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Reinsurance, Capital Structure and Profitability: Evidence from the Lloyd's Market

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摘 要

本研究探討勞依茲辛迪卡之再保險、財務槓桿與獲利性之間的關係。我們利用 2004-2009 年辛迪卡的資料及聯立方程式模型，發現：(1) 使用比較多再保險的辛迪卡，獲利比較差；而獲利比較好的辛迪卡，再保險的使用比較少；(2) 高槓桿的辛迪卡，通常獲利性比較差；而獲利比較好的辛迪卡，通常槓桿比較低；(3) 再保險比較高的辛迪卡，槓桿比較高，但反之不成立。我們的結果支持融資順位理論、風險承擔假說與預期破產成本假說。

關鍵字：勞依茲、辛迪卡、再保險、槓桿、獲利性

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Abstract

This study examines the relations among Lloyd's syndicates' reinsurance, leverage and profitability. A simultaneous equations model is adopted, using data on syndicates for the period 2004-2009. We find some two-way relations among these variables. First, syndicates with higher reinsurance have worse profitability and those with better profitabilityrely less on reinsurance. Second, highly leveraged syndicates are generally less profitable and profitable syndicates are less leveraged. In regards to the relation between reinsurance and leverage, we find that reinsurance positively affects leverage; a reverse causality is not supported by our data. Our findings are consistent with *pecking order theory,* the *riskbearing hypothesis,* and the *expected bankruptcy cost hypothesis*.

Keywords: Lloyd's, Syndicates, Reinsurance, Leverage, Profitability

1. INTRODUCTION

Lloyd's of London is a traditional British insurance market that is over three hundred years old. In 2009, Lloyd's market was ranked as the world's fifth largest reinsurer (Standard & Poor's, 2010), and today it continues to play a crucial role in the global insurance and reinsurance industry. At the end of 2009, Lloyd's generated annual premiums of £21.9 billion and held assets with a total market value of approximately £55.2billion (Lloyd's, 2010). Lloyd's has been and continues to be one of the world's most important underwriters of large and hard to place insurance risks. However, despite its important role in the global insurance market, Lloyd's has attracted little previous financialresearch. The aim of this study is to fill in the gap in the literature by investigating therelation ships between reinsurance, leverage, and profitability of Lloyd's syndicates.

Reinsurance is an important hedging method for insurers by which they transfer their risk and uncertainties to reinsurers. In previous articles, leverage is found to be an important determinant of reinsurance purchasing behavior (Adams, 1996b; Garven and Tennant, 2003). However, based on evidence from U.K.'s non-life insurance industry, Shiu (2011) suggests that the relationship between leverage and reinsurance also seesa reverse causality. Thus, following the study of Shiu (2011), we propose that leverage and reinsurance are jointly determined in Lloyd's.

Profitability plays an important role in reinsurance purchasing. Based on an increase in cash flow and ability to bear risk, several prior articlesdocument profitability as a determinant of reinsurance (e.g., Adams, Hardwick, and Zou, 2008; Kader *et al*., 2010). Furthermore, reinsurance is also suggested to have an influence on insurers' profitability (Choi and Elyasiani, 2011). Taken together, we suggest that there is a two-way relation ship between profitability and reinsurance.

The relation between profitability and leverage is also assumed to be simultaneous in our study. Traditionally, profitability is considered an important determinant of capital structure within the *pecking order theory* and *trade-off theory*. Several studies (e.g., Hovakimian, Opler, and Titman, 2001; Mazur, 2007; Titman and Wessels, 1988) contend that profitability has an influence on leverage. Conversely, leverage is also considered to have an effect on profitability (Adams, 1996a; Adams and Buckle, 2003).

Most extant studies focus on one-way relationships between the above factors. However, if the factors are jointly determined it is important to confirm this in order to gain a better understanding of the relationships between these factors. We therefore investigate this in the current study.

One prior study that has a close connection to ours is Shiu (2011). However, several major differences exist. First, Shiu (2011) uses data from the U.K. non-life insurance industry, while we use data from Lloyd's syndicates. Second, Shiu (2011) examines the relation between insurers' leverage and reinsurance and finds a positive two-way relation. In contrast, we examine the two-way relations between (1) profitability and reinsurance and (2) profitability and leverage.

Furthermore, Lloyd's market differs from the U.K. non-life insurance market. Unlike non-life insurance companies, Lloyd's syndicates are not stock or mutual insurers; all of its capital is provided from individual or corporate members, where members can decide whether to participate in syndicates the following year or not. In addition, Lloyd's market has central funds that provide syndicates with capital efficiency. In cases of large underwriting losses that deplete a syndicate's capital, Lloyd's satisfiesits syndicates' unfunded liabilities from its central funds. Lloyd's market also under writes many specialist and complicated businesses, like celebrity body parts, major airlines, world's largest banks, and sporting events. Lloyd's uniqueness there fore makes it an interesting environment in which to empirically examine the proposition that there are two-way relationships between reinsurance, leverage, and profitability.

The remainder of this paper is organized as follows. Section 2 provides background information on Lloyd's, with a focus on its unique ownership and capital structure. Section 3 presents our hypotheses as developed based on existing financial literature. Section 4 describes the research design. Section 5 presents and discusses our empirical results, while Section 6 concludes the study.

2. INSTITUTIONAL BACKGROUND

2.1 Lloyd's of London

Lloyd's of London is globally considered a crucial insurance and reinsurance market. Conducting business in over 200 countries and territories, Lloyd's wrote gross premiums of

£21.9 billion across a diverse range of classes in 2009.Lloyd's is not a company, but a marketplace that provides a location, a set of rules, and procedures by which to conduct insurance transactions. As at November 2010, there were 85 syndicates in Lloyd's market. The major business of Lloyd's includes reinsurance (36%), property insurance (23%), and casualty insurance (20%) (Lloyd's, 2010).

Lloyd's originated in Edward Lloyd's coffee house on Tower Street in London in 1688. Over the years, it has evolved into one of the well-known and leading insurance markets providing specialist property and casualty insurance. The market's key participants are its members, syndicates, managing agents, brokers, and the Society of Lloyd's. At Lloyd's, members provide capital to support syndicates' underwriting. The members can beprivate individual members (so-called Names) as well as corporate members (i.e., insurance groups and listed companies); the latteraccount for more than 80% of Lloyd's total capital (Lloyd's, 2010). A syndicate is a vehicle used for underwriting policies. Syndicates can either be made up of several members or just one corporate member. Managing agents managethe day-to-day running of a syndicate's operations. They can manage one or more syndicatessimultaneously. At Lloyd's, most policyholders access the market through Lloyd's brokers. As the predominant distribution, brokersengage in insurance business with managing agents on behalf of their clients.

Members of Lloyd's can decide whether to continue to participate in a syndicate the following year or not. In practice, most syndicates are supported by the same capital providers for several years (Lloyd's, 2010). The Lloyd's market is governed by the Council of Lloyd's, which is regulated by the Financial Services Authority (FSA). The function of the Council is mainly to act through the Franchise Board, which manages the day-to-day running of the Lloyd's market and lays down guidelines for all syndicates. It also supervises the managing agents, who underwrite policies and manage risk, in order to ensure sustainable profitability and thus enhance the financial strength of the Lloyd's market.

2.2 Chain of Security

The Chain of Security makes up Lloyd's unique capital structure, providing capital efficiency for members as well as financial security to policyholders. The Chain of Security provides Lloyd's with its robust capitalization and financial strength. There are three levels of capital in the Chain of Security—syndicate level assets, members' funds at Lloyd's, and central fund assets.

Syndicate level assets are made up of premium trust funds (PTFs), and area syndicate's first resource for paying policyholder claims. Each syndicate holds all premiums received in its PTFs. Generally, PTFs are held in liquid, short duration assets in order to easily meet the syndicate's liabilities. Around 83% of the assets are invested in bonds. In December 2009, the total PTFs in Lloyd's had reached £37.4 billion (Lloyd's, 2010).

Members' funds at Lloyd's (FAL) are the second level of capital, and are provided by members to support their own individual underwriting; they are not available to meet insurance liabilities of other members. According to FSA, each managing agent makes an individual capital assessment (ICA) stating how much capital it requires to cover its underlying business risks at a 99.5% confidence level (Lloyd's, 2010). After reviewing each syndicate's ICA, the Corporation of Lloyd's determines the amount of deposited fundsrequired. In December 2009, the total value of FAL was £13.2billion (Lloyd's, 2010).

Central fund assets are the third level of security. Under the discretion of the Council of Lloyd's, central fund assets are prepared to meet liabilities that cannot be met by the resources of any individual member. All Lloyd's syndicates benefit from Lloyd's central funds. The fundsareraised from two sources, members' annual contributions and subordinated debt issued by the Corporation. Members' contributions are currently set at 0.5% of annual gross written premiums. And the end of 2009, central fund assets had accumulated to £2.1billion (Lloyd's, 2010).

In the case of a huge underwriting loss that depletes a member's PTFs and FAL, Lloyd's satisfies the member's unfunded underwriting liability from the central fund. Though the central fund covers any valid claim by members that they cannot pay themselves, the member still remains liable for the debt unless forgiven by Lloyd's. In 2008 and 2009, Lloyd's performed well against other global reinsurance companies, achieving a low combined ratio of 86.1% and 91.3%, respectively (Lloyd's, 2010).

Unlike other U.K. insurance concerns, the business of Lloyd's is largely self-regulated. Its jurisdiction is provided by a separate Act of Parliament, the Lloyd's Act 1982.As previously discussed, syndicates are an annual venture. The Lloyd's Agency Agreement governs the relationship between the manager of a syndicate and the members that provide its capital. The agreement forms the basis of the annual venture structure and allows each member to terminate its participation in a given syndicate after one year.

Prior studies suggest that Lloyd's syndicates, given their unique ownership structure, tend to buy more reinsurance than other insurers with different ownership structures, e.g.,

stock insurance companies. Mayers and Smith (1990) positth at the more significant the fraction of total wealth the insurer represents for its owner(s), the greater the reinsurance demand. They show that Lloyd's associations have the greatest demand for reinsurance when compared with single-family, closely held, and widely held stocks insurers[1].

3. HYPOTHESIS DEVELOPMENT

3.1 Effects of profitability on reinsurance

Under the *expected bankruptcy cost* argument, insurers with higher profitability are predicted to purchase less reinsurance (Adams *et al*., 2008; Kader, et al., 2010). Profitable insurers generally have larger cash flows with which to fulfill policyholder claims and thus face a lower risk of bankruptcy. This reduces their expected bankruptcy cost, thereby also reducing their need for reinsurance. Adams *et al*. (2008) further suggest that insurers with a higher level of profitability have more resources to counter financial risk than less profitable insurers, and are there by less likely to buy reinsurance. Cole and McCullough (2006) additionally contend that profitable insurers are better able to absorb large unexpected losses and are thus less affected by the problem of under investment. The above discussions suggest that profitable insurers demand less reinsurance.

The *renting capital hypothesis* suggests that reinsurance can be considered a form of external capital financing (Shiu, 2010) as well as a form of off-balance-sheet capital (Shiu, 2011). When insurers become more profitable, they have an increased access to internal funds, thereby decreasing their demand for external financing. It thus follows that insurers with higher levels of profitability are expected to demand less reinsurance. Mann (1995, p. 485) further contends that insurers tend to rationally compare the cost of capital with the cost of hedging methods, especially reinsurance, to counter risk. When raising capital becomes easier, i.e., when a firm is more profitable, insurers have less incentive to use reinsurance.

Profitability may also influence a firm's reinsurance purchasing behavior because of the impact corresponding tax incentives have. The *income level enhancement argument* suggests that reinsurance enhances insurers' current income level via the commissions received from

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1 Mayer and Smith's (1990) data are from A. M. Best; their file identifies each firm's ownership structure such as Lloyd's, stock, and mutual. Lloyd's associations are not Lloyd's syndicates, they are U.S. firms whose ownership is organized in the same way as Lloyd's.

reinsurers, and thus increase tax liabilities (Adiel, 1996). Therefore, insurers facing a high marginal tax rate tend to purchase less reinsurance than insurers facing a low marginal tax rate. Profitable insurance companies may be subject to a high marginal tax rate, thereby increasing their incentive to have a lower level of reinsurance, as they wish to avoid an increase in their tax liabilities(Adams, Hardwick, and Zou, 2008).

3.2 Effects of reinsurance on profitability

The most prominent reason for insurers to engage in reinsurance purchasing be havior is that it can lead to more stable underwriting results. Ma and Elango (2008) contend that via reinsurance purchases, stable underwriting results can contribute to higher risk-adjusted returns and improved profitability. Insurers use reinsurance to transfer unexpected losses to reinsurers and thereby reduce their underwriting risk. Companies with a lower level of income volatility may perform better than companies with a higher level of volatility (Gschwandtner, 2005). Furthermore, a high possible insurance loss can increase corporate management expenses ex-ante and ex-post (e.g., claims investigations and loss adjustment costs) and further deplete financial performance. Therefore, purchasing reinsurance should have a positive impact on profitability.

Furthermore, not only does reinsurance purchasing behavior mitigateincentive conflicts and the problem of under investment (e.g., Zou, 2010; Mayers and Smith, 1987), which positively influences the insurer's profitability, but it also decreases the expected cost of financial distress. This benefits the insurer because it reduces monitoring costs, increases the price that customers are willing to pay for insurance policies, and "prevents insurers from losing their franchise value" (Harrington, Mann, and Niehaus, 1995), thereby improving their profitability.

Reinsurance is further beneficial to insurers because reinsurers can provide them with real services. The provision of advice related to pricing and underwriting operations strengthens insurers' underwriting ability. Furthermore, the information provided by reinsurers also reduces the need for insurers to procure such information in the market. Insurers' cost of underwriting may thereby be reduced, and thus their underwriting performance increased.

Last, reinsurance purchasing behavior allows insurance companies to effectively diversify their policies. Insurers are able to write more profitable policies when they are more diversified than when less diversified (Harrington and Niehaus, 1999). Choi and Elyasiani

(2011) also suggest that an "effective use of reinsurance transaction can affect the revenues and costs due to better management and scale economies."

However, although the use of reinsurance can help insurers avoid large unexpected losses, achieve a scale of operations, and improve cost efficiency, they may at the same time miss potential underwriting profitsas part of the premiums are ceded to the reinsurers (Choi and Elyasiani, 2011). Based on evidence from property insurance use, Zou (2010) finds that, to a certain degree, insurance use has a positive influence on firm value; however, over-insurance appears to deplete firm value. The arguments above suggest that insurers tend to find an optimal level of reinsurance coverage that can maximize firm value.

3.3 Effects of leverage on reinsurance

Several previous articles (Adams, 1996b; Garven and Tennant, 2003) suggest that leverage has a positive effect on reinsurance. A prominent explanation for why highly leveraged insurers purchase reinsurance is the *risk-bearing hypothesis*. This hypothesis suggests that the reinsurance decision is motivated by the incentive of risk reduction. As highly leveraged firms' ability to bear risk should be lower and they are exposed to the problem of insolvency, they require more reinsurance (Wang, Chang, Lai, and Tzeng, 2008). Adams (1996b) tests the *risk-bearing hypothesis* using data from New Zealand life insurance firms; his findings indicate that insurers' reinsurance purchasing behavior is positively associated with their level of leverage.

In order to mitigate the problem of under investment, highly leveraged insurance firms may increase their reinsurance purchasing behavior (Adams, 1996b; Mayers and Smith, 1987; Mayers and Smith, 19902; Myers, 1977). That is to say, for insurers with a high probability of expected loss (i.e., high leverage), taking a positive NPV project may benefit the policy holders rather than the shareholders (Mayers and Smith, 1987; Myers, 1977). As a result, the shareholders of highly leveraged insurers have the incentive to forgo profitable investment projects. Reinsurance can mitigate this problem by "indemnifying shareholders against any reduction in firm value resulting from a severe claims experience" (Adams, 1996b). For this reason, highly leveraged insurers have a greater incentive to engage in reinsurance purchasing behavior.

3.4 Effects of reinsurance on leverage

According to the *renting capital hypothesis*, insurers that purchase more reinsurance are

likely to increase their level of leverage. Shiu (2011) argues that purchasing reinsurance, which is analogous to renting capital from reinsurers, enables the insurer to underwrite more new policies. Several studies (e.g., Chen, Hamwi, and Hudson, 2001; Harrington, Mann, and Niehaus, 1995) also contend that the purchase of reinsurance reduces the capital needed to engage in new business opportunities while still allowing insurers to meet the regulatory requirements.

Reinsurance can further have a positive effect on leverage because it can lower insurers' underwriting risk. Business risk (i.e., underwriting risk) is usually reported to be inversely related to leverage-firms with higher business risk tend to choose to operate using a lower level of financial leverage (Bradley, Jarrell, and Kim, 1984). Thus, as insurance firms with high underwriting risk have a higher probability of insolvency, managers of these firms may tend to avoid excessive leverage. However, the purchase of reinsurance can effectively stabilize the underwriting results and thereby allows the insurer to increase its leverage (e.g., write more new policies) (Harrington and Niehaus, 1999).

In addition, *pecking order theory* suggests that firms have an incentive to accumulate cash during good years in order to confront the volatility of cash flow (Mazur, 2007). Such an accumulation of cash would reduce the firm's level of leverage. In the insurance industry, the purchase of reinsurance can stabilize insurers' financial results, i.e., reduce the volatility of cash flow, and thereby reduce their incentive to accumulate cash. For this reason, reinsurance purchasing behavior allows insurers to accumulate less cash and thereby be more highly leveraged.

3.5 Effects of profitability on leverage

Several articles (e.g., Hovakimian, Opler, and Titman, 2001; Mazur, 2007; Titman and Wessels, 1988; Toy *et al*., 1974) provide evidence that firms with higher profitability tend to be less leveraged. This is be cause firms that passively accumulate retained earnings, there by increasing their capital, become less leveraged when they are profitable. Toy *et al*. (1974) also suggest that profitable firms tend to maintain low debt ratios because of their ability to use financing from internally generated funds. This is in line with *pecking order theory*, which states that firms prefer to apply financing first from retained earnings, second from debt, and third from issuing new equity.

On the other hand, Hovakimian *et al*. (2001) find that although past profits are an important predictor of leverage, firms often make financing decisions, like issuing new debt

or repurchasing stock, that can offset these earnings-driven changes in their capital structure. Their aim is to maintain an optimal capital structure. In addition, according to *trade-off theory,* highly profitable firms would choose to have higher debt ratios when compared with less profitable firms in order to obtain attractive tax shields. Highly profitable insurers are furthermore able to attract more policyholders than less profitable insurers, thereby increasing their insurance sales. This is because policyholders are reluctant to purchase insurance from insurers who perform poorly (Harrington and Niehaus, 1999); high profitability provides a positive signal regarding a company's financial position (Zou, 2010). Last, profitable firms have more resources to counter risk and relatively lower probability of insolvency. Consistent with these arguments, Zou (2010) finds that profitable firms are better able to increase their debt financing than unprofitable firms. Taken these theories and arguments together, the effect of profitability on leverage still remains to be clarified.

3.6 Effects of leverage on profitability

Leverage can influence insurance companies' profitability in several ways. Jensen's (1986) *free cash flow hypothesis* contends that high financial leverage can bind managers to their promise to pay out future available cash; the agency cost of free cash flow is also thereby mitigated by "reducing the cash flow available for spending at the discretion of the manager". Adams and Buckle (2003) fur ther suggest that high leverage motivates managers to useavailable cash flow to fulfill the firm's investment and underwriting obligations in order to avoid bankruptcy and loss of human capital; in other words, ensuring a certain level of profitability is maintained. The *free cash flow hypothesis* also suggests that higher leverage can force managers to manage resources more efficiently, resulting in a better performance (Adams, 1996a)

However, the enhanced agency problem between owners and creditors that is brought on by a high debt ratio may deplete the firm's investment performance (Serrasqueiro and Macas Nunes, 2008). Based on the possibility that insurers that are highly leveraged may wish to invest in profitable but high-risk projects, creditors have to attach more restrictive conditions to the granting of credit, which contributes to diminished performance. Jensen and Meckling (1976) also contend that debt claims occasionally limit management's ability to makeoptimal decisions regarding certain issues and opportunities. The above argument suggests that increasing leverage may reduce the profitability of insurance firms.

Leverage is an important proxy for insolvency risk and ratings. Insurers whose ratings are reduced are likely to find their policies selling at lower prices than policies of well-rated insurers (Berger, Cummins, and Tennyson, 1992; Doherty and Tinic, 1981). Harrington and Niehaus (1999) also state that policyholders are generally not willing to pay as high of a price for policies from insurers that are not as likely to fulfill their promise. Based on the above it can be posited that because a highly leveraged in surer will tend to be less solvent, they will likely find their policies selling at lower prices, which will result in lower profitability.

4. METHODOLOGY AND FRAMEWORK

4.1 Methodology

As put forth in our hypotheses, we suggest that the causalities between (1) reinsurance and leverage, (2) reinsurance and profitability, and (3) leverage and profitability are not just one way, as most extant studies present. For instance, for a syndicate in Lloyd's, its leverage can be affected by its reinsurance purchasing behavior, while its decision to purchase reinsurance may at the same time depend on its degree of leverage. We therefore hypothesize that there are two-way or simultaneous relationships between (1) reinsurance and leverage, (2) reinsurance and profitability, and (3) leverage and profitability. In order to test the hypotheses, the relationships between these factors are modeled by a three-equation simultaneous equation model and estimated by a two stage least squares (2SLS) regression.

The three-equation simultaneous equation model's structure is constructed as follows:

$$REIN_{i,t} = f_1(LEV_{i,t}, PROF_{i,t}, CV_{i,t\text{-}1}) + e_{i,t} \quad (1)$$

$$LEV_{i,t} = f_2(REIN_{i,t}, PROF_{i,t}, CV_{i,t\text{-}1}) + e_{i,t} \quad (2)$$

$$PROF_{i,t} = f_3(LEV_{i,t}, REIN_{i,t}, CV_{i,t\text{-}1}) + e_{i,t} \quad (3)$$

where *REIN* represents the reinsurance premiums ceded to gross premiums written for syndicate *i* in year *t*; *LEV* is the leverage of syndicate *i* in year *t*, measured as the ratio of total liabilities to total assets; and *PROF* represents the profitability of syndicate *i* in year *t*, measured by the annual reported return on revenue of the syndicate. There are three sets of control variables, CV_1, CV_2, and CV_3, that are predicted to have an influence on the dependent variables based on previous related studies. We assume all of the control variables are

predetermined and thus treat them as exogenous variables in the model. To control for the problem of potential endogeneity, all of the control variables are lagged for one period.

4.2 Data

The data is collected from Standard & Poor's *Classic Direct*. The financial characteristic data of Lloyd's syndicates are collected for the period 2004-2009, and includes each syndicate's yearly based balance sheet, income statement, ratio report, and business lines. The financial reports are filed in accordance with the Generally Accepted Accounting Principles (GAAP), which is generally known as the Accounting Standards. Our sample includes 80 syndicates. Since not all of the syndicates exist from the year of 2004, the final sample includes only 398 yearly observations. Table 1 presents the number of observations and the real number of syndicates in Lloyd's market for each year. Notwithstanding some missing information, our data, on average, represents 91 percent of the total syndicates in Lloyd's market during the period 2004 through 2009.

Table 1: Number of syndicates

	2004	2005	2006	2007	2008	2009
Number of syndicates in the market	68	64	66	72	81	85
Number of syndicatesin the data set	52	60	64	72	80	70
Representation of sample	76%	93%	96%	100%	98%	82%
Total representation of sample	91%					

4.3 Dependent variables

Reinsurance. In this study, we measure reinsurance purchases as the ratio of reinsurance premiums ceded to total business premiums. Total business premiums is defined as direct premiums written plus reinsurance assumed (Adams, 1996b; Garven and Tennant, 2003; Mayers and Smith, 1990).

Leverage. Following Adams *et al*. (2008), we use the ratio of total liabilities to total assets as the definition of leverage.

Profitability. For an insurance firm, underwriting income and investment income together make up total annual income. We define profitability by return on revenue. The return on revenue is measured as annual pretax income over annual revenue.

4.4 Control variables

Prior research (e.g., Adams et al., 2008; Titman and Wessels, 1988; Adams and Buckle, 2003) indicates that there are other factors that can affect insurers' reinsurance purchasing behavior, capital structure, and profitability. We include these factors as control variables in the simultaneous equation model. The control variables in each equation are defined as follows.

Control variables in the reinsurance equation

Firm Size. Previous research (e.g., Adams, Hardwick and Zou, 2008; Cole and McCullough, 2006) predicts that small insurers are likely to purchase more reinsurance. Warner (1977) finds that the bankruptcy costs do not appear to be directly proportional to firm size because there are substantial fixed costs associated with the bankruptcy process, and thus large firms experience economies of scale with respect to bankruptcy costs. Therefore, based on the *expected bankruptcy cost hypothesis*, smaller firms would need to purchase more reinsurance than larger firms. Mayers and Smith (1990) and Adams (1996b) also suggest that real services provided by reinsurers are more valuable to small firms than large firms, and thus small insurers tend to reinsure more. We measure firm size by the natural logarithm of total market value of assets.

Reinsurer. Most of the syndicates in Lloyd's market directly underwrite insurance premiums. There are some syndicates, however, that work asreinsurers, whose premiums are composed mostly from underwriting reinsurance premiums. For reinsurers, the underwriting risks are more uncertain in terms of their timing, magnitude, and probability of loss than for primary insurers. Therefore, reinsurers are expected to have a higher underwriting risk. We expect reinsurers to purchase more reinsurance than primary insurers. Following Cole and McCullough (2006) and Shiu (2011), we define syndicates whose reinsurance business is greater than 75 percent of their total business written as rein surers. Rein surer is a dummy variable labeled 1 for a rein surer syndicate, and zero otherwise.

Ownership. In Lloyd's, some syndicates' capital is wholly owned by corporate members while others are supported by both individual and corporate members. Mayers and Smith (1990) suggest that the less diversified the owners' portfolios, the greater the demand for reinsurance. Thus, we expect that syndicates wholly owned by corporate members tend to

purchase less reinsurance because they can better diversify their portfolios than individual members. Ownership style is a dummy variable that is labeled 1 for syndicates owned by both individual and corporate members, and zero otherwise.

Control variables in the leverage equation

Underwriting risk. Leverage is predicted to be inversely related to business risk (Bradley, Jarrell, and Kim, 1984; Faulkender and Petersen, 2006). Bradley *et al*. (1984) argue that firms with higher volatility have a higher probability of bankruptcy. Risk-reverse managers of such firms would thereby tend to avoid an excessive debt ratio. Following Adams, Hardwick, and Zou (2008), underwriting risk, is measured by the coefficient of variation of annual loss ratio.

Liquidity. Jensen's (1986) *free cash flow hypothesis* predicts that firms with high liquidity should increase their debt to prevent managers from wasting cash; a high debt ratio can put pressure on managers to manage cash flow more appropriately. However, the hypothesis that liquidity has a positive effect on debt ratio is not supported by some previous studies (e.g., Titman and Wessels, 1988).Liquidity is measured as annual amount of current assets divided by current liabilities.

Growth opportunity. Several prior articles suggest that leverage is inversely related to growth opportunity. This is because firms with more growth opportunities are prone to invest in risky projects and thus increase their agency problem between debt-holders and shareholders (e.g., Mazur, 2007; Myers, 1977; Titman and Wessels, 1988). However, a number of other authors (e.g., Titman and Wessels, 1988), find growth opportunity to be positively correlated with leverage. We apply the average growth rate of total assets as the proxy to measure growth opportunity in this study.

Control variables in the profitability equation

Firm size. Some arguments suggest that larger firms can outperform smaller ones. First, larger companies can achieve operating cost efficiencies through economies of scale (Hardwick, 1997; Ma and Elango, 2008). Second, larger insurance companies can more effectively diversify their assumed risk than smaller ones (Adams and Buckle, 2003). Third, large insurers can respond more quickly to market conditions than small insurers due to their superior resources (Adams, 1996a). As in the reinsurance equation, we measure firm size by

the natural logarithm of total market value of assets.

Degree of business concentration. Syndicates can effectively hedge against risk and achieve increased economies of scale and of scope by diversifying their business (Mayers and Smith, 1990, p. 38). Furthermore, as rein surers generally provide insurers with special knowledge, insurers who issue policies in multiple lines of business benefit more from said services as the breadth of knowledge received increases (Mayers and Smith, 1990). For the reasons above, insurers with a lower business concentration can perform better than insurers with a higher business concentration. Most previous studies (e.g., Adams, 1996b; Choi and Elyasiani, 2011) use the *Herfindahl* concentration index as a measurement of business concentration. The *Herfindahl* concentration index is computed as follows:

$$H = \sum_{j=1}^{n} S_j^2$$

Where *j* is the line of business, and S_j is equal to PI/TPI, where PI is the amount of premiums from a particular line of business and TPI is the total value of premiums for all lines of business. The more concentrated a syndicate's line of business is, the closer to one its *Herfindahl* index becomes.

Reinsurer. Previous studies include the type of insurer, i.e., direct insurer vs. reinsurer, as a determinant of companies' profitability. Adams and Buckle (2003) suggest that reinsurers have better financial performance than direct insurers because of their lower cost of regulatory compliance and ability to realize profit from diversification. Reinsurer is represented by a dummy variable assigned a value of 1 for reinsurer, as defined above, and zero otherwise.

Growth opportunity. Boose (1993) suggests that increased growth opportunities can lead to poorer profitability. This is because firms that are facing a higher growth ratet end to make conservative investments to offset the risk inherent in rapid growth. As in the leverage equation, growth opportunity is proxied by applying the average growth rate of total assets. The definitions for the dependent and explanatory variables used in the analysis are presented in Table 2.

Table 2: Variable description

Variable	Definition	Source
Endogenous variables		
Reinsurance	The ratio of reinsurance premiums ceded to direct business written plus reinsurance assumed.	Shiu (2010)
Profitability	Net income divided by revenue (return on revenue).	
Leverage	Total liabilities divided by total assets.	Adamset al. (2008); Serrasqueiro and Nunes (2007)
Explanatory variables		
Liquidity	Current assets divided by current liabilities.	Cummins and Song (2008, p.17)
Growth opportunity	Annually growth rate of total assets.	Titman and Wessels (1988)
Firmsize	The natural logarithm of the total book value of assets.	Cole and McCullough (2006)
Underwriting risk	The coefficient of variation of loss ratio.	Adams (1996)
Business concentration	The *Herfindahl* concentration index forline(s) of business.	Adams (1996); Choi and Elyasiani (2011)
Reinsurer	1 for a reinsurer; 0 for a direct insurer. Syndicates whose reinsurance business is greater than 75 percentof total business are classified as reinsurers.	Adams and Buckle (2003)
Ownership	1 for syndicates owned by both individual and corporate members; 0 for syndicates wholly owned by corporate members.	

5. EMPIRICAL RESULTS

5.1 Descriptive statistics

Table 3 presents descriptive statistics for the variables used in the analysis. The sample period is from 2004 to 2009. The sample includes 398 observations. Syndicate reinsurance has a mean of 0.19, which is lower than the typically reported mean of 0.27 in U.S. non-life insurance companies. The mean of return on revenue is about 0.1 and the standard deviation is 0.34. The average leverage ratio is 0.96, where the maximum is 1.89; this implies some syndicates have more liabilities than assets. About 80% of our sample syndicates are wholly owned by company members (i.e., there are no individual members participating in these syndicates). In addition, about 9% of the sample syndicates act like reinsurers, as their reinsurance business accounts for more than 75% of their total business.

Table 3: Descriptive statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Reinsurance	0.194	0.127	0.000	0.90
Leverage	0.963	0.161	0.262	1.889
Profitability	0.098	0.336	-3.575	1.268
Liquidity	0.853	0.326	0.000	2.435
Growth opportunity	0.017	0.052	-0.394	0.369
Firm size	12.163	1.616	6.357	18.172
Underwriting risk	0.226	0.293	0.006	2.164
Business concentration	0.515	0.256	0.067	1.000
Ownership	0.206	0.405	0.000	1.000
Reinsurer	0.090	0.288	0.000	1.000

Table 4 presents the Pearson correlation coefficient matrix for the variables. The correlations between the three endogenous variables, i.e., reinsurance, leverage, and profitability, are all statistically significant. Reinsurance is negatively and significantly correlated with profitability at the 0.05 level. Leverage is also negatively correlated with profitability, implying that both reinsurance and leverage can decrease a syndicate's profitability. Consistent with Shiu (2011), the correlation between reinsurance and leverage is positive and statistically significant.

5.2 Multivariate results

Reinsurance equation results

We first examine the results for the reinsurance equation. As shown in Table 5, profitability has a negative influence on reinsurance and is statistically significant at the 0.05level. This finding is consistent with our hypothesis that profitable syndicates tend to reinsure less, and supports the *expected bankruptcy hypothesis* that predicts profitable insurers demand less reinsurance because they have a lower likelihood of bankruptcy. Profitable insurers also have more resources to counter financial risks, thus their dependence on reinsurance is lower than for unprofitable insurers. This result is in line with several prior studies (e.g., Adams *et al*., 2008; Kader et al., 2010).

Table 4:

	Reinsurance	Profitability	Leverage	Liquidity	Growth opportunity	Firm size	Underwriting risk	Business concentration	Ownership	Reinsurer
Reinsurance	1.000	-0.240**	0.139*	0.083	-0.016	0.128*	0.236**	-0.074	-0.171**	-0.128*
Profitability		1.000	-0.448**	0.076	-0.036	0.251**	-0.233**	-0.038	-0.048	0.006
Leverage			1.000	-0.251**	-0.003	-0.114*	-0.010	-0.027	0.074	-0.094
Liquidity				1.000	-0.114*	0.250**	0.107	-0.022	0.058	-0.146**
Growth opportunity					1.000	-0.355**	0.016	0.015	0.022	-0.010
Firm size						1.000	-0.290**	-0.452**	-0.036	-0.171**
Underwriting risk							1.000	0.236**	-0.173**	0.181**
Business concentration								1.000	-0.077	0.404**
Ownership									1.000	-0.107
Reinsurer										1.000

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 5: Reinsurance equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		-0.721*	0.397	-1.819	0.070
Profitability	−	-0.523**	0.219	-2.390	0.017
Leverage	+	0.246	0.358	0.686	0.493
Firm size	−	0.062***	0.021	2.892	0.004
Ownership	+	-0.071	0.039	-1.808	0.172
Reinsurer	+	-0.090	0.060	-1.517	0.130
Adjusted *R*-squared	0.045				
F-value	3.952				
p-value	0.002				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Leverage is found to have a positive influence on reinsurance; however, it is not significant. The result does not support the *risk bearing hypothesis* that states syndicates that are highly leveraged tend to reinsure more than syndicates that are less leveraged. This is likely because the central guarantee funds provides syndicates with a certain level of security, thereby increasing their willingness to bear risk as they can borrow capital from the central funds when they cannot meet their liabilities to pay policyholders. The importance of reinsurance for highly levered syndicates is therefore reduced.

Regarding the control variables, company size has a significantly positive effect. This result is in contrast with our expectations, and suggests that large syndicates tend to reinsure more. No statistically significant relation could be found for ownership style, i.e., reinsurers vs. direct insurers, however. This suggests that in Lloyd's, neither syndicates owned by both individual and corporate membern or reinsurers purchase more reinsurance than those wholly owned by corporate members or direct insurers, respectively.

Leverage equation results

Table 6 presents the results for the leverage regression. Reinsurance has a significant and positive impact on leverage at the 0.01 level. This result is in line with our expectation that syndicates with higher reinsurance are better able to increase their leverage. It also supports the *renting capital hypothesis* that purchasing reinsurance is analogous to renting capital from reinsurers, allowing insurers to underwrite more new policies.

Table 6: Leverage equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		1.048***	0.035	29.713	0.000
Reinsurance	+	0.350***	0.135	2.588	0.010
Profitability	+/−	-0.194***	0.074	-2.628	0.009
Underwriting risk	−	-0.029	0.054	-0.540	0.590
Liquidity	+/−	-0.135***	0.032	-4.257	0.000
Growth opportunity	−	-0.234	0.203	-1.156	0.249
Adjusted *R*-squared	0.080				
F-value	6.467				
p-value	0.000				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

The coefficient for profitability is negative and is statistically significant at the 0.01 level, suggesting that syndicates with higher levels of profitability tend to have lower levels of leverage. The result supports *pecking order theory,* which predicts that when firms are more profitable, they tend to retain earnings and thus increase their capital and reduce their leverage. This finding is in line with several financial articles that investigate firms' capital structures (e.g., Hovakimian, Opler, and Titman, 2001; Mazur, 2007; Titman and Wessels, 1988).

In terms of the control variables, liquidity has a negative and statistically significant effect on leverage. This is in line with Mazur (2007) who suggests that firms with higher liquidity tend to choose to be less leveraged. This is because firms lacking internal funds tend to seek more external capital financing than firms with adequate internal funds. Finally, the estimated coefficients of company size and rein surer are not statistically significant.

Profitability equation results

Table 7 presents the results for the profitability equation. The reinsurance variable has a negative and statistically significant impact on profitability at the 0.05 level. The result indicates that, despite the benefits it brings to insurers (i.e., more stable underwriting results, lower expected cost of financial distress, efficient real services provided by reinsurers, and mitigation of the under investment problem), reinsurance still reduces the profitability of insurers. This is likely because insurers have to share their profits with reinsurers, which decreases their potential underwriting profits.

Table 7: Profitability equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		0.312	0.475	0.657	0.512
Reinsurance	+/—	-1.358**	0.522	-2.600	0.010
Leverage	+/—	-0.760**	0.374	-2.034	0.043
Firmsize	+	0.062***	0.015	4.017	0.000
Business concentration	—	0.061	0.081	0.755	0.451
Reinsurer	+	-0.058	0.070	-0.826	0.410
Growth opportunity	—	0.023	0.032	0.763	0.406
Adjusted *R*-squared	0.102				
F-value	8.204				
p-value	0.000				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

The coefficient for leverageis also negative and statistically significantat the 0.05 level, suggesting that increasing leverage reduces the profitability of syndicates. This is consistent with the findings of Berger et al. (1992) and Doherty and Tinic (1981) that leverage can reduce an insurer's solvency ability, which leads to a decrease in the price policyholders are willing to pay. This lower price decreases the potential profitability of highly levered syndicates. The resultfurther supports the argument that an enhanced agency problem between owners and creditors may deplete the firm's investment performance.

As expected, the coefficient for company size is also statistically significantly positive, suggesting large insurers are more profitable than small insurers. However, product concentration, growth opportunity, and reinsurer do not have statistically significant effects on profitability.

The results above show that the two-way relationships between (1) leverage and profitability, (2) leverage and reinsurance, and (3) profitability and reinsurance are partly supported. First, our findings indicate that profitability and leverage are jointly determined. Insurers with higher profitability tend to choose to operate with a lower level of leverage and highly levered insurers are expected to be less profitable. This supports *pecking order theory,* which states that profitable firms tend to accumulate earnings as their first line of capital resources. The negative impact of leverage on profitability suggests that, for syndicates, the cost of leverage is higher than its benefits.

The two-way relationship between profitability and reinsurance is also supported. The impact of profitability on reinsurance and the impact of reinsurance on profitability are both

negative and statistically significant. As expected, syndicates with higher profitability demand less reinsurance than syndicates who are less profitable, suggesting profitable syndicates have more resources available and are better at bearing risk. Reinsurance is inversely related to profitability, implying that reinsurance dependence can reduce a syndicate's profitability. The results suggest that, for a Lloyd's syndicate, the advantages of reinsurance have less of an impact on profitability than its disadvantages.

Last, regarding the relationship between leverage and reinsurance, we find that reinsurance has a positive effect on leverage, but that leverage does not have a significantly positive effect on reinsurance. These results are not consistent with the findings of Shiu (2011). This unexpected result is likely due to how the guarantee of central funds reduces the syndicates' dependence on reinsurance.

5.3 Robustness check

Extreme values

In order to avoid the undesirable influence of extreme values, we exclude the outliers from our regression. Following Shiu (2011), we exclude the observations that are less than the 0.5^{th} percentile and larger than the 99.5^{th} percentile. The results are presented in Tables 8, 9, and 10. They show that excluding outliers does not have much of an impact on our results. Our findings for the relationships between these three factors remain the same.

Table 8: Analysis of outliers: Reinsurance equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		0.143*	0.225	0.637	0.524
Profitability	−	-0.396**	0.150	-2.636	0.008
Leverage	+	-0.233	0.227	-0.983	0.326
Firmsize	−	0.026***	0.007	3.560	0.000
Ownership	+	-0.059***	0.019	-3.057	0.002
Reinsurer	+	-0.040	0.029	-1.600	0.116
Adjusted *R*-squared	0.06				
F-value	5.139				
p-value	0.002				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 9: Analysis of outliers: Leverage equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		1.015***	0.050	20.078	0.000
Reinsurance	+	0.520*	0.313	1.670	0.096
Profitability	+/—	-0.485***	0.157	-3.087	0.002
Reinsurer	+	0.520*	0.313	1.670	0.096
Liquidity	+/—	-0.090***	0.032	-2.931	0.003
Growth opportunity	+	-0.063	0.075	-0.836	0.404
Underwriting risk	—	-0.096	0.054	-1.298	0.192
Adjusted *R*-squared	0.072				
F-value	5.946				
p-value	0.000				

Note: ***,** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels,respectively.

Table 10: Analysis of outliers: Profitability equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		0.479	0.420	1.140	0.255
Reinsurance	+/—	-0.906**	0.444	-2.042	0.042
Leverage	+/—	-0.880***	0.328	-2.667	0.007
Firmsize	+	0.050***	0.013	3.786	0.000
Business concentration	—	0.072	0.070	1.027	0.305
Reinsurer	+	-0.067	0.061	-1.099	0.272
Growth opportunity	—	0.033	0.038	0.903	0.409
Adjusted *R*-squared	0.108				
F-value	8.720				
p-value	0.000				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Prior studies (e.g., Shiu, 2011) on the insurance industry suggest that the decision of leverage and reinsurance may tend to be sticky, i.e., insurers are likely to have a long-run reinsurance dependence and leverage level and gradually adjust each to the target. Furthermore, profitability one period prior may influence current profitability. Therefore, we include one-period lag of reinsurance purchasing, leverage, and profitability in the regressions as control variables. For instance, in the reinsurance equation, the lagged value of reinsurance appears as an explanatory variable on the right-hand side of the equation. Tables 11, 12, and 13 present the results of the model as it includes the one-period lag endogenous

variables. For the reinsurance equation, the coefficient of lagged reinsurance is not significant, implying that purchasing reinsurance in the previous year does not have an impact on the current year; profitability remains a significant influence on reinsurance purchases. When the one-period lagged leverage is included in the leverage equation, reinsurance and profitability are still significant at the 0.1 and 0.01 levels, respectively. However, the coefficient of lagged leverage is not significant, suggesting no correlation between syndicates' current and prior leverage levels. In the profitability equation, the results show that leverage and reinsurance still have a significantly negative impact on profitability, while the lagged profitability does not have a significant influence. The findings above indicate that in Lloyd's market, reinsurance, leverage, and profitability one year back have no in fluence on the current year.

Table 11: Dynamic model: Reinsurance equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		0.144*	0.225	0.640	0.523
Reinsurance $_{t-1}$		0.000	0.001	0.006	0.946
Profitability	—	-0.396***	0.150	-2.642	0.009
Leverage	+	-0.233	0.225	-0.989	0.323
Firmsize	—	0.026***	0.007	3.545	0.001
Ownership	+	-0.057***	0.019	-3.051	0.002
Reinsurer	+	-0.046	0.029	-1.584	0.114
Adjusted *R*-squared	0.058				
F-value	4.272				
p-value	0.000				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 12: Dynamicmodel: Leverage equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		1.013***	0.056	18.047	0.000
Leverage $_{t-1}$		0.002	0.021	18.047	0.918
Reinsurance	+	0.517*	0.310	1.667	0.097
Profitability	+/—	-0.482***	0.156	-3.094	0.002
Liquidity	+/—	-0.094***	0.032	-2.938	0.003
Growth opportunity	+	-0.063	0.075	-0.837	0.404
Underwriting risk	—	-0.094	0.074	-1.292	0.197
Adjusted *R*-squared	0.071				
F-value	5.010				
p-value	0.000				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Table 13: Dynamic Model: Profitability equation results

	Predicted sign	Coefficient	Standard error	*t*-value	*p*-value
Intercept		0.464	0.419	1.109	0.268
Profitability $_{t-1}$		-0.001	0.007	-0.114	0.903
Reinsurance	+/—	-0.912**	0.444	-2.053	0.040
Leverage	+/—	-0.868***	0.328	-2.656	0.083
Firmsize	+	0.051***	0.013	3.976	0.000
Business concentration	—	0.073	0.071	1.032	0.303
Reinsurer	+	-0.067	0.061	-1.085	0.278
Growth opportunity	—	0.029	0.038	0.753	0.306
Adjusted *R*-squared	0.106				
F-value	7.250				
p-value	0.000				

Note: ***, ** and * represent statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

6. CONCLUSION

This paper provides an empirical analysis of the two-way relationships between (1) reinsurance and leverage, (2) leverage and profitability, and (3) profitability and reinsurance. We use the reported financial data of Lloyd's syndicates for the period of 2004 to 2009 and apply athree-equation simultaneous equation model.

The empirical evidence supports the two-way relations between profitability and leverage. Consistent with *pecking order theory*, more profitable syndicates tend to choose a lower level of leverage. Firms prefer to use retained earnings as financing over external capital (i.e., insurance premiums). As such, profitable firms have less dependence on external capital and tend to maintain leverage at a lower level. In terms of reverse causality, we find that leverage has a negative effect on syndicates' profitability. Our findings support the argument that leverage can deplete a firm's investment and operating performance. Joined together, our study suggests that leverage negatively in fluences a firm's profitability and profitability negatively influencesits level of leverage.

The hypotheses of causality and reverse causality between reinsurance and profitability also receive empirical support. Consistent with the *expected bankruptcy cost hypothesis*, our evidence shows that highly profitable syndicates have a lower dependence on reinsurance

than less profitable syndicates, suggesting that profitable syndicates are exposed to less expected bankruptcy costs and thus demand less reinsurance. Furthermore, reinsurance is inversely related to profitability, indicating that syndicates with higher reinsurance dependence are expected to be less profitable. This evidence implies that the negative impact of reinsurance on a Lloyd's syndicate tend to be greater than the positive impact.

The two-way relationship between leverage and reinsurance is only partly supported. Our findings show that, in Lloyd's market, syndicates with higher reinsurance tend to have a higher leverage level. This is in line with the *renting capital hypothesis,* which predicts that insurers with higher reinsurance tend to increase their leverage. As purchasing reinsurance is analogous to renting capital from reinsurers, it can increase insurers' off-balance-sheet capital and thus allows insurers to underwrite more new policies. However, the prediction that highly leveraged syndicates tend to reinsure more does not receive support. Considering Lloyd's unique capital structure, the Chain of Security, syndicates may not need as large an amount of reinsurance as they increase their leverage level. This is likely because the security from the central guarantee funds can increase the syndicates' willingness to bear risk: in cases where syndicates cannot meet the liabilities of policy holders, they can borrow capital from the central funds. The importance of reinsurance for highly levered syndicates is therefore reduced. Taken together, the findings indicate that reinsurance positively affects leverage, but the reverse causality is not supported.

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