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

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Agenda

1. Introduction
2. Literature Review
3. Hypotheses
4. Data and Method
5. Empirical Results
6. Conclusions
Introduction

- Loss Reserve Errors
- Income Smoothing
Loss Reserve Errors

- Non-discretionary V.S. Discretionary Errors

Typical time line of a non-life insurance claim

Loss Reserve Errors of Property/Casualty Insurance Industry
($millions)

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

- **Income smoothing**: reduce volatility

- **Loss Reserve: a “good smoother”** (Copeland 1968)
  1. Does not commit the firm to any particular future action;
  2. Based on the exercise of professional actuaries;
  3. Leads to material shift of income;
  4. Does not require a “real” transaction with second parties;
  5. Adjustments can be conducted over consecutive years.

- **Benefits of income smoothing**
  - Increase firm value
    - Less dependence on costly external financing market
    - Less likelihood of **negative earnings surprises**
    - Less forecast errors (more followers) thus more attractive to investors
    - ….
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Literature Review

- Income Smoothing

- Increase Tax Shield

- Financial Distress

- Rate Regulation

- Executive Compensation
  - Browne at al. 2009, Eckles and Halek 2010

- Others
Limitations: Income Smoothing

- Univariate analysis (e.g. F-variance test)
  - Anderson 1971, Smith 1985

- Based on ex-post results
  - Smooth = average overall net income of previous three years
    - E.g. Grace 1990, Grace and Leverty 2012
  - Distribution of overall net income

- Difficulty: “True” underwriting income = reported underwriting income - loss reserve errors
An alternative way

- Overall income
  \[ \text{Overall income} = \text{underwriting income} + \text{investment income} + \text{other income} \]
- Loss reserve errors V.S. investment income

Incomes are scaled by total assets. Data source: NAIC annual Statements (Annually).
An alternative way: feasibility

- Loss reserves
  - Estimation of future unpaid liability of losses incurred
- If without manipulation: loss reserve errors are related to underwriting risk, but not significantly related to investment risk
  - SAP: Loss reserves are undiscounted (with exceptions)
  - Loss reserving: most are based on run-off triangles
  - Loss reserve error: moves accrual between “liability” and “equity”
  - Sources of investment income: funds attribute to underwriting (loss reserves, unearned premium reserves), and policyholders’ surplus
    - Decrease reserve will increase policyholders’ surplus
  - Rate of investment return on assets of previous years
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Hypotheses

- Ha: Loss reserve errors are positively associated with the investment risk of insurers, after controlling firm characteristics and risk in underwriting.

All else equal:

- Ha 1.1: Loss reserve errors + volatility of investment income of P/C insurers

- Ha 1.2: Loss reserve errors - level of average investment return of P/C insurers

- Ha 1.3: Loss reserve errors + risk in investment portfolios of P/C insurers
Hypotheses (1.1)

Income Smoothing and volatility of income

Firm 1

Firm 2

C A Target Income B D
Hypotheses (1.2)

Incentive of income smoothing with different income levels

![Graph showing probability distributions for different firms at various rate of return points](image)
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Methodology

\[ \text{Error}_{i,t} = \alpha + \delta \text{Risk}_{i,t} + \theta Z_{i,t} + \beta X_{i,t} + \varepsilon_{i,t} \]

- **Error**: Loss reserve errors
- **Risk**: Investment risk & Underwriting risk
- **Z**: Other factors tested in previous literature
- **X**: Firm demographics
Loss Reserve Errors

- Prevalent measures of loss reserve errors:
  - Kazenski, Feldhaus, and Schneider (1992)

\[
KFS\ Error_{i,t} = \text{Losses Incurred}_{i,t} - \text{Developed Losses Incurred}_{i,t+j}
\]
Investment Risk

- **INVSTD**
- **INVMEAN**
- **BONDCHARGE**: a measure of default risk of bond investments
  
  \[ BONDCHARGE = (\text{bondclass}1 \times 0.003 + \text{bondclass}2 \times 0.01 + \text{bondclass}3 \times 0.02 + \]
  
  \[ \text{bondclass}4 \times 0.045 + \text{bondclass}5 \times 0.10 + \text{bondclass}6 \times 0.30)/\text{TotalAsst} \times 100 \]

  - NAIC Risk-Based Capital formula

- **RLMRTG**
- **AFFIINV**
Underwriting Risk

- LIABILITY
- AUTO
- WCOMP
- REINSASMD
- BUSHERF
- GEOHERF

Others

- REINSURANCE
- TAXSHIELD
  \[ \text{TAXSHIELD}_{i,t} = \frac{\text{Net Income}_{i,t} + \text{Reserve}_{i,t}}{\text{Total Assets}_{i,t}} \times 100 \]
- RBCRATIO

Demographics

- AGE, SIZE, STOCK, GROUP, GROWTH
DATA and Model

- NAIC Annual Statement database (1991 to 2012)
- Data used: 1996-2007
- Sample size after screening: 14326

- Feasible general least square (FGLS, Mixed effects)
  - Fixed effects on year dummies
  - Random effects on companies
  - Adjust for autocorrelation and heteroskedasticity

1893 companies
Average time period = 7.6 years
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KFS Errors and Income Streams


Data Source: Best's Aggregates & Averages - Property/Casualty(Annually).
KFS Error-Corrected Policyholders' Surplus of P/C Insurance Industry (1982-2012)

Data Source: Best's Aggregates & Averages - Property/Casualty (Annually).
### Model Results (1)

<table>
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<tr>
<th>Dependent Variable</th>
<th>ABS(ERROR)</th>
<th>ERROR</th>
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<tr>
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<td>Model (1)</td>
<td>Model (2)</td>
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<tr>
<td></td>
<td>Full Sample</td>
<td>Over-reserve (ERROR&gt;0)</td>
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<td>INVMEAN</td>
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<td>INVSTD</td>
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<td>REINSURANCE</td>
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</tr>
</tbody>
</table>
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Conclusions

- The results suggest income smoothing via loss reserves are related to the performance of investment.

- The reserves are more accurate when:
  - Investment income level is higher
  - Investment income volatility is lower
  - The default risk of bonds is lower
  - % of affiliated investment is lower

- Further Research
  - Improve the investment risk measures (e.g. diversification)
  - Identify lines of business with higher process errors
  - Asset-liability management of property/casualty insurers
THANK YOU!