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The Impact of Market Concentration on Financial Stability in the Korean Non-life Insurance Industry

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We investigate the relationship between market concentration and financial stability in the Korean non-life insurance industry over the period 2002-2022. We measure market concentration by using Herfindahl-Hirschman Index (HHI) and four-firm concentration ratio (CR4), and Z-score is employed as a proxy for insurer's financial soundness. Our evidence shows that market concentration is positively associated with insurer's financial stability, indicating that higher market concentration may lead to decreased insolvency risk, consistent with the "concentration-stability" view. We also find that there exists an inverse U-shaped relationship between market concentration and financial health in the Korean non-life insurance industry. Lastly, we provide evidence that as market concentration increases, insurers belonging to a financial holding company are more likely to exhibit better financial soundness. Our study has important implications for regulatory authorities as well as industry practitioners who concern about insurer's financial stability.

Keywords: Market Concentration; Financial Stability; Concentration-stability View; Korean Non-life Insurers
JEL classifications: G22; G28; L11

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I. Introduction

The insurance industry plays a pivotal role in underwriting risks for economic agents, expanding a safety net for society, and facilitating economic activities. They also serve as institutional investors in the financial markets, with insurance assets accounting for 12 percent of all global financial assets (IAIS, 2012). As such, financial instability in the insurance sector could have a substantial direct impact on both society and financial markets. Additionally, the risks associated with insurance firms not only affect stakeholders within the same industry but also have the potential to spill over into the entire financial system due to integration and interconnectedness of financial institutions (Cummins et al., 2008; Dreassi et al., 2018). A representative example is American International Group (AIG), which was considered systemically important during the 2008-2009 global financial crisis and received the largest bailout the government doled out that exceeded $182.3 billion. Therefore, maintaining the financial stability of the insurance market is always paramount among insurers and insurance regulatory authorities alike worldwide.

Over the past four decades, Korean insurance industry has grown significantly and as a result, it is ranked seventh in terms of nominal premiums in the global insurance market.[1] In particular, there has been an accelerated focus on deregulation and liberalization, thereby inducing changes in market structure in the Korean insurance industry. So far, extensive research has been conducted on the effect of market concentration on firm's financial stability in financial markets, with a primary focus on the banking industry. Although both theoretical and empirical results are inconclusive and still ambiguous (e.g., Mishkin, 1999; De Nicoló et al., 2004; Beck et al., 2006; Uhde and

1) Swiss re sigma 3/2023 - World insurance

Heimeshoff, 2009), they have significantly expanded our understanding of how market concentration affects firm's financial stability. However, despite the importance of this issue, the effect of market concentration on financial soundness has received relatively less attention in the insurance literature and especially, in the context of non-US insurance firms.[2] Therefore, we try to fill this gap by exploring the relationship between market concentration and financial stability in the Korean non-life insurance sector.

Using data from Korean non-life insurance companies from 2002 through 2022, we investigate the effect of market concentration, as measured by Herfindahl-Hirschman Index (HHI) and four-firm concentration ratio (CR4), on financial stability, which is calculated by Z-score. By way of preview, we find that market concentration is significantly and positively related to insurer's financial stability, indicating that higher market concentration may lead to decreased insolvency risk in Korean non-life insurance companies. This provides support for "concentration-stability" view. Our evidence also shows an inverse U-shaped relationship between market concentration and insurer's financial soundness, implying that as market concentration goes up, insurer's financial health initially increases, and then decreases in the Korean non-life insurance industry. Moreover, we present evidence that unlike insurers belonging to a large business group and stand-alone insurers, insurers belonging to a financial holding company are more likely to exhibit better financial soundness when market concentration increases. Finally, we show

2) To our knowledge, few studies examining the relationship between market concentration and financial stability in the insurance literature are Shim (2017) in US property-liability insurance companies and Altuntas and Rauch (2017) in the global property-liability insurance market. Our study is different from these studies because we provide new empirical evidence that market concentration is positively associated with insurer's financial stability in Korean non-life insurance companies, which is contrary to the findings of Shim (2017) and Altuntas and Rauch (2017).

that our main results remain robust when we use alternative measures of market concentration and financial stability, and employ a two-stage least squares (2SLS) regression in order to address potential endogeneity problem.

Our study contributes to the literature by showing the first empirical findings of the effect of market concentration on financial stability in Korean non-life insurance companies. Whereas previous studies have typically focused on US and European companies, our study provides new evidence from the Asian insurance industry like Korean insurance sector, which has attracted little attention among scholars in spite of its importance in the global insurance market. Especially, our finding is consistent with "concentration-stability view" for Korean non-life insurers that is different from previous studies (e.g., Shim, 2017; Altuntas and Rauch, 2017), which provide support for "concentration-fragility view" in the insurance industry. Therefore, this study helps us improve our knowledge and understanding of insurance market and regulatory landscape in the context of non-US countries. Furthermore, our results provide important implications for financial authorities as well as industry practitioners who have considerable concerns over insurer's financial soundness.

The rest of the paper is structured as follows. The following section provides a description of the market structure of the Korean non-life insurance industry. Next, we review the literature about the relationship between market concentration and firm's financial stability in Section 3. Section 4 describes data and empirical methodology, and the definitions of variables are reported in Section 5. Section 6 presents empirical findings, and Section 7 concludes with a summary of main findings.

II. Market Structure of the Korean Non-Life Insurance Industry

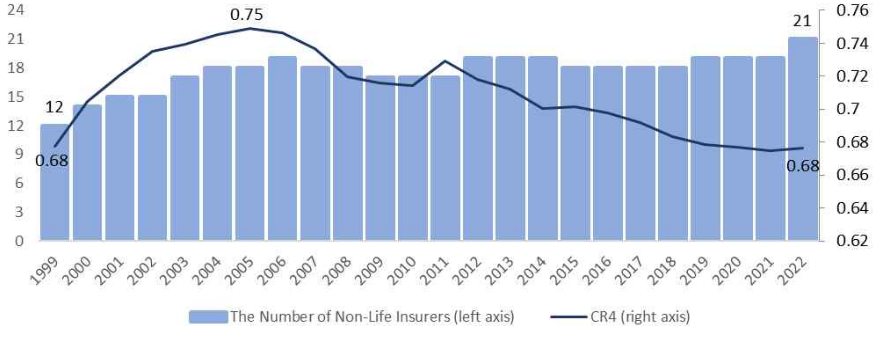
Over the last four decades, the Korean insurance industry has experienced rapid growth because of financial market deregulation and liberalization. However, after the 1997 Asian financial crisis, explicit and implicit regulations were tightened to prevent insurer insolvency and protect policyholders' interests. However, the regulations have been criticized as an obstacle to market dynamism through market competition. In recent years, financial authorities have been reducing the stringent regulations and accelerating the pace of deregulation in response to environmental changes such as the proliferation of the digital economy and the emergence of new service demands due to the aging population. In October 2015, as part of the financial reform, the Financial Services Commission (FSC) announced the 'Roadmap for Strengthening Competitiveness in the Insurance Industry' to promote competition in the insurance market and enhance consumer benefits. In May 2018, the Financial Industry Competitiveness Assessment Committee that is composed of private sector experts was established to foster competition and innovation within the financial industry. This committee conducts biennial evaluations of competitiveness in various financial sectors. According to this assessment, Korean non-life insurance sector is classified as a concentrated market.

Figure 1 illustrates the changes in the number and the degree of market concentration in the Korean non-life insurance industry. Unlike the US property-liability insurance industry with a large number of companies,[3] there are very small number of players competing in the Korean non-life insurance

3) According to insurance business (2021), there are approximately 3,700 property and casualty insurance firms in the US.

market, with 4 large-sized companies, 10 small and medium-sized companies, and 7 foreign insurers in 2022. Currently, the four largest Korean non-life insurers occupy more than 70 percent of the total Korean non-life insurance market share in terms of direct premiums written.4) While the number of Korean non-life insurance firms has nearly doubled from 12 to 21 over the period 1999-2022 (excluding reinsurance, guarantee, and single-line insurance firms), it still remains small. In an effort to lower barriers to entry in the Korean non-life insurance market, financial authorities allowed insurers to operate the small-amount and short-term insurance (SASTI) business, and the requirements for minimum capital for insurers operating SASTI were relaxed in June 2021. The market concentration, as measured by the share of the four largest non-life insurance companies, has fluctuated between 68 percent and 75 percent over the past 20 years, showing a slight decline since the mid-2000s. The continuous deregulation and liberalization in the Korean insurance industry are considered as the driving force behind this decline in market concentration.

Figure 1. The number of insurers and CR4 in the Korean Non-Life Insurance Industry



Source: The Financial Supervisory Service (FSS)

4) On average, Samsung Fire & Marine, Hyundai Marine & Fire, DB Insurance, KB Insurance accounted for 71 percent of the total market share of the Korean non-life insurance market during our sample period.

Ⅲ. Literature Review

The relationship between market concentration and firm's financial stability has been widely researched in the banking industry and the topic has been a subject of ongoing discussion. Despite extensive studies, theoretical and empirical studies have suggested two opposing views, and a consensus has not yet been reached. On the one hand, proponents of the "concentration-stability" hypothesis argue that high market concentration can improve firm's financial health. According to this view, exerting market power to impose higher interest rates can yield high profits, which can serve as a capital buffer against unexpected internal and external shocks, enhancing the stability of banks (e.g., Montgomery, 1985; Allen and Gale, 2004; Boyd et al., 2004). Keeley (1990) states that banks with more market power generally hold more capital relative to assets (on a market-value basis), which lowers default risk.

In contrast, the "concentration-fragility" hypothesis points out that higher market concentration may impair bank's financial stability. The first channel involves the moral hazard of banks and borrowers. As the "too big to fail" implies, larger banks are more likely to receive government support during crises, resulting in bank managers pursuing greater risks (e.g., Chong, 1991; Boyd and Runkle, 1993; Mishikin, 1999). Boyd and De Nicoló (2005) mention that when banks exert market dominance and impose high interest rates on borrowers, it increases the likelihood of borrowers using their loans in riskier ways. As the borrower's credit risk increases, the bank's credit risk increases as well. Thus, both forms of moral hazard can decrease the financial stability of banks.

In addition, some studies have proposed the theoretical model that illustrates a U-shaped relationship between market competition and financial stability, where both the views are observed, varying with the degree of market competition (e.g., Martinez-Miera and Repullo, 2010). This model implies that in markets with low competition, which are monopolistic, the use of market power to charge high interest rates exacerbates risk-taking due to borrower moral hazard, therefore resulting in riskier banks, and conversely, more competition leads to lower loan rates for banks, thus leading to lower revenues from performing loans, which provide a buffer against loan losses, and so it could increase more risk of insolvency. This third view is supported by the literature, demonstrating an inverse U-shaped relationship between market concentration and firm's financial soundness (e.g., Kasman and Kasman, 2015).

Even in the insurance literature, the effect of market concentration on financial stability exhibits somewhat mixed findings that hold either the "concentration-stability" hypothesis or "concentration-fragility" hypothesis. For instance, Shim (2017) finds evidence to support the "concentration-fragility" view in the U.S. property-liability insurance industry by showing that market concentration is negatively associated with insurer's financial stability. In addition, Altuntas and Rauch (2017) report the negative link between market concentration and financial soundness in the property-liability insurance sector using data from 29 countries. Cummins et al. (2017) investigate the life insurance industry in 10 EU countries and reveal that market competition enhances the soundness of the EU life insurance markets. Furthermore, they demonstrate that higher levels of competition have a larger impact on the solvency of financially weak insurers than on financially strong insurers.

Kasman et al. (2020) exhibits somewhat mixed findings depend on proxies for market competition (the Lerner index and the Boone indicator) and concentration (the HHI and the five-firm concentration ratio). They provide support for "the competition-fragility" and the "competition-stability" views simultaneously in the Turkish non-life insurance sector. They find that while there is a negative relation between market concentration and financial soundness in the non-life insurance firms, life/pension insurers in more concentrated markets display higher financial stability. In robustness tests, they also show that there is no nonlinear relationship between competition and stability. Besides, Alhassan and Biekpe (2018) present evidence on the existence of a U-shaped relationship between competition and risk-taking in the South African non-life insurance market, thereby illustrating that the nature of this relationship may change according to the level of market competition.

With regard to previous studies related to this topic in Korean companies, Jung and Kang (2006) show that an increase in market concentration tend to improve banks' profit efficiency in the Korean banking industry. On the contrary, Park (2011) finds a negative relationship between market concentration and the level of firm efficiency, suggesting that an increase in market concentration may not lead to improved efficiency through the economies of scale in the Korean banking sector. Jung and Cho (2009) examine the effect of market concentration on firm's risk-taking in Korean banking companies after the 1997 Asian financial crisis. They report that as market concentration increases, banks are likely to take more risk, as measured by the loan-to-deposit ratio (LDR).

Based on the above discussions and previous studies, we anticipate that market concentration would increase or decrease financial soundness in Korean non-life insurance companies. Therefore, we propose the following hypothesis:

Hypothesis: Market concentration is positively or negatively related to firm's financial stability in the Korean non-life insurance industry.

Ⅳ. Data and Methodology

1. Data

The primary data source for this study is from the annual financial statements of the Korean non-life insurance firms filed with the Financial Supervisory Service (FSS) during 2002-2022. The interest rate data is obtained from the Economic Statistics System (ECOS) provided by the Bank of Korea. Our initial sample includes all 26 non-life insurance firms that disclose their financial information to the FSS. We exclude reinsurance firms and guarantee insurance firms from our sample, since they do not directly underwrite property-liability products in the Korean non-life insurance market. In addition, we omit insurance firms that exclusively sell specific single-line insurance product that are not typically offered by non-life insurers, such as legal expenses insurance and mortgage insurance. As a result, our final sample consists of 313 firm-year observations from 22 Korean non-life insurance companies. Note that the fiscal year of Korean insurance companies changed from April-March to January-December in 2013. Therefore, for years prior to 2014, we adjust the accounting data based on the calendar year (January through December) to keep it consistent throughout our sample period.

2. Methodology

Following the prior literature (e.g., Shim, 2017), we employ an ordinary least squares (OLS) estimation with clustering at the firm level to explore the relationship between market concentration and financial stability in Korean non-life insurance firms. The regression equation is constructed as follows:

$$Z_{i,t} = \alpha + \beta MC_t + \gamma Controls_{i,t} + \epsilon_{i,t} \tag{1}$$

where i and t denote the insurance firm and year, respectively. Z represents the financial stability of the insurance company, as measured by the logarithmically transformed Z-score. MC is a proxy for market concentration, which is computed by HHI and CR4. $Cnotols$ indicate firm-specific and macroeconomic variables to control for insurer-specific effects and economic environment changes. $\epsilon_{i,t}$ is the zero-mean error term. The coefficient of interest is denoted as β, which captures the impact of market concentration on insurer's financial health.

Ⅴ. Variables

1. Measuring insurer financial stability

In this study, we measure insurer's financial stability by utilizing the Z-score, which has been commonly used in the insurance literature as a proxy for the likelihood of insurer insolvency (e.g., Altuntas and Rauch, 2017; Cummins et al., 2017; Shim 2017). The Z-score measures a firm's distance from insolvency risk (Hannan and Hanweck, 1988; Boyd et al., 1993), meaning the number of the standard deviations by which returns should fall to wipe out the insurer's all equity capital. Thus, a higher Z-score is indicative of a lower insolvency risk, suggesting greater financial stability (Boyd et al., 1993; Shim, 2017). The Z-score is calculated as follows:

$$Z_{it} = \frac{ROA_{it} + Equtiy\ to\ Asset_{it}}{\sigma(ROA_{it})}$$

where the return on assets (ROA) is computed by dividing the net income by total assets, and we use three-year rolling standard deviation of the ROA as a denominator. Due to the right-skewed nature of simple Z-scores, we utilize the logarithm of the Z-score in our analysis, as suggested by Lepetit and Strobel (2015). To prevent the loss of samples due to negative Z-values, the Z-scores are adjusted by adding the sample median to them before applying a logarithmic transformation (Ijtsma et al., 2017). For the robustness check, we also use ROE based Z-score measure as an alternative measure of insurer's financial soundness. ROE based Z-score is defined as follows (Goyeau and Tarazi, 1992; Lepetit and Strobel, 2015):

$$Z_{e,\ it} = \frac{1+ROE_{it}}{\sigma(ROE_{it})}$$

2. Measuring market concentration

Market Competition is the key explanatory variable in our study. To measure market concentration in the Korean non-life insurance industry, we first employ the Herfindahl-Hirschman Index (HHI). The HHI is calculated by as the sum of squared market shares, where market share is the share of net premium written (NPW) of an insurer in total net premium written of all firms operating in the Korean non-life insurance market for each year t. A higher HHI means that a few firms dominate the insurance market, whereas a lower HHI indicates that the market is spread and competitive among many insurance firms. As an alternative measure of market concentration, we also use the four-firm concentration ratio (CR4), which is computed based on the proportion of net premiums written (NPW) held by the four largest insurance companies in each year.

$$HHI_t = \sum_{i=1}^{n} \left[\frac{NPW_{i,t}}{\sum_{i=1}^{n} NPW_{i,t}} \right]^2$$

3. Control variables

To control for firm-specific and macroeconomic effects, we include several variables in our regression models. First, insurer size is calculated as a natural logarithm of total assets. Leverage is computed by dividing net premiums written by policyholder's surplus (equity). Stock investment ratio is the ratio of stock investment to invested assets. Asset growth is computed as the change in the natural logarithm of total assets. Investment asset ratio is measured as the ratio of invested assets to total assets. We calculated reinsurance as the ratio of reinsurance premiums ceded to gross premium written. Combined ratio is defined as the ratio of losses incurred to earned premiums plus incurred expense to earned premiums. For the macroeconomic variable, we use the real interest rate of Bank of Korea (BOK). Lastly, we use After2013, which is the indicator variable equal to one for the period after the fiscal year adjustment in 2013, and zero otherwise to control for the effect of change in fiscal year. Table 1 summarizes the definition of all variables used in our regression analyses.

Table 1. Variable Definitions

Variable	Definition
Dependent Variable	
Z-score	The ratio of the sum of capital ratio and ROA to SD (ROA)
ROA	Net income / Total assets
SD (ROA)	Three-year rolling standard deviation of ROA
Capital ratio	The ratio of equity to total assets
RBC ratio	The ratio of available capital to required capital
Explanatory Variables	
HHI	The sum of the squares of the percentage of net premium written (NPW) across all insurance firms
CR4	Firm concentration ratio, as measured by the proportion of net premiums written held by the largest four insurers
Price-Cost Margin	{Earned Premiums - (Incurred Loss + Operating Expenses)} / Earned Premiums
Control Variables	
Size	The natural logarithm of total assets in thousands of Won
Leverage	The ratio of net premiums written to equity
Stock investment ratio	The ratio of stock investment to invested assets
Asset growth	The change in the natural logarithm of total admissible assets
Investment asset ratio	The ratio of invested assets to total assets
Reinsurance	The ratio of reinsurance premiums ceded to gross premium written
Combined Ratio	Loss ratio + Expense ratio = (Incurred Claims + Expenses) / Earned Premiums
Interest rate	Base interest rate changes in Bank of Korea
After2013	Dummy variable equal to one for the period after the Fiscal Year adjustment (2013) and zero otherwise.
Instrumental Variables	
NPW 5-year growth rate	5-year average growth rate of insurers' net premium written
GDP 3-year growth rate	3-year average growth rate of real GDP

Ⅵ. Empirical Results

1. Descriptive Statistics

Panel A of Table 2 reports summary statistics for Korean non-life insurance companies. The mean value of Z-score is 23.657. HHI has a mean of 0.159, and the average of CR4 is 0.727, indicating that the small number of large insurers accounts for a high percentage of the total Korean non-life insurance market share. The mean of stock ratio is 0.027, implying that Korean non-life insurance firms are required to hold capital against their investment portfolio, and therefore, these capital requirements limit investment in more volatile products, such as stock. The combined ratio has a mean value of 0.812. This means that Korean non-life insurers, on average, generate underwriting profits with the combined ratio of less than 100 percent.

In Panel B of Table 2, we divide our sample into two groups according to firm size (four largest insurers vs the remaining eighteen small and medium sized insurers), and compare means between two groups by performing a T-test. The results show that large insurers exhibit higher values in Z-score and the difference is statistically significant, implying that large insurance firms have better financial soundness compared to small and medium counterparties. The differences between means in stock investment ratio and investment asset ratio are statistically significant. These results indicate that large insurers have more invested assets and invest more in risky assets relative to small and medium insurers. Conversely, the small and medium sized insurers display higher values in reinsurance ratio and combined ratio, and the differences are statistically significant, suggesting that small and medium insurers purchase more reinsurance to manage their risks, and they have lower underwriting profits than large insurers. However, we do not find a statistically significant difference between two groups in terms of leverage and asset growth rate.

Table 2. Descriptive Statistics

Panel A: All firms

Variable	N	Mean	S.D.	Min.	Max.
Z-score	313	23.657	32.184	-0.586	184.223
HHI	313	0.159	0.011	0.146	0.182
CR4	313	0.727	0.022	0.699	0.770
RBC ratio	224	236.287	109.852	88	621
Price-Cost Margin	313	0.188	0.562	-3.256	0.625
Ln(Size)	313	14.514	2.211	9.811	18.252
Leverage	313	4.089	2.722	0.033	12.505
Stock investment ratio	313	0.027	0.039	0.000	0.206
Asset growth	313	0.126	0.126	-0.277	0.614
Investment asset ratio	313	0.779	0.101	0.464	0.909
Reinsurance ratio	313	0.182	0.151	0.008	0.751
Combined ratio	313	0.812	0.562	0.375	4.256
Interest rate	313	-0.039	0.867	-2.000	2.250
NPW 5-year growth rate	282	0.093	0.047	0.034	0.163
GDP 3-year growth rate	313	0.036	0.010	0.016	0.053

Note: All variables are winsorized at the 1st and 99th percentiles, except for the RBC ratio, which is winsorized at the 1st and 98th percentiles to mitigate the influence of extreme values.

Panel B: Descriptive Statistics by firm size and t-test results

Variable	Large firms		Small & Med firms		Differences	
	Mean	SD	Mean	SD	Mean	p-value
Z-score	49.253	47.551	14.869	17.877	34.384	0.000
RBC ratio	229.250	70.074	236.171	116.701	-6.921	0.712
Price-Cost Margin	0.407	0.067	0.112	0.633	0.295	0.000
Size	16.878	0.865	13.703	1.932	3.175	0.000
Leverage	4.245	2.064	4.035	2.916	0.210	0.553

Stock investment ratio	0.056	0.031	0.016	0.036	0.040	0.000
Asset growth	0.120	0.060	0.128	0.142	-0.008	0.621
Investment asset ratio	0.822	0.029	0.764	0.112	0.058	0.000
Reinsurance ratio	0.087	0.028	0.215	0.162	-0.127	0.000
Combined ratio	0.593	0.067	0.888	0.633	-0.295	0.000
NPW 5-year growth	0.093	0.046	0.093	0.048	0.001	0.915
GDP 3-year growth	0.036	0.011	0.035	0.010	0.001	0.577

The unreported results of the Pearson correlation coefficients among all variables show that some explanatory variables are highly correlated. To check to see if there is multicollinearity between independent variables, we compute the Variance-Inflation Factors (VIFs). We find that the VIF values of all variables in the regressions are less than 5, suggesting that our regression results are not adversely influenced by the presence of multicollinearity.[5)]

2. Empirical Results

The estimates of the parameters from the OLS regression of the relationship between market concentration and insurers' financial stability are presented in Table 3. Our main interest is in the market concentration coefficient estimate. In columns 1 and 2, the coefficients of market concentration measures (HHI and CR4) are statistically significant and positive in Z-score at the 1 percent level. This indicates that as market concentration increases in the Korean non-life insurance industry, insurer's financial soundness tends to increase, providing support for "concentration-stability" view. This finding is contradictory to the results of Shim (2017) and Altuntas and Rauch (2017) that support the

5) Untabulated results are not provided to save space and it is available upon request.

"concentration-fragility" view in US and global property-liability insurance companies. The potential reason for this result is that Korean non-life insurance industry is much more highly concentrated compared to US property-liability insurance counterparty,[6] and therefore, an increase in market concentration may enable Korean non-life insurers to benefit more from economies of scale and scope, thereby promoting insurer's financial stability. We also use ROE based Z-score as a dependent variable instead of ROA based Z-score. In columns 3, the coefficient of HHI is positive but insignificant. However, CR4 is significantly and positively associated with ROE based Z-score measure in columns 4. These results confirm our previous findings with ROA based Z-score, suggesting that our results remain qualitatively unchanged when we use alternative measures of insurer's financial soundness.

With respect to control variables, insurer size is positively related to insurer's financial stability, implying that large insurers are likely to have greater financial health than small insurers because they benefit from economies of scale and lower insolvency risk (Cummins et al., 1995; Liebenberg and Sommer, 2008; Shim, 2017).[7] Leverage is significantly and

6) According to Shim (2017), the average values of HHI and CR4 are 0.033 and 0.282, respectively for US property-liability insurers. For Korean non-life insurers, the mean values of those variables are 0.159 and 0.727, respectively in our sample.

7) For instance, the largest Korean non-life insurers-Samsung Fire & Marine, Hyundai Marine & Fire, DB Insurance, and KB Insurance-are all ranked within the top five in terms of Z-score among the 22 sample insurers, indicating that financially large insurers tend to exhibit better financial stability. In terms of financial soundness, these companies hold strong ratings from A.M. Best (as of October 2025)-Samsung Fire & Marine (A++), Hyundai Marine & Fire (A), DB Insurance (A+), and KB Insurance (A). Similarly, in the US, major insurers, such as State Farm, Allstate, Progressive, and Berkshire Hathaway, display high financial strength ratings from A.M. Best (as of October 2025)-State Farm (A+), Allstate (A+), Progressive (A+), and Berkshire Hathaway (A++)-demonstrating that the advantages of economies of scale contribute to insurer's financial health across different insurance markets.

negatively associated with Z-score. This suggests that when insurers have higher leverage ratio, the risk of insolvency tends to increase, consistent with Carson and Hoyt (1995). The coefficient of asset growth rate is significant and positive in Z-score, indicating that insurers with higher asset growth rates tend to be more financially stable, since higher asset growth rates are associated with higher firm profitability (Senderovitz et al., 2016), thus resulting in higher financial soundness. Reinsurance is significantly and negatively associated with financial soundness, suggesting that purchasing more reinsurance may have a detrimental effect on insurer's financial stability because of the substantial cost of reinsurance (Cummins et al., 2021). The coefficient of combined ratio is negatively significant, meaning that an increase in incurred losses and expenses reduce an insurer's solvency. Lastly, the coefficient of After 2013 is positively significant, indicating that insurers are more likely to be financially sound after the change in fiscal year. One potential explanation for this result is that there has been a significant increase in premiums of car insurance and medical reimbursement insurance since 2014, thereby leading to an increase in financial profitability and stability in Korean non-life insurance companies.

Table 3. Regression results of the effect of market concentration on Z-score

VARIABLES	ln(Z-score)		ln(Ze-score)	
	(1)	(2)	(3)	(4)
HHI	38.264**		19.500	
	(15.602)		(11.981)	
CR4		23.048***		15.714***
		(5.542)		(4.715)
ln(size)	0.389***	0.395***	0.368***	0.379***
	(0.055)	(0.053)	(0.050)	(0.052)
Leverage	-0.295***	-0.292***	-0.277***	-0.281***
	(0.055)	(0.064)	(0.051)	(0.056)
Stock invest ratio	-5.214	-5.250	-3.202	-3.587
	(3.755)	(3.769)	(3.060)	(2.888)
Asset growth	1.894**	1.809**	1.674**	1.637***
	(0.770)	(0.716)	(0.610)	(0.568)
Investment asset ratio	-0.335	-0.235	-0.448	-0.504
	(1.216)	(0.992)	(1.264)	(1.070)
Reinsurance	-1.489**	-1.333***	-1.210**	-1.167**
	(0.579)	(0.456)	(0.543)	(0.429)
Combined ratio	-0.579***	-0.569***	-0.751***	-0.746***
	(0.121)	(0.158)	(0.089)	(0.102)
Interest rate	-0.101	-0.125	-0.086	-0.106
	(0.072)	(0.080)	(0.055)	(0.067)
After 2013	0.460**	0.574***	0.302*	0.467***
	(0.214)	(0.159)	(0.174)	(0.137)
Constant	-7.410**	-18.333***	-3.993*	-12.495***
	(3.010)	(4.772)	(2.276)	(3.993)
Observations	313	313	313	313
R-squared	0.550	0.558	0.629	0.639

Note: See Table 1 for variable definitions. Standard errors clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Our study employs an ordinary least squares (OLS) model, and thus, we cannot fully address endogeneity problems. Therefore, we use one-year lagged market concentration variable to address potential reverse causality issues.[8] The results in

8) Consumers may gravitate towards more stable insurance firms, thereby leading

columns 1 and 2 of Table 4 show that the coefficients of lagged market concentration variables are significantly positive in Z-score, consistent with our previous results. As an additional analysis, we test a U-shaped relationship proposed by Martinez-Miera and Repullo (2010) that the effect of market concentration on firm's financial stability may change with the degree of market competition, and thus, both contrasting views can be simultaneously observed. To do so, we add the squared term of market concentration variable (HHI^2) in column 3 of Table 4. The coefficient of the squared term is significant and negative at the 5 percent level, providing evidence on the existence of inverse U-shaped relationship between market concentration and insurer's financial stability. This implies that as market concentration goes up, insurer's financial health initially increases, and then decreases in the Korean non-life insurance industry. Given the existence of non-linear effects of the HHI, it is interesting to identify the thresholds of these non-linear relationships. Thus, we calculate the threshold of HHI. The estimated threshold of HHI is approximately 0.178, which lies near the upper bound of the observed range (0.146-0.182, mean = 0.159). This indicates that insurer's financial stability increases with market concentration up to this level but declines beyond it. From a policy perspective, this turning point provides a useful benchmark for assessing the optimal level of market structure in the Korean non-life insurance industry. Thus, this finding suggests that policymakers should recognize that not only excessive market concentration but also excessive market competition can threaten the overall financial stability in the Korean non-life insurance sector.

to increased market concentration.

Table 4. Regression results of the effect of lagged market concentration on Z-score

VARIABLES	(1)	(2)	(3)
L1. HHI	37.827**		
	(13.903)		
L1. CR4		21.028***	
		(6.283)	
HHI			697.888**
			(333.519)
HHI2			-1,961.224*
			(1,000.298)
ln(size)	0.372***	0.375***	0.403***
	(0.053)	(0.050)	(0.054)
Leverage	-0.313***	-0.310***	-0.299***
	(0.057)	(0.057)	(0.054)
Stock invest ratio	-5.548	-5.301	-5.425
	(3.780)	(3.607)	(3.637)
Asset growth	2.278***	2.256***	1.671**
	(0.768)	(0.740)	(0.751)
Investment asset ratio	-0.166	-0.080	-0.301
	(1.251)	(1.219)	(1.225)
Reinsurance	-1.440**	-1.308**	-1.302**
	(0.575)	(0.544)	(0.598)
Combined ratio	-0.621***	-0.604***	-0.569***
	(0.121)	(0.118)	(0.111)
Interest rate	-0.063	-0.032	-0.033
	(0.079)	(0.078)	(0.070)
After 2013	0.453**	0.486**	0.856***
	(0.204)	(0.196)	(0.203)
Constant	-7.194**	-16.635***	-62.871**
	(2.842)	(4.967)	(27.907)
Observations	291	291	313
R-squared	0.541	0.544	0.558

Note: See Table 1 for variable definitions. Standard errors clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Next, we explore whether the relationship between market concentration and financial stability of insurance companies varies according to the type of organizational structure. To do so, we split insurance companies into three groups: financial holding company (FHC), large business group (LBG), and stand-alone company.[9] It is especially interesting because insurance companies' profitability, earnings volatility, and insolvency risks could be different depending on the type of organizational structure. Kim (2020) finds that insurers belonging to a large business group tend to show higher earnings volatility and insolvency risks compared to ones belonging to a financial holding company in the Korean insurance market, since weaker regulations apply to a large business group relative to a financial holding company. Table 5 presents the results. The coefficients of both HHI and CR4 are significant and positive in Z-score for insurers belonging to a financial holding company (FHC). However, for insurers belonging to a large business group (LBG) and stand-alone company, market concentration measures are not significantly related to insurer's financial stability. The possible explanation of these findings is that as market concentration increases, insurers belonging to a financial holding company tend to display better financial health compared to ones belonging to a large business group and stand-alone insurers because of cost reduction and profit stabilization stemming from economics of scope and efficient risk diversification.

9) Financial holding company (FHC), large business group (LBG), and stand-alone company indicate insurance firms belonging to a financial holding group, ones belonging to a large corporate group, and ones that are not belong to both FHC and LBG, respectively. There are 5 FHC, 8 LBG, and 9 stand-alone company in our sample.

Table 5. Regression results of the effect of market concentration on Z-score by types of organizational structure

VARIABLES	FHC		LBG		Stand-alone	
	(1)	(2)	(3)	(4)	(5)	(6)
HHI	47.512**		2.854		31.908	
	(12.463)		(10.864)		(26.151)	
CR4		29.627***		7.058		18.386
		(6.233)		(6.355)		(9.973)
ln(size)	0.425***	0.441***	0.014	0.088	0.197	0.187
	(0.043)	(0.031)	(0.170)	(0.174)	(0.275)	(0.313)
Leverage	-0.514*	-0.541*	-0.260**	-0.258**	-0.359*	-0.348
	(0.227)	(0.196)	(0.083)	(0.084)	(0.179)	(0.188)
Stock invest ratio	14.364	15.077	4.169	2.730	-4.863**	-4.923**
	(9.531)	(8.904)	(3.581)	(3.047)	(1.967)	(2.049)
Asset growth	1.180**	1.170**	1.894	2.064	1.074	1.023
	(0.329)	(0.358)	(1.733)	(1.850)	(1.416)	(1.428)
Investment asset ratio	4.921*	5.611**	1.970**	1.845**	-4.277***	-4.239***
	(1.851)	(1.792)	(0.707)	(0.759)	(0.965)	(0.940)
Reinsurance	0.007	0.465	-3.120**	-2.827**	-2.262**	-2.161**
	(0.830)	(0.572)	(1.249)	(1.128)	(0.880)	(0.797)
Combined ratio	-0.547**	-0.561**	-1.904	-1.640	-0.695**	-0.677**
	(0.143)	(0.134)	(1.328)	(1.492)	(0.287)	(0.294)
Interest rate	-0.082	-0.100	-0.020	-0.039	-0.074	-0.091
	(0.076)	(0.073)	(0.085)	(0.075)	(0.164)	(0.167)
After 2013	0.177	0.280**	0.516**	0.573**	0.827	0.925
	(0.104)	(0.066)	(0.161)	(0.170)	(0.818)	(0.725)
Constant	-13.108***	-27.885***	2.960	-3.021	-0.720	-9.031
	(2.547)	(4.989)	(4.779)	(7.954)	(3.674)	(7.163)
Observations	80	80	132	132	101	101
R-squared	0.697	0.718	0.658	0.660	0.469	0.473

Note: See Table 1 for variable definitions. Standard errors clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Ⅶ. Robustness Check

To check the robustness of our main results, we first use a price-cost margin (PCM), which is an indicator used to measure a firm's market power as an alternative market concentration measure. Columns 1-2 of Table 6 report the results. The coefficients of PCM are significant and positive at the 1 percent level, indicating that as competition in the insurance market decreases (as the PCM increases), an insurer's financial stability tends to increase, which is consistent with our main findings providing support for the concentration-stability view. Second, we utilize risk-based capital (RBC), which is a regulatory requirement that mandates a minimum amount of capital for an insurance company as a dependent variable instead Z-score. The Columns 3-5 in Table 6 show that the coefficients of market concentration measures are positive but not statistically significant. This result implies that RBC is a regulatory minimum capital requirement designed to maintain a certain level (e.g., above 150% recommended) by regulatory authorities, and therefore, it may be not highly sensitive to market competition. This suggests that while market concentration substantially influences insurer's financial stability by improving insurers' profitability and earnings volatility, it does not significantly affect static financial strength indicators, such as regulation-based capital ratios.

Table 6. Robustness checks using alternative measures of market concentration and financial stability

VARIABLES	ln(Z-score)	ln(Ze-score)	RBC Ratio		
	(1)	(2)	(3)	(4)	(5)
Price-Cost Margin	0.569***	0.746***	0.788		
	(0.122)	(0.086)	(0.725)		
HHI				3.174	
				(33.145)	
CR4					0.820
					(9.132)
ln(size)	0.348***	0.347***	-0.206*	-0.205*	-0.205*
	(0.055)	(0.047)	(0.109)	(0.114)	(0.115)
Leverage	-0.264***	-0.262***	-0.346***	-0.347***	-0.347***
	(0.058)	(0.050)	(0.079)	(0.084)	(0.085)
Stock invest ratio	-3.119	-2.134	14.083***	14.014***	14.009***
	(4.220)	(3.284)	(4.174)	(4.560)	(4.639)
Asset growth	1.771**	1.611**	2.917***	2.907***	2.907***
	(0.725)	(0.591)	(0.812)	(0.794)	(0.793)
Investment asset ratio	0.387	-0.080	1.386**	1.387**	1.387**
	(1.096)	(1.149)	(0.496)	(0.500)	(0.500)
Reinsurance	-1.118**	-1.021**	1.472	1.484	1.483
	(0.495)	(0.469)	(1.257)	(1.278)	(1.284)
Combined ratio				-0.781	-0.781
				(0.726)	(0.725)
Interest rate	-0.077	-0.073	0.116	0.121	0.119
	(0.074)	(0.056)	(0.077)	(0.081)	(0.075)
After 2013	-0.044	0.046	-0.414*	-0.400**	-0.404**
	(0.240)	(0.231)	(0.201)	(0.185)	(0.174)
Constant	-1.851	-1.616	4.876**	5.142	5.041
	(1.264)	(1.188)	(1.807)	(6.185)	(7.620)
Observations	313	313	167	167	167
R-squared	0.520	0.620	0.678	0.678	0.678

Note: See Table 1 for variable definitions. Standard errors clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, market concentration may be jointly determined with firm's financial stability, and thus, the feedback effect between dependent and independent variables may violate the consistency of the OLS estimator, leading to the problem of endogeneity. To address this problem, we conduct a further robustness check with the two-stage least squares (2SLS) method to determine whether our regression results are robust to endogeneity. In the 2SLS model, we treat market concentration variables as endogenous variables for which we use instrumental variables that are correlated with market concentration, but are uncorrelated with the error term of the regression. Prior literature (e.g., Campa and Kedia, 2002; Shim, 2017) uses lagged or historical averaged measures of firm characteristics, industry growth, and economics growth as an instrument of market concentration. Thus, we employ 5-year growth rate of insurer's net premium written and 3-year growth rate of real GDP in Korea as potential instrumental variables for our market concentration measures. We find that these two variables satisfy the two requirements of instruments: relevance and exogeneity.[10] The results using 2SLS are presented in Table 7. In column 3-4, the estimates from the second stage of 2SLS show that the market concentration is positively and significantly associated with Z-score measure. Therefore, we conclude that our main findings are robust to the endogeneity issue.

10) To check whether our instrumental variables fulfill the two conditions mentioned above, we use an F-test of the joint significance of the excluded instruments and Hansen's J test of over-identifying restrictions to examine whether the instruments are valid, and are uncorrelated with the error term, respectively. We find that the F-test of excluded instruments rejects the null hypothesis of weak instruments with the F-statistic well exceeding the Stock-Yogo critical values, and Hansen's J test does not reject the null hypothesis that the instruments are uncorrelated with the error term, indicating that our two instruments (5-year average of insurer's net premiums written growth and 3-year average of real GDP growth) are valid.

Table 7. Regression results of the effect of market concentration on Z-score (2SLS)

VARIABLES	First Stage		Second Stage ln(-score)	
	HHI	CR4		
	(1)	(2)	(3)	(4)
NPW 5-year growth	-0.082*** (0.009)	-0.075*** (0.015)		
GDP 3-year growth	0.524*** (0.019)	1.222*** (0.030)		
HHI			46.186** (18.239)	
CR4				24.067*** (8.365)
ln(size)	-0.001** (0.000)	-0.001* (0.000)	0.384*** (0.049)	0.386*** (0.047)
Leverage	0.000** (0.000)	0.001* (0.000)	-0.317*** (0.054)	-0.313*** (0.054)
Stock invest ratio	0.028* (0.014)	0.045* (0.023)	-6.058* (3.582)	-5.794* (3.458)
Asset growth	0.001 (0.003)	0.001 (0.006)	2.304*** (0.822)	2.246*** (0.803)
Investment asset ratio	0.005* (0.003)	0.007 (0.005)	0.007 (1.197)	0.155 (1.147)
Reinsurance	0.001 (0.003)	0.000 (0.005)	-1.233** (0.494)	-1.068** (0.473)
Combined ratio	0.000 (0.001)	0.001 (0.002)	-0.539*** (0.118)	-0.536*** (0.118)
Interest rate	0.000** (0.000)	0.002*** (0.000)	-0.113 (0.077)	-0.129 (0.079)
After 2013	-0.012*** (0.001)	-0.016*** (0.002)	0.498** (0.230)	0.552*** (0.213)
Constant	0.154*** (0.005)	0.701*** (0.009)	-8.839*** (3.384)	-19.202*** (6.463)
F statistic			397.209	886.080
Hansen J statistic p-value			0.7247	0.6744
Observations	282	282	282	282
R-squared	0.819	0.821	0.541	0.547

Note: See Table 1 for variable definitions. Standard errors clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Ⅷ. Conclusion

This study investigates the relationship between market concentration and financial stability in the Korean non-life insurance industry over the period 2002-2022. We utilize the Z-score to measure insurer's financial soundness and both the Herfindahl-Hirschman Index (HHI) and the four-firm concentration ratio (CR4) are employed as proxies for market concentration. Our evidence shows that market concentration is positively associated with insurer's financial stability in Korean non-life insurance companies, consistent with the "concentration-stability" view. We also find the existence of inverse U-shaped relationship between market concentration and insurer's financial stability. Lastly, we reveal that when market concentration increases, insurers belonging to a financial holding company are likely to display better financial soundness relative to a large business group and stand-alone insurers.

Overall, our results suggest that an increase in market concentration may enable Korean non-life insurers to benefit more from economies of scale, thereby promoting financial stability, and therefore, excessive government regulation to increase market competition may potentially undermine firm's financial stability in the Korean non-life insurance sector. Our findings are noteworthy and contribute to the extant literature by providing new perspectives on the relationship between market concentration and firm's financial stability in the Korean insurance industry, which has received relatively less attention despite its importance in the global insurance market. Our study also has important implications for regulatory authorities as well as policymakers who concerns about insurer's financial health.

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초 록

본 연구는 2002년부터 2022년까지 국내 손해보험 산업에서 시장집중도와 보험회사의 재무 안정성 간의 관계를 분석한다. 시장집중도는 허핀달-허쉬만 지수(HHI)와 상위 4개 기업 집중률(CR4)을 사용하고, 보험사의 재무 건전성은 Z-score를 통해 측정하였다. 분석 결과, 시장집중도는 손해보험사의 재무 안정성과 유의한 양(+)의 상관관계를 가지는 것으로 나타났는데, 이는 시장집중도가 높을수록 부실 위험이 감소한다는 "집중-안정성" 견해(concentration-stability view) 와 일치한다. 또한, 국내 손해보험 산업에서는 시장집중도와 재무 건전성 사이에 역U자형 관계가 존재함이 확인되었다. 마지막으로, 본 연구는 시장 집중도가 증가할수록 금융지주회사에 속한 보험사들이 더 높은 재무 건전성을 보이는 경향이 있음을 발견하였다. 본 연구의 결과는 보험회사의 재무 안정성에 관심을 갖는 금융규제 당국과 보험업계 관계자들에게 중요한 시사점을 제공한다.