \qquad \lambda_j\geq 0 \qquad \textbf{j=(1, n)}$$

$$\boldsymbol{d_r^+}\geq 0 \qquad \boldsymbol{d_i^-}\geq 0 \qquad (3.2)$$

If $\theta^*=1$ and $d_r^{+*}=d_r^{-*}=0$, then, unit j_0 is DEA effective; if $\theta^*=1$ and d_r^{+*} and d_r^{-*} have non-zero values, then, unit j_0 is DEA weakly effective; if $\theta^*>1$ then, unit j_0 is DEA ineffective. The θ^* value is the relative efficiency indicator calculated by DEA model. By sorting the θ^* value of DMU of small and medium-sized insurance companies, the core competitiveness of DMU is compared.

(V) Conclusion of Three-stage DEA Analysis

By analyzing the results of the relative efficiency index θ^* of the three-stage DEA, the effectiveness evaluation of 41 small and medium-sized insurance companies in China from 2008 to 2011 is shown in Appendix Table 6.

As we can be seen from Appendix Table 6 to the end of the thesis, the efficiency of five small and medium-sized insurance companies including China Life CMG., Minan Property Insurance, Yong An Property Insurance, Sinosafe Property Insurance and BOC Property Insurance is greater than 0.8, higher than other 36 small and medium-sized insurance companies. And obviously, the efficiency of small and medium-sized property insurance companies is generally higher than that of small and medium-sized life insurance companies. As can be seen from the definition, China Life CMG., Minan Property Insurance, Yong An Property Insurance, Sinosafe Property Insurance and BOC Property Insurance are at least weakly effective, while the other 36 small and medium-sized insurance companies are not weakly effective. However, by examining slack variables, it can be seen that the slack variables of China Life CMG., Minan Property Insurance, Yong An Property Insurance, Sinosafe Property Insurance and BOC

Property Insurance is 0, which shows that they are relatively efficient, indicating that these five small insurance companies are in the best state in terms of fixed assets, total number of people, premium income, and the input and output are relatively balanced.

As we can be seen from Appendix Table 6, from 2008 to 2011, the relative efficiency of DEA of 41 small and medium-sized insurance companies in China is ranked one by one. In general, among the 41 analyzed small and medium-sized insurance companies in China, five small and medium-sized insurance companies such as China Life CMG., Minan Property Insurance, Yong An Property Insurance, Sinosafe Property Insurance and BOC Property Insurance have higher operating performance while the operating performance of 36 small and medium-sized insurance companies is relatively low, indicating that the input and output efficiency of most of China's small and medium-sized insurance companies is still at a low level, and also proving that China's small and medium-sized insurance companies lack core competitiveness from another perspective.

(VI) Suggestions on Improving the Core Competitiveness of China's Small and Medium-Sized Insurance Companies

According to the statistical analysis of the DEA method in this chapter, we can know that the main reasons for the weak core competitiveness of China's small and medium-sized insurance companies are the uneven matching and the unreasonable allocation of resources of such input indicators as total number of personnel and fixed assets, such output indicators as premium income and other aspects, which leads to lower efficiency. Therefore, to improve the efficiency of China's small and medium-sized insurance companies, thereby enhancing the core competitiveness of insurance companies, the following measures are summarized:

1. Evaluate and analyze the efficiency of insurance companies. Through reasonable allocation of resources and gradual optimization of management strategies, further control of costs and expenses are important factors affecting the efficiency of insurance companies, and also the key factors for Chinese insurance companies, especially small and medium-sized enterprises, to improve their core competitiveness.

2. Through continuous improvement and perfection of solvency, Chinese insurance companies

can not only fully protect the interests of insurance company customers, but also ensure the stable operation and development of the company.

The annual premium income of an insurance company is the main source of capital, while the premium income is a liability rather than an asset. The insurance company operates risk, and the uncertainty of risk, the time of cost expenditure and other uncertainties are the operating pressure of the insurance company. An insurance company assumes insurance responsibility, so the maintenance of a certain solvency is the most important indicator that measures whether the insurance company can assure insurant rights and interests. Through the above empirical study, solvency is one of the important factors influencing efficiency of insurance companies, and the China Banking Regulatory Commission should also focus on solvency as a regulatory focus. It is recommended that while gradually easing the supervision of the insurance market, it should pay more attention to the solvency indicators of insurance companies. It should strengthen the supervision and requirement standards for insurance companies' capital adequacy ratio, financial status, profitability, solvency and operational risk, thereby improving the efficiency of insurance companies and enhancing their core competitiveness. Through the establishment of a comprehensive, reasonable and scientific index system and risk assessment model, as well as the measurement of cash flow and dynamic solvency, the model uses solvency to carry out necessary early warning, so as to study the efficiency of insurance companies and objectively evaluate the actual operation and management of insurance companies.

3. Build a Professional and Honest Team and a Learning Organization

The insurance industry is an industry that manages risks and credits. Therefore, integrity is the foundation of small and medium-sized insurance companies and also the premise and condition for the risk of decentralized operation of small and medium-sized insurance companies and their ability to survive and develop in a highly competitive environment. Small and medium-sized insurance companies should ensure the implementation of the principle of good faith from the system, increase the transparency of information disclosure of insurance companies, regularly disclose business information, timely prompt the policy-holder about the possible risks in the new insurance products, gradually standardize the agent system, and establish the agent's integrity system. Insurance companies should establish good faith and

positive public image, publicize integrity as a good brand image, and selectively carry out some social welfare activities to continuously enhance brand value and market recognition.

Building a learning organization and establishing a sound and efficient learning mechanism are the necessary conditions and basic guarantees for the core competitiveness of insurance companies.

4. Establish Excellent Corporate Culture, Perfect Reasonable Incentive Mechanism and Pay Attention to Human Resource Management

Studying the core competitiveness of insurance companies leads to the long-term, steady and sustainable development of insurance companies not only in the formal organization of human resources, but also in the corporate culture of informal organizations.

According to the empirical analysis results in this chapter, the overall competitiveness of China's insurance industry is not high. For Chinese-funded insurance companies, they should improve their operating ability and profitability in as many ways as possible on the basis of the current scale and speed. For some foreign-funded and joint-venture insurance companies, they may, in accordance with their own business strategies, implement their established business policies and routes, appropriately expand their business scale, increase their market share and realize large-scale operation. By standardizing their competitive behaviors, insurance companies can be more concerned about their long-term interests rather than short-term interests, and focus on improving operation and service quality rather than blindly carrying out price competition, so as to ultimately promote the competitiveness of China's insurance industry. Through the foregoing status quo analysis and empirical research, it is clarified the international position of China's insurance industry and the important point to improve the international competitiveness of the insurance industry.

3.5 Conclusiones and Advices

The thesis selected property insurance companies and life insurance companies as the research subjects, using the three-stage DEA model to assess the efficiency of the Chinese insurance industry in the years 2008-2011. The three-stage DEA method overcomes the

influence of environmental variables on the industry to eliminate the impact of random errors. In the initial stage, the output and input values were put into the DEA model to calculate the efficiency of property insurance companies. In the second stage, stochastic frontier analysis (SFA) was conducted to calculate the input and output values, and eliminate the influence of external environment and random error factors. In the third last stage, input and output values were again s put into the DEA model to obtain numerical efficiency and to eliminate the environmental factors and random error factors that affect the insurance industry efficiency values.

From the data analysis in this chapter, in the four years from 2008 to 2011, Chinese property insurance industry’s average technical efficiency is 0.631, pure technical efficiency is 0.766, and scale efficiency is 0.807. Chinese life insurance industry’s average technical efficiency is 0.723, pure technical efficiency is 0.820, and average scale efficiency is 0.855.

On the basis of the data, we can draw a conclusion and provide some suggestions:

1. The technical efficiency of property insurance industry is obviously lower than that of pure technical efficiency and scale efficiency in the same period.Therefore, the main problem of restricting the efficiency of China's property insurance industry lies in the staff's level of proficiency and effort (measured by technical efficiency).

   Although the average technical efficiency of China's property insurance industry is low, the gap between property insurance companies is obvious. An established company’s technical efficiency is usually higher. For example, PICC and CUPI have technical efficiency value of 1 for four consecutive years, which has reached the forefront of efficiency. The efficiency value of Taibao property Insurance and Pingan property Insurance are also close to the forefront of efficiency. This also shows that the technical proficiency of employees is positively related to the technical efficiency of insurance companies, and there is much room for improvement in the technical efficiency of some small, short operating time property insurance companies.

2. Analyzing from the angle of scale return of Chinese insurance industry, most insurance companies are still in the stage of increasing scale return, and they can adjust or improve

their scale returns to higher levels. It can be seen that the insurance market is large and those insurance companies with increasing scale returns would expand in the future. On the contrary, some foreign-funded or joint-ventured insurance companies, such as Zhong Hong Life, YING DA Life, and some newly established life and health insurance companies, such as PICC Health, are in a state of diminishing in scale returns. These insurance companies should not blindly pursue the expansion of scale, but to optimize company’s internal governance structure and improve employees’ professional quality, so as to use existing input to achieve more output. They should streamline their personnel and organizations to improve their output input ratio.

3. from the angle of scale reward of China's insurance industry, most insurance companies are still in the stage of increasing returns, but scale reward still has upside potential. It is obvious that the scale of the insurance market is large and the insurance companies with increasing returns will still be in a continuous expansion period for a period of time. In contrast, some foreign capital and joint venture insurance companies, such as Zhong Hong life, YingDa life, and some newly established life insurance and health insurance companies, such as PICC health insurance company, is in diminishing period of scale reward, indicating that these insurance companies should not blindly pursue the expansion of the scale, and should optimize the internal governance structure of the company and improve the employees' quality. In order to increase output—input ratio, we should strive to gain more output from existing inputs, or to streamline personnel and institutions.

4. Then compare the Chinese insurance industry with the foreign insurance industry.

The technical efficiency and scale efficiency of foreign property insurance companies are lower than that of Chinese insurance companies, but the pure technical efficiency of foreign property insurance companies is generally higher than that of Chinese insurance companies. But, the outside life insurance company each efficiency value difference is not big.

The empirical conclusion is that the European and American insurance industry started earlier than the Chinese insurance industry, and the European and American insurance

industry is more mature and more experienced. European and American insurance companies have set up joint venture property insurance companies in China, their management level, cost utilization ratio and human resource utilization ratio are higher than that of Chinese insurance industry. But the Chinese insurance industry started late, so pure technology efficiency is low, but China has a huge population base, the development potential of Chinese insurance industry is very great.

After foreign investment entered the Chinese insurance market, due to the differences in regulatory policies and market environment, foreign investor were very cautious. The initial scale of the joint venture insurance companies was small and the market share was low. Chinese local insurance companies are still in a clear dominant position. However, with the gradual opening of the Chinese insurance market, the scale and geographical advantages of China insurance industry have been gradually lost. Therefore, Chinese insurance companies should learn from the advanced management methods and techniques of foreign insurance companies. In improving the efficiency of pure technology, Chinese insurance companies can adapt to the fierce market competition in the gradually open market environment and maintain the leading position in the long-term, stable, and sustainable development.

Chapter 4: Analysis the influence factors of the efficiency of China's insurance companies

The purpose of the previous chapter is to clarify the production capacity of insurance companies, and then the thesis studies the factors that affect efficiency to explain why there are differences in efficiency among different companies. In this chapter, Tobit regression analysis will be carried out on the influencing factors of technology, pure technology and scale efficiency of insurance companies. The selected variables are closely related to the business situation of insurance companies, such as business channel selection index, enterprise benefit index, cost index, personnel assessment index and so on. The results of these indicators will provide reference for insurance companies to evaluate their operations and improve their operating efficiency.

4.1 Model selection-Tobit model.

In this thesis, the Tobit model is selected because the sample dependent variables show continuous distribution on the positive value. For example, most insurers have a positive market share, with some small insurers having a market share of less than 0.001. For example, a capital value of 0 is for Chinese domestic insurers.

The simplified expression of Tobit regression model:

$$y = \max(0, \hat{\beta} x_i + u_i) \qquad (4.1)$$

Using the least square method to estimate the parameters of the model with truncated data will produce deviation, and the estimation is inconsistent. Under certain assumptions, the parameters can be estimated by the maximum likelihood method.

4.2 Index Selection of Insurance Company Efficiency

The specific variables in this thesis include: the company scale, accident insurance premium income, profit earning ratio, marketing model, market share, fund usage, capital

nature, and other indicators. Based on these factors, an empirical analysis was conducted to calculate the efficiency of insurance institutions. The specific variables in the analysis are as the following:

1. Company scale

Yu (2005) found that profitability and asset scale indicators can affect China's insurance companies operating efficiency, and gain significant influence conclusion. Strong corporate capital can provide adequate resources for the development of the scale of the insurance company. The asset size (i.e. company scale) can be measured by the total assets of the insurance company. This chapter takes the natural logarithm of the assets as a relatively stable measurement index. (Liu, 2009).

2. Product mix

The characteristics of pricing cost, payment probability, and the degree of market acceptance of different insurance products are not the same. Considering that the product mix will affect the company's cost and profit, thus affect the efficiency of the operation, accident insurance premium which is relatively high in the pricing of insurance products was chosen to represent this factor.

3. Profitability

Yu（2005）used the premium margin, profit per capita, return on assets, return on investment and other indicators as the measures of the insurance company profitability. This chapter takes the profit income ratio, i.e., net profit / premium income as a measure of profitability factor, and takes the rate of return on investment, i.e., investment income / premium income as a measure of investment profitability.

4. Market concentration

The market competitive intensity has some influence on the capital allocation and competition strategy of insurance companies, thus affecting the efficiency of the company. A fierce competition market is difficult for monopoly to emerge, thereby the market concentration

is not high. At this time the company needs to improve its efficiency in order to maintain its market share.

5．Marketing model

Yao et al (2005) suggested that different marketing models will bring different agency costs for insurance companies, among which direct sales agency is the lowest. Insurance companies with lower agency costs occupy a dominant position in the competitive market environment. They can enjoy more flexible ways to sell and own more customers. This chapter will set the dummy variables (0 represents personal channels, 1 banks and other channels) to measure this factor of the marketing mode.

6. Capital nature:

Huang (2011) found that the entry of foreign capital, by changing the market capital structure, may improve the efficiency of China's insurance industry significantly, and increase the intensity of market competition. To analyze the impact of this factor, this chapter will set dummy variables (1 for foreign companies, 0 for Chinese companies) to analyze the influence of capital nature to the insurance company efficiency.

Based on the analysis conclusion of the efficiency of China’s insurance companies in the fourth chapter, this chapter using Tobit regression model to study the interaction between the above six indexes and technical efficiency, pure technical efficiency, and scale efficiency.

4.3 Analysis of Efficiency Factors of Property Insurance Companies

4.3.1 Sample data description

This chapter analyzes samples as the chapter 3 studies, extracting the relevant business and capital data of 43 property insurance companies, a total of 172 observations in the years of 2008~2011. Appendix Table-2 at the end of the thesislisted the detailed influencing indicators adopted in the process of efficiency analysis among which independent variable data came from the balance sheet and income statement of property insurance companies published in the years of 2008-2012 "China insurance Yearbook". The dependent variable data came from the

calculation results in chapter 3. The basic data of the influencing factors analysis of the sampled insurance companies in the years of 2008~2012 were listed in Appendix Table-2 at the end of the thesis. The summary of the factors affecting the property insurance companies is shown in table 4-1.

Table 4-1 Variables Summary of Influencing Factors Analysis of Property Insurance Company

Dependent variable		
ytech	technical efficiency	
yptech	pure technical efficiency	
yscale	scale efficiency	
independent variable		
X1	company size	natural logarithm of total assets
X2	product mix	accident insurance premium income
X3	Financial profitability	profit earnings ratio: net profit / premium income
X4	market concentration	market share
		company premium income / year property insurance premium income
X5	investment profitability	investment income / premium income
X6	capital nature	dummy variable
		x7=0，chinese capital；x7=1， foreign capital

4.3.2 Efficiency influence results

Use indictors in Appendix Table-2 at the end of the thesis to establish the Tobit regression model, and get the coefficients of the three regression equations, t value, P value, as shown in Table4-2.

Table 4-2 Tobit Regression Model Results of Efficiency Effect ofChina Property Insurance Company

variable		**ytech**	**Yptech**	**yscale**
X1: natural logarithm of total assets	coefficient	0.2918***	0.1265***	0.1975***
	T value	5.9808	2.7143	4.7404
	P value	0	0.0066	0
X2: accident insurance premium income	coefficient	-0.0002*	-0.0001	-0.0002**
	T value	-1.8213	-0.446	-1.974
	P value	0.0686	0.6555	0.0483
X3: net profit / premium income	coefficient	0.005	-0.0028	0.0121**
	T value	0.7517	-0.45	2.1213
	P value	0.4522	0.6527	0.0339

variable		ytech	Yptech	yscale
X4: company premium income / year life (property) insurance premium income	coefficient	1.8871	0.629	0.7347
	T value	1.616	0.9447	1.2346
	P value	0.106	0.3448	0.217
X5: investment income / premium income	coefficient	-0.0326	0.0258	-0.0353
	T value	-0.4006	0.3312	-0.5069
	P value	0.6887	0.7405	0.6122
X6: capital nature: x7=0, Chinese capital; x7=1, foreign capital	coefficient	0.2114***	0.1353***	0.0802*
	T value	4.2321	2.8349	1.8803
	P value	0	0.0046	0.0601
likelihood function value		33.2786	40.3076	57.6042

注：'*'0.1 significant level，'**'0.05 significant level，'***'0.01 significant level

According to the results of Table 4-2, we can further sort out the impact direction of the influencing indicators on the technical efficiency, pure technical efficiency and scale efficiency, which is shown in Table 4-3results.

Table 4-3 Impact Results of the Influencing Indicators on the Efficiency of the Property Insurance Companies

	ytech	yptech	Yscale
X1	Positive***	Positive ***	Positive ***
X2	Negative*	Negative	Negative **
X3	Positive	Negative	Positive **
X4	Positive	Positive	Positive
X5	Negative	Positive	Negative
X6	Positive***	Positive ***	Positive*

Through the results of tables 4-2 and 4-3, the following conclusions can be obtained:

1. The assets size has an obviously positive impact on the efficiency of Chinese property insurance companies.

   Empirical research shows that the variables of asset size have a significant positive

impact on the technical efficiency, pure technical efficiency and scale efficiency of Chinese property insurance companies. China property insurance industry in nowadays is still in the increasing scale returns at the present stage. Expanding the investment of assets can obviously improve the income and profit ratio of the industry.

2. The premium income of accident insurance has a significant negative effect on scale efficiency and a significant negative impact on technical efficiency.

Accident insurance is calculated on the basis of the probability of an accident, so the increase in accident insurance premiums means that the greaterloss rationof the property insurance company, which leads to the increase of the cost of the company and affects the efficiency.

3. Profit-income ratio has a significant positive impact on scale efficiency.

Profit-income ratio measures the balance between input cost and operating income. The companies with high profit ratio always have the increase of scale return, that is, the scale efficiency is greater.

4. The capital nature has a positive and significant relationship with the technical efficiency and pure technical efficiency of china property insurance company, and has a significant positive relationship with the scale efficiency.

Empirical research shows that foreign property insurance companies have obvious efficiency advantages compare with China property insurance companies. In the background of foreign countries paying more attention to the safety of personal private property, foreign property insurance industry is more mature than domestic ones, and the types and development of property insurance business are more perfect. In addition, foreign enterprises have more advantages than domestic enterprises, including capital, management, and resources, technology, experience and insurance theory, so they have higher technical efficiency, pure technical efficiency and scale efficiency.

4.4 Analysis of the Efficiency Influencing Factors of Life Insurance Companies

4.4.1 Sample Data Description

The relevant business and capital data from 2008 to 2011 within 53 life insurance companies, has a total of 212 samples. Appendix Table-3 at the end of the thesis lists the detailed impact indicators in the process of efficiency analysis, among which independent variable data come from the balance sheet and income statement of life insurance companies published in 2009～2012 "China insurance Yearbook", and dependent variable data come from the calculation results in the fourth chapter.

Table 4-4 Variables summary of influencing factors analysis of life insurance company

Dependent variable		
vtech	technical efficiency	
vptech	pure technical efficiency	
vscale	scale efficiency	
independent variable		
X1	company size	natural logarithm of total assets
X2	product mix	accident insurance premium income
X3	Financial profitability	profit earnings ratio: net profit / premium income
X4	innovative	marketing model dummy variable
		x4=0, individual channel based; x4=1, bank channel based
X5	market concentration	market share
		company premium income / year life insurance premium income
X6	investment profitability	investment income / premium income
X7	capital nature	dummy variable
		x7=0，chinese capital；x7=1， foreign capital

4.4.2 Efficiency influence results

Use indictors in Appendix Table-3 to establish the Tobit regression model, and get the coefficients of the three regression equations, t value, p value, as shown in Table 4-2.

Table 4-5 Tobit regression model results of efficiency effect ofChina life insurance company

Variable		Ytech	Yptech	Yscale
X1 natural logarithm of total assets	coefficient	0.0997**	0.0469	0.1182***
	T value	2.2287	0.9002	5.1596
	P value	0.0258	0.3680	0.0000
X2 accident insurance premium income	coefficient	-0.0001	-0.0001	0.00001
	T value	-0.9266	-0.9011	0.3510
	P value	0.3541	0.3675	0.7256
X3 net profit / premium income	coefficient	-0.0078	-0.0204	0.0090
	T value	-0.4823	-1.0699	1.0776
	P value	0.6296	0.2846	0.2812
X4 marketing model dummy variable：x4=0，individual channel based；x4=1，bank channel based	coefficient	0.1260	0.0909	0.0381
	T value	1.2269	0.7595	0.7245
	P value	0.2199	0.4476	0.4687
X5 company premium income / year life insurance premium income	coefficient	1.8871	2.5387*	-0.6356
	T value	1.1475	1.8971	-1.0807
	P value	0.1001	0.0578	0.2798
X6 investment income / premium income	系数	0.0036	0.0204	0.0072
	T value	0.1419	0.6806	0.5465
	P value	0.8872	0.4961	0.5847
X7 capital nature：x7=0,Chinese capital；x7=1,Foreign capital	系数	-0.1213**	-0.0842	0.0128
	T value	-2.1334	-1.2708	0.4403
	P value	0.0329	0.2038	0.6597
likelihood function value		-28.9698	-52.4794	73.2963

注：'*'0.1significant level，'**'0.05 significant level，'***'0.01 significant level

According to the results of Table 4-5, we can further sort out the impact direction of the influencing indicators on the technical efficiency, pure technical efficiency and scale efficiency, which is shown in Table 4-6 results.

Table 4-6 Impact results of the influencing indicators on the efficiency of life insurance companies

	ytech	yptech	Yscale
X1	positive**	positive	positive***

X2	negative	negative	positive
X3	negative	negative	positive
X4	positive	positive	positive
X5	positive	positive	negative
X6	positive	positive	positive
X7	negative**	negative	positive

The following conclusions can be drawn from the results of Table 4-3 and Table 4-4:

1. Asset size has significantly positive impact on the technical efficiency and scale efficiency of China's insurance companies. Empirical study shows that the larger a China's life insurance company's assets scale is, the higher technical efficiency and scale efficiency it would have, which is related to the development stage of China's life insurance industry. For the developing stage, China's insurance enterprises enjoy the advantage of increasing returns to scale. Expanding capital investment can bring higher marginal revenue for enterprises.

2. Capital nature has a significant negative impact on the technical efficiency. The empirical results show that China's life insurance companies have obvious advantages to the foreign life insurance companies in terms of technical efficiency. As analyzed, the large population has huge demand for life insurance products, and the government gives strong support to China's insurance companies. This market environment encourages China's life insurance companies to continuously update the products to meet the increasing demand for life insurance. On the other hand, China's life insurance companies have mature sales system and incentive mechanism and more sales channels with higher domestic popularity and recognition. The favorable conditions can promote the sustainable development of domestic life insurance companies.

4.5 Robustness Test

The consistency of maximum likelihood estimation in Tobit model depends on the normality and variance homogeneity of error items in its latent variable model. Hausman test is used to test whether the error items in Tobit model obey normal distribution.

The factors influencing the efficiency of property insurance and life insurance are analyzed. Stationary effect regression, random effect regression and Hausman test are used to identify the

equilibrium and unbalanced data. The test results of Y1, Y2 and Y3 of property insurance are validated by random effect model. This is the case.

The regression results are not very different from the previous Tobit regression results, and the validation is successful. See below for raw data collation, specific regression process, results and analysis conclusions.

4.5.1 STATA Regression Results of Property Insurance

For a summary of the variables in the analysis of the influencing factors of property insurance companies, see Appendix 5.

1. Y1 (technical efficiency) regression results

   By comparing the fixed effect regression results with the random effect regression results, Hausman test results, P value is 0.6903. So we should accept the original hypothesis, and chose random effects model.
2. Y2 (Pure technical efficiency) regression results

   By comparing the fixed effect regression results with the random effect regression results, Hausman test results, P value is 0.1319. So we should accept the original hypothesis, and chose random effects model.
3. Y3 (Scale efficiency) regression results

   By comparing the fixed effect regression results with the random effect regression results, Hausman test results, P value is 0.8227. So we should accept the original hypothesis, and chose random effects model.

4.5.2 Life Insurance STATA regression results

For a summary of the variables in the analysis of influencing factors of life insurance companies, see Appendix 6.

1. By calculating respectively the results of Y1 fixed effect regression and Y1 random effect regression, the fixed effect is more suitable to study the difference between samples, and the random effect is suitable to infer the overall characteristics from the sample.

The Hausman test of Y1 shows that the P value is 0.8227. Therefore, the original hypothesis is accepted and the random effect is selected.

2. By calculating respectively the results of Y1 fixed effect regression and Y1 random effect regression, the Hausman test of Y2 shows that the P value is 0.4081. Therefore, the original hypothesis is accepted and the random effect is selected.

3. By calculating respectively the results of Y1 fixed effect regression and Y1 random effect regression, the Hausman test of Y2 shows that the P value is 0.2096. Therefore, the original hypothesis is accepted and the random effect is selected.

4.5.3 Results Summary of Fixed Effect Regression Model and Random Effect Regression Model of Property Insurance and Life Insurance

I. Analysis of Factors Affecting the Efficiency of Property Insurance Companies

In this chapter, 172 samples were collected and analyses from the relevant operating and capital data of 43 property insurance companies from 2008 to 2011, which are consistent with those in Chapter 4. Appendix Table 7 lists the influence indicators adopted in the process of efficiency impact analysis in detail, among which the data of independent variables come from the balance sheets and profit statements of property insurance companies in *China Insurance Yearbook* from 2009 to 2012, and the data of dependent variables are the calculation results in Chapter 4.

By adopting the indicators in Appendix Table 7, the fixed effect regression model and the random effect regression model were respectively used for regression through STATA software. Then the HAUSMAN test was used to test the results of the two models, and the results showed that the null hypothesis was rejected, so the random effect regression model should be selected. For a summary of the results of property insurance regression, see Appendix Table 8.

The following conclusions can be drawn from the results in Appendix Table 8:

1. The asset size has a significant positive impact on the efficiency of Chinese property

insurance companies.

The empirical study shows that the variable of asset size has a significant positive impact on the technical efficiency, pure technical efficiency and scale efficiency of Chinese property insurance companies. For China's current property insurance industry is still in the stage of increasing returns to scale, expanding asset investment can significantly improve the industry's revenue and profit ratio.

2. The nature of capital has a significant positive relationship with the efficiency of property insurance companies.

The empirical study shows that foreign property insurance companies have obvious efficiency advantages over Chinese property insurance companies. Under the environment of paying more attention to the security of personal private property abroad, its property insurance industry is more mature than the domestic one, and the types and development of property insurance business are more perfect. Moreover, foreign-funded companies have more advantages than domestic ones, including capital, management, resources, technology, experience, and insurance theory, so their technical efficiency, pure technical efficiency, and scale efficiency are all higher.

II. Analysis of Factors Affecting the Efficiency of Life Insurance Companies

A total of 212 samples were collected from the relevant operating and capital data of 53 life insurance companies from 2008 to 2011. Table 4-5 lists the influence indicators adopted in the process of efficiency impact analysis in detail, among which the data of independent variables come from the balance sheets and profit statements of life insurance companies in *China Insurance Yearbook* from 2009 to 2012, and the data of dependent variables are the calculation results in Chapter 4.

By adopting the indicators in Table 4-5, the fixed effect regression model and the random effect regression model were respectively used for regression through STATA software. Then the HAUSMAN test was used to test the results of the two models, and the results showed that the null hypothesis was rejected, so the random effect regression model should be selected. The

results of all index coefficients, value t and value p of the three regression equations. Please see Appendix Table 9 for a summary of life insurance regression results. The conclusion is as follows:

1. Asset size has a significant positive impact on technical efficiency and scale efficiency.

The empirical results show that the larger the asset size of Chinese life insurance companies is, the greater their technical efficiency and scale efficiency will be, which is related to the development stage of China's life insurance industry. Most companies in the development stage enjoy the advantage of increasing returns to scale, and the increased capital input can bring higher marginal revenue for companies.

2. The nature of capital has a significant negative relationship with technical efficiency.

The empirical results show that Chinese life insurance companies have obvious advantages over foreign life insurance companies in terms of technical efficiency. It can be analyzed that China has a large population base, a high demand for life insurance products, and a large degree of support for Chinese insurance companies. This market environment encourages Chinese life insurance companies to continuously update and develop their products to meet the increasing demand for life insurance. On the other hand, life insurance companies have formed sales system and incentive mechanism, and have more sales channels, so they are better known and recognized in China. This favorable condition promotes the sustainable development of life insurance companies in China.

4.6 Conclusions

On the premise of selecting the appropriate sample size and sample interval, this chapter makes empirical analysis of the influencing factors on technical efficiency, pure technical efficiency and scale efficiency of China's life insurance and property insurance industry. This chapter has the following findings:

(1) At the present stage for China’s insurance industry, the asset size promotion will significantly increase the technical efficiency and scale efficiency of China’s life insurance and property insurance companies;

(2) Foreign companies have more advantages in property insurancebusiness efficiency and China’s companies have more advantages in the life insurance business;

(3) Higher pricing costs of accident insurance premium income have a significant negative impact on technical efficiency. This chapter gets the conclusion which can provide reference for China’s insurance companies to promote their operational efficiency and improve their operation system.

Chapter 5 Conclusion and limitaitons of the study

5.1 Conclusion

An economics study will be meaningless if it is unable to guide the practice. The 12th national five-year plan and WTO entry transition period of China’s insurance industry have ended. Many professionals within the industry have realized the extensive management pattern in the past decades did not cope well with the competition in the new generation. However, learning lessons from abroad in the recent years brought up new difficulties that are not in conformity with China’s situation.

This thesis provides some suggestions for the further development of Chinese insurance companies：

1. Efficiency analysis will help insurance companies understand the status quo of the insurance industry and provide incentives for them to improve efficiency. By quantifying the efficiency of the insurance companies, efficiency values of different companies can be compared objectively and gaps between the companies can be seen clearly. Multiple regression analysis will find the different strengths of those impacting factors on sales efficiency. The findings will help companies understand the causes for low efficiency and make improvement on sales capability.

2. The purpose of this thesis is to improve the personnel management system, to reserve and train the excellent high-end talents, to improve the talent literacy, and to establish a more scientific performance evaluation system by adjusting the management decision strategy of the insurance company. Only by helping the management of insurance companies to improve the level of comprehensive management, can the comprehensive efficiency of insurance companies be improved. At the same time, it can also provide the necessary basis for the introduction of regulatory policies.

3. In order to enhance the competitiveness of China's insurance industry, suggestions are provided operation mode from extensive to intensive type. Although the scale efficiency of the

insurance industry in our country has maintained certain advantages for the time being, with the gradual opening of the insurance market, the insurance industry in our country is facing more complicated and fierce market competition. In the past, only relying on the extensive business model of blindly expanding the scale can no longer support the long-term, stable and sustainable development of the Chinese insurance industry. The problem of the lack of efficiency of the Chinese insurance industry has become more serious. Blind expansion of investment is not only in capital. Manpower, operating expenses and other aspects cause unnecessary waste of resources, but also lead to low efficiency of resource allocation and low production output. Therefore, we should realize the goal of reform and development of China's insurance industry by promoting the efficiency of the intensive business model, more reasonable allocation of resources, more refined management, and achieve the goal of the reform and development of China's insurance industry.

5.2 Limitations of the study

As there are limitations of research abilities and sample data selection, the measurement of the efficiency of insurance institution will be not precise in this thesis. The measurement of the efficiency of insurance institutions and other financial institution is an emerging research direction. Its strong analysis and explanation ability to predict is not limited on financial institution development, but also has a great implications for the research development of enterprise management. After all, the measurement for the efficiency of financial institutions is from a professor of American business school and his team.

As China’s insurance companies have a shorter disclosed data period, start-up insurance companies are generally in a loss-making stage. Therefore, any researchers in such project are very likely getting biased results. However, this thesis recommends that other researchers and experts shall be in line with the mentality of tolerance. This is because economics studies, especially those in econometrics empirical research, need strong and rigorous proof. Sometimes it takes many years for a continuous research in order to get complete data. Exploration of research methods is always necessary, even it might end of with demonstrating that these methods are wrong.

This thesis does not simply repeat the existing research conclusion, or relying on subjective conclusions. Rather, it started with specific data collection. Following the established standards, this study used classified data and built a model for economic research and got the final general conclusion. Due to the limitation of data, the conclusion in this thesis might be biased to some extent from the reality, but the research method will be adjusted and optimized in the future to better study the real condition of China's insurance industry efficiency.

Bibliography

Adams M, Hardwick P. (2003).Claims Estimation in Life Insurance Firms: United Kingdom and New Zealand Evidence. *Risk Management*, 5(1):51-63.

Ai, C.X. (2011). Efficiency analysis of liability insurance in China based on DEA model. *Contemporary Economic Management*, 33 (2), 91-96.

Aigner, D., Lovell, C. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of econometrics*, *6*(1), 21-37.

Banker, R. D., Charnes, A., & Cooper.W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management science*, *30*(9), 1078-1092.

Barros, C. P., Barroso, N., & Borges M. R. (2005). Evaluating the efficiency and productivity of insurance companies with a Malmquist index: A case study for Portugal. *The Geneva Thesiss on Risk and Insurance-Issues and Practice*, *30*(2), 244-267.

Berger, A N, Cummins J D, Weiss M A (2000). Conglomeration versus Strategic Focus: Evidence from the Insurance Industry. *Journal of Financial Intermediation*, 9(4):323-362.

Boonyasai, T., Grace, M. F., & Skipper Jr, H. D. (1999). The effect of liberalization and deregulation on life insurer efficiency. Doctoral dissertation, Georgia State University.

Brockett, P. L., Cooper, W. W., Golden, L. L., Rousseau, J. J., & Wang, Y. (2005). Financial intermediary versus production approach to efficiency of marketing distribution systems and organizational structure of insurance companies. *Journal of Risk and Insurance*, *72*(3), 393-412.

Cao, Q. (2006). Decomposition and Analysis of Total Factor Productivity growth in China's Insurance Industry.*Audit and Economic Research,* 21, 70-73.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, *2*(6), 429-444.

Chen, L. (2005), Index Analysis of Dynamic Change of China's Insurance Efficiency. *Contemporary Economic Science*, 5, 3944.

Chen, Y. (2010), The present situation and development of supply chain management in life insurance companies. *Science and Technology Economic Market* 2010(02) 1009-3788.

Cummins (1998) Comparison of Frontier Efficiency Methods: An Application to the U.S. Life Insurance Industry. Journal of Productivity Analysis, 1998, 10(2):131-152.

Cummins, J. D., Tennyson, S., & Weiss, M. A. (1999). Consolidation and efficiency in the US life insurance industry. *Journal of Banking & Finance*, *23*(2-4), 325-357.

Cummins, J. D., Rubio-Misas, M., & Zi, H. (2004). The effect of organizational struc-ture on efficiency: Evidence from the Spanish insurance industry. *Journal of Banking and Finance*, 28 (12), 3113–3150.

Cummins, J. D., & Rubio-Misas, M. (2006). Deregulation, consolidation, and effi-ciency: Evidence from the Spanish insurance industry. *Journal of Money, Credit and Banking*, 38 (2), 323–355.

Farrell, M. (1957) The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society, 120, 253-290*

Fang, F. (2005), *An Analysis of the opening up and Competitiveness of China's Insurance Industry* [M]. 2005.

Fried, H. O., Schmidt, S. S., & Yaisawarng, S. (1999). Incorporating the operating environment into a nonparametric measure of technical efficiency. *Journal of productivity Analysis*, *12*(3), 249-267.

Fried, H. O., Lovell, C. K., Schmidt, S. S., & Yaisawarng, S. (2002). Accounting for environmental effects and statistical noise in data envelopment analysis. *Journal of productivity Analysis*, *17*(1-2), 157-174.

Gardner and Grace (1993). X-Efficiency in the US life insurance industry. Journal of Banking and Finance, 17(2-3):0-510.

Gan, Q., Hu S. (2007) Analysis on the efficiency of Life Insurance Industry and the contribution of Bank Insurance in China. *Science of Finance and Economics*, (9): 31-36.

Gardner, L. A., & Grace, M. F. (1993). X-efficiency in the US life insurance industry. *Journal of Banking & Finance*, *17*(2-3), 497-510.

Han S., Wang D. (2009) Efficiency Analysis of China's Insurance Industry: based on data from 2003 to 2007. *Insurance Research*, (6): 20-28.

Hao, L.N. (2008), "Some thoughts on the Development process, existing problems and Countermeasures of China's Insurance Industry ", *Modern economy*, 7 (1)

Hao, J. (2009), *Evaluation of the management efficiency of China's non life insurance company based on DEA model*. Tianjin University of Finance Economics.

Harvey, L. (1986) Allocative Efficiency vs. "X-Efficiency", *American Economic Review,* 2(1)

He, J., Li C. P. (2005). Empirical analysis of technical efficiency of Chinese insurance companies based on SFA method. *Journal of Xiangyang Vocational and Technical College*, 4 (4): 60.

Hong, H. (2007). *International experience in comprehensive financial management and the choice of China's model.* Tongji University.

Hou, J., Zhu, L. (2004), An empirical analysis of the non life insurance of the operating efficiency of China's insurance companies. *Nankai economic research,* 108-112.

Hu, Y., Ye, Y. (2008), An empirical study on the factors affecting the efficiency of Insurance companies in China. *Journal of Jinan (philosophy and Social Sciences Edition)*, 2008: 28-34

Huang, W. (2006), Based on SFA method empirical research on the efficiency of China insurance institutions, *Nankai economic studies*

Huang, W. (2007), An empirical study of the China insurance industry -- The analysis based on the generalized translog cost function, *Quantitative and technical economics*

Huang, W. (2008a), An empirical study on the efficiency of China insurance company risk perspective based on Stochastic Frontier Analysis, *Quantitative and technical economics*

Huang, W. (2008b), Study on total factor productivity Chinese insurance industry，*Modern*

economic science

Huang, W. (2011), The influence of foreign capital on the efficiency of China insurance industry, *financial research 3*: 72-85

Huang, W., Gong L. (2013). A Comparative study of Insurance Development in emerging Market countries: an efficiency-based Perspective. *World economy*, 2013 (7): 112-137.

Huang, W., & Eling, M. (2013). An efficiency comparison of the non-life insurance industry in the BRIC countries. *European Journal of Operational Research,* 226 (3), 577–591.

Huang X., Yu D., Yang L. (2008). Research on X efficiency of Commercial Banks in China: an empirical Analysis based on DEA three-stage Model. *Quantitative Economic, Technical and Economic Research*, 25 (7): 80-91.

Hwang, S., Tong L., K. (2006), Measuring Managerial Efficiency in Non-Life Insurance Companies: An Application of two stage data envelopment analysis. *International Journal of Management*; 23

Kao, C., & Hwang, S. N. (2014). Multi-period efficiency and Malmquist productivity index in two-stage production systems. *European Journal of Operational Research*, 232 (3), 512–521.

Li, K.C (2005), Empirical Analysis on the operating efficiency of domestic Life Insurance Company. *Insurance Research,* 37-41.

Li, X., Yun M. (2003), Efficiency Analysis of Insurance Company based on DEA method. *Modern Management Science,* 7-8.

Liang, L. C. (2010), Empirical study on the marketing performance model of life insurance company, *Chinese Economic Publishing House* (April 1, 2010) first edition

Liang, P. & Liang P. Y. (2011) Research on X-efficiency of Chinese Insurance Industry based on SFA (doctoral thesis)

Liu, L. (2010), A study on the efficiency of China's Life Insurance Industry. *People's Publishing House*: 5-15

Liu, L. (2011), Empirical study on the performance of commercial banks in China -- Based on the hypothesis of small bank advantage perspective, *Wuhan Finance Monthly*

Liu, M. (2007). Creative thinking ability and core competence of insurance enterprise. *Shanghai Insurance,* (4):9-11.

Liu, X., Yang D. (2012). An empirical analysis of the relationship between economic growth and insurance efficiency based on DEA method. *New accountant*. (6):1-3.

Liu, Y.X. (2015) An empirical analysis of the impact of the development of Internet insurance on the operating efficiency of insurance enterprises. *Insurance Research*, (9):104-116.

Liu, Z., Zhang C. (2013). An empirical study on X efficiency of Insurance companies in China: a case study of Chinese property Insurance companies. *Insurance Research*, (1): 58-67.

Lu, W. M., Wang, W. K. , & Kweh, Q. L. (2014). Intellectual capital and performance in the Chinese life insurance industry. *Omega*, 42 (1), 65–74.

Lv, X.P. (2010). Analysis of the influencing factors on the efficiency of China insurance industry, *Insurance research* 5: 3-9

Paul, F., Dev, V., Stephen, D. (2009). Market Structure and the Efficiency of European Insurance Companies: A stochastic Frontier Analysis, *KPMG Business Measurement Research Program*

Patrick N O'Farrell. (1957). Manufacturing Demand for Business Services. *Oxford Univ Press. 10.1093*

Pei, G. (2002). A study on the Competitiveness of China's Insurance Industry [M].

Ping, X.Q. (2001), *Micro economics*, Class eighteen, *Peking University Press*

Qian, H. (2002). On the cultivation of the Core Competitiveness of Chinese Insurance companies after China's entry into WTO. *Insurance Research*, (10): 9-11.

Shen, Y. (2012). *Empirical analysis on the efficiency of life insurance companies in China* [D]. Fudan University.

Shi, L., Li X.F. (2007), Analysis of Technical efficiency of Chinese property Insurance Company based on DEA method . *Insurance Research,* 2007(4):50-52.

Song, M.M. (2016). Research on operating efficiency of property Insurance companies in China-based on three-stage DEA Evaluation Model. *Journal of Insurance Vocational College*, 30 (4): 15-20.

Sun, H., Chen J. (2007), Study on the Application of DEA in the Evaluation of Operation efficiency of Life Insurance Company. *Enterprise economy*, 132-134.

Sun, Q.X., Zheng W. (2007), Chinese insurance industry from the perspective of economic social development——evaluation, problems and Prospects，*Economic Science Press*

Sun, Q. X., Zheng W. (2007), Evaluation, problems and prospects of China's Insurance Industry from the Perspective of Economic and Social Development. *Economic Science Pre*ss. 2007 Edition

Sun, Q. X., Zheng W. (2009). Insurance system and Market economy: six basic Concepts, *Insurance Research* (07): 22

Sun, Q. X. (2017). Analysis of operating efficiency of Life Insurance companies from the Perspective of rate marketization: a Comparative Analysis based on SFA and DEA. *Insurance Research*, (06): 51-60.

Sun, S.L. & Lu X.W. (2010) *Two-stage "and efficiency" DEA evaluation of Chinese property insurance companies* (doctoral thesis).

Tang, D.H. (2015). *A study on the efficiency of Chinese insurance companies*. Master thesis, East China normal University, [2]

Tang, Y.X. (2002) On Economic Globalization and the Development of Insurance Industry in mainland China. Insurance Research, (4): 4-5.

Tone K. (2001). On Returns to Scale under Weight Restrictions in Data Envelopment Analysis. *Journal of Productivity Analysis,* 16(1):31-47

Wang, J.T., Zhao L, (2010). An empirical study on the measurement and improvement of operating efficiency of property insurance industry in China. Quantitative economic, technical and economic research.03:23-45

Weiss, M. A. (1990). Productivity growth and regulation of P/L insurance: 1980–1984. *Journal of productivity analysis*, 2(1), 15-38.

Wu, Y.M., Li C. P., & He J. (2005). *Efficiency Evaluation of Chinese Insurance companies based on DEA method* (Doctoral dissertation)

Xu, J.F., &Li D.L. (2010). Research on the efficiency of Life Insurance companies: an Analysis method based on DEA Model. *Exploration of Economic problems*, (2): 179-186.

Xu, W.H. (2005). A study on the Transformation of China's Insurance Market [M].

Yao, S.J., Feng G.F., Han Z.W. (2005). An empirical Analysis of the efficiency of China's Insurance Industry. *Economic Research* 56-65

Yu, J.S. (2005). An empirical analysis on the operating performance of China property insurance companies, *Journal of Southwest University of Political Science and Law.* 7.2: 54-57

Yu, J.J. (2011).*An empirical analysis of efficiency and marketing decision of insurance companies.* Master thesis, 12

Zhang, C.H. (2011). Research on the measure of operating efficiency of China's property Insurance Company based on three stages of DEA. *Insurance Research*, 22-29.

Zhang, J.L., Hou Z.Q. (2008). Comparative study on scale efficiency Measurement of Chinese property Insurance Company based on DEA. *Statistical education*, 17-18.

Zhao, G.Q., Wu, H. (2010), Empirical Analysis of SBM efficiency in China's Insurance Industry-A modified three-stage DEA Model. *Financial Economics Research,* 72-84.

Zhao, X. (2003), Empirical analysis on market behavior and market performance of Chinese insurance companies. *Economic Review*, 118-121.

Zheng, W. (2000). Chinese Insurance Industry Development Research, *Economic Science Press*, 114

Zhu, N.J., Zhang Z.R. (2015). Measurement of operational efficiency and Analysis of influencing factors of Chinese Insurance companies based on the Perspective of Enterprise and Society. *Insurance Research*, (11): 36-46.

Zhu, M.L., Li X.P. (2012). A study on the operating efficiency of Foreign Insurance companies: an Analysis of the effect of China's entry into WTO based on unbalanced data at the corporate level. *Journal of Jiangxi University of Finance and Economics*, (1): 67-72.

Appendix

The appendix table 1 2008-2011 the Efficiency of Property Insurance Company Estimates

Year	Ins-Companies	premium	Staff number	Fixed-assets	Accident insurance premium	Disbursement of accident-insurance	loss-ratio	Fee and commission
2008	PICC	81121.64	79268	12102. 44	2177.94	899.15	0.41	8616.41
2008	ChinalifeProperty	3035. 53	16015	236. 96	133.27	30.39	0.23	621.37
2008	CCIC	5986. 33	28341	524.17	566.67	216.78	0.38	777. 36
2008	China Taiping	3260.98	8545	332. 67	161.32	67.2	0.42	487. 60
2008	Sunshine Ins	3987. 63	18222	1185. 27	247.74	122.09	0.49	464.63
2008	CUPI	16622.95	0	1542. 05	541.03	203.01	0.38	1603.53
2008	CPI	20132	33247	1973. 00	1238	545	0.44	2508
2008	PingAn Property	20419. 34	417213	1050. 74	913.4	278.47	0.3	2978.27
2008	huatai	1797.13	2881	300. 13	77.37	19.62	0.25	259.75
2008	TiananProperty	4531.41	16995	325. 27	180.04	107.75	0.6	596. 39
2008	STARR	95.71	0	113. 59	39.38	15.16	0.38	138. 27
2008	SINOSAFE	4572.19	13577	122. 22	120.18	39.98	0.33	558. 54
2008	YAIC	8007. 93	27861	238. 33	307.93	141.96	0.46	462. 53
2008	Alltrust	1410. 50	3720	84. 84	64.96	17.54	0.27	191.61
2008	AAIC	342.18	201	49. 07	6.46	2.06	0.32	32. 08
2008	Anbang	5364.44	8012	1926. 22	186.5	45.59	0.24	568. 22
2008	AnhuaAgri	1467.06	3326	75.01	16.83	16.35	0.97	53.81
2008	Auto Company	968. 53	1256	37.19	6.19	2.39	0.39	126. 85
2008	SUNLIGHT	1374.02	335	32.18	18.41	7.2	0.39	25. 75
2008	BOHAI INS	1008. 91	3288	337. 22	31.39	6.08	0.19	107.17
2008	DUBON INS	2709. 45	3613	749. 43	194.84	59.15	0.3	-431.84
2008	CHIC	78.62	450	14.22	2.95	0.22	0.07	13.31
2008	CAS PICC	527.95	2525	65.14	31.33	3.49	0.11	155. 55
2008	ANCHENG	362.94	1824	20.61	20.09	3.41	0.17	56. 50
2008	BOC INS	988. 93	1743	64. 36	47.52	4.26	0.09	198. 32
2008	YING DA	3.23	90	11.96	0.05	0	0	2. 24
2008	ChanganProperty	73.05	3124	99. 85	14.04	1.15	0.08	39. 05

Year	Ins-Companies	premium	Staff number	Fixed-assets	Accident insurance premium	Disbursement of accident-insurance	loss-ratio	Fee and commission
2008	gynybx	94.29	300	15. 92	1.72	0.03	0.02	1.05
2008	generali-china	11.63	103	7. 77	0.24	0	0	1.01
2008	AIG	483. 71	989	10.01	133.86	39.07	0.29	55. 06
2008	MARINE	377. 30	234	4.42	2.26	0.16	0.07	7.18
2008	Fengtai Shanghai	93. 37	78	4.15	0.68	0	0	11.5
2008	Sun Alliance	117.17	121	4.1	11.49	0.31	0.03	22. 44
2008	Hillock	98	132	6. 27	0.92	0	0	8. 58
2008	Sumitomo Mitsui	213.03	246	3.45	2.15	0.46	0.21	6. 24
2008	SAMSUNG	92.22	75	2.25	11.07	0.63	0.06	2.5
2008	Allianz GZ	23.97	84	1.67	4.71	0.06	0.01	14.25
2008	Sompo Japan	141.19	245	8.12	7.72	0.15	0.02	15. 05
2008	Liberty	79. 35	428	8. 99	9.68	0.76	0.08	27. 74
2008	UNITA Ins	4.81	453	2. 65	1.05	0.01	0.01	3.87
2008	Zurich Beijing	2.01	72	2.11	0.2	0	0	1.54
2008	Hyundai Ins	12.52	56	10. 35	0.59	0.01	0.02	2.71
2008	Aioi	25.32	49	1.78	0.29	0	0	0.76
2009	PICC	122990.31	78430	11732.62	2165	1070	0.49	12094.5
2009	chinalife	8213.23	6496	529.41	162.73	55.53	0.34	973.22
2009	CCIC	10618	43710	1308	543	230	0.42	1054
2009	China Taiping	4382.69	6914	337.23	136.19	63.08	0.46	412.53
2009	Sunshine Ins	8620.81	17140	1216.36	300.84	86.07	0.29	477.56
2009	CUPI	19467.43	25754	1455.97	497.22	179.02	0.36	1702.33
2009	CPI	34894	35181	1953	1109.77	556.38	0.5	-3194
2009	PingAn Propert	45452.26	530629	1153.06	1138.5	272.36	0.24	4704.42
2009	ehuatai	2832.43	3510	272.21	112.47	24.35	0.22	369.3
2009	TiananPropert y	7195.45	13914	213.72	159.78	61.15	0.38	690.14
2009	STARR	1295.2	2102	107.08	35.96	8.93	0.25	174.03
2009	MARINE	385.7	240	7.63	1.89	0	0	5.45
2009	Fengtai Shanghai	54.91	89	2.25	2.04	0.03	0.01	12.96

Year	Ins-Companies	premium	Staff number	Fixed-assets	Accident insurance premium	Disbursement of accident-insurance	loss-ratio	Fee and commission
2009	Sun Alliance	85.46	94	3.07	8.98	0.94	0.1	18.78
2009	Hillock	106.77	124	5.17	2.1	0	0	9.78
2009	Sumitomo Mitsui	421.84	311	4.71	5.83	0.49	0.08	10.76
2009	SAMSUNG	125.03	138	9.16	16.06	1.5	0.09	3.71
2009	Allianz	63.78	82	0.76	7.54	2.43	0.32	19.04
2009	Sompo Japan	241.17	299	9.6	8.02	0.87	0.11	6.51
2009	Liberty	296.13	508	15.02	16.33	3.2	0.2	57.2
2009	UNITA Ins	50.26	562	3.28	4.36	0.57	0.13	8.69
2009	Zurich Beijing	23.86	68	1.24	0.31	0.07	0.23	4.52
2009	Hyundai Ins	45.66	43	5.02	0.71	0.05	0.07	8.36
2009	Aioi	42.33	63	2.27	0.48	0	0	1.27
2010	PICC	122990.31	245429	11732.62	2288.39	855.09	0.49	12094.5
2010	chinalife	8213.23	6496	529.41	267.56	73.43	0.34	973.22
2010	CCIC	10618	43710	1308	528	221	0.42	1054
2010	China Taiping	4382.69	6914	337.23	128.01	50.22	0.46	412.53
2010	Sunshine Ins	8620.81	17140	1216.36	368.44	72.59	0.29	477.56
2010	CUPI	19467.43	25754	1455.97	529.99	155.26	0.36	1702.33
2010	CPI	34894	35181	1953	1337.73	473.76	0.5	-3194
2010	PingAn Propert	45452.26	530629	1153.06	1358.34	530.35	0.24	4704.42
2010	ehuatai	2832.43	3510	272.21	170.55	30.86	0.22	369.3
2010	TiananPropert y	7195.45	13914	213.72	180.9	47.87	0.38	690.14
2010	STARR	1295.2	2102	107.08	52.13	9.91	0.25	174.03
2010	SINOSAFE	3809.84	5213	1617.24	122.49	35.48	0.2	286.9
2010	YAIC	5238.6	12654	71.9	254.2	118.11	0.5	573.53
2010	Alltrust	3919.58	4719	94.99	202.69	64.56	0.28	405.73
2010	AAIC	605.23	353	155.19	14.18	5.07	0.29	57.53
2010	Anbang	6816.77	23979	4066.61	42.21	15.45	2.46	468.87
2010	AnhuaAgri	2155.46	6439	73.64	21.89	5.34	0.54	82.44
2010	Auto Company	2374	1283	44	63.85	5.27	0.1	199.21
2010	SUNLIGHT INS	1417.33	1507	72.02	18.93	7.55	0.4	49.3

Year	Ins-Companies	premium	Staff number	Fixed-assets	Accident insurance premium	Disbursement of accident-insurance	loss-ratio	Fee and commission
2010	BOHAI INS	944.7	3834	287.48	23.24	5.5	0.36	92.44
2010	DUBON INS	3526.51	7317	687.13	171.58	35.79	0.21	-480.56
2010	CHIC	127.97	337	11.66	11.88	0.94	0.08	20.22
2010	CAS PICC	1244.65	3433	50.64	35.24	11.59	0.33	169.28
2010	ANCHENG	1326.44	2556	56.85	29.94	8.88	0.3	150.14
2010	BOC INS	2042.49	2124	59.65	135.08	13.84	0.17	258.8
2010	YING DA	1311.15	405	53.86	6.95	0.23	0	92.91
2010	Changan Property	919.18	2015	107.27	63.54	13.06	0.09	130.04
2010	gynybx	1119.54	740	37.04	9.02	1.87	0.21	9.06
2010	generali-china	169.7	126	5.81	2.43	0.25	0	9.79
2010	AIG	686.4	913	3.53	211.81	66.71	0.25	61.76
2010	MARINE	385.7	240	7.63	1.98	0.1	0	5.45
2010	Fengtai Shanghai	54.91	89	2.25	3.9	0	0.01	12.96
2010	Sun Alliance	85.46	94	3.07	8.97	1.11	0.1	18.78
2010	Hillock	106.77	124	5.17	8.25	0.47	0	9.78
2010	Sumitomo Mitsui	421.84	311	4.71	2.41	0.46	0.08	10.76
2010	SAMSUNG	125.03	138	9.16	23.88	2.78	0.09	3.71
2010	Allianz	63.78	82	0.76	1.96	0.74	0.32	19.04
2010	Sompo Japan	241.17	299	9.6	10.64	1.54	0.11	6.51
2010	Liberty	296.13	508	15.02	16.58	4.69	0.2	57.2
2010	UNITA Ins	50.26	562	3.28	4.18	2.77	0.13	8.69
2010	Zurich Beijing	23.86	68	1.24	1.36	0.01	0.23	4.52
2010	Hyundai Ins	45.66	43	5.02	0.51	0.02	0.07	8.36
2010	Aioi	42.33	63	2.27	0.77	0.1	0	1.27
2011	PICC	133133.68	240226	12718.42	2717.08	790.39	0.49	12094.5
2011	chinalife	12507.63	7874	577.35	345.31	95.38	0.34	973.22
2011	CCIC	13717	44829	1391	697.18	239.61	0.42	1054
2011	China Taiping	4855.36	7181	347.24	165.5	54.61	0.46	412.53
2011	Sunshine Ins	11078.72	23759	1793.92	383.6	82.15	0.29	477.56
2011	CUPI	19467.43	27749	1455.97	628.08	154.71	0.36	1702.33
2011	CPI	46486	39846	2292	1507.35	524.89	0.5	-3194

Year	Ins-Companies	premium	Staff number	Fixed-assets	Accident insurance premium	Disbursement of accident-insurance	loss-ratio	Fee and commission
2011	PingAn Propert	63318.98	576592	2614.1	1724.47	476.46	0.24	4704.42
2011	ehuatai	1583.74	4485	445.73	229.26	36.86	0.22	369.3
2011	TiananPropert y	5604.39	13816	170.78	167.91	51.62	0.38	690.14
2011	STARR	1450.29	2005	104.57	43.68	12.39	0.25	174.03
2011	SINOSAFE	4612.88	5666	815.05	216.6	43.62	0.2	286.9
2011	YAIC	5625.46	31063	87.93	307.31	111.34	0.5	573.53
2011	Alltrust	3921.78	5330	86.85	171.99	115.87	0.28	405.73
2011	AAIC	613.29	295	186.84	14.28	6.07	0.29	57.53
2011	Anbang	7230	11389	5193.4	0.29	#N/A	2.46	468.87
2011	AnhuaAgri	2125.17	7074	76.36	16.57	5.47	0.54	82.44
2011	Auto Company	3224.29	1377	366.35	24.54	3.78	0.1	199.21
2011	SUNLIGHT INS	1528.47	2185	82.18	24.54	7.32	0.4	49.3
2011	BOHAI INS	1280.23	3336	277.29	36.66	4.48	0.36	92.44
2011	DUBON INS	3238.56	7090	632.6	148.75	40.59	0.21	-480.56
2011	CHIC	166.42	445	11.26	7.45	2.24	0.08	20.22
2011	CAS PICC	1550.9	4335	41.9	42.84	10.15	0.33	169.28
2011	ANCHENG	1686.35	2811	47.72	66.62	10.42	0.3	150.14
2011	BOC INS	2180.42	2505	748.84	264.23	28.25	0.17	258.8
2011	YING DA	2216.04	1963	73.36	32.97	4.13	0	92.91
2011	Changan Property	1214.43	2894	112.17	67.17	13.19	0.09	130.04
2011	gynybx	1350.66	910	53.52	18.63	4.83	0.21	9.06
2011	generali-china	168.4	131	5.09	1.92	1.08	0	9.79
2011	AIG	754.75	872	3	274	79	0.25	61.76
2011	MARINE	450.14	272	7.47	0.28	0.34	0	5.45
2011	Fengtai Shanghai	82.56	99	1.9	0.84	0.48	0.01	12.96
2011	Sun Alliance	91.45	88	1.95	12.97	1.33	0.1	18.78
2011	Hillock	129.23	125	4.07	42.33	3.51	0	9.78
2011	Sumitomo Mitsui	583.31	332	5.29	3.49	0.75	0.08	10.76
2011	SAMSUNG	134.23	192	10.01	27.81	4.04	0.09	3.71
2011	Allianz	97.54	125	2.71	3.67	1.46	0.32	19.04

Year	Ins-Companies	premium	Staff number	Fixed-assets	Accident insurance premium	Disbursement of accident-insurance	loss-ratio	Fee and commission
2011	Sompo Japan	311.14	294	11.96	9.22	3.19	0.11	6.51
2011	Liberty	419.49	753	21.8	19.87	7.72	0.2	57.2
2011	UNITA Ins	111.17	301	9.57	4.65	2.51	0.13	8.69
2011	Zurich Beijing	74.57	74	0.54	2	0.32	0.23	4.52
2011	Hyundai Ins	52.79	45	2.81	2.22	0.04	0.07	8.36
2011	Aioi	48.77	91	3.17	1.68	0.02	0	1.27

Appendix Table-2 basic data for calculating the efficiency of life insurance companies from 2008 to 2011

Year	insurance companies' name	total number of staff	fixed assets	fees total premium and commission	commission received for the whole year
2008	PICC	111105	147. 36	1130. 99	28697. 63
2008	chinalife	13880	232. 50	377. 07	13651. 30
2008	CCIC	818241	16272. 00	24200. 00	294939
2008	China Taiping	63374	2214. 50	1869.81	18768.61
2008	Sunshine Ins	62614	425.58	824.5	6217. 50
2008	CUPI	1918	51.88	93.76	2777. 32
2008	CPI	263619	2203. 00	4739	64005
2008	PingAn Propert	16893	5228. 63	11799.48	100145. 24
2008	ehuatai	14286	25. 40	164.58	2679. 93
2008	TiananProperty	219512	2246. 93	4196.81	55683.94
2008	STARR	399200	616. 92	3861.12	57567. 55
2008	SINOSAFE	27861	238. 33	462. 53	8007. 93
2008	YAIC	58975	481. 85	776. 64	5507. 65
2008	Alltrust	16599	31.21	252. 77	1689. 77
2008	AAIC	22872	101.59	377. 77	2822.83
2008	Anbang	59	7. 57	1.28	16. 20
2008	AnhuaAgri	426	4.78	22. 16	239.85

Year	insurance companies' name	total number of staff	fixed assets	fees total premium and commission	commission received for the whole year
2008	Auto Company	6289	10. 82	51. 49	1863. 58
2008	SUNLIGHT INS	24457	33. 36	217. 44	1936. 08
2008	BOHAI INS	1670	29.13	140. 10	1288.72
2008	DUBON INS	500	67.29	38.01	2147.98
2008	CHIC	898	18.91	42. 51	889. 27
2008	CAS PICC	1335	44. 87	30. 84	1030.59
2008	ANCHENG	917	44. 59	259. 86	1006. 63
2008	BOC INS	3062	12.81	96. 40	1043. 70
2008	YING DA	1628	23. 85	158. 03	2399.04
2008	ChanganProperty	3809	9. 04	37. 46	566. 49
2008	gynybx	378	0. 67	8.21	153. 64
2008	generali-china	17247	31.3	479. 35	3651. 62
2008	AIG	8766	286. 59	153. 03	1952.8
2008	MARINE	263	29.11	112. 79	1443. 72
2008	Fengtai Shanghai	580	27. 33	153. 82	1819. 73
2008	Sun Alliance	1026	24.92	83. 36	415. 38
2008	Hillock	8330	51.75	424. 03	3925.97
2008	Sumitomo Mitsui	942	29.23	163. 48	1546. 59
2008	SAMSUNG	1647	9. 50	140. 73	1545.07
2008	Allianz	767	4.79	15.02	162.22
2008	Sompo Japan	5678	51.12	151. 16	2025.02
2008	Liberty	212	9.1	22. 45	362. 45
2008	UNITA Ins	1346	20. 23	204. 39	1582.8
2008	Zurich Beijing	3038	41.26	63. 24	592. 26
2008	Hyundai Ins	600	3. 94	17.13	117. 62
2008	Aioi	537	12.46	33.81	1008. 43

Year	insurance companies' name	total number of staff	fixed assets	fees total premium and commission	commission received for the whole year
2008	New Oriental in China	1930	7.26	17. 07	106. 24
2008	AIG	28358	59.75	279.48	86.61
2009	PICC	22847	202.59	2528.87	52202.97
2009	chinalife	121	224.36	328.37	5903.46
2009	CCIC	818241	13511	22936	275077
2009	China Taiping	79696	1688.77	2475.77	22370.24
2009	Sunshine Ins	4542	420.02	867.81	4678.14
2009	CUPI	35428	84.12	273.14	3160.88
2009	CPI	263619	2768	-5633	59058
2009	PingAn Propert	16893	4887.76	7049.2	71319.89
2009	ehuatai	21596	25.91	168.91	2454.09
2009	TiananProperty	263991	2736	-5450.33	64997.57
2009	STARR	347138	845.55	4342.59	66629.81
2009	SINOSAFE	35944	273.02	532.26	6954.84
2009	YAIC	37967	473.9	534.16	4982.48
2009	Alltrust	1780	26.63	117.14	1512.12
2009	AAIC	14505	93.07	213.33	-671.22
2009	Anbang	139	5.52	4.71	84.28
2009	AnhuaAgri	260	3.55	0.38	27.92
2009	Auto Company	848	9.44	104.75	544
2009	SUNLIGHT INS	33277	33.1	420.68	2713.23
2009	BOHAI INS	15381	33.21	174.18	789.31
2009	DUBON INS	4753	69.55	52.76	763.06
2009	CHIC	4865	104.01	157.95	3793.34
2009	CAS PICC	2253	60.52	218.08	3477.06
2009	ANCHENG	1011	34.55	277.54	1632.61
2009	BOC INS	491	10.41	65	614.54
2009	YING DA	1344	17.16	172.47	1128.84
2009	ChanganProperty	2432	10.13	35.67	473.56

Year	insurance companies' name	total number of staff	fixed assets	fees total premium and commission	commission received for the whole year
2009	gynybx	412	0.47	4.7	83.2
2009	generali-china	13702	25	263.84	2250.44
2009	AIG	7355	278	208	4325
2009	MARINE	3241	24.47	117.81	1462.08
2009	Fengtai Shanghai	653	20.62	98.11	562.36
2009	Sun Alliance	3464	23.06	66.88	449.6
2009	Hillock	1241	46.19	332.42	3078.2
2009	Sumitomo Mitsui	2381	25.83	204.52	984.99
2009	SAMSUNG	1204	19.98	151.15	730.93
2009	Allianz	1061	4.4	10.12	40.48
2009	Sompo Japan	4326	44.24	174.16	1445.1
2009	Liberty	285	7.89	26.52	515.7
2009	UNITA Ins	1290	23.32	158.15	2035.68
2009	Zurich Beijing	3228	35.47	49.08	225.3
2009	Hyundai Ins	464	4.84	26.93	221.76
2009	Aioi	866	9.11	28.04	439.31
2009	New Oriental in China	1737	6.38	17.87	158.71
2009	AIG	28059	98.65	660.19	7970.18
2010	PICC	184526	1332.92	3161.3	72127.3
2010	chinalife	4472	206.01	130.76	2863.38
2010	CCIC	103220	16498	27256	318228
2010	China Taiping	71136	1649.07	2946.1	32293.47
2010	Sunshine Ins	53118	406.73	911.36	7933.48
2010	CUPI	63985	148.86	894.61	14075.88
2010	CPI	38667	2373	-7010	87873.33
2010	PingAn Propert	16893	3923	8273.35	92645.01
2010	ehuatai	2906	26.93	301.56	5133.22

Year	insurance companies' name	total number of staff	fixed assets	fees total premium and commission	commission received for the whole year
2010	TiananProperty	242837	2531.72	-7182.19	91679.08
2010	STARR	285582	1177.9	4663.74	65459.7
2010	SINOSAFE	88858	1067.41	1265.52	14527.22
2010	YAIC	38564	451.81	625.89	7026.33
2010	Alltrust	13129	107.53	191.15	2512.6
2010	AAIC	21455	89.84	217.11	3171.55
2010	Anbang	367	4.69	9.77	203.6
2010	AnhuaAgri	190	3.96	0.32	2.79
2010	Auto Company	2922	8.71	116.07	424.6
2010	SUNLIGHT INS	23212	30.2	442.65	2904.22
2010	BOHAI INS	10768	27.43	212.44	2090.78
2010	DUBON INS	3793	72.66	59.58	175.52
2010	CHIC	2994	504.4	147.15	3919.21
2010	CAS PICC	28855	60.08	386.5	4491.44
2010	ANCHENG	1179	28.46	288.24	1986.56
2010	BOC INS	486	9.49	82.12	708.02
2010	YING DA	1152	13.47	143.67	945.97
2010	ChanganProperty	2212	11.15	55.47	757.98
2010	gynybx	329	4.2	7.5	124.6
2010	generali-china	12895	19.13	324.38	3702.54
2010	AIG	8100	586.36	219.88	5712.35
2010	MARINE	1838	34.59	162.33	3941.85
2010	Fengtai Shanghai	3360	15.02	101.1	2437.8
2010	Sun Alliance	842	18.06	31.34	404.32
2010	Hillock	1307	41.81	440.55	3749.31
2010	Sumitomo Mitsui	2324	21.76	197.3	1155.64
2010	SAMSUNG	735	21.31	252.92	2647.63
2010	Allianz	1746	8.95	16.43	181.27

Year	insurance companies' name	total number of staff	fixed assets	fees total premium and commission	commission received for the whole year
2010	Sompo Japan	4375	36.95	180.16	680.31
2010	Liberty	351	7.14	0.9	7.24
2010	UNITA Ins	741	29.7	152.62	2048.5
2010	Zurich Beijing	1102	30.03	34.51	401.22
2010	Hyundai Ins	175	6.49	23.59	105.92
2010	Aioi	615	10.08	51	718.04
2010	New Oriental in China	2199	8.53	32.88	458.29
2010	AIG	26501	82.69	751.21	7743.77
2011	PICC	201532	1528.89	3405	70361.47
2011	chinalife	5019	190.48	187.66	4596.43
2011	CCIC	100319	16830	27434	318252
2011	China Taiping	68240	2166.82	2897.93	31457.94
2011	Sunshine Ins	50653	428.2	1085.88	9768.74
2011	CUPI	18601	1121.48	1092.71	15954.07
2011	CPI	41014	2750	-8182	93203.1
2011	PingAn Propert	16893	4978.06	10711.68	118967.41
2011	ehuatai	3398	32.13	293.68	3042.51
2011	TiananProperty	250970	3897.96	7265.61	94796.67
2011	STARR	246437	1648.8	5149.42	67937.39
2011	SINOSAFE	139231	1266.5	2705.45	23365.44
2011	YAIC	42477	429.41	826.14	9982.5
2011	Alltrust	16386	138.64	351.02	3127.32
2011	AAIC	17869	77.68	253.94	3162.78
2011	Anbang	822	4.99	15.19	83.23
2011	AnhuaAgri	328	6.48	0.12	7.61
2011	Auto Company	1295	8.92	205.45	361.36
2011	SUNLIGHT INS	29351	680.24	443.52	5164.47
2011	BOHAI INS	8025	27.65	194.9	2248.23

Year	insurance companies' name	total number of staff	fixed assets	fees total premium and commission	commission received for the whole year
2011	DUBON INS	6528	76.88	84.43	658.72
2011	CHIC	5153	414.13	252.6	3139.47
2011	CAS PICC	17687	73.24	447.49	5045.98
2011	ANCHENG	354	25.31	329.21	2314.04
2011	BOC INS	1432	28.16	-117.24	1281.19
2011	YING DA	923	8.22	104.71	1004.9
2011	ChanganProperty	2278	19.05	107.86	1601.97
2011	gynybx	285	11.09	9.7	176.47
2011	generali-china	16183	30.54	320.06	3431.05
2011	AIG	8233	454.94	281.13	3583.93
2011	MARINE	2805	59.48	306.73	3585.41
2011	Fengtai Shanghai	4152	19.08	141.23	1480.66
2011	Sun Alliance	956	14.69	25.96	471.68
2011	Hillock	1439	47.59	492.5	3541.51
2011	Sumitomo Mitsui	914	21.82	137.44	1174.25
2011	SAMSUNG	918	25.7	268.51	1926.7
2011	Allianz	1901	9.98	27.04	257.94
2011	Sompo Japan	4517	31.35	159.81	1026.79
2011	Liberty	473	8.38	4.98	41.88
2011	UNITA Ins	6628	39.45	232.15	3175.04
2011	Zurich Beijing	2388	24.57	34.78	496.74
2011	Hyundai Ins	129	6.58	37.87	323.8
2011	Aioi	41	0.46	2.69	65.54
2011	New Oriental in China	1858	139.66	22.82	274.69
2011	AIG	22758	46.29	902.41	8186.73

Appendix Table-3 2008-2012 Sample Property Insurance Company Influence Factor Analysis

year	company	asset(ln)	product	Profit/revenue	Maket-share	Fund-apply	Capital-nature	TE	PTE	SE
2008	PICC	5.1696	2177.94	0.0108	0.4222	0.0765	0	1	1	1
2008	chinalife	3.9534	133.27	-0.4846	0.0158	0.0609	0	0.871	0.994	0.876
2008	CCIC	4.274	566.67	-0.2984	0.0312	-0.0246	0	0.822	0.993	0.828
2008	China Taiping	3.7348	161.32	-0.1711	0.017	0.0156	0	0.76	0.859	0.885
2008	Sunshine Ins	4.4986	247.74	0.0174	0.0208	0.3432	0	0.659	0.714	0.923
2008	CUPI	4.107	541.03	-0.1481	0.0865	0.0078	0	0.655	0.712	0.92
2008	CPI	4.5753	1238	0.0182	0.1048	0.0763	0	1	1	1
2008	PingAnPropert	4.608	913.4	0.024	0.1063	0.0974	0	0.806	0.811	0.994
2008	ehuatai	4.4975	77.37	0.1249	0.0094	0.2151	0	0.471	0.621	0.758
2008	TiananProperty	4.0344	180.04	-0.3507	0.0236	0.0509	0	0.815	0.882	0.924
2008	STARR	3.2236	39.38	-3.7146	0.0005	-0.5834	0	1	1	1
2008	SINOSAFE		120.18	-0.1279	0.0238		0	0.911	0.991	0.919
2008	YAIC	3.8857	307.93	-0.1153	0.0417	0.0473	0	0.776	0.842	0.922
2008	Alltrust	3.5865	64.96	0.0129	0.0073	0.098	0	0.432	0.991	0.436
2008	AAIC	2.9305	6.46	0.0629	0.0018	0.0987	0	0.513	0.845	0.607
2008	Anbang	4.4042	186.5	0.0432	0.0279	0.0293	0	0.998	1	0.998
2008	Anhua	3.1477	16.83	0.014	0.0076	-0.0796	0	0.519	0.679	0.764
2008	AutoCompany	3.1628	6.19	0.0129	0.005	0.0123	0	0.567	0.627	0.904
2008	SUNLIGHT	3.0202	18.41	-0.0029	0.0072		0	0.256	0.614	0.417

year	company	asset(ln)	product	Profit/revenue	Maket-share	Fund-apply	Capital-nature	TE	PTE	SE
2008	BOHAI INS	3.8762	31.39	-0.2715	0.0053	0.3184	0	0.566	0.656	0.863
2008	DUBON INS	3.6258	194.84	-0.3534	0.0141	-0.0685	0	0.721	0.882	0.817
2008	CHIC	2.7594	2.95	-0.8742	0.0004	-0.0122	0	0.325	0.743	0.437
2008	CAS PICC	3.2327	31.33	-0.5845	0.0027	0.1166	0	0.272	0.301	0.904
2008	ANCHENG	2.9331	20.09	-0.594	0.0019	0.0725	0	0.345	0.672	0.513
2008	BOC INS	3.4725	47.52	-0.2965	0.0051	0.103	0	0.245	0.772	0.317
2008	YING DA	3.0564	0.05	-30.7183	0	0.6409	0	0.256	0.676	0.378
2008	Changan	2.7916	14.04	-3.3845	0.0004	0	0	0.266	0.677	0.393
2008	gynybx	2.7109	1.72	0.0042	0.0005	0.0231	0	0.983	1	0.983
2008	generali-china	2.7125	0.24	-4.3267	0.0001	1.9398	1	0.772	0.841	0.918
2008	AIG	3.2689	133.86	-0.0127	0.0025	0.0605	1	0.595	0.608	0.978
2008	MARINE & NICHIDO	2.9857	2.26	-0.1526	0.002	0.0275	1	0.906	0.964	0.94
2008	Fengtai Shanghai	2.5795	0.68	0.022	0.0005	0.0892	1	0.406	0.498	0.815
2008	Sun Alliance	2.9068	11.49	-1.0276	0.0006	0.1547	1	0.678	0.678	1
2008	Hillock	2.6241	0.92	-0.4546	0.0005	0.0943	1	0.689	0.865	0.797
2008	Sumitomo	2.9479	2.15	0.0561	0.0011	0.096	1	0.597	0.701	0.852
2008	SAMSUNG	2.7956	11.07	0.7939	0.0005	0.1746	1	1	1	1
2008	Allianz	2.964	4.71	0.0788	0.0001	0.4969	1			
2008	Sompo Japan	2.8958	7.72	0.0085	0.0007	0.1293	1	0.69	0.716	0.964
2008	Liberty	2.4546	9.68	-0.8854	0.0004	0.0925	1	0.254	0.981	0.259

year	company	asset(ln)	product	Profit/revenue	Maket-share	Fund-apply	Capital-nature	TE	PTE	SE
2008	UNITA Ins		1.05	-5.2765	0		1			
2008	Zurich Beijing		0.2	-14.5821	0		1			
2008	Hyundai Ins	2.4029	0.59	-1.0383	0.0001	0.3938	1	0.256	0.881	0.291
2008	Aioi	2.3617	0.29	-0.8677	0.0001	0.2464	1	0.547	0.772	0.709
2009	PICC	5.2185	2165	0.0191	0.4023	0.0436	0	1	1	1
2009	chinalife	4.0797	162.73	0.012	0.0286	0.1038	0	0.709	0.712	0.996
2009	CCIC	4.1717	543	0.1219	0.0375	0.0225	0	0.547	0.677	0.808
2009	China Taiping	3.7787	136.19	-0.0706	0.016	0.044	0	0.449	0.481	0.933
2009	Sunshine Ins	4.0116	300.84	0.0317	0.0232	0.1253	0	0.461	0.521	0.885
2009	CUPI	4.0895	497.22	-0.0479	0.084	0.0088	0	0.978	1	0.978
2009	CPI	4.6565	1109.77	0.0571	0.1074	0.0543	0	1	1	1
2009	PingAn Propert	4.7047	1138.5	0.0228	0.1226	0.0532	0	0.621	0.933	0.666
2009	ehuatai	4.26	112.47	0.2081	0.0092	0.3255	0	0.722	0.743	0.972
2009	TiananPropert	3.8621	159.78	-0.0616	0.0278	0.0356	0	0.604	0.641	0.942
2009	STARR	3.3271	35.96	-0.0208	0.0049	0.0204	0	0.433	0.45	0.962
2009	SINOSAFE	4.483	154.34	0.2401	0.0067	1.2734	0	0.987	0.991	0.996
2009	YAIC	3.8268	258.48	0.0192	0.0218	0.0667	0	0.613	0.689	0.89
2009	Alltrust	3.7671	120.43	0.0121	0.0109	0.1142	0	0.501	0.762	0.657
2009	AAIC	3.0263	9.9	0.0361	0.002	0.09	0	0.611	0.755	0.809
2009	Anbang	4.3401	10.4	0.1868	0.0186	0.2387	0	0.988	1	0.988
2009	Anhua	3.3028	17.64	0.0124	0.0088	0.0019	0	0.672	0.754	0.891
2009	AutoCompany	3.4027	31.34	0.1044	0.0058	0.1174	0	0.982	0.991	0.991

year	company	asset(ln)	product	Profit/revenue	Maket-share	Fund-apply	Capital-nature	TE	PTE	SE
2009	SUNLIGHT	3.2647	22.29	0.0883	0.0068	0.0051	0	0.225	0.255	0.882
2009	BOHAI INS	3.5319	20.62	0.0526	0.0047	0.2863	0	0.632	0.641	0.986
2009	DUBON INS	3.5661	185.14	-0.0467	0.0163	0.0384	0	0.421	0.511	0.824
2009	CHIC	2.7552	16.39	-0.2631	0.0006	0.2257	0	0.381	0.512	0.744
2009	CAS PICC	3.3002	34.2	-0.0998	0.0044	0.0604	0	0.321	0.325	0.988
2009	ANCHENG	3.2297	27.18	-0.0832	0.005	0.0341	0	0.477	0.491	0.972
2009	BOC INS	3.4985	76.96	-0.1566	0.0072	0.0471	0	0.536	0.556	0.964
2009	YING DA	3.1784	2.43	0.024	0.0019	0.1489	0			
2009	Changan	3.0743	53.06	-0.0882	0.0031	0.0036	0	0.291	0.299	0.973
2009	gynybx	3.2044	4.93	0.0308	0.0034	0.0203	0	1	1	1
2009	generali-china	2.8075	1.32	-0.0366	0.0003	0.1644	1	0.422	0.654	0.645
2009	AIG	3.2517	166.99	0.0369	0.0022	0.0358	1	0.49	0.501	0.978
2009	MARINE & NICHIDO	2.9067	1.89	0.1797	0.0014	0.0217	1	0.645	0.768	0.84
2009	Fengtai Shanghai	2.6606	2.04	-0.3268	0.0002	0.1072	1	0.678	0.702	0.979
2009	Sun Alliance	2.8896	8.98	0.171	0.0004	0.0462	1	0.271	0.566	0.479
2009	Hillock	2.6047	2.1	-0.6419	0.0003	0.0481	1	0.156	0.414	0.377
2009	Sumitomo	3.0408	5.83	0.1235	0.0012	0.0635	1	0.557	0.688	0.81
2009	SAMSUNG	2.9611	16.06	0.7029	0.0004	0.1947	1	0.95	1	0.95
2009	Allianz	3.0161	7.54	0.0361	0.0002	0.2145	1			
2009	Sompo Japan	2.9054	8.02	-0.2004	0.0006	0.1051	1	0.708	0.731	0.969

year	company	asset(ln)	product	Profit/revenue	Maket-share	Fund-apply	Capital-nature	TE	PTE	SE
2009	Liberty	2.5859	16.33	-0.5419	0.0007	0.0332	1	0.271	0.431	0.629
2009	UNITA Ins	2.2795	4.36	-0.7032	0.0001	0.1418	1			
2009	Zurich Beijing	2.4339	0.31	-2.8903	0	0.2426	1			
2009	Hyundai Ins	2.5766	0.71	-1.3362	0.0001	0.1715	1	0.382	0.991	0.385
2009	Aioi	2.4681	0.48	-0.3626	0.0002	0.128	1	0.312	0.913	0.342
2010	PICC	5.3049	2288.39	0.0145	0.3998	0.0432	0	1	1	1
2010	chinalife	4.1782	267.56	0.0097	0.0267	0.0855	0	1	0.743	1
2010	CCIC	4.2382	528	0.0999	0.0345	0.0383	0	0.719	0.778	0.968
2010	China Taiping	3.8551	128.01	-0.0599	0.0142	0.0445	0	0.642	0.578	0.825
2010	Sunshine Ins	4.1725	368.44	0.0198	0.028	0.0542	0	0.652	0.714	0.913
2010	CUPI		529.99	-0.0479	0.0633		0	0.894	1	0.894
2010	CPI	4.8112	1337.73	0.0408	0.1134	0.0683	0	0.861	1	0.861
2010	PingAn	4.8969	1358.34	0.0143	0.1477	0.0459	0	0.992	1	0.992
2010	ehuatai	4.1696	170.55	0.1568	0.0092	0.148	0	0.407	0.913	0.446
2010	TiananPropert	4.023	180.9	-0.0552	0.0234	0.0408	0	0.853	0.853	1
2010	STARR	3.3788	52.13	-0.0182	0.0042	0.0162	0	0.619	0.873	0.709
2010	SINOSAFE	4.2834	122.49	0.0983	0.0124	0.2572	0	0.891	1	0.891
2010	YAIC	3.9259	254.2	0.0186	0.017	0.0566	0	0.794	0.813	0.977
2010	Alltrust	3.8339	202.69	0.0078	0.0127	0.0576	0	0.714	1	0.714
2010	AAIC	3.0526	14.18	0.0279	0.002	0.0391	0	0.516	0.692	0.746
2010	Anbang	4.4095	42.21	0.1185	0.0222	0.0056	0	1	1	1
2010	Anhua	3.3693	21.89	0.0117	0.007	0.0014	0	0.651	0.845	0.771
2010	AutoCompany	3.6585	63.85	0.0591	0.0077	0.056	0	0.671	0.891	0.753

year	company	asset(ln)	product	Profit/revenue	Maket-share	Fund-apply	Capital-nature	TE	PTE	SE
2010	SUNLIGHT	3.1572	18.93	0.0989	0.0046	0.006	0	0.426	0.561	0.759
2010	BOHAI INS	3.6363	23.24	0.0602	0.0031	0.1247	0	0.424	0.613	0.691
2010	DUBON INS	3.5823	171.58	-0.05	0.0115	0.0304	0	0.583	0.672	0.867
2010	CHIC	2.7474	11.88	-0.2766	0.0004	0.3745	0	0.266	0.363	0.733
2010	CAS PICC	3.2976	35.24	-0.0823	0.004	0.0348	0	0.407	0.494	0.824
2010	ANCHENG	3.3196	29.94	-0.0725	0.0043	0.0582	0	0.566	0.724	0.782
2010	BOC INS	3.7039	135.08	-0.1279	0.0066	0.0309	0	0.345	0.724	0.476
2010	YING DA	3.4989	6.95	0.0081	0.0043	0.0407	0			
2010	Changan	3.3034	63.54	-0.0697	0.003	0.013	0	0.724	0.733	0.988
2010	gynybx	3.2653	9.02	0.0214	0.0036	0.0362	0	0.994	0.998	0.996
2010	generali-china	2.8931	2.43	-0.0158	0.0006	0.0626	1	0.623	0.677	0.921
2010	AIG	3.2933	211.81	0.0269	0.0022	0.0289	1	0.43	0.451	0.953
2010	MARINE &NICHIDO	2.9683	1.98	0.1488	0.088	0.0152	1	0.935	0.993	0.942
2010	Fengtai Shanghai	2.7151	3.9	-0.2897	0.0002	0.0832	1	0.941	0.991	0.951
2010	Sun Alliance	2.9174	8.97	0.1808	0.0003	0.1258	1	0.631	0.976	0.647
2010	Hillock	2.6416	8.25	-0.4401	0.0003	0.0429	1	0.633	0.816	0.776
2010	Sumitomo	3.093	2.41	0.0846	0.0014	0.0316	1	0.893	0.983	0.908
2010	SAMSUNG	2.9527	23.88	0.4944	0.0004	0.1817	1	0.675	1	0.675
2010	Allianz	3.081	1.96	0.0245	0.0002	0.1149	1			
2010	Sompo Japan	2.9594	10.64	-0.1245	0.0008	0.0574	1	0.871	0.994	0.876

year	company	asset(ln)	product	Profit/revenue	Maket-share	Fund-apply	Capital-nature	TE	PTE	SE
2010	Liberty	2.6504	16.58	-0.3097	0.001	0.0257	1	0.5813	0.641	0.907
2010	UNITA Ins	2.5899	4.18	-0.4204	0.0002	0.0665	1			
2010	Zurich Beijing	2.835	1.36	-1.1484	0.0001	0.1119	1			
2010	Hyundai Ins	2.5979	0.51	-0.7608	0.0001	0.1078	1	0.356	0.968	0.368
2010	Aioi	2.4818	0.77	-0.3031	0.0001	0.1084	1	0.624	0.788	0.792
2011	PICC	5.4243	2717.08	0.0603	0.3693	0.0437	0	1	1	1
2011	chinalife	4.3506	345.31	0.0337	0.0347	0.0518	0	1	0.874	1
2011	CCIC	4.3564	697.18	0.0539	0.0381	0.0179	0	0.787	0.592	0.994
2011	China Taiping	3.9319	165.5	0.029	0.0135	0.0402	0	0.737	0.694	0.928
2011	Sunshine Ins	4.2847	383.6	0.0556	0.0307	0.0632	0	0.859	0.941	0.913
2011	CUPI		628.08		0.054		0	0.856	1	0.856
2011	CPI	4.9307	1507.35	0.081	0.129	0.0514	0	0.931	1	0.931
2011	PingAnPropert	5.036	1724.47	0.0791	0.1757	0.0488	0	0.994	0.913	0.994
2011	ehuatai	4.0471	229.26	0.0332	0.0044	0.0479	0	0.613	0.625	0.981
2011	TiananPropert	4.0062	167.91	-0.0779	0.0155	0.0528	0	0.622	0.633	0.983
2011	STARR	3.4434	43.68	0.0462	0.004	0.0396	0	0.538	0.548	0.982
2011	SINOSAFE	4.054	216.6	0.0581	0.0128	0.0488	0	1	1	1
2011	YAIC	4.0014	307.31	0.0505	0.0156	0.0415	0	0.913	0.829	0.983
2011	Alltrust	3.8568	171.99	0.0325	0.0109	0.0362	0	0.695	0.791	0.879
2011	AAIC	3.0868	14.28	0.0713	0.0017	0.0475	0	0.357	0.432	0.826
2011	Anbang	3.7155	0.29	0.0002	0.0201	0	0	1	1	1
2011	Anhua	3.4753	16.57	0.1165	0.0059	0.0071	0	0.419	0.438	0.957

2011	AutoCompany	3.7636	41.84	0.0783	0.0089	0.0205	0	0.69	0.763	0.904
year	**company**	**asset(ln)**	**product**	**Profit/revenue**	**Maket-share**	**Fund-apply**	**Capital-nature**	**TE**	**PTE**	**SE**
2011	SUNLIGHT	3.3021	24.54	0.2049	0.0042	0.0123	0	0.46	0.497	0.926
2011	BOHAI INS	3.3996	36.66	-0.166	0.0036	0.0712	0	0.469	0.924	0.508
2011	DUBON INS	3.558	148.75	0.0146	0.009	0.0105	0	0.611	1	0.611
2011	CHIC	2.6387	7.45	-0.2897	0.0005	0.0206	0	0.224	0.425	0.527
2011	CAS PICC	3.3996	42.84	-0.1492	0.0043	0.0104	0	0.605	0.637	0.95
2011	ANCHENG	3.6068	66.62	0.0023	0.0047	0.0633	0	0.293	0.311	0.942
2011	BOC INS	3.7929	264.23	0.0197	0.006	0.0779	0	0.27	0.579	0.466
2011	YING DA	3.6903	32.97	0.0981	0.0061	0.0792	0	0.553	0.562	0.984
2011	Changan	3.3767	67.17	-0.2418	0.0034	0.0348	0	0.834	0.848	0.983
2011	gynybx	3.3442	18.63	0.0474	0.0037	0.0241	0	0.837	0.47	0.962
2011	generali-china	2.9386	1.92	-0.9194	0.0005	0.1094	1	1	1	1
2011	AIG	3.3249	274	-0.0084	0.0021	0.0424	1	0.498	0.552	0.902
2011	MARINE & NICHIDO	3.028	2.23	0.1913	0.0012	0.0334	1	0.956	0.883	0.973
2011	Fengtai Shanghai	2.8283	7.04	-0.0558	0.0002	0.0746	1	0.622	0.843	0.738
2011	Sun Alliance	2.868	12.97	-0.0177	0.0003	0.1787	1	0.377	0.662	0.57
2011	Hillock	2.7768	42.33	-0.5523	0.0004	0.058	1	1	1	1
2011	Sumitomo	3.1909	3.49	0.0627	0.0016	0.0405	1	0.979	0.434	0.995
2011	SAMSUNG	3.0432	27.81	0.471	0.0004	0.1636	1	0.679	0.463	0.89
2011	Allianz	3.1245	3.67	-0.072	0.0003	0.0377	1			

2011	Sompo Japan	3.0429	9.22	0.0208	0.0009	0.0582	1	0.675	0.416	0.827
year	**company**	**asset(ln)**	**product**	**Profit/revenue**	**Maket-share**	**Fund-apply**	**Capital-nature**	**TE**	**PTE**	**SE**
2011	Liberty	2.8133	19.87	-0.2511	0.0012	0.0311	1	0.425	0.479	0.887
2011	UNITA Ins	2.8076	4.65	-0.391	0.0003	0.0586	1			
2011	Zurich Beijing	2.8928	2	-0.4617	0.0002	0.1436	1			
2011	Hyundai Ins	2.701	2.22	-0.1417	0.0001	0.1633	1	0.389	0.843	0.461
2011	Aioi	2.4992	1.68	0.0068	0.0001	0.1339	1	0.389	0.715	0.544

Appendix Table-4 2008-2012 sample life insurance company influence factor analysis

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2008	PICC Life	4.6284	97.88	-0.0678	0	0.0404	0.0397	0	1	1	1
2008	PICC Health	4.2333	169.01	-0.079	1	0.0192	0.047	0	0.892	0.988	0.91
2008	China Life shares	5.9957	6224	0.0348	0	0.4157	0.1808	0	0.82	1	0.998
2008	Taiping Life	4.7775	258.42	0.0143	0	0.0265	0.1107	0	0.234	0.304	0.895
2008	MINSHENG LIFE	4.051	73.95	-0.0913	0	0.0088	0.0736	0	0.135	0.151	0.986
2008	Sun life	3.7151	9.09	-0.1337	0	0.0039	0.0295	0	1	1	1
2008	CPIC life insurance	5.4162	2232	0.0459	0	0.0902	0.2152	0	0.825	0.856	0.979
2008	PingAn Life	5.675	1901.82	-0.0165	0	0.1412	0.2387	0	1	1	0.927
2008	PingAn Annuity	3.4451	0	-0.3693	1	0.0016	0.0798	0			
2008	PingAn Health	2.7714	3.19	-1.0517	1	0	1.9658	0			
2008	HuaTai Life	3.7075	10.4	-0.1083	0	0.0038	0.026	0	0.056	0.058	0.999
2008	Xinhua Life	5.2177	386.03	0.0329	0	0.0785	0.1839	0	0.637	0.637	1
2008	Taikang Life	5.2833	402.19	0.0293	0	0.0811	0.1746	0	0.925	1	0.999
2008	FUDE Sino Life	4.2643	69.69	-0.1039	0	0.0125	0.0199	0	0.101	0.124	0.996

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2008	HeZhong Life	4.0335	55.65	-0.1478	0	0.0078	0.0647	0	0.134	0.413	0.798
2008	Great Life	3.6638	27.44	-0.1384	0	0.0024	0.0656	0	0.034	0.035	1
2008	Jiahe Life	3.9508	34.31	-0.1511	0	0.004	0.0577	0	0.134	0.431	0.528
2008	Kunlun Health	2.2202	0.43	-1.829	0	0	0.5457	0	0.232	0.513	0.298
2008	Hexie Health		14.86	-0.5211	1	0.0003		0	0.513	0.793	0.411
2008	ZhengDe Health	3.3768	-13.7	-0.087	0	0.0026	0.033	0	0.425	0.784	0.747
2008	Hua Life	3.298	24.19	-0.2286	0	0.0027	0.0411	0	0.642	0.899	0.92
2008	XinTai Life	3.1587	7.4	-0.1979	0	0.0018	0.014	0	1	1	0.755
2008	YingDa Life	3.3768	30.25	-0.113	1	0.003	0.0214	0	1	1	1
2008	GuoHua Life	3.2459	2.89	-0.1945	0	0.0013	0.0232	0	0.021	0.023	0.863
2008	Happy Life	3.3603	2.19	-0.1681	0	0.0015	0.0763	0	0.026	0.027	0.984
2008	ZhongHong Life	3.6871	25.62	0.0676	0	0.0014	0.1617	0	0.021	0.023	1
2008	CCB Life	3.5131	22.58	0.0014	0	0.0015	0.2027	0			
2008	Allianz China Life	3.7182	15.04	-0.0762	0	0.0034	-0.2611	1	0.242	0.455	0.998
2008	AXA China Life	3.3102	16.38	-0.409	0	0.0008	0.3313	1	0.122	0.456	0.498
2008	PICC Kanglian Life	3.0205	1.36	-0.068		0.0002	0.3708	1	0.886	1	0.399

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2008	Citic-prudential Life	3.8784	68.54	-0.0664	0	0.0051	0.094	1	0.049	0.051	0.987
2008	Generali China	4.4686	47.17	-0.0545	0	0.0028	0.3696	1	0.313	0.564	0.933
2008	Sunlife Everbright Life	3.5365	12.36	-0.1681	0	0.002	0.1641	1	0.291	0.911	1
2008	Shouchangantai Life	3.583	11.18	-0.1172	0	0.0026	0.0832	1			
2008	Haier Life	3.0724	9.03	-0.359	0	0.0006	0.0758	1	0.231	0.345	0.889
2008	aviva-cofco Life	3.9228	52.06	-0.0874	0	0.0055	0.0861	1	0.055	0.055	0.976
2008	Aegon-Cnooc Life	3.4313	30.04	-0.2052	0	0.0021	-0.0812	1	0.338	0.567	0.902
2008	Cignacmb Life	3.5211	252.3	0.0515	0	0.0022	0.009	1	0.113	0.433	0.828
2008	Prime-care Life		2.6	-0.3181	0	0.0002		1	0.472	1	0.708
2008	HengAn standard	3.6115	17.92	-0.208	0	0.0029	-0.0264	1	0.034	0.083	0.848
2008	RuiTai Life	3.2949	0.05	-0.1772	0	0.0005	-1.141	1	0.526	0.893	0.523
2008	Met Life	3.4053	33.11	-0.0626	0	0.0022	-0.0229	1			
2008	Cathaylife	3.3438	28.81	-0.2132	0	0.0008	0.1977	1	0.013	0.016	0.982
2008	AVIC Samsung	2.753	6	-0.338	0	0.0002	0.1559	1	0.003	0.008	0.634
2008	LianTai Life	3.3209	5.82	-0.1309	0	0.0014	-0.0056	1			

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2008	Great Eastern	2.6238	2.09	-0.379	0	0.0001	0.0988	1	0.288	1	0.526
2008	AIA SH	4.1659	115.91	-0.0902	0	0.0031	0.1851	1			
2008	AIA GZ	#N/A	146.69	0.0667	0	0.0034	#N/A	1			
2008	AIA SZ	3.5283	40.3	0.0659	0	0.0013	-0.0177	1			
2008	AIA BJ	3.7253	51.79	0.0494	0	0.002	-0.0287	1			
2008	AIA SuZhou	#N/A	21.79	-0.2383	0	0.0004	#N/A	1			
2008	AIA Dongwan	2.6731	8.5	-0.144	0	0.0002	-0.1777	1			
2008	AIA Jiangmen	2.6735	5.91	-0.1114	0	0.0001	-0.1802	1			
2009	PICC Life	4.9683	323.17	0.0001	0	0.0764	0.0669	0	0.777	1	0.796
2009	PICC Health	4.3454	182.55	0.0027	1	0.0086	0.2063	0	0.783	0.889	0.871
2009	China Life shares	6.0886	7076	0.1201	0	0.4023	0.2283	0	0.775	1	1
2009	Taiping Life	4.9019	307.07	0.0041	0	0.0327	0.1493	0	0.463	0.476	0.871
2009	MINSHENG LIFE	4.1541	48	-0.0143	0	0.0068	0.1366	0	0.101	0.104	0.979
2009	Sun life	3.9151	85.48	-0.1496	0	0.0046	0.1071	0	0.088	0.091	1
2009	CPIC life insurance	5.4909	2715	0.0919	0	0.0864	0.2867	0	0.638	0.671	0.983
2009	PingAn Life	5.7757	1416.06	0.1535	0	0.1043	0.375	0	1	1	1
2009	PingAn Annuity	3.851	546.9	-1.1055	1	0.0008	0.3454	0			

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2009	PingAn Health	2.7969	7.26	-0.311	1	0.0001	1.0068	0			
2009	HuaTai Life	3.8653	19.96	-0.0766	0	0.0036	0.1028	0	0.072	0.074	0.991
2009	Xinhua Life	5.315	554.67	0.0408	0	0.0951	0.1105	0	0.972	1	0.759
2009	Taikang Life	5.3041	642.31	0.0375	0	0.0975	0.1919	0	0.756	0.841	1
2009	FUDE Sino Life	4.4529	103.87	0.0097	0	0.0102	0.1678	0	0.215	0.202	0.994
2009	HeZhong Life	4.1791	60.44	0.0158	0	0.0073	0.196	0	0.244	0.789	0.9
2009	Great Life	3.7583	4.51	-0.1226	0	0.0022	0.2469	0	0.566	0.636	0.92
2009	Jiahe Life	4.0954	58.43	-0.0139	0	-0.001	-0.7977	0	0.223	0.441	0.565
2009	Kunlun Health	2.4642	1.94	-0.3838	0	0.0001	0.0177	0	0.513	0.784	0.421
2009	Hexie Health	2.5897	13.03	-1.7052	1	0	0.1633	0	0.214	0.783	0.61
2009	ZhengDe Health	3.8408	3.78	-0.3268	0	0.0008	0.2955	0	0.324	0.874	0.905
2009	Hua Life	3.6369	127.51	-0.1779	0	0.004	0.0362	0	0.526	0.894	0.995
2009	XinTai Life	3.278	25.98	-0.2695	0	0.0012	0.0839	0	0.015	0.021	0.891
2009	YingDa Life	3.7419	48.31	-0.2349	1	0.0011	0.2601	0	0.026	0.031	0.994
2009	GuoHua Life	3.783	18.33	0.0072	0	0.0055	0.0739	0	1	1	0.887
2009	Happy Life	3.7945	21.75	-0.0679	0	0.0051	0.0913	0	1	1	0.834
2009	ZhongHong Life	3.7731	30.43	0.0185	0	0.0024	0.1117	0	0.031	0.034	0.97
2009	CCB Life	3.5718	23.94	0.2313	0	0.0009	0.2305	0			

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2009	Allianz China Life	3.8469	16.75	-0.3454	0	0.0017	0.1247	1	0.411	0.598	0.908
2009	AXA China Life	3.4568	25.07	-0.2095	0	0.0007	0.13	1	0.144	0.324	0.662
2009	PICC Kanglian Life	3.041	1.23	-0.0162		0.0001	0.6142	1	0.737	1	0.761
2009	Citic-prudential Life	4.0468	70.98	0.0389	0	0.0033	0.1052	1	0.052	0.053	0.987
2009	Generali China	4.5353	57	-0.0099	0	0.0063	0.3175	1	0.433	0.758	0.988
2009	Sunlife Everbright Life	3.8402	12.75	-0.1258	0	0.0021	0.0243	1	0.033	0.112	0.865
2009	Shouchangantai Life	3.6562	14.49	-0.0522	0	0.0008	0.3955	1			
2009	Haier Life	3.1153	9.19	-0.2584	0	0.0007	0.0966	1	0.441	0.513	0.859
2009	aviva-cofco Life	4.0804	68.07	0.0506	0	0.0045	0.1237	1	0.071	0.072	1
2009	Aegon-Cnooc Life	3.5713	33.93	-0.1389	0	0.0014	0.094	1	0.451	0.741	0.888
2009	Cignacmb Life	3.6325	305.36	0.2176	0	0.0011	0.0215	1	0.013	0.067	0.984
2009	Prime-care Life	3.1736	3.01	1.2179	0	0.0001	0.4098	1	0.002	0.011	0.33
2009	HengAn standard	3.6759	19.35	-0.231	0	0.0021	0.1829	1	0.133	0.314	0.989

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2009	RuiTai Life	3.4765	0.06		0	0		1	0.672	0.783	0.272
2009	Met Life	3.6118	28.97	0.0446	0	0.003	0.0277	1			
2009	Cathaylife	3.383	38.61	-0.6277	0	0.0003	0.4667	1	0.011	0.018	0.907
2009	AVIC Samsung	2.8167	13.78	-0.2371	0	0.0003	0.1275	1	0.581	1	0.772
2009	LianTai Life	3.4871	5	-0.1364	0	0.0006	0.0648	1			
2009	Great Eastern	3.0854	9.28	-0.3476	0	0.0002	0.0932	1	0.004	0.011	0.331
2009	AIA SH	4.2294	112.26	-0.0364	0	0.0034	0.3117	1			
2009	AIA GZ	4.0715	146.84	0.0819	0	0.0036	0.1989	1			
2009	AIA SZ	3.6143	36.35	0.1108	0	0.0013	0.1656	1			
2009	AIA BJ	3.8339	46.21	0.0312	0	0.0025	0.1306	1			
2009	AIA SuZhou	2.9881	27.89	-0.2839	0	0.0006	0.0919	1			
2009	AIA Dongwan	2.753	9.31	-0.0588	0	0.0002	0.1035	1			
2009	AIA Jiangmen	2.7217	6.02	-0.0093	0	0.0001	0.2074	1			
2010	PICC Life	5.2715	594.37	0.0103	0	0.0832	0.1068	0	0.779	1	1
2010	PICC Health	4.4245	324.29	0.0329	1	0.0019	0.8329	0	0.678	0.788	0.837
2010	China Life shares	6.1494	7657	0.1063	0	0.3681	0.2147	0	0.779	1	0.963
2010	Taiping Life	5.0466	385.01	0.0297	0	0.037	0.1238	0	0.484	0.487	0.748
2010	MINSHENG LIFE	4.333	65.04	0.0022	0	0.009	0.0903	0	0.112	0.125	0.992

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2010	Sun life	4.3958	233.53	-0.0231	0	0.0162	0.0578	0	0.259	0.266	0.985
2010	CPIC life insurance	5.5786	3309.2	0.0545	0	0.098	0.2063	0	1	1	0.876
2010	PingAn Life	5.8818	676.65	0.0941	0	0.1073	0.2919	0	1	1	0.946
2010	PingAn Annuity	4.0493	1800.04	0.0581	1	0.0032	0.1168	0			
2010	PingAn Health	2.9471	2.82	-0.7687	1	0	0.4977	0			
2010	HuaTai Life	4.1111	42.44	-0.0288	0	0.0059	0.079	0	0.105	0.119	0.989
2010	Xinhua Life	5.4835	720.52	0.0244	0	0.106	0.1166	0	1	1	0.835
2010	Taikang Life	5.4676	980.76	0.0323	0	0.0752	0.1839	0	0.718	0.719	0.836
2010	FUDE Sino Life	4.6366	167.94	0.0068	0	0.0168	0.0988	0	0.779	0.823	0.826
2010	HeZhong Life	4.383	90.46	0.0357	0	0.0077	0.1279	0	0.341	0.888	0.985
2010	Great Life	3.9341	4.81	-0.0725	0	0.0026	0.12	0	0.046	0.057	0.994
2010	Jiahe Life	4.2456	55.39	0.0108	0	0.0015	0.5395	0	0.241	0.542	0.523
2010	Kunlun Health	2.5036	#N/A	-0.5216	0	0.0001	0.0511	0	0.241	0.543	0.759
2010	Hexie Health	2.9834	1.36	-8.9249	1	0	1.106	0	0.454	0.554	0.702
2010	ZhengDe Health	3.9505	2.27	0.0017	0	0.0005	1.08	0	0.423	0.778	0.623
2010	Hua Life	3.8648	218.81	-0.1098	0	0.0033	0.066	0	0.452	0.784	0.979
2010	XinTai Life	3.6177	16.95	-0.0765	0	0.0024	0.0503	0	0.039	0.052	0.977
2010	YingDa Life	3.9123	76.75	-0.4646	1	0.0009	0.3658	0	0.027	0.033	0.977

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2010	GuoHua Life	4.0187	38.72	0.0168	0	0.0045	0.1477	0	1	1	0.868
2010	Happy Life	4.1021	71.85	-0.1008	0	0.0052	0.1482	0	0.089	0.097	0.999
2010	ZhongHong Life	3.8911	36.09	0.0617	0	0.0023	0.1316	0	0.919	1	0.879
2010	CCB Life	3.6278	27.64	0.0536	0	0.0008	0.233	0			
2010	Allianz China Life	3.8747	16.14	-0.3453	0	0.001	0.1779	1	0.133	0.466	0.881
2010	AXA China Life	3.5778	45.42	-0.1253	0	0.0007	0.1083	1	0.213	0.542	0.505
2010	PICC KanglianLife	3.2769	1.23	-0.0334		0.0008	0.0967	1			
2010	Citic-prudential Life	4.1876	83.15	0.0516	0	0.0041	0.1005	1	0.061	0.071	0.981
2010	Generali China	4.5964	64.58	0.0126	0	0.0063	0.2805	1	0.432	0.684	1
2010	Sunlife Everbright Life	4.0218	30.33	-0.0539	0	0.0045	0.0679	1	0.144	0.217	1
2010	Haier Life	3.1571	9.25	-0.0961	0	0.0005	0.1251	1	0.312	0.783	0.868
2010	aviva-cofco Life	4.1869	78.28	0.0606	0	0.0042	0.1398	1	0.051	0.059	0.999
2010	Aegon-Cnooc Life	3.686	30.78	-0.0838	0	0.0012	0.1267	1	0.536	0.822	0.982
2010	Cignacmb Life	3.7951	331.01	0.1204	0	0.0016	0.0259	1	0.413	0.563	0.86

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2010	Prime-care Life	3.2175	4.88	-0.2841	0	0.0002	0.2345	1	0.003	0.016	0.496
2010	HengAn standard	3.7352	37.45	-0.2509	0	0.0008	0.2599	1	0.134	0.431	0.523
2010	Prime-care Life	3.2175	4.88	-0.2841	0	0.0002	0.2345	1	0.003	0.016	0.496
2010	HengAn standard	3.7352	37.45	-0.2509	0	0.0008	0.2599	1	0.134	0.431	0.523
2010	RuiTai Life	3.599	0.07	-15.658	0	0	1.4278	1	0.422	0.845	0.736
2010	Met Life	3.7631	41.14	0.1195	0	0.0023	0.073	1			
2010	Cathaylife	3.4434	71.46	-0.4817	0	0.0004	0.3369	1	0.014	0.021	0.925
2010	AVIC Samsung	2.9472	23	-0.6259	0	0.0001	0.3721	1	0.951	1	0.957
2010	LianTai Life	3.6336	7.4	-0.1073	0	0.0008	0.0647	1			
2010	Great Eastern	3.1982	12.76	-0.1099	0	0.0005	0.0684	1	0.008	0.021	0.665
2010	AIA SH	4.2698	112.04	-0.0322	0	0.0024	0.3857	1			
2010	AIA GZ	4.1587	160.6	0.0894	0	0.0029	0.2287	1			
2010	AIA SZ	3.7013	36.11	0.086	0	0.001	0.2055	1			
2010	AIA BJ	3.9256	46.47	0.0384	0	0.0018	0.1862	1			
2010	AIA SuZhou	3.1008	34.75	-0.2199	0	0.0005	0.0574	1			
2010	AIA Dongwan	2.8143	8.72	-0.0511	0	0.0002	0.0927	1			
2010	AIA Jiangmen	2.7619	6.4	-0.0547	0	0.0001	0.193	1			
2011	PICC Life	5.4363	870.62	0.0079	0	0.0765	0.1276	0	0.731	1	1

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2011	PICC Health	4.3798	484.77	-0.1799	1	0.0029	0.2801	0	0.978	1	0.796
2011	China Life shares	6.1997	8768	0.0581	0	0.3475	0.2037	0	0.731	1	1
2011	Taiping Life	5.1225	296.19	0.0211	0	0.0349	0.1399	0	0.724	0.748	0.946
2011	MINSHENG LIFE	4.4775	71.59	0.0012	0	0.0105	0.1077	0	0.242	0.254	1
2011	Sun life	4.6904	291.5	-0.0167	0	0.0173	0.1193	0	1	1	1
2011	CPIC life insurance	5.6634	3681.32	0.0351	0	0.0988	0.1768	0	1	1	0.992
2011	PingAn Life	5.9284	1094.48	0.0903	0	0.1295	0.2446	0	1	1	0.99
2011	PingAn Annuity	4.1343	2394.66	0.0444	1	0.0049	0.0826	0			
2011	PingAn Health	3.0016	3.34	-0.8291	1	0.0001	0.5142	0			
2011	HuaTai Life	4.2462	60.37	-0.1062	0	0.0033	0.1801	0	0.078	0.091	0.996
2011	Xinhua Life	5.5873	865.6	0.0292	0	0.1041	0.1548	0	0.075	0.831	0.994
2011	Taikang Life	5.5454	1173.94	0.0203	0	0.0734	0.2094	0	0.599	0.601	0.979
2011	FUDE Sino Life	4.7968	265.02	0.0064	0	0.0255	0.0956	0	0.499	0.511	0.977
2011	HeZhong Life	4.5219	84.99	-0.0935	0	0.0105	-0.0162	0	0.413	0.495	0.851
2011	Great Life	4.1484	8.43	-0.6413	0	0.0009	0.2309	0	0.091	0.096	0.976
2011	Jiahe Life	4.3061	35.82	-0.0828	0	0.0033	0.2173	0	0.314	0.662	0.447
2011	Kunlun Health	2.9728	11.54	-1.4165	0	0.0001	0.1223	0	0.345	0.655	0.501

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2011	Hexie Health	3.0322	1.1	1.2775	1	0	11.5434	0	0.513	0.899	0.845
2011	ZhengDe Health	4.2011	0.57	-0.0168	0	-0.0002	-2.0465	0	0.432	0.866	0.529
2011	Hua Life	4.1513	190.25	0.1831	0	0.0045	0.0853	0	0.524	0.874	0.878
2011	XinTai Life	3.7964	18.37	-0.0929	0	0.0023	0.0801	0	0.621	0.783	0.692
2011	YingDa Life	4.0264	96.11	-0.4314	1	0.0008	0.4147	0	0.037	0.051	0.997
2011	GuoHua Life	4.0934	62.91	-0.1278	0	0.0034	0.0762	0	0.028	0.039	0.984
2011	Happy Life	4.2962	123.63	-0.1503	0	0.0054	0.1555	0	0.142	0.153	0.999
2011	ZhongHong Life	3.9627	43.56	0.0505	0	0.0025	0.1306	0	1	1	0.989
2011	CCB Life	3.7389	32.31	0.0264	0	0.0014	0.1406	0			
2011	Allianz China Life	3.8873	16.64	-1.9217	0	0.0001	2.1214	1	0.156	0.233	0.897
2011	AXA China Life	3.6875	72.72	-0.2332	0	0.0009	0.1038	1	0.433	0.879	0.839
2011	PICC Kanglian Life	3.3358	2.62	-0.0973	0	0.0005	0.1883	1			
2011	Citic-prudential Life	4.2391	93.11	0.0986	0	0.0036	0.1553	1	0.077	0.089	0.999
2011	Generali China	4.5895	82.34	0.0217	0	0.0035	0.4877	1	0.234	0.721	1

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2011	Sunlife Everbright Life	4.2295	142.29	-0.0898	0	0.0037	0.1395	1	0.084	0.224	0.997
2011	Shouchangantai Life	3.8314	20.81	-0.0741	0	0.0016	0.2021	1			
2011	Haier Life	3.323	10.46	0.0034	0	0.0005	0.1593	1	0.413	0.892	0.771
2011	aviva-cofco Life	4.2818	65.46	0.0251	0	0.0037	0.1779	1	0.076	0.083	0.829
2011	Aegon-Cnooc Life	3.7715	18.2	-0.0203	0	0.0011	0.1887	1	0.145	0.423	0.83
2011	Cignacmb Life	3.8504	386.37	0.0867	0	0.0019	0.041	1	0.523	0.673	0.634
2011	Prime-care Life	3.2304	8.56	-0.3005	0	0.0003	0.2519	1	0.007	0.024	0.828
2011	HengAn standard	3.7737	50.05	-0.2099	0	0.0011	0.1986	1	0.516	0.789	0.621
2011	RuiTai Life	3.575	3.96	-2.3303	0	0	1.1572	1	0.413	0.873	0.621
2011	Met Life	4.0812	93.43	0.025	0	0.0033	0.0796	1			
2011	Cathaylife	3.4118	85.44	-0.329	0	0.0005	0.2093	1	0.012	0.029	0.94
2011	AVIC Samsung	3.0697	30.18	-0.2447	0	0.0003	0.106	1	1	1	1
2011	LianTai Life	2.9162	0	-0.3908	0	0.0001	0.5404	1			
2011	Great Eastern	3.2478	13.23	-0.3918	0	0.0003	0.1908	1	0.007	0.023	0.697
2011	AIA SH	4.2978	110.45	-0.0546	0	0.0024	0.3244	1			
2011	AIA GZ	4.2057	175.46	0.1209	0	0.0031	0.1879	1			
2011	AIA SZ	3.7351	38.49	0.1876	0	0.001	0.1781	1			

year	insurance company name	total assets (ln)	accident insurance income	Profit income ratio	marketing model	market share	investment yield	capital nature	technical efficiency	pure technical efficiency	scale efficiency
2011	AIA BJ	3.951	51.69	0.1494	0	0.0015	0.1854	1			
2011	AIA SuZhou	3.2197	32.36	-0.0783	0	0.0006	0.0453	1			
2011	AIA Dongwan	2.866	9.45	0.0784	0	0.0002	0.0934	1			
2011	AIA Jiangmen	2.79	7.48	0.1049	0	0.0001	0.1554	1			

Appendix Table5 The effectiveness evaluation of 41 small and medium-sized insurance companies in China from 2008 to 2011

Decision-making unit	DEA effective value (θ*)	Rank	Decision-making unit	DEA effective value (θ*)	Rank
China Life CMG.	0.906	1	AIG Property Insurance	0.582	22
Minan Property Insurance	0.862	2	Tokio Marine Nichido China	0.581	23
Yong An Property Insurance	0.824	3	General China Insurance	0.567	24
Sinosafe Property Insurance	0.82	4	Oldmutual Guodian	0.509	25
BOC Property Insurance	0.814	5	CHIC	0.481	26
Chang An Property & Casualty Insurance	0.78	6	Hyundai Property Insurance	0.462	27
ACIC	0.763	7	Sun Alliance	0.451	28
Anhua Agricultural Insurance	0.756	8	Samsung Property Insurance	0.434	29
Alltrust Property Insurance	0.746	9	Hexie Health	0.424	30
Tianping Auto	0.711	10	Allianz Property Insurance	0.405	31
Dazhong Property Insurance Company	0.707	11	Aioi	0.383	32
SMBC	0.699	12	Haier Life	0.35	33
Groupama-AVIC Property Insurance	0.68	13	Chubb Property Insurance	0.333	34
Guoyuan Agricultural Insurance	0.651	14	Kunlun Health	0.333	35
AAIC	0.645	15	Zurich (Beijing)	0.308	36
Samsung-AVIC	0.634	16	Sino-French Life	0.243	37
Sompo Japan Property Insurance	0.633	17	AXA-Minmetals	0.228	38
Sunlight Agricultural Insurance	0.626	18	Great Wall Changsheng Life	0.121	39
Liberty Mutual	0.623	19	Great Eastern	0.077	40
Yingda Property Insurance	0.616	20	Cathay Life	0.013	41
Winterthur Swiss Insurance Shanghai	0.588	21			

Appendix Table 6 Summary of variables for analysis of influencing factors of property insurance companies

dependent variable		
Y1	Technical efficiency	
Y2	Pure Technical Efficiency	
Y3	Scale Efficiency	
independent variable		
X1	Company Scale	The natural logarithm of the total assets
X2	Product Structure	Income from Accident Insurance Premium
X3	Financial profitability	Profit-income ratio: net profit/premium income
X4	Market Concentration	Market Share: Premium Income/Total Premium Income of Life (Property) Insurance of the Company
X5	Investment profitability	return on investment/premium income
X6	Capital nature	Capital nature： X7 = 0, Chinese capital; X7 = 1, foreign capital

Appendix Table7 variables Summary of influencing factors of Life Insurance companies

dependent variable		
Y1	Technical efficiency	
Y2	Pure Technical Efficiency	
Y3	Scale Efficiency	
independent variable		
X1	Company Scale	The natural logarithm of the total assets
X2	Product Structure	Income from Accident Insurance Premium
X3	Financial profitability	Profit-income ratio: net profit/premium income
X4	innovative	marketing model fictitious variable: x4=0, personal channel; x4 =1, bank channel
X5	Market Concentration	Market Share: Premium Income/Total Premium Income of Life (Property) Insurance of the Company
X6	Investment profitability	return on investment/premium income
X7	Capital nature	Capital nature： X7 = 0, Chinese capital; X7 = 1, foreign capital

Appendix Table 8 Summary of Regression Results of Property Insurance

Variable		Y1	Y2	Y3
X1 natural logarithm of total assets	coefficient	0.2694	0.1074	0.1993
	T value	4.26	1.91	3.82
	P value	0.000	0.056	0.000
X2 accident insurance premium income	coefficient	-0.0001	-0.0000	-0.0002
	T value	-0.80	-0.21	-1.40
	P value	0.425	0.836	0.163
X3 net profit / premium income	coefficient	0.0024	-0.0047	0.0137
	T value	0.38	-0.73	2.43
	P value	0.704	0.468	0.015
X4 Company premium income / current life (/ property) insurance premium total income	coefficient	0.6146	0.5889	0.4999
	T value	0.74	0.76	0.71
	P value	0.457	0.445	0.476
X5 investment Capital income / premium income	coefficient	-0.0357	-0.0042	0.0073
	T value	-0.48	-0.05	0.11
	P value	0.631	0.958	0.914
X6 capital nature: x6=0, Chinese capital; X6=1, foreign investment	coefficient	0.2039	0.1251	0.0804
	T value	2.85	2.1	1.41
	P value	0.004	0.036	0.157

Appendix Table 9 Summary of Regression Results of Life Insurance

Variable		Y1	Y2	Y3
X1 natural logarithm of total assets	coefficient	0.1046	0.0373	0.0834
	T value	1.96	0.56	2.79
	P value	0.05	0.573	0.005
X2 accident insurance premium income	coefficient	-0.00005	-0.00005	-0.00001
	T value	-0.8	-0.6	-0.34
	P value	0.424	0.551	0.737
X3 net profit / premium income	coefficient	0.0051	0.016	0.0006
	T value	0.16	0.43	0.05
	P value	0.875	0.664	0.963
X4 Marketing mode virtual variables: x4=0, personal agent; x4=1, the bank agent	coefficient	0.1409	0.1372	0.0085
	T value	1.11	0.83	0.09
	P value	0.266	0.405	0.924
X5 Company premium income / current life (/ property) insurance premium total income	coefficient	1.7834	2.323	-0.0427
	T value	1.42	1.56	-0.07
	P value	0.155	0.12	0.942
X6 investment Capital income / premium income	coefficient	0.001	0.0085	0.0126
	T value	0.04	0.28	1.15
	P value	0.97	0.779	0.251
X7 capital nature: x7=0, Chinese capital; X7=1, foreign investment	coefficient	-0.1362	-0.0983	-0.0084
	T value	-1.88	-1.05	-0.17
	P value	0.061	0.295	0.868