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Determinants of property-liability insurer retention: Evidence from Taiwan insurance industry

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The determination of an appropriate retention level is an important decision for insurers since the results show the influence on risk exposure and firm profitability. In this study, we examine the determinants of insurer retentions for property-liability insurance companies in the Taiwan insurance industry. Three models are estimated in this study including ordinary least squares regression and two panel data models, fixed effects model and random effects model. The results show underwriting risk, premium growth and listed companies are negatively related to insurer retention, while liabilities to liquidity assets ratio and business concentration have a positive impact on insurer retention. In addition, when macroeconomic factors are taken into account, we also find that they have significant influence of return on investment, inflation rate and interest rate changes on insurer retention. Our results have practical implications for the property-liability insurance operational business and competent authorities.

Key words: Reinsurance, insurer retention, property-liability insurance, panel data, fixed effects.

INTRODUCTION

Property-liability insurers often manage risk by purchasing reinsurance, which effectively serves as a substitute for capital in reducing the insurer's probabilities of incurring the costs of financial distress or bankruptcy (Adiel, 1996; Garven and Lamm-Tennant, 2003), as the core of reinsurance policies is the setting for the retention of insurers. The determination of an appropriate retention level is an important decision for insurers as the results have an ultimate influence on risk exposure and firm profitability. Retention establishes the maximum individual

claim amount that insurer can tolerate, given its financial and operating characteristics (Lee et al., 1992). If the retention is low, then the insurer's capital and surplus cannot be effectively used because low retention means low underwriting profit and investment income and thus low-retention affects the growth and scale. On the other hand, if the retention is high, then the insurer will probably confront a risk of high variability and financial ruin in extreme events. Hence, the retention exceeding underwriting limits often jeopardizes business conditions. In the property-liability insurance market of Taiwan, the percentage of using reinsurance as a tool to diversify risk is high.According to Taiwan Insurance Institute (TII) of statistics, over the past decade (1999 to 2008), the over-all insurer retention percentage in the property-liability insurance industry was 58%, which is lower than those in Europe, the United State, Japan and South Korea.

The result of over-reliance on reinsurance means the risk undertaken by property-liability insurers is low. The resultant insufficient retained premiums are detrimental to

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Abbreviations: TII, Taiwan Insurance Institute; ROA, returns on assets; ROI, returns on investment; GDP, gross domestic product; OLS, ordinary least squares; FE, fixed- effects; RE, random-effects; VIF, variance inflation factor; LM, Lagrange multiplier.

the growth and value creation of the industry as a whole. Therefore, it is critical for property-liability insurers to improve their retention capacity. Different from previous studies, this paper analyzes the extent and effects of firm-specific and economic factors on retention decision in the context of Taiwanese property-liability insurers with panel data for the period 1999 to 2008. There are several contributions made in this paper and they are as follows. First, a comprehensive research on retention deter-minants using economic data has not been conducted in the property-liability insurance industry. Therefore, this study can be used to fill the gap in the insurance literature. Secondly, this article is the first to evaluate the effect of various factors on property-liability insurer's retention in Taiwan. Thirdly, the research provides the insight into the factors affecting retention decision on Taiwan property-liability insurers and competent authorities. The rest of this paper is organized as follows. The next section provides a brief review of prior literature on insurer's retention decisions. The subsequent section presents the research design and variables development. In the penultimate section, we describe the data and present empirical results. Finally, we conclude in the last section with discussion of our findings.

LITERATURE REVIEW

Previous research has reported a number of theories and studies to explain the retention decision in insurance literature. Carter (1979) considered that the setting of retention is still based largely on rules of thumb. Carter (1979) suggests that the hypothetical key elements in the retention decision making process are size of the portfolio, size of loss, capital, rate of return, the selected probability of run, the price of reinsurance, and the investment policy. Reinarz et al. (1990) indicated before setting retentions, there are several considerations, such as management attitudes toward risk, exposures, class and size of insurers and costs consideration. Mayers and Smith (1990); Graven and Lamm-Tennant (2003) from the perspectives of reinsurance demand tackle this issue and they concluded that the firm characteristics, such as operating result, leverage, liquidity, organization structure, line-of-business concentration are substantially related to the net retention level. Friedlos et al. (1997) provided pragmatic approach including solvency regulations, financial strength, underwriting capacity, corporate willingness to take in risks, portfolio composition and the reinsurance market would affect retention decision.

  With regard to empirical studies, Gottheimer (1983) hypothesized a positive linear relationship between the retention limit selected by a property-liability insurer and its assets, policyholders' surplus, premium volume and loss ratio. Gottheimer (1983) concluded that the two most significant factors to consider in selecting an appropriate retention level were assets and premium volume. In addition, Jonghag (2001) examined the determinants of property-liability catastrophe excess-of–loss reinsurance retentions and limits in United State insurance industry. The result found upper limits, policyholder's surplus, liquidity ratio, reinsurance price have significantly positive on insurer's retention, contrary to insurer's retention was significantly negative related to operational ratio and catastrophe exposure. Above literature most focus on firm-specific factors, however, Schmutz (1999) noted that economic factors as economic situation that would affect reinsurance program. Hence this paper is different from prior researches and will increase the inclusion of macroeconomic factors to discuss insurer retention decision.

RESEARCH DESIGN AND VARIABLES DEVELOPMENT

Based on literature reviews, we hypothesize that insurer retention is affected by a number of explanatory variables including firm specific factors and macroeconomic factors. Our dependent in the empirical model is retention ratio (retention), which is calculated by net premiums divided direct premiums written, similar to an approach taken by Regan and Tzeng (1999).This retention is used as a measurement of the risk undertaking capacity, profi-tability likelihood and quality of business for individual property-liability insurers. In addition, our independent variables are described as follows:

Firm specific factors

Company size

A larger insurance company can gain competitive benefits through efficient facilities (Mayers and Smith, 1990) and also reduce risk through greater portfolio diversification (Cummins and Sommer, 1996). Hence, it is possible for a large insurance company to adopt a high retention. This study refers to the approach developed by Mayers and Smith (1990) and uses the natural logarithm of total assets as a measurement of company size.

Insurance leverage

Insurance leverage measures the capacity of an insurance company in the undertaking of pricing risks and the level of risks absorbable by owners' equity. A higher and broader risk exposure leads to higher pricing error and risks undertaken by owners' equity. Hence, the insurer retention is lower. This study refers to Klenin et al. (2002) to measure insurance leverage with net premiums divided by the surplus.

Returns on assets (ROA)

This measurement represents the ability of an insurance company to utilize assets to create profits. A higher ROA means better profits during the period. Better profits imply a strong capacity in dealing with losses or financial stresses and hence, a lesser need for reinsurance (Powell and Sommer, 2007), which may lead to an increase in retained premiums. This study refers to the approach developed by Cole and Mccullough (2006) and Elango et al. (2008) and defines ROA as pre-tax earnings divided by the average asset value.

Underwriting risk

Underwriting risks of spread will help the company to generate better profits. The lower the expected losses, the better performances and the higher insurer retentions are for insurance companies. In order to ensure the bankruptcy probability at a certain level, insurance companies may lower their financial risks in the face of increasing risks (Sommer, 1996). This is to avoid any increase in bankruptcy costs due to major losses. This study refers to the approach developed by Adams and Buckle (2003), uses annual losses incurred divided by annual premiums earned to measure undertaking risks.

Reinsurance price

An increase in reinsurance cost means a reduction in reinsurance demand. As a response, insurance companies may increase their own retained premiums. According to the empirical analysis performed by Cummins et al. (2008) on the costs and benefits of reinsurance, insurance companies are willing to pay high prices to purchase reinsurance in order to mitigate undertaking risks. There is a trade-off relationship between reinsurance costs and risks. This study measures reinsurance price with reinsurance premiums minus the reinsurance commission earned divided by claim recovered from reinsurers.

Growth of premiums

Black and Skipper (1994) suggested that new businesses may affect the retention of insurance companies. When there are growth opportunities, companies may reduce the risks undertaken by lowering liabilities in order to avoid the loss of future growth due to excess risks. Hence, there is a negative correlation between growth and insurer retentions. Conversely, a higher business growth indicates more aggressive business strategies and in turn, a higher retentions. Following Cummins and Nini (2002), we measure the growth variable by the percentage growth in premiums from year t-1 to year t.

Liquidity ratio

Liquidity ratio measures the ability of insurance companies in meeting debt obligations to policyholders and creditors. Financial and risk management studies indicate that a high liquidity ratio means low probability in financial distress. It is possible to increase insurer retentions if insurance companies own sufficient funds. This study refers to Chen and Wong (2004) which uses an inverse measure of liquidity, this variable is stated liabilities divided by liquidity assets to measure liquidity.

Returns on investment (ROI)

Premiums are received and invested in advance of claims for losses. Consequently, an insurer's superior investment performance could yield a competitive advantage, particularly if the relative importance of investments exceeds that of underwriting, as a high ROI can generate better financial performances. In such instances, insurer retention will increase. Following Gatzlaff (2009), we mea-sure the ROI variable by investment income divided by average invested assets.

Business concentration

When the business concentration is high, more accurate predictions of the losses of property-liability insurance are possible (Mayers and Smith, 1988), thus, insurer is more likely to adopt a high retentions. Conversely, with a higher concentration of business, more risks are involved. In order to avoid excess losses and the resultant bankruptcy costs, the insurer retentions will decline. Following Mayers and Smith (1988), we use the Herfindahl index to proxy business concentration. The concentration variable is computed as the sum of the squares of the ratio of individual line-of-business premiums written to gross premiums written.

Listed companies dummy

As listed companies have better access to capital markets for fund raising, this study expects that listed insurance companies have a wide source of capital and hence low insurer retentions and uses a dummy variable to observe the correlation between listing and retentions. When a property-liability insurance company is listed. It is classified as 1, otherwise it is 0.

Macroeconomic factors

Inflation rates

Premiums are calculated based on past losses and costs. If inflation is higher than expected, insurance companies

will not have sufficient premiums to meet with losses and would thus experience increased insolvency probabilities (Browne and Hoyt, 1995).Inflation affects the financial performances of insurance companies by squeezing profit margins. Hence, inflation may lead to changes in retained premiums. This study refers to Grace and Hotchkiss (1995) and assesses inflation according to annual increase rates of the consumer price Index.

Interest rate changes

Interest rate changes have significant influences on the underwriting profits of insurance companies. Grace and Hotchkiss (1995) performed empirical analysis on the impacts of macroeconomic factors in the United States on the total costs of property-liability insurance companies. The results showed that interest rates have reverse effects on the underwriting profits of property-liability insurance companies in the United States Browne and Hoyt (1995) also found that under greater interest rate volatility, the changes in assets value will exceed the changes in liabilities values. Hence, there is a positive correlation between interest rate volatility and the loss of solvency. In such instances, insurers may increase retained premiums to maintain cash flows. This study refers to Browne et al. (2001) and uses the one-year prime rates for deposits in the banking industry in Taiwan to measure interest rate changes.

Economic growth rates

Economic growth rates can be use to reflect the risks of economy volatility. A higher economic growth indicates the level of economic development. Grace and Hotchkiss (1995) tested for a long-run relationship between real gross domestic product, inflation and the short-term interest rate on the insurance underwriting cycle as measured by the combined ratio. The result found a long-run relationship between general economic changes and underwriting performance. Any growth of actual national incomes results in a short-term increase of premiums and possibly changes of retained premiums of the property-liability insurance industry. Following Grace and Hotchkiss (1995); Lin (2010), we measure the economic growth variable by the change in gross domestic product (GDP) to measure growth.

METHODOLOGY AND DATA SOURCES

This study samples cross-section data of insurance companies and time-series data. Therefore, panel data are used to examine the determinants of insurer retentions for property-liability insurance companies in the Taiwan insurance industry. Panel data describe a given sample pool within a period of time. Multiple observations are required for each sample. It does not only carry the dynamics of time-series data but also expresses different phenomena in the same way cross-section data does (Hsiao,1985).Three models are

estimated in this study including ordinary least squares (OLS) regression analysis and two panel data models, fixed- effects (FE) and random-effects (RE) model. The empirical models for testing the hypotheses can be written in the following form:

Model 1: Firm-specific factors and retention

Retention ^{it} =

$$\alpha + \beta_1 SIZE_{it} + \beta_2 IL_{it} + \beta_3 ROA_{it} + \beta_4 UR_{it} + \beta_5 RP_{it} + \beta_6 GP_{it} + \beta_7 LR_{it} + \beta_8 ROI_{it} + \beta_9 BC_{it} + \beta_{10} LIST_{it} + \varepsilon_{it}$$

Model 2: Firm-Specific, macroeconomic factors and retention

Retention ^{it} =

$$\alpha + \beta_1 SIZE_{it} + \beta_2 IL_{it} + \beta_3 ROA_{it} + \beta_4 UR_{it} + \beta_5 RP_{it} + \beta_6 GP_{it} + \beta_7 LR_{it} + \beta_8 ROI_{it} + \beta_9 BC_{it} + \beta_{10} IRC_{it} + \beta_{11} IR_{it} + \beta_{12} EGR_{it} + \beta_{13} LIST_{it} + \varepsilon_{it}$$

The panel data of each insurer during the year t is used. Table 1 summarizes the expected result of the model and defines the variables used in the analysis. The sample pool consists of data from 15 property-liability insurers in the period 1999 to 2008, with a total of 150 data entries. These fifteen companies are taken as the research sample, because their shares of the property-liability insurance market add up to 95% in Taiwan. Data of the insurance companies is sourced from Taiwan Insurance Institute. Macroeconomic data is obtained from the Central Bank of Republic of China. Since most property-liability insurers in Taiwan are private and data are incomplete, this paper refers to the overall retained premiums for individual property-liability insurers as the calculation basis.Table 2 provides basic statistics for the companies in the sample. In this table, the explanatory variables' values of variance inflation factor (VIF), an indicator of the severity of multicollinearity, also are reported. According to Gujarati (1995), multicollinearity is not considered a severe problem if the VIF value is less than ten. All the VIF values of the explanatory variables are smaller then ten. It appears that multicollinerairy does not unduly influence the least squares estimates. This study performs F test and LaGrange multiplier (LM) tests on the empirical results of the regression model on retention decisions. The results show that the FE model and RE model are more suitable than the OLS model, while the Hausman test results indicate that the FE model is appropriate than the RE model.

EMPIRCIAL RESULTS

Firm- specific factors and retention empirical model results

The empirical findings suggest that insurer retention was a significantly positive correlation between liabilities to liquidity assets ratio and the concentration of business. A high ratio of liabilities to liquid assets suggests a weak repayment capacity and poor liquidity; therefore, insurer retention may rise in order to increase internal cash flow and debt-servicing capacity. Consistent with Jonghag's (2001) findings, insurers with a greater portion of liquidity assets have lower retentions. Meanwhile, as the majority of the property-liability insurer in Taiwan concentration on a number of businesses, it is possible to accurately pre-dict the losses of business. Therefore, they tend to increase

Table 1. Research variable definitions and expected result.

Variable	Definition	Expected result
Dependent variable		
Retention ratio (RR)	(Direct written premiums + reinsurance premiums - premiums ceded)/ (direct written premiums)	
Explanatory variable		
Company size (SIZE)	Natural logarithm of assets	+
Insurance leverage (IL)	Net premium/ surplus	-
Return of assets (ROA)	Profit before tax/average assets	+
Underwriting risk (UR)	Annual losses incurred (net of loss adjustment expenses) divided by annual premium earned	-
Reinsurance price (RP)	(Reinsurance premiums – reinsurance commission earned)/(claims recovered from reinsures)	-
Growth of premium (GP)	Percentage growth in premiums from year t-1 to year t	±
Liquidity ratio (LR)	Stated liabilities/liquidity assets	+
Return on investment (ROI)	Investment income/average invested assets	+
Business concentration (BC)	Line-of-business Herfindahl index	±
Inflation rates (IR)	$(CPI_t - CPI_{t-1})/CPI_{t-1}$, where CPI respect consumer price index	±
Interest rate changes (IRC)	One-year rate of change in banking deposits rates	±
Economic growth rates (EGR)	$(GDP_t - GDP_{t-1})/GDP_{t-1}$, where GDP respects real gross domestic product	+
Listed companies dummy	Dummy variable equals 1 if listed company; 0 otherwise	-

Table 2. Summary statistics and variance inflation factors (VIF).

Variable	Mean	Std. dev	VIF
Retention ratio	0.52	0.13	-
Company size	16.01	1.45	1.70
Insurance leverage	0.84	2.97	1.15
Return of assets	0.02	0.06	1.37
Underwriting risk	0.56	0.19	1.36
Reinsurance price	2.35	5.18	1.22
Growth of premium	0.05	0.15	1.12
Liquidity ratio	1.14	0.40	1.55
Return on investment	0.03	0.02	1.31
Business concentration	0.34	0.13	1.31
Inflation rates	1.08	1.19	1.29
Interest rate changes	-0.11	0.28	1.29
Economic growth rates	0.04	0.03	1.16
Listed companies dummy	0.55	0.50	1.60

The definitions of the variables can be found in Table 1.

increase the retention for the businesses they focus on, such as automobile insurance. There is significant negative correlation between underwriting risks, growth of premium, listed companies and insurer retention. The higher the underwriting risks, the more likely it is for insurer to diversify risks with reinsurance and lower retention accordingly. Kim et al. (1995) reported that there is a significantly positive correlation between premium growth and the insolvency of property-liability insurers. The higher the growth, the greater the risk, it indicates that it is possible to lower insurer retention. There is a significantly negative correlation between listed companies

Table 3. Firm specific factors and retention empirical model results.

Explanatory variable	OLS	FEM	REM
Intercept	0.4111***	0.3114	0.4111***
Company size	-0.0103	0.0088	-0.0103
Insurance leverage	0.0032	0.0013	0.0032
Return of assets	0.3199*	-0.0677	0.3199*
Underwriting risk	-0.1288***	-0.1281***	-0.1288***
Reinsurance price	-0.0015	-0.0015	-0.0015
Growth of premium	-0.0763	-0.1519***	-0.0763
Liquidity ratio	0.1208***	0.1019***	0.1208***
Return on investment	0.7815**	0.5204	0.7815**
Business concentration	0.5127***	0.1731*	0.5127***
Listed companies dummy	0.0390*	-0.0575*	0.0390*
Number of observations	150	150	150
Adjusted R^2	0.3817	0.1896	0.4235
F test	10.14 (0.0000)***	5.73 (0.0000)***	
LM test			101.37 (0.0000)***
Hausman test			32.33 (0.0004)***

The definitions of the variables can be found in Table 1. p values are in brackets. *Significant at 0.10 level; **Significant at 0.05 level; *** Significant at 0.01 level. Based on the results of LM test and Hausman test, we would conclude that of the three alternative regression specifications, the fixed-effects model is the better choice.

and insurer retention. The result presented that listed companies have good access to capital markets and hence possess low retention ratio. Other variables, such as company size, insurance leverage, return on assets, reinsurance price and returns on investment, are not statistically different from zero. Table 3 summarizes the empirical results.

Firm-specifics, macroeconomic factors and retention empirical model results

The incorporation into macroeconomic variables shows that insurer retention is positively related to liabilities to liquid assets ratio, ROI, business concentration, inflation, interest rate changes, whereas negatively related to underwriting risks, growth of premium, listed companies. The results of underwriting risk, premium growth, liabilities to liquidity assets ratio, business concentration and listed companies are the same as model 1. A high ROI means good profitability, and hence increases insurer retention. Graven and Tennant (2003) found that a low ROI leads to a strong demand for reinsurance, which leads to a low insurer retention. Inflation and insurer retentions are positively correlated, possibly because asset values increase along with inflation. As a result, the growth of premium revenue allows insurers to increase retained premiums. In order to maintain volatility within an acceptable estimation, retained premiums may have to maintain a pace with inflation; otherwise, retained premiums would shrink in relative terms and losses may

surge. Meanwhile, the higher the changes of interest rates the worse the negative effects on underwriting profits (Grace and Hotchkiss, 1995).In such instances, insurers may increase retention in order to maintain stable cash flows and counter interest rate risks. Other variables, such as company size, insurance leverage, return on assets, reinsurance price and economic growth rates, are not statistically different from zero. The empirical results are summarized in Table 4.

Conclusions

Using data for the period 1999 to 2008, this study empirically identified the insurer retention determinants in the Taiwan property-liability insurance industry. Our results show that relationship between firm-specific factors and insurer retentions in the insurance industry. We also find the affects of macroeconomic factors on insurer retentions. When monitoring insurer retention, the manager should pay attention to these determinants due to their importance in determining insurer retention. This study proposes the following managerial implications for property-liability insurance operational business and competent authorities in Taiwan. First, an increase in liabilities to liquidity assets ratio and business concentration can enhance retained premiums. Hence, the lower the liquidity assets, the higher the retained premiums become. When the concentration of business is high, it is possible to make accurate predictions of the losses of insurance (Myers and Smith, 1988). In such instances, it

Table 4. Firm specific, macroeconomic factors and retention empirical model results.

Explanatory variable	OLS	FEM	REM
Intercept	0.3062***	0.1241	0.3062***
Company size	-0.0066	0.0171	-0.0066
Insurance leverage	0.0035	0.0016	0.0035
Return of assets	0.2667*	-0.0987	0.2667*
Underwriting risk	-0.0693	-0.6634*	-0.0693
Reinsurance price	-0.0004	-0.0004	-0.0004
Growth of premium	-0.0344	-0.1206***	-0.0344
Liquidity ratio	0.0941***	0.0632**	0.0941***
Return on investment	1.0725***	0.8034**	1.0725***
Business concentration	0.5362***	0.2048**	0.5362***
Listed companies dummy	0.0367**	-0.0472*	0.0367**
Inflation rates	0.0389***	0.0359***	0.0389***
Interest rate changes	0.0660**	0.0564**	0.0660**
Economic growth rates	-0.2417	0.1230	-0.2417
Number of observations	150	150	150
Adjusted R^2	0.5011	0.3273	0.5449
F test	12.44 (0.0000)***	6.56 (0.0000)***	
LM test			161.66(0.0000) ***
Hausman test			41.49 (0.0001) ***

The definitions of the variables can be found in Table 1. p values are in brackets. *Significant at 0.10 level; **Significant at 0.05 level; *** Significant at 0.01 level. Based on the results of LM test and Hausman test, we would conclude that of the three alternative regression specifications, the fixed-effects model is the better choice.

Meanwhile, reinsurance is able to diversity risks by lowering the variances of cash flows and enhancing risk-taking ability (Hoerger et al., 1990), although insurers can reduce underwriting risk by purchasing reinsurance. They have to try strike a balance between decreasing insolvency risk and reducing potential profitability (Shiu, 2009). Thirdly, it is worth noting the influence of macroeconomic factors, such as inflation rates and interest rates changes on insurer retention. Competent authorities and the industry managers should perform a dynamic analysis in order to predict the impact of markets and macroeconomic variables on environments. These implications may be helpful for those involved in monitoring insurer retention and creating corporate profitability.

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