Peer-reviewed and Open access journal
ISSN: 1804-5006 | www.academicpublishingplatforms.com
The primary version of the journal is the on-line version

BEH - Business and Economic Horizons
Volume 14 | Issue 4 | 2018 | pp.829-850
DOI: http://dx.doi.org/10.15208/beh.2018.57

The analysis of capital structure for property-liability insurers: A quantile regression approach

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Abstract: By using a two-stage quantile regression approach (2SQR), this study demonstrates how the insurer's leverage is determined across various quantiles. The evidence shows that the influence of the business concentration and marketing channel at the lower leverage quantiles is opposite to that at the higher leverage quantiles, which proposes that the mean effects of the two-stage ordinary least squares method are insufficient to capture the effects of business strategies on the insurer's capital structure determination. Moreover, the 2SQR evidence also shows that the magnitude of the impacts for some determinations varies among the different leverage quantiles. In sum, the evidence suggests that these two competing approaches should be viewed as complementary functions when discussing the insurer's capital structure.

JEL Classifications: G22, G32, G33

Keywords: Capital structure, leverage, two-stage quantile regression, two-stage least squares regression
Citation: Hung, Jessica., & Chang, Vincent Y. L. (2018). The analysis of capital structure for property-liability insurers: a quantile regression approach. *Business and Economic Horizons, 14*(4), 829-850. http://dx.doi.org/10.15208/beh.2018.57

1. Introduction

Capital structure decisions are a critical issue in the corporate finance regime. Previous studies have proposed that many firm-specific characteristics play an important role in the firm's leverage determination (e.g., Titman & Wessels, 1988; Cummins & Sommer, 1996; Baranoff & Sager, 2002; Gropp & Heider, 2010; Shiu, 2011; Chang & Jeng, 2016). Additionally, the literature has provided a number of distinct and conflicting hypotheses, such as the static tradeoff theory, the pecking-order theory, and the marketing time argument to explain the firm's capital structure decision (e.g., Shyam-Sunder & Myers, 1999; Baker & Wurgler, 2002, Fama & French, 2002; Frank & Goyal, 2003; Welch, 2004; Huang & Ritter, 2009). Even though the literature has provided much insightful evidence on the determinants of corporate capital structures, most of the analyses have adopted regressions based on the familiar ordinary least squares regression (OLS) or a two-stage least squares regression (2SLS) to capture the mean effects of the covariates of the independent variables on the dependent variable. These approaches are highly effective for understanding the central tendency within a dataset, but they are less useful for assessing the behavior close to the upper or lower extremes within a population.

For the financial industry (e.g., banking and insurance industry), it should be noted that the regulations are stricter and that the firms' leverage levels are always higher than those in the non-financial industry. The bankruptcy cost theory suggests that a high leverage usually infers a high probability of bankruptcy. Thus, the monitoring intensity from the regulatory bodies is relatively high in order to take the necessary precautions against the insolvency problem, as well as to force firms to behave more conservatively. In addition, stricter regulations enforce more constraints on the firm's investment portfolio, business strategy, capital requirements, and risk taking behavior. Thus, the firm's capital structure is naturally influenced by these firm-specific characteristics.

It is worth noting that firms with a higher leverage tend to confront greater financial pressures, bankruptcy costs, as well as debt-overhang problems (the issue of raising capital). Additionally, firms with a lower leverage encounter such disadvantages as fewer tax shields and profits, as well as lower agency costs for debtors. Thus, it is predicted that the incentive effects and risk behavior related to investment portfolios, business strategies, capital requirements, and risk taking for firms with a higher leverage differ from firms with a lower leverage. In accordance with this rationale, this study proposes that it is important to analyze the determinants of leverage for firms in the lower and higher quantiles, and especially for firms with a higher leverage. It so happens that the quantile regression (QR; Koenker & Bassett, 1978) method is a good paradigm to employ when analyzing the determinants of leverage for insurers in the lower and higher leverage quantiles.

Instead of the average effects of the covariates on leverage, this study applies the QR approach to explore the potentially differential effects across the insurer's leverage distribution. The QR approach represents an extension of the conventional OLS or 2SLS methods. As well, it provides more insightful information and explores the potential differential effects across the firm's leverage distribution. Previous studies (e.g., Shiu, 2011; Chang, 2015; Chang & Jeng, 2016) propose that the insurer's reinsurance demand and liquidity may endogenously correlate with its leverage decision. Therefore, the two-stage quantile regression (2SQR) method is introduced to correct the endogeneity bias that may arise from the dependence between the explanatory variables and the unobserved error terms (Amemiya 1982; Chen & Portnoy 1996; Kim & Muller 2004; Powell 1983).

There is evidence in the literature that the determinants of capital structure are non-linear across various leverage quantiles for the non-financial industry (Fattouh, Harris, & Scaramozzino, 2005; Fattouh, Scaramozzino, & Harris, 2008; Sanchez-Vidal, 2014; Margaritis & Psillaki, 2007, 2010). Lai & Shui (2009) discuss the relationship between capital and risk in Taiwan's banking industry. They propose that the 2SLS approach fails to capture the incentive effects of undercapitalized banks, but the 2SQR approach shows evidence that the investment incentives for lower-capitalized banks differ from higher-capitalized banks. Overall, the previous literature suggests that the incentive effects and risk behavior of firms with higher leverages are indeed distinct from those with lower leverages. Therefore, to distinguish the different incentive effects and risk behavior across various leverage quantiles, this study intends to reexamine the determinants of the insurer's capital structure by using a 2SQR approach.

An unbalanced panel data from 2006 to 2010 for the U.S. property liability insurers was collected to examine the determinants of leverage in the lower and higher quantiles. The results of the 2SQR method show that the estimated coefficients for some explanatory variables (e.g., business concentration index and marketing channel) have a different sign for the lower and higher quantiles. However, the 2SLS results suggest that the business concentration index, on average, does not affect the insurer's capital structure. In addition, the magnitude of some firm-specific characteristics is significantly different across various leverage quantiles, even when consistent results are presented. The evidence indicates that the incentive effects and risk behavior related to investment portfolios, business strategies, capital requirements, and risk taking for firms with a higher leverage differ from firms with a lower leverage. Therefore, traditional empirical analysis (OLS or 2SLS) may insufficiently describe the determinants of the insurer's leverage. It should be noted that these two competing approaches can be viewed as complementary when analyzing the insurer's capital structure as a whole.

This study contributes to the literature in several ways. First, it complements the literature gap in terms of analyzing the determinants of the U.S. property liability insurer's leverage for an insurer included within a particular quantile of the overall distribution when using the 2SQR approach. In addition, the evidence shows that the impact of firm-specific characteristics shows distinct signs (or magnitudes) and varies within different leverage quantiles. The results prove that incentive effects and risk behavior related to investment portfolios, business strategies, capital requirements, and risk taking for firms with a higher leverage differ from firms with a lower leverage. Indeed, these results differ from the previous literature (e.g., Cummins & Sommer, 1996; Baranoff & Sager, 2002; Shiu, 2011; Chang & Jeng, 2016). Second, the findings suggest that the traditional analysis may insufficiently describe the determinants of the insurer's leverage. Further, the 2SQR approach may provide more insightful information across the firm's leverage distribution. We conclude that simultaneously evaluating the insurer's capital structure in terms of both the 2SLS and 2SQR approaches is critical, especially in the case of insurers with higher leverages.

The remainder of this study is organized as follows. Section 2 discusses the main hypotheses. Section 3 describes the variables and their influence on firm leverage. Section 4 introduces the methodology. The data, empirical results, and robustness checks are reported in Section 5, while Section 6 concludes.

2. Hypothesis development

The literature has provided much insightful evidence on the determinants of the insurer's capital structure in terms of the familiar OLS or 2SLS approaches rather than the 2SQR approach. Thus, this study proposes that it is critical to analyze the determinants of the insurer's leverage in the lower and higher quantiles. We can also expect that all explanatory variables for the traditional 2SLS approach may differ from the 2SQR approach. For example, the renting capital hypothesis proposes that insurers with a higher level of reinsurance choose higher debt ratios because reinsurance serves as a substitute for equity capital, which can increase an insurer's surplus (Adiel, 1996; Chen, Hamwi, & Hudson, 2001; Shiu, 2011; Chang & Jeng, 2016). Nevertheless, the impact of reinsurance demand on leverage may differ between insurers in the lower and higher leverage quantiles. Since the positive marginal effect of leverage on financial pressure or bankruptcy risk is likely to increase in the higher leverage quantiles, the effect of reinsurance on leverage is likely to increase as the level of leverage increases. An insurer with a high level of leverage will need "more" reinsurance to mitigate its financial pressure or bankruptcy risk at a target level. In contrast, the opposite argument is proposed regarding the lower leverage quantiles. An insurer with a lower level of leverage will need "less" reinsurance to satisfy its target level of financial pressure or bankruptcy risk because the positive marginal effect of leverage on financial pressure or bankruptcy risk is likely to be lower for insurers with lower leverage.

Additionally, the complementary hypothesis indicates that higher liquidity insurers tend to increase their leverage (Chang & Jeng, 2016). Panno (2003) discusses the effect of liquidity upon leverage and proposes that firms with a higher liquidity may support a higher debt ratio because they can meet their short-term obligations in a timely manner. Moreover, the financial pressure and monitoring hypotheses predict that financial pressure increases the need for precautionary liquidity. Firms tend to maintain higher liquidity in order to convince policyholders or regulators that their operations are stable (de Haan, 1997; Ees et al., 1998; Opler et al., 1999; Faulkender, 2002). However, it is also predicted that the impact of liquidity on leverage in the lower quantiles is distinct from that in the higher quantiles. Similarly, following the above argument, since the positive marginal effect of leverage on financial pressure or bankruptcy risk is likely to increase in the higher leverage quantiles, the effect of liquidity on leverage is likely to decrease in the higher quantiles. Thus, for each increment of liquidity, an insurer with a high level of leverage will need "more" liquidity to sustain its target level of financial pressure or bankruptcy risk. On the contrary, to maintain its target level of financial pressure or bankruptcy risk, an insurer with a low level of leverage will need "less" liquidity for each increment of liquidity in the lower leverage quantiles because insurers in the lower leverage quantiles encounter less financial pressures or bankruptcy risk.

Accordingly, based on a similar rationale of reinsurance demand and liquidity, as above, it is reasonable to predict that the impact of all other explanatory variables (e.g., firm size, business concentration, organizational form, profitability, and New York licensed, etc.) on the insurers' capital structure across the leverage distribution are also different. This further suggests that the incentive effects and risk behavior related to investment portfolios, business strategies, capital requirements, and risk taking for insurers with a higher leverage differ from insurers with a lower leverage. We believe that these results can be determined empirically. Therefore, this study sets out to test the following hypothesis:

Hypothesis 1: The impact of firm-specific characteristics on the insurer's capital structure determination is different for firms at the opposite ends of the leverage distribution.

Most of the traditional analyses of the insurer's leverage determinants employ the OLS/2SLS approach (e.g., Cummins & Sommer, 1996; Baranoff & Sager, 2002; Shiu, 2011; Chang & Jeng, 2016). Chang (2015) indicates that the OLS/2SLS approach relies on an a priori distributional assumption and he accepts a homogeneous influence on the dependent variable. This study suggests that the traditional OLS/2SLS approach always increases the estimation bias when the dependent variable is heterogeneous. Chang (2015) further indicates that the QR/2SQR approach allows us to examine the differential effects across the leverage distribution when a set of percentiles is modeled. This presents a more complete picture of the covariate effect so that we can assess the insurer's leverage across the distribution by identifying the determinants separately. Furthermore, the 2SQR approach is robust and less sensitive to the presence of outliers or skewed tails. In sum, similar to Chang (2015), we also propose that the 2SQR approach could effectively provide more insightful information than the 2SLS approach in determining the insurer's capital structure. We further hypothesize that:

Hypothesis 2: The 2SQR approach complements the 2SLS approach in terms of providing more insightful information in determining the insurer's capital structure.

3. Variable descriptions

3.1. Explained variable

How to measure the insurer's leverage is an important issue. We note that the regulatory strength of the financial industry is rigidly enforced. As well, the leverage level of financial institutions is always higher than that of non-financial institutions. The literature suggests that the business leverage, defined as the net premiums written divided by the surplus, is a suitable proxy measure of the insurer's leverage (e.g., Cole & McCullough, 2006; Wang et al., 2008; Shiu, 2011; Weiss & Cheng, 2012; Fier, McCullough & Carson, 2013; Chang, 2015; Chang & Jeng, 2016; Yanase & Limpaphayom, 2017). Thus, for a consistent comparison with the prior literature, this study adopts the business leverage (named Lev) to measure the insurer's leverage because it can depict the major financial pressures and/or business characteristics for an insurer as a whole.

3.2. Explanatory variables

Previous literature has concluded that reinsurance usage, liquidity, firm size, business and/or geographic concentrations, organizational form, group or single insurers, regulatory measures, product mix, profitability, and insolvency play an important role in determining an insurer's capital structure (Cummins & Sommer, 1996; Baranoff & Sager, 2002, 2003; Shiu, 2011; Weiss & Cheng, 2012; Chang & Jeng, 2016). Accordingly, we first explain the variables in the regression model and the expectations behind them.

3.2.1. Endogenous variables

The *renting capital hypothesis* proposes that insurers with a higher level of reinsurance choose higher debt ratios because reinsurance serves as a substitute for equity capital (i.e., complementary to leverage), which can increase an insurer's surplus (Adiel, 1996; Chen, Hamwi, & Hudson, 2001; Shiu, 2011; Weiss & Cheng, 2012; Chang & Jeng, 2016). Thus, reinsurance is expected to be positively related to the insurer's leverage. In this study, we use reinsurance ratio ($Reins$) as a proxy for the insurer's demand for reinsurance, which is defined as: affiliated reinsurance ceded + nonaffiliated reinsurance ceded/direct business written plus reinsurance assumed.

The literature suggests that debt could provide a ready source of financing so that firms can use debt as a substitute for liquidity maintenance (John, 1993; Kim, Mauer, & Sherman, 1998; Ferreira & Vilela, 2004; Kalcheva & Lins, 2007; Chang & Tsai, 2014; Chang & Jeng, 2016). Hence, it is predicted that the relationship between liquidity and leverage becomes negative. In contrast, alternative arguments (e.g., financial pressure and monitoring hypotheses) predict that financial pressure increases the need for precautionary liquidity to avoid the threat of bankruptcy (e.g., de Haan, 1997; Ees et al., 1998; Kim, Mauer, & Sherman, 1998; Opler et al., 1999; Faulkender, 2002; Bruinshoofd & Kool, 2002; Shiu, 2006; Chang & Jeng, 2016). To convince policyholders and/or regulators that firms are operating stably, it is expected that higher leveraged firms will maintain a higher liquidity. Taken together, the expectation between the insurer's leverage and liquidity is ambiguous. In this study, Liq is defined as the sum of cash plus invested assets divided by total assets.

3.2.2. Other explanatory variables

The operational property of commercial lines is expected to be more volatile than personal lines (Weiss & Cheng, 2012). Thus, a firm with a higher commercial lines ratio tends to maintain a higher level of capital (i.e., less leverage). Cummins & Nini (2002) and Fier, McCullough, & Carson (2013) indicate that the corporate purchasers not only have greater knowledge of an insurer's financial health, but they also have lower switching costs than the individual purchasers. Thus, to reduce the risk of commercial lines of credit, insurers write more business with commercial lines and they tend to maintain a lower level of leverage. In sum, the expected sign for the ratio of commercial lines is negative. The Com_line is defined as the premiums written for commercial lines of business divided by the net premiums written.

Cummins & Nini (2002) propose that long-tail lines of business also play a role and are a critical factor in determining an insurer's capital structure. Weiss & Cheng (2012) hypothesize that an insurer writing relatively more long-tail lines of business tends to have a lower capital level (i.e., a higher leverage) because the higher cost of holding capital could be generated from incentive conflicts between the manager and owner (i.e., agency costs of the manager). Overall, the prediction of long-tail lines of business is positive. The $Long - tail$ variable is defined as the total loss in reserves divided by the total losses incurred.

The literature suggests that the geographic and business concentration indices also influence the insurer's capital structure decision (Shiu, 2011; Weiss & Cheng, 2012; Fier, McCullough, & Carson, 2013; Chang & Jeng, 2016). Weiss & Cheng (2012) indicate that less-diversified insurers tend to require more relative capital (i.e., lower leverage) so that the expected sign for the degree of concentration is negative.* Nevertheless, Shiu (2011) and Fier, McCullough, & Carson (2013) indicate that the relationship between diversification and leverage is unclear. Given that less diversification is generally associated with higher risk, insurers who are less diversified may maintain a higher level of leverage. On the other hand, firms with less diversification may maintain lower levels of leverage to offset the higher risk associated with the lack of diversification. In this study, the Geo_H and Bus_H variables represent the insurer's geographic and business Herfindahl indices, respectively.†

Insurers with independent agency channels can bear higher levels of insolvency risk and underwriting portfolio risk than exclusive agency firms because independent agents have less insurer-specific human capital. Thus, independent agency insurers may tend to have lower capital ratios and higher portfolio risk levels than insurers with exclusive agents (Cummins & Sommer, 1996; Regan, 1997; Chang & Jeng, 2016). Thus, a positive sign for the independent agency system is expected. The $Agency$ variable equals 1, if the insurer is an independent agency, and zero otherwise.

Firm size is also a critical factor in determining the insurer's capital structure. Larger

* That is, decreases in product mix and geographic distribution are associated with increases in the Herfindahl index and less diversification.

† Geo_H is the geography Herfindahl index, which is defined as the sum of the squares of the ratio of the dollar amount of net premiums in state j to the total amount of net premiums across all states. Bus_H is the lines of business Herfindahl index, which is defined as sum of the squares of the ratio of the dollar amount of net premiums written in a particular line of insurance to the dollar amount of net premiums across all 26 lines of insurance.

insurers are expected to be more diversified and thus, they tend to require less capital to achieve a better spread of risk than smaller insurers (Cummins & Sommer, 1996; Frank & Goyal, 2009; Weiss & Cheng, 2012; Chang & Jeng, 2016). Additionally, Fier, McCullough, & Carson (2013) propose that the expected sign between firm size and leverage is mixed. They propose that larger insurers tend to have a larger pool of insureds than smaller insurers. On the one hand, the lower initial risk suggests that larger insurers may maintain lower leverage because they are inherently less risky. On the other hand, lower initial risk may encourage larger insurers to take on greater risk so that they tend to maintain higher leverages. In this study, $Size$ is defined as the natural logarithm of total assets.

The *raising capital hypothesis* and *risk diversification hypothesis* (*risk bearing* and/or *bankruptcy cost hypotheses)* propose that stock insurers tend to have higher leverages than mutual insurers because they are more flexible in raising capital and in risk diversification (Mayers & Smith, 1994; Harrington & Niehaus, 2002; Weiss & Cheng, 2012; Fier, McCullough, & Carson, 2013; Chang & Jeng, 2016). In contrast, the *agency cost hypothesis* indicates that stock insurers tend to sustain lower leverages than mutual insurers. Since mutual insurers tend to encounter less owner-policyholder incentive conflicts (i.e., policyholder benefits are less preyed by owners), the cost of capital holdings for mutual insurers is higher than that for stock insurers. To sum up, the relationship between organizational form and leverage is mixed. This study also includes an organizational form dummy ($Stock$) to control for the substantial differences between organizational forms, which equals 1 if it is a stock insurer and 0 if it is a mutual insurer.

Two variables are adopted to assess the influence of groups in determining the insurer's leverage: the single dummy ($Single$), which equals 1 if the insurer is non-affiliated and 0 if it is affiliated, and the intra-group Herfindahl index ($Intra\_gruop\_H$), which is based on the net premiums written. The *risk diversification* and *internal capital market hypotheses* predict an inverse sign for the $Single$ variable (Cummins & Sommer, 1996; Weiss & Cheng, 2012; Fier, McCullough & Carson, 2013; Chang & Jeng, 2016). In addition, Cummins & Sommer (1996) and Chang & Jeng (2016) indicate that the intra-group Herfindahl index is expected to be inversely related to capitalization and risk. Thus, the intra-group Herfindahl index is positively related to the insurer's leverage.

Prior studies suggest that insurers have incentives to create "window dressings" by manipulating reserve losses (Weiss, 1985; Petroni, 1992; Gaver & Paterson, 2004; Weiss & Cheng, 2012; Grace & Leverty, 2012; Fier, McCullough, & Carson, 2013; Chang & Jeng, 2016). This study uses $LnRBC$, which is defined as the natural logarithm of the risk-based capital ratio (RBC ratio), in order to control for the reserve-loss manipulation issue on the determinants of the insurer's capital structure. Accordingly, the expected sign of $LnRBC$ is negative.

Nationally operating insurers tend to maintain greater capital for catering to the policyholders' requirements (Mayers & Smith, 1988; Cummins & Sommer, 1996; Chang & Jeng, 2016). Hence, this study expects a negative coefficient for the $National$ dummy variable, which equals 1, if the insurer is licensed in over 16 states, and equals 0 for a regional firm. It should be noted that the regulatory environment and the system of solvency surveillance are more rigorous in the New York region than in the other U.S. regions. Thus, insurers operating in the New York region are required to have more capital (i.e., less leverage) to meet the regulatory requirements (Cummins & Sommer, 1996; Chang & Jeng, 2016). Consequently, the New York dummy ($New\,York$) is negatively related to leverage.

Growth opportunity is also expected to be related to the capital structure. The pecking-order theory predicts that firms prefer to use internal funds (retained earnings) to finance a new project if they have a profitable investment opportunity (Myers & Majluf, 1984). This argument implies that a higher premium growth rate is associated with a lower leverage. In contrast, since the premium earned is also treated as a liability for insurers, increasing the premium earned will result in greater liability, as well as a decreasing surplus. Thus, based on this argument, the expected sign is positive. Summing up, the expectation of the premium-earned growth rate is ambiguous (Weiss & Cheng, 2012; Fier, McCullough, & Carson, 2013; Chang & Jeng, 2016). This study uses the premium-earned growth rate ($Prem\_growth$) to proxy for the insurer's growth opportunity. In addition, the pecking-order theory proposes that profitable firms will maintain a lower leverage if internal funds (retained earnings) are available (Titman & Wessels, 1988; Frank & Goyal, 2009; Shiu, 2011; Chang & Jeng, 2016). On the contrary, arguments of lower expected bankruptcy costs, as well as tax shield benefits, indicate that profitable firms tend to maintain a high leverage. As a result, the expectation of the effect of profitability on the insurer's leverage is mixed. This study uses return on capital (ROC) as a proxy for the insurer's profitability. Finally, year dummies are also included for controlling the time-series heterogeneous effects.

4. Methodology

Prior studies frequently use regressions based on the familiar OLS approach to analyze the capital structure issue. This is highly effective for understanding the central tendency within a dataset. Nevertheless, if the distribution of respondents is incorrectly specified, the estimation procedure may produce a biased estimate. In addition, the OLS approach always increases the estimation bias if the impacts of the dependent variables are more complex (heterogeneity) than assumed in the functional form. Owing to the biased estimation issue and the less useful information from assessing the behavior of data points close to the upper or lower extremes within a population, this study uses the QR approach to overcome these weaknesses of the OLS approach.[*]

The QR approach can offer a complete picture of the covariate effect when a set of percentiles is modeled and it can capture the critical features of the database used. Therefore, it could represent an extension of the conventional OLS method and enhance an empirical analysis of the factor effectiveness applied to the insurer's leverage. Thus, it is expected that the QR analysis will provide more insightful information on the determinants of the insurer's leverage.

Even though the literature has provided plenty of evidence on the determinants of the corporate capital structure, some studies propose that it is critical to analyze the differences in different quantiles of the firm's leverage distribution. Fattouh, Harris, & Scaramozzino (2005) adopt a QR approach to explore the evolution and determinants of the Korean firms' capital structure. Their evidence indicates that the variables associated with asymmetric information costs are significantly different throughout the leverage distribution both in terms of sign and magnitude. They also conclude that the determinants of capital structure are non-linear across various leverage quantiles. Fattouh,

[*] The insurance industry is a highly regulated industry because the leverage level of insurers is always rather high. Thus, the leverage distribution shows a left skewness. Additionally, the QR analysis is better than the OLS analysis because it clearly captures the effects of the firm's specific characteristics on leverage in both the higher and lower leverage quantiles.

Scaramozzino, & Harris (2008) further find that the determinants of the UK firms' capital structure present a non-linearity pattern. They propose that the conditional QR approach yields more and new insights on the choice of the firms' capital structure for UK-listed firms. Consistent to their 2005 study, they find that the effects of the explanatory variables are distinct at different leverage quantiles and that the signs change from the lower to the higher leverage quantiles. By using the QR approach, Sanchez-Vidal (2014) focuses on an analysis of the determinants of the high-debt firms in Spain. To address the advantages of the QR approach, he finds that the cash flow significantly influences the leverage decision for those firms with debt-overhang problems.

The QR method also has been proposed to analyze the related issues that interact with the firm's capital structure. Margaritis & Psillaki (2007) apply the QR approach to discuss the relationship between the capital structure and firm efficiency for New Zealand firms. Their empirical results show that the reverse causality effect of efficiency on leverage is significant across various leverage quantiles. As well, firm size also presents a non-monotonic effect on leverage. In addition, Margaritis & Psillaki (2010) further discuss the relationship among capital structure, ownership structure, and firm performance by using a sample of French manufacturing firms and the QR approach. Specifically, more concentrated ownership is positively related to debt usage, whereas a lack of evidence suggests that ownership type has an effect on the leverage decision.

The QR method also has many applications in the insurance field: for example, Chou, Liu, & Hammitt (2003) - the households' precautionary savings issue; Born, Viscusi, & Carlton (1998) and Viscusi & Born (2005) - the liability reform-related issues; Centeno & Novo (2006) - the unemployment insurance issue; McCullough & Epermanis (2007) - expenditures on defense costs; Shi & Frees (2010) - insurance company expenses; Schaeck (2008) - the bank failure cost issue; Pitselis (2009) - the solvency ability issue; Chang & Tsai (2014) - the liquidity issue; and Chang (2015) - the demand for reinsurance issue. Even though the prior literature has provided much insightful evidence on the related insurance issues, to the best of our knowledge, no published work has ever directly discussed the determinants of the insurer's capital structure using the QR approach. To examine the different determinants of the insurer's capital structure across various leverage quantiles, the QR approach could provide an alternative viewpoint by assessing the insurer's capital structure at the tail ends of the distribution and identifying the determinants separately. Thus, to fill the research gap, this study intends to revisit the determinants of the insurer's capital structure using the QR approach.

Shiu (2011) proposes that the dual casualty relationship between the insurer's leverage and reinsurance demand exists for the UK non-life insurance industry. Chang & Jeng (2016) also conclude that the insurer's leverage, reinsurance demand, and liquidity might be jointly and simultaneously determined. In accordance with the rationale of these studies, this study postulates that the insurer's reinsurance demand and liquidity have an endogenous impact in determining a company's capital structure.[*] Accordingly, following

[*] This study further implements a Hausman endogeneity test to confirm whether or not the insurer's reinsurance demand and liquidity are endogenous with its leverage. Accordingly, the explanatory variables of the reinsurance demand equation are identified according to Mayers & Smith (1990), Garven & Lamm-Tennant (2003), Cole & McCullough (2006), Wang et al. (2008), Yanase & Limpaphayom (2015), Shiu (2011), Chang & Jeng (2016), and Chang (2015). These variables include liquidity, leverage, tax-exempt factor, business and geographic Herfindahl indices, profitability, loss development, firm size, single firm dummy, organizational form dummy, the proportion of the commercial lines business, the natural logarithm of the RBC ratio, the variation effects of direct premiums written in each line of business, and year dummies. The independent variables of the liquidity equation are obtained from the existing literature (e.g.,

the literature suggestions (e.g., Amemiya, 1982; Powell, 1983; Chen & Portnoy, 1996; Kim & Muller, 2004; Chang, 2015), this study implements the 2SQR approach to correct for the endogeneity bias in terms of replacing the endogenous regressors with the fitted values generated from the reduced-form regressions.*

Similar to the model specification of Chang (2015), the 2SQR estimation procedure in this study is introduced as follows. Consider a liner model described as:

$$Y_1 = \alpha_0 + Y_2\alpha_1 + Z_1\alpha_2 + \varepsilon_1, \tag{1}$$

$$Y_2 = \beta_0 + Z_2\beta_1 + \varepsilon_2, \tag{2}$$

where Y_1 is the dependent variable of interest, Y_2 is the endogenous regressors vector, Z_1 is the exogenous variables vector of Y_1, Z_2 is the exogenous variables vector of Y_2, ε_1 is the unobserved structural error term of Y_1, and ε_2 is the disturbance terms of Y_2. Let $Z = [1, Z_1, Z_2]'$ be a vector of all exogenous variables. The endogeneity of Y_2 is due to the dependence between ε_1 and ε_2, conditional on Z.

To correct for the endogeneity bias, the endogenous regressors are replaced by their fitted values from the reduced-form equations in the first stage.† The reduced-form equations are set as:

$$Y_2 = Z\xi + \nu, \tag{3}$$

From equation (3), the fitted values can be generated; i.e., $\hat{Y}_2 = Z\hat{\xi}$.

In the second stage, Y_2 in equation (1) is replaced by $\hat{Y}_2$. Then, the 2SQR estimator of $\hat{\alpha}(\tau)$ is the solution to the following minimization problem:

John, 1993; Kim, Mauer, & Sherman, 1998; Opler et al., 1999; Bruinshoofd & Kool, 2002; Shiu, 2006; Chang & Tsai, 2014; Chang & Jeng, 2016). These variables include reinsurance demand, leverage, business and geographic Herfindahl indices, two years loss development, firm size, stock dummy, single firm dummy, return spread, firm growth rate, cash flow volatility, reserves of liability and property lines, claims of liability and property lines, and year dummies. The F value of the Hausman's specification test is 254.9, which indicates that endogeneity influences exist for the insurer's reinsurance demand and liquidity on its leverage.

* Ignoring the dependence between the endogenous variables and the unobserved error terms will result in a biased estimation for the QR analysis. The QR estimation tends to have a larger MSE (mean square errors) when the degree of endogeneity is higher. Thus, this study uses the 2SQR approach to correct for the endogeneity bias.

† The instrument variables include all exogenous, controlled, and year dummy variables for the reinsurance demand, liquidity, and leverage equations.

$$\underset{\alpha \in R^K}{Min} \sum_{Y_1 \geq \alpha_0 + \hat{Y}_2\alpha_1 + Z_1\alpha_2} \tau \left| Y_1 - \alpha_0 - \hat{Y}_2\alpha_1 - Z_1\alpha_2 \right| + \sum_{Y_1 < \alpha_0 + \hat{Y}_2\alpha_1 + Z_1\alpha_2} (1-\tau) \left| Y_1 - \alpha_0 - \hat{Y}_2\alpha_1 - Z_1\alpha_2 \right| , \quad (4)$$

Chang (2015) proposes that it is critical to examine the distinct influences on the determinants for the insurer's leverage between the higher and lower quantiles. As a result, the equality test of the estimated parameters for each explanatory variable across various leverage quantiles is implemented. Moreover, to test whether the leverage distribution is normal and to test for data fitness, diagnostic tests of model fitness are also conducted.*

5. Data and empirical results

5.1. Data

The sample consists of all available U.S property liability insurers from the NAIC (National Association of Insurance Commissioners) annual data tapes for the period from 2006 to 2010, which originally comprised of 3,007 insurers. For the analysis, some sample criteria need to be satisfied. First of all, complete insurer data for each year need to be met. Thus, insurers with missing raw values were deleted. At this stage, 2,045 insurers remained. In addition, insurers with unreasonable (or illogical) values were also deleted† and, as a result, 1,872 insurers remained. Following the suggestion of previous studies (Cole & McCullough, 2006; Powell & Sommer, 2007; Shiu, 2011; Chang & Jeng, 2016; Chang, 2015), this study also excluded insurers that operated as professional reinsurers, who accounted for more than 75% of the total premiums written.‡ Thus, the final sample included 1,775 insurers and 5,621 firm-year observations. To control for the outlier issue, this study ensured that all of the variables were winsorized at the 1st and 99th percentiles to avoid the influence of extreme values; except for the dummy variables such as the stock, single, and national dummy variables.§

Summary statistics of all variables for the pooled time-series and cross-sectional data are shown in Table 1 (see the Appendix). The mean of Lev is about 1.7866, which ranges from a minimum of 0.0447 to a maximum of 12.4742 of the insurer's surplus. The mean value of the reinsurance ratio ($Reins$) is 39.09%, with a 29.4% standard deviation. The average liquidity measurement (Liq) is 82.83%,** which suggests that insurers seem to

* Similar to Chang (2015), this study implements the histogram of the standardized residuals and the quantile-quantile probability plots to examine the model fitness issue for τ = 0.1, 0.25, 0.5, 0.75, and 0.9. Overall, the test of the histogram of the standardized residuals indicates that the higher quantile regressions fit the data well, whereas the lower quantile regressions do not. Furthermore, the quantile-quantile probability plots imply that the data distribution seems to be skewed to the right.

† For instance, the reinsurance ratio <0 and >1, the leverage <0, and the geographic and business Herfindahl index >1 and/or <0.

‡ The reason is that reinsurance demand has an endogenous impact on the insurer's leverage determinations.

§ For the extreme-value robustness check, this study also deletes the values less than the 1st percentile and greater than the 99th percentile from the database, which comprise 4,365 firm-year observations. The results are quantitatively similar to the main findings.

** Following the previous literature (e.g., de Haan, 1997; Ees et al., 1998; Kim, Mauer, & Sherman, 1998; Opler et al., 1999; Faulkender, 2002; Bruinshoofd & Kool, 2002; Shiu, 2006; Chang & Jeng, 2016), liquidity in this study is defined as cash plus invested assets divided by total assets. In addition, the liquidity number in behave conservatively in order to mitigate the potential liquidity risk and financial pressure. In addition, Table 1 (Appendix) shows that approximately 67.8% of the observations are stock insurers. Moreover, 40.35% are single insurers. In addition, the mean of the return on capital is about 9.14%. Most insurers are fairly diversified across both lines of business and geographic locations. Finally, the proportion of the commercial lines of business is about 62.72% of the total net premiums written. To sum up, the numbers for all variables resemble those in the previous literature, which indicates that the sample used in this study represents an appropriate selection.*

5.2. Empirical results

This study proposes that the 2SQR approach provides more insightful information than the 2SLS approach in determining the insurer's capital structure. To compare the performance between the 2SLS and 2SQR methods, both results of these approaches are presented in Table 2 (see the Appendix). First of all, the coefficients for $Reins$ are significantly and positively related to the insurer's capital structure for both the 2SLS and higher quantiles of the 2SQR models (τ = 0.75 and 0.9). These results are consistent with the hypothesis of the *renting capital hypothesis*, which indicates that reinsurance serves as a substitute for equity capital (i.e., as a complement to leverage) (Adiel, 1996; Chen, Hamwi, & Hudson, 2001; Shiu, 2011; Weiss & Cheng, 2012; Chang & Jeng, 2015). Furthermore, both the 2SLS and 2SQR models also propose that ROC is positively related to the insurer's leverage, which supports the notion that profitable firms tend to maintain a higher leverage because of a lower expected bankruptcy and tax shield benefits. In addition, overall, the results of the $Stock$ dummy variable (for insurers located within both the lower and higher leverage quantiles) suggest that stock insurers tend to maintain a higher leverage level than mutual insurers because they are more flexible in raising capital and in risk diversification (Mayers & Smith, 1994; Harrington & Niehaus, 2002; Weiss & Cheng, 2012; Fier, McCullough & Carson, 2013; Chang & Jeng, 2016). All of these results from both the 2SLS and 2SQR models support the *raising capital hypothesis* and *risk diversification hypothesis* (the *risk bearing* and/or *bankruptcy cost hypotheses*).

In Table 2 (Appendix), the empirical results propose that the Liq, $Size$, Com_line, $LnRBC$ factors are significantly and negatively related to the insurer's leverage for both of the 2SLS and 2SQR models, which is consistent with expectations. The results for Liq consistently show that the substitute relationship between leverage and liquidity is strongly supported; not only in the lower leverage quantiles, but also in the higher ones. This further contradicts the argument of Panno (2003), in which firms intend to maintain a higher liquidity in order to meet short-term obligations in a timely manner. In addition, the evidence of firm size ($Size$) tends to support the argument of Fier, McCullough, & Carson (2013). They propose that larger insurers tend to have a larger pool of insureds than smaller insurers, so the lower initial risk of larger insurers may result in maintaining lower leverages because they are inherently less risky as a whole. Consistent with this

Table 1 is similar to the number in the NAIC Property & Casualty and Title Mid-Year Industry Analysis Report (http://www.naic.org/documents/topic_insurance_industry_snapshots_pc_report_2012.pdf). Thus, this proves that the mean of liquidity in this study is plausible. We thank the anonymous reviewer who made this suggestion.

* See, e.g., Mayers & Smith (1990), Garven & Lamm-Tennant (2003), Cole & McCullough (2006), Wang et al. (2008), Weiss & Cheng (2012), Fier, McCullough, & Carson (2013), Chang & Jeng (2016), and Chang (2015).

prediction, insurers write more business along commercial lines (Com_line) and they tend to maintain lower leverage levels because the commercial lines are expected to be more volatile and risky than the personal lines (Weiss & Cheng, 2012; Fier, McCullough, & Carson, 2013). Both the 2SLS and 2SQR models support the window-dressing issue. Higher RBC insurers have higher incentives to manipulate their loss reserves and, as a result, they could lower their leverages as a whole.

Some interesting results are also found in Table 2 (Appendix), such as the Bus_H and $Agency$ variables. The empirical results show that these two variables show an inverse sign or have dissimilar impacts (magnitude) between the lower and higher leverage quantiles. This suggests that the determination of the insurer's leverage at the lower end of the distribution from that at the higher end is different. Moreover, the results of the equality test support the fact that the estimated parameters are significantly distinct across the five quantiles (τ = 0.1, 0.25, 0.5, 0.75, and 0.9). Specifically, the coefficient for Bus_H is insignificantly negative when using the traditional 2SLS model. Nevertheless, given the insurers in the lower leverage quantiles (τ = 0.1, 0.25, and 0.5), business concentration is negatively related to the insurer's leverage. This indicates that the less-diversified insurers maintain lower levels of leverage to offset the higher risk associated with the lack of diversification. These results are consistent with the arguments of Weiss & Cheng (2012) and Fier, McCullough, & Carson (2013). Conversely, significantly positive coefficients are found for the insurers in the higher leverage quantiles (τ = 0.75 and 0.9). This suggests that the higher leveraged and less-diversified insurers intend to increase their leverage (the positive argument of Fier, McCullough, & Carson, 2013). A plausible explanation is that the less-diversified insurers with higher leverages are generally associated with higher risks and risk-transfer marginal costs. As a result, they may have incentives to increase the amount of business written (i.e., increasing leverage) and to increase profits in order to mitigate the costs of higher risk. In addition, it is reasonable to postulate that the less-diversified insurers with higher leverage may have a higher level of moral hazard, so that they intend to increase their leverage even if they encounter higher risks and risk-transfer marginal costs. Therefore, the less diversified insurers may increase their leverage as a whole when they are in a position of having a higher level of leverage.

Additionally, the $Agency$ coefficient in Table 2 is significantly negative in the traditional 2SLS model, which contradicts the literature predictions. Moreover, the empirical results of the 2SQR model also show a different impact between the lower and higher leverage quantiles. Given the insurers with a lower leverage (τ = 0.1), the empirical results are consistent with the positive expectation, which suggests that the insurers with independent agents tend to have a lower capital ratio (i.e., higher leverage). Firstly, insurers with independent agency systems can bear higher levels of insolvency risk and underwriting portfolio risk than insurers with exclusive agencies (Cummins & Sommer, 1996; Regan, 1997; Chang & Jeng, 2016). In addition, insurers with lower leverage tend to have a higher capacity for increasing their leverage (i.e., writing more business). Based on these two arguments, lower-leveraged insurers with independent agency systems tend to have higher incentives to increase their overall leverage. In contrast, given the insurers with a higher leverage (τ = 0.9), the $Agency$ variable is negatively related to the insurers' leverage, which contradicts the literature's expectation. On the one hand, insurers with independent agency systems can bear higher levels of insolvency risk and underwriting portfolio risk than insurers with exclusive agencies. Therefore, they possess a higher ability to write more business, which may generate higher business profits as well as increase their leverage. On the other hand, insolvency risk concerns will force the higher-leveraged insurers to decrease their underwriting leverage. It so happens that, if insurers are risk averse, it is expected that the reduction of insolvency risk is more valuable than the rise in business profits. Therefore, the higher-leveraged insurers with independent agency systems will tend to decrease their leverage as a whole. The reason is that the marginal cost of insolvency risks (insurers with a higher leverage) is greater than the marginal benefit of independent agency systems (a higher capacity to write more business).

In Table 2 (Appendix), the $Long\_tail$ and $National$ dummy variables show contradictory empirical results from expectations for both the 2SLS and 2SQR models. Cummins & Nini (2002) and Weiss & Cheng (2012) propose that an insurer who writes relatively more long-tail lines of business tends to have a lower capital level (i.e., a higher leverage). However, this argument does not support the analysis of the 2SLS and 2SQR models. The literature indicates that nationally operating insurers tend to maintain greater capital to cater for their policyholder requirements (Mayers & Smith, 1988; Cummins & Sommer, 1996; Chang & Jeng, 2016). Also, the results of the 2SLS model and higher quantiles of the 2SQR model contradict this prediction. This study postulates that nationally operating insurers tend to write more business (i.e., increase leverage) than non-nationally operating insurers, so that they naturally operate with a relatively higher leverage. Finally, although some variables such as geo_H, $Prem\_growth$, $Single$, $Intra\_g\_H$, and $Newyork$ provide very weak or insignificant empirical results, overall, the 2SQR model provides more information than the 2SLS model.

This study proposes that it is critical to analyze the determinants of the insurers' leverage across various quantiles. It is predicted that the influence of the insurers' leverage for each variable may present a different sign or magnitude in the lower and higher quantiles. In Table 2, the tests of equality for each variable across the five quantiles (τ = 0.1, 0.25, 0.5, 0.75, and 0.9) are implemented to examine whether or not the impact of each variable presents a different sign or magnitude in the lower and higher quantiles. The tests of equality for each variable indicate that the estimated coefficients are not constant across the five quantiles, except for the $Newyork$ and ROC variables. In addition, the evidence indicates that the influence of these variables shows dissimilar impacts (magnitude) between the lower and higher leverage quantiles. Specifically, the Liq, $Size$, Com_line, and $LnRBC$ variables show an increasing impact on leverage from the lower to the higher leverage quantiles,[*] whereas the $Reins$ and $Stock$ variables show a decreasing impact pattern, and the ROC variable has an inverted U-sharped influence. This study also finds that the signs of the Bus_H and $Agency$ variables are significantly different between the lower and higher reinsurance quantiles. Overall, these results are consistent with the argument of the nonlinear leverage determinants (Fattouh, Harris, & Scaramozzino, 2005; Fattouh, Scaramozzino, & Harris, 2008; Margaritis & Psillaki, 2007). Summing up, the test results indicate that ***Hypothesis 1***, which proposes that the impact of firm-specific characteristics on the insurer's capital structure determination is different for firms at opposite ends of the leverage distribution, is supported. Incentive effects and risk behaviors, such as investment portfolios, business strategies, capital requirements, and risk-taking behavior for insurers with a higher leverage differ from those insurers with a lower leverage.

It is expected that the 2SQR analysis could complement the 2SLS approach by

[*] For example, the absolute value of the coefficients in the lower quantiles is smaller than that in the higher quantiles. Thus, the total impact on leverage in the higher quantiles is greater than that in the lower quantiles.

highlighting the influence of firm-specific characteristics along the distribution of the insurer's leverage. As well, to make a performance comparison between the 2SLS and 2SQR approaches, this study presents the empirical results of both methods in Table 2 (Appendix). Based on the empirical results of this study, the evidence suggests that the 2SQR approach reveals distinct influences in terms of both sign and magnitude on the insurer's leverage across various leverage quantiles. For example, the Bus_H coefficient is insignificantly negative in the traditional 2SLS model. However, the signs for the insurers in the lower leverage quantiles (τ = 0.1, 0.25, and 0.5) and in the higher quantiles (τ = 0.75 and 0.9) are opposite to the extreme. This further proves that the 2SQR approach could provide insightful information more effectively than the 2SLS approach in determining the insurer's capital structure. In sum, consistent with Chang (2015), this study concludes that ***Hypothesis 2*** is strongly supported.

5.3. Robustness checks

Some robustness checks are implemented to complement the main findings of Table 2. First of all, an alternative estimation method, named the control function quantile regression (CFQR), is also implemented (Blundell & Powell, 2007; Lee, 2007; Imbens & Newey, 2009). Lee (2007) proposes that the CFQR approach can offer advantages for nonlinear models in terms of the endogenous variables and parameters. Furthermore, this approach is successful for not only the endogeneity issue, but also in terms of the assumptions about the stochastic relationship between the unobserved components and observed variables. The empirical results of the CFQR approach are presented in Table 3 (see the Appendix). Overall, most of the results are consistent with our main findings, except for the Geo_H variable. The evidence shows that Geo_H is significantly and negatively related to the insurer's leverage, which differs from the 2SQR approach. This implies that more geographically diversified insurers tend to require less relative capital (i.e., they have a higher leverage).

Second, for the extreme value issue, this study tries to exclude the values less than the 1st percentile and greater than the 99th percentile from the dataset, which ultimately comprises 4,365 firm-year observations.* The empirical results are shown in Table 4 (see the Appendix). Overall, the main results are also totally consistent with our main findings in Table 2.

6. Concluding remarks

The purpose of this study is to reexamine the determinants of the insurer's leverage that lie within a specific quantile of the overall leverage distribution, especially at the lower and higher quantiles. It is important to recognize the incentives and risk behavior of firms within the lower and higher leverage levels. Firms with higher leverage tend to confront higher financial pressures, bankruptcy costs, as well as debt-overhang problems (the raising capital issue), whereas fewer tax shields, lower profits, and less pressure on debtors (i.e., the agency cost of debtors) may emerge for firms with lower leverage. Therefore, we show that the incentive effects and risk behaviors for insurers with lower versus higher leverages are significantly different.

* This study excludes the values less than the 1st percentile and greater than the 99th percentile for each variable. Thus, overall, more than 2% of the data points are deleted.

The evidence of the 2SQR method shows that the estimated coefficients for some explanatory variables; for example, business concentration and the marketing channel, show inverse signs in the lower and higher leverage quantiles. And these results are decidedly different from previous findings (Weiss & Cheng, 2012; Shiu, 2011; Fier, McCullough, & Carson, 2013; Chang & Jeng, 2013, 2015). Additionally, although consistent results are reported for some firm-specific characteristics, the magnitude of these results is significantly different across the various leverage quantiles (i.e., showing a nonlinear pattern). Furthermore, the robustness checks show that our findings are absolutely consistent. Overall, the evidence of this study shows that policyholders, policymakers, and regulators may need to recognize that the incentive effects and the behavior of firms in the lower and higher leverage levels are unique. To sum up, the new findings propose that, indeed, the 2SQR analysis is more efficient and can provide more insightful information than the traditional 2SLS approach. It is critical to assess the insurer's leverage level by carefully integrating the empirical implications of both the 2SLS and 2SQR models, especially in the higher leverage quantiles.

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Appendix

TABLE 1. DESCRIPTION STATISTICS

VARIABLES	MINIMUM	MEAN	MEDIAN	MAXIMUM	STD DEV
Lev	0.0447	1.7866	1.1582	12.4742	2.0124
Reins	0.0000	0.3909	0.3463	0.9895	0.2940
Liq	0.2753	0.8283	0.8619	0.9923	0.1347
Size	14.5825	18.3259	18.2337	22.9624	1.8275
Stock	0.0000	0.6780	1.0000	1.0000	0.4673
Single	0.0000	0.4035	0.0000	1.0000	0.4906
Bus_H	0.1411	0.5781	0.5121	1.0000	0.3024
Geo_H	0.0420	0.5673	0.5248	1.0000	0.3853
National	0.0000	0.3334	0.0000	1.0000	0.4715
Intra_g_H	0.1988	0.6398	0.4903	1.0000	0.3131
Newyork	0.0000	0.3218	0.0000	1.0000	0.4672
Agency	0.0000	0.6113	1.0000	1.0000	0.4875
Com_line	0.0000	0.6272	0.8275	1.0000	0.3995
Long_tail	0.2171	4.4096	2.7352	41.2960	5.6917
ROC	-0.5755	0.0914	0.0953	0.5628	0.1584
LnRBC	0.2695	2.1929	2.1361	4.7193	0.7634
Prem_growth	-0.9336	0.0368	0.0093	1.5309	0.3115

OBSERVATIONS: 5,621.

Note: The dependent variable is Lev, which is defined as net premiums written/surplus. The independent variables include the following: $Reins$ is defined as (affiliated reinsurance ceded + nonaffiliated reinsurance ceded) / (net premium written plus reinsurance assumed); *Liq* is defined as the sum of cash plus invested assets divided by total assets; $Size$ is defined as the natural logarithm of total assets; the organizational form dummy is $Stock$, which equals 1 if the insurer is a stock and 0 if it is a mutual; the group dummy is $Single$, which equals 1 if the insurer is non-affiliated and 0 if it is affiliated; the Geo_H variable is the geographic Herfindahl index for insurers, which is defined as the sum of the squares of the ratio of the dollar amount of net premiums in state j to the total amount of net premiums across all states; on the other hand, the *Bus_H* variable is the line of business Herfindahl index for insurers, which is defined as the sum of the squares of the ratio of the dollar amount of net premiums written in a particular line of insurance to the dollar amount of net premiums across all 26 lines of insurance; the $National$ variable equals 1 if the insurer is licensed in over 16 states and equals 0 for a regional firm; the *Intra_gruop_H* is the intra group Herfindahl index based on net premiums written; the variable for the $New\ York$ dummy equals 1 if the insurer operates in New York State, otherwise it equals 0; the $Agency$ variable equals 1 if the insurer is an independent agency and it equals 0, otherwise; Com_lines represents the premiums of the commercial lines of business divided by the net premiums written; $Long\_tail$ is the total loss in reserves divided by the total losses incurred; ROC is the return of capital; $lnRBC$ is the natural logarithm of the RBC ratio; and finally, $Prem\_growth$ is the premium-earned growth rate. The sample consists of 5,621 firm-year observations and winsorizes at the 1st and 99th percentiles.

TABLE 2. EMPIRICAL RESULTS OF THE 2SQR APPROACH

Variables	Expected sign	2SLS		2SQR/ Quantiles (τ=0.1, 0.25, 0.5, 0.75, and 0.9)											
				0.1		0.25		0.5		0.75		0.9		Test of Equality	
Intercept		10.9054	***	3.6442	***	5.1807	***	7.1108	***	9.2506	***	16.7989	***		
Reins	+	1.2511	***	-0.1873		-0.1631		-0.0286		1.4042	***	1.7200	***	22.9159	***
Liq	+/-	-6.9089	***	-2.3653	***	-3.2395	***	-4.5533	***	-5.7223	***	-11.2728	***	56.2101	***
Size	+/-	-0.1276	***	-0.0273	***	-0.0448	***	-0.0587	***	-0.0895	***	-0.1572	***	20.6710	***
Stock	+/-	0.1525	**	-0.0048		0.0743	***	0.1608	***	0.2372	***	0.5461	***	60.2783	***
Single	-	0.2143		0.0392		-0.0025		0.1038		0.4053	***	0.3775		38.6587	***
Bus_H	+/-	-0.1289		-0.1741	***	-0.1941	***	-0.1916	***	0.1360	*	0.4305	**	22.0559	***
Geo_H	+/-	0.0820		0.0250		0.0073		0.0617		0.1692	**	0.0943		9.2957	*
National	-	0.2341	***	-0.0450		-0.0412		0.0423		0.2165	***	0.6793	***	17.1739	***
Intra_g_H	+	-0.2323		0.1335		0.1905		-0.0077		-0.4216	**	-0.6233		15.0034	***
Newyork	-	0.0972		0.0724	***	0.0580	**	0.0423		0.0031		-0.0436		1.3061	
Agency	+	-0.1772	***	0.0401	**	0.0206		-0.0046		-0.0136		-0.2768	**	10.2660	**
Com_line	-	-0.8044	***	-0.1927	***	-0.2944	***	-0.4366	***	-0.9573	***	-1.9998	***	84.5899	***
Long_tail	+	-0.0163	***	-0.0154	***	-0.0123	***	-0.0107	***	-0.0133	***	-0.0040		15.1773	***
ROC	+/-	0.9465	***	0.8337	***	0.8994	***	0.8726	***	0.9656	***	0.6925	**	2.2424	
LnRBC	-	-0.4873	***	-0.2339	***	-0.3216	***	-0.3746	***	-0.5004	***	-0.4473	***	67.0484	***
Prem_growth	+/-	0.1322		0.0345		0.1176	***	0.0811		0.2787	**	0.3059		13.5178	***

OBSERVATIONS: 5,621.

Note: This Table reports the results of both the 2SLS (column 3) and 2SQR approaches for quantiles τ = 0.1, 0.25, 0.5, 0.75, and 0.9 (columns 4 ~ 8). Column 2 shows the signs of the expectations for the firm-specific characteristics. Column 9 shows the test of coefficient equality for each variable across various quantiles. The sample consists of 5,621 firm-year observations and winsorizes at the 1st and 99th percentiles.
***, **, and * - represent statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 3. EMPIRICAL RESULTS OF THE CFQR APPROACH

Variables	Expected sign	2SLS		2SQR/ Quantiles (τ=0.1, 0.25, 0.5, 0.75, and 0.9)											
				0.1		0.25		0.5		0.75		0.9		Test of Equality	
Intercept		10.9054	***	3.4577	***	4.1632	***	6.1720	***	8.9853	***	12.4286	***		
Reins	+	1.2511	***	0.7488	***	1.0883	***	1.6638	***	2.9022	***	4.8485	***	622.433	***
Liq	+/-	-6.9089	***	-1.0175	***	-1.4470	***	-2.6922	***	-3.7303	***	-3.8625	***	183.307	***
Size	+/-	-0.1276	***	-0.0818	***	-0.0904	***	-0.1367	***	-0.2019	***	-0.3244	***	255.115	***
Stock	+/-	0.1525	**	0.0231		0.0866	***	0.1296	***	0.2847	***	0.4797	***	90.8359	***
Single	-	0.2143		-0.0130		0.0761		0.1084		0.3189	***	0.3822	**	18.7805	***
Bus_H	+/-	-0.1289		-0.1430	***	-0.1582	***	-0.1286	***	0.0490		0.4253	***	30.3223	***
Geo_H	+/-	0.0820		-0.0837	**	-0.0641	**	-0.0992	***	-0.3126	***	-0.4815	***	37.1631	***
National	-	0.2341	***	-0.0010		0.0851	***	0.1650	***	0.2007	***	0.2451	***	38.7586	***
Intra_g_H	+	-0.2323		-0.0189		-0.1604		-0.4479	***	-1.2832	***	-1.9380	***	118.308	***
Newyork	-	0.0972		0.0454	**	-0.0038		-0.0002		-0.0190		0.2121	***	19.4682	***
Agency	+	-0.1772	***	-0.0113		-0.0244		-0.0730	***	-0.1365	***	-0.1717	***	23.9829	***
Com_line	-	-0.8044	***	-0.3840	***	-0.4941	***	-0.7880	***	-1.1398	***	-1.3910	***	301.571	***
Long_tail	+	-0.0163	***	-0.0260	***	-0.0249	***	-0.0185	***	-0.0143	***	-0.0072	**	32.0216	***
ROC	+/-	0.9465	***	0.7764	***	0.6347	***	0.4073	***	0.2394	**	-0.1109		37.7096	***
LnRBC	-	-0.4873	***	-0.4213	***	-0.4864	***	-0.6488	***	-0.7739	***	-0.7514	***	382.049	***
Prem_growth	+/-	0.1322		0.0947	***	0.1648	***	0.2242	***	0.4874	***	0.4564	***	35.8858	***

OBSERVATIONS: 5,621.

Note: This Table reports the results of both the 2SLS (column 3) and CFQR approaches for quantiles τ = 0.1, 0.25, 0.5, 0.75, and 0.9 (columns 4 ~ 8). Column 2 shows the signs of the expectations for the firm-specific characteristics. Column 9 shows the test of coefficient equality for each variable across various quantiles. The sample consists of 5,621 firm-year observations and winsorizes at the 1st and 99th percentiles.
***, **, and * - represent statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 4. EMPIRICAL RESULTS OF CONTROLLING EXTREME VALUES

Variables	Expected sign	2SLS		2SQR/ Quantiles (τ=0.1, 0.25, 0.5, 0.75, and 0.9)											
				0.1		0.25		0.5		0.75		0.9		Test of Equality	
Intercept		8.4141	***	4.2104	***	5.2060	***	6.8433	***	8.4097	***	12.6339	***		
Reins	+	1.5669	***	-0.2311		-0.0302		0.1458		1.3474	***	2.1099	***	39.4821	***
Liq	+/-	-6.3125	***	-3.9804	***	-4.1317	***	-4.8690	***	-6.0596	***	-8.9630	***	22.1982	***
Size	+/-	-0.0479	**	0.0024		-0.0175	*	-0.0403	***	-0.0457	***	-0.0601	*	22.8024	***
Stock	+/-	0.1452	***	0.0472	**	0.0947	***	0.1522	***	0.2192	***	0.2640	***	23.2072	***
Single	-	0.1489		0.0087		-0.0765		0.0649		0.2405	**	0.2198		30.0033	***
Bus_H	+/-	-0.2607	***	-0.1783	***	-0.1996	***	-0.2262	***	0.0252		0.0633		15.0248	***
Geo_H	+/-	0.0917		0.0359		0.0342		0.0725	*	0.0855		0.1193		2.2275	
National	-	0.0689		-0.1032	***	-0.0844	***	0.0084		0.0995		0.3741	**	14.3119	***
Intra_g_H	+	0.0753		0.3984	***	0.4902	***	0.2010		-0.0699		-0.6482		16.3703	***
Newyork	-	-0.0283		0.0952	***	0.0433		0.0196		-0.0559		-0.0238		11.3369	**
Agency	+	-0.1357	***	0.0533	**	0.0451	**	0.0200		0.0217		-0.1572	*	12.7315	**
Com_line	-	-0.6200	***	-0.1325	***	-0.2261	***	-0.3475	***	-0.7448	***	-1.4520	***	93.6334	***
Long_tail	+	-0.0216	***	-0.0210	***	-0.0223	***	-0.0142	***	-0.0109	**	-0.0031		9.5361	**
ROC	+/-	1.0694	***	0.9637	***	1.0173	***	0.9481	***	0.9300	***	0.9290	***	0.9673	
LnRBC	-	-0.4338	***	-0.2040	***	-0.3333	***	-0.4014	***	-0.4656	***	-0.4389	***	94.0106	***
Prem_growth	+/-	0.1560	*	-0.0334		0.0526		0.1073		0.2059	*	0.3519	*	12.1367	**

OBSERVATIONS: 4,365

Note: This Table reports the results of both the 2SLS (column 3) and 2SQR approaches for quantiles τ = 0.1, 0.25, 0.5, 0.75, and 0.9 (columns 4 ~ 8). Column 2 shows the signs of the expectations for the firm-specific characteristics. Column 9 shows the test of coefficient equality for each variable across various quantiles. The sample consists of 4,365 firm-year observations and extreme values are deleted if the values are less than the 1st percentile and greater than the 99th percentile.
***, **, and * - represent statistical significance at the 1%, 5%, and 10% levels, respectively.