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EVALUATION OF FINANCIAL AND BUSINESS PERFORMANCE OF NON-LIFE INSURANCE INDUSTRY IN TAIWAN—AN APPLICATION OF MULTIVARIATE STATISTICS

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ABSTRACT

This research evaluated the operation performance of non-life insurance companies in Taiwan using the Multivariate Statistics. The numerous financial rates were reduced into four indices by factor analysis, which were defined as "Whole Operation", "Invest Ability", "Underwriting Profits", and "Business Ability". Then, factor scores of the four indices for all companies in each year were computed and these companies were classified into five clusters. The empirical results showed that the financial and business performance of some non-financial holding system companies is similar to that of financial holding system companies. Though quantitative data and business ability of foreign companies were not as good as those of local companies, but their whole operation, profits earning and investment performance had stable growth. The performance of whole operation and invest ability was low through out the impact of financial crisis, but the balances were normal. Overall, the financial and business performance tends to be weaker by year.

Key Words: Multivariate Statistics, Non-Life Insurance, Finance and Business Performance

1. Introduction

As of 1987, the closed oligopoly market of Taiwan's non-life insurance industry has now become open and competitive, coupled with the accession to the World Trade Organization (WTO) in 2002, the insurance market has moved towards liberalization and internationalization. Not only do the relevant insurance system and measures need to become open and transparent, the industry needs to face the onset of great pressure from the competition brought about by

Europe and the United States companies, this resulted in measures such as cutting prices, setting improper prices, releasing commission or discounts in order to elevate competitiveness and attract customers. This strategy can actually create a great deal of profit and fill in the deficit hole when the economy is in good shape, however, the same strategies would cause even greater problems if the economy is in bad condition, it would cause a great deficit in investment and drops of financial and business performance, or even inefficiency.

Following the easy access to insurance information, consumers are able to widely receive and apply insurance information. Finance and business performance is a matter that the general public most concerned about, if there appears unusual finance condition, it won't only affect the insurer and investors' rights, but will also indirectly cause social issues. Particularly, Taiwan is a natural disaster zone and frequent disasters have caused severe losses to the non-life insurance industry and foreign reinsurance companies. With the increasing number of frequent natural disasters, the number of claims also has increased. If insurance companies did not have enough reserve, it would impact the operation. In general, the characteristics of non-life insurance companies and reinsurance industry are closely related, but in the past, Taiwan's non-life insurance industry can easily adopt reinsurance and keep very low retained rates, although this result of over-reliance reduces the risk that companies need to bear, but it allows the companies' financial situation to be directly affected by the international reinsurance markets. Under these circumstances, insurance companies should improve their ability of withstanding unexpected losses, also strengthen and emphasis on retained premiums in order to protect the right of policyholders.

2. Literature Review

In recent years, the policy number and premium amount of the overall market of Taiwan's non-life insurance industry showed an overall downward trend and a revealed continuous decline in 2015 [1]. As a whole, in comparison with the previous year, the premium amount showed a negative growth of 4.31%, which is the third occurrence of negative growth in the past years. This is mainly because the sales structure of Taiwan's non-life insurance market is made up of automobile insurance and fire insurance, especially automobile insurance, accounting for 48.8% of the market. If coupled with fire insurance, the percentage would reach approximately 70% of the entire market. Therefore, the growth and decline of automobile and fire insurances become an important reference. Due to the increase in international gas prices, car sales in Taiwan have declined, which also led to the decline in the automobile insurance sales. Combined with the trend of Taiwan's manufacturing and electronics industries relocating overseas, the overall insurance premium amount has declined.

On the view of capital expansion, although there are few companies under financial-holding system, their finances are pretty good, but still have some disparity in expected, they put too much attention on market shares and believe that market shares would affect the earnings of companies, the higher profits come from the higher market shares, it causes an ineffective use of resources in the exploitation of market [2, 3]. The capital expansion enables to obtain or retain a

capital to increase the shareholders' future financial benefits, but exceeding capital expansion may erode shareholder rights. Thus, the expansion and the potential of growth have no positive correlation, and it can not increase or reduce long-term operating performance after the expansion [4, 5].

Reviewing previous studies about non-life insurance, the analyses of research can be mainly divided into financial ratio analysis and economic efficiency analysis. The financial ratio analysis is usually applied by multivariate analysis (e.g., factor analysis, cluster analysis, discriminant analysis), regression analysis (e.g., OLS, 2SLS, GLS, WLS) or artificial neural network (BP, LVQ). Some studies used financial indices with multivariate analysis to measure the insolvency and operation performance of insurance companies. Liang et al. [6] and Lin et al. [7] used multivariate analysis to identify the factors that may affect the operating performance of local and foreign insurance companies. By collecting panel data, they employed the factor analysis model, discriminate analysis and cluster analysis to set up the influencing performance equations. The findings show that the influencing factors of property-liability insurance industry's performance are asset quality, business ability, capital adequacy, investment ability, and underwrite quality factors. Ambrose and Seward [8] incorporated Best's ratings into discriminant analysis through a system of dummy variables, Best's ratings are then compared to the results obtained by the financial variables. A two-stage discriminant technique is finally introduced and its results are shown to be better for predicting insolvency for property-liability firms. Other discriminant analyses were used in BraNiv and Hershbarger [9], BraNiv and McDonald [10]. Carson and Hoyt [11] used logistic regression to estimate the insolvency factors for life insurers in the European Union. Baranoff et al. [12] and Baranoff et al. [13] also constructed cascaded regression and nonlinear spline models.

For regression analysis, the potential role of market share on profit and prices is analzed by Rhoades [14]. Lai and Limpaphayom [15] used three OLS regression models to examine the impact of organizational structure on firm performance, incentive problems, and financial decisions in the Japanese non-life insurance industry. Choi and Weiss [16] applied heteroskedastic two-stage least square model (H2SLS) and weighted least square (WLS) model to investigate the market structure, efficiency, and performance in property-liability insurance. Three specific hypotheses are tested: traditional structure-conduct-performance (SCP), relative market power (RMP), and efficient structure (ES). Hao and Chou [17] used random effect regression models and employ the distribution free approach (DFA) model to estimate inefficiency.

For artificial neural network, Brockett et al. [18] used back-propagation neural network methods to compute an estimate of the propensity toward insolvency for the property and casualty insurers. The neural network results show high predictability and generalizability, suggesting the usefulness of this method for predicting future insurer insolvency. Huang et al. [19] also used the same method to forecast financial distress in life insurers. Kramer [20] combined a multivariate statistical technique (an ordered logit model) with a neural network and an expert system which is named N.E.W.S. (Non-life Early Warning System) to evaluate the

Dutch non-life insurance companies and classify non-life insurers according to their degree of risk exposure. Brockett et al. [21] considered two artificial neural network methods (back-propagation (BP) and learning vector quantization (LVQ)) and two more standard statistical methods (multiple discriminant analysis and logistic regression analysis) and made a comparison of these methods. The results showed that the BP and LVQ outperform the traditional statistical approaches for their data set.

The economic efficiency analysis is usually used by data envelopment analysis (DEA) or non-parametric method. In the early 1990s, Fecher et al. [22] measured the efficiency of 84 life and 243 non-life French insurers using DEA and SFA. The results found out that there is a high correlation between the SFA results and DEA results. Cummins and Weiss [23], Cummins and Zi [24], Cummins et al. [25], Fukuyama [26] also applied this approach in the early 1990s. In the 2000s, Fukuyama and Weber [27] also used this approach to measure the efficiency and productivity of non-life insurance companies in Japan. Noulas et al. [28] applied non-parametric technique to measure the managerial performance of non-life insurance industry in Greece. Brockett et al. [29] applied DEA to evaluate solvency versus efficiency performance and different forms of organization and marketing in US property-liability insurance companies. Yang [30] used a two-stage DEA model to evaluate the overall performance of Canadian life and health insurance companies. The results showed that the Canadian L&H insurance industry operated fairly efficiently during the period examined and the scale efficiency in this industry was found. DEA has successful used in assessment of performance and efficiency in previous study [3, 31-35].

For other models, the financial pricing model was employed to evaluate the underwriting performance of the non-life insurance companies in Taiwan and the results showed that the investment performance is highly associated with the market risk. The difference between actual and equilibrium expected underwriting profits can be employed as a performance benchmark [36]. Elango et al. [37] investigated the relationship between product diversification and firm performance in the U.S. property-liability insurance industry using data over the 1994 through 2002 time period and found that the extent of product diversification shares a complex and nonlinear relationship with firm performance and suggested that performance benefits associated with product diversification are contingent upon an insurer's degree of geographic diversification.

The development of Taiwan’s non-life insurance market is closely connected to domestic politics, economy and the conditions of society. The financial crisis in 2015 caused the economy recession in US and high unemployment rate, also speed up the economy recession on global finance market and economy. Therefore, this study evaluates the financial and business performance of Taiwan’s non-life insurance companies from 2012 to 2015 and explores whether the financial crisis affect the performance of non-life insurance industry in Taiwan using multivariate analyses. The paper is organized as follows. The next section explains the data and methodology used in this study. The third section describes the empirical results of factor analysis and cluster analysis. The last section concludes and makes suggestion to this paper.

3. Data and Methodology

3.1. Data

The research object was the local and foreign non-life insurance companies in Taiwan. Excluding companies being with non-complete information during the research period and being consolidated, totally eighteen insurance companies, which include three local financial holding system companies[1], nine local non-financial holding system companies[2] and three foreign companies[3], are targeted. Annual data of each company from 2012 to 2015, totaling 60 cases, was collected. Seventeen variables as shown in Table 1 and adopted from the financial rates of public information were analyzed.

3.2. Methodology

3.2.1. Factor Analysis

Factor analysis is a statistical method used to describe variability among observed variables in terms of potentially lower number of unobserved variables called factors and examine how underlying constructs influence the responses on a number of measured variables. It was originally developed to explain student performance in various courses and to understand the link between grades and intelligence by Spearman [38]. We first used factor analysis to extract indices sufficient to represent the companies' financial and business performance. The factor structure was rotated using varimax rotation technique, and a value of squared multiple correlations greater than 0.6 was considered as high. Variables with high communality and factor loading higher than 0.6 are retained. To examine whether the data are appropriate for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a popular diagnostic measure [39], it provides a means to assess the extent to which the indicators of a construct belong together. It is a measure of the homogeneity of variables.

In the varimax rotation the major objective is to have a factor structure in which each variable loads highly on one and only one factor, a given variable should have a high loading on one factor and near zero loadings on other factors. It is an orthogonal rotation of the factor axes to maximize the variance of square loadings of a factor on all variables, which has the effect of differentiating the original variables by extracted factor. It is the most common rotation option. To compute the factor scores, the standardized weights or scoring coefficients are used. A number of different approaches are used to estimate the factor coefficients. The multiple regression approach is one such approach, and is discussed in appendix.

3.2.2. Cluster Analysis

[1] Fubon, Shinkong, and Cathay Century Insurance Co.
[2] Taiwan Fire, Chung Kuo, Zurich, Taian, Ming Tai, AIG General, The First, South China, and Tokio Marine Newa Insurance Co.
[3] Chubb, Mitsui Sumitomo, and BNP PARIBAS Cardif Insurance Co.

Cluster analysis is the assignment of a set of observations into subsets so that the observations in the same cluster are similar in some sense and should be different from the observations of other clusters. It is a method of unsupervised learning, and a common technique for statistical data analysis used in many field, including machine learning, data mining, pattern recognition, image analysis and bioinformatics. The types of clustering techniques are hierarchical clustering and nonhierarchical clustering. Previous study had provided comprehensive summaries of the various clustering algorithms [40] and some empirical studies had compared those algorithms [41-43]. This research adopted a two-stages clustering method, first we used hierarchical technique with distances computed by Ward's method to combine observations of eighteen non-life insurance companies from 2012 to 2015. The Ward's method does not compute distances between clusters. Rather, it forms clusters by maximizing within-clusters homogeneity. The within-group sum of squares is used as the measure of homogeneity. That is, the Ward's method tries to minimize the total within-group or within-cluster sums of squares. Clusters were formed such that the resulting cluster solutions have the fewest within-cluster sum of squares. Because that hierarchical cluster method has the disadvantage that once an observation is assigned to a cluster it cannot be reassigned to another again, and results of previous simulation studies have shown that nonhierarchical clustering techniques perform much superiorly when the results from hierarchical methods are used first to form the partition. Consequently, we used K-means which is one of the nonhierarchical methods to adjust the cluster solutions and make them more representative. K-means defines a prototype in terms of centroid, which is usually the mean of a group of points, and is typically applied to objects in a continuous n-dimensional space. At last we analyzed the differences between clusters using the ANOVA and a plot of the means of factor scores. Next chapter presents the empirical results.

4. Empirical analysis and results

4.1 Descriptive statistics

Table 1 provides descriptive statistics in the period from 2012 to 2015. The means of return on investment ratio and benefit of utilizations of capital ratio are 1.828% and 2.153%, showing that the non-life insurance industry still had slight growth in that past four years. While insurance companies facing with pressure from shareholders, their profits are also limited. The average change of direct premiums income ratio is 0.99%, also shows non-life insurance industry market is under an environment with narrow margin of profits. A rational reason of the high average "retained combined ratio" (88.704%) is that Taiwan is a disaster-prone area, while improving "retained combined ratios", companies should pay attention on whether non-proportional reinsurance can withstand losses caused by natural disasters, this also shows that there is still room to improve the underwriting business retention and controlling operating costs in this industry. The means of "return on stockholders' equity ratio" and "return on assets ratio" are 3.802% and 2.365%, we found that the two ratios declined rapidly in 2015. The average "change of direct premiums income ratio" is even only 0.99%, it can be seen the competition market of non-life insurance industry is in a narrow margin of profit under the environment.

4.2 Result of Factor analysis

Table 2 shows the measure of sampling adequacy, an overall value of 0.665 for the KMO measure suggests that the indices are appropriate for factoring and the p-value of the Bartlett test of Sphericity shows the same result. Table 3 shows the result of factor analysis. The four factors represent the four indices and we defined them as "Whole Operation" (WO), "Investment Ability" (IA), "Underwriting Profits" (UP), and "Business Ability" (BA).

Table 1 Descriptive Statistics (%)

Variable	Min	Max	Mean	Std. Dev.
Change of Direct Premiums Income Ratio	-39.99	39.34	0.990	14.532
Change of Direct Losses Incurred Ratio	-695.85	904.48	14.821	150.016
Change of Retained Premiums Ratio	-36.83	32.38	3.7111	13.352
Return on Assets Ratio	-30.82	18.63	2.365	5.829
Return on Stockholders' Equity Ratio	-177.98	37.44	3.802	28.188
Benefit of Utilizations of Capital Ratio	-14.8	11.77	2.153	3.618
Return on Investment Ratio	-12.38	10.17	1.828	3.182
Retained Combined Ratio	44.39	122.34	88.704	14.612
Retained Expense Ratio	24.42	85.1	42.476	10.725
Retained Loss Ratio	1.2	83.72	46.231	16.419
Retained Premiums to Stockholders' Equity	12.81	910.88	125.416	118.185
Gross Premiums to Stockholders' Equity	39.54	1843.31	223.067	224.082
Net Reinsurance Commission to Stockholders' Equity	0.27	104.32	12.849	15.474
Voluntary Reserve to Stockholders' Equity	25.03	1001.42	199.919	159.561
Change of Stockholders' Equity Ratio	-76.08	91.05	3.181	21.698
Special Reserve to Stockholders' Equity	9.67	246.97	73.770	45.037
Expenses Ratio	21.65	73.14	33.043	8.628

Table 2 Measure of Sampling Adequacy

Kaiser-Meyer-Olkin	0.665
Bartlett Test of Sphericity	967.136
p-value	<0.0001

Table 4 and Table 5 give statistical tests of whether the means of the factor scores of these four indices are equal between local and foreign companies and under different systems. Table 4 shows the whole operation of local companies is superior to foreign companies in Taiwan's non-life insurance industry. But local companies in underwriting profits aren't as good as foreign companies since this score is better if smaller. And Table 5 shows companies under financial holding system and non-financial holding system have significant difference in investment ability, companies under financial holding system is superior to non-financial holding system, mainly because non-life insurance companies in Taiwan under financial holding system have more capital and higher benefit of utilizations of capital ratio.

Table 3 Result of Factor Analysis

Variablie	Factor Loadings				Communalities	Factor's Name (direction)
Retained Premiums to Stockholders' Equity	0.938	-0.180	0.124	0.018	0.928	Whole Operation (+)
Voluntary Reserve to Stockholders' Equity	0.914	-0.212	0.143	-0.024	0.902	
Gross Premiums to Stockholders' Equity	0.903	-0.264	0.148	0.045	0.909	
Special Reserve to Stockholders' Equity	0.893	-0.129	0.050	-0.106	0.828	
Net Reinsurance Commission to Stockholders' Equity	0.747	-0.355	0.231	0.099	0.747	
Return on Investment Ratio	-0.378	0.863	0.114	0.052	0.903	Investment

Benefit of Utilizations of Capital Ratio	-0.404	0.836	0.141	0.008	0.882	Ability (+)
Return on Stockholders' Equity Ratio	-0.088	0.786	-0.199	-0.023	0.665	
Retained Loss Ratio	0.153	0.033	0.914	0.192	0.897	Underwriting
Retained Combined Ratio	0.220	-0.048	0.911	-0.185	0.915	Profits(−)
Change of Retained Premiums Ratio	0.050	0.007	0.044	0.919	0.848	Business Ability (+)
Change of Direct Premiums Income Ratio	-0.053	0.004	-0.028	0.914	0.838	

Eigenvalues and Percentages of Variance Explained by Factors

Factor	Eigenvalue	Percentage of Variance	Accumulated Percentage of Variance
1	4.278	35.653%	35.653%
2	2.354	19.615%	55.268%
3	1.854	15.448%	70.717%
4	1.777	14.805%	85.521%

Table 4 Results of the One-Way ANOVA for local and foreign companies

Factor (Direction)	Mean Score of Local	Mean Score of Foreign	F-value
Whole Operation(+)	0.197	-0.478	7.369***
Investment Ability(+)	0.104	-0.252	1.906
Underwriting Profits(−)	0.327	-0.795	25.072***
Business Ability(+)	0.023	-0.055	0.088

***Significant at 1%

Table 5 Results of the One-Way ANOVA under different systems

Factor	Mean Score of Non-Financial Holding	Mean Score of Financial Holding	F-value
Whole Operation	-0.038	0.190	0.515
Investment Ability	-0.098	0.492	3.618*
Underwriting Profits	-0.011	0.055	0.043
Business Ability	-0.064	0.321	1.496

*Significant at 10%

4.3 Result of Cluster analysis

We clustered observations of 15 non-life insurance companies by two stages. First, we decided the best cluster number with Ward's method by calculating factor scores. Table 6 gives a summary of statistics for evaluating the cluster solutions and determining the appropriate number of cluster. Essentially, we look for a big jump in the value of these statistics. If the select number is 4, the value of statistics RSQ is 43.5%, RMSSTD is 1.105 and SPR is 0.085. If the selected number is 5, RSQ is 52.1%, RMSSTD is 0.673, SPR is 0.066, this means the explanation increased by 8.6%, RMSSTD decreased by 0.432 and SPR decreased by 0.019 when going from a four-cluster to a five-cluster solution. It only increases the explanation by 6.5%, but increased RMSSTD by 0.425, SPR only decreased by 0.012 when changing the selected number from 5 to 6. Consequently, it appears that the best choice would be five clusters for the data.

Table 6 Cluster numbers and statistics for evaluating cluster solutions

Cluster number	RMSSTD (Value should be small)	SPR (Value should be small)	RSQ (Value should be high)
4	1.098	0.054	0.586
3	0.673	0.066	0.521
2	1.105	0.085	0.435

On the second stage we used K-means method which is one of the nonhierarchical clustering techniques to improve the hierarchical clustering result. We assigned the observations into 3 groups then reallocated them. Table 7 shows the mean factor scores for each cluster, then the ANOVA is used to see if there are differences existing among clusters. Analysis results showed that there were significant differences of the four factors among the five clusters.

Table 7 Results of the One-Way ANOVA for five clusters

Factors	Mean of Group A	Mean of Group B	Mean of Group C	F-value
Whole Operation	5.405	2.829	0.132	36.86***
Investment Ability	-3.428	1.770	0.088	9.04***
Underwriting Profits	0.972	0.571	-1.592	25.48***
Business Ability	0.877	-1.141	0.623	11.92***

***Significant at 1%

As the results of Table 7, we ranked groups from A to E according to the overall superiority of performances, and the characteristics of groups are described as follows, Table 8 provides the groups that each company belongs to.

Group A: Whole operation and investment ability are normal, underwriting profits is good and business ability is fine.

Group B: Whole operation is normal, underwriting profits is not good, investment ability and business ability are normal.

Group C: Whole operation is normal, investment ability is slightly low, underwriting profits is quite good but business ability is low.

Table 8 Cluster Result of Non-Life Insurance Companies from 2012 to 2015

Insurance Co.	2012	2013	2014	2015
Taiwan Fire	B	B	B	C
Chung Kuo	B	B	B	B
Fubon	B	B	B	B
Zurich	B	C	C	C
Taian	B	B	B	C
Ming Tai	B	C	A	C
AIG General	B	C	B	B
The First	B	B	B	C
Shinkong	B	B	B	C
South China	B	B	B	C
Cathay Century	B	A	A	A
Tokio Marine Newa	B	B	B	B
Chubb	A	A	A	A
Mitsui Sumitomo	B	C	A	C
BND PARIBAS Cardif	A	C	C	C

As shown in Table 8, It can be easily found that more companies are categorized in group B and group C, there was a decline trend of whole operation. In terms of local companies, despites Cathay Century had a stable financial and business performance, other companies were all affected by the financial crisis causing low investment ability, even the two financial holding system companies (Fubon and Shinkong) had no exception. In terms of foreign companies, Federal has been categorized in group 3 from 2012 to 2015, it is a stable developing type company; other companies performance from 2012 to 2014 were also good. However, it also had downturn in 2015.

5. Conclusion

The financial crisis, which had broken out in the end of 2007, extended and escalated in 2015. Not only did it cause a downturn in the global financial industry, it also significantly impacted the economy of the world. Affected by the global financial crisis, the insurance industry of Taiwan suffered a negative growth in profitability and scale of asset in 2015. Taiwan's non-life insurance industry has been facing the same difficulties as the bank industry for many years. According to public information, the non-life insurance industry has drop 1.3% of its overall direct written premium in 2014, it is the second negative growth in years. In 2015, there added 4.31% loss, bringing the third consecutive negative growth. The business structure of Taiwan's non-life insurance market is mainly formulated by automobile insurance and fire insurance, automobile insurance took up 49.3% in 2014 and 48.8% in 2015 [1]. In addition, domestic companies have been relocating overseas, not only has this caused a decrease in sales, but also a reduction in profit earnings due to non-improved domestic economy and a fiercer market place. In such situation, more natural disasters will increase the frequency of companies' compensations, if a company does not have enough voluntary reserve to fulfill its compensation, it will directly affect the operation.

All the financial holding system companies make up one fifth of the market share of non-life insurance industry. Although Cathay Century and Shinkong are financial holding system companies, their market share are only a bit higher than others. This indicates that even though financial holding system companies have more capital and more market share, there financial and business performance and level of integrity are not always better than non-financial holding system companies, only Cathay Century is categorized in group A from 2013 to 2015. The financial and business performance of some non-financial holding system companies is similar to that of financial holding system companies. Take MingTai as an example, it's categorized in group A in 2014, although non-financial holding system companies are smaller in company size, assets and useful capital are far less than that of financial holding system companies, if the whole operation of these companies are normal and make good profit from investment, they can still survive well in the non-life insurance market.

Though foreign companies did not perform better business ability and quantitative data than local companies, but their whole operation, profits earning and investment performance were

better than those of local companies. From these aspects, it has been proved that foreign companies are developing steadily in Taiwan. Foreign companies locate their subsidiaries in Taiwan whereas their headquarters are in homeland and foreign parent companies have integrated policies, thus they are affected only mildly by Taiwan's economy. Nonetheless, foreign companies have started to change their developmental strategies in Taiwan's market due to no significant growth of investment performance and business ability in recent years. For underwriting profits, people normally concerned about the growth rate of direct written premiums, however, local non-life insurance companies have close relation of reinsurance, the non-life insurance industry should pay more attention to its retained premiums. Even though Taiwan is a natural disaster zone with frequent disasters, the profit and loss of non-life insurance industry is considered normal and the retained ratio has also arisen. To make progress, companies should evaluate whether the increase of retained proportion could take on the retained loss caused by natural disasters.

Overall, if companies can follow the act of liberalization of market rate, make improvements on the insufficient areas and operate normally in the years to come, control efficiently over risk bearing and strengthen underwriting quality to gain good underwriting profits, all these will enable stable growth and lead to enhancing the financial and business performance.

Appendix

As discussed in section 2.2, the objective of varimax rotation is to determine the transformation matrix, **C**, such that any give factor will have some variables that will load very high on it and some that will load very low on it. It is achieved by maximizing the variance of the squared loading across variables, subject to the constraint that the communality of each variable is unchanged. For any given factor,

$$V_j = \frac{\sum_{i=1}^{p}(l_{ij}^2 - l_{.j}^2)^2}{p} = \frac{p\sum_{i=1}^{p} l_{ij}^4 - (\sum_{i=1}^{p} l_{ij}^2)^2}{p^2}$$

Where V_j is the variance of the communalities of the variables within factor j and $l_{.j}^2$ is the average squared loading for factor j. The total variance for all the factors is then given by

$$V = \sum_{j=1}^{m} V_j = \sum_{j=1}^{m}\left(\frac{p\sum_{i=1}^{p} l_{ij}^4 - (\sum_{i=1}^{p} l_{ij}^2)^2}{p^2} \right) = \frac{\sum_{j=1}^{m}\sum_{i=1}^{p} l_{ij}^4}{p} - \frac{\sum_{j=1}^{m}(\sum_{i=1}^{p} l_{ij}^2)^2}{p^2}.$$

Maximizing the preceding equation so the orthogonal matrix, **C**, is obtained and subject to the constraint that the communality of each variable remains the same.

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