U.S. Property-Casualty: Underwriting Cycle Modeling and Risk Benchmarks

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Joint research with Guy Carpenter

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Agenda

1. **Background & Motivation**
2. **Data Gathering & Cleaning**
3. **Underwriting Cycle Modeling**
4. **Benchmark Parameters for** Pricing Risk, Reserving Risks and Correlation Parameters

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Background & Motivation

- In summer 2010, Risk Lighthouse and Guy Carpenter undertook a joint research project
- Thousands of hours (5 months, 7+ persons)
- Compiled extensive insurance company data filings
- Developed an underwriting cycle model for P&C insurers
- Calculated benchmark parameters for pricing and reserving risks

Data Sources

- SNL, NAIC, and A.M. Best
- Unit: insurance company (sub)group
- Lines of Business:
  i. Private Passenger Auto Liability
  ii. Commercial Auto Liability
  iii. Workers Compensation
  iv. Other Liability (Occurrence & Claims-made)
  v. Product Liability (Occurrence)
  vi. Medical Professional Liability (Occurrence & Claims-made)

Type of Data Compiled

- Gross and Net Premium triangles from 1987 to 2009 (reported as of 1996 to 2009)
- Gross Paid, Case Incurred and INBR loss triangles reported as of 1996 to 2009
- Net Paid, Case and IBNR loss triangles from 1987 to 2009 (reported as of 1996 to 2009)

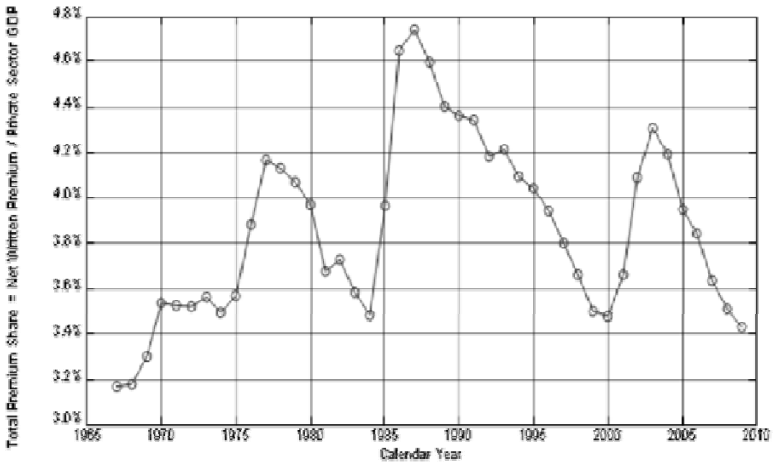
Correct for Data Inconsistencies

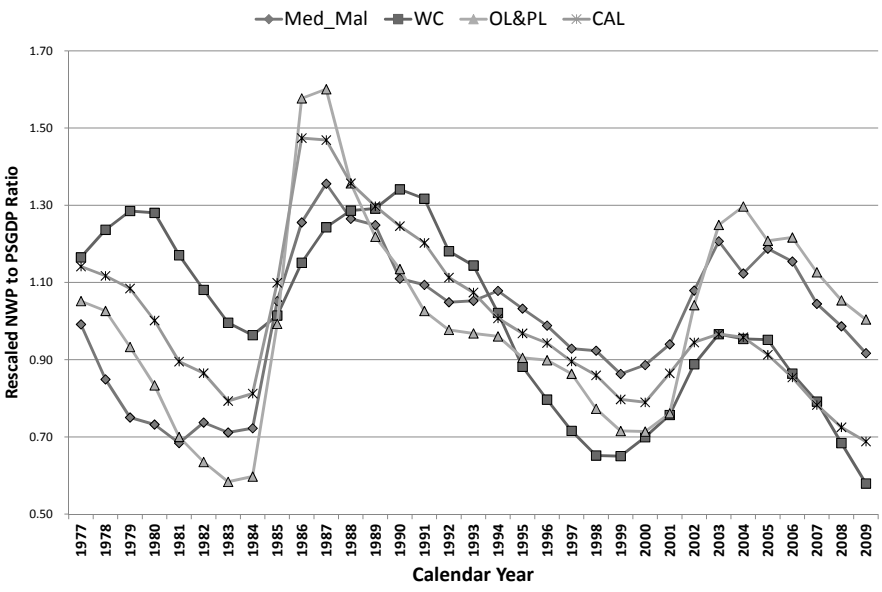
1) Restatement of historical data (under new regulations a previous transaction does not meet the test of risk transfer and must be treated as deposit accounting)
2) Company reported a number with a higher (or lower) value in one annual statement year but reduced (or increased) the same amount in the next year
3) Inter-company reinsurance
4) Missing companies from the company group

Segments of Company Groups

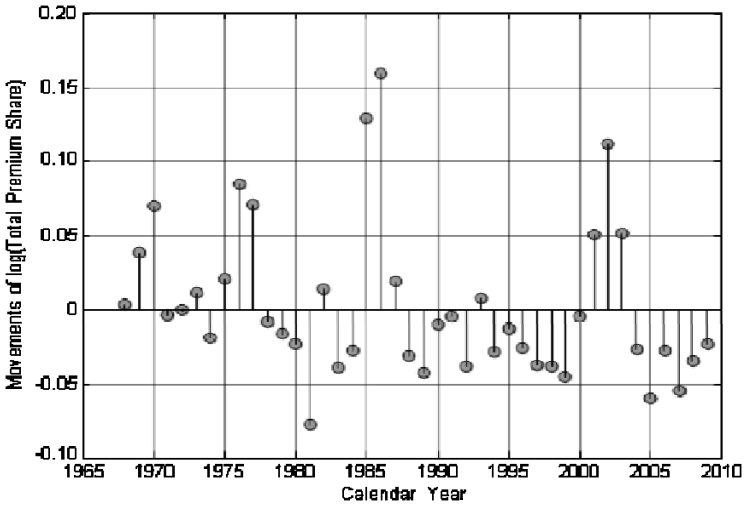
Segment	Number of Company Groups
Large National	23
Super Regional	30
Small Regional	474
Specialty Writer	55
Reinsurer	19
Other	113
Homeowner	16

Total Written Premium to Private Sector GDP Ratio (1967-2009)





Movements of Total Premium Share



Regime-shifting model for the TPS

- **Up-regime**

$$Y_{t+1} - Y_t = -0.4891 - 0.1597 \cdot Y_t + \varepsilon_{UP,t}$$

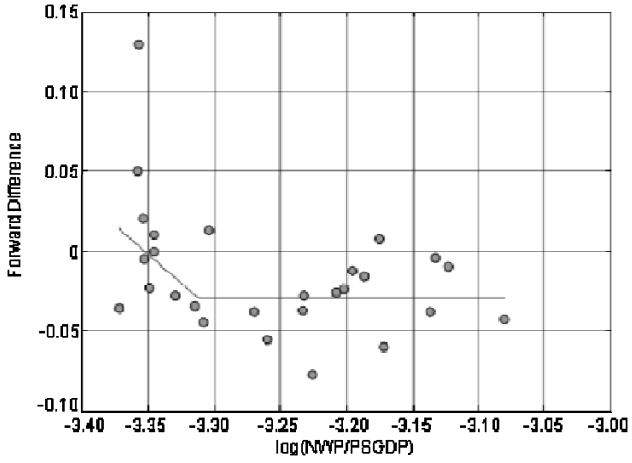
$$\varepsilon_{UP,t} \sim N(0, 0.0032)$$

- **Down-regime**

$$Y_{t+1} - Y_t = -2.4358 - 0.7266 \cdot \min(Y_t, -3.3129) + \varepsilon_{DOWN,t}$$

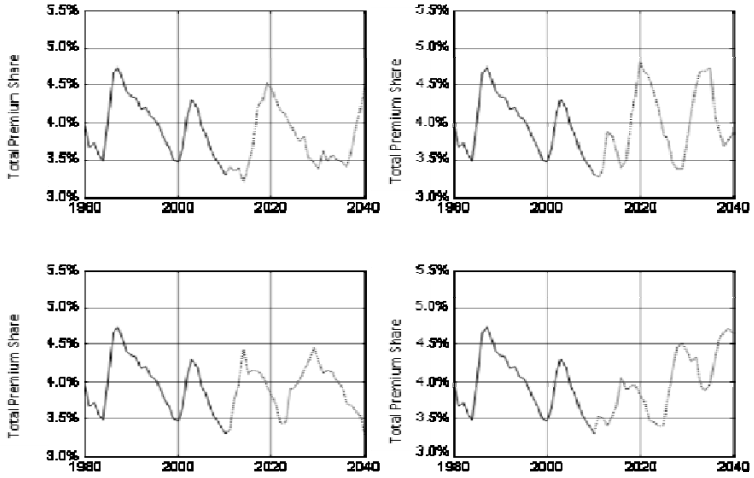
$$\varepsilon_{DOWN,t} \sim N(0, 0.0012)$$

Down-regime modeled as Hockey-stick

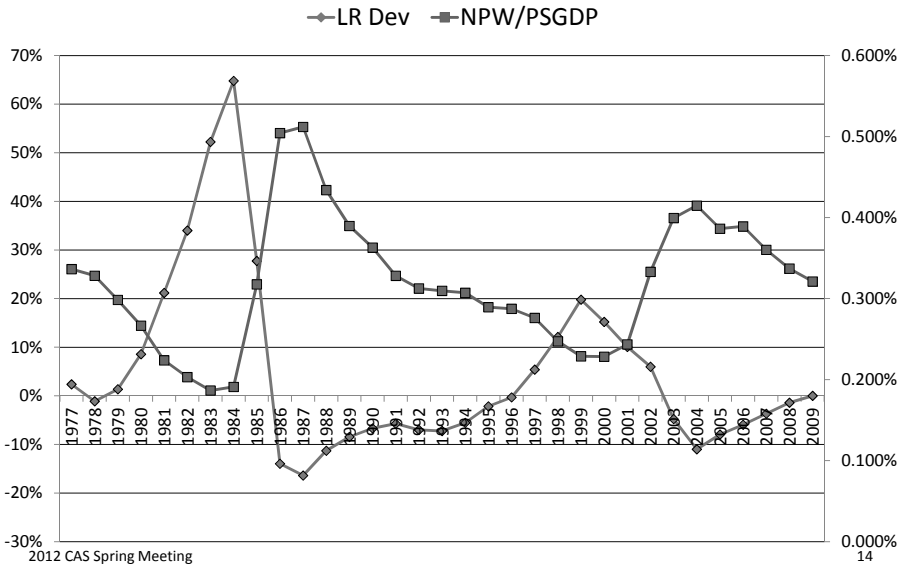


$$Y_{t+1} - Y_t = -2.4358 - 0.7266 \cdot \min(Y_t, -3.3129) + \varepsilon_{DOWN,t}$$

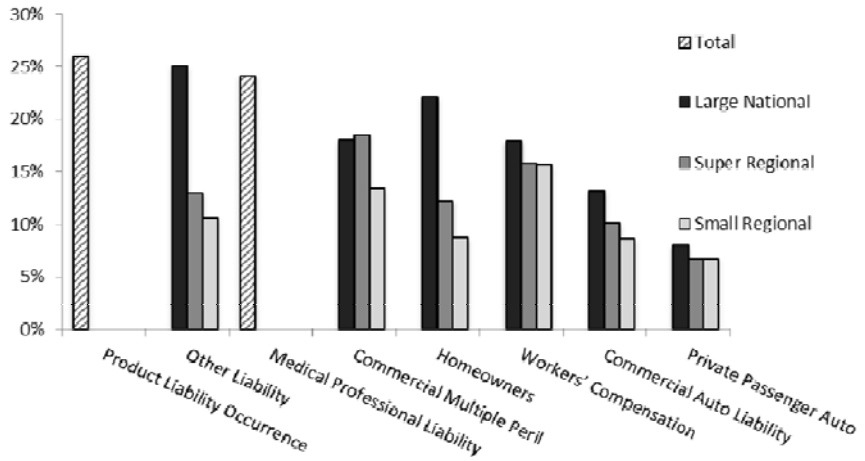
Example Simulation Paths of Total Premium Share



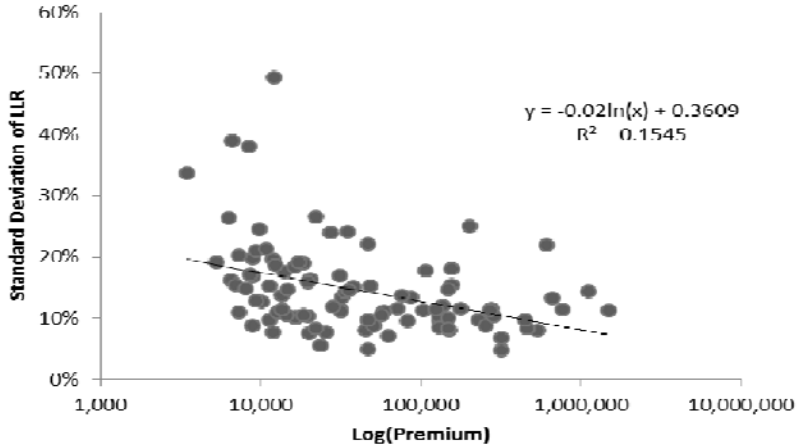
General Liability (Other Liability + Product Liability): Loss Ratio Development versus NWP/PSGDP



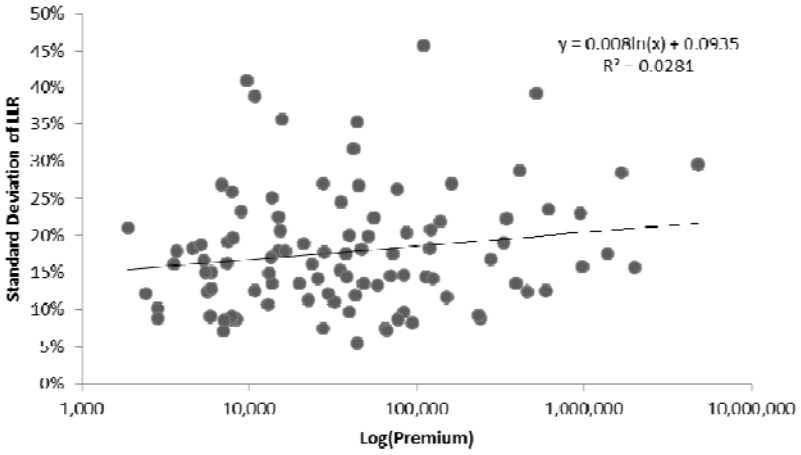
CV of Net LR across AY 1987-2004 by Segments and LOB



"Stdev of Net ULR" vs. Premium for Commercial Auto Liability



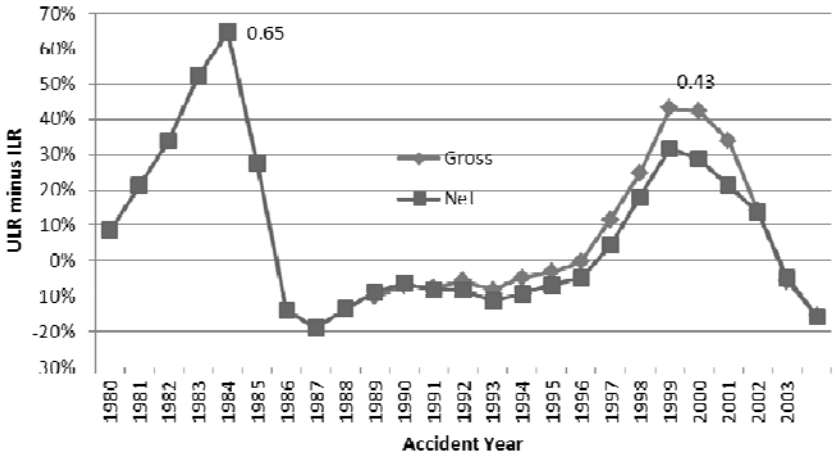
"Stdev of Net ULR" vs. Premium for Other Liability



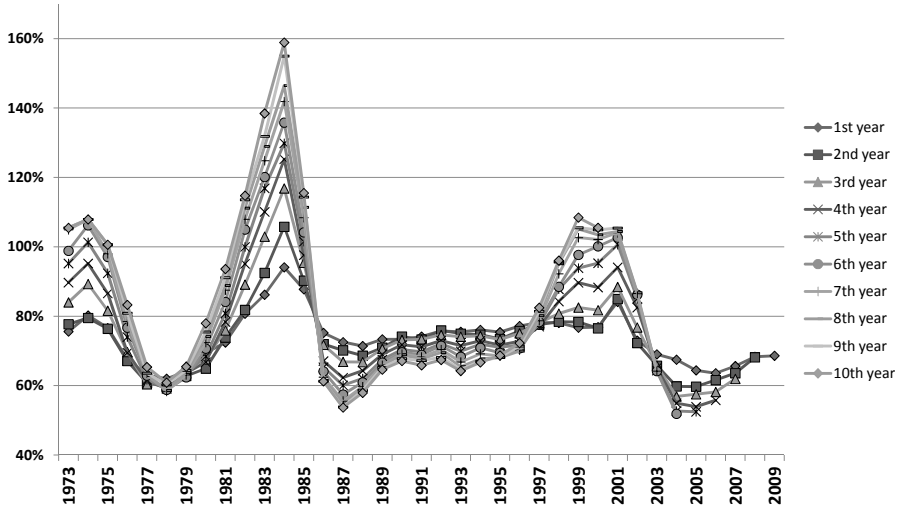
Reserving Risk by LOB & Segment: Maximum of Net ULR/ILR-1

	Total	Large National	Super Regional	Small Regional
Product Liability Occurrence	74%			
Other Liability		47%	(3)%	96%
Workers' Compensation		29%	13%	14%
Commercial Auto Liability		18%	6%	15%
Medical Professional Liability	17%			
Commercial Multi Peril		14%	7%	6%
Homeowners		7%	2%	(1)%
Private Passenger Auto Liability		2%	(1)%	1%

AY Ultimate LR minus Initial LR for Other Liability



Reported Loss Ratio for General Liability by Accident Year and Development Year



Rank Correlation of Loss Reserve Developments by LOB

LOB	Total	Other Liability	Comml Multi Peril	Home Owners	Medical Prof. Liability	Comml Auto Liability	PPA Liability	Workers' Comp.
Total	100%	86%	81%	57%	76%	91%	85%	82%
Other Liability	86%	100%	74%	49%	84%	75%	62%	55%
Comml Multi Peril	81%	74%	100%	51%	60%	80%	56%	63%
Home Owners	57%	49%	51%	100%	38%	51%	51%	49%
Medical Prof. Liability	76%	84%	60%	38%	100%	81%	65%	38%
Comml Auto Liability	91%	75%	80%	51%	81%	100%	82%	72%
PPA Liability	85%	62%	56%	51%	65%	82%	100%	80%
Workers' Comp.	82%	55%	63%	49%	38%	72%	80%	100%

Summary

1) We analyze the historical underwriting cycle, develop a regime-switching model for simulating future cycles
2) We compute benchmarks for pricing and reserving risks for different lines of business and segments
3) We also compute the historical correlation of the changes in the reserve estimate between lines of business

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