The Impact of Sarbanes-Oxley on Property-Casualty Insurer Loss Reserve Estimates

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Abstract

The implementation of the Sarbanes-Oxley (SOX) Act in 2002 imposed a wide range of new standards seeking to assure greater accuracy and transparency in the financial reporting of publicly traded firms in the U.S. We investigate whether the passage of SOX shares a relationship with a reduction of reserve error estimation among publicly traded U.S. property-casualty insurers. Using data covering insurers from 1998-2006, our analyses do not find compelling evidence to suggest that the implementation of SOX is associated with a change in the loss reserving behavior of public insurers. Our results remain robust with different model specifications. In light of our findings that focus on SOX, the value of the additional level of regulation imposed by the Annual Financial Reporting Model Regulation may be questionable and serve as an example of over-regulation of the industry.

Introduction

Public Company Accounting Reform Act – more popularly known as the Sarbanes-Oxley (SOX) Act, was implemented in 2002 in response to a wave of corporate scandals that raised concerns as to the integrity of the accounting information provided to stakeholders (Jain and Rezaee 2006; Rezaee 2004).[1] While broad in scope, a primary purpose of SOX is to improve the accuracy and reliability of the financial reporting of publicly traded firms (Data Governance Institute, 2012). Given the unique fiduciary nature of the insurance transaction and its associated accounting idiosyncrasies, SOX holds special implications for the property-casualty insurance industry and its loss reserving practices.

Because of the magnitude of loss reserves as an element of an insurer's financial reports and the degree of discretion allocated to senior management in setting those reserves, loss reserves

[1] The content of the Act is available online at http://www.sec.gov/about/laws/soa2002.pdf.

represent a uniquely important aspect of insurer financial reporting. A significant body of research has concluded that some property-casualty insurers regularly engage in the manipulation of loss reserve estimates to achieve predetermined goals in their financial reporting (e.g. Anderson, 1973; Grace, 1990; Petroni, 1992; Eckles and Halek, 2010; Grace and Leverty, 2012). Whether such behavior rises to the level of unethical behavior is the subject of significant regulatory scrutiny (Nelson, Elliot, and Tarpley, 2003).

The value and costs associated with compliance with SOX's mandates is a matter of great debate with significant opposition (see for example, Leon, 2006; McKinsey & Company, 2007; Prentice, 2007). Conversely, more recent empirical research suggests that SOX has had a positive impact on the accuracy and transparency of the financial reporting of public firms (Cohen, Dey, and Lys, 2008). This current research focuses on the relationship SOX shares with the misestimation of loss reserve accruals by publicly traded property-casualty insurers. We investigate whether public insurers generate relatively smaller, i.e. more accurate, reserve errors during the period following the passage of SOX, as compared to the pre-SOX period.

This assessment comes at a particularly poignant time. The recent adoption of the Annual Financial Reporting Model Regulation by state insurance departments essentially imposes most of the financial reporting requirements of SOX to *all* insurers operating in the U.S. marketplace.[2] As was the case with SOX, the value of additional regulation of the insurance market is also the subject of significant debate (Augustinos, 2005).

The remainder of the paper is organized as follows. The next section provides an overview of SOX, as well as pertinent literature on loss accrual estimation and reserve errors in the insurance industry. We then present our empirical analysis followed by a conclusion section that offer a summary of our important findings and implications.

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[2] Following the lead of Federal legislators in the creation of SOX, the National Association of Insurance Commissioners (NAIC) reviewed and modified its own proposed model regulation and has adopted revisions to the Annual Financial Reporting Model Regulation (colloquially known as the *Model Audit Rule*) that has been vetted and adopted by virtually all state insurance departments as of 2010. The actual text of the Model Audit Rule is available online at http://oci.wi.gov/advcoun/ar_naic.pdf. A summary of the regulation and its implications for the insurance industry is available through Deloitte in its publication titled, *NAIC Model Audit Rule and Implementation*, available online at http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us_lshc_naic_model_audit_1007.pdf.

Background

Sarbanes-Oxley

The passage of SOX in 2002 was heralded as groundbreaking reform. When signed into law, then-President George W. Bush stated that the Act was among "the most far-reaching reforms of American business practices since the time of Franklin D. Roosevelt. The era of low standards and false profits is over; no boardroom in America is above or beyond the law" (New York Times, 2007).[3] SOX sought to restore public confidence in corporate America in light of a number high profile scandals that surfaced near the turn of the century by honing corporate governance standards and strengthening accountability.[4] Specifically, SOX seeks to:

- Formalize and strengthen internal checks and balances within corporations,
- Institute various new levels of control and sign-off designed to,
- Ensure that financial reporting exercises full disclosure, and
- Require corporate governance is transacted with full transparency.

While the scope of SOX is broad (the Act contains eleven different titles) Section 302 of Title III (Corporate Responsibility) has special applicability to potential activities related to earnings management. Section 302 (Corporate Responsibility for Financial Reports) acutely highlights the personal responsibility placed on senior management when attesting to the accuracy and transparency of the financial reporting of public firms.

In the broader industry literature, ample evidence suggests the use of accrual-based earnings management prior to the passage of SOX.[5] For example, Robb (1998) shows that bank managers make greater use of the loan loss provision to manipulate earnings upward when analysts have reached a consensus in their earnings predictions. Payne and Robb (2000) find that firms with pre-managed earnings below analysts' earnings expectations have greater

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[3] For a discussion of the Act's contents please see, "A Guide to The Sarbanes-Oxley Act" (http://www.soxlaw.com/).

[4] See for example, the financial misadventures of Enron, Tyco International, Adelphia, Peregrine Systems, and WorldCom.

[5] Earnings management is the process by which management takes legitimate advantage of the flexibility of certain accounting rules to deliberately affect outcomes included on financial reports. These manipulations are often associated with expenses and recognized revenues. It can sometimes be difficult to differentiate allowable practices from earnings fraud or manipulation.

positive abnormal, or discretionary accruals. Moehrle (2002) reports that firms use restructuring accrual reversals to manage earnings to beat analysts' forecasts. Kasznik and McNichols (2002) also provide evidence consistent with accruals manipulation to meet or beat analysts' estimates. Evidence of SOX's ability to actually impact accrual-based earnings management is only now beginning to emerge and some are finding a positive result (Cohen, Dey, and Lys, 2008), a finding that lends support for this current assessment of SOX's potential impact on reserving behavior in the insurance industry.

Loss Accrual Estimation and Reserve Errors in the Insurance Industry

Accounting rules require property-casualty insurers to periodically establish a liability estimate for unpaid claims based on the estimated ultimate cost of settling the claims (including the effects of inflation and other societal and economic factors).[6] Estimates for these loss reserves are required to be based upon past experience adjusted for current trends, and any other factors that would modify past experience.[7]

Incurred losses are comprised of both paid losses and estimates of values of incurred-but-not-yet-paid losses; these latter values are recognized on the insurer's financial statements as loss reserves. As time passes, new evidence is presented or reported and claims are settled and/or associated reserves are modified. Because of these complexities, insurers typically enlist the services of actuaries in developing an estimation model that will generate a distribution of feasible values for consideration by the senior executive who must ultimately sign-off on the insurer's financial reports. Retrospectively, one can determine the degree to which the insurer either over- or under-reserved for any given accident year.

Given the imprecise nature of estimating future values, the fact that insurers consistently incur errors in their reserve estimates should come as little surprise.[8] The magnitude of the errors however, can be sizable; aggregate industry errors frequently exceed $25 billion in a given year. Figure 1 reveals the aggregate net loss reserve errors by the U.S. property-casualty

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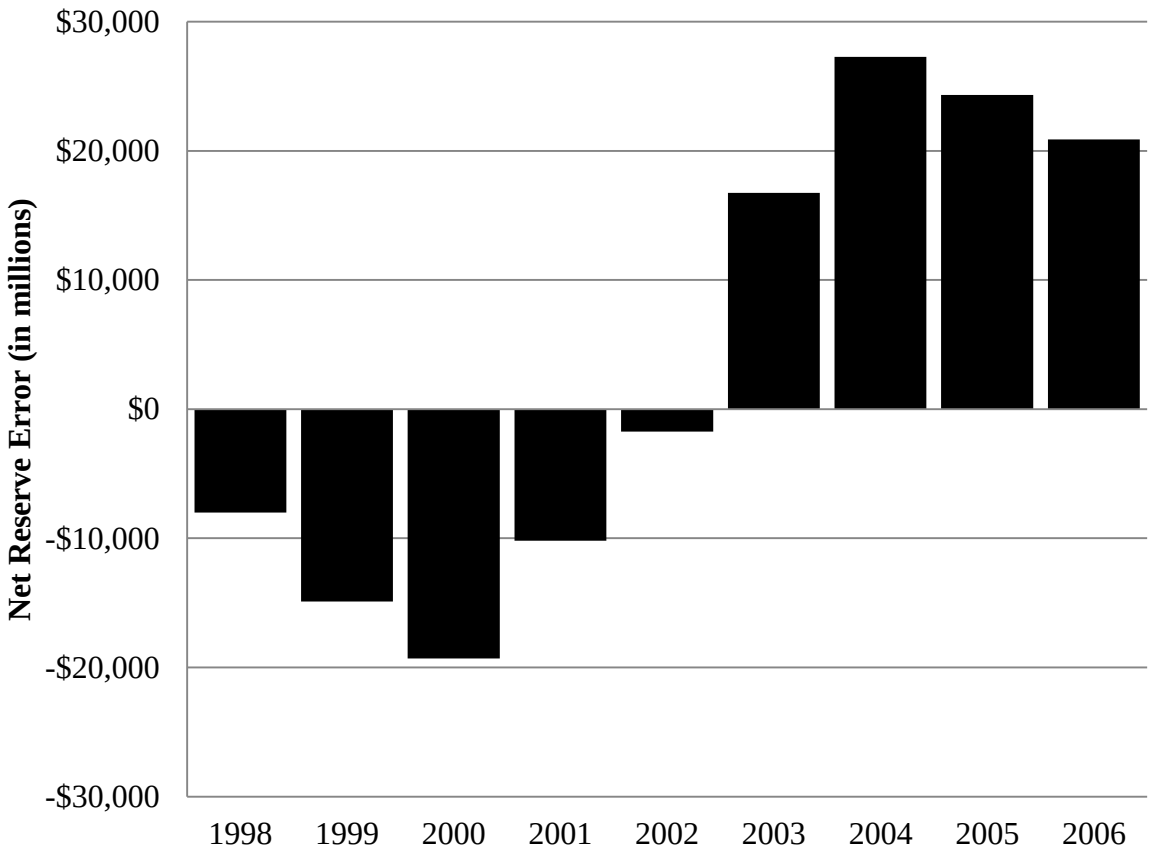
[6] For more details please see the Financial Accounting Standards Board's (FASB) Statement of Financial Accounting Standards No. 60, available online at http://www.fasb.org/pdf/fas60.pdf.

[7] For a deeper discussion of the actuarial process in setting loss reserves, please see Brown and Miller, 1988.

[8] Loss reserves are typically the single largest entry in the liability section of an insurer's balance sheet; often comprising more than 60 percent of an insurer's total liabilities.

insurance industry from 1998 to 2006. Interestingly, historical results reveal that not only do these errors vary significantly over time, but the aggregate industry errors reveal an undulating pattern. While errors are to be expected in these estimates, the existence of a pattern suggests that these are not random errors but rather, patterned errors. The issue has not gone unnoticed in the earlier literature.

Figure 1. Aggregate Insurance Industry Net Reserve Error



Smith (1980) examines insurer reserving behavior and shows that the incidence of underestimating and overestimating reserves was not random. Prior to that study, Anderson (1973) analyzes the effects of reserve errors on policyholders' surplus and finds that insurer reserve errors have an income stabilization effect. Similarly, Grace (1990) and Beaver, McNichols, and Nelson (2003) provide evidence that insurers use loss reserve estimation to impact reported earnings. Petroni (1992) shows that insurers may manipulate reserve

estimations to achieve certain performance ratios in order to avoid regulatory scrutiny. Grace and Leverty (2012) revisit the issue using two measures of reserve errors and conclude that empirical findings are contingent upon the definitions of reserve errors. Browne, Ju, and Lei (2012) further report reserve errors to be related to reinsurance usage and contingent commissions. With regard to the effect on stock market reaction, Anthony and Petroni (1997) find that financial markets provide smaller earnings response coefficients to insurers with more variable reserve estimation error than to insurers with less variation in their estimation error. Petroni, Ryan, and Wahlen (2000) further report empirical support for a negative relationship between discretionary revisions of loss reserve and stock valuation. Gaver and Paterson (2001) assess the relationship between major actuarial consulting groups as oversight entities and insurer reserve errors. They conclude that major consulting groups insist on more conservative loss reserving behavior as compared to smaller, less influential actuarial consulting firms. With regard to public insurers, Browne, Ma, and Wang (2009) provides evidence that public insurers may under-reserve to increase short-term stock price and thereby benefit executives with stock-based compensation. Similarly, Eckles and Halek (2010) provide evidence that managers manipulate loss reserves to maximize their compensation. Taken together, this body of literature suggests that some level of earnings management is indeed occurring with respect to the insurance industry's estimation of its loss reserves. The question addressed in this research is whether the passage of SOX shares a relationship with a reduction in the magnitude of the average public insurer's loss reserve error.

Research Methodology

Reserve Error Calculation

Following earlier research on the subject (e.g. Petroni, 1992; Beaver *et al*, 2003), we define the magnitude of a reserve error to be:[9]

[9] Some prior literature used the difference between incurred losses at time t and cumulative paid losses at time *t*+5 as a measure for reserve errors (see for example, Weiss, 1985; Grace, 1990; Browne *et al*., 2008). This method, however, is not recommended by actuaries because paid losses do not include cases and estimates of incurred but not reported losses. Thus, we chose the incurred losses instead of paid losses in our calculation of reserve errors, which is more in line with how the insurance industry measures such estimates.

$$Error_{i,t} = [Incurred\ Losses_{i,t} - Incurred\ Losses_{i,t+5}].$$

where $Incurred\ Losses_{i,t}$ is insurer *i*'s estimated incurred losses and allocated expenses at the end of year *t* for premium earned in year *t*. $Incurred\ Losses_{i,\,t+5}$ is the re-estimation of the incurred losses and expenses made five years later for premiums earned in year *t*. A positive (negative) value of $Error_i$ indicates insurer *i* has overstated (understated) reserve errors. Previous studies have found that a five year period is sufficient to observe statistically significant reserve errors (see for example, Smith, 1980; Kazenski, Feldhaus, and Schneider, 1992).

To illustrate, Tables 1 and 2 present incurred loss and loss adjustment expenses and paid losses and allocated expenses, respectively, from 2006 to 2011 for ABC insurance company. In 2006, ABC insurance company reported incurred loss and loss adjustment expenses to be $169,810. Loss reserve for 2006 accident year as reported in 2006 is $56,791, the difference between $169,810 and $113,019, the reported paid loss and loss adjustment expenses by the end of 2006. In 2011, five years after the original estimation year, ABC insurance company revised incurred loss and loss adjustment expenses for accident year 2006 to be $372,802. Consequently, the revised loss reserve for loss year 2006 reported in 2011 is $259,783, which is the difference between $372,802 and $113,019. In this case, ABC insurance company has under-estimated their loss reserve for accident year 2006 by $202,992 based on loss development over a five-year period.

Table 1. Summary of Incurred Losses & Loss Adjustment Expenses for ABC Insurance Company

Accident Year	Net Reported Incurred Losses & Loss Adjustment Expenses (000s omitted)					
	Calendar Year					
	2006	2007	2008	2009	2010	2011
2006	169,810	254,866	275,755	311,914	317,510	372,802
2007		240,720	322,303	415,237	393,054	379,744
2008			323,646	432,530	512,882	497,862
2009				343,170	412,346	453,884
2010					359,064	471,115
2011						325,441

Table 2. Summary of Paid Losses & Allocated Expenses for ABC Insurance Company

Accident Year	Paid Losses and Allocated Expenses (000s omitted)					
	Calendar Year					
	2006	2007	2008	2009	2010	2011
2006	113,019	203,393	228,278	250,743	300,892	337,078
2007		157,322	254,929	316,855	345,418	355,149
2008			194,148	298,552	383,200	413,039
2009				215,817	323,320	387,629
2010					210,575	332,769
2011						174,525

Empirical Models

Given that reserve errors can be either positive (i.e. over-reserve error) or negative (i.e. under-reserve error), we take the absolute value of the reserve error as our dependent variable to capture the magnitude of loss reserve errors in a given period. To control for the variation in insurer size, reserve errors are scaled using an insurer's total admitted assets. While our key interest lies in whether public insurers experience smaller reserving errors subsequent to the implementation of SOX, we include non-public insurers in our sample as a control group.[10] Non-Public insurers are a logical control group for this study as they are not bound by SOX regulation, but are otherwise largely subject to the same rules and regulations applicable to all insurers. We observe all insurers for both pre- and post-SOX periods and use the difference-in-differences estimation to identify relative changes in reserve errors by public insurers that may be attributable to SOX (Card and Krueger, 1994). This method removes biases in calculating reserve error changes by public firms from pre- and post-SOX periods that are due to trends common to all insurers.[11] It also removes biases from comparing public insurers with non-public insurers during the post-SOX period that are due to the permanent difference between those two groups. Therefore, we estimate the following equation:

$$\left|y_{i,t}\right| = \phi k_t + \gamma x_i + \lambda k_t x_i + \delta z_{i,t} + \varepsilon_{i,t} \qquad (1)$$

[10] We include all mutual and privately held insurers in our non-public insurer category.

[11] Prior to 2002, all insurers filed reports in accordance with the NAIC Annual Statement requirements. With the passage of SOX, public insurers now report under both SOX and NAIC.

where $y_{i,t}$ represents reserve error for firm *i* at year *t*, *k* is a dummy variable that indicates whether the observation year is post-SOX (i.e. years 2002 and after), *x* is a dummy variable for public firms that captures the differences between public and non-public firms and *z* is a matrix of firm and industry level control variables.[12] Our main coefficient of interest is the difference-in-differences estimate λ, which captures the changes in reserve errors by public firms between pre- and post-SOX periods after removing the time trend. Specifically,

$$\lambda=\left(\bar{y}_{public,post-SOX}-\bar{y}_{public,pre-SOX}\right)-\left(\bar{y}_{private,post-SOX}-\bar{y}_{private,pre-SOX}\right)$$

If SOX has had the expected effect on reserve estimation errors, we expect λ to bear a negative sign.

Data

Our data are from two main sources: the NAIC annual statement database and the Best's Key Rating Guide. The NAIC database contains information that allows for the construction of the variable that measures the insurer's reserve errors as well as other control variables. Solvency rating information is collected from the Best's Key Rating Guide. While our main focus is on public insurers, our sample covers all insurers that report positive values on total assets, direct premium written and losses incurred. We identify public insurers by using SNL database. Insurers that belong to an ultimate owner that are publicly traded are recognized as public insurers. We make use of data spanning the 1995 to 2011 period to create a sample over 1998-2006 period.[13] This allows us to compare the reserving practice of the four years prior to SOX with the five years immediately following the implementation of the legislation. We include all stock and mutual insurers with positive total assets and direct premiums written. Our final sample includes 11,678 insurer-year observations.

Table 3 reports the summary statistics of the variables used in our empirical models. To control for the variation in insurer size, the reserve errors are scaled using a firm's total admitted assets (Petroni, 1992; Gaver and Paterson, 2001). Overall, the scaled reserve errors

[12] Re-classification of 2002 as part of the pre-SOX period yields similar results as to those reported here.

[13] Given that reserve error estimation relies on the loss development values of the ensuing five years, we use data extending out to 2011, i.e. 2006 plus five years, to calculate 2006 reserve errors. Additionally, given that our lagged return on asset (ROA) variable is generated using the three prior periods, we incorporated data as early as 1995 in creating our 1998 lagged ROA variable.

Table 3. Summary Statistics[†]

Variable	Mean	Std. Dev.	Minimum	Maximum
|Reserve errors|	0.025	0.037	0.000	1.167
Public	0.222	0.415	0.000	1.000
Mutual	0.236	0.424	0.000	1.000
Group	0.722	0.448	0.000	1.000
Total assets (millions)	720.445	3502.320	0.611	98348.110
Lagged ROA	0.026	0.048	-0.643	0.590
Tax	0.166	0.055	0.150	0.390
Good rating	0.187	0.390	0.000	1.000
Long tail	0.457	0.323	0.000	1.000
Contingent commission	0.513	0.500	0.000	1.000
Reinsurance	0.388	0.300	0.000	1.000
Product Herf	0.483	0.298	0.081	1.000
Geo Herf	0.543	0.379	0.030	1.000
Industry loss ratio	0.766	0.061	0.652	0.881

[†] Variable definitions are as follows: |Reserve errors|= absolute value of (incurred $loss_{i,t}$ – incurred $loss_{i,t+5}$)/total assets; public = dummy variable which equals to one if the firm belongs an ultimate owner that is a publicly traded company, and 0 otherwise; mutual = dummy variable which equals to one if the firm is a mutual insurer, and 0 otherwise; group = dummy variable which equals to one if the firm belongs to a group, and 0 otherwise; total assets = total admitted assets in millions; reinsurance = reinsurance premiums ceded/(direct premiums written + reinsurance premiums assumed); contingent commission = dummy variable which equals to one if the firm uses contingent commission, 0 otherwise; lagged ROA = average ROA over the previous three years; tax = marginal tax rate corresponding to the net income plus reserve errors; long tail = percentage of net premiums written in long-tailed lines; good rating = dummy variable which equals to one if rating from AM Best is A- or above, 0 otherwise; product Herf = line of business Herfindahl Index; Geo Herf = geographical Herfindahl Index; industry loss ratio = insurance industry average loss ratio.

in both under- and over-estimation account for an average of 2.5% of an insurer's total assets. In our sample, 22.2% of the observations are publicly traded companies and 23.6% of the firms are mutual insurers. A preliminary examination of the reserving practice of public, mutual and privately held insurers revealed mutual to be uniquely conservative in their reserving practices when compared to the other two groups and thus, we include an indicator variable identifying mutual insurers in our models. We also identify whether an insurer is a group member or is a single company. 72.2% of the insurers in our sample are affiliated with a group. The average assets of the firms are $7.2 billion.

Additional control variables included in the analysis have been gleaned from earlier studies on the subject. Depending on an insurer's financial position, it may be motivated to engage in

earnings manipulation for a variety of reasons, e.g. tax minimization, income smoothing, avoidance of regulatory attention, etc. The basis for many of these motives has been empirically tested but to date, the findings have been mixed (see for example, Grace, 1990; Petroni, 1992; Browne *et al*., 2009; Eckles and Halek, 2010; Grace and Leverty, 2012; Browne *et al*., 2012). Insurers have been found to adjust loss reserves to reduce their income variability (Grace, 1990; Petroni *et al*., 2000; and Smith, 1980). To control for that behavior, we calculate the average return on assets (ROA) over the previous three years to capture the income smoothing incentive. Insurers have also been found to inflate loss reserves for the purpose of postponing the payment of taxes during the current year (Grace, 1990). We control for this effect by including the marginal tax rate an insurer would have been exposed to if they were to have reported accurate anticipated losses by adding reserve errors back into the reported net income for any given year.[14] The average marginal tax rate for our sample is 16.6%, with values ranging from 15% to 39%. We include insurer solvency ratings to capture an insurer's motivation to manipulate loss reserves for financial purposes.[15] An insurer is identified as having a good rating from A.M. Best if its rating is A- or above. 18.7% of insurers receive ratings that are qualified as financially secure. Reserving patterns may vary depending on the character of the lines of business a given insurer writes. Given that it is more difficult to estimate long-tail insurance claims, long-tail lines tend to experience greater reserve revision (Petroni, 1992; Petroni and Beasley, 1996). We measure the percentage of premiums written in workers' compensation, medical malpractice, general liability, and auto liability, to total premiums written for each insurer. On average 45.7% of an insurer's book of business is written in those long-tail lines. Browne *et al.* (2012) argue that insurers may have greater incentives to manipulate loss reserves if they pay contingent commissions as the payment of such commissions are often based on financial results. Following Browne *et al*. (2012), we include a dummy variable that indicates whether the insurer pays contingent commissions. 51.3% of our sample firms use this form of intermediary remuneration. Reinsurance usage has also been found to be associated with reserve accuracy in prior studies

[14] Federal corporate tax rate can be found at http:www.taxfoundation.org/taxdata/show/2140.html.

[15] Browne *et al.* (2012) suggest that A.M. Best solvency rating, the risk-based capital (RBC) ratio and the number of violations according to Insurance Regulatory Information system (IRIS) ratios, are all valid proxies of the insurers' financial condition and provide similar implications in empirical models.

(see for example, Browne *et al*., 2012, and Grace and Leverty, 2012). We use the ratio of reinsurance premium ceded to direct premiums written plus reinsurance assumed to capture the level of an insurer's reinsurance utilization. Product line Herfindahl Index and Geographical Herfindahl Index are also included in our models to control for a firm's diversification strategies. The mean Herfindahl Index for product line and geographical coverage are 50.3% and 57%, respectively. Additionally, reserve error patterns at the industry level also demonstrate a marked correlation with the property-casualty underwriting cycle. The capacity-constraint hypothesis has received significant support in the literature as a rationale for the existence of the underwriting cycle (e.g. Niehaus and Terry, 1993; Gron, 1994). It appears that the errors associated with the initial setting of reserves are not random but rather, an industry-wide pattern of consistently over or under-reserving initial loss estimates (as evidenced by Figure 1). In an effort to control for those effects, we also include industry average loss ratio in our empirical models.[16]

Table 4 summarizes the levels of the absolute values of reserve errors as a percentage of assets for public insurers and for non-public insurers before and after SOX. We also perform t-tests to examine whether public and non-public insurers have differing levels of reserve

Table 4. Reserve Errors for Pre- and Post-SOX periods: Public Insurers vs. Non-public Insurers[†]

	Means with standard deviations in parentheses		
	Public	Non-Public	Difference between Public and Non-Public
Pre-SOX	0.0219 (0.0285)	0.0273 (0.0480)	-0.0054*** (0.0449)
Post-SOX	0.0219 (0.0235)	0.0258 (0.0326)	-0.0039*** (0.0307)
Changes in |Reserve Errors|	<-0.0001 (0.0254)	0.0015* (0.0402)	

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

[16] We have also estimated alternative models by including other industry level control variables, including overall surplus capacity and investment yield. The coefficients for those variables are generally not statistically significant and thus are not included in the final models.

errors during each period, as well as whether the changes in reserve errors before and after SOX are statistically different for each group. A comparison of the figures between public and non-public firms reveals some interesting results. Prior to SOX, the average reserve error is 2.19% and 2.73% of assets for public and non-public insurers, respectively. During the post-SOX period, reserve errors for public insurers remained the same at 2.19% while the same error decreased to from 2.73% to 2.58% for non-public insurers. However, the change experienced by non-public insurers is only statistically significant at the 10% level. When using t-tests and looking at each period separately, public insurers were found to have significantly smaller reserve errors when compared to those of non-public insurers for both pre- and post-SOX periods.

Empirical Results

Table 5 reports our regression results. There are a total of six models. The first two models include all reserve errors – both positive and negative. That presentation stands in contrast to the segmented analyses presented in Models (3) through (6) that assess positive and negative reserve errors separately. Models (3) and (4) include only over-reserving errors (i.e. reserve errors that are positive before taking the absolute value) and Models (5) and (6) include only under-reserving errors (i.e. reserve errors that are negative before taking the absolute value). Models (1), (3), and (5) are basic models without any control variables, and Models (2), (4), and (6) include both insurer-level and industry-level control variables. We estimate the models using White's (1980) consistent covariance matrix estimation is used to adjust for heteroscedasticity. To account for serial correlation in reserve estimation, our standard errors are adjusted for potential autocorrelation. The covariance structure is assumed to follow a first order autoregressive process *AR* (1). Thus, the random error terms $\varepsilon_{i,t}$ in equation (1) are defined as $\rho\,\varepsilon_{i,t-1} + e_{i,t}$, where ρ represents first order correlation and *e* represents random error terms.

The results from the basic models (i.e. Models 1, 3, and 5) are consistent with the models that include additional insurer and industry control variables. Looking at the models that include total errors, the coefficients for *public* are negatively significant, which suggests that public insurers have smaller reserve errors when compared to non-public insurers prior to SOX. The

coefficients for *post-SOX* are also negatively significant, indicating non-public insurers experienced a reduction in reserve errors during the post-SOX period. The coefficients for the interaction terms of *public* and *post-SOX* are not statistically significant, suggesting that public insurers do not experience smaller reserve errors during the post-*SOX* period. When looking at the directional reserve errors in Models (3) through (6), the negative and statistically significant coefficients for *public* in those models suggest that public insurers have smaller scaled over-reserving and under-reserving errors when compared to non-public insurers before SOX. The coefficients for *post-SOX* are positively significant in Models (3) and (4), but negatively significant in Models (5) and (6). These results suggest that non-public insurers have greater over-reserving errors, but smaller under-reserving errors during *post-SOX* period. This finding is consistent with the pattern observed in Figure 1 that reveals that the industry in general tends to over-reserve during the latter part of the period under investigation. Combined with the negative coefficients for *post-SOX* in Models (1) and (2), our results suggest that the increases in over-reserving errors for non-public insurers are smaller than the reductions in under-reserving errors during the post-SOX period.

Among the remaining control variables, the signs of the coefficients are generally consistent across different models, suggesting that most control variables have the same effect on reserve errors, regardless of the direction of the error. In other words, when a variable is found to have an effect on increasing positive reserve errors, it also has the same effect on increasing negative reserve errors. The only exceptions to those findings are the *contingent commissions* and *tax* variables. The coefficients for *mutual* and *group* are both negatively significant, which suggests that mutual insurers and insurers with group affiliation have smaller reserve errors. The coefficients associated with insurer size are also found to be negatively significant in Models (2) and (4), suggesting that large insurers have smaller over-reserving errors (relative to their asset base). This may be expected, as larger insurers are likely to have a deeper experience and broader database from which to draw on when developing reserve estimates. Firms that pay contingent commissions are found to have greater over-reserving errors while generating smaller under-reserving errors. Our results support Browne *et al*. (2012)'s contention that insurers may manipulate loss reserves to impact contingent commission payments. Consistent with prior studies, we also find reinsurance usage to be

Table 5. Difference-in-Difference Regression Results[†]

	Total Errors		Over-Reserving Errors		Under-Reserving Errors	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.026***	0.029***	0.022***	0.025***	0.027***	0.052***
	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)	(0.012)
Public	-0.005***	-0.004***	-0.004***	-0.004***	-0.005***	-0.004**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Post-SOX	-0.002*	-0.003***	0.003***	0.002***	-0.005***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Public*Post-SOX	0.001	0.001	0.001	0.002	-0.001	<0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Mutual		-0.007***		-0.004***		-0.011***
		(0.001)		(0.001)		(0.002)
Group		-0.007***		-0.006***		-0.008***
		(0.001)		(0.001)		(0.002)
Ln(Assets)		-0.001***		-0.002***		<0.001
		(<0.001)		(<0.001)		(0.001)
Contingent		<0.001		0.002**		-0.003**
Commissions		(0.001)		(0.001)		(0.002)
Reinsurance		-0.005***		-0.006***		-0.003
		(0.001)		(0.001)		(0.003)
Lagged ROA		-0.038***		-0.018*		-0.075***
		(0.011)		(0.011)		(0.021)
Tax		0.025***		0.046***		-0.036***
		(0.006)		(0.007)		(0.011)
Good rating		-0.002*		-0.001		-0.004**
		(0.001)		(0.001)		(0.002)
Long tail		0.014***		0.013***		0.009***
		(0.002)		(0.002)		(0.003)
Product Herf		0.006***		0.010***		0.006
		(0.002)		(0.002)		(0.004)
Geo Herf		-0.002		<0.001		-0.003
		(0.002)		(0.001)		(0.003)
Industry loss ratio		-0.002		-0.009*		-0.012
		(0.006)		(0.005)		(0.013)
-2 Log likelihood	-50180.6	-44542	-37226.8	-33483	-14774.5	-12649
Number of Observations	11678		7580		4012	

Notes: * significance at 10% level ** significance at 5% level *** indicate significance at 1% level

[†] Standard errors are heteroscedasticity and autocorrelation consistent. Robust standard errors are reported in the parentheses below coefficient estimates.

associated with smaller over-reserving errors. The coefficients for the *lagged ROA* variable are negatively significant in all models, which suggests that insurers with higher income in the past have smaller over- and under-reserving errors. The *tax* variable is positively significant in Models (2) and (4), and negatively significant in Model (6), suggesting insurers with higher tax liabilities have greater over-reserving errors but smaller under-reserving errors. This finding is consistent with prior studies that found insurers with higher taxable income tend to over-reserve in order to reduce its tax liability (e.g. Grace, 1990; Browne *et al*., 2009). As expected, insurers with good ratings from A.M. Best have smaller under-reserving errors and insurers that write more long-tail lines have greater reserve errors in both directions. Consistent with prior studies, we also found product diversification (*Product Herf*) to be positively associated with reserve errors, in particular over-reserving errors. This suggests that focused insurers tend to over-reserve compared to highly diversified insurers, a finding that reflects the similar conclusions of Grace and Leverty (2010). The industry average loss ratio is also found to be negatively related to over-reserving errors (however, only at the 10% level). Insurers tend to have smaller over-reserving errors when loss ratios are high. This behavior would agree with earnings management strategies to mitigate the negative effects of relatively high paid losses and/or reduce premium volumes in a given period.

Robustness Check

To confirm the robustness of our study we also performed several alternative analyses that use different variables as well as different samples and our findings were confirmed to be robust. SOX was enacted in the middle of 2002 and for our analysis we associated 2002 data with the post-SOX period. Given the potential ambiguity as to the date on which SOX actually began to affect marketplace behavior, we repeated the analyses allocating 2002 year data to the *pre*-SOX period and obtained similar results. We also tried alternative samples by applying additional screening criteria that were used in prior studies such as removing firms with more than 25 percent of written premiums in reinsurance, workers compensation, accident and health, surety, credit, etc. The results were qualitatively identical to the results reported above. We also repeated our analysis at the group level where each group has only one observation – with findings that once again support our earlier results.

Conclusion

This research examines the relationship the enactment of SOX shares with changes in the loss reserving behavior of public insurers in the U.S. property-casualty insurance market. If SOX has been effective, we would expect the magnitude of public insurer loss reserve errors to be dampened after controlling for insurer characteristics and other environmental factors. Using data spanning the 1998 to 2006 period, we do not find evidence that the implementation of SOX in 2002 is associated with a change in the reserving behavior of public insurers. Our findings support the contention that the existing regulation of the U.S. property-casualty insurance industry already addresses these issues as well as might be expected with regard to financial reporting; additional mandates by SOX may simply be redundant for the already highly regulated insurance industry. Those findings may also call into question the ability of the Annual Financial Reporting Model Regulation to impact the reserving behavior of non-public insurers.

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