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The Impact of Product Diversification on Risk-taking Behavior in Property and Liability Insurance Firms

Chen-Ying Lee[1]

Abstract

This paper aims to analyze product diversification and risk taking behavior with a comprehensive look at the property-liability (P-L) insurance operations for a developing economic environment. Using a panel data to examine the impact of product diversification and risk taking behavior in Taiwanese P-L insurers. The study finds that product diversification is significantly negatively related to the risk taking behavior of P-L insurers, which implies that product diversification reduces the risk inherent in each business line and ultimately the overall portfolio risk. The results are consistent with the portfolio theory in finance. I find that firm growth, long-tail line and financial holdings have significant impacts on underwriting risk. Furthermore, the firm age, insurance leverage, long-tail line, ROI, and liquidity ratio have significant effects on leverage risk. The study provides some valuable insights into the effects of diversification and risk taking behavior of P-L insurers in a developing country as well as for the improvement of insurance regulation policy in Taiwan.

JEL classification numbers: C23, G22, L25.
Keywords: Risk-taking, Product diversification, Property-liability insurance.

[1] Department of Risk Management and Insurance, Shih Chien University, Taiwan.

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1. Introduction

Risk-taking behavior in P-L insurance industry is an important issue because of considerable loss variability. Huge losses may result from catastrophes such as major hurricanes or weather disasters. Galai and Masulis (1976) point out shareholders with limited liability have some incentive to take excessive risk in order to maximize corporate value at the expense of bondholders. The argument is applicable to insurance companies. Therefore, the risk taking behavior of an insurer has impact on the investors, stockholders, policyholders, employees and other stockholders.

Product diversification is one of the most direct ways for corporations to reduce risk by smoothing expected cash flows (Che and Lienenberg, 2017). In the insurance industry, diversification reduces the volatility of underwriting cash flows by assuaging large unexpected losses and cross-subsidizing unpredictable lines (Che and Lienenberg, 2017). By contrast, Hoyt and Trieshman (1991) proposed that diversified companies have lower yields and higher risks than those that focus on a single insurance company. Hsieh et al.(2015) indicates that a higher level of diversification leads to higher returns and insurers' risk, while intending to decrease the degree of leverage. However, diversification may also magnify agency costs (Rotemberg and Saloner, 1994), and allow inefficient cross-subsidization of poorly performing business units (Rajan, et al., 2000). Therefore, the product diversification strategy may be a double-edged sword, it might make companies profitable, but it may also make companies bear the relative costs (Kang et al., 2010). Liao (2008) indicated that Taiwan's P-L insurance market products are to homogenous. In order to pursue performance growth, they often ignore the quality of underwriting and bury their solvency. Therefore, the competition of insurers is likely to cause excessive risk-taking behavior and the possibility of insolvency. In addition, the Taiwan insurance industry has experienced a wave of structure changes as the Taiwanese Congress passed the Merger Law of Financial Institutions and Financial Holding Company Act and some insurers were acquired or merged with other firms over past years. P-L insurer expect product diversification are largely attributable to the ability to cross-sell products, generate cost savings, enter new markets, and create hybrid products, all while developing new sales channels (Seol,2000) and achieve the effect of co-marketing. Thus, the Taiwan insurance industry provides an interesting setting for examining the relationships of product diversification and risk-taking behavior.

This paper makes some contributions to the financial literature on risk-taking and diversification in insurance area. First, I believe the article is the first to examine the product diversification strategy of the insurers and their relationship to risk-taking behavior in Taiwanese P-L insurance industry¬. Second, the study expands my understanding of the effects of product diversification and risk-taking on insurance companies by focusing on a developing economic environment. Finally, the study offers managers important lessons on insurer risk-taking management. The evidence can be used by the Taiwanese decision makers in P-L insurance to

formulate and improve suitable product diversification strategies and risk–taking behavior and offers an early warning of bankruptcy for insurers.

The remainder of the paper is organized as follows. The following section locates this research within the literature on product diversification and risk-taking behavior. The third section explains the research methodology and variables development. Results and discussion are resented in fourth section, followed by concluding remarks in fifth section.

2. Related Literature

2.1 Risk-taking behavior

The relation between insurers and risk–taking has been an important topic in the insurance industry. Some papers discuss the risk-taking behaviors on insurance companies. These studies mainly explore the factors that affect risk behaviors from different directions. The factors involved include the insurers' governance structure, organizational structure, product types, and directors' and officers' liability insurance (D&O insurance) purchase behaviors (Ho et al , 2013; Chen et al, 2010; Baranoff and Sager,2003). Fields et al (2012) investigate how investor protection, government quality, and contract enforcement affect risk taking and they find that better investor protection results in less risk taking, as do higher quality government and greater contract enforceability. Ho et al.(2013) examine the impact of organizational structure and board composition on risk taking in the U.S. P-L insurance. They find that some board composition variables not only have impact on risk-taking behaviors but also affect different risk measures different. Alhassan and Biekpe (2018) examine the non-linear effect of competition on risk-taking behavior in an emerging insurance market, and suggests a non-linear inverted U-shaped relationship between competition and insurance solvency.

2.2 Diversification and firm risk- taking

The conventional opinion is that product diversification reduce a firm's exposure to a specific risk from providing particular product, thus, reduce its risk; whereas an alternative view is that expansion into new nontraditional activities may result in unstable income and greater risk (e.g., Berger et al.,2000; Esho et al., 2005). Empirically, the prior studies produced mixed results (e.g., Brewer, 1989; Hassan et al., 1994; Esho et al., 2005). Recentiy, Che et al.(2017) also find that diversified insurers outperform their focused counterparts in terms of investment return, but that they underperform in terms of underwriting profitability.

Diversification reduces idiosyncratic risk by pooling imperfectly correlated cash floes. For diversified companies, imperfectly correlated cash flows create a natural hedge that reduces cash volatility (Lewellen, 1971). Schrand and Unal (1998) porposed the coordinated risk management theory that firm use hedging to allocate risk between actives rather than simply to reduce overall risk. Che and Liebenberg (2017) test the coordinated risk management theory in the P-L insurance industry, and they found that cross-sectional evidence that diversified insurers (that likely

have lower underwriting risk) tend to hold assets. Martin and Sayrak (2003) indicated that in terms of cross-subsidization, diversification can mitigate losses from failures in some products and markets. Cheng and Weiss (2013) suggested that the capital and risk position of an insurer is likely to be affected its degree of diversification. Insurers that are more diversified are expected to require less relative capital to operate and can take on relatively larger risk. Thus, Business line diversification refers to the underwriting of insurance policies across a spectrum of product lines ensuring a diversified revenue source. This reduces the risk inherent in each business line and ultimately the overall portfolio risk (Alhassan and Biekpe, 2018). In other hand, Lamont and Polk (2001) suggested that diversified firms are potentially more risky (thus having higher realized return) than single segment firms. Acharya et al.(2006) found that diversification of bank loans across sectors and industries, does neither necessarily improve return nor reduce risk, perhaps because diversification of bank products reduces the effectiveness of bank monitoring and information gathering functions. In the insurance industry, Ho et al.(2013) studied P-L insurer's risk taking behavior found that the relation between business line concentration and underwriting risk is positive, whereas the relation between business line concentration and investment risk is negative. Cummins and Weiss (2014) also found that diversification into noncore actives, such as financial guarantees and derivatives trading, may heighten system risk.

There is less analysis of product diversification and risk-taking behavior in the literature, and the discussion of diversification is mostly based on empirical evidence from developed countries. Therefore, this research use data from developing countries and focus on product diversification and risk-taking in insurance industries to provide valuable insight on financial literature.

3. Methodology, Data, and Variables

3.1 Data sources

This study uses an unbalanced panel data on the P-L insurance industry in Taiwan. The sample consists of an annual data on 15 P-L insurers in 2001-2014, resulting in a total of 210 firm-year observations. There are 15 insurance companies in 2011, representing over 97 percent of the total assets of all P/L insurance market in Taiwan. Hence, the dataset is a good representative sample. The data was collected from several sources, including the Non-life Association of Taiwan, the websites of the sampled insurers and Taiwan Insurance Institute (TII). It includes both surviving and non-surviving P-L insurance firms from 2001 to 2014. Since the data includes both cross-sectional and time series elements, it allows conducting statistical analysis to explore the relationships between product diversification and risk–taking behavior of P-L insurers over the study period.

3.2 Dependent variable and explanatory variables

Most studies examining the risk taking behavior focus only on one proxy for risk–taking. I use three risk-taking measures: total risk, underwriting risk, and leverage

risk variables in a comprehensive examination of the risk-taking issue. These three risk measures are used to depict the risks faced by an insurer from different perspectives. Total risk is defined as the standard deviation of return on assets, following Ho et al.(2013) ; Hong and Bao(2015). The standard deviation of the return on assets gives a picture of an insurer's comprehensive risk, while underwriting and leverage risks measure specific risks arising from certain aspects or its operations. Underwriting risk is measured by the company's loss ratio. The loss ratio is defined as the ratio of loss incurred divided by premiums earned. Leverage risk is defined as 1 minus the surplus-to-assets ratio. The underwriting risk refers to the risk of loss on underwriting activity. The leverage risk is related to the default risk (Ho et al, 2013). It should be noted that the appropriate leverage ratio is firm-specific. Total risk, which reflects a combination of underwriting risk, and leverage risk, is the most important overall risk for shareholders or policyholders.

Following the previous studies (Cummins and Nini, 2002; Shim 2011), a Herfindahl index is used to measure the extent of a P-L insurer's product diversification. The scope of products is divided into 12 line of business in order to consider the entire number of product lines presented by Taiwan Insurance Institute's (TII) annual statutory filings. Each product line's Herfindahl index is then calculated by the sum of the squares of the percentages of direct premium written across all lines of business for each insurer in each year. Product Diversification is the complement of a Herfindahl index of net premiums written (NPW). It is calculated as follows, 1-Herfindahl index (HHI) of product line.

3.3 Control variables

A number of insurer's characteristics are also included in the regressions analysis to control for omitted variables bias, following the recommendations of past research. Behr et al.(2010) identified an extensive list of control variables in their cross-country risk analysis, including the firm's specific characteristics, legal system efficiency and financial system development. Due to Taiwan's insurance companies are all stock companies, the organizational structure factors that affect the firm's risk-taking will not be discussed in this study.

With regard to the control variables, firm size, as the 'Too-Big-to–Fall' hypothesis which assumes that large conglomerates are prone to excessive risk-taking. In insurance market, Hardwick (1997) argues that through economics of scale large insurers can reach a high level of performance to improve their risk absorption capacity. Ng et al.(2013) also suggested that a positive link between the insurance firm size and underwriting risk. I measure firm size (SIZE) as the natural logarithm of total assets. Mayers and smith (1990) indicated insurers use reinsurance to hedge risk. Previous studies (Hoerger et al., 1990; Froot, 2007) showed that as a risk management mechanism, reinsurance can help insurance companies reduce their expected costs of bankruptcy, and reduces insurers' insolvency risk by stabilising loss experience. I measure the reinsurance ratio (RE) as the total reinsurance ceded

divided by gross premiums written. This study also checks for the effect of capitalization differences on insurance solvency and risk with the inclusion of equity variable. I follow Alhassan and Biekpe (2018) use insurance leverage (IL) to measure, that is, the ratio of net earned premiums to shareholder's equity. The view is that increases in equity lowers the risk of financial distress and insolvency. Conversely, equity increases could also affect the portfolio of risky assets and the firm's overall risk (Koehn and Santomero, 1980). Yu et al.(2008) suggested that insurance companies writing more business in long-tail lines take asset risk to achieve a balanced portfolio. The percentage of long-tail product lines is also used to capture PL insurers' risk preference (Hong and Bao, 2015). I am calculated by the premiums of long-tail lines(LTL) divided by total net written premiums to measure the weight of long-tail business in an insurer's underwriting portfolio, Long-tail line include auto liability, compulsory auto liability, ocean marine, product liability, other liability, professional liability and aircraft.

In addition, market competition affects insurers' risk-taking strategies. In a competitive market, insurers have to develop strategies for retaining market share, and those facing tough competition may take risky measures such as promising unrealistically high commissions to agents or selling products on the basis of misleading information. The market share (MS) is used as a proxy for market competition and is calculated as the firm's premium ÷ total market premium. Firm age reflects an insurance company's ability to survive. For example, startups are prone to fail. Insurance companies with a long history are assumed to be more sophisticated at dealing with difficult market conditions and to be able sustain stable growth through hard times. I measure firm age (FA) follow Hong and Bao (2015) is the number of years since an insurer was established. Firm riskiness is likely to be influenced by the magnitude and variability of returns on an insurer's asset portfolio (Milidonis et al.2019). I use return of investment (ROI), to represent potential investment capacity, since a firm's investing experience is positively correlated with risk-taking.(Tsai and Luan,2016). A higher revenue growth rate implies a large investment opportunity (Wen and Chen, 2008), which can possibly induce risk-taking, hence a positive correlation between risk and growth rate. I measure the firm growth (FG) as percentage growth in premiums from year t-1 to year t. The insurer with more liquid assets would be relatively unlikely to expose itself to liquidity risk than would an insurer with less liquid assets. The non-life insurer exhibit more skewed liquid asset holdings and is consistent with the short-term nature of their liability structure (Fields et al., 2012), therefore, this will reduce the risk of liquidity. This study refers to Chen and Wong (2004) uses an inverse measure of liquidity, liquidity ratio (LR) is measured as stated liabilities divided by liquid assets. If an insurer is a member of a financial holding that group insures might have an advantage by being able to diversify risks within the group (through intra-group reinsurance) and operate with relatively lower capital levels and higher asset and underwriting risk. On the other hand, financial mergers will complicate the financial system and increase the risk correlation between institutions. In this study, if a sampled company is a subsidiary of a financial holding group, the dummy

variable is defined as 1. If it is otherwise, the dummy variable is 0. The definitions of control variables are described in Table 1, and their hypothesized relationships with insurer risk-taking behavior are discussed literature.

Table 1: Definition of variables

Variable	Definition
Total risk (STDROA)	The Standard deviation of ROA
Underwriting risk	Annual losses incurred (net of loss adjustment expenses) divided by annual premium earned.
Leverage risk	Measured by 1-the surplus-to-assets ratio.
Product Diversification	Measured by 1-Herfindahl index (HHI) of product line.
Control variables	
Firm size	Natural logarithm of total assets.
Firm age	Number of years since an insurer was established.
Reinsurance	The ratio of reinsurance premium ceded to direct business written plus reinsurance assume.
Insurance leverage	The ratio of net earned premiums to shareholder's equity.
Firm growth	Percentage growth in premiums from year t-1 to year t
Long-Tail Line	The premiums of long-tail lines divided by total net written premiums.
Market share	Each firm's premium / total market premium.
Return on Investment	Investment Income / average invested assets.
Liquidity ratio	Stated liabilities / Liquidity Assets.
Financial holdings group	Dummy variable equals 1 if financial holding company; 0 otherwise.

3.4 Methodology

I use ordinary least square (OLS) regression model, fixed effect model (FEM) and random effect model (REM) for the analysis of panel data to examine the impacts of product diversification on risk-taking in Taiwanese P-L insurers. Through literature review, I construct an empirical regression model that tests the following relation: Risk Taking =f (Diversification, Controls).

Risk taking behavior measures variables including total risk, underwriting risk and leverage risk. In examining the relationship between product diversification and risk-taking behavior of firm, first, OLS regression model, FEM and REM are run and then tested to determine the best-fit model. This study use Lagrange multiplier (LM) test to determine whether OLS model is better fit than FEM or REM. Subsequently, Hausman test is employed to determine whether FEM or REM is

better fit for the study data. In this study, risk-taking variable is tested with regression models based on total risk, underwriting risk and leverage risk. The empirical results are checked by LM test; they indicate that both the FEM and REM are better fit than OLS regression model. The results of Hausman test also show that REM is a better estimator than FEM in both total risk and leverage risk models. However, the results of Hausman test show that FEM is a better estimator than REM in underwriting risk models.

4. Empirical Results

4.1 Model Specification and Descriptive Statistic

Table 2 presents the descriptive statistics of major variables depicting the individual properties of insurers. As shown, the mean of total risk, underwriting risk, leverage risk and product diversification of sampled firms between 2001 and 2014 are 0.0275, 0.5274, 0.7069 and 0.6740 respectively, indicating insurer have a higher level of leverage risk and product diversification in the P-L insurance market in Taiwan. The possible reason is that most of the insurance firms belong to the financial holding groups, therefore the insurer cross-sell products cause the phenomenon of high degree of diversification. In addition, firm growth has a mean of 0.0393 displaying highly competition in the Taiwanese P-L insurance market, in which high firm growth was difficult to achieve and profits were limited.

To test the relationships between variables, I perform correlation coefficient analysis and find correlation between independent variables. Table 3 shows the Pearson correlation matrix of all independent variables. I find some variables are highly correlated. For example, the market share is positively and significantly related to firm size (0.688 at less than the 1percent level). The VIFs of all independent variables in the regressions are lower than 4, indicating a minor multicollinearity problem (Gujarati, 1995), so the regression result of independent variables in not adversely affected by multicollinearity.

Table 2: Descriptive statistics of major variables

Variable	Mean	Std. dev.	Min	Max
Total risk (STDROA)	0.0275	0.0426	0.0006	0.3500
Underwriting risk	0.5274	0.1484	0.1400	1.2900
Leverage risk	0.7069	0.0929	0.4353	0.9612
Product diversification	0.6740	0.0997	0.1431	0.8427
Firm size	16.2756	1.2145	11.3025	20.4645
Firm age	42.9313	16.7434	2.0000	83.0000
Reinsurance	0.4225	0.1330	0.1900	0.8000
Insurance leverage	1.2300	0.8655	0.0800	9.1100
Firm growth	0.0393	0.1398	-0.5000	1.226
Long-Tail line	03355	0.1503	0.1379	0.9650
Market share	0.0650	0.0467	0.0002	0.2208
Return on investment	0.0241	0.0234	-0.0822	0.1610
Liquidity ratio	1.0896	0.3612	0.3500	2.6200
Financial holding	0.2696	0.4448	0.000	1.000

Table 3: Correlations of independent of variables

	PD	SIZE	FA	RE	IL	FG	LT	MR	ROI	LR	FH
PD	1										
SIZE	0.122	1									
FA	0.569	-0.226**	1								
RE	0.259***	-0.197	-0.151***	1							
IL	-0.221**	-0.064	-0.292***	-0.143*	1						
FG	-0.045	0.093	-0.139*	0.160*	-0.041	1					
LTL	0.104	-0.074	-0.225**	0.497***	-0.091	0.135	1				
MS	0.033	0.688***	-0.032	-0.249***	0.056	0.061	-0.307***	1			
ROI	-0.033	0.016	0.010	-0.118	-0.116	0.014	-0.608**	0.038	1		
LR	0.062	0.154*	-0.073	-0.036	0.321***	-0.021	.0.214*	0.021	0.030	1	
FH	0.154*	0.250***	0.099*	-0.030	0.175***	0.084	-0.196*	0.368***	0.010	-.0.098	1

Notes1: PD=Product diversification; SIZE=Firm size; FA=Firm age; RE=Reinsurance; IL=Insurance leverage; FG=Firm grow; LTL= Long tail; MS=Market share; ROI=Return on investment; LR= liquidity ratio; FH=Financial holding; Notes 2: ***, **, and* represent significance 1%,5%,and 10% levels, respectively.

4.2 The effect of product diversification and risk taking-Total risk

Table 4 shows the estimations of the parameters from the REM using total risk as the dependent variable. The product diversification is significantly negatively related to total risk, while insurers may choose to diversify by expanding into other lines of business. If sources of risk are not perfectly correlated, product diversification can reduce an insurer's overall portfolio risk (Milidonis et al.2019). The results are consistent with Alhassan and Biekpe (2018) suggests that business line diversification reduces the risk inherent in each buiness line and ultimately the overall portfolio risk. Berry-Stölzle et al. (2013) indicate that in insurance industries, more volatile business exhibit higher levels of diversification. Organizations diversify in the relation product market. This finding is consistent with portfolio theory in finance. However, financial holding groups show significant positive relationship with total risk, which implies that financial holding groups might take more risk than single insurance firm. This result supports the view of Cummins and Sommer (1996) reveal that the market deems insurance groups more risky than unaffiliated single insurance firm. Other variables such as firm age, reinsurance, insurance leverage, ROI, and liquidity ratio are all found to be positively related to total risk, whereas firm size, long-tail line, and market share exhibits negative correlation with total risk, but are not significantly different from zero. Table 4 summarizes the empirical results.

Table 4: Product diversification and firm risk-taking (total risk)

Dependent Variable	OLS		REM	
Variable	**coefficient**	**p-value**	**coefficient**	**p-value**
Intercept	0.1484	0.042**	0.1514	0.052*
Product diversification	-0.0642	0.118	-0.0737	0.096*
Firm size	-0.0067	0.139	-0.0051	0.281
Firm age	0.0005	0.043**	0.0005	0.172
Reinsurance	0.0094	0.761	0.0103	0.761
Insurance leverage	0.0004	0.740	0.0006	0.606
Firm growth	-0.0397	0.079*	-0.0353	0.110
Long-Tail line	-0.0116	0.724	-0.0334	0.417
Market share	-0.0592	0.552	-0.1895	0.203
Return on investment	0.0396	0.760	0.0535	0.682
Liquidity ratio	0.0095	0.288	0.0009	0.923
Financial holding	-0.0642	0.140	0.0179	0.057*
Adjusted R^2	0.0431		0.0823	
F-value	1.88**		18.52**	

Notes:1.Table 4 reports the result of panel data random-effect regression.
2.The Hausman test value in H0: REM vs H1: FEM is 6.08, (p>0.05), insignificant, supporting REM as best-fit model.
3. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

4.3 The effect of product diversification and risk taking-underwriting risk

Table 5 shows estimations of the parameters from the FEM with underwriting risk as the dependent variable. The product diversification is significantly negatively related to underwriting risk, while insurers may choose product diversification diminish the volatility of underwriting returns (Shim, 2017). Firm growth is significantly and positively associated with underwriting risk. This evidence supports the view of Klein (1995) that unusually high annual growth in assets is associated with excessive risk taking because such growth has been linked with a

myopic strategy to gain market share or profitability. Long-tail line and underwriting risk is also found to exhibit significant and positive correlation, suggesting higher long–tail line increases a firm's underwriting risk and reduces the firm's profitability. However, financial holding groups show significant negative relationship with underwriting risk. The result suggests if an insurer is a member of a financial holding that they might have an advantage by being able to diversify risks within the group (through intra-group reinsurance).Other variables such as firm size, reinsurance, and market share are all found to be positively related to underwriting risk, whereas firm age, insurance leverage, ROI, and liquidity ratio exhibits negative correlation with underwriting risk, but are not significantly different from zero. Table 5 summarizes the empirical results.

Table 5: Product diversification and firm risk-taking (underwriting risk)

Dependent Variable	OLS		FEM	
Variable	**coefficie**	**p-value**	**coefficient**	**p-value**
Intercept	-0.1000	0.683	0.3994	1.32
Product diversification	-0.3357	0.016**	-0.4994	0.002***
Firm size	0.0389	0.011**	0.0266	0.177
Firm age	0.0008	0.330	-0.0048	0.293
Reinsurance	0.1704	0.102	0.0388	0.818
Insurance leverage	0.0007	0.864	-0.0031	0.463
Firm growth	0.1413	0.064*	0.1324	0.076*
Long-tail line	0.1438	0.196	0.5988	0.001***
Market share	0.0782	0.864	0.8755	0.366
Return on investment	0.0722	0.869	-0.3750	0.412
Liquidity ratio	0.0554	0.067*	-0.0069	0.859
Financial holding	-0.0297	0.241	-0.0817	0.024**
Adjusted R^2	0.1011		0.0156	
F-value	3.08 ***		4.21***	

Notes:1.Table 5 reports the result of panel data fixed-effect regression.
2.The Hausman test value in H0: REM vs H1: FEM is 56.39, ($p<0.05$), significant, supporting FEM as best-fit model.
3. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

4.4 The effect of product diversification and risk taking-leverage risk

Table 6 shows estimations of the parameters from the REM with leverage risk as the dependent variable. The product diversification is significantly negatively related to leverage risk. This result is consistent with the study by Hong and Bao (2015). Insurer by increasing the magnitude of the insurance pool through product diversification, expected losses become more predictable and earnings volatility can be educed (Shim, 2011). The less volatile earnings that reduce the expected costs of financial distress or bankruptcy may permit insurers to hold cost equity capital for

risks underwritten (Cummins et al,1999). Thus, Firm risk-reduction decreases the cost of financial distress and increases the debt capacity. For other control variables, the results show that firm age, insurance leverage, long-tail line and liquidity ratio are significantly and positively associated with leverage risk. For example, the firm age has a positive effect that is statistically significant at the 0.009 level in leverage risk. This result supports the view of Hong and Bao (2015) who found a positive relationship between the firm age and leverage risk in the P/L insurance industry. Insurance leverage and leverage risk is also found to exhibit significantly positive relationship, suggesting increases in equity lowers the risk of financial distress and insolvency. The effect of long tail line is positive and statistically significant in the leverage risk. These findings are consistent with view that higher levels of long tail business would likely increased operational risk and ultimately have bankruptcy risks. The estimated coefficients of liquidity ratio have the expected positive sign and are statistically significant in leverage risk model. ROI is significantly and negatively related to leverage risk. This result supports the finding from Elango et al.(2008). This means an insurance firm with better ROI would take on more risks, which could result in better performance. Other variables such as firm size, market share are all found to be positively related to leverage risk, whereas reinsurance, financial holding exhibits negative, but are not significantly different from zero. Table 6 summarizes the empirical results.

Table 6: Product diversification and firm risk-taking (leverage risk)

Dependent Variable	***OLS***		**REM**	
Variable	**coefficient**	**p-value**	**coefficient**	**p-value**
Intercept	0.4556	0.000***	0.4836	0.000***
Product diversification	-0.7820	0.207	-0.1482	0.016**
Firm size	0.0088	0.203	0.0057	0.400
Firm age	0.0004	0.318	0.0018	0.009**
Reinsurance	-0.0811	0.074*	-0.0535	0.241
Insurance leverage	0.0638	0.000***	0.0503	0.000***
Firm growth	-0.0180	0.593	-0.0292	0.326
Long-Tail line	0.2398	0.000***	0.2189	0.000***
Market share	-0.2465	0.097*	0.1864	0.454
Return on investment	-0.9616	0.000***	-0.7206	0.000***
Liquidity ratio	0.0583	0.001***	0.0546	0.001***
Financial holding	-0.0123	0.277	-0.1858	0.174
Adjusted R^2	0.5675		0.4847	
F-value	26.62***		137.01***	

Notes: 1.Table 6 reports the result of panel data random-effect regression.
2.The Hausman test value in H0: REM vs H1: FEM is 18.46, (p>0.05), insignificant, supporting REM as best-fit model.
3. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

4.5 Robustness Checks

As further check for the robustness of the above results, the study explores alternative analyses. The above analyses are repeated using a different measure of the risk–taking for P-L insurers. Following Shiu (2011), the solvency risk is used as a proxy to measure insurer risk–taking behavior. Insurer solvency risk as the solvency margin expressed as a percentage of the premium income. The findings using solvency risk as the sensitivity measure are consistent with the results based on above three major models (the product diversification is significantly negatively related to solvency risk).

5. Conclusions and Discussion

This study investigates the impacts of product diversification on risk–taking behavior using a panel data on Taiwanese P-L insurers from 2001 to 2014. The main findings from the empirical analyses are summarized as follows. First, there is a negative relationship between product diversification and risk-taking behavior in three risk measures which implies that product diversification reduces the risk inherent in each business line and ultimately the overall portfolio risk. This finding is consistent with portfolio theory in finance literature. Second, I find financial holding groups tend to have lower underwriting risk and more high total risk. If an insurer is a member of a financial holding that they might have an advantage by being able to diversify risks within the group (through intra-group reinsurance), but they are also more risk than single insurance firm. Third, the present study provides some interesting results with respect to several control variables. It provides new evidence that insurer with high firm growth and long-tail line will cause high underwriting risks, but inverse relationships with insurer of financial holding groups. In addition, this result also find insurer age, insurance leverage, long-tail line, and liquidity is positive and statistically significant with leverage risk, and ROI is negative with leverage risk. To conclude, the empirical results of study confirm to the current status of the P-L insurance in Taiwan, in which companies with greater product diversification exhibit low risk taking. In particular, the insurer of financial holding groups need to reduce their overall risk through product diversification.

Overall, the implication of my results is that, first, a more competitive environment should be encouraged in Taiwanese insurance industry; diversified insurance company can take risks to reduce an insurer's overall portfolio risk. Second, the results illustrate the effect of diversification on corporate risk. Therefore, the authorities and policyholders should actively monitor the financial status and risk-taking behavior of insurance companies. In addition to other supervisory information, risk disclosure information should be provided to the public on a regular basis. Finally, the study provides some valuable insights into the effects of product diversification and risk taking behavior, which can be useful for the insurance industry in some the developing ASEAN countries and offers an early warning of bankruptcy for insurers.

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