Are Loss Reserve Errors and Internal Capital Markets Substitute?

For Submission to
Financial Management Association 2016

Jan 15, 2016

Abstract

Property-liability insurer loss reserves are managed across the entire distribution of earnings to mask fluctuations in income to increase firm value. Studies find insurers generally put money aside for good years and take money out for bad years (Grace 1990 and Beaver, McNichols and Nelson, 2003). We first examine if single unaffiliated insurers over-reserve more than insurers affiliated with a group. Then, we further investigate whether single unaffiliated insurers have to take money out of the reserves to deal with high losses whereas firms with access to internal capital markets (ICMs) are less likely to do that because their group members can transfer capitals internally to the rest of groups via ICMs. Thus we inspect the relation between insurers' profitability and their use of loss reserve error to see if it is substitute of internal capital markets. We show evidence that single unaffiliated insurers over-reserve more on average than firms affiliated with a group and access to ICMs. Also single unaffiliated firms take money out of the reserves to deal with high losses whereas firms with access to ICMs do that less. Therefore, insurer loss reserve errors are internal capital markets substitutes to deal with fluctuations in losses.

Keywords: Earning Management, Loss Reserve Error, Internal Capital Markets, Accounting Discretion, Insurance

JEL classification: G34, G32; G22

Introduction

Loss reserves, insurer's estimated liability for unpaid claims, are the largest and most important liability item on a property-liability insurer's balance sheet. Insurance companies need to estimate the proper amount of reserves to meet future liabilities from losses.

Under Statutory Accounting Principles (SAP), Schedule P of the National Association of Insurance Commissioner's (NAIC) annual statement requires the Property and liability insurers to disclose the gradual settlement of claims over time and record all changes of the loss reserve estimate. Those changes provide whether the previously reported amount involves with high error or low error. Comparing previous loss reserves for certain claims with the actual dollars paid for those claims indicates the degree to which the reserves were estimated appropriately. Insurers reestimate prior years' loss estimates each year to reflect actual payments made and changes in estimates.

Estimation of loss reserves not only requires quantitative methods but also subjective consideration and managerial judgment. Frequently, an insurer's loss reserve errors are used as a measure of managerial discretion. Most of previous studies look at managerial discretion via earnings' management by loss reserve manipulation and have shown that it is driven by a number of incentives such as income smoothing, financial weakness of a firm, tax liability, regulatory scrutiny, and executive compensations (Weiss, 1985; Grace, 1990; Petroni, 1992; Harrington and Danzon, 1994; Gaver and Paterson, 1994, 2004; Nelson, 2000; Beaver, McNichols and Nelson, 2003; Eckles and Halek, 2010; Eckles et al., 2011; Grace and Leverty, 2012).

This paper particularly focuses on income smoothing incentives among others. Loss reserve has a great potential to act as an income smoother among the property-liability insurers. In general, when the profit is high in a good year, the insurer tends to over-reserve, retaining the profit in loss reserve funds and enhancing the actual solvency of the insurance company.

On the other hand, when the profitability is low in a bad year, the insurer tends to under-reserve, releasing some of the stored resource into the earnings (Grace, 1990; Beaver, McNichols and Nelson, 2003).

Accounting measures such as loss reserves are widely used for a firm's information dissemination to managers, shareholders, investors and analysts, and regulators. They all have an interest in knowing the magnitude and variability of these potential deviations in loss reserves over the time period. Managers often alter loss reserve estimates for many reasons as stated in the previous paragraph. Shareholders and regulators pay attention to loss reserves in terms of financial weakness and solvency of the firm. Insurers may make sure to keep their values in line with expectations because variability can be seen as an indicator of a firm's risk.

The insurance industry is a perfect laboratory to study the loss reserves. It provides a homogeneous sample of firms and insurer-specific accruals, loss reserves, which can be used to measure the actual error in accruals. In addition to the unique ability to witness the loss reserve errors, the insurance industry is also comprised of two distinct structures; group affiliated and single unaffiliated firms.[1] The group structure allows for a potentially active internal capital markets (ICMs) with corporate headquarters allocating capital among the group members in the form of reinsurance ceded to affiliates (William, 1975; Stein, 1997; Houston, James, and Marcus, 1997).

We first hypothesize whether single unaffiliated insurers over-reserve more than insurers affiliated with a group. Then, we further investigate if single unaffiliated insurers have to take money out of the reserves to deal with high losses whereas firms with access to internal capital markets are less likely to do that because they group members can transfer capitals

[1] Insurance regulation has focused on the operations and financial strength of insurers on a legal entity basis. Property-liability insurers have the ability to operate in groups and they are required to prepare statutory filings at the group level. Additionally, model laws specifically states as insurance holding companies and regulate transactions within the insurance group. Single unaffiliated firms are defined if no other firms on the National Association of Insurance Commissioner (NAIC) property-liability database shares the same group code and group affiliated firms are the opposite.

internally to the rest of groups via ICMs. Unaffiliated single firms have their own authority to manage their reserves to meet corporate goals and they do not have the ability to transfer capital to affiliates unlike affiliated insurers. This way, insurers' loss reserve errors can be considered as substitutes of internal capital markets. Thus we inspect the relation between insurers' profitability and their use of loss reserve error to see if it is substitute of internal capital markets. We show evidence that single unaffiliated insurers over-reserve more on average than firms affiliated with a group and access to ICMs. Also single unaffiliated firms take money out of the reserves to deal with high losses whereas firms with access to ICMs do that less. Therefore, ICMs and insurer loss reserve errors are substitutes to deal with fluctuations in losses.

This paper will fill the gap in the literature as we inspect the relation between insurer loss reserve error and internal capital markets. Prior literature provides support for the existence of ICMs within group insurers but has not incorporated loss reserve error. The remainder of this paper proceeds as follows. The second section summarizes prior literature on loss reserve errors and internal capital markets. The third section discusses conceptual background and hypotheses. The following section presents the model and data followed by the empirical results. The last section concludes.

Literature Review

Loss Reserve Error

Property-liability insurer reserve error has been thoroughly discussed in the existing literature but not on its use as internal capital market substitutes. Most of previous studies look at earnings' management via loss reserve manipulation and have shown that it is driven by various reasons such as financial weakness of a firm (Petroni, 1992; Harrington and Danzon, 1994; Gaver and Paterson, 1994), income smoothing (Anderson, 1971; Smith, 1980; Weiss, 1985; Grace, 1990; Beaver, McNichols and Nelson, 2003; Grace and Leverty 2012), minimization of

tax liability (Grace, 1990; Gaver and Peterson, 2001; Grace and Leverty, 2012), regulatory scrutiny (Nelson, 2000; Petroni, 1992; Gaver and Paterson, 2004; Grace and Leverty, 2012), and executive compensations (Eckles and Halek, 2010; Eckles et al., 2011).

This paper focuses on income smoothing incentives among others. Income smoothing by property-liability insurers via loss reserve manipulation has been discussed frequently in the context of insurers manipulating their loss reserves to smooth their income since it has a great potential to act as an income smoother among the property-liability insurers.

Anderson (1971) studies property and liability insurer under-estimating loss reserves upon policyholder's surplus to compare the significance of under-estimating with that of unfavorable underwriting results and decreasing assets values. He finds that reserve errors have a stabilizing effect on underwriting income. Smith (1980) uses auto liability loss reserve estimates are not random and intentionally managed to smooth reported underwriting results. Both Anderson (1971) and Smith (1980) find that loss reserving errors stabilize reported underwriting results but these results do not control for the effect other economic factors and insurer characteristics may have on loss reserving errors. Weiss (1985) takes this into account. In addition to the hypothesis that loss reserves are used as a tool in smoothing underwriting results is proved, the hypothesis that economic development and insurer characteristics effect the loss reserve in automobile liability line.

Theoretical analysis with respect to income smoothing is also introduced by Grace (1990). Grace (1990) developed a theory in which an insurer maximizes discounted cash flow subject to estimation errors and empirical results support its theory. She shows evidence that there is negative relation between insurer loss reserve error and the average net income of past three years. Furthermore, Aiuppa and Trieschmann (1987) incorporate size, organizational structure, and product mix of the firm. They show evidence that small insurers experience relatively more reserve error and stock insurers experience relatively more accurate reserves.

Beaver, McNichols, and Nelson (2003) conclude that insurers manage reserves across the distribution of earnings. They find that firms in the left tail of the earnings distribution understate reserve relative to those in the right tail of the earnings distribution which is consistent with income smoothing. They divided the earning into four categories: *Negative, Below, Above, and Positive*.[2] Insurers with high earnings, the income-decreasing reserve accruals are reported whereas firms with low earnings tend to report income-decreasing reserve accruals. Also insurers with small positive earnings are more motivated to understate loss reserves than insurers with small negative earnings. Specifically for public and mutual firms, small firms with positive earnings understate loss reserves relative to insurers with small negative earnings. They conclude that insurers manage reserves across the distribution of earnings rather than primarily in the region around zero.

Recently, Grace and Leverty (2012) consider four hypotheses: income smoothing, financial weakness, tax, and rate regulation. Though, they do not show evidence between loss reserve errors and income distribution indicators. In this paper, we extend the income smoothing hypothesis via loss reserve error to incorporate with internal capital markets. No prior studies explore the association between these two yet thus it will fill the gap in the existing property-liability insurer loss reserve error literature.

Internal Capital Markets (ICMs)

A substantial theoretical and empirical literature on internal capital markets and its efficiencies has developed in property and casualty insurer. Yet, prior studies has not integrate ICMs with insurer loss reserve errors nor prior studies has not examined the relation between

[2] In Beaver, McNichols and Nelson (2003), *Negative* is equal to one if the observation is to the left of the first portfolio below zero. *Below* is equal to one if the observation is in the first portfolio below zero. *Above* is equal to one if the observation is in the first portfolio above zero and *Positive* is equal to one if the observation is to the right of the first portfolio above zero.

property and casualty insurers' profitability and their use of loss reserve error to examine if they are substitute of internal capital markets.

The property-liability insurance industry provides the ability for insurers to operate in groups which allows for ICM activities. In general, the literature shows that conglomerates have the benefit of ICMs since the insurers within the group structure can allocate internal capitals across the group members (Gertner, Scharfstein and Stein, 1994; Stein, 1997; Houston and James, 1998; Maksimovic and Phillips, 2002,2006; Powell and Sommer, 2007; Powell, Sommer, and Eckles, 2008; Fier, McCullough, and Carson, 2012) though empirical results for ICM efficiency are mixed (Shin and Stulz, 1998; Rajan, Servaes, and Zingales, 2000; Powell and Sommer, 2007).

Stein (1997) develops a model in which headquarters creates value by engaging in "winner picking" and allocating capital to projects having the highest expected returns.[3] On one hand, headquarters could raise more than stand-alone firms because of fewer credit constraints. On the other hand, there involves high expense in monitoring headquarters.

A number of studies find internal capital markets play an important role in the operations of financial intermediaries (Houston, James, and Marcus 1997), nonfinancial industry (Khanna and Tice 2001), and Property-casualty insurance industry (Powell and Sommer 2007 and Powell, Sommer and Eckles 2008).

In Powell, Sommer, Eckles (2008), the authors model a change in an affiliated insurer's capitalization through ICM transactions by transferring capital to another affiliated insurer through reinsurance. They distinguish between affiliate and non-affiliate uses of capital and reinsurance and find that ICM transactions in group insurers stimulate growth in affiliate's investment. The common proxy for ICMs used in many studies is reinsurance which can be

[3] "Winner picking" represents headquarters having the ability to reallocate capitals from divisions where returns are low (losers) to divisions where returns are high (winners) (Stein, 1997; and Gertner, Scharfstein and Stein, 1994)

measured as the changes in net reinsurance ceded or the difference in the ratio of net reinsurance premiums ceded to total premiums written. Both measures affect the internal capital structure since increasing the premium ceded to reinsurers allows an insurer to write more insurance.

Recently, Niehaus (2014) shows that a profit maximizing group may want to recapitalize subsidiaries after negative capital shocks. Recapitalizing weak subsidiaries allows the group to continue to earn rents from previous investments in the subsidiary's reputation. He examines insurers receiving internal capital contributions as well as insurers paying internal shareholder dividends as proxies for internal capital markets. He finds evidence that insurance groups manage capital with respect to insolvency risk and concludes that ICMs play a crucial role within groups for life and health insurers.

In opposite, other studies indicate that internal capital market activities are not a significant factor in the investment strategy of conglomerate firms (Shin and Stulz 1998, Scharfstein and Stein, 2000; Rajan, Servaes, and Zingales 2000) and rather it involves with less efficiency. Scharfstein and Stein (2000) introduce the agency problems among division managers and conclude the hierarchies lead to misallocation of internal capital. Further, Rajan, Servaes, and Zingales (2000) argue diversified firms may invest inefficiently since ICMs might in fact hinder investment efficiency by allocating resources more poorly than would external capital markets.

Theory indicates that diversification via ICMs is associated with both costs and benefits. In general, benefits associated with diversification include economies of scope (Teece, 1980), internal capital markets without information asymmetries (Stein, 1997), as well as risk pooling (Cummins, Phillips, and Smith, 2001). Gertner, Scharfstein and Stein (1994) compare internal capital markets with external capital markets via bank lending and find that ICMs are less costly and more efficient than external capital markets since they reduce agency costs as

well as information asymmetries. Gertner, Scharfstein and Stein (1994) and Stein (1997) both find that ICMs play a significant role as conglomerates allocate capital to the divisions with the best expected returns. Corporate headquarters creates value in a way that headquarters has the ability to reallocate capital from divisions where expected returns are low to divisions where expected returns are high.

On the contrary, transferring capital among affiliates can create an information asymmetry between insurance groups and other parties such as shareholders, policyholders, and regulators. Diversification via internal capital markets may magnify agency costs (Harris, Kriebel, and Raviv, 1982; Rotemberg and Saloner, 1994) and agency problems can increase among division managers which may lead to misallocation of internal capital according to Scharfstein and Stein (2000). Likewise, it may allow inefficient cross-subsidization of poorly performing business units (Rajan, Servaes, and Zingales, 2000). Some of potential benefits associated with ICMs include lower monitoring costs, reduced agency problems, greater efficiency of capital allocation and lower cost of internal capital compared to external capital. The lower cost of capital drives the reduced information asymmetries and lower agency costs within the internal capital markets.

So far, the prior literature provides support for the existence of internal capital markets within group insurers and various incentives for earnings' management by insurers via loss reserve error but prior studies has not incorporate ICMs with insurer loss reserve errors nor has not examined the relation between insurers' profitability and their use of loss reserve error to examine if they are substitute of internal capital markets.

Conceptual Background and Hypotheses

Loss reserve has a great potential to act as an income smoother among the property-liability insurers. Generally, the insurer tends to over-reserve, retaining the profit in loss reserve

funds and enhancing the actual solvency of the insurance company in high profit years. Conversely, when the profitability is low in a bad year, the insurer tends to under-reserve, releasing some of the stored resource into the earnings (Grace, 1990; Beaver, McNichols and Nelson, 2003).

Insurance industry not only provides an insurer-specific accruals, loss reserves, but also comprised of two distinct structure: group affiliated and single unaffiliated firms. The group structure allows for a potentially active internal capital markets with corporate headquarters allocating capital among the group members in the form of reinsurance ceded to affiliates (William, 1975; Stein, 1997; Houston, James, and Marcus, 1997).

Basically, there are two mechanisms to smooth income. Single unaffiliated insurers can only use income smoothing via loss reserve just like a piggy bank. On the other hand, affiliated insurers can smooth income via loss reserves as well as by transferring capitals thru internal capital markets. In this paper, we expect income smoothing via loss reserves to be less important within a group.

We first examine whether single unaffiliated insurers over-reserve more than insurers affiliated with a group. Unaffiliated single firms have their own authority to manage their reserves to meet corporate goals and they do not have the ability to transfer capital to affiliates unlike affiliated insurers. Thus we propose the following hypothesis:

Hypothesis 1 (Piggy bank hypothesis): Single unaffiliated firms over-reserve more on average than firms affiliated with a group and access to an internal capital market

Then, we further investigate if single unaffiliated insurers have to take money out of the reserves to deal with high losses whereas firms with access to internal capital markets are less likely to do that because their group members can transfer capitals internally to the rest of

groups via ICMs. This way, insurers' loss reserve errors can be considered as substitutes of internal capital markets. Thus we inspect the relation between insurers' profitability and their use of loss reserve error to see if it is substitute of internal capital markets. Our second hypothesis is as follows:

> *Hypothesis 2 (Substitute Hypothesis): Affiliated insurers with access to more active internal capital markets under-reserve less in loss years than insurers with limited or without access to active internal capital markets*

We expect to show that single unaffiliated insurers over-reserve more on average than firms affiliated with a group and access to ICMs. Also single unaffiliated firms take money out of the reserves to deal with high losses whereas firms with access to ICMs do that less. Therefore, internal capital markets and insurer loss reserve errors are substitutes to deal with fluctuations in losses for property-liability insurers.

Model, Data and Methodology

Model

We follow the same measures of reserve error that have been widely and most effectively used in the literature (Kazenski, Feldhaus, and Schneider 1992, Petroni 1992, Beaver, McNichols, and Nelson 2003, Gaver and Paterson 2004).[4]

$$Reserve\ Error\ (RE)_{i,t} = Incurred\ Losses_{i,t} - Incurred\ Losses_{i,t+n} \quad (1)$$

[4] Another way to measure the reserve is discussed in Weiss (1985) and Grace (1990). They use the difference between total incurred losses for a firm *i* as of a given year *t* and cumulative developed losses paid in future year *t+j* where *j* also equals to five years. Unlike KFS (1992), reserve error is determined by comparing the initial estimate of reserves with claims paid. These claims paid are not ultimate claims paid since it is limited to just five years. It cannot guarantee all the claims are paid and thus very likely to overstate the reserve error. Thus we follow the measure used in KFS (1992) because it does not depend on the development of losses when losses are paid. This is the same measures of reserve error that has been widely used in the existing literature (Petroni 1992, Beaver, McNichols, and Nelson 2003, Gaver and Paterson 2004 and Grace and Leverty 2010).

The insurance literature has primarily used two loss reserve error scaling factors: total assets and developed reserves. Reserve Error is positive if insurer over-reserve and negative if insurer under-reserve.

$$\textit{Reserve Error (RE1)}_{i,t} = \frac{(Incurred\ Losses\ i,t - Incurred\ Losses\ i,t+5)}{Total\ assets\ i,t} \quad (2)$$

$$\textit{Reserve Error (RE2)}_{i,t} = \frac{(Incurred\ Losses\ i,t - Incurred\ Losses\ i,t+5)}{Developed\ Reserve\ i,t} \quad (3)$$

In order to test our first hypothesis, we develop our first analysis employs the following Ordinary Least Square (OLS) regressions. The regression includes year fixed effect and standard error accounts for heteroskedasticity.

$$RE_{i,t} = \beta 0 + \beta 1\ Group_{i,t} + \beta 2\ ROA_{i,t} + \beta 3\ Size_{,t} + \beta 4\ Age_{,t} + \beta 5\ Growth_{i,t} + \beta 6\ Mutual_{i,t} + \beta 7\ Capasset_{i,t} + \beta 8\ Reinsurance\_external_{i,t} + \beta 9\ Geo\text{-}Herf_{i,t} + \beta 10\ Product\text{-}Herf_{i,t} + \beta 11\ Longtail_{i,t} + \varepsilon_{i,t} \quad (4)$$

where *i* represents each individual at year *t*. Our main interesting variables are $Group_{i,t,}$ $ROA_{i,t.}$ Indicator variable, $Group_{i,t,,}$ equals to one if a firm *i* is a member of an insurer group and zero otherwise. $ROA_{i,t}$ is a net income scaled by total assets.

From equation (4), we inspect whether single unaffiliated insurers over-reserve more than insurers affiliated with a group. Unaffiliated single firms have their own authority to manage their reserves to meet corporate goals and they do not have the ability to transfer capital to affiliates unlike affiliated insurers. It is designed to test our first hypothesis that whether single unaffiliated insurers over-reserve more on average than firms affiliated with a group.

Other variable explanation is following. $Size_{i,t}$ is the natural logarithm of total assets. $Age_{i,t}$ is how many years a firm *i* operating businesses since established. $Growth_{i,t}$ is the one year percentage change in net premiums written. $Mutual_{i,t}$ is a binary variable equal to one if organizational structure form is a mutual and zero if stock. *Capasset i,t* is capital to asset ratio.

Reinsurance_external$_{i,t}$ is the ratio of reinsurance ceded to non-affiliated divided by reinsurance assumed plus direct premiums. *Geo-Herf*$_{i,t}$ is a geographic Herfindahl index, which is the sum of the squared percentage of business written in each of the 50 states and the District of Columbia in United States. *Product-Herf*$_{i,t}$ is a product Herfindahl index which is the sum of the squared percentage of premiums earned in each of the lines of P/L insurance. *Longtail*$_{i,t}$ is the proportion of a firm *i*'s business written in "long-tailed" insurance lines.[5] $\varepsilon_{i,t}$ is an error term. All variables are defined in Table 2.

For the second hypothesis, we further develop our next analysis employs the following Ordinary Least Square (OLS) regressions.

$$RE_{i,t} = \beta 0 + \beta 1 ICM_{i,t} + \beta 2\ Large\_loss_{i,t} + \beta 3\ ICM*Large\_loss_{i,t} + \beta 4\ Age_{i,t} + \beta 5\ Size_{i.t} + \beta 6\ Mutual_{i,t} + \beta 7\ Reinsurance\_external_{i,t} + \beta 8\ Growth_{i,t} + \beta 9\ Capasset_{i,t} + \beta 10\ Product\text{-}Herf_{i,t} + \beta 11\ Product\text{-}Herf_{i,t} + \beta 12\ Longtail_{i,t} + \varepsilon_{i,t} \quad (5)$$

where *i* represents each individual at year *t*. Note that all the definitions of variables from the second analysis are identical as the variables from the first regression except the following variables. *ICM*$_{i,t}$ has five internal capital markets proxies. First proxy is a *Group*$_{i,t}$, an indicator variable equals to 1 if a firm is a member of group, 0 otherwise. Second proxy is *ICMs participants*$_{i,t}$ which is the number of subsidiaries for each firm *i* for year *t*. Then next proxy is the average number of subsidiaries, *ICMs participants avg* $_{i,t}$, for each firm *i* for entire sample period. Moreover, *ICMs transactions*$_{i,t}$ also known as internal reinsurance is widely used to proxy for internal capital markets (Powell and Sommer, 2007; Powell, Sommer and Eckles, 2008; Fier, McCullough and Carson, 2012). It is calculated as the ratio of reinsurance ceded to affiliates minus reinsurance assumed from affiliates to the total reinsurance assumed plus direct

[5] Prior literature defines longtail lines as farm multi peril, homewoner's multi peril, commercial multi peril, medical malpractice, workers' compensation, products liability, automobile liability, and other liability (Berger et al 2000, Grace and Leverty 2012, Eckles, Halek and Zhang 2013).

premiums is used for the fourth proxy. Our last ICM proxy, $ICMs\_transactions\_avg_{i,t}$, is the average of the internal reinsurance for each firm *i* for entire sample period. $Large\_loss_{i,t}$ is binary variable equal to 1 if a firm has earning in the worst 30% of the negative earnings distribution.

Our main variable of interest is the interaction term, $ICM*Large\_loss_{i,t}$ which represents the association between internal capital markets and firm's worst negative earnings on insurers loss reserving practice..

From equation (5), we examine if single unaffiliated insurers have to take money out of the reserves to deal with high losses whereas firms with access to internal capital markets are less likely to do that because their group members can transfer capitals internally to the rest of groups via ICMs. In that sense, insurers' loss reserve errors can be considered as substitutes of internal capital markets. It is proposed to test our second hypothesis that is whether affiliated insurers with access to internal capital markets under-reserve less in loss years than insurers with limited or without access to active internal capital markets.

Data

Our data is from all property-liability insurers in the United States. Insurer characteristics are from insurers' annual statutory filings of National Association of Insurance Commissioner's (NAIC) from 1996 to 2012. Since the reserve error calculation requires five year data, our final sample ranges from 1996 to 2007 for insurer reserve error. In total there are 2,622 unique insurers and 636 groups with 14,225 firm-year observations.

Table 3 shows the descriptive statistics. The majority of firms over-reserve. The average magnitude of reserve error scaled by total assets ($RE1_{i,t}$) is 1.08% while reserve error scaled by developed reserve ($RE2_{i,t}$) is 5.13%. This indicates firms on average overestimate their reserve. To test whether single unaffiliated generally over-reserve more than the affiliated insurers, we

further conduct univariate comparison test. Table 4 shows the univariate comparison results. Statistical significance of differences is based on a *t*-tests for means and a nonparametric *k*-sample test for median. Unaffiliated firms over-reserve more on average and median than affiliated firms whether reserve error is scaled by assets or developed reserve and it is significantly different at 1% level.

We conduct univariate comparison tests for not only $Group_{i,t}$ variable but also for all other internal capital markets proxies. For $ICMs\ participants_{i,t}$ and $ICMs\ participants\ avg_{i,t}$, we create a subsample of top 30% and bottom 30% of our sample to conduct univariate comparison test on them. Similiarly, $ICMs\ transactions_{i,t}$ and $ICMs\_transactions\_avg_{i,t}$ are also divided into two subsamples, top 30% and bottom 30% of our sample, and univariate comparison test is conducted as shown in Table 4.

For all five ICM proxies in the table 4, unaffiliated and bottom 30% of insurers seem to over-reserve more than top 30% of sample. Univariate comparison results indicate that single unaffiliated and insurers with less or limited access to ICMs over-reserve more than affiliated and insurers with more access to ICMs. It is consistent with our first *piggy bank hypothesis* which says unaffiliated single firms have their own authority to manage their reserves to meet corporate goals and they do not have the ability to transfer capital to affiliates unlike affiliated insurers thus they over-reserve more on average than firms affiliated with a group and access to an internal capital market.

We follow standard exclusions and cleaning for our data. For data screening, we implement a screen similar to existing studies. We remove all insurers with negative total assets, and negative surplus. We also remove professional reinsurers defined as any insurer whose reinsurance assumed from unaffiliated firms is greater than 75% of the direct premiums written less reinsurance assumed from affiliated insurers. Also we only include either stock or mutual firms and exclude firms with values of $Geo\text{-}Herf_{i,t,}$ $Product\text{-}Herf_{i,t,}$ and $Longtail_{i,t}$ greater than

one or less than zero. We also exclude firms with dramatic extreme loss reserve errors when the difference between developed loss reserve and original loss reserve is more than 50% of the original reserve and it is because maybe data input error or pool arrangement is misplaced. Finally, we eliminate firms which cede all premiums to reinsurers and write most of their premiums in workers compensation.

Empirical Results

The regression results for the first *piggy bank hypotheses* corresponding to equation (4) is reported in Table 5. In the first column (1) and second column (2), the dependent variable is insurers reserve error scaled by total assets ($RE1_{i,t}$) whereas dependent variables for third column (3) and forth column (4) is insurers reserve error scaled by developed reserve ($RE2_{i,t}$). Also, second column (2) and last column (4) include $ROA_{i,t}$ variable but first column (1) and third column (3) do not. Other explanatory variables are defined and explained in Table 2.

In all of the regressions in Table 5, whether with or without $ROA_{i,t}$ variable, the estimated coefficient of our variable of interest, $Group_{i,t}$, is strongly significant and negative with values ranges from -0.7% to -5.0%. This result illustrates evidence that unaffiliated insurers over-reserve more on average than affiliated insurers.

As discussed earlier, unaffiliated single firms have more control over reserves and do not have access to internal capital markets. On the other hand, group affiliated insurers have less individual control and have access to internal capital markets. Our regression results support our first hypothesis and suggest that insurers that are not part of group over-reserve more than insurers that affiliated with a group.

Also, we find that $ROA_{i,t}$ is positively associated with the both dependent variable $RE1_{i,t}$ and $RE2_{i,t}$. It indicates that firms over-reserve as their profit increases which is consistent with previous studies (Grace, 1990; Beaver, McNichols and Nelson, 2003). Notice that negative

and significant coefficient for $Group_{i,t}$, remains the same. The positive and significant coefficient for $Size_{i,t}$ variable shows that bigger firms tend to over-reserve more than smaller firms. Moreover, mutual firms and the more diversified firms over-reserve more although the coefficient of $Longtail_{i,t}$ is insignificant. $Age_{i,t}$, $Growth_{i,t}$, $Reinsurance\_external_{i,t}$ are negatively associated with loss reserve error meaning that older firms, firms with high growth, and firms with more reinsurance_external transactions tend to under-reserve more on average. In the existing literature, the signs and the significance of coefficient on control variables vary depending on the pursuing hypotheses in particular papers. All the regressions include year fixed effect and standard error account for heteroskedasticity.

Beaver, McNichols and Nelson (2003) find that insurers manage reserves across the distribution of earnings. They separated the earning into four categories; $Negative_{i,t}$, *Below, Above, and Positive*.[6] In this paper, we separated the earnings into similar categories: *Large Loss, Small Loss, Small Profit, and Large Profit.*[7]

In Table 6, we show the regression results with four subcategories of earnings distribution instead of *ROA.* Dependent variables for the first column (1) is $RE1_{i,t}$ and the second column (2) is $RE2_{i,t}$. Insurers with high earnings, $Large\ Profit_{i,t}$, the income-decreasing reserve accruals are reported from 1% to 2.2%. However, firms with low earnings, $Large\ Loss_{i,t}$, tend to report income-decreasing reserve accruals from 3.4% to 4.8%. Also insurers with small positive earnings, $Small\ Profit_{i,t}$, are more motivated to understate loss reserves from 1.3% to 2% than insurers with small negative earnings, $Small\ Loss_{i,t}$. These results are consistent with

[6] In Beaver, McNichols and Nelson (2003), *Negative* is equal to one if the observation is to the left of the first portfolio below zero. *Below* is equal to one if the observation is in the first portfolio below zero. *Above* is equal to one if the observation is in the first portfolio above zero and *Positive* is equal to one if the observation is to the right of the first portfolio above zero.

[7] In this paper, *Large Loss* is a binary variable equal to 1 if a firm has earning in the bottom 30% of the negative earnings distribution. *Small Loss* is a binary variable equal to 1 if a firm has earning in the top 30% of the negative earnings distribution. *Small Profit* is a binary variable equal to 1 if a firm has earning in the bottom 30% of the positive earnings distribution. *Large Profit* is a binary variable equal to 1 if a firm has earning in the top 30% of the positive earnings distribution.

Beaver, McNichols and Nelson (2003). Other control variables looks steady except *Capasset* became positive and significant.

The regression results for the second hypothesis, *substitute hypotheses*, corresponding to equation (5) is reported in Table 7 for when dependent variable is $RE1_{i,t}$ and in Table 8 when dependent variable is $RE2_{i,t}$.[8] We use five internal capital markets proxies: (1) $Group_{i,t}$, *(2) ICMs participants*$_{i,t}$, *(3) ICMs participants avg*$_{i,t}$, *(4) ICMs transactions*$_{i,t,}$ and (5) *ICMs transactions avg* $_{i,t}$.

$Group_{i,t}$, an indicator variable equals to 1 if a firm is a member of group, 0 otherwise. *ICMs participants*$_{i,t}$ represents the number of subsidiaries for each firm *i* for year *t* and the average number of subsidiaries for each firm *i* for entire sample period is *ICMs participants avg* $_{i,t}$. Moreover, *ICMs transactions*$_{i,t}$ is commonly known as internal reinsurance and is widely used to proxy for internal capital markets (Powell and Sommer, 2007; Powell, Sommer and Eckles, 2008; Fier, McCullough and Carson, 2012). It is calculated as the ratio of reinsurance ceded to affiliates minus reinsurance assumed from affiliates to the total reinsurance assumed plus direct premiums for each firm *i* for year *t* and is used for the fourth proxy. *ICMs_transactions_avg*$_{i,t}$, is the average of the proxy four for each firm *i* for entire sample period.

In Table 7, the estimated coefficient of all five proxies for internal capital markets is strongly significant and negative with values ranged from 0.1% to 3.1%. This proposes that affiliated insurers and insurers with access to more internal capital markets have under-reserve than unaffiliated insurers and insurers with less active internal capital markets. Next, *Large_loss*$_{i,t}$ is binary variable equal to 1 if a firm has earnings in the worst 30% of the negative earnings distribution. The estimated coefficient of *Large_loss*$_{i,t}$ are strongly significant and

[8] For the purpose of length of the paper, we only indicate the results for the regression in Table 7 where the dependent variable equals to *RE1*. For *RE2*, refer to Table 8. The results are similar although slight significance changes may be detected. Our main interesting variables are interpreted in the same way as in Table 7.

negative with values ranged from 3.8% to 6.7% which indicates that insurers in bottom 30% of the negative earnings distribution report income-decreasing reserve accruals.

Our main variable of interest is the interaction term, $ICM*Large\_loss_{i,t}$ which represents the association between internal capital markets and firm's negative earnings on insurers loss reserving practice. In all five proxies, the estimated coefficient of the interactions term are positive and significant with the value ranges from 0.3% to 1.5%. This results show evidence that single unaffiliated and insurers with less access to ICMs have to take money out of the reserves to deal with high losses whereas affiliated and insurers with access to internal capital markets are less likely to do that because their group members can transfer capitals internally to the rest of groups via internal capital markets. In contrast, unaffiliated single firms have their own authority to manage their reserves to meet corporate goals and they do not have the ability to transfer capital to affiliates unlike affiliated insurers.

Insurers' loss reserve errors can be considered as substitutes of internal capital markets. Thus we examine the relation between insurers' profitability their use of loss reserve error to see if it is substitute of internal capital markets and conclude that ICMs and insurer loss reserve errors are substitutes to deal with fluctuations in losses in the property and liability insurance industry.

Conclusion

Property-liability insurer loss reserve errors are used as a measure of managerial discretion across the entire distribution of earnings to mask fluctuations in income to increase firm value. In general, insurers put money aside for high profit years and take money out for low profit years (Grace 1990 and Beaver, McNichols and Nelson, 2003).

Insurance industry not only provides an insurer-specific accruals, loss reserves, but also comprised of two distinct structures; group affiliated and single unaffiliated firms.

Basically, there are two mechanisms to smooth income. Single unaffiliated insurers can only use income smoothing via loss reserve just like a piggy bank. On the other hand, affiliated insurers can smooth income via loss reserves as well as by transferring capitals thru internal capital markets.

Thus, we examine if single unaffiliated insurers over-reserve more than insurers affiliated with a group. Then, we further investigate whether single unaffiliated insurers have to take money out of the reserves to deal with high losses whereas firms with access to ICMs are less likely to do that because they group members can transfer capitals internally to the rest of groups via ICMs. This way, we inspect the relation between insurers' profitability and their use of loss reserve error to see if it is substitute of internal capital markets.

We show evidence that single unaffiliated insurer over-reserve more on average than firms affiliated with a group and insurers with more access to ICMs. Also single unaffiliated firms take money out of the reserves to deal with high losses whereas firms with access to ICMs do that less. We conclude income smoothing via loss reserves is less important within a group and internal capital markets and insurer loss reserve errors are substitutes to deal with fluctuations in losses.

References

Aiuppa, T. A., and Trieschmann, J. S., 1987, An Empirical Analysis of the Magnitude and Accuracy of Incurred-But-Not Reported Reserves, The Journal of Risk and Insurance, 54:100-118

Anderson, D. R.,1971, Effects of Under and Overvaluation in Loss Reserves, The Journal of Risk and Insurance, 98:585-600

Beatty, A., Ke, B., Petroni, K., 2002. Differential earnings management to avoid earnings declines and losses across publicly and privately held banks. The Accounting Review 77, 547–570

Beatty, A., S. L. Chamberlain, and J. Magliolo. 1995. Managing financial reports of commercial banks: the influence of taxes, regulatory capital, and earnings. Journal of Accounting Research 33 (Autumn): 231-61

Beaver, W.H., McNichols, M.F., 1998. The characteristics and valuation of loss reserves of property casualty insurers. Review of Accounting Studies 3, 73–95

Berger, P. G., and E. Ofek, 1995, Diversification's Effect on Firm Value, Journal of Financial Economics, 37: 39-65.

Berger, L. A., J. David Cummins, and S. Tennyson, 1992, Reinsurance and the Liability Crisis, Journal of Risk and Uncertainty, 5: 253-272.

Burgstahler, D., Dichev, I., 1997. Earnings management to avoid earnings decreases and losses. Journal of Accounting and Economics 24, 99–126

Cummins, J. D., and P. Danzon, 1997, Price Shocks and Capital Flows in Liability Insurance, Journal of Financial Intermediation, 6(1): 3-38.

Cummins, J. D., R. D. Phillips, and S. D. Smith, 2001, Derivatives and Corporate Risk Management: Participation andVolume Decisions in the Insurance Industry, Journal of Risk and Insurance, 68(1): 51-91.

Cummins, J. D., and E. Grace. 1994. Tax management and investment strategies of property-liability insurers. Journal of Banking and Finance 18 (January): 43-72

Comin, D. *and* T. Philippon, 2006. The rise in firm-level volatility: Causes and Consequences, *NBER Macro Annual, NBER and MIT Press.*

Dechow, P., Skinner, D., 2000. Earnings management: reconciling the views of accounting academics, practitioners, and regulators. Accounting Horizons 14, 235–250

Degeorge, F., Patel, J., Zeckhauser, R., 1999. Earnings management to exceed thresholds. Journal of Business 72, 1–33

Eckles, D. L., Halek, M., He, E., Sommer, D. W. and Zhang, R. 2011, Earnings Smoothing, Executive Compensation, and Corporate Governance: Evidence From the Property–Liability Insurance Industry. Journal of Risk and Insurance, 78: 761–790

Eckles,D. L., and M.Halek, 2010, Insurer Reserve Error and Executive Compensation, Journal of Risk and Insurance, 77(2): 329-346

Eckles, D. L., Halek, M. and Zhang, R. 2013, Information Risk and the Cost of Capital. Journal of Risk and Insurance, 81(4):861-882

Forbes, S. W., 1969, Automobile Bodily Injury Liability Loss Reserving Techniques and Simulation, Journal of Risk and Insurance, 36,597-614

Forbes, S. W., 1970, Loss Reserving Performance within the Regulatory Framework, The Journal of Risk and Insurance, 37, 527-538

Gaver, J. J., K. M. Gaver, and J. R. Austin, 1995, Additional Evidence on Bonus Plans and Income Management, Journal of Accounting and Economics, 19(1): 3-28

Gaver, J. J., and J. S. Paterson, 2000, Earnings Management Under Changing Regulatory Regimes: State Accreditation in the Insurance Industry, Journal of Accounting and Public Policy, 19(4-5): 399-420

Gaver, J. J., and J. S. Paterson, 2004, Do Insurers Manipulate Loss Reserves to Mask Insolvency Problems? Journal of Accounting and Economics, 37(3): 393-416

Gaver, J. J. and Pottier, S. W., 2005, The Role of Holding Company Financial Information in the Insurer-Rating Process: Evidence From the Property-Liability Industry. Journal of Risk and Insurance, 72: 77–103

Gertner, R.H., Scharfstein, D.S., and Stein, J.C., 1994. Internal Versus External Capital Markets. The Quarterly Journal of Economics, 109, 1211-1230

Grace, M. and Leverty, T. (2012). "External Monitor Quality and Managerial Discretion." Working Paper, Risk Theory Society 2013.

Grace, M. F. and Leverty, J. T., 2012, Property–Liability Insurer Reserve Error: Motive, Manipulation, or Mistake. Journal of Risk and Insurance, 79: 351–380

Grace, E., 1990, Property-Liability Insurer Reserve Errors: A Theoretical and Empirical Analysis, Journal of Risk and Insurance, 57(1): 28-46

Harrington, S.E., Danzon, P.M., 1994. Price cutting in liability insurance markets. Journal of Business 67, 511–538

Harris, M. Kriebel, C.H., Raviv, A. 1982. Asymmetric Information, Incentives and Intrafirm Resource Allocation, Journal of Management Science, 28 (6), 604-620

Healy, P.M., Wahlen, J., 1999. A review of the earnings management literature and its implications for standard setting. Accounting Horizons 13, 365–383

Healy, P. M., 1985, The Effect of Bonus Schemes on Accounting Decisions, Journal of Accounting and Economics, 7(1-3): 85-107

Holthausen, R. W., D. F. Larcker, and R. G. Sloan, 1995, Annual Bonus Schemes and the Manipulation of Earnings, Journal of Accounting and Economics, 19(1): 29-74

Houston, J., C. James, and D. Marcus, 1997, Capital Market Frictions and the Role of Internal Capital Markets in Banking, Journal of Financial Economics, 46: 135-164

Kazenski, P. M., W. R. Feldhaus, and H. C. Schneider. 1992. Empirical evidence for alternative loss development horizons and the measurement of reserve error. Journal of Risk and Insurance 59 (December): 668-81

Khanna, N., and S. Tice, 2001, The Bright Side of Internal Capital Markets, Journal of Finance, 56(4): 1489-1528.

Klein, A., 2002, Audit committee, Board of Director Characteristics, and Earnings Management, Journal of Accounting Economics, 33(3): 375-400

Laeven, Luc & Levine, Ross, 2007. "Is there a diversification discount in discount in financial conglomerates?", Journal of Financial Economics, Elsevier, vol. 85(2), pages 331-367

Lamm-Tennant, J., Starks, L., 1993. Stock versus mutual ownership structures: the risk implications. Journal of Business 66, 29–46

Lamm-Tennant, J., Starks, L. T., Stokes, L., 1992, An Empirical Bayes Approach to Estimating Loss Ratios, Journal of Risk and Insurance, 59, 426-442

Liebenberg, Andre P. and Sommer, David W., 2008, Effects of Corporate Diversification: Evidence from the Property Liability Insurance Industry. Journal of Risk & Insurance, Vol. 75, Issue 4, pp. 893-919.

Mayers, D., Smith, C.W., 1988. Ownership structure across lines of property-casualty insurance. Journal of Law and Economics 31, 351–378

Mayers, D., Smith, C.W., 1994. Managerial discretion, regulation, and stock insurer ownership structure. The Journal of Risk and Insurance 61, 638–655

McNichols, M.F., Wilson, G.P., 1988. Evidence of earnings management from the provision for bad debts. Journal of Accounting Research 26, 1–31

McNichols, M. F., 2000, Research design issues in earnings management studies. Journal of Accounting and Public policy, 19, 313–345.

Nelson, K.K., 2000. Rate regulation, competition, and loss reserve discounting by property-casualty insurers. The Accounting Review 75, 115–138

Niehaus, G. 2014. Managing Capital via Internal Capital Market Transactions: The case of Life Insurers: working paper

Penalva, F., 1998. Loss reserves and accounting discretion in the property-casualty insurance industry. Working paper, University of California at Berkeley

Petroni, K. R., 1992, Optimistic Reporting in the Property-Casualty Insurance Industry, Journal of Accounting and Economics, 15(4): 485-508

Petroni, K., 1992. Management's response to the differential costs and benefits of optimistic reporting within the property-casualty insurance industry. Journal of Accounting and Economics 15, 485–508

Petroni, K., Beasley, M., 1996. Errors in accounting estimates and their relation to audit firm type. Journal of Accounting Research 34, 151–171

Petroni, K. R., and D. A. Shackelford, 1999, Managing Annual Accounting Reports to Avoid State Taxes: An Analysis of Property-Casualty Insurers, Accounting Review, 74(3): 371-393

Petroni, K., Ryan, S., Wahlen, J., 2000. Discretionary and non-discretionary revisions of loss reserves by property-casualty insurers: differential implications for future profitability an, risk, and market value. Review of Accounting Studies 5, 95–125

Rajan, R. G., H. Servaes, and L. Zingales, 2000, The Cost of Diversity: The Diversification Discount and Inefficient Investment, Journal of Finance, 55(1): 35-80.

Rotemberg, Julio, *and* Garth Saloner., 1994, Benefits of narrow business strategies, *American Economic Review* **84**, 1330–1349

Scharfstein, D. S., and J. C. Stein, 2000, The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment, Journal of Finance, 55(6): 2537-2564.

Schmid, M., and Walter, I., 2009, Do financial Conglomerates create or destroy economic value?, Journal of Financial Intermediation, 18(2): 193-216

Shin, H.-H., and R. M. Stulz, 1998, Are Internal Capital Markets Efficient? Quarterly Journal of Economics, 113: 531-552.

Smith, B., 1980, An Analysis of Auto Liability Loss Reserves and Underwriting Results, The Journal of Risk and Insurance, 47: 305-320

Sommer, D.W., 1996, The Impact of Firm Risk on Property-Liability Insurance Prices, Journal of Risk and Insurance, 63(3): 501-514.

Stein, J. C., 1997, Internal Capital Markets and the Competition for Corporate Resources, Journal of Finance, 52: 111-133.
Teece, D. J., 1980, Economies of Scope and the Scope of the Enterprise, *Journal of Economic Behavior and Organization*, **1***:* 223-247

Tsai, C., Kuo, W. and Chiang, D. M.-H., 2009, The Distributions of Policy Reserves Considering the Policy-Year Structures of Surrender Rates and Expense Ratios. Journal of Risk and Insurance, 76: 909–931

Troxei, Terrie E.. and Cormiek L. Breslin. (1983). Property-Liahility Insurance Accounting and Finance. Malvern. PA: American Institute for Property and Liability Underwriters

Weiss, M., 1985, A Multivariate Analysis of Loss Reserving Estimates in Property-Liability Insurance Companies, Journal of Risk and Insurance, 52: 199-221

Table 1. Excerpt from Schedule P-Part 2

Excerpt from the 2011 Annual Statement of GEICO Co.

NAIC Property-Liability Annual Statement: Schedule P- Part 2- Summary

Incurred Net Losses and Defense and Cost Containment Expenses Reported at Year End ($000 omitted)

1	2	3	4	5	6	7	8	9	10	11
Accident year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Prior	14,270	12,332	12,409	11,862	11,450	10,699	11,565	11,655	10,803	10,507
2002	25,935	29,067	27,005	26,173	25,102	24,862	27,232	26,481	27,128	27,003
2003		40,952	38,783	36,863	35,189	36,153	45,696	44,786	47,436	47,249
2004			50,991	45,372	43,303	45,077	58,668	60,607	60,529	59,972
2005				63,841	59,571	56,435	76,458	73,427	74,208	73,086
2006					89,901	89,254	121,568	119,920	123,154	123,011
2007						99,596	147,998	147,561	156,010	148,487
2008							166,207	164,978	173,253	168,396
2009								148,450	164,460	169,724
2010									172,428	182,811
2011										397,577

Note: This table is an excerpt from 2011 Annual National Association of Insurance Commissioners' (NAIC) annual statutory filing for GEICO Co. Schedule P-Part 2. Data are used to calculate loss reserve errors. A firm's reserve error is calculated by incurred losses in year t minus incurred losses in year t+5, scaled by total assets (RE1) and scaled by developed reserve (RE2). For example, we sum all the values in column 6 for year 2006 (264,516) and subtract it from the sum of all the values in column 11 (340,828). Then loss reserve error equals to 76,312. Positive error represents over-reserving whereas negative error indicates under-reserving. Thus it means GEICO Co. over-reserved by around $76 million.

Table 2. Variable Definitions

Variable	Definition
	Dependent Variable
RE1$_{i,t}$	A firm's reserve error calculated by incurred losses in year *t* minus incurred losses in year *t+5*, scaled by total assets.
RE2$_{i,t}$	A firm's reserve error calculated by incurred losses in year *t* minus incurred losses in year *t+5* scaled by developed reserve.
	Independent Variable
ICMs$_{i,t}$	(1) Group: An indicator variable equals to 1 if a firm is a member of group, 0 otherwise. (2) ICMs participants : Number of subsidiaries for each firm *i* for year *t.* (3) ICMs participants avg : Number of subsidiaries on average for each firm *i* for entire sample period. (4) ICMs transactions : Reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total net premiums written for each firm *i* for year *t.* (5) ICMs transactions avg : Reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total net premiums written on average over the sample period for each firm *i* for entire sample period.
	Control Variable
ROA$_{i,t}$	Return on assets, a firm's net income scaled by total assets in year *t.*
Large Loss$_{i,t}$	A binary variable equal to 1 if a firm has earning in the bottom 30% of the negative earnings distribution.
Small Loss$_{i,t}$	A binary variable equal to 1 if a firm has earning in the top 30% of the negative earnings distribution.
Small Profit$_{i,t}$	A binary variable equal to 1 if a firm has earning in the bottom 30% of the positive earnings distribution.
Large Profit$_{i,t}$	A binary variable equal to 1 if a firm has earning in the top 30% of the positive earnings distribution.
Age$_{i,t}$	Number of years a firm is doing business since established.
Size$_{i,t}$	The natural log of firm's total assets.
Mutual$_{i,t}$	A indicator variable equal to 1 if a firm is organized as a mutual in year t, 0 if a firm is organized as a stock in year *t.*
Reinsurance_external$_{i,t}$	Reinsurance ceded to non-affiliated minus reinsurance assumed from non-affiliated divided by reinsurance assumed plus direct premiums.
Growth$_{i,t}$	The one year percentage change in net premiums written from year t-1 to year *t.*
Capasset$_{i,t}$	A firm's net premium written divided by surplus.
Geo-Heft$_{i,t}$	Herfindahl index of a firm's direct premiums written in each of the 50 United States and Washington D.C. in year *t.*
Product-Herf$_{i,t}$	Herfindahl index of a firm's net premiums written across lines of business in year *t.*
Longtail$_{i,t}$	The proportion of a firm's net premiums written in long-tailed lines of business in year *t.* Long-tailed lines are farm multi-peril, homeowners' multi-peril, commercial multi-peril, medical malpractice, workers' compensation, products liability, automobile liability, and "other" liability.

Table 3. Descriptive Statistics

	Mean	Std.Dev	Min	Max
RE1	.0108001	.0938639	-.4221337	.3157827
RE2	.0513696	.2667947	-.9991685	1.726901
ROA	.0186685	.0716215	-2.427735	1.434437
Large_Loss	.0354607	.1849447	0	1
Small_Loss	.0212244	.1441343	0	1
Small_Profit	.0420028	.2005991	0	1
Large_Profit	.075828	.2647276	0	1
Group	.6368063	.4809289	0	1
ICMs participants	3.823105	5.291521	2	28
ICMs participants avg	3.823105	4.928687	2	24
ICMs transactions	.1331497	.2803713	0	1
ICMs transactions avg	.135042	.1776492	0	.9840639
Age	52.82957	42.80906	1	219
Size	17.77715	1.95321	10.58223	25.53576
Mutual	.2621269	.4397995	0	1
Reinsurance_external	.1603987	.2232897	0	.9999705
Growth	.1060656	.3357157	-.399571	1.116613
Capasset	.4561634	.2140495	.0001511	1.391987
Geo-Heft	.6220325	.3855696	.0326807	1
Product-Herf	.5162152	.3066454	0	1
Longtail	.4362797	.3715588	.0	1

Note: Our data is from all property-liability insurers in the United States. Insurer characteristics are from insurers' annual statutory filings of National Association of Insurance Commissioner's (NAIC) from 1996 to 2012. Since the reserve error calculation requires five year data, our final sample ranges from 1996 to 2007 for insurer reserve error. In total there are 2,622 unique insurers and 636 groups with 14,225 firm-year observations. $RE1_{i,t}$ is a firm's reserve error calculated by incurred losses in year t minus incurred losses in year $t+5$, scaled by total assets. $RE2_{i,t}$ is a firm's reserve error calculated by incurred losses in year t minus incurred losses in year $t+5$, scaled by developed reserve. Our main interesting variable is $Group_{i,t}$ which is an indicator variable equal to one if a firm i is a member of an insurer group and zero otherwise. *ICM participants*$_{i,t}$ indicates the number of subsidiaries within a group and *ICM participants avg*$_{i,t}$ indicates the number of subsidiaries within a group on average for each firm i for entire sample period. *ICM transactions*$_{i,t}$ represents reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written. *ICM transactions avg*$_{i,t}$ average reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written on average for each firm i for entire sample period. $ROA_{i,t}$ is firm's net income scaled by total assets. *Large Loss*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the bottom 30% of the negative earnings distribution. *Small Loss*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the top 30% of the negative earnings distribution. *Small Profit*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the bottom 30% of the positive earnings distribution. *Large Profit*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the top 30% of the positive earnings distribution. $Age_{i,t}$ is the number of years a firm is doing business since established. $Size_{i,t}$ is the natural logarithm of total assets. $Mutual_{i,t}$ equals to one if a firm is a mutual and zero otherwise. *Reinsurance_external*$_{i,t}$ is the ratio of reinsurance ceded to non-affiliated divided by reinsurance assumed plus direct premiums. $Growth_{i,t}$ is the one year percentage change in net premiums written. $Capasset_{i,t}$ is a firm's net premium written divided by surplus. *Geo-Herf*$_{i,t}$ is a geographic Herfindahl index based on premiums written in 50 states in United States. *Product-Herf*$_{i,t}$ is a product Herfindahl index via a line of business. $Longtail_{i,t}$ is the proportion of a firms' business written in "long-tailed" insurance lines. Long-tailed lines as farm multi peril, homewoner's multi peril, commercial multi peril, medical malpractice, workers' compensation, products liability, automobile liability, and other liability (Berger et al 2000, Grace and Leverty 2012, Eckles, Halek and Zhang 2013).

Table 4. Univariate Comparison

(1) Group

	Unaffiliated			Affiliated			Difference	
	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.	Mean	Median
RE1	.0190664	.0095279	.1023107	.006431	.0041947	.0887706	***	***
RE2	.0889043	.0194306	.3252948	.0317213	.010998	.2278864	***	***

(2) ICMs participants : Number of subsidiaries

	Bottom 30% of sample			Top 30% of sample			Difference	
	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.	Mean	Median
RE1	.0166333	.01011	.1020006	.0009195	.0003415	.081887	***	***
RE2	.0762121	.018713	.3062741	.0222995	.0066073	.2102437	***	***

(3) ICMs participants avg : Number of subsidiaries on average over the sample period

	Bottom 30% of sample			Top 30% of sample			Difference	
	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.	Mean	Median
RE1	.0170144	.0011302	.1026402	.0016985	.0090514	.0805775	***	***
RE2	.0806299	.018313	.3188283	.0199566	.0071736	.209019	***	***

(4) ICMs transactions : Reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total net premiums written

	Bottom 30% of sample			Top 30% of sample			Difference	
	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.	Mean	Median
RE1	.0182354	.0099	.0992032	-.004078	.0001567	.0848932	***	***
RE2	.0703824	.0172699	.2897083	.0176585	.0056298	.232084	***	***

(5) ICMs participants avg : Reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total net premiums written on average over the sample period

	Bottom 30% of sample			Top 30% of sample			Difference	
	Mean	Median	Std.Dev.	Median	Median	Std.Dev.	Mean	Median
RE1	.0171387	.0094872	.0884931	.0022957	.0023694	.0846969	***	***
RE2	.0500814	.015718	.2373721	.0250512	.0093838	.2236279	***	***

Note: Our data is from all property-liability insurers in the United States. Insurer characteristics are from insurers' annual statutory filings of National Association of Insurance Commissioner's (NAIC) from 1996 to 2012. Since the reserve error calculation requires five year data, our final sample ranges from 1996 to 2007 for insurer reserve error. In total there are 2,622 unique insurers and 636 groups with 14,225 firm-year observations. $RE1_{i,t}$ is a firm's reserve error calculated by incurred losses in year t minus incurred losses in year $t+5$, scaled by total assets. $RE2_{i,t}$ is a firm's reserve error calculated by incurred losses in year t minus incurred losses in year $t+5$, scaled by developed reserve. There are five ICM proxies: (1) $Group_{i,t}$ which is an indicator variable equal to one if a firm i is a member of an insurer group and zero otherwise. (2) $ICM\ participants_{i,t}$ indicates the number of subsidiaries within a group and (3) $ICM\ participants\ avg_{i,t}$ indicates the number of subsidiaries within a group on average for each firm i for entire sample period. (4) $ICM\ transactions_{i,t}$ represents reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written. (5) $ICM\ transactions\ avg_{i,t}$ average reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written on average for each firm i for entire sample period. We conduct univariate comparison tests for $Group_{i,t}$ variable and all other internal capital markets proxies. We create a subsample of top 30% and bottom 30% of our sample to conduct univariate comparison test on them. Statistical significance of differences is based on a t-tests for means and a nonparametric k-sample test for median with * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 5. Regression Results with and without ROA

Variable	(1) RE 1	(2) RE 1	(3) RE 2	(4) RE 2
Group	-0.007***	-0.005**	-0.050***	-0.048***
	(-3.22)	(-2.50)	(-8.43)	(-8.19)
ROA		0.142***		0.172***
		(8.31)		(3.97)
Size	0.003***	0.002***	0.007***	0.006***
	(6.12)	(4.54)	(4.22)	(3.43)
Age	-0.000***	-0.000***	-0.000***	-0.000***
	(-7.67)	(-7.38)	(-7.97)	(-7.83)
Growth	-0.012***	-0.011***	0.008	0.011
	(-4.74)	(-4.01)	(0.87)	(1.10)
Mutual	0.020***	0.022***	0.000***	0.002***
	(8.87)	(9.36)	(3.07)	(4.28)
Capasset	0.006	-0.004	0.108***	0.096***
	(1.33)	(-0.89)	(6.25)	(5.38)
Reinsurance_external	-0.028***	-0.026***	-0.044***	-0.042***
	(-7.02)	(-6.48)	(-3.30)	(-3.14)
Geo-Heft	0.015***	0.015***	0.017**	0.017**
	(6.29)	(6.26)	(2.47)	(2.46)
Product-Heft	0.034***	0.033***	0.135***	0.133***
	(11.03)	(10.63)	(13.75)	(13.59)
Longtail	-0.002	-0.001	-0.004	-0.003
	(-0.82)	(-0.49)	(-0.47)	(-0.33)
Year fixed effect	Yes	Yes	Yes	Yes
Clustered Std. Error	Yes	Yes	Yes	Yes
R-squared	0.067	0.075	0.068	0.069
N	14225	14225	13142	13142

Note: Our data is from all property-liability insurers in the United States. Insurer characteristics are from insurers' annual statutory filings of National Association of Insurance Commissioner's (NAIC) from 1996 to 2012. Since the reserve error calculation requires five year data, our final sample ranges from 1996 to 2007 for insurer reserve error. In total there are 2,622 unique insurers and 636 groups with 14,225 firm-year observations. $RE1_{i,t}$ is a firm's reserve error calculated by incurred losses in year t minus incurred losses in year $t+5$, scaled by total assets. $RE2_{i,t}$ is a firm's reserve error calculated by incurred losses in year t minus incurred losses in year $t+5$, scaled by developed reserve. In the first column (1) and second column (2), the dependent variable is insurers reserve error scaled by total assets ($RE1_{i,t}$) whereas dependent variables for third column (3) and forth column (4) is insurers reserve error scaled by developed reserve ($RE2_{i,t}$). Also, first column (1) and second column (2) include $ROA_{i,t}$ variable but third column (3) and forth column (4) do not. Other explanatory variables are defined and explained in earlier section and Table 2. All models control for year fixed effects and have clustered standard errors. Standard errors account for heteroskedasticity and t statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001

Table 6. Regression Results with Distribution of ROA

Variable	(1) RE 1	(2) RE 2
Group	-0.007***	-0.050***
	(-3.22)	(-8.43)
Large Loss	-0.034***	-0.048***
	(-4.23)	(-3.76)
Small Loss	-0.005	0.013
	(-0.79)	(0.99)
Small Profit	-0.020***	-0.013***
	(-4.40)	(-3.96)
Large Profit	0.010***	0.022**
	(3.73)	(2.04)
Size	0.003***	0.006***
	(5.41)	(3.86)
Age	-0.000***	-0.000***
	(-7.65)	(-8.01)
Growth	-0.011***	0.010
	(-4.33)	(1.03)
Mutual	0.021***	0.001
	(9.20)	(0.25)
Capasset	0.001**	0.101***
	(2.28)	(5.80)
Reinsurance_external	-0.027***	-0.043***
	(-6.77)	(-3.20)
Geo-Heft	0.015***	0.017**
	(6.35)	(2.51)
Product-Heft	0.033***	0.133***
	(10.76)	(13.58)
Longtail	-0.002	-0.003
	(-0.77)	(-0.39)
Year fixed effect	Yes	Yes
Clustered Std. Error	Yes	Yes
R-squared	0.072	0.069
N	14225	13142

Note: Our data is from all property-liability insurers in the United States. Insurer characteristics are from insurers' annual statutory filings of National Association of Insurance Commissioner's (NAIC) from 1996 to 2012. Since the reserve error calculation requires five year data, our final sample ranges from 1996 to 2007 for insurer reserve error. In total there are 2,622 unique insurers and 636 groups with 14,225 firm-year observations. In the first column (1), the dependent variable is insurers reserve error scaled by total assets ($RE1_{i,t}$) whereas dependent variables for second column (2) is insurers reserve error scaled by developed reserve ($RE2_{i,t}$). *Large Loss*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the bottom 30% of the negative earnings distribution. *Small Loss*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the top 30% of the negative earnings distribution. *Small Profit*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the bottom 30% of the positive earnings distribution. *Large Profit*$_{i,t}$ *t* is a binary variable equal to 1 if a firm has earning in the top 30% of the positive earnings distribution. Other explanatory variables are defined and explained in earlier section and Table 2. All models control for year fixed effects and have clustered standard errors. Standard errors account for heteroskedasticity and t statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001

Table 7. Regression Results with Interaction term (Y=RE1)

Variable	(1) *Group*	(2) *ICMs Participants*	(3) *ICMs Participants avg*	(4) *ICMs Transactions*	(5) *ICMs Transactions avg*
ICM	-0.007***	-0.001**	-0.001**	-0.028***	-0.031***
	(-3.55)	(-2.29)	(-2.26)	(-10.03)	(-6.95)
Large_loss	-0.067***	-0.045***	-0.047***	-0.038***	-0.050***
	(-4.35)	(-4.33)	(-4.35)	(-4.12)	(-4.79)
ICM*Large_loss	0.053***	0.003**	0.004**	0.050**	0.154***
	(3.00)	(2.47)	(2.58)	(2.28)	(3.68)
Age	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(-7.68)	(-7.58)	(-7.47)	(-8.58)	(-8.06)
Size	0.003***	0.002***	0.002***	0.002***	0.003***
	(5.47)	(4.82)	(4.50)	(3.11)	(5.00)
Mutual	0.020***	0.021***	0.022***	0.020***	0.020***
	(8.89)	(9.42)	(9.73)	(8.79)	(8.86)
Reinsurance_external	-0.027***	-0.026***	-0.026***	-0.035***	-0.030***
	(-6.82)	(-6.62)	(-6.42)	(-8.44)	(-7.41)
Growth	-0.012***	-0.012***	-0.012***	-0.013***	-0.012***
	(-4.71)	(-4.69)	(-4.69)	(-4.72)	(-4.65)
Capasset	0.003	0.002	0.001	0.004	0.003
	(0.68)	(0.45)	(0.29)	(0.83)	(0.72)
Geo-Heft	0.015***	0.016***	0.016***	0.012***	0.013***
	(6.27)	(6.54)	(6.74)	(5.13)	(5.37)
Product-Heft	0.034***	0.035***	0.036***	0.031***	0.032***
	(11.12)	(11.57)	(11.90)	(10.09)	(10.38)
Longtail	-0.002	-0.002	-0.002	0.000	-0.001
	(-0.91)	(-0.82)	(-0.77)	(0.19)	(-0.42)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Clustered Std. Error	Yes	Yes	Yes	Yes	Yes
R-squared	0.071	0.069	0.069	0.074	0.072
N	14225	14225	14225	14157	14225

Note: Our data is from all property-liability insurers in the United States. Insurer characteristics are from insurers' annual statutory filings of National Association of Insurance Commissioner's (NAIC) from 1996 to 2012. Since the reserve error calculation requires five year data, our final sample ranges from 1996 to 2007 for insurer reserve error. In total there are 2,622 unique insurers and 636 groups with 14,225 firm-year observations. In the table, the dependent variable is insurers reserve error scaled by total assets (*RE1*$_{i,t}$*).* Our five ICM proxies are (1) *Group*$_{i,t}$ which is an indicator variable equal to one if a firm *i* is a member of an insurer group and zero otherwise. (2) *ICM participants*$_{i,t}$ indicates the number of subsidiaries within a group and (3) *ICM participants avg*$_{i,t}$ indicates the number of subsidiaries within a group on average for each firm *i* for entire sample period. (4) *ICM transactions*$_{i,t}$ represents reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written. (5) *ICM transactions avg*$_{i,t}$ average reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written on average for each firm *i* for entire sample period. *Large Loss*$_{i,t}$ is a binary variable equal to 1 if a firm has earning in the bottom 30% of the negative earnings distribution. Our interesting variable is the interaction term, *ICM*Large_loss*$_{i,t}$ which represents the association between internal capital markets and firm's negative earnings on insurers loss reserving practice. Other explanatory variables are defined and explained in earlier section and Table 2. All models control for year fixed effects and have clustered standard errors. Standard errors account for heteroskedasticity and t statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001

Table 8. Regression Results with Interaction term (Y=RE2)

Variable	(1) *Group*	(2) *ICMs Participants*	(3) *ICMs Participants avg*	(4) *ICMs Transactions*	(5) *ICMs Transactions avg*
ICM	-0.050***	-0.001	-0.000	-0.068***	-0.078***
	(-8.46)	(-1.51)	(-0.47)	(-7.48)	(-5.79)
Large_loss	-0.090***	-0.077***	-0.076***	-0.070***	-0.083***
	(-3.41)	(-4.47)	(-4.31)	(-4.67)	(-4.74)
ICM*Large_loss	0.064**	0.008*	0.007**	0.159**	0.288**
	(2.23)	(1.93)	(1.96)	(2.38)	(2.43)
Age	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(-7.96)	(-7.51)	(-7.45)	(-8.37)	(-8.02)
Size	0.006	0.002	0.002	-0.000	0.002
	(0.87)	(1.26)	(1.15)	(-0.15)	(1.32)
Mutual	0.000	0.011**	0.012**	0.008	0.008
	(0.07)	(1.97)	(2.14)	(1.35)	(1.47)
Reinsurance_external	-0.043***	-0.035***	-0.035**	-0.056***	-0.044***
	(-3.20)	(-2.92)	(-2.55)	(-3.93)	(-3.24)
Growth	0.009	0.007	0.007	0.007	0.008
	(0.91)	(0.77)	(0.77)	(0.71)	(0.81)
Capasset	0.103***	0.095***	0.094***	0.097***	0.097***
	(5.99)	(5.49)	(5.45)	(5.57)	(5.65)
Geo-Heft	0.017**	0.022***	0.023***	0.015**	0.016**
	(2.48)	(3.21)	(3.29)	(2.13)	(2.22)
Product-Heft	0.135***	0.147***	0.148***	0.137***	0.139***
	(13.78)	(14.58)	(14.76)	(13.37)	(13.69)
Longtail	-0.004	-0.002	-0.002	0.004	0.000
	(-0.51)	(-0.26)	(-0.23)	(0.46)	(0.04)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Clustered Std. Error	Yes	Yes	Yes	Yes	Yes
R-squared	0.069	0.063	0.063	0.067	0.065
N	13142	13142	13142	13077	13142

Note: Our data is from all property-liability insurers in the United States. Insurer characteristics are from insurers' annual statutory filings of National Association of Insurance Commissioner's (NAIC) from 1996 to 2012. Since the reserve error calculation requires five year data, our final sample ranges from 1996 to 2007 for insurer reserve error. In total there are 2,622 unique insurers and 636 groups with 14,225 firm-year observations. In the table, the dependent variable is insurers reserve error scaled by developed reserve ($RE2_{i,t}$). Our five ICM proxies are (1) $Group_{i,t}$ which is an indicator variable equal to one if a firm i is a member of an insurer group and zero otherwise. (2) $ICM\ participants_{i,t}$ indicates the number of subsidiaries within a group and (3) $ICM\ participants\ avg_{i,t}$ indicates the number of subsidiaries within a group on average for each firm i for entire sample period. (4) $ICM\ transactions_{i,t}$ represents reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written. (5) $ICM\ transactions\ avg_{i,t}$ average reinsurance ceded to affiliates minus reinsurance assumed from affiliates divided by total premiums written on average for each firm i for entire sample period. $Large\ Loss_{i,t}$ is a binary variable equal to 1 if a firm has earning in the bottom 30% of the negative earnings distribution. Our interesting variable is the interaction term, $ICM*Large\_loss_{i,t}$ which represents the association between internal capital markets and firm's negative earnings on insurers loss reserving practice. Other explanatory variables are defined and explained in earlier section and Table 2. All models control for year fixed effects and have clustered standard errors. Standard errors account for heteroskedasticity and t statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001