3. Sample selection, Methodology and Empirical Results

3.1 Sample Selection and Methodology

The data in this paper come from the NAIC and the A.M Best Key Rating Guide. Every insurer in our sample is included in each of the years 1994 to 2000. When processing data we treated unreasonable results in a specific way.

There are 18,911 observations in the original data. When the samples we took from the NAIC were less than zero, they were considered to be unreasonable and were designated as zero. So if the denominator is less than zero in the process of calculating the variables, we delete it. For example, the capital ratio is capital divided by total admitted assets. If the total admitted assets are less than or equal to zero, we exclude them from our data[1]. Another variable of note is the Herfindahl index. The denominator of this index is the sum of all the numbers of a group's premiums. We also delete this sample if the denominator is less than or equal to zero. The above deletion results in 16,622 observations.

In the event that some variables appear unreasonable, for example, if the CAP is greater than one and the product risk and the asset risk are equal to zero, we remove them from our data. Also, if the RBC ratio is greater than 1000, it will be deleted in

[1] The other variables are capital, ad-capital, RBC-capital and reserve.

order to condense our sample for analysis. The final criterion in selecting sample is that the firm must exist in both t and t-1 year. Our data contain 11,148 observations[2], and the statistics summarizing our findings are shown in Table1.

The capital ratio and risk equations have similar endogenous and lagged endogenous explanatory variables and the single equation assumes that exogenous factors are also involved in the insurer's capital ratio and risk. We use a two stage least squares (2SLS) model to analyze the relationship between capital ratio and risk. The 2SLS method can clearly express the endogenous character of both capital and risk[3].

3.2 The Empirical Results

The model we use to analyze the relationship of CAP and RISK is similar to the one used by CS. In order to measure the influence of the RBC ratio on an insurer's risk taking behavior, we rank the RBC ratio into ten classes and group our sample into either stock insurers or mutual insurers. Another important variable is the size of the insurer. We class our sample by size into five groups and then analyze their risk-taking behavior.

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[2] The number of samples in 1994, 1995, 1996, 1997, 1998, 1999, and 2000 are 1766, 1991, 1949, 1986, 2037, 2021, and 2006, respectively.

[3] When we use 3SLS method, the results are the same.

3.2.1 Basic Model

The basic model indicates that the regulatory variable is the RBC ratio, which lags by one period. The model is similar to the one used in previous research. Our results are illustrated in Table 2.

- Decision variables

For property-liability insurers, changes in the capital ratio and changes in total risk are positively correlated. This result confirms the findings of CS. Higher risk insurers hold more capital.

When risk is divided into asset risk and product risk, the changes in capital ratio are negatively correlated with asset risk and positively correlated with product risk. This result explains that by raising capital, insurers decrease asset risk and increase product risk. We find that our result is opposite to the finding of BS, which would be due to the difference between life insurance and property-liability insurance. It appears that the higher risk insurers hold more capital in order to avoid regulatory and bankruptcy costs and managerial risk aversion and to protect franchise values.

- Instrumental variables

In Table 2, some of the variables are not statistically significant. In the capital equation, these variables are NEWYORK (if the insurer is licensed in New York) and

STOCK (if the insurer is a stock company). In the total risk equation, these variables are HERINDEX (the Herfindahl index in the insurance group), NATIONAL (if the insurer is licensed in over 16 states), MUTUAL (if the insurer is a mutual company) and STOCK (if the insurer is a stock company). When considering the asset risk and product risk results, the variables seem insignificant in asset risk but significant in product risk. It seems that property-liability insurers prefer to adjust product risk. These insurance products are usually short-term and the insurers can manipulate sales easily in the property-liability industry. We speculate that the results are affected by the products' characteristics.

The size of a company has a negative correlation with capital ratio and a positive correlation with total risk. This is because of the fact that larger insurers have more benefits from diversification and can lower their capital ratios and take higher risks. When the insurer belongs to an insurance group, the capital ratio of the firm will decrease and the total risk will increase. The Herfindahl index measures the centralization of the insurance group and shows a positive effect on capital ratio. If the insurer is licensed in over 16 states, the capital ratio will increase. If the insurer is licensed in New York, the total risk will decrease mainly because of product risk. The insurers with an independent agents marketing system (AGENCY) have a negative correlation with capital ratio and positive correlation with total risk. The estimated

coefficients are the same as our predictions. Mutual insurers have significant effects on capital ratios and their relationships are positive. This is the same with asset risk.

- Regulatory variable

The regulatory variable used in this paper is the RBC ratio, which is also an important point in our discussion. The RBC ratio is negatively correlated with capital ratio and positively correlated with asset risk and product risk, although the estimated coefficients are small. It seems that the RBC system can achieve the regulatory target by making the insurers with low RBC ratios increase the capital or decrease risk to prevent the insolvency. The conclusion of BS is that the RBC ratio does not have a significant influence on capital ratio, asset risk or product risk. In order to understand its influence and effect, we ranked the RBC ratio into ten classes[4] and discuss them below.

3.2.2 The RBC ratio is ranked into ten classes

The outcome of this model is shown in Table 3. The instrumental variables have the same results when compared to Table 2. Decision variables and instrumental variables are also similar to Table 2. Since our primary concern is about the effect of RBC, we further produce a summary table (Table 4) to facilitate the analysis.

[4] The insurers with bottom 20% and with top 20% have the same result. But the 10 classes lead to more complete analysis.

Property-liability insurers with an RBC ratio in the bottom 10% increased their capital ratio and decreased their total risk. Insurers with RBC ratios in the top 10% also decrease their risk. It is difficult to analyze exactly why the insurer with a high RBC ratio tends to increase capital and decrease total risk. This contradicts the reason for the regulation.

3.2.3 The sample is divided into two groups by insurer's organizational form

The type of organization a property-liability insurer falls into influences an insurer's risk taking behavior. The MUTUAL variable has statistically significant results in Table 2. The samples of CS are stock companies, and statistically, the RBC ratios of stock insurers are significantly different from those of the mutual insurers, as shown in Table 5. The outcomes of two sub-samples are listed in Tables 6 and 7[5].

We further summarize the results of Table 6 and 7 in Table 8. The stock insurer with an RBC ratio in the bottom 10% increase capital ratio and decrease total risk and the stock insurer in the top 10% RBC ratio decrease their total risk. Mutual insurers show the same results. Even though the RBC ratios are different, the results are identical. This still cannot explain why the insurer with a high RBC ratio increases both capital ratio and total risk.

[5] The summary statistics of the sub-samples are shown in Appendix B.

3.2.4 The sample is divided into five groups by insurer size

Another important variable of property-liability companies is the size of the firm. It affects not only the insurer's risk-taking behavior but also the RBC ratio. A small insurer can easily achieve a high RBC ratio, while a large insurer has a stable RBC ratio. We divide our sample into five groups by the size of the firms. For example, Size 1 represents firms in the bottom 20% according to size[6]. The results from the difference in size of property-liability insurance companies are shown in Table 9.

In the two equations, the small insurers with high RBC ratios[7] increase their capital ratios and decrease their total risk. On the other hand, large insurers with high RBC ratios decrease their capital ratios and increase total risk. The results are listed in Tables 10 and 11. Compared to Tables 13 and 14, where, if we separate the risk into asset risk and product risk for analysis, the small insurers increase their product risk while the large insurers decrease their asset risk and increase their product risk. The key results in Table10 – Table 14 are summarized in Table15. The results are interesting. For instance, it is difficult to explain why insurers with high RBC ratios prefer to increase capital ratios and decrease total risk, as noted in sections 3.2.2 and 3.2.3. The size of the insurer may be the answer. In the property-liability insurance

[6] The summary statistics of the sub-samples are shown in Appendix C.
[7] To simplify the outcome of the RBC ratio, we compared the insurers in the bottom 10% of RBC ratios with those in the top 10% of RBC ratios.

industry, the small insurer with a high RBC ratio may want to increase the firm's capital to increase capacity and to prevent future catastrophe. The large insurers with high RBC ratios tend to decrease capital ratios and increase risk to reduce held capital. The empirical results also prove this statement[8]. The small insurers with high RBC ratio increase their capacity in order to prevent any catastrophe in the future. Large insurers with high RBC ratios would decrease capital and increase risk to avoid management inefficiency.

[8] We approached the type and size of the organization simultaneously.