**Portfolio Management and Earnings Management: Evidence from Property and Casualty Insurers***


## Abstract

This paper investigates whether portfolio management and earnings management are jointly determined in the Property and Casualty (P&C) insurance setting. When underwriting losses occur, managers may look to rebalance the asset side of the balance sheet and the firm's investments (i.e., bonds, stock, real estate, etc.). Alternatively, the largest items on the liability side of the balance sheet are the loss reserves and prior research has shown that managers have a wide range of discretion over these liabilities. Since managers of P&Cs have discretion over both sides of the balance sheet, we investigate whether asset management and operating losses or gains are endogenous. By nature, P&Cs usually maintain a conservative posture that ensures they are sound enough to withstand adverse market conditions and meet the expectations of investors, rating agencies, and regulators. However, we find that when P&Cs have underwriting losses a positive association exists between portfolio management and earnings management. We also provide evidence supporting the income smoothing and tax hypotheses for P&Cs loss reserve errors - an area of much debate in the recent literature.



**JEL Classifications:** G22, G32, C36, M41, K21

**Key words:** Simultaneous Equation, Accounting, Loss Reserves, Portfolio Management

## 1. Introduction

This paper examines the joint determination between earnings management (i.e., loss reserves errors) and portfolio management. Prior studies that examine the effects of operating losses on portfolio management primarily focus on the opportunistic behavior of managers rebalancing their investment portfolios (Hendershott and Koch, 1980; Heaton, 1986; Chen and PonArul, 1991; Cummins and Grace, 1994). Earnings management has also been the focus of many studies. The literature examines the effects of taxes (e.g., Grace, 1990; Scholes, Wilson, and Wolfson, 1990; Petroni, 1992; Gaver and Paterson, 1999), income smoothing (e.g., Burgstahler and Dichev, 1997; Betty, Ke, and Petroni, 2002; Beaver, McNichols, and Nelson, 2003), organizational structure (e.g., Mayers and Smith, 1981, 1986; Mayers, Shivdasani, and Smith, 1997, Cummins, Weiss, and Zi, 1999; He and Sommer, 2010; Mayers and Smith, 2010), product and geographical diversification (e.g., Comment and Jarrell, 1995; Berger and Ofek, 1995; Berger, Cummins, Weiss, and Zi, 2000) on earnings management. However, without considering the two opportunistic behaviors of managers together, the picture of what determines optimal portfolio management or earnings management is far from apparent. Surprisingly, no empirical research has formally considered what factors jointly determine the association between both measures of opportunistic behavior. By connecting the two literatures on portfolio management and earnings management, this study attempts to fill this gap.

To conduct our investigation into the relation between portfolio management and earnings management we use a sample of Property and Casualty (P&C) insurance firms for a number of important reasons. First, using a homogenous group of firms allows us to reduce

variation due to industry-specific factors. Second, the unique reporting requirements of P&Cs allow us to examine both portfolio management and earnings management directly. Access to details of portfolio changes is limited in many industries, but P&Cs are required to make this information available. Finally, P&Cs are subject to regulatory requirements that may serve extra incentive to engage in earnings management behaviors (Healy and Whalen, 1999), thus allowing us a better opportunity to observe them. In all, the P&C industry is an ideal environment in which to test our hypotheses.

This paper is related to a large volume of literature concluding that P&Cs engage in earnings management by way of loss reserves (e.g., Petroni, 1992; Gaver and Paterson, 2001; Beaver, McNichols, and Nelson, 2003). More importantly, it determines the joint association between portfolio management and earnings management and how P&Cs approach this strategy when losses occur. Our study is conducted using simultaneous equation method. In this method, the difference between whether P&Cs rebalance their investment portfolio because they manage their loss reserves or whether they manipulate their loss reserves because they rebalance their investment portfolio is endogenous. To address this endogeneity issue, we use the lagged values of our main independent variable for each regression. We estimate an OLS regression that includes the portfolio management and earnings management measures as the dependent variables and determinants of a P&C decision to rebalance their investment portfolio or a P&C decision to manage their loss reserve errors.

This analysis adds to the literature that examines the interplay between P&Cs rebalancing their investment portfolios and their choice to manipulate their loss reserves. By using simultaneous equation we are able to address the potential endogeneity between

whether P&Cs that frequently manipulate loss reserves may have an incentive to rebalance their investment portfolio, or P&Cs that rebalance their portfolio may have an incentive to manipulate loss reserves. This paper also adds to the literature on the effect of using statutory financial statement information and understanding the joint relationship between the two largest balance sheet items of P&C insurers when operating losses occur. In addition, this paper contributes to the large literature on earnings management which is derived by using financial statement information and assesses the effects of loss reserve errors on portfolio management.

Overall, for P&Cs in our sample, we find support that earnings management measured by loss reserve errors, is associated with portfolio management when underwriting losses occur. Our main finding is that P&Cs that manage their loss reserve errors are more likely to rebalance their portfolio towards taxable securities when operating losses occur. This result is consistent with the view that P&Cs conduct portfolio management effectively when they are managing their loss reserves and have operating losses. Since we study the joint determination of earnings management and portfolio management, we are also able to provide new evidence concerning another important area that is currently being debated in the literature. Specifically, we find evidence in support of prior research that suggests an income smoothing motivation for loss reserve errors (Grace, 1990; Beaver, McNichols, and Nelson, 2003) as well as a tax incentive (Grace, 1990; Penalva, 1998; Gaver and Paterson, 1999, 2000; Nelson, 2000; Beaver, McNichols, and Nelson, 2003; Grace and Leverty, 2012). This paper proceeds as follows. In the next section we discuss related literature and the conceptual background of our research design. This is followed by a description of the data and methodology used to empirically test our hypothesis, and a section containing our results. The final section concludes.

## 2. Literature Review

### *2.1 Portfolio Management*

Portfolio management goals vary by industry. While hedge funds may use risky strategies in hopes of obtaining high returns, P&Cs are typically risk-averse. Due to strict regulatory requirements and an intensely competitive business environment, P&Cs' portfolio management strategies are extremely conservative - capital preservation is a common goal. Building on the Black (1980) and Tepper (1981) arbitrage hypothesis, Hendershott and Koch (1980) find that taxes play a particularly important role in portfolio management decisions of financial institutions. Specifically, they argue that firms can use tax laws to shelter income and thereby maximize profit. Furthermore, the literature suggests that P&Cs with losses[1] should rebalance their tax-free investments towards taxable investments (e.g., Hendershott and Koch, 1980; Heaton, 1986; Chen and PonArul, 1991; Cummins and Grace, 1994). However, since managers have discretion about how to reallocate their investments, do P&Cs that manage their earnings (i.e., loss reserves) keep their conservative nature intact and manage their portfolios effectively?

### *2.2 Earnings Management*

In this study, we use the Healy and Whalen (1999) definition of earnings management. Specifically, earnings management occurs when managers utilize discretion when creating financial reports with the purpose of misleading stakeholders or influencing processes that are reliant upon the financial reports. One benefit of using the P&C industry to conduct our study is that it provides an interesting way to measure earnings management - loss reserve errors.

[1] P&Cs derive their income from two sources: underwriting and investing. Income from underwriting can be volatile and has historically generated negative income (Fairley, 1979). To truly see how the losses change the asset mix in the following year, only underwriting gains and losses are observed in this study.

Studies have shown that loan loss provisions and gains and losses are used to manage earnings and taxes and to reduce regulatory costs (e.g., Scholes, Wilson, Wolfson, 1990; Warfield and Linsmeier, 1992; Beatty, Chamberlain, Magliolo, 1995; Collins, Shackelford, Wahlen, 1995; Ahmed, Takeda, Thomas, 1999; Beatty, Ke, and Petroni, 2002; Cornett, McNutt, and Tehranian, 2009; Adams, Carow, and Perry, 2009; Song and Linsmeier, 2004).

Following prior studies on the subject (e.g., Petroni, 1992; Petroni and Beasley, 1996; Beavers and McNichols, 1998; Penalva, 1998; Gaver and Paterson, 1999, 2000, 2004, 2007; Petroni, Ryan, and Wahlen, 2000; Nelson, 2000; Beaver, McNichols, and Nelson, 2003; Grace and Leverty, 2010, 2012), we need information provided in Schedule P: Part2 & Part3 of the NAIC statements to calculate the discretionary loss reserve errors:

$$DLRE_{i,t} = (DRI_{i,t+j} - LRI_{i,t})/ASSETS_{i,t} \qquad (1)$$

where, $LRI_{i,t}$ is the total losses reserve incurred for insurer *i* and reported in financial year *t*, and $DRI_{i,t+j}$ is the developed reserve of total losses incurred for insurer *i* reported in financial year *t* and *j* (e.g., *j=0,1,2,3,4*). Similar to Beaver, McNichols, and Nelson (2003), Gaver and Paterson (1999; 2004; 2007), and Grace and Leverty (2010; 2012), we scale $DLRE_{i,t+j}$ by total admitted assets in year t. As in Beaver, McNichols, and Nelson (2003), we calculate $DLRE_{i,t}$ for a five year loss reserve window period (e.g., *j=0,1,2,3,4*). $DLRE_{i,t}$ is the developed reserve of total losses incurred subtracted from total losses reserve incurred scaled by total admitted assets. If $DLRE_{i,t}$ is initially negative, then the P&C over-reserved the loss reserve errors, and vice versa.[2]

[2] See Appendix A for detailed information regarding an example and reserve error calculation.

To illustrate, in 2011, Allstate Insurance Company, Schedule P – Part 2 estimated that $13,214,861,000 of losses occurred in 2006. This estimate of 2006 losses was revised downward to $13,094,492,000 by 2011. Schedule P – Part 3 cash payments to policyholders for losses incurred in each accident year shows that payments of $8,213,041,000 for 2006 losses were made by the end of 2006. By the end of 2011, additional payments of $4,673,254,000 ($12,886,295,000-$8,213,041,000) were made on the 2006 losses.

The loss reserve nets total estimated losses against cumulative cash payments for current and previous loss years. Thus, the loss reserves value reported in 2006 Allstate Insurance Company balance sheet is the sum of all loss estimates in column 6 (2006) of Schedule P – Part 2, less the sum of all cash payments in the corresponding column of Schedule P – Part 3. The amount is $13,147,165,000 ($76,555,796,000-$63,408,631,000). Even though cash payments ($63,408,631,000) are a matter of record, loss expenses are subject to managerial discretion. At the end of 2006, estimated losses for all years up to and including 2006 totaled $76,555,796,000. By the end of 2011, the estimate for the same loss period had been increased to $77,189,784,000. The difference between the revised estimate of cumulative losses ($77,189,784,000) and the cumulative cash payment ($63,408,631,000) is known as the "developed reserve." Thus, the 2011 developed reserve for 2006 (and earlier) losses is $13,781,153,000 ($77,189,784,000-$63,408,631,000).

Similar to Gaver and Paterson (2004), we use a 5-year development reserve period to determine the discretionary loss reserve error. For each P&C, we subtract the loss reserve incurred from the developed reserve. We then divide the results by the net admitted assets to

control for variation in insurers size.[3] For Allstate, the 5-year developed reserve for 2006 is $13,781,153,000, and the 2006 loss reserve incurred is $13,147,165,000. This produces a positive loss reserve error in the amount of $633,988,000. Here, the P&C under-reserved by approximately $0.634 billion. In general, a positive number indicates under-reserving, while a negative number indicates over-reserving.

**3. Hypothesis Development**

Previous research in the banking industry has shown that loan loss provisions for gains and losses are used to manage earnings and taxes and to reduce regulatory costs (e.g., Scholes, Wilson, Wolfson, 1990; Warfield and Linsmeier, 1992; Beatty, Chamberlain, Magliolo, 1995; Collins, Shackelford, Wahlen, 1995; Ahmed, Takeda, Thomas, 1999; Beatty, Ke, and Petroni, 2002; Song and Linsmeier, 2004). However, the P&C industry setting provides us with a unique homogenous setting. Thus, the hypothesis presented here is that P&Cs that manage their loss reserves are more likely to rebalance their investment portfolio. The following hypothesis, stated in alternative form, will be tested:

*H1a: P&Cs that engage in earnings management by managing their loss reserve will more likely rebalance their investment portfolio effectively.*

*H1b: P&Cs that engage in earnings management by managing their loss reserve will more likely rebalance their investment portfolio effectively when losses or gains occur.*

The second hypothesis relates to P&Cs that manage their loss reserves and how they manage their investment portfolio. As indicated earlier, due to management's discretion over how they can manipulate their loss reserve and rebalance their investment portfolio can alter their behavior. There is no existing evidence that jointly determines if there is an association

[3] Prior studies use multiple scaling proxies. For example, Grace (1990) uses net premium earned, Gaver and Paterson (2004; 2007) uses developed reserve, and Petroni (1992) and Beaver, McNichols, and Nelson (2003) use net admitted assets. Our results are qualitatively similar to prior studies.

between P&Cs that manage their loss reserves and with rebalancing of their investment portfolio. Therefore, the issue of whether P&Cs rebalance their investment portfolio when manipulating their loss reserves will be examined. The second hypothesis, stated in alternative form, is:

*H2: P&Cs that rebalance their investment towards taxable securities will be less likely to engage in earnings management by managing their loss reserve.*

## 4. Methodology and Data

### *4.1 Methodology*

The hypotheses introduced in the previous section suggest that portfolio management and earnings management are jointly determined. This is consistent with what is observed in practice. Managers of P&Cs are able to manage both entities and they are not exogenously given but endogenously determined. Thus, estimating the equations of portfolio management and earnings management is not a proper way to test predictions. The parameter estimates will be biased since regressors are endogenously determined along the dependent variable. Hence, we adopt a simultaneous equation approach.

To investigate the endogenous relation between a P&C's portfolio management choice and earnings management we estimate a simultaneous equation model. In equation (2), the portfolio management variable is regressed on exogenous control variables and an independent variable (e.g., loss reserve errors). We estimate the following model:

$$\Delta y_{i,t} = \beta Z_{i,t-1} + \Delta\theta X_{i,t} + \Gamma_i + \Lambda_t + \varepsilon_{i,t} \qquad (2)$$

where, $i$ indexes the P&Cs and $t$ indexes the financial year, $y_{i,t}$ is the dependent variable, $Z_{i,t-1}$ is a vector of the main independent variable, $\Delta X_{i,t}$ is a vector of control variables, $\Gamma_i$ is P&C fixed effect, $\Lambda_t$ is year fixed effect. The standard errors are adjusted for P&C clustering. The

variables in equation (2) follow prior literature. We include additional exogenous variables: *Regulatory Flexibility*, *Tax Shield, Growth*, *Net Assets, Reinsurance, Short-Tail, Liability, Auto, Worker's Compensation, HHState, HHLine, Mutual Insurer, Public Insurer, Group,* and *RBC*.

Our next model follows:

$$\Delta \dot{y}_{i,t} = \lambda L_{i,t-1} + \Delta \delta W_{i,t} + \phi_i + \psi_t + \mu_{i,t} \quad (3)$$

where, $i$ indexes the P&Cs and $t$ indexes the financial year, $\Delta \dot{y}_{i,t}$ is the dependent variable, $L_{i,t-1}$ is a vector of the main independent variable, $W_{i,t}$ is a vector of control variables, $\phi_i$ is P&C fixed effect, $\psi_t$ is year fixed effect. The standard errors are adjusted for P&Cs clustering. We include the variables *Smoothing, Tax Shield, Growth, Net Assets, Reinsurance, Short-Tail, Liability, Auto, Worker's Compensation, HHState, HHLine, Mutual Insurer, Public Insurer, and Group*.[4]

*4.1 Data*

We obtain data from NAIC (National Association of Insurance Commissioners) annual statement database, which is prepared using SAP. The NAIC database contains information that allows for the construction of the variables that measures the P&Cs' investment portfolios, loss reserve errors as well as other control variables. Our sample covers all types of insurers that report total admitted assets (i.e., taxable and non-taxable investments), direct premium business written, and losses incurred. We make use of data spanning the 1996 to 2012 period

[4] Including all exogenous variables from the simultaneous model (2) and model (3) is a common econometric practice as long as they are all valid instruments.

to create a sample over 1997 to 2007 period.[5] Our final sample consists of 2,430 unique P&Cs from 1997 to 2007. This amounts to 20,111 insurer-year observations.

Table 1 reports the summary statistics of the variables used in our simultaneous equations. The first dependent variable, *Portfolio Management,* is which is the change in the ratio of earned taxable investment income to total earned income from year t-1 to year t.[6] On average, in our sample, negative 0.14 percent of P&Cs rebalance towards taxable investments. The second dependent variable, *DLRE,* is the revised (future) estimate subtracted by the loss reserve (current) in year t minus t-1. To control for difference in P&Cs size in model (2), the loss reserve errors (*DLRE*) are scaled by total admitted assets (Petroni, 1992; Gaver and Paterson, 2001, 2004, 2007). Overall, the difference of the loss reserve errors accounts for an average of negative 0.44 percent. Turing to the independent variables, *Underwriting Income* is a continuous variable that indicates if the P&C had underwriting gains or losses from the prior year.[7] *Underwriting Losses* is a lagged dichotomous variable with a value of one for insurer that has underwriting losses. 48.8 percent of our sample accounts for firm that suffered underwriting losses.

[Insert Table 1 here]

We next observe the yearly average of underwriting losses and gains and the association between portfolio management and discretionary loss reserve errors for 1997 to 2007. In Figure 1, we see that P&Cs with underwriting losses are moving in parallel with each other until 2004. At this point, there is a larger variance between the two variables. This could be due to

[5] When calculating loss reserve errors, our estimates rely on the five year developed loss reserve incurred (See Appendix A). We use data extending out to 2012, to calculate 2007 loss reserve errors. Similar to (Brandt et al., 2013), we incorporate data as early as 1996 in creating our 1997 lagged smoothing variable (*Smoothing*).
[6] NAIC - Exhibit of Net Investment Income Pages.
[7] NAIC - Statement of Income Pages.

the impact of major hurricanes that took place during 2003-2005. In Figure 2, we see that P&Cs with underwriting gains are moving in relation with one another.

[Insert Figure 1 & 2]

Since there are other important variables that affect P&Cs management of investment portfolios and loss reserves, we consider as control variables the variables used in prior studies. As determinants of the portfolio management, discretionary loss reserve errors, operating income, and other portfolio management components are included in a regression. Among several variables of portfolio management characteristics, we employ regulatory investment environment, tax shield, and RBC. *Regulatory Flexibility* is the percent of investment classes subject to the regulatory investment limitations per state, per year (Reddic, 2014). The tax variable (*Tax Shield*) is similar to other studies (e.g., Grace, 1990; Grace and Leverty, 2012). *Tax Shield* is the sum of net income and the estimated reserves (5 years prior to resolution) over net admitted assets. Tax management strategies play an important role among P&Cs' portfolio management and earnings management (Cummins and Grace, 1994; Leland, 1999). We also include RBC as one of the regressors for portfolio management. *RBC* is RBC ratio, calculated as the Total Adjusted Capital divided by Authorized Control Level Risk-Based .[8, 9] Within the RBC calculation, investment and other asset risks are included because these matter to regulators (NAIC, 2009). As an important determinant of discretionary loss reserve errors, we use portfolio

[8] NAIC - Five Year Historical Data Pages.

[9] There are five distinctive outcomes to the RBC calculation. For more information about the general overview of RBC see http://www.naic.org/documents/committee_e_caped_RBCoverview.prdf or a critique see (Feldblum, 1996).

1. "No Action" – If an insurer's RBC ratio is greater than 200 percent
2. "Company Action Level" – If an insurers' RBC ratio is between 150 to 200 percent
3. "Regulatory Action Level" – If an insurers' RBC ratio is between 100 to 150 percent
4. "Authorized Control Level" – If an insurers' RBC ratio is between 70 to 100 percent
5. "Mandatory Action Level" – If an insurers' RBC ratio is less than 70 percent

management, operating income, and other earnings management components. The variables *Smoothing* and *Tax Shield* have been widely used as factors of discretionary loss reserve errors. *Smoothing* is measured with the average return on assets over previous three years (Grace, 1990; Grace and Leverty, 2012).

## 5. Results

### *5.1 Correlation among Portfolio Management, DLRE, and Control variables*

In Table 2, we report the correlation coefficients between portfolio management, discretionary loss reserve errors, and related control variables. First, we examine the contemporaneous relation between *Portfolio Management* and the earnings management variable, *DLRE* and find that the Spearman correlation is positive and significant. Furthermore, as predicted in H1, *Portfolio Management* and *lagDLRE* are positive and significantly correlated with each other. These results suggest that P&Cs that manage earnings in the prior year (e.g., through discretionary loss reserves) are more likely to rebalance their portfolio of investments towards taxable securities. However, as observed for H2, *lagPortfolio Management* and *DLRE* are negative and significantly correlated with each other, suggesting that P&Cs that rebalanced their portfolio towards taxable securities in the prior year are less likely to manage their loss reserves. These conflicting results warrant further investigation in a multivariate setting.

[Insert Table 2]

### *5.2 Multivariate results for Portfolio Management, DLRE, and Control variables*

To test Hypothesis 1a, we examine P&Cs managing their discretionary loss reserve errors in the prior year on the change of the investment portfolio. Our main results are found in models (1), (3), and (5). For the model (1), we observe that P&Cs that manage their loss

reserves are more likely to rebalance their investment portfolio. For H1b, we see in models (3) and (5) that P&Cs rebalance towards taxable securities whether an underwriting loss or gain occurs in the prior year. These results suggest P&Cs will manage their investment portfolio when engaging in earnings management regardless of whether underwriting gains or losses occur. In contrast to our results for H1, our H2 results are less robust. In model (2) we find a negative relation between *lagPortfolioManagement* and *DLRE.* However, this result is marginally significant for firms with underwriting losses (model 4) and insignificant for firms with underwriting gains (model 6). Although less significant than our primary results, these results may reflect the complex endogenous relationship between earnings management and portfolio management.

We also find some interesting results in the estimation of coefficients for the control variables. We find that *Regulatory Flexibility* is positively related to *Portfolio Management* for all observations (Model 1) and for firms reporting underwriting levels (Model 3), significant at the 1 percent level. A similar result is found in firms with underwriting gains (Model 6) but it is marginally significant. The use of loss reserves to smooth income has found mixed support in the literature. Beaver, McNichols, and Nelson (2003) find that P&Cs use loss reserves to smooth income, while Grace and Leverty (2012) find little support for income smoothing. We find a negative relation between *Smoothing* and *DLRE* in Model 2, a result that supports the findings of Beaver, McNichols, and Nelson (2003). Since the negative relation presents in observations with both underwriting losses (Model 4) and underwriting gains (Model 6) it seems that the smoothing is not dependent on underwriting losses. The effect of taxes on loss reserve errors is another area that has received mixed support in the literature. We find that *TaxShield* is

positively related to earnings management, which lends support to other studies that argue a tax incentive for loss reserve management (Grace, 1990; Penalva, 1998; Gaver and Paterson, 1999, 2000; Nelson, 2000; Beaver, McNichols, and Nelson, 2003; Grace and Leverty, 2012).

[Insert Table 3]

Our final analyses, reported in Table 4 investigate whether the relation between portfolio management and earnings management changes due to the nature of the earnings management. Literature suggests that there may be differences in P&C behavior when the earnings management is motivated by taxes. Many studies find that firms with higher tax rates have more incentive to over-reserve (Grace, 1990; Penalva, 1998; Gaver and Paterson, 1999, 2000; Nelson, 2000; Beaver, McNichols, and Nelson, 2003; Grace and Leverty, 2012). Accordingly, we reports separate models for firm-year observations where loss reserve errors are positive, indicating that firms over-reserved (models (1) and (2)), as well as firm-year observations where loss reserve errors are negative, signifying that the firms under-reserved (models (3) and (4)). As in the Table 3, we estimate the models using simultaneous equations. Consistent with our previous results, we find a positive relation between *PortfolioManagement* and *lagDLRE.* However we find that this result is only marginally significant in model (1), where firms over-reserve, but highly significant at the one percent level in model (3) for firms that under-reserve. These results may be driven by a desire to satisfy regulatory requirements. Again for models that have earnings management, or *DLRE,* as the dependent variable, we find a marginal or insignificant relation between earnings management and lagged portfolio management.

The results for control variables reinforce our findings from Table 3. *Regulatory Flexibility* is positively related to *Portfolio Management* for firms that over-reserve and under-reserve in Models 1 and 3, respectively. Once again, *Smoothing* is negatively related to loss reserve errors, for both under-reserving firms (Model 2) and over- reserving firms (Model 4). The coefficient of *Tax Shield* is positive and significant in both Model 2 and Model 4. Earlier studies associate tax-motivated earnings management with P&Cs that over-reserve (Grace, 1990; Penalva, 1998, Gaver and Paterson, 1999, 2000; Nelson, 2000; Beaver, McNichols, and Nelson, 2003; Grace and Leverty, 2012). However Grace and Leverty (2012) also find that the results are dependent on model specification. Taken together, these results suggest that income smoothing and taxes are incentives for P&Cs to engage in earnings management by both over- and under- estimate loss reserves.

[Insert Table 4]

**6. Conclusion**

The objective of our study is to investigate the joint determination between portfolio management and earnings management. Previous research finds that both portfolio management and earnings management can be affected by opportunistic behaviors. However, to the best of our knowledge, ours is the first paper to examine these two important management activities together. Using a large sample of P&Cs, we measure portfolio management by observing tax-motivated portfolio rebalancing and measure earnings management by loss reserve errors. In recognition of the endogenous nature of portfolio management and earnings management decisions, we employ a simultaneous equation methodology. We find a positive relation between portfolio management and earnings

management when P&Cs have underwriting losses. Our findings provide strong evidence that portfolio management and earnings management are interrelated and provide evidence toward a more complete understanding of the interplay between portfolio management and earnings management.

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## Appendix A

Example of loss reserve data from the 2011 Statutory Annual Statement of the Allstate Insurance Company (NAIC 19232).

| Annual Statement for the Year 2011 of the Allstate Insurance Company | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NAIC Property and Casualty Annual Statement: Schedule P Part 2 - Summary | | | | | | | | | | |
| Incurred Net Losses and Defense and Cost Containment Expenses Reported at Year End ($000 Ommitted) | | | | | | | | | | |
| Yrs. In Which Losses Were Incurred | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| 1. Prior | 7,013,450 | 7,639,414 | 8,013,552 | 8,256,293 | 8,324,393 | 8,485,609 | 8,595,706 | 8,874,086 | 9,175,476 | 9,345,538 |
| 2. 2002 | 13,641,857 | 13,499,599 | 13,329,105 | 13,276,962 | 13,262,002 | 13,269,069 | 13,273,030 | 13,278,325 | 13,269,506 | 13,279,980 |
| 3. 2003 | XXX | 12,523,155 | 13,080,280 | 12,894,498 | 12,828,066 | 12,817,908 | 12,802,360 | 12,805,400 | 12,783,451 | 12,802,442 |
| 4. 2004 | XXX | XXX | 13,199,732 | 12,776,860 | 12,528,060 | 12,742,160 | 12,473,568 | 12,497,020 | 12,489,335 | 12,483,509 |
| 5. 2005 | XXX | XXX | XXX | 16,993,357 | 16,398,414 | 16,098,860 | 16,206,303 | 16,215,839 | 16,190,270 | 16,183,823 |
| 6. 2006 | XXX | XXX | XXX | XXX | 13,214,861 | 13,274,092 | 13,215,321 | 13,184,977 | 13,104,097 | 13,094,492 |
| 7. 2007 | XXX | XXX | XXX | XXX | XXX | 14,033,899 | 14,064,175 | 13,908,744 | 13,823,226 | 13,818,519 |
| 8. 2008 | XXX | XXX | XXX | XXX | XXX | XXX | 15,691,173 | 15,488,971 | 15,482,323 | 15,474,599 |
| 9. 2009 | XXX | XXX | XXX | XXX | XXX | XXX | XXX | 14,949,344 | 14,901,125 | 14,742,864 |
| 10. 2010 | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | 15,178,721 | 14,915,338 |
| 11. 2011 | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | 16,235,011 |
| | | | | | =76,555,796 | | | | | =77,189,784 |

| Annual Statement for the Year 2011 of the Allstate Insurance Company | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NAIC Property and Casualty Annual Statement: Schedule P Part 3 - Summary | | | | | | | | | | |
| Cumulative Paid Net Losses and Defense and Cost Containment Expenses Reported at Year End ($000 Ommitted) | | | | | | | | | | |
| Yrs. In Which Losses Were Incurred | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| 1. Prior | 0 | 2,534,012 | 4,017,056 | 4,992,700 | 5,513,803 | 5,909,752 | 6,270,233 | 6,507,475 | 6,739,713 | 7,013,311 |
| 2. 2002 | 8,306,746 | 11,027,292 | 11,989,661 | 12,550,771 | 12,870,662 | 13,039,270 | 13,130,080 | 13,183,306 | 13,212,506 | 13,237,973 |
| 3. 2003 | XXX | 8,040,984 | 10,652,731 | 11,564,391 | 12,107,845 | 12,426,230 | 12,591,247 | 12,671,526 | 12,713,270 | 12,735,678 |
| 4. 2004 | XXX | XXX | 7,722,449 | 10,308,811 | 11,206,575 | 11,769,628 | 12,103,298 | 12,280,723 | 12,365,565 | 12,401,684 |
| 5. 2005 | XXX | XXX | XXX | 9,736,934 | 13,496,705 | 14,673,681 | 15,396,315 | 15,756,314 | 15,290,421 | 15,981,987 |
| 6. 2006 | XXX | XXX | XXX | XXX | 8,213,041 | 10,879,160 | 11,830,267 | 12,406,558 | 12,726,320 | 12,886,295 |
| 7. 2007 | XXX | XXX | XXX | XXX | XXX | 8,706,215 | 11,569,308 | 12,484,334 | 13,078,161 | 13,388,679 |
| 8. 2008 | XXX | XXX | XXX | XXX | XXX | XXX | 9,953,455 | 13,132,825 | 14,099,086 | 14,681,995 |
| 9. 2009 | XXX | XXX | XXX | XXX | XXX | XXX | XXX | 9,418,510 | 12,358,723 | 13,257,958 |
| 10. 2010 | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | 9,451,032 | 12,254,494 |
| 11. 2011 | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | 10,603,166 |
| | | | | | =63,408,631 | | | | | |

Loss Reserve Incurred

$LRI_{i,t}$

(76,555,796 – 63,408,631)

=$13,147,165

Developed Loss Reserves Incurred

$DLRI_{i,t+j}$

(77,189,784 – 63,408,631)

=$13,781,153

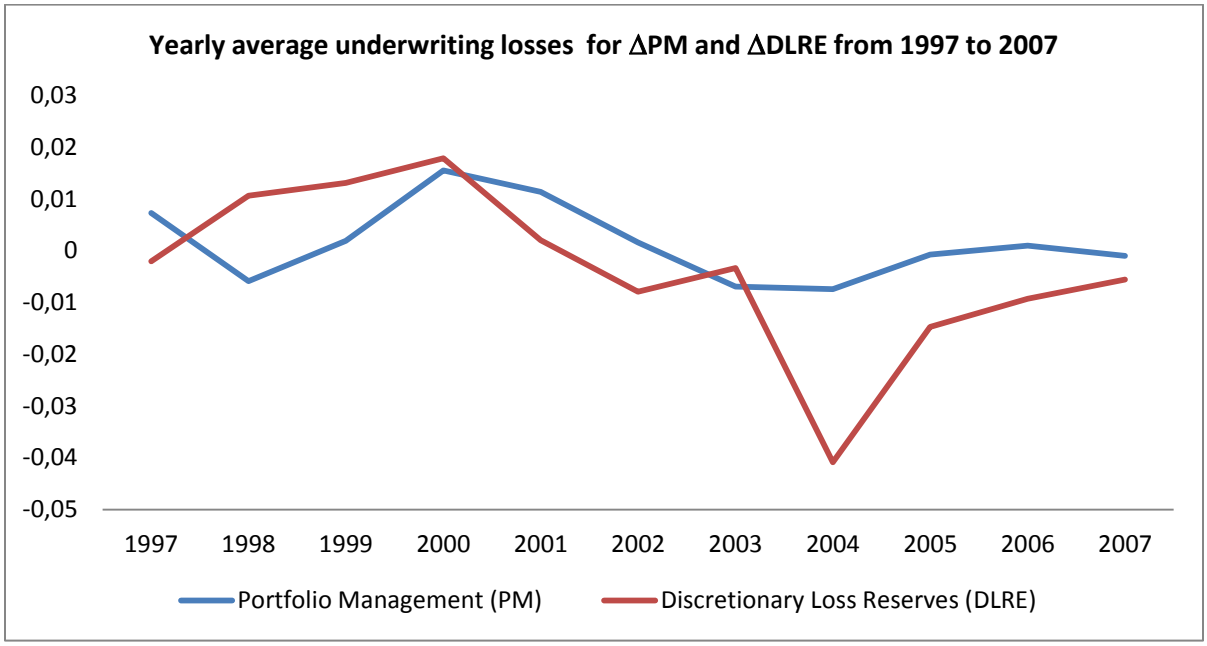
Discretionary Loss Reserve Error

$DLRE_{i.t}$

(13,781,153 – 13,147,165)

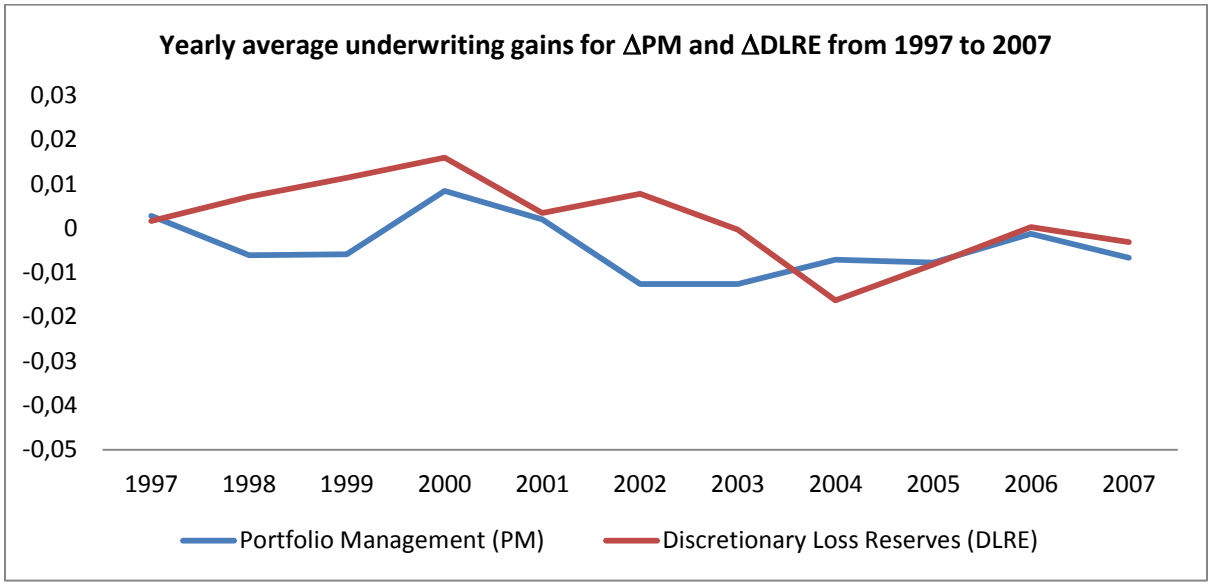
= $633,988

Figure 1




This chart shows the average yearly underwriting losses scaled by total net admitted assets for both insurers over the period 1997 to 2007 for categories of insurers defined as follows: 1) $\Delta PM$ is the difference of earned taxable investment income deflated by the sum of earned taxable investment income plus earned tax-free investment in year t minus earned taxable investment income deflated by the sum of earned taxable investment income plus earned tax-free investment in year t-1, 2) $\Delta DLRE$ is the revised (future) estimate subtracted by the loss reserve (current) in year t minus t-1 scaled by total admitted assets. Yearly means values are based on all insurers with available investment and loss reserves data.

Figure 2




This chart shows the average yearly underwriting gains scaled by total net admitted assets for both insurers over the period 1997 to 2007 for categories of insurers defined as follows: 1) $\Delta PM$ is the difference of earned taxable investment income deflated by the sum of earned taxable investment income plus earned tax-free investment in year t minus earned taxable investment income deflated by the sum of earned taxable investment income plus earned tax-free investment in year t-1, 2) $\Delta DLRE$ is the revised (future) estimate subtracted by the loss reserve (current) in year t minus t-1 scaled by total admitted assets. Yearly means values are based on all insurers with available investment and loss reserves data.

## Table 1. Descriptive Statistics

| Variables | Mean | Std. | Min | Percentiles 10th | 25th | 50th | 75th | 90th | Max |
|---|---|---|---|---|---|---|---|---|---|
| ΔPortfolio Management | -0.001 | 0.057 | -0.238 | -0.050 | -0.009 | 0.000 | 0.008 | 0.043 | 0.230 |
| ΔDLRE | -0.004 | 0.124 | -0.990 | -0.080 | -0.023 | 0.000 | 0.017 | 0.064 | 0.998 |
| Underwriting Income | -0.004 | 0.061 | -0.231 | -0.069 | -0.027 | 0.000 | 0.022 | 0.061 | 0.182 |
| Underwriting Losses | 0.488 | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| Smoothing | 0.028 | 0.067 | -0.099 | -0.014 | 0.008 | 0.027 | 0.045 | 0.070 | 0.164 |
| Tax Shield | 0.028 | 0.067 | -1.970 | -0.022 | 0.008 | 0.028 | 0.050 | 0.078 | 1.636 |
| Regulatory Flexibility | 0.651 | 0.270 | 0.000 | 0.231 | 0.538 | 0.653 | 0.881 | 0.999 | 1.000 |
| RBC | 292 | 1062 | 0.062 | 0.944 | 5.597 | 26.289 | 114 | 507 | 8413 |
| Growth | 0.291 | 1.256 | -0.955 | -0.216 | -0.038 | 0.067 | 0.221 | 0.592 | 9.987 |
| Reinsurance | 0.445 | 0.352 | 0.000 | 0.008 | 0.123 | 0.376 | 0.770 | 1.000 | 1.000 |
| Short Tail | 0.296 | 0.309 | 0.000 | 0.000 | 0.044 | 0.214 | 0.375 | 0.999 | 1.000 |
| Liability | 0.247 | 0.333 | 0.000 | 0.000 | 0.000 | 0.078 | 0.363 | 0.984 | 1.000 |
| Auto | 0.184 | 0.244 | 0.000 | 0.000 | 0.000 | 0.051 | 0.302 | 0.588 | 0.997 |
| Workers Compensation | 0.097 | 0.237 | 0.000 | 0.000 | 0.000 | 0.000 | 0.054 | 0.278 | 1.000 |
| Herfindahl (State) | 0.547 | 0.399 | 0.000 | 0.053 | 0.127 | 0.512 | 1.000 | 1.000 | 1.000 |
| Herfindahl (Line) | 0.431 | 0.347 | 0.000 | 0.000 | 0.146 | 0.354 | 0.698 | 1.000 | 1.000 |
| Mutual Insurer | 0.180 | 0.384 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 |
| Public Insurer | 0.360 | 0.480 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| Group | 0.738 | 0.440 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Net Assets (in $ Millions) | 452 | 1419 | 1.22 | 5.65 | 14.06 | 53.02 | 221 | 895 | 1060 |
| Underwriting Income (in $ Millions) | .686 | 37 | -207 | -8.286 | -1.052 | 0.000 | 1.426 | 10.829 | 190 |
| Loss Reserves (in $ Millions) | 6.08 | 117 | -440 | -22.02 | -3.12 | -.018 | 0.86 | 17.96 | 891 |

The table presents summary statistics for years 1997-2007, respectively. There are 20,111 insurer-year observations. ***Portfolio Management*** is the difference of earned taxable investment income deflated by the sum of earned taxable investment income plus earned tax-free investment in year t minus earned taxable investment income deflated by the sum of earned taxable investment income plus earned tax-free investment in year t-1. ***DLRE*** is the revised (future) estimate subtracted by the loss reserve (current) in year t minus t-1 scaled by total admitted assets. ***Underwriting Income*** is the lagged underwriting gains or losses scaled by net admitted assets. ***Underwriting Losses*** is a lagged dichotomous variable with a value of one for insurer that has underwriting losses. ***Smoothing*** is measured with the average return on assets over previous three years (Grace, 1990; Grace and Leverty, 2012). ***Tax Shield*** is the sum of net income and the estimated reserves (5 years prior to resolution) over net admitted assets (Grace, 1990; Grace and Leverty, 2012). ***Regulatory Flexibility*** is the percent of investment classes subject to the regulatory investment limitations per state, per year (Reddic, 2014). ***RBC*** is risk-adjusted capital ratio is the total adjusted capital divided by the authorized control level. ***Growth*** is the one-year percent increase in net premium. ***Net Assets*** is defined as net admitted assets. ***Reinsurance*** is the proportion of gross premium written ceded to reinsurers. ***Short Tail*** is the proportion of net premium written in typical short-tail lines of business. ***Liability*** is the proportion of net premium written in liability lines of product liability, other liability, and medical malpractice. ***Auto*** is the proportion of net premium written in private and commercial auto liabilities. ***Workers Compensation*** is the proportion of net premium written in workers' compensation. ***Herfindahl (Line)*** is the insurers' business line Herfindahl index. ***Herfindahl (State)*** is the geographical Herfindahl index. ***Mutual Insurer*** is a dichotomous variable with a value of one for insurer that has a mutual structure, zero otherwise. ***Public Insurer*** is a dichotomous variable with a value of one if the insurers' is publicly traded and listed on an exchange or OTC, it is zero otherwise. ***Group*** is a dichotomous variable with a value of one for insurer that belongs to a group of insurers, zero otherwise.

Table 2: Correlation Matrix

*Portfolio Management, DLRE, Underwriting Losses*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Portfolio Management | | *0.016*** | *-0.157**** | *0.035**** | *-0.087**** | *0.071**** | *-0.026**** | *0.031**** | *0.016*** | *0.026**** | *-0.032**** | *0.000* | *0.022**** | *-0.002* | *-0.007* | *-0.004* | *0.010* | *0.021**** | *-0.011* | *0.011* | *0.010* | *-0.002* |
| (2) DLRE | -0.009 | | *-0.024**** | *-0.252**** | *0.032**** | *-0.018**** | *-0.102**** | *0.045**** | *0.037**** | *0.039**** | *-0.082**** | *0.045**** | *0.036**** | *-0.015*** | *-0.012** | *0.000* | *-0.023*** | *-0.028**** | *-0.098**** | *0.017*** | *0.003* | *0.005* |
| (3) LagPortfolio Management | -0.184*** | -0.014** | | *0.010* | *-0.115**** | *0.110**** | *0.046**** | *0.015*** | *0.023**** | *-0.015*** | *-0.001* | *-0.005* | *-0.012** | *-0.022**** | *0.032**** | *0.000* | *0.026**** | *0.021**** | *-0.004* | *0.016*** | *-0.144**** | *-0.187**** |
| (4) LagDLRE | 0.029*** | -0.285*** | -0.010 | | *-0.172**** | *0.134**** | *-0.064**** | *0.038**** | *-0.088**** | *0.022**** | *0.019**** | *-0.002* | *-0.037**** | *0.040**** | *0.011* | *0.014*** | *0.022**** | *0.041**** | *0.076**** | *-0.069**** | *0.102**** | *0.133**** |
| (5) LagUnderwriting Income | -0.064*** | 0.028*** | -0.085*** | -0.093*** | | *-0.866**** | *-0.072**** | *-0.064**** | *-0.287**** | *-0.017*** | *0.103**** | *-0.025**** | *-0.005* | *-0.004* | *0.005* | *0.016*** | *-0.038**** | *-0.036**** | *0.032**** | *-0.035*** | *0.068**** | *-0.006* |
| (6) LagUnderwriting Losses | 0.058*** | -0.012* | 0.093*** | 0.088*** | -0.658*** | | *0.061**** | *0.042**** | *0.209**** | *0.016*** | *-0.072**** | *0.028**** | *0.005* | *0.014*** | *-0.011* | *-0.008* | *0.035**** | *0.031**** | *-0.018**** | *0.043**** | *-0.054**** | *-0.021**** |
| (7) Smoothing | -0.010 | -0.038*** | 0.034*** | -0.060*** | -0.098*** | 0.057*** | | *-0.085**** | *0.231**** | *-0.065**** | *0.089**** | *-0.029**** | *-0.044**** | *0.009* | *-0.000* | *-0.011* | *0.026**** | *0.039**** | *-0.015*** | *-0.009* | *-0.001* | *-0.011** |
| (8) Regulatory Flexiblity | 0.041*** | 0.040*** | 0.007 | 0.012* | -0.040*** | 0.054*** | -0.095*** | | *-0.056**** | *0.043**** | *-0.041**** | *0.021**** | *0.023**** | *0.008* | *-0.007* | *0.012** | *0.008* | *-0.005* | *-0.017*** | *-0.018**** | *0.016*** | *0.014*** |
| (9) Tax Shield | 0.016** | 0.049*** | 0.015** | -0.064*** | -0.354*** | 0.194*** | 0.194*** | -0.061*** | | *-0.097**** | *0.023**** | *0.011* | *-0.026**** | *0.005* | *-0.008* | *0.002* | *0.023**** | *0.022**** | *-0.129**** | *-0.001* | *-0.008* | *-0.006* |
| (10) Growth | 0.015** | 0.007 | -0.018*** | 0.015** | 0.036*** | -0.034*** | -0.029*** | -0.010 | -0.081*** | | *0.045**** | *-0.290**** | *-0.032**** | *-0.005* | *-0.027**** | *-0.017*** | *-0.001* | *-0.034**** | *0.072**** | *0.028**** | *-0.001* | *0.009* |
| (11) Net Assets | -0.036*** | -0.047*** | 0.028*** | 0.033*** | 0.004 | -0.010 | 0.021*** | -0.027*** | -0.024*** | 0.025*** | | *-0.082**** | *-0.052**** | *0.023**** | *0.017*** | *0.020**** | *-0.059**** | *0.005* | *0.405**** | *-0.023**** | *-0.014*** | *-0.033**** |
| (12) Reinsurance | -0.002 | 0.034*** | -0.003 | -0.024*** | -0.026*** | 0.030*** | -0.009 | 0.011 | 0.050*** | -0.177*** | -0.092*** | | *0.030**** | *0.010* | *0.020**** | *0.027**** | *-0.023**** | *-0.018*** | *-0.067**** | *0.002* | *-0.011* | *-0.002* |
| (13) Short Tail | 0.010 | 0.003 | -0.006 | -0.008 | 0.003 | -0.007 | 0.002 | 0.021*** | -0.001 | -0.042*** | -0.019*** | 0.014** | | *-0.258**** | *-0.157**** | *-0.181**** | *0.002* | *-0.191**** | *-0.019**** | *-0.060**** | *0.036**** | *0.003**** |
| (14) Liability | 0.003 | -0.005 | -0.000 | 0.017** | -0.005 | -0.008 | -0.003 | -0.019*** | 0.002 | 0.06 | 0.017** | -0.010 | -0.366*** | | *-0.175**** | *-0.031**** | *-0.023**** | *-0.043**** | *0.015*** | *0.029**** | *0.016*** | *0.021**** |
| (15) Auto | -0.015** | -0.007 | 0.011 | 0.004 | -0.005 | 0.010 | -0.012* | -0.002 | -0.000 | -0.007 | 0.032*** | 0.023*** | -0.236*** | -0.177*** | | *-0.143**** | *-0.009* | *0.119**** | *0.022**** | *-0.020**** | *-0.008* | *-0.046**** |
| (16) Worker's Compensation | 0.006 | 0.007 | -0.003 | 0.016** | 0.012* | -0.001 | 0.000 | 0.022*** | -0.003 | 0.002 | 0.019*** | 0.024*** | -0.159*** | -0.171*** | -0.163*** | | *-0.004* | *0.024*** | *0.006* | *0.010* | *0.000* | *-0.014*** |
| (17) Herfindahl (State) | -0.003 | -0.011 | 0.011 | 0.011 | -0.019*** | 0.025*** | 0.007 | 0.019*** | -0.021*** | 0.024*** | 0.057*** | 0.006 | 0.009 | -0.011 | -0.011 | 0.004 | | *0.058**** | *-0.055**** | *0.014*** | *0.004* | *-0.004* |
| (18) Herfindahl (Line) | 0.008 | -0.005 | 0.014* | 0.007 | -0.025*** | 0.029*** | 0.009 | 0.008 | 0.010 | -0.014** | 0.072*** | -0.025*** | -0.067*** | -0.015** | -0.015** | 0.026*** | 0.266*** | | *0.009* | *-0.001* | *0.004* | *-0.023**** |
| (19) RBC | -0.026** | -0.045*** | 0.036*** | 0.039*** | 0.007 | 0.015** | -0.023*** | 0.002 | -0.085*** | 0.033*** | 0.448*** | -0.090*** | -0.006 | 0.001 | 0.023*** | 0.002 | 0.119*** | 0.141*** | | *-0.023**** | *-0.012** | *-0.009* |
| (20) Mutual Insurer | 0.008 | 0.013* | 0.010 | -0.037*** | -0.035*** | 0.043*** | 0.001 | -0.009 | 0.002 | 0.039*** | -0.058*** | 0.006 | -0.015** | 0.009 | -0.015** | -0.005 | -0.011 | -0.015** | -0.061*** | | *-0.334**** | *-0.278**** |
| (21) Public Insurer | 0.002 | -0.010 | -0.101*** | 0.062*** | 0.077*** | -0.054*** | -0.018*** | 0.006 | -0.016** | -0.005 | 0.015** | -0.005 | -0.008 | 0.003 | 0.005 | 0.05 | 0.000 | 0.004 | 0.007 | -0.334*** | | *0.384**** |
| (22) Group | -0.002 | -0.002 | -0.098*** | 0.074*** | -0.002 | -0.021*** | -0.016** | 0.011 | -0.011 | 0.005 | -0.010 | 0.019*** | 0.013** | 0.012* | -0.011 | -0.009 | 0.003 | -0.008 | 0.006 | -0.278*** | 0.381*** | |

This table present correlations for the years 2000-2007. Pearson correlations are in the lower triangle (unitalized) and Spearman correlations are in the upper triangle (italized). All variables are defined in Table 1. *, **, and *** indicate significance at the 0.10, 0.05, 0.01 percent levels, respectively.

**Table 3.**
**Results of estimation for the simultaneous equations**

| | (1) ΔPortfolio Management | | (2) ΔDLRE | | (3) ΔPortfolio Management Underwriting Losses | | (4) ΔDLRE Underwriting Losses | | (5) ΔPortfolio Management Underwriting Gains | | (6) ΔDLRE Underwriting Gains | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. |
| Intercept | -.004 | .001*** | .008 | .003** | .000 | .001 | .009 | .006 | -.003 | .002* | .003 | .004 |
| LagPortfolio Management | | | -.006 | .003** | | | -.010 | .006* | | | -.002 | .003 |
| LagDLRE | .009 | .003*** | | | .007 | .003** | | | .012 | .004*** | | |
| LagUnderwriting Losses | .006 | .001*** | -.005 | .002*** | | | | | | | | |
| ΔRegulatory Flexibility | .011 | .001*** | | | .014 | .003*** | | | .006 | .003* | | |
| ΔSmoothing | | | -.283 | .053*** | | | -.289 | .075*** | | | -.273 | .073*** |
| ΔTax Shield | .014 | .010 | .143 | .023*** | .025 | .011** | .137 | .031*** | -.006 | .016 | .145 | .037*** |
| ΔGrowth | .001 | .000** | .002 | .001* | .001 | .000** | .001 | .001 | .001 | .001 | .003 | .002* |
| ΔNet Assets | -.006 | .002** | -.017 | .004*** | -.006 | .002** | -.071 | .006*** | -.005 | .003* | -.009 | .005* |
| ΔReinsurance | -.004 | .005 | .042 | .013*** | .002 | .006 | .029 | .017* | -.013 | .008 | .061 | .021*** |
| ΔShort Tail | .028 | .013** | -.004 | .035 | .046 | .016*** | -.003 | .052 | .002 | .020 | -.002 | .041 |
| ΔLiability | -.025 | .014* | -.026 | .039 | .049 | .019*** | .023 | .054 | -.018 | .022 | -.106 | .051** |
| ΔAuto | -.009 | .016 | -.032 | .049 | -.007 | .020 | -.072 | .067 | -.010 | .028 | .049 | .063 |
| ΔWorker's Compensation | .031 | .024 | .044 | .074 | .057 | .030* | .093 | .099 | -.023 | .041 | -.053 | .105 |
| ΔHerfindahl (State) | -.004 | .005 | -.004 | .009 | -.004 | .005 | -.010 | .013 | -.005 | .007 | .003 | .013 |
| ΔHerfindahl (Line) | .008 | .005 | -.002 | .013 | .003 | .007* | .019 | .018 | .003 | .008 | -.020 | .018 |
| Mutual Insurer | .001 | .001 | .003 | .002 | .003 | .001** | .001 | .003 | -.002 | .002 | .004 | .003 |
| Public Insurer | .001 | .001 | -.002 | .002 | -.001 | .001 | -.002 | .003 | .003 | .001* | -.002 | .003 |
| Group | -.000 | .001 | -.000 | .002 | .001 | .001 | -.001 | .003 | -.002 | .001 | .001 | .003 |
| ΔRBC | -.001 | .000 | -.002 | .001** | -.001 | .001 | -.002 | .001* | -.000 | .001 | -.002 | .001 |
| P&C Indicators? | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| Year Indicators? | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Obs. | 20111 | 20111 | 10014 | 10014 | 10097 | 10097 |

All variables are defined in Table 1. P&C and Year indicators are included in the model but not reported to conserve space. *, **, and *** indicate significance at the 0.10, 0.05, 0.01 percent levels, respectively.

**Table 4.**
**Results of estimation for the simultaneous equations**

| | (1) ΔPortfolio Management Over-Reserve | | (2) ΔDLRE Over-Reserve | | (3) ΔPortfolio Management Under-Reserve | | (4) ΔDLRE Under-Reserve | |
|---|---|---|---|---|---|---|---|---|
| Variable | Coef. | Std. Err | Coef. | Std. Err | Coef. | Std. Err | Coef. | Std. Err |
| Intercept | -.001 | .001 | .012 | .004*** | -.002 | .002 | -.018 | .006*** |
| LagPortfolio Management | | | -.001 | .004 | | | -.006 | .004* |
| LagDLRE | .007 | .004* | | | .012 | .005*** | | |
| LagUnderwriting | -.060 | .009*** | .041 | .021 | -.057 | .013*** | .038 | .037 |
| ΔRegulatory Flexibility | .011 | .003*** | | | .009 | .003*** | | |
| ΔSmoothing | | | -.202 | .064*** | | | -.472 | .088*** |
| ΔTax Shield | -.013 | .012 | .125 | .030*** | .019 | .016 | .129 | .043*** |
| ΔGrowth | .001 | .001 | .002 | .001 | .001 | .001* | .002 | .002 |
| ΔNet Assets | -.007 | .002*** | .011 | .004** | -.003 | .003 | -.054 | .009*** |
| ΔReinsurance | -.012 | .007* | .049 | .017*** | .008 | .007 | .023 | .020 |
| ΔShort Tail | .047 | .017*** | .004 | .039 | .000 | .020 | -.008 | .066 |
| ΔLiability | .052 | .019*** | .028 | .060 | -.008 | .021 | -.058 | .066 |
| ΔAuto | -.020 | .021 | .096 | .096 | -.002 | .024 | -.089 | .079 |
| ΔWorker's Compensation | .036 | .033 | -.013 | .010 | .030 | .034 | .028 | .113 |
| ΔHerfindahl (State) | -.005 | .005 | -.013 | .010 | .001 | .006 | -.008 | .020 |
| ΔHerfindahl (Line) | .006 | .007 | .001 | .015 | .010 | .008 | -.001 | .025 |
| Mutual Insurer | .001 | .001 | .000 | .002 | -.000 | .002 | .006 | .004 |
| Public Insurer | .001 | .001 | -.000 | .002 | .001 | .002 | -.001 | .004 |
| Group | -.001 | .001 | -.001 | .002 | -.000 | .002 | .007 | .004* |
| ΔRBC | -.001 | .001 | -.003 | .001*** | -.001 | .001 | -.003 | .003 |
| P&C Indicators? | Yes | | Yes | | Yes | | Yes | |
| Year Indicators? | Yes | | Yes | | Yes | | Yes | |
| Obs. | 13280 | | 13280 | | 6831 | | 6831 | |

All variables are defined in Table 1. P&C and Year indicators are included in the model but not reported to conserve space. *, **, and *** indicate significance at the 0.10, 0.05, 0.01 percent levels, respectively.