

Safety Evaluation Index System of China Insurance Industry

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Abstract. With strong public and social recognize, insurance business involves all walks of life and thousands of families, and it bears certain social responsibilities and obligations. Insurance industry's major business is to operate risk. Its security is of great significance for the stable operation of the entire financial industry. This work design a scientific evaluation index system to analyze and evaluate the security of the Chinese insurance industry by External environment (Macroeconomic environment, Industry controlling power, Industry developing power) and Internal environment (Market size , Profitability , Liquidity of assets) is an important practical significance.

Keywords: Insurance industry, industry safety; index system

1. Introduction

Insurance, based on the law of large numbers, is a kind of mechanism which can transfer risk for thousands of businesses, families and individuals [Li, 2010]. As a means to spread and transfer risk, insurance has obtained a widely application and rapid development, and became an important part of the country's economy [Li, 2012]. With strong public and social recognize, insurance business involves all walks of life and thousands of families, and it bears certain social responsibilities and obligations [Blackbuurn, 1998]. In modern economy, the role of insurance and its sphere of influence continues to expand. Insurance provide security services provided to all levels of society [Chick, 1997]. Especially in recent years, frequent natural disasters occurred, the insurance industry enable enterprises to resume

production quickly after the disaster, reduce the economic loss of people, and promote the social stability.

In the background of economic globalization, foreign investment has flooded into the insurance industry [Blonigen, 1996]. It's true that we cannot deny that the entry of foreign capital and foreign insurance companies can help the host country's insurance industry expanding strength, learning advanced technology and improving management and decision-making level [Eric, 2005]. Meanwhile, we should also take the challenges seriously. External factors influencing the security of the insurance industry are gradually increased, and with the accelerating process of opening up, the external influence factors will be more and more [Mansor, 2000]. If foreign capital dominant the insurance system, insurance security will be threatened and damaged in the sense of "economic sovereignty". In 2008, the world financial crisis push problem of risk on the forefront of the financial industry. Insurance industry's major business is to operate risk [Barnic, 1992]. Its security is of great significance for the stable operation of the entire financial industry. Therefore, how to design a scientific evaluation index system to analyze and evaluate the security of the Chinese insurance industry is an important practical significance.

2. Principle of Constructing Insurance Industry Safety Evaluation Index System

(1)Comprehensiveness principle: To objectively reflect the contents of evaluation objects, the index number and its system structure should follow the comprehensiveness principle.

(2)Level principle: The evaluation index system should take all aspects of the relationship into consideration. For there are existence of constraint relationships among same level index, one should take into account all aspects of the indicators in the design of index system.

(3)The scientific principle: The scientific principle is mainly embodied in the combination of theory and the used of scientific method etc. The setting of index

system shall conform to the goal of industrial safety evaluation and shall reflect the effects and the existence of problems about mechanism function comprehensively and truly.

(4) Principle of comparability: Evaluation index can reflect the deviation information of industry business activities. It can make rapid reflection about abnormal phenomenon in business activities. By that way, it provides the basis for correct analysis and determination.

(5) Principle of operation: The data evaluation index calculation based on must be available from insurance financial statements or other public ways, and should make the data timely, true, accurate and complete. Index meaning must be clear. The calculation process must be simple and easily operate.

3. Construction of Insurance Industry Safety Evaluation Index System

Insurance industry safety evaluation is a complicated economic problem and it cannot be measured by a single index attribute. Through a comprehensive analysis of many factors which influence the external environment and internal environment of insurance industry, one can evaluate insurance industry safety by identifying the following main index (table 1).

Table 1. the safety evaluation index system of China insurance industry.

Target layer	Principle layer		Index layer
	One-level principle layer	Two-level principle layer	
Safety evaluation index system of insurance industry	External environment	Macroeconomic environment	real GDP growth rate
			real exchange rate
			Inflation rate
		Industry controlling power	market control rate of foreign capital
			foreign equity control rate
			foreign assets control rate
			foreign investment control
		Industry developing power	insurance density
			insurance depth
			premium growth rate of total
			fixed assets net value growth rate

	Internal environment	Market size	employment growth rate
			industry loss
			gross premium
			total assets
			market share
		Profitability	loss ratio
			scale of charges
			overall labor productivity
			rate of return on investment
			growth rate of balance in the use of funds
			reward rate of ownership
			all capital earnings rate
		Liquidity of assets	investment rate
			current ratio
			total debt ratio

3.1 External environment

A business does not operate in a vacuum. It has to act and react to what happens outside the factory and office walls. These factors that happen outside the business are known as external factors or influences. These will affect the main internal functions of the business and possibly the objectives of the business and its strategies.

(1) Macroeconomic environment

Mainly refers to the stage of development of the economy, the level of development, economic system, market system, income level, budget, trade and balance of payments situation of the host country.

- Real GDP growth rate: This indicator is a dynamic index that reflects the changing degree of economic development in a certain period. It is also a basic index that reflects whether the country economy is dynamic.
- Real exchange rate: Exchange rate risk is very important to an industry especially to foreign trade industry. Therefore, one chooses index of exchange rate to reflect the influence of the exchange rate risk.
- Inflation rate: In practice, it is not possible to directly calculate inflation, but indirectly through the growth rate of the price index. The consumer price index fully and comprehensively reflects the inflation rate of the price index.

(2) Industry controlling power

In open conditions, the national capital must dominate the home market. Through the realization of industrial control, it can determine the pricing of the product, control the flow of wealth and realize industry's survival safety. At the same time, through the realization of industrial control, it can change the process and the development direction of the industry and ensure industry safety.

- The control rate of insurance's foreign capital market: The index reflects the extent of which the China insurance enterprises of foreign capital control to the domestic market. It can be measured by the industrial market share of foreign capital control and the total market share of domestic insurance industry. The higher the control rates of foreign capital market, the greater the influence on China insurance industry safety development.
- Foreign equity control rate of insurance: The index reflects the conditions of foreign equity control towards domestic industrial from the perspective of equity. In general, if the single enterprise foreign equity share is of more than 20%, it can relatively control the enterprise. If it is of more than 50%, it can absolute control enterprises. It can be measured by the ratio of possessory rights and interests of foreign ownership control and domestic industry's total owner's equity. The higher the ratio, the greater the influence on industrial safety development will be.
- Foreign assets control rate in insurance industry: This index reflects the situation of foreign investment's control to our domestic industry from the point of view of asset, and it can be measured by total capital ratio between total assets in foreign-funded enterprises and industries. The higher control rate of foreign assets to China's insurance industry, the greater the risk is and the lower the safety of our insurance industry.
- Control degree of foreign investment in the insurance industry: This index reflects the situation of foreign investment's control of our domestic industry from an investment perspective, and it can be measured by the ratio between total net fixed assets of foreign enterprise and total net fixed assets of whole

industry. The higher control rate of foreign assets to China's insurance industry, the greater the risk is and the lower the safety of our insurance industry.

(3) Industry developing power

Enterprise and industry want to have the potential capacity of expanding the scale and growing strength.

- Insurance density: It reflects the per capita premium income level of a country's insurance industry by calculating population. It equals to the ratio of premium income and population. The larger the value is, the higher the average level and the higher the degree of insurance industry safety.
- Insurance depth: It reflects the standard average of a country's insurance industry as compared to GDP. That is, the level of premium income per unit GDP, which equals to the ratio of premium income and GDP. The greater the value, the higher the average level and the safer the insurance industry will be.
- The growth rate of the total premium: This index reflects the scale of development of the insurance industry, the higher the amount of it, the higher level of insurance's effective supply, the greater development ability of the insurance industry.
- The growth rate of net fixed assets: This index reflects the development of the industry from the perspective of fixed assets, and it can be measured by the ratio between net added value of accumulated capacity and net ratio of fixed assets at the beginning. The higher the ratio is, the smaller the extent of the effects on industrial safety.
- Employment growth rate: This index analyzes the development of an industry from the perspective of the employee's employment, the more employment is, the more gaining accesses to suitable talents, the more helpfulness to the development of enterprise. Therefore, the higher the ratio is, the smaller the extent of the effects on industrial safety.
- Industry loss: This index analyzes development of the industry from the

perspective of corporate net income, the smaller losses of Industry are, the stronger development ability of the Industry and the more conducive to industrial safety.

3.2 *Internal environment*

An organization's internal environment is composed of the elements within the organization, including current employees, management, and especially corporate culture, which defines employee behavior.

(1)Market size

It is composed of three indicators: gross premium, total assets and market share. In order to do a better comparison between different countries and regions, with the last day exchange rate of report, the national currency is translated into U.S. dollars for comparing.

Market share: The indicator is the proportion about the product sales of our country nation industry or enterprise accounted for the total sales of the products in the international or domestic market under the condition of open economy.

(2)Profitability

The profitability mainly tests the health of company operating and the company's profit contributing to the company's financial strength. There are seven indicators as follows:

- Loss ratio: The loss ratio reflects underwriting business payout of insurance companies. This ratio measures the company underwriting profit or loss experience in insurance business. This is a negative indicator.
- Scale of charges: This indicator reflects the insurance companies underwriting the cost of business. The expense ratio is a measure of underwriting expenses. This is a negative indicator.
- Overall labor productivity: Labor productivity is the comprehensive performance of enterprise's production technology level, management level, technical proficiency degree and labor enthusiasm. The higher the labor productivity is, the safer the industry.

- Rate of return on investment: This ratio is defined as the net investment income ratio of total investment assets. This is a positive indicator.
- Growth rate of balance in the use of funds: This index reflects the development ability of the industry from the perspective of capital accumulation capacity, and it can be measured by the ratio between increase the value of a fund balance and fund balance at the beginning. The higher the ratio is, the smaller the extent of the effects on industrial safety.
- Reward rate of ownership: This ratio measures the efficiency of using surplus on the basis of total income. The total income is the income with all after-tax net income of underwriting and investment activities, including unrealized capital gains. This is a positive indicator.
- All capital earnings rate: It is the company's after-tax net income to total assets ratio. This ratio measures the efficiency of using asset on the basis of gross rate. This is a positive indicator.

(3)Liquidity of assets

Mobility is testing company's ability to fulfill expectations of short-term and long-term obligations to its policyholders and other creditors. To evaluate company liquidity, there are following indicators:

- Investment rate: This indicator can be defined as the ratio of total investment assets. This ratio measures the ability of using its assets effectively. This is a positive indicator.
- Current ratio: This indicator is the ratio of current assets to current liabilities. It measures the ability of paying current liabilities by cash and short-term investments.
- Total debt ratio: This ratio measures the ability of paying total liabilities by company's total assets.

4. Empirical analysis of safety warning in the insurance industry

4.1 Establishment of early warning model of BP neural network

(1) The way of data normalization. Because the problem of the various indicators with the different direction and magnitudes and other issues, in order to make all kinds of index have comparability throughout the system, and better BP artificial neural network training, before the establishment of BP neural network, it need to have data normalization on the non-dimensional index value to converse the closed interval $[0,1]$. The normalization method used in this book is short form nominalization, namely:

$$Y_{ij} = \frac{X_{ij} - \min X_i}{\max X_i - \min X_i}$$

Where i is the i -warning economic indicators, and j is the j -th year, X_{ij} is the j -raw data of i index, Y_{ij} is the normalized data of i index in the j -th year. To take raw data generation of early warning indicators from year 2000 to 2008 into the above formula, sample data of the new BP artificial neural network of early warning systems is available.

(2) The determination of network layers. In 1989, Robert Hecht-Nielson proved that for any continuous function of a closed interval can be used to approximate a hidden layer of BP network, and thus a three-layer BP neural network can complete any mapping from n -dimensional to m -dimensional. So this BP neural network model uses a single hidden layer network.

(3) The select of input layer nodes. The number of input layer nodes Corresponds to the number of evaluation. This book has a simulated evaluation selected from year 2000 to 2008 twenty-two monitoring index value. Therefore, the network input layer node i is 22.

(4) The determination of the hidden nodes. The choice of the number of hidden units and the amount of input and output units have direct relations, which can refer to the following formula:

$$n_i = (m + n) / 2 + a$$

Where n_i , m , n , a is the units number of hidden layer, the number of input neurons, output neurons and the constant term, a can randomly selects 1-10 constant respectively.

When we are building a BP neural network, we can use the following methods to increase or decrease the hidden layer nodes-the constructor method, firstly set less hidden layer nodes, if the network output occur errors and does not meet the requirements, then gradually increase the number of nodes until the network error is no longer significant decrease up; delete method is to give a larger hidden layer nodes to the network, if it does not meet the requirements, then gradually remove the hidden layer node, until the appropriate date. Taking into account the nonlinear mapping ability of single hidden layer network is weak, for the same problem, in order to achieve the desired mapping; hidden layer nodes to be more to increase the network adjustable parameters, the network eventually determine the hidden layer number is 22.

5. Selection and processing of the output node. The selection of the output node corresponds to the evaluation results, and this need to determine the desired output. In the learning and training phase of neural network, the desired output value of the "sample" is a known quantity; it can be assessed by the given historical data or through a number of mathematical and statistical methods. The following will use the evaluation results of the multivariate factor analysis as the expected value.

Using the factor analysis module of the SPSS13.0 software, and normalized data from 22 indicators that reflects the insurance industry safety from year 2000 to 2008 as the foundation the for factor analysis. Using main component analysis method to extract 22 factors, but extract four factors, the cumulative variance will reached 89.853%.

According to the basic principle of main component analysis, the number of main components can be determined by the cumulative contribution rate. Generally, set the standard of cumulative contribution ratio as $\alpha \geq 0.85$. For the selected q main components, the cumulative contribution rate will reach 85%, i.e. $\alpha \geq 0.85$; then the main ingredient can be identified as q. It indicates that the selected main component q, basically retain the information of the original p variables. When determining the number of the main components under the condition of $\alpha \geq 0.85$, minimize the number of the main components. Therefore, in this case we provide

four factors, denoted as F1, F2, F3, and F4 factor.

Calculate the score of each factor through Factor loading matrix and calculate total factor Ft score by four factors as the weight of the proportion of variance contribution rate to the maximum rotation factor accounts for the total variance contribution rate.

$$F_t = (\lambda_1 / \sum \lambda_i) F_1 + (\lambda_2 / \sum \lambda_i) F_2 + (\lambda_3 / \sum \lambda_i) F_3 + (\lambda_4 / \sum \lambda_i) F_4$$

According to previously content early warning system is divided into five parts: danger 1, threat 1, safe, threat 2, and danger 2. And correspondently divided into five security zones: danger 1, threat 1, safe, threat 2 and danger 2. The 4 intervals are corresponds to the factor score table in 5 states: $F < \text{danger 1}$, $F \in (\text{danger 1}, \text{threat 1})$, $F \in (\text{threat 1}, \text{threat 2})$, $F \in (\text{threat 2}, \text{danger 2})$, $F > \text{danger 2}$. The score interval of every security status are corresponding to the network desired output value A(00001), B(00010), C(00100), D(01000) and E(10000). Thus the Network desired output value of each factor.

4.2 The training, testing, and early warning of the MATLAB in early warning model

The 22 early warning indicators, a total of nine years of index data from year 2000 to 2008, select indicators from year 2000 to 2006 data as a training set to train the network. And the year 2007 data to be tested as a test set, the year 2008 data as enter value to the early warning.

First thing is the confirmation of the transfer and training function. Due to the Input data is in [0, 1] and the desired output is also in [0,1], so the implicit layer and output layer are both adopt LOGSIG conversion functions. Share conjugate gradient algorithm training function to train the network, in order to obtain fast convergence rate.

Second is the confirmation of learning rate (η). With the increases of learning rate, the number of iterations is significantly reduced. Small network, the learning rate can be made bigger, a relatively large-scale network, when the learning rate is larger, the network will diverge, and the small learning rate will substantially extend the training time. After comprehensive consideration, the learning rate is determined η

to 0.01.

Third is to determine the maximum number of epochs. if the maximum number of steps to reach convergence but it did not achieve the target accuracy, then increase the maximum number of steps; if the training achieve the target accuracy after N steps, but far from reaching the maximum number of steps, then smaller the maximum number of steps, if its value is still slightly larger than N. Ultimately determine the maximum number of steps as 150.

Fourth, determine the goal. The higher general goal the higher accuracy of network training, thus the training output values and target are closer, but the training time will be longer. The finalization of the target precision is $1e-10$ (scientific notation).

The fifth is the simulation program. After the training network, firstly, emulate the normalized network input values, the data from year 2000 to 2006, the training sample, and compare the output value and the desired output value of the test samples; then simulation of the normalized data in year 2007, and compare the actual output value and the desired output value. When the error is within the acceptable range, indicating that this network has to meet the requirements.

(1) Training the early-warning model based on the BP artificial neural network. Training on the normalized data from year 2000 to 2006, the training input of BP model are as follows: F1, F2, F3, F4, each factors output in Ft neural network training, and compare the output values and the desired output value.

(2) Test of BP artificial neural network early-warning model. Normalized data in year 2007 as input come up with the neural network training output factor of year 2008, compare desired and actual output value to determine the error situation, analyze the BP model of inspection effectiveness.

(3) The early warning of BP artificial neural network early warning model. Normalized data in year 2008 as input, we can have the factored neural network prediction output in year 2009, forecast the conclusion by the early warning criteria.

4.3 Result analysis

According to the foregoing, the early warning system area is divided into: danger 1,

threat 1, safe, threat 2, danger 2. Correspond to divide into five security zones: A danger 1, B threat 1, C safe, D threats 2 and E danger 2. The overall industrial security level of the Chinese insurance industry in year 2009 is in "threat ", and mainly influence by the factor of F2 and F4. According to the factor loading matrix, F2 and the F4 factors controlled by seven indicators that is the foreign capital market rates, foreign equity control rate, foreign assets control, control of foreign investment, the growth rate of the total premium, the total investment growth, as well as the insurance depth. The seven indicators can be classified as industrial control of the insurance industry, the use of premium income and premium funds. Therefore, in order to enhance the safety of China's insurance industry, China should strengthen the control and management of foreign investment, and strive to improve the industrial control of the insurance industry; insurance product innovation to meet the needs of potential insurance market; improve insurance coverage, raise premiums income; broaden funds use channels, increase the use of insurance funds the professional level, to obtain a higher return on investment income.

5. Summary

This work design a scientific evaluation index system to analyze and evaluate the security of the Chinese insurance industry by External environment (Macroeconomic environment, Industry controlling power, Industry developing power) and Internal environment (Market size , Profitability , Liquidity of assets) is an important practical significance.

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