Loss Reserve Errors, Income Smoothing and Firm Risk of Property and Casualty Insurance Companies

Chunyan Zhang

PhD Candidate in Department of Actuarial Science, Risk Management and Insurance
Wisconsin School of Business
University of Wisconsin-Madison
975 University Avenue
Madison, WI 53706
Phone: 608-320-4466
Email: czhang46@wisc.edu

Advisor: Mark J. Browne, PhD

Robert Clements Distinguished Chair in Risk Management and Insurance
Chair of the Faculty of Risk Management, Insurance and Actuarial Science
School of Risk Management, Tobin College of Business
St. John's University
101 Murray St, New York, NY 10007
Phone: 212-277-5175
Email: mbrowne@bus.wisc.edu

Abstract

Income smoothing is one of the central topics in the finance and accounting literature. It has been identified in the literature as a motivation for accounting manipulation. Loss reserving in the insurance industry is a means by which accounting manipulation can occur. However, prior literature is not strongly supportive of the hypothesis that managers manipulate reserve levels to smooth income. The smoothing measures are subject to the ex-post problem. This study uses data of U.S. property and casualty insurance companies from 1991 to 2012 to test whether insurers manage reserves to smooth income by investigating whether accuracy of reserve errors are associated with the investment performance of insurers. This paper tests this relationship while specifically controlling for the underwriting related risk of the firm and incentives that have been reported in prior literature such as tax deferral, financial distress, and reinsurance purchases. The results identify and positive relationship between magnitude of loss reserve errors and investment risk. The influence of investment risk on the reporting of loss reserves is driven by income smoothing, rather than the change of underwriting capacity and underwriting standard.

1. Introduction

1.1 Research Questions

Accurate accounting reveals important information about the real performance of a firm to shareholders, investors and analysts, and helps them make the correct decisions on investments. However, a firm can mask the fluctuations of income by changing its operation/production process or by doing accounting tricks. The latter is a practical choice because, under current accounting rules, firms have certain flexibilities in their financial statement reporting. Thus it is very likely that the reported income is intentionally smoothed by firms. Income smoothing behavior is defined as "*the repetitive selection of accounting measurement or reporting rules in a particular pattern, the effect of which is to report a stream of income with a smaller variation from trend than otherwise would have appeared*" (Copeland 1968). It is a common practice in all industries (Grace 1990) and is one of the topics that are intensively discussed by the media, investors and researchers.

To smooth income, a firm may either change the real income by changing the investment strategies, modifying productions, or playing accounting tricks. This paper will examine the "artificial" income smoothing practices, which are performed by the manipulation of the reserves reported by P/C insurers. For insurance companies with sizable reserve balances, loss reserve has a great potential to act as an income smoother. Due to the complexity of the loss claim process, managers have certain degree of flexibility in reporting their reserves.

Loss reserves in the insurance industry provide a good opportunity to investigate income smoothing. One big challenge of studying income smoothing is how to measure the magnitudes of smoothing. In order to obtain the measure of how much the reported value is away from the actual value, one needs to find the truth which might be unobservable. Fortunately, the statutory annual statement requires insurer to display information on the losses incurred and payments over the past 10 years in its Schedule P, thus we can use the losses incurred or cumulative payments developed several years later as a proxy to measure the "actual" level of loss reserve, thus solving the "actual value" problem.

However, the income smoothing measurement in previous literature may not be valid because they are based on the ex-post results of the earnings. The solution provided by this paper is: testing income smoothing from another angle by focusing on the investment income, which is an important component of an insurer's income as well. Theoretically, loss reserving process is independent of the investment income of the property/casualty insurer if there is no manipulation. Thus, a significant relationship between loss reserve errors and past investment income level and investment volatility implies that loss reserve is used as an income smoothing tool. When variation of income is larger, the range of possible income outcomes will be wider and greater smoothing is expected to maintain the income level. If an insurer uses loss reserves to smooth income, larger reserve errors are expected. Since the investment return is a major source of an insurer's income, the incentives will be stronger when the volatility in investment income is larger. From the view of downside risk, given the volatility of investment income, insurers have less incentive to manipulate loss reserves when the level of investment income is higher.

This study contributes to the literature in three ways. First, it is the first paper which investigates how property/casualty insurers manage their reserve accruals with regard to investment earnings. This paper tests income smoothing incentive of loss reserve management without using the reported underwriting income which is the outcome of potential loss reserve manipulations. Second, it also explores the relationship between risk of the investments and reserve errors. The results suggest a co-movement of the reserving risk (under-reserving is considered to be aggresive) and default risk of investments, but there is no significant relationship between loss reserve errors and liquidation risk. Third, the correlation between loss reserve errors and investment income implies that loss reserve is used to smooth the overall income, with consideration of both underwriting income and investment income while most prior literature focus on the smoothing of underwriting income.

The remainder of the paper is organized as follows: the rest of this section is the background. Section 2 is a literature review. Section 3 states problems in previous literature when testing income smoothing and the development of hypotheses. Section 4 is the variable selections. Data descriptions and models are presented in Section 5. Section 6 discusses the empirical results, and the final section is a summary of the study.

1.2 Background

Two-thirds of a typical property and casualty (P/C) insurance firm's liabilities are loss and loss adjustment expense (LAE) reserves [1] (See Figure 1). The estimation of loss reserves can materially impact a firm's financial condition, including its surplus level, reported profit level, tax payments, pricing, capital allocation and financial ratios, which may place the firm under stringent regulatory attentions and affect the strategies that a firm is able to pursue(Anderson 1971). Statement of Statutory Accounting Principles (SSAP) No. 55 requires that "management's best estimate" of the liability for these items be recorded in the company's statutory financial statements. The "best estimate" that insurers make frequently misses the mark. Their loss reserve errors emerge when claims are closed, which may be years after the reserve for a claim is initially posted.

Figure 1

Loss Reserve to Liability Ratio of Property/ Casualty Insurance Industry (1996 to 2012)

Data Source: National Association of Insurance Commissioners (NAIC) *annual statement database (1996 to 2012).*

There are two main reasons why reserve errors may occur: non-discretionary misestimating and manipulation (discretionary). Non-discretionary misestimating may occur for a variety of reasons. These include, but are not limited to, delays in the reporting of claims, changes in claims

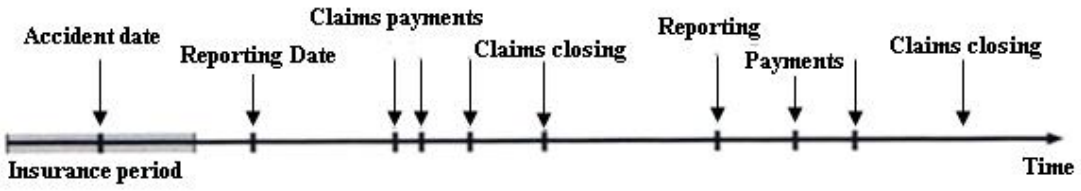
[1] In this paper, for simplicity, the term "losses" represents "losses and loss adjustment expenses", and "loss reserves" represents the total of loss and loss adjustment expenses reserves.

patterns, increases in claim settlement costs due to inflation, the effects of new regulatory or judicial decisions on loss amounts, and limitations in actuarial modeling techniques.

The claim process of a typical non-life insurer can be illustrated in Figure 2 (Wütheich and Merz, 2008). The insurance company is usually unable to settle a claim immediately: the reporting of the claim may be delayed by years, and for the reported claims, it may take years to settle the claim. The claim may be reopened due to unexpected developments. The stochastic nature of the claim process makes it difficult to estimate the future payment of claims and loss reserves.

Figure 2

Typical time line of a non-life insurance claim



Source: "*Stochastic claims reserving methods in insurance,*" by Mario V. Wütheich and Michael Merz, Willey Finance, 2008, page 2.

On the other hand, insurers may intentionally over-reserve or under-reserve to achieve certain firm objectives. The calculation of loss reserve levels may not be just a process of actuarial estimation. A growing body of research on insurance company operations provides evidence that insurers strategically manage their reserves. Since the 1970s, there have been numerous studies that have tried to identify the incentives and potential impact of loss reserve errors. The incentives including income smoothing, tax deferral, financial distress, rate regulation, and executive compensation, as we will see in the literature review section.

There are connections between the uncertainty of the loss claim and the degree of manipulation. For some types of lines of business, there are more uncertainties in the future unpaid losses. For example, liability lines usually take longer time to settle the claims and the liability claims are more complicated than property lines. Due to the complexity of the loss claim process, insurance firms have a greater degree of flexibility in reporting their reserves when there is higher

uncertainty in the claim process. Thus, non-discretionary estimating has both direct and indirect effects on the estimation of loss reserves, and it must be controlled if we want to identify the effects of various incentives on loss reserve estimation.

Over-reserving errors and under-reserving errors impact insurers differently. With an over-reserving error, the estimated future liability is higher than the actual ultimate payment, which reduces the reported policyholders' surplus, profit level and tax payment. Policyholders' surplus is an indicator of an insurance company's financial strength. If an insurer over-reserves during prosperous years, the over-reserve may not materially impact a regulator's assessment of its financial strength; but if the insurer over-reserves in lean years, a resulting low surplus level may draw a regulator's attention and action (Petroni 1992). In addition, over-reserving may bring the attention of tax regulators and the possibility of punishment by the IRS (Internal Revenue Service) will increase. The IRS punishes those who over-reserved beyond a certain extent but takes no action if an insurer under-reserves.

Under-reserving increases the level of policyholders' surplus and reported profits, and reduces the attention from regulators. Petroni (1992) finds that under-reserving strictly improves five IRIS [2] (Insurance Regulatory Information System) ratios, generally improves one ratio, but negatively affects only one ratio. She finds that financially weak insurers are more likely to under-reserve, to mask their financial difficulties. There are still risks of regulatory scrutiny when the insurer is under-reserving, because insurers are required to be examined at least once every five years or more frequently as deemed appropriate by the *U.S. Insurance Company Financial Solvency Requirements*. The more severe the degree of under-reserving, the more likely it is that an "accounting manipulation" will be discovered. In addition, if the market information about the profitability of the company is negative, but the company's financial statement offers favorable profit level, outside investors can reasonably suspect that the insurer is greatly under-reserving (Grace and Leverty 2012) .

[2] National Association of Insurance Commissioners (NAIC) Insurance Regulatory Information System (IRIS) has been used since 1972 to help insurance regulators evaluate the financial condition of insurance companies. More than 5,000 companies file their financial statements with the NAIC each year. (Per the description of the publication *Ratio Results for the IRIS* on the NAIC and The Center for Insurance Policy and Research, NAIC Store, Financial Regulation Publication on IRIS)

2. Literature Review

Most of the early research finds that loss reserves are either over-stated or under-stated in different time period in the insurance industry. In an early study, Anderson (1971) examines a sample of 36 stock companies over the years 1955 to 1964. He finds that there was a distinct tendency for the sample companies to move from a heavily over-reserved position in the early years of his analysis to a less over-reserved or even under-reserved position in later years. Beaver and McNichols (1998) discover that the reported loss reserves do not reflect all available information and they conclude that the accrual reporting is intentionally managed by the insurers. Bierens and Bradford (2005) find that in the period from 1983 to 1993 the property and casualty insurers in the U.S. were systematically overstating their reserves.

There has been considerable research on the causes of reserve errors and the strategic incentives for insurers to manage loss reserves. Prior research has focused on the following loss reserve manipulation incentives: income smoothing (Anderson 1971; Smith 1980; Weiss 1985; Grace 1990; Petroni 1992; Beaver, McNichols, and Nelson 2003), tax incentives (Grace 1990; Petroni 1992; Nelson 2000), solvency/regulatory incentives (Forbes 1970; Petroni 1992; Nelson 2000; Gaver and Paterson 2004), rate regulation (Cummins and Harrington 1987; Nelson 2000; Grace and Phillips 2008; Grace and Leverty 2010), executive compensation incentives (Browne, Ma, and Wang 2009; Eckles and Halek 2010; Hoyt and McCullough 2010), and reinsurance purchase (Browne, Ju, and Lei 2012). A recent paper by Grace and Leverty(2012) investigates all the incentives discussed by prior literature. Many authors agree that insurance companies can adjust reserve levels to manipulate their financial statements and do so as a response to unfavorable/favorable underwriting periods or for purposes of tax deferral and avoidance of regulatory scrutiny. And the incentives to manage reserves may change over time. Grace (1990) shows that prior to 1972, reserving practices aided in the reduction of tax bills; from 1972 through 1979, reserve errors were related to taxable income and income smoothing, as well as inflation rate changes.

2.1 Income Smoothing

Income smoothing has been studied in finance, accounting and risk management literatures for more than one hundred years. Income-smoothing behavior by factories, mines and industrial undertakings was first identified in the 1890s (Matheson 1893; Dicksee 1895, 1903). Many studies find evidence of income smoothing (Copeland and Licastro 1968; Simpson 1969; Dascher and Malcom 1970; White 1970; Barefield and Comiskey 1972; Jones 1991; Liu and Ryan 2006; Shuto 2007). Income smoothing is motivated by reducing tax payments, projecting a better managerial image (Hepworth 1953), attracting investors, increasing stock price, lowering the cost of financing, reducing the risk premium of capital assets, and all of which increase firm value.[3] Some other researchers find income smoothing is associated with the income-based compensation package of the executives (Watts and Zimmerman 1978; Ronen and Sadan 1981).

Many empirical studies have found a negative relationship between earnings volatility and firm value (e.g. Lambert 1984; Minton and Schrand 1999; Rountree, Weston, and Allayannis 2008). Lambert (1984) shows that a risk-averse manager who cannot access the capital markets has the incentive to smooth reported income. Trueman and Titman (1988) show that in their economic model setting, even if managers are not risk-averse and the firm cannot borrow/lend from capital markets, income smoothing still increases the firm's market value. A study conducted by Graham, Harvey, and Rajgopal (2005) indicates that most CFOs believe that earnings are the key metric considered by outsiders, and seventy-eight percent of the 400 executives in their sample would rather sacrifice the long-term value to smooth reported earnings. When the manager of a firm has the option to choose the time when income is recognized, he or she may prefer the accounting measurement and reporting rules that are expected to result in more smoothed income streams. Recent empirical work by Rountree, Weston, and Allayannis (2008) suggests that earnings volatility decreases firm value.

Executives perceive that smaller earnings volatility can bring good benefits to the firm, while high income variation decreases the firm value mainly for the following reasons.

First, low income volatility increases firm value because it is preferred by both individual and institutional investors. It enhances the reputation and credibility of the firm, and maintains or

[3] Some researchers such as Imhoff (1875, 1981) argue that income smoothing can only increase firm value temporarily. Shareholders, investors and analysts will not be fooled in the long run.

increases a firm's stock price. High earning volatility increases the likelihood of negative earnings surprises, which may hurt the stock price of the company, as investors overreact if the firm fails to meet benchmark earnings (Brav et al. 2005; Graham, Harvey, and Rajgopal 2005). The investors may suspect that there are hidden problems in the operation of the company and become less optimistic toward its future performance. Studies show that low earnings volatility is especially attractive to institutional investors (Ronen and Sadan 1981; Badrinath, Gay, and Kale 1989), as low earnings volatility is perceived as a signal of the robust operation of a company. Income smoothing masks the volatility of underlying earnings, thus lowering the perceived probability of bankruptcy and bringing favorable terms to the transactions of the firm (Titman 1984). Consequently, outside investors may over-evaluate the price of the firm's stock as the volatility is "masked", which will artificially increase the stock price of the firm.

Second, many researchers suggest that low earnings volatility increases firm value by reducing the firm's dependence on costly external finance (Shapiro and Titman 1985; René M 1990; Lessard 1991; Froot, Scharfstein, and Stein 1993). Earnings-volatility reducing activities add value to the extent that they help ensure that a corporation has sufficient internal funds available to take advantage of attractive investment opportunities. Minton and Schrand (1999) suggest that higher income volatility not only increases the firm's need to access expensive external capital market, but also forces the firm to forgo valuable investment opportunities. In another study, Geczy, Minton, and Schrand (1997) find empirical evidence that firms with high value investment opportunities and low access to internal and external financing are more likely to reduce variations in cash flow or earnings.

Third, low earning volatility decreases the probability and magnitude of forecast errors, thus making the firm more attractive for investment analysts to follow. A larger number of analysts following a firm implies more resources are spent on private information acquisition about the firm (Bhushan 1989) and increases investors' perception of the firm value. Lang, Lins, and Miller (2003) find that the number of analysts following a firm and forecast accuracy are positively associated with firm market valuations.

Some researchers find that income smoothing activities are associated with the managers' compensation (e.g. Watts and Zimmerman 1978; Koch 1981; Ronen and Sadan 1981; Lambert 1984; Fudenberg and Tirole 1995). Managers may smooth the income for other concerns.

Fudenberg and Tirole (1995) show that managers prefer to smooth income when they are concerned about keeping their position or avoiding interference. Koch (1981) finds that smoothing is greater when the management is more diverse, and the income reported by owner-controlled firms shows more variations than manager-controlled companies.

Income smoothing incentive in insurance industry has been discussed in many papers, for example, Anderson(1971), Smith(1980), Weiss (1985), Grace (1990), Beaver, McNichols, and Nelson (2003), Grace and Leverty (2012).

Anderson (1971) analyzes the effects of reserve errors on policyholders' surplus and finds that reserve errors have a stabilizing effect on underwriting income. Balcarek (1975) and Ansley (1979) further relate inadequate loss reserving to a dismal underwriting experience in the 1970s. Smith (1980) concludes that insurers may manage loss reserves to smooth underwriting results as he observes that the incidence of over- and under-reserving errors was not random for a sample of property-liability insurers in the auto liability line. Tests by Weiss (1985) provide significant evidence to support the hypothesis that exogenous economic developments and smoothing activity significantly affect loss reserving errors in the automobile liability insurance line. Grace (1990) develops a general model in which she hypothesizes that income smoothing is an important constraint when an insurer maximizes discounted cash flow. And she finds negative association between the average net income of past three years and loss reserve errors. Beaver, McNichols, and Nelson (2003) document that property-casualty insurers with small positive earnings are more motivated to understate loss reserves than insurers with small negative earnings; for firms with high earnings, the income-decreasing reserve accruals are commonly reported, and for firms with small profits, income-increasing reserve accruals are more likely to be reported. Similar to Beaver et al. (2003), Browne, Ma, and Wang (2009) find that firms with positive income have greater over-reserve errors. Grace and Leverty (2010) discover that firms with small profit tend to under-reserve more than those report losses, while insurers with high profit over-reserve to decrease the reported income. The results are not completely consistent with income smoothing theory which predicts that insurers with larger losses are supposed to under-reserve more. In another study, Grace and Leverty (2012) find no significant association between loss reserve errors and income distribution indicators.

2.2 Taxes

Reserve errors may arise as the insurer tries to reduce its federal tax bill, for loss estimates are associated with the determination of tax liabilities. By overestimating future losses attributable to current premiums, an insurer increases its reserves and incurred losses, and reduces its current tax liability. An insurer does not eliminate any taxes with reserve errors, but it does postpone the payment of taxes until future periods when ultimate claim costs are known. Over-reserving errors result in tax deferral, allowing the company to "borrow" money from the government for free. Therefore, accurate estimation of loss reserve is sought by the Internal Revenue Service (IRS). If the IRS feels the insurer is manipulating earnings through loss reserves, the insurer will be penalized by an increase in federal tax (Grace 1990). However, deferral of the tax bill still works as an important incentive to over-reserve.

The empirical test of Grace (1990) reveals that tax is significantly associated with loss reserve errors. Cummins and Grace (1994) construct a model which predicts that property-casualty insurers will use loss reserves to shelter taxable investment. Their empirical findings are consistent with the theoretical model. The 1986 Tax Reform Act (TRA) requires insurers to report the present value of future claim costs on their tax returns. One purpose of TRA (1986) is to lessen the degree to which taxes are affected by reserve manipulation. However, Bradford and Logue (1999) find that tax rules, especially the changes of tax rules, created a relatively strong incentive to overstate reserves from 1985 to 1987. In fact, the over-reserving became more severe after TRA. Nelson (2000) finds some evidence that is consistent with the tax reduction hypothesis: insurers with a high marginal tax rate implicitly discount loss reserves at a lower rate than other insurers.

2.3 Financial distress and regulator intervention avoidance

The regulators set up a series of ratios to monitor the financial conditions of the insurers, such as the Insurance Regulatory Information System (IRIS) ratios and Risk-Based Capital Ratio (RBC Ratio). IRIS sets the usual range of eleven ratios for P/C insurers. Eight of these are non-reserve ratios, and the other three are reserve-related ratios. If a ratio is outside of the usual range predetermined by the National Association of Insurance Commissioners (NAIC), it is considered unusual. If the insurer has more than three unusual ratios, it may receive special regulator

attention and intervention: A team of specialists will examine the statutory statement of the firm and decide if the firm is in need of “immediate regulatory attention” or “targeted regulatory attention” by state regulators (Appendix 3). More unusual ratios will induce more stringent suppression from the regulators. Financially troubled insurers have stronger incentives to mask their financial status in their financial statement so as to avoid penalties or intervention from the regulators.

The empirical tests by Petroni (1992) suggest that managers of financially weak insurers bias down their estimates of claim loss reserves relative to other insurers after controlling for exogenous economic factors. Evidence reveals that managers of insurers "close" to receiving regulatory attention understate reserve estimates to an even larger degree. Gaver and Paterson (2004) achieve a similar conclusion that firms manage loss reserves to avoid violating certain test ratio bounds that are used by regulators for solvency assessment. By adjusting loss reserve, two-thirds of their sampled companies that are close to receiving regulation intervention successfully limit the number of unusual ratios to less than four, which is the cut-off number to receive stringent intervention by IRIS.

The RBC formulas were developed by NAIC in 1994 and are continually recalibrated. It is uniform among the states, and provides regulatory authority for timely action. It is regarded as perhaps the most important regulatory reform on insurance regulation in the United States (Cummins and Sommer 1996). The 2011 NAIC Risk-Based Capital Forecasting & Instructions states that “*Risk-based capital is a method of establishing the minimum amount of capital appropriate for an insurance company to support its overall business operations in consideration of its size and risk profile.*” The RBC ratio is the total adjusted capital (TAC) divided by the authorized control level (ACL) using the RBC Formula. Firms with higher RBC are financially stronger. Regulation action will be taken if the RBC ratio is lower than two, more severe action required at lower levels (Appendix 3). Hoyt and McCullough (2010) find that insurers under regulatory scrutiny reduce their INBR (incurred but not reported) loss reserve levels after the implementation of risk-based capital (RBC) requirements. Bowne, Ju and Lei (2012) use RBC ratio as a measure of financial strength, and they find that RBC is negatively related to the size of under-reserving errors.

2.4 Rate regulation

For certain lines of business, the state regulators may place restrictions on the underwriting and pricing policies of the insurers. In some states with a non-competitive rating (NCR) law, the regulator may restrict discriminative pricing based on certain characteristics, such as age, race, and some pre-existing conditions. This is especially common for certain lines of business such as health insurance, auto insurance, workers' compensation, and other lines in which universal coverage, mandatory coverage or social influence are the concerns of the regulators. Such regulations may motivate the insurers to strategically manage their reserves.

Previous literature on the impact of rate regulation on reserve management can be divided into two groups. One group maintains that stringent rate regulation is positively correlated with under-reserve behavior, while the other group suggests the other side—over-reserve. The first group assumes that insurers implicitly discount their loss reserves to account for the time value of money (Lowe and Philbrick 1986; Nelson 2000). Nelson (2000) hypothesizes that the P&C industry is highly competitive. Using data from the 1989-1993 statutory annual reports of 755 P&C insurers, he finds evidence that insurers tend to report the present value of expected future claim payments by implicitly discounting, in order to satisfy the requirement of regulators while competing with other companies, making profit, and winning more customers and market share. And this incentive is stronger if the rate regulation is more stringent. The implicit discount results in lower reported loss reserve levels on the firms' financial statements. That is, under more stringent rate regulation, the insurers are more likely to under-reserve. Alternatively, stringent rate regulation may also drive the reported loss reserve upward. Grace and Leverty (2010; 2011; 2012) find evidence that if regulation suppresses rates below the economic cost of writing business, then stringent rate regulation will create an incentive for managers to over-reserve in an attempt to reduce the effect of rate suppression.

2.5 Other studies

Other theories supplement the literature on reserve manipulations, such as the managerial compensation, the choice of audit firms and actuarial firms, and the purchase of reinsurance. Manages may manage loss reserves to maximize the value of their compensation. Lin and Lai (2008) find evidence that the managers who are rewarded with a great amount of stocks and

options tend to under-reserve when they have the opportunity to sell the stocks or exercise the options in the next period. Browne, Ma, and Wang (2009) test whether the awarding of stock options to insurance company executives is associated with the loss-reserving practices. They find that the greater sensitivity of option-based compensation on stock prices is associated with more under-reserving errors or less over-reserving errors. Eckles and Halek (2010) find that managers who receive bonuses that are capped or no bonuses tend to over-reserve for current-year incurred losses. However, managers who receive bonuses that are not capped tend to under-reserve for current-year incurred losses. They also find that managers who exercise stock options tend to under-reserve in the current period.

Auditors and actuaries are external monitors of insurers. Reputational monitors may have more ability and a stronger sense of responsibility to report accurate reserve. Empirical findings in the literature support that bigger auditors and/or actuaries are associated with more accurate reserve estimates for financially weak insurers. Petroni and Beasley (1996) explore whether the audit firm type is associated with the accuracy of insurers' estimation of loss reserves. Although in the model based on the entire sample they find no significant difference of accuracy of reserving or conservativeness among insurers with different types of auditors, they do find that the subset of financially stressed insurers that use Big Eight auditors are reserving much more conservatively. Similarly, Gaver and Paterson (2001) find that the financially distressed insurers that use auditors and actuaries from the Big Six accounting firms are less likely to under-reserve. Moreover, the usage of non–Big Six actuaries (regardless of whether the auditor is a member of the Big Six) is associated more with under-reserving by weak insurers. They conjecture that these results are related to the fact that Big Six actuaries are more conservative in loss reserving and they are more attuned to the liability exposure of the auditor. Grace and Leverty (2011) find that high reputation actuaries can significantly improve the loss reserve accuracy, but the effect is not significant for high reputation auditor firms.

Browne, Ju, and Lei (2012) suggest that smaller over-reserve errors help insurers obtain better terms from reinsurers and maintain better relationship with broker /agents. They find that purchase of reinsurance and payment of contingent commissions to intermediaries by property and casualty insurers are associated with smaller over-reserving errors, but the association is insignificant for under-reserving errors.

3. Development of Hypotheses

3.1 Problems in previous research on income smoothing

The previous studies (e.g. Anderson, 1971; Smith, 1980; Weiss, 1985; Grace, 1990; Beaver, McNichols, and Nelson, 2003) investigating income smoothing through loss reserves are all subject to limitations. Grace (1990) uses the average net income of the past three years scaled by the net premium earned for auto insurers. She finds that the insurers will under-reserve if the past income is high for the insurers who write business on auto liability, other liability, and/or workers' compensation policies. However, as pointed out by Grace and Leverty (2012), after 3 years of high income, the 4th year may still be a good year thus it is not necessary for the insurer to under-reserve to maintain the income level.

Similar to Beaver, et al. (2003) and Browne et al. (2009), Grace and Leverty (2012) measure the smooth incentive by using indicator variables based on the profit distribution in the industry. Different from Beaver, et al. (2003) and Browne et al. (2009), they do not find evidence of income smoothing when controlling variables tested in most previous literature. However, the smooth measures based on reported income distribution may not work properly because the reported underwriting income or overall income of the firm is the ex-post result after potential manipulation. The income reported in an annual statement is the sum of the underwriting income, investment income and other income. And underwriting income (gain/loss), which is a major source of the overall income, is greatly influenced by the level of reserve errors[4]. So the smooth measurements which involve the current year's underwriting income would be misleading. For instance, considering an insurer that makes less profit than it normally did in the past, it may intentionally under-state its loss reserve to increase the accounting income. The consequence is that it may change its position in the income distribution from "loss" to the "profit" or "small profit" category. Thus the authors may find some companies make profit but under-reserve. Similarly, after over-reserving, profitable companies will be ranked in the small or median profit range. This may help explain the inconclusive results found in Grace and Leverty (2009 and 2012).

[4] This is because the underwriting income is reported as the difference between net premiums earned and underwriting deductions (including losses incurred, loss adjustment expenses incurred and other deductions), while losses incurred is calculated as the net paid losses plus the difference of unpaid losses in current year and the unpaid losses in prior year. Since the unpaid losses in prior year are a given fact in current year, under-stating the unpaid losses in current year will increase the underwriting income, and vice versa.

To measure the "true" income that is not masked by loss reserve manipulation, one possible way is correcting it using reserve errors: we can add the errors back to the underwriting income or total pre-tax income, just as Anderson (1971) and Smith (1980) did in their research. However, this may bring new problems if regression methods are used: the independent variable will contemporaneously correlate with the independent variable - loss reserve errors. The methods used in Anderson (1971) and Smith (1980) are non regression analyses based on comparison of the underwriting results reported and the results corrected by reserve errors. They do not consider various firm characteristics and other important incentives such as tax shield and financial distress. Smith (1980) admits that "*Statistical evidence that insurers intentionally manage loss reserve estimates in order to smooth reported underwriting results is presented but it is not convincing*" because other factors are not considered. So the dilemma is: if we want to include the "true" underwriting or overall income measurement in our research to test income smoothing while controlling other firm demographic measures and incentives explored in other studies, we will have the problem of contemporaneous correlation and regression methods will not be appropriate; if we use non regression methods it is difficult to simultaneously control so many factors that relate to loss reserve errors.

3.2 Hypotheses

The solution provided by this paper is: testing income smoothing from another angle by focusing on the investment income, which is an important component of an insurer's income as well. Theoretically, loss reserving process is independent of the investment income of the property/casualty insurer if there is no manipulation. Under Statutory Accounting Principles (SAP), the loss reserve is defined as an insurer's estimated liability for unpaid claims on all losses that occurred prior to the balance sheet date. Thus the error in loss reserve is embedded in the uncertainty in the future losses (and limitations in actuarial modeling techniques, of course). The practices of loss reserving are based on either the incurred losses or payments run-off triangles of claims. Different from life insurance industry, investment income is barely considered when estimating unpaid losses (Brown 1994). The SAP requires P/C insurers to

report loss reserve on an undiscounted basis, thus the interested rate has little influence on the estimation of unpaid losses[5].

Loss reserves do have certain influence on investment, but the influence of loss reserve errors on rate of investment return is limited. The investment income is generated from two sources: investment income from policyholders' surplus and investment income from funds attributable to insurance transactions (including loss reserves, unearned premium reserves). So the understatement of loss reserves will decrease the investment income from one part (reserve), but it will increase investment income from surplus (although not as much considering tax, surplus distribution and other factors). The understatement or overstatement of reserve only changes the distribution of the errors in the liability and surplus, without significant influence on the overall investment. The influence may further be mitigated when investment income is scaled by assets.

Thus, a significant relationship between loss reserve errors and investment income level and investment risk implies that loss reserve is used as an income smoothing tool. And our study also contributes to the literature on whether the insurers are only trying to smooth underwriting income or the overall income of the company.

The main hypothesis is:

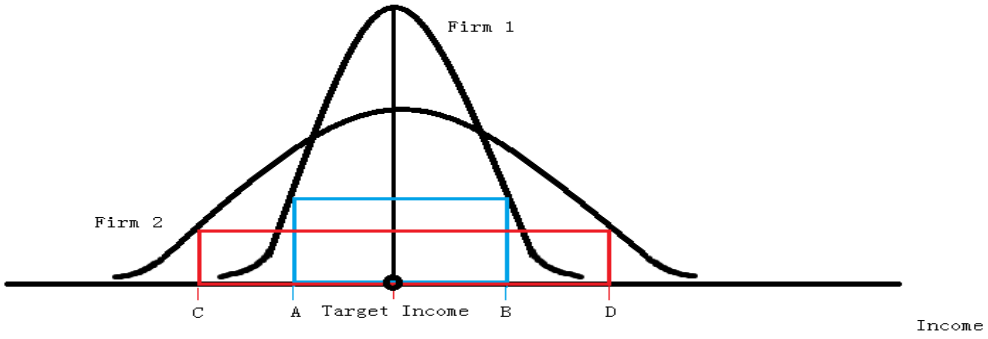
Ha 1: The magnitude of loss reserve errors is positively associated with the investment risk of insurers, holding all other variables constant.

The first measurement to evaluate the risk in investment is the volatility of the investment income. Figure 3 illustrates the linkage between volatility and income smoothing. Higher firm risk is associated with larger variations of income, thus it has a wider range of possible income outcomes and more smoothing is needed to achieve the target income level. If an insurer uses loss reserves to smooth income, larger reserve errors are expected. Since the investment is a major source of an insurer's income, if loss reserve is used to smooth the overall income, then incentives will be stronger when the volatility in investment income is larger.

[5] Statutory accounting practices (SAP) require that, with a few exceptions, loss reserves should be reported at the nominal value rather than the present value in the statutory financial statements. It makes an exception to this rule for workers' compensation loss reserves related to pension and long-term disability benefits, and for insurers who receive authorization from their domiciliary state to discount the loss reserves for other lines of insurance.

Figure 3

Volatility of Income and Income Smoothing



Firm 1 and Firm 2 have the same target income. However, the standard deviation of income stream for Firm 2 is larger than Firm 1. More smoothing is needed to approach the target income for Firm 2 thus its loss reserve errors are expected to be greater.

Furthermore, as we have discussed in Section 2, the non-discretionary loss reserve errors are associated with underwriting risk and discretionary loss reserve errors are associated with both underwriting risk and investment risk. Therefore, if the relationship between loss reserve errors and income volatility is not significant, we fail to find evidence of income smoothing towards overall income, but it is still possible that insurers over or under reserve to smooth underwriting income. However, if there is a significant relationship between loss reserve errors and volatility of investment income and the risk in investment activities, then we find strong evidence of income smoothing of the overall income of the insurers.

The main hypothesis is developed as:

Ha 1.1: The magnitude of loss reserve errors is positively associated with the volatility of investment income of insurers, holding all other variables constant.

One potential problem with the above hypothesis is that the volatility of investment income and volatility of underwriting income might be strongly correlated. They may be influenced by the same factor such as interest rate and inflation in the market. We tested the correlation between the standard deviation of investment income of the past five years and the standard deviation of

the underwriting income in the past five years. And considering the underwriting income is influenced by reserve error[6], we add the reserve error back to get the error-adjusted underwriting income and its volatility in the past five years. The reported underwriting income volatility is significantly correlated with investment income volatility, but all the coefficients of correlation are very small[7]: only 1.2% of the variation in investment income volatility can be explained by the volatility of underwriting income (Table 1) .

Table 1

Pairwise correlations of volality of incomes[1, 2]

	INVSTD	**ADJUWSTD**
ADJUWSTD	0.0044	
(p-value)	(0.536)	
UWSTD	0.1174***	0.115***
(p-value)	(0.000)	(0.000)

ADJUWSTD5: The standard deviation of error-adjusted underwriting income of the past five years; *INVSTD5*: The standard deviation of error-adjusted investment income of the past five years; *UWSTD5*: The standard deviation of reported underwriting income of the past five years.

Note 1: To avoid loss of sample size when calculating the standard deviation of income in the past years, the most recent 4 years of data are used when five years past history is not available.

Note 2: All the incomes are scaled by total assets.

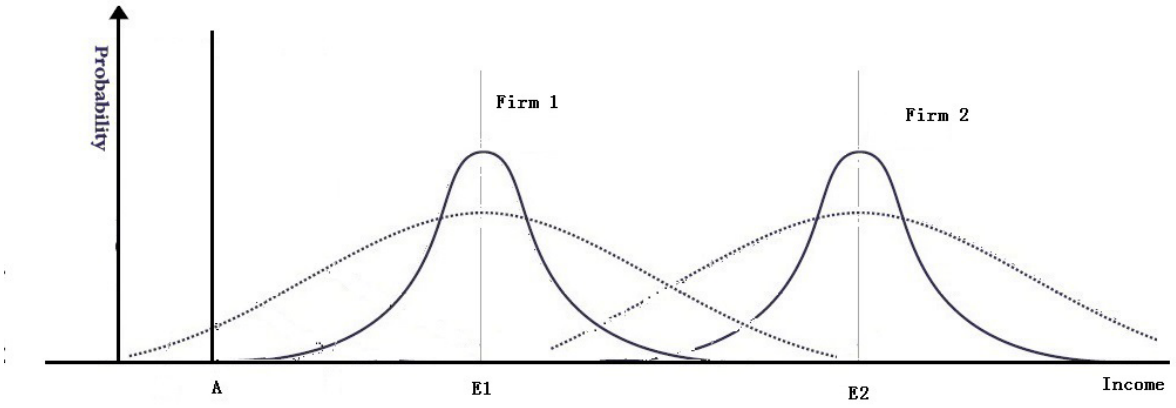
Another important aspect of the investment income is the level of investment income. When the investment income is higher than normal, an insurer might have less incentive to do manipulation because the high investment income relieves the stress of low or negative overall income.

[6] The reserve error used here is the difference between the original reported reserve and the developed reserves five years later, scaled by total assets, following KFS model ((Kazenski, Feldhaus, and Schneider 1992).

[7] The correlation between variance of the two incomes is even smaller.

Figure 4

Level of Income and Income Smoothing



The X-axis represents income measured by rate of return on asset (ROA). The average income of Firm 1 and Firm 2 are E1 and E2: E1<E2. A is a cut-off value. If the rate of return on asset is lower than A, a firm will be subject to higher cost of financing or other financial stress/cost due to low profitability (e.g. lower stock price, less customer confidence). Firm 1 has more incentive to smooth income and decrease the volatility of income. For Firm 2, it is not so likely for it to reach the cut-off value A, thus it has less incentive to do income smoothing and smaller loss reserve errors are expected.

Figure 4 shows that given two firms with same volatility of income but different income level (income is scaled by total asset to eliminate the effects of size). The firm with higher income level has less incentive to smooth its income because it has less probability to suffer from the unexpected low income. So the hypothesis is:

Ha 1.2: The magnitude of loss reserve errors is negatively associated with the level of investment income of insurers, holding all other variables constant.

In addition to the level and volatility of investment income, we want to find out if reserve errors are related to the investment portfolios, such as higher risk bonds, investment in affiliates. So the sub-hypothesis is:

Ha 1.3: The magnitude of loss reserve errors is positively associated with the risk in the investment portfolio of insurers, holding all other variables constant.

A second group of hypotheses based on the underwriting capacity predict differently. The investment earnings will impact the underwriting capacity of the insurance companies. When the investment performance is better (investment return is higher and volatility of investment is lower), insurers will loosen their underwriting standards to obtain more premiums to take advantage of the investment opportunities. The less strict underwriting standards introduce high uncertainty to the risk characteristics of the insured and the loss claim process, and it is more difficult to estimate the loss reserves. Thus, the underwriting capacity theory predicts that the investment risk is positively associated with the accuracy of loss reserves. For the direction of loss reserve errors, when the underwriting standard is less strict, insurers will lose money from underwriting activities, thus more under-reserving is expected to increase the reported underwriting income.

Ha 2 The magnitude of loss reserve errors is negatively associated with the investment risk of insurers, holding all other variables constant.

Ha 2.1 The magnitude of loss reserve errors is negatively associated with the volatility of investment income of insurers, holding all other variables constant.

Ha 2.2 The magnitude of loss reserve errors is positively associated with the level of investment income of insurers, holding all other variables constant.

Ha 2.3 The magnitude of loss reserve errors is negatively associated with the risk in the investment portfolio of insurers, holding all other variables constant.

Income smoothing Hypotheses 1s and underwriting capacity Hypotheses 2s predict opposite relationships between loss reserve errors and level/volatility/risk profile of investment earnings.

We also test the factors that have been reported in prior literature, namely tax deferral benefit, reinsurance purchase and financial weakness. The secondary hypotheses tested in this paper include:

Ha 3: Insurers with high tax over-reserve more than those with low tax rate (e.g. Grace 1990; Petroni 1992; Nelson 2000) .

Ha 4: Insurers with higher amount of reinsurance purchase tend to have smaller over-reserving errors (e.g. Forbes 1970; Petroni 1992; Nelson 2000; Gaver and Paterson 2004).

Ha 5: Financially weaker insurers tend to have more under-reserving errors (e.g. Petroni 1992; Browne, Ju, and Lei 2012).

4. Variables

4.1 Loss Reserve Error

Several ways have been developed to measure the reserve errors. Basically, an error (bias) is defined as the difference between the estimate and its actual (or realized) value. For loss reserves, it is the difference between the initial estimate and the ultimate payment. The basic non-scaled reserve error is defined as:

$$Error = Reserve\ Estimate - True\ Reserve \quad (1)$$

In this formula, “Reserve Estimate” is the value of the estimate of losses incurred in the current year to be paid in the future, and “True Reserve” is the value of the actual amount of losses incurred in the current year to be paid in the future (Grace 1990). The "Reserve Estimate" is the difference between estimates of losses incurred and cumulative paid losses by the end of the current year. The incurred losses of each accident year are revised in each calendar year to reflect new information about the losses. The revised losses incurred are called "developed losses incurred". There are two methods that are commonly used to measure the "True Reserve". The commonly method used is the Kazenski, Feldhaus, and Schneider method (1992), or "KFS" method. The "True Reserve" value is estimated using the difference between developed losses incurred five years later and the cumulative loss payments by the end the current year. The development of losses incurred and cumulative payments are shown in Schedule P Part 2 and Part 3 of NAIC Annual Statement (Appendix 1). Because the cumulative loss payments of the current year are the minuend of the "Reserve Estimate" and "True Reserve" proxies, the method is simplified as shown in Equation (3):

$$\text{Reserve}_{\text{i,t}} = Losses\ Incurred_{i,t} - Cumulative\ Payments_{i,t} \quad (2.1)$$

$$Developed\ Reserve_{i,t+j} = \text{Developed Losses Incurred}_{\text{i,t+j}} - Cumulative\ Payments_{i,t} \quad (2.2)$$

$$\text{ERROR}_{\text{i.t}} = \text{Reserve}_{\text{ i,t}} - Developed\ Reserve_{i,t+j}$$

$$= \text{Losses Incurred}_{\text{i,t}} - \text{Developed Losses Incurred}_{\text{i,t+j}} \quad (3)$$

In these equations, *i* denotes company, *t* denotes the reporting year (calendar year), *j* is the number of development years. The value most commonly used for *j* is 4 or 5. And the errors are usually scaled by initial loss reserve estimate, developed loss reserve estimate, net premiums earned or total assets to catch the size effect. The total assets are used to scale the reserve errors in this paper.

4.2 Investment Income

The average investment income in the past five years (INVMEAN) is included in our model to see how the loss reserve errors are related to the level of the investment income in the past.

The investment income volatility (INVSTD) is measured by the standard deviation of the rate of return on total assets (ROA) in the previous five years of the reporting year t.

$$INVSTD_{i,t} = \sqrt{\frac{\sum_{j=1}^{5}(Investment\ ROA_{i,t-j} - \overline{Investment\ ROA}_{i,t-1\ to\ t-5})}{4}} \quad (4)$$

When the history of a company is less than five years, a four year standard deviation is used.

The benefit of using investment income of past years is that we can mitigate the endogeneity problem introduced by insurance companies' asset-liability management (ALM), such as duration match. Most life and property/casualty insurers adopt the liability driven ALM: asset strategy is driven by liabilities of the companies. Investments are "managed" to match the liabilities, with consideration of the characteristics of the insurance product mix which also impact the loss and claim payment patterns. With this context, it is possible that investments are influenced by loss reserve errors, since they influence the liabilities of the insurers. However, insurers cannot create or destroy value simply by owning a different portfolio of assets with the

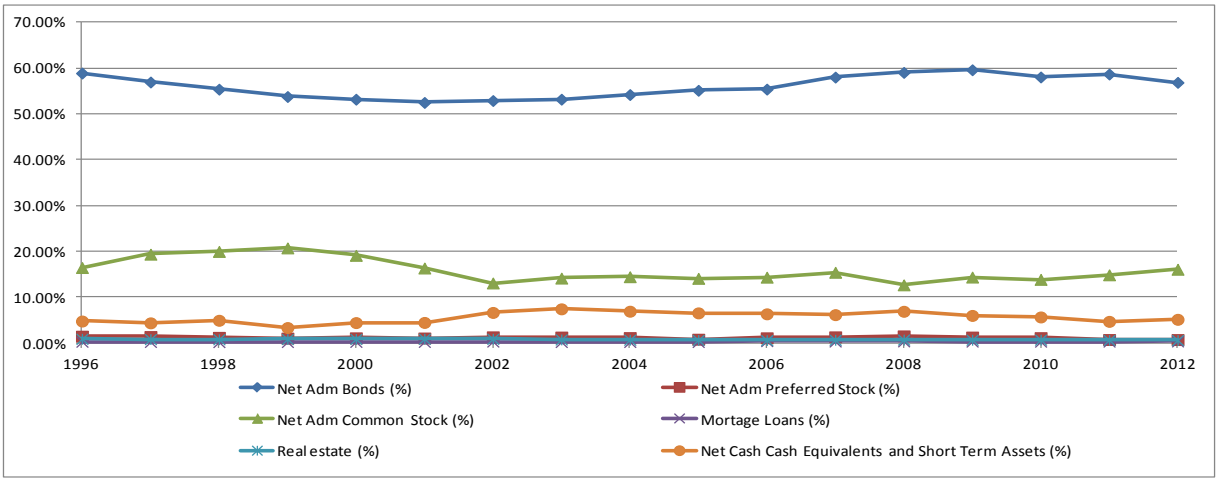
same market value. If property/casualty insurers have longer duration liabilities, then it makes sense to buy longer duration assets to minimize ALM risk. By deciding to invest in longer-duration and higher-yielding assets, the company doesn't increase its overall value. It may turn out to have greater value over time if events play out well, but that is not given when the company makes the decision to buy long. Thus the effect of loss reserve on investment has a time lag: the change of current loss reserve will only affect future investment income and volatilities. Using the past investment income will help reduce the problem of endogeneity.

4.3 Investment Portfolio

The major investments of a property-casualty insurer reported in the annual statement are listed in Figure 5. Among the investments, bonds are the largest for the property and casualty insurance industry. Figure 5 shows that about 65% of the cash and invested assets are in the form of bonds. By the end of 2012, 67.21% of total admitted assets were invested in bonds, followed by investments in common stock (17.04%) for the property and casualty insurance industry (NAIC). For the income earned, our data shows that from 1996 to 2012, averagely about 72% of the income earned in the property/casualty insurance industry are generated by bonds, and only 10% are from common stocks. The riskiness in bonds represents a majority of the investment risks.

Figure 5

Key allocations of cash and invested assets (by net admitted assets value)



Data source: NAIC annual Statements (1996 to 2012 annually).

NAIC SVO (Securities Valuations Office) Designation categorizes the bonds owned by insurers into six credit quality groups: rating from the highest credit rating Class 1 to lowest Class 6 (Appendix 2). Among the six classes, Class 3 to Class 6 are of lower credit quality and regarded as non-investment grade bonds. Table 2 shows that the percentages of bonds by NAIC designation. More than 95 percent of the bonds held by U.S. property/casualty insurance companies are of investment grade.

Table 2

Percentage of bonds by NAIC Designation of U.S. P/C Industry

Year	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
1996	92.29%	5.67%	1.00%	0.71%	0.29%	0.04%
1997	92.47%	5.55%	0.96%	0.80%	0.18%	0.04%
1998	91.62%	6.20%	1.17%	0.71%	0.22%	0.08%
1999	90.56%	7.35%	1.08%	0.72%	0.22%	0.08%
2000	88.55%	8.76%	1.38%	0.87%	0.31%	0.12%
2001	86.90%	10.01%	1.73%	0.88%	0.26%	0.22%
2002	87.88%	8.75%	1.82%	0.94%	0.41%	0.21%
2003	88.56%	8.76%	1.38%	0.87%	0.31%	0.12%
2004	90.67%	7.24%	1.08%	0.72%	0.22%	0.08%
2005	91.67%	6.15%	1.16%	0.72%	0.22%	0.08%
2006	92.47%	5.55%	0.96%	0.80%	0.18%	0.04%
2007	92.27%	5.69%	1.01%	0.69%	0.29%	0.04%
2008	89.79%	7.95%	0.95%	0.94%	0.28%	0.09%
2009	88.06%	9.33%	1.18%	0.95%	0.31%	0.17%
2010	86.95%	9.99%	1.34%	1.24%	0.34%	0.14%
2011	86.05%	10.85%	1.40%	1.27%	0.22%	0.20%
2012	84.22%	11.71%	1.86%	1.07%	0.96%	0.18%

Data source: NAIC annual Statements (1996 to 2012).

To measure the risk in bonds, we applied the risk factors used in the Risk-Based Capital Formula provided by NAIC Risk-Based Capital Report Including Overview and Instructions (Table 3). The risk factors differ by NAIC SVO designation. The factors are set based on the statistical analysis of the default risk of each NAIC designation.

We construct the risk measure for unaffiliated bonds ("BONDCHARGE") as:

$$BONDCHARGE = (bondclass1 * 0.003 + bondclass2 * 0.01 + bondclass3 * 0.02 + bondclass4 * 0.045 + bondclass5 * 0.10 + bondclass6 * 0.30)/TotalAsst * 100$$

Table 3

Risk factor for unaffiliated bonds

Bonds Credit Category	Risk Factor
Federal government bonds	0
NAIC1	0.003
NAIC 2	0.01
NAIC 3	0.02
NAIC 4	0.045
NAIC 5	0.1
NAIC 6	0.3

Source: NAIC Risk-Based Capital Report Including Overview and Instructions, annually.

Given that real estate and mortgage are assets with lower liquidity, we include the percentage of real estate and mortgage loans in total assets (RLMRTG). Both NAIC Risk Based Capital Formula and rating agencies such as A.M. Best apply higher risk charge for investments in affiliates than investments in the unaffiliated because the risk of default is higher for affiliated investments (A.M. Best, 2010[8]). The percentage of investment to affiliates is included in our model (AFFIINV). Real estate and mortgage are invested assets with less liquidity, and the investments in affiliated institutions are subject to higher market risk due to the dependence between the insurer and its affiliates. All the investment profile measurements are one-year lag of the current year to mitigate the endogeneity problem.

4.4 Underwriting Related Risk

The underwriting related risk will make it more difficult to estimate the ultimate payment thus more reserve error may occur. On the other hand, it gives the insurers more room to conduct reserve manipulation. We control the underwriting risk through the risk characteristics in different lines of business. The traditional way used in most literature is the net premiums written in long-tail lines of business similar to Sommer (1996). Their long-tail lines include all the liability lines and liability/property combined lines: auto liability, other liability,

[8] For example, A.M. Best apply a baseline risk charge of 100% to the investment in affiliates, regardless of which investment schedule it is recorded in (i.e. surplus notes recorded as other investments in Schedule BA, etc.). Source: Best's Credit Rating Methodology(BCRM). Aug.10, 2011.
http://www.ambest.com/ratings/methodology/BCAR_UNDERSTANDING_PC_Insurers.pdf

farmowners/homeowners, commercial multiple peril, medical malpractice, workers' compensation, ocean marine, aircraft, boiler and machinery[9]. However, the actual lengths of tails are quite different within this classification. As noted by Nelson (2000), among those lines, some lines of business have much shorter lines than others. For example, about 90% of the farmowners/homeowners losses incurred are paid within the first three years, while it takes thirteen to fifteen years for lines such as other liability and medical malpractice to settle 90% of the losses incurred (Nelson 2000). And reserving process of workers' compensation is different from others because the reserves are discounted to present value. Therefore, we further divide the long-tail lines of business into several groups: (the longer-tail) liability lines, auto liabilities, workers' compensation, following Petroni et al.(2000) and Beaver et al. (2003).

Liability Lines (LIABILITY): net premiums written in liability lines of product liability, other liability, and medical malpractice as a percentage of total net premiums earned. Those liability lines are longer than other long-tail lines. Those lines of business are prone to exogenous ex-post shocks (Beaver, McNichols, and Nelson 2003), including the impact of changing contract interpretations and legal environment. Thus LIABILITY is expected to be associated with larger degree of reserve errors.

Auto liabilities (AUTO): net premiums written for private and commercial auto liabilities as a percentage of total premiums written. Those are lines of business less subject to exogenous ex-post shocks (Petroni, Ryan, and Wahlen 2000; Beaver, McNichols, and Nelson 2003). We expect less reserve errors when there are more premiums written on auto liabilities.

Workers' Compensation (WCOMP): net premiums written for workers' compensation as a percentage of total net premiums written. Although workers' compensation is a long-tail line of business, the estimation of reserve for workers' compensation is discounted to present value based on strict tabulated discount, thus the reserve for this line is increasing to reflect the time value of money(Petroni, Ryan, and Wahlen 2000). There are more under-reserving errors or less

[9] This classification is also consistent with Schedule P of statutory annual statement: Homeowners, Farmowners, Private Passenger Auto Liability, Commercial Auto Liability, Workers' Compensation, Commercial Multiple Peril, Medical Malpractice (occurrence policies and claims-made policies), Special Liability (Ocean Marine, Aircraft (All Perils), Boiler and Machinery), Other Liability (occurrence and claims-made), International, Products Liability (occurrence and claims-made).

over-reserving errors when the proportion of net premiums written on workers' compensation increases.

We include the proportion of net premiums written in typical short-tail lines of business (SHORTTAIL). Short-tail lines of business include: special property (fire, allied lines, inland marine, earthquake, burglary and theft), automobile physical damage, fidelity, surety, credit, accident and health, financial guaranty, mortgage guaranty, and warranty. More business written on short-tail lines is associated with higher accuracy of loss reserves.

Reinsurance purchases (REINSURANCE): Reinsurance ceded as a percentage of gross premiums written. Reinsurance purchases are found to associate with higher accuracy of loss reserves ((Browne, Ju, and Lei 2012; Grace and Leverty 2012).

Reinsurance assumed (REINSASMD): In addition to the reinsurance purchased, we include the reinsurance assumed as a percentage of gross premiums written. The loss reserves for reinsurance assumed are mainly decided by the ceding company thus the insurer has less discretion on the business assumed. We expect the effect of reinsurance assumed on loss reserve errors to be negative.

Business Herfindahl index (BUSHERF) and Geography Herfindahl index (GEOHERF) are included to measure the diversifications on lines of business and geographic locations. Higher Herfindahl index implies higher risk of concentration (thus partially catch the catastrophe risk). We expect that the Herfindahl index is positively correlated with loss reserve errors. However, an insurer with higher business or geographic concentration may be more professional on the lines of business or geographic areas it focuses on, so the insurer will be able to establish loss reserves more accurately(Browne, Ju, and Lei 2012).

4.5 Tax Shield

We use the Grace (1990) measure of tax shield (TAXSHIELD) to control the incentive of tax deduction using loss reserves.

$$\text{TAXSHIELD}_{i,t} = \frac{\text{Net Income}_{i,t}+\text{Reserve}_{i,t}}{\text{Total Assets}_{i,t}} * 100 \quad (5)$$

Although the calculation of the tax shield involves the ex-post results of net income, the summation of net income and reserve is not subject to the ex-post measurement problem: "true" net income=(reported) net income + reserve errors and "true" reserve=(reported) reserve - reserve errors. The total of net income and reserve are the same in both ex-ante and ex-post cases.

4.6 Financial Strength

Petroni (1992) finds that financially weaker insurers are more likely to under-reserve loss reserves. She uses IRIS-ratio based measure to proxy the financial weakness of the insurers. Grace and Leverty (2012) use the probability of failure based on an insolvency model. In this paper, the financial weakness is measured by NAIC risk-adjusted capital ratio (RBC), following Bowne, Ju and Lei (2012). The RBC formula is grounded in actuarial and financial analysis of the risks faced by insurance companies and of the capital needed to guard against those risks (Feldblum 1996). Lower RBC ratio is an indicator of financial weakness.

4.7 Demographics

The following demographic measures of insures are included to control the firm level characteristics. Specifically, we control size (natural log of total assets), age, firm ownership (stock or mutual), and group affiliation. Companies of larger size and longer age are supposed to be able to reserve more accurately. And managers of stock companies may have more incentives to manipulate loss reserves.

Table 4

Demographic Variables

Firm characteristic variables (X)	
$SIZE_{i,t}$	Firm size of insurer *i* in year *t*, =natural log of total assets
$AGE_{i,t}$	Firm age
$STOCK_{i,t}$	=1 if the insurer *i* is a stock company in year *t*, =0 otherwise
$MUTUAL_{i,t}$	=1 if the insurer *i* is a mutual company in year *t*, =0 otherwise
$GROUP_{i,t}$	=1 if the insurer *i* is a member of a group in year *t*
$GROWTH_{i,t}$	1-year growth rate of net premium written of insurer *i* in year *t*

5. Data and Model

5.1 Data

The data are from NAIC Annual Statement covering 1991 to 2012. Since reserve errors are calculated using data 5 years after the original loss reserve estimation, and the volatility measure of investment income takes another four to five years back into history, the data used to do this analysis cover years from 1996 to 2007. The following screening of the raw data is conducted:

1). The losses incurred are larger than zero. This screening makes sure the insurer is still active in underwriting. We use the NAIC demographic variable of "company status[10]" to further exclude the inactive companies.

2). Loss reserves are larger than zero. So reserve errors can be calculated.

3). Direct premiums written are non-negative. This will exclude insurers that do reinsurance business only.

4). Firms with dramatic extreme loss reserve errors are excluded[11]. Those changes may be due to data input error or pool arrangement.

5). Insurers who write more than 25% of its net premiums on Accident and Health, Surety and Fidelity, Credit are excluded. Those lines are categorized as short lines by NAIC Schedule P, and only two years of losses incurred/payment histories are shown in Schedule P. Those companies

[10] Valid values for Company Status are:
0 Active - Conservatorship
1 Active - No regulatory action in process
3 Inactive - Merged or combined into another company
4 Active - Rehabilitation, permanent or temporary receivership
5 Inactive - Voluntarily out of business
6 Active - Being liquidated or has been liquidated
7 Inactive - Estate has closed
8 Inactive - Charter is inactive
9 Inactive - Combined statement filer

We keep the active companies. In our sample, among the 14326 companies, there are 0 companies in Status 0, 14309 companies in Status 1, 14 companies in Status 4 and only 3 companies in Status 6.

[11] We define extreme loss reserve error=1 when the difference between developed loss reserve and original loss reserve is more than 50% of the original reserve, similar to Grace and Leverty (2012).

are excluded because for those short lines, the insurers have less opportunity to under or over state the loss reserves(Petroni 1992).

6). All the independent and dependent variables are not missing.

After the screening, 1893 companies are included in our sample, with an average time periods of 7.6 years, 166 of the companies have only 1 year period of data, accounting for approximately 80% of the total assets of the property and casualty insurance industry during the sample years.

5.2 Summary of Statistics

Table 5 shows the descriptive statistics for loss reserve errors in each sample year. The overall average loss reserve error as a percentage of total assets is 1.135.

Table 5

Summary of Statistics: Loss Reserve Errors by Year (sample size=14326)

year	Mean	Obs	Std. deviation	Min	Max
1996	3.282	1215	9.519	-28.069	208.309
1997	2.567	1198	7.443	-30.872	95.901
1998	0.829	1171	8.369	-129.952	38.348
1999	-0.298	1140	8.282	-93.135	76.727
2000	-1.745	1096	8.321	-74.104	54.523
2001	-1.984	1130	7.442	-35.400	24.554
2002	-1.397	1177	9.583	-32.174	224.377
2003	0.166	1214	10.775	-304.951	48.634
2004	1.686	1234	10.972	-318.782	37.133
2005	2.445	1229	11.510	-306.821	39.939
2006	3.204	1260	7.354	-132.207	30.900
2007	3.989	1262	14.571	-32.260	334.188
Total	1.135	14326	9.984	-318.782	334.188

Table 6 is the summary of statistics for the sample after screening. 70% of the insurers in the sample are stock companies, 22.3% of the insurers are mutual companies.

Table 6

Summary of Statistics (sample size=14326)

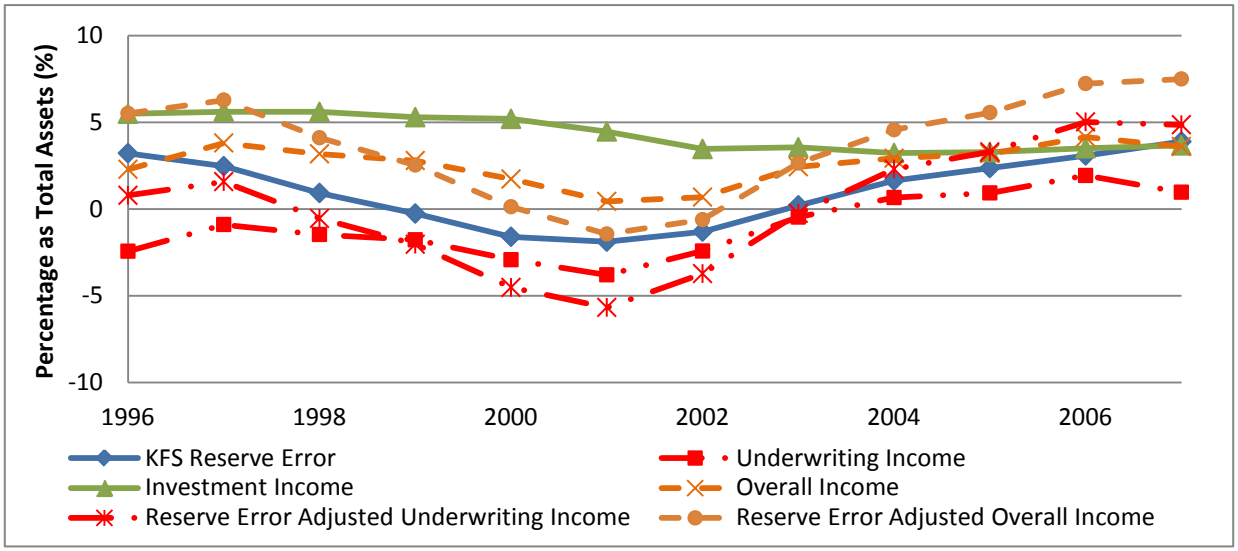
Variable	Mean	Std. Dev.	Min	Max
ERROR (%)	1.135	9.983	-318.782	334.188
INVMEAN (%)	4.811	2.104	-8.602	87.931
INVSTD (%)	1.500	3.319	0.000	185.274
BONDCHARGE (%)	25.582	17.728	0.000	817.239
RLMRTG (%)	0.964	2.389	0.000	39.202
AFFINV (%)	4.192	9.225	0.000	100.000
LIABLINE (%)	17.308	30.360	0.000	100.000
AUTO (%)	24.427	24.124	0.000	100.000
WCOMP (%)	10.513	25.170	0.000	100.000
SHORTTAIL (%)	27.049	23.013	0.000	100.000
REINSASMD (%)	22.789	28.728	0.000	100.000
REINSURANCE (%)	38.340	28.771	0.000	100.000
BUSHERF	0.459	0.257	0.090	1.000
GEOHERF	0.529	0.387	0.000	1.000
GROWTH (%)	18.704	73.778	-99.875	564.631
TAXSHIELD (%)	33.811	17.105	-146.593	227.300
RBCRATIO	11.132	20.022	-7.903	777.620
AGE	45.727	41.654	1.000	215.000
SIZE	11.565	1.832	5.990	18.468
GROUP	0.729	0.444	0.000	1.000
STOCK	0.700	0.458	0.000	1.000
MUTUAL	0.223	0.416	0.000	1.000

Figure 6 shows the income streams with and without loss reserve errors. By subtracting the reserve errors from the reported loss reserves, the "true" underwriting income and total income can be obtained (without taking into consideration the change of tax and dividend to

policyholders' due to the income change). As we can see, in the aggregated level, the fluctuation of assets scaled underwriting income and overall income are much higher if there is no reserve error (the loss reserve error adjusted income). Moreover, the investment income stream is much more stable than the underwriting income. While the underwriting income fluctuates with the potential underwriting cycles, there are no obvious cycle patterns for investment income.

Figure 6

Loss Reserve Errors and Income Streams



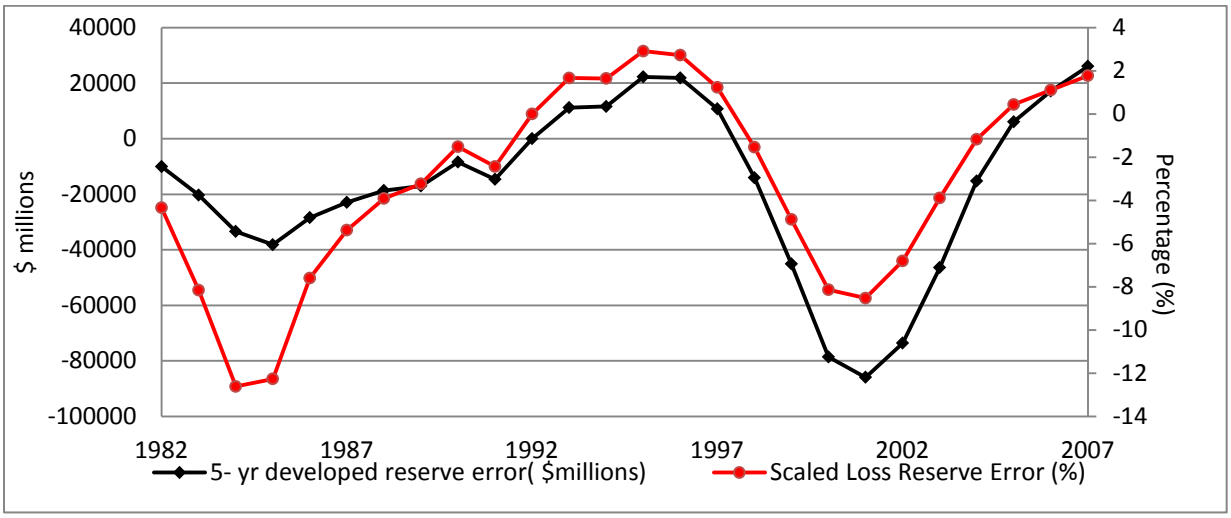
Data source: NAIC annual Statements (1996 to 2012).

Using the industry losses incurred development data from Best's Aggregates & Averages for Property/Casualty industry we are able to obtain the industry level loss reserve errors from 1982 to 2007.

Figure 7 is the magnitude of P/C insurance industry aggregated loss reserve errors from 1982 to 2007 measured by millions of dollars and proportion of total assets. A runs test of randomness is conducted. The null hypothesis is rejected with p-value 0.0003, suggesting that the time-series of industry level loss reserve errors are not random.

Figure 7

Loss Reserve Errors of U.S. P/C Insurance Industry (1982-2007)

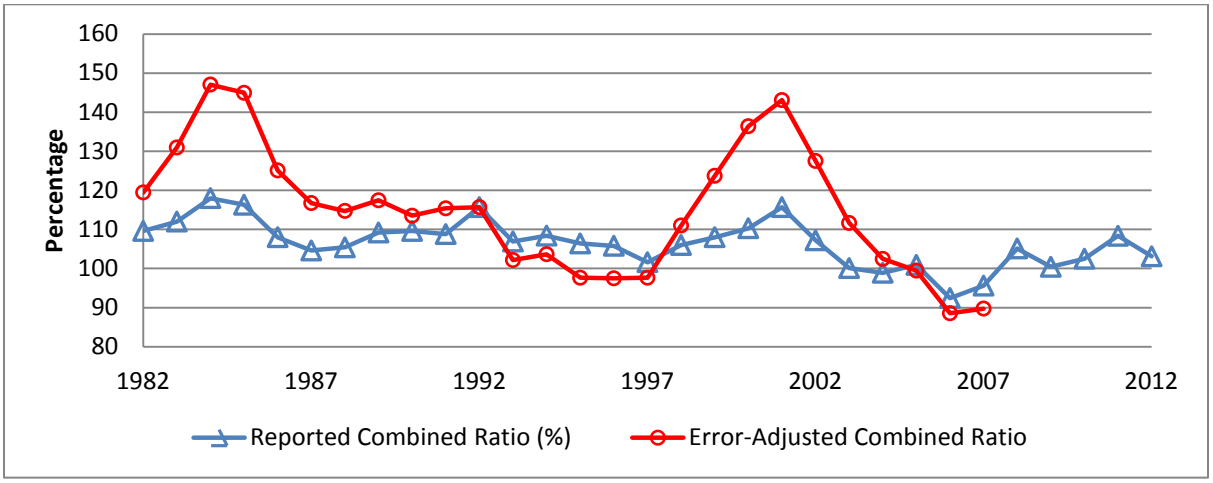


Data Source: Best's Aggregates & Averages - Property/Casualty (Annually).

Figure 8 and Figure 9 are the error-adjusted combined ratio and error-adjusted policyholders' surplus. We can see that the reported combined ratios and policyholders' surplus are smoother than those without loss reserve errors, indicating the possibility of smoothing by managing loss reserves.

Figure 8

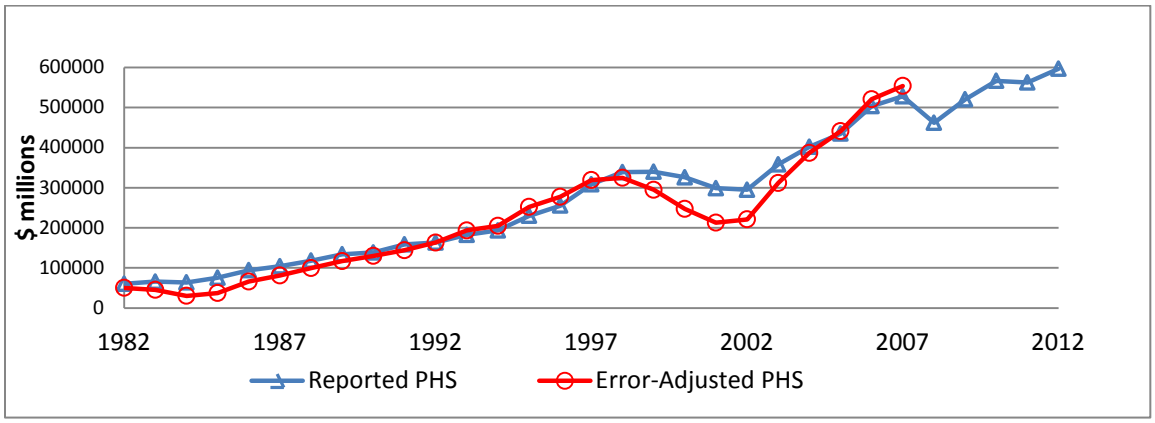
Reserve Error-Adjusted Combined Ratio of P/C Insurance Industry (1982-2012)



Data Source: Best's Aggregates & Averages - Property/Casualty (Annually).

Figure 9

Reserve Error-Adjusted Policyholders' Surplus of P/C Insurance Industry (1982-2012)[12]



Data Source: Best's Aggregates & Averages - Property/Casualty (Annually)

A comparison of Figure 6, Figure 7 and Figure 8 shows that in our sample, from 1997 to 2001, the combined ratio of the property and casualty insurance industry increases (Figure8), the underwriting profit drops (Figure 6), and the degree of under-reserving grows (Figure 7). On the contrary, from 2001 to 2007, while the combined ratio is dropping (Figure 8) and underwriting profit is increasing, insurers tend to have more over-reserve errors (Figure 6).

5.3 Model Specification

To test our hypotheses, the following model is estimated:

$$Error_{i,t} = \alpha + \delta\, Risk_{i,t} + \theta\, Z_{i,t} + \beta\, X_{i,t} + \varepsilon_{i,t} \qquad (6)$$

In this model, $Error_{i,t}$ is the reserve error of company i in year t. $X_{i,t}$ is a vector of firm characteristic variables; $Z_{i,t}$ is a vector of variables tested in previous literature and other control variables; and $Risk_{i,t}$ is a vector of investment risk measures.

The data are unbalanced, with autocorrelation and heteroskedasticity across panels. Wooldridge F-test for autocorrelation in panel data (Wooldridge 2002; Drukker 2003) rejects the null hypothesis of no serial correlation (p-value<0.0001). Both Breusch-Pagan / Cook-Weisberg test

[12] Note: Loss reserve errors are not scaled by total assets.

and White's general test for heteroskedasticity reject the null hypothesis that the variance of residuals is homogenous in pooled-OLS. The modified Wald test for group wise heteroskedasticity rejects the null hypothesis of homoscedasticity for all companies (p-value<0.001) in fixed-effects model. Feasible general least square (FGLS) method with adjustments for autocorrelation and panel heteroskedasticity is used to estimate the effects. 166 observations are dropped from the sample because they only have 1 year time period and impossible to apply autocorrelation coefficient estimation. We include year dummies in the model. The year dummies control some of the common panel invariant factors such as interest rates that influence all the companies in the same time period. The values of the macro-economy variables are commonly the same for all individual companies, so the year dummies can absorb the effects of those factors. The maximum variance inflation factor (VIF) after an ordinary least square regression is 2.74, suggesting that there is no multicollinearity problem.

6 Empirical Results

Table 7 shows the results with measures of investment income level and volatility. Four sets of models are included: first we use the absolute value of the reserve error as a dependent variable, and run the model for the full sample, the over-reserving sample and under-reserving sample; then we use the value of the reserve error as a dependent variable and run the model for the full sample.

According to Table 7, the volatility of investment income is positively related to the magnitude of loss reserve errors across the first three sets of models: the full sample, the over-reserve sample and the under-reserve sample. The results are consistent with our hypothesis: when the volatility of the investment is higher, insurers tend to have more reserve errors. Theoretically, loss reserving is the procedure of estimating future unpaid losses incurred, and the future payments are dependent on the nature of the losses, and independent of the risk in the investment activities of the company. The significant association between loss reserve errors and income volatility suggests that insurers implicitly take the investment risk into consideration when setting up the loss reserves. And loss reserves can be used as "savings" for insurers, similar to savings made by individuals to cope with uncertain outcomes of life events in the future. When there is higher uncertainty related to the future income, like individuals, there are more errors in

the amount of "savings": the magnitude of over-savings or under-savings is greater when the volatility of income is higher. The sign of coefficient for volatility of investment income is consistent in dynamic panel data model (with lag of the dependent variable) and robust OLS model settings.

Table 7

Model Results

Dependent Variable	ABS(ERROR)						ERROR	
	Model (1)		Model (2)		Model (3)		Model (4)	
	Full Sample		Over-reserve (ERROR>0)		Under-Reserve (ERROR≤0)		Full sample	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
INVMEAN	-0.0393	0.0169**	-0.0329	0.0219	-0.1462	0.0370***	0.0263	0.0283
INVSTD	0.0247	0.0124**	0.0276	0.0146*	0.0654	0.0272**	-0.0017	0.0165
BONDCHARGE	0.2925	0.1304**	-0.2126	0.1515	0.5338	0.2172**	-0.4221	0.1838**
RLMRTG	-0.0085	0.0136	-0.0111	0.0137	0.0162	0.0225	-0.0440	0.0173
AFFINV	0.0056	0.0031*	0.0031	0.0033	-0.0010	0.0053	0.0025	0.0048
LIABLINE	0.0328	0.0016***	0.0380	0.0020***	0.0049	0.0028*	0.0390	0.0024***
AUTO	-0.0036	0.0016**	0.0013	0.0017	-0.0106	0.0028***	0.0086	0.0022***
WCOMP	0.0045	0.0035	-0.0017	0.0037	0.0045	0.0056	-0.0170	0.0043***
SHORTTAIL	-0.0088	0.0014***	-0.0068	0.0013***	-0.0047	0.0030	0.0005	0.0021
REINSASMD	-0.0078	0.0012***	-0.0081	0.0012***	0.0021	0.0021	-0.0107	0.0016***
REINSURANCE	-0.0080	0.0011***	-0.0121	0.0011***	-0.0003	0.0018	-0.0105	0.0014***
BUSHERF	0.1391	0.1328	0.0030	0.1421	0.0891	0.2563	-0.1426	0.1778
GEOHERF	0.2054	0.0934**	0.5063	0.0938***	-0.7785	0.1608***	1.3186	0.1306***
GROWTH	-0.0021	0.0002***	-0.0010	0.0003***	-0.0018	0.0004***	0.0004	0.0003
TAXSHIELD	0.0827	0.0023***	0.0923	0.0025***	0.0646	0.0042***	0.0534	0.0028***
RBCRATIO	-0.0075	0.0015***	-0.0029	0.0010***	-0.0058	0.0027**	-0.0013	0.0016
AGE	-0.0063	0.0009***	-0.0061	0.0010***	-0.0013	0.0015	-0.0028	0.0014*
SIZE	-0.1337	0.0226***	-0.1944	0.0237***	-0.1871	0.0391***	0.0034	0.0342
GROUP	0.0892	0.0838	-0.1092	0.0886	0.2880	0.1468**	-0.5912	0.1275***
STOCK	-0.0365	0.0834	-0.3312	0.0895***	0.7830	0.1470***	-0.7492	0.1269***
Year Dummies		***		***		***		***
Constant	3.9044	0.3287***	4.8047	0.3495***	3.7782	0.5487***	1.5445	0.4776***
ρ (coefficient of autocorrelation)	0.5646		0.6074		0.5925		0.7115	
Sample Size	14160[1]		8671[2]		5091[3]		14160[1]	

Note 1: 166 observations dropped because only 1 observation in group;
Note 2: 274 observations dropped because only 1 observation in group;
Note 3: 290 observations dropped because only 1 observation in group.
***: Significant at the 0.01 level; **: Significant at the 0.05 level; *: Significant at the 0.1 level.

Model (1), Model (2) and Model (3) show that loss reserve errors are negatively associated with the average investment income in the past few years. Grace (1990) finds negative association between loss reserve errors and average overall income in the past three years, and she explains that when the past income is higher, the insurers have more incentives to under-reserve to maintain the income level. However, I interpret this association in a different way. The investment income contributes greatly to the overall income of the insurer (as seen from Figure 6). When the investment income is higher, the downside-risk for the overall income is smaller. Thus there is less stress for managers to manipulate loss reserves to increase income because the probability of making unfavorable income is smaller. This explains the results that the absolute values of reserve errors for both the under-reserving companies and over-reserving companies decrease when the average investment income is higher.

Model (4) shows that insurers tend to over-reserve when the investment income level is higher, and they under-reserve when volatility of investment income is greater, which is consistent with the income smoothing incentive. However the association is not significant when we use the loss reserve error as a dependent variable.

When looking at the investment profile of the insurers, Model (1) shows that the default risk in bonds is positively associated with loss reserve errors. Commonly, the non-investment grade bonds are high-yield but with higher default risk, and deliver unstable future payments. Investments in lower-rating bonds bring high uncertainty to the income of the insurer. These investments may bring higher than usual profit to the company, but they may make little profit due to the high default risk: the company who issues the bonds may not pay coupon interest or the principal amount due at maturity in a timely manner. Thus it increases both the volatility of the total income and the downside risk. The results of Model (2), Model (3) and Model (4) indicate that the default risk in bond investments is associated with less over-reserving errors and more under-reserving errors, that is, it increases the incentive of income-increasing smoothing. This can also be explained by the increase of downside risk: the potential "worst" results brought by the default risk motivate the insurers to use income-increasing strategies to avoid large income drops. The coefficient of investments in real estate and mortgage loans (RLMRTG) is not significant in all the model settings of Table 7, which implies that liquidation risk is not significantly associated with loss reserve errors. When the risk of affiliated investments is higher,

insurers tend to reserve less accurately. The investment in affiliated institutions (AFFINV) is significantly positively correlated with magnitude of loss reserve errors in Model (1) but the effects are not significant in other models.

The results discussed above suggest that when the investment risk (in form of downside risk, income volatility, and default risk of bonds) is higher, insurers tend to reserve less accurately, and insignificantly under-reserve. The outcomes are consistent with the income smoothing hypotheses (Ha 1) rather than the underwriting capacity hypotheses (Ha 2).

The full sample and over-reserving sub-sample are consistent with tax hypothesis: insurers tend to over-reserve when the tax rate is higher. Generally, insurers tend to have larger over-reserve errors when the tax deferral benefit is higher, as shown in Model (4).

The RBC ratio is negatively associated with the magnitude of loss reserve errors, which means financially stronger insurers tend to estimate the loss reserve more accurately. Bowne et al. (2012) use RBC ratio as a measure of financial strength, and our results are consistent with theirs. Petroni (1992) finds that weak insurers are more likely to under-reserve. Our results show that weak insurers make more reserve errors, either under-reserve or over-reserve. This might be due to the fact that the weak insurers lack the ability to accurately estimate reserve errors.

Both the reinsurance assumed (REINSASMD) and reinsurance purchased (REINSURANCE) are negatively correlated with the reserve errors. The findings for reinsurance purchase are consistent with previous literature (Browne, Ju, and Lei 2012), for all the four sets of models. Insurers that cede more business to reinsurers tend to reserve more accurately. There over-reserving errors are significantly lower when more reinsurance premiums are ceded to reinsurers. The improvement of accuracy can be explained by the incentive to get better reinsurance terms (Browne, Ju, and Lei 2012) and the transfer of risky business to reinsurers. For reinsurance assumed, because the managers have less discretion over the reserve for the assumed reinsurance(Petroni 1992), less discretional loss reserve errors are expected when the company assumes more reinsurance. However, the reinsurance assumed does increase the volatility of the underwriting income since risks are transferred from the ceding company. Therefore, the insurers with a moderate amount of reinsurance assumed may have more incentive to manipulate loss reserve errors than those who assume less reinsurance from the ceding companies. This might

contribute to the positive but insignificant correlation between reinsurance assumed and the under-reserving errors.

For the lines of business mix, more premiums written on liability lines are associated with more reserve errors. The long-tail feature of liability insurance does not only increases the uncertainty in estimating the loss reserves, but also gives managers more room to manipulate. On the contrary, auto insurances are less risky lines, with more than 90 percent of the claims settled within the first five years(Nelson 2000). Our results are consistent with the prediction that there are smaller reserve errors if the proportion of business in auto insurance is higher. According to Model (2) to Model (4), AUTO is significantly associated with smaller under-reserving errors, but not significantly related to over-reserving errors. Greater loss reserve errors are observed when the insurer writes more business in workers' compensation. The results of Model (2), Model (3) and Model (4) are consistent with the fact that reserves of workers' compensation are allowed to be discounted to present values, so under-reserving errors increases when the proportion of net premiums written on workers' compensation increases.

The results suggest that both the business Herfindahl index and geographic Herfindahl index are positively correlated with reserve errors. The business concentration is not significantly correlated with the magnitude of loss reserve errors. This indicates that insurers that focus on certain lines of business are more professional and able to reserve more accurately, so they can mitigate the reserve errors brought by the exposure of catastrophe shocks in the concentrated lines. Insurers with higher geographic concentration tend to be more conservative and report larger over-reserving errors due to the lack of diversification. The model results show that insurers with rapid premiums growth, older age and larger size tend to have smaller loss reserve errors. Insurers with group affiliation are significantly reporting more under-reserving errors. Stock insurers report more under-reserving errors. Thus we conclude that mutual insurers and insurers without group affiliation are more conservative in loss reserving.

7. Conclusion

In this paper, we investigate the relationship between loss reserve errors and the investment risk of property/casualty insurance companies. We find significant positive relationships between the

loss reserve errors and investment risk while controlling risk related to underwriting risk, financial weakness and tax shield. Our results show that loss reserve errors are not only significantly associated with underwriting but also connected to investment activities. More specifically, the relationship is more consistent with the income smoothing hypotheses (Ha 1) than the underwriting capacity hypotheses (Ha2). The results suggest income smoothing via loss reserves are related to both the level and volatility of investment income. Generally, when risk in investment is higher, insurers report less accurate loss reserves. When the volatilities of investment income are higher, insures tend to make greater loss reserve errors. And the loss reserve errors are smaller when the average investment income level is higher. There is also a positive and significant relationship between loss reserve errors and exposure of default risk in bonds investments and affiliated investments.

One implication of our study is that if insurers manage reserves to smooth income, posted loss reserves are also a function of their investment strategy. Since larger risk implies larger volatility in earnings, it requires more reserve manipulation to smooth income. Another implication is that if loss reserve is used as a smoothing tool, the smoothing target is the overall income, which includes both underwriting income and investment income.

This study finds consistent evidences that support the hypothesis of tax shield incentive, financial weakness and reinsurance purchase. However, financially weaker insurers report larger over-reserving errors and larger under-reserving errors, which implies that they may be unable to reserve accurately, while the prior literature finds they under-reserve to mask their financial problems.

Appendix

Appendix 1
Schedule P Part 2 and Part 3 in Annual Statement for the year of 2005 of

Allstate Insurance Company

A: Initial estimate of Losses Incurred

B: Developed estimate of Losses

SCHEDULE P - PART 2 - SUMMARY

Years in Which Losses Were Incurred	INCURRED NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)										DEVELOPMENT	
	1	2	3	4	5	6	7	8	9	10	11	12
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	One Year	Two Year
1. Prior	9,007,699	8,451,168	8,153,179	8,045,357	7,935,080	7,917,663	8,154,942	8,748,097	9,380,776	9,661,834	281,058	913,737
2. 1996	12,930,430	12,832,227	12,543,818	12,375,958	12,288,849	12,289,713	12,303,277	12,311,452	12,315,726	12,319,400	3,674	7,948
3. 1997	XXX	11,881,098	11,591,006	11,433,961	11,348,172	11,351,311	11,356,016	11,367,494	11,350,884	11,355,010	4,126	(12,484)
4. 1998	XXX	XXX	11,946,010	11,866,938	11,803,522	11,764,534	11,779,668	11,805,978	11,770,072	11,748,167	(21,905)	(57,811)
5. 1999	XXX	XXX	XXX	12,509,371	12,476,870	12,469,222	12,508,156	12,510,396	12,467,204	12,467,258	54	(43,138)
6. 2000	XXX	XXX	XXX	XXX	14,061,797	14,496,116	14,591,047	14,587,441	14,514,281	14,500,088	(14,193)	(87,353)
7. 2001	XXX	XXX	XXX	XXX	XXX	14,097,696	14,445,693	14,433,905	14,339,958	14,329,885	(10,073)	(104,020)
8. 2002	XXX	XXX	XXX	XXX	XXX	XXX	13,641,857	13,499,599	13,329,105	13,276,962	(52,143)	(222,637)
9. 2003	XXX	XXX	XXX	XXX	XXX	XXX	XXX	13,523,155	13,080,280	12,894,498	(185,782)	(628,657)
10. 2004	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	13,199,732	12,776,860	(422,872)	XXX
11. 2005	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	16,993,357	XXX	XXX
										12. Totals	(418,056)	(234,415)

C: Cumulative Payment at reporting

SCHEDULE P - PART 3 - SUMMARY

Years in Which Losses Were Incurred	CUMULATIVE PAID NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)										11	12
	1	2	3	4	5	6	7	8	9	10	Number of Claims Closed With Loss Payment	Number of Claims Closed Without Loss Payment
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005		
1. Prior	000	2,190,983	3,774,575	4,725,671	5,511,803	6,008,062	6,498,083	6,746,519	6,972,904	7,310,807	XXX	XXX
2. 1996	7,611,314	9,876,324	10,799,446	11,472,722	11,836,844	12,066,165	12,189,825	12,235,589	12,265,289	12,282,059	XXX	XXX
3. 1997	XXX	6,744,129	8,920,109	9,879,259	10,523,412	10,925,433	11,144,905	11,231,382	11,281,573	11,308,342	XXX	XXX
4. 1998	XXX	XXX	7,107,859	9,429,360	10,368,865	10,992,437	11,388,065	11,562,087	11,645,350	11,685,172	XXX	XXX
5. 1999	XXX	XXX	XXX	7,762,331	10,216,301	11,172,895	11,763,108	12,094,046	12,265,431	12,337,857	XXX	XXX
6. 2000	XXX	XXX	XXX	XXX	8,974,493	12,072,615	13,151,948	13,761,081	14,103,850	14,262,186	XXX	XXX
7. 2001	XXX	XXX	XXX	XXX	XXX	8,912,523	11,989,415	13,028,657	13,608,008	13,931,626	XXX	XXX
8. 2002	XXX	XXX	XXX	XXX	XXX	XXX	8,306,746	11,027,292	11,989,661	12,550,771	XXX	XXX
9. 2003	XXX	XXX	XXX	XXX	XXX	XXX	XXX	8,040,984	10,652,731	11,564,391	XXX	XXX
10. 2004	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	7,722,449	10,308,811	XXX	XXX
11. 2005	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	9,736,934	XXX	XXX

Initial Loss Reserve= A-C, Developed Loss Reserve=B-C, Reserve Error= (A-C)-(B-C) =A-B

Appendix2

NAIC SVO Designation[13]

Credit Category	Description
NAIC 1 (Highest Quality)	Interest, principal or both will be paid in accordance with the contractual agreement and that repayment of principal is well protected.
NAIC 2 (High Quality)	For the present, the obligation's protective elements suggest a high likelihood that interest, principal or both will be paid in accordance with the contractual agreement, but there are suggestions that an adverse change in circumstances or economic, financial or business conditions will affect the degree of protection and lead to a weakened capacity to pay.
NAIC 3 (Medium Quality)	The likelihood that interest, principal or both will be paid in accordance with the contractual agreement is reasonable for the present, but an exposure to an adverse change in circumstances or economic, financial or business conditions would create an uncertainty about the issuer's capacity to make timely payments.
NAIC 4 (Low Quality)	The likelihood that interest, principal or both will be paid in accordance with the contractual agreement is low and that an adverse change in circumstances or business, financial or economic conditions would accelerate credit risk, leading to a significant impairment in the issuer's capacity to make timely payments.
NAIC 5 (Lower Quality)	The likelihood that interest, principal or both will be paid in accordance with the contractual agreement is significantly impaired given any adverse business, financial or economic conditions.
NAIC 6 (In or near default)	Payment of interest, principal or both is not being made, or will not be made, in accordance with the contractual agreement.

Source: NAIC Securities Valuations Office (SVO).

[13] Details see "NAIC Designation", link: http://www.naic.org/documents/svo_naic_public_listing.pdf

Appendix 3

Risk-Based Capital Action Levels[1]

The NAIC RBC formula generates the regulatory minimum amount of capital that a company is required to maintain to avoid regulatory action. There are five levels of action that a company can trigger under the formula. The base action level is the Authorized Control Level. If a company's actual capital dips below its Authorized Control Level Risk-Based Capital, the state insurance regulator has the authority to place the company under regulatory control. Therefore, the Authorized Control Level (ACL) is used as the base level, and the other regulatory intervention levels are defined relative to the ACL. The five action levels are:

1) No Action, which means that a company's total adjusted capital (TAC) is at least twice its ACL;

2) Company Action Level, which means that a company's TAC is at least 1.5 times its ACL but less than twice its ACL;

3) Regulatory Action Level, which means that the company's TAC is at least equal to its ACL but less than 1.5 times its ACL;

4) Authorized Control Level, which means that a company's TAC is at least 0.70 times its ACL but less than its ACL; and

5) Mandatory Control Level, which means that the company's TAC is less than 0.70 times its Authorized Control Level RBC.

Note 1: Per description of NAIC Property & Casualty Industry RBC Results and Risk-Based Capital Forecasting and Instructions.

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