

The Market Cycle and Its Impact on Reserves

Prepared for: Buckeye Actuarial Continuing Education

Presented by: Zachary A. Ballweg, FCAS, MAAA
Consulting Actuary

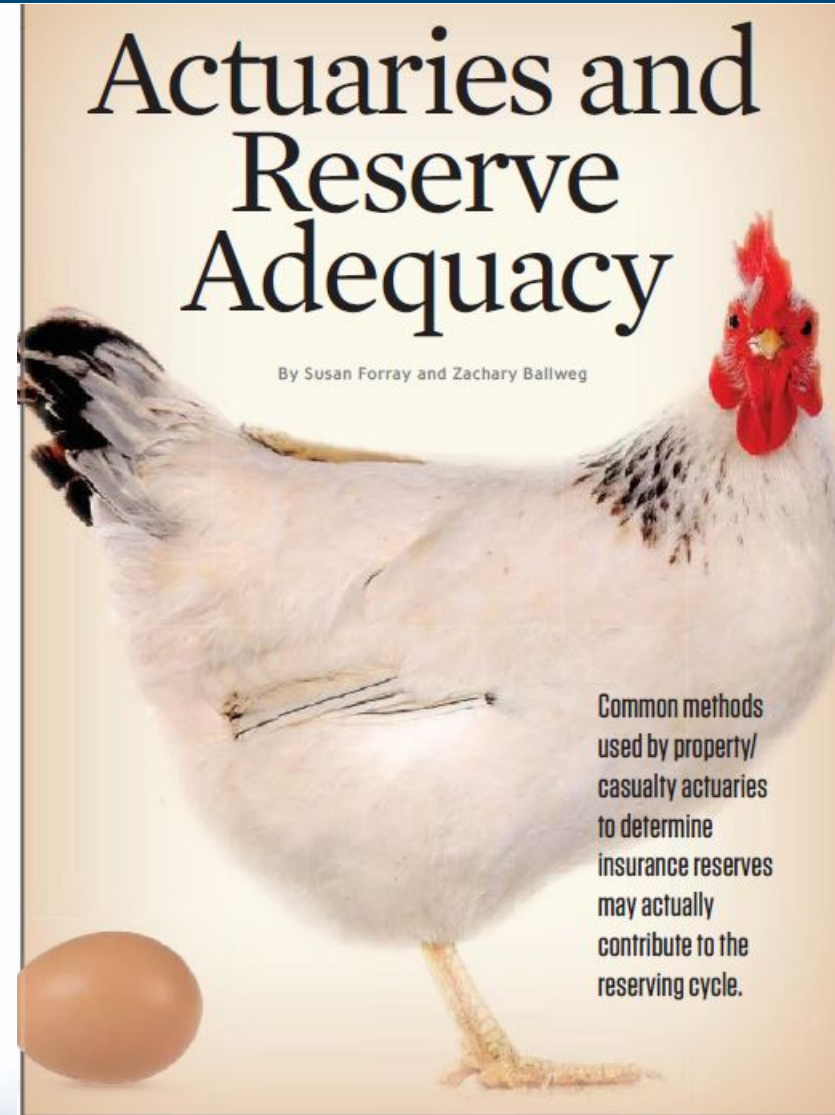
Date: April 8, 2015



Peaks and Troughs: Reserving Through the Market Cycle

Susan J. Forray, FCAS, MAAA

Zachary A. Ballweg, FCAS, MAAA

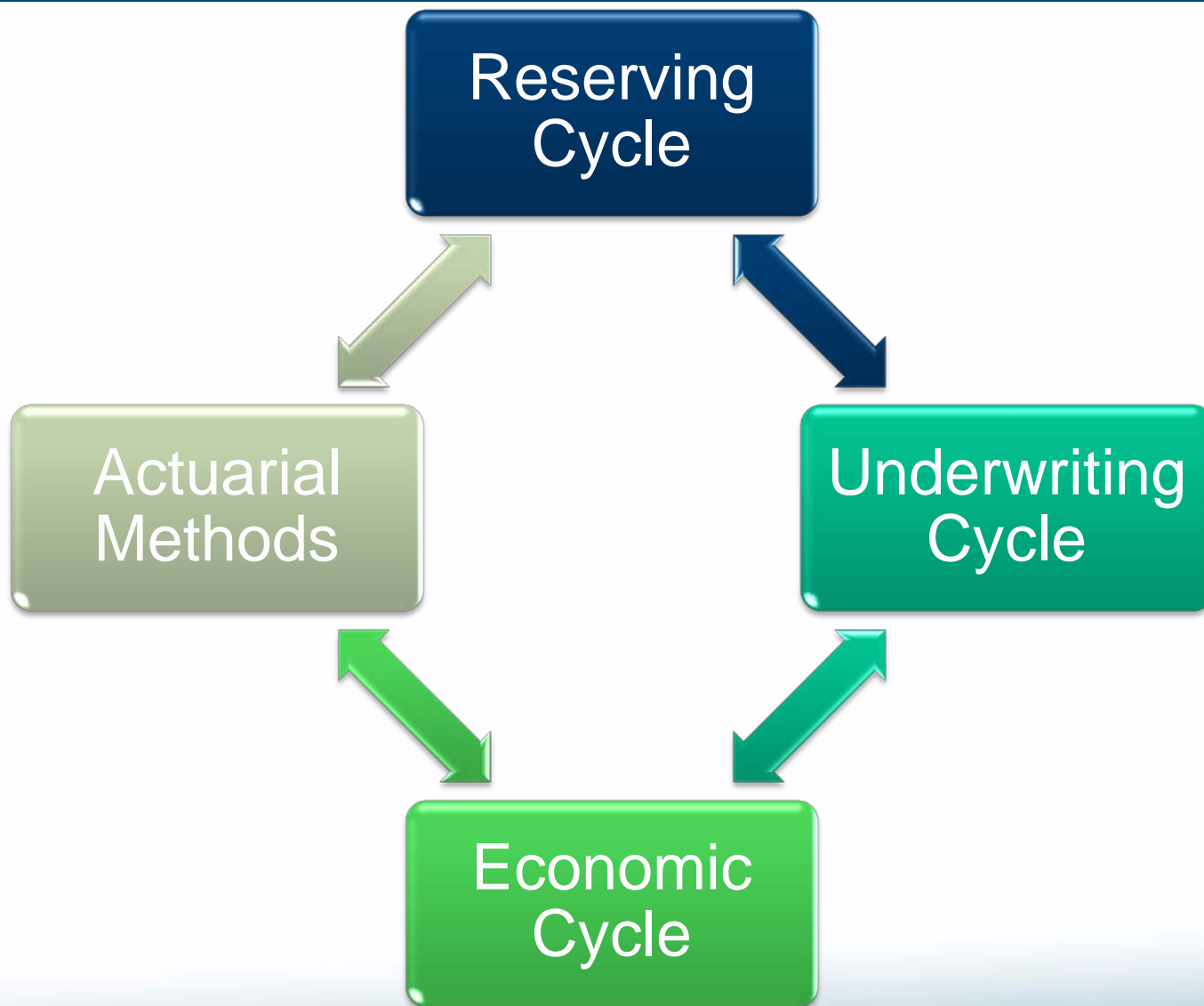


SHUTTERSTOCK/LENA PAN/THINKSTOCK

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- **P/C Reserve Adequacy Highly Cyclical 30+ Years**
 - ❖ Sources Uncertain
 - ❖ Prevailing thought cycle stems from internal industry influences:
 - Claims dept. practices
 - Changes in pricing
 - Management decisions
- **No conclusive evidence to suggest primary reason(s) for reserve cycle**
 - ❖ Actuarial Methods?

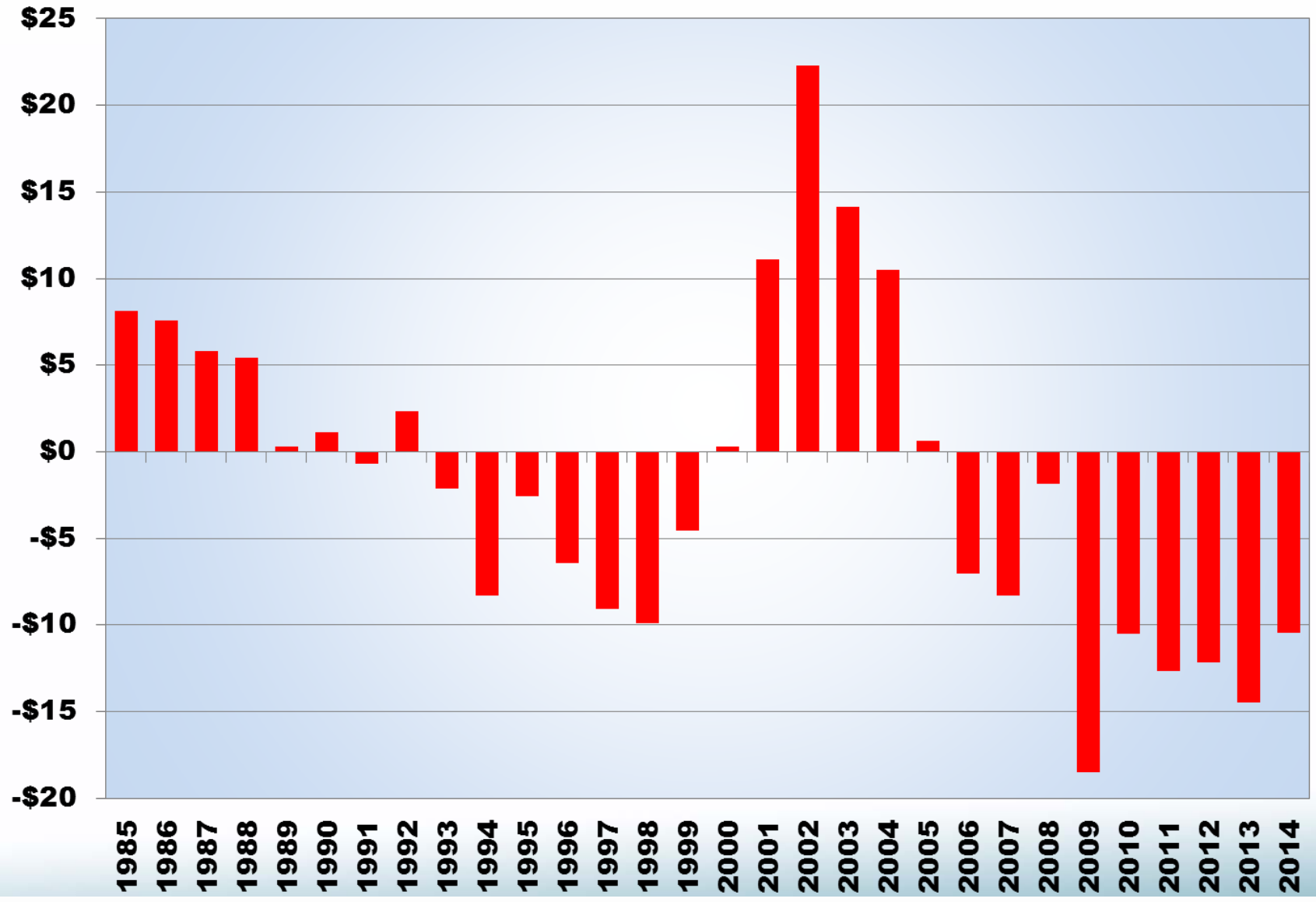
Overview



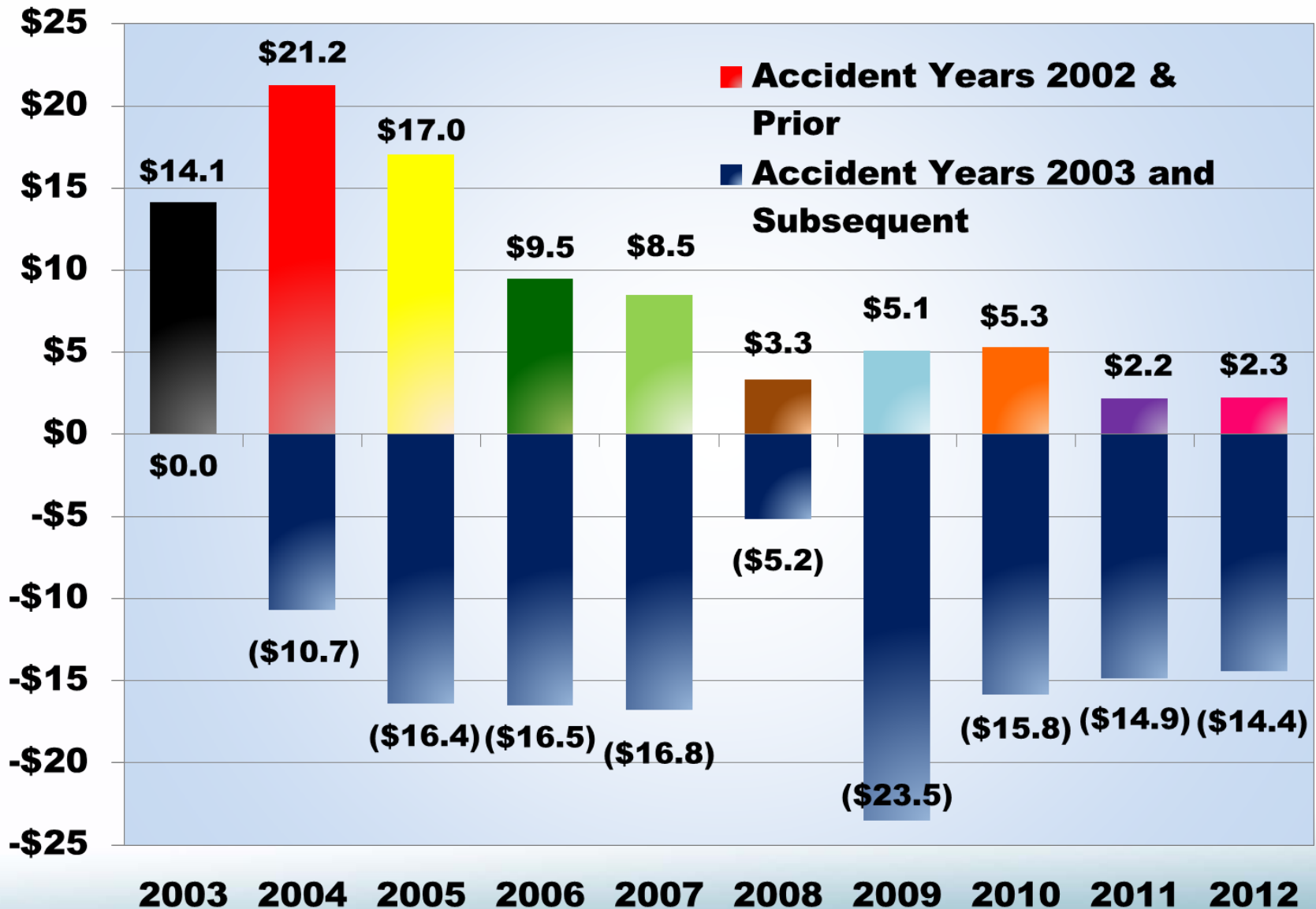
Discussion

THE RESERVING CYCLE

Reserve Development by Calendar Year (\$B)



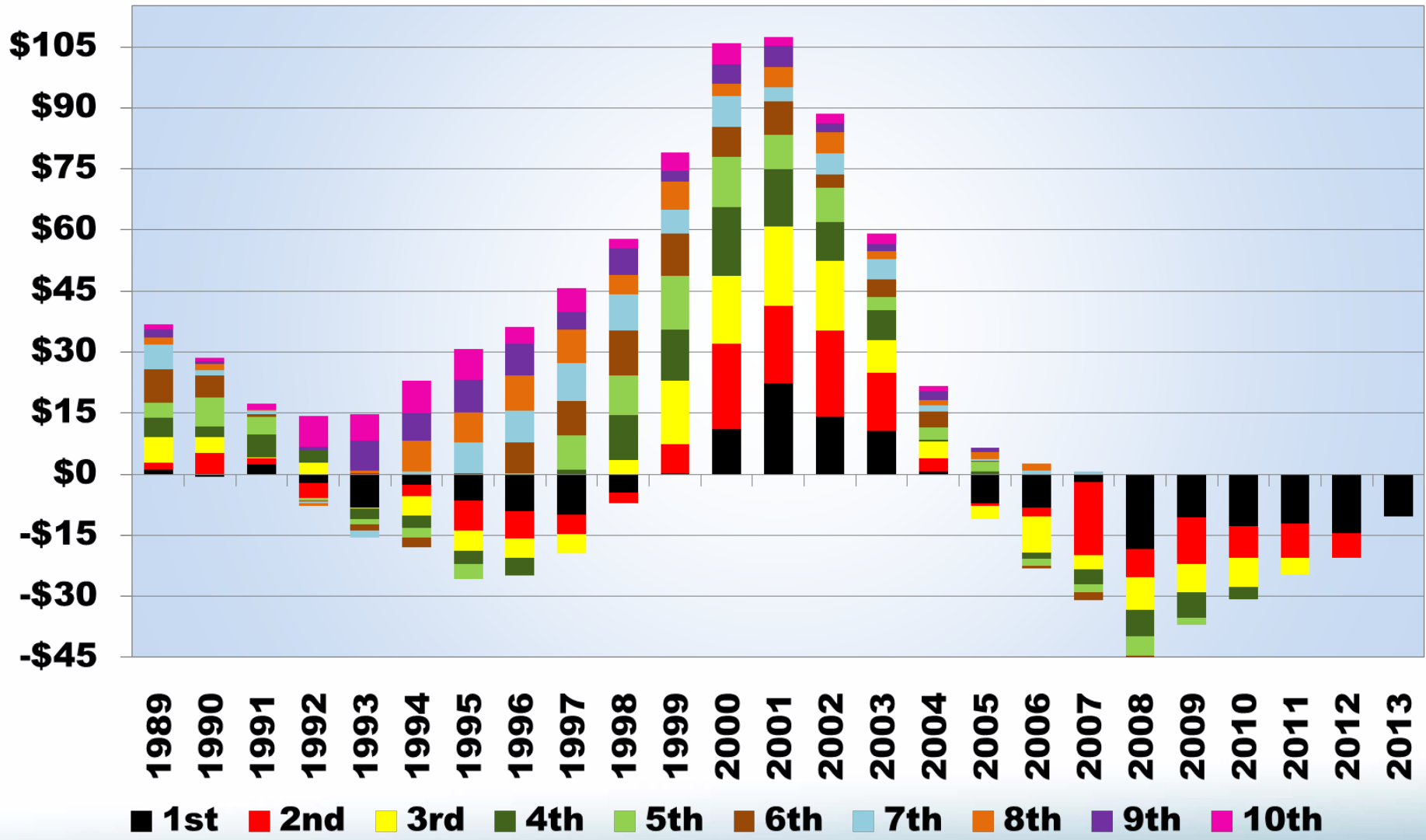
Reserve Development by Calendar Year (\$B)



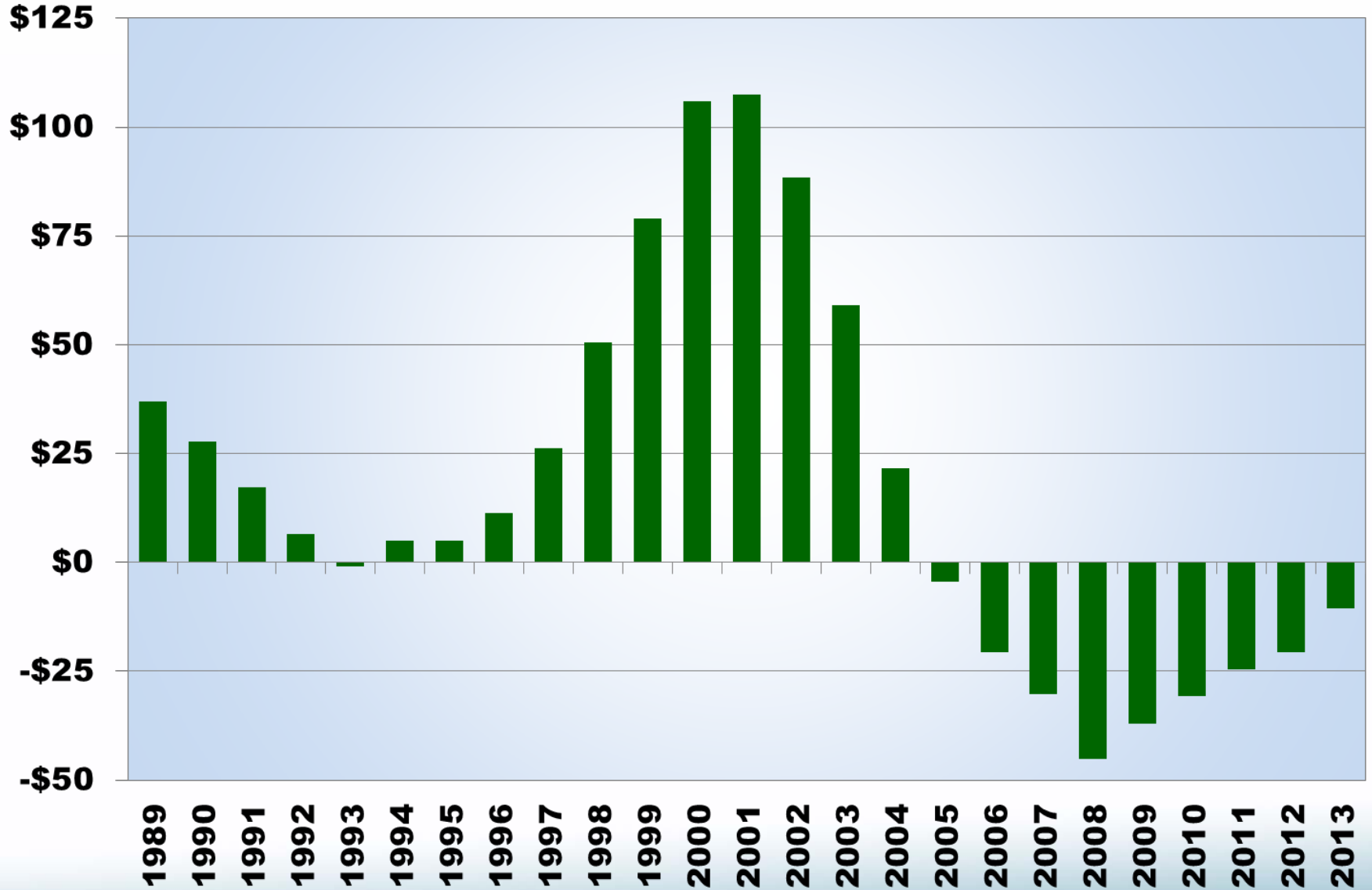
Statement Year 2002 Reserve Development (\$B)



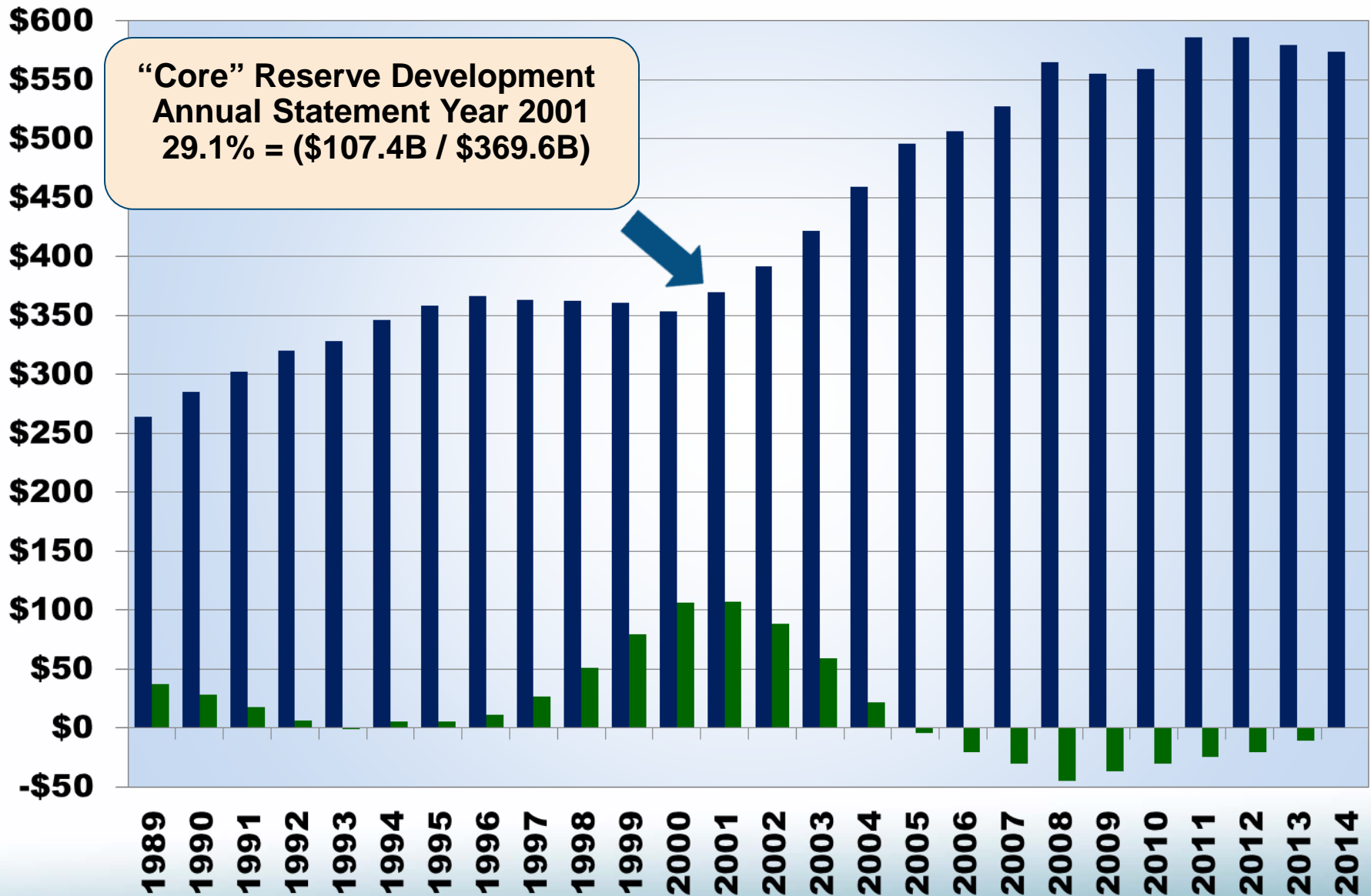
Reserve Development by Statement Year (\$B)



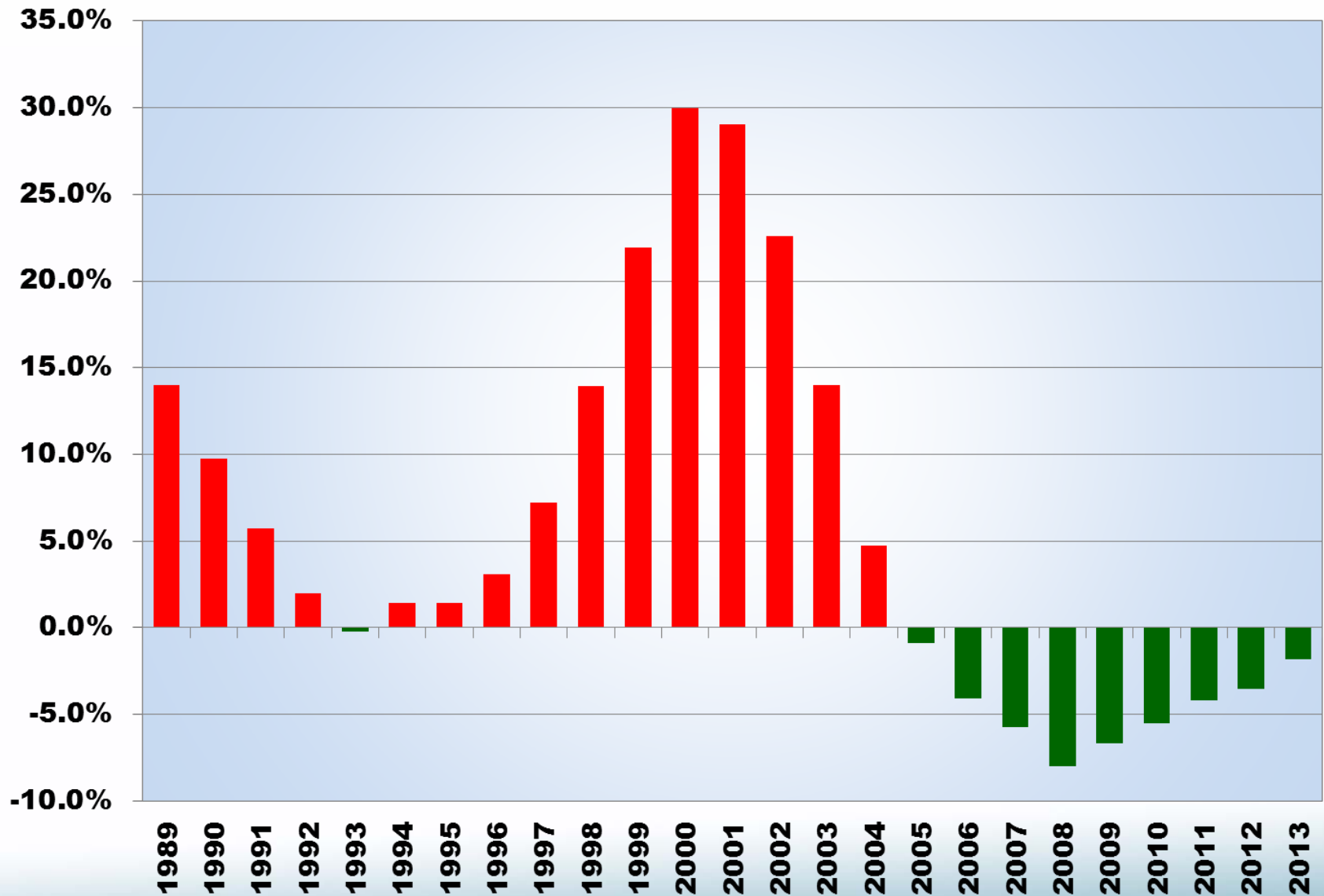
Reserve Development by Statement Year (\$B)



Carried Reserves and Subsequent Development (\$B)



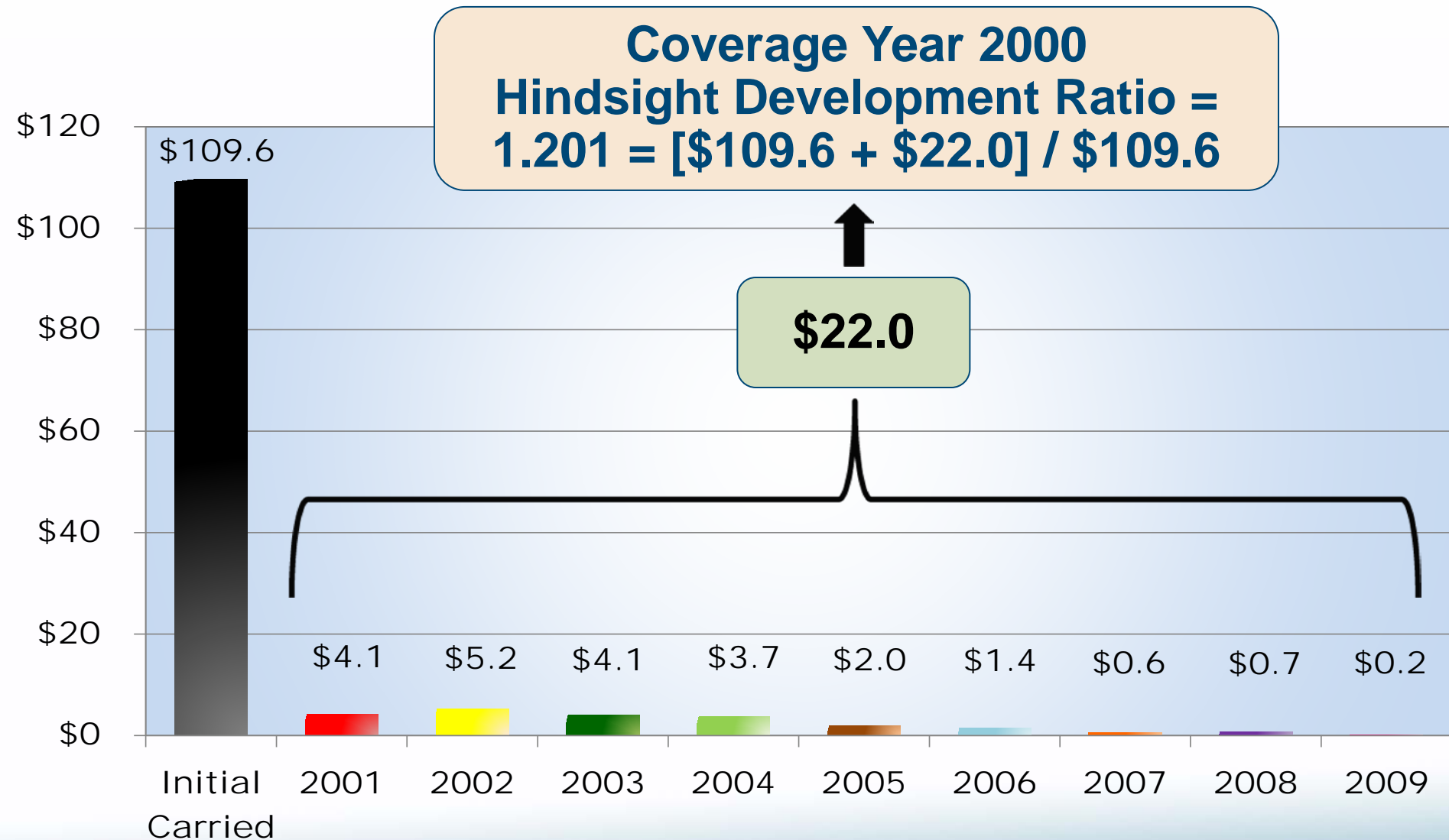
“Core” Reserve Development by Statement Year



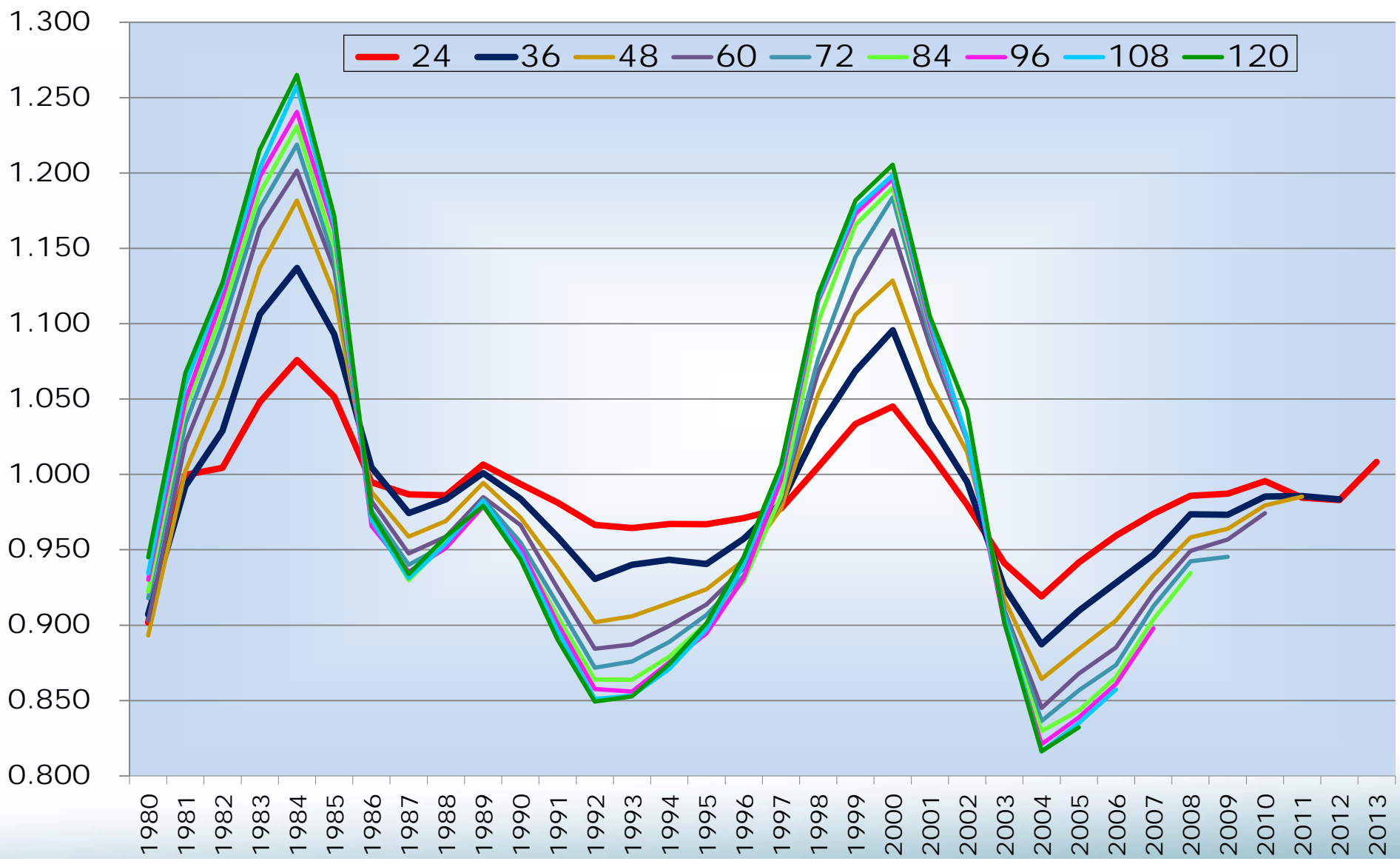
Hindsight Development Ratios

THE RESERVING CYCLE

Example – Coverage Year 2000 (\$B)



Hindsight Development by Evaluation Month



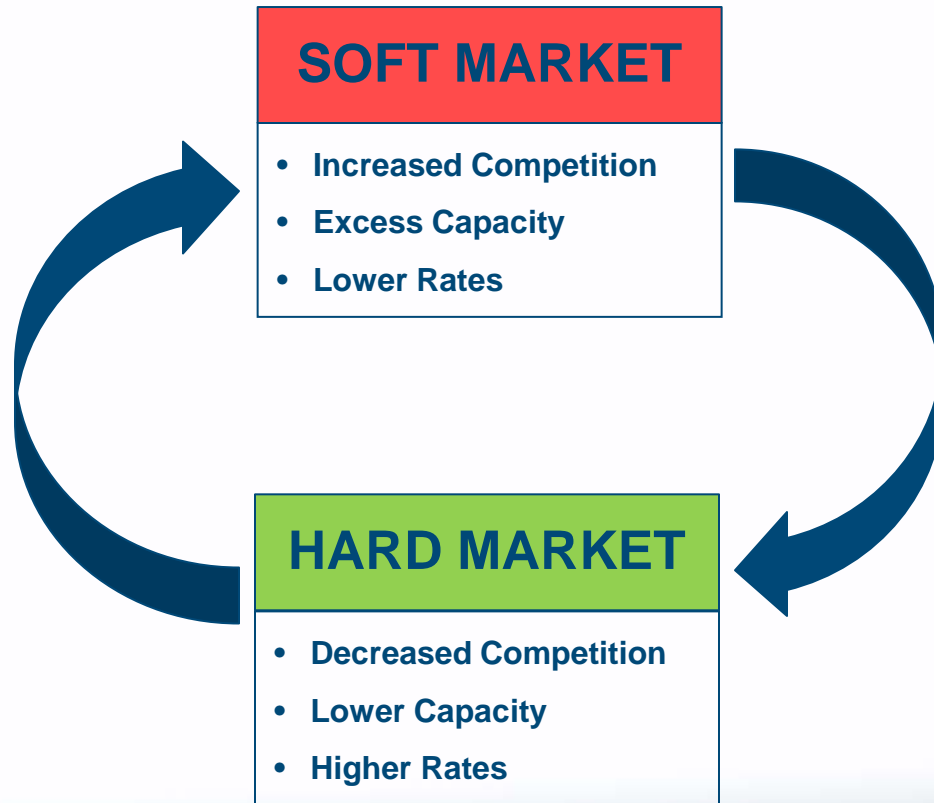
Coverage Year

Analysis

THE UNDERWRITING CYCLE

The Underwriting Cycle

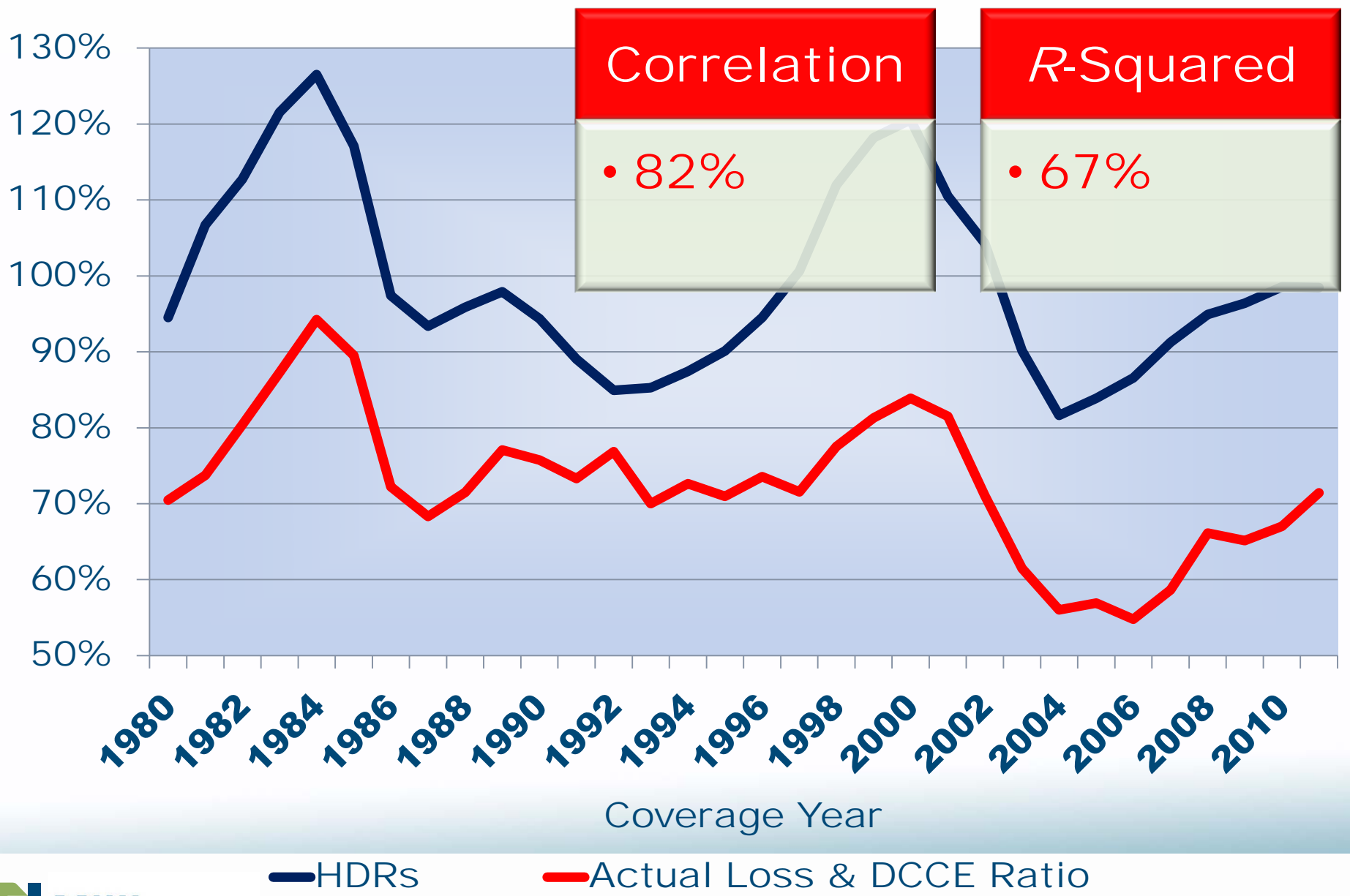
- Also known as Insurance Cycle
- Characterized by Soft and Hard Markets



- U/W Environment attracts more competition
- Gradual Increase in Capacity & Lower Rates

- Event(s) – (e.g., natural disaster or CAT)
- Increased claim activity
- Exit of lesser capitalized insurers

The Underwriting and Reserving Cycles



Reserving as a Response to Pricing

➤ **Psychological Effect**

- **Underestimate magnitude of u/w cycle - difficulty deviating from results of prior coverage years**
 - ✓ **Soft Market - may believe results better than priced**
 - ✓ **Hard Market - hedging expectations**

➤ **Policy Limits**

- **Soft Market offerings tend to be higher**

➤ **Mix of Business, e.g., Self-Insured Exposure**

Pricing as a Response to Reserving

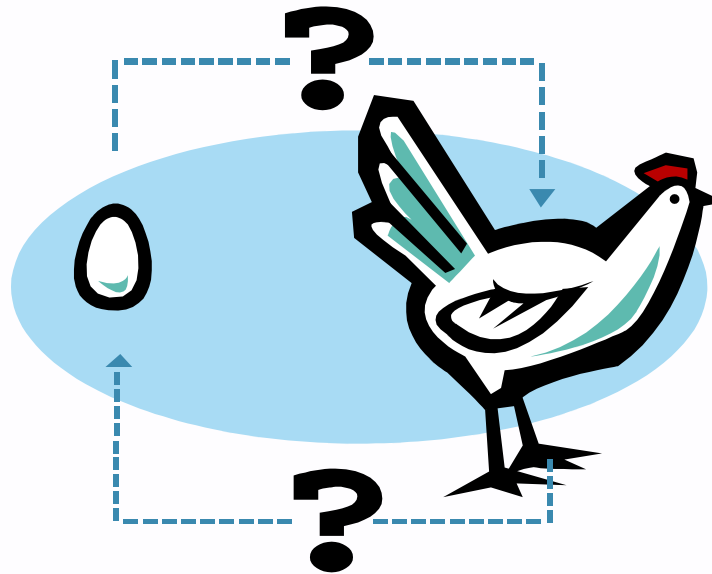
➤ Pressure to Write More / Less

- Overstated reserves → less pressure to write →
Hard Market
- Understated reserves → incentives to write more →
Soft Market

➤ Pressure only exists if degree of reserve bias not known

The Pricing and Reserving Relationship

- **Attempting to pin-point which cycle causes which a bit like asking which came first...**



- **More Likely, a Common Underlying Cause**

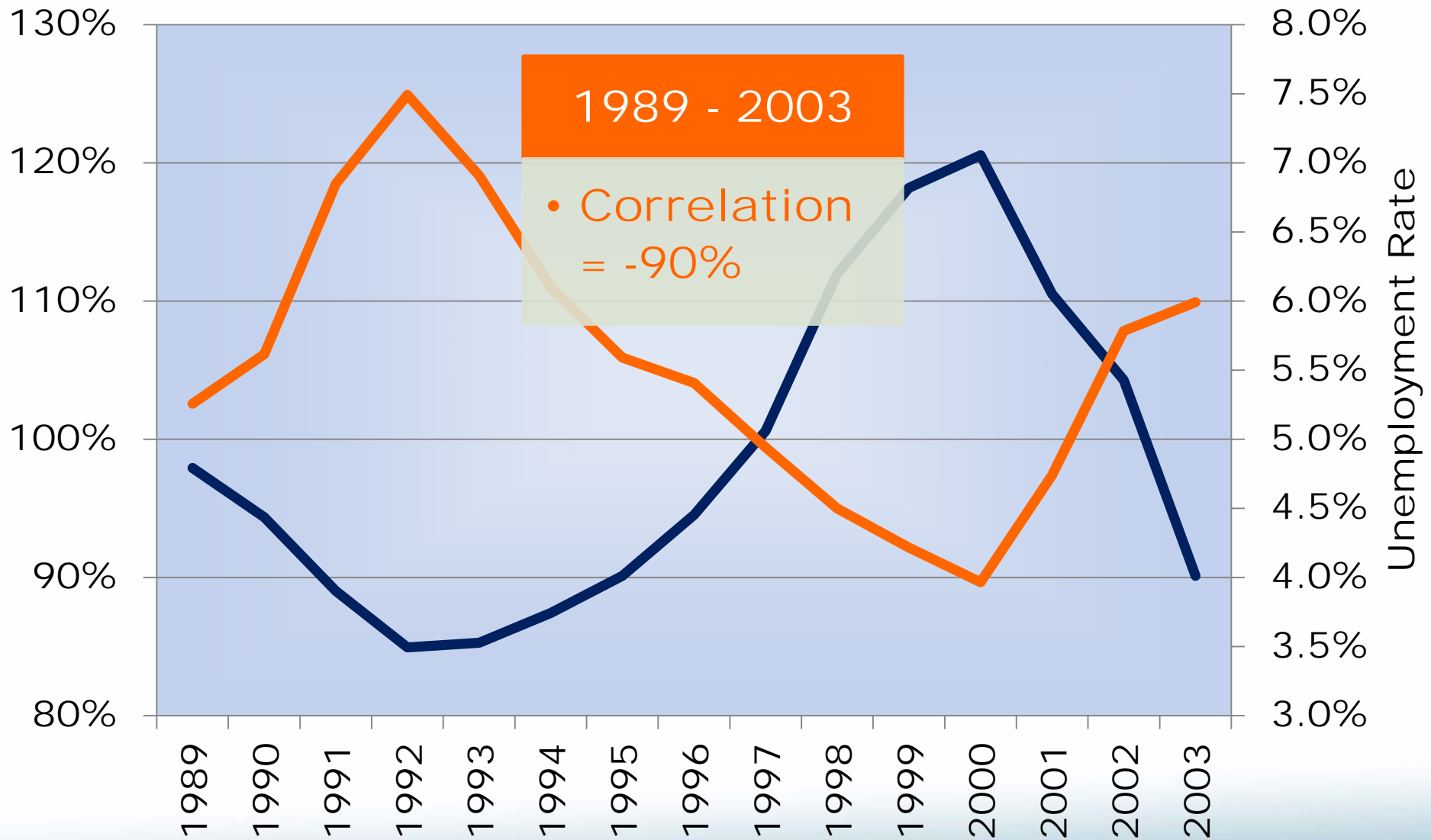
Analysis

THE ECONOMIC CYCLE

The Economic Cycle

- Relationship b/w Economic and Reserving Cycles not Explicitly Considered Previously
- Characterized by Ebb and Flow of US Economy
- Variety of Measures (e.g., GDP, Inflation, Consumer Confidence, etc.)
- We Proxy the Economic Cycle with US Unemployment Rates
 - Bureau of Labor Statistics
 - Readily available, measure of acceptance

The Economic Cycle and the Reserving Cycle



■ HDRs

■ U.S. Unemployment Rate

What Happens When the Economy Is Booming?

- **“More to Lose”**
 - More human activity in general (more working, driving, building, consuming, etc.)
 - Increasing likelihood of accidents and claims that develop
- **Inflation – May be Higher**
 - Would have a calendar year impact on payments
- **“Supply” tend to be High**
 - Supply = Capital
 - Drives down pricing
 - Process takes time...

Economic Cycle – Additional Considerations

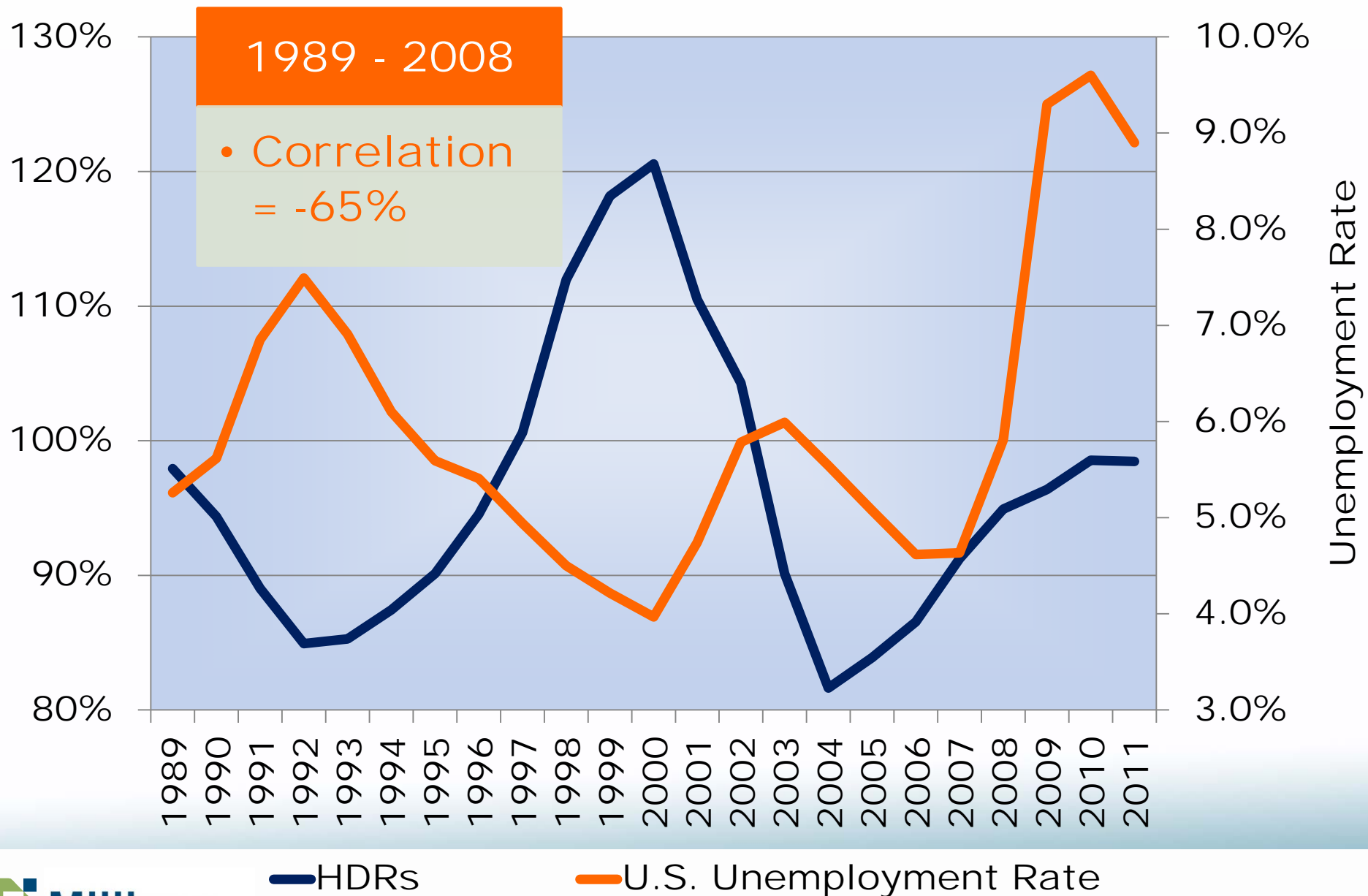
➤ **Propensity to report claims (volume impact)**

- **Down Economy – perhaps file when otherwise not**
- **Fraudulent Activity**
 - ✓ **Auto “give-ups” and staged accidents**
 - ✓ **Slip-and-fall accidents**

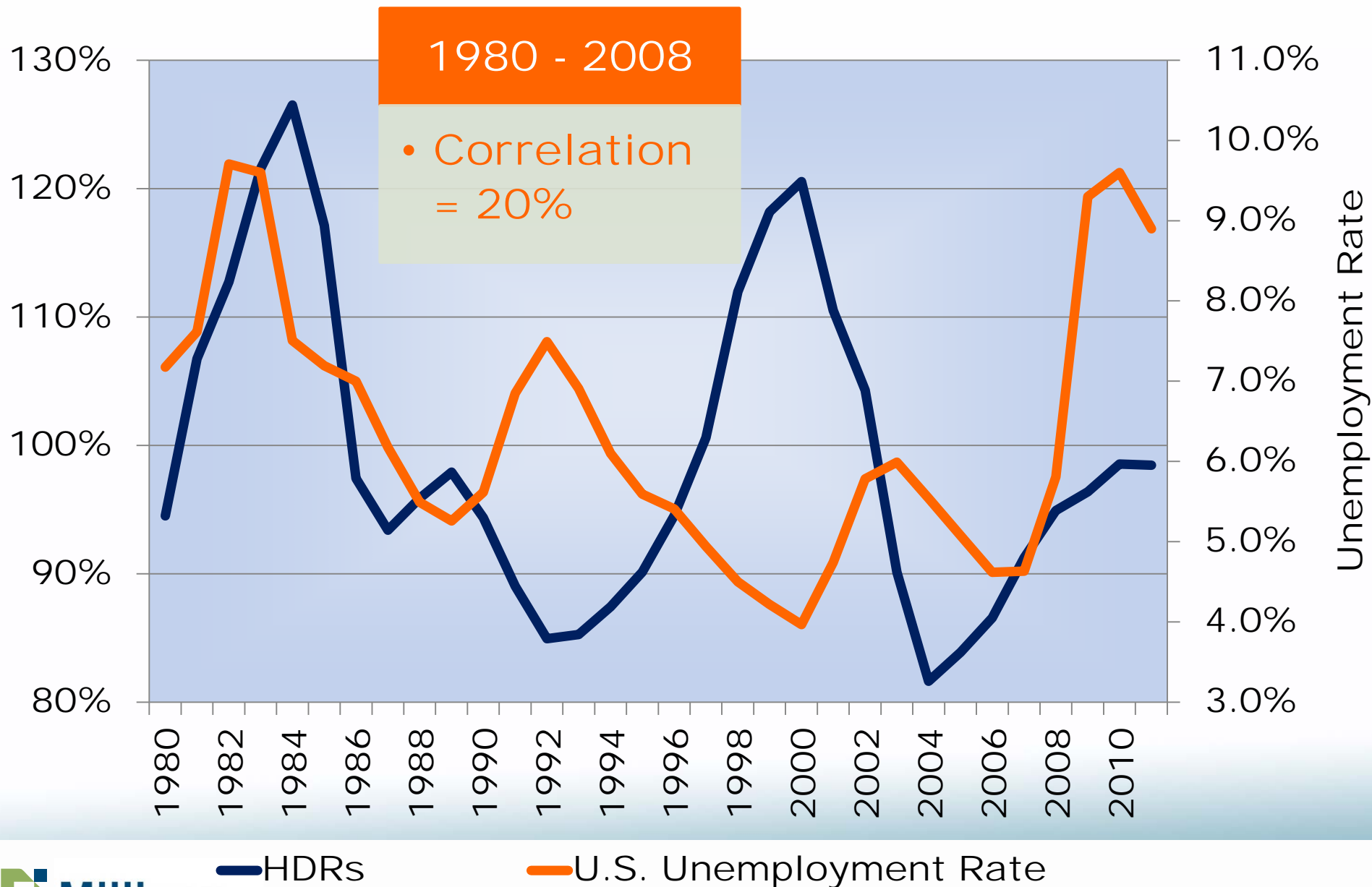
➤ **Composition of claims (severity impact)**

- **Vacant homes increase insurance risk**
 - ✓ **Power off, no AC, mold, total loss**
 - ✓ **Water leaks go undetected longer**
- **Lawsuits may increase in down periods (DCC)**
 - ✓ **Professional and other liability lines susceptible**

The Economic Cycle and the Reserving Cycle



The Economic Cycle and the Reserving Cycle



Economic Cycle Takeaways

- 1) **Reasons for the Impact of the Economic Cycle on Reserving Cycle Far From Understood**
- 2) **Notion that a “fixed orange line” Exists that May Give Insights on Reserve Movements Intriguing**
- 3) **Other Proxies Likely More Effective**
- 4) **Likely a Common Underlying Cause of Reserving and Underwriting Cycles**

Approach to Analysis

ACTUARIAL METHODS

Approach to Analysis

➤ Compiled Industry Aggregate Data by LOB

- Schedule P - Parts 1 through 5

Statement Years	Data Source
1984 – 1988	Best's Aggregates & Averages (1985 – 1989 editions)*
1989 - 1995	Best's Aggregates & Averages (1990 – 1996 editions)**
1996 - 2012	SNL Financial LC

* No 10 year triangles included (single evaluation point, moving to 6 year triangles over time)

** 10 year triangles included

Approach to Analysis Cont.

➤ Twelve Lines of Business

- All 10 year Schedule P LOB except International and Reinsurance
- Analyzed individually

➤ Goal: To Calculate Hindsight Development Ratios

- By LOB and AY at successive evaluations
- Based on Actuarial Indications of 51 Methods

Actuarial Methods Tested (51)

- Chain Ladder – 10 (Paid/Incurred WA, L7,L5, L3, L1)
- Incremental – 5 (Paid/Incurred Incr. Add/Mult, Backwards Recursive)
- Least Squares – 4 (variants on Brosius)
- Count-Based – 5 (BS, Claim Closure, HS OS unpaid/IBNR, FS)
- Loss Ratio – 3
- Composite – 24 (MCL, BF, Benktander, Cape Cod, Regression, Trend/CPI Adj., Case Reserve + variations of each)
- Formulaic approach; HDR Calculation Same

HDR Calculation Example - PPAL AY 1999 (\$B)

Accident Year	Net Paid Loss & DCC (Sch. P Part 3) by MOD									
	12	24	36	48	60	72	84	96	108	120
1990	14.1	25.8	31.7	34.9	36.5	37.2	37.5	37.7	37.8	37.8
1991	13.2	25.6	31.5	34.5	35.9	36.6	37.0	37.1	37.2	
1992	14.2	27.4	33.3	36.3	37.8	38.6	39.0	39.2		
1993	15.5	29.4	35.5	38.6	40.4	41.2	41.6			
1994	17.0	31.5	37.8	41.3	43.0	43.9				
1995	17.7	32.1	38.7	42.3	44.1					
1996	18.3	32.9	39.5	43.3						
1997	18.6	33.1	39.9							
1998	18.9	33.9								
1999	20.8									

Paid LR = 29.8%

Accident Year	Paid LDFs									
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120+
1990	1.824	1.232	1.100	1.045	1.019	1.009	1.005	1.002	1.001	
1991	1.941	1.232	1.094	1.042	1.019	1.009	1.005	1.002		
1992	1.928	1.215	1.090	1.041	1.021	1.010	1.005			
1993	1.900	1.209	1.088	1.045	1.019	1.010				
1994	1.850	1.199	1.092	1.043	1.020					
1995	1.814	1.205	1.093	1.044						
1996	1.795	1.202	1.094							
1997	1.779	1.204								
1998	1.797									
WA	1.841	1.211	1.093	1.043	1.020	1.010	1.005	1.002	1.001	1.003
CUM WA	2.649	1.438	1.188	1.087	1.041	1.021	1.012	1.007	1.004	1.003

**Tail =
AY 1990 Reported
/ Paid Loss & DCC**

Indicated Ult. = \$55.1 (or 79.0%)



1.003
1.003

HDR Calculation Example - PPAL AY 1999 (\$B)

Accident Year	Net Paid Loss & DCC (Sch. P Part 3) by MOD									
	12	24	36	48	60	72	84	96	108	120
1991	13.3	25.5	31.4	34.4	35.9	36.5	36.9	37.1	37.2	37.2
1992	14.2	27.4	33.2	36.2	37.7	38.5	38.9	39.1	39.2	
1993	15.4	29.3	35.5	38.6	40.3	41.1	41.5	41.7		
1994	17.0	31.4	37.7	41.2	42.9	43.8	44.2			
1995	17.7	32.0	38.6	42.2	44.0	44.9				
1996	18.3	32.8	39.5	43.2	45.2					
1997	18.6	33.0	39.8	43.6						
1998	18.8	33.8	40.8							
1999	20.7	36.6								
2000	22.4									

HDR @ 24 MOD = 93.5% =
[75.8% - 29.8%] / [79.0% - 29.8%]

Accident Year	Paid LDFs									
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120+
1991	1.918	1.233	1.094	1.042	1.019	1.010	1.005	1.002	1.001	
1992	1.929	1.215	1.091	1.041	1.021	1.010	1.005	1.002		
1993	1.900	1.209	1.088	1.045	1.019	1.010	1.005			
1994	1.850	1.199	1.092	1.043	1.020	1.010				
1995	1.814	1.205	1.093	1.044	1.020					
1996	1.795	1.203	1.095	1.047						
1997	1.779	1.205	1.095							
1998	1.798	1.205								
1999	1.772									
WA	1.832	1.208	1.093	1.044	1.020	1.010	1.005	1.002	1.001	1.003
CUM WA	2.631	1.436	1.188	1.088	1.042	1.021	1.012	1.007	1.005	1.003

Indicated Ult. = \$52.6 (or 75.8%)

HDR Calculation Example - PPAL AY 1999 (\$B)

Accident Year	Net Paid Loss & DCC (Sch. P Part 3) by MOD									
	12	24	36	48	60	72	84	96	108	120
1999	20.5	36.3	43.4	47.4	49.4	50.4	50.8	51.1	51.2	51.3
2000	22.2	39.1	46.6	50.8	52.9	53.9	54.5	54.7	54.9	
2001	23.1	40.2	47.9	52.2	54.5	55.6	56.1	56.3		
2002	24.2	41.9	50.1	54.5	56.9	58.0	58.5			
2003	24.1	41.5	49.2	53.7	56.1	57.2				
2004	24.4	41.6	49.3	53.9	56.2					
2005	25.2	42.8	50.7	55.3						
2006	25.7	43.7	51.8							
2007	27.2	46.3								
2008	27.0									

HDR @ 120 MOD = 91.3% =
[74.7% - 29.8%] / [79.0% - 29.8%]

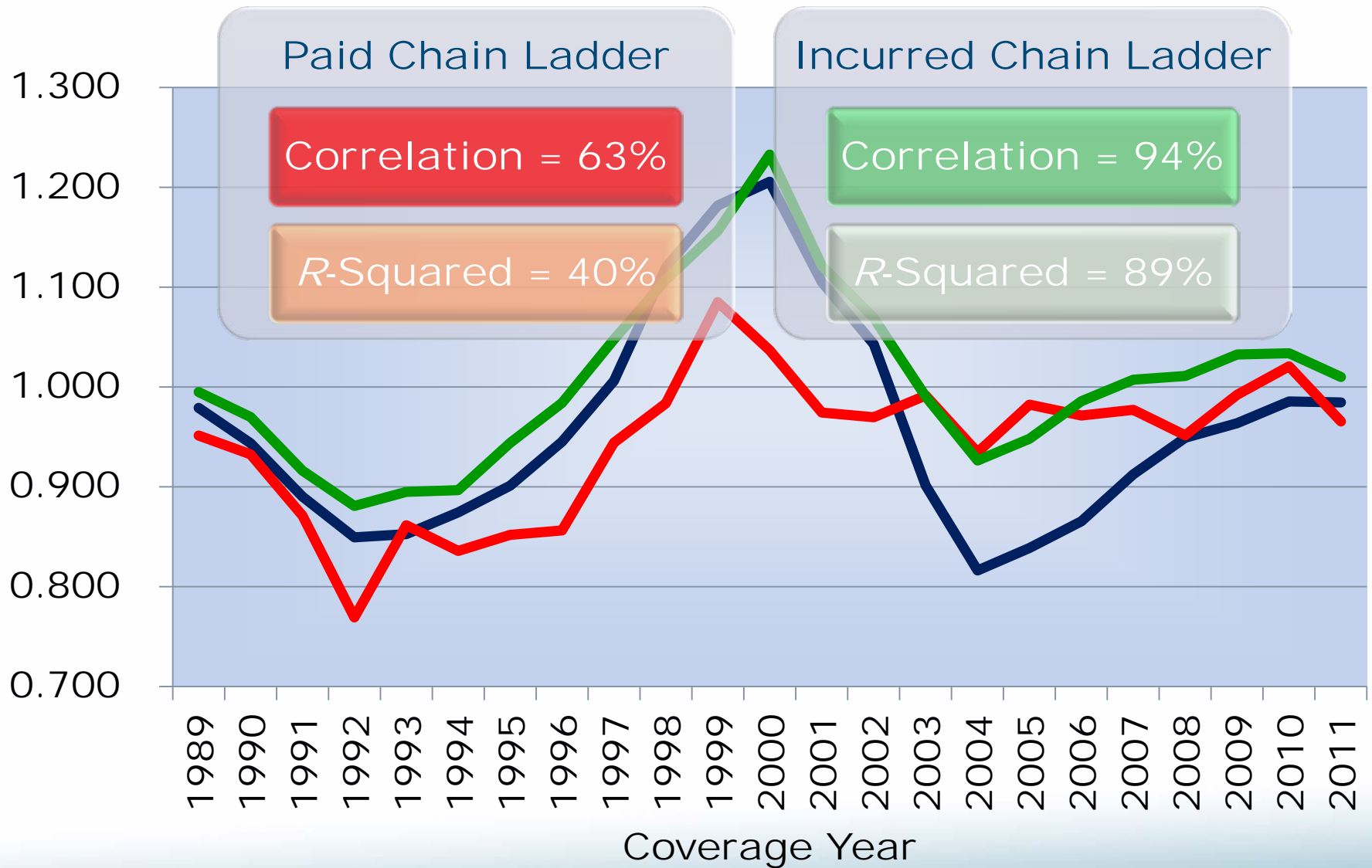
Accident Year	Paid LDFs									
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120+
1999	1.769	1.198	1.090	1.043	1.019	1.009	1.005	1.002	1.002	
2000	1.762	1.190	1.090	1.043	1.019	1.010	1.005	1.003		
2001	1.744	1.191	1.090	1.044	1.019	1.009	1.005			
2002	1.736	1.194	1.089	1.044	1.019	1.009				
2003	1.719	1.185	1.092	1.044	1.020					
2004	1.702	1.187	1.092	1.043						
2005	1.701	1.186	1.090							
2006	1.701	1.185								
2007	1.701									
WA	1.724	1.189	1.090	1.044	1.019	1.009	1.005	1.003	1.002	1.002
CUM WA	2.428	1.408	1.184	1.086	1.040	1.021	1.011	1.006	1.004	1.002

Indicated Ult. = \$51.4 (or 74.7%)

Aggregate Results

ACTUARIAL METHODS

Hindsight Development Ratios

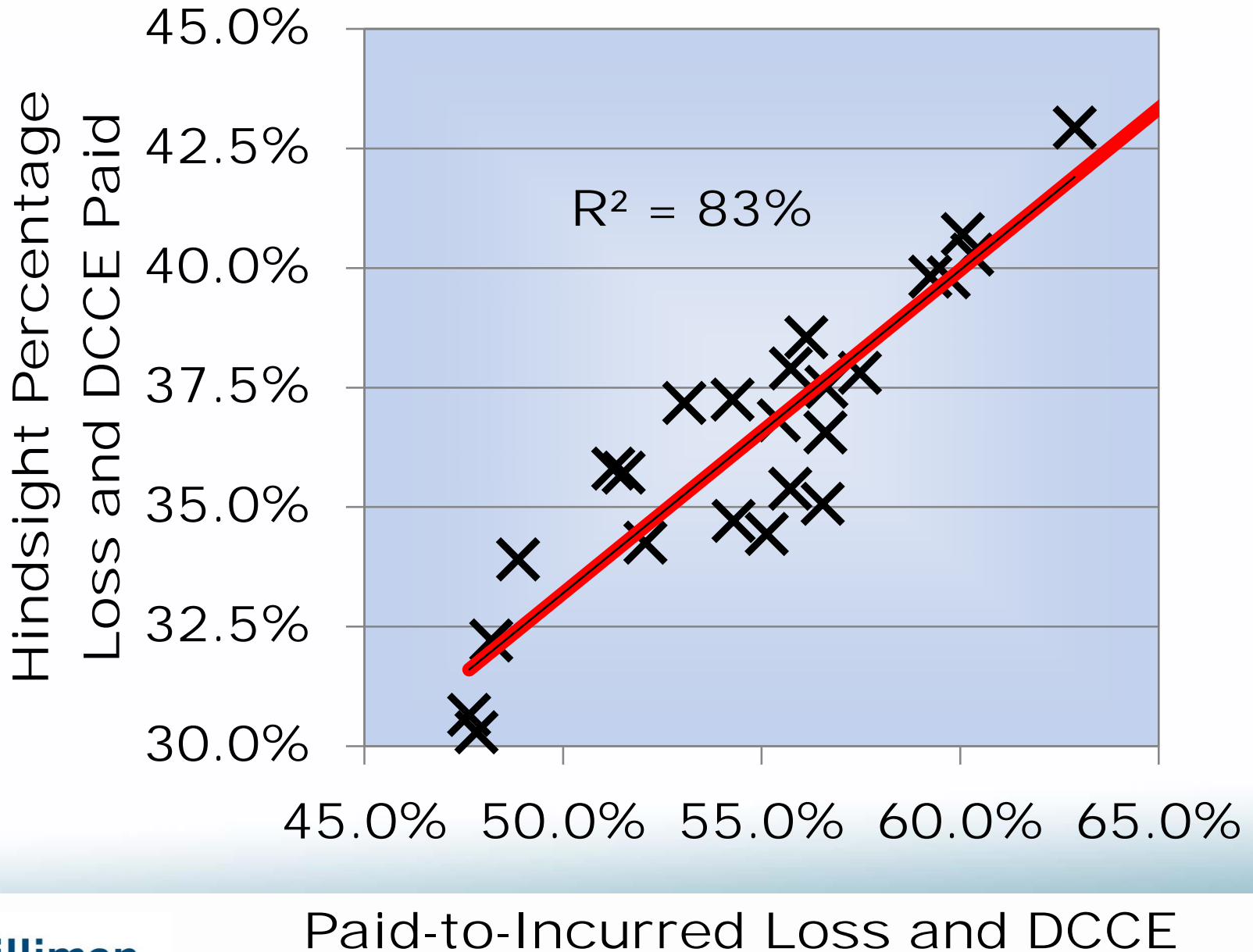


■ Carried

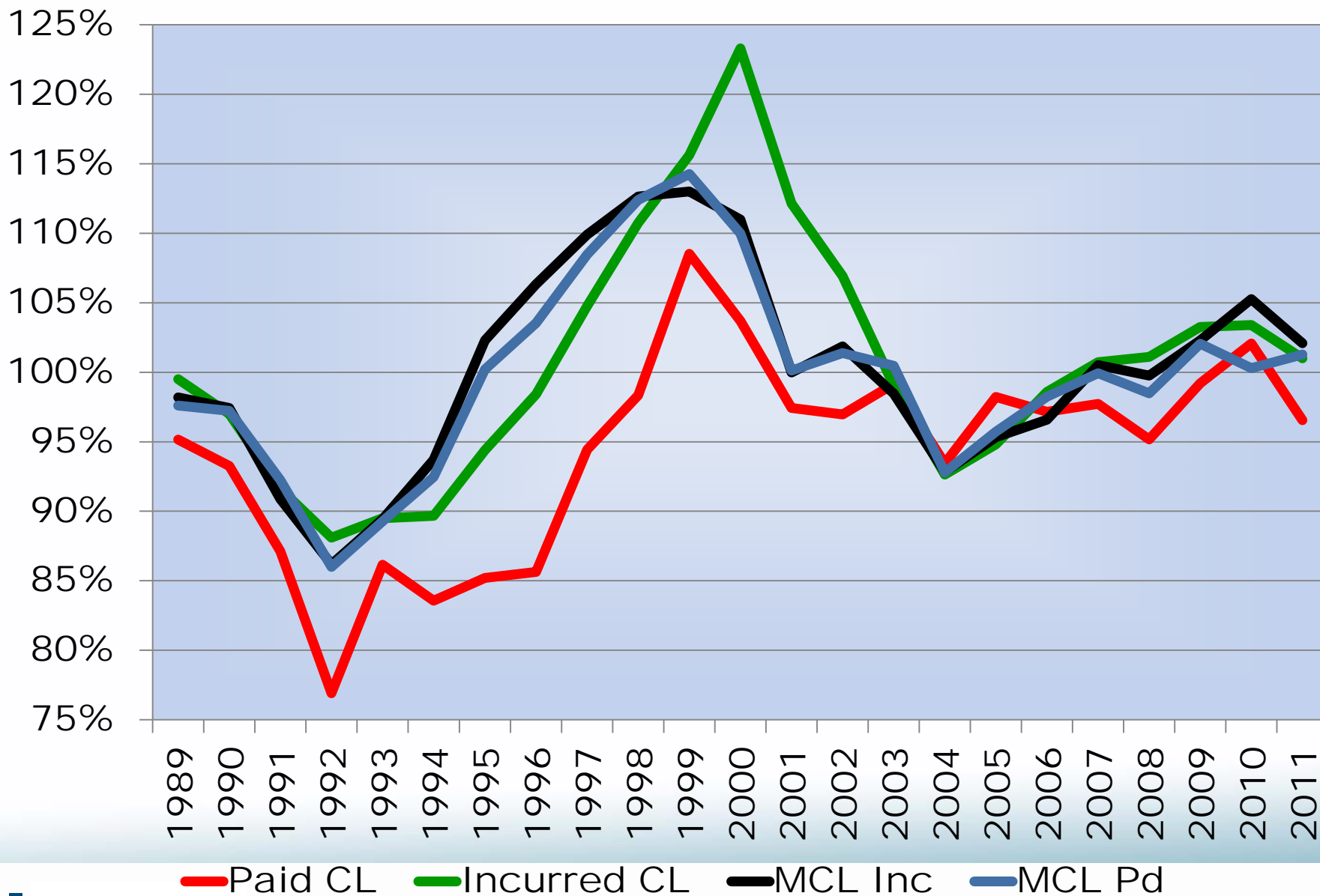
■ Paid Chain Ladder

■ Incurred Chain Ladder

Projecting Paid Development Factors

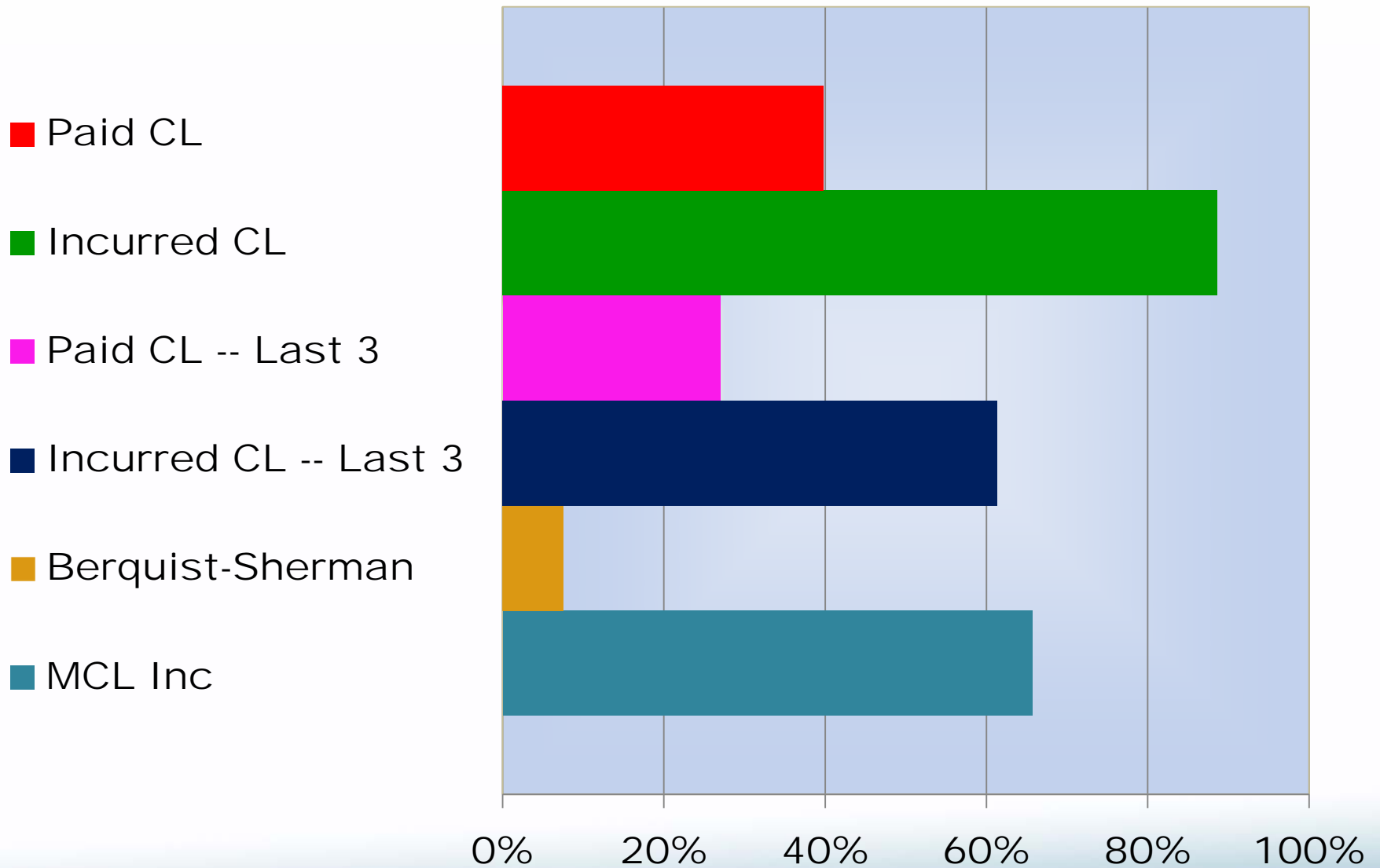


Other Actuarial Methods – Cyclical Indications



— Paid CL
 — Incurred CL
 — MCL Inc
 — MCL Pd

R-Squareds of Method HDRs with Carried HDRs



Results by Line of Business

ACTUARIAL METHODS

Actuarial Methods – Results by Line

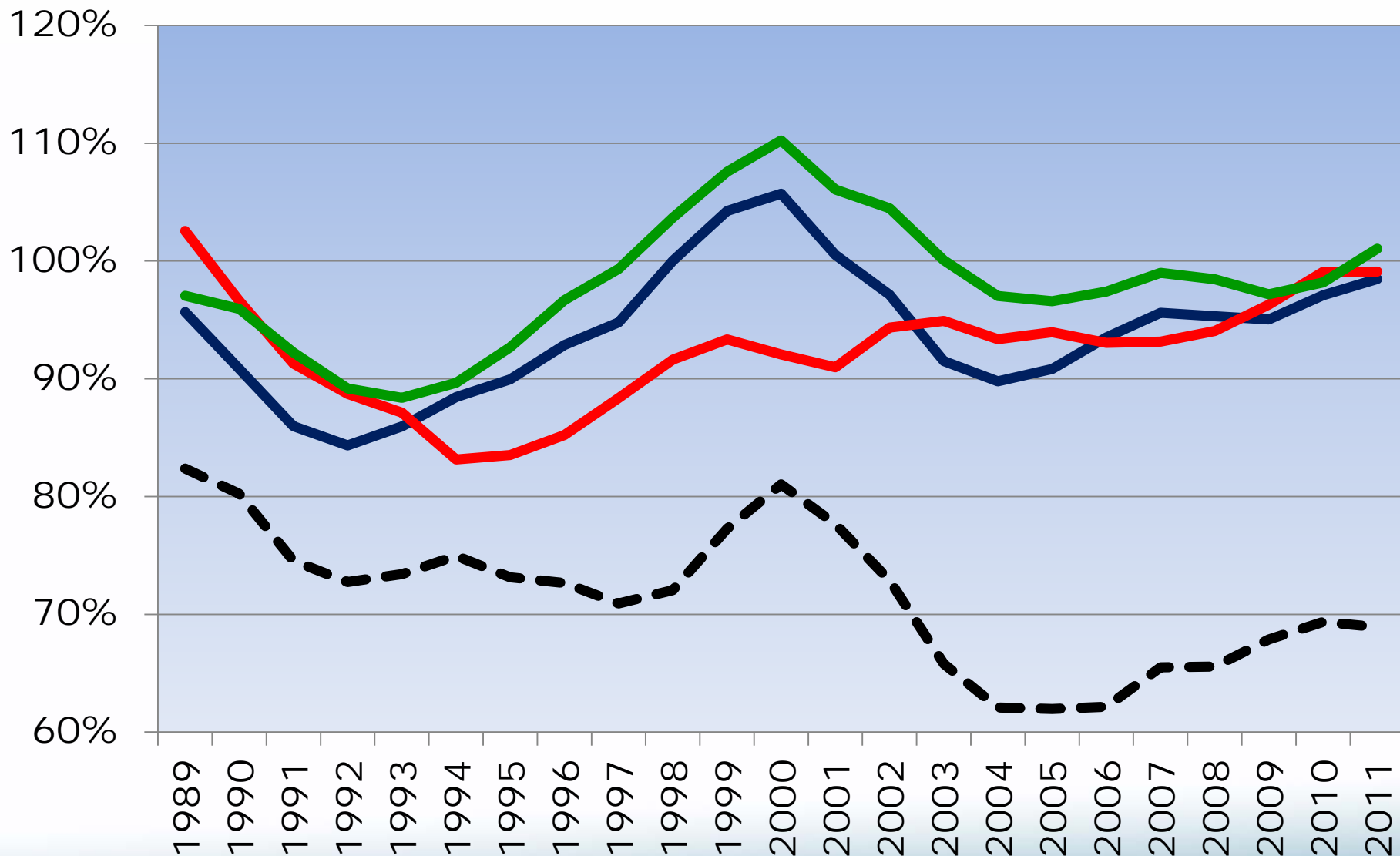
➤ Resulting Indications Grouped into Five Cohorts

- 1) Auto Liability (CAL, PPAL)
- 2) Workers' Compensation
- 3) Other Liability (OL Occ., OL CM, PL Occ., PL CM)
- 4) Medical Liability (MM Occ., MM CM)
- 5) Homeowners (HO, CMP, Spec Liability)

➤ Segmentation Changes in Schedule P

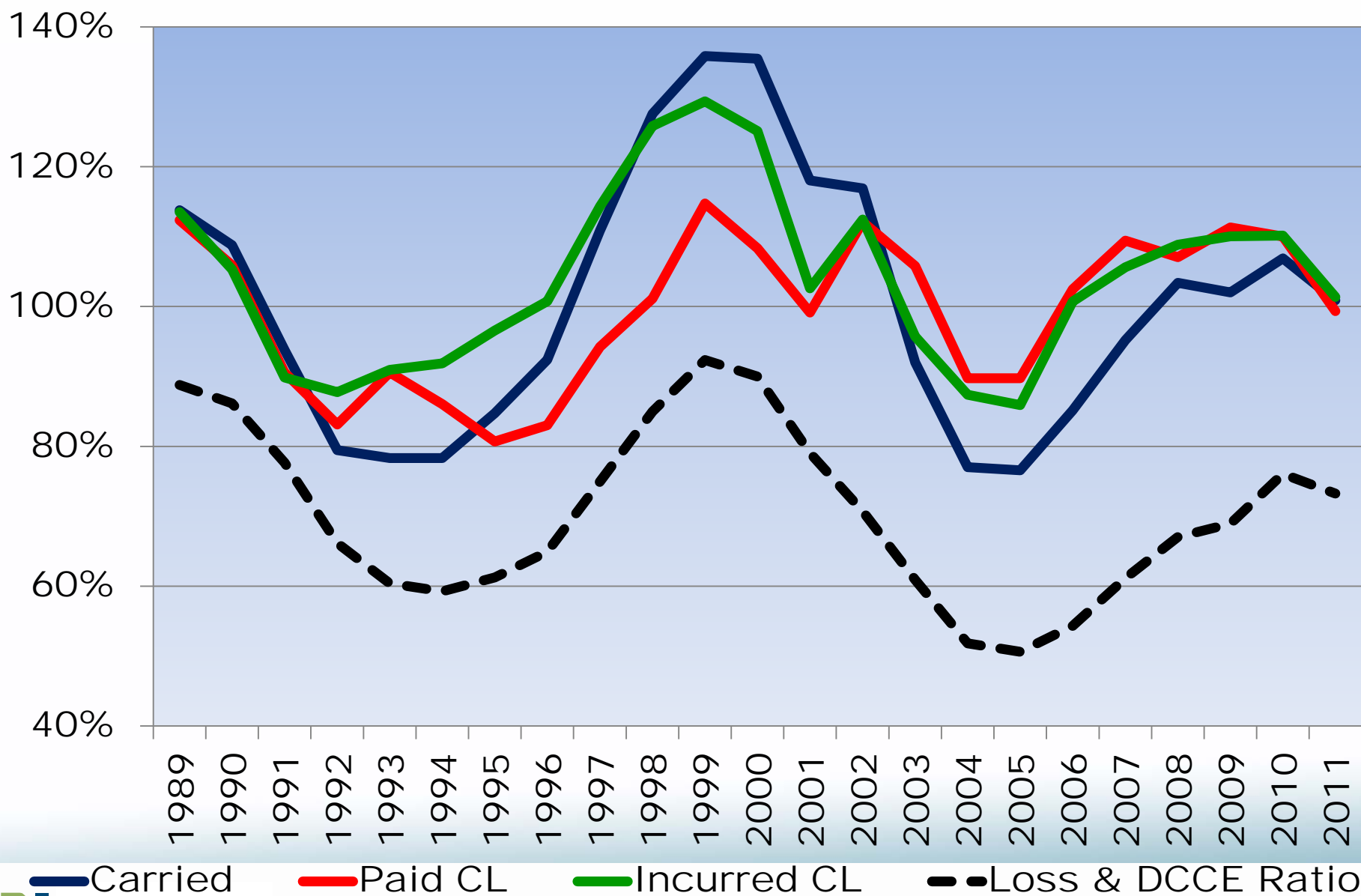
- ML & OL not tracked by policy form until SY 1993
- PL not tracked separately until SY 1991 and not by policy form until 1993

Auto Liability – Hindsight Development Ratios

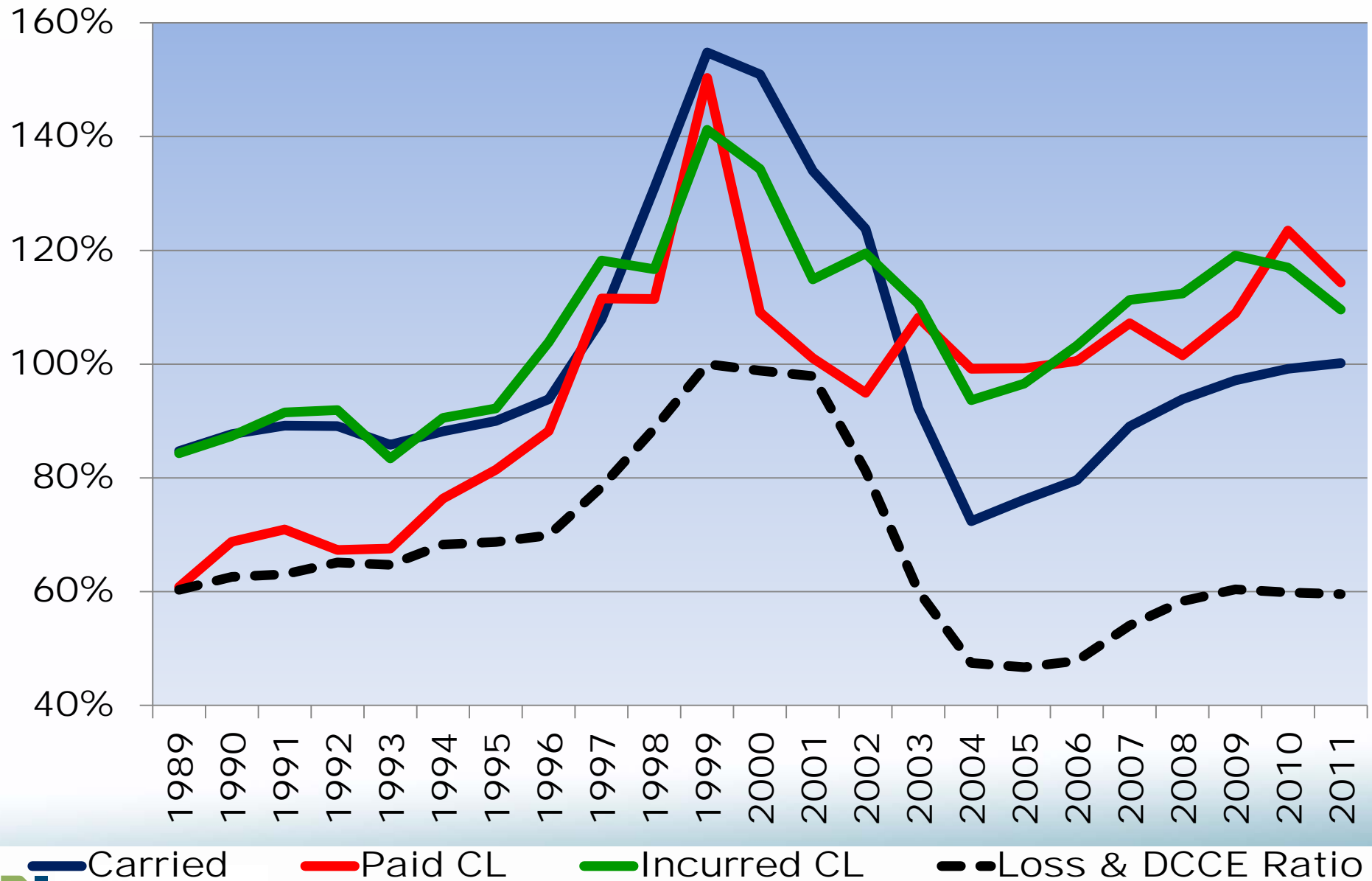


■ Carried
 ■ Paid CL
 ■ Incurred CL
 - - Loss & DCCE Ratio

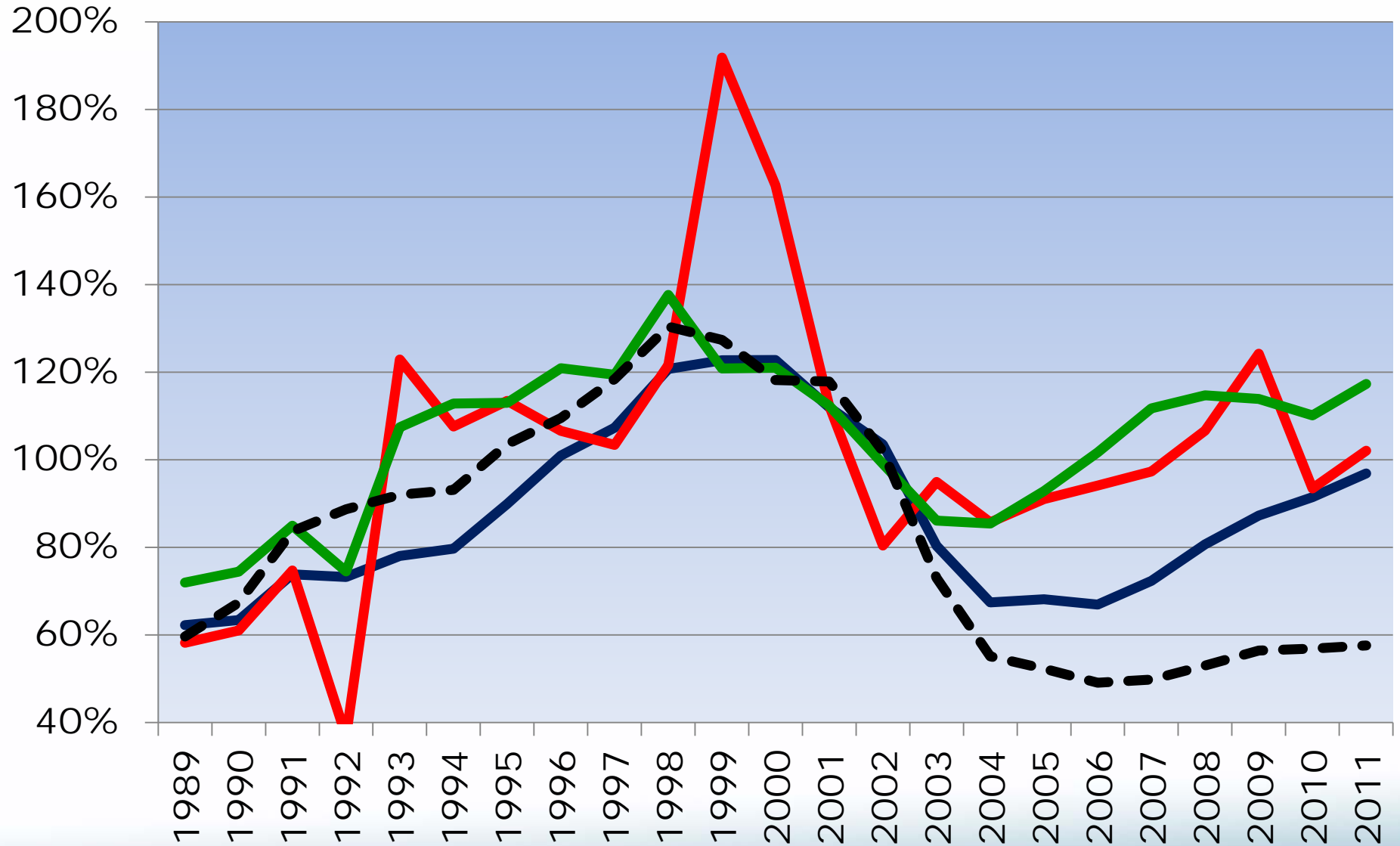
Workers' Comp – Hindsight Development Ratios



Other Liability – Hindsight Development Ratios



Medical Liability – Hindsight Development Ratios



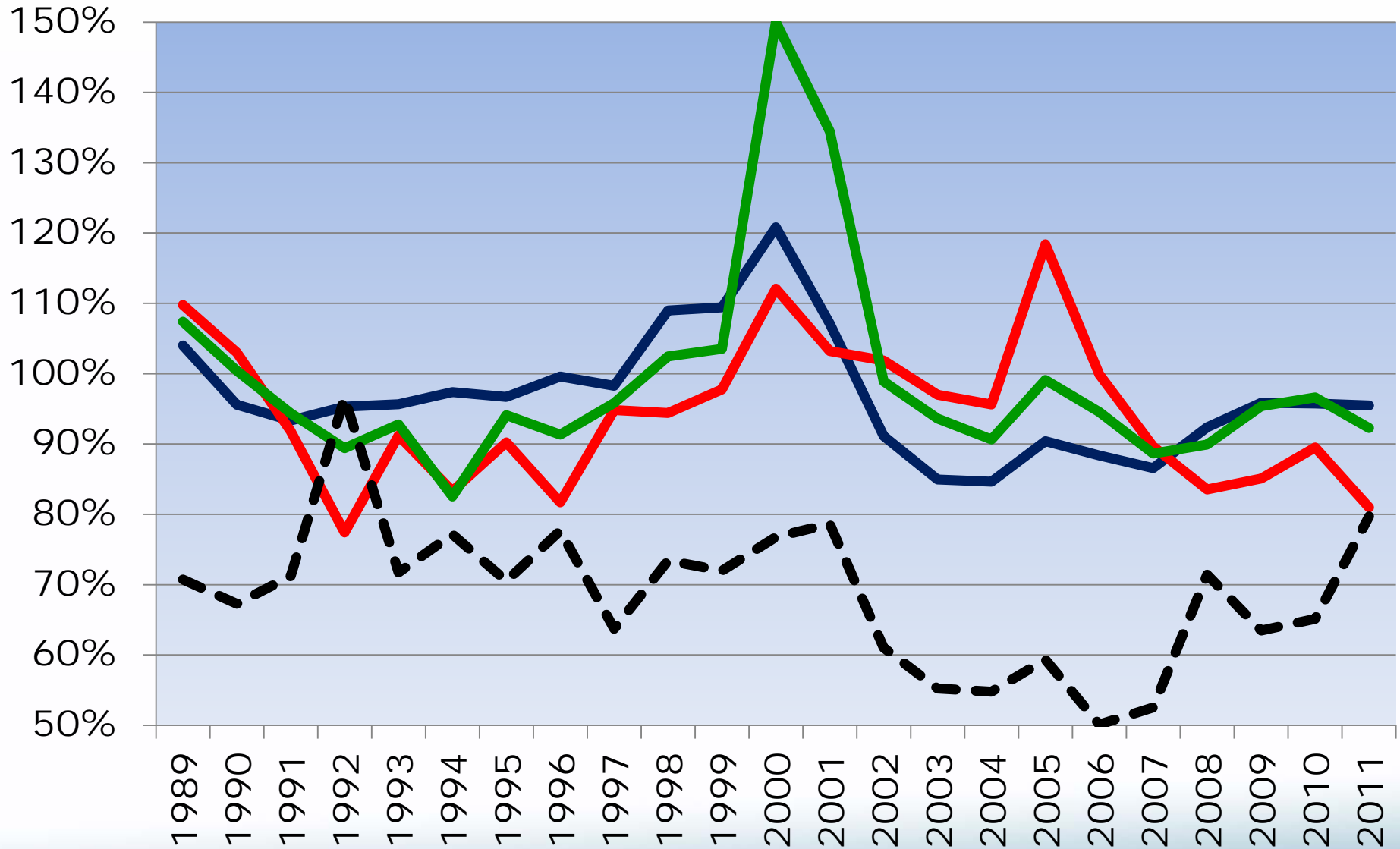
Carried

Paid CL

Incurred CL

Loss & DCCE Ratio

Homeowners – Hindsight Development Ratios



Discussion of Analysis

LIMITATIONS

Limitations

➤ Analysis Performed on Industry Aggregate Basis

- pro - stability
- con - limited ability to understand changes when they occur

➤ Interpretation of Methods

- Should not conclude methods that appear to perform well on industry aggregate basis would be best for company
- Case O/S important, especially for smaller companies

➤ Results May Differ Materially if Performed on Individual Company Data

- Cyclicity difficult to detect for most, and may be masked by year-to-year volatility in results

Discussion

OTHER RESEARCH

Brief History

- **2002 - Bob Conger (former CAS President) Brought Connection b/w the Underwriting and Reserving Cycles to Prominence**
 - Keynote presentation - 2002 GIRO Convention in the UK
 - Presented “in phase” relationship 1980-2001
- **Speech prompted UK working party**
 - tasked with investigating existence and possible causes of reserving cycle in UK

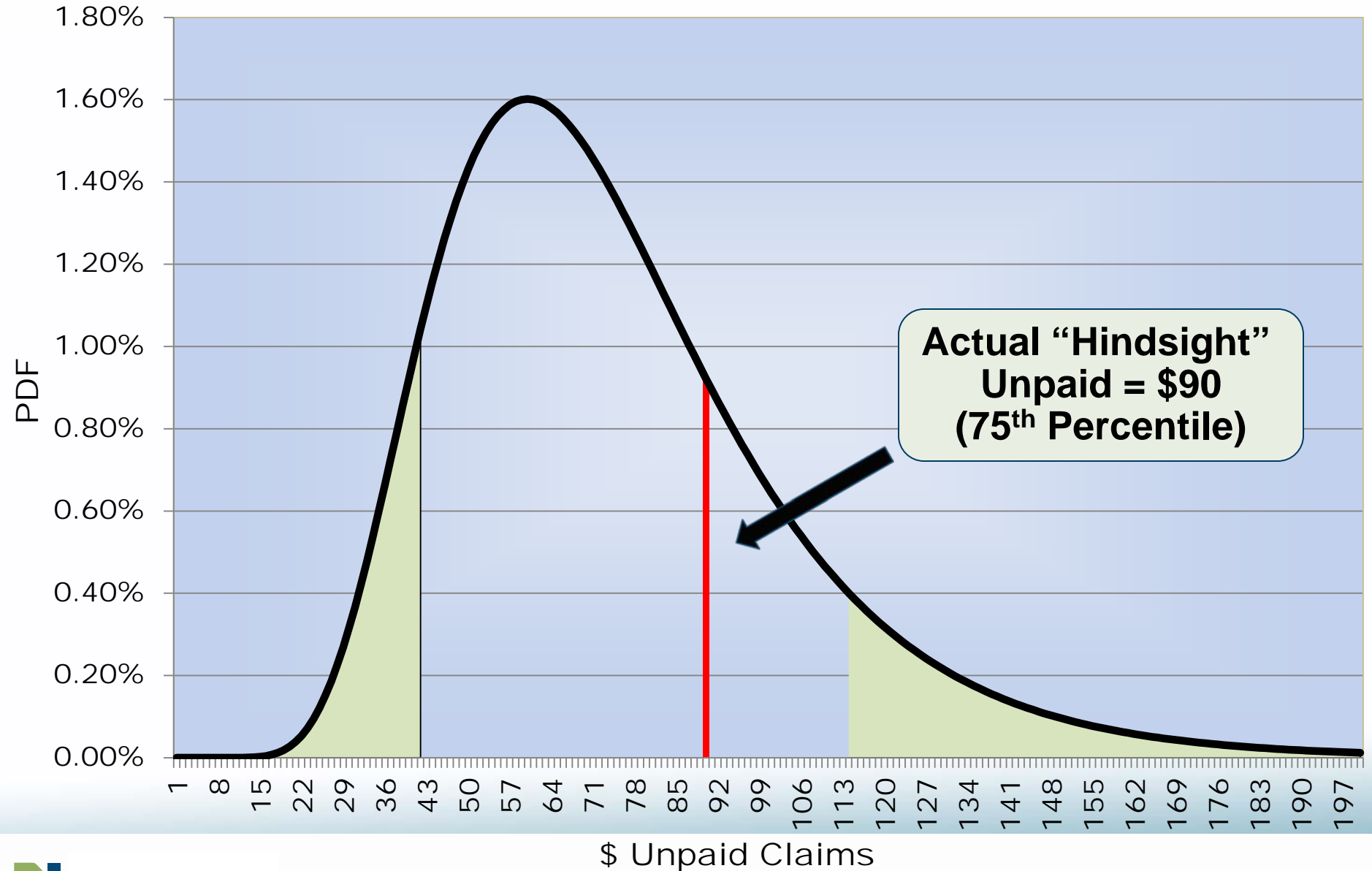
2003 - UK Working Party Conclusions

- 1) Reserving Cycle Existed in UK
- 2) Standard actuarial methods probably a contributory cause of reserving cycle
- 3) Some evidence (inconclusive) that development patterns vary with the u/w cycle, tending to be longer-tailed when premium rates are low
- 4) Clear evidence that Lloyd's premium rate indices had tended to understate the true magnitude of the u/w cycle
 - If softness understated, prior ELR understated
 - Compounding effect with (3)

Progression of Other Research

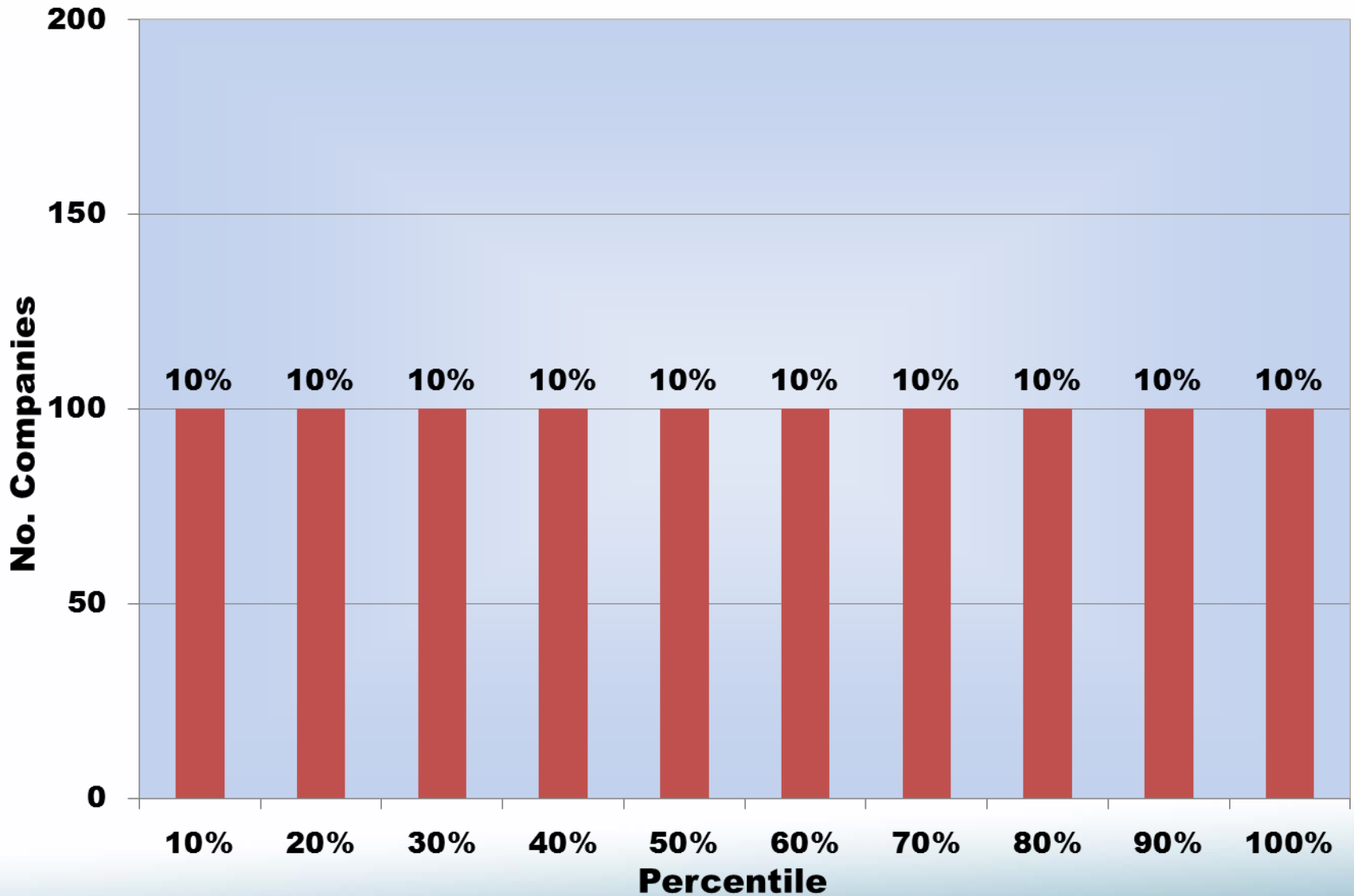
- **2008 - Wright Develops Idea of Curve-Fitting to Allow Possibility of Cyclical Variation of LDFs**
 - Doesn't look for evidence of each possible cause of cyclicity
 - Instead, model developed to accommodate causes if they exist
- **No Additional Direct Research on Topic**
- **However, Much Indirect Research on Seemingly Unrelated Topic**
 - Lack of variability - Stochastic Models

Hypothetical Stochastic Reserve Distribution



**Actual "Hindsight"
Unpaid = \$90
(75th Percentile)**

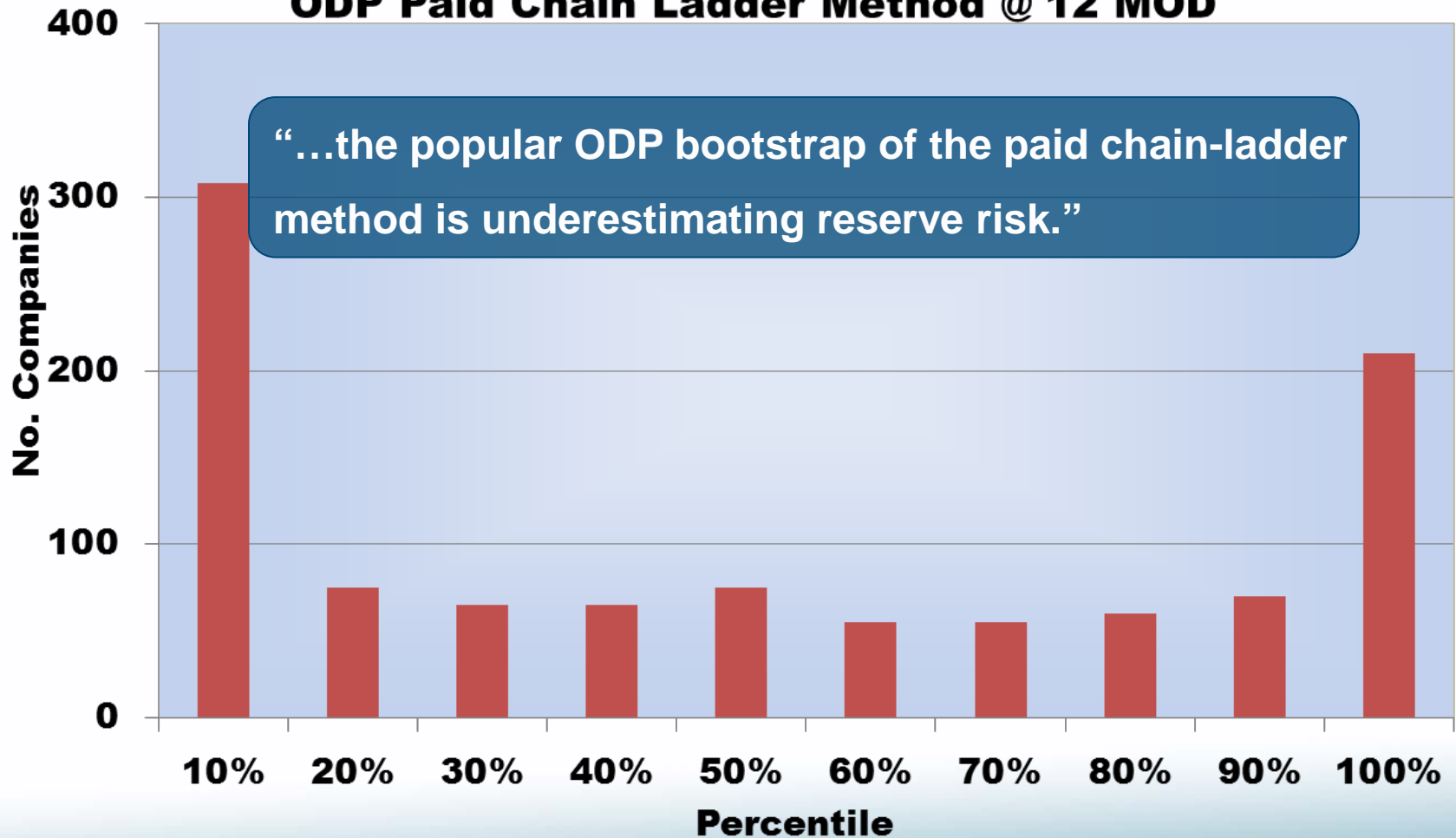
Ideal Histogram – In Theory



Histogram – In Practice

Homeowners & Farmowners Accident Years 1989 - 2002

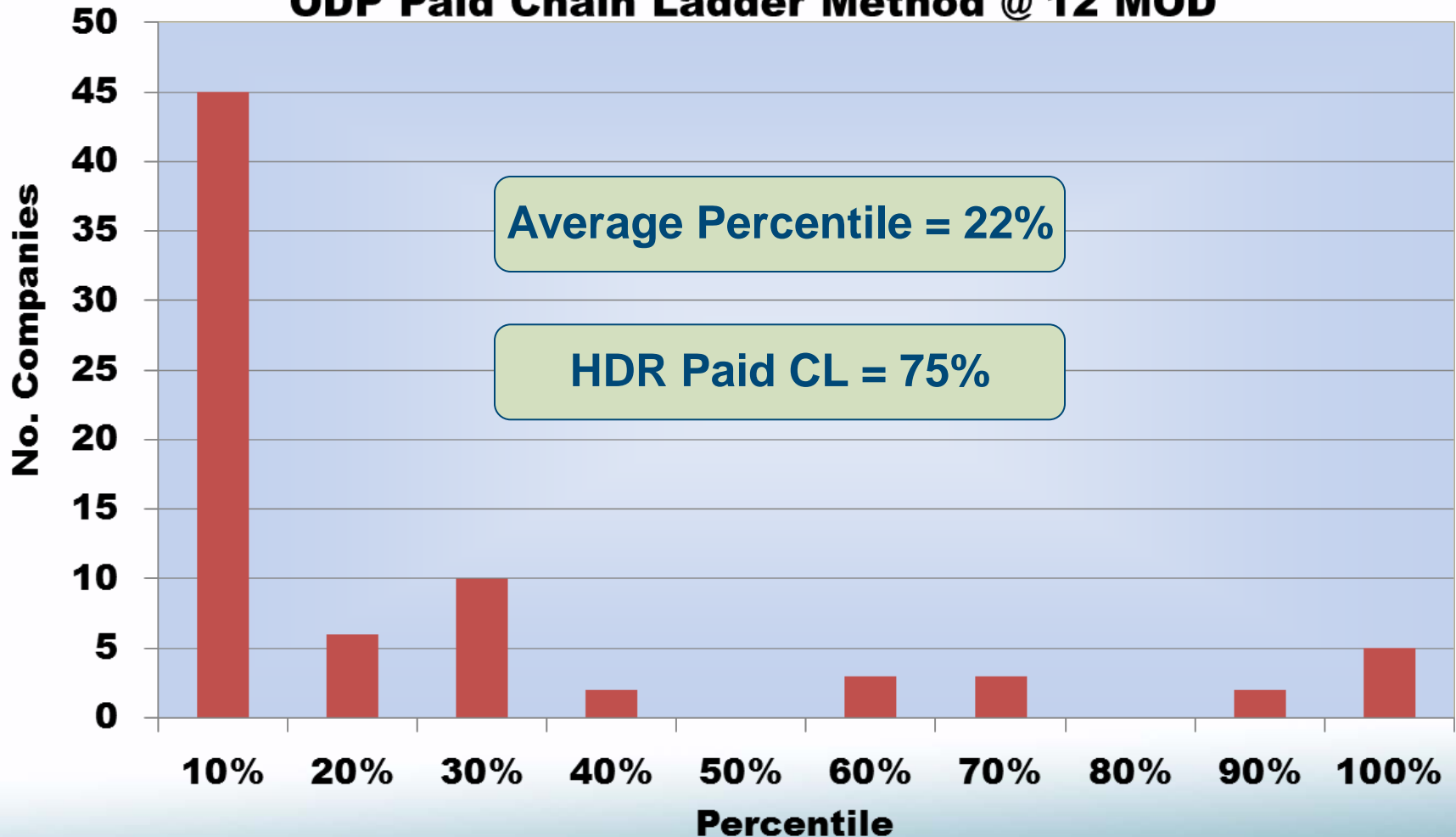
ODP Paid Chain Ladder Method @ 12 MOD



Histogram – In Practice

Homeowners & Farmowners Accident Year 1996

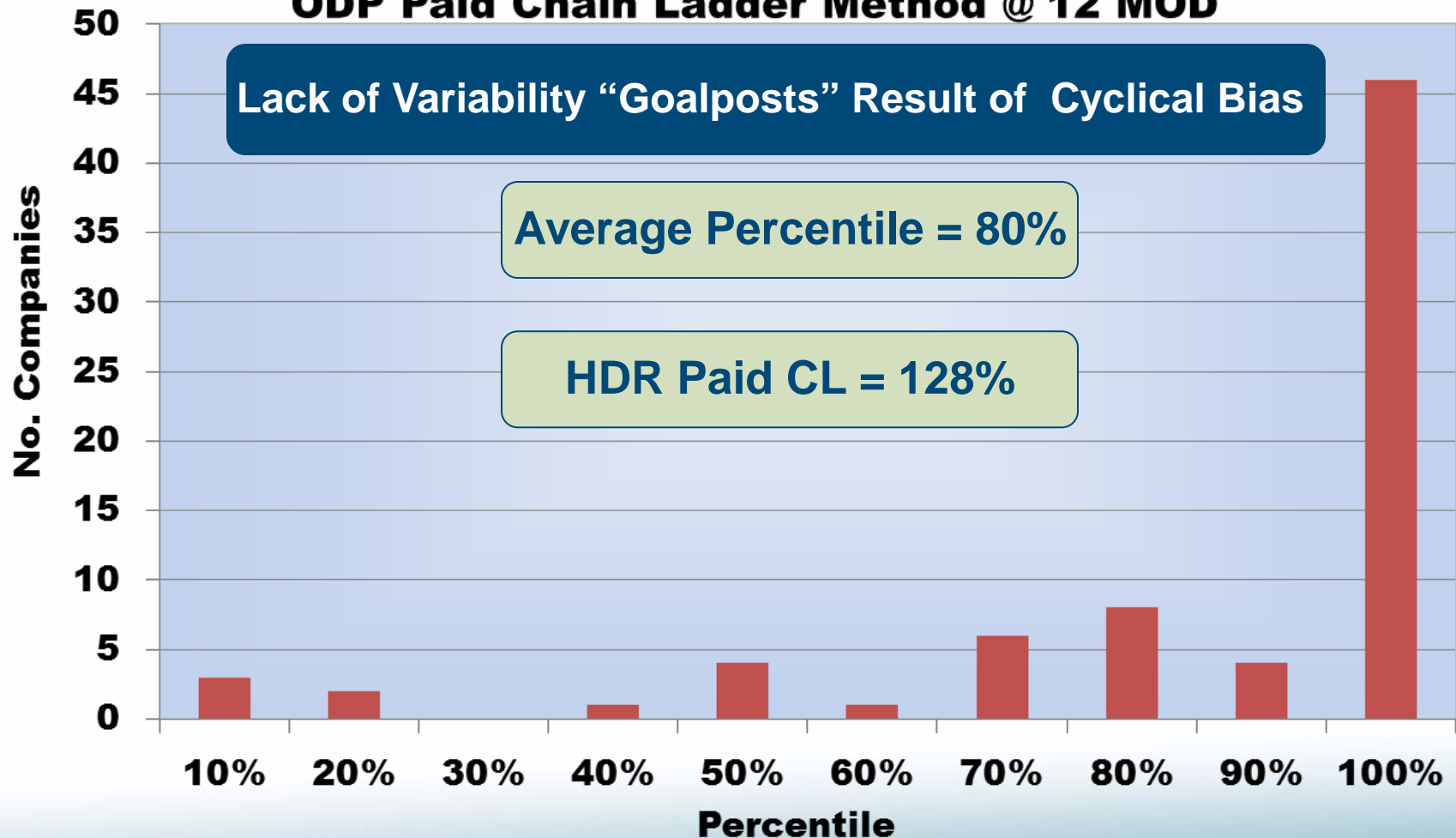
ODP Paid Chain Ladder Method @ 12 MOD



Histogram – In Practice

Homeowners & Farmowners Accident Year 2000

ODP Paid Chain Ladder Method @ 12 MOD

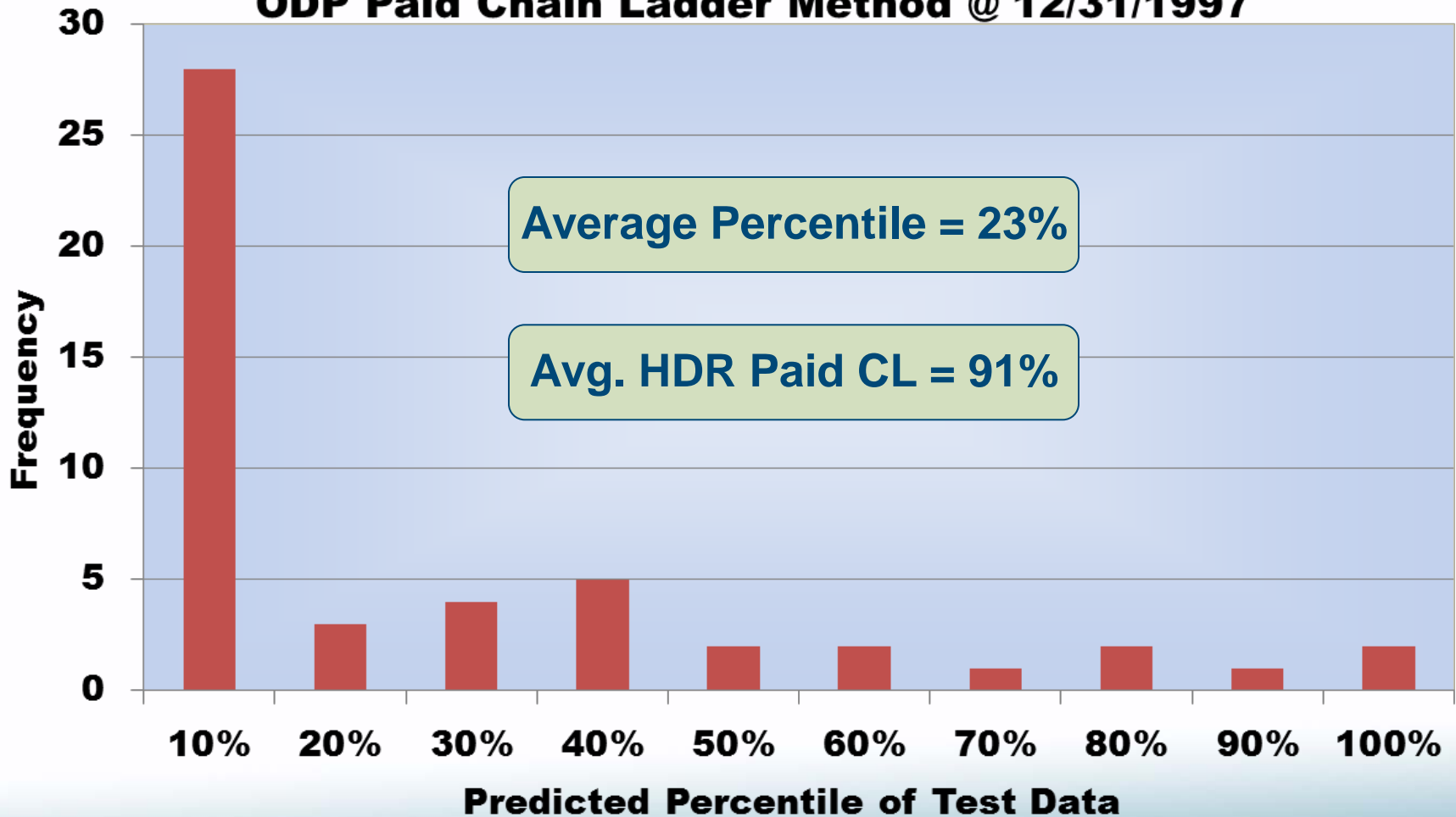


Histogram – In Practice

Commercial Auto Liability

Accident Years 1989 - 1997

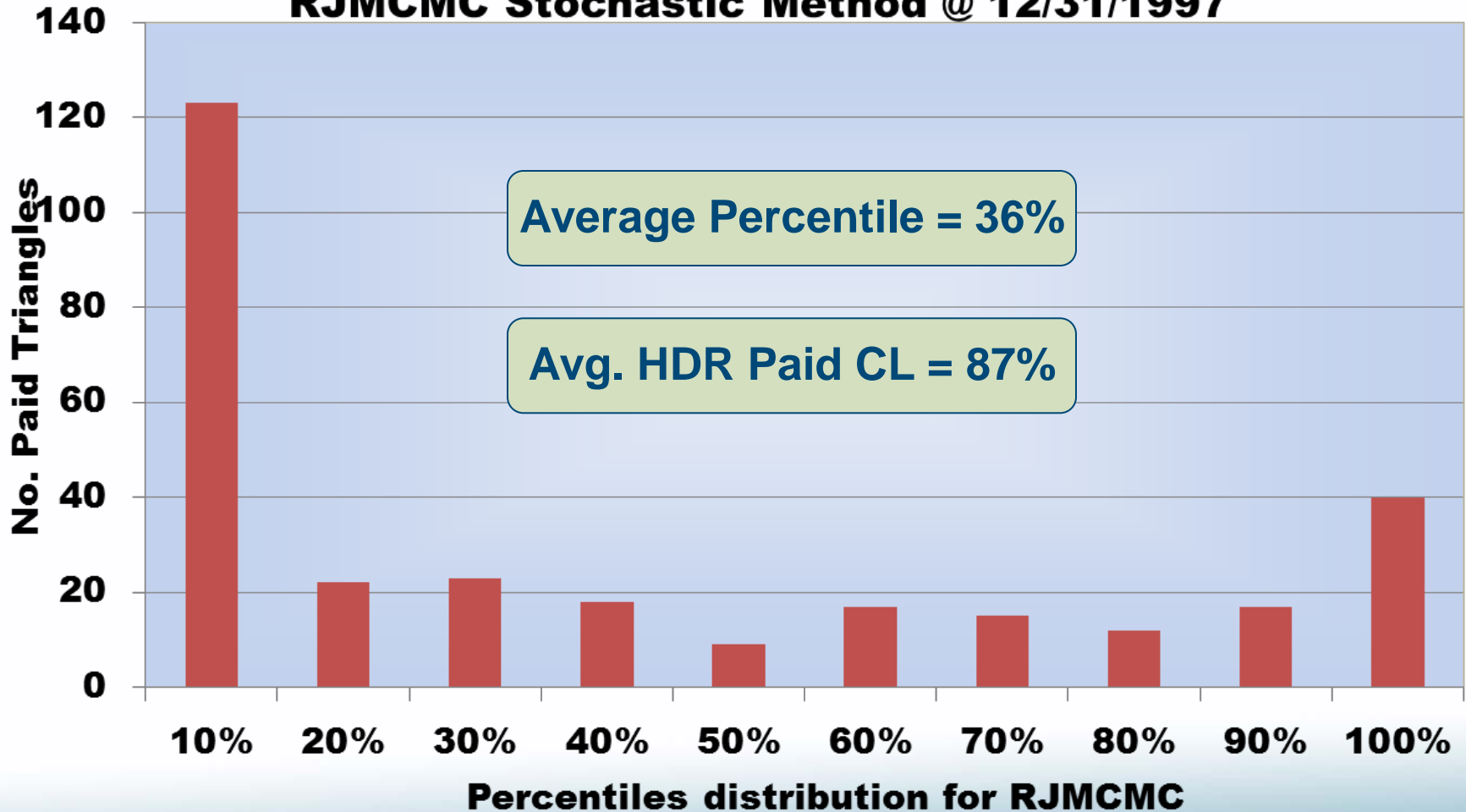
ODP Paid Chain Ladder Method @ 12/31/1997



Histogram – In Practice

**Total (CAL, PPAL, WC, Oth Liab)
Accident Years 1989 - 1997**

RJMCMC Stochastic Method @ 12/31/1997



Gremillet, Marion, and Pierre Miehe, “Back-Testing the Reversible Jump Markov Chain Monte Carlo & further extensions,” ICA 1-38 (2013)

Other Research – Gremillet & Miehe

- **“...it is core to have adjustments by actuaries prior to running the stochastic methods ‘automatically.’ ”**

Gremillet, Marion, and Pierre Miehe, “Back-Testing the Reversible Jump Markov Chain Monte Carlo & further extensions,” ICA 1-38 (2013)

Discussion of Analysis

CONCLUSIONS

Takeaways

- 1) Reserving and Underwriting Cycles in Phase and Likely Stem from a Common Underlying Cause**
- 2) Actuarial Methods Bear Some Attribution (Likely Material) for Existence of Reserving Cycle**
 - Contrast to prevailing attribution
- 3) Our Results Consistent with Other Research**
 - UK Results - Go Further by Quantifying
 - Stochastic Methods - Lack of Variability / Cyclical Bias
- 4) More Research Needed to Mitigate Cycle**

QUESTIONS?

Other Considerations

Accompanying Oral Discussion

- This document is not complete without the accompanying oral discussion and explanation of the underlying information and concepts as well as any interpretational limitations.

Limited Distribution

- This document should not be distributed, disclosed or otherwise furnished, in whole or in part, without the express written consent of Milliman.

Data Reliance

- We have relied upon data and other background information prepared by others, as documented throughout this presentation. We have performed a limited review of the data for reasonableness and consistency and have not found material defects in the data. If there are material defects in the data, it is possible that they would be uncovered by a detailed, systematic review and comparison of the data to search for data values that are questionable or relationships that are materially inconsistent. Such a review was beyond the scope of our assignment.