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Franco Fiordelisi[a,b*], Antonio Meles[c], Stefano Monferra[b,c] and Maria Grazia Starita[c]

[a] *University of Rome III, Italy*
[b] *SDA Bocconi, Italy*
[c] *University of Naples Parthenope, Italy*

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Abstract

This study analyses the determining factors of reserve errors in publicly listed property and casualty insurance companies in the U.S. This subject deserves special attention because the previous literature does not control for trade-offs between executive remuneration and other incentives regarding such insurers' discretionary accounting choices. We find that insurance managers manipulate loss reserves to increase their stock-based remuneration and to achieve corporate goals particularly those goals that relate to reducing tax burdens and obscuring financial weakness. We also observe that enactment of the Sarbanes-Oxley Act has constrained the loss reserve underestimation and changed the structure of reserve error incentives.

JEL classification: M43, G22; G32

Keywords: P&C insurers; reserve manipulation; executive compensation

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* *Corresponding author: Department of Business Studies, University of Rome III, Via S. D'Amico 77, 00145 Rome, Italy,* tel. + 39 059 2056772; fax: + 39 059 2056947*e-mail: franco.fiordelisi@uniroma3.it, and SDA Bocconi, Bocconi University, Via S. Bocconi, 8, 20136 Milan, Italy, tel. 02 58366121, fax 02 56366893, e-mail: franco.fiordelisi@unibocconi.it*

1. Introduction

Earnings management practices have been extensively investigated with respect to both U.S. firms (Burgstahler and Dichev, 1997; Degeorge, Patel and Zeckhauser, 1999; and Daniel, Denis and Naveen, 2008) and non-U.S. firms (Ali and Hwang, 2000; Ball, Kothari and Robin, 2000; Ball, Robin and Wu, 2003; and Leuz, Nanda and Wysockic, 2003) and with respect to non-financial firms (Jones, 1991; Dechow, Sloan and Sweeney, 1995; and Roychowdhury, 2006) and financial firms, such as banks and insurance companies (Collins, Shackelford and Wahlen, 1995; Ahmed, Takeda, and Thomas, 1999; Gaver and Paterson, 2004; and Grace and Leverty, 2010). In examining earnings management motivation, various papers have analyzed whether managers aim to achieve either corporate goals (Bartov, 1993; Collins, Shackelford, and Wahlen, 1995; Hunt, Moyer and Shevlin, 1996; DeFond and Park, 1997; Phillips and Pincus, 2003; and Grace and Leverty 2010) or personal benefits (Guidry, Leone and Rock, 1999; Burns and Kedia, 2006; and Baker, Collins and Reitenga, 2009). Surprisingly, there are no studies investigating whether managers are able to achieve both corporate goals and personal benefits by manipulating earnings.

Why do managers manipulate loss reserves? Do they aim to achieve personal and/or corporate goals? Is there a trade-off between personal and corporate goals? Our paper answers these questions by focusing on a large sample of publicly listed property and casualty (P&C) insurance companies in the U.S. and has two main findings. First, we show that personal and corporate goals may be complementary: insurance managers manipulate loss reserves both to increase their stock-based remuneration and to achieve corporate goals particularly those goals that relate to reducing tax burdens and obscuring financial weakness. Specifically, we find statistically significant evidence that stock options, tax benefits and risk benefits predict reserve errors. Our results shed light on previous papers (e.g., Eckles et al., 2011) by suggesting that the achievement of corporate goals is an intermediate step toward the increase of manager’s compensation through stock options.

Second, we find that the Sarbanes-Oxley Act[a] (SOA), which was enacted on July 30, 2002, has reduced loss reserve manipulation practices and altered the structure of reserve error incentives.

We focus on P&C property and casualty insurance companies because earnings in this industry can be easily manipulated through over/underestimation of loss reserves (Smith, 1980; Weiss, 1985; Kazenski, Feldhaus, and Schneider, 1992). There is convergent evidence that insurance company managers manipulate earnings to smooth net income (Weiss, 1985; Grace, 1990; Petroni, 1992; and Grace and Leverty, 2011), to minimize taxes (Grace, 1990; Petroni, 1992; and Grace and Leverty, 2011), to obscure financial weakness (Petroni, 1992; Harrington and Danzon, 1994; Gaver and Paterson, 2004; and Grace and Leverty, 2011), to maximize executive compensation (Browne, Ma, and Wang, 2009; Eckles and Halek, 2010; and Eckles et al., 2011) and to comply with regulations (Grace and Leverty, 2010 and Eckles et al., 2011). We contribute to this stream of the literature because we are the first study to analyze whether there is trade-off between managers' personal (i.e., maximizing management compensation) and corporate goals. Specifically, we assess the causality between earnings management and a large set of variables that capture both managers' personal and corporate aims, which is important because pursuing corporate goals without controlling for personal goals or *vice versa* may lead to biased results.

We also focus on U.S. insurance because the introduction of the SOA in 2002 offers us the unique opportunity to study the impact of regulations on earnings management practices in a sector in which these practices may be easily (and frequently) undertaken. We show that insurers are less inclined to manipulate loss reserves when they are in a state of financial weakness and to maximize managers' personal compensation since the enactment of the SOA.

As such, we build a unique data set from 10-K reports of publicly listed P&C insurers in the U.S. from 1995 to 2010. Our sample is representative of the entire U.S. P&C insurance industry;

[a] The SOA was enacted by U.S. regulators after various corporate and accounting scandals questioned the integrity of public financial information, which affected investor confidence (Iliev, 2010). The SOA has established new or enhanced standards for the boards and management of all U.S. public companies, in addition to outside accounting firms servicing such companies. The primary features of the SOA include individual certification by top management of the accuracy of financial information, tightening of penalties for fraudulent financial activity, strengthening the independence of outside auditors who review the accuracy of corporate financial statements and a stronger oversight role for boards of directors and audit committees.

thus, companies in our sample represents the 50.9% of the overall industry net premiums written in 2005[b].

The remainder of the paper is organized as follows. Section 2 presents the literature on loss reserve manipulation and discusses research hypotheses. Section 3 contains a description of the data. Variables and the methodological approach are presented in Sections 4 and 5, respectively. Section 6 presents the empirical results, and the final section concludes.

2. Literature Review and Research Hypotheses

Earnings management is a common practice in all industries, but empirical methods to assess whether and how firms misestimate their income differ substantially among non-financial firms, commercial banks, and insurance companies. Earnings management in P&C insurance companies is particularly compelling for accounting research for several reasons. First, P&C insurers can easily manipulate their income by adjusting the claim loss reserve because such reserves are highly dependent on management judgment and their amounts are substantial (much greater than insurers' net income). Second, the detection of loss reserve manipulation is straightforward because publicly listed insurers must disclose loss reserve revisions (i.e., reserve errors).

In a seminal paper, Smith (1980) investigated reserve errors by testing whether insurers manage loss reserves to smooth underwriting results and found that reserve errors are not random but are caused by specific loss reserve goals set by management. Following Smith (1980), a significant literature has tested whether insurers manage loss reserves to achieve the following goals: (1) to smooth income, (2) to minimize tax burdens, (3) to obscure financial weakness for strategic reasons, (4) to maximize executive compensation, and (5) to comply with regulations.

In the reminder of this section, we develop our research hypotheses.

[b] Source of data: U.S. Census Bureau (2012).

2.1. Hypothesis 1: the income-smoothing hypothesis

The income-smoothing hypothesis assumes that accounting data are managed to reduce the fluctuations of incomes around a 'normal' level (typically, normal income coincides with the average historical income). The income-smoothing hypothesis has been investigated in the insurance industry by various papers (e.g., Beaver, McNichols, and Nelson 2003; and Grace and Leverty, 2010, and 2011): if profitability is unexpectedly high (low), then the insurer will over- (under-) estimate its loss reserve to reduce (increase) current income. Various papers have also focused on the incentives for income smoothing in the insurance industry (Weiss, 1985; Grace, 1990; Grace and Leverty, 2010 and 2011). The first explanation is that insurers may aim to stabilize reported financial results and absorb economic shocks (Weiss, 1985). An alternative explanation is that insurers may have an incentive to select discretionary accounting practices that yield the highest rates of return with acceptable levels of earnings variability (Grace, 1990). Finally, insurers may also smooth income for purposes of regulatory requirements (Grace and Leverty, 2010 and 2011).

Following previous studies, we define the income-smoothing hypothesis tested in this paper as follows: Insurers under- (over-) estimate loss reserves when historical income is higher (lower) than current income (H_1).

2.2. Hypothesis 2: the tax-shield hypothesis

The tax-shield hypothesis has been proposed by Grace (1990), according to which insurer managers have incentives to minimize tax burdens, particularly when the income level is high. Thus, because the claim loss provision is tax deductible, insurers—particularly profitable insurers—have an incentive to overestimate the loss reserve to reduce their current tax liability.

The tax-shield hypothesis has been tested in the insurance industry by various papers (Gaver and Paterson, 1999; Nelson, 2000; Beaver, McNichols, and Nelson, 2003; Petroni, 1992; and Grace and Leverty, 2010, 2011), which have had mixed results[c].

Following these studies, we define the tax-shield hypothesis as follows: insurers overestimate loss reserves when current income is high (H_2).

2.3. Hypothesis 3: the financial-weakness hypothesis

Various papers (Petroni, 1992; Gaver and Paterson, 2004; and Grace and Leverty, 2011) support the financial-weakness hypothesis, according to which insurers under financial distress are more inclined to underestimate the loss reserve compared to other insurers. However, beginning from identical results, the explanations for the financial-weakness hypothesis are different. The first explanation focuses on the incentives of weak insurers to avoid regulatory intervention (Petroni, 1992; Gaver and Paterson, 2004; Grace and Leverty, 2011). The second explanation is that insurers with more substantial solvency problems caused by risk-insensitive guaranty funds have an incentive to under-report claim liabilities to show increased firm growth (Harrington and Danzon, 1994).

Following the previous studies, we define the financial-weakness hypothesis tested in this paper as follows: Insurers underestimate their loss reserve when their level of financial weakness is high (H_3).

2.4. Hypothesis 4: executive-compensation hypothesis

The executive-compensation hypothesis posits that managers manipulate accounting data to maximize their compensation. The effect of executive compensation contracts on accounting discretion choices in non-financial firms is one of the most thoroughly investigated areas of

[c] Grace and Leverty (2011) highlight that the evidence for the incentive to over-reserve for tax purposes depends on how the reserve manipulation is defined and the tax incentive is measured.

accounting research (Healy, 1985; Holthausen, Larcker, and Sloan, 1995; Gaver, Gaver, and Austin, 1995; and Bergstresser and Philippon, 2006).

Conversely, the executive-compensation hypothesis has been investigated only recently in the insurance industry (Browne, Ma, and Wang, 2009; Eckles and Halek, 2010; and Eckles et al., 2011). These papers find significant relationships between loss reserve manipulation and different components of managers' compensation, including salary, bonus payments, and awards of restricted stock and stock options. Moreover, they note that each component of compensation does not necessarily induce the same managerial behavior. Thus, managers who can transform positive short-term results into higher salaries in the following years have an incentive to under-estimate loss reserves (Eckles and Halek, 2010). Alternatively, managers with larger proportions of stock options and restricted stock awarded are more likely to overestimate loss reserves to shift firm value forward in the years to come when this long-term compensation is realized (Eckles and Halek, 2010 and Eckles et al., 2011). Finally, earnings management incentives created by bonuses are not straightforward and other components can induce either over- or under-reserving by managers based on their structure (Browne, Ma, and Wang, 2009; and Eckles and Halek, 2010).

Following previous studies we define the executive-compensation hypothesis as follows: Insurers over- (under-) estimate loss reserves to maximize their compensation (H_4). Moreover, we define the following three related sub-hypotheses:

Insurers whose managers have substantial performance-based salary arrangements have more incentive to under-estimate loss reserves (H_{4a}).

Insurers whose managers receive significant bonus payments are more likely to over- (under-) estimate loss reserves (H_{4b}).

Insurers whose managers are compensated by significant awards of stock options and restricted stock (i.e., stock-based compensation) are more likely to over-estimate loss reserves (H_{4c}).

2.5. Hypothesis 5: the regulation hypothesis

Several studies (Watts and Zimmerman, 1986; Jones, 1991; and Grace and Leverty, 2010) observe that regulation has a substantial influence on earnings management. In view of its importance, it is remarkable that only a limited number of papers have analyzed the negative impact of the SOA on earnings management (e.g., Cohen, Dey, and Lys, 2008 and Eckles et al., 2011). Following these papers and exploiting the idea that serious shareholder losses arise primarily from inflated earnings we define the fifth hypothesis as follows: the SOA plays a role in constraining the loss reserve underestimation (H_{5a}).

In addition, the enactment of the SOA might also have affected insurers' incentives for managing loss reserves. For example, Eckles et al. (2011) find weaker relations between reserve errors and executive compensation incentives after the enactment of the SOA. In attempting to explore such propositions, we define our second regulation-related hypothesis as follows: the SOA has changed the incentives under which insurers manage loss reserve (H_{5b}).

3. Data

Our sample included insurance companies selected according to the following criteria: 1) insurers must operate in the P&C sector, and we do not consider life and health insurance companies because data for gradual settlement of claims over time (the so-called "run-off triangle") are not available; 2) P&C insurers are listed on a U.S. stock exchange during the 1995-2005 period because data for reserve error calculations are not available before 1995 and after 2005; 3) insurers are based in the U.S. We must omit non-U.S. listed insurers that do not disclose data related to the run-off triangle. Overall, our sample consists of a balanced panel data of 54 insurers from 1995 through 2010 that represent 50% of the net written premiums[d] of the U.S. P&C industry.

Data are collected from the following sources: 1) information about loss development, consolidated balance sheets, consolidated statements of income, and consolidated statements of

[d] Specifically, insurers in our sample collected 217.6 dollar billion of net written premiums in 2005 (i.e., 50.9% the overall industry net written premiums). The data are consistent with the circumstances that the U.S. P&C insurance market is highly concentrated. Source of data: U.S. Census Bureau (2012). .

cash flow are obtained from applicable 10-K reports; 2) executive compensation data are obtained from DEF 14A forms; 3) financial market data are taken from Datastream; and 4) data on the U. S. P&C industry are collected from U.S. Census Bureau.

Definitions of variables are summarized in Table 1.

< INSERT TABLE 1 >

Table 2 presents descriptive statistics for insurer-specific variables, reserve error measures, and loss reserve manipulation incentives. The average value of total assets is nearly $25 billion, and the average value of net written premiums is approximately $2.8 billion (Panel A of Table 2). Similar to the prior literature (e.g., Beaver, McNichols, and Nelson, 2003; Gaver and Paterson, 2004; and Grace and Leverty, 2011), we find that the average insurer overestimates reserves.

< INSERT TABLE 2 >

Table A1 presents the descriptive statistics of the reserve error on an annual basis. The data reveal the existence of a relationship between the business cycle and the reserve error. The trend of the reserve error suggests that insurance companies are less likely to overestimate loss reserves during the peaks of the business cycle (2000-2001) and during recessions (2002), i.e., when it is difficult to meet expectations on earnings growth rates and when the effects of a crisis begin to affect a company's profitability. This evidence appears consistent with the income-smoothing hypothesis.

In the appendix, we present two tables that assess the correlation among variables used in the empirical analysis. Specifically, Table A2 reports the Pearson’s pair-wise correlation matrix between independent variables, which shows that multicollinearity among the incentives should not be a concern. Table A3 presents the correlations between smoothing indicators and risk measures:

we observe that *Smooth1* shows a high and significant correlation with the risk measures, whereas *Smooth2* reveals a significant correlation only with *PV* (however the coefficient is lower than that of *Smooth1*).

4. Variables

This section describes the variables we use in our analysis. Specifically, we describe our dependent variable (i.e., the reserve error) (Section 4.1), the independent variable (i.e., smooth indicators) (Section 4.2), the tax variable (Section 4.3), accounting-based and market-based estimates of insurers risk (Section 4.4), the executive compensation variables (Section 4.5), the regulation indicator (Section 4.6), and control variables (Section 4.7).

4.1 Reserve error

Following various papers (e.g., Weiss, 1985; Petroni, 1992; and Grace and Leverty, 2011), we measure the reserve error as the difference between the originally reported reserve and the 5-year cumulative developed losses as follows:

$$Error_{i,t}^{j} = ORLR_{i,t} - CPL_{i,t+j} \tag{1}$$

where i denotes an insurer (i = 1, 2, …, 54), t denotes a time period (t = 1995, 1996,…, 2005), j denotes a development time horizon (j = 5), *ORLR* is the originally reported loss reserve, and *CPL* is the cumulative paid losses after a given later period. Moreover, *Error* is scaled by total assets to reduce problems of heteroskedasticity.

4.2 Smooth indicators

The Smoothing incentive has traditionally been and measured (e.g., Weiss, 1985; Grace, 1990; Grace and Leverty, 2011) by the average ROA (Return on Assets) over the previous three years (*Smooth1*):

$$\text{Smooth1}_{\text{t}} = \frac{\sum_{t=1}^{3} ROA_t}{3} \tag{2}$$

However, this measure of income smoothing has certain drawbacks. First, it is not able to capture the smoothing effect because it does not compare current profitability with historical profitability. Second, we find this measure is highly correlated with insurers' risk indicators, which could bias results (see Table A.3). As such, we also measure the smoothing incentive as follows (*Smooth2*):

$$\text{Smooth2}_{\text{t}} = \frac{\sum_{t=1}^{3} ROA_t}{3} - ROA_t \tag{3}$$

This measure enables us to reduce the correlation with risk indicators and to better capture the smoothing effect alone. Because shareholders typically prefer a stable earnings trend, managers may have a strong incentive to underestimate the reserve error when earnings are lower than the historical profitability. Conversely, managers would overestimate the error reserve when earnings are higher than the average over the previous three years.

4.3 Tax variable

Following Grace (1990) and Grace and Leverty (2011), we measure the tax indicator (*Tax*) as follows:

$$\text{Tax}_{\text{t}} = \frac{(\text{NI}_{\text{t}} + \text{ORLR}_{\text{t}})}{\text{TA}_{\text{t}}} \tag{4}$$

where NI is the disclosed Net Income, ORLR is the Originally Reported Loss Reserve (as reported in the 10-K reports) and TA is the book value of total assets. This variable expresses the level of taxable income (as a percentage of assets) before the loss reserve is determined. Because overestimating the claim costs diminishes current taxable income, the amount of future claim losses are added back to taxable income to derive the decision variable. In particular, insurers should over-report future claim costs as taxable income increases; thus the sign of *Tax* is expected to be positive.

4.4 Accounting-based and market-based risk indicators

An insurer has been traditionally defined as "financially distressed" if there is more than one IRIS ratio outside the range considered acceptable by the NAIC (Petroni, 1992; Beaver, McNichols and Nelson, 2003; Gaver and Paterson, 2004). However, this approach has been criticized (Grace and Leverty, 2011) because it is based on a subjective assessment of the "NAIC acceptable range". Thus, we build a unique dataset that includes measures of insurer risk based on accounting information (*L*), and information about financial markets (*PV*, *VaR*, and *Beta*).

Following various studies (Saunders, Strock, and Travlos, 1990; and Carson and Hoyt, 1995 among others), we use Leverage (*L*) (i.e., 1- E/TA, where E/TA is measured as the ratio between the book value of total equity and the book value of total assets) because it is one of the simplest and most commonly used accounting risk measures. In addition, we use data from the financial markets to construct other measures of insurers' financial weakness, such as total risk, downside risk, and systematic risk. First, we calculate total risk[e] as the standard deviation of the insurer's daily stock returns (R_{it}) for each fiscal year (*PV*). The daily equity return is measured as the natural logarithmic of the ratio of the stock return series, i.e., $R_{it} = \ln(P_{it}/P_{it-1})$, where P_{it} is the stock price, which is also corrected for any capital adjustment, including dividends and stock splits. *PV* captures the overall variability in insurer stock returns and reflects the market's perceptions about the risks inherent in the firm's assets and liabilities.

Following various papers (e.g., Hopper, 1996; Johansson et al., 1999; Basak and Shapiro, 2001; Campbell et al., 2001; Gaivoronski and Pflug, 2004), we also measure the downside risk

[e] Following, among others, Saunders, Strock, and Travlos (1990), Anderson and Fraser (2000), and Pathan (2009).

through the *VaR*. First, we estimate daily stock returns' distribution for each fiscal year. Second, we rank daily stock returns from highest to lowest. Third, we estimate the VaR as the first value of the lowest 5% quantile of the daily returns distribution (i.e., the highest value of the "left tail" of the daily returns distribution)[f]. As shown by Ang, Chen, and Xing (2006), investors demand additional compensation for holding stocks with high sensitivities to downside market movements.

In the final version, we use the *Beta* - which is measured as the ratio between the *VaR* of insurer's stock and the *VaR* of the market index[g] - because it is able to capture systematic risk. Various papers (e.g., Lang and Stulz, 1992; Denis and Denis, 1995; Opler and Titman, 1994; Asquith et al., 1994; Altman 1993, Dichev, 1998; Vassalou and Xing, 2004; Campbell, Hilscher, and Szilagyi, 2008; Fiordelisi and Marques-Ibanez, 2013) have extensively investigated whether the default risk is systematic and have had mixed results.

4.5. Executive compensation variables

Each component of executive compensation affects management's behavior differently (Gaver, Gaver, and Austin, 1995; Cohen, Dey, and Lys, 2008; Bergstresser and Philippon, 2006; Eckles and Halek, 2010; Eckles et al., 2011). To assess a managers' use of accounting practices to pursue self-interest, we analyze the CEO's compensation by focusing on three components[h]: 1) change in salary; 2) bonus payments; and 3) awards of restricted stock and stock options (i.e., stock-based components).

Following Eckles and Halek (2010), we use change in salary (*S_Ch*), i.e., the ratio between a forthcoming change in salary ($S_{year\ t+1}$ - $S_{year\ t}$) and total compensation. Managers who expect an increase in salary from year *t* to year *t+1* have an incentive to underestimate the loss reserve reported in year *t*.

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[f] The VaR has a negative value, but we change its sign to compare it to other risk measures.
[g] In this study, we use the S&P 500 Index.
[h] We do not include long-term incentive plans because insurance managers in our sample receive this type of remuneration in only a few cases.

Following Eckles et al. (2011), we also use *BP,* i.e., the ratio between the bonus payments and total compensation. Bonus payments can be considered as a way to align the interests of managers to the interests of shareholders; however, they can simultaneously encourage a manager to manipulate the loss reserve. Specifically, managers might engage in under-reserving to receive bonus payments; however, if they have exhausted compensation from bonus plans, they might overestimate the loss reserve to shift earnings to the future (Eckles et al., 2011). Therefore, the relationship between *BP* and the reserve error in year *t* is difficult to predict.

Contrary to Eckles and Halek (2010) and Eckles et al. (2011), we sum the values of the restricted stock and stock options awarded as a percentage of total compensation (*St&Opt*) because both these components are long-term incentives and should affect the loss reserve evaluation in the same manner. As such, both stocks awarded and stock options granted may represent a rationale for overestimating the loss reserve in year *t* and improving a firm's future profitability; by increasing both the probability to exercise stock options and the opportunity to sell restricted stock, managers may over-estimate the loss reserve.

4.6 Regulation variable

Various papers (Cohen, Dey, and Lys, 2008; Iliev, 2010; Eckles et al., 2011) provide evidence for the role of the SOA in constraining earnings management. Accordingly, and to test the impact of the SOA on P&C insurers' reserve errors, we use a dummy (*SOA*) that assumes the value of 1 for the years after the SOA had become effective (i.e., the year 2002 and onward) and 0 otherwise.

4.7 Control variables

Previous papers have noted that reserve errors may also derive from insurer managers' mistakes (i.e., non-discretionary component) related to the difficulty of estimating the loss reserve (e.g., Weiss, 1985; Grace, 1989). As such, the incentives for managing the loss reserve cannot be accurately isolated without controlling for non-discretionary component. Whereas several studies (e.g., Grace and Leverty, 2010) have tried to capture this component by controlling for a set of variables at the firm and macroeconomic level, we use a variable at the industry level that measures unexpected motor vehicle accidents over a development time horizon of a loss reserve (*UA*). This variable is calculated as follows:

$$\mathrm{UA}_t = \sum_{j=t+1}^{t+5} MA_j - \sum_{k=t}^{t+4} MA_k * (1+g) \tag{5}$$

where t denotes a time period (t = 1995, 1996,…, 2005), *MA* is the number of motor vehicle accidents and g represents the growth rate of accidents between t-1 and t-2.

Because the automobile business is highly representative of the entire US P&C insurance, e.g., in 2005, it represents 43.6% of the overall industry net premiums written, we recognize that this variable is able to capture the non-discretionary component at the industry level.

Furthermore, we define a set of control variables at the firm level to account for managerial ability to exercise discretion over reserves.

The first control variable is the longtail ratio (*LR*) because prior research finds that insurers underwriting long-tail lines of business have more discretion over their reserves (e.g., Petroni and Beasley, 1996; Beaver, McNichols, and Nelson, 2003; Browne, Ma, and Wang, 2009; Grace and Leverty, 2011). Following Browne, Ma, and Wang (2009), the long tail ratio is defined as the percentage of net written premiums from longtail lines (such as workers' compensation, medical malpractice, general liability, auto liability, etc.) over total net written premiums.

Our second type of control variable accounts for differences in efficiency. As such, we use a combined ratio (*CR*) - the sum of the loss ratio and the expense ratio - that describes the level of efficiency in the extensive claim settlement process. As initially reported by Weiss (1985), when the underwriting process shows low efficiency, insurers have an incentive to overestimate the loss reserve to increase the level of premiums.

5. Methodology

We specify a linear model to investigate the determining factors of reserve error as found in the established empirical literature on loss reserve manipulation (e.g., Beaver, McNichols, and Nelson 2003; Grace and Leverty, 2010). We estimate the Eq. (6) using OLS, where reserve error is a function of various corporate and personal goals, a regulation intensity indicator, and insurer-specific variables:

$$
\begin{aligned}
Error_{i,t} &= \alpha + \beta_1 SOA_t + \beta_2 Smooth_{i,t} + \beta_3 Tax_{i,t} + \beta_4 Risk_{i,t} + \\
&\beta_5 S\_Ch_{i,t} + \beta_6 BP_{i,t} + \beta_7 St\,\&\,Opt_{i,t} + \beta_8 UA_t + \beta_9 LR_{i,t} + \beta_{10} CR_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{6}
$$

where *i* denotes an insurer (*i* = 1, 2, …, 54), *Error* reports the difference between the originally reported reserve and the cumulative developed losses paid after 5 years[i]; *SOA* is a dummy variable accounting for the coming into force of the SOA; *Smooth* denotes one of the two smoothing indicators (*Smooth1* and *Smooth2*); *Tax* is a variable accounting for tax burden; *Risk* denotes one of the four risk measures (*PV*, *VaR*, *L* or *Beta*); *S_Ch* measures the forthcoming change in salary; *BP* takes into account the level of bonus payments; *St&Opt* is a measure of restricted stock and stock options awarded; *LR* is a measure of longtail business; *CR* is a measure of efficiency; and ε is the random error term. The variable definitions are summarized in Table 1.

Because *SOA* could affect the structure of incentives and the reserve error, we add the moderating effects of SOA on corporate and personal goals to Eq. (6) as shown in Eq. (7):

$$
\begin{aligned}
Error_{i,t} &= \alpha + \beta_1 SOA_t + \beta_2 Smooth_{i,t} + \beta_3 Tax_{i,t} + \beta_4 Risk_{i,t} + \beta_5 S\_Ch_{i,t} + \beta_6 BP_{i,t} + \\
&+ \beta_7 St\,\&\,Opt_{i,t} + \beta_8 Smooth_{i,t} * SOA_t + \beta_9 Tax_{i,t} * SOA_t + \beta_{10} Risk_{i,t} * SOA_t + \\
&+ \beta_{11} S\_Ch_{i,t} * SOA_t + \beta_{12} BP_{i,t} * SOA_t + \beta_{13} St\,\&\,Opt_{i,t} * SOA_t + \beta_{14} UA_t + \beta_{15} LR_{i,t} + \beta_{16} CR_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{7}
$$

where the other variables have the same specification as in Eq. (6).

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[i] The reserve errors are scaled by total assets to mitigate the heteroskedasticity issue.

We estimate Eq. (6) and Eq. (7) using OLS[j]. However, we are aware that various problems arise in the estimation of such a model. First, the reserve error distribution might be non-normal[k]. Second, the incentives for managing loss reserves may be different across reserve error levels. Therefore, following previous studies (e.g., Grace and Leverty, 2010), we also use a multilevel quantile regression that allows for full characterization of the conditional distribution of the reserve error and can offer a richer description of the heterogeneous relations among incentives and reserve error. This approach, which is a generalization of median regression analysis (Koenker and Bassett, 1978), allows us to derive different parameter estimates for various conditional quantiles of the reserve error distribution.

Thus, the quantile regression model can be written as:

$$Error_i = \alpha_\tau + \beta_\tau x_i + e_{\tau,i} \text{ with } Quant_\tau(Error_i | x_i) = \beta_\tau x_i \quad (8)$$

where x_i is the vector of incentives and control variables[l] and β_τ is the vector of parameters. $Quant_\tau(Error_i | x_i)$ denotes the τ_{th} conditional quantile of *Error* given x[m].

6. Empirical Results

Table 3 reports the results obtained from estimating Eq. (6) with OLS. This table shows eight columns because we use two different indicators (i.e., *Smooth1* and *Smooth2*) to test the income-smoothing hypothesis and include accounting-based (*L*) and market-based measures (*PV*, *VaR*, *Beta*) to test the financial-weakness hypothesis[n].

Various factors are found to be significant determinants of loss reserve manipulation. Beginning from corporate goals, *Tax* exhibits positive and significant coefficients, which confirms

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[j] These models utilize White's standard errors to effectively address any concerns related to modest departures from normality.
[k] Unlike other studies (e.g., Grace and Leverty, 2010), we find a very low skewness for reserve error distribution (see Table 2). However, this condition is not sufficient to accept the hypothesis that reserve error is normally distributed.
[l] x_i may affect other features of the conditional distribution of Y|X in addition to the location (i.e., the mean), and those features may be of interest to this study.
[m] The τ_{th} regression quantile is defined as one of the possible solutions of this problem of minimization (Koencker and Basset, 1978): $\min \sum_i \rho_\tau (Error_i - x_i \beta_\tau)$, where $\rho_\tau(\varepsilon)$ is the check function defined as $\rho_\tau(\varepsilon)=(\tau-1)\varepsilon$ if $\varepsilon<0$ or $\rho_\tau(\varepsilon)=\tau\varepsilon$ if $\varepsilon \geq 0$. To solve this problem we use the bootstrapping method. The Least Absolute Deviation (LAD) estimator of β is obtained by setting τ=0.10, 0.25, 0.50, 0.75, 0.90.
[n] The regression Eq. (6) is well fitted and shows an overall R^2 that is always higher than the threshold of 35 percent: the goodness of fit of the model increases when we replace the traditional smoothing indicator (*Smooth1*) with our smoothing variable (*Smooth2*).

the prediction that the incentive to overestimate the loss reserve is higher when there is a greater potential for tax savings (Grace, 1990; Grace and Leverty, 2011). In addition, both income-smoothing indicators are negatively and significantly related to reserve error, which suggests that insurers manage the loss reserve in an attempt to stabilize earnings (Weiss, 1985; Grace, 1990; Browne, Ma, and Wang, 2009; Grace and Leverty, 2011). Considering the goals related to financial weakness, all risk measures (i.e., *PV*, *VaR*, *Beta*, and *L*) have the predicted sign. This indicates that financially weak insurers are more likely to underestimate their loss reserves, which is consistent with previous studies (Petroni, 1992; Gaver and Paterson, 2004; Grace and Leverty, 2011).

Regarding personal goals, we report that managers who derive a large portion of total compensation from stocks and options awarded (*St&Opt*) are more inclined to overestimate the loss reserves in an attempt to shift earnings into the future when the restricted stock will be sold and stock options exercised. Moreover, we find evidence (albeit not robust evidence) that the other compensation components, i.e., bonus and salary change, predict reserve errors.

As opposed to previous papers that investigate corporate goals without controlling for personal goals (among other Grace and Leverty, 2011) or *vice versa* (e.g., Eckles and Halek, 2010) we find that personal and corporate goals complement one another: insurance managers manipulate the loss reserve to both maximize their stock option remuneration and to achieve corporate goals, particularly incentives that arise from alleviating tax burdens and obscuring financial weakness. Our results advance previous papers (e.g., Eckles et al., 2011) by suggesting that the achievement of corporate goals is an intermediate step toward increasing managerial compensation through stock options. In this way we provide evidence that compensation based on restricted stock awards and stock options are effective in aligning shareholder goals with those of managers because they create an incentive for managers to maximize the value of their firm’s stock. This result is somewhat unexpected: in recent years, awarding stock-based compensation to firms’ managers has been criticized (e.g., Denis, Hanouna and Sarin, 2006 and Goldman and Slezak, 2006) for encouraging financial fraud and increasing incentives for managers to pursue short-term goals, which is expected to occur at the expense of firm's long-term performance.

With reference to the regulation hypothesis, we find that the SOA has played a role in reducing the loss reserve underestimation, although our data only include four years in which the SOA was in effect. This result has important implications because most stakeholders do not perform adequate checks on the accuracy of loss reserve estimates and inadequate reserves (i.e., underestimated reserve) can create problems for insurers long-term financial health.

Because the SOA might affect the reasons for managing the loss reserve, we add the moderating effects of the SOA on corporate and personal goals as shown in Eq. (7) (Table 4). Thus, our model increases its explanatory power even if the effects of various incentives on reserve errors remain substantially unchanged. In addition, we find that interactions between *SOA* and risk measures display a positive statistical link with reserve errors, whereas *St&Opt*SOA* shows a negative and significant coefficient. Because the other interactions are not significant, our results provide evidence that managers appear less inclined to manipulate the loss reserve when they are in a state of financial weakness and to maximize their personal goals after enactment of the SOA.

Therefore, a second notable result of this study is that we extend the research of Eckles et al. (2011) that finds weaker relations between reserve errors and executive compensation incentives after enactment of the SOA.

Finally, our results are robust while controlling for a non-discretionary component (i.e., *UA*) and for managerial ability to exercise discretion over loss reserves (i.e., *LR* and *CR*).

Following Grace and Leverty (2010), we also use a quantile regression to provide an effective method of describing how the incentives for managing loss reserves may change across different levels of reserve errors (i.e., corporate and personal goals do not have a uniform effect on reserve errors).

As shown in Tables 5 and 6, the results appear consistent with those of the OLS regressions; however, there are certain differences across the percentiles of the distribution that offer crucial additional information. Beginning with *Tax*, its coefficient is statistically significant in all percentiles, but Wald tests show that OLS overestimates the impact of tax incentives at the lower tail and underestimates it at the upper tail of the distribution. This evidence is not surprising because insurers that underestimate loss reserves should not be driven by tax incentives.

Also with reference to *Risk* (e.g., *PV*), the conditional distribution provides certain interesting snapshots of the relationship between the reserve error and the financial weakness indicator. In particular, *Risk* exhibits a coefficient that is almost always significant but more pronounced in the lower tails (see for example *Columns 2*, and *3* in *Table 6*), as confirmed by the Wald tests. However, this evidence is consistent with the financial weakness hypothesis, i.e., weaker insurers (in the lower tails of conditional distribution) are more inclined to underestimate the loss reserve compared to other insurers (in the upper tails of the same distribution). Personal goals - particularly those captured by *St&Opt* - seem to produce the greatest effect on the central quantiles than on other quantiles. This might indicate that personal goals play a role in managing loss reserves particularly when the incentives related to corporate goals (i.e., those captured by *Tax* and *Risk*) produce a moderated impact. Finally, with reference to interactions, the quantile regression seems to confirm that the enactment of the SOA affected the reasons why insurers manage loss reserves (see, for example, *Column* 3 of Table 6 with reference to the interaction between *Risk* and *SOA*).

Therefore, a third notable result of this study is that we support the results of Grace and Leverty (2011) by observing that the incentives for managing the loss reserve are different across reserve error levels.

Robustness checks

To further confirm the findings of the OLS and quantile regressions, we perform a number of robustness checks. First, because we find that reserve errors are positively serially correlated (which is consistent with previous studies, such as Beaver and McNichols, 1998 and Grace and Leverty,

2010) we also estimate OLS with one, two, and three lagged values of the dependent variable in an attempt to account for the autoregressive process in the data regarding the behavior of reserve error. The unreported results obtained are similar to those reported in Tables 3 and 4.

Second, to address the possible simultaneity endogeneity issues (e.g., reserve estimations influence both Return on Asset (ROA) (related to the income-smoothing and executive-compensation variables) and to net income (related to the tax variable), we use OLS with one lagged value of the regressors with potential endogeneity problems (i.e., *Tax*, Smoothing indicators and *BP*). Once again, the unreported results of these regressions are qualitatively similar to the reported OLS results (Tables 3 and 4).

7. Conclusions

This study analyses the determinants of insurers' reserve errors for a sample of U.S. listed P&C insurance companies between 1995 and 2005. Whereas there is extensive literature that focuses on various factors that affect insurers' loss reserve manipulation, there are no papers that analyze whether there are trade-offs between managerial (personal) and corporate goals. Therefore, we use OLS models to investigate the reserve error as a linear function of various corporate and personal goals, a regulation intensity indicator, insurer-specific variables, and multilevel quantile regressions to analyze how the incentives for managing loss reserves may change across different reserve error levels.

We find that personal and corporate goals complement one another: insurance managers manipulate the loss reserve both to maximize their stock option remuneration and to achieve corporate goals, particularly with respect to alleviating tax burdens and obscuring financial weakness. In so doing, we provide evidence that stock-based compensation is an effective instrument to align shareholder goals with those of managers.

Finally, we find that the enactment of the SOA has reduced the inclination of firms to underestimate loss reserves and changed the structure of reserve error incentives; in particular, insurers appear less inclined after enactment of the SOA to manage their loss reserves when they are in a state of financial distress to pursue personal goals. These results bring added value to previous research (e.g., Eckles et al., 2001) that simply observes weaker relationships between reserve error and various executive compensation incentives after the enactment of the SOA.

Our results are resilient to robustness tests performed to check for autoregressive and endogeneity concerns.

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Table 1- Description of variables

Variables	**Symbol**	**Description**
Reserve error	Error	Difference between the originally reported reserve[a] and the 5-year cumulative developed losses[a]
Traditional smoothing indicator	Smooth 1	Average ROA over the previous three years[a]
New smoothing indicator	Smooth 2	The average ROA over the previous three years[a] minus ROA for the current year
Tax indicator	Tax	Sum of disclosed net income and estimated error reserve divided by total assets[a]
Leverage	L	1 minus the ratio between book value of total equity and book value of total assets[a]
Price volatility	PV	Standard deviation of insurer's daily stock returns (R_{it}) for each fiscal year[b]
VaR	VaR	First value of the lowest 5% quantile of the daily returns distribution[b]
BetaVaR	Beta	*VaR* of insurer's stock divided by *VaR* of the market index[b]
Change in Salary	S_Ch	Forthcoming change in salary ($S_{year\ t+1}$ - $S_{year\ t}$) divided by total compensation[c]
Bonus payments	BP	Bonus payments divided total compensation[c]
Stock and stock options awarded	St&Opt	Sum of the values of restricted stock and stock options awarded, divided by total compensation[c]
Unexpected accidents	UA	Difference between the sum of motor vehicle accidents between t+1 and t+5 and the sum of expected motor vehicle accidents between t+1 and t+5 estimated on the basis of the accidents growth rate between t-1 and t-2[d]
Longtail ratio	LR	Net written premiums from longtail lines divided by total net written premiums[a]
Combined ratio	CR	Sum of the loss ratio (loss divided by gross written premiums) and the expense ratio (expenses divided by gross written premiums)[a]
SOA	SOA	SOA assumes the value of 0 for the years before the coming into force of the SOA (Sarbanes-Oxley Act 30 July 2002)

[a] Source of data: 10-K reports
[b] Source of data: Datastream
[c] Source of data: Def 14_A reports
[d] Source of data: U.S, Census Bureau

Table 2. Descriptive statistics of the sample companies

Variables:	Mean	Standard deviation	Minimun	Median	Maximum	Skewness	Kurtosis	Observation
Panel A: Insurer-specific variables:								
TA (billion)	24.7	80.2	0.025	2.41	853	6.4829	54.1502	543
CR	95.1902	26.049	0	100	172.6	-2.5263	10.5304	592
LR	0.5748	0.3772	0	0.6719	1	-0.3763	1.6194	592
Panel B: Dependent variable:								
Error	0.0605	0.0739	-0.2779	0.0493	0.3297	-0.0059	4.7759	529
Panel C: Loss reserve manipulation incentives								
Smooth $_1$	0.0326	0.0311	-0.0863	0.0294	0.2034	0.78854	7.1479	412
Smooth $_2$	0.0090	0.0453	-0.2166	0.0086	0.1799	-0.4432	5.8385	482
Tax	0.2983	0.1441	0.0089	0.2911	0.8882	0.4114	3.2401	540
Risk	0.0097	0.0061	0.0035	0.0085	0.0856	5.7661	61.9904	425
S_Ch	0.0191	0.1698	-0.5973	0.0069	3.0950	13.9914	254.4932	428
BP	0.1927	0.1726	0	0.1635	0.7652	0.6844	2.6585	478
St&Opt	0.2985	0.2814	0	0.2614	1	0.4322	1.9071	479

This table presents the distribution of variables by showing mean, standard deviation, minimum, median, skewness, kurtosis and the number of observations. *TA* is the total asset at fiscal year-end (billions of dollar). *LR* is the weight of premiums written in longtail business as percentage of total premiums written. *CR* is the sum of loss ratio and expense ratio calculated on GAAP basis. *Error* is the difference between the originally reported reserve and the cumulative developed losses paid after five years. *Smooth* $_1$ is the previous three year's average ROA. *Smooth* $_2$ is the difference between the previous three year's average ROA and the ROA for the current fiscal year. *Tax* is the ratio between the sum of net income and the estimated reserve and total asset. *Risk* is the annualized standard deviation of the daily stock returns. *S_ch* is the ratio between the forthcoming change in salary and the total compensation. *BP* is the amount of bonus as percentage of total compensation. *St&Opt* is the sum of stock awarded value and option granted value as percentage of total compensation.

Table 3. Results from OLS Regression (Eq. (6))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SOA	0.0121*	0.0126*	0.0154*	0.0101*	0.0157**	0.0158**	0.0176***	0.0121**
	(1.73)	(1.78)	(2.20)	(1.54)	(2.45)	(2.47)	(2.71)	(2.01)
Smooth1	-0.2766**	-0.2674**	-0.2629**	-0.3314**				
	(-2.17)	(-2.08)	(-2.01)	(-2.42)				
Smooth2					-0.1814**	-0.1816**	-0.1964**	-0.1293
					(-2.02)	(-2.01)	(-2.14)	(-1.55)
Tax	0.2251***	0.2259***	0.2268***	0.2295***	0.2354***	0.2360***	0.2370***	0.2479***
	(9.07)	(9.02)	(8.93)	(9.83)	(10.15)	(10.18)	(10.10)	(11.27)
PV	-1.3329*				-1.3198*			
	(-1.72)				(-1.79)			
VaR		-0.7830*				-0.7991*		
		(-1.66)				(-1.78)		
Beta			-0.0058*				-0.0051*	
			(-1.95)				(-1.90)	
L				-0.0487*				0.0123
				(-1.79)				(0.57)
S_Ch	-0.0284	-0.0299	-0.0289	0.0043	-0.0500	-0.0494	-0.0461	0.0060
	(-0.73)	(-0.75)	(-0.73)	(0.42)	(-1.41)	(-1.39)	(-1.32)	(0.52)
BP	0.0379	0.0385	0.0390	0.0408*	0.0326	0.0340	0.0367	0.0356*
	(1.58)	(1.60)	(1.62)	(1.98)	(1.34)	(1.40)	(1.49)	(1.68)
St&Opt	0.0293**	0.0292**	0.0290**	0.0299***	0.0341***	0.0344***	0.0349***	0.0311***
	(2.44)	(2.42)	(2.40)	(2.61)	(2.99)	(3.01)	(3.00)	(2.99)
UA	0.0001*	0.0001*	0.0001**	0.0001**	0.0001	0.0001*	0.0001**	0.0001**
	(1.67)	(1.73)	(2.48)	(2.26)	(1.58)	(1.66)	(2.37)	(2.19)
LR	0.0195**	0.0193**	0.0188**	0.0240***	0.0227***	0.0229***	0.0225***	0.0293***

	(2.28)	(2.25)	(2.18)	(2.94)	(2.65)	(2.66)	(2.61)	(3.90)
CR	-0.0003	-0.0003	-0.0003	-0.0002	0.0003	0.0003	0.0002	0.0001
	(-1.33)	(-1.37)	(-1.50)	(-1.09)	(1.27)	(1.31)	(1.21)	(0.64)
Intercept	0.0097	0.0079	0.0100	0.0254	-0.0609**	-0.0642**	-0.0647***	-0.0759***
	(0.35)	(0.28)	(0.36)	(0.77)	(-2.33)	(-2.52)	(-2.61)	(-2.94)
N. obs.	289	289	289	337	327	327	327	383
Adj R^2	0.3622	0.3579	0.3548	0.3635	0.3934	0.3902	0.3848	0.3841

See Table 1 for variable definitions. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

Table 4. Results from OLS Regression (Eq. (7))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SOA	0.0021	0.0058	0.0102	-0.0185	0.0133	0.0185	0.0310	0.0671*
	(0.09)	(0.24)	(0.42)	(-0.34)	(0.61)	(0.87)	(1.42)	(1.67)
Smooth1	-0.2992*	-0.3143*	-0.3138*	-0.4835**				
	(-1.84)	(-1.87)	(-1.86)	(-2.45)				
Smooth2					-0.1159	-0.1400	-0.2027*	-0.1689
					(-1.08)	(-1.29)	(-1.85)	(-1.61)
Tax	0.2202***	0.2225***	0.2259***	0.2316***	0.2351***	0.2354***	0.2406***	0.2575***
	(7.04)	(7.04)	(7.02)	(7.43)	(8.60)	(8.59)	(8.57)	(9.51)
PV	-3.8239***				-3.7918***			
	(-3.02)				(-3.54)			
VaR		-2.2219***				-2.1783***		
		(-2.77)				(-3.33)		
Beta			-0.0179**				-0.0132***	
			(-2.58)				(-2.63)	
L				-0.0619*				0.0260
				(-1.91)				(0.95)
S_Ch	-0.0230	-0.0273	-0.0281	0.0033	-0.0264	-0.0310	-0.0339	0.0079
	(-0.62)	(-0.73)	(-0.73)	(0.30)	(-0.67)	(-0.78)	(-0.85)	(0.63)
BP	0.0733**	0.0730**	0.0744**	0.0635**	0.0536	0.0552	0.0622*	0.0534*
	(2.08)	(2.02)	(2.06)	(2.02)	(1.52)	(1.55)	(1.74)	(1.66)
St&Opt	0.0437***	0.0430***	0.0434***	0.0433***	0.0495***	0.0495***	0.0499***	0.0433***
	(2.79)	(2.75)	(2.77)	(2.94)	(3.42)	(3.43)	(3.33)	(3.16)
UA	0.0001**	0.0001**	0.0001***	0.0001**	0.0001*	0.0001**	0.0001**	0.0001**
	(2.10)	(2.17)	(2.65)	(2.35)	(1.90)	(2.04)	(2.58)	(2.37)
LR	0.0212**	0.0213**	0.0207**	0.0262***	0.0219**	0.0228***	0.0227**	0.0299***
	(2.52)	(2.53)	(2.44)	(3.28)	(2.53)	(2.64)	(2.60)	(4.00)

CR	-0.0001	-0.0002	-0.0002	-0.0003	0.0003	0.0003	0.0003	0.0001
	(-0.56)	(-0.79)	(-1.00)	(-1.12)	(1.25)	(1.48)	(1.39)	(0.68)
Smooth1 * SOA	0.1592	0.1924	0.1880	0.4220				
	(0.66)	(0.80)	(0.76)	(1.58)				
Smooth2 * SOA					0.0053	0.0345	0.0955	0.1456
					(0.03)	(0.19)	(0.51)	(0.87)
Tax * SOA	0.0010	-0.0014	-0.0045	0.0029	-0.0152	-0.0157	-0.0208	-0.0265
	(0.02)	(-0.03)	(-0.09)	(0.06)	(-0.34)	(-0.35)	(-0.45)	(-0.63)
PV * SOA	3.1621**				3.1960***			
	(2.24)				(2.65)			
VaR * SOA		-1.8651**				-1.8336**		
		(-2.07)				(-2.49)		
Beta * SOA			0.0150*				0.0103*	
			(1.96)				(1.79)	
L * SOA				0.0494				-0.0351
				(0.81)				(-0.80)
S_Ch * SOA	-0.0094	-0.0024	-0.0007	0.0128	-0.0269	-0.0207	-0.0152	-0.0139
	(-0.08)	(-0.02)	(-0.01)	(0.15)	(-0.31)	(-0.24)	(-0.18)	(-0.20)
BP * SOA	-0.0731	-0.0726	-0.0751	-0.0523	-0.0539	-0.0534	-0.0611	-0.0391
	(-1.58)	(-1.55)	(-1.61)	(-1.25)	(-1.19)	(-1.17)	(-1.33)	(-0.96)
St&Opt * SOA	-0.0375	-0.0369	-0.0384*	-0.0384*	-0.0432**	-0.0423**	-0.0433**	-0.0367*
	(-1.60)	(-1.56)	(-1.65)	(-1.72)	(-2.03)	(-1.98)	(-2.01)	(-1.83)
Intercept	0.0098	0.0089	0.0116	0.0329	-0.0437	-0.0554**	-0.0639**	-0.0971***
	(0.34)	(0.31)	(0.40)	(0.84)	(-1.50)	(-2.07)	(-2.31)	(-3.16)
N. obs.	289	289	289	337	327	327	327	383
Adj R^2	0.3966	0.3880	0.3832	0.3751	0.4279	0.4200	0.4075	0.3944

See Table 1 for variable definitions. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

Table 5. Results from OLS (Eq. (7)) and Quantile Regression (Eq. (8))

	OLS	Quantile regression (Quantiles)					Wald test F Statistics		
		0.10	0.25	0.50	0.75	0.90	All equal	0.25=0.75	0.10=0.90
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SOA	0.0021	-0.0038	-0.0047	0.0107	0.0247	0.0049	0.39	0.79	0.03
	(0.09)	(-0.10)	(-0.29)	(0.38)	(1.02)	(0.17)			
Smooth1	-0.2992*	-0.3786	-0.3916**	-0.0517	-0.0263	-0.0573	0.94	3.58	0.81
	(-1.84)	(-0.86)	(-2.22)	(-0.31)	(-0.15)	(-0.25)			
Tax	0.2202***	0.1500*	0.1732***	0.2152***	0.2798***	0.2850***	3.28*	7.11*	2.86
	(7.04)	(1.87)	(3.95)	(7.51)	(6.78)	(5.25)			
Risk	-3.8239***	-6.0688**	-4.5236***	-3.2732***	-1.8241**	-2.3789***	1.22	4.08**	1.20
	(-3.02)	(-2.17)	(-3.26)	(-3.01)	(-2.13)	(-2.87)			
S_Ch	-0.0230	-0.0038	0.0238	-0.0080	0.0375	-0.0157	0.33	0.02	0.00
	(-0.62)	(-0.05)	(0.82)	(-0.16)	(0.46)	(-0.19)			
BP	0.0733**	0.0428	0.0377	0.0821**	0.0825***	0.0828**	0.34	0.96	0.42
	(2.08)	(0.93)	(0.87)	(1.98)	(3.04)	(2.35)			
St&Opt	0.0437***	0.0492*	0.0362*	0.0555***	0.0233**	0.0167	1.35	0.26	0.75
	(2.79)	(1.65)	(1.65)	(4.12)	(1.41)	(0.91)			
UA	0.0001**	0.0001	0.0001	0.0001***	0.0001	0.0001	0.45	0.14	0.02
	(2.10)	(0.42)	(0.82)	(2.65)	(1.37)	(0.84)			
LR	0.0212**	-0.0197**	0.0059	0.0301***	0.0384***	0.0442***	4.94***	7.16*	8.58**
	(2.52)	(-1.18)	(0.57)	(3.16)	(4.25)	(3.56)			
CR	-0.0001	-0.0002	0.0002	-0.0001	0.0002	0.0001	1.63	0.00	0.19
	(-0.56)	(-0.32)	(0.83)	(-0.39)	(0.88)	(0.46)			
Smooth1 * SOA	0.1592	-0.5235	-0.1495	0.01054	0.0332	0.2134	0.45	0.32	1.25
	(0.66)	(-0.86)	(-0.42)	(0.47)	(0.17)	(0.75)			
Tax * SOA	0.0010	-0.0001	0.0298	0.0593	0.0045	0.0432	0.45	0.10	0.21
	(0.02)	(-0.00)	(0.44)	(1.26)	(0.09)	(0.62)			
Risk * SOA	3.1621**	2.9528	2.2734	3.0776*	1.1947	1.5072	0.27	0.26	0.16
	(2.24)	(0.96)	(1.20)	(1.82)	(1.00)	(1.12)			
S_Ch * SOA	-0.0094	0.0334	-0.0654	-0.2909*	-0.1946	0.0299	1.49	0.46	0.04
	(-0.08)	(0.23)	(-0.38)	(-1.78)	(-1.05)	(-0.19)			
BP * SOA	-0.0731	-0.0201	-0.0351	-0.0996**	-0.1004**	-0.1100***	0.45	1.01	0.80
	(-1.58)	(-0.32)	(-0.49)	(-2.01)	(-2.29)	(-2.90)			
St&Opt * SOA	-0.0375	-0.0310	-0.0199	-0.0435**	-0.0214	-0.0188	0.61	0.00	0.07
	(-1.60)	(-0.60)	(-0.95)	(-2.15)	(-0.82)	(-0.75)			
Intercept	0.0098	0.0402	-0.0118	-0.0183	-0.0468	-0.0147	1.29	0.46	0.39

	(0.034)	(0.58)	(-0.32)	(-0.58)	(-1.49)	(-0.46)
N. obs.	289	289	289	289	289	289
R^2	0.3966	0.1321	0.1730	0.2994	0.3656	0.4183

Risk is standard deviation of insurer's daily stock returns for each fiscal year. See Table 1 for other variable definitions. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

Table 6. Results from OLS (Eq. (7)) and Quantile Regression (Eq. (8))

	OLS	Quantile regression (Quantiles)					Wald test F Statistics		
		0.10	0.25	0.50	0.75	0.90	All equal	0.25=0.75	0.10=0.90
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SOA	0.0133	-0.0184	-0.0341	0.0060	0.0247	0.0133	1.29	4.43*	0.77
	(0.61)	(-0.48)	(-0.94)	(0.15)	(0.99)	(0.44)			
Smooth2	-0.1159	-0.0948	-0.1227	-0.1385	-0.0621	0.0676	0.46	0.14	0.49
	(-1.08)	(-0.56)	(-0.77)	(-0.75)	(-0.34)	(0.38)			
Tax	0.2351***	0.0914	0.1689***	0.2202***	0.3013***	0.3432***	5.71***	9.70***	7.64***
	(8.60)	(1.32)	(4.28)	(10.63)	(12.41)	(5.35)			
Risk	-3.7918***	-7.0040**	-5.8102***	-2.5251	-2.1001*	-2.4875*	1.66	5.33**	1.77
	(-3.54)	(-2.57)	(-2.86)	(-1.49)	(-1.66)	(-1.69)			
S_Ch	-0.0264	0.0494	0.0267	-0.0521	0.0281	0.0460	0.39	0.00	0.00
	(-0.67)	(0.57)	(0.52)	(-0.77)	(0.45)	(0.44)			
BP	0.0536	-0.0276	0.0177	0.0930*	0.0975***	0.0412	2.43*	5.25**	1.52
	(1.52)	(-0.57)	(0.39)	(1.81)	(3.42)	(1.07)			
St&Opt	0.0495***	0.0441	0.0335	0.0525***	0.0368**	0.0290	0.67	0.02	0.19
	(3.42)	(1.38)	(1.36)	(3.21)	(2.32)	(1.41)			
UA	0.0001*	0.0001	0.0001*	0.0001*	0.0001*	0.0001	1.89	0.39	0.02
	(1.90)	(0.34)	(1.73)	(1.65)	(1.90)	(0.22)			
LR	0.0219**	0.0003	0.0146	0.0290***	0.0309***	0.0460***	1.46	2.38	4.55**
	(2.53)	(0.02)	(1.46)	(2.61)	(4.07)	(3.25)			
CR	0.0003	0.0003	0.0006*	0.0001	0.0002	0.0001	1.54	1.05	0.46
	(1.25)	(0.90)	(1.70)	(0.41)	(1.16)	(0.11)			
Smooth2 * SOA	0.0053	0.0482	0.2693	0.1932	0.1142	-0.1558	0.88	0.46	0.21
	(0.03)	(0.14)	(1.09)	(0.91)	(0.65)	(-0.66)			
Tax * SOA	-0.0152	-0.0169	-0.0019	0.0666	0.0037	-0.0255	0.77	0.01	0.01
	(-0.34)	(-0.19)	(-0.04)	(1.46)	(0.09)	(-0.37)			
Risk * SOA	3.1960**	4.4825	5.7354**	2.3583	1.5495	1.4907	2.10	5.66**	0.57
	(2.65)	(1.36)	(2.28)	(0.98)	(1.02)	(0.90)			

S_Ch * SOA	-0.0269	-0.0251	-0.0173	-0.1529	-0.1414	-0.0649	0.43	0.99	0.05
	(-0.31)	(-0.18)	(-0.11)	(-1.22)	(-1.17)	(-0.66)			
BP * SOA	-0.0539	0.0124	0.0238	-0.0865	-0.0984**	-0.0646*	1.09	3.07	0.72
	(-1.19)	(0.13)	(0.32)	(-1.19)	(-2.50)	(-1.87)			
St&Opt * SOA	-0.0432**	-0.0294	-0.0047	-0.0306	-0.0289	-0.0284	0.46	0.57	0.00
	(-2.03)	(-0.63)	(-0.14)	(-0.88)	(-1.13)	(-0.79)			
Intercept	-0.0437	-0.0050	-0.0550	-0.0442	-0.0538*	-0.0113	1.74	0.00	0.02
	(-1.50)	(-0.14)	(-1.07)	(-1.09)	(-1.73)	(-0.24)			
N. obs	327	327	327	327	327	327			
R^2	0.4279	0.1276	0.1809	0.3156	0.3906	0.4533			

Risk is standard deviation of insurer's daily stock returns for each fiscal year. See Table 1 for other variable definitions. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

Appendix

Table A1. Descriptive statistics of *Error* by year

Year	Mean	Std. Dev.	First quartile	Median	Third quartile	*p*-value mean
1995	0.0920	0.0754	0.0285	0.1001	0.1454	0.0000
1996	0.0925	0.0859	0.0241	0.0747	0.1494	0.0000
1997	0.0795	0.0787	0.0171	0.0666	0.1299	0.0000
1998	0.0643	0.0735	0.0119	0.0485	0.0989	0.0000
1999	0.0438	0.0717	0.0055	0.0347	0.0956	0.0001
2000	0.0269	0.0672	-0.0060	0.0175	0.0578	0.0048
2001	0.0278	0.0654	0.0053	0.0219	0.0567	0.0032
2002	0.0369	0.0597	0.0098	0.0391	0.0671	0.0000
2003	0.0595	0.0625	0.0228	0.0599	0.1059	0.0000
2004	0.0782	0.0693	0.0333	0.0868	0.1221	0.0000
2005	0.0897	0.0690	0.0412	0.0935	0.1354	0.0000
1995-2005	0.0605	0.0739	0.0129	0.0493	0.1056	0.0000

Table A2. Correlation matrix between independent variables

	Variables	1	2	3	4	5	6	7	8	9	10	11
1	SOA	1.0000										
2	Smooth1	**-0.2865**	1.0000									
3	Smooth2	-0.1105	**0.1271**	1.0000								
4	Tax	-0.0948	-0.0068	**-0.1364**	1.0000							
5	Risk	-0.0539	**-0.2731**	0.1209	-0.0303	1.0000						
6	S_Ch	-0.0069	-0.0425	-0.0134	0.0575	-0.0543	1.0000					
7	BP	**0.2102**	-0.0497	**-0.2738**	0.0259	**-0.2403**	-0.0090	1.0000				
8	St&Opt	-0.0604	-0.0806	-0.0319	-0.0602	-0.1207	-0.0329	**-0.2427**	1.0000			
9	UA	**-0.3626**	**0.1231**	-0.0523	0.0402	**-0.1750**	-0.0055	0.0038	-0.0260	1.000		
10	LR	**0.1399**	**-0.1596**	0.1080	**0.2309**	0.0361	0.0503	0.1060	-0.0060	-0.0183	1.0000	
11	CR	**-0.1172**	**-0.2863**	**0.4965**	0.0162	**0.1787**	-0.0109	**-0.2704**	-0.0535	-0.0566	**0.3569**	1.000

The table shows Pearson pairs-wise correlation matrix. Bold texts indicate statistically significant at 1% level or better. *Risk* is standard deviation of insurer's daily stock returns for each fiscal year See Table 1 for other variable definitions.

Table A.3. Correlation matrix among smoothing indicators and risk measures

	Variables	1	2	3	4	5	6
1	Smooth1	1.000					
2	Smooth2	**0.1271**	1.000				
3	L	**-0.6123**	**0.1677**	1.000			
4	PV	**-0.2731**	0.1209	0.0772	1.000		
5	VaR	**-0.2788**	0.1317	0.0683	**0.9705**	1.000	
6	Beta	**-0.3095**	-0.0544	0.0165	**0.6989**	**0.7485**	1.000

The table shows Pearson pairs-wise correlation matrix. Bold texts indicate statistically significant at 1% level or better. See Table 1 for variable definitions.