

Inflation Risk on Reserves with Economic Scenarios

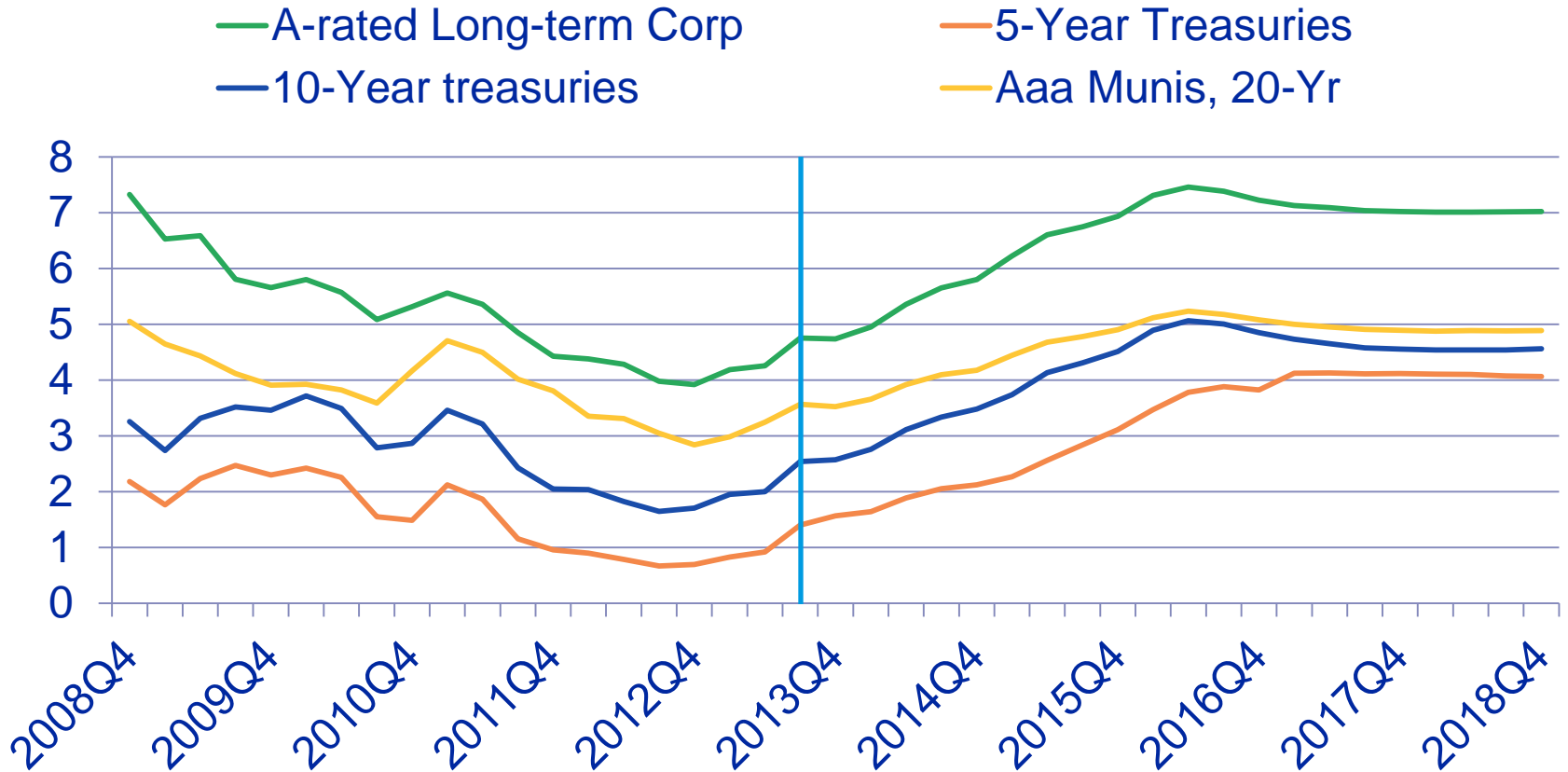
2013 Casualty Loss Reserve Seminar, Boston

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Current Economic Environment

Interest Rates

Moody's central forecast



Investment Risk for the P&C Insurance Industry

Risk scenario #1: Interest rates remain near historical lows

- » Continued pressure on profitability from weak investment income
 - Investment income is a key contributor to overall industry earnings
 - Average new money yield ~2.4% during Q1 2013 (typical P&C bond allocation – treasuries/munis/corporates)
 - Yield on industry’s existing bond portfolio ~4.0% in 2012 (down from 4.8% in 2008)
 - Based on average duration, assume (conservatively) 5 years for the industry portfolio to turn over
 - » ~ 30bps decline per year on the P&C industry’s fixed income portfolio yield
 - » \$16B reduction in annual investment income by 2017 (on the industry’s \$900B bond portfolio)
- » Mitigation
 - Make up for shortfalls in investment earnings by increasing premium rates and improving underwriting margins
 - » \$16B corresponds to a 3.6 point improvement on the combined ratio (industry’s total EP ~\$450B)
 - » Varies by lines of business
 - Increase investment risk
 - » Over the last 5 years: Slight increase in allocations to equities and near doubling in “other investments”
 - » In general, companies have refrained from increasing yield by extending the duration of their portfolios
 - Slight decrease over the last two years to 4.3 years from 4.6 years (concern over rising rates?)

Investment Risk for the P&C Insurance Industry

Risk scenario #2: Interest rates continue rising

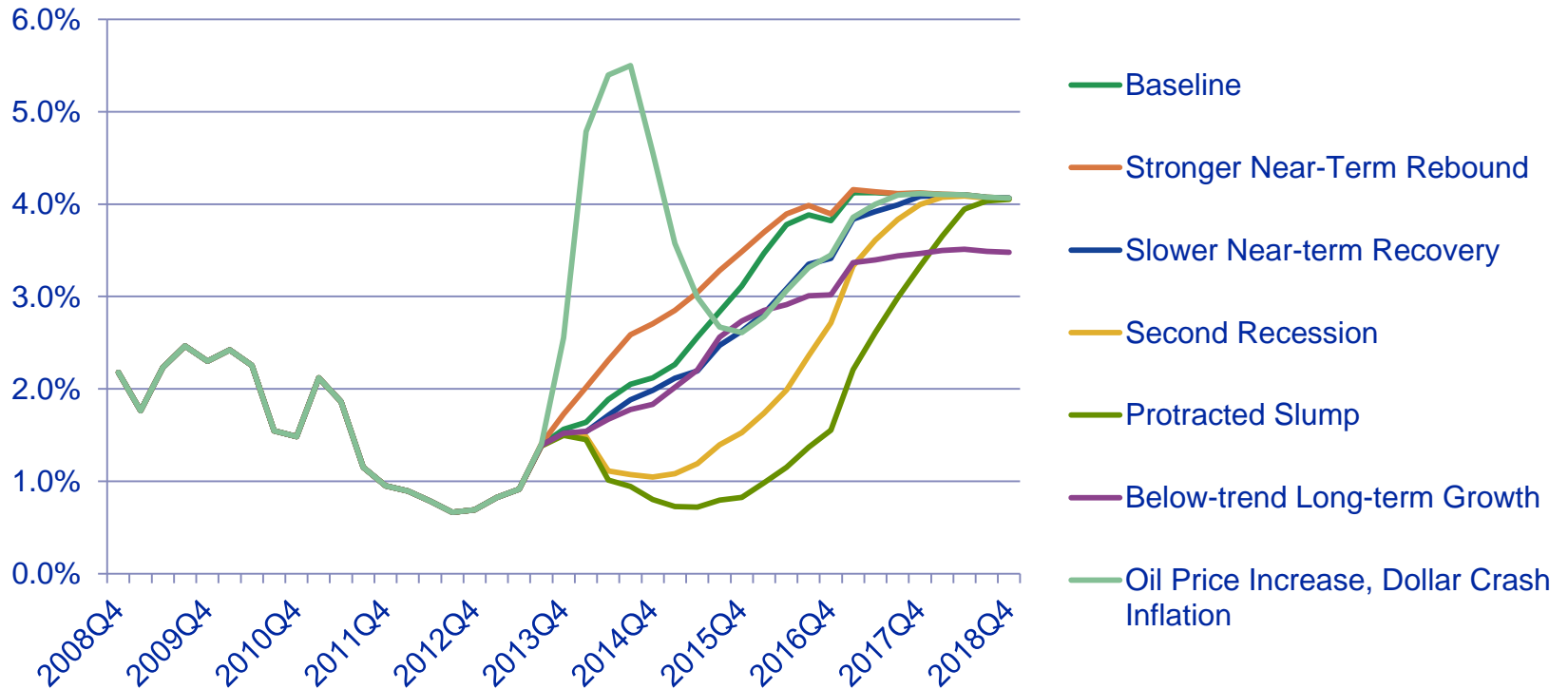
» Capital volatility

- P&C industry: ~2/3 of \$1.4 trillion of invested assets allocated to fixed income (\$900 billion mostly US government and agencies securities, high quality munis and investment grade corporates)
- Moody's baseline scenario: Rate increase of about 80 bps over one year and 130 bps over two years for the average company's fixed income portfolio
 - » 100 bps rise in interest rates: Industry bond values decline by ~\$40B (7% of industry capital)
 - » Interest rate spike scenario – 300 bps rise in rates over the next 12 to 18 months: Industry unrealized losses ~\$120B (20% of policyholders' surplus)
 - » Variations among individual companies
 - 100 bps parallel increase in interest rates leads to 2%-7% capital losses to fixed income portfolios, corresponding to a capital impact of 5%-15%
 - 300 bps could cause substantial volatility in shareholders' equity (15%-45%)
- » Rising interest rates + higher than expected claims inflation could be very problematic for P&C insurers (lower asset valuations + increases in loss reserve liabilities)
 - While interest rates would boost investment income and industry profitability over time, they could also curtail industry pricing momentum
- » Mitigation
 - Strong liquidity, practice of holding bonds long term, unlikely need to liquidate investment portfolios

Outlook

Will interest rates stay low or keep rising?

- » Of these two scenarios, a continued upward movement in interest rates is the higher risk scenario for P&C companies due to its greater impact on capital and its potential combination with higher than expected claims inflation for the industry
- » Economists predict rates will continue rising. E.g. 5-yr Treasuries:



Historical Inflation

CPI inflation: 1948-2012

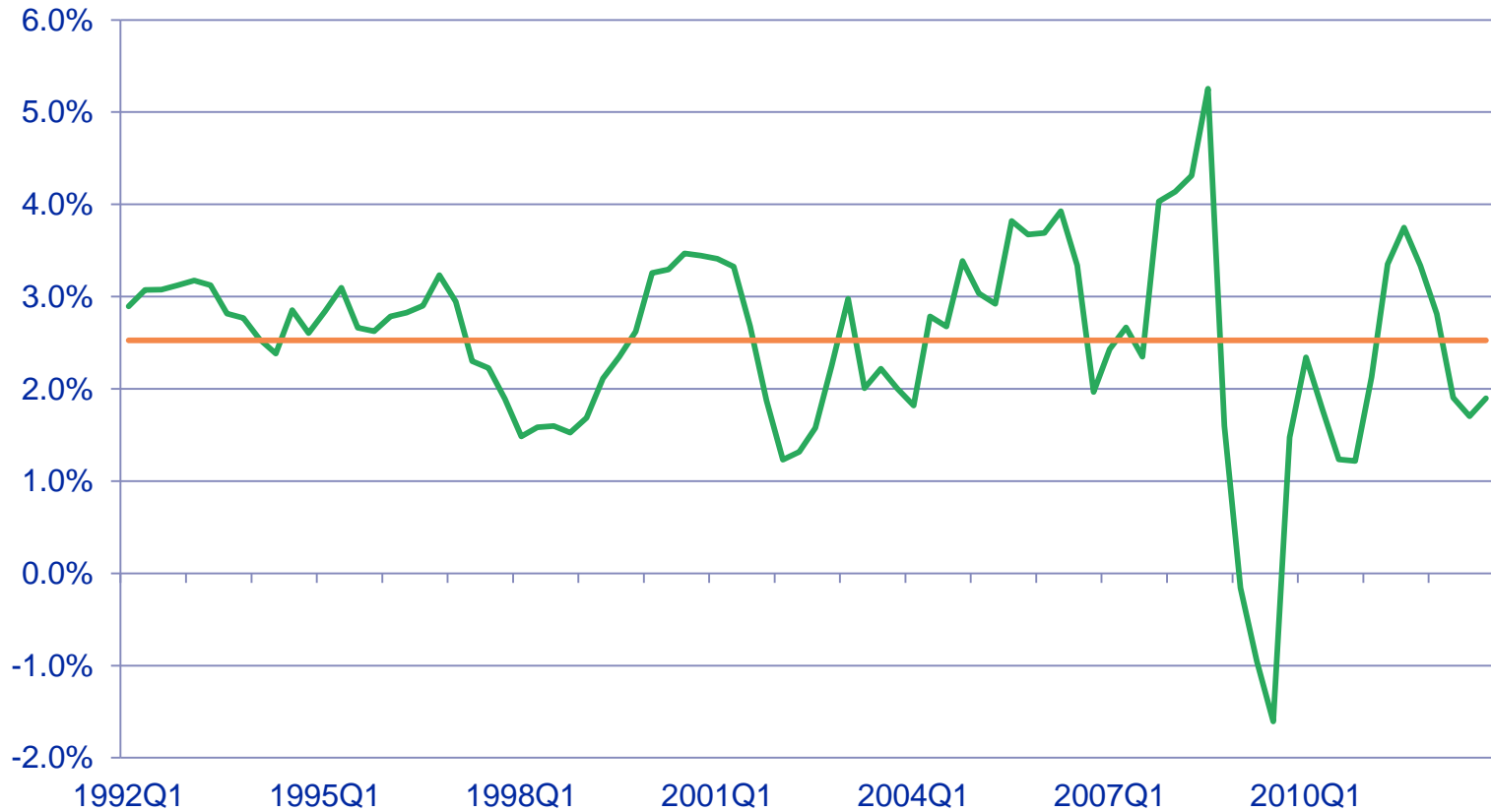
» Average: ~4%



Recent Historical Inflation

CPI inflation: 1992-2012

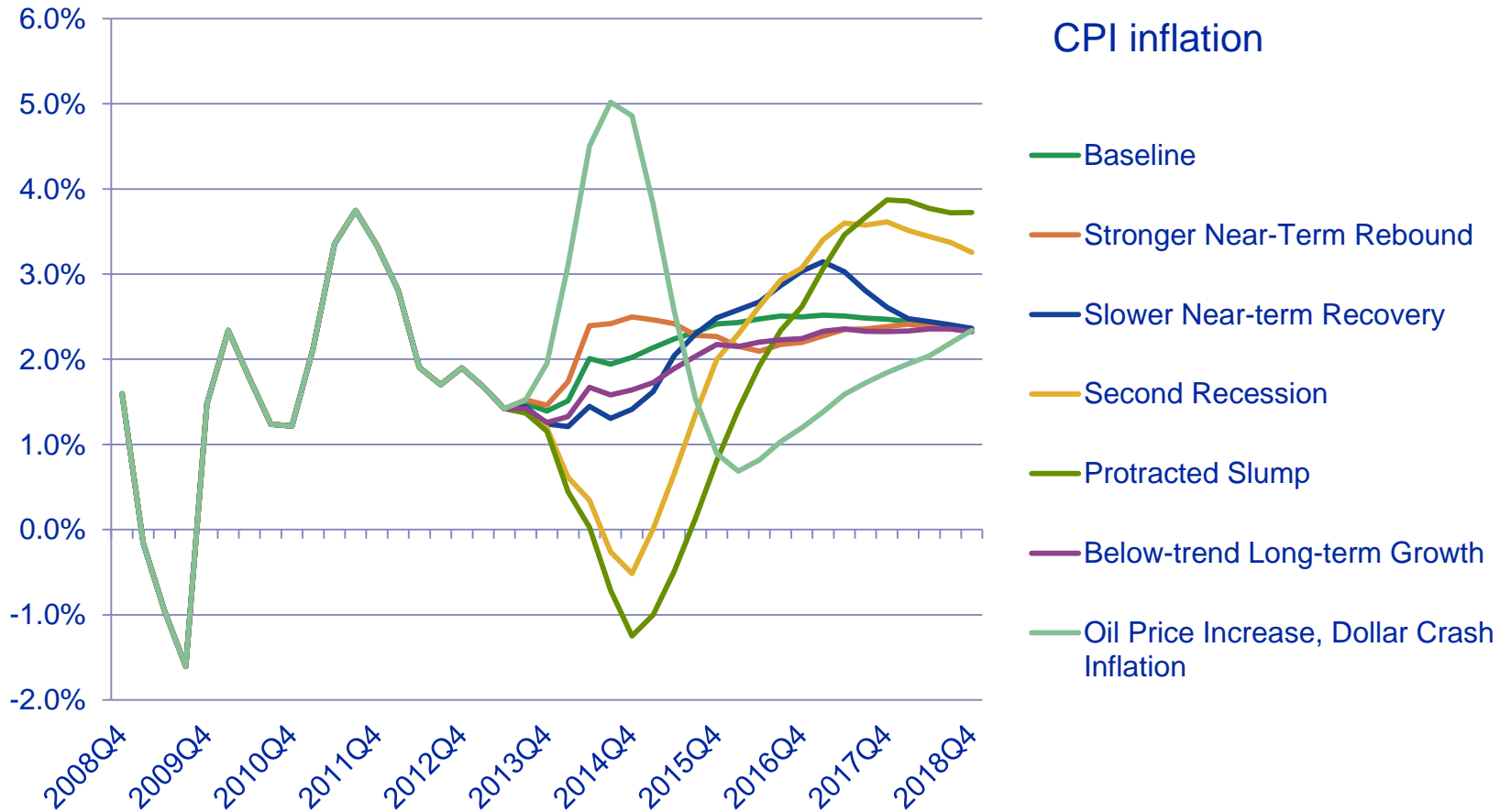
» Average: ~2.5%



Inflation Projections

ECCA scenarios

» A lot of faith in central banks



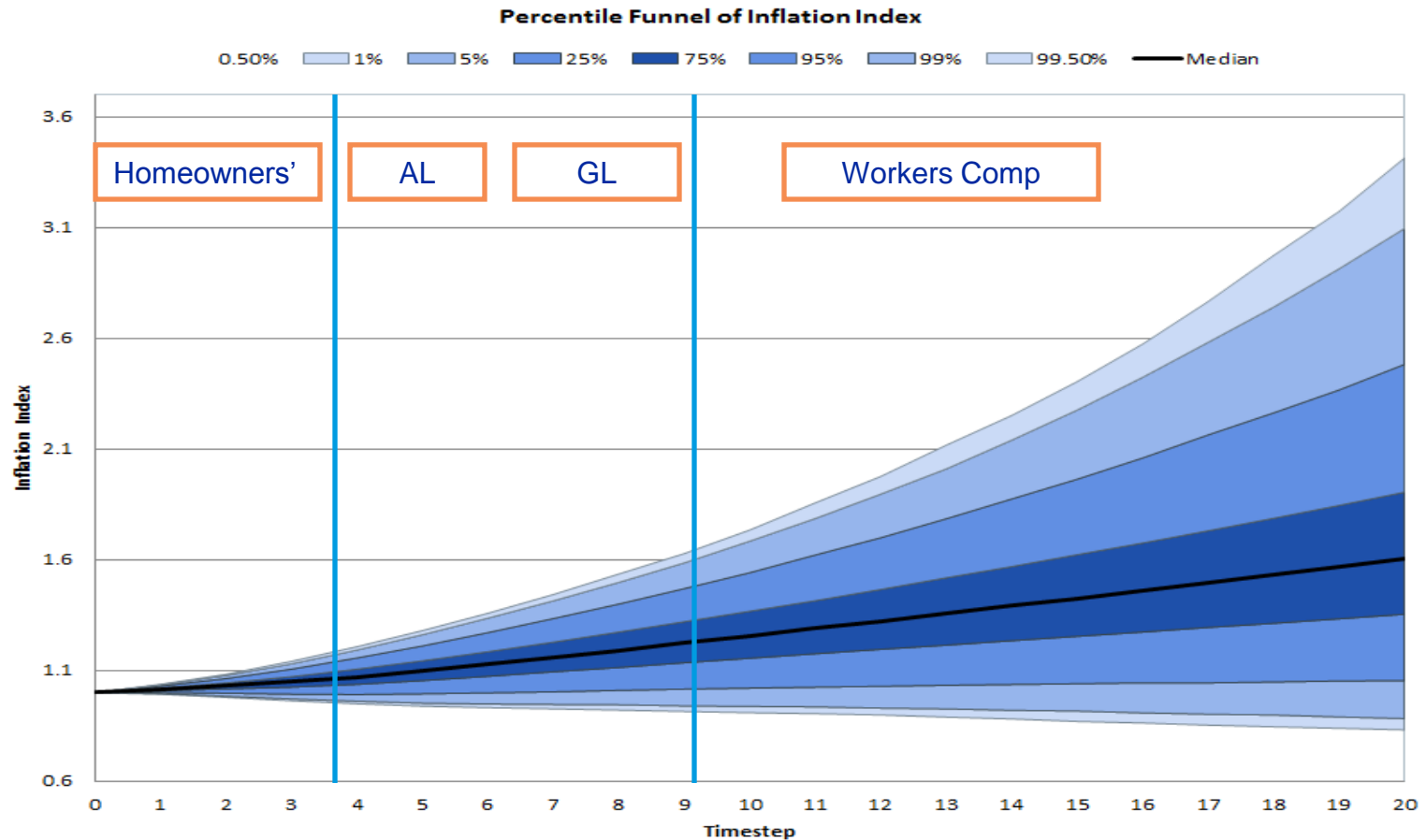
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Inflation Risk on Reserves

Inflation and Reserves

Inflation risk on reserves

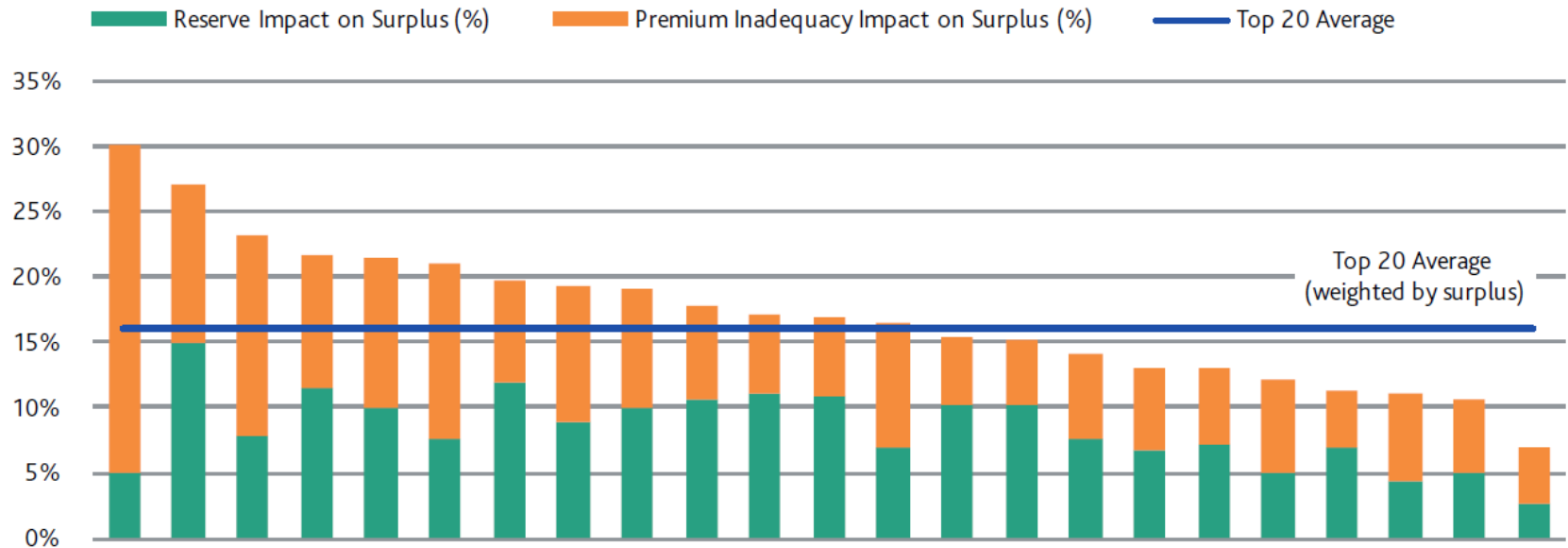
» Inflation risk can be very significant especially on long-tailed lines of business



Impact on Surplus

Moody's Investors Service

US Top 20 : Adverse Surplus Impact on Casualty Writers of Unexpected Medical & Liability Claim Inflation



Source: SNL, Moody's

Note: Capital Impact of 3% unexpected inflation for three years. The issue of reserve sensitivity to claims inflation is relevant not only because of concern about the implications of inflation volatility—particularly related to medical costs and the impact of trends in public health (e.g., obesity, opioid prescription abuse, utilization), but also because reserve cushions in carried reserve positions have declined meaningfully. For this analysis, casualty lines include workers' compensation, commercial auto liability, commercial multiple peril, other liability - occurrence and claims made, products liability - occurrence and claims made, medical professional liability - occurrence and claims made, and reinsurance - XOL liability,.

Impact of Inflation on Loss Reserves

Traditional reserving methods and capital models

» 2 Questions

- What inflationary assumptions underlie current reserve levels?
- How much will current reserve adequacy be impacted if future inflation differs from expectations?
- These questions cannot be answered when inflation is dealt with indirectly

» LDFs reserving methods

- Usually, no explicit inflation adjustment: Past inflation is implicitly reflected in the selected LDFs
- And is projected forward (if no trends adjustments), without consideration for inflation variability
- Usually undiscounted

» Capital Models

- Look at reserve variability, usually discounted reserves
- Use ESG outputs
 - » Interest rates, inflation indices

» Incorporate inflation as an explicit risk factor

- By explicit consideration of inflation, its economic impact on the overall balance sheet can be gauged

Example

Schedule P WC triangle

» Cumulative paid losses

Acc. Year	Months of Development									
	12	24	36	48	60	72	84	96	108	120
1	5,476	11,300	14,038	15,719	16,624	18,020	18,533	18,863	19,108	19,232
2	5,151	10,740	13,270	14,510	15,908	16,334	16,507	16,791	17,018	
3	5,921	11,802	14,356	16,670	17,543	18,290	18,704	18,919		
4	5,564	12,371	17,891	19,709	21,015	22,054	22,338			
5	5,283	13,795	16,878	18,958	20,435	20,917				
6	4,148	9,048	11,418	13,350	14,443					
7	3,337	6,358	8,336	9,516						
8	3,008	7,723	9,349							
9	4,307	9,724								
10	3,717									

Implicit Inflation

E.g. paid chain-ladder

- » Reserve = \$34,041
 - Hard to assess impact of unexpected inflation

Acc. Year	Months of Development										
	12	24	36	48	60	72	84	96	108	120	Ult.
1	5,476	11,300	14,038	15,719	16,624	18,020	18,533	18,863	19,108	19,232	20,194
2	5,151	10,740	13,270	14,510	15,908	16,334	16,507	16,791	17,018	17,128	17,985
3	5,921	11,802	14,356	16,670	17,543	18,290	18,704	18,919	19,169	19,294	20,259
4	5,564	12,371	17,891	19,709	21,015	22,054	22,338	22,683	22,983	23,132	24,289
5	5,283	13,795	16,878	18,958	20,435	20,917	21,305	21,633	21,920	22,062	23,165
6	4,148	9,048	11,418	13,350	14,443	15,088	15,368	15,605	15,812	15,914	16,710
7	3,337	6,358	8,336	9,516	10,194	10,650	10,847	11,015	11,160	11,233	11,795
8	3,008	7,723	9,349	10,539	11,291	11,795	12,014	12,199	12,360	12,441	13,063
9	4,307	9,724	12,344	13,915	14,907	15,574	15,862	16,107	16,320	16,426	17,247
10	3,717	8,180	10,384	11,706	12,541	13,101	13,344	13,550	13,729	13,818	14,509
LDF (wtd avg)	2.201	1.269	1.127	1.071	1.045	1.019	1.015	1.013	1.006	Tail	
Cumulative	3.903	1.774	1.397	1.239	1.157	1.107	1.087	1.071	1.057	1.050	

Explicit Consideration of Inflation in Reserving

3 steps using existing reserving models

1. Factor out the effects of inflation from historical loss data
2. Forecast the reserve using current methodology
3. Replace the effect of inflation including an assumption of future inflation

Step 1 – Removing Historical Inflation

Remove historical inflation prior to completing the triangle

» Incremental triangle

- Divide each diagonal by the corresponding index value

	Months of Development									
Acc. Year	12	24	36	48	60	72	84	96	108	120
1	5,476	5,824	2,738	1,681	905	1,396	513	330	245	124
2	5,151	5,589	2,530	1,240	1,398	426	173	284	227	
3	5,921	5,881	2,554	2,314	873	747	414	215		
4	5,564	6,807	5,520	1,818	1,306	1,039	284			
5	5,283	8,512	3,083	2,080	1,477	482				
6	4,148	4,900	2,370	1,932	1,093					
7	3,337	3,021	1,978	1,180						
8	3,008	4,715	1,626							
9	4,307	5,417								
10	3,717									
Inflation		4.2%	4.2%	3.6%	5.2%	2.7%	3.4%	3.3%	3.5%	3.2%
Index	0.721	0.751	0.783	0.812	0.854	0.877	0.907	0.936	0.969	1.000

Step 1 – Removing Historical Inflation

Remove historical inflation prior to completing the triangle

» Restate cumulative triangle

Acc. Year	Months of Development									
	12	24	36	48	60	72	84	96	108	120
1	7,596	15,347	18,843	20,914	21,974	23,565	24,131	24,483	24,736	24,860
2	6,856	13,991	17,108	18,560	20,154	20,623	20,808	21,101	21,328	
3	7,560	14,804	17,795	20,433	21,395	22,193	22,620	22,835		
4	6,854	14,826	21,117	23,122	24,517	25,589	25,873			
5	6,187	15,889	19,289	21,510	23,034	23,516				
6	4,728	10,131	12,662	14,656	15,749					
7	3,680	6,906	8,947	10,127						
8	3,212	8,078	9,704							
9	4,445	9,862								
10	3,717									
Inflation		4.2%	4.2%	3.6%	5.2%	2.7%	3.4%	3.3%	3.5%	3.2%
Index	0.721	0.751	0.783	0.812	0.854	0.877	0.907	0.936	0.969	1.000

Step 1 – Removing Historical Inflation

In practice

- » Establish profile of loss costs
 - What portion of the loss payment is medical, wage, legal fees...
- » Identify those economic indices which best measure the inflation in those costs
- » Determine the timing of the inflationary impact (accident date, report date, paid date, ...)
 - E.g. for Workers' Comp, the wage portion of the claim may be at time of accident while the medical portion is at time of payment
 - Give consideration to the changing proportions of types of cost as the development period matures. E.g. medical may be paid early and wages later in the development of an accident year
- » Test these relationships on historical loss development patterns and find the combination which best explains the long term growth in claim costs
 - E.g. Masterson

Which Inflation Time Series to Choose

Various inflation indices

- » Various economic inflation measures with different characteristics
- » Claims inflation
 - Different measure than CPI-like indices
- » Gearing effect of deductible
- » Stochastic projections
 - Specific claims inflation calibrations
 - Approximations: E.g. affine index in Metarisk

Step 2 – Reserving

Same paid chain-ladder

» Complete the (restated) triangle as usual

Acc. Year	Months of Development										
	12	24	36	48	60	72	84	96	108	120	Ult.
1	7,596	15,347	18,843	20,914	21,974	23,565	24,131	24,483	24,736	24,860	25,805
2	6,856	13,991	17,108	18,560	20,154	20,623	20,808	21,101	21,328	21,435	22,250
3	7,560	14,804	17,795	20,433	21,395	22,193	22,620	22,835	23,076	23,191	24,073
4	6,854	14,826	21,117	23,122	24,517	25,589	25,873	26,203	26,478	26,611	27,622
5	6,187	15,889	19,289	21,510	23,034	23,516	23,890	24,194	24,449	24,572	25,505
6	4,728	10,131	12,662	14,656	15,749	16,375	16,635	16,847	17,024	17,110	17,760
7	3,680	6,906	8,947	10,127	10,775	11,204	11,382	11,527	11,648	11,706	12,151
8	3,212	8,078	9,704	10,841	11,535	11,993	12,184	12,339	12,469	12,531	13,007
9	4,445	9,862	12,377	13,826	14,711	15,296	15,539	15,737	15,902	15,982	16,589
10	3,717	7,987	10,023	11,197	11,914	12,387	12,584	12,745	12,879	12,943	13,435
LDF (wtd avg)	2.149	1.255	1.117	1.064	1.040	1.016	1.013	1.011	1.005	Tail	
Cumulative	3.656	1.702	1.356	1.214	1.141	1.097	1.080	1.066	1.055	1.038	

Step 3 – Replace Inflation

Apply an estimate of future inflation to future payments

» Inflation sensitivity

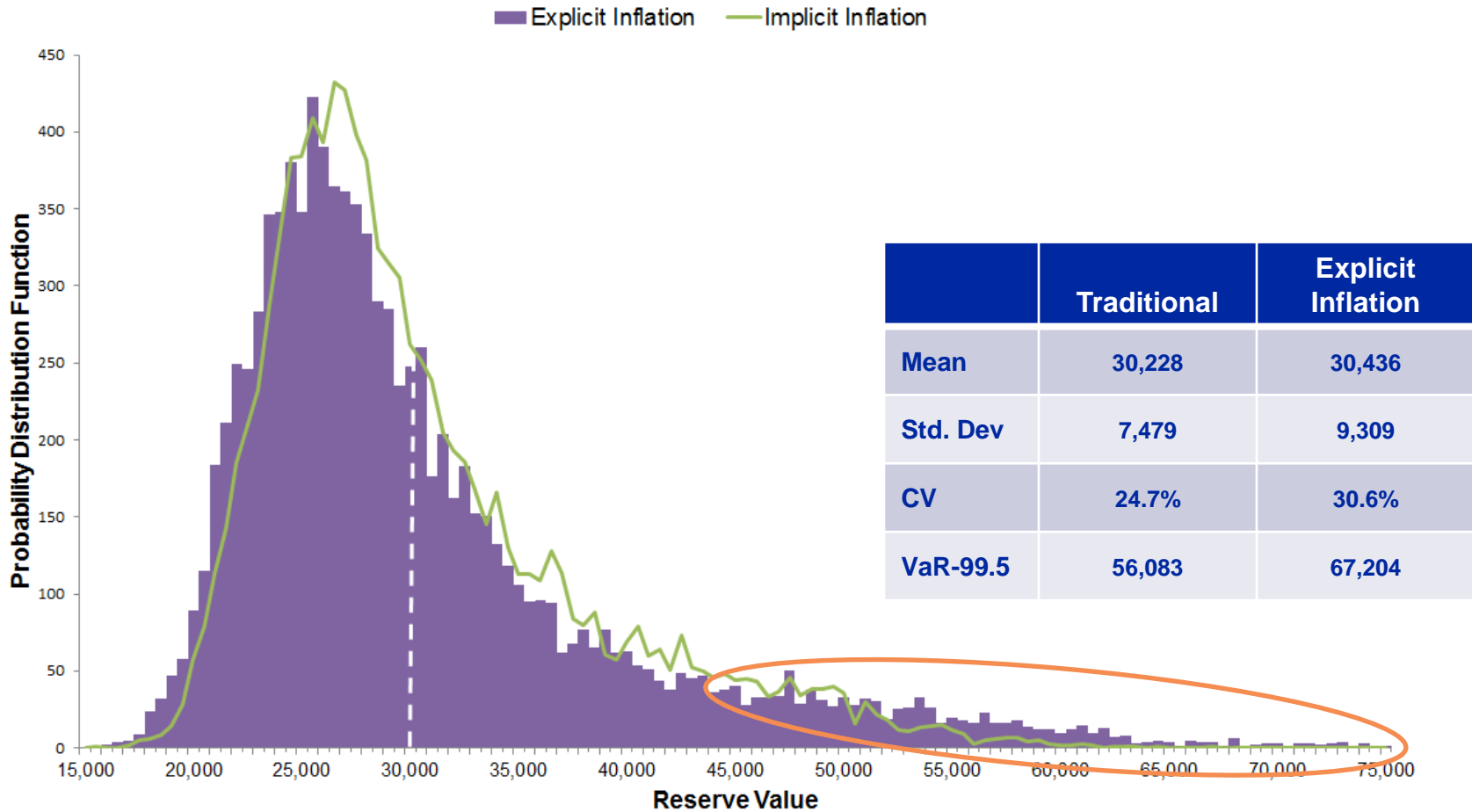
Inflation	Reserve
2.0%	32,451
3.0%	33,416
3.7%	34,112
5.0%	35,456

Acc. Year	Months of Development										
	12	24	36	48	60	72	84	96	108	120	Ult.
1	7,596	15,347	18,843	20,914	21,974	23,565	24,131	24,483	24,736	24,860	945
2	6,856	13,991	17,108	18,560	20,154	20,623	20,808	21,101	21,328	107	815
3	7,560	14,804	17,795	20,433	21,395	22,193	22,620	22,835	240	116	881
4	6,854	14,826	21,117	23,122	24,517	25,589	25,873	330	276	133	1,011
5	6,187	15,889	19,289	21,510	23,034	23,516	374	304	255	123	934
6	4,728	10,131	12,662	14,656	15,749	626	260	212	177	85	650
7	3,680	6,906	8,947	10,127	648	428	178	145	121	58	445
8	3,212	8,078	9,704	1,137	694	458	191	155	130	63	476
9	4,445	9,862	2,515	1,450	885	584	243	198	166	80	607
10	3,717	4,270	2,037	1,174	717	473	197	160	134	65	492
Inflation		3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	
Index	1.000	1.037	1.075	1.115	1.156	1.199	1.244	1.290	1.337	1.387	

Reserve Variability

Bootstrap results – nominal reserve

Bootstrap Reserve Distribution with Explicit Inflation Adjustment

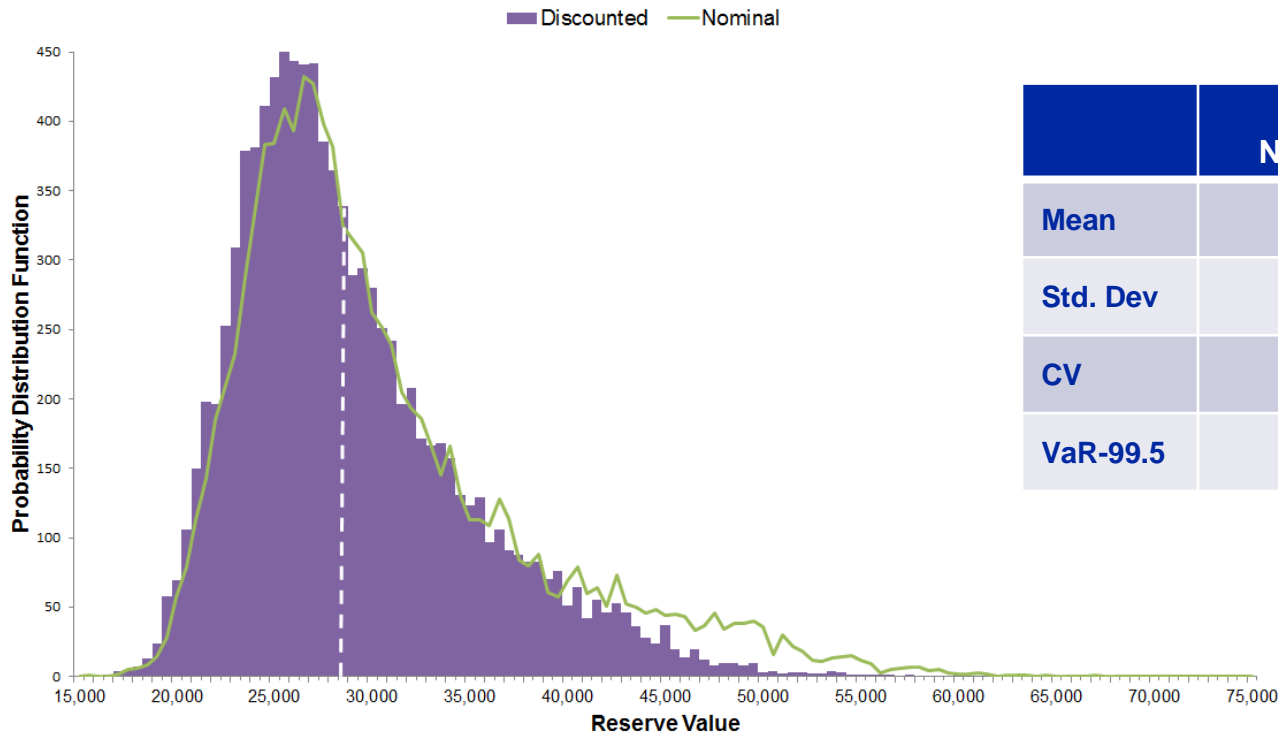


Discounting

No explicit inflation adjustment

- » Discounted reserves have lower variability than nominal reserves
 - Much of reserve variability stems from uncertainty in tail factors
 - This is mitigated by larger discount factors

Bootstrap Reserve Distribution without Explicit Inflation Adjustment



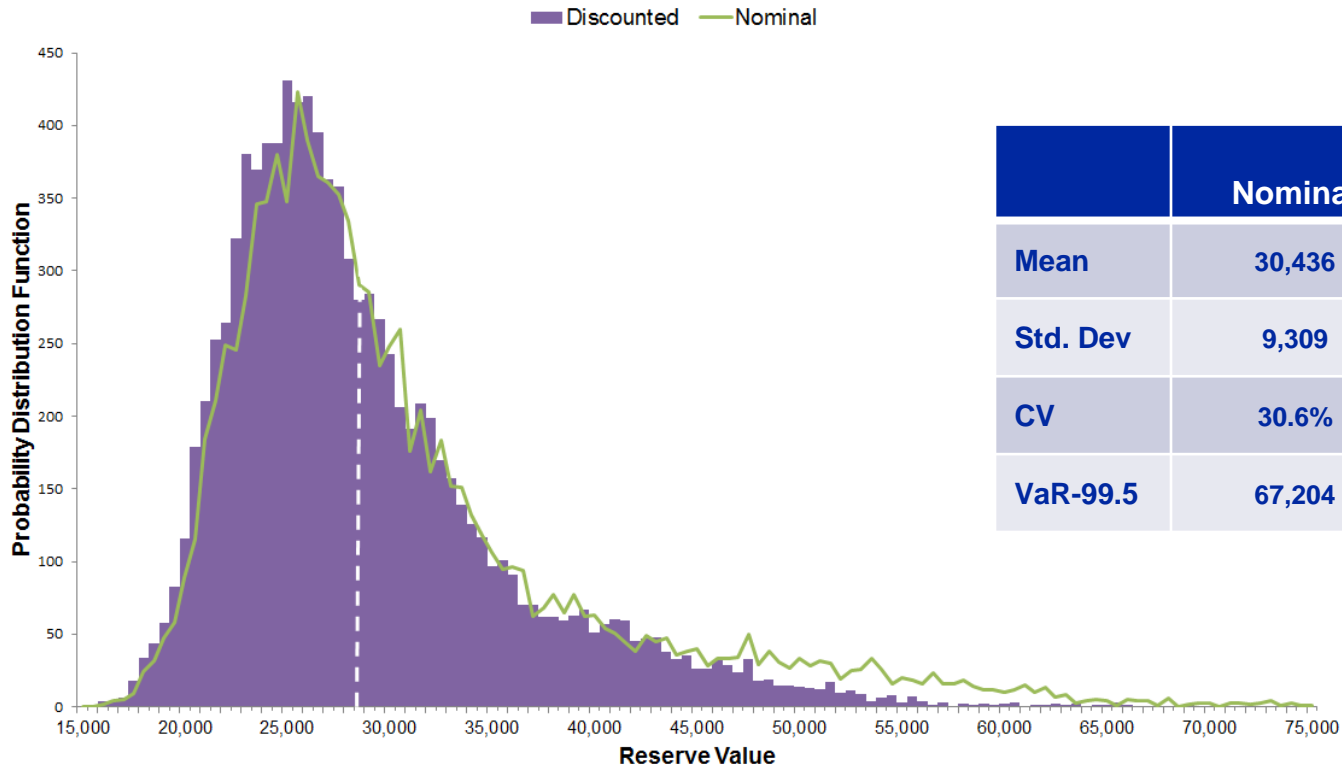
	Nominal	Discounted
Mean	30,228	28,633
Std. Dev	7,479	5,939
CV	24.7%	20.7%
VaR-99.5	56,083	48,669

Discounting

With explicit inflation adjustment

- » Discounting reduces variability further
 - Correlations between interest rates and inflation

Bootstrap Reserve Distribution with Explicit Inflation Adjustment

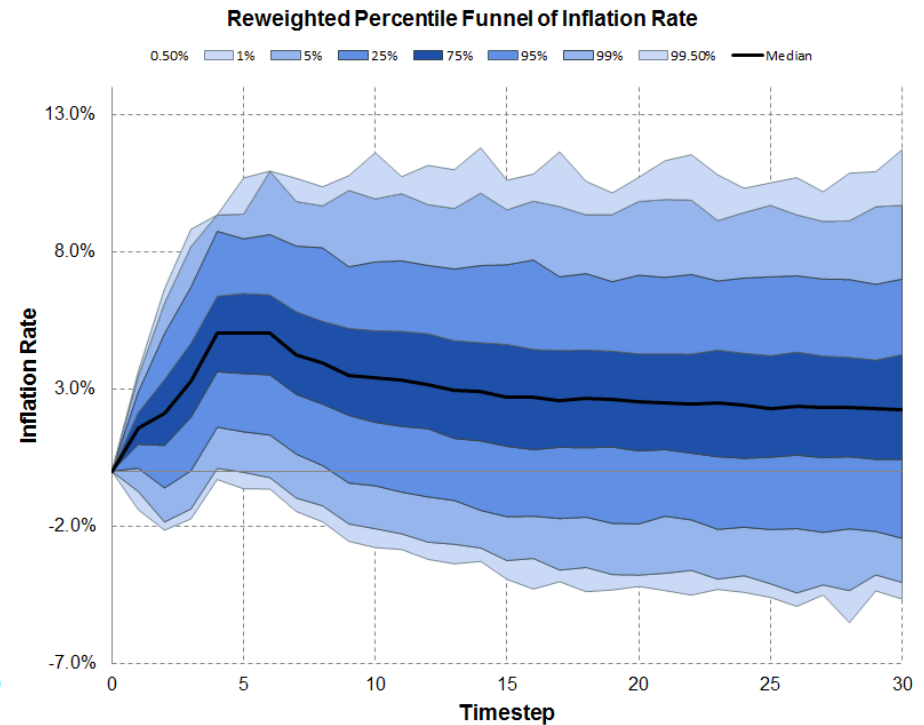
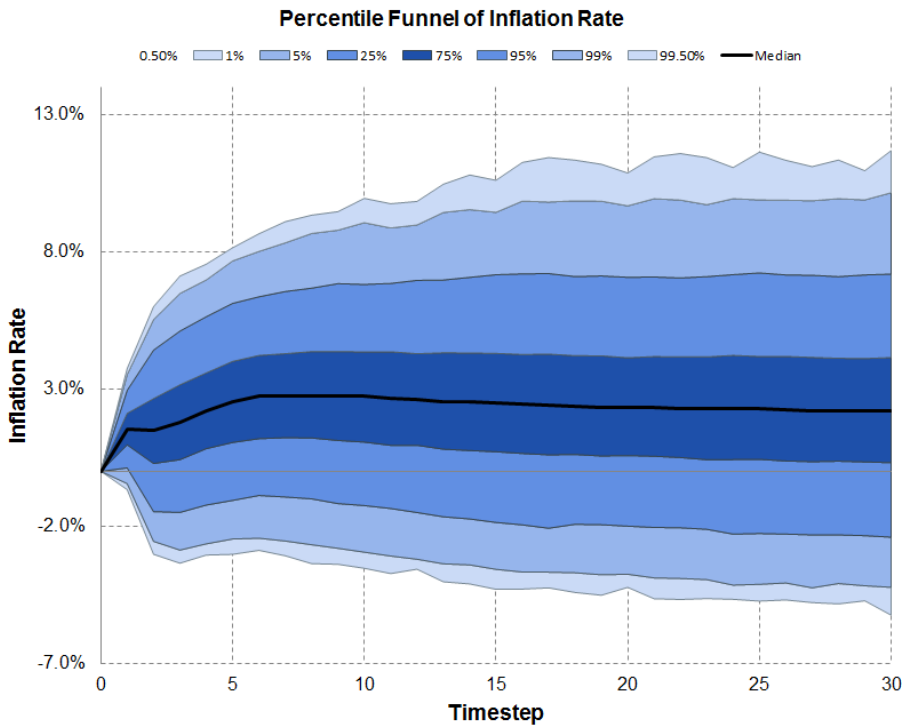


	Nominal	Discounted
Mean	30,436	28,503
Std. Dev	9,309	6,979
CV	30.6%	24.5%
VaR-99.5	67,204	54,064

Inflation Stress Test

Hard to achieve without explicit inflation treatment

- » Requirement from AM Best
- » E.g. target inflation at 5% for year 4, 5 and 6

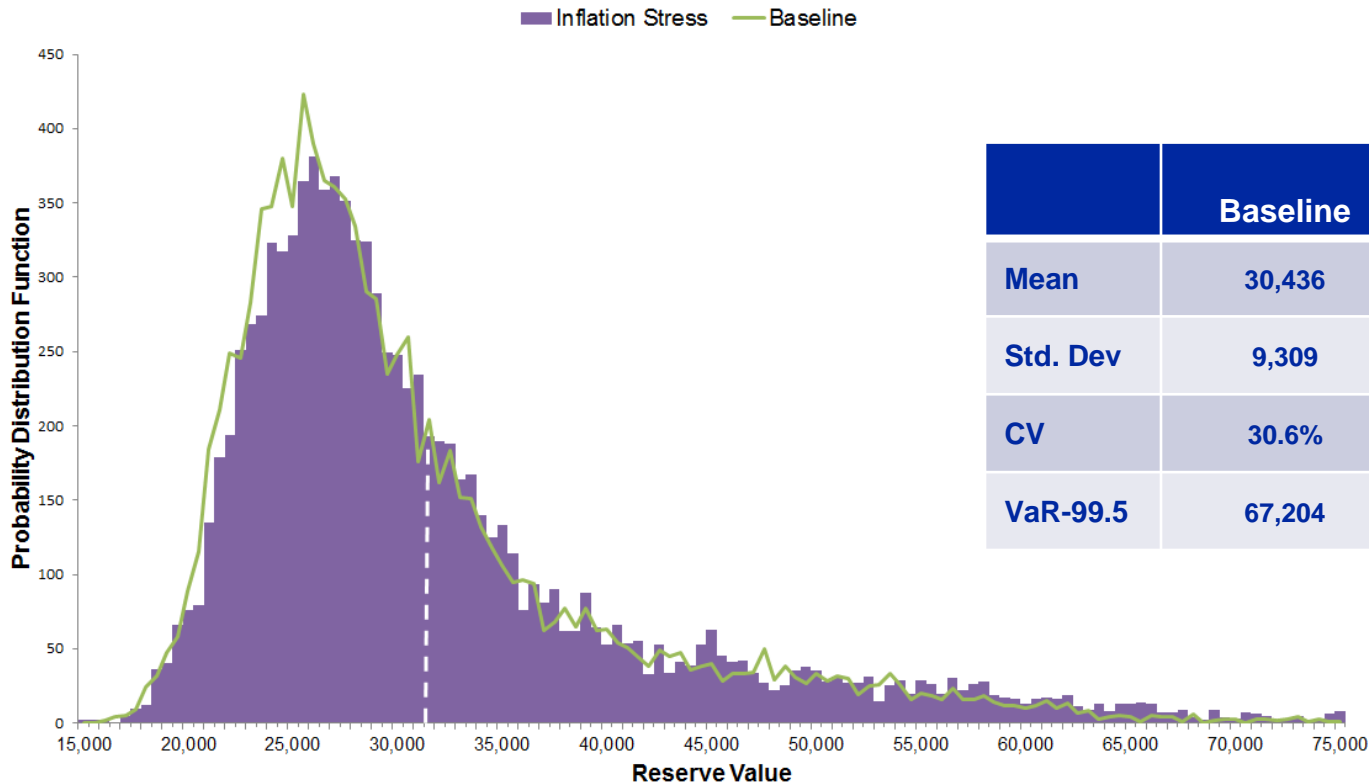


Inflation Stress Test

Results

- » Noticeable impact
 - Even without leverage

Bootstrap Reserve Distribution with Explicit Inflation Adjustment

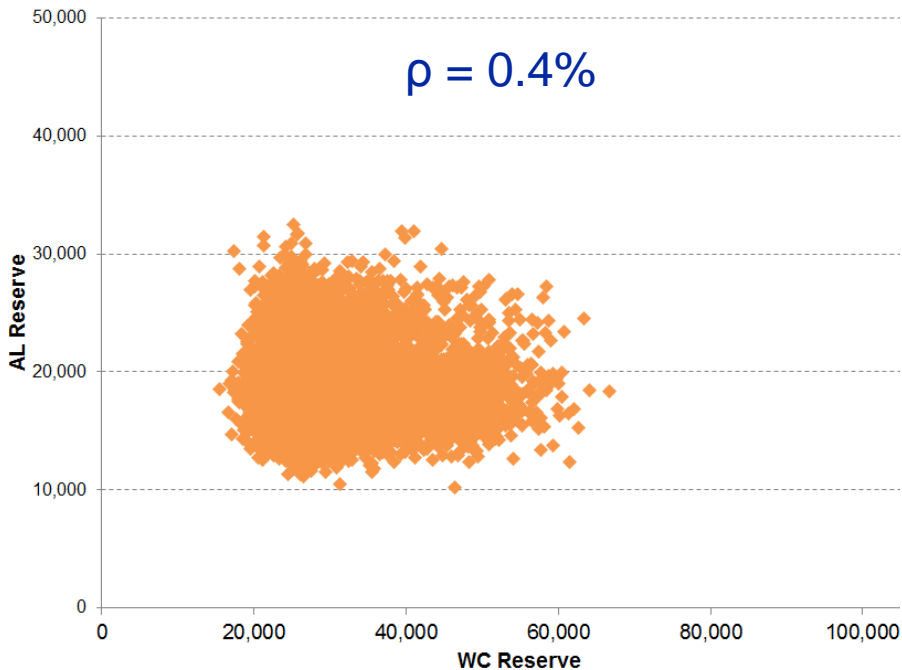


Induced Correlations Between Lines of Business

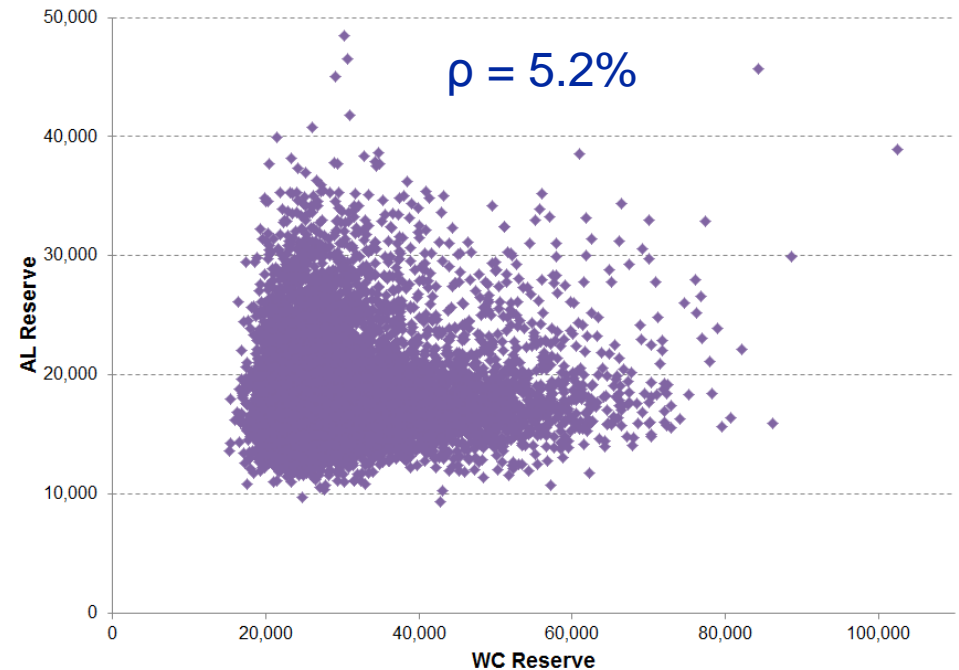
Same exercise with two lines of business

- » Inflation acts as a common driver between lines of business
 - Generates correlations between lines of business
 - Easy to explain

Correlations - No Inflation Adjustment



Correlations - Explicit Inflation Adjustment



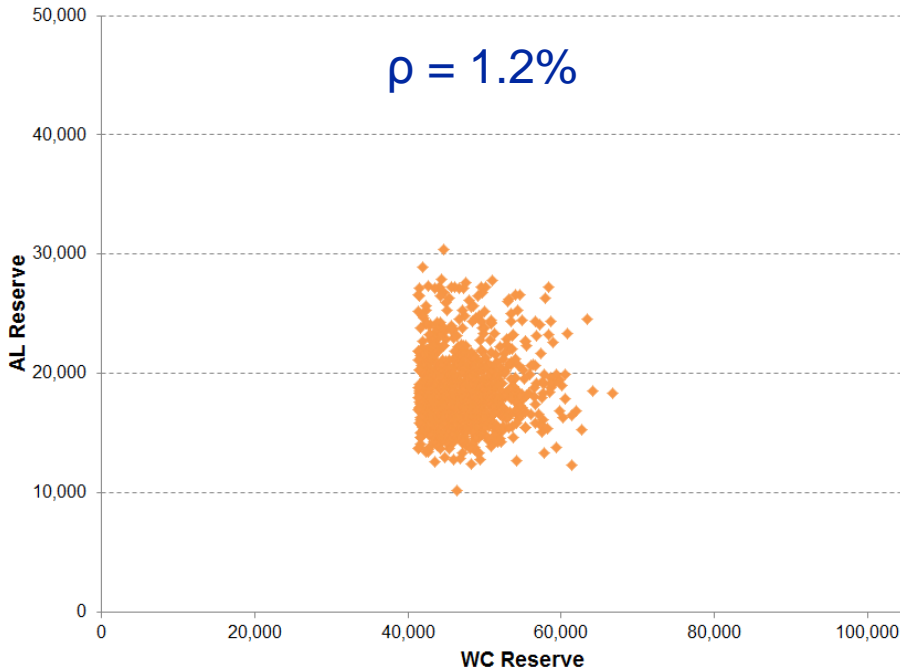
Tail Correlations Between Lines of Business

Same exercise with two lines of business

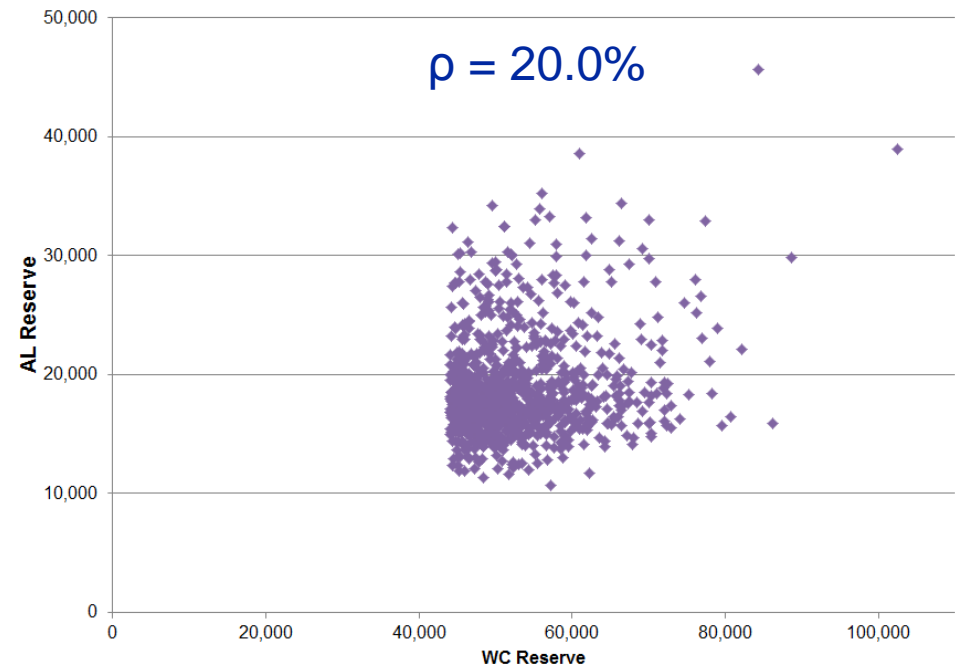
- » Correlations increase in the tail
 - E.g. 90th percentile

%-ile	No Inflation Adjustment	Explicit Inflation
0%	0.4%	5.2%
50%	1.4%	5.2%
75%	0.0%	7.6%
90%	1.2%	20.0%
99%	-0.1%	41.0%

Tail Correlations - No Inflation Adjustment



Tail Correlations - Explicit Inflation Adjustment



Induced Correlations Between Reserving and U/W

Apply ESG inflation to payment patterns for the new business

- » Same mechanism as induced correlations between lines of business
- » Inflation acts as a common driver between reserving and underwriting
 - Generates correlations between reserving and underwriting risks
 - Easy to explain
- » Not the only source of correlations
 - May need to impose additional explicit correlations using copulas
- » Consistency with the asset side of the balance sheet
 - E.g. TIPS

Summary

- » Given the current economic environment, interest rate and inflation risk should be watched for
- » Traditional reserving methods can be easily adapted to treat inflation as an explicit risk factor...
- » Leading to a better assessment of inflation risk, with benefits:
 - Correlations between lines of business
 - Correlations between reserving and underwriting
 - Hedge with the asset side

References & Further Reading

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