An Investigation of the Economic Crisis and Financial Stability: Evidence from the Taiwanese Insurance Industry

Chen-Ying Lee

Department of Risk Management and Insurance, Shih Chien University, Taiwan. R.O.C
bean44019@gmail.com

ABSTRACT

This study aims to examine the impact of the economic crisis on the financial stability of property-liability (P-L) insurance industry in Taiwan, and further explores the determinants of financial stability in insurance. The results suggest that the impact of economic crisis is significant negative on the P-L insurer's financial stability, indicating economic crisis decreases insurers' financial stability. My results also show both firm-specific factors and macroeconomic factors play important role, including ROE, business concentration, loss ratio and insurance leverage are important determinant insurer financial stability system. In addition, the study also reveal that firm size has moderating effect on economic crisis between with financial stability. The results have practical implications for supervision and management of the solvency, and can provide reference for the establishment of early warning and stable financial system for P-L insurance companies in developing country.

I.   INTRODUCTION

The insurance sector makes an important contribution to Taiwan's economic welfare and growth. Insurers spread the costs of risk events across time and the population, helping to reduce the impact of major risk events on the wider economy. Insurers also provide long-term investment finance to the economy, by channeling into investments the reserves from the premiums they receive (Vucetich et al., 2014). Insurers' role of risk absorption promote financial stability in the financial markets thus renders tranquility to economic entities (Jaaman and Hinn, 2019). However, the property-liability (P-L) insurance industry, especially the provision risk protection for households and firms transfers risks to entities that are better suited to handle them, is an important force for social security and stability, whether P-L insurance can survive forever is a critical role in the social economy. Taiwanese P-L insurers began to implement risk-based capital (RBC) systems in 2003. This system considers the insurers' business scale and various risk combinations to measure the risks of insurers and require them to hold the legal minimum capital, and is used as an indicator of the insurance industry's solvency. This suggests that solvency issues of insurance companies are of great importance to the insurance supervisory authority. However, after the 2008 financial crisis, financial institutions, including the insurance sector have received unprecedented attention. The financial stability of these institutions will have a significant impact on the social economy. However, the increasingly interactions among the insurance and banking sector which has increasingly blurred the distinction between insurance and banking activities and the types of risk they bear. Entry into each other's markets and the transfer of risk between financial institutions through the exchange of credit derivatives have changed the nature and incidence of systemic risk (Carey and Stulz, 2005). The insurance sector is therefore increasingly viewed as displaying the potential to destabilize the financial system (Das et al., 2003). Baluch et al. (2011) suggested systemic risk remains lower in insurance than in the banking sector, it is not negligible and has grown in recent years, partly because of insurers' increasing links with banks and their recent focus on non-traditional insurance activities, including structured finance. Therefore, the financial stability of insurance firms is crucial for the overall economy, given their vital role as intermediaries and investors (IAIS, 2011).

Consequently, both emerging and developed countries are working to upgrade their regulation and supervision framework in order to safeguard the insurance industry (Pasiouras and Gaganis, 2013). More recently, the economic crisis generated a new round of discussions on the soundness of insurance firms and maintaining effective supervision of insurers. The post-liberalized insurance industry in Taiwan has been witnessing a discernible shift from the sellers to the buyers' market (Rohit and Manjit, 2009). Further, industry will become more professional (Shenhbargraman, 2001) and lowering the entry barriers and growing sophistication of customers will make insurance market oligopolistic. In recent years the insurance industry has experienced rapid growth in Taiwan. According to Insurance Bureau (Taiwan) report, the asset ratio in Taiwan insurance sector to all financial institutions has increased from 24.56% of 2009 to 36.33% of 2020. The impact of insurance on financial institutions and its growing important to the economy, so its financial stability will be an issue worth exploring.

A. The Overview of the Insurance Market in Taiwan

In 1986, new foreign insurers started entering the market as the government gradually opened it to foreign insurance firms. Therefore, the insurance industry in Taiwan stared developing and became more financially sound during the 1990s. Due to deregulation, entrance of foreign and new domestic competitors in to the market and the formation of Financial Holding Companies appear to have had impacts on the operational scale and premium revenues of insurance companies. Taiwan insurance market has kept generally stable and fast growth. As of 2020, according to the report of Swiss Re, Sigma (2021), Taiwan's insurance penetration rate reached 17% and ranked 2nd in global ranking, it shows that Taiwan insurance has gradually developed and people have a basic insurance concept, but there is still a gap with mature countries in Europe and U.S. However, Taiwanese insurance industry is unique in many ways (1) limited products offered, (2) most domestic insurance companies are large family business, political, and not pure play, (3) the largest players are foreign insurance companies. Compared with international insurance product, Taiwanese insurance innovation and diversification are still needed, such as the development of green insurance, fragmented insurance, and spillover insurance. In addition, although Taiwanese insurance have foreign companies' operation such as Tokio marine newa insurance, MSIG Mingtai insurance and Chubb insurance etc., but there are still many large insurers (such as Fubon, Cathay insurance) belong to family business, not pure players. Coupled with the limited domestic underwriting capacity and high catastrophe risks, they rely on assistance from foreign reinsurance, the average reinsurance ratio is 0.369 of this study during period was higher than the reported mean of 0.310 in the 33 OECD countries (González-Fernández et al., 2022), it can be seen the Taiwan property-liability insurance market is more dependent foreign reinsurance spread risk. Under the circumstances, it is very meaningful to analyze and find the primary factors of financial stability in the P-L insurance sector. The structure of Taiwan insurance market provides an appropriate scenario analysis for the above research.

This paper complements the existing literature in various ways. First, the study expands our understanding of the impacts of economics crisis and financial stability on P-L insurer by focusing on a developing economic environment with an application to Taiwanese insurance industry. Second, it adds to the generally scarce empirical research on financial stability in the insurance sector by providing new evidence on the issue. Moreover, it is the first research of financial stability on the Asian insurance developing country. Since this study deals with emerging insurance markets, it also contributes to the financial literature on this topic. Third, the study also extends the prior studies by examining the impact of economics crisis on insurer solvency risks. Finally, the study offers managers important lessons on insurer solvency management. The evidence can be used by the Taiwanese decision makers in P-L insurance to determinants of insurers' solvency in a context and provide an early warning system for policy makers, i.e., supervision agencies, insurer.

The rest of this paper is organized as follows. The next section locates this research within the literature on financial stability and insurer solvency risk. The subsequent section explains the research methodology and variables development. The penultimate section discusses the results of the empirical study. The final section concludes and provides implications.

II.   RRLATED LITERATURE AND RESEARCH HYPOTHESES

Insurers provide three main services that are relevant from a financial stability perspective: financial intermediation, risk diversification/risk mitigation, and risk transfer. These main functions contribute to strengthening the resilience of the financial system by ensuring an efficient allocation of capital and risks within the economy (European Central Bank, 2007). Insurance companies have traditionally not been considered as core financial institutions which could be a source of systemic risk (Trainar, 2004). Although, insurance companies have been considered less risky than banks because they are less exposed to liquidity risk (Caporale et al., 2017), the increasing interactions among the insurance sector, financial markets, and other financial intermediaries, as well as the financial innovation, globalization, and deregulation of the financial system, have made the operations of financial intermediaries over the last decades more complex and potentially riskier (Sharpe and Stadnik, 2007). In fact, the topic of systemic risk in the financial sector has attracted renewed attention following the 2008 financial crisis. The crisis of American International Group Inc. (AIG) put the spotlight on insurance companies and raised concerns by policymakers, practitioners, and academics about the role of the insurance industry in the crisis and the extent to which the insurance industry is systemically risky. The failure of an insurer, or of multiple insurers, could constrain the ability of individuals and firms to transfer risk to those better able to bear it. Consequently, the benefits the insurance system creates for economic growth and financial stability may be compromised (Vucetich et al., 2014). Therefore, insurance regulation primarily aims to protect policyholders from default of insurance firms (Klein, 1995). However, under the maintenance of insurers financial stability, solvency capital requirements have become a focal point of insurer failure studies.

A.   Economics Crisis and Insurance Financial Stability

Trichet (2005) stated that life insurers downward pressure on long-term interest rates and non-life insurers were confronted with significant increases in claims due to terrorist attacks, corporate defaults and natural catastrophes exposures made insurers financial vulnerable. Baluch et al. (2011) found that the impact of the crisis on firms most directly affected are the specialist financial guarantee insurers, companies that extended their operations beyond traditional insurance business into risky areas of structured finance and, to a lesser extent, firms writing lines of insurance business that are particularly sensitive to an economic downturn, such as credit and liability insurers. Drake et al. (2017) analyzes equity risks of financial services companies with a focus on insurance firms and find that not all insurance lines of business contribute to the financial system risk. They find that financial guarantee and surety insurers do exhibit interconnectedness to bank risks. Bouzouita and Craiovennu (2019) indicates that the insurance segment analysis reveals differences among sectors, both for the volatility and correlation. The correlations for the life insurers, health insurers, and P-L insurers are high during the financial crisis, while the correlations for the surety and financial guarantee insurers and hospital and medical service plans with the overall market index remain at lower values throughout the financial crisis. The surety and financial segment also exhibit the highest volatility. Cummins and Weiss (2014) also indicated that the core activities of U.S. insurers do not pose systemic risk. However, life insurers are vulnerable to interactor crises, and both

life and property casualty insurers are vulnerable to reinsurance crises. Noncore activities such as financial guarantees and derivatives trading may cause systemic risk. Janina and Gregor (2015) argue that insurance firms are becoming more similar to banks and increasingly contribute to the systemic risk of the financial sector. Similarly, Bierth et al. (2015) also found that the contribution of insurance firms to the fragility of the financial system reached its peak during the crisis. However, the bankruptcy of insurance firms may reduce financial stability. Many studies (Das et al., 2003; Lee and Chang, 2015) suggest that insurers can enhance financial stability by transferring risk to multiple parties through insurance and reinsurance activities. Rubio-Misas et al. (2017) indicated insurer solvency not only protects policyholders by ensuring that the insurer will be able to meet its financial obligations in the future but also contributes to the stability of the financial system. Recently, Ma and Ren (2021) measure both the level and persistence of monitoring institutional ownership and also find a negative relationship between monitoring institutional ownership and an insurer's stock stability and performance during the crisis. Based on the above discussion, the following hypotheses were developed:

H1:   There is a negative relationship between economics crisis and financial stability in the P-L insurance.

B.   The Determinants of Financial Stability in the Insurance

There are few papers analyzing affect the insurer financial stability and solvency risk. Chen and Wong (2004) find that firm size and investment performance significantly affect insurer's financial health. When segregated into life and non-life businesses, their results show that for non-life insurers, financial health is associated with liquidity ratio, surplus growth, combined ratio, and operating margin. An insurer's spread of risk is commonly proxied by its underwriting exposures in long-tail vs short-tail business lines (Lee and Urrutia, 1996). However, different short/ long-tail business lines exhibit statistically different insolvency frequencies during the study period (Dang, 2014). Cummins and Xie (2013) also show that firms with a higher proportion of long-tail personal lines business experienced significant lower scale and cost efficiency gains in comparison with firms writing more commercial lines business. Caporale et al. (2017) analyzed the insolvency risk of insurance companies, the study showed that macroeconomic factors including interest rates, real exchange rate, and foreign direct investment are necessary to assess the credit risk of insurers, while firms' factors such as underwriting, leverage, liquidity, reinsurance, and organizational structure have a positive impact on insurers' insolvency, but the growth and size are not statistically significant. In additional, Shim (2017) analyzed in the U.S. property-liability insurance industry the link between market concentration and financial stability, providing support of a negative relationship. and inversely with company size, reinsurance use, and life insurance specialization. Pavic et al. (2019) explores financial stability of insurance companies and reveal that insufficient size and reinsurance coverage might endanger the financial stability of the insurer. However, Moreno et al. (2020) analyse the factors determining the solvency of insurance companies operating from 2008-2015, using a dynamic panel data model. The study found that actual solvency margins were positively correlated with profitability, underwriting risk, and mutual-type organization, and

inversely with company size, reinsurance use, and life insurance specialization. Nguyen and Vo (2020) examined enterprise risk management and solvency, they found that firm-specific characteristics such as leverage, ROA, combined-ratio and business type are significant increase the EU insurers' solvency, whereas the impact of firm size and age is insignificant. In additional, Fort et al. (2013) indicates that smaller firms are more sensitive to economic cycles and fluctuations and were hit harder by economic recession, relative to larger firms. Due to economic crisis may have an impact on the size of insurers and capitalization difference on financial risk taking, lead to insurers financial instability. Therefore, this study will further examine moderating effect of insurers firm size and insurance leverage on economic crisis on the financial stability of insurance. Based on the above discussion, the following hypotheses were developed:

H2: *There is an impact of firm-specific and macroeconomics factors on financial stability in the P-L insurance.*

H3: *There is a moderating effect between economic crisis with the financial stability*

H3$_1$: *There is a moderating effect of firm size between economic crisis between the financial stability in the P-L insurance.*

H3$_2$: *There is a moderating effect of firm insurance leverage between economic crisis between the financial stability in the P-L insurance.*

III.   DATA SOURCES, VARIABLES, AND METHODOLOGY

A.   Data Sources

The sample includes data on 14 Taiwan property-liability insurance companies over the period 2006-2016. This paper employs unbalanced panel data that contain information both across firms and over time for each firm. These 14 companies approximately 97% of the total gross premiums written in the Taiwan market and covers the years 2006-2016. Therefore, the sample dataset is representative. The data are obtained from several sources, including Taiwan Insurance Institute (TII), the Non-life Insurance Review of Taiwan and Insurance Open Information Observatory. Since the data includes both cross-sectional and time series elements, it allows conducting statistical analysis to explore the relationships between economics crisis and financial stability in P-L insurers over the study period.

B.   Variable's Definition: Dependent Variables

This study key dependent variable are the solvency ratio and Z-score. Indicators of insurer solvency are mostly defined in terms of capitalization: as mentioned before, I use as a proxy of the insurer's solvency (denoted SOLV) as the total capital expressed as a percentage of the total assets (Fields et al., 2012; Mankaï and Belgacem, 2016). The ratio indicates the percentage of shareholder surplus available to meet the insurance company's unexpected liabilities. That is to say, the measure indicates the variability in the percentage of shareholder surplus available to meet the insurer's future obligations (Fields et al., 2012).

The popularity of the Z-score derives from its relative simplicity and the fact that it can be computed using accounting information alone. Therefore, the Z-score can be

considered an alternative measure of risk and thus a good indicator of the financial soundness of insurers that consideration factors beyond capitalization or the particularly event of bankruptcy. Z-score has frequently been used in the financial stability literature as a proxy for the probability of a firm's insolvency (Rauch et al., 2015).The Z-score measure, which has traditionally been used as a proxy of individual risk for the banking sector (Laeven and Levine, 2009; Baselga-Pascual et al., 2015; Khan et al., 2017), may be a useful tool when applied in the insurance sector (Altuntas and Rauch, 2017; Cummins et al., 2017; Shim, 2017; Alhassan and Biekpe, 2018; Pavic et al., 2019; Rubio-Misas, 2020; Moreno et al., 2021). The Z-score relates a firm's capital level to the variability in its return on assets (ROA), revealing how much variability in returns can be absorbed by capital without the firm becoming insolvent (Li et al., 2017). The mathematical specification of the Z-score is given as:

$$\text{Z-Score} = (\text{ROA} + \text{Capital to Asset Ratio})/(\text{Standard deviation of ROA}) \qquad (1)$$

where ROA stands for return on assets measured by net income before taxes but after policyholder dividends divided by total asset. This study uses a three-year rolling window for the standard deviation of ROA. Higher Z-score implies a lower likelihood of insolvency and vice versa.

C.   Independent Variable: Macroeconomic Risk Factors

Moreno et al. (2020) find that a context of economic crisis decreases solvency margins. This study is to understand the impact of economics crisis on the insurance financial stability, this paper follow Contreras et al. (2021) set up a dummy variable for the economic crisis, a dummy variable equal to one for the years 2008-2010 and zero otherwise. in order to observe the impact of this economic crisis on P-L insurers financial stability. In addition, it seems obvious that general economic conditions are also likely to affect insurer capitalization as raising capital may be easier in a relatively strong economy (Cummins and Sommer, 1996). I include the change in interest as macroeconomic variable. The change in interest rate is calculated as the annual change that results from one-year rate of change in Taiwan banking deposits rates. Cheng and Weiss (2013) find a positive relationship between change in interest rate and the probability of insolvency. However, Shim (2017) finds a positive and significant relationship between change in interest rate and insurer financial stability.

D.   Independent Variable: Insurance-Specific Risk Factors

Berry-Stolzle et al. (2010) indicate that the insurer's asset size represents bigger risk pools, which leads to less volatile claim payments. I use the log of assets to control for the size determinant (Eling and Jia, 2016). Insures with higher profitability contributes to higher levels of capitalization and lower probabilities of insolvency (Rauch and Wende, 2015; Shim, 2017). Caporale et al. (2017) report that highly profitable insurers are less likely to become insolvent because they manage expenses effectively and can set competitive premium rates. I use return on equity (ROE) to assess the profitability determinant. Moreover, this paper examines the impact of premium growth on insurer financial stability. Long-tail lines of insurance may have a negative effect in an insurer's

solvency as they tend to generate less income from underwriting than shorter-tail lines (De Haan and Kakes, 2010). Additional, long-tailed business implies that managers control policyholder's funds for longer periods of time, which gives managers greater chances of squandering these funds (Carayannopoulos and Kelly, 2004). Prior studies (Ambrose and Seward, 1988) have used the loss ratio as a proxy for the quality of underwriting rigors a firm undertakes. Firms that have higher losses and higher costs associated with settling claims per dollar of premium are more likely to experience financial difficulties. I measured the loss ratio by the ratio of loss paid to premium, and use standard deviation of three years. The purchase of reinsurance can increase the primary insurer's underwriting capacity to write new business and allow an insurer to hold less capital without increasing the probability of its insolvency (Shim, 2017). Like to Cole and Mcullough (2006), reinsurance ratio is measured as the total reinsurance ceded divided by gross premiums written. The competition-fragility nexus posits that competition negatively affects the solvency of insurers. Shiu (2005) found that market competition was negatively and significantly related to solvency in the longer term and in the recovery of the late 1990s. This is possibly because market competition generally involves inappropriate price-cutting and insurer solvency may be impaired, On other hand, Schaeck et al. (2006) show that competitive banking systems are less likely to experience systematic financial crisis and hence support the "competition-stability" hypothesis. Thus, this study follows Chio and Weiss (2005) measure market share by firm's premium dividing by total market premium as a proxy variable of market competition.

Insurance leverage is defined as net premiums written to equity. Insurance leverage could amplify the return on equity resulting in higher surplus (Berry-Stolzle et al., 2010) and consequently in higher regulatory solvency. On the other hand, underwriting leverage could make it too challenging to fulfill claim obligation in the future (Pottier and Sommer, 2005) have a negative effect on the regulatory solvency ratio. As a proxy for investment risk, I follow Gatzlaff (2009) and use the Return on investment (ROI) variable by investment income divided by average invested assets. Rauch and Wende (2015) show a negative and significant relationship between investment risk and the regulatory solvency ratio for the years 2008 and 2009. The 'concentration-stability' view states that a concentrated industry with few large firms is more stable because large firms are likely to earn more profits due to market power. However, the 'concentration-fragility' view asserts that a more concentrated industry is more vulnerable to financial fragility because the 'too-big-to fail' protective mechanism may lead to excessive risk-taking by managers, thus negatively affecting the solvency of the companies. However, there are only a few recent studies analyzing this relationship in the insurance sector, Cummins et al. (2017) report a positive relationship between market concentration and stability in European life insurance firms, Shim (2017) conclude that higher market concentration is associated with low financial stability in the P-L insurance sector. I use a market structure variable, the Herfindahl-Hirschman index of net premiums written, to assets business concentration. Firm age reflects an insurer's ability to survive. For example, startups are more likely to fail. Insurer with a long history is assumed to be more sophisticated at dealing with difficult market conditions and to be to sustain stable growth through hard times (Hong and Bao, 2015). This study uses the number of years since the insurer was established to measure the firm age of the company. Pottier and Sommer (2005) find that it is the overall strength of the group that ultimately affects the

probability of insolvency. Affiliated insurers with better capitalization, that were more profitable, and that were members of more diversified groups have a lower probability of insolvency. Thus, I use dummy variable if a sampled company is a subsidiary of a financial-holding group is defined as 1. If it is otherwise, the dummy variable is 0. The definitions of the variables are presented in Table 1.

Table 1
Variables and Their Definitions

Variable	Definition
Z-score	(ROA+ Capital to Asset Ratio) / (Standard deviation of ROA)
Solvency ratio (SOLV)	Ratio of total capital to total assets
Firm size (FS)	Natural logarithm of total assets
Return on equity (ROE)	Pre-tax income (losses) /average equity
Return on investment (ROI)	Investment income/average invested assets
Long-tailed business (LTB)	The premiums of long-tail lines divided by total net written premiums.
SD of loss ratio (SDLR)	Standard deviation of loss ratio over past 3 years.
Reinsurance ratio (RE)	The ratio of the total reinsurance ceded divided by gross premiums written.
Market share (MS)	Each firm's premium / total market premium.
Insurance leverage (IL)	The ratio of net earned premiums to shareholder's equity.
Line-of-business concentration (LBC)	Line-of-business Herfindahl index
Firm age (FA)	Number of years since an insurer was established
Financial holding (FH)	Dummy variable equals 1 if financial holding company; 0 otherwise
Economic crisis (EC)	Dummy variable equals 1 if 2008, 2009, 2010; 0 otherwise.
Interest rate changes (IR)	One-year rate of change in banking deposits rates

E.　Methodology

To examine the relationship between economics crisis and financial stability while controlling for firm-specific and macroeconomic characteristics. This study employs ordinary least squares regression analysis (OLS) and two panel data models (fixed effects and random-effects models) to test the economic crisis with relation between an insurers' financial stability. Through literature review, the basic regression of insurers' financial stability states that the insurers' financial stability can be predicted by different factors as follows.

$$
\begin{aligned}
Financial\ stability_{it} &= \alpha + \beta_1 FS_{it} + \beta_2 ROE_{it} + \beta_3 ROI_{it} + \beta_4 LTB_{it} \\
&+ \beta_5 SDLR_{it}\beta_6 RE_{it}\beta_7 MS_{it}\beta_8 IL_{it} + \beta_9 LBC_{it} + \beta_{10} FA_{it} \quad (2) \\
&+ \beta_{11} FH_{it} + \beta_{12} EC_{it} \\
&+ \beta_{13} IR_{it} + \beta_{14} FS_{it} * EC_{it} + \beta_{15} LI_{it} * EC_{it} + e_{it}
\end{aligned}
$$

where i indexes firms, t represents years, and e_{it} is the error term, αis the intercept; β_j is the estimated regression coefficient of independent variable; j = 1, 2, 3…15; assuming it follows a normal distribution. Financial stability is measured by the Z-score and solvency ratio, this study defines dependent variable as the natural logarithm of the Z-score, and use as a proxy of the insurer's solvency ratio as the total capital expressed as a percentage of the total assets (Fields et al., 2012; Mankaï and Belgacem, 2016).

　　　　Panel data model technique allow for a choice between either for a fixed or random effect approach. Fixed effect model (FEM) treats firm specific effects as a fixed, but

unknown, parameters. Random effect model (REM), however, treats firm specific effects as randomly distributed across cross-sectional units (Greene, 1997). This study uses 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.

IV.   EMPIRICAL RESULTS

A.   Model Specification and Descriptive Statistic

Table 2 shows summary statistics for the variables and variance inflation factors (VIF) of variables used in my regression analysis. As shown, the mean of Z-score and solvency ratio of sampled firms between 2006 and 2016 are 3.2025 and 0.2813 respectively, indicating that the P-L insurers are in good financial condition and have sufficient solvency. Furthermore, the average return on equity is 10.52, indicating that the average insurer in my sample makes thin profitable. and Table 2 lists the VIF value.

Table 3 shows the Pearson correlation coefficients of all independent variables. I find that firm size, long tail business, market share, economic crisis and interest rate change are highly correlated with each other, and the Z-score and solvency ratio are negatively related to economics crisis. Therefore, I use variance inflation factors (VIFs) to test for multicollinearity among independent variables in the regression design. According to Gujarati and Porter (2009) multicollinearity is not considered a severe problem if the VIF value is less than 10. The VIFs of all independent variables in the regressions are lower than 7, so the regression result of independent variable is not adversely affected by multicollinearity. Table 2 lists the VIF value.

Table 2
Descriptive Statistics of Major Variables

Variable	Mean	Median	Std. dev.	Min	Max	VIF
Z-score	3.2025	3.2196	1.2936	-1.8490	6.4630	
Solvency ratio	0.2813	0.2810	0.0777	0.0720	0.4660	
Firm size	16.4884	16.5138	0.8816	11.7097	18.3309	5.59
Return on equity	0.10524	0.0358	0.2138	-1.7284	0.7835	1.54
Return on investment	0.0212	0.0170	0.0247	-0.0822	0.1610	1.16
Long-tailed business	0.3054	0.2686	0.1517	0.1339	0.965	4.95
SD of loss ratio	0.0749	0.0529	0.0948	0.0021	0.5760	1.98
Reinsurance	0.3686	0.3600	0.13154	0.1900	0.7800	2.86
Market share	0.0695	0.0534	0.0498	0.0002	0.2408	3.78
Insurance leverage	1.2221	0.9900	0.8960	0.0800	9.1100	2.28
Line-of-business concentration	0.3542	0.3517	0.0662	0.2346	0.6282	1.71
Firm age	46.0000	48.5000	16.7621	7.0000	85.0000	3.24
Financial holding	0.2792	0.0000	0.4501	0.0000	1.0000	1.52
Economic crisis	0.1818	0.0000	0.3870	0.0000	1.0000	1.42
Interest rate changes	-0.0232	0.0000	0.2168	-0.0181	0.2610	1.43

Table 3
Pearson's Correlation Matrix

	Z-score	SOLV	FS	ROE	ROI	LTB	SDLR	RE	MS	IL	LBC	FA	FH	EC	IR
Z-score	1.00														
SOLV	0.25***	1.00													
FS	0.26***	0.01	1.00												
ROE	0.41***	0.25***	-0.02	1.00											
ROI	0.10	0.21***	0.09	0.13	1.00										
LTB	-0.11	-0.24***	-0.70***	0.09	-0.06	1.00									
SDLR	-0.23***	-0.12	-0.59***	0.06	-0.07	0.60***	1.00								
RE	-0.17**	-0.17**	-0.44***	-.0.11	-0.16	0.62***	0.42***	1.00							
MS	-0.30***	-0.11	0.72***	0.03	0.10	-0.30***	-0.31***	-0.39***	1.00						
IL	-0.26***	-0.61***	0.07	-0.66***	-0.11	0.13	-0.10	-0.10	0.18***	1.00					
LBC	0.16**	-0.23***	-0.09	0.01	-0.04	0.04	0.06	-0.13	-0.01	0.24***	1.00				
FA	-0.04	0.39***	0.18**	-0.15	0.04	-0.23***	-0.18**	0.24***	-0.12	-0.33***	-0.58***	1.00			
FH	-0.01	-0.11	0.26***	-0.11	-0.04	-0.21***	-0.15	-0.05	0.38***	0.27***	-0.23***	0.11	1.00 -		
EC	-0.34***	-0.30***	-0.04	-0.08	0.07	0.12	0.04	0.07	0.003	0.06	0.02	-0.07	-0.02	1.00	
IR	0.11	0.08	-0.01	0.02	0.07	-0.01	0.19**	0.02	-0.007	-0.04	0.04	-0.007	0.03	-0.46***	1.00

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.1$

B. Comparison of The Average of Variables During and After the Economic Crisis

Table 4 shows comparison of the average of various variables during and after the economic crisis. The table includes the during of crisis and post-the end of crisis averages and the differences between means. Focusing on the differences that are statistically significant, we can see that the average of the Z-score and solvency ratio for the during of crisis and post-the end of crisis periods was 2.4666, 3.5329, and 0.2435, 0.2920 respectively, indicating during of crisis period there is a high risk of insolvency. The average of the firm size for the during of crisis and post-crisis periods were 16.4363 and 16.610, respectively, indicating that the firm size of Taiwan P-L insurers increased in the post-the end of crisis period. Long-tail line, SD of loss ratio and insurance leverage of average for the post-the end of crisis period have a decrease on the above variables compared with during of crisis period. Finally, the interest rate change was on average -0.1866 for the during of crisis and 1.0915 for the post-crisis period, suggesting an increase on the interest rate change in the after-crisis period. These figures indicate that the P-L insurance industry, in the during period compared with the post-the end of crisis period of the average of the Z-score and solvency ratio are increase, it reveals the impact of economic crisis on financial stability. The above univariate analysis shows that most of the variables are significantly different during of the economic crisis and after the end of the economic crisis. The relative test results detail as Table 4.

C. Economics Crisis and Financial Stability Empirical Results

Table5-Table 6 present the results of this study. The White test was employed to test for heteroskedasticity. Table 5 reports the result of the empirical estimation of equation using ordinary least squares (OLS) to Z-score and solvency ratio as the dependent variable. The empirical results are checked by LM test; they indicate that both the FEM and REM are better fit than OLS regression model.

Table 4
Comparison of the Average of Variables during and after the Economic Crisis

	During the crisis average (2008-2010)	Post-the end of crisis average (2011-2016)	Difference between crisis and post crisis average
Key variables			
Z-score	2.4666	3.5329	4.7742***
Solvency ratio	0.2435	0.2927	3.3437***
Firm size	16.4363	16.6610	1.6419
Return on assets	0.0259	0.0348	1.1122
Return on Investment	0.0241	0.0163	-1.6515
Long-tailed business	0.3358	0.2779	-2.1254**
SD of Loss Ratio	0.0815	0.0521	-2.0806**
Reinsurance	0.3817	0.3495	-1.4455
Market share	0.0697	0.0702	0.0470
Insurance leverage	1.3160	1.0820	-2.0503**
Line-of-business concentration	0.3523	0.3525	0.0113
Firm age	44.000	48.500	1.4341
Financial holding	0.2619	0.2857	0.2791
Interest rate changes	-0.1866	0.0002	4.8677***

Notes: ***, **, and * indicate significant at the 0.01, 0.05 and 0.10 level, respectively.

Table 5
Economics Crisis and Financial Stability (OLS)

Variable	Z-score	Solvency ratio
Constant	1.9177 (0.71)	1.6350*** (9.00)
Firm size	-0.0124 (-0.07)	-0.0703*** (-6.33)
Return on assets	1.8391*** (3.21)	0.1364*** (4.67)
Return on Investment	-1.3012 (-0.49)	0.45654** (2.94)
Long-tailed business	0.8279 (0.72)	-0.2684** (-5.11)
SD of Loss Ratio	-3.1699*** (-2.76)	-0.1376** (-2.45)
Reinsurance	-0.2183 (-0.18)	-0.0411 (-0.78)
Market share	7.2432** (2.40)	0.458*** (3.30)
Insurance leverage	-0.7469*** (-3.04)	-0.0791*** (-9.43)
Line-of-business concentration	5.5609*** (4.13)	-0.0211 (-0.30)
Firm age	-0.0008 (-0.10)	0.0001 (0.04)
Financial holding	0.0511 (0.23)	0.0043 (0.44)
Economic crisis	-0.8344** (-2.24)	-0.0396** (-2.35)
Interest rate changes	-0.2997 (-0.77)	-0.0365* (-1.83)
Economic crisis x insurance leverage	0.0498 (0.19)	-0.0055 (-0.50)
Economic crisis x firm size	0.3799 *** (2.64)	0.0397*** (3.98)
Adjusted R^2	0.4085	0.6788

Notes: t statistics in parentheses. The symbols ***, **and * denote statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Hausman's test suggests that random-effect models (REM) are superior to fixed-effect models in the case of Z-score model, and therefore this study present random-effect models as Table 6. The economic crisis, insurance leverage and SD of loss ratio are significantly negatively related to Z-score. The coefficient of the economic crisis is negative and statistically significant (P < 0.05) indicating a decrease in the solvency capacity since the economic crisis started. The result is consistent with the findings of Moreno et al. (2020), and support that a context of economic crisis decreases solvency

margins in the insurance sector. The insurance leverage result is consistent with Ahmed et al. (2020), implies that insurers may be at greater insolvency risk if they attempt to increase premium revenues without maintaining corresponding policyholders' surplus (Shim, 2017). The SD of loss ratio is negative and statistically significant with Z-score, shows a significant increase in net claims may generate liquidity risk for an insurer, which will eventually become insolvent if it cannot rase enough capital (Caporale et al., 2017). The return on equity (ROE), market share and business concentration are significantly positively related to Z-score. ROE is positive and statistically significant with Z-score, indicates the higher profitable, the higher the capitalization. However, I find a positive relationship between market share and Z-score, and hence support competition-stability hypothesis, indicates insurers to operate in a more efficient manner and hence stabilizes the market. Business concentration has a positive relationship with Z-score, which states that the more concentrated the sector is, the higher the insurer capitalization tends to be, show that support concentration-stability view. In addition, model adds the interaction term FS x EC dummy and IL x EC dummy as dependent variables to test the moderating effect of firm size and insurance leverage on financial stability. Regarding the moderating effect of firm size on the relationship between economics crisis and insurers' financial stability, the coefficient of the interaction term FS x EC dummy is positively significant. Therefore, the results provide evidence that firm size contribute to strength the positive impact on insurers' financial stability to economic crisis, but the coefficient of the interaction term LL x EC Dummy is not significant, show insurance leverage has no moderating effect.

Table 6 also reports the result of the empirical estimation of equation using to solvency ratios as the dependent variable. Hausman's test suggests that fixed-effect models (FEM) are superior to random-effect models (REM) in the case of solvency ratio model, and therefore I present fixed-effect models (FEM). The economic crisis, firm size, ROE, SD of loss ratio, insurance leverage, and long-tailed line are significantly negatively related to solvency ratio. In this model, I also find that economic crisis still negative affect ($P < 0.05$) the financial stability of the P-L insurance sector. Thus, economic crisis negatively impacts on insurers' financial stability across all model, support hypothesis 1. However, insurance leverage and SD of loss ratio are consistent with the results of Z-score model, firm size and long-tailed business are negative and statistically significant with solvency ratio, show that larger insurers may need less capital than smaller firms because they normally benefit from economies of scale and scope and have lower financing costs (Bouzouita and Young, 1998; Adams et al., 2003; Caporale et al., 2017). Long-tailed business of insurance due to the fact that they tend to generate less income from underwriting than shorter-tailed business (De Haan and Kakes, 2010). However, higher long-tailed business increases a firm's underwriting risk and reduces the firm's profitability (Lee, 2020) lead to decrease solvency ratio. Finally, ROE, return on investment (ROI) and business concentration are positive and statistically significant with solvency ratio, business concentration is same as Z-score model. Return on investment has a positive impact on solvency ratio is consistent with Rauch and Wende (2015) of findings, the investment risk had a positive impact on the regulatory solvency of insurance companies. Thus, hypothesis 2 is partially support. In addition, the coefficient of the interaction term FS x EC dummy is positively significant, reveal that firm size also has moderating effect on economic crisis between with financial stability, but the coefficient of the interaction term LL x EC Dummy is not significant, show

insurance leverage has no moderating effect. Therefore, hypothesis 3-1is supported, but hypothesis 3-2 is not.

Table 6
Economics Crisis and Financial Stability (REM and FEM)

Variable	Z-score	Solvency ratio
Constant	1.9178 (0.47)	1.5128*** (9.42)
Firm size	-0.0124 (-0.05)	-0.0872*** (-7.21)
Return on assets	1.8391*** (2.73)	0.0860*** (3.14)
Return on Investment	-1.3012 (-0.37)	0.2434** (2.09)
Long-tailed business	0.8279 (0.70)	-0.1782** (-2.11)
SD of Loss Ratio	-3.1699** (-2.49)	-0.1420*** (-3.29)
Reinsurance	-0.2183 (-0.18)	0.1312 (1.59)
Market share	7.2432** (2.30)	-0.1068 (-0.32)
Insurance leverage	-0.77470*** (-3.04)	-0.0419*** (-4.85)
Line-of-business concentration	5.5610*** (3.47)	0.2590*** (3.37)
Firm age	-0.0008 (-0.09)	0.0046*** (2.90)
Financial holding	0.0511 (0.22)	-0.0204 (1.54)
Economic crisis	-0.8344** (-2.07)	-0.0510*** (-4.13)
Interest rate changes	-0.2997 (-0.67)	-0.0202 (-1.40)
Economic crisis x insurance leverage	0.0498 (0.17)	0.0079 (1.01)
Economic crisis x firm size	0.3799* (1.67)	0.0353*** (4.87)
Adjusted R^2	0.4669	0.2742
LM test	119.98***	16.55***
Hausman test	14.18	236.86***
Best fit model	REM	FEM

Notes: t statistics in parentheses. The symbols ***, **and * denote statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

D.   Robustness Tests

I perform robustness tests by using alternative measures of insurer's financial stability. To potentially represent the category of an insurer's total risk, I consider a most important overall risk for shareholders or policyholders measure called standard deviation of return on equity (STDROE) following Ho et al. (2013) and Hong and Bao (2015). The STDROE which is calculated as the standard deviation of ratio of net income plus taxes and interest expenses divided by net equity. The check the robustness of the results, find that the most appropriate panel data regression model is the FEM. The findings using STDROE as the sensitivity measure are consistent with my previous result. The relationship between economic crisis and P-L insurers' financial stability is significant and negative, indicating that economic crisis decreases solvency margins of insurers to be troublesome for insurers' financial stability. In addition, the findings using STDROE as the measure are same with the results based on the major variables of Z-score and solvency ratio models.

V.   CONCLUSIONS AND DISCUSSION

Although Taiwan insurance has unique characteristics, the results of this study are still consistent with developed counties such as Spanish (Moreno et al., 2020), and U.S. (Bouzouita and Craiovennu, 2019). The economic crisis does affect the financial stability

of P-L insurance. To conclude, this present study explores the relationship between the economic crisis and the financial stability of Taiwanese P-L insurance industry over the period 2006-2016. I measure the insurer's financial stability with an accounting measure of insolvency risk, the Z-score and solvency ratio. The results of empirical tests show that the impact of economic crisis is significant and negative on the P-L insurer's financial stability across all model. I find evidence supporting the Moreno et al. (2020), indicating economic crisis decreases solvency margins. My results are consistent with several empirical banking studies (e.g., Bourkhis and Nabi, 2013; Shehzada and De Haan, 2013; Alqahtani and Mayers, 2018). The outcomes of the research suggest that regulator should be solvency capital requirements have become an early warning mechanism to strengthen insurer's financial stability to cope with future economic crisis.

Empirical results also show other important determinants in ensuring a safe and sound insurance system. Among them, more market concentration is associated with higher financial stability indicates larger firms operating in highly concentrated markets are likely to earn more profits through the implementation of market power (Uhde and Heimeshoff, 2009), support concentration-stability view. The inverse relationship between insurance leverage and the Z-score and solvency ratio suggests that higher premium growth without corresponding policyholders' surplus may harm the insurer's financial stability. The SD of loss ratio variables is negative and statistically significant with Z-score and solvency ratio show insurers with relatively higher losses and costs associated with setting claims have a higher probability of incurring financial distress (Kleffner and Lee, 2009). Finally, the results provide empirical support for insurers firm size moderating effect, contribute to strength the positive impact on insurers' financial stability between with economic crisis. By identifying the firm factors and macroeconomic status that affect insurers' financial stability, my results have practical implications for the future operation of the insurance industry. It can also provide to policy makers for the financial strategy of supervision and management of the solvency about the determinants of the insurers' financial health. The experience can be used as a reference for the business operation and development of insurance industry in developing countries.

REFETRENCE

Adams, M.B., Burton, B., and Hardwick, P., 2003, "The Determinants of Credit Ratings in the United Kingdom Insurance Industry", *Journal of Business Finance and Accounting*, 30, 539-572.

Ahmed, D., Shahab, Y., Ullah, F., and Ye, Z., 2020, "Investor Sentiment and Insurer's Financial Stability: Do Sovereign Ratings Matter?", *The Geneva Papers on Risk and Insurance*, 45, 281-312.

Alhassan, A.L., and Biekpe, N., 2018, "Competition and Risk-taking Behaviour in the Non-life Insurance Market in South Africa", *The Geneva Papers on Risk and Insurance*, 43, 492-519.

Altuntas, M., and Rauch, J., 2017, "Concentration and Financial Stability in the Property-Liability Insurance Sector: Global Evidence", *The Journal of Risk Finance*, 18, 284-302.

Alqahtania, F., and Mayes D.G., 2018, "Financial Stability of Islamic Banking and the Global Financial Crisis: Evidence from the Gulf Cooperation Council", *Economic Systems*, 42, 346-360.

Ambrose, J.M. and Seward, J.A., 1988, "Best's Ratings, Financial Ratios and Prior Probabilities in Insolvency Prediction", *Journal of Risk and Insurance*, 55, 229-244.

Baselga-Pascual, L., Trujillo-Ponce, A., and Cardone-Riportella, C., 2015, "Factors Influencing Bank Risk in Europe: Evidence from the Financial Crisis", *The North American Journal of Economics and Finance*, 34, 138-166.

Baluch, F., Mutenga, S., and Parsons, C., 2011, "Insurance, System Risk and Financial Crisis", *The Geneva Papers on Risk and Insurance- Issues and Practice,* 36,126-163.

Berry-Stölze, T., Koissi, M.C., and Shapiro, A.F., 2010, "Detecting Fuzzy Relationships in Regression Models: The Case of Insurer Solvency Surveillance in Germany", *Insurance: Mathematics and Economics*, 46, 554-567.

Bierth, C., Irresberger, F., and Weiß, G.N.F., 2015, "Systemic Risk of Insurers around the Globe", *Journal of Banking & Finance*, 55, 232-245.

Bourkhis, K., and Nabi, M.S., 2013, "Islamic and Conventional Banks' Soundness during 2007-2008 Financial Crisis", *Review of Financial Economics*, 22,68-77.

Bouzouita, R., and Craiovennu, M., 2019, "Insurance Industry Risk during the 2008 Financial Crisis", *Academy of Accounting and Financial Studies Journal*, 23,1-12.

Bouzouita, R., and Young, A.J., 1998, "A Probit Analysis of Best Ratings", *The Journal of Insurance Issues*, 21, 23-34.

Carayannopoulos, P., and Kelly, M., 2004, "Determinants of Capital Holdings: Evidence from the Canadian Property/Casualty Insurance Industry", *Journal of Insurance Regulation*, 23, 45-65.

Carey, M., and Stulz, R.M., 2005, "The Risks of Financial Institutions", NBER Working Paper, 11442.

Caporale, G.M., Cerrato, M., and Zhang, X., 2017, "Analysing the Determinants of Insolvency Risk for General Insurance Firms in the UK", *Journal of Banking and Finance*, 84, 107-122.

Chen, R., and Wong, K., 2004, "The Determinants of Financial Health of Asian Insurance Companies," *Journal of Risk and Insurance*, 71, 469-499.

Cheng, J., and Weiss, M.A., 2013, "Risk-based Capital and Firm Risk Taking in Property-Liability Insurance", *The Geneva Papers on Risk and Insurance- Issues and Practice*, 38, 274-307.

Choi, B.P., and Weiss, M.A., 2005, "An Empirical Investigation of Market Structure, Efficiency, and Performance in Property-Liability Insurance", *Journal of Risk and Insurance*, 72, 635-673.

Cole, C.R., and McCullough, K.A., 2006, "A Reexamination of the Corporate Demand for Reinsurance," *Journal of Risk and Insurance* ,73, 169-192.

Contreras, S., Ghosh, A., and Kong, J.H., 2021, "Financial Crisis, Bank Failures and Corporate Innovation", *Journal of Banking & Finance*, 129, 106161.

Cummins, J.D., Rubio-Misas, M., and Vencappa, D., 2017, "Competition Efficiency and Soundness in the European Life Insurance Markets", *Journal of Financial Stability*, 28, 66-78.

Cummins, J.D., and Sommer, D.W., 1996, "Capital and Risk in Property-liability Insurance Markets", *Journal of Banking and Finance*, 20, 1069-1092.

Cummins, J.D., and Weiss, M.A., 2014, "Systemic Risk and the U.S. Insurance Sector", *Journal of Risk and Insurance*, 81, 489-523.

Cummins J.D, and Xie, X., 2013, "Efficiency, Productivity, and Scale Economies in the U.S. Property Liability Insurance Industry", *Journal of Productivity Analysis*, 39, 141-164.

Dang, H., 2014, "A Competing Risks Dynamic Hazard Approach to Investigate the Insolvency Outcomes of Property-casualty Insurers", *The Geneva Papers on Risk and Insurance- Issues and Practice*, 39, 42-76.

Das, U.S., Davies, N. and Podpiera, R., 2003, "Insurance and Issues in Financial Soundness", IMF Working Paper, 138.

De Haan, L., and Kakes, J., 2010, "Are Non-risk based Capital Requirements for Insurance Companies Binding?", *Journal of Banking & Finance*, 34, 1618-1627.

Drake, P.P., Neale, F.R., Schorno, P.J., and Semaan, E., 2017. "Risk during the Financial Crisis: The Role of the Insurance Industry", *Journal of Insurance Issues*, 40, 181-214.

Eling, M., and Jia, R., 2016, "A Walk through the Graveyard: Which Insurance Companies Have to Leave the Market", (Working Paper). Paper presented at the Institute of Insurance Economics, University of St. Gall, Switzerland.

European Central Bank, 2007, *Potential Impact of Solvency II on Financial Stability*, Frankfurt, Germany.

Fields, L.G., Gupta, M., and Parkash, P., 2012, "Risk-taking and Performance of Public Insurers: A International Comparison", *Journal of Risk and Insurance*, 79, 931-962.

Fort, T.C., Haltiwanger, J., Jarmin, R.S., and Miranda, J., 2013. "How Firms Respond to Business Cycles: The Role of Firm Age and Firm Size", *NBER Working Papers*, 19134.

Gatzlaff, K., 2009, *Dimensions of Property-liability Insurer Performance*. Unpublished Doctoral Dissertation, Florida State University Doctoral Dissertation.

Greene, W., 1997, *Econometric Analysis*, (Upper Saddle River, NJ: Prentice Hall).

González-Fernández, A.I., Rubio-Misas, M., and Ruiz, F., 2022. "Multi-objective Reference Point Techniques to Optimize Profitability, Growth, and Risk in the Non-life Insurance Industry: International Analysis," *International Transactions in Operational Research,* 30, 2464-2570.

Gujarati, D.N., and Porter, D.C., 2009, *Basic Econometrics*, 5th ed, New York: McGraw-Hill.

Ho, C.L., Gene, C.L., and Lee, J.P., 2013, "Organizational Structure, Board Composition, and Risk Taking in the U.S. Property Casualty Insurance Industry", *Journal of Risk and Insurance*, 80, 169-203.

Hong, S., and Bao, S., 2015, "Guaranty Funds, Government Shareholding and Risk Taking: Evidence from China," *The Geneva Papers on Risk and Insurance-Issues and Practice*, 40, 653-677.

IAIS, 2011, *Insurance and Financial Stability.* International Association of Insurance Supervisors, Basel.

Jaaman, S.H., and Hinn, O.C., 2019, "Solvency Analysis by Business Classifications of General Insurance Industry in Malaysia," *International Journal of Sciences: Basic and Applied Research*, 48, 24-32.

Janina, M., and Gregor, N.F.W., 2015, "Consolidation and Systemic Risk in the International Insurance Industry", *Journal of Financial Stability*, 18, 187-202.

Khan, M.S., Scheule, H., and Wu, E., 2017, "Funding Liquidity and Bank Risk Taking", *Journal of Banking and Finance*, 82, 203-216.

Klein, R.W., 1995, "Insurance Regulation in Transition", *Journal of Risk and Insurance*, 62, 363-404.

Kleffner, A.E., and Lee, R.B., 2009, "An Examination of Property and Casualty Insurer Solvency in Canada", *Journal of Insurance Issues*, 32, 52-77.

Laeven, L., and Levine, R., 2009, "Bank Governance, Regulation and Risk Taking", *Journal of Financial Economics*, 93, 259-275.

Lee, C.Y., 2020, "The Impact of Product Diversification on Risk-taking Behavior in Property and Liability Insurance Firm", *Journal of Applied Finance & Banking*, 10, 177-197.

Lee, C.C., and Chang, C.H., 2015, "Financial Policy and Insurance Development: Do Financial Reforms Matter and How", *International Review of Economic & Finance*, 38, 258-278.

Lee, S.H., and Urrutia, J.L.,1996, "Analysis and Prediction of Insolvency in the Property-Liability Insurance Industry: A Comparison of Logit and Hazard Models", *The Journal of Risk and Insurance*, 63,121-130.

Li, X., Tripe, D., and Malone, C., 2017, "Measuring Bank Risk: An Exploration of Z-score", *Social Science Research Network (SSRN)*, 1-38.

Ma, Y.L., and Ren, Y., 2021, "Insurer Risk and Performance before, during, and after the 2008 Financial Crisis: The role of Monitoring Institutional Ownership", *The Journal of Risk and Insurance*, 88, 351-380.

Mankaï, S., and Belgacem, A., 2016, "Interactions between Risk Taking, Capital, and Reinsurance for Property-liability Firms", *Journal of Risk and Insurance*, 83, 1007-1043.

Moreno, I. Parrado-Martínez, P., and Trujillo-Ponce, A., 2020, "Economic Crisis and Determinants of Solvency in the Insurance Sector: New Evidence from Spain", *Accounting & Finance*, 60, 2965-2994.

Moreno,I. Parrado-Martínez, P., and Trujillo-Ponce, A., 2021, "Using the Z-score to Analyze the Financial Soundness of Insurance Firms", *European Journal of Management and Business Economics*, 31, 22-39.

Nguyen, D., and Vo, D.T., 2020, "Enterprise Risk Management and Solvency: The Case of the Listed EU Insurers", *Journal of Business Research*, 113, 360-369.

Pasiouras, F. and Gaganis, C., 2013, "Regulations and Soundness of Insurance Firms: International Evidence", *Journal of Business Research*, 66, 632-642.

Pavic, T., Miletic, M., and Kozul, R., 2019, "Financial Stability of Insurance Companies in Selected CEE Countries", *Business System Research*, 10,163-178.

Pottier, S.W., and Sommer, D.W., 2005, "On the Use of Group-level Financial Information in Insurer Solvency Surveillance", *Working Paper Presented at the World Risk and Insurance Economics Congress*.

Rohit, K., and Manjit, S., 2009, "Emerging Trends in Financial Performance of General Insurance Industry in India", *Indian management Studies Journal*, 13, 31-44.

Rauch, J., and Wende, S., 2015, "Solvency Prediction for Property-liability Insurance Companies: Evidence from the Financial Crisis", *The Geneva Papers on Risk and Insurance-Issues and Practice*, 40, 47-65.

Rubio-Misas, M., and Fernández-Moreno, M., 2017, "Solvency Surveillance and Financial Crisis: Evidence from the Spanish Insurance Industry", *Spanish Journal of Finance and Accounting*, 46, 272-297.

Rubio-Misas, M., 2020, "Ownership Structure and Financial Stability: Evidence from Takaful and Conventional Insurance Firms", *Pacific-Basin Finance Journal,* 62, 101355.

Schaeck, K., Cihak, M., and Wimon, W., 2006, "Are More Competitive Banking Systems More Stable", *International Monetary Fund Working Paper WP/06/143*, Washington D.C.

Shenhbargraman, K., 2001, "Insurers are Partners in Economic Growth", *The Insurance Times*, 21, 77-86.

Sharpe, I.G., and Stadnik, A., 2007, "Financial Distress in Australian General Insurers", *Journal of Risk and Insurance*, 74, 377-399.

Shiu, Y.M., 2005, "The Determinants of Solvency in the United Kingdom Life Insurance Market", *Applied Economics Letter*s, 12, 339-344.

Shehzada, C.T., and De Haan, J., 2013, "Was the 2007 Crisis Really a Global Banking Crisis?", *The North American Journal of Economics and Finance*, 24, 113-124.

Shim, J., 2017, "An Investigation of Market Concentration and Financial Stability in Property-liability Insurance Industry", *Journal of Risk and Insurance*, 84, 567-697.

Swiss Re Management Ltd., 2021, "Word Insurance: The Recovery Gains Peace", *Sigma*, 3, 1-44.

Trainar, P., 2004, "Insurance and Financial Stability", *Financial Stability Review*, 5, 73-89, Banque de France.

Trichet, J.C., 2005, "Financial Stability and the Insurance Sector", *The Geneva Papers on Risk and Insurance-issues and Practice*, 30, 65-71.

Uhde, A., and Heimeshoff, U., 2009, "Consolidation in Banking and Financial Stability in Europe: Empirical Evidence", *Journal of Banking and Finance*, 33, 1299-1311.

Vucetich, A., Perry, R., and Dean, R., 2014, "The Insurance Sector and Economic Stability," *Reserve Bank of New Zealand: Bulletin*, 77, 1-12.