CEO Compensation and Internal Capital Markets in the U.S. Property-Liability Insurance Industry

Abstract

This paper examines the relationship between CEO compensation and internal capital market efficiency in the U.S. property-liability insurance industry for the period 2000-2015. The results indicate that a CEO's total equity ownership has a significant and positive influence on the efficiency of internal capital allocation. However, this incentive would be lowered if unvested equity comprises a large proportion of total equity holdings. In addition, I find evidence of a non-linear relationship between efficiency and the size of internal capital markets. Internal capital markets should continue to expand as long as the benefit of relaxing credit constraints is greater than the cost of managing large internal capital markets. The results of a subsample analysis show that a CEO's incentive for efficient internal capital allocation is different depending on the type of compensation, the size of internal capital markets, and external events such as the global financial crisis. These findings are robust to corrections for potential endogeneity bias. Overall, the result of the study is consistent with the view that better alignment of CEO incentives with shareholder interests leads to efficient internal capital allocation.

Key Words: CEO compensation, Internal capital markets, Property-liability insurance

1. Introduction

Although the internal capital market in conglomerate firms has been studied for many years, there is still no consensus among researchers about the efficiency of internal capital markets. Internal capital is generally thought to be less costly than external capital because outside investors know less about investment opportunities than managers inside the firm (Myers and Majluf, 1984). However, allocating internal capital efficiently and increasing firm value depend on managerial discretion. Stein (1997) argues that headquarters could create value by engaging in "winner picking" and allocating capital to divisions where returns are highest. On the other hand, "socialism" in internal capital markets is severe when the incentives of managers at the headquarters are misaligned with those of outside investors (Scharfstein and Stein, 2000). Ozbas and Scharfstein (2009) find evidence of inefficient investment behavior within conglomerates due to agency problems at the chief executive officer (CEO) level. Thus, the decision about allocating internal capital to segments with the highest value-added projects will depend on the discretion of the managers at the headquarters.

This study starts by questioning whether CEO compensation is related to internal capital market efficiency, and whether it is used as a means of mitigating agency problems between the CEO and shareholders. I regard the CEO as the representative of the top managers at headquarters making capital allocation decisions. Since the internal capital market in the U.S. property-liability insurance industry is proven to be active and efficient (Powell, Sommer, and Eckles, 2008), CEO compensation could be an effective tool preventing CEOs from misallocating internal resources and reducing agency conflicts between managers and shareholders. Datta, D'Mello, and Iskandar-Datta (2009) empirically show that CEO incentive compensation plays a fundamental role in determining internal capital market allocation efficiency; CEO equity-based compensation is effective in mitigating inefficiencies in allocating internal capital and is positively related to the

excess value of diversified firms.[1]

However, they do not consider the potential endogeneity problem that enhancement of internal capital market efficiency could lead to an increase in the CEO's equity ownership. This study tests the relationship between CEO compensation and internal capital markets in the property-liability insurance industry using a different measure than Datta, D'Mello, and Iskandar-Datta (2009); also this study takes into account the potential endogeneity issue. Whereas Datta, D'Mello, and Iskandar-Datta (2009) test their hypotheses using segment-level data of diversified firms, I use affiliate-level data of property-liability insurers. Insurer groups are prevalent in the U.S. insurance industry, and a grouping structure creates an active internal capital market within the group, such that the holding company allocates capital across affiliated insurers.

To increase investment, insurers must increase capital, increase reinsurance, alter its loss exposure, or accept an increase in the probability of insolvency (Powell, Sommer, and Eckles, 2008). Increasing capital (or reinsurance) may be accomplished within internal capital markets in the form of reinsurance ceded to affiliates or other intragroup capital transactions. Internal capital market transactions among members of insurance groups and holding companies are reported in statutory filings, the National Association of Insurance Commissioner's (NAIC) regulatory annual statements. Specifically, the proxy for internal capital market efficiency is measured using the data regarding reinsurance premiums assumed from affiliates and reinsurance ceded to affiliates.[2]

For a sample of 382 firm-year observations during the period 2000-2015, I find evidence that a CEO's total equity ownership has a positive relationship with internal capital market

[1] Datta, D'Mello, and Iskandar-Datta (2009) employ the definition of excess value by Berger and Ofek (1995) and estimate excess value of multi-segment firms with capital-to-sales multiples. Excess value is the natural log of the ratio of a firm's market value to imputed value; the firm's market value is book values of assets plus the difference between market value and book value of equity; the firm's imputed value is the sum of each segment's market value, which is defined as a segment's sales value multiplied by the multiple of the matched firm's total capital to sales.

[2] Reinsurance transactions between affiliates are reported in the Underwriting and Investment Exhibit Part 2B - Premiums Written in the NAIC annual statement.

efficiency. If CEOs hold more equity, they are more likely to enhance internal capital market efficiency. This finding is consistent with Datta, D'Mello, and Iskandar-Datta (2009) and robust to corrections for potential endogeneity bias. The results also reveal that unvested equity ownership is negatively related to internal capital market efficiency, suggesting that CEOs' incentives for efficient internal capital allocation would be reduced if unvested equity comprises a large proportion of total equity holdings. Perhaps, this may be caused by a mismatch between the CEO's incentives in the short run and the graded vesting schedule; CEOs would be reluctant to take actions that could lead to the stock price fall at the time of vesting (i.e., CEOs preference for investments could change due to unvested equity holdings).

The results of a subsample analysis regarding the size of internal capital markets show that there are differences in the impact of CEO compensation on internal capital market efficiency. When insurers have small internal capital markets, all types of CEO compensation except for unvested equity holdings provide incentives for CEOs to manage internal capital markets efficiently. In insurers with large internal capital markets, the CEO's cash compensation and equity compensation are negatively related to efficiency, whereas CEO's equity ownership is positively related to efficiency.

In addition, I find different impacts of compensation on efficiency from the global financial crisis; no compensation variables are related to internal capital market efficiency during the crisis period, while the positive influence of CEO total equity ownership on efficiency is found during the non-crisis period. Perhaps this is because the role of CEO compensation as a means of aligning CEOs' interests with shareholders' interests was weakened during the crisis. The reduced incentives of CEO compensation can be such that CEOs care more about survival the crisis than their private benefits, and that a large proportion of options granted to CEOs were out of the money in the stock market fell in 2008.

Furthermore, this study provides evidence that the relationship between the size of internal capital markets and internal capital market efficiency is not linear. This result is consistent with Stein (1997), who argues that the optimal size of the internal capital market depends on the tradeoff between the tightness of credit constraints and monitoring quality. This finding is also in line with the argument by Matsusaka and Nanda (2002) that internal capital markets have a low value if a firm has scarce internal resources or enough internal resources to fund all investment. They show a non-monotonic relationship between the value of internal capital markets and the quantity of internal resources in their model.

The internal capital markets in various industries have been examined in many studies, but there are a limited number of studies regarding the relationship between internal capital market efficiency and CEO compensation. Most of the internal capital market studies are focused on the existence of active internal capital markets and the efficiency of the internal capital market activities. Therefore, this study will contribute to the internal capital market literature by providing empirical evidence that CEO compensation is one of the determinants of the efficiency of internal capital allocation in U.S. property-liability insurance companies. Furthermore, the results of this study have implications not only for investors to align CEOs' interests with those of investors, but for regulators to set up and evaluate regulations regarding executive compensation and inter-company transactions.

The remainder of this paper is organized as follows. Section 2 reviews the prior theoretical and empirical literature regarding internal capital markets and CEO compensation in the property-liability insurance industry. Section 3 develops hypotheses. Section 4 presents the data and sample selection. Section 5 introduces the internal capital market efficiency measure, models, and variables. In Section 6, the empirical results are analyzed. Section 7 concludes.

2. Literature Review

2.1. Internal Capital Markets

Many studies have discussed the role of internal capital markets in corporate value creation. There are two strands of literature on the efficiency of internal capital markets. The first and the older strand supports the notion that there are efficiency gains from utilizing internal capital markets. Conglomeration may improve financial efficiency by creating internal capital markets because management can efficiently redeploy the assets of poorly performing projects (Williamson, 1975; Gertner, Scharfstein, and Stein, 1994; Stein, 1997). In the Stein (1997) model, headquarters create value by engaging in "winner picking" and allocating capital to divisions having the highest returns on investment.

Information asymmetry and agency costs make external financing costly, and internal capital markets are less affected by capital market frictions. In this context, Matsusaka and Nanda (2002) develop a model to examine the effect of relative efficiencies of internal and external capital markets on the form of organization. They argue that the optimal level of diversification is determined by trading off the benefit of an option to avoid external capital markets against the cost of overinvestment.

There also exists empirical evidence of efficient internal capital markets. Internal capital markets in the discount retailing industry are found to be active and efficient (Khanna and Tice, 2001). In large bank holding companies, internal capital markets tend to play an efficiency-enhancing role (Campello, 2002). Using plant-level data, Maksimovic and Phillips (2002) provide evidence that conglomerates make optimal resource allocation decisions and are not subsidizing less productive segments using resources from other segments at the manufacturing plant level. Kuppuswamy and Villalonga (2015) use the efficiency measure devised by Rajan, Servaes, and Zingales (2000) and provide evidence of the increased efficiency of internal capital markets during the 2008-2009 financial crisis.

In the insurance industry, Powell, Sommer, and Eckles (2008) find a positive relationship between investments and internal capital transfers, suggesting that internal capital transactions play an economically significant role in the investment decisions for affiliated insurers. Furthermore, they show that internal capital markets are utilized to provide internal capital to the affiliates with the best investment opportunities. Additionally, Fier, McCullough, and Carson (2013) provide empirical evidence that the internal capital market activity is used to manage deviations from target leverage in property-liability insurers.

The other strand of the internal capital market literature suggests that there are inefficient internal capital markets in multi-segment firms leading to value destruction. Many researchers reason that the misallocation of internal capital arises from managerial agency problems. Rent seeking behaviors of divisional managers cause overinvestment and an underinvestment problem, leading to cross-subsidization among divisions (Scharfstein and Stein, 2000; Meyer, Milgrom, and Roberts, 1992). Scharfstein and Stein (2000) incorporate both divisional manager–CEO agency conflicts and CEO–outside investor agency conflicts into their model to examine inefficient cross-subsidies in internal capital markets. Rajan, Servaes, and Zingales (2000) develop a model and provide empirical evidence that internal resources flow toward the most inefficient division as diversity in resources and opportunities increase.

The inefficiency of internal capital markets is examined empirically. Lamont (1997) finds that oil companies significantly reduced non-oil investment when oil price decreased, suggesting that non-oil divisions were subsidized by the profit from oil divisions. Shin and Stulz (1998) also provide evidence of inefficient internal capital markets by showing that divisional investment is affected by the cash flow shortfall of other divisions regardless of the value of its investment opportunities. Ozbas and Scharfstein (2009) document that the investment of stand-alone firms is

more sensitive to industry Q if managers of conglomerate firms have small ownership stakes.[3] They thus argue that "inefficient investment behavior of conglomerate firms is at least in part due to agency problems at the top of conglomerates" (p. 596).

Whereas the internal capital market has been studied theoretically and empirically in a wide range of industries, there is little empirical research focusing on the relationship between internal capital allocation and executive compensation. Datta, D'Mello, and Iskandar-Datta (2009) document that CEO's equity-based incentives play an important role in more efficient internal capital markets. They support the argument by Scharfstein and Stein (2000) that CEOs derive private benefits with increases in internal capital misallocation.

Many studies regarding the compensation in the insurance industry are mainly focused on organizational structures and corporate governance. Mayers and Smith (1992) find differential compensation levels between executives of mutual and stock insurance companies; executive compensation of mutual companies is lower and less responsive to firm performance than those of stock companies. There exists a significant and positive association between return on assets and the level of compensation for executives in publicly-held insurers (Ke, Petroni, and Safieddine, 1999). Wilson and Higgins (2001) suggest that total compensation in the insurance industry is sensitive to both market returns and firm size. For a sample of property-liability insurance executives, Grace (2004) finds that managers in bigger and riskier companies receive greater incentive compensation as a percentage of total compensation, but there is limited evidence that incentive compensation increases significantly with an insurer's investment opportunities.

2.2. Internal Capital Market Efficiency Measures

In terms of internal capital market efficiency measures, Rajan, Servaes, and Zingales (2000) measure the relative value of a diversified firm by incorporating both firm and industry

[3] "Q" measures the responsiveness of capital expenditures to industry investment opportunities.

adjustments. Since they do not have direct data on the funds transferred across divisions, they use the data of single-segment firms in the corresponding industry. The "relative value added by allocation" is defined as follows (p. 66): $\frac{\sum_{j=1}^{n} BA_j\left(q_j-\bar{q}\right)\left(\frac{I_j}{BA_j}-\frac{I_j^{SS}}{BA_j^{SS}}-\sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j}-\frac{I_j^{SS}}{BA_j^{SS}}\right)\right)}{BA}$, where q_j is the asset-weighted Q of single-segment firms operating exclusively in segment j, and $\bar{q}$ is the asset-weighted average of segment Qs for the firm. Thus $\left(q_j-\bar{q}\right)$ captures the relative level of investment opportunities for segment j. I_j is the capital expenditure of segment j, BA_j is the book value of assets of segment j, $\frac{I_j}{BA_j}$ is the capital expenditure to assets ratio of segment j, and $\frac{I_j^{SS}}{BA_j^{SS}}$ is the capital expenditure to assets ratio for single-segment firms in the corresponding industry. Therefore, $\left(\frac{I_j}{BA_j}-\frac{I_j^{SS}}{BA_j^{SS}}\right)$ is an industry-adjusted investment ratio, and $\sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j}-\frac{I_j^{SS}}{BA_j^{SS}}\right)$ represents the asset-weighted industry-adjusted investment ratio across the segments of the firm; w_j is segment j's share of total firm assets. They call $\left(\frac{I_j}{BA_j}-\frac{I_j^{SS}}{BA_j^{SS}}-\sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j}-\frac{I_j^{SS}}{BA_j^{SS}}\right)\right)$ "the adjusted investment ratio," which is the proxy for the transfers that the segment makes or receives (p.58). In sum, they measure the relative efficiency of internal allocation of each segment in a diversified firm relative to single-segment firms in the corresponding industry. The relative efficiency is decided by whether a segment with better than average Q in the firm invests more or less compared to other segments in the firm. Then, each segment's relative efficiency is aggregated to the firm level weighted by the segment's book value of assets, representing the diversified firm's overall efficiency of internal allocation.

Datta, D'Mello, and Iskandar-Datta (2009) use three measures of internal capital market efficiency; the industry-adjusted value added, the relative value added, and the absolute value added from internal capital allocations. The latter two measures are consistent with the measures

of Rajan, Servaes, and Zingales (2000). The "industry-adjusted value added" measure is defined as follows (p. 246). RVIA $= \sum_{j=1}^{n} w_j \left(q_j - \bar{q}\right) \left(\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i}\right)$, where w_j is the proportion of segment j's book value of assets to firm assets, $\bar{q}$ is the mean asset-weighted q_j's of the firm, and q_j is segment j's q, which is proxied by the mean asset-weighted Tobin's q of single segment firms operating in the same three-digit SIC industry as segment j. $\frac{Capex_j}{BA_j}$ is the investment ratio of segment j, which is the capital expenditure of segment j divided by the segment's assets. $\frac{Capex_j^i}{BA_j^i}$ is the asset-weighted investment ratio of peer single-segment firms operating in the same industry as segment j. Therefore, Datta, D'Mello, and Iskandar-Datta (2009) measure the efficiency of transfers using the deviation of the investment ratio of segment j from the asset-weighted investment ratio of peer firms in the same industry and the segment's relative investment opportunities to the asset-weighted average q's of the firm.[4]

In the insurance industry, Goh, Kamiya, and Lou (2018) define the internal capital market efficiency measure as the sum across internal reinsurance of each of the firm's lines of business and its relative profitability; the relative profitability measures one line's deviation from the median profitability for all lines of business within this firm. Their measure can be viewed as an extension of Rajan, Servaes, and Zingales (2000). Specifically, the measure is defined as follows (p. 14). $ICM\ Eff\ index_i = \frac{1}{NPE_i} \sum_{j=1}^{N_{lob}} \left[ICMSubsidy_j * \left[\left(\frac{Profit_j}{NPE_j} \right) - Firm\ median_i \left(\frac{Profit}{NPE} \right) \right] \right]$, where NPE_i is firm i's total net premiums earned, $ICMSubsidy_j$ is the reinsurance ceded to affiliated companies minus the reinsurance assumed from affiliated companies divided by the gross premium written, $Profit_j$ is the ratio of pre-tax profit excluding investment gains for line j to net

[4] Q is Tobin's q, which is defined as the market-to-book asset ratio.

premiums earned in that line.

Although there have been extensive studies on the internal capital market as discussed above, the relationship between CEO compensation and internal capital market efficiency in the insurance industry has not been fully considered. This study thus contributes to the literature on internal capital markets by filling this gap.

3. Research Design

3. 1. Hypothesis Development

The efficiency of internal capital allocation depends on the discretion of top managers and whether they provide funds to affiliates with the highest investment opportunities. However, they could extract private benefits at the cost of misallocating internal resources at the same time. For example, they could overinvest free cash flow for empire-building (Jensen, 1986), or engage in "pet" projects that generate high private benefits for the CEO (Scharfstein and Stein, 2000). Shin and Stulz (1998) also provide evidence of inefficient cross-subsidization in highly diversified firms. In this context, CEO compensation can be a powerful mechanism to align CEOs' interests with shareholders' interests and motivate CEOs to manage internal resources efficiently.

The development of hypotheses is based on three assumptions. First, the CEO's private benefits are assumed to be increasing in internal capital misallocation, as suggested by Scharfstein and Stein (2000). If the costs to the CEO of misallocating internal capital are greater than the associated private benefits, then the CEO would be less likely to engage in value-destroying internal capital misallocation decisions. Datta, D'Mello, and Iskandar-Datta (2009) test this assumption empirically, and find that private benefits by managers at headquarters are positively related to internal capital misallocation.

Second, internal capital allocation decisions are not affected by the agency conflict between the CEO and divisional managers. If the interest alignment between the CEO and the shareholders

is strong, the cost to the CEO of giving capital to the rent-seeking divisional managers will be too high relative to private benefits that may accrue to the CEO (Datta, D'Mello, and Iskandar-Datta, 2009). This paper, therefore, assumes no agency conflict between the CEO and divisional managers and instead focuses on the role of CEOs' incentives in internal capital market efficiency.

Third, the internal capital market is assumed to be active in U.S. property-liability insurers. Powell, Sommer, and Eckles (2008) find that internal capital markets play a significant role in the investment behavior of insurance groups by promoting the growth of investment in affiliates. They suggest that the efficiency of internal capital markets in insurers may be explained by specific characteristics of the insurance industry; an advantage of studying the insurance industry is that insurance companies are narrowly focused and perform a relatively homogenous set of activities relative to conglomerates in other industries.

Based on the aforementioned discussion and assumptions, I assume that CEOs have the discretion of allocating internal funds across affiliates in the group, and may extract private benefits from misallocating internal resources. Thus, the CEO compensation could be an effective means of aligning CEOs' interests with shareholders' interests by making it costly for CEOs to misallocate internal capital. If the costs to CEOs for internal capital misallocation are greater than their private benefits, CEOs will manage internal resources efficiently and create value. Therefore, I hypothesize that CEO compensation influences corporate decision-making leading to more efficient internal capital allocation in the U.S. property-liability insurance industry. If CEOs are motivated by their compensation to optimally allocate capital across affiliates, we would observe a positive relationship between CEO compensation and internal capital market efficiency. This relationship could be affected by the different components of CEO compensation and the CEOs' preferences for the type of compensation. Hence, I use the comprehensive term "CEO compensation" rather than a specific type of compensation.

Hypothesis 1: CEO compensation is positively associated with internal capital market efficiency.

In the Stein (1997) model, the optimal size of internal capital markets is decided by the benefits and costs of internal capital markets; firms expand their internal capital market to ease credit constraints until the headquarters' monitoring costs exceed the benefits. Matsusaka and Nanda (2002) also argue that the value of internal capital markets has a non-monotonic relationship with the size of internal capital markets. In their model, the value of internal capital markets comes from the ability to transfer resources between divisions, and they call it "a real option to avoid external financing costs" (p. 178). This real option makes internal capital markets more valuable as internal funds increase. However, once internal resources become sufficient to fund all profitable projects, the real option has no value or a negative value if the agency cost of overinvestment dominates. In sum, the benefits of internal capital markets change depending on the quantity of internal capital.

CEOs decide how much internal capital to utilize and which affiliates receive internal capital to fund their investment. Thus, the level of available internal resources would affect managerial incentives and thereby the efficiency of internal capital markets. I assume that the size of internal capital markets reflects the availability of internal resources. Therefore, Hypothesis 2 states that there could be differences in the impact of managerial incentives on internal capital allocation, depending on the size of internal capital markets.

Hypothesis 2: The size of internal capital markets affects the relationship between internal capital market efficiency and CEO compensation.

In addition to the impact of the internal capital market size, I question whether managerial incentives have a different influence on internal capital market efficiency during the financial crisis. The recent global financial crisis might change insurers' behavior of utilizing internal capital markets. The impact of the financial crisis made accessing external capital more difficult for firms

in general. Hubbard and Palia (1999) provide evidence that internal capital markets would be more valuable in the absence of informationally well-developed external capital markets. This suggests that the relative value of internal capital markets would be more valuable when raising funds from external capital markets is costly or unavailable. Stein (1997) finds that headquarters' incentives to pick the winners would increase when credit constraints are binding and individual projects compete for scarce funds.

Kuppuswamy and Villalonga (2015) consider the 2008-2009 financial crisis an exogenous shock to external capital markets and find that the efficiency of internal capital markets significantly increased during the crisis. They argue that conglomerates' access to internal capital becomes valuable when external financing is constrained. Therefore, I hypothesize that CEOs' incentives for efficient internal capital allocation would be greater in the presence of external financing constraints due to the global financial crisis. In other words, the crisis affects CEOs' ways of managing internal capital in a positive way, strengthening the relationship between CEO compensation and internal capital market efficiency.

> ***Hypothesis 3***: The global financial crisis strengthens the relationship between internal capital market efficiency and CEO compensation.

4. Data and Sample Selection

The data for this study is taken from the NAIC annual statement database and Standard and Poor's ExecuComp database over the period 2000-2015. The financial data, including internal capital transactions, are from the annual statutory statements filed with the NAIC. To measure internal capital market efficiency, I use the data regarding reinsurance premiums ceded to affiliates and reinsurance premiums assumed from affiliates reported in the Underwriting and Investment Exhibit Part 1B. The data is summed up to the group level by group codes, and variables are winsorized at the 1% and 99% quantiles.

The ExecuComp database provides detailed executive compensation data for publicly

traded companies. The drawback to using ExecuComp is the reduction in the sample size because about one-third of U.S. property-liability insurers are mutuals (i.e., they are not public). First, I started with the 3,032 firm-year observations in the ExecuComp database with a Standard Industrial Classification (SIC) code 6331 (fire, marine, and casualty insurance) for the sample period. The observations for other executives except the CEO are dropped, and 505 observations are left.[5] Then, firms that are not matched with the NAIC annual statements by company name are eliminated. Unaffiliated single insurers are excluded since they are assumed to operate without internal capital markets. Insurers with less than $ 0.5 million in assets are also excluded because extremely small firms are not representative of the market. Firms with zero or negative net premiums written, surplus, assets, or expenses are also eliminated. [6] Lastly, using the lagged values of compensation as instruments reduces the number of observations. This resulted in a final sample of 382 firm-year observations. The final dataset is an unbalanced panel, and firms in the sample account for about 25% of industry assets in 2015.

5. Methodology

5.1. Measuring Internal Capital Market Efficiency

I define a measure of internal capital market efficiency based on the measure developed by Datta, D'Mello, and Iskandar-Datta (2009). Since they test their hypothesis for a sample of diversified firms in multiple industrial segments, I modify their "industry-adjusted value added" measure to incorporate the characteristics of insurance groups; a brief summary of this measure including the equation is mentioned in Section 2.

For internal capital markets to be efficient, internal capital should be allocated to affiliates

[5] The ExecuComp database includes the information not only on the CEO but also on other executives and directors. Thus, the data of other executives are eliminated in this study.
[6] Excluded are five firms that are not matched with the NAIC annual statements by company name. Three firms are also eliminated because they are not a group insurer.

with better investment opportunities and away from those with poorer investment prospects. Powell, Sommer, and Eckles (2008) find evidence of efficient internal capital markets in U.S. property-liability insurers by showing a positive relationship between expected performance and the net internal transactions. They also show that increases in reinsurance ceded by an affiliate to other members in the group lead to increases in the affiliate's investment, i.e., higher growth in premiums written. In the Powell, Sommer, and Eckles (2008) model, expected performance is defined as the lagged difference between return on assets (ROA) of a firm and the average ROA of all affiliates in the group, and the net internal transaction is defined as reinsurance premiums ceded to affiliates minus reinsurance premiums assumed from affiliates in the group. Thus, I modify the measure by Datta, D'Mello, and Iskandar-Datta (2009) using definitions from Powell, Sommer, and Eckles (2008).[7]

Specifically, Datta, D'Mello, and Iskandar-Datta (2009) use the ratio of segment capital expenditures to book value of assets to proxy for internal investment, but I use the ratio of net internal reinsurance premiums ceded to total premiums written. Whereas Datta, D'Mello, and Iskandar-Datta (2009) use a segment's Q for investment opportunities of the segment, I use each affiliate's prior year return as a proxy for investment prospects: $ROA_{i,t-1}$ and (underwriting ROA) $_{i,t-1}$. Whereas ROA is an overall measure of performance, underwriting ROA is also tested as a robustness check because underwriting is an insurer's core business activity.

The measure of internal capital market efficiency is *ICM Efficiency*, defined below:

$$ICM\ Efficiency_{grp,t} = \sum_{i=1}^{n} w_{i,t}\left(Return_{i,t-1} - Return_{grp,t-1}\right)\left[\frac{ICMT_{i,t}}{PW_{i,t}} - \frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}\right] \quad (1)$$

where $w_{i,t}$is the proportion of affiliate i's book value of assets to group assets, PW_i is the total

[7] Powell, Sommer, and Eckles (2008) use the amount of internal capital transfers and show a positive relationship between internal capital transfers and expected performance to prove efficient internal capital markets. Thus, I could not use their measure directly and define a measure of internal capital market efficiency based on their definition of internal capital transfers.

premiums written of affiliate i, $Return_{i,t-1}$ is ROA or underwriting ROA of affiliate i for the prior year, and $Return_{grp,t-1}$ is ROA or underwriting ROA of the group which affiliate i is in. $ICMT_{i,t}$ is reinsurance premiums ceded from affiliate i to other affiliates in the group minus reinsurance premiums assumed from other affiliates to affiliate i. $PW_{i,t}$ is total premiums written by affiliate i. Thus, $\frac{ICMT_{i,t}}{PW_{i,t}}$ represents the investment ratio of affiliate i, the ratio of net internal reinsurance to total premiums written. N is the number of affiliates within the group, and $\frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}$ is the average investment ratio of affiliates except affiliate i in the group to which affiliate i belongs.

In summary, the term $(Return_{i,t-1} - Return_{grp,t-1})$ represents the relative investment opportunity of affiliate i compared to that of the group as a whole based on the prior year's performance, following Powell, Sommer, and Eckles (2008). The term $\left[\frac{ICMT_{i,t}}{PW_{i,t}} - \frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}\right]$ captures the deviation of the investment ratio of affiliate i from the average investment ratio of affiliates in the group. If an affiliate with better investment opportunities, $(Return_{i,t-1} - Return_{grp,t-1} > 0)$, increases their capacity to write more premium by ceding reinsurance more than weighted average of investment of other affiliates in the group, $\left(\frac{ICMT_{i,t}}{PW_{i,t}} - \frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}} > 0\right)$, then the affiliate's internal capital market efficiency would be positive. On the other hand, if an affiliate has better investment opportunities but has less capacity by ceding less (or assuming more) than other affiliates, then the affiliate's internal capital market efficiency would be negative (i.e., inefficient internal capital markets). Similarly, if an affiliate with worse investment opportunities increases its investment by ceding more reinsurance internally than other affiliates in the group, the internal capital market efficiency measure would be negative. Each affiliate's internal capital market efficiency is summed up to the group level for the analysis. Therefore, the main dependent variable, $ICM\ Efficiency_{grp,t}$, is defined as the sum

of affiliates' internal capital market efficiency weighted by each affiliate's asset size. I illustrate a simple example of the calculation of *ICM Efficiency* in Appendix A for better understanding.

5.2. Model Specification

First, I regress the internal capital market efficiency on CEO compensation with year dummy variables and firm fixed effects. If the coefficient of compensation in equation (2) is positive and significant, Hypothesis 1 would be supported.

$$ICM\ Efficiency_{i,t} = \beta_0 + \beta_1 Compensation_{i,t} + \beta_2 Firm\ Size_{i,t} +$$

$$\beta_3 Num\ of\ Affiliates_{i,t} + \beta_4 Firm\ Age_{i,t} + \beta_5 GeoHHI_{i,t} + \beta_6 LofBHHI_{i,t} +$$

$$\beta_7 Longtail_{i,t} + \beta_8 Capital_{i,t} + \beta_9 ICM\ Size_{i,t} + \beta_{10}(ICM\ Size)^2{}_{i,t} + u_i + v_t + \varepsilon_{i,t} \quad (2)$$

where ICM Efficiency = asset-weighted sum of each affiliate's internal capital market efficiency in the group,

Compensation = natural logarithm of each type of compensation (i.e., total compensation, cash compensation, equity compensation, total equity ownership (%), or unvested equity ownership (%)),[8]

Firm Size = natural logarithm of total assets,

Number of Affiliates = natural logarithm of the number of affiliates in the group,

Firm Age = natural logarithm of the insurer's age,

GeoHHI = Herfindahl-Hirschman index of premiums written by state,

LofBHHI = Herfindahl-Hirschman index of premiums written by business line,

Longtail = proportion of premiums written in long-tail business lines,[9]

Capital = policyholders' surplus divided by assets,

ICM Size = Sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written,

(ICM Size)^2 = squared value of ICM Size,

[8] The Pearson correlations between the variables are presented in Appendix B. Total compensation is positively related to cash and equity compensation and negatively related to total equity ownership. Specifically, the correlation coefficients of cash compensation, equity compensation, and total equity ownership regarding total compensation are 0.539, 0.576, and -0.207, respectively, and they are significant at the 5% level.

[9] Following Cummins and Danzon (1991), long-tail lines include homeowners' and farmowners' multiple peril, commercial multiple peril, ocean marine, workers' compensation, other liability, medical malpractice, automobile liability, aircraft, and boiler and machinery.

u_i = firm-fixed effects,

v_t = year-fixed effects, and

$\varepsilon_{i,t}$ = random error term for insurer i in year t.

However, the problem of potential endogeneity between internal capital market efficiency and managerial incentives exists. Specifically, CEO compensation could be endogenously determined in response to the level of internal capital market efficiency (i.e., enhancement of internal capital market efficiency leads to an increase in CEO compensation). Not considering the endogeneity problem may result in biased and inconsistent estimates. Therefore, I conduct Durbin–Wu–Hausman tests to test for the endogeneity of the compensation variables. Test results reject the null hypothesis at the 5% or 10% significance level, indicating that estimates obtained by ordinary least squares are not consistent.[10] Therefore, I employ two-stage least squares (2SLS) regression with relevant and valid instruments to deal with the potential endogeneity bias.

I choose instruments based on the discussions in prior literature and the results of the instruments' relevance and validity tests. I use the Kleibergen-Paap rk LM test for the under-identification test and the Kleibergen-Paap rk Wald F test for a weak instrument test. For the over-identification test for more than one instrument, I perform the Sargan–Hansen J test.

A set of instruments are the number of years as CEO (*Tenure*), the age of CEO (*CEO Age*), a lagged value of compensation (*Lagged Comp*), and/or a rank of the lagged compensation variable (*Rank of Lagged Comp*) as instruments. I assume that these instrumental variables have no significant relation with internal capital market efficiency. The lagged compensation and the rank of the lagged compensation are expected to be positively related to all compensation variables because in general CEO compensation increases compared to the prior year, based on the firm's growth and inflation.

[10] The Durbin-Wu-Hausman test statistics for 2SLS regressions regarding each type of the compensation variables range from 3.2 to 5.3.

Tenure is expected to be positively related to executive compensation because the time served as a CEO could be a proxy for experience or general training levels. Chung and Pruitt (1996) provide evidence that the number of years as a chief executive is positively related to executive compensation and executive stock holding. Thus, I presume that more experienced CEOs may receive greater levels of compensation. Tenure is included in the equity ownership equations based on the result of the instrument's relevance and validity tests.

CEO Age is included in the equations regarding cash compensation, equity compensation, and total equity ownership. It is expected to have a positive relationship with cash compensation because older CEOs might prefer cash compensation due to their shorter employment horizon (Mehran, 1995). On the other hand, the coefficient on equity compensation is expected to be negative. As age increases, CEOs tend to become more conservative and are less likely to take risks (Eaton and Rosen, 1983). Since equity compensation is regarded as the reward for taking risky projects, a negative relation is expected between the age of the CEO and equity compensation.

Appendix B reports the Pearson correlations between the variables included in the regression model. I use the variance inflation factor (VIF) method to check for the possibility of multicollinearity among independent variables. The results show that all VIF values range between 2.54 and 2.84, indicating that multicollinearity is not a concern.

5.3. Definition of Variables

In this section, CEO compensation variables and control variables are described. As reported in SEC filings, total compensation paid to the CEO is the sum of the salary, bonus, stock awards, option awards, non-equity incentive, changes in pension value and other compensation such as contributions to defined contribution plans. The cash compensation variable is defined as the natural log of the sum of salary and the bonus. Equity compensation is the log of the sum of stock-related awards and option-related awards. Total equity ownership is the total number of

shares owned by the CEO divided by shares outstanding.

Besides total equity ownership, I also include unvested stock and option holdings as one of the dependent variables. Bryan, Hwang, and Lilien (2000) show that restricted stock awards are less likely to provide CEOs with the incentives to select value-maximizing risky projects because CEOs bear the downside risks associated with stock ownership. Grace (2004) also finds evidence that restricted stock is used to attract and retain CEOs rather than provide incentives in U.S. property-liability insurers. Unvested equity ownership is the ratio of the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested to total shares outstanding.

Control variables include firm size, the number of affiliates in the group, firm age, geographical concentration, line-of-business concentration, long-tail risk exposure, the capital ratio, the size of internal capital markets, and the squared value of internal capital market size. Table 1 displays the definition of all variables used in the analysis.

First, *Firm Size* is the measure of size to control for the differences in the size of insurers. Larger insurers face smaller relative cost when raising external capital, and thus have a lesser need to rely on internal capital markets (Phifer, 1996; Powell, Sommer, and Eckles, 2008). Additionally, the bankruptcy cost hypothesis suggests that the costs of bankruptcy would be lower for larger firms (Gruber and Warner, 1977); the demand for reinsurance would be lower for larger insurers than smaller insurers. Thus, Firm size may be related to the level of internal capital market use. However, as Matsusaka and Nanda (2002) suggest, the relationship between internal capital market utilization and its efficiency is assumed to be non-linear. Therefore, the coefficient on *Firm Size* could be either negative or positive depending on the level of internal capital market utilization. *Firm size* is defined as the logarithm of assets.

Number of Affiliates is defined as the natural logarithm of the number of affiliates in the

group. Insurers with more affiliates may have a greater supply of internal reinsurance and could reinsure internally to spread the risks across the group (Powell and Sommer, 2007). Although having more projects may provide headquarters with the ability to relax credit constraints, overseeing many projects lead headquarters to compromise their monitoring efforts (Stein, 1997). Therefore, insurers with a number of affiliates are more likely to experience lower internal capital market efficiency due to lower monitoring effectiveness. Hence, I expect the relationship between the number of affiliates and internal capital market efficiency could be either positive or negative.

Firm Age is included as a proxy for information asymmetry. If inside information is better shared in the group over time, headquarters of older firms are expected to allocate their internal resources more efficiently than those of younger firms. In this case, *Firm Age* would have a positive relationship with internal capital market efficiency. On the other hand, (external) reinsurers obtain more precise information on the insurer's quality based on the past experience as time passes (Jean-Baptiste and Santomero, 2000). Therefore, older firms face smaller information costs and are less likely to depend on internal capital markets than younger firms. As mentioned in Section 3, the efficiency of internal capital markets is assumed to have a non-linear relationship with the quantity of internal capital (Stein, 1997; Matsusaka and Nanda, 2002); utilizing less internal capital does not necessarily means lower internal capital market efficiency. Therefore, the relationship between *Firm Age* and efficiency is indeterminate.

Rajan, Servaes, and Zingales (2000) provide evidence of an inefficient internal capital market in firms with a high degree of diversity in resources. This suggests that internal capital market efficiency would increase as insurers' business is concentrated geographically or by line; and thus a positive relation between efficiency and concentration is expected. However, Matsusaka and Nanda (2002) argue that the relationship between internal capital market efficiency and diversification depends on model parameters. Assuming that the costs of raising external funds are

greater than those of internal funds, they suggest that the value of internal capital markets becomes more valuable as the firm's business becomes more variable. In this case, the concentration variables are expected to have a negative relation with internal capital market efficiency. Thus, I expect this relationship to go in either direction. Geographic concentration (*GeoHHI*) is measured as a Herfindahl-Hirschman index of premiums written by state.[11] Line-of-business concentration (LofB*HHI*) is measured as a Herfindahl-Hirschman index of premiums written by business line.[12]

One of the proxies for underwriting risk is long-tail risk (*Longtail*), defined as the proportion of premiums written in long-tail business lines. Long-tail refers to a long period between receipt of premium and claim payment. For long-tail liabilities, insurers do not know the total loss amounts for years following policy issue, thus creating significant risks. Since long-tail lines of business could experience higher volatility in their losses (Cummins, Phillips, and Smith, 2001), it is hard for CEOs to know whether to expect that the performance would be good or poor in coming years. Thus, CEOs of insurers writing more business in long-tail lines may be less likely to allocate internal capital efficiently, leading to a negative relationship between long-tail lines and internal capital market efficiency.

Capital serves as a buffer fund for insurers to pay unexpected losses and write more insurance. Insurers with higher capital ratios have a lesser need for additional capital (Powell, Sommer, and Eckles, 2008). Better capitalized insurers are less likely to need internal capital markets compared to insurers with less capital. Considering the aforementioned non-monotonic relationship between the size of internal capital markets and their efficiency (Matsusaka and Nanda, 2002), I assume that the relation of capital to internal capital market efficiency cannot be determined a priori. *Capital* is measured as policyholders' surplus divided by assets.

[11] Premiums written by state are reported in Schedule T of the NAIC annual statement.
[12] Premiums written by line of business are reported in the Underwriting and Investment Exhibit of the NAIC annual statement.

ICM Size represents the volume of the internal capital market transactions via internal reinsurance, defined as the sum of each affiliate's ratio of reinsurance premium ceded to affiliates minus reinsurance premium assumed from affiliates to total premiums written.[13] Not only ceding but also assuming reinsurance premiums is considered an internal capital market transaction because affiliates can exchange internal capital by ceding and assuming reinsurance (Powell, Sommer, and Eckles, 2008). Therefore, if affiliates in a group assume more than they cede on average, *ICM Size* of the group would be negative.

Stein (1997) argues that the optimal size of the internal capital market depends on credit constraints and the effectiveness of monitoring. In his model, headquarters' monitoring efforts will be compromised when it oversees a large number of projects. Therefore, I also include the square of internal capital market size to examine a possible non-linear relation between internal capital market efficiency and its size. To eliminate the potential collinearity problem from the correlation between the size and its quadratic term, I use the centering method following Shim (2011); I subtract the average of the ICM size from each observation prior to taking its square.

6. Empirical Results

6.1. Summary Statistics

Table 2 presents descriptive statistics for the internal capital market efficiency measure, CEO compensation, and control variables for 382 observations. The positive sample mean for ICM Efficiency suggests an efficient internal capital allocation strategy on average, consistent with Powell, Sommer, and Eckles (2008). The mean value of CEO total compensation is $6,617,000. The mean values of cash compensation and equity compensation are $1,571,000 and $3,077,000, respectively, indicating that equity compensation is almost double the amount of cash

[13] The sum of reinsurance premium ceded to affiliates and reinsurance premium assumed from affiliates would be zero at the group level. Thus, I use the sum of each affiliate's net internal reinsurance ratio instead of aggregating the volume of internal reinsurance premium to the group level.

compensation. The percentage of total equity ownership and unvested equity ownership are 2% and 0.3%, respectively; unvested equity holdings account for about 12% of total equity holdings (not reported here).

I also test whether there are statistical differences between the observations with efficient internal capital markets (ICM Efficiency > 0) and those with inefficient internal capital markets (ICM Efficiency ≤ 0). The first two columns in Table 3 show that CEOs of the insurers with efficient internal capital markets have less unvested equity holdings than those of insurers with inefficient internal capital markets. On average, insurers allocating internal capital efficiently are larger in size, more diversified over business lines, and hold more capital. CEO tenure is significantly shorter in insurers with efficient internal capital markets, implying that those working as a CEO for a long time are less likely to manage internal capital efficiently.

Additionally, I perform a t-test for differences in means for the observations during the global financial crisis. As shown in the crisis subsample column in Table 3, internal capital market efficiency during the crisis is significantly higher than in the non-crisis period at the 5% significance level, consistent with Kuppuswamy and Villalonga (2015). CEOs are compensated less in the form of cash and equity during the crisis, whereas there is no difference in total compensation. It is interesting that CEOs are younger and have shorter tenure compared to those in the non-crisis period. This may be because those having served for a long time as a CEO are replaced during the crisis period.

6.2. Analysis of Results

The results of the second stage of the 2SLS regression regarding internal capital market efficiency and CEO compensation are presented in Table 4, along with the test results for instruments. Whereas the coefficients on total compensation and cash compensation are not statistically significant, the estimate for equity compensation is negative and significant at the 5%

significance level. Since the elasticity of internal capital market efficiency with respect to equity compensation is -0.0113, a one percent increase in CEO equity compensation would lead to a decrease in internal capital market efficiency by 1.13%. The negative relationship implies that CEOs' incentive to enhance internal capital market efficiency would be reduced if they are compensated in the form of stock-related awards or option-related awards.

A substantial portion of equity compensation has graded vesting schedules, which vest in increments over time; for instance, 78% of equity awards granted to S&P 1500 CEOs in 2012 had graded vesting schedules (Equilar, Inc., 2012). Thus, the negative relationship between equity compensation and internal capital market efficiency can be explained by Bryan, Hwang, and Lilien (2000) that restricted stock is ineffective in inducing risk-averse CEOs to invest in risky, value-increasing projects. They argue that firms use graded vesting schedules more to retain CEOs than to provide them with incentives to maximize firm value. Similarly, unvested equity ownership shows a negative relationship with internal capital market efficiency at the 10% significance level. I assume that CEOs have less incentives to allocate internal resources efficiently and ultimately increase firm value in the short run if their actions are likely to have a negative effect on stock price at the time their equity will be vested.

On the other hand, the estimate for total equity ownership is positive and significant at the 10% significance level, consistent with the result from Datta, D'Mello, and Iskandar-Datta (2009). CEOs who hold a number of shares of stock are more likely to allocate internal capital efficiently. To be specific, the coefficient on total equity ownership is 0.054, and the elasticity of internal capital market efficiency is 0.001. This suggests that a one percent increase in CEO share ownership would lead to 0.1% increase in internal capital market efficiency. Collectively, I conclude that CEOs are motivated to manage internal capital efficiently by their total shareholdings, while unvested stocks and unexercisable options provide no incentives for CEOs

to do so. These results are robust to corrections for endogeneity bias.

The control variables for the size of internal capital markets, ICM Size and the squared value of ICM Size, are highly significant across all equations in Table 4. A positive sign on ICM Size and a negative sign on its square term indicate that the relationship between the size of internal capital markets and internal capital market efficiency has a parabolic shape. This implies that an increase in internal capital market size leads to an increase in efficiency up to a certain point and then efficiency starts to decrease beyond that point. The point would be decided where the cost of expanding internal capital markets outweighs the benefit of efficient internal capital allocation.

The efficiency of internal capital markets is positively related to line-of-business concentration. Consistent with Rajan, Servaes, and Zingales (2000), it suggests that internal capital misallocation through cross-subsidizing affiliates with poor investment opportunities increases with diversity in lines of business. Long-tail risk is also positively related to internal capital market efficiency in all but one equation, which is opposite to the expected sign. I assume that the positive sign on long-tail risk may result from the interaction between concentration and long-tail lines.[14] A more detailed analysis is needed in future study to understand why insurers writing more business in long-tail lines have higher internal capital market efficiency.

The first stage regression results are reported in Appendix C, and the instruments are significant and have the expected signs. Specifically, the age of the CEO shows a positive sign in the cash compensation equation but has a negative relationship with equity compensation. Changes in risk preference may explain this result; younger CEOs prefer equity to cash compensation. The positive relationship between the age and total equity ownership may result from the accumulation

[14] I estimate regressions with the interaction term between long-tail risk and concentration variables (geographic concentration and line-of-business concentration). The results show significant and negative coefficients of the interaction term of long-tail risk and line-of-business concentration across all equation except for the total compensation equation. The negative interaction term means if insurers' lines of business are concentrated, having more long-tail risk would lead to a negative impact on internal capital market efficiency. The sign and significance of other variables stays the same as those in Table 4.

of shares as a CEO gets older. Tenure is positively related to total equity ownership, consistent with Chung and Pruitt (1996). The negative relationship between tenure and unvested equity ownership may be explained by the fact that a higher portion of restricted stocks and unexercisable options are vested as time passes.

In summary, I conclude that CEO compensation plays an important role in determining internal capital market efficiency; especially, CEOs' total equity ownership would encourage CEOs to allocate internal capital efficiently, whereas unvested equity is an ineffective means of motivating CEOs to increase internal capital market efficiency. Therefore, Hypothesis 1 that CEO compensation is positively associated with internal capital market efficiency is partially supported depending on the type of compensation.

6.3. Subsample Analysis

First, I question whether the results in Table 4 would change depending on the size of internal capital markets. Thus, I split the sample into three subsamples, small, medium, and large, based on the size of internal capital markets, *ICM Size* defined in Table 1.[15] Tables 5 and 6 shows the results of 2SLS regressions for a sample of small internal capital market insurers and a sample of large internal capital markets insurers, respectively. The results of the subsample for insurers with medium internal capital markets show no significance on the compensation variables in all equations (not reported here).

The coefficient on total compensation in Table 5 is 0.001 and significant at the 10% significance level, and the elasticity of internal capital market efficiency is 0.0095. This suggests that if the value of total compensation package increases by one percent, the efficiency of internal

[15] I perform a regression including the interaction term between internal capital market size and the compensation variables. As shown in Appendix E, the interaction term with respect to total equity ownership is positive and significant at the 10% level, while other interactions are not significant. These findings suggest that the influence of the CEO's total equity holdings on internal capital market efficiency would be greater if the size of internal capital markets is larger.

capital market of insurers with small internal capital markets will also increase by 0.95%. However, no relationship between total compensation and efficiency is found in insurers with large internal capital market, as shown in Table 6. It is notable that the estimates of cash compensation and equity compensation are also positive and significant at the 10% and 5% level, respectively in Table 5. On the other hand, the estimates in Table 6 have opposite signs; both cash compensation and equity compensation are negatively related to internal capital market efficiency at the 5% significance level. This opposite result indicates that cash and equity compensation can be a means of motivating CEOs to increase the efficiency of internal capital markets when insurers have small internal capital markets, but this is not the case for CEOs of insurers with large internal capital markets. This contrasting result may be in line with Matsusaka and Nanda (2002) that when internal resources become abundant, an overinvestment problem arises. Thus, I suppose that having enough internal capital to fund all investment opportunities, (i.e., large internal capital markets), would reduce CEO incentives for efficient internal capital allocation.

Consistent with the results for the whole sample in Table 4, CEOs' total equity ownership is positively related with internal capital market efficiency in Tables 5 and 6. Thus, total equity ownership seems to have a positive influence on the internal capital market efficiency whether the size of internal capital markets is large or small. Only unvested equity ownership has a negative relation with internal capital market efficiency in Table 5, suggesting that CEOs of insurers with small internal capital markets are encouraged by all types of compensation except an unvested portion of equity holdings.

In Table 5, the internal capital market efficiency is negatively related to the number of affiliates, and geographic concentration, whereas it is positively related to line-of-business concentration. Stein (1997) argues that internal capital markets work more efficiently when headquarters manage a small and focused set of projects. Thus, I interpret the negative sign on the

number of affiliates variables as CEOs are better at picking winners if they manage a fewer number of affiliates. The negative sign on geographic concentration suggests that internal capital market efficiency would increase as the firms' business varies geographically, consistent with Matsusaka and Nanda (2002). Other control variables including line-of-business concentration, ICM Size and $(\text{ICM Size})^2$ show a similar pattern to those in Table 4.

Table 6 has two distinct results: a negative coefficient on the firm size variable and a positive coefficient on the long-tail variable. Larger insurers might have better access to external capital markets, and thus have a lesser need to utilize internal capital markets. The positive relationship between long-tail risk and internal capital markets efficiency needs to be addressed in future analysis, as discussed in Section 6.1.

It is also noteworthy that both coefficients on ICM Size and its squared value are not significant when insurers have large internal capital markets; on the other hand, the relationship between size and efficiency of internal capital markets has a parabolic shape for insurers with small internal capital markets as shown in Table 5. These findings suggest that if insurers have utilized their internal resources actively and thus have large internal capital markets already, they cannot expect an increase in internal capital market efficiency from its expansion. This result is consistent with the argument by Matsusaka and Nanda (2002) that the internal capital market has low value if a firm has enough internal resources to fund all investment; once resources become sufficient, the value of internal capital markets decreases and could be zero or negative if an agency problem is present. In summary, the results in Tables 5 and 6 support Hypothesis 2 that the size of internal capital markets affects the relationship between internal capital market efficiency and CEO compensation; only the CEO's total equity ownership shows consistent sign and significance

regardless of insurers' internal capital market size.[16]

Second, I divide the sample into two subsamples to test the impact of the global financial crisis. A crisis subsample includes observations in the years 2007-2010, and a non-crisis subsample includes the rest of the sample. Table 7 presents the results of the 2SLS regression for the non-crisis subsample, which is from the year before 2007 and the year after 2010. Similar to the result in Table 4, total equity ownership is shown to have a positive relationship with internal capital market efficiency, and equity compensation is negatively related to internal capital market efficiency. However, the regression result using the crisis subsample shows that all coefficients on the compensation variables are insignificant (not reported here). This contrast in results implies that the global financial crisis weakens the relationship between internal capital market efficiency and CEO compensation, not supporting Hypothesis 3.

The changes in CEO incentives may explain the differences in the effect of CEO compensation on internal capital markets between the financial crisis period and non-crisis period. Kuppuswamy and Villalonga (2010) reason that external pressure to allocate internal capital efficiently may lead to the enhanced efficiency of internal capital markets during the financial crisis. When firms are under unfavorable conditions and external pressure surrounding firms, they would face greater costs of raising funds from external markets and thus have to maximize the utilization of internal resources. Thus, CEOs would have been more concerned to survive the crisis than derive their private benefits by misallocating internal resources; the role of the CEO compensation would become less critical in aligning CEOs' interests with shareholders' interests. An alternative explanation is that a substantial portion of options granted went out of the money

[16] As a robustness check, I perform a regression with the interaction term of internal capital market size and the compensation variables, and results are presented in Appendix E. Only the interaction term with CEO's total equity ownership is positive and significant, suggesting that both the size of internal capital markets and the level of CEO compensation affect internal capital market efficiency in the same direction (i.e., larger internal capital markets strengthen the positive effect of CEO compensation on internal capital market efficiency, and vice versa).

due to the decline of stock prices during the crisis, causing the changes in CEO incentives.[17] In summary, perhaps during the financial crisis, weakened CEO incentives lead to insignificant relationship between CEO compensation and internal capital market efficiency. I rule out the possibility that no excess capital for allocation leads to the insignificant relationship because there is no difference in the size of internal capital markets between the crisis subsample and the non-crisis subsample, as shown in Table 3.

The focus of this crisis analysis is on the changes in CEOs' incentives for efficient internal capital markets in the presence of external financing constraints. Thus, I test the hypothesis for crisis versus non-crisis subsamples. Since there were changes in financial regulation after the crisis such as new guidelines for executive compensation mandated by the Financial Stability Board, it is worthwhile to analyze whether CEOs change their way of managing the internal capital markets for the post-crisis period compared to the pre-crisis period in future study.

6.4. Robustness Check

To check the robustness of the results, I use an alternative measure of internal capital market efficiency based on underwriting ROA rather than ROA. However, none of the estimates for the compensation variables are shown to be significant. It implies that CEO compensation is less likely to be related to underwriting return itself, but it is linked to ROA which incorporates both investment return and underwriting return.

I also employ a three-stage least squares (3SLS) model in case cross-equation correlations exist in the residuals. The equation simultaneously estimated with equation (2) in 3SLS is as follow.

$$Compensation_{i,t} = \beta_0 + \beta_1 ICM\ Efficiency_{i,t} + \beta_2 Firm\ Size_{i,t} + \beta_3 Num\ of\ Affiliates_{i,t} + \beta_4 Firm\ Age_{i,t} + \beta_5 GeoHHI_{i,t} + \beta_6 HHI_{i,t} + \beta_7 Longtail_{i,t} + \beta_8 Capital_{i,t} + u_i + v_t + \varepsilon_{i,t} \quad (3)$$

[17] Fahlenbrach and Stulz (2009) find that approximately 70% of all options granted before 2007 were out of the money at the end of the year 2008 for a sample of bank CEOs.

The definitions of variables in equation (3) are presented in Table 1. The 3SLS regression model requires at least one identification variable in each equation. Thus, I use tenure, CEO age, the lagged value of compensation, and/or the rank of the lagged value of compensation as instruments for the compensation variables in equation (2), and ICM Size and the squared value of ICM Size as instruments for the ICM Efficiency variable in equation (3). The efficiency results are not significantly better than 2SLS, and the sign and significance of the compensation variables in equation (2) is similar to those in Table 4. However, the ICM Efficiency variable in equation (3) is not significant across all equations, confirming that the level of efficiency has no influence on CEO compensation after controlling the potential endogeneity.

Additionally, I estimate equation (2) with internal reinsurance premiums ceded[18] as the measure of internal capital market efficiency; a number of internal capital market studies in the insurance industry use internal reinsurance premiums as a measure of internal capital markets. Under the assumption that internal capital markets of U.S. property-liability insurers are efficient (Powell, Eckles, and Sommer, 2008), a higher use of internal capital markets may lead to higher efficiency. The results are reported in Appendix D. The key results are unchanged; the magnitude of the coefficients and errors are different, but the signs and significance of the coefficients for the compensation variables stay the same. The notable difference is that the coefficient on cash compensation is positive and significant at the 5% significance level, whereas those in Table 4 are insignificant.

I also perform another set of robustness checks by using a 2008-2009 subsample and a 2007-2009 subsample for the financial crisis. The results are similar to those for the 2007-2010 subsample analysis; the signs and significance of the coefficients for the compensation variables

[18] It is defined as the sum of reinsurance premiums ceded to affiliates divided by total premiums written following Powell and Sommer (2007) and Mayers and Smith (1990).

stay the same. Therefore, the result in Table 7 for the impact of the global financial crisis is robust to alternative periods.

7. Conclusion

This paper examines the relationship between CEO compensation and internal capital market efficiency in the U.S. property-liability insurance industry during the period 2000-2015. I use internal reinsurance transaction data of insurers and employ 2SLS regression to address endogeneity concerns. The main question of this study is whether CEO compensation improves internal capital market efficiency. The results show that CEOs' total equity ownership has a significant and positive influence on the enhancement of internal capital market efficiency, while equity compensation and unvested equity holdings have a negative relationship with internal capital market efficiency. The positive relationship between equity holdings and internal capital market efficiency suggests that better alignment of CEO long-term incentives with shareholder interests leads to an increase in internal capital market efficiency. This result is consistent with Datta, D'Mello, and Iskandar-Datta (2009) after controlling for potential endogeneity of internal capital allocation decision. It is also in line with the argument by Scharfstein (1998) that "socialism" in capital allocation is driven by a misalignment of incentives between CEOs and investors.

Additionally, I conduct two subsample analyses to examine the impact of the size of internal capital markets and the global financial crisis on the main results. There are differences in the impact of compensation on internal capital market efficiency, depending on the internal capital market size. When insurers have small internal capital markets, CEO compensation provides incentives for CEOs to manage internal capital markets efficiently. However, this incentive would be lowered if unvested equity comprises a large portion of total equity holdings. In insurers with large internal capital markets, CEO's cash compensation and equity compensation are negatively related to efficiency, whereas CEO's equity ownership is positively related to efficiency. Whether

the internal capital market size is large or small, total equity ownership has a positive influence on the internal capital market efficiency.

Regarding the global financial crisis, the subsample analysis provides evidence that total equity ownership is positively linked to internal capital market efficiency, and equity compensation is negatively related to internal capital market efficiency during the non-crisis period. During the financial crisis, no compensation variables are shown to be significantly related to efficiency, implying the weakened role of CEO compensation. This may be not only because CEOs care more about survival the crisis than their private benefits, but because a large proportion of options granted to CEOs were out of the money in the stock market fell in 2008.

In addition to the main result, I find evidence of a non-linear relationship between internal capital market efficiency and the size of the internal capital markets, consistent with Stein (1997) and Matsusaka and Nanda (2002). The result suggests that efficiency would increase up to a certain point as internal capital markets expand and then decrease beyond that point. This effect seems to disappear if resources are sufficient enough to fund all investment, and an overinvestment problem arises.

In conclusion, this study finds evidence supporting the central hypothesis that CEO compensation plays an important role in the efficiency of internal capital markets. The results also suggest that the impact of compensation on the efficient allocation of internal capital depends on the type of compensation, the size of internal capital markets, and external events such as the global financial crisis. By answering the question regarding the role of CEO compensation in internal capital markets, this study would help insurers improve the efficiency of internal capital markets and thereby reduce value destruction from internal capital misallocation. It would also be helpful for investors to know how CEO compensation is related to internal capital market efficiency in order to align CEOs' interests with those of investors. Overall, this study contributes to the internal

capital market literature by empirically showing a link between CEO compensation and internal capital market efficiency.

Table 1
Variable Definitions

Variable	Definition
ICM Variables	
ICM Efficiency	Asset-weighted sum of each affiliate's internal capital market efficiency, which is measured as an affiliate's relative investment opportunity multiplied by the relative amount of investment; the investment opportunity is based on ROA; the investment is defined as reinsurance premiums ceded to other affiliates in the group minus reinsurance premiums assumed from other affiliates divided by total premiums written
Compensation Variables	
Total Compensation	Natural logarithm of total compensation which includes salary, bonus, the value of stock-related awards, the value of option-related awards, the value of amounts paid under non-equity incentive plans and long-term incentive plans, and all other compensation such as contributions to defined contribution plans (e.g. 401K plans), life insurance premiums, discounted share purchases etc.
Cash Compensation	Natural logarithm of the sum of salary and bonus
Equity Compensation	Natural logarithm of the sum of the value of stock-related awards and option-related awards
Total Equity Ownership	Number of shares owned by the CEO divided by shares outstanding
Unvested Equity Ownership	Sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding
Control Variables	
Firm Size	Natural logarithm of total assets
Number of Affiliates	Natural logarithm of the number of affiliates in the group
Firm Age	Natural logarithm of the insurer's age
Geographic HHI	Herfindahl-Hirschman index of premiums written by state
Line-of-Business HHI	Herfindahl-Hirschman index of premiums written by business line
Long-tail Risk	Proportion of premiums written in long-tail business lines including farmowners' multiple peril, homeowners' multiple peril, commercial multiple peril, ocean marine, workers' compensation, other liability, medical malpractice, automobile liability, aircraft, and boiler and machinery
Capital	Policyholders' surplus divided by assets
ICM Size	Sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written
Square of ICM Size	Square of ICM size
Tenure	Natural logarithm of the number of years that an individual has been the CEO of a company
CEO Age	CEO's age

Table 2
Summary Statistics

Variables	Mean	Std. Dev	Min	Max
ICM Efficiency based on ROA	0.0005	0.018	-0.092	0.110
ICM Efficiency based on UROA	0.0010	0.013	-0.040	0.095
Total Compensation (in thousands)	$ 6,617	$ 5,975	$ 423	$ 33,680
Ln(Total Compensation)	8.407	0.909	6.050	10.425
Cash Compensation (in thousands)	$ 1,571	$ 1,468	$ 281	$ 11,125
Ln(Cash Compensation)	7.103	0.646	5.639	9.317
Equity Compensation (in thousands)	$ 3,077	$ 3,544	0	$ 26,166
Ln(Equity Compensation)	6.610	2.779	0.000	10.172
Total Equity Ownership (%)	0.020	0.050	0.000	0.548
Unvested Equity Ownership (%)	0.003	0.005	0.000	0.052
Ln(Firm Size)	22.267	1.503	18.470	25.373
Ln(Number of Affiliates)	2.304	0.811	0.693	3.951
Ln(Firm Age)	4.423	0.617	2.303	5.416
Geographic HHI	0.157	0.238	0.000	1.000
Line-of-Business HHI	0.154	0.227	0.000	1.000
Long-tail Risk	0.518	0.214	0.000	0.987
Capital	0.322	0.074	0.064	0.483
ICM Size	0.040	5.580	-5.737	17.503
ROA	0.047	0.039	-0.067	0.169
Ln(Tenure)	1.936	0.811	0.693	3.892
CEO Age	57.523	7.597	41.000	85.000

Number of observations: 382

Note: The sample includes 382 firm-year observations for the period 2000-2015; 38 insurer groups are included in the sample. All variables are defined in Table 1. Data are obtained from the National Association of Insurance Commissioners annual statements and Standards and Poor's ExecuComp database and summed to the group level.

Table 3
Summary Statistics and Differences in Mean Values of Subsamples

	ICM Efficiency Subsample[1]			Crisis Subsample[2]		
Variables	**Efficiency ≤ 0**	**Efficiency > 0**	**t-test**	**Non-Crisis Period**	**Crisis Period**	**t-test**
ICM Efficiency				-0.0003	0.0023	**
Total Compensation (in thousands)	$ 6,647	$ 6,575		$ 6,827	$ 6,152	
Ln(Total Compensation)	8.424	8.384		8.457	8.296	
Cash Compensation (in thousands)	$ 1,489	$ 1,684		$ 1,693	$ 1,301	**
Ln(Cash Compensation)	7.067	7.153		7.169	6.958	***
Equity Compensation (in thousands)	$ 3,062	$ 3,098		$ 3,324	$ 2,532	**
Ln(Equity Compensation)	6.681	6.512		6.757	6.287	
Total Equity Ownership (%)	0.022	0.016		0.019	0.021	
Unvested Equity Ownership (%)	0.003	0.002	*	0.003	0.002	
Ln(Firm Size)	22.116	22.476	**	22.348	22.088	
Ln(Number of Affiliates)	2.357	2.231		2.342	2.221	
Ln(Firm Age)	4.420	4.426		4.464	4.332	*
Geographic HHI	0.167	0.144		0.146	0.182	
Line-of-Business HHI	0.170	0.130	*	0.145	0.172	
Long-tail Risk	0.522	0.511		0.515	0.523	
Capital	0.314	0.334	***	0.319	0.330	
ICM Size	0.046	0.032		0.154	-0.211	
Ln(Tenure)	2.008	1.838	**	1.986	1.828	*
CEO Age	57.057	58.171		58.396	55.595	***
Number of observations	222	160		263	119	

[1] The ICM efficiency subsample is based on the sign of the measure of internal capital market efficiency; a positive efficiency measure is considered an efficient internal capital market, and a negative efficiency measure represents an inefficient internal capital market.
[2] The crisis subsample divide based on the year; the crisis period includes observations during the year 2007-2010, and the non-crisis period includes the rest of the year.
Note: This table provides the result of student's t-tests for differences in means depending on the internal capital market efficiency and the financial crisis period. The t-test measures the statistical significance of the differences in the mean values of each variable.
Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.

Table 4.
ICM Efficiency and CEO Compensation

Variable	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency
Total Compensation	0.008				
	(0.005)				
Cash Compensation		-0.005			
		(0.006)			
Equity Compensation			-0.002**		
			(0.001)		
Total Equity (%)				0.054*	
				(0.029)	
Unvested Equity (%)					-0.651*
					(0.334)
Firm Size	-0.010**	-0.005	-0.006	-0.006	-0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of Affiliates	-0.004	-0.002	-0.004	-0.005	-0.003
	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
Firm Age	0.002	-0.000	-0.001	0.000	0.002
	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
Geographic HHI	0.003	0.001	0.002	0.001	0.001
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Line-of-Business HHI	0.050***	0.038**	0.041**	0.040**	0.032*
	(0.019)	(0.017)	(0.019)	(0.018)	(0.017)
Long-tail Risk	0.026*	0.029*	0.031**	0.030*	0.023
	(0.015)	(0.016)	(0.015)	(0.015)	(0.014)
Capital	-0.025*	-0.014	-0.018	-0.014	-0.023*
	(0.014)	(0.014)	(0.013)	(0.012)	(0.012)
ICM Size	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$(\text{ICM Size})^2$	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted-R^2	0.385	0.405	0.388	0.396	0.394
Kleibergen-Paap rk LM Stat	28.560***	19.286***	16.629***	27.618***	18.948***
Wald F Stat	40.579	16.413	38.364	13.110	13.713
Hansen J Stat				1.237	0.409
Observations	382	382	382	382	382

Note: This table presents the results for two-stage least squares regression to estimate the effect of CEO compensation on internal capital market efficiency. In the first-stage regression, CEO Tenure, CEO Age, the lagged value of compensation, and/or the rank of the lagged compensation variables are included to

instrument CEO compensation. The relevance of instruments are tested by a Kleibergen-Paap rk LM test and a Wald test, and the Hansen J test is used for over-identification in the regressions with more than one instrument. The estimates for the first-stage regression are reported in Appendix C.

ICM Efficiency is the measure of internal capital market efficiency, defined as the asset-weighted sum of each affiliate's relative investment opportunity based on ROA multiplied by the relative amount of net reinsurance premiums ceded to affiliates; Total Compensation is the natural log of the sum of salary, bonus, stock awards, option awards, non-equity incentives, and long-term incentive plans; Cash Compensation is measured in natural log of the sum of salary and bonus; Equity Compensation is the natural log of the sum of stock-related awards and option-related awards; Total Equity (%) is the CEO's share holdings as a percentage of total shares outstanding; Unvested Equity (%) is the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding; Firm size is the natural log of total assets; Number of Affiliates is the natural log of the number of affiliates in the group; Firm Age is the insurer's age; Geographic HHI is the Herfindahl-Hirschman index of premiums written by state; Line-of-Business HHI is the Herfindahl-Hirschman index of premiums written by business line; Long-tail Risk is the proportion of premiums written in long-tail business lines; Capital is defined as policyholders' surplus divided by assets; ICM Size is measured as the sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written; $(\text{ICM Size})^2$ is the square of ICM size.

Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.

Table 5.
ICM Efficiency and CEO Compensation for Small Internal Capital Market Subsample

Variable	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency
Total Compensation	0.001*				
	(0.001)				
Cash Compensation		0.004**			
		(0.002)			
Equity Compensation			0.000*		
			(0.000)		
Total Equity (%)				0.020**	
				(0.008)	
Unvested Equity (%)					-0.122**
					(0.055)
Firm Size	-0.002	-0.000	-0.002*	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of Affiliates	-0.002**	-0.003**	-0.002	-0.003**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	-0.001	-0.000	-0.002	-0.003**	-0.003*
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Geographic HHI	-0.001*	-0.001*	-0.001	-0.002***	-0.001**
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Line-of-Business HHI	0.013***	0.008*	0.010**	-0.003	0.002
	(0.005)	(0.004)	(0.004)	(0.006)	(0.005)
Long-tail Risk	-0.005	-0.009*	-0.005	-0.001	-0.003
	(0.004)	(0.005)	(0.004)	(0.003)	(0.003)
Capital	-0.011**	-0.009**	-0.011**	0.000	-0.005
	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)
ICM Size	-0.013**	-0.008	-0.017***	-0.016***	-0.018***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
$(\text{ICM Size})^2$	-0.001**	-0.001	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Adjusted-R^2	0.980	0.967	0.981	0.980	0.978
Kleibergen-Paap rk LM Stat	12.820***	10.662***	11.365***	15.855***	15.872***
Wald F Stat	12.143	12.871	12.216	16.034	21.351
Observations	124	124	124	124	124

Note: This table presents the results for two-stage least squares regression to estimate the effect of CEO compensation on internal capital market efficiency for the subsample of small internal capital market insurers. The sample split into three subsamples based on the size of internal capital markets. In the first-stage regression, CEO Tenure, CEO Age, the lagged value of compensation, and/or the rank of the lagged compensation variables are included to instrument CEO

compensation. The relevance of instruments is tested by a Kleibergen-Paap rk LM test and a Wald test.

ICM Efficiency is the measure of internal capital market efficiency, defined as the asset-weighted sum of each affiliate's relative investment opportunity based on ROA multiplied by the relative amount of net reinsurance premiums ceded to affiliates; Total Compensation is the natural log of the sum of salary, bonus, stock awards, option awards, non-equity incentives, and long-term incentive plans; Cash Compensation is measured in natural log of the sum of salary and bonus; Equity Compensation is the natural log of the sum of stock-related awards and option-related awards; Total Equity (%) is the CEO's share holdings as a percentage of total shares outstanding; Unvested Equity (%) is the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding; Firm size is the natural log of total assets; Number of Affiliates is the natural log of the number of affiliates in the group; Firm Age is the insurer's age; Geographic HHI is the Herfindahl-Hirschman index of premiums written by state; Line-of-Business HHI is the Herfindahl-Hirschman index of premiums written by business line; Long-tail Risk is the proportion of premiums written in long-tail business lines; Capital is defined as policyholders' surplus divided by assets; ICM Size is measured as the sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written; $(\text{ICM Size})^2$ is the square of ICM size.

Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.

Table 6.
ICM Efficiency and CEO Compensation for Large Internal Capital Market Subsample

Variable	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency
Total Compensation	0.014				
	(0.011)				
Cash Compensation		-0.035**			
		(0.017)			
Equity Compensation			-0.007**		
			(0.003)		
Total Equity (%)				1.216**	
				(0.605)	
Unvested Equity (%)					4.799**
					(2.266)
Firm Size	-0.022*	-0.029**	-0.029**	-0.028**	-0.038**
	(0.011)	(0.014)	(0.014)	(0.011)	(0.015)
Number of Affiliates	-0.018	-0.010	-0.026	-0.028	-0.026
	(0.026)	(0.026)	(0.023)	(0.026)	(0.024)
Firm Age	-0.008	-0.017	0.003	-0.006	-0.009
	(0.011)	(0.019)	(0.026)	(0.009)	(0.009)
Geographic HHI	0.005	0.016	0.014	0.006	0.003
	(0.011)	(0.013)	(0.014)	(0.011)	(0.011)
Line-of-Business HHI	0.020	-0.115	0.006	0.051	0.070
	(0.054)	(0.098)	(0.063)	(0.054)	(0.059)
Long-tail Risk	0.235***	0.192**	0.083	0.224***	0.276***
	(0.088)	(0.083)	(0.095)	(0.077)	(0.086)
Capital	-0.031	0.014	-0.152**	-0.038	-0.045
	(0.047)	(0.053)	(0.074)	(0.047)	(0.048)
ICM Size	-0.001	-0.003	-0.002	-0.002	-0.002
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
$(\text{ICM Size})^2$	-0.000	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted-R^2	0.563	0.473	0.460	0.605	0.612
Kleibergen-Paap rk LM Stat	18.519***	6.887***	6.886***	23.128***	16.748***
Wald F Stat	9.549	13.157	16.310	22.791	19.464
Hansen J Stat	0.261			0.389	0.971
Observations	130	130	130	130	130

Note: This table presents the results for two-stage least squares regression to estimate the effect of CEO compensation on internal capital market efficiency for the subsample of large internal capital market insurers. The sample split into three subsamples based on the size of internal capital markets. In the first-stage

regression, CEO Tenure, CEO Age, the lagged value of compensation, and/or the rank of the lagged compensation variables are included to instrument CEO compensation. The relevance of instruments is tested by a Kleibergen-Paap rk LM test and a Wald test, and the Hansen J test is used for over-identification in the regressions with more than one instrument.

ICM Efficiency is the measure of internal capital market efficiency, defined as the asset-weighted sum of each affiliate's relative investment opportunity based on ROA multiplied by the relative amount of net reinsurance premiums ceded to affiliates; Total Compensation is the natural log of the sum of salary, bonus, stock awards, option awards, non-equity incentives, and long-term incentive plans; Cash Compensation is measured in natural log of the sum of salary and bonus; Equity Compensation is the natural log of the sum of stock-related awards and option-related awards; Total Equity (%) is the CEO's share holdings as a percentage of total shares outstanding; Unvested Equity (%) is the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding; Firm size is the natural log of total assets; Number of Affiliates is the natural log of the number of affiliates in the group; Firm Age is the insurer's age; Geographic HHI is the Herfindahl-Hirschman index of premiums written by state; Line-of-Business HHI is the Herfindahl-Hirschman index of premiums written by business line; Long-tail Risk is the proportion of premiums written in long-tail business lines; Capital is defined as policyholders' surplus divided by assets; ICM Size is measured as the sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written; $(\text{ICM Size})^2$ is the square of ICM size.

Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.

Table 7.
ICM Efficiency and CEO Compensation for Non Financial Crisis Subsample

Variable	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency
Total Compensation	0.007				
	(0.005)				
Cash Compensation		0.000			
		(0.006)			
Equity Compensation			-0.002**		
			(0.001)		
Total Equity (%)				0.062**	
				(0.032)	
Unvested Equity (%)					-0.228
					(0.401)
Firm Size	-0.011**	-0.008	-0.008	-0.006	-0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
Number of Affiliates	-0.004	-0.003	-0.004	-0.004	-0.002
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Firm Age	0.009	0.010	0.003	0.006	0.007
	(0.014)	(0.012)	(0.013)	(0.013)	(0.013)
Geographic HHI	0.041	0.034	0.031	0.041*	0.037
	(0.026)	(0.024)	(0.025)	(0.024)	(0.025)
Line-of-Business HHI	0.002	0.002	0.001	0.000	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Long-tail Risk	0.063**	0.064**	0.066**	0.062**	0.044**
	(0.031)	(0.027)	(0.026)	(0.027)	(0.022)
Capital	-0.016	-0.014	-0.013	-0.000	-0.006
	(0.018)	(0.019)	(0.016)	(0.015)	(0.015)
ICM Size	0.002**	0.002*	0.002*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$(\text{ICM Size})^2$	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted-R^2	0.113	0.174	0.155	0.153	0.164
Kleibergen-Paap rk LM Stat	25.301***	14.334***	17.536***	16.313***	12.322***
Wald F Stat	35.695	11.138	49.613	15.149	11.993
Hansen J Stat				1.569	
Observations	292	292	292	292	292

Note: This table presents the results for two-stage least squares regression to estimate the effect of CEO compensation on internal capital market efficiency for the non-crisis subsample. The sample split into two subsamples to examine the impact of the global financial crisis; the crisis subsample includes observations

during 2007-2010, and the non-crisis subsample includes the rest of the observations. In the first-stage regression, CEO Tenure, CEO Age, the lagged value of compensation, and/or the rank of the lagged compensation variables are included to instrument CEO compensation. The relevance of instruments is tested by a Kleibergen-Paap rk LM test and a Wald test, and the Hansen J test is used for over-identification in the regressions with more than one instrument.
ICM Efficiency is the measure of internal capital market efficiency, defined as the asset-weighted sum of each affiliate's relative investment opportunity based on ROA multiplied by the relative amount of net reinsurance premiums ceded to affiliates; Total Compensation is the natural log of the sum of salary, bonus, stock awards, option awards, non-equity incentives, and long-term incentive plans; Cash Compensation is measured in natural log of the sum of salary and bonus; Equity Compensation is the natural log of the sum of stock-related awards and option-related awards; Total Equity (%) is the CEO's share holdings as a percentage of total shares outstanding; Unvested Equity (%) is the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding; Firm size is the natural log of total assets; Number of Affiliates is the natural log of the number of affiliates in the group; Firm Age is the insurer's age; Geographic HHI is the Herfindahl-Hirschman index of premiums written by state; Line-of-Business HHI is the Herfindahl-Hirschman index of premiums written by business line; Long-tail Risk is the proportion of premiums written in long-tail business lines; Capital is defined as policyholders' surplus divided by assets; ICM Size is measured as the sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written; $(\text{ICM Size})^2$ is the square of ICM size.
Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.

References

Ahn, Seoungpil and David J. Denis, 2004, "Internal Capital Markets and Investment policy: Evidence from Corporate Spinoffs," *Journal of Financial Economics* 71: 489-516.

Berger, Allen N., J. David Cummins, Mary A. Weiss, and Hongmin Zi, 2000, "Conglomeration versus Strategic Focus: Evidence from the Insurance Industry," *Journal of Financial Intermediation* 9: 323-362.

Berger, Philip G. and Eli Ofek, 1995, "Diversification's Effect on Firm Value," *Journal of Financial Economics* 37: 39-65.

Berger, Allen N., Anthony Saunders, Joseph M. Scalise, and Gregory F. Udell, 1998, "The Effects of Bank Mergers and Acquisition on Small Business Lending," *Journal of Financial Economics* 50:187–229.

Billett, Matthew T. and David C. Mauer, 2003, "Cross-subsidies, External Financing Cnstraints, and the Contribution of the Internal Capital Market to Firm Value," *Review of Financial Studies* 16: 1167-1201.

Brusco, Sandro and Fausto Panunzi, 2005, "Reallocation of Corporate Resources and Managerial Incentives in Internal Capital Markets," *European Economic Review* 49: 659-681.

Bryan, Stephen, LeeSeok Hwang, and Steven Lilien, 2000, "CEO Stock-Based Compensation: An Empirical Analysis of Incentive-Intensity, Relative Mix, and Economic Determinants," *Journal of Business* 73: 661-93.

Campello, Murillo, 2002, "Internal Capital Markets in Financial Conglomerates: Evidence from Small Bank Responses to Monetary Policy," *Journal of Finance* 57: 2773-2805.

Choi, Byeongyong P. and Mary A. Weiss, 2005, "An Empirical Investigation of Market Structure, Efficiency, and Performance in Property-Liability Insurance," *Journal of Risk and Insurance* 72: 635–673.

Chung, Kee H. and Stephen W. Pruitt, 1996, "Executive Ownership, Corporate Value, and Executive Compensation: A Unifying Framework," *Journal of Banking and Finance* 20: 1135-1159.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen, 2006, "Managerial Incentives and Risk-taking," *Journal of Financial Economics* 79: 431-468.

Core, John E. and Wayne R. Guay, 2010, "Is CEO Pay Too High and Are Incentives Too Low? A Wealth-based Contracting Framework," *Academy of Management Perspectives* 24: 5-19.

Cummins, J. David and Patricia M. Danzon, 1991, "Price Shocks and Capital Flows in Liability Insurance," in Lawrence A. Berger, ed., *Cycles and Crises in Property/Casualty Insurance: Causes and Implications for Public Policy* (NAIC)

Cummins, J. David and Patricia M. Danzon, 1997, "Price, Financial Quality, and Capital Flows in Insurance Markets," *Journal of Financial Intermediation* 6: 3-38.

Cummins, J. David, Zhijian Feng, and Mary A. Weiss, 2012, "Reinsurance Counterparty Relationships and Firm Performance in the U.S. Property-Liability Insurance Industry," working paper, Fox School of Business, Temple University, Philadelphia, PA.

Cummins, J. David and Gregory P. Nini, 2002, "Optimal Capital Utilization by Financial Firms: Evidence from the Property-Liability Insurance Industry," *Journal of Financial Services Research* 21: 15-53.

Cummins, J. David, Richard D. Phillips, and Stephen D. Smith, 2001, "Derivatives and Corporate Risk Management: Participation and Volume Decisions in the Insurance Industry," *Journal of Risk and Insurance* 68: 51-91.

Cummins, J. David and David W. Sommer, 1996, "Capital and Risk in Property-Liability Insurance Markets," *Journal of Banking and Finance* 20: 1069-1092.

Cummins, J. David, Sharon Tennyson, and Mary A. Weiss, 1999, "Consolidation and Efficiency in the U.S. Life Insurance Industry," *Journal of Banking and Finance* 23: 325-357.

Cummins, J. David and Mary A. Weiss, 2016, "Equity Capital, Internal Capital Markets, and Optimal Capital Structure in the US Property-Casualty Insurance Industry," *Annual Review of Financial Economics* 8: 121-153.

Datta, Sudip, Ranjan D'Mello, and Mai Iskandar-Datta, 2009, "Executive Compensation and Internal Capital Market Efficiency," *Journal of financial intermediation* 18: 242-258.

Eaton, Jonathan and Harvey S. Rosen, 1983, "Agency, Delayed Compensation, and the Structure of Executive Remuneration," *Journal of Finance* 38: 1489-1505.

Equilar, Inc., 2012, Equilar S&P 500 CEO Pay Strategies Report (Redwood City, CA).

Fahlenbrach, Rüdiger and René M. Stulz, 2009, "Bank CEO Incentives and the Credit Crisis," *Journal of Financial Economics* 99: 11-26.

Fazzari, Steven M., R. Glenn Hubbard, and Bruce P. Petersen, 1988, "Financing Constraints and Investment," *Brookings Papers on Economic Activity* 1: 141-195.

Fier, Stephen G., Kathleen A. McCullough, and James M. Carson, 2013, "Internal Capital Markets and the Partial Adjustment of Leverage," *Journal of Banking and Finance* 37: 1029-1039.

Finkelstein, Sydney and Donald C. Hambrick, 1990, "Top-management-team Tenure and Organizational Outcomes: The Moderating Role of Managerial Discretion," *Administrative Science Quarterly* 35: 484-503.

Froot, Kenneth A., 2007, "Risk Management, Capital Budgeting, and Capital Structure Policy for Insurers and Reinsurers," *Journal of Risk and Insurance* 74: 273-299.

Froot, Kenneth A., David S. Scharfstein, and Jeremy C. Stein, 1993, "Risk Management: Coordinating Corporate Investment and Financing Policies," *Journal of Finance* 48: 1629-1658.

Gabaix, Xavier and Augustin Landier, 2008, "Why Has CEO Pay Increased So Much?" *Quarterly Journal of Economics* 123: 49-100.

Gertner, Robert H., David S. Scharfstein, and Jeremy C. Stein, 1994, "Internal versus External Capital Markets," *Quarterly Journal of Economics* 109: 1211-1230.

Goh, Jing Rong, Shinichi Kamiya, and Pingyi Lou, 2018, "Internal Capital Markets and Organizational Forms," working paper, Nanyang Business School, Singapore. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3150126

Grace, Elizabeth, 2004, "Contracting Incentives and Compensation for Property-Liability Insurer Executives," *Journal of Risk and Insurance* 71: 285-307.

Graham, John R., Campbell R. Harvey, and Manju Puri, 2011, "Capital Allocation and Delegation of Decision-making Authority within Firms," working paper, National Bureau of Economic Research No. w17370.

Gruber, Martin J. and Jerold B. Warner, 1977, "Bankruptcy Costs: Some Evidence," *Journal of Finance* 32: 337-347.

Harrington, Scott E., 2009, "The Financial Crisis, Systemic Risk, and the Future of Insurance Regulation," *Journal of Risk and Insurance* 76: 785-819.

Houston, Joel, Christopher James, and David Marcus, 1997, "Capital Market Frictions and the Role of Internal Capital Markets in Banking," *Journal of Financial Economics* 46: 135-164.

Jean-Baptiste, Eslyn L. and Anthony M. Santomero, 2000, "The Design of Private Reinsurance Contracts," *Journal of Financial Intermediation* 9: 274-297.

Jensen, Michael C, 1986, "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review* 7: 323-329.

Ke, Bin, Kathy Petroni, and Assem Safieddine, 1999, "Ownership Concentration and Sensitivity of Executive Pay to Accounting Performance Measures: Evidence from Publicly and Privately-held Insurance Companies," *Journal of Accounting and Economics* 28: 185-209.

Khanna, Naveen and Sheri Tice, 2001, "The Bright Side of Internal Capital Markets," *Journal of Finance* 56: 1489-1528.

Kuppuswamy, Venkat and Belen Villalonga, 2015, "Does Diversification Create Value in the Presence of External Financing Constraints? Evidence from the 2007–2009 Financial Crisis," *Management Science* 62: 905-923.

Lamont, Owen, 1997, "Cash Flow and Investment: Evidence from Internal Capital Markets,"

Journal of Finance 52: 83-109.

Maksimovic, Vojislav and Gordon Phillips, 2002, "Do Conglomerate Firms Allocate Resources Inefficiently Across Industries? Theory and Evidence," *Journal of Finance* 57: 721-767.

Matsusaka, John G. and Vikram Nanda, 2002, "Internal Capital Markets and Corporate Refocusing," *Journal of Financial Intermediation* 11: 176-211.

Mayers, David and Clifford W. Smith, 1988, "Ownership Structure across Lines of Property Casualty Insurance," *Journal of Risk and Insurance* 31: 351-378.

Mayers, David and Clifford W. Smith, 1990, "On the Corporate Demand for Insurance: Evidence from Reinsurance Market," *Journal of Business,* 63: 19-40.

Mayers, David and Clifford W. Smith, 1994, "Managerial Discretion, Regulation, and Stock Insurer Ownership Structure," *Journal of Risk and Insurance* 31: 351-378.

Mayers, David, and Clifford W. Smith, 1992, "Executive Compensation in the Life Insurance Industry," *Journal of Business* 65: 51-74.

Mayers, David, and Clifford W. Smith, 2010, "Compensation and Board Structure: Evidence from the Insurance Industry," *Journal of Risk and Insurance* 77: 297-327.

Mehran, Hamid, 1995, "Executive Compensation Structure, Ownership, and Firm Performance," *Journal of Financial Economics* 38: 163-184.

Meyer, Margaret, Paul Milgrom, and John Roberts, 1992, "Organizational Prospects, Influence Costs, and Ownership Changes," *Journal of Economics and Management Strategy* 1: 9-35.

Myers, Stewart C. and Nicholas S. Majluf, 1984, "Corporate Financing and Investment Decisions When Firms Have Information that Investors Do Not Have," *Journal of Financial Economics* 13: 187-221.

Ozbas, Oguzhan and David S. Scharfstein, 2009, "Evidence on the Dark Side of Internal Capital Markets," *Review of Financial Studies* 23: 581–599.

Phifer, Ross, 1996, *Reinsurance Fundamentals* (New York: John Wiley and Sons, Inc.)

Powell, Lawrence S. and David W. Sommer, 2007, "Internal versus External Capital Markets in the Insurance Industry: The Role of Reinsurance," *Journal of Finance Service Research* 31: 173-188.

Powell, Lawrence S., David W. Sommer, and David L. Eckles, 2008, "The Role of Internal Capital Markets in Financial Intermediaries: Evidence from Insurer Groups," *Journal of Risk and Insuracne* 75: 439-461.

Rajan, Raghuram, Henri Servaes, and Luigi Zingales, 2000, "The Cost of Diversity: The Diversification Discount and Inefficient Investment," *Journal of Finance* 55: 35-80.

Scharfstein, David S, 1998, "The Dark Side of Internal Capital Markets II: Evidence from Diversified Conglomerates," National Bureau of Economic Research, Working Paper No. 6352, January, Cambridge, MA.

Scharfstein, David and Jeremy Stein, 2000, "The Dark Side of Internal Capital Markets: Divisional Rent Seeking and Inefficient Investment," *Journal of Finance* 55: 2537-2567.

Shin, Hyun-Han and René M. Stulz, 1998, "Are Internal Capital Markets Efficient?" *Quarterly Journal of Economics* 113: 531-552.

Shiu, Yung-Ming, 2011, "Reinsurance and Capital Structure: Evidence from the United Kingdom Non-Life Insurance Industry," *Journal of Risk and Insurance* 78: 475-494.

Stein, Jeremy C., 1997, "Internal Capital Markets and the Competition for Corporate Resources," *Journal of Finance* 52: 111-133.

Williamson, Oliver E, 1975, "Markets and Hierarchies: Some Elementary Considerations," *The American economic review* 63: 316-325.

Wilson, Alex H. and Eric James Higgins, 2001, "CEO Pay/Firm Performance Sensitivity in the Insurance Industry," *Journal of Insurance Issues* 24: 1-16.

Wulf, Julie, 2009, "Influence and inefficiency in the internal capital market," *Journal of Economic Behavior & Organization* 72: 305-321.

Zanjani, George, 2002, "Capital Allocation in Catastrophe Insurance," *Journal of Financial Economics* 65: 283-305.

Appendix A.
A Simple Example of Internal Capital Market Efficiency Calculation

$$ICM\ Efficiency_{grp,t} = \sum_{i=1}^{n} w_{i,t}\left(Return_{i,t-1} - Return_{grp,t-1}\right)\left[\frac{ICMT_{i,t}}{PW_{i,t}} - \frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}\right]$$

I illustrate a simple example of the efficiency measure calculation for better understanding. Above is equation (1), which defines the ICM Efficiency measure used in the study. Suppose there are only two affiliates in the group, affiliate A and affiliate B. Each writes 100 in direct premiums, and B cedes 50 to A. Thus, affiliate B would increase their capacity to write more premiums by ceding 50 of their premium to affiliate A. The investment ratio of each affiliate and the deviation from the group average are calculated below.

	(1)	(2)	(3)	(4) = (2)-(3)	(5) = (1)+(3)	(6) = (4)/(5)	(7)	(8)
Affiliate	Direct Premiums Written	Reinsurance Premiums Ceded to Affiliates	Reinsurance Premiums Assumed from Affiliates	Net Internal Reinsurance	Total Premiums Written	Investment Ratio	Average Investment Ratio of Other Affiliates	Deviation of Affiliate i's Investment Ratio from Group Average
				$ICMT_{i,t}$	$PW_{i,t}$	$\frac{ICMT_{i,t}}{PW_{i,t}}$	$\left(\frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}\right)$	$\left[\frac{ICMT_{i,t}}{PW_{i,t}} - \frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}\right]$
A	100	0	50	-50	150	-0.33	0.50	-0.83
B	100	50	0	50	100	0.50	-0.33	0.83

Case 1. If affiliate A has better expected performance, ICM Efficiency would be negative. This suggests inefficient internal capital markets because affiliate A's investment ratio is negative whereas A's expected performance is better than affiliate B.

	(9)	(10)	(11) = (9)-(10)	(12)	(13) = (12)*(11)*(8)
Affiliate	Affiliate's Return in the Prior Year	Group's Return in the Prior Year	Relative Investment Opportunity	Affiliate's Assets to Group Assets	ICM Efficiency of the Group
	$Return_{i,t-1}$	$Return_{grp,t-1}$	$\left(Return_{i,t-1} - Return_{grp,t-1}\right)$	$w_{i,t}$	$ICM\ Efficiency_{grp,t} = \sum_{i=1}^{n} w_{i,t}\left(Return_{i,t-1} - Return_{grp,t-1}\right)\left[\frac{ICMT_{i,t}}{PW_{i,t}} - \frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}\right]$
A	0.04	0.03	0.01	0.5	-0.0083
B	0.02	0.03	-0.01	0.5	

Appendix A. (continued)

Case 2. If affiliate B has better expected performance, ICM Efficiency would be positive. This suggests efficient internal capital markets because affiliate B has better investment opportunities and increase premiums written by ceding reinsurance to other affiliates in the group.

	(9)	(10)	(11) = (9)-(10)	(12)	(13) = (12)*(11)*(8)
Affiliate	Affiliate's Return in the Prior Year	Group's Return in the Prior Year	Relative Investment Opportunity	Affiliate's Assets to Group Assets	ICM Efficiency of the Group
	$Return_{i,t-1}$	$Return_{grp,t-1}$	$\left(Return_{i,t-1} - Return_{grp,t-1}\right)$	$w_{i,t}$	$ICM\ Efficiency_{grp,t} = \sum_{i=1}^{n} w_{i,t}\left(Return_{i,t-1} - Return_{grp,t-1}\right)\left[\frac{ICMT_{i,t}}{PW_{i,t}} - \frac{1}{N-1}\sum_{j=1,j\neq i}^{n}\frac{ICMT_{j,t}}{PW_{j,t}}\right]$
A	0.02	0.025	-0.005	0.5	0.0042
B	0.03	0.025	0.005	0.5	

Case 3. If affiliate A and B both have the same expected performance, then there is no need to pick a winner, and ICM Efficiency would be zero.

Appendix B.
Pearson Correlation Matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. ICM Efficiency	1																
2. Total Comp	-0.013	1															
3. Cash Comp	0.029	0.539*	1														
4. Equity Comp	-0.028	0.576*	0.146	1													
5. Total Equity(%)	0.014	-0.207*	-0.023	-0.272*	1												
6. Unvested Equity(%)	-0.030	-0.112	-0.101	0.064	0.331*	1											
7. Firm Size	0.073	0.610*	0.309*	0.407*	-0.387*	-0.318*	1										
8. Num of Affiliates	-0.045	0.487*	0.193*	0.337*	-0.329*	-0.344*	0.681*	1									
9. Firm Age	0.050	0.402*	0.157	0.280*	-0.314*	-0.270*	0.612*	0.769*	1								
10. LofB HHI	-0.020	-0.163	-0.026	-0.193	0.390*	0.279*	-0.504*	-0.481*	-0.610*	1							
11. Geographic HHI	-0.032	-0.164	-0.129	-0.159	0.196	0.133*	-0.222*	-0.272*	-0.404*	0.266*	1						
12. Long-tail Risk	0.032	-0.312*	-0.063	-0.332*	0.208*	0.181	-0.228*	-0.592*	-0.570*	0.278*	0.312*	1					
13. Capital	-0.042	-0.233*	-0.225*	-0.157	-0.019	-0.066	-0.022	-0.220	-0.280*	0.108	0.099	0.357*	1				
14. ICM Size	-0.076	0.336*	0.056	0.233*	-0.189*	-0.124*	0.436*	0.597*	0.366*	-0.234*	-0.097	-0.345*	-0.009	1			
15. $(ICM\ Size)^2$	-0.152	0.120	-0.058	0.081	-0.075	-0.046	0.200*	0.340*	0.129	-0.105	0.003	-0.193*	0.026	0.785	1		
16. Tenure	-0.094	0.108	0.067	-0.150	0.263*	-0.127	-0.094	-0.027	-0.052	0.135	0.028	0.116	-0.059	-0.056	-0.015	1	
17. CEO Age	0.075	0.061	0.094	-0.215*	0.039	-0.307*	0.195	0.219*	0.191	-0.189*	-0.085*	0.039	0.068	0.048	0.028	0.383*	1

Note: This table presents the Pearson correlation matrix for all variables. The definitions of variables are presented in Table 1.
* denotes statistical significance at the 5% level.

Appendix C.
ICM Efficiency and CEO Compensation

Variable	1st Stage Total	2nd Stage Efficiency	1st Stage Cash	2nd Stage Efficiency	1st Stage Equity	2nd Stage Efficiency	1st Stage Total Eq (%)	2nd Stage Efficiency	1st Stage Unvested (%)	2nd Stage Efficiency
Total Comp		0.008								
		(0.005)								
Cash Comp				-0.005						
				(0.006)						
Equity Comp						-0.002**				
						(0.001)				
Total Eq (%)								0.054*		
								(0.029)		
Unvested (%)										-0.651*
										(0.334)
Firm Size	0.352**	-0.010**	0.319***	-0.005	0.522	-0.005	-0.039***	-0.006	0.001	-0.005
	(0.149)	(0.004)	(0.115)	(0.004)	(0.588)	(0.003)	(0.012)	(0.004)	(0.001)	(0.004)
Num of Affil	0.099	-0.004	0.248*	-0.002	-0.315	-0.001	0.002	-0.005	0.001	-0.003
	(0.111)	(0.008)	(0.140)	(0.007)	(0.682)	(0.007)	(0.008)	(0.008)	(0.001)	(0.008)
Firm Age	-0.101	0.002	-0.279	-0.000	0.208	0.002	0.012	0.000	-0.000	0.002
	(0.142)	(0.009)	(0.225)	(0.008)	(1.419)	(0.006)	(0.011)	(0.009)	(0.001)	(0.009)
Geo HHI	-0.297	0.050***	-0.537	0.038**	-4.982	0.027	0.076	0.040**	-0.006	0.032*
	(0.599)	(0.019)	(0.510)	(0.017)	(3.955)	(0.017)	(0.076)	(0.018)	(0.009)	(0.017)
LofB HHI	-0.148*	0.003	-0.123*	0.001	-0.170	0.000	0.018	0.001	-0.001	0.001
	(0.089)	(0.003)	(0.075)	(0.002)	(0.613)	(0.002)	(0.012)	(0.003)	(0.002)	(0.003)
Long-tail Risk	0.515	0.026*	0.221	0.029*	1.116	0.018	-0.042	0.030*	-0.004**	0.023
	(0.523)	(0.015)	(0.377)	(0.016)	(2.278)	(0.012)	(0.030)	(0.015)	(0.002)	(0.014)
Capital	0.508	-0.025*	1.035**	-0.014	0.387	-0.019	-0.104*	-0.014	-0.009	-0.023*
	(0.518)	(0.014)	(0.484)	(0.014)	(2.766)	(0.012)	(0.061)	(0.012)	(0.006)	(0.012)
ICM Size	-0.029**	0.003***	-0.018	0.003***	-0.061	0.003***	0.001	0.003***	-0.000	0.003***
	(0.012)	(0.001)	(0.012)	(0.001)	(0.061)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
$(\text{ICM Size})^2$	0.001	-0.000***	-0.000	-0.000***	-0.003	-0.000***	-0.000	-0.000***	0.000	-0.000***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CEO Age			0.346***		-0.121***		0.002**			
			(0.086)		(0.019)		(0.001)			
Tenure							0.009**		-0.001*	
							(0.004)		(0.001)	
Lagged Comp	0.409***									
	(0.064)									
Rank of Lagged Comp							0.000***		0.000***	
							(0.000)		(0.000)	

Adjusted-R^2	0.870	0.385	0.790	0.405	0.554	0.371	0.663	0.396	0.642	0.394
K-P rk LM Stat	28.560***		19.286***		16.629***		27.618***		18.948***	
Wald F Stat	40.579		16.413		38.364		13.110		13.713	
Hansen J Stat							1.237		0.409	
Observations	382	382	382	382	382	382	382	382	382	382

Note: This table presents the first stage and the second stage results of two-stage least squares regression to estimate the effect of CEO compensation on internal capital market efficiency. In the first-stage regression, CEO Tenure, CEO Age, the lagged value of compensation, and/or the rank of the lagged compensation variables are included to instrument CEO compensation. The relevance of instruments are tested by a Kleibergen-Paap rk LM test and a Wald test, and the Hansen J test is used for over-identification in the regressions with more than one instrument.

ICM Efficiency is the measure of internal capital market efficiency, defined as the asset-weighted sum of each affiliate's relative investment opportunity based on ROA multiplied by the relative amount of net reinsurance premiums ceded to affiliates; Total Compensation is the natural log of the sum of salary, bonus, stock awards, option awards, non-equity incentives, and long-term incentive plans; Cash Compensation is measured in natural log of the sum of salary and bonus; Equity Compensation is the natural log of the sum of stock-related awards and option-related awards; Total Equity (%) is the CEO's share holdings as a percentage of total shares outstanding; Unvested Equity (%) is the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding; Firm size is the natural log of total assets; Number of Affiliates is the natural log of the number of affiliates in the group; Firm Age is the insurer's age; Geographic HHI is the Herfindahl-Hirschman index of premiums written by state; Line-of-Business HHI is the Herfindahl-Hirschman index of premiums written by business line; Long-tail Risk is the proportion of premiums written in long-tail business lines; Capital is defined as policyholders' surplus divided by assets; ICM Size is measured as the sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written; $(\text{ICM Size})^2$ is the square of ICM size; CEO Age is CEO's age; Tenure is the natural log of the number of years that an individual had been the CEO of a company; Lagged Comp is a lagged value of compensation; Rank of Lagged Comp is a rank of the lagged value of compensation.

Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.

Appendix D.
Internal Capital Market Utilization and CEO Compensation

Variable	ICM Utilization	ICM Utilization	ICM Utilization	ICM Utilization	ICM Utilization
Total Compensation	0.100				
	(0.064)				
Cash Compensation		0.081***			
		(0.031)			
Equity Compensation			-0.014*		
			(0.008)		
Total Equity (%)				0.778***	
				(0.228)	
Unvested Equity (%)					-6.987**
					(3.225)
Firm Size	-0.082***	-0.114***	-0.051**	-0.062**	-0.061**
	(0.030)	(0.032)	(0.022)	(0.027)	(0.029)
Number of Affiliates	0.188***	0.173***	0.182***	0.189***	0.203***
	(0.036)	(0.036)	(0.035)	(0.035)	(0.035)
Firm Age	0.020	0.051	0.022	0.001	0.023
	(0.044)	(0.055)	(0.043)	(0.057)	(0.057)
Geographic HHI	0.026	0.031	0.020	0.006	0.013
	(0.024)	(0.022)	(0.022)	(0.025)	(0.025)
Line-of-Business HHI	0.026	-0.118	-0.175	-0.224	-0.302
	(0.191)	(0.196)	(0.149)	(0.183)	(0.199)
Long-tail Risk	-0.013	0.110	-0.001	0.155*	0.080
	(0.104)	(0.091)	(0.091)	(0.083)	(0.093)
Capital	0.386**	0.289	0.379**	0.502***	0.380**
	(0.164)	(0.187)	(0.157)	(0.169)	(0.180)
ICM Size	0.016***	0.019***	0.012***	0.017***	0.017***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$(\text{ICM Size})^2$	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted-R^2	0.875	0.904	0.893	0.907	0.902
Kleibergen-Paap rk LM Stat	12.093***	19.286***	22.120***	14.623***	15.002***
Wald F Stat	11.635	16.413	41.835	22.631	13.656
Hansen J Stat				0.827	0.148
Observations	382	382	382	382	382

Note: This table presents the results for two-stage least squares regression to estimate the effect of CEO compensation on internal capital market utilization. In the first-stage regression, CEO Tenure, CEO Age, the lagged value of compensation, and/or the rank of the lagged compensation variables are included to instrument CEO compensation. The relevance of instruments are tested by a Kleibergen-Paap rk LM test and a Wald test, and the Hansen J test is used for over-identification in the regressions with more than one instrument.

ICM Utilization is defined as the sum of reinsurance premiums ceded to affiliates divided by total premiums written; Total Compensation is the natural log of the sum of salary, bonus, stock awards, option awards, non-equity incentives, and long-term incentive plans; Cash Compensation is measured in natural log of the sum of salary and bonus; Equity Compensation is the natural log of the sum of stock-related awards and option-related awards; Total Equity (%) is the CEO's share holdings as a percentage of total shares outstanding; Unvested Equity (%) is the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding; Firm size is the natural log of total assets; Number of Affiliates is the natural log of the number of affiliates in the group; Firm Age is the insurer's age; Geographic HHI is the Herfindahl-Hirschman index of premiums written by state; Line-of-Business HHI is the Herfindahl-Hirschman index of premiums written by business line; Long-tail Risk is the proportion of premiums written in long-tail business lines; Capital is defined as policyholders' surplus divided by assets; ICM Size is measured as the sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written; $(\text{ICM Size})^2$ is the square of ICM size.

Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.

Appendix E.
Internal Capital Market Efficiency and CEO Compensation with ICM Size Interaction

Variable	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency	ICM Efficiency
Total Compensation	0.008				
	(0.005)				
Cash Compensation		-0.005			
		(0.006)			
Equity Compensation			-0.001**		
			(0.001)		
Total Equity (%)				0.184*	
				(0.107)	
Unvested Equity (%)					-0.980
					(0.615)
Firm Size	-0.010**	-0.005	-0.005	-0.009**	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of Affiliates	-0.004	-0.002	-0.004	-0.004	-0.003
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
Firm Age	0.002	-0.000	-0.002	0.003	0.001
	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
Geographic HHI	0.002	0.001	0.002	0.002	0.001
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Line-of-Business HHI	0.049***	0.038**	0.045**	0.060***	0.022
	(0.018)	(0.017)	(0.019)	(0.020)	(0.019)
Long-tail Risk	0.026*	0.028*	0.023	0.031**	0.023
	(0.016)	(0.016)	(0.014)	(0.016)	(0.014)
Capital	-0.024*	-0.013	-0.023*	-0.026*	-0.018
	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)
ICM Size	0.003	0.005	0.004***	0.003***	0.003***
	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)
$(\text{ICM Size})^2$	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(ICM Size)*Compensation	0.000	-0.000	-0.000	0.047*	-0.116
	(0.000)	(0.001)	(0.000)	(0.028)	(0.105)
Adjusted-R^2	0.385	0.409	0.398	0.395	0.388
Observations	382	382	382	382	382

Note: This table presents the results for two-stage least squares regression to estimate the effect of CEO compensation on internal capital market efficiency with

the interaction term of the size of internal capital markets. In the first-stage regression, CEO Tenure, CEO Age, the lagged value of compensation, and/or the rank of the lagged compensation variables are included to instrument CEO compensation. The relevance of instruments are tested by a Kleibergen-Paap rk LM test and a Wald test, and the Hansen J test is used for over-identification in the regressions with more than one instrument. The estimates for the first-stage regression are the same as those reported in Appendix C.

ICM Efficiency is the measure of internal capital market efficiency, defined as the asset-weighted sum of each affiliate's relative investment opportunity based on ROA multiplied by the relative amount of net reinsurance premiums ceded to affiliates; Total Compensation is the natural log of the sum of salary, bonus, stock awards, option awards, non-equity incentives, and long-term incentive plans; Cash Compensation is measured in natural log of the sum of salary and bonus; Equity Compensation is the natural log of the sum of stock-related awards and option-related awards; Total Equity (%) is the CEO's share holdings as a percentage of total shares outstanding; Unvested Equity (%) is the sum of the number of unexercised options and the number of restricted stocks held by the CEO that were not yet vested divided by shares outstanding; Firm size is the natural log of total assets; Number of Affiliates is the natural log of the number of affiliates in the group; Firm Age is the insurer's age; Geographic HHI is the Herfindahl-Hirschman index of premiums written by state; Line-of-Business HHI is the Herfindahl-Hirschman index of premiums written by business line; Long-tail Risk is the proportion of premiums written in long-tail business lines; Capital is defined as policyholders' surplus divided by assets; ICM Size is measured as the sum of each affiliate's net internal reinsurance premiums ceded divided by total premiums written; $(\text{ICM Size})^2$ is the square of ICM size; (ICM Size)*Compensation is the interaction between ICM Size and CEO compensation.

Statistical significance at the 1, 5, and 10 percent levels are denoted by ***, **, and * respectively.