

Determinants of the Reinsurance Decisions of Korean Life Insurance Companies

생명보험사의 재보험 의사결정 영향요인 분석

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This paper examines how company-specific features of Korean life insurance companies are associated with companies' use of reinsurance. Using panel data covering 372 firm-year observations for the eighteen consecutive years from 2001 to 2018, we perform Hausman-Taylor instrumental variable estimation. We observe that higher underwriting risk, lower solvency ratio, higher financial leverage, smaller firm size, and more diversified portfolios are associated with greater use of reinsurance. In addition, It seems that life insurance companies that are a part of financial conglomerates buy more reinsurance, while foreign-owned life insurers retain more risk. Being the first empirical reinsurance study using Korean life insurance company data, this research implies that various company-specific characteristics should be considered in reinsurance decision-making in the changing life insurance market environment in Korea.

Key words: Reinsurance Decision, Life Insurance Companies, Korea

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I. Introduction

People buy insurance to relieve the financial burden of unexpected adverse events, and the same is true for companies. An insurance company's purchase of insurance, known as reinsurance, is an important way to reduce insurer risk and to manage the firm's required capital. In particular, life insurance companies are required to control retained risk and maintain a strong capital base, as most life insurance policies are long-term contracts. The insurance premiums paid by policyholders must be safely invested for long periods of time so that payouts on policies can be made as promised. Life insurance companies recognize the following benefits of purchasing reinsurance: (1) reduced underwriting risk and improved underwriting capacity, (2) maintenance of a prudent solvency ratio, and (3) provision of valuable services.

All entrepreneurial organizations have features that affect managerial decision-making. For insurance companies, the decision to purchase reinsurance differs according to firm-specific characteristics. These can be organizational factors such as ownership structure or financial aspects such as leverage, investment structure, and tax status (Mayers and Smith, 1990; Adams, 1996; Garven and Lamm-Tennant, 2003; Kader, Adams, and Mouratidis, 2010). Similar to non-life insurance companies, life insurance companies exhibit a demand for reinsurance that varies by firm-specific factors, and their correlations differ according to each of these characteristics (Adams, 1996). This study builds upon the existing research exploring the demand for reinsurance, focusing on Korean life insurance companies and their specific features.

Even though it has been over 50 years since the first life reinsurance transaction in Korea was completed, studies on the use of reinsurance by

Korean insurance companies remain limited. Among these studies, Lee (2018) and Cho (2015) investigate the reinsurance structure. Lee (2018) examines the reinsurance structure decisions of life insurance companies in Korea while Cho (2015) proposes an optimal reinsurance structure a non-life insurance company can select using a risk aversion's estimation. Many recent studies are based on the risk-based capital (RBC) regulations and reinsurance decision-making. Kim (2012) shows using Korean life insurance data that under the current RBC scheme, the reinsurance cost exceeds other capital expenses. Kim and Kim (2015) and Kim (2016) examine the optimal level of retention for non-life and life insurance companies in Korea, suggesting that from the cost-efficiency perspective, both Korean non-life and life insurance companies have room to retain more risk and reduce reinsurance. Moreover, Kim and Lee (2019) suggest reinsurance strategies for non-life insurance companies by providing mathematical models, highlighting the importance of company-specific characteristics and lines of business in developing a reinsurance strategy.

The abovementioned previous studies use mathematical models unlike this paper that takes company-specific data into account. In this regard, Chang (1999) argues that the reinsurance decision should be made based on various factors rather than fragmentally based on conventions or cost. Kim (2016), who proposes reducing reinsurance, also admits that his research has a limitation of not considering company-specific features and business relationships between insurance companies and reinsurance companies. To the best of my knowledge, this paper is the first to perform empirical tests on the reinsurance decision while using company-specific features in the life insurance industry in Korea.

Country-specific features such as government regulations affect managers'

behavior in most countries, and Korea is not an exception. The Korean life insurance industry has a low reinsurance acceptance rate despite its relatively large market share in the Korean insurance market. Over the past 10 years, the life insurance market in Korea averaged 59.8% of Korea's total insurance market, compared to the OECD average of 51.0% (OECD, 2018). In contrast, the use of reinsurance in Korea is markedly lower than the OECD average. The reinsurance acceptance rate computed from gross premiums in Korea over the past 10 years is 1.9%, while the OECD average is 7.0% (OECD, 2018). This study reviews various features of the Korean life insurance industry to show the firm-specific factors that correlate strongly with demand for reinsurance in Korea, and to contribute to an extended understanding of the Korean life insurance industry. The study also incorporates the context of the regulatory environment, financial supervision, and the historical background of the industry.

We perform an empirical study using panel data of Korean life insurance companies from 2001 to 2018. In 2018, use of reinsurance measured by the ratio of reinsurance expense to gross risk premiums ranged from 2.2% to 59.1% across companies. This suggests that reinsurance decisions vary by company. We attempt to categorize firm-specific factors by the three main benefits associated with purchasing reinsurance. Underwriting risk and improved underwriting capacity are measured by the gross loss ratio. The relationship between solvency prudence and demand for reinsurance is tested using the risk-based capital (RBC) ratio and the financial leverage ratio. Service efficiency is difficult to measure with a financial metric. Instead, we associate size and business concentration with service provision because they are factors of insurance company requiring outsourced help for the sake of competitiveness (Mayers and Smith, 1990). We also include organizational

factors such as whether the insurer is part of a financial conglomerate and whether its ownership is foreign or domestic and develop hypotheses about the use of reinsurance and the solvency ratios of foreign-owned insurers in Korea. These hypotheses build on previous studies, such as those of Yanase and Limpaphayom (2017) and Ho (2016), who examined Japan and China, respectively.

The results of this study either strengthen the findings of existing studies or imply the need for a further explanation on why the results are not consistent with the hypotheses. This study attempts to find answers to these questions based on the characteristics of the Korean life insurance industry.

Industry participants including life insurance companies, reinsurance companies, and financial regulators may obtain insights from this study. Moreover, in 2023, a new accounting regime and statutory framework will be introduced in Korea. The analysis of the link between firm characteristics and the demand for reinsurance can be used to provide indicators for anticipating how reinsurance strategies will change in the near future.

The rest of this paper is organized as follows. Section 2 provides a literature review and describes the current state of the Korean life insurance market. Section 3 develops our hypotheses and describes the data used in this paper. Section 4 describes the research design. The summary of empirical results is presented in Section 5. Section 6 offers the conclusions.

II. Literature Review and Institutional Background

1. Literature Review

Mayers and Smith (1990) define reinsurance as a traditional form of corporate demand for insurance, different only in that such demand arises within the insurance industry. Throughout this study, a reinsurance contract is defined as a set of insurance policies written by one insurer and purchased by another insurance company, known as the insurer or the ceding company, and the reinsurer, respectively. The term “reinsurance” is used broadly, referring to reinsurance contracts, treaties, or the business itself.

Mayers and Smith (1990) were the first to focus on the corporate demand for insurance while considering firm-specific characteristics. The researchers used data from 1,276 property and casualty insurance companies across different countries and with a broad range of ownership structures to provide evidence that ownership structure affected reinsurance purchases. In addition to ownership structure, other firm-specific features such as size, credit rating, line-of-business concentration, etc. were also shown to be either neutral or playing important roles in reinsurance contracts. Later studies adopted an approach similar to that of the study of Mayers and Smith (1990), using data from different countries and taking the differences in market regulations and conditions in each country into account. Adams (1996) empirically tested a risk-bearing hypothesis that is the most widely accepted explanation of reinsurance decision-making in insurance firms using panel data on New Zealand life insurance companies. Considering New Zealand’s relatively unregulated market, the article focused on five main features: organizational factors, firm size, product concentration, leverage, and underwriting risk. Ho

(2016) discussed the impact of ownership structure and firm characteristics on reinsurance decisions in the Chinese non-life insurance industry. The latter study contrasted with others by shedding light on the impact of regulations, China's compulsory reinsurance ratio, and the demand for reinsurance. The study emphasized how regulatory changes were related to firm-specific features and reinsurance. Further research on the topic used empirical data for different jurisdictions, insurance segments, and time periods. The respective studies observed that similar though not identical features of companies were significant (Garven and Lamm-Tennant, 2003; Cole and McCullough, 2006; Lian-can, Shu-guang, and Liang, 2010).

All of these previous studies agree that company-specific features materially impact the demand for reinsurance. For example, firm size is negatively related to reinsurance demand, while financial leverage is positively related to reinsurance purchases (Mayers and Smith, 1990; Adams, 1996; Kader, Adams, and Mouratidis, 2010). However, not all of the features studied have been shown to have a strong relationship with the reinsurance purchase decision.

Some of the previous studies offer conflicting findings. For instance, there are studies that conclude that the ownership structure does not have a material relationship with reinsurance demand (Adams, 1996; Cole and McCullough, 2006), while other studies suggest that organizational structure is statistically significant in predicting reinsurance demand (Mayers and Smith, 1990). These findings suggest that the empirical evidence on company characteristics and reinsurance decisions is inconclusive and imply that the context of the market is important. The following section describes the institutional background of the life reinsurance industry in Korea.

2. Institutional Background

The Enforcement Decree of the Insurance Business Act in Korea defines life insurance as contracts made in coverage of mortality or morbidity risk. As of December 31, 2018, there were twenty-four stock life insurance companies and six mutual companies. Although mutual companies are allowed to write life insurance policies and indeed purchase reinsurance, mutual life insurance companies are excluded from this study since their financial results are not public information.

The twenty-four stock life insurance companies in Korea are licensed organizations that currently generate approximately KRW 111 trillion (US\$ 98 billion) in gross annual premiums (Korea Life Insurance Association, 2018). They vary in ownership structure, size, product mix, and financial solvency status. In 1987, Lina Life Insurance Company opened a branch in Korea as first foreign life insurance company. Since then, several foreign life insurance companies have been established and operated in Korea (Shin, 2006). In October 2000, the Korean government enacted the Financial Holding Company Act, and since then several large life insurance companies have been operating under a holding company structure. Not all financial conglomerates are structured as financial holding companies; there are other structures, such as the parent-subsidiary model or mixed conglomerates (Hahm and Kim, 2006).

There are eight professional reinsurance companies in Korea. Of these, the only domestic company is the Korean Reinsurance Company. There is no state-sponsored reinsurance company in Korea. A foreign reinsurer is required to operate as a branch if it wishes to reinsure business in the Korean market, unless it incorporates as a local company.

There are two insurance supervisors in Korea: the Financial Service

Commission (FSC) and the Financial Supervisory Services (FSS). In July 2002, various forms of reinsurance transactions were permitted. Article 63 of the Enforcement Decree of the Insurance Business Act requires reinsurance to include transfer of insurance risk to have a potential for loss to the reinsurer. The latter must also satisfy standards of financial soundness prescribed by supervisory authorities or credit rating agencies. Reinsurance that does not satisfy the requirements for reinsurance under Article 63 of the Enforcement Decree of the Insurance Business Act must be treated as a deposit for accounting purposes (Regulation on Supervision of Insurance Business 2014, Article 7-13). There is uncertainty on the issue of whether a reinsurer can assume timing, operational, and credit risk in addition to insurance risk. The laws in Korea do not explicitly prohibit ceding risk other than insurance risk, which is pure mortality and morbidity risk in life insurance; however, in practice the regulators have recognized only yearly renewable term (YRT) reinsurance based on the transfer of risk premiums as reinsurance, stating that this is to prevent abuse usage of reinsurance.

There exist other types of life reinsurance actively used in other countries. For instance, with coinsurance the ceding company pays the reinsurer all policyholder premiums or considerations, and in return the reinsurer pays the ceding company all benefits paid to policyholders that are not limited to mortality and morbidity risk but also include surrender benefits, interest credited, etc. In other words, coinsurance involves a transfer of all types of risk rather than only the insurance risk, expanding the scope of reinsurance. Another example of life reinsurance can be finite reinsurance, sometimes called financial reinsurance. The International Association of Insurance Supervision (IAIS) (2006) characterizes finite reinsurance as a combined form of reinsurance and financing. Finite reinsurance encompasses an entire

spectrum of reinsurance arrangements. As long as a ceding company transfers limited risks characterized by volatility, which is the feature of reinsurance, the latter can be utilized for financing by upfront commission, financial investment income, or profit sharing. Future investment income can also be included in the price of the contract. In short, depending on the needs and objectives of the ceding company and the regulatory and supervisory rules, various reinsurance structures could be specified. However, such reinsurance structures have not been observed in the Korean reinsurance market.

The use of reinsurance by Korean life insurance companies has been restricted due to regulations, as only insurance risk can be transferred from the ceding company to the reinsurer. Such a restriction may have limited the decision-making of ceding companies, almost as if there were compulsory reinsurance requirements. Having discussed the main concepts and reviewed the institutional background of life reinsurance in Korea, we now turn to developing our hypotheses.

III. Hypotheses

1. Underwriting Risk

The primary reasons for life insurance companies to purchase reinsurance are to reduce the underwriting risk and improve the underwriting capacity. Firms with higher underwriting risks often signal that they are engaging in riskier business activities than do firms with lower underwriting risks. For example, life insurance companies that establish liberal underwriting standards (e.g., whole-life insurance written on the lives of smokers or the

elderly at a higher maximum policy limit) provide a greater maximum insurable amount than do companies that have conservative underwriting guidelines. Companies that use aggressive sales strategies sell insurance products at lower margins. Such companies have a higher probability of loss due to an actuarial mispricing or, since life insurance is a long-tailed business, a higher volatility of future losses. In other words, firms with greater underwriting risk are likely to have uncertain future net cash flows (Lamm-Tennant and Starks, 1993).

To limit policy losses and reduce the cost of financial distress, insurance companies can choose to reinsure (Hoerger, Sloan, and Hassan, 1990). By purchasing reinsurance, insurance companies can issue a greater number of policies without substantially increasing risk. They can also stay within statutory minimum levels of solvency and minimize the risk and cost of bankruptcy (Adams, 1996). Mayers and Smith (1990) explain that firms that engage in relatively risky lines of business can purchase reinsurance to alleviate the risk and adverse financial effects of mispriced policies, including the negative effects on earnings. The authors add that reinsurance can also mitigate the agency problems arising from managerial control and can reduce the risk of information asymmetries in the underwriting process. Based on above, Hypothesis 1 is as follows:

Hypothesis 1. The amount of reinsurance purchased by companies with high underwriting risk is likely to be greater than the amount purchased by companies with low underwriting risk (ceteris paribus).

2. Solvency Ratio and RBC

Life insurance companies must maintain a prudent solvency ratio, often used as a measure for ability of a company to meet its long-term debts. Each country has its own solvency regulations for insurers and may include regulatory centralization and harmonization, for instance, within the United States (U.S.) and the European Union (E.U.)

In the U.S., the National Association of Insurance Commissioners developed risk-based capital (RBC) standards after recognizing the limitations of controlling the insolvency risk of insurance companies based only on asset size. The RBC standard became effective for life insurance companies in the U.S. in 1994. Similarly, the E.U. introduced Solvency II requirements in 2009. To regulate the solvency of Korean insurance companies, Korea modified the U.S. RBC standards, reflecting the Korean domestic insurance industry, and introduced the Korean standards in April 2009. The life insurer's RBC formula includes the following components: insurance risk, interest rate, and credit risk, asset risk (focusing on the impact of financial market volatility on asset values), operational risk, and miscellaneous business risk. The solvency regulations consider various risks an insurer can face, with the goal of preserving the value of policyholders' deposits in various worst-case scenarios. Since reinsurance is a risk-carrying device, a transfer of assets and liabilities to a reinsurer can be regarded as a way of reducing RBC charges associated with those assets and liabilities for the ceding companies.

However, reinsurance transactions have occurred less frequently than predicted in the U.S. since its RBC standards became effective (Hill, 1996). Cho, Kim, and Lee (2014) claim that the current Korean RBC formula somewhat reflects the risk transfer provided by reinsurance but fails to fully

capture the incremental charge for retained risk. Kim (2012) claims that under the current Korean RBC standard, because the maximum reinsurance credit the ceding companies can receive is 50% and the scope of reinsurance is limited to insurance risk, insurance companies in Korea are reluctant to utilize reinsurance as a solution to increase RBC ratio. Insurance risk being the only risk transferrable by reinsurance among five risk components of RBC also contributes to a low reinsurance ratio. Because of these limitations, insurance companies may not have a sufficient incentive to use reinsurance as a risk reduction vehicle to minimize RBC charges. Therefore, Hypothesis 2 is as follows:

Hypothesis 2 The amount of reinsurance a company uses is likely to have a weakly negative relationship or no relationship to its RBC ratio.

3. Financial Leverage

Adams (1996), Cole and McCullough (2006), and Kader, Adams, and Mouratidis (2010) suggest that firms seek to achieve an optimal level of debt while constrained either by internal actuarial rules or external regulations. Hoerger, Sloan, and Hassan (1990), Mayers and Smith (1990), and Kader, Adams, and Mouratidis (2010), among others, contend that given the high cost of regulatory intervention needed to prevent bankruptcy, insurers instead choose to pay for reinsurance. The latter helps insurance companies alleviate the risk of insolvency in several ways since buying reinsurance shifts a portion of assumed risk from a ceding company's book to that of the reinsurer in exchange for annual reinsurance premiums and commissions. Reinsurance (1) addresses the potential claim dilution problem in which policyholders can receive less than what an insurance company is obligated to pay if that

company has insufficient assets to cover the claims, and (2) shifts a portion of liabilities from the ceding company's book, thereby alleviating the financial strain on the retained capital; additionally, (3) depending on the structure of the reinsurance contract, upfront commissions provided by the reinsurer in the beginning of the contract term can help ceding companies reduce cash flow constraints. Therefore, Hypothesis 3 is as follows:

Hypothesis 3. The amount of reinsurance purchased is likely to be greater for highly leveraged insurance companies than for less leveraged insurance companies (ceteris paribus).

4. Firm Size

Hoerger, Sloan, and Hassan (1990), Mayers and Smith (1990) and Adams (1996) contend that an insurer's size is highly significant in predicting the demand for reinsurance. In most cases, reinsurers have a comparative advantage in providing a real service to insurers due to reinsurers' specialized knowledge, investment in research and development, and economies of scale. Furthermore, because reinsurers are less concentrated in terms of business mix and geography and may also use retrocession (i.e., reinsuring a portion of their exposures), they have incentive to alleviate financial strains (Hoerger et al., 1990).

Economies of scale allow large insurance companies to reduce bankruptcy costs and provide services such as new product development, claims handling, and underwriting high-risk cases on their own. Such companies are expected to employ experts on assessing the retained risk in the portfolio and to purchase optimal reinsurance to reduce reinsurance transaction costs. They tend to retain a relatively low-risk portfolio by reinsuring high-risk policies.

They also have a greater propensity to self-insure or use different reinsurance structures in addition to the traditional YRT insurance, including several non-proportional techniques or facultative reinsurance (covering a specific risk) in some cases. In contrast, due to a lack of resources or experience, smaller insurance companies tend to require more value-added services. Mayer and Smith (1990) report that the private information provided by reinsurance companies for pricing and claims adjustment services is particularly beneficial to small insurance companies. In recent years, the scope of these value-added services has changed. Life insurance companies see value in consulting services dealing with regulations or taxation, business strategy, or co-developing trendy underwriting platforms. Though the scope of a value-added service may vary, smaller companies are demanding more real services in return for purchasing relatively large amounts of reinsurance, essentially paying reinsurance premiums as the price of those services. Smaller insurance companies are also more likely to purchase reinsurance to improve risk-bearing efficiency and reduce cash flow volatility (Adams, 1996). Therefore, Hypothesis 4 is as follows:

Hypothesis 4. Small insurance companies are likely to purchase more reinsurance than do large insurance companies (ceteris paribus)

5. Product Concentration

Product diversification helps firms hedge against business risks. Diversification can be a natural hedging mechanism for a firm, thereby reducing the insurer's needs for other hedging mechanisms, such as reinsurance, financial derivatives, etc. In other words, if a business is more diversified, there is less need for reinsurance.

For life insurance companies, products can be grouped into those related to mortality risk, morbidity risk, and longevity risk. Life insurance companies that retain mortality risk and longevity risk can benefit from natural hedging, and this is considered to be a way to lower solvency requirements under some regulations, such as Solvency II in the EU. Life insurance companies with diverse product lines can also realize economies of scale and scope that can lead to efficiencies in other services such as asset management and risk management (Huberman, Mayers, and Smith, 1983). These benefits of product diversification support the idea that the more diversified a company's portfolio is, the less the demand for reinsurance.

However, several previous studies argue that product concentration and reinsurance demand have an ambiguous or negative relationship. Mayers and Smith (1990) state that the impact of business concentration on the demand for reinsurance is ambiguous, as cash flow volatilities across business lines can be distorted by other underlying factors such as taxes, bankruptcy cost, and liability rule changes. Adams (1996) provides possible explanations for a negative relationship between product concentration and reinsurance demand, such as a possibility of financial strain from new business intensifying business risk to multiproduct companies. Therefore, we construct Hypothesis 5 as follows:

Hypothesis 5: Product concentration is not significantly related to the amount of reinsurance.

6. Ownership Structure

Previous studies have focused on the organizational structures of stock companies and mutual companies and have observed that ownership structure

has a relationship with the demand for reinsurance (Adams, 1996; Garven and Lamm-Tennant, 2003; Cole and McCullough, 2006). Among the twenty-four life insurance companies in Korea as of year-end of 2018, only five were publicly listed in the stock market. Others were private. Additionally, mutual insurance companies in Korea are unions, cooperatives, or the Korea Post that are not obligated to provide public information.

Rather than using the categorization of stock versus mutual companies, this study reflects a distinctive feature of Korean financial companies: the financial conglomerate. Since the 1997 financial crisis, financial consolidation through mergers and acquisitions as well as financial consolidation among banks and non-bank financial institutions—typically life insurance companies, non-life insurance companies, banks, and securities firms—has been commonplace in Korea. There are three types of Korean financial conglomerates¹⁾: those following the parent-subsidiary model, those achieving financial concentration through financial holding companies, and mixed conglomerates that are primarily commercially oriented but contain at least one regulated non-bank financial institution (Hahm and Kim, 2006). In this study, all life insurance companies that belong to a financial conglomerate of any type are defined as a part of a financial conglomerate. One of the most unique features of financial conglomerates is that the constituent companies are linked together through mutual shareholding. Since these conglomerates are often owned by a chaebol,²⁾ the largest shareholder is the family that controls the

1) As initially stated by the Tripartite Group of bank, securities, and insurance regulators that includes the Basel Committee on Banking Supervision, the International Organization of Securities Commissions and the International Association of Insurance Supervision (IAIS), the term “financial conglomerate” indicates any group of companies predominantly engaged in two or more financial sectors (i.e., banking, insurance, and securities) controlled by common owners. (Joint Forum on Financial Conglomerates, “Supervision of Financial Conglomerates”, 1999)

financial conglomerate.

Hahm and Kim (2006) point out that large financial conglomerates face challenging tasks: (1) management of operational risks due to the increased operational complexity, and the incentive to take aggressive actions due to the presence of moral hazards, and (2) management of increased potential of systemic risk due to similarities in characteristics of portfolios and asset structures of individual institutions within a financial conglomerate.

Reinsurance enables life insurance companies to underwrite more insurance business and to limit their exposures to heavy losses (Adams, 1996). Moreover, reinsurance provides an alternative to cash resources as a source of capital for business growth (Mayers and Smith, 1982). At the same time, reinsurance diversifies asset structures without violating minimum capital requirements. As a consequence, reinsurance can play a significant role in alleviating the potential for systemic risk. Therefore, using reinsurance encourages insurers to overcome challenges arising from belonging to financial conglomerates.

Another way to categorize companies is by domestic or foreign management and/or ownership of capital. Skipper (1997) suggests that, led by the liberalization of markets, foreign insurance companies' entrance in emerging markets has the potential to play a constructive role in achieving a more efficient resource allocation. By fostering greater competition, foreign ownership introduces more effective customer service to developing markets, and more advanced technical (e.g., loss control and actuarial) skills and managerial know-how are transferred as well. The quality of domestic insurance regulations improves because foreign insurance company involvement often accompanies deregulation, which leads to market

2) Chaebols are involved in various types of business not limited to a single industry. There are several large and powerful groups of companies in South Korea known as chaebols. (Cambridge dictionary).

liberalization, and, according to economic theory, market growth tends to result when markets are liberalized. Skipper (1997) proposes that domestic spillovers allow the emerging market's industry to grow through what economists call positive externalities.

The Korean life insurance industry is no exception. After the Asian financial crisis of 1997, a government-driven restructuring of financial institutions, deregulation, managerial improvement, and prudent supervisory control transformed Korea's life insurance market. Foreign insurance companies expanded their market share using technical and scale efficiencies that in turn resulted in higher productivity (Shin, 2006). Foreign insurers have advantages in terms of financial strength, technology, actual service provision, and managerial experience. Having such advantages can be viewed as firms already possessing the main benefits that reinsurance provides; therefore, firms have less need for reinsurance. Therefore, Hypotheses 6.1 and 6.2 are proposed as follows:

Hypothesis 6.1: The amount of reinsurance is likely to be higher for life insurance companies that are owned by financial conglomerates than for unaffiliated companies (ceteris paribus).

Hypothesis 6.2: The amount of reinsurance is likely to be higher for domestic life insurance companies than for foreign-owned companies (ceteris paribus).

IV. Research Design

1. Empirical Model

The panel data estimation models include the random effect (RE) model and the fixed effect (FE) model. The RE model is a generalized least-squares version of the pooled OLS model, assuming that variation across entities is random and uncorrelated with the time-varying independent variables in the model. In the context of the present study, the RE model does not allow for an arbitrary correlation between a firm-specific variable i and the explanatory variables. In contrast, the FE model accounts for correlation between firm-specific variables and the explanatory variables. To decide whether such an assumption for the RE model is statistically reasonable, the Hausman test is normally performed. If the Hausman test rejects the null hypothesis of no correlation between and across explanatory variables, the FE model is considered to be the more convincing tool for analyzing the marginal impact of explanatory variables. However, the FE model has a significant weakness: it drops the time-invariant variables of our interest.

In the model, REINS indicates the dependent variable, namely, the company's reinsurance ratio. In previous studies (Mayers and Smith, 1990; Adams, 1996; Garven and Lamm-Tennant, 2003; Cole and McCullough, 2006; and Ho, 2016), the reinsurance ratio was calculated as the reinsurance-ceded premium divided by the total business premiums, where the latter were the sum of direct premiums written and reinsurance assumed. However, this study uses a reinsurance ratio calculated as the ceded premium divided by risk premiums. The risk premium is a portion of the gross premium that only mathematically prices the pure risk component of an insurance policy,

excluding other expenses. This reflects the tendency of Korean life insurance companies to buy reinsurance due to Korean regulations that currently utilize risk-only traditional reinsurance.

Variables UWRISK, RBC, FLEV, lnSIZE, LINE, CONG and FOR represent underwriting risk, solvency ratio, financial leverage, (the logarithm of) firm size, product concentration, an indicator of being a financial conglomerate or an unaffiliated firm, and being foreign- or domestically-owned, respectively. To control for any time-dependent effects (e.g., regulation, supervision, and changes in external economic conditions) on ceding companies' reinsurance decisions, year dummies are added to the regression model. Each independent variable is explained below.

We suspect a possible endogeneity problem in particular, with variables UWRISK and FLEV in the reinsurance decision. An increase in underwriting risk impacts reinsurance purchase behavior, and at the same time, the moral hazard arising from a high reinsurance ratio may lead to an increased underwriting risk. Endogeneity is also suspected for FLEV. Companies with higher financial leverage ratio may use more reinsurance, and at the same time, a highly reinsured company may use more leverage due to increased debt capacity.

Considering that our model includes time-invariant variables (CONG and FOR) and variables with possible endogeneity problems (UWRISK and FLEV), we elect to apply the Hausman-Taylor instrumental variable (HT-IV) model that can be used with panel data with time-invariant variables and endogeneity. Time-variant variables are used to estimate their own coefficients while serving as instruments for endogenous time-invariant variables (Hausman and Taylor, 1981).

The following HT-IV model is used to examine the above six hypotheses

regarding the relationship between company-specific features and reinsurance, and to analyze life insurers' reinsurance purchasing behavior.

$$REINS_{it} = f(UWRISK_{it}, RBC_{it}, FLEV_{it}, lnSIZE_{it}, LINE_{it}, CONG_{it}, FOR_{it}, Year\ Dummies) + \mu_i + \varepsilon_{it}$$

Underwriting risk (UWRISK): Similarly to the usage in Adams (1996) and Kader, Adams, and Mouratidis (2010), this variable represents the company's annual gross claims divided by its annual gross premiums for the fiscal year. Gross claim amounts include all cash outflows paid to policyholders, including death benefits, cash surrender values, and dividends, both in the general account and in separate accounts. The gross annual premium is the total premium inflow for both the general account and separate accounts.

The solvency ratio (RBC): The RBC ratio represents Korea's solvency regulations for insurance companies. Regulators introduced an RBC scheme in April 2009, and data has been available since 2012. Therefore, RBC is available in the sample only for year-end dates from 2012 to 2018.

Financial leverage (FLEV): Financial leverage is defined as total liabilities divided by total assets. This definition is similar to the approach used in Garven and Lamm-Tennant (2003) and Ho (2016) and is the simplest way of measuring financial leverage.

Firm size (lnSIZE): This variable is the natural logarithm of the ceding company's total assets. Previous studies have used total assets as a proxy for firm size; however, using the logarithm reduces skewness and helps make extreme data more interpretable (Mayers and Smith, 1990; Adams, 1996; Kader et al., 2010). Values are not inflation-adjusted.

Product concentration (LINE): the Herfindahl concentration index, is computed for seven major types of products sold by life insurers in Korea.

Reporting the sales volume in the annual report for these categories is standard in Korea and is required by financial supervisors. Each type represents a type of coverage provided and can be categorized into group or individual. Individual product categories are life, pure endowment, endowment, pension, and variable insurance. Group products are divided into group life and retirement insurance.³⁾ The Herfindahl index is computed for each company as

$$H = \sum_{l=1}^7 s_l^2$$

where l is the type of product (1, 2, . . . , 7), $S_l = P_l/TP$, P_l is the amount of annual premium income written for a given type of insurance, and TP is the total value of annual premium income for all seven lines of business. The maximum value of the Herfindahl index is 1, and the closer the index is to 1, the more concentrated the product portfolio of the company.

Financial conglomerate or unaffiliated (CONG): This dummy variable takes a value of one for a life insurance company that belongs to a financial conglomerate and a value of zero for a company that does not belong to a financial conglomerate. In this study, life insurers not belonging to any financial conglomerates are called 'unaffiliated'. Note that here, financial conglomerates are all domestic companies since companies with foreign capital or that have foreign management do not have the unique features of Korean financial conglomerates. In case of a change in a company's status, the value is assigned based on the company's status in the beginning of the year.

3) For further information on products in the Korean life insurance industry, see Insurance Product Change and Development: Life Insurance Products (Kim, Kim, and Lee, 2018).

The foreign/domestic (FOR): Foreign/domestic status is a dummy variable that takes a value of one for a company that is owned or managed by a company located in a foreign country and a value of zero for a domestic life insurance company. If a company's status changes, the value is assigned based on the company's status in the beginning of the year. For instance, Tongyang Life Insurance Company was sold to the Anbang Group of China in September 2015. The name of the company was unchanged. In this study, the company is considered to be a domestic company in 2015, and a foreign company starting from 2016.

2. Data

The data used in this study covers 36 life insurance companies that operated from fiscal year 2001 to 2018. All data in this study is based on fiscal years that covered the period from April 1 to March 31 until fiscal year 2012, and from January 1 to December 31 beginning with fiscal year 2013. Therefore, fiscal year 2013 only consists of 9 months. Because most of the variables used here are mostly ratios that do not depend on the time period covered, or balance sheet items that are sampled as of a single date, there is no need to adjust the values of fiscal year 2013. Insurance companies that changed their names but remained unchanged otherwise are considered to be the same company. All other cases of companies with different names are regarded as separate companies. The panel is unbalanced because not all companies existed for the entire sample period. Reinsurers are excluded from the sample to capture the demand for reinsurance. Mutual companies are also excluded from the study for reasons explained previously. Four firm-years of observations resulted in reinsurance ratios, defined as ceded premiums divided by the total risk

premium, that were greater than 200%. These were considered incomplete and were removed from the sample.

The above criteria resulted in an unbalanced panel of 474 firm-year observations for thirty-six primary life insurance companies operating in Korea from 2001 to 2018. Among them, 372 firm-year observations corresponding to 29 firms were valid and were used in the model. Data for all of the variables was obtained from the Korea Life Insurance Association and the Financial Statistics Information System operated by Korea's FSS. All of the data pertains to independently operating and reporting life insurance companies licensed by the FSS to conduct life insurance and pension business in Korea.

Table 1 shows descriptive statistics for the dependent and independent variables. On average, life insurers in the sample reinsured 32.13% of the annual risk premium income, although some companies did not buy any reinsurance in certain years. The maximum REINS value is 1.0356, so it is assumed that in that year, ceded premiums from one or more previous years were accounted for in later years. Because that particular company is small and would not affect the overall results, the data was not excluded. The reinsurance-ceded premium is divided by the risk premium in this study, while the previous studies (Adams, 1996; Kader et al., 2010; Ho, 2016) divided by the total business premium. Since the ways of measuring the average reinsurance ratio differ, it is difficult to compare the use of reinsurance with figures in empirical studies based on data for insurers in other countries.

The average value of UWRISK for Korean life insurers in the sample is 0.5467. UWRISK can be converted into the gross loss ratio. Life insurance companies spend approximately half of their gross premium income annually to make payouts for claims (i.e., payouts related to maturities, mortalities,

surrenders, etc.). Given that the standard deviation of UWRISK is 0.3268, the loss ratio varies substantially by company. However, as the mean and median values are similar, the dataset is assumed to be approximately symmetric.

〈Table 1〉 Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Min	Max
REINS	0.3213	0.2782	0.2581	0	1.0356
UWRISK	0.5467	0.5362	0.3268	0	3.4104
RBC(%)	178.47	0	825.07	0	11353.72
FLEV	0.9152	0.9316	0.1526	0.0367	2.4822
FLEV*	0.6847	0.7313	0.1965	0.0007	1.4582
lnSIZE	15.6094	15.7184	1.8133	7.7196	19.3847
LINE	0.3967	0.3391	0.1808	0.1448	1
CONG	0.5711	1	0.4956	0	1
FOR	0.3850	0	0.4872	0	1

The RBC ratio has been provided in life insurance companies' annual reports for each year since year 2012. On average, life insurance companies have 416.08% of capital required under the RBC rules. However, the median value of 232.76% suggests an extreme asymmetry and variation across these solvency ratios. A large standard deviation of 1221.91% also shows that RBC ratios of insurers vary significantly across companies and years.⁴⁾

FLEV is a proxy for financial leverage. The average ratio of total liabilities to total assets for Korean life insurers is 91.52%; in other words, 8.48% of the

4) Having performed a closer examination, we observed that most of the variation was due to a single company called Kyobo Lifeplanet that was established in 2013 as a digital insurance company. The company's RBC ratio recently changed from 11353.72% to 228.26%. If this company is excluded, the average RBC ratio becomes 245.93%, and the standard deviation becomes 99.35%. Regardless of whether this company is included, on average all life insurance companies in Korea maintain RBC ratios higher than the statutory minimum of 150%.

capital structure is the total share of equity. The mean and median are close in value, and the standard deviation is 0.0367, which is relatively small compared to those of other variables, indicating that this variable is fairly stable across companies and years. The liabilities of Korean insurers consist of reserves, policyholders' equity adjustments, other liabilities and special liabilities' accounts. Reserves are created to protect the insurance company from losses, help pay policyholders' claims and make annuities' payments over extended periods of time. Therefore, reserves are the essential component of a life insurance company's balance sheet. To assess whether variable FLEV reflects the importance of reserves, variable FLEV* is calculated as reserves divided by assets. The results show that liabilities of Korean life insurers consist mostly of reserves, and the differences between the mean and median values for FLEV and FLEV* are similar. The standard deviations for FLEV and FLEV* differ, but as the standard deviation of FLEV is smaller than that of FLEV*, FLEV exhibits less variation than does FLEV*. Aiming to use a more comprehensive and less volatile measure, this study uses FLEV as the single proxy for financial leverage.

On average, the natural logarithm of assets of Korean life insurers is 15.6094, which is equivalent to assets of 14.912 trillion won, or approximately 13 billion USD. The median value of $\ln\text{SIZE}$ is 15.7184, indicating that Korean life insurance companies are dispersed in the market in terms of asset size. If the total assets in KRW are used in the calculation instead of the natural logarithm, as of December 31, 2018 the three largest life insurance companies (Samsung, Kyobo, and Hanwha) in fact represent 56% of the total market (Korea Life Insurance Association, 2019). However, as of March 31, 2002 (the end of fiscal year 2001) the three largest companies represented 85% of the total market. The three largest companies did not change between 2001 and

2018, indicating that Korean life insurance industry has become more competitive and more dispersed over time.

According to how the Herfindahl-Hirschman Index is specified, the smaller the LINE value is, the more diversified the product lines of a company. The value can range between 0 and 1. The entry for LINE in Table 1 suggests that Korean life insurance companies have product portfolios that are quite diversified compared to a reported average of 0.62 for U.K. life insurance companies measured between 1992-2004, and an average of 0.52 for New Zealand life insurance companies measured between 1988-1993 (Adams, 1996; Kader et al., 2010). The maximum value of 1 for LINE would indicate that companies have a single business line in the sample data of the current study.

The average value of 0.5711 of CONG indicates that Korean life insurance companies that were part of financial conglomerates were more numerous than those that were not over the period of 2001-2018. Less than half of life insurance companies were foreign-owned or under foreign management during the period.

V. Empirical Results

The Pearson pairwise correlation coefficients are shown in Table 2. The simple linear correlations between REINS and each of independent variables indicate a statistically significant association with REINS with the exception of UWRISK and RBC.

A positive association between UWRISK and FLEV suggests that companies that tend to offer more risky types of insurance and have a higher than average likelihood of financial distress are highly leveraged. In addition, the

idea that large companies are more likely to exhibit such a likelihood is supported by the positive relationship between UWRISK and FLEV. The negative relationship between UWRISK and RBC is also consistent with expectations. Companies with less underwriting risk and a lower risk of financial distress tend to have higher solvency ratios. The negative correlation between UWRISK and LINE implies that companies with concentrated portfolios can be effective in controlling underwriting risk. FLEV and lnSIZE have statistically significant negative relationships with RBC. This indicates that companies with higher financial leverage ratios and larger companies tend to have lower solvency ratios, i.e., less of a capital cushion for emergencies. Companies that are part of financial conglomerates tend to have higher UWRISK, maintain higher RBC ratios, utilize higher financial leverage, and tend to be larger than unaffiliated companies. Insurers belonging to financial conglomerates are also likely to have well-diversified product portfolios.

Table 2 also indicates that FOR has significantly negative relationships with UWRISK, FLEV, lnSIZE and CONG while having a significantly positive relationship with LINE. Foreign companies prefer to take less underwriting risk, keep sizable free assets, are usually smaller than average, and focus on a relatively small number of product lines. They are not likely to be part of conglomerates, as the latter are a unique feature of Korean companies.

〈Table 2〉 Correlation Coefficient Matrix

	REINS	UWRISK	RBC	FLEV	lnSIZE	LINE	CONG	FOR
REINS	1.000							
UWRISK	0.0873	1.000						
RBC	-0.098	-0.128*	1.000					
FLEV	0.153**	0.396**	-0.489**	1.000				
lnSIZE	-0.275**	0.218**	-0.192**	0.146**	1.000			
LINE	-0.215**	-0.283**	0.107*	-0.380**	-0.550**	1.000		
CONG	0.293**	0.107*	0.069	0.193**	0.249**	-0.458**	1.000	
FOR	-0.274**	-0.127*	-0.052	-0.220**	-0.260**	0.506**	-0.913**	1.000

Note: ** and * indicate statistical significance at 1% and 5% levels, respectively.

Variance inflation factors (VIFs) are computed as an intuitive indication of multicollinearity. The rule of 10, the most commonly used rule of thumb regarding VIF, interprets values exceeding 10 as a sign of substantial multicollinearity (Kennedy, 2003; O'Brien, 2007). The highest values of VIF in the regression model for this study are 8.10 and 8.52 for CONG and FOR, respectively, because they are time-invariant values. The mean VIF is 2.81, and other variables have VIFs that are less than 3.0. Hence, no independent variable used in the model is excluded from the study.

It is standard practice to estimate both RE and FE panel regressions and then apply the Hausman test to establish statistically significant differences in the coefficients of time-varying controls. Table 3 shows the results of RE and FE model estimations. Variable CONG is dropped from the FE model, as it is a time-invariant variable while other variables are all time-variant. Though FOR is also a categorical variable, the status of life insurance companies changed due to mergers and acquisitions over time. It appears that the results of RE and FE model estimations are qualitatively the same, as the signs of coefficients do not differ in the models.

〈Table 3〉 Random Effect and Fixed Effect Estimations

Independent Variable	Predicted Sign (+/-)	RE	FE
UWRISK	+	0.0727*	0.1235**
RBC	-	-0.0064**	-0.0043*
FLEV	+	0.0173	0.4971**
lnSIZE	-	-0.0713**	-0.0851**
LINE	+/-	-0.4316**	-0.3381**
CONG	+	0.1270	(omitted)
FOR	-	-0.0160	-0.1231
Constant		1.4898**	1.3204**
Number of obs.		372	372
Hausman test's chi2		31.44	
Prob. > chi2		0.0000	

Note: Dependent variable = REINS (the reinsurance ratio, defined as annual ceded premiums divided by annual risk premiums); UWRISK = gross underwriting risk, defined as annual gross claims divided by annual gross premiums, considering both the general account and separate accounts; RBC = statutory solvency ratio; FLEV = financial leverage, i.e., total liabilities at year-end divided by total assets at year-end; lnSIZE = natural logarithm of total assets; LINE = product mix, measured by the Herfindahl concentration index; CONG = 1 for life insurers in financial conglomerates, and 0 for unaffiliated life insurers, i.e., those not owned by a financial conglomerate; FOR = 1 for foreign-owned or managed life insurers, and 0 for domestically-owned or managed life insurance companies. Labels ** and * indicate statistical significance at 1% and 5% levels, respectively. The null hypothesis for the Hausman test is H0: the difference in coefficients is not symmetric.

The Hausman test result shows a chi-squared value of 31.44 with the p-value of 0.0000, rejecting the null hypothesis. This test result indicates that the FE model is more appropriate than the RE model, implying a possible unknown variable impacting explanatory variables.

Considering that our model includes time-invariant variables (CONG and FOR) and possible endogeneity problems (UWRISK and FLEV), we ultimately choose to use the HT-IV model. Table 4 shows that all of the independent variables have the expected signs, though not all are statistically significant.

〈Table 4〉 Hausman–Taylor Instrumental Variable Estimation

Independent Variable	Predicted Sign (+/-)	Coefficient	Std. Err	z	p > z
UWRISK	+	0.1028**	0.0373	2.76	0.006
RBC	-	-0.0045**	0.0017	-2.60	0.009
FLEV	+	0.3668**	0.1259	2.91	0.004
lnSIZE	-	-0.0792**	0.0116	-6.81	0.000
LINE	+/-	-0.3551**	0.1139	-3.12	0.002
CONG	+	0.0738	0.1258	0.59	0.557
FOR	-	-0.0685	0.1040	-0.66	0.510
Constant		1.2744**	0.2387	5.34	0.000
Number of obs.		372			

Note: Dependent variable = REINS (the reinsurance ratio, defined as annual ceded premiums divided by annual risk premiums); UWRISK = gross underwriting risk, defined as annual gross claims divided by annual gross premiums, considering both the general account and separate accounts; RBC = statutory solvency ratio; FLEV = financial leverage, i.e., total liabilities at year-end divided by total assets at year-end; lnSIZE = natural logarithm of total assets; LINE = product mix, measured by the Herfindahl concentration index; CONG = 1 for life insurers in financial conglomerates, and 0 for unaffiliated life insurers, i.e., those not owned by a financial conglomerate; FOR = 1 for foreign-owned or managed life insurers, and 0 for domestically-owned or managed life insurance companies. Labels ** and * indicate statistical significance at 1% and 5% levels, respectively.

Empirical evidence indicates that Korean life insurers taking increasingly higher levels of underwriting risk have a growing tendency to use more reinsurance, which is consistent with the prediction and is statistically significant at the 1% level. Insurance companies use reinsurance to reduce the volatility of returns and to increase profitability. These results support findings of previous studies, including that by Mayers and Smith (1990) of reinsurance in the US property casualty insurance industry, that by Adams (1996) of reinsurance use by New Zealand life insurance companies, and that by Kader, Adams, and Mouratidis (2010) of reinsurance use by U.K. life insurance firms. Hypothesis 1 is therefore supported.

The estimated coefficient of the solvency ratio (RBC) is negative though close to zero, indicating a very weak relationship, and statistically significant. It supports Hypothesis 2. The negative value of the estimated coefficient implies that purchasing reinsurance could be regarded as a strategy for raising the RBC ratio. However, instead of purchasing reinsurance, many life insurance companies with RBC ratios that are unacceptably low (near 150%) are likely to choose other options to improve their solvency ratios. Such options include issuance of subordinated bonds. A low interest rate environment makes issuing a subordinated bond a cost-effective option for insurance companies that need to raise capital. As Kim (2012) pointed out, given the limitations of Korea's current RBC rules, reinsurance could not be used as a way to adjust the RBC ratio. However, as the Korean life insurance industry is expecting the introduction of K-IFRS17 and K-ICS in 2023, this situation may change.

The coefficient of financial leverage (FLEV) is 0.3668 and statistically significant, supporting Hypothesis 3. Financial leverage, measured as total liabilities divided by total assets, reflects the overall business results and the financial condition of the company. Life insurance companies utilize reinsurance to relieve financial stress for various purposes. For example, in the US reinsurance has been observed being used for facilitating new business financing, increasing capital by transferring in-force blocks, and reducing risk concentration by using the reinsurer's lower cost of capital. These are examples of the ways life insurers can benefit financially from purchasing reinsurance (Tiller and Tiller, 2005). Although the scope of reinsurance is limited to insurance risk in Korea, financial leverage is shown to be an important feature of high demand for reinsurance. Hence, when the scope of reinsurance widens in Korea, life insurance companies may create various

structures for reinsurance that already exist in many foreign markets to reinforce the usefulness of reinsurance in controlling financial liabilities.

Variable $\ln\text{SIZE}$ reflect the preponderance of large companies in the Korean life insurance industry and has a statistically significant negative relationship with REINS. Consistently with findings of previous studies (e.g., Hoerger, Sloan, and Hassan, 1990; Mayers and Smith, 1990; Adams, 1996), Hypothesis 4 is supported by these results. Over the past two decades, the number of life insurers has decreased due to mergers and acquisitions. In 2001, there were 29 companies, but their number declined to 24 in 2018. Due to recent and expected changes in statutory regimes worldwide, such as Solvency II in Europe and K-IFRS17 and K-ICS in Korea, more life insurers are likely to be put up for sale. In 2018, the PCA Life Insurance Company merged with Mireasset Life Insurance Company, while Orange Life Insurance Company merged with Shinhan Life Insurance in 2019. As of year-end of 2019, Prudential Life Insurance Company and the KDB Life Insurance Company are waiting to be sold in the market, possibly to one of Korean financial conglomerates. As the pace of M&A accelerates, the Korean life insurance market will be more dominated by few large companies. Based on the findings of this study, there will be less demand for reinsurance from these large companies, assuming that all other circumstances remain unchanged.

The estimated coefficient of LINE is -0.3551 and statistically significant at the 1% level, suggesting that life insurance companies with diversified product portfolios tend to purchase more reinsurance. This result is consistent with Mayers and Smith (1990) and Adams (1996), who argue that the benefits of product diversification may be greatly exceeded by the accompanying risks, which leads companies to retain less business risks and use more reinsurance. Although product diversification can result in economies of scale and cash

flow stability, it may at the same time cause business risk to grow, challenging the company to enter an unknown market segment. It appears that Korean life insurance companies tend to utilize reinsurance to avoid business risks arising from diverse business portfolios.

As predicted, the estimated coefficient of variable CONG is observed to be positively related to reinsurance purchasing behavior, though it is not statistically significant. Financial conglomerates in Korea are often compared to horizontally structured financial keiretsu in Japan. Both involve extensive cross-shareholdings among the member companies. Yanase and Limpaphayom (2017) observe that non-life insurance companies in Japanese keiretsu use less reinsurance than do unaffiliated non-life insurance companies in Japan. Yanase and Lidmpaphayom (2017) explain that "the keiretsu have relatively low bankruptcy costs, low agency conflicts, low information asymmetry, and low effective taxes," and these characteristics reduce what could otherwise be gained from purchasing reinsurance. The researchers' finding conflicts with the findings in this thesis. The reason could be inferred to be a difference between Korea's and Japan's historical backgrounds, discrepant characteristics of Korean financial conglomerates and Japanese keiretsu, or life insurance firms differing from non-life insurance companies. Moreover, as the coefficient of CONG is statistically insignificant, it is difficult to confirm that life insurance companies in Korea tend to mitigate systematic risks by utilizing reinsurance purchases. Therefore, it is suggested that further research be done regarding financial conglomerates and risk management through the use of reinsurance.

Lastly, the foreign-owned/managed company variable FOR is negatively related to the use of reinsurance. The result is consistent with the notion that foreign insurance companies spread the benefits of market liberalization and possess the know-how in risk management, real-service provision, and

efficiencies in various operations that may reduce the use of reinsurance as a risk management method. Moreover, as Table 2 shows, foreign life insurance companies maintain low financial leverage, encourage low underwriting risk, and have concentrated product portfolios. Such tendencies reduce many of the benefits of buying reinsurance. However, it is difficult to draw clear conclusions from the results due to the high $p > |z|$ value. A further study of the influence of foreign-owned life insurance companies on the market and their reinsurance decision-making is required.

VI. Conclusions

Using unbalanced panel data for a sample of Korean life insurance firms for the period between fiscal years 2001 and 2018, this study empirically investigates how the selected characteristics of life insurance companies are related to an important insurance risk management tool, namely, the use of reinsurance. Selected firm-specific factors include risk-bearing tendency through underwriting, financial leverage, solvency ratio, size, portfolio concentration, and form of ownership. By providing statistically significant estimates of the relationships between reinsurance demand and firm-specific features, this study overcomes limitations of previous studies of Korea that adopted the cost-only perspective on evaluating the usefulness of reinsurance. At the same time, this study provides insights to managers of life insurance companies for evaluating company features and redeveloping reinsurance strategies fit for each company's characteristics.

In general, the results show that the more underwriting risk a life insurance company's management takes, the greater the company's demand for

reinsurance. The solvency ratio has a slight impact on reinsurance purchases, as reinsurance can help insurance companies stay above the minimum required level of RBC. Companies with higher financial leverage are more likely to purchase more reinsurance, while the larger the company is and the more diversified its lines of business are, the greater its demand for reinsurance. Companies that are part of financial conglomerates seem to purchase more reinsurance due to their complex holding structures and the need for additional means of hedging risk. Domestic Korean life insurance companies seem to purchase more reinsurance than do foreign-owned or managed companies. These findings broadly confirm those of previous studies that used samples of insurers in different countries and different eras, namely, that company-specific features have a definite relationship with the demand for reinsurance.

This study has inherent limitations. For example, due to changes in company ownership and accounting requirements, the data used in the study may be imperfect. Other major limitations mostly arise from the lack of access to detailed data. If underwriting risk is measured as pure mortality and morbidity payouts divided by the risk premium, it will be more closely related to the reinsurance ratio measured in this paper, and hence will more appropriately assess the underwriting capacity linked to reinsurance. In addition, since companies do not publish detailed information about their reserves and funds, the default risk was measured approximately using the financial leverage ratio, i.e., total liabilities divided by total assets. The RBC ratio was only published after 2012, so it was difficult to measure the exact solvency ratio before 2012. Moreover, although Korean life insurance companies have diversified product portfolios, the financial results of each product are confidential, and discovering detailed product portfolios was

impossible.

Conservative regulations regarding the scope of reinsurance also restrict the ability to establish more evidence regarding the correlation between company features and use of reinsurance. The regulations also conceal the benefits of reinsurance, restricting the ability of managers of life insurance companies to plan diverse structures while taking reinsurance into account.

Nevertheless, despite limitations, this study provides several new insights into the motivations for use of reinsurance by Korean life insurance companies and could have potentially important policymaking implications. Predictions of the impacts of new accounting standards and a new solvency framework, known as K-IFRS17 and K-ICS, respectively, are under investigation. In January 2020, the FSC announced that coinsurance would be introduced in the Korean insurance industry in June 2020 at the earliest. The decision was based on concerns about an increased capital burden of life insurance companies after the introduction of K-IFRS17 and K-ICS. The life insurance industry as a whole, including life insurance companies, reinsurance companies, the FSS, and the FSC, contends that widening the definition of reinsurance is inevitable for the long-term viability of the industry. The link between company-specific features and demand for reinsurance discovered in this study could be used when establishing the detailed boundaries of coinsurance in Korea. Reinsurance managers of each company could also utilize the results of this study when choosing the company's reinsurance strategies after the introduction of coinsurance, K-IFRS17 and K-ICS.

As the very first study to empirically analyze the demand for reinsurance in Korean life insurance companies, this study offers a foundation for future research. Finding trade-offs between company characteristics and how reinsurance decisions are jointly determined, and exploring comparisons of

demand for reinsurance before and after the introduction of coinsurance, or comparisons with non-life insurance companies are among the various conceivable directions of future research.

References

- 금융통계정보시스템 (2018), “생명보험 통계”.
 (Translated in English) Financial Statistics Information System (2018). “Life Insurance Statistics”.
- 김석영 (2012), “RBC 체계에서의 재보험 효과 연구”, *보험연구*, 제92권, pp. 1-22.
 (Translated in English) Kim, S. (2012). “A Study on Effects of Reinsurance under RBC Scheme”, *Korean Journal of Insurance*, 92:1 22.
- _____ (2016), “재보험 출재비율 최적화 전략 연구”, *보험연구*, 제105권, pp. 113-140.
 (Translated in English) _____ (2016). “A Study on Optimization of Reinsurance Quota Share Ratio”, *Korean Journal of Insurance*, 105:113-140.
- 김석영·김세영·이선주 (2018), *보험산업의 변화와 발전: 생명보험의 현황과 전망*, 연구보고서, 2018-5, 보험연구원.
 (Translated in English) Kim, S., S., Kim and S., Lee (2018). *Insurance Product Change and Development: Life Insurance Products in Korea*, Research Report, 2018-5, KIRI.
- 김석영·이규성 (2019), *재보험 전략 연구*, 연구보고서, 2019-7, 보험연구원.
 (Translated in English) Kim S., and K., Lee (2019). *A Study on Reinsurance Strategy*, Research Report, 2019-7, KIRI.
- 김현수·김석영 (2015), “손해보험사의 출재는 과다한가? RBC 규제에 기초한 분석”, *보험연구*, 제26권 제1호, pp. 51-71.
 (Translated in English) Kim, H., and S., Kim (2015). “Do P/L Insurers Ceded Too Much? An Analysis Based on the RBC Regulation”, *Journal of Insurance and Finance*, 26(1):51-71.
- 생명보험협회 (2018), “생명보험사 재무제표”.
 (Translated in English) Korea Life Insurance Association (2018). “Life

- Insurance Company Financial Statements”.
- _____ (2019), “2018/2019 생명보험사 연차보고서”.
- (Translated in English) _____ (2019). “Life Insurance Business in Korea-annual Report 2018/2019”.
- 신종각 (2006), “생명보험회사의 설립형태 및 규모별 생산성 변화추이 분석”, _____, 제47권, pp. 3-34.
- (Translated in English) Shin, J. (2006). “An Analysis on Productivity Growth and Efficiency Change in the Korean Life Insurance Industry”, *Journal of Insurance and Finance*, 47:3 34.
- 이유리 (2018), “비례재보험 계약 조건의 결정”, 성균관대학교 학위논문(석사).
- (Translated in English) Lee, Y. (2017). “Conditions for Quota Share Reinsurance Contract”, Sungkyunkwan University.
- 장동한 (1999), “합리적인 보험결정에 관한 연구”, _____, 제53권, pp. 25-39.
- (Translated in English) Chang, D. (1999). “A Study on the Efficient Retention Setting”, *Korean Journal of Insurance*, 53:25-39.
- 조재훈 (2015), “위험회피도 추정에 의한 최적 재보험구조 선택”, _____, 제26권 제4호, pp. 101-124.
- (Translated in English) Cho. J. (2015). “Optimal Reinsurance Structure Selection by Risk Aversion Estimation”, *The Journal of Risk Management*, 26:101-124.
- 조재훈·김정호·이항석 (2014), “재보험의 위험경감과 RBC”, _____, 제25권 제2호, pp. 95-121.
- (Translated in English) Cho, J., J., Kim and H., Lee (2014). “Risk Reduction by Reinsurance and RBC”, *The Journal of Risk Management*, 25(2):95 121.
- 함준호·김준경 (2006), “금융그룹화와 금융위험: 실증분석 및 정책과제”, _____, 제28권 제1호, pp. 145-191.

- (Translated in English) Hahm, J., and J., Kim (2006). "Risks and Supervisory Challenges of Financial Conglomerates in Korea", *KDI Journal of Economic Policy*, 28(1):145 191.
- Adams, M. (1996). "The reinsurance decision in life insurance firms: an empirical test of the risk-bearing hypothesis", *Accounting and Finance*, 36(1):15 30.
- Cole, C., and K., McCullough (2006). "A reexamination of the corporate demand for reinsurance", *Journal of Risk and Insurance*, 73(1):169 192.
- Garven, J., and J., Lamm-Tennant (2003). "The demand for reinsurance: Theory and empirical tests", *Insurance and Risk Management*, 7(3):217 237.
- Hill, N. (1996). "Risk-based capital (RBC) Ratios", Colorado Springs Meeting, Society of Actuaries, Record, 22.
- Ho, C. (2016). "Ownership Structure and Reinsurance Decisions: Evidence from the Property Casualty Insurance Industry in China", *Chinese Economy*, 49(1):14 31.
- Hoerger, T., F., Sloan and Hassan, M. (1990). "Loss volatility, bankruptcy, and the demand for reinsurance", *Journal of Risk and Uncertainty*, 3(3):221 245.
- IAIS (2006). "Guidance Paper on Risk transfer, Disclosure and Analysis of Finite Reinsurance", IAIS Guidance Paper No. 11, Beijing, October 26.
- Joint Forum on Financial Conglomerates, Supervision of Financial Conglomerates, Bank for International Settlement, Basel Committee on Banking Supervision, International Organization of Securities Commissions (IOSCO) and International Association of Insurance

- Supervision (IAIS), February(1999).
- Kader, H., M., Adams and K., Mouratidis (2010). "Testing for trade-offs in the reinsurance decision of U.K. life insurance firms", *Journal of Accounting, Auditing and Finance*, 25:491 522.
- Kennedy, P. (2003). *A guide to econometrics*, MIT press.
- Lian-can, W., S., Shu-guang and W., Liang (2010). "Reinsurance Demand and its Determinants of the PR China's Property-Casualty Insurance Industry-Evidence From Panel Data", *Collected Essays on Finance and Economics*, 3.
- Mayers, D., and C., Smith (1990). "On the corporate demand for insurance: evidence from the reinsurance market", *Journal of Business*, 63(1):19 40.
- O'brien, R. (2007). "A caution regarding rules of thumb for variance inflation factors", *Quality and Quantity*, 41(5):673 690.
- OECD, Insurance indicators (2018). "Ratio of reinsurance accepted".
_____ (2018). "Life insurance share".
- Tiller, J., and D., Tiller (2005). *Life, Health and Annuity Reinsurance*, ACTEX Publications.
- Yanase, N., and P., Limpaphayom (2017). "Organization Structure and Corporate Demand for Reinsurance: The Case of the Japanese Keiretsu", *Journal of Risk and Insurance*, 84(2):599 629.

요 약

본고는 한국 생명보험사를 대상으로 재보험 출재 의사결정에 미치는 영향요인을 분석하고 있다. 회계연도 2001년부터 2018년까지 18개년 동안의 패널데이터를 사용하여 하우스만-테일러 도구변수 추정을 시행하였다. 연구 결과, 언더라이팅 리스크, 재무 부채비율, 사업다각화 정도가 높을수록, 지급여력비율이 낮을수록, 회사규모가 작을수록 재보험 출재 성향이 강한 것으로 나타났다. 또한 금융그룹 내에 속해 있는 생명보험사의 경우 재보험 출재 비율이 높은 반면, 외국계 생명보험사들은 위험보유 성향이 강한 것으로 보인다. 본 연구는 한국 생명보험사의 실증데이터를 이용한 최초의 재보험 관련 연구로, 변화하는 보험산업 환경 내에서 재보험 의사결정 시 다양한 회사별 특성이 고려되고 있음을 시사하고 있다.

※ 국문 색인어: 재보험 의사결정, 생명보험사, 한국