CEO Overconfidence or Private Information? Evidence from U.S. Property-Liability Insurance Companies

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ABSTRACT

This paper uses conventional measures of CEO overconfidence: option holdings-based and net stock purchase-based measures to examine the impact of CEOs who hold firm-specific risk on insurer's risk-taking and firm performance. We focus on the insurance industry because using reinsurance demand as a proxy for risk-taking provides a precise measurement of CEO's risk-taking. We find that the two CEO overconfidence measures are negatively associated with insurer's risk-taking and positively related to firm performance. Our findings suggest that it may not be CEO overconfidence, but rather the private information and the intention to control the company's risk that drive our results.

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1. Introduction

This paper examines the impact of CEOs who maintain high personal exposure to company-specific risk on insurer's risk-taking and firm performance in the U.S. property-liability insurance industry. Recently, a substantial body of literature on managerial overconfidence has focused attention on understanding important patterns of corporate decision-making that have not yet been fully explained by traditional finance theory (Skata, 2008). Existing empirical research has examined the important role of CEO overconfidence in a wide range of corporate decisions, such as risk taking (e.g., Sanders and Hambrick, 2007; Malmendier and Tate, 2008; Hirshleifer et al., 2012; Cain and McKeon, 2014). Specifically, the literature finds a positive relation between CEO overconfidence and risk-taking in non-financial industries. [1]

Despite growing research, the relationship between CEO overconfidence and firm performance relation remains ambiguous. CEO overconfidence may generate positive firm performance by leading risk-averse CEOs to take on sufficient risk (Goel and Thakor, 2008). On the other hand, CEO overconfidence can have a negative impact on firm performance due to value-destroying overinvestment (Malmendier and Tate, 2008).

Prior literature has noted that one of the biggest challenges to the empirical analysis of managerial overconfidence is constructing proxies for unobservable CEO overconfidence, since overconfidence is a biased belief that cannot be easily measured (Baker et al., 2007). Although previous studies have employed different proxies for managerial overconfidence, the most commonly used measures of CEO overconfidence are the option holdings-based and the net stock purchase-based measures developed by Malmendier and Tate (2005). These two conventional

[1] The implication of these results is that companies should focus more on assessing the impact of managerial overconfidence on risk-taking in order to mitigate managers' excessive risk-taking, and to steer managers toward optimal risk-taking (Goel and Thakor, 2008; Campbell et al., 2011; Hirshleifer et al., 2012).

overconfidence measures build upon the notion that overconfident CEOs are likely to maintain high levels of personal exposure to company-specific risk by delaying their option exercise and by purchasing more of their company's stock since they are too optimistic about the firm's prospects (Hirshleifer et al., 2012).

In spite of the wide use of these measures, there have been several alternative explanations for the two CEO overconfidence measures. CEO's late option exercise and additional stock purchase may be due to other factors, such as stock mispricing and growth opportunities (Cao, 2011) or inside information about the firm's future stock prices (Bouwman, 2014). Thus, these proxies do not necessarily measure CEO overconfidence.

In this study, we revisit the alternative explanations of these two conventional CEO overconfidence measures. We examine this issue by looking at the relationship between the two CEO overconfidence measures, risk-taking and firm performance in the U.S. property-liability insurance industry. We focus on the insurance industry because using reinsurance demand as a proxy for risk-taking enables us to directly observe CEO's risk-taking behavior in insurance companies.[2] Unlike the insurance industry, the risk-taking behavior of non-financial and banking industries cannot be measured directly. For example, the volatility of stock returns, which is a widely used measure of risk-taking in the prior literature, reflects more than just the risk-taking behavior of CEOs because stock returns reflect unexpected events and investors' perception of the company. Thus, by investigating how CEOs who hold high levels of company-specific risk make reinsurance decisions, we can clearly see whether CEO's late option exercise and buying more of their firm's stock are really due to CEO overconfidence or to other causes.

[2] Purchasing reinsurance is an important mechanism for insurers to limit their risk (Wang et al., 2008).

Our sample consists of 28 U.S. publicly traded property-liability insurance companies over the period 1996-2011.[3] Our findings can be summarized as follows. First, we find that the two proxies for CEO overconfidence are negatively related to insurer's risk-taking behavior, including total risk, underwriting risk, and leverage risk. More importantly, our evidence shows that the two CEO overconfidence measures are positively associated with insurer's reinsurance demand, implying that overconfident CEOs[4] may purchase more reinsurance to protect themselves against unexpected losses, which could harm their job security as well as their personal portfolio. Specifically, we find that overconfident CEOs purchase more reinsurance than non-overconfident CEOs by 9.9 percent and 8.2 percent for the option holdings-based and the net stock purchase-based measure, respectively. These results are different from those in previous studies (e.g., Banerjee et al., 2015) which find that firms with overconfident CEOs tend to display higher risk-taking behavior.

For performance measures, the two proxies for CEO overconfidence are consistently found to be positively related to Tobin's Q, return on assets (ROA), return on equity (ROE), and stock return. In addition, our evidence shows that CEOs classified as overconfident do earn positive abnormal stock returns and significantly increase their holdings of options and stock relative to non-overconfident CEOs.

In summary, our overall results show that overconfident CEOs tend to take lower risk (such as purchasing more reinsurance and taking lower underwriting risk) and achieve higher firm performance. These results are different from the traditional finance paradigm: high risk and high

[3] Due to the limited number of publicly traded property-liability insurance companies, our sample size is relatively small. The small sample size is common in the insurance literature studying publicly traded property-liability insurers (e.g., Eckles and Halek, 2010; Huang et al., 2011; Miller, 2011; Ma and Wang, 2014).

[4] Hereafter, for simplicity, we use the term "overconfident CEOs" to refer to CEOs who hold significant firm-specific risk, as measured by late option exercise and habitual stock purchases.

expected return. One possible explanation of these results is that CEOs delay their option exercise and buy additional shares of their firm's stock because they intend to benefit from future high stock prices by lowering their company's risk and improving firm performance. The results imply that private information that CEOs can exploit for their personal profit may motivate them to maintain high personal exposure to company-specific risk.

We also examine the impact of Sarbanes-Oxley Acts (SOX) and recent financial crisis on the relationship between two CEO overconfidence measures and insurer's risk-taking behavior. With respect to the effect of SOX on the relation between the two proxies for CEO overconfidence and insurer's risk-taking, we find mixed results. The results suggest that overconfident CEOs may reduce their firm's total risk through management of underwriting, investment, and leverage risks that determine an insurer's risk profile after SOX. We also find that the two CEO overconfidence measures are associated with lower risk-taking during the 2008-2009 financial crisis relative to the period before the crisis.

This study potentially contributes to the literature in several ways. First, we provide the first empirical evidence on the alternative explanations of two conventional CEO overconfidence measures by investigating the impact of CEOs who maintain high personal exposure to the firm-specific risk on risk-taking and firm performance in the insurance sector. Second, our study distinguishes itself from the previous literature by utilizing a direct measure of CEO's risk-taking behavior. Unlike the prior literature in the non-financial and banking industries, we examine how overconfident CEOs affect insurer's reinsurance, underwriting, investment, and leverage risk-taking decisions over which CEOs of insurance companies have total or partial control. Previous studies mainly use market-based risk-taking measures, such as systematic risk, unsystematic risk and stock return volatility (e.g., Niu, 2010; Suntheim and Sirini, 2012; Banerjee et al., 2015). While

these risk measures reflect some aspects of firms' risk-taking behavior, there are many other factors that impact these measures. For example, CEOs do not have total control over their firms' stock returns.

Third, since this study specifically focuses on the publicly traded property-liability insurance companies, we can efficiently control for a variety of potential omitted variables that may confound the interpretation of inter-industry studies**.** Fourth, this study explores the effects of major external shocks, such as SOX and financial crisis in 2008-2009 on managerial risk-taking. Thus, this paper helps enhance our understanding of how overconfident CEOs react to changes in the regulatory and economic environments.

Finally, our overall findings indicate that overconfident CEOs may control the overall risk of the firm through lower underwriting and leverage risk-taking and increased use of reinsurance, achieving higher firm performance. The result suggests that it may not be CEO overconfidence, but rather the private information about the firm's future stock prices and the intention to control the company's risk that drives our results. Therefore**,** we cast doubt on whether the two conventional measures of CEO overconfidence really proxy for CEO overconfidence in U.S. property-liability insurance companies.

The reminder of the paper is structured as follows. Section 2 provides an overview of the alternative explanations of our CEO overconfidence measures, and formulates our main hypotheses. The data, sample selection criteria, and empirical methodology are discussed in Section 3. Section 4 presents the empirical results, and Section 5 concludes with a summary of our main findings.

2. Background and Hypotheses Development

2.1. Alternative Explanations of CEO Overconfidence Measures

Over the last decade, managerial overconfidence has received much attention from scholars and practitioners alike, since this behavioral bias can have a pronounced influence on the firm (Hackbarth, 2008). CEO overconfidence is defined as the systematically upward biased beliefs of CEOs about the future returns to their investment projects or as the overestimation of the accuracy of their beliefs and underestimation of risks they are actually facing (Malmendier and Tate, 2005). The literature provides evidence that overconfident CEOs significantly affect corporate policies, including capital expenditures (Malmendier and Tate, 2005), mergers and acquisitions decisions (Malmendier and Tate, 2008), innovation (Hirshleifer et al., 2012), CEO turnover (Campbell et al., 2011), earnings management (Schrand and Zechman, 2012), dividend policy (Deshmukh et al., 2013), and corporate diversification (Andreou et al., 2016).

Although prior literature has employed different proxies for managerial overconfidence[5], the most commonly used measures for CEO overconfidence are the option holdings-based and the net stock purchase-based measures developed by Malmendier and Tate (2005). The main idea behind the two CEO overconfidence measures is based on CEOs' late option exercise and additional stock purchases in spite of their high personal exposure to the firm's idiosyncratic risk. Malmendier and Tate (2005) point out that rational CEOs are likely to exercise options early or minimize their holding of their company's stock to address the under-diversification problem, whereas overconfident CEOs who are too optimistic about the outcomes of their decisions tend to do exactly the opposite in order to benefit from the expected future gains. These two overconfidence

[5] Previous studies have used a variety of managerial overconfidence measures, such as the Longholder measure defined by the dummy variable that equals to one if the CEO ever held an option until the last year prior to expiration (Malmendier and Tate, 2005; Malmendier et al., 2011), manager's propensity to acquire companies (Doukas and Petzemas, 2007), manager's status as an entrepreneur (Barros and Sylveira, 2007), a press-based measure (Malmendier and Tate, 2008; Hirshleifer et al., 2012), an overconfidence score based on CEOs' prevalence in photographs in the annual report and their cash and non-cash pay relative to that of the second highest paid executive (Schrand and Zechman, 2012), a survey-based measure (Ben-David et al., 2013), and the fraction of a firm's voluntarily earnings forecasts that exceeds the ex post realized earnings (Otto, 2014).

measures have been widely used in many other studies (e.g., Campbell et al., 2011; Hirshleifer et al., 2012; Ahmed and Duellman, 2013; Banerjee et al., 2015; Hribar and Yang, 2015, Andreou et al., 2016; Ho et al., 2016).

Despite their widespread use, there have been several alternative explanations for the two CEO overconfidence measures. First, CEOs may choose to delay the exercise of their highly in-the-money options and to buy more of their company's stock because they have positive private information about future stock prices. If private information is the true reason for CEO's late option exercise or additional stock purchases instead of CEO overconfidence, the stock returns of firms with CEOs defined as overconfident using the two CEO overconfidence measures should be higher than the average stock market return.

Malmendier and Tate (2005, 2008) rule out the possibility of inside information by demonstrating that, on average, CEOs who are classified as overconfident using the option holdings-based measure do not earn abnormal returns relative to the S&P 500 index. However, Bouwman (2014) examines the possibility that CEOs may exercise options late not because of optimism but because of favorable private information by dividing CEOs who are defined as optimistic using the option holdings-based measure (*Holders 67*)[6] into those who made gains from exercising their options late and those who did not. He shows that 72.7 percent of *Holders 67* earned significantly positive abnormal returns relative to the S&P 500, suggesting that most of *Holders 67* may actually be rational CEOs with favorable inside information rather than optimistic CEOs.

Secondly, another reason why CEOs maintain high personal exposure to company-specific risk is to convey a costly signal to the capital market, indicating that their firms have better prospects

[6] For a more detailed explanation on the option holdings-based overconfidence measure (*Holder 67*), see Section 3.3.1.

than other firms, in an attempt to reduce information asymmetries between the firm and the market. Malmendier and Tate (2005) state that signaling should reduce information asymmetries, thereby removing investment-cash flows sensitivity of CEOs who hold their options. They argue that high investment-cash flow sensitivity of overconfident CEOs dispels the possibility that option holdings-based measure is a proxy for signaling motives.

Thirdly, CEOs may hold exercisable options too long because of their inertia or procrastination. Malmendier and Tate (2008) tease out the possibility of procrastination by showing that over 68 percent of CEOs under the Longholder overconfidence measure conduct other transactions on their personal portfolios in the two years before their longheld options expire. Fourth, one may argue that risk-tolerant CEOs prefer to delay the exercise of their options, and thus appear to be overconfident. Malmendier and Tate (2005) contend that since less risk-averse managers are likely to leverage up the firm, lower risk aversion should lead to lower investment-cash flow sensitivity, which is inconsistent with the high investment-cash flow sensitivity of CEOs who hold deep in-the-money options. Thus, they eliminate this alternative explanation.

Fifth, Cao (2011) documents that if firms are overvalued or have better growth opportunities, CEOs tend to postpone their option exercise because they concern about the market's negative reaction to CEO option exercise or want to profit from high growth potential. He argues that CEO's late option exercise, which is closely related to stock mispricing and growth opportunities, may not be the appropriate proxy for CEO overconfidence. Lastly, overconfidence is considered to be stable and persistent trait over time (Hirshleifer et al., 2012). Bayat et al. (2016) provide evidence against the notion by showing that when CEOs switch firms, they tend to change their option excise decisions. They find that firm characteristics, such as firm's growth potential, cash flow, cash holding, and leverage significantly affect CEOs' decisions to hold or exercise their options,

thus questioning the validity of option holdings-based overconfidence measure. In summary, the above arguments and empirical findings cast some doubts on the argument that the two commonly used CEO overconfidence measures in the literature are good proxies for actual overconfidence.

2.2. CEO Overconfidence and Risk Taking

A firm's risk-taking behavior has aroused considerable interest from academics and policy makers because it concerns the financial interests of various corporate stakeholders (Zou et al., 2012). Managerial risk-taking is fundamental to corporate decision-making and has crucial implications for firm performance and survival (Boubakri et al., 2013). Financial scandals resulting from accounting fraud and earnings management in such large players as Enron, WorldCom and Adelphia illuminate the detrimental results of excessive risk-taking by top executives.

Risk taking has been a main concern for the insurance sector where the protection of policyholders is always paramount among insurer's priorities. In addition, excessive risk taking or a substantial loss variability caused by the environmental challenges, such as major natural disasters, may lead to a high likelihood of insurer insolvency (Ho et al., 2013). Since property-liability insurers are mainly in the business of taking risk, we are interested in how overconfident CEOs affect insurer's risk-taking behavior in the property-liability insurance industry.[7]

The literature shows that overconfident managers who expose themselves to a substantial degree of risk (Kahneman and Lovallo, 1993) tend to overestimate the precision of exogenous noisy signals (Gervais et al., 2011), underestimate the riskiness of future cash flows (Hackbarth, 2008), and, therefore, undertake projects that are too risky (Malmendier and Tate, 2005).

[7] We primarily focus on the CEO because CEO as an ultimate decision maker in his/her company is supposed to have some discretion on the firm's risk-taking decisions (Suntheim and Sironi, 2012).

Previous studies find that CEO overconfidence defined using the option holdings-based or the net stock purchase-based measure is positively related to firm's risk-taking in non-financial and banking firms.[8] Hirshleifer et al. (2010) find that firms with overconfident CEOs tend to show higher stock return volatility. Cain and McKeon (2014) show that CEO overconfidence is positively associated with corporate risk taking. Niu (2010) reports that banks managed by overconfident CEOs tend to take greater risk. Suntheim and Sironi (2012) provide evidence that CEO overconfidence results in higher risk-taking and higher levels of fragility in the banking industry. Based on previous literature, we hypothesize that the two proxies of CEO overconfidence are positively related to risk-taking in the property-liability insurance industry.

However, it is also possible for CEO's late option exercise and additional stock purchases to be negatively associated with insurer's risk-taking behavior. CEOs whose personal wealth and human capital are closely tied to their companies tend to be more risk-averse and to avoid risky investment in order to preserve their own personal portfolio (Smith and Stulz, 1985). Jensen et al. (2004) state that CEOs who are highly exposed to firm-specific risk may want to reduce the riskiness of their firms by underinvesting in risky projects and overinvesting in risk-reducing activities. Lewellen (2006) notes that CEOs with in-the-money options tend to take on less risk because in-the-money options make their portfolio more sensitive to stock price volatility, thus causing CEOs who hold undiversified portfolio to be more risk-averse. Also, high investment risk-taking can lead to a more volatile surplus and underwriting capacity, which may weaken the insurers' ability to pay claims and may be detrimental to their survival (Zou et al., 2012).

[8] Other risk-taking related literature includes Malmendier and Tate (2008), which demonstrates that overconfident CEOs are more prone to engage in riskier projects, such as value-destroying M&A activities, and Kim et al. (2015), which shows that firms with overconfident CEOs have higher stock price crash risk than firms with non-overconfident CEOs.

Thus, it is argued that CEOs who hold significant company-specific risk may reduce the company risk by adopting less risky underwriting policies, investing more in low risk projects, and choosing a lower level of leverage to protect their personal wealth. In light of above competing views, we suggest the following null hypothesis.

Hypothesis 1.1: The two proxies for CEO overconfidence are not related to risk-taking in property-liability insurance companies. [9]

Reinsurance has been widely used as an effective risk management and hedging tool against unexpected catastrophic losses in the property-liability insurance industry (Cummins and Weiss, 2000). As the insurance of insurers, reinsurance enables insurers to transfer risks among each other, enhancing the financial soundness of insurance companies. Thus, insurance companies optimally combine the use of capital and reinsurance to manage their risk (Yan and Hong, 2014). In addition, reinsurance companies play an important role in monitoring the primary insurers' behavior, thereby mitigating insurer's excessive risk-taking.

While reinsurance has the advantage of improving insurer's financial stability and reducing insolvency risk, it can also have a negative impact on firm performance because of the substantial cost of reinsurance. [10] Since both risk-taking and firm performance are important to managerial decision-making, CEOs need to make reinsurance decisions carefully.

The relationship between CEO overconfidence measures and insurer's reinsurance demand is unclear. Alsubaie (2009) points out that overconfident CEOs underestimate risk, and therefore they may engage in less hedging behavior than non-overconfident CEOs. In line with this argument,

[9] Since the arguments for the different risk measures are similar, we generally use the term "risk-taking" to denote four different risk-taking measures: total risk, underwriting risk, investment risk, and leverage risk, in our hypothesis development.

[10] Cummins et al. (2008) examine the effect of reinsurance purchase on the costs and the underwriting risk of 554 U.S. property-liability insurers from 1995 to 2003. They find that the average quantity of reinsurance purchased from non-affiliated reinsurers is about $124 million/year, representing about 21 percent of total written premiums.

we predict that if overconfident CEOs who systematically overestimate the returns to their investment projects focus more on firm performance than on the riskiness of their firms, then they would prefer not to hedge risks by using reinsurance, and thus choose to purchase less reinsurance. In this case, the two proxies for CEO overconfidence would be negatively related to insurer's reinsurance demand.

On the other hand, CEOs who hold high levels of company-specific risk may reduce the riskiness of their firms by increasing the usage of reinsurance in order to protect themselves from unexpected losses that could be harmful to their job security as well as to their personal wealth. Thus, the relationship between the two proxies for CEO overconfidence and insurer's reinsurance demand cannot be determined. These competing hypotheses lead to the following null hypothesis.

Hypothesis 1.2: The two proxies for CEO overconfidence are not related to reinsurance demand in property-liability insurance companies.

2.3. Effect of SOX on Relation between CEO Overconfidence and Risk Taking

The Sarbanes-Oxley Act (SOX) was enacted in 2002 in response to a series of high profile corporate and accounting scandals. Since the enactment, SOX has dramatically changed the accounting profession and has affected all publicly traded companies in the U. S. The main purpose of SOX is to restrict managerial excesses, increase transparency, and improve corporate governance and ethical behavior by exposing CEOs to more personal liability (Banerjee et al., 2015). Akhigbe et al. (2009) find that increased transparency and better disclosure after the introduction of SOX have reduced opacity in the insurance industry.

However, despite extensive research, there is little agreement on the impact of SOX on CEO's risk-taking behavior. Proponents of SOX argue that the stringent regulations on corporate governance, such as more independent boards, independent audit committees and mandated

disclosure may cause firms to engage in less risk-taking behavior. Cohen et al. (2007) note that increased legal and political exposure after SOX have resulted in a substantial decrease in the incentives of CEOs to invest in risky projects. Banerjee et al. (2015) demonstrate that after the passage of SOX, overconfident CEOs tend to reduce the level of risk exposure considerably. These arguments and empirical findings indicate that SOX may be effective in controlling CEO's high risk-taking behavior when CEOs are overconfident.

In contrast, opponents of SOX assert that SOX may not have a mitigating effect on managerial risk-taking. John et al. (2008) find that improved investor protection is positively related to higher managerial risk-taking. They point out that managers whose personal wealth is more closely tied to their firms have incentives to reduce firm-specific risk to protect their private benefits extracted from the corporation, but better investor protection can mitigate such behavior, resulting in higher corporate risk taking. Kim and Lu (2011) suggest that strong external governance holds CEOs accountable for firm performance by dampening the risk-reducing effect of CEO ownership. If that is the case, CEOs who hold under-diversified personal portfolio by delaying their option exercise and buying more of their company's stock are expected to take on more risk after the enactment of SOX. Given the forgoing contradictory views, we suggest a null hypothesis about the effect of SOX on the relationship between two proxies for CEO overconfidence and risk-taking.

Hypothesis 2: CEOs who maintain high personal exposure to company risk do not change their risk-taking behavior after the enactment of the Sarbanes-Oxley Act (SOX).

2.4. Effect of Financial Crisis on Relation between CEO Overconfidence and Risk Taking

The financial crisis of 2008-2009 had a devastating impact on global economy, resulting in the collapse of a number of financial institutions and government bailouts of large financial

institutions. Recent studies show that firm's risk management and financial policies had a significant influence on the degree to which firms were impacted by the financial crisis (e.g., Brunnermeier, 2009). Prior literature suggests that the financial crisis may have had different impacts on the relation between the two proxies for CEO overconfidence and risk-taking.

On the one hand, CEOs' late option exercise is expected to be positively associated with insurer's risk-taking during the financial crisis. CEOs with stock options can increase their personal wealth when the stock price increases, and experience no reduction in their wealth when the stock price declines. This unlimited upside potential and zero downside risk of stock options may encourage managerial risk-taking behavior. Thus, we expect that CEOs who hold substantial amount of exercisable options would take higher risk during the financial crisis when they can inflate stock prices and cash out their options under uncertainty in the stock market. Luo and Song (2012) present evidence that CEO's exercisable option holdings had a positive impact on a firm's risk-taking during the financial crisis in the banking industry.

On the other hand, increased stock ownership may lead CEOs whose personal wealth is closely linked to their firms to make conservative risk taking decisions during the financial crisis because CEOs who have high stock ownership can experience substantial losses in their personal wealth due to declining stock prices. Core et al. (2003) state that for risk-averse CEOs who hold company-specific risk, large stock holdings may induce less risk-taking behavior. Kim and Lu (2011) point out that large stock ownership can discourage CEOs whose personal portfolios are less diversified from taking more risk. Gormley and Matsa (2016) reveal that managers who have a large ownership stake tend to reduce their firms' stock volatility and risk of distress.

We extend these arguments and argue that it is possible that CEOs who hold too much company-specific risk may take on lower risk during the financial crisis, which is a high-risk period. As a

result, these different views of the impact of financial crisis on the relation between two overconfidence measures and insurer's risk-taking lead to the following null hypothesis.

Hypothesis 3: CEOs who maintain high personal exposure to company risk do not change their risk-taking behavior during the period of financial crisis.

2.5. CEO Overconfidence and Firm Performance

Existing studies provide mixed results for the effect of CEO overconfidence, defined by the two conventional CEO overconfidence measures, on firm performance. Several studies show that overconfident CEOs can reduce the value of the firm as a result of overinvestment (e.g., Malmendier and Tate, 2005, 2008; Campbell et al., 2011). Malmendier and Tate (2008) find that firms with overconfident CEOs who underestimate risk have lower firm performance because they tend to engage in more value-destroying mergers and acquisitions. Hackbarth (2009) contends that managerial overconfidence can lead to a higher probability of default, thereby resulting in high potential costs of financial distress. Chen et al. (2010) show that CEO overconfidence is associated with lower abnormal stock returns and operating performance.

On the contrary, Goel and Tate (2008) document that overconfident CEOs may increase firm value by mitigating the underinvestment problem. Hirshleifer et al. (2010) find no evidence that CEO overconfidence reduces firm performance as measured by sales, Tobin's Q, and ROA. They argue that overconfident CEOs can help firms achieve greater innovative success, and do not necessarily harm firm value or profitability. Vitanova (2014) provides evidence that firms with overconfident CEOs achieve significantly higher firm performance than similar firms with non-overconfident CEOs.

In addition, CEOs may postpone the exercise of their highly in-the-money options or purchase more of their firm's stock because of positive private information about future high stock prices.

If the alternative explanation for CEO overconfidence measures is valid, we expect a positive relationship between the two proxies for CEO overconfidence and firm performance. Based on the above discussions, we suggest our hypothesis 4 as the null form.

Hypothesis 4: The two proxies for CEO overconfidence are not related to firm performance in the property-liability insurance companies.[11]

3. Data and Methodology

This section discusses data and methodology.

3.1. Data and Sample Selection

Our sample includes data on 28 U.S. publicly-traded property-liability insurance companies over the period 1996-2011. We employ panel data that contain information both across firms and over time for each firm. Each of the variables for the analysis is calculated annually for the sample firms. Our data sources are described below. We use ExecuComp database to construct two proxies for CEO overconfidence. Monthly stock returns used to estimate buy-and-hold stock return are derived from the Center for Research in Security Prices (CRSP). The data on Tobin's Q are obtained from the Compustat database. We manually collect the data on corporate governance variables from SEC-filed annual proxy statements (DEF 14A) in the EDGAR database. The information about institutional ownership is extracted from the Thomson-Reuters Institutional Holdings **(**13F**)** database.

All other insurance company-specific data are obtained from the annual statutory statements filed with the National Association of Insurance Commissioners (NAIC). We use 3-year rolling periods of data to compute three risk-taking measures, such as total risk (i.e., standard deviation

[11] Since the arguments for the different performance measures are similar, we generally use the term "firm performance" to denote four different performance measures: Tobin's Q, ROA, ROE, and stock return, in our hypothesis development.

of return on assets), underwriting risk (i.e., standard deviation of loss ratios) and investment risk (i.e., standard deviation of return on investment). For example, standard deviation of the return on assets (ROA) for 1996 is calculated using ROAs from 1996 to 1998.

We initially obtained 3,589 executive-firm-year observations of option holdings and shares owned excluding options from the ExecuComp database for 52 U.S. publicly traded property-liability insurance firms over the period 1996-2013. In calculating CEO overconfidence variables, we use the data only on option holdings and shares owned by CEOs, and exclude the data on option holdings and shares owned by other executives (i.e., option holdings and shares owned by CFO, president, vice-president and CEO of subsidiaries). Similar to Malmendier and Tate (2005), we require CEOs to have at least five years of data on option holdings and shares owned excluding options.

These requirements reduce the sample size to 467 and 472 CEO-firm-year observations for option holdings and shares owned excluding options, respectively. Calculation of risk-taking measures requires 3 years rolling data, and thus, the most recent two years of data (2012-2013) are not included in our sample. After merging the data set used to construct the two proxies for CEO overconfidence with the data required to calculate risk-taking, firm performance and control variables, we have 233 and 235 CEO-firm-year observations for the option holdings-based measure and the net stock purchase-based measure, respectively, for 28 U.S. publicly traded property-liability insurance companies over the period 1996-2011.

The ExecuComp database reports data on individual annual option holdings and shares owned excluding options for the CEO at the holding level, but the NAIC provides firm-specific as well as consolidated data for insurers that are comprised of multiple insurance companies. Since the CEO generally represents an entire insurance group, we use consolidated data for each insurance

group based on the aggregation of insurance companies within each group. A limitation of this study is the relatively small sample size, but this is a common concern of all insurance literature conducted with publicly traded property-liability insurers.[12]

3.2. Methodology

We conduct regression analyses using a series of pooled, cross-sectional, and time-series data. The estimates of coefficients derived from OLS regression may be biased if there are some unknown variables or variables that cannot be controlled for that affect the dependent variable (Greene, 2011). To address this potential bias, we employ a two-way fixed effects model.[13] Given the cross-sectional and time-series data structure, the functional form of the two-way fixed effects model for the relationship between CEO overconfidence measures and insurer's risk-taking has the following specification:

$$\begin{aligned} Risk_{i,t} = {} & \alpha_0 + \alpha_1 Overconfidence_{i,t} + \alpha_2 Bsize_{i,t} + \alpha_3 Insider_{i,t} + \alpha_4 Busy_{i,t} \\ & + \alpha_5 Duality_{i,t} + \alpha_6 Institution_{i,t} + \alpha_7 Size_{i,t} + \alpha_8 Reinsurance_{i,t} \\ & + \alpha_9 ProdHHI_{i,t} + \alpha_{10} GeoHHI_{i,t} + \alpha_{11} Longtail_{i,t} + \alpha_{12} Weak_{i,t} + d_t + f_t + \varepsilon_{i,t} \end{aligned}$$

where *i* indexes the insurance company and *t* represents time (year), d_t is a vector of time fixed-effects, f_t is a vector of firm fixed-effects, and ε_{it} is the error term. $Risk_{i,t}$ is one of several types of risk measures for an insurer *i* at time *t*.

For testing our hypothesis 1.2 and 4, we employ the lagged-structure model to correct for potential endogeneity problems, such as the reverse causality because the two measures of CEO

[12] Eckles and Halek (2010) use 348 firm-year observations over the period 1992-2000. Eckles et al. (2011) have 213 firm-year observations from 1992 to 2000. Huang et al. (2011) use 224 firm-year observations for the period 2000-2007. Ma and Wang (2014) include 247 firm-year observations from 2006 to 2010.

[13] We conduct the Hausman test of the null hypothesis that the firm-specific error term is uncorrelated with the residuals to determine which model to use between fixed effects or random effects. The Hausman test rejects the null hypothesis for all the estimations, suggesting that fixed effects model fits the data better.

overconfidence are likely to be influenced by insurer's reinsurance demand and firm performance. The regression models to test the relationship between two proxies for CEO overconfidence, reinsurance demand and firm performance can be expressed as follows:

$$\begin{aligned} Reinsurance_{i,t+1} = {} & \alpha_0 + \alpha_1 Overconfidence_{i,t} + \alpha_2 Bsize_{i,t} + \alpha_3 Insider_{i,t} + \alpha_4 Busy_{i,t} \\ & + \alpha_5 Duality_{i,t} + \alpha_6 Institution_{i,t} + \alpha_7 Size_{i,t} + \alpha_8 ProdHHI_{i,t} \\ & + \alpha_9 GeoHHI_{i,t} + \alpha_{10} Longtail_{i,t} + \alpha_{11} Weak_{i,t} + \alpha_{12} Tax_{i,t} \\ & + \alpha_{13} Coastal\_state_{i,t} + \alpha_{14} 2year\_Loss\_Dev_{i,t} + d_t + f_t + \varepsilon_{i,t} \end{aligned}$$

where $Reinsurance_{i,t+1}$ is the reinsurance ratio for an insurer *i* at time *t*+1.

$$\begin{aligned} Performance_{i,t+1} = {} & \alpha_0 + \alpha_1 Overconfidence_{i,t} + \alpha_2 Bsize_{i,t} + \alpha_3 Insider_{i,t} + \alpha_4 Busy_{i,t} \\ & + \alpha_5 Duality_{i,t} + \alpha_6 Institution_{i,t} + \alpha_7 Size_{i,t} + \alpha_8 Reinsurance_{i,t} \\ & + \alpha_9 ProdHHI_{i,t} + \alpha_{10} GeoHHI_{i,t} + \alpha_{11} Longtail_{i,t} + \alpha_{12} Weak_{i,t} \\ & + d_t + f_t + \varepsilon_{i,t} \end{aligned}$$

where $Performance_{i,t+1}$ is one of several types of profitability measures for an insurer *i* at time *t*+1.

The variables in the above equations are discussed next.

3.3. Variable Definitions

The variables we describe in this section fall into four categories: CEO overconfidence measures, risk taking measures, firm performance measures, and control variables.

3.3.1. CEO Overconfidence Measures

CEO overconfidence is measured using two conventional proxies for CEO overconfidence, which are an option holdings-based measure of overconfidence (e.g., Malmendier and Tate, 2005; Campbell et al., 2011; Hirshleifer et al., 2012; Ho et al., 2016) and a net stock purchase-based

measure of overconfidence (e.g., Malmendier and Tate, 2005; Jarboui et al., 2014; Andreou et al., 2016).

As our first measure of CEO overconfidence, we employ an option holdings-based overconfidence measure using the information on CEO option holdings for U.S. publicly traded property-liability insurance companies. Following Malmendier and Tate (2005)[14], we classify CEOs as overconfident if they keep their options too long to be considered rational. Specifically, the dummy variable (*OC67*) takes a value of one if a CEO postpones the exercise of his/her options that are 67 percent or more in the money at least twice over the sample period, and zero otherwise. We classify a CEO as overconfident from the first time he/she has exercisable options that are 67 percent or more in the money.[15] Once a CEO is identified as overconfident, we assume that he/she remains overconfident for the rest of sample period because overconfidence is a persistent trait (Hirshleifer et al., 2012).

Malmendier and Tate (2005) use very detailed data on option exercise to define overconfident CEOs. However, we cannot access the detailed data on CEO's option holdings and exercise prices for each option grant as they do. Thus, we follow the method employed by Campbell et al. (2011) to compute the average moneyness of the CEO's option portfolio for each year by using ExecuComp database. Campbell et al. (2011) demonstrate that this alternative measure is valid and useful in measuring CEO overconfidence.[16] To calculate the average moneyness, we first compute the average realizable value for the option by dividing the total realizable value of the

[14] Hall and Murphy (2002) assume that risk-averse executives generally hold undiversified portfolios and they should exercise options early if they are rational utility maximizers. In their numerical simulations, Hall and Murphy (2002) demonstrate that rational CEOs should exercise their options packages once their options are 67 percent in the money (i.e., stock price exceeds the exercise price by more than 67 percent) for each year of the stock option's exercisability. Malmendier and Tate (2005) adopt this framework as a threshold level for CEO overconfidence.

[15] We obtain similar results when we define CEOs who fail to exercise the options with 67 percent or more in the money at least twice as overconfident in all periods, not just starting from the first time they crossed the 67 percent threshold.

[16] For a detailed discussion of the measure, see Campbell et al. (2011).

exercisable options (ExecuComp variable: OPT_UNEX_EXER_EST_VAL*)* by the number of exercisable options held by the CEO (ExecuComp variable: OPT_UNEX_EXER_NUM) for each year. Next, we subtract the per-option average realizable value from the stock price at the fiscal year end (ExecuComp variable: PRCCF) to obtain an estimate of the average exercise price of the options (i.e., estimated strike price). Lastly, the average percent moneyness of the options equals the stock price at the fiscal year end (PRCCF) divided by the estimated strike price minus 1.

Our second measure of CEO overconfidence is based on the tendency of CEOs to buy more of their firm's stock despite their already high personal exposure to company-specific risk (Malmendier and Tate, 2005). Malmendier and Tate (2005) contend that while rational CEOs tend to minimize the holding of their company's stock in order to divest themselves of firm-specific risk, overconfident CEOs are likely to habitually increase their equity positions by purchasing new shares of their firm's stock or accumulating new stock grants. Similar to Malmendier and Tate (2005), we define a CEO as overconfident if there are more years in which a CEO is a net buyer of their company's stock than there are years in which a CEO is a net seller over the sample period.

Following the prior literature (e.g., Malmendier and Tate, 2005; Jarboui et al., 2014), we require CEOs to have been in their position for at least 5 years to be included in our sample. To calculate the net stock purchase-based measure, we regard the increase (decrease) in shares owned by CEO in each year as the net amount of shares the CEO has bought (sold). Specifically, CEOs are classified as net buyers (net sellers) if the difference between the number of stocks held at current fiscal-year end and the number of stocks held at the prior fiscal-year end is positive (negative). Shares owned excluding options by CEO (ExecuComp variable: SHROWN_EXCL_OPTS) is

used to compute the overconfidence measure. We use a dummy variable (*Net Buyer*) that equals one if the CEO is a net buyer of company stock during the sample period, and zero otherwise.[17]

3.3.2. Risk Taking Measures

To investigate insurer's risk-taking behavior in a comprehensive way, we employ a variety of risk-taking measures, such as reinsurance demand, total risk, underwriting risk, investment risk, and leverage risk.[18] Unlike the previous studies that typically use market-based risk-taking measures, we focus mainly on observable risky-taking behavior of CEOs by utilizing insurer's reinsurance demand over which only CEOs of insurance companies have total control in order to directly examine whether two proxies for CEO overconfidence really measure overconfidence or not in the U.S property-liability insurance industry. First, we use insurer's reinsurance demand as the most important risk measure in this study. Reinsurance is an important mechanism by which an insurer manages risk (Wang et al., 2008). We measure reinsurance demand as the ratio of reinsurance ceded to the sum of direct premiums written and reinsurance assumed (Klein et al., 2002).

Second, total risk is the overall risk for shareholders or policyholders, and reflects a combination of underwriting risk, leverage risk and investment risk (Ho et al., 2013). We measure total risk as the standard deviation of return on assets (ROA) where ROA is calculated as the ratio of net income plus taxes and interest expenses divided by net admitted assets.[19] Third, underwriting risk is especially important for insurers because it is closely associated with the uncertainty of

[17] Following, Andreou et al. (2016), we also classify CEOs as overconfident for their entire tenure if they are net buyer of their firm's stock during their first five years. The results using this alternative measure are very similar to those reported.

[18] Ho et al. (2013) point out that using different risk measures is better than using one risk measure in the examination of insurer's risk-taking behavior.

[19] Admitted assets are the assets permitted by state laws to be included in an insurer's financial statement in determining the solvency of insurers. Admitted assets typically exclude illiquid and hard-to-value assets, such as overdue receivables and furniture and equipment.

insurance contract losses.[20] Underwriting risk is measured by the standard deviation of the firm's loss ratio where the loss ratio is the ratio of loss incurred divided by premiums earned.

Fourth, investment risk is related to the investment activities that may adversely affect insurer's financial stability. Since underwriting profit could be negative in many instances,[21] effectively taking and managing investment risk are essential to success of insurance companies (Hoyt and Trieschmann, 1991). We measure investment risk by using the standard deviation of return on investment (ROI) where ROI is measured by the ratio of net investment gain divided by investment assets. Finally, leverage risk is crucial to insurers because an insurance company having a relatively lower level of surplus is more likely to become insolvent than a firm with a high level of surplus.[22] Leverage risk is computed as 1 minus the surplus-to-asset ratio.

3.3.3. Performance Measures

The key performance measures used in this study are identified from the literature. We first employ Tobin's Q as a market-based measure of firm performance. Tobin's Q is a widely used measure in the prior literature on the relationship between CEO overconfidence and firm performance (e.g., Malmendier and Tate, 2005; Hirshleifer et al., 2010; Vitanova, 2014). Brainard and Tobin (1968) define Tobin's Q as the market value of equities to the replacement costs of the physical assets. However, since it is difficult to measure replacement costs of the physical assets due to data limitations, previous studies have used book value of assets instead of replacement costs in calculating Tobin's Q. In this study, we compute Tobin's Q by dividing market value of assets by the book value of assets where market value of assets is estimated as the total assets plus

[20] Browne and Hoyt (1995) find that high underwriting risk has a negative influence on insurer's financial stability in the U.S. property-liability insurance industry.

[21] According to a report by Insurance Information Institute (I.I.I), between 1980 and 2013, underwriting income for the U.S. property-casualty industry has been net positive in only five years.

[22] Carson and Hoyt (1995) provide evidence that insurers with low levels of leverage tend to have a lower likelihood of insolvency.

market value of equity minus book value of equity. Market value of equity is calculated by multiplying the number of common shares outstanding by stock price at fiscal year end. Following Daniel and Titman (1997), we estimate book value of equity as stockholder's equity + deferred taxes + investment tax credit – preferred stock.

Following the prior literature (e.g., Elango et al., 2008; Shim, 2011; Huang et al., 2013), we also use various accounting and market-value measures of profitability, such as return on assets (ROA), return on equity (ROE) and stock return as proxy measures of the insurer's performance. We define ROA as the ratio of net income plus taxes and interest expenses to net admitted assets. ROE is computed by dividing net income plus taxes and interest expenses by insurer's equity capital. Stock return is the annual buy-and-hold stock return as measured by compounding monthly stock returns over the fiscal year.

3.3.4. Control Variables

We include corporate governance variables as explanatory variables in the regression analysis because the extant literature suggests that corporate governance structure may affect the insurer's reinsurance demand, risk-taking behavior, and firm performance (e.g., Garven and Lamm-Tennant, 2003; Brick and Chidambaran, 2008; Cheng, 2008). Board size is the number of all directors (*Bsize*). Insider percentage is the percentage of executive directors on the board (*Insider*). We define a busy board with the dummy variable (*Busy*) that takes the value of one if 50 percent or more independent board members hold three or more directorships, and zero otherwise. CEO duality is a dummy variable (*Duality*) that equals one if the same person is the CEO and Chairperson of the board, and zero otherwise. Institutional ownership is measured as the percentage of shares held by institutional investors (*Institution*).

In addition, we use several firm characteristics as control variables**.** The natural logarithm of total net written premiums is used as a proxy for firm size (*Size*). Lines of business Herfindahl index is calculated as the sum of the squares of the percentages of direct premium written across product lines (*ProdHHI*).[23] Geographical Herfindahl index is computed by the sum of the squares of the percentages of direct premium written across 50 states for each insurer (*GeoHHI*). The percentage of long-tail lines is defined as the ratio of premiums of long-tail lines to total net written premiums (*Longtail*).[24] Insurer financial condition is an indicator variable (*Weak*) that takes a value of one if the insurer is financially unhealthy, where unhealthy is defined as more than four unusual Insurance Regulatory Information System (IRIS) ratios,[25] and zero otherwise.

Prior literature has documented a variety of factors affecting insurer's reinsurance demand. Thus, we use additional control variables, such as tax effect, coastal states, and 2 year loss development in the regressions where reinsurance demand is a dependent variable. Tax effect is a proxy for the tax liability or tax-favored assets (*Tax*). We measure tax effect as the ratio of tax-exempt investment income relative to total investment income (Wang et al., 2008). Coastal States is a dummy variable (*Coastal_State*) that takes value of one if the insurer is domiciled in a hurricane-prone state (Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, and Virginia), and zero otherwise. 2 year Loss Development (*2year_Loss_Dev*) is computed by dividing the developed

[23] We include approximately 30 different lines of business in calculating the lines of business Herfindahl index. The percentage of lines of business is obtained from the National Association of Insurance Commissioners' (NAIC) annual statutory filings.

[24] Long-tail lines are lines of business for which losses may not be known for some period, and it takes a long period of time for the claims to be settled (e.g., general liability, directors and officers liability (D&O), and workers' compensation).

[25] The Insurance Regulatory Information System (IRIS) is a set of financial ratios used by the National Association of Insurance Commissioners (NAIC) to assess insurer's financial soundness. If an insurer has more than three unusual ratios outside of the usual range set by the NAIC, it may receive more intense regulatory intervention.

reserve for the reserve of two years ago (i.e., managements' currently revised estimate of the reserve of two years ago) minus the reserve reported two years ago by policyholders' surplus of two years ago (Petroni, 1992).[26] The definitions of all variables are summarized in Appendix 1.

4. Results

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics for all variables. The results of *OC67* and *Net buyer* measures show that about 59 percent and 72 percent of CEO-firm-years are defined as overconfident, respectively. These percentages are comparable with those in prior studies using similar measures for CEO overconfidence.[27] Table 2 provides the Pearson correlation coefficients between all independent variables. The correlation coefficient between two different proxies for CEO overconfidence measures is 0.083, which is very similar to that of 0.063 in Malmendier and Tate (2005). Table 2 also shows that some independent variables are highly correlated. For example, the correlation coefficients on reinsurance and firm size, line of business Herfindahl index and 2 year loss development, and board size and geographical Herfindahl index are -0.491, -0.457 and -0.547, respectively, and are statistically significant at the 1 percent level. We perform the variance inflation factor (VIF) test to check for multicollinearity among independent variables in the regression design. We find that VIFs of all independent variables in the regressions are less than 4 and thus, conclude that multicollinearity does not adversely affect our regression results.

4.2. Empirical Results

[26] U.S. Property-liability insurers are required to report originally estimated losses and loss expenses as well as revised estimate (or development) of those values based on subsequent experience in later years to state insurance commissioners in Schedule P of insurers' financial statement filings following the Statutory Accounting Principles (SAP).

[27] Malmendier and Tate (2005) classify 51 percent and 61 percent of CEO-years as overconfident for the option holdings-based and the net stock purchase-based measure, respectively.

The estimates of the parameters from our two-way fixed effects regression of the relationship between two CEO overconfidence measures and risk-taking are presented in Table 3. We first report the results of the reinsurance demand model. The coefficients on both proxies for CEO overconfidence are positively significant in reinsurance demand at the 1 percent and 5 percent level for the option holdings-based and the net stock purchase-based measure, respectively. These results imply that overconfident CEOs may increase the usage of reinsurance in order to protect themselves against unexpected losses that could harm their job security as well as their personal wealth.

As for the control variables, we find a negative relationship between firm size and insurer's reinsurance demand, implying that small insurance firms are more likely to purchase reinsurance as a way to manage unexpected losses (Mayers and Smith, 1990). Both product and geographic concentration are significantly and positively related to reinsurance demand. The results indicate that insurers with a higher concentration in a given line of business or geographic area may have a higher incentive to purchase more reinsurance in order to diversify the risks associated with the concentrations (Cole and McCullough, 2006).

The coefficients of the percentage of long-tail lines are significantly negative, consistent with Altuntas et al. (2015) that insurers with a higher percentage of long-tailed line business typically hold large reserves compared with premiums, and thus less reinsurance may be required to cover future claim payments. Weak is positively related to reinsurance demand, implying that financially weak insurers purchase more reinsurance to reduce insolvency risk. Tax is not significantly related to reinsurance demand, consistent with Garven and Lamm-Tennant (2003). The coefficient on 2 year loss development is positively significant, implying that firms that underreport their loss reserves tend to purchase higher levels of reinsurance (Cole and McCullough, 2006).

The results of the risk taking models (total risk, underwriting risk, investment risk, and leverage risk) in Table 3 are discussed next. The evidence shows that the coefficients on CEO overconfidence variable are negative and significant in total risk, underwriting risk, and leverage risk for both the option holdings-based and the net stock purchase-based measures. However, we do not find any significant relations between CEO overconfidence and investment risk for both overconfidence measures. The results imply that overconfident CEOs take lower total risk, underwriting risk and leverage risk relative to non-overconfident CEOs by 4.8 percent, 2.0 percent and 3.2 percent, respectively, for the option holdings-based measure, and by 3.4 percent, 4.9 percent and 3.3 percent, respectively, for the net stock purchase-based measure.

Some possible explanations for these results are provided below. In terms of the negative relationship between CEO overconfidence measures and underwriting risk, CEOs who hold firm-specific risk may not want to harm their company's underwriting profits by taking on more risk in underwriting activities because high underwriting risk may result in high losses. High losses could have a harmful effect on the profitability of the firm, thereby increasing the concerns on their career and personal wealth. The negative relationship between CEO overconfidence measures and leverage risk could be explained by the fact that CEOs who maintain high personal exposure to company-specific risk may prefer to take lower levels of corporate leverage to avoid high financial risk in their personal portfolio.[28] Considering that total risk is a combination of underwriting risk, investment risk, and leverage risk (Ho et al. 2013), it seems reasonable to have the negative relationship between CEO overconfidence measures and total risk.

The findings together with the positive relation between CEO overconfidence measures and insurer's reinsurance demand imply that overconfident CEOs try to limit their risk exposures to

[28] High leverage risk results in high probability of financial distress or bankruptcy in the insurance sector (Carson and Hoyt, 1995).

protect their wealth. This result is consistent with the finding of Lewellen (2006) that if CEOs are not well diversified, in-the-money options discourage them from taking risks. Also, the result supports the "playing it safe" hypothesis (Gormley and Matsa, 2016) that managers who hold a large ownership stake tend to undertake less risk than desired by a diversified shareholder because their personal wealth is closely related to firm's performance.

With regard to the control variables for all risk taking models, only the important results are discussed to save space. The evidence in Table 3 shows that board size is negatively and significantly related to total risk and leverage risk, indicating that the performance of firms with large boards may be less volatile because the decisions made by large boards tend to be less extreme (Cheng, 2008). Firm size is found to be positively related to total risk and leverage risk, implying that larger insurers tend to take more risk. We also find that the coefficients on the product concentration are significant and positive in total risk and underwriting risk, whereas the coefficients on geographical concentration are negatively significant in all four risk measures. The results indicate that insurers with higher concentrations in a given line of business exhibit greater risk-taking behavior, and that operating over wider geographical areas may expose insurers to greater risk because the complexity of diversified firms increases the difficulty of monitoring managers' excessive risk-taking.

The results in Table 4 show that the implementation of SOX has different impacts on managerial risk-taking behavior. We find that interaction term SOX × *OC67* is significantly positively related to reinsurance demand, and the coefficients on the interaction term are significant and negative in total risk, underwriting risk and leverage risk. The coefficients on SOX × *Net buyer* are negative and statistically significant in underwriting risk and leverage risk. These results support the view that SOX may have a mitigating effect on overconfident CEO's risk-taking behavior (Banerjee et

al., 2015). We also find that the interaction terms of SOX × *OC67* and SOX × *Net buyer* are positively and significantly related to investment risk, implying that overconfident CEOs tend to take on higher investment risk after the enactment of SOX. One possible explanation for these mixed results is that overconfident CEOs may choose higher investment risk, but lower underwriting risk and leverage risk as its strategy to control the firm's total risk through management of underwriting, investment, and leverage risks that determine an insurer's risk profile.[29]

We next examine the effect of the recent financial crisis on the relationship between CEO overconfidence and insurer's risk-taking. The dependent variable is the change in risk-taking before and during the financial crisis as measured by the average of 2008-2009 risk-taking measures minus the average of 2005-2006 risk-taking measures, and CEO overconfidence measures and control variables of 2007 are used as independent variables. Table 5 reports that the coefficients on *OC67* are significant and negative in total risk, investment risk, and leverage risk, implying that CEOs who postpone their exercisable options tend to take on lower risk during the financial crisis relative to the before crisis period. We also find that the signs on *Net buyer* are significantly negative in total risk and leverage risk. These results indicate that CEOs who hold high levels of firm-specific risk reduce the riskiness of their firms during the financial crisis in an effort to protect their own personal wealth.

Table 6 presents the estimations of the parameters of the relationship between CEO overconfidence measures and firm performance. The coefficients on CEO overconfidence measured by both *OC67* and *Net Buyer* are significant and positive in all four profitability measures, implying that insurers with overconfident CEOs tend to achieve better financial

[29] Please see Ho et al. (2013). It should be noted that they examine insurers' risk-taking behavior, while this study investigates CEOs' risk-taking behavior.

performance. The results, together with the negative relation between CEO overconfidence measures and risk-taking, suggest that overconfident CEOs improve their personal wealth as a result of both higher firm performance and lower risk.

There are some interesting results with respect to several control variables. Table 6 reports that a busy board is positively related to firm performance, implying that busy directors help firms improve performance by bringing in more experience and knowledge (Elyasiani and Zhang, 2015). Institutional ownership is found to have a positive impact on firm performance, suggesting that monitoring by institutional investors helps managers focus more on firm's performance and less on opportunistic behaviors (Del Guercio and Hawkins, 1999).

We also find that firm size is positively associated with firm performance. This result implies that large insurers may achieve higher performance due to economies of scale. Reinsurance demand is negatively related to insurer's financial performance, consistent with the finding of Lee and Lee (2012) that insurers with higher reinsurance ratios tend to have lower firm performance. We find that product and geographical concentration are positively associated with firm performance, indicating that focused insurers tend to have greater financial performance. Lastly, insurer's financial weakness is found to be negatively related to firm performance.

4.3. CEO Overconfidence or Private Information

Prior literature suggests that CEOs may decide not to reduce their personal exposure to firm-specific risk because they have private information about future stock prices, thereby keeping their exercisable options longer and increasing their equity holdings (e.g., Bouwman, 2014). In order to examine this possibility, we calculate the average abnormal stock returns for the firms with overconfident or non-overconfident CEOs by using the Fama-French (1993) three-factor and the

Carhart (1997) four-factor models.[30] We measure the monthly abnormal returns of firms with overconfident CEOs for 60-month period,[31] starting from the first year when CEO are classified as overconfident. Also, we perform the same analysis for non-overconfident CEO firms over the same period and compare abnormal returns between overconfident-CEO firms and non-overconfident-CEO firms. To estimate the monthly abnormal returns (α_i), we employ the following equation based on the Fama-French three-factor model:

$$R_{pt} - R_{ft} = \alpha_i + \beta_i \left(R_{mt} - R_{ft}\right) + s_i SMB_t + h_i HML_t + \varepsilon_{it},$$

where R_{it} is the stock return on an equal- or a value-weighted portfolio of firms with overconfident or non-overconfident CEOs in month t. R_{ft} is the 1-month treasury bill return, R_{mt} is the CRSP value-weighted market index return, SMB_t is the difference in the returns on the value weighted portfolios of small and big stocks, HML_t is the difference in the returns on the value weighted portfolios of high and low book-to-market stocks.

For the Carhart four-factor model, we use the following equation:

$$R_{pt} - R_{ft} = \alpha_i + \beta_i \left(R_{mt} - R_{ft}\right) + s_i SMB_t + h_i HML_t + m_i UMD_t + \varepsilon_{it},$$

where UMD_t is the difference in the return on the value weighted portfolios of high and low momentum stocks. Table 7 presents the abnormal stock returns of firms with overconfident or non-overconfident CEOs. Panel A of Table 7 shows the results of the option holdings-based measure. We find that the monthly abnormal returns of overconfident CEOs are significantly positive at the

[30] See Fama and French (1993) and Carhart (1997) for a more detailed explanation on these methods. The data on R_{mt}, R_{ft}, *SMB, HML, UMD* are taken from Kenneth French's web page (http://mba.tuck.dartmouth.edu/pages/fa/faculty/ken.french/data library.html).

[31] We also estimate the abnormal stock returns by using the 12- and 36- month periods. The results are very similar to those for 60-month period.

1 percent level for equal- and value-weighted portfolios in both the Fama-French three-factor model (0.6 percent and 0.6 percent) and the Carhart four-factor model (0.7 percent and 0.8 percent). For the non-overconfident CEOs, the abnormal returns are not significantly different from zero for equal- and value-weighted portfolios under both models. The return differentials between two CEO groups are positively significant for the equal- and value-weight portfolios in both the Fama-French three-factor and the Carhart four-factor models.

We also find similar results for the net stock purchase-based measure. As reported in Panel B of Table 7, for both the Fama-French three-factor and the Carhart four-factor models, the average monthly abnormal stock returns for equal- and value-weighted portfolios of overconfident CEOs are significantly positive, and those returns for equal- and value-weighted cases of non-overconfident CEOs are not statistically significant in both models. The return differentials between overconfident and non-overconfident CEOs are significant and positive in all cases. These results are consistent with the finding of Bouwman (2014) that CEOs who postpone exercising their highly-in-the-money options may be rational CEOs with favorable inside information about the future stock prices rather than optimistic CEOs.[32]

Furthermore, we compute the average of insurer's reinsurance demand for overconfident CEOs for each five-year window, starting from the first year when they hold options at least 67 percent in the money or the first year when they are net buyers of their firm's stock. For non-overconfident CEOs, we calculate the average reinsurance demand over the same period. The results in Table 8 show that overconfident CEOs purchase more reinsurance than their non-overconfident

[32] We also calculate the average of annual buy-and-hold stock returns of firms with overconfident or non-overconfident CEOs for a five-year period, beginning from the first year of holding options at least 67 percent in the money or the first year of being a net buyer of their firm's stock. The results show that on average, the returns of overconfident CEOs do beat those of non-overconfident CEOs by 13 percent and 7 percent for the option holdings-based and the net stock purchase-based measure, respectively, and the return differentials are statistically significant.

counterparts by 9.9 percent and 8.2 percent for the option holdings-based (*OC67*) and the net stock purchase-based measure (*Net Buyer 50*), respectively, and the differentials in reinsurance demand between overconfident and non-overconfident CEOs are significantly positive. To check the robustness of these results, we perform the same test for CEOs who hold options at least 75 percent in the money (*OC75*) or are net buyers of their company's stock over at least 80 percent of years that they are in the CEO position (*Net Buyer 80*). We find that these CEOs purchase more reinsurance relative to those who hold options at least 67 percent in the money and are net buyers in more than 50 percent of the sample period and the differences in reinsurance demand between two CEO groups for *OC75* and *Net Buyer 80* (13 percent and 12.2 percent) are larger than differences for *OC67* and *Net Buyer 50* (9.9 percent and 8.2 percent). The results indicate that when overconfident CEOs hold more options and buy more of their firm's stock, they tend to purchase more reinsurance.

Overall, these results imply that CEOs who maintain high exposure to firm-specific risk intend to lower their company's risk by purchasing more reinsurance in order to maximize benefits from future high stock prices, suggesting that private information instead of CEO overconfidence may motivate CEOs to hold their deep-in-the-money options and to buy more of their company's stock in U.S. property-liability insurance companies.

4.4. Trends in CEO Option Holdings and Stock Ownership

Our empirical results indicate that CEOs who delay their option exercise and purchase more of their firm's stock tend to reduce risk-taking to maximize benefits from private information. Alternative explanations for lower risk taking behavior of overconfident CEOs are that in-the-money options and a large stock ownership may cause CEOs who hold firm-specific risk to be

more risk-averse, thereby discouraging them from taking risks (e.g., Lewellen, 2006; Gormley and Matsa, 2016).

To rule out these alternative explanations, we examine whether CEOs increase (or decrease) their option holdings and/or stock ownership after being defined as overconfident. If CEOs who are classified as overconfident continue to increase the number of unexercised but exercisable stock options or their holdings of company's stock, it would support our argument that CEOs who maintain high exposure to firm-specific risk may actually be rational CEOs with private information and tease out the alternative explanations for low risk-taking tendencies of risk-averse CEOs who hold in-the-money options and large holdings of equity.

To do so, we first examine whether CEOs defined as overconfident increase (or decrease) their option holdings or stock ownership[33] for each five-year period, beginning from the first year when they hold at least 67 percent in-the-money options or the first year when they are net buyer of their company's stock. We find that almost all CEOs defined as overconfident increase their holdings of options and stock over a 5-year interval.[34] Specifically, 19 out of 19 overconfident CEOs (option holdings-based measure) and 21 out of 22 overconfident CEOs (net stock purchase-based measure) increase the number of vested but unexercised options and the number of holdings of their firm's stock over a five-year interval. Also, we compute the average percentage changes in CEO option holdings and stock ownership for three different time intervals (one-year, three-year and five-year period following the first year when CEO are classified as overconfident). Table 9

[33] We exclude shares acquired on option exercise (ExecuComp item: OPT_EXER_NUM) and restricted stocks (ExecuComp item: SHRS_UNVEST_NUM) from shares owned excluding options (ExecuComp item: SHROWN_EXCL_OPTS) to only examine the increase in CEO stock holdings due to stock purchase from the open market.

[34] Especially, we find that overconfident CEOs keep increasing the number of option holdings and stock ownership every year for 16 out of 19 CEOs (option holdings-based measure) and for 18 out of 22 CEOs (net stock purchase-based measure). For non-overconfident CEOs, only 7 out of 15 and 5 out of 12 CEOs increase their holdings of options and stock over the same five-year interval for the option holdings-based and the net stock purchase-based measure, respectively.

report the results. The mean percentage changes in the number of vested but unexercised options for overconfident CEOs defined using option holdings-based (net stock purchase-based measure) are 52 percent (61 percent), 82 percent (94 percent), and 124 percent (132 percent) for one-year, three-year and five-year period, respectively.

For non-overconfident CEOs, the corresponding mean percentage increases are 23 percent (26 percent), 32 percent (39 percent), and 57 percent (61 percent) for the option holdings-based (net stock purchase-based measure) in three different time periods. The differences in means across two CEO groups are huge (as high as 66 percent and 70 percent for the option holdings-based and the net stock purchase-based measure, respectively) and statistically significant for all cases. In summary, the increasing trends of option holdings and stock ownership by CEOs defined as overconfident suggest that private information instead of overconfidence may motivate these CEOs to expose themselves more to firm-specific risk and to reduce risk-taking behavior, giving support to our previous results.

4.5. Robustness Check and Additional Tests

In this section, we report the results of a series of robustness checks of our main findings. First**,** CEO's late option exercise or additional stock purchase behavior may be jointly determined with firm's risk-taking behavior, and thus the feedback effect between dependent and independent variables may violate the consistency of the OLS estimator, leading to the problem of endogeneity. For example, boards of insurance companies that want to maintain lower levels of firm risk might take CEO's willingness to tie their personal wealth to performance of the firm into account when selecting a CEO because they recognize that these CEOs tend to reduce the riskiness of firm in order to protect their own portfolio.

Thus, we conduct a further robustness check with the two-stage least squares (2SLS) method to determine whether our regression results are robust to endogeneity. In the 2SLS model, we treat CEO overconfidence variables as endogenous variables for which we use instrumental variables that are correlated with the two proxies for CEO overconfidence, but are uncorrelated with the error term of the regression. The lagged or historically averaged measures of firm characteristics, industry growth, and general economic growth are commonly used instrumental variables (Campa and Kedia, 2002). Also, prior literature (e.g., Ho et al., 2016) uses the age of the CEO as an instrument of CEO overconfidence. Therefore, we initially employ 3-year average of firm size, 3-year average of industry premium growth rate, 3-year average of real GDP growth, CEO age, and lagged values of the firm characteristics included in our regressions as the potential instrumental variables for the two CEO overconfidence variables. Our test results show that only 3-year average firm size and 3-year average of real GDP growth fulfill the two requirements.[35]

The estimated results using 2SLS are presented in Table 10. The coefficients on CEO overconfidence measures are positively significant in reinsurance demand, and negatively significant in total risk, underwriting risk, and leverage risk for the net stock purchase-based measure. For the option holdings-based measure, we find similar results, except for leverage risk. Thus, we conclude that our findings are robust to the endogeneity issue. Although not reported here,[36] the results of the effect of SOX and the financial crisis on the relation between the two proxies for CEO overconfidence and insurer's risk taking confirm our previous findings.

[35] To check whether our instrumental variables satisfy the two conditions mentioned above, we use an *F*-test of the joint significance of the excluded instruments and Hansen's *J* test of over-identifying restrictions to examine whether the instruments are valid, and are uncorrelated with the error term, respectively. We find that the *F*-test of excluded instruments rejects the null hypothesis of weak instruments at the 1 percent level (the *p*-value is 0.0001), and Hansen's *J* test does not reject the null hypothesis that the instruments are uncorrelated with the error term (the *p*-value is 0.2571), indicating that our two instrumental variables (3-year average firm size and 3-year average of real GDP growth) are valid.

[36] Untabulated results are not reported to preserve space. The authors would be happy to provide the results upon request.

Second, we examine the robustness of our results to an alternative risk-taking measure by using the Z-score as a proxy for the insurer insolvency risk. The Z-score is inversely related to the likelihood of insolvency, with a higher Z-score indicating a lower probability of default (Boyd and Runkle, 1993). Z-score is calculated by dividing the sum of ROA and capital to asset ratio by the standard deviation of ROA. In untabulated results, we find that both CEO overconfidence measures are significantly positively related to the Z-score, implying that overconfident CEOs tend to achieve higher financial stability, consistent with our previous findings that CEO who hold their options longer and buy more of their firm's stock tend to take lower risk.

Third, Andreou et al. (2016) point out that changes in the shares owned by CEOs may be driven not only by stocks that CEOs purchase from the open market but also by stocks that CEOs retain after exercising their vested options. Ofek and Yermack (2000) show that managers tend to sell almost all stocks acquired through the exercise of vested options. Thus, if we do not exclude the changes in the stock ownership due to the exercise of vested stock options, we may incorrectly attribute increase in CEO stock holdings caused by the exercise of vested options to overconfidence. We address this concern by using an alternative net stock purchased-based measure based on CEO's open market stock purchases. Following Andreou et al. (2016), we redefine the net buyer measure after subtracting the number of shares acquired on option exercise (ExecuComp item: OPT_EXER_NUM) from shares owned excluding options (ExecuComp item: SHROWN_EXCL_OPTS). We find that our main results are robust to using the alternative net buyer measure of overconfidence (untabulated).

Fourth, our sample period, ending in 2011, was characterized much more heavily by stock grants as firms moved away from option-based compensation in favor of restricted share grants. Thus, our net stock purchased-based measure may be problematic, considering the recent trends of

increases in CEO shareholdings due to stock grants. This could explain why 72 percent of all observations are categorized as overconfident based on this measure. To address this issue, we remove the number of restricted stocks outstanding at the end of each year (ExecuComp item: SHRS_UNVEST_NUM) from shares owned excluding options (ExecuComp item: SHROWN_EXCL_OPTS). Untabulated results show that our main findings remain the same for the exclusion of restricted stock grants.

Fifth, Kim and Lu (2011) find that large stock ownership can discourage CEOs who are highly exposed to the idiosyncratic risk of their company from taking more risk. It is possible that CEOs who delay their option exercise and buy additional shares of their firm's stock could also have a high level of stock ownership, and thus the negative relationship between two CEO overconfidence measures and risk-taking may be due to CEOs' large holdings of equity that lead them to reduce the riskiness of their firms in an effort to protect their personal portfolio.

To disentangle wealth effects of CEO ownership, we rerun the regressions in Table 3 by adding CEO equity ownership (as measured by the proportion of the number of shares owned by CEO) as an additional control variable. The results are reported in Table 11. The coefficients of CEO ownership are positively significant in reinsurance demand, and negatively significant in total risk, underwriting risk, investment risk and leverage risk. These results are consistent with the "playing it safe" hypothesis (Gormley and Matsa, 2016) that managers whose personal wealth is closely linked to their firm tend to take on less risk or undertake value-destroying actions that reduce the firm's risk. More importantly, we find that the negative relationship between CEO overconfidence measures and insurer's risk-taking is still present after controlling for CEO equity ownership. Thus, we conclude that our main findings are robust to the wealth effects from CEO's stock holdings.

Sixth, the prior literature has shown that executive compensation is closely linked to the insurer's risk-taking behavior (Downs and Sommer, 1999; Eckles and Halek, 2010; Ma and Wang, 2014). Thus, we include several variables capturing different aspects of CEO compensation, such as bonus, long-term incentive pay, stock options awarded, stock options exercised, and restricted stock as control variables in the regressions in order to control for the impact of CEO compensation on insurer's risk-taking. All variables are scaled by total compensation. Untabulated results show that our main results remain consistent and robust when we control for CEO compensation variables.

Seventh, the result in Table 2 shows that the correlation coefficient between two CEO overconfidence measures is slightly weak (0.083). Although we find consistent results for both overconfidence measures, it might be interesting to examine whether we could obtain the same results for intersection of two overconfidence measures (i.e., CEOs are defined as overconfident if they not only hold highly-in-the-money options but also habitually purchase their company's stock) to check the robustness of our results. We find that the new measure based on the intersection of two overconfidence measures is positively related to reinsurance demand and negatively associated with risk-taking (untabulated), thus confirming our previous results. As a last robustness check, we use A.M. Best ratings as an additional explanatory variable because credit rating could have a significant impact on corporate risk-taking decisions (Graham and Harvey, 2001). Again, we find that our results remain robust (untabulated).

5. Conclusion

Despite their prominence, alternative explanations have been suggested for the two conventional CEO overconfidence measures. This study revisits this issue by examining the impact of CEOs who maintain high personal exposure to company-specific risk on insurer's risk-taking behavior

and firm performance in U.S. publicly traded property-liability insurance companies. We focus on the insurance industry because of the availability of more accurate measurement of CEO's risk-taking behavior: insurer's reinsurance demand.

Interestingly, we find that the two CEO overconfidence measures are positively related to insurer's reinsurance demand and negatively associated with insurer's risk-taking, including total risk, underwriting risk, and leverage risk. We also find a positive relationship between the two proxies for CEO overconfidence and firm performance, indicating that overconfident CEOs may lead to greater firm profitability and higher stock returns.

The evidence shows that overconfident CEOs earn positive abnormal returns, significantly increase their holdings of options and stock, and purchase more reinsurance relative to non-overconfident CEOs. In addition, we find that overconfident CEOs are more likely to hold exercisable options and keep purchasing stocks in the five-year period after they are classified as overconfident than non-overconfident CEOs.

Taken together, our overall results suggest that CEOs defined as overconfident try to control the overall risk of the firm through increased use of reinsurance and lower underwriting and leverage risk-taking, achieving higher firm performance. One possible explanation for the results is that it is not CEO overconfidence but the private information or the intention to control the company's risk that drives our results. Therefore, we cast doubt on whether the two conventional measures of CEO overconfidence really proxy for CEO overconfidence in U.S. property-liability insurance companies. In addition, our findings are not unique to the insurance industry.[37] Our results are robust to the endogeneity issue, using the Z-score as a proxy for the insurer insolvency risk, using

[37] See Appendix for the results of the relation between CEO overconfidence measures and risk-taking across different industries.

the alternative overconfidence measures, and adding CEO ownership, executive compensation and A.M. Best ratings as control variables.

Appendix

Prior literature in banking and non-financial industries has provided evidence that CEO overconfidence defined using the option holdings-based or the net stock purchase-based measure is positively associated with corporate risk taking. Thus, we examine the relationship between two proxies for CEO overconfidence and risk-taking, using market-based risk measures. Following Banerjee et al. (2015), we employ three market-based risk-taking measures, such as stock return volatility (i.e., total risk), systematic risk (i.e., exposure to market risk) and unsystematic risk (i.e., firm-specific risk). We measure stock return volatility by calculating the standard deviation of daily stock returns. To measure systematic risk, we estimate the annual beta (β) by using daily stock return data for each firm. We employ the following a single-index market model to estimate the beta for each insurer *i* in each year t.

$$R_{it} = \alpha + \beta R_{mt} + \mu_{it}$$

where R_{it} is the daily return on the insurer's stock, R_{mt} is the daily return on the CRSP equal weighted index, and μ_{it} is the error term. In addition, we compute the mean squared error (MSE) from the estimation of the single index model over the year to measure unsystematic risk. We take a natural logarithm of MSE to mitigate concerns about skewness.

To gain a deeper understanding of risk-taking of CEOs who hold firm-specific risk, we investigate the relation between CEO overconfidence measures and risk-taking across different industries. To do so, we first classify firms into 48 industry groups based on the Fama and French

(1997) categories and then estimate separate regressions for each of the 48 industries.[38] The results show that the relationship between CEO overconfidence variables and risk-taking varies across industries (not tabulated).

Specifically, we find that the coefficients of CEO overconfidence are significant and positive in only 21 (23) out of 48 industries for the option holdings-based (net stock purchase-based measure) in at least one of the three market-based risk measures. And the coefficients are either not statistically significant or significantly negative in 27 (25) industries in at least one of the three risk measures for the option holdings-based (net stock purchase-based measure).[39] These findings indicate that lower risk-taking of overconfident CEOs is not unique to the insurance industry, suggesting that the validity of two conventional CEO overconfidence measures is not very robust.

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[38] Regressions are estimated using ordinary least squares (OLS) that include firm and year fixed effects over the period 1992-2015. The data on the market-based risk measures is obtained from the CRSP database. We use the same control variables (CEO-related, Firm-related and Market-related controls) as in Banerjee et al. (2015). See Banerjee et al. (2015) for the details of the variables.

[39] We find the negative relationship between CEO overconfidence measures and market-based risk measures in 8 industries (i.e., tobacco products, entertainment, healthcare, rubber and plastic products, automobiles and trucks, transportation, life insurance, and property-liability insurance industry) for both the option-based and the net buyer measures.

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Appendix 1: Variable Definitions

Variable	Definition
CEO Overconfidence	
OC67	Dummy is 1 if CEO holds unexercised excisable options that are 67 percent or more in the money at least twice over the period, and zero otherwise. CEO is defined as overconfident from the first moment they hold unexercised exercisable options that are at least 67 percent in the money
Net Buyer	Dummy is 1 if years of change in shares owned > 0 is greater than years of change in shares owned < 0, and zero otherwise
Risk Taking	
Reinsurance Demand	Ratio of reinsurance ceded divided by the sum of direct premiums written and reinsurance assumed
Total Risk	Standard deviation of return on assets (ROA)
Underwriting Risk	Standard deviation of the firm's loss ratio
Investment Risk	Standard deviation of return on investment (ROI)
Leverage Risk	1 minus the surplus-to asset ratio
Firm Performance	
Tobin's Q	(AT + ME – BE) / AT AT: total assets ME: market value at year-end BE: book value of equity (Following Daniel and Titman, 1997) BE = (Stockholder's equity + Deferred taxes + Investment Tax Credit – Preferred Stock)
ROA	Ratio of net income plus taxes and interest expenses to net admitted assets
ROE	Ratio of net income plus taxes and interest expenses to the insurer's equity capital
Stock return	Buy-and-hold return from compounding monthly stock returns over the fiscal year

Appendix 1. (Continued)

Variable	Definition
Corporate Governance	
Bsize	Number of all directors
Insider	Percentage of executive directors on the board
Busy	Dummy is 1 if 50 percent or more independent board members hold three or more directorships, and zero otherwise
Duality	Dummy is 1 if the same person is the CEO and Chairperson, and zero otherwise
Institution	Percentage of shares held by institutional investors
CEO Ownership	Proportion of the number of shares owned by CEO
Firm characteristics	
Size	Natural log of total net written premiums
ProdHHI	Sum of the squares of the percentages of direct premium written across product lines
GeoHHI	Sum of the squares of the percentages of direct premium written across 50 states
Longtail	Premiums of long-tail lines divided by total net written premiums
Weak	Dummy is 1 if insurer has more than four unusual Insurance Regulatory Information System (IRIS) ratios, and zero otherwise
Tax	Ratio of tax-exempt investment income to total investment income
Coastal_state	Dummy is 1 if the insurer is domiciled in a hurricane-prone state (Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, and Virginia), and zero otherwise
2 year_loss_Dev	The developed reserve for the reserve of two years ago (i.e., managements' currently revised estimate of the reserve of two years ago) minus the reserve reported two years ago divided by policyholders' surplus of two years ago

Table 1. Descriptive Statistics

Variables	N	Mean	Median	Std. Dev	Min	Max
CEO Overconfidence						
OC67	233	0.588	1.000	0.493	0.000	1.000
Net Buyer	235	0.719	1.000	0.450	0.000	1.000
Risk Taking						
Reinsurance Demand	235	0.206	0.108	0.234	0.000	1.000
Total Risk	235	0.033	0.022	0.062	0.003	0.575
Underwritng Risk	235	0.063	0.052	0.043	0.008	0.261
Investment Risk	235	0.022	0.008	0.084	0.001	0.752
Leverage Risk	235	0.662	0.685	0.126	0.049	0.827
Performance						
Tobin's Q	232	1.066	1.073	0.188	0.335	2.149
ROA	235	0.038	0.037	0.028	-0.064	0.126
ROE	235	0.117	0.113	0.091	-0.257	0.541
Stock Return	232	0.118	0.093	0.266	-0.568	1.261
Corporate Governance						
Bsize	235	10.617	11.000	2.260	5.000	17.000
Insider	235	0.165	0.133	0.083	0.063	0.445
Busy	235	0.268	0.000	0.443	0.000	1.000
Duality	235	0.689	1.000	0.464	0.000	1.000
Institution	229	0.726	0.737	0.162	0.326	1.000
CEO Ownership	232	0.035	0.014	0.057	0.000	0.383
Control Variables						
Size	234	20.832	20.550	1.828	12.391	24.008
ProdHHI	231	0.330	0.242	0.263	0.093	1.000
GeoHHI	230	0.195	0.070	0.271	0.038	1.000
Longtail	229	0.772	0.774	0.143	0.261	1.000
Weak	235	0.022	0.000	0.147	0.000	1.000
Tax	235	0.461	0.445	0.246	-0.504	1.059
Coastal_state	231	0.560	1.000	0.498	0.000	1.000
2year_Loss_Dev	225	-0.037	-0.044	0.133	-0.455	0.554

Table 2. Correlation Matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
1. OC67	1																								
2. Net Buyer	0.083 0.022	1																							
3. Reinsurance	0.196 0.004	0.082 0.230	1																						
4. Total Risk	-0.042 0.538	-0.205 0.002	0.260 <0.0001	1																					
5. Underwriting Risk	-0.379 <0.0001	-0.147 0.029	0.151 0.026	0.368 <0.0001	1																				
6. Investment Risk	-0.017 0.806	-0.192 0.004	0.276 <0.0001	0.577 <0.0001	0.261 <0.0001	1																			
7. Leverage Risk	-0.007 0.914	-0.048 0.480	-0.352 <0.0001	-0.019 0.782	-0.075 0.267	0.013 0.850	1																		
8. Tobins's Q	0.207 0.002	0.040 0.559	-0.163 0.017	-0.125 0.069	-0.090 0.185	-0.172 0.011	0.057 0.396	1																	
9. ROA	0.030 0.662	0.001 0.924	-0.352 <0.0001	-0.044 0.516	0.124 0.068	-0.116 0.086	-0.076 0.263	0.298 <0.0001	1																
10. ROE	0.068 0.321	0.016 0.813	-0.387 <0.0001	-0.039 0.571	0.117 0.084	-0.104 0.126	0.200 0.003	0.343 <0.0001	0.815 <0.0001	1															
11. Return	0.191 0.015	0.025 0.750	0.015 0.848	0.014 0.859	-0.039 0.619	0.008 0.917	0.120 0.128	0.314 <0.0001	0.003 0.971	0.047 0.553	1														
12. Bsize	-0.147 0.029	0.262 <0.0001	-0.030 0.664	-0.034 0.616	-0.227 0.001	0.023 0.732	0.064 0.341	-0.045 0.511	-0.134 0.048	-0.068 0.317	-0.070 0.372	1													
13. Insider	0.138 0.040	-0.020 0.762	0.105 0.125	0.032 0.639	0.100 0.140	0.030 0.654	-0.312 <0.0001	0.113 0.094	0.107 0.115	0.054 0.424	0.058 0.465	0.301 <0.0001	1												
14. Busy	-0.196 0.003	0.091 0.175	-0.316 <0.0001	-0.070 0.298	-0.062 0.362	-0.107 0.113	0.125 0.067	0.273 <0.0001	0.136 0.045	0.170 0.012	0.059 0.457	0.061 0.366	-0.311 <0.0001	1											
15.Duality	-0.160 0.017	-0.149 0.027	-0.462 <0.0001	-0.182 0.007	-0.186 0.006	-0.161 0.017	0.401 <0.0001	-0.126 0.069	0.051 0.451	0.143 0.035	0.051 0.518	-0.038 0.578	-0.142 0.034	0.119 0.077	1										
16. Institution	0.094 0.190	0.133 0.063	0.002 0.977	0.073 0.310	0.165 0.021	-0.121 0.092	0.333 <0.0001	-0.013 0.856	0.159 0.028	0.190 0.008	-0.022 0.794	-0.238 0.001	-0.125 0.082	0.072 0.315	0.117 0.102	1									
17. CEO Ownership	0.177 0.008	0.262 <0.0001	0.099 0.146	-0.047 0.488	-0.104 0.012	-0.006 0.931	-0.019 0.008	0.112 0.073	0.101 0.133	0.098 0.147	0.155 0.048	-0.139 0.039	0.299 <0.0001	-0.177 0.008	0.175 0.010	-0.165 0.020	1								
18. Size	-0.089 0.190	0.233 0.001	-0.491 <0.0001	-0.113 0.097	-0.311 <0.0001	-0.128 0.060	0.407 <0.0001	0.188 0.006	0.174 0.010	0.264 <0.0001	0.044 0.577	0.364 <0.0001	-0.393 <0.0001	0.472 <0.0001	0.346 <0.0001	0.009 0.904	0.126 0.062	1							
19. ProdHHI	-0.172 0.012	-0.087 0.206	-0.321 <0.0001	0.029 0.669	0.301 <0.0001	-0.013 0.849	0.040 0.558	0.185 0.007	0.196 0.004	0.258 0.000	-0.066 0.411	-0.361 <0.0001	0.196 0.004	-0.024 0.725	-0.043 0.535	0.109 0.135	-0.049 0.473	-0.268 <0.0001	1						
20. GeoHHI	-0.156 0.022	-0.307 <0.0001	0.031 0.654	0.017 0.808	0.156 0.022	-0.039 0.575	-0.376 <0.0001	-0.052 0.451	0.095 0.167	0.053 0.442	-0.010 0.903	-0.547 <0.0001	0.296 <0.0001	0.130 0.057	-0.010 0.885	-0.236 0.001	-0.065 0.344	-0.395 <0.0001	0.300 <0.0001	1					
21. Longtail	-0.347 <0.0001	-0.238 0.001	-0.205 0.003	-0.028 0.685	0.180 0.008	-0.003 0.968	0.440 <0.0001	-0.096 0.163	0.020 0.771	0.158 0.020	-0.035 0.664	-0.066 0.334	0.070 0.308	-0.125 0.066	0.172 0.011	0.165 0.023	0.224 0.000	-0.047 0.497	0.456 <0.0001	-0.065 0.348	1				
22. Weak	-0.129 0.057	-0.108 0.103	0.003 0.962	0.013 0.846	0.169 0.012	0.026 0.705	0.078 0.248	-0.070 0.301	-0.069 0.312	-0.030 0.658	-0.007 0.932	-0.065 0.337	-0.014 0.838	-0.053 0.429	0.062 0.354	-0.069 0.338	0.095 0.158	-0.038 0.578	0.096 0.161	-0.003 0.964	0.159 0.020	1			
23. Tax	-0.149 0.027	0.050 0.460	0.005 0.923	-0.103 0.127	0.030 0.652	-0.087 0.195	-0.289 <0.0001	-0.094 0.167	0.285 <0.0001	0.201 0.003	0.022 0.778	0.115 0.088	-0.032 0.640	0.174 0.009	-0.024 0.718	-0.342 <0.0001	0.002 0.473	0.129 0.057	-0.122 0.075	0.037 0.590	-0.025 0.713	0.144 0.032	1		
24. Coast_state	0.164 0.016	0.058 0.390	0.268 <0.0001	0.042 0.541	-0.213 0.002	0.086 0.204	0.109 0.105	-0.098 0.152	-0.151 0.027	-0.072 0.290	0.060 0.449	-0.129 0.057	0.349 <0.0001	-0.078 0.253	0.010 0.887	0.202 0.005	-0.069 0.315	-0.226 0.001	-0.088 0.197	0.175 0.010	0.249 0.002	-0.089 0.190	-0.020 0.765	1	
25. 2year_loss_Dev	0.014 0.844	-0.182 0.008	0.206 0.003	0.086 0.214	0.172 0.012	0.068 0.321	0.170 0.013	0.051 0.460	-0.234 0.001	-0.197 0.004	0.176 0.028	-0.058 0.411	-0.050 0.466	-0.108 0.117	0.023 0.734	-0.095 0.190	0.160 0.019	0.040 0.564	-0.457 <0.0001	-0.081 0.242	-0.027 0.699	0.295 <0.0001	0.039 0.574	-0.057 0.409	1

Note: The table presents the Pearson correlation matrix for all variables. See Table 1 for variable definitions.

Table 3. Regression Results of Risk Taking on CEO Overconfidence Measures

Dependent Variable:	Reinsurance Demand		Total Risk		Underwriting Risk		Investment Risk		Leverage Risk	
	OC67	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
Intercept	3.561***	3.612***	0.042**	0.012***	0.081**	0.082**	-0.312	-0.208**	-1.595***	-1.704***
	(0.000)	(0.000)	(0.039)	(0.000)	(0.046)	(0.042)	(0.241)	(0.038)	(0.000)	(0.000)
OC67(1)	0.053***		-0.048***		-0.020**		-0.024		-0.032***	
	(0.000)		(0.007)		(0.041)		(0.298)		(0.001)	
Net Buyer(2)		0.045**		-0.034***		-0.049**		-0.008		-0.033***
		(0.034)		(0.000)		(0.025)		(0.126)		(0.000)
Bsize	-0.001	-0.002	-0.005	-0.002***	-0.001	-0.006	-0.006	-0.001	-0.002	-0.004***
	(0.853)	(0.674)	(0.115)	(0.000)	(0.543)	(0.106)	(0.267)	(0.150)	(0.759)	(0.005)
Insider	-0.001	-0.001	0.001	0.001	0.002	-0.003*	0.005***	0.002	-0.001	-0.005
	(0.231)	(0.392)	(0.618)	(0.764)	(0.886)	(0.084)	(0.003)	(0.503)	(0.543)	(0.721)
Busy	-0.011	-0.013	-0.012	-0.004	-0.014	-0.005	-0.040	-0.002	-0.009	-0.043**
	(0.707)	(0.642)	(0.188)	(0.184)	(0.163)	(0.802)	(0.122)	(0.675)	(0.796)	(0.025)
Duality	-0.009	-0.017	-0.001	-0.002	-0.003	-0.019	0.010	0.001	0.022	0.005
	(0.625)	(0.367)	(0.868)	(0.505)	(0.733)	(0.198)	(0.279)	(0.244)	(0.410)	(0.175)
Institution	0.056	0.069	-0.007	-0.002	0.065**	0.152***	-0.009	-0.014	-0.061	-0.015
	(0.193)	(0.199)	(0.485)	(0.816)	(0.027)	(0.003)	(0.615)	(0.264)	(0.536)	(0.761)
Size	-0.184***	-0.165***	0.003*	0.003***	0.001	0.006	0.013	0.004	0.005*	0.020***
	(0.000)	(0.000)	(0.084)	(0.002)	(0.920)	(0.206)	(0.260)	(0.447)	(0.088)	(0.009)
Reinsurance			0.004	0.002	0.018	0.133**	0.001	0.003	0.058	0.121**
			(0.241)	(0.772)	(0.267)	(0.027)	(0.154)	(0.764)	(0.623)	(0.033)
ProdHHI	0.213***	0.231***	0.007**	0.034***	0.016***	0.056***	0.043	0.002	0.067	0.013
	(0.000)	(0.001)	(0.012)	(0.000)	(0.009)	(0.002)	(0.475)	(0.108)	(0.459)	(0.775)
GeoHHI	0.455***	0.426***	-0.020**	-0.002	-0.025***	-0.039***	-0.040	-0.099***	-0.032**	-0.067***
	(0.003)	(0.001)	(0.010)	(0.735)	(0.000)	(0.000)	(0.598)	(0.000)	(0.031)	(0.001)
Longtail	-0.615***	-0.593***	-0.032	-0.034***	-0.0533	-0.065	-0.079	-0.037	-0.070	-0.038
	(0.000)	(0.000)	(0.655)	(0.000)	(0.194)	(0.537)	(0.148)	(0.159)	(0.608)	(0.702)
Weak	0.042**	0.045**	0.012**	0.009*	0.036*	0.005	-0.065	0.012**	0.065*	0.046**
	(0.032)	(0.029)	(0.039)	(0.079)	(0.081)	(0.791)	(0.170)	(0.017)	(0.064)	(0.015)
Tax	-0.002	-0.007								
	(0.719)	(0.795)								
Coastal_state	0.003	0.006***								
	(0.226)	(0.002)								
2year_Loss_Dev	0.203***	0.187***								
	(0.000)	(0.001)								
Observations	226	228	233	235	233	235	233	235	233	235
Adjusted R-square	0.636	0.652	0.494	0.486	0.668	0.473	0.491	0.501	0.750	0.792

Note: The table reports the results of two-way fixed effects regressions. See Table 1 for variable definitions. Standard errors are adjusted for heteroskedasticity and within-panel serial correlation. P-values are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.

Table 4. Regression Results of Effect of SOX on CEO Overconfidence Measures and Risk Taking

Dependent Variable:	Reinsurance Demand		Total Risk		Underwriting Risk		Investment Risk		Leverage Risk	
	OC67	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
Intercept	3.709***	3.880***	0.035**	0.013**	0.068***	0.076**	-0.398	-0.223***	-1.761***	-1.362***
	(0.000)	(0.000)	(0.026)	(0.025)	(0.000)	(0.045)	(0.177)	(0.008)	(0.000)	(0.000)
OC67(1)	0.048**		-0.050***		-0.017***		-0.031		-0.036***	
	(0.026)		(0.004)		(0.000)		(0.217)		(0.000)	
SOX (1)	0.039		-0.048**		-0.009		0.031*		-0.012	
	(0.157)		(0.028)		(0.195)		(0.058)		(0.699)	
SOX×OC67(1)	0.048**		-0.031**		-0.020**		0.015**		-0.054**	
	(0.022)		(0.018)		(0.040)		(0.011)		(0.025)	
Net Buyer(2)		0.054**		-0.031***		-0.052**		-0.007		-0.032***
		(0.019)		(0.000)		(0.020)		(0.179)		(0.000)
SOX (2)		0.048		-0.007		-0.005		0.028		-0.006
		(0.118)		(0.178)		(0.165)		(0.121)		(0.117)
SOX ×Net Buyer(2)		0.029		-0.012		-0.048***		0.014***		-0.098***
		(0.318)		(0.109)		(0.002)		(0.010)		(0.000)
Bsize	-0.010	-0.007	-0.006	-0.002	-0.002	-0.006	-0.004	-0.002	-0.003	-0.003***
	(0.133)	(0.212)	(0.132)	(0.173)	(0.515)	(0.144)	(0.154)	(0.135)	(0.610)	(0.005)
Insider	-0.003	-0.002	0.004	0.002	0.001	-0.003*	0.005	0.001	-0.002	-0.006
	(0.471)	(0.235)	(0.183)	(0.617)	(0.801)	(0.064)	(0.109)	(0.739)	(0.241)	(0.259)
Busy	-0.026	-0.019	-0.013	-0.005	-0.016	-0.065**	-0.038	-0.003	-0.010	-0.042**
	(0.461)	(0.312)	(0.290)	(0.385)	(0.160)	(0.030)	(0.125)	(0.155)	(0.221)	(0.021)
Duality	-0.013**	-0.016	-0.009	-0.001	-0.004	-0.020	0.010	0.004	0.023	0.004
	(0.047)	(0.428)	(0.199)	(0.520)	(0.618)	(0.163)	(0.201)	(0.184)	(0.369)	(0.169)
Institution	0.053	0.089	-0.010	-0.002	0.079**	0.137***	-0.006	-0.017	-0.058	-0.014
	(0.179)	(0.216)	(0.207)	(0.342)	(0.023)	(0.007)	(0.195)	(0.120)	(0.145)	(0.581)
Size	-0.190***	-0.175***	0.004**	0.003**	0.010	0.003	0.013**	0.004	0.007***	0.032***
	(0.000)	(0.000)	(0.029)	(0.012)	(0.182)	(0.141)	(0.012)	(0.306)	(0.000)	(0.000)
Reinsurance			0.005	0.003	0.016	0.134**	0.001	0.006**	0.074	0.117***
			(0.208)	(0.147)	(0.214)	(0.023)	(0.150)	(0.035)	(0.282)	(0.000)
ProdHHI	0.269***	0.257***	0.010***	0.040**	0.015**	0.089***	0.046*	0.002	0.067	0.015
	(0.000)	(0.003)	(0.000)	(0.021)	(0.021)	(0.002)	(0.069)	(0.125)	(0.184)	(0.108)
GeoHHI	0.498***	0.379***	-0.021**	-0.003**	-0.014***	-0.024***	-0.034***	-0.090***	-0.043***	-0.059***
	(0.000)	(0.005)	(0.045)	(0.034)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Longtail	-0.665***	-0.563***	-0.032	-0.041**	-0.050	-0.062	-0.080	-0.034	-0.062	-0.038
	(0.000)	(0.000)	(0.124)	(0.049)	(0.227)	(0.556)	(0.110)	(0.141)	(0.215)	(0.688)
Weak	0.050**	0.046	0.016***	0.010*	0.037*	0.006	-0.067	0.0178**	0.068	0.049***
	(0.028)	(0.132)	(0.002)	(0.086)	(0.076)	(0.228)	(0.105)	(0.014)	(0.261)	(0.007)
Tax	-0.006	-0.004								
	(0.302)	(0.190)								
Coastal_state	0.003	0.005								
	(0.238)	(0.143)								
2year_Loss_Dev	0.286***	0.186***								
	(0.001)	(0.002)								
Observations	226	228	233	235	233	235	233	235	233	235
Adjusted R-square	0.671	0.635	0.490	0.474	0.669	0.696	0.501	0.477	0.672	0.605

Note: The table reports the results of two-way fixed effects regressions. See Table 1 for variable definitions. Standard errors are adjusted for heteroskedasticity and within-panel serial correlation. P-values are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.

Table 5. Regression Results of Financial Crisis on CEO Overconfidence Measures and Risk Taking

Dependent Variable:	Δ Reinsurance Demand		Δ Total Risk		Δ Underwriting Risk		Δ Investment Risk		Δ Leverage Risk	
	OC67	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
Intercept	3.174***	2.406***	-0.132	-0.381	0.398	0.735	0.207	0.043	3.002**	2.751***
	(0.000)	(0.000)	(0.219)	(0.161)	(0.422)	(0.171)	(0.175)	(0.528)	(0.048)	(0.008)
OC67(1)	0.134		-0.019***		-0.025		-0.026**		-0.233**	
	(0.115)		(0.004)		(0.409)		(0.018)		(0.013)	
Net Buyer(2)		0.272		-0.051**		-0.044		-0.003		-0.407***
		(0.119)		(0.011)		(0.365)		(0.715)		(0.000)
Bsize	-0.016**	-0.012	-0.004	-0.016	-0.010	-0.030	-0.003	-0.005	-0.027	-0.013
	(0.013)	(0.207)	(0.417)	(0.281)	(0.730)	(0.155)	(0.285)	(0.304)	(0.341)	(0.276)
Insider	-0.007	-0.004	0.009	0.006	0.006	0.004*	0.008	0.004	-0.004	-0.011
	(0.244)	(0.306)	(0.231)	(0.541)	(0.645)	(0.083)	(0.258)	(0.424)	(0.584)	(0.722)
Busy	-0.019	-0.007	-0.004	-0.007	-0.047	-0.043	-0.013	-0.010	-0.014	-0.135***
	(0.292)	(0.390)	(0.657)	(0.255)	(0.271)	(0.344)	(0.357)	(0.178)	(0.301)	(0.003)
Duality	-0.047	-0.022	-0.005	-0.019	-0.042	-0.013***	0.009	0.007	0.108	0.362***
	(0.401)	(0.598)	(0.572)	(0.459)	(0.221)	(0.000)	(0.489)	(0.187)	(0.318)	(0.000)
Institution	0.044	0.158	-0.041	-0.016	0.262**	0.019	-0.015***	-0.012***	-0.067***	-0.083
	(0.178)	(0.280)	(0.126)	(0.187)	(0.031)	(0.136)	(0.000)	(0.000)	(0.000)	(0.505)
Size	-0.135***	-0.132***	0.004***	0.002***	0.005	0.028	0.006	0.003	0.084**	0.017
	(0.000)	(0.000)	(0.000)	(0.000)	(0.198)	(0.147)	(0.174)	(0.172)	(0.048)	(0.158)
Reinsurance			0.005	0.020	0.036	0.127	0.008	0.011	0.139	0.147**
			(0.119)	(0.385)	(0.211)	(0.158)	(0.176)	(0.305)	(0.191)	(0.048)
ProdHHI	0.463***	0.395***	0.027*	0.008***	0.031***	0.045**	0.007	0.019	0.305	0.454*
	(0.004)	(0.000)	(0.097)	(0.009)	(0.000)	(0.032)	(0.121)	(0.154)	(0.198)	(0.098)
GeoHHI	0.611**	0.710***	-0.050***	-0.028	-0.021	-0.083***	-0.022***	-0.031	-0.131	-0.123
	(0.018)	(0.000)	(0.007)	(0.759)	(0.102)	(0.000)	(0.000)	(0.169)	(0.222)	(0.260)
Longtail	-0.159***	-0.290**	-0.093***	-0.015*	-0.107	-0.081	-0.038	-0.045**	-0.330	-0.437
	(0.000)	(0.011)	(0.003)	(0.084)	(0.464)	(0.549)	(0.406)	(0.040)	(0.463)	(0.547)
Weak	0.047	0.036	0.007***	0.005	0.026	0.028**	0.036**	0.012	0.025**	0.045*
	(0.137)	(0.206)	(0.000)	(0.178)	(0.732)	(0.016)	(0.015)	(0.798)	(0.029)	(0.060)
Tax	-0.154	-0.156								
	(0.168)	(0.290)								
Coastal_state	0.012**	0.025**								
	(0.027)	(0.021)								
2year_Loss_Dev	0.392***	0.260***								
	(0.000)	(0.000)								
Observations	24	26	24	26	24	26	24	26	24	26
Adjusted R-square	0.727	0.789	0.643	0.641	0.503	0.495	0.597	0.587	0.771	0.724

Note: The table reports the results of cross-sectional regressions. See Table 1 for variable definitions. Standard errors are adjusted for heteroskedasticity and within-panel serial correlation. P-values are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.

Table 6. Regression Results of Firm Performance on CEO Overconfidence Measures

Dependent Variable:	**Tobin's Q**		**ROA**		**ROE**		**Stock Return**	
	OC67	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
Intercept	0.353**	0.271***	0.059	0.110	-0.014	-0.273**	-1.124	-1.963**
	(0.000)	(0.000)	(0.305)	(0.211)	(0.714)	(0.045)	(0.139)	(0.011)
OC67(1)	0.071**		0.014**		0.035**		0.165**	
	(0.013)		(0.042)		(0.043)		(0.038)	
Net Buyer(2)		0.127***		0.020**		0.072**		0.292***
		(0.000)		(0.047)		(0.040)		(0.001)
Bsize	0.003	0.004	0.002	0.001	0.004	0.002	-0.018**	-0.026***
	(0.198)	(0218)	(0.920)	(0.154)	(0.121)	(0.227)	(0.015)	(0.000)
Insider	-0.008**	-0.004	0.003	0.001	0.001*	0.008	-0.002	0.003
	(0.025)	(0.125)	(0.184)	(0.154)	(0.097)	(0.617)	(0.800)	(0.160)
Busy	0.015	0.126***	0.004	0.016*	0.034	0.032	0.060***	0.029*
	(0.793)	(0.000)	(0.294)	(0.095)	(0.142)	(0.168)	(0.000)	(0.085)
Duality	0.016	0.015	0.003	0.004	0.015	0.027	0.021*	0.038***
	(0.695)	(0.199)	(0.764)	(0.187)	(0.391)	(0.240)	(0.094)	(0.002)
Institution	0.067	0.157**	0.019	0.019	0.017	0.108	0.043**	0.370***
	(0.634)	(0.035)	(0.247)	(0.169)	(0.779)	(0.184)	(0.023)	(0.002)
Size	0.020**	0.020	0.002	0.005	0.006	0.052**	0.065*	0.064**
	(0.029)	(0.245)	(0.108)	(0.535)	(0.132)	(0.039)	(0.097)	(0.046)
Reinsurance	-0.162	-0.118	-0.010**	-0.064**	-0.037***	-0.139	-0.191	-0.435
	(0.362)	(0.178)	(0.024)	(0.023)	(0.000)	(0.148)	(0.974)	(0.162)
ProdHHI	0.054	0.211***	0.014	0.068***	0.030**	0.307***	0.196***	0.318
	(0.103)	(0.003)	(0.235)	(0.003)	(0.047)	(0.000)	(0.004)	(0.160)
GeoHHI	0.107	0.024	0.005	0.077**	0.028	0.273**	0.438*	0.115***
	(0.209)	(0.852)	(0.198)	(0.013)	(0.145)	(0.041)	(0.071)	(0.000)
Longtail	-0.166	-0.004	-0.013	-0.063	-0.049	-0.188	-0.177	-0.185***
	(0.428)	(0.979)	(0.426)	(0.201)	(0.567)	(0.263)	(0.787)	(0.000)
Weak	0.016	0.006	-0.037***	-0.012	-0.013***	-0.040	-0.051***	-0.065
	(0.450)	(0.106)	(0.008)	(0.223)	(0.000)	(0.218)	(0.000)	(0.104)
Observations	226	228	226	228	226	228	226	228
Adjusted R-square	0.343	0.431	0.570	0.591	0.602	0.592	0.401	0.517

Note: The table reports the results of two-way fixed effects regressions. See Table 1 for variable definitions. Standard errors are adjusted for heteroskedasticity and within-panel serial correlation. P-values are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.

Table 7. Comparison of Abnormal Returns between Firms with Overconfident CEOs and non-Overconfident CEOs

CEO Overconfidence		Fama-French Three-Factor Model				Carhart Four-Factor Model				
		α	b	s	h	α	b	s	h	m
Panel A: Option holdings-based measure										
Equal Weight	OC CEOs	0.006***	0.958***	0.570**	-0.354***	0.007***	0.947***	0.552***	-0.359***	-0.038
		(2.74)	(34.06)	(2.45)	(-3.05)	(2.92)	(34.51)	(3.42)	(-3.85)	(-1.35)
	Non-OC CEOs	-0.001	0.945***	0.559	-0.311	-0.002	0.936***	0.509	-0.331	-0.029
		(-1.43)	(38.14)	(1.87)	(-1.32)	(-1.65)	(38.70)	(1.46)	(-1.46)	(-0.86)
	Difference	0.007***	0.013	0.011	-0.043**	0.009***	0.011	0.043***	-0.028*	-0.009
		(2.80)	(1.53)	(1.64)	(-2.10)	(3.35)	(1.55)	(2.94)	(-1.84)	(-1.45)
Value Weight	OC CEOs	0.006***	0.945***	0.612**	-0.386	0.008***	0.950***	0.615**	-0.377**	-0.029
		(2.95)	(31.12)	(2.43)	(-1.57)	(3.25)	(30.13)	(2.43)	(-2.13)	(-1.47)
	Non-OC CEOs	0.001	0.941***	0.602	-0.371	0.001	0.938***	0.590***	-0.312*	-0.022
		(1.19)	(33.45)	(1.25)	(-1.62)	(1.07)	(34.72)	(3.25)	(-1.81)	(-0.85)
	Difference	0.005**	0.004	0.010	-0.015	0.007**	0.012	0.025*	-0.065***	-0.007
		(2.43)	(0.80)	(1.47)	(-1.15)	(2.57)	(1.64)	(1.85)	(-3.13)	(-1.16)
Panel B: Net stock purchase-based measure										
Equal Weight	OC CEOs	0.007***	0.947***	0.634**	-0.407**	0.007***	0.943***	0.642***	-0.428***	-0.103
		(3.06)	(36.55)	(2.19)	(-3.08)	(3.04)	(33.73)	(2.63)	(-3.51)	(-1.22)
	Non-OC CEOs	0.001	0.932***	0.607	-0.399	0.002	0.935***	0.633	-0.413	-0.098
		(1.08)	(38.23)	(1.55)	(-1.21)	(1.32)	(30.29)	(1.30)	(-1.53)	(-1.06)
	Difference	0.006**	0.015*	0.027**	-0.008	0.005**	0.008	0.009	-0.015*	-0.005
		(2.51)	(1.73)	(2.07)	(-0.75)	(2.23)	(1.30)	(1.22)	(-1.70)	(-1.05)
Value Weight	OC CEOs	0.006***	0.949***	0.629**	-0.424	0.005***	0.940***	0.673***	-0.416	-0.106
		(3.35)	(39.20)	(2.18)	(-1.18)	(2.68)	(34.74)	(2.76)	(-1.16)	(-1.19)
	Non-OC CEOs	0.001	0.930***	0.624	-0.421	0.002	0.937***	0.667	-0.406	-0.094*
		(1.19)	(33.98)	(1.53)	(-1.44)	(1.40)	(30.67)	(1.48)	(-1.32)	(-1.95)
	Difference	0.005**	0.019*	0.005	-0.003	0.003**	0.003	0.006	-0.010	-0.012
		(2.48)	(1.80)	(0.88)	(-0.62)	(2.04)	(0.40)	(1.03)	(-1.05)	(-1.60)

Note: The table presents the abnormal returns for the sample firms based on the Fama-French three-factor model (1993) and the Carhart (1997) four-factor model. OC CEOs and Non-OC CEOs refer to firms with overconfident CEOs and non-overconfident CEOs, respectively. In parentheses are t-statistics adjusted for serial correlation and heteroscedasticity. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.

Table 8. Comparison of Reinsurance Demand between Firms with Overconfident CEOs and non-Overconfident CEOs

Reinsurance Demand			
	Mean		Mean
Overconfident CEOs (*OC 67*)	0.249	Overconfident CEOs (*OC 75*)	0.277
Non-Overconfident CEOs	0.150	Non-Overconfident CEOs	0.147
Difference	0.099**	Difference	0.130***
(t-statistic)	(2.33)	(t-statistic)	(2.94)
Overconfident CEOs (*Net Buyer 50*)	0.231	Overconfident CEOs (*Net Buyer 80*)	0.263
Non-Overconfident CEOs	0.149	Non-Overconfident CEOs	0.141
Difference	0.082**	Difference	0.122***
(t-statistic)	(2.15)	(t-statistic)	(2.87)

Note: The table reports the results of the difference in the average of reinsurance demand between overconfident and non-overconfident CEOs. Average of insurer's reinsurance demand for overconfident CEOs is calculated for each five-year window, starting from the first year when they hold options at least 67 percent in the money or the first year when they are net buyers of their firm's stock. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.

Table 9. Trends of CEO Option Holdings and Stock Ownership

Average Percentage Change in Option Holding			Average Percentage Change in Stock Ownership	
		Mean (%)		Mean (%)
One-year (AVG t to t+1)	Overconfident CEOs (*OC 67*)	51.5	Overconfident CEOs (*Net Buyer*)	61.2
	Non-Overconfident CEOs	22.8	Non-Overconfident CEOs	26.4
	Difference	28.7**	Difference	34.8**
	(t-statistic)	(2.12)	(t-statistic)	(2.30)
Three-year (AVG t to t+3)	Overconfident CEOs (*OC 67*)	82.0	Overconfident CEOs (*Net Buyer*)	94.1
	Non-Overconfident CEOs	31.7	Non-Overconfident CEOs	39.0
	Difference	50.3***	Difference	55.1***
	(t-statistic)	(2.81)	(t-statistic)	(2.95)
Five-year (AVG t to t+5)	Overconfident CEOs (*OC 67*)	123.6	Overconfident CEOs (*Net Buyer*)	131.7
	Non-Overconfident CEOs	57.2	Non-Overconfident CEOs	61.4
	Difference	66.4***	Difference	70.3***
	(t-statistic)	(3.37)	(t-statistic)	(3.45)

Note: The table reports the results of the average percentage changes in option holdings and stock ownership for overconfident and non-overconfident CEOs. Average percentage increase in CEO option holdings and stock ownership is computed for one-year, three-year and five-year period, beginning from the first year when they hold options at least 67 percent in the money or the first year when they are net buyers of their firm's stock. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively

Table 10. 2SLS Regression Results of Risk Taking on CEO Overconfidence Measures

Dependent Variable:	Reinsurance Demand		Total Risk		Underwriting Risk		Investment Risk		Leverage Risk	
	OC67	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
Intercept	0.598***	2.060***	0.029***	0.037***	0.101***	0.085**	0.043***	0.044***	-0.762***	-0.223***
	(0.000)	(0.000)	(0.003)	(0.008)	(0.007)	(0.025)	(0.005)	(0.000)	(0.000)	(0.003)
OC67(1)	0.151***		-0.112**		-0.031***		-0.111		-0.005	
	(0.001)		(0.033)		(0.000)		(0.267)		(0.742)	
Net Buyer(2)		0.153**		-0.066**		-0.040**		-0.051		-0.031**
		(0.036)		(0.031)		(0.024)		(0.292)		(0.029)
Bsize	-0.010***	-0.010	-0.001	-0.003	-0.001	-0.005	-0.005	-0.002	-0.001	-0.011
	(0.006)	(0.155)	(0.886)	(0.189)	(0.631)	(0.210)	(0.289)	(0.195)	(0.703)	(0.227)
Insider	-0.016	-0.006***	0.001	0.001***	0.001	-0.001	0.003	0.083	-0.001	-0.002
	(0.304)	(0.000)	(0.184)	(0.000)	(0.110)	(0.267)	(0.205)	(0.109)	(0.784)	(0.454)
Busy	-0.114	-0.029	-0.010	-0.005	-0.002	-0.018	-0.060**	-0.009**	-0.019	-0.016**
	(0.650)	(0.407)	(0.405)	(0.433)	(0.240)	(0.441)	(0.046)	(0.029)	(0.228)	(0.047)
Duality	-0.098	-0.056	-0.017	-0.018	-0.002	-0.010	0.028	0.020	0.020**	0.015
	(0.660)	(0.114)	(0.421)	(0.129)	(0.176)	(0.706)	(0.478)	(0.143)	(0.044)	(0.337)
Institution	0.062	0.113	-0.141***	-0.023	0.030**	0.281***	-0.056	-0.077***	-0.073**	-0.123
	(0.265)	(0.254)	(0.007)	(0.425)	(0.037)	(0.000)	(0.437)	(0.003)	(0.025)	(0.159)
Size	-0.033***	-0.099	0.035	0.041**	0.001	0.002	0.028	0.033	0.003	0.048**
	(0.000)	(0.196)	(0.199)	(0.043)	(0.505)	(0.720)	(0.195)	(0.207)	(0.630)	(0.037)
Reinsurance			0.052	0.058	0.014	0.215***	0.054	0.030	0.011	0.108
			(0.210)	(0.142)	(0.281)	(0.000)	(0.276)	(0.289)	(0.660)	(0.167)
ProdHHI	0.690	0.247***	0.073***	0.037***	0.027	0.172	0.107	0.034***	0.015	0.047
	(0.158)	(0.000)	(0.000)	(0.002)	(0.200)	(0.781)	(0.116)	(0.000)	(0.122)	(0.274)
GeoHHI	0.353***	0.189**	-0.069**	-0.031	-0.001**	-0.363***	-0.068	-0.022	-0.155	-0.099***
	(0.000)	(0.050)	(0.012)	(0.251)	(0.012)	(0.000)	(0.265)	(0.217)	(0.745)	(0.004)
Longtail	-0.234	-0.007	-0.100	-0.109***	-0.091**	-0.065	-0.042	-0.038	-0.067	-0.003
	(0.358)	(0.186)	(0.154)	(0.005)	(0.037)	(0.620)	(0.657)	(0.887)	(0.253)	(0.787)
Weak	0.152	0.053	0.034	0.006	0.019	0.048**	-0.004	-0.013	0.020	0.018
	(0.655)	(0.126)	(0.118)	(0.106)	(0.135)	(0.039)	(0.487)	(0.178)	(0.304)	(0.471)
Tax	-0.416	-0.038								
	(0.316)	(0.424)								
Coastal_state	0.0208	0.048**								
	(0.507)	(0.025)								
2year_Loss_Dev	0.451***	0.098**								
	(0.000)	(0.039)								
Observations	226	228	233	235	233	235	233	235	233	235
Adjusted R-square	0.432	0.549	0.491	0.478	0.563	0.493	0.482	0.532	0.487	0.449

Note: The table reports the results of 2SLS regressions. See Table 1 for variable definitions. Standard errors are adjusted for heteroskedasticity and within-panel serial correlation. P-values are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.

Table 11. Regression Results of Risk Taking on CEO Overconfidence Measures (with CEO equity ownership)

Dependent Variable:	**Reinsurance Demand**		**Total Risk**		**Underwriting Risk**		**Investment Risk**		**Leverage Risk**	
	OC67	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*	*OC67*	*Net Buyer*
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
Intercept	3.155***	3.221***	0.032**	0.015***	0.076***	0.089***	-0.151	-0.363**	-2.388***	-1.718***
	(0.000)	(0.000)	(0.022)	(0.000)	(0.000)	(0.000)	(0.505)	(0.041)	(0.005)	(0.000)
OC67(1)	0.057**		-0.045***		-0.031**		-0.028		-0.043***	
	(0.012)		(0.003)		(0.024)		(0.450)		(0.002)	
Net Buyer(2)		0.032**		-0.031***		-0.054**		-0.006		-0.037***
		(0.038)		(0.000)		(0.013)		(0.480)		(0.000)
CEO Ownership	-0.004**	-0.003***	-0.005***	-0.007***	-0.004**	-0.010**	-0.002**	-0.009***	-0.015***	-0.012***
	(0.015)	(0.007)	(0.000)	(0.002)	(0.029)	(0.025)	(0.043)	(0.003)	(0.000)	(0.000)
Board-related controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm-related controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	226	228	233	235	233	235	233	235	233	235
Adjusted R-square	0.647	0.681	0.499	0.492	0.683	0.495	0.504	0.537	0.805	0.839

Note: The table reports the results of two-way fixed effects regressions. See Table 1 for variable definitions. Standard errors are adjusted for heteroskedasticity and within-panel serial correlation. P-values are reported in parentheses. ***, ** and * represent statistical significance at 0.01, 0.05, and 0.10 level, respectively.