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Actuarial Independence and Managerial Discretion

Abstract

Appointed actuaries are responsible for estimating the largest liability on property-casualty insurance companies' balance sheet. Actuarial independence is crucial in safeguarding accurate estimates, where this independence is self-regulated by actuarial professional institutions. However, professional conflicts of interest arise when appointed actuaries also hold an officer position within the same firm, as officer actuaries also face managerial incentives. Using a sample of US insurers that employ in-house appointed actuaries from 2007 to 2014, we find evidence that officer actuaries have different reserving practices than non-officer actuaries. This difference in reserving is associated with tax shielding and earnings management incentives. Results are consistent with managerial discretion dominating actuarial independence, they are economically significant and should be of concern to regulators and professional institutions.

JEL Classification: G22, M12, M41.

Key Words: appointed actuary, compensation incentives, managerial discretion, insurance, reserve error.

1. Introduction

Safeguarding auditor independence is crucial in minimizing management of financial statements. To limit potential conflicts of interest that might arise between auditors and audited firms, the Sarbanes–Oxley Act of 2002 puts in place new auditor requirements. One of the requirements restricts auditing firms from providing non-audit services (e.g., consulting) for the same clients. However, this restriction does not apply to similar professional bodies like the actuarial profession. Actuaries are responsible for accurately estimating insurance loss reserves (valued at almost USD 500 billion in 2013)¹, set aside to pay future unpaid contract claims. However actuarial independence might be compromised when actuaries are also provided with managerial incentives.

The actuarial profession is largely self-regulated. Each property-casualty insurance company has an appointed actuary, who is responsible of evaluating the estimation of loss reserves.² Appointed actuaries are either external actuarial consultants, or in-house employees of the firm. In-house appointed actuaries can also hold an officer position in the firm, which means that they are actively involved in firm managerial or policy-making decisions (NAIC, 2011). Such managerial duties are typically coupled with a more convex compensation structure that rewards better firm performance. Clearly, a direct conflict of professional interest arises between actuarial independence and managerial discretion for appointed actuaries who also hold an officer position.

In this paper, we focus on revisions in loss reserve estimates produced by in-house appointed actuaries of US property-casualty (PC) insurance companies. We manually separate in-house appointed actuaries, into officer actuaries (OA; in-house appointed actuaries who also hold an officer position), and non-officer actuaries (NOA; in-house appointed actuaries who do not hold an officer position). Using data from 2007-2014, we estimate five-year reserve errors as the difference between an originally reported

¹ Authors' calculations from www.snl.com.

² Appointed Actuary is defined to be: "...an actuary who is appointed or retained in accordance with the provisions of law, regulation, or contract or other arrangement, as the designee to issue a statement of actuarial opinion." (Actuarial Standards Board, 2000). The appointed actuary for each firm is appointed by the firm's board of directors.

reserve estimate and the revised estimate, five years later, and test whether reserve errors differ between OA and NOA. Reserve errors are expected to be zero on average. However we observe deviations from originally reported reserves in both cases. Specifically, OA have a lower proportion of reserve errors being zero and a higher proportion in the negative region (under-reserving) during the sample period.³ This study investigates whether the officer role of the appointed actuary is associated with systematic differences in loss reserve errors.

Actuarial independence can be compromised, when appointed actuaries also hold an officer position for two reasons. First OA face a more convex compensation structure than NOA, such as performance related bonuses (Eastman et al., 2014; DW Simpson, 2015; XpertHR, 2015), which encourage improving short-term profitability for the firm, with a parallel short-term compensation benefit for OA. Second, the duties of OA go beyond those of NOA (i.e. to oversee the accurate estimation of loss reserves) as they are also part of the management team, which faces incentives that could affect loss reserving practices. In summary, OA face stronger compensation incentives than NOA, incentives that are typically associated with increasing firm value in the short-term horizon.

Managerial incentives are often studied by measuring loss reserve errors (bias) of PC insurers (see e.g., Petroni, 1992; Petroni and Beasley, 1996; Gaver and Paterson, 2004; Gaver and Paterson, 2007; Grace and Leverty, 2012), which is the measure we also use in our study. The literature has identified evidence of managerial incentives to manage firm's financial results for several reasons: to minimize tax burden (e.g., Grace, 1990; Gaver and Paterson, 1999, 2000; Nelson, 2000; Beaver, McNichols, and Nelson, 2003), to manage (smooth) income (e.g., Weiss, 1985; Grace, 1990; Beaver, McNichols, and Nelson, 2003), to improve financial strength (e.g., Petroni, 1992; Gaver and Paterson, 2004), and to

³ The means of five-year reserve errors for OA and NOA during our sample period are 1.02 and 2.19, respectively (Table 2 panel B). The mean difference between the two mutually exclusive groups of actuaries is statistically significant at the 1 percent significance level (two-sample t-test with unequal variance). A plot of the reserve error distributions (for the full sample, and also by the type of actuary) is shown in the Supplementary Material (Kamiya and Milidonis, 2016).

reduce the impact of rate regulation on their firms (e.g., Nelson, 2000; Grace and Leverty, 2010). Notably, the literature has traditionally linked the earnings management incentive with earnings smoothing.

However, more recently, Eckles and Halek (2010) focus on earnings management by insurance executives to show that managing earnings does not only happen for earnings smoothing purposes. The authors show a link between earnings management and compensation incentives; that is, insurance executives manage earnings to increase their compensation in the short-term (1-2 years). Such motivation translates into harvesting payoffs (through convex compensation schemes) from the upside earnings' potential while not penalizing executives for the downside earnings' potential.

Using panel regressions with random effects on a sample of 539 firm-year observations (256 unique firms from 2007-2009), we examine the association between the reserve error and the managerial incentives tested in the literature, conditional on whether appointed actuaries are OA or NOA. Since OA face a more convex compensation structure than NOA, and are incentivized to increase firm value over a short-term horizon (in contrast to NOA who are less subject to the short-term view), we use the interaction of the OA indicator with the literature's major managerial incentives to disentangle the effect of potential reserve error management by type of appointed actuary.

We have two major results. Our first finding is evidence of over-reserving to shield taxes by the average appointed actuary. Over-reserving could add value to the firm in the long-run, mainly because taxes are paid over a longer horizon.⁴ More importantly, our results show that over-reserving is different between OA and NOA, as OA tend to over-reserve much less than NOA, for tax-shielding purposes. Intuitively, results are consistent with the view that NOA face a stronger tax-saving incentive than OA, since tax-saving provides a long-term instead of a short-term benefit to firms. On the contrary, OA face stronger compensation incentives which are aligned with more short-term than long-term benefits for the

⁴ This is a form of "time diversification" in the sense that reserves remain un-taxed for a longer period of time, thus allowing the insurance company to keep a "cushion" in case an influx of losses appears in the near future; a reasonable expectation for the period following a market crisis. Davidson (1996) provides an overview of the regulation proposal that would allow insurers to use time-diversification for catastrophe losses, while Milidonis and Grace (2008) show the pricing implications of such a proposal.

firm. Our second finding is evidence of under-reserving by OA to show higher profitability. This finding does not hold for NOA. This is additional, more direct evidence consistent with managerial and compensation, short-term incentives that OA face but NOA do not. Both results are economically significant.

Next, we conduct a series of robustness checks related to our main findings. First, we use alternative dependent variable specifications by replicating results using a three-year reserve error. Second, we use alternative specifications for some of the incentive variables (i.e. financial weakness, earnings management). Third, we repeat our analysis using alternative estimation techniques (feasible generalized least squares) adopted by the literature (e.g. Grace and Leverty, 2012; Eastman et al., 2014). Our results remain robust.

Our study contributes to two literatures. The first is on auditor independence which could be jeopardized when governance mechanisms are weak, for example, when auditors also provide other consulting services to firms they monitor (Murphy and Sandino, 2010). We contribute by showing how other managerial duties of the in-house appointed actuaries (i.e. officer status) could compromise actuarial independence. The second literature is on the structure of managerial compensation, which provides different incentives to managers than regular employees (e.g. Eckles and Halek, 2010; Eastman et al. 2014). We contribute by using the case of in-house officer actuaries as a proxy for heterogeneous compensation structure, to show that reserve estimates are more consistent with managerial incentives than actuarial independence.

The most relevant papers to ours are Kelly et al. (2012) and Grace and Leverty (2013) that we discuss in detail below.⁵ Kelly et al. (2012) examine the Canadian PC insurer sample from 1995-2008 to examine whether the status of the appointed actuary impacts loss reserve accuracy. They do not find systematic differences in loss reserve errors between in-house and external actuaries. However, they identify

⁵ A previous paper by Gaver and Paterson (2001) investigates the effect of both actuaries and auditors on the magnitude of under-reserving in a sample of the US property-liability insurers in 1993. Their results suggest that actuaries have a more significant role than auditors alone in estimating loss reserves.

differences in reserve error under some market conditions and firm characteristics such as a) increasing global stock market returns; b) decreasing unanticipated inflation; c) the insurance market cycle; d) increase in the proportion of short-tailed business. Grace and Leverty (2013) use US PC insurer data from 2005 to 2009 to examine the relation between actuaries (in-house and external) and auditors. In contrast to Kelly et al. (2012), they use the actuarial consulting market share as a measure for independence and find that more independent actuaries are better at mitigating the impact of managerial discretion. However, Grace and Leverty (2013) do not explore differences between officer and non-officer in-house actuaries.

We differ from both studies by taking a closer look at the in-house sample which is more homogeneous than the sample also including external consultants. We do this by separating the in-house group into the OA and NOA mutually exclusive groups. OA and NOA are characterized by differences in the structure of their compensation (Eastman et al., 2014; D.W. Simpson, 2015; XpertHR, 2015), which is aligned with the different incentives that the two groups face. We also differ from Kelly et al. (2012) by focusing on the US instead of the Canadian sample over a later period. More importantly, since appointed actuaries in Canada are *not* allowed to hold an officer position (OSFIC, 2012), our study is the first to examine the separation of appointed actuaries into OA and NOA. Finally, we differ from Grace and Leverty (2013) by using the traditional reserve error measure to allow comparison with prior literature.

Our results have public policy implications. For example, in countries such as Australia (APRA, 2014), Canada (OSFIC, 2012), England (BOE, 2016), or Malaysia (Central Bank, 2014), appointed actuaries are not allowed to also have an officer position to avoid conflict of interests. Surprisingly, there is no such restriction in the US, as we observe several instances in our sample where the appointed actuary is also noted to be the firm's CEO and/or president. Furthermore, the actuarial professional bodies raise concerns about pressure being placed on appointed actuaries to manage reserves to meet managerial pressure (NAIC, 2013). In summary, it seems that eliminating situations of conflict of interest when estimating such reserves is important, given the sheer size of the US insurance reserves.

The paper is structured as follows. Section 2 describes the literature and sets up the hypotheses. In section 3 we describe the data, in section 4 the methodology and in section 5 we present the results. In section 6 we discuss the public policy implications and conclude.⁶

2. Motivation and Research Question

2.1. Actuarial Independence

Actuaries are trained and professionally accredited to estimate loss reserves using a diverse toolbox of statistics, mathematics, economics and finance, always within the prevailing accounting guidelines and regulatory constraints. In the United States, the board of directors of each insurer is required to appoint an actuary (i.e. the “Appointed Actuary”) who is responsible to issue a statement of (actuarial) professional opinion discussing any issues related to the company’s reserve estimates according to statutory requirements.⁷

To maintain and improve the quality of actuarial opinions by certified actuaries, the Casualty Actuarial Society (CAS) and the American Academy of Actuaries set stringent qualification requirements and provide rigorous professional training to their candidates and members. In addition to successfully completing professional qualifications, appointed actuaries also need to develop extensive work experience, under the supervision of qualified actuaries before they are entitled to become an appointed actuary. Given the self-regulatory nature of the actuarial profession, appointed actuaries are required to adhere to the Code of Professional Conduct adopted by the actuarial professional bodies (American Academy of Actuaries, 2001), so that they provide transparent, objective and independent assessments of the insurance risks they are called to oversee.

⁶ Additional material such as the description of variables used and some descriptive figures are provided in an online appendix to this article. We refer to this online appendix in the paper by “Supplementary Material” (Kamiya and Milidonis, 2016).

⁷ In Canada, the appointed actuary procedure is similar to the US. Specifically, according to guidelines by OSFIC (the Office of Superintendent of Financial Institutions; revised in September 2012), “Each company must appoint an actuary of the company...and notify the Superintendent, in writing, of the appointment...”. Also, “The directors of a company or, in case of a foreign company, the company itself, may revoke the appointment of the AA.”

Several conflicts of interest could arise for the professional independence of appointed actuaries as discussed by Gutterman (2002) and the business ethics literature (Gunz et al., 2009; Gunz and Laan, 2011). The general view is that actuaries face similar conflicts of interest that auditors faced before the reforms of the Sarbanes–Oxley Act (2002) were introduced, to address accounting scandals that surfaced at the time.

Managerial discretion can also interfere with actuarial independence in determining loss reserve estimates. A recent notable example of such interference is evident from the October 2013 “Regulatory Guidance” issued by the NAIC’s (NAIC, 2013) Casualty Actuarial and Statistical Task Force (CASTF):

“The CASTF encourages management to seek feedback from a “qualified actuary” prior to management’s decision on establishing carried reserves. This allows management to make an informed decision with the benefit of actuarial analysis. It also helps to avoid a difficult situation in which management is committed to a decision that results in pressure on the actuary to “stretch” the range of reasonable reserve estimates.”

The key issue from this statement is that actuaries are called to provide a reasonable estimate (range) of reserves to the management team. The management team can then decide on the amount of reserves to be put aside. Hence it is important to understand if any potential managerial incentives could affect/dominate over actuarial independence when deciding the final reserve estimate for the year.

2.2. Managerial compensation incentives

A major conflict of interest identified by Gutterman (2002) is that appointed actuaries are paid by the companies for which they provide independent professional opinion. Hence a strict interpretation of this argument would be that all appointed actuaries face a conflict of interest. Managerial compensation incentives could play a significant role in managerial behavior. Taking a broader view into the corporate finance literature, managerial incentives seem to play a significant role with respect to earnings management (e.g. Berstreser and Philippon, 2006; Cheng and Warfield, 2005; Eckles et al. 2011) and tax incentives (Rego and Wilson, 2012). Focusing on the sample of publicly traded PC insurers from 1992-

2000, Eckles and Halek (2010) find that insurance executives manage reserves to increase their compensation over a short term horizon (typically 1-2 years).

With respect to the convexity of the managerial compensation and the response to risk-increasing incentives, Milidonis and Stathopoulos (2011) show that the more convex the compensation structure of insurance executives is, the higher the default risk of insurance companies is in the following year. Furthermore, Eastman et al. (2014) use a sample of stock and mutual insurers required to file compensation data in Nebraska between 2003-2005 to show that as the bonus-based compensation of managers working for stock (vs. mutual) insurers increases, they manage reserves in such a way that their bonus increases. According to Eastman et al. (2014), the compensation structure of Chief actuaries closely resembles the compensation structure of other high-ranking executives (i.e. officers in our sample) within the firm. On average, Chief actuaries receive 19% of the total compensation as a performance bonus in the sample examined by Eastman et al. (2014).

This statistic (from years 2003-2005 in Nebraska) is also consistent with two recent industry actuarial salary surveys that took place in 2015. D.W. Simpson & Company (2015), reports on US salary data to show that the percentage of bonus to total compensation increases with years of work experience. Similarly, XpertHR (2015) conducts a salary survey on the UK market and reports that the highest paid group of actuaries receives 51% of their total compensation as bonus, while the respective percentages for the next successive highly paid groups are 28%, and about 20%, respectively.

Given the opposing forces of managerial discretion and actuarial independence (e.g. Gutterman, 2002), it is then natural to ask: What happens when appointed actuaries also hold an officer position in the firm? Is actuarial independence compromised by managerial discretion when appointed actuaries are also associated with the company's managerial decisions (i.e. officer appointed actuaries)? To answer this question, we create an indicator variable (OA) that takes the value of 1 if the in-house appointed actuary is also an officer, and 0 otherwise (i.e. in-house non-officer appointed actuary). We adopt this approach

because detailed compensation data is not a required reporting item according to NAIC, for all states and for an extended time period; at least not in the period that we examine.

The answer is not straight-forward, because being provided with a compensation incentive does not necessarily mean that there will be a response to it, if there is an stronger incentive working in the opposite direction. For example, Milidonis and Stathopoulos (2014) show that even when companies that are close to default (bankruptcy) provide their managers with compensation incentives to *increase* firm risk, managers actually take the opposite action (*decrease* risk) to save the firm, primarily due to the managers' career concerns. However, such career concerns do not seem as relevant for the actuarial profession, for the reasons we explain below.

Even though actuaries (just like any employee) would want to maximize their compensation, they also have a strong incentive to protect their reputation, primarily because they would want to follow business ethics⁸ but also because they face attractive “outside options” with other employers. Specifically, the US Department of Labor⁹ projects that the strong demand for actuaries is expected to remain strong at least up to year 2022, while respective compensation is also expected to increase over this time period. Specifically the average job growth rate for 2012-2022 is “much faster than average” (26% vs. the US average of 11%). Hence career concerns do not seem as strong for actuaries as it is for the sample of executives examined by Milidonis and Stathopoulos (2014), however OA could have more to lose than NOA, since the market for OA would be more competitive than the market for NOA.

By definition, OA are among the few employees listed as officers by the reporting firm, they are among the highest paid in the firm, and are expected to be provided with more convex compensation incentives, such as a higher bonus percentage (D.W Simpson and Company, 2015; XpertHR, 2015)¹⁰. Hence, OA would benefit more than NOA from a more positive firm performance, as they would receive

⁸ Professional actuarial associations have disciplinary mechanisms in place to prevent any professional misconduct from their members, thus strengthening the incentive to maintain a good reputation.

⁹ <http://www.bls.gov/ooh/math/actuaries.htm>

¹⁰ DW Simpson has been carrying our actuarial salary surveys since 1998 according to their website <https://www.dwsimpson.com>

a larger bonus. On the downside, OA stand to lose more (in terms of forgone bonus) from a bad performance if the company does not do well.¹¹

In addition to the OA's compensation incentives, which are expected to be more aligned with managerial compensation than those of NOA, OA are closer to management and are expected to have more frequent communication with management, hence better information. Such information is unlikely to be related to reserve estimation (since the expert would be the OA) but rather to overall management's strategies. This setting is expected to add more pressure on the OA to succumb to managerial suggestions for reserve management given that OA are not only responsible for reserve management (like NOA) but they also participate in broader managerial decision making.

2.3. Hypotheses related to Reserve Error Management

There are several targets that managers could try to achieve using loss reserve estimates (see for example the survey by Grace and Leverty, 2012). For example, managerial incentives could be linked to tax incentives, earnings management, financial weakness and rate regulation. The general idea is that OA have stronger compensation incentives to focus on the firm's *short-term* profitability than NOA, who would be inclined to focus on adding value in the *long-run*. We discuss this expectation in reference to each of the incentives below.

Tax Incentives

Insurers could deliberately increase loss reserves to reduce taxable income and their current tax burden (see e.g., Grace, 1990; Gaver and Paterson, 1999, 2000; Grace and Leverty, 2012). This happens because some losses corresponding to current fiscal year's premiums received might not be fully paid by the end of the fiscal year. Insurance companies are allowed to set reserves aside for future unpaid losses, thus defer potential tax payments on taxable income until the actual losses are realized. Hence, if such

¹¹ If we consider an extreme scenario where the firm's management decides to fire/replace the in-house appointed actuary, then such a penalty function will likely hurt the OA more than the NOA. This is because the market for OA is expected to be more competitive than the market for NOA. We thank an anonymous referee for this comment.

loss reserves are overestimated, then tax payments are delayed for at least another fiscal year. To measure the “tax shield” incentive we use the following variable (similar to Grace, 1990; Grace and Leverty, 2012):

$$Tax\ Shield = \frac{Net\ Income + (Losses\ \&\ Loss\ adjustment\ expense\ reserve)}{Assets} \quad (1)$$

Tax-shielding is a form of time-diversification for insurance companies as they can use tax deferrals to offset anticipated, increased losses (e.g. Davidson, 1996; Milidonis and Grace, 2008). Furthermore, since insurance losses take several years to be fully realized (Nelson, 2000), then over-reserving makes insurance firms more prepared for a potential unexpected influx in future loss payments. Hence a positive relationship is expected between the Tax Shield of the typical appointed actuary and reserve errors (i.e. over-reserving with higher tax shields).¹²

The uniqueness of our manually parsed sample of appointed actuaries into OA and NOA, allows us to refine this hypothesis further based on differences in reserve management by OA and NOA, as motivated by their respective compensation incentives. To receive any compensation additional to fixed salaries (e.g. bonuses), the firm almost always needs to be profitable. In addition, since bonuses typically increase with firm performance, then the (compensation) payoff function for OA is similar to the payoff function of a call option.¹³ Since OA are incentivized to increase firm value in a shorter horizon than NOA, then OA are expected to over-reserve *less* than NOA. As mentioned before, over-reserving could be justified as a form of time-diversification, as it defers taxation for some time, however the subgroup of OA face competing incentives (in the opposite direction) to show profitability in a shorter-horizon.

Earnings Management

According to the earnings management hypothesis, insurers could manage loss reserves to smooth income to meet earnings expectations primarily due to agency problems (Weiss, 1985; Grace, 1990; Froot,

¹² Even if insurance claims increase contemporaneously with the crisis, this effect will likely reduce the incentives of appointed actuaries to under-reserve to show more earnings, hence it would go against our results.

¹³ For example, when firm profitability is negative, the bonus would likely be zero. The trigger for positive bonus would likely be a positive firm profit, where the size of the bonus (e.g. as a percentage of fixed salary) would likely increase if profitability continues to increase.

et al., 1993; Beaver, et al., 2003). Specifically, the literature hypothesizes a positive relationship between earnings management and reserve errors in the sense that insurers over-reserve (under-reserve) when profitability is higher (lower) than anticipated.

However, earnings' smoothing may not be the only hypothesis related to earnings management. Compensation incentives have also been linked to earnings management (e.g. Berstreser and Philippon, 2006; Cheng and Warfield, 2005; Eckles et al. 2011). Eckles and Halek (2010) show that insurance executive manage earnings to increase their compensation in the short-run. Similarly, since OA are offered more short-term, compensation incentives (relative to NOA), we expect that responding to such incentives would result in under-reserving to show more positive earnings. In contrast, since NOA face weaker compensation incentives, we predict that this effect would be weaker for NOA than OA.

To measure the effect of earnings management we follow the rationale of Grace and Leverty (2012) and create four indicator variables to capture an insurer's relative position in the earnings distribution (small profit or loss; large profit or loss) in each year of our sample. *Small Profit* indicator is defined to be one if an insurer's reported earnings (scaled by assets) are the first 10% of the positive earnings distribution (i.e. positive values starting above zero earnings). The *Large Profit* indicator is defined to be one if insurer's earnings starts from the 10th percentile and ends at the maximum value of the positive earnings distribution. Similarly, the *Small Loss* indicator is defined to be one if insurer's reported earnings (scaled by assets) are the first 10% of the negative earnings distribution (i.e. negative values starting below zero earnings). The *Large Loss* indicator is defined to be one if insurer's earnings range from the minimum value to the 90th percentile of the negative earnings distribution .¹⁴

Since our sample size is smaller than those of previous studies (e.g. Kelly et al. 2012; Grace and Leverty 2013), we also propose two alternative measures of earnings management. Since we are

¹⁴ Since we have a small sample size, we have slightly deviated from the definition by using a cut-off of 10% instead of 5%, so that we can have enough observations in each of the small profit/loss indicator variables. For example, the small loss variable has 10 observations (while we would have had about 5 observations), which then has to be interacted with OA, thus rendering this analysis not very meaningful. We report the results though for comparability to prior studies.

interested in variables that would also capture any differences in reserving practices by OA relative to NOA, we focus on variables associated with positive profitability that are expected to trigger payment of performance-linked compensation. Our first measure is similar to the “small profit” indicator above, but broader. We capture the positive returns on equity (ROE) by splitting the distribution into *ROE 0-10%* (takes the value of one if a company has ROE ranging from 0 to 10%) and *ROE above 10%* (takes the value of one if ROE is greater than 10%). The third variable we use is an industry variation of ROE, typically referred to as Comprehensive ROE (Progressive, 2014), which reports income on a total return basis.¹⁵ Comprehensive ROE (*CROE*) is the sum of net income plus changes in unrealized investment gains, normalized by average surplus. We use the indicator variable *CROE_pos*, which takes the value of 1 if comprehensive ROE is positive and zero otherwise.

Financial Weakness

There are two major hypotheses to connect under-reserving and financial weakness. First, insurers underestimate loss reserves to avoid regulatory attention (Petroni, 1992; Petroni and Beasley, 1996; Petroni, et al., 2000; Gaver and Paterson, 2004). Second, insurers have incentives to underestimate loss reserves due to limited liability and the presence of guaranty funds (Harrington and Danzon, 1994). Hence, we expect a negative relationship between the financial weakness variable and reserve error (i.e. under-reserving). Since compensation incentives are typically linked to company’s upside performance, where an upside potential may be less common for financially weak firms, it is less likely that there will be significant differences between OA and NOA, with respect to under-reserving to improve a firm’s financial strength’s indicators.

To control for *Financial Weakness* we follow the literature (e.g., Gaver and Paterson, 2004) and create an indicator variable which takes the value of one if four or more out of the thirteen reported IRIS ratios are unusual according to NAIC guidelines.

¹⁵ “Use of Comprehensive ROE is consistent with the Company’s policy to manage on a total return basis and reflects changes in unrealized gains and losses on securities held in our portfolio.”

Rate Regulation

Rate Regulation could provide incentives for reserve management. One hypothesis is that insurers underestimate loss reserves to offer more competitive rates (Nelson, 2000). Another hypothesis, which receives more empirical support, is that insurers over-reserve to ensure adequate rates because regulation tends to depress rates (e.g., Harrington, 2002; Grace and Phillips, 2008; Grace and Leverty, 2012).

To examine these hypotheses we control for the level of regulation by line of business faced by each insurer. Given the heterogeneity in rate regulation among different states but also the varying amount of premiums by line of insurance business, which falls under a different regulatory regime, we construct a rate regulation index that weights the stringency of rate regulation (Grace and Leverty, 2012). Using data from the NAIC's Compendium of State Laws on Insurance Topics, we estimate the following variable:

$$Rate\ Regulation = \frac{\sum_{i,s,t,l} PW_{istl} \times STR_{stl}}{\sum_{i,s,t,l} PW_{istl}} \quad (2)$$

Intuitively, the variable *Rate Regulation* gives the percentage of total premiums written (PW) by each insurer that is subject to a stringent regulation regime. The denominator of this variable is the total premiums written by each firm i , in state s , for each insurance business l , in every year t . The numerator, first takes the product of each insurance business' premiums written (PW) multiplied by an indicator variable (STR) which takes the value of 1 if there is stringent regulation in that state and 0 otherwise, and then sums over all products.

3. Data and Descriptive Statistics

Our sample comprises affiliated and unaffiliated single PC insurers reporting data through the NAIC Annual Statements. To estimate the five-year reserve error ($5YRE$), we need 5 years of data to measure one year's reserve error (section 3.2). Hence we estimate $5YRE$ for years 2007-2009 using data from 2007-2014. We remove insurers which are exempted from either or both actuarial opinion or/and auditing by certified public accountant: insurers with less than \$1 million total direct plus assumed written premiums during a calendar year, and less than \$1 million total direct plus assumed loss and loss

adjustment expense reserves. We further remove samples which prepare the NAIC statement using a basis of accounting other than Statutory Accounting Principles. To focus on firms writing business and bearing the liability for future claim payments, we further restrict our sample into firms with positive direct premium written, positive net premium written, positive loss and loss adjustment expense and also positive loss reserve.

We focus on stock or mutual insurers, and exclude firms which have under-gone a recent merger and/or acquisition, firms that have an external consultant as an appointed actuary (i.e. we only use firms with in-house appointed actuaries) and firms that have missing data for appointed actuaries. Finally, we exclude reinsurance companies, companies whose loss reserve has changed from prior year by more than 50%, reinsurance assumed is more than 25% of net premium written, and the financial line direct premium is more than 1% of total direct premium. Our final sample comprises 563 firm-year observations.

3.1. Appointed Actuary Status

To identify the status of appointed actuaries, their names are matched with the names listed in “Officers” in the NAIC statements since 2007.¹⁶ An officer is a title given to an individual who is actively involved in firm managerial or policy-making decisions (NAIC, 2011).¹⁷ On average about 9-10 officers are reported per firm per year.

NAIC statements also report whether officers have more specific titles. For example, the names of Chairman, President, CEO (Chief Executive Officer), CFO (Chief Financial Officer), CRO (Chief Risk Officer), and Chief Actuary are reported. Surprisingly, some appointed actuaries are also listed to be one

¹⁶ A list of officers is reported in the NAIC annual statement before 2007. Yet, only two officers are listed in the 2006 data and only one officer is listed before 2006.

¹⁷ In the instructions by the National Association of Insurance Commissioners (NAIC) as to how the NAIC statements should be filled (NAIC, 2011) the following instructions are given with respect to officers: “*The state of domicile regulatory authority may dictate the required officers, directors, trustees and any other positions to be listed on the Jurat Page. Show full name (initials not acceptable) and title (indicate by number sign (#) those officers and directors who did not occupy the indicated position in the prior annual statement). Additional lines may be required to identify officers, directors, trustees and any other positions in primary policy-making or managerial roles. Examples of titles are 1) President, Chief Executive Officer or Chief Operating Officer; 2) Secretary, or Corporate Secretary; 3) Treasurer or Chief Financial Officer; and, 4) Actuary.*”

of the five titles mentioned above (e.g. CEO, CFO, and CRO). Even though this number is small, this is initial evidence of the conflict of interest that exists in having both the appointed actuary role but also another executive role in the firm's management.

[Table 1]

In Table 1, we present the number of in-house appointed actuaries by year and in total. For the entire sample we observe that OA are about 43% (244/563) of in-house actuaries vs. 57% (319/563) which are NOA. The split remains similar across the years 2007-2009.

3.2. Loss Reserve Error

Loss reserve is the largest liability on an insurance company's balance sheet and can be defined as an estimate of all losses that have occurred but not yet realized by the fiscal year end. US PC insurance companies are required to estimate loss reserves on an annual basis. In addition, they are required to publish revisions to their loss reserve estimates as new claim-related information arrives.

Loss reserve errors can be defined as the deviations from the original reported estimated loss reserves. In some lines of business, the average time for all losses to be revealed is estimated to range from seven years (homeowners' policies) to about twenty years (medical malpractice policies) (Nelson, 2000). As a result, loss reserve errors have the potential to vary significantly across lines and over time.

The loss reserve estimation method for the PC insurance industry comprises an ex-post measure. This method either takes the difference between the originally reported loss reserves and claims paid over the next five years (used by Weiss, 1985; Grace, 1990; Diacon, et al., 2004; Browne, et al., 2008), or it takes the difference between the originally reported loss reserve to a revised estimate five years in the future (e.g., Petroni, 1992; Kazenski, et al., 1992; Beaver et al., 2003; Eckles and Halek, 2010), which is the one we use. More formally, we define the loss reserve error as:

$$Reserve\ Error\ (t) = \frac{Reserve(t) - Reserve(t+n)}{Assets(t)} \quad (3)$$

We follow the literature and use the five-year reserve error normalized by the total value of assets at the time of the original reserve estimate (time t) ($5YRE$). In the Supplementary Material provide a detailed explanation of the $5YRE$ we use and also an additional robustness check (the three year reserve error).

[Table 2]

In Table 2, panel A, we present the distribution of the $5YRE$, which is used as the dependent variable in our regressions. There are a total of 539 non-missing observations across all years for the $5YRE$, which are evenly balanced across the three years (2007-2009). The average (median) $5YRE$ is 1.69% (0.90%) of the value of assets, with a standard deviation of 5.58%. To minimize the impact of outliers, we winsorize all variables (dependent and independent) at the 1% and 99% levels.

In Table 2, panel B, we present the distributions of the $5YRE$ conditional on the type of actuary; OA vs. NOA. Results show that OA seem to have lower average reserve errors, where the lower end of the distribution also seems more negative for OA than NOA. We also conduct t-tests with unequal variances on the means of reserve errors for OA and NOA. We find that OA produce a more negative $5YRE$ than NOA, where the difference is -1.17% (p-value < 0.01).

3.3. Explanatory Variables

In Table 3 we provide descriptive statistics for the independent variables in our regressions. Variables are split into two major categories: incentive variables and control variables (detailed definitions of the control variables are given in the Supplementary Material). To control for the amount of work that each appointed actuary has to do with respect to loss reserving, we count the number of times they appear as the appointed actuary in different firms. The average and median number of appointments is 11 and 5 respectively.¹⁸

[Table 3]

¹⁸ Note that the “Appointment” variable is based on the universe of PC insurance companies with non-missing appointed actuaries.

With respect to the characteristics of each firm in our sample, we observe that the mean (median) firm holds assets worth about 673 (186) million USD, where the distribution seems highly skewed to the right with a standard deviation of 1,716 million USD. In terms of firms' organizational structure, about 88% are stock companies and in addition, about 90% belong to a group. If the reporting insurer belongs to a group which has a ticker, then it falls under the "public" description, which represents about 61% of the sample. Moreover, about 26% of companies are controlled by foreign firms (>10% foreign ownership). Finally, about 45% of the firms are audited by a major audit firm (PwC, E&Y, KPMG, or Deloitte).

To measure the business concentration of each firm we construct the *Line Herfindahl* variable, which has an average (median) value of 0.42 (0.37) indicating considerable diversification across lines of business (a value of 1 indicates a single line of insurance). Similarly to measure the geographic concentration of each firm we construct the *Geo Herfindahl* index, which has an average mean (median) value of 0.44 (0.25), indicating about similar diversification across states as across business lines (a value of 1 indicates insurance operations in a single state). In addition we observe that the percentage of long-tail business written by firms has an average (median) value of 41% (41%), where the reinsurance variable (proportion of ceded premium to the sum of direct premium written and reinsurance assumed) is large as it has an average (median) of 57% (73%).

Next we describe the variables used to quantify the most common explanations in the literature about reserve mis-estimation. The *Tax Shield* variable shows the relative magnitude of the incentive to hide income in reserves, normalized by firm's assets. We match closely the descriptive statistics of the tax shield variable to those of Grace (1990) with an average (median) value of 24% (22%) and a standard deviation of 16%, with a minimum of 2% and a maximum of 57%. Next, *Rate Regulation* reflects the stringency of rate regulation that the firm faces; the average (median) firm has 39% (36%) of premiums regulated by a stringent state regulation regime. The *Financial Weakness* variable indicates that only 7% of the sample has four or more IRIS ratios violating the NAIC threshold while the median company has a

value of 0. Finally we show descriptive statistics for the variables we use to capture the earnings-related incentives that OA face.

For the earnings management incentive, we start with the literature's measure of capturing small/large profits/losses, to make our results comparable to the prior studies. In our sample, 8% (75%) of the firms show small (large) profits, while 2% (15%) show small (large) losses. Since these measures add up to 1, in our regression models we keep the "large loss" indicator as the hold-out group. Moving on to the measure based on the positive end of the "Return on Equity" distribution, we find that 35% of the firms have a positive ROE up to 10% (*ROE 0-10%*), while 48% have ROE above 10% (*ROE above 10%*). The third measure (*CROE_pos*), shows that 79% of the sample reports a positive comprehensive ROE.

[Table 4]

In Table 4, we present t-tests in the explanatory variables in Table 3, conditional on whether the appointed actuary is an officer or not. We estimate t-tests (with un-equal variance) for each year and report results for year 2009. Results are similar across all years. We observe only small differences between the sub-sample of OA vs. NOA, specifically, with respect to only three (p-value < 0.05) out of twenty-one variables examined.

4. Methodology

Our initial approach is to examine the relationship between reserve error and the four commonly used incentives to explain reserve mis-estimation, controlling for firm characteristics that could affect reserve management practices. We do this through the following linear equation between the five-year reserve error (*5YRE*), control variables and incentive variables:

$$5YRE_{it} = \alpha + \alpha_i + \alpha_t + \beta_1 X_1 + \beta_2 X_2 + \gamma_1 OA_{it} + \varepsilon_{it} \quad (4)$$

where α represents intercept, α_i represents firm indicator variable, α_t represents year indicator variable, OA_{it} is the officer actuary indicator variable and ε_{it} is a normally distributed error term. X_1 stands for a vector of control variables discussed above and X_2 stands for the incentive variables.

Next, to evaluate the relationship between the appointed actuary's status and the five-year reserve error (*5YRE*), we build on equation (4) above to estimate the following linear equation:

$$5YRE_{it} = \alpha + \alpha_i + \alpha_t + \beta_1 X_1 + \beta_2 X_2 + \gamma_1 OA_{it} + \delta_1 (OA_{it} * X_2) + \varepsilon_{it} \quad (5)$$

The difference between equation (4) and (5) is that equation (5) introduces a vector of coefficients of interaction terms, δ_i , between the *OA* indicator and the incentive variables. These interaction terms allow us to identify differential reserve error treatment between OA and NOA, with respect to the incentive variables defined above.

To determine which regression model to be fit, several tests are conducted. First we run the Breusch Pagan diagnostic test to select between random effects' models and ordinary least squares (OLS) regressions, where the random effects model always dominates the OLS model (p-value < 0.01). Then, we run Hausman tests to decide between fixed or random effects regressions. If the null hypothesis (H_0 : Error terms are uncorrelated with the independent variables) is not rejected, we proceed with running random effects models, otherwise we run firm-fixed effects models. Unless otherwise stated, we observe support for running random effects model, which we report in Tables 5 and 6.¹⁹ Hence the reported results are based on random effects models, with year indicators in all regressions with clustered standard errors at the firm level and robust to heteroskedasticity.

5. Results

In this section we provide results of the random effects regressions (Tables 5 and 6) in section 5.1. Since we are essentially testing four hypotheses together (i.e. the four incentive variables) we also report F-tests that check whether the coefficients of the incentive variables (Table 5) are jointly zero. We repeat the same approach in Table 6 (also including the coefficients of the OA interactions with the incentive

¹⁹ In those cases where fixed effects models are suggested by Hausman tests over random effects models (i.e. when the Null is rejected with a p-value < 0.05), we run regressions using fixed effects regressions (untabulated) and discuss results in the text. Henceforth, "untabulated" implies that those tables are not reported in the paper but are available from the authors.

variables). The joint F-tests reject this hypothesis in both tables. In section 5.2 we discuss the economic significance of the results and in section 5.3 we describe robustness checks conducted on our results.

5.1. *5YRE*, managerial incentives and actuary status

In Table 5, we show the results of equation (4) for the four incentive variables (tax-shielding, earnings management, rate regulation and financial weakness). As implied the base case is the group of NOA, and the OA indicator variable captures any marginal effect over the base case that OA bring into the equation. The three columns in Table 5 present results of the three alternative proxies for earnings management. Column (1) shows the results for the commonly used measure used in the literature, for comparability purposes with prior studies. Results in columns (2) and (3) use the two proposed earnings management variables (section 2.3), that relate directly to the positive end of the firm profitability.

[Table 5]

We find a strong positive association between the Tax Shield variable and reserve error (i.e. over-reserving). This relationship is consistent with the tax incentive hypothesis (Grace, 1990), the results of Grace and Leverty (2012), and also our expectation. Specifically, managers have an incentive to over-reserve to shield taxes, primarily because of the uncertainty surrounding insurance loss realization over the next years. In short, such over-reserving through tax-shielding allows an indirect time-diversification benefit for insurance firms.

Next, we examine the three models (columns) in isolation. All three models show evidence of a strong positive association ($p\text{-value} < 0.01$) between reserve errors and the Tax shield variable. The size of the coefficient is also economically significant since an increase in the Tax shield variable by one standard deviation (0.16) will increase reserve estimates by a range of 1.18% (model 3: 7.37×0.16) to 1.24% (model 2: 7.77×0.16).

We do not observe any other significant relationships between *5YRE* and the remaining three managerial incentives (at least not in Table 5). We do observe however, that the OA indicator obtains a negative, statistically significant ($p\text{-value} < 0.05$) in all three models, which shows differential reserve

error treatment by OA relative to NOA, albeit, this effect cannot be attributed to any of the literature's common incentives using the relationship tested by equation 4. In addition, to address a potential criticism that OA are busier than NOA, hence their reserve estimates may differ from those of NOA, we include the "Appointment" variable that captures the number of companies an appointed actuary is responsible for. This variable is not significant in any of the three models.

[Table 6]

In Table 6, we show the results of equation 5, where we also introduce the interaction of the OA variable with the four incentive variables. The interaction terms allow us to attribute any differential reserve error treatment between OA and NOA, precisely on those incentives that justify a difference in reserving practices between the two mutually exclusive groups of appointed actuaries. Specifically, if the interaction coefficient of the OA variable with a specific incentive variable is statistically significant, this would imply that, in addition to the effect that the incentive variable alone would have (an effect entirely attributed to the base case, i.e. NOA), the overall effect attributed to OA with respect to the specific incentive would be the sum of the two coefficients (incentive variable plus OA*incentive variable).

One major result from Table 6 is that the strong positive relationship between reserve error (i.e. over-reserving) and tax shield is primarily attributed to NOA. Specifically, the positive and significant coefficient of the Tax Shield variable implies an over-reserving effect by NOA to shield taxes, where the size of the coefficient indicates an effect about 40-50% larger than the effect documented in Table 5 for the entire sample of in-house actuaries (e.g. model (2): 11.62 vs. 7.77, respectively).

OA seem to behave differently than NOA with respect to tax-shielding. Even though they still over-reserve to shield taxes (i.e. model 2: $11.62 - 6.78$ is still a positive number) they over-reserve less than NOA (results of models 2 and 3).²⁰ This is evident from the opposite sign of the OA*Tax Shield variable where the negative and statistically significant (p-value < 0.10) coefficient reduces the tax shield effect by

²⁰ Models 2 and 3 show a statistically different interaction term of OA with the earnings management incentive at the 10% level. Model 1 shows that over-reserving for OA is not statistically different than over-reserving by NOA. In addition, Hausman tests suggest using firm fixed effects for model 1, which provide similar results.

about 60%. To understand the magnitude of the reserve management, we examine how one standard deviation increase in the Tax Shield variable affects reserve management. Specifically, as the Tax Shield variable increases by one standard deviation, NOA are associated with an over-reserving effect of about 1.86%. On the other hand, as the OA turns from 0 to 1, this effect is reduced by about 1.09%, hence the net over-reserving effect by OA related to tax shield is about 0.77%. Less over-reserving by OA relative to NOA is consistent with OA's more convex compensation structure, which favors income-increasing practices in a short horizon (i.e. they use less earnings than NOA to increase reserves).

The second major result related to the difference between the short-term vs. the long-term view of OA and NOA respectively, becomes more apparent on how earnings management incentives affect reserving practices. Focusing again on models 2 and 3, we observe no significant results associated with earnings management for NOA. In contrast, all interaction terms between OA and earnings management incentives obtain negative and significant coefficients. Specifically in model 2, when firms report positive ROE up to 10% (i.e. ROE 0-10% indicator turns from 0 to 1), reserves are under-stated by 3.65% (p-value < 0.01), while, when firms report ROE above 10% (i.e. ROE above 10% indicator turns from 0 to 1), reserves are under-stated by 2.39% (p-value < 0.10), relative to the base case. Finally, in model 3 where the CROE measure is used, we obtain similar results. When firms report positive CROE, reserves are under-stated by 1.99% (p-value < 0.05).

5.2. Economic Significance

Next we discuss the economic significance of our results in monetary terms. Taken together, all models in Table 6 provide consistent evidence of over-reserving for tax-shielding purposes. With the exception of model 1, which shows that both NOA and OA over-reserve by the same amount for tax-shielding purposes (e.g. OA*Tax Shield is not significant), models 2 and 3 show that OA over-reserve less than NOA (p-value < 0.10). In dollar values, the over-reserving effect associated with a one standard deviation (0.16) increase in Tax-Shield is \$11.4 million for model 1 for both OA and NOA, while for models 2 and 3 over-reserving differs by type of actuary. Specifically, NOA over-reserve about \$11.7

million to \$12.5 million (i.e. $0.16 \times 10.86\%$ to $0.16 \times 11.62\%$ of assets, for models 3 and 2, respectively), while OA over-reserve about \$5.2 million to \$5.4 million for the average firm (for models 2 and 3, respectively).

In addition to over-reserving for tax-shielding purposes, the analysis also shows evidence consistent with under-reserving associated with positive profitability, practiced by firms with OA relative to those with NOA. This result is robust across the three variables used for earnings management, which is consistent with the stronger income-increasing incentives provided to OA than to NOA, through OA's more convex compensation structure. In dollar terms, the full extent of under-reserving to show positive (higher) profitability ranges from \$13.4 million (model 3: -1.99% of firm assets) to \$26 million (model 1, large profit variable: -3.88% of firm assets) for the average firm.

Both results are consistent with the stronger income-increasing compensation incentives, provided to OA relative to NOA. This is because OA tend to reserve in a way that increases firm value (and their compensation) in the short-term, while NOA tend to reserve in a way that increase firm value in the long-term (as compensation incentives are much weaker).

5.3. Robustness checks (untabulated)

One potential shortcoming of the dependent variable (*5YRE*) is that an arguably long period (five years) passes from the initial reserve estimate to the revised estimate that is used to calculate the reserve error. This period may include new reserve-related information that may be reflected in revised estimates. Even though we follow the literature to include a battery of control variables including year-specific indicator variables, to account for such information, we take the analysis a step further to alleviate such concerns. Specifically we replace the *5YRE* with the 3-year reserve error as an alternative dependent variable (defined in the Supplementary Material). Results remain robust.

On the incentive variables and specifically on the financial weakness variables we use, Grace and Leverty (2012) mention that financial weakness proxies based on IRIS ratios could have a mechanical relationship to reserve management. Hence, we re-run our results (with similar results) using the financial

weakness variable used by Petroni (1992) and Beaver et al. (2003). This variable takes the value of 1 if more than one of the “non-reserve” IRIS ratio violates the pre-specified range.

Other robustness checks related to the earnings management variables are described below, all of which yield consistent results. The rationale is that OA have incentives to show positive profitability, hence all variables below focus on positive profitability. First we use a dummy variable for positive ROE (instead of splitting above and below the positive distribution at the 10% level). Second, we use an indicator variable for ROE being between 0 and 5%. Third, when using the literature’s preferred variable of earnings management (model 1 in Table 5 and 6), we only include those capturing the positive end of the distribution (i.e. small and large profit).

The last round of robustness checks relates to econometric variations of our main models in Table 5 and 6. To address the issue of panel-specific heteroskedasticity and serial correlation in error terms, the insurance literature on reserve errors seems to prefer using feasible generalized least squares (FGLS) models with the assumption that an autoregressive process with degree 1, AR(1), governs the potential serial correlation in the error terms. We follow the literature and run FGLS model with an assumed AR(1) process governing the error terms. Next, we re-run the analysis on the following sub-samples with similar and sometimes stronger results: (a) only affiliated firms (about 90%) of our sample; only stock companies (about 88% of our sample); (c) firms that are both affiliated and stock companies (about 84% of our sample). Finally, we re-run tables 5 and 6 using group fixed effects and standard errors clustered at the group level (since our sample comprises primarily affiliated firms) with similar results. Since the different model specifications, alternative estimation techniques, and sub-sample analysis provide consistent results with respect to the tax-shielding and earnings management incentives, we conclude that our findings of differential reserve management between OA and NOA are robust.

6. Conclusion and public policy implications

Guttermann (2002) has identified several conflicts of interest that exist in the actuarial profession. We consider the case of in-house actuaries, and specifically the case where appointed in-house actuaries also hold a managerial position to be the one deserving more attention. However, the fact that external actuaries are also paid by the company that they are called to estimate the reserves for, creates another situation of conflict of interest, albeit milder, and deserves more research.

We examine the relationship between revisions in reserve error estimates from 2007-2009 and the status of the appointed actuary (responsible for the reserve estimation accuracy) for the property-casualty US insurance industry. We focus on the sample of in-house appointed actuaries and separate them into those who also hold an officer position (officer actuaries; OA) and those who do not (non-officer actuaries; NOA). Senior firm employees, such as OA, are provided with income-increasing compensation incentives. Hence, this setting creates a conflict of interest (Guttermann, 2002), because actuarial independence should govern the reserve estimation process, while compensation incentives of OA align their interests with those of the short-term firm profitability.

This study shows that OA seem to manage reserves differently than NOA. Results show that on average, actuaries over-reserve for tax-shielding purposes, however, OA tend to over-reserve less than NOA. More importantly, OA tend to under-reserve to increase positive profitability, while NOA do not. Both results suggest that OA manage reserves in a way that is consistent with increasing firm value over a shorter horizon than NOA. As implied, increasing firm value in the short run, is consistent with the more convex compensation benefits provided to OA (relative to NOA), which imply higher realized compensation (through payment of bonuses) with more positive firm profitability. Hence, in a situation where this study identifies a conflict of interest, the evidence is suggestive of the hypothesis that actuarial independence could be compromised by managerial discretion. Given the size of the US PC insurance industry reserves, the size of this effect is economically significant.

To reiterate the need to disconnect the misalignment of actuarial independence from conflicting

managerial incentives, it is helpful to look at what other countries do around the world. Not surprisingly, countries with similar institutional quality as the US (approximated by the transparency international index score²¹) such as Australia, Canada and England do not allow the appointed actuary to also hold an officer position (APRA, 2014; OSFIC, 2012; BOE, 2016). The same applies to countries of lower institutional quality, such as Malaysia (Central Bank, 2014). Given that appointed actuaries are not allowed to also hold an officer position in several countries around the world, it seems that US regulating bodies should be concerned.

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²¹ www.transparency.org

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Tables

Table 1: Actuarial Appointments in U.S. Property and Casualty Insurance (2007-2009)

This table shows the number of appointed actuaries in the U.S. Property and Casualty Insurance Industry as reported by detailed NAIC statements for the years 2007-2009. We focus only on the sample of in-house appointed actuaries, split into those that also hold an officer position (OA: office actuaries) and those that do not (NOA: non-officer actuaries). There are 563 firm-year observations.

Actuarial Appointments	2007	2008	2009	Total
Officer Actuary (OA)	78	79	87	244
Non-Officer Actuary (NOA)	110	113	96	319
Total	188	192	183	563

Table 2: Reserve Error Distribution

In this table we show descriptive statistics of the dependent variable, the five year reserve error (*5YRE*), for the entire sample (panel A) and by type of actuary (panel B). The reserve error is defined as the difference of the revised reserve estimate at year $t+5$ from the initial reserve estimate made at time t , scaled by the total assets of the firm and presented as a percentage (See Supplementary Material). OA stands for officer actuary. NOA stands for non-officer actuary. Both variables are winsorized at the 1% and 99% level.

Panel A (Overall)	Year	N	Mean	Median	Std	Min	Max
5-Year Reserve Error (<i>5YRE</i>)	2007	179	2.10	1.13	5.36	-19.38	18.51
	2008	184	1.48	0.55	5.30	-19.38	17.00
	2009	176	1.49	0.97	6.08	-19.38	18.51
	All	539	1.69	0.90	5.58	-19.38	18.51
Panel B (By type of Actuary)	Year	N	Mean	Median	Std	Min	Max
<i>5YRE - NOA</i>	2007	105	2.86	1.18	5.40	-7.23	18.51
	2008	109	1.78	0.45	5.19	-11.97	16.67
	2009	94	1.93	1.21	5.94	-19.38	18.51
	All	308	2.19	0.95	5.50	-19.38	18.51
<i>5YRE - OA</i>	2007	74	1.02	1.00	5.14	-19.38	13.39
	2008	75	1.06	0.81	5.45	-19.38	17.00
	2009	82	0.99	0.57	6.23	-19.38	18.51
	All	231	1.02	0.82	5.62	-19.38	18.51

Table 3: Descriptive Statistics

This table presents descriptive statistics for the control variables used in the analysis. Assets are the firm's total assets reported in millions US\$. Appointment is the number of appointments corresponding to each actuary in each year, in our sample. Indicator variables (and 0 otherwise) are used for the following characteristics: Stock for a stock company; Group for an individual insurer belonging to a group; Public for a company which is affiliated with a publicly traded group company; Foreign control when ownership is greater than 10% non-US; Major Auditor if appointed audit firm is a large audit firm (PwC, E&Y, KPMG, or Deloitte). Reinsurance is the proportion of ceded premium to the sum of direct premium written and reinsurance assumed. Line Herfindahl measures how diversified across different lines of business a company is, where 1 denotes a single line. Geo Herfindahl measures how diversified across different states a company is, where 1 denotes a single state. Long-tail denotes the percentage of premiums written in long tail risk. Tax Shield is the ratio of the sum of net income and loss and loss adjustment expense reserves to assets. Rate regulation is the proportion of direct premiums written under stringent rate regulation. Financial Weakness indicator is 1 when 4 or more out of 13 IRIS ratios are unusual. Income smoothing is measured using four indicator variables: (a) Large Profit (top 90% of positive earnings distribution); (b) large loss (lower 90% of negative earnings distribution); (c) small profit (lower 10% of positive earnings distribution); (d) small loss (first 10% of negative earnings distribution). ROE 0-10% indicator is 1 if return on equity between 0-10%. ROE above 10% indicator is 1 if return on equity is above 10%. CROE_pos is 1 if comprehensive ROE is positive. Comprehensive ROE is the ratio of the sum of net income and changes in unrealized investment gains (net of taxes) to average surplus if the ratio is positive; 0 otherwise.

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max
Appointment	539	10.85	5.00	11.86	1.00	47.00
Assets (in million \$)	539	672.57	185.47	1716.15	2.59	15920.31
Stock	539	0.88	1.00	0.33	0.00	1.00
Group	539	0.90	1.00	0.30	0.00	1.00
Public	539	0.61	1.00	0.49	0.00	1.00
Reinsurance	539	0.57	0.73	0.35	0.00	1.00
Line Herfindahl (1=single line)	539	0.42	0.37	0.24	0.10	1.00
Geo Herfindahl (1=single state)	539	0.44	0.25	0.39	0.04	1.00
Major Auditor	539	0.45	0.00	0.50	0.00	1.00
Long-tail	539	0.41	0.41	0.36	0.00	1.00
Foreign Control	539	0.26	0.00	0.44	0.00	1.00
<i><u>Incentives</u></i>						
Tax Shield	539	0.24	0.22	0.16	0.02	0.57
Rate Regulation	539	0.39	0.36	0.32	0.00	1.00
Financial Weakness	539	0.07	0.00	0.25	0.00	1.00
Large Profit	539	0.75	1.00	0.43	0.00	1.00
Small Profit	539	0.08	0.00	0.27	0.00	1.00
Small Loss	539	0.02	0.00	0.14	0.00	1.00
Large Loss	539	0.15	0.00	0.36	0.00	1.00
ROE 0-10%	539	0.35	0.00	0.48	0.00	1.00
ROE above 10%	539	0.48	0.00	0.50	0.00	1.00
CROE_pos	539	0.79	1.00	0.41	0.00	1.00

Table 4: Firm Characteristics by Type of Appointed Actuary

We report differences in major firm characteristics, conditional on the type of appointed actuary. We focus on in-house appointed actuaries and report differences between officer and non-officer actuaries. We conduct t-tests (with un-equal variance) for each year in our sample and report results for year 2009 (results are similar across all years). We denote statistical significance at the 1% (***), 5% (**) and 10% (*) level.

	Non-Officer Actuary (NOA)		Officer Actuary (OA)		Diff. Mean	t-stat
	Obs.=94		Obs.=82			
	Mean	Std. Error	Mean	Std. Error		
Log(Appointment)	1.67	0.12	1.87	0.13	-0.21	-1.22
Size: log(assets)	5.43	0.17	5.06	0.16	0.37	1.61
Stock	0.86	0.04	0.89	0.03	-0.03	-0.57
Group	0.90	0.03	0.91	0.03	-0.01	-0.24
Public	0.56	0.05	0.57	0.06	-0.01	-0.12
Reinsurance	0.51	0.04	0.65	0.04	-0.14	*** -2.84
Line Herfindahl	0.39	0.02	0.43	0.03	-0.04	-0.96
Geo Herfindahl	0.43	0.04	0.42	0.04	0.01	0.11
Long-tail	0.37	0.04	0.47	0.04	-0.10	* -1.96
Major Audit Firm	0.49	0.05	0.34	0.05	0.15	** 2.00
Foreign Control	0.19	0.04	0.39	0.05	-0.20	*** -2.93
Tax Shield	0.23	0.02	0.27	0.02	-0.05	* -1.83
Rate Regulation	0.36	0.03	0.39	0.04	-0.03	-0.63
Financial Weakness	0.09	0.03	0.07	0.03	0.01	0.29
Large Profit	0.76	0.04	0.78	0.05	-0.03	-0.39
Small Profit	0.11	0.03	0.06	0.03	0.05	1.09
Small Loss	0.02	0.02	0.01	0.01	0.01	0.47
Large Loss	0.12	0.03	0.15	0.04	-0.03	-0.57
ROE 0-10%	0.57	0.05	0.45	0.06	0.12	1.63
ROE above 10%	0.29	0.05	0.39	0.05	-0.10	-1.44
CROE_pos	0.89	0.03	0.87	0.04	0.03	0.56

Table 5: Reserve Error on Managerial Incentives (2007-2009)

This table presents panel regression results of the 5-year Reserve Error scaled by total assets (*5YRE*), for years 2007-2009 on the managerial incentives, controlling for firm characteristics (See Supplementary Material). Differences between the three models are the variables used to capture the earnings management incentive (See Supplementary Material). Results are based on firm random-effect models (RE). There are 256 firms, 539 firm-year observations and year effects in all regressions. We denote statistical significance at the 1% (***), 5% (**) level and 10% (*) level by heteroskedasticity and cluster robust standard errors at the firm level. All variables are winsorized at 1% and 99%.

	(1)		(2)		(3)	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Officer Actuary (OA)	-1.835 **	-2.22	-1.817 **	-2.16	-1.816 **	-2.19
Ln(Appointment)	-0.202	-0.71	-0.213	-0.76	-0.195	-0.70
Major Audit Firm	0.581	0.99	0.592	1.00	0.611	1.04
Size: Ln(Assets)	0.334	1.59	0.343	1.62	0.343	1.64
Public	-0.358	-0.45	-0.272	-0.35	-0.303	-0.39
Stock	1.053	0.89	0.996	0.83	0.966	0.81
Group	-1.805 *	-1.75	-1.898 *	-1.80	-1.862 *	-1.79
Reinsurance	0.335	0.43	0.446	0.56	0.359	0.47
Line Herfindahl	1.756	1.08	1.792	1.09	1.747	1.07
Geo Herfindahl	-0.530	-0.68	-0.555	-0.71	-0.609	-0.78
Long-tail	3.402 ***	3.21	3.333 ***	3.09	3.360 ***	3.14
Foreign Control	-1.629 ***	-2.66	-1.654 ***	-2.67	-1.647 ***	-2.68
<u>Incentives</u>						
Tax Shield	7.537 ***	3.16	7.766 ***	3.03	7.369 ***	3.19
Rate Regulation	1.229	1.31	1.260	1.32	1.257	1.33
Financial Weakness	-1.716	-1.60	-1.574	-1.54	-1.489	-1.46
Large Profit	-0.269	-0.40				
Small Profit	-0.962	-1.25				
Small Loss	-0.304	-0.40				
ROE 0-10%			-0.392	-0.57		
ROE above 10%			-0.277	-0.46		
ROE Positive						
CROE_pos					-0.097	-0.20

Year FE	Yes	Yes	Yes
Firm Effects	RE	RE	RE
Firms	256	256	256
Observations	539	539	539
Joint F-test for incentive variables (p-value)	0.00	0.00	0.00
Joint F-test for all variables (p-value)	0.00	0.00	0.00

Table 6: Reserve Error on Managerial Incentives (2007-2009)

This table presents panel regression results of the 5-year Reserve Error scaled by total assets (5YRE), for years 2007-2009 on the managerial incentives, controlling for firm characteristics (See Supplementary Material). Differences between the three models are the variables used to capture the earnings management incentive (See Supplementary Material). With reference to Table 5, all incentive variables are interacted with the officer actuary (OA) indicator. Results are based on firm random-effect (RE) models. There are 256 firms, 539 firm-year observations and year effects in all regressions. We denote statistical significance at the 1% (***), 5% (**) level and 10% (*) level by heteroskedasticity and cluster robust standard errors at the firm level. All variables are winsorized at 1% and 99%.

	(1)		(2)		(3)	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Officer Actuary (OA)	2.054	1.29	1.881	1.25	0.715	0.49
Ln(Appointment)	-0.181	-0.65	-0.187	-0.67	-0.194	-0.7
Major Audit Firm	0.739	1.26	0.773	1.32	0.704	1.19
Size: Ln(Assets)	0.351 *	1.72	0.356 *	1.77	0.356 *	1.77
Public	-0.456	-0.57	-0.356	-0.46	-0.302	-0.39
Stock	1.047	0.86	0.893	0.73	0.916	0.74
Group	-1.817 *	-1.70	-1.905 *	-1.73	-1.872 *	-1.77
Reinsurance	0.877	1.11	1.036	1.3	0.912	1.16
Line Herfindahl	1.899	1.15	2.003	1.21	1.904	1.15
Geo Herfindahl	-0.502	-0.64	-0.477	-0.61	-0.602	-0.76
Long-tail	3.512 ***	3.48	3.285 ***	3.23	3.287 ***	3.23
Foreign Control	-1.681 ***	-2.70	-1.685 ***	-2.7	-1.752 ***	-2.78
<u>Incentives</u>						
Tax Shield	10.60 ***	3.58	11.62 ***	3.62	10.86 ***	3.68
Rate Regulation	0.644	0.62	0.704	0.67	0.67	0.63
Financial Weakness	-0.953	-1.30	-0.842	-1.21	-1.011	-1.46
Large Profit	1.430	1.54				
Small Profit	0.668	0.65				
Small Loss	1.009	0.73				
ROE 0-10%			1.335	1.55		
ROE above 10%			0.759	0.82		
CROE_pos					0.828	1.2

Officer Actuary (OA) interactions

Tax Shield*OA	-4.913	-1.43	-6.784 *	-1.82	-5.875 *	-1.71
Rate Regulation*OA	1.588	0.87	1.502	0.83	1.425	0.78
Financial Weakness*OA	-1.413	-0.52	-1.182	-0.43	-0.637	-0.23
Large Profit*OA	-3.883 **	-2.75				
Small Profit*OA	-3.622 **	-2.4				
Small Loss*OA	-3.116 *	-1.77				
ROE 0-10%*OA			-3.65 ***	-2.66		
ROE above 10%*OA			-2.385 *	-1.86		
CROE_pos*OA					-1.994 **	-2.07
Year FE	Yes		Yes		Yes	
Firms	256		256		256	
Observations	539		539		539	
Joint F-test for incentive variables (p-value)	0		0		0	
Joint F-test for all variables (p-value)	0		0		0	