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D6: Claims Inflation: Linking Triangles, Future Run-off and other Assumptions

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AXA XL

20 September 2019

Agenda

Claims inflation: linking triangles, future run-off and other assumptions

General Inflation outlook & Claims Severity Inflation

Technical Reserving Focus: Matching Nominal Claim Payments, Claims Severity Inflation and modelling

Example of model application

Ideas for Estimating Future Claims Severity Inflation

Other Extensions; incurred claims, reserve committee/board reporting, reserve risk

Some leaving thoughts, Discussion & Questions

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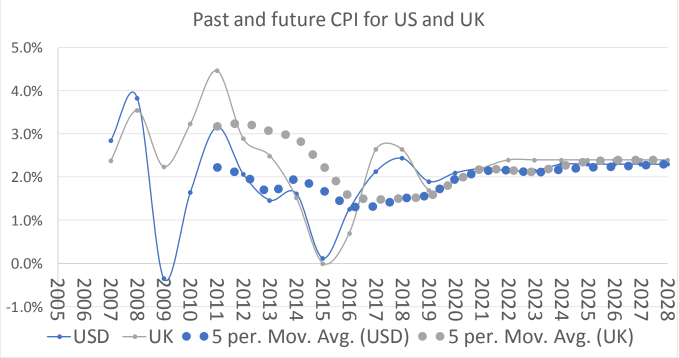
General Inflation outlook & Claims Severity Inflation

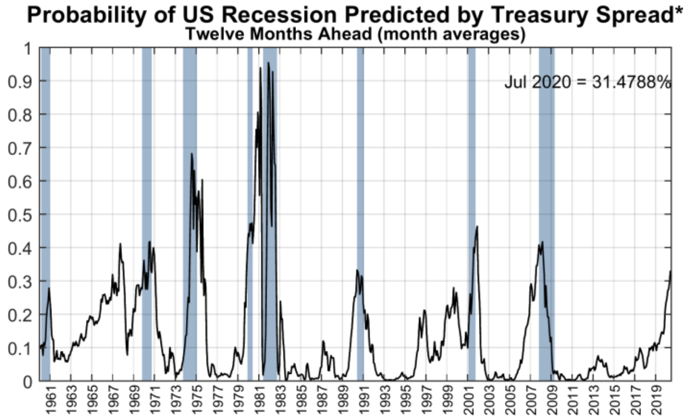
20 September 2019

Recent history as a guide to the future:

UK&US 2013-2018 CPI @ 1.5%, vs. 2019-2023 @ 2.1%, similar trend for other major economies

Changing economic landscape; *not to mention non-economic factors…*





1. Inflation history low vs. future expectations (US/UK etc.)

- Trade Wars
- CPI forecasts high
- Wages up
- Climate change
- Central Banks
- The B word

2. Probability of US recession predicted by Treasury Spread >30% (NY FED, Aug 19)

- Deflation in 08/09
- Trade Wars unwind
- USD strength
- QE
- Central Banks
- The B word

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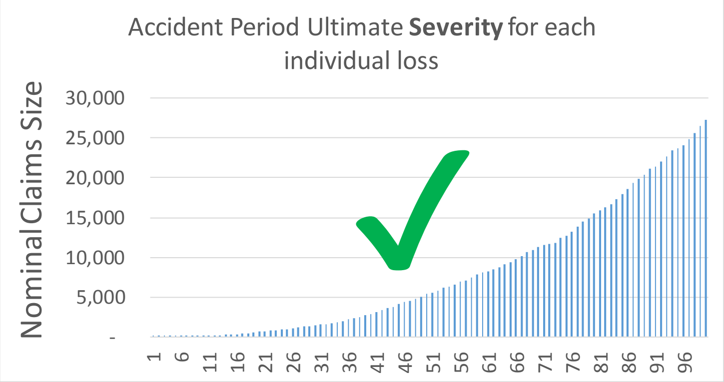
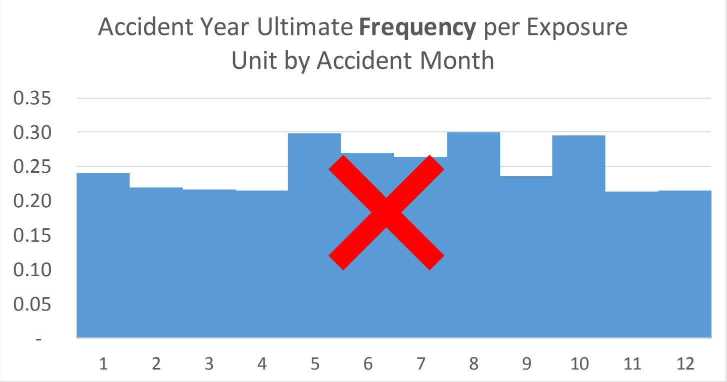
Claims inflation: Here we consider only Claims Severity Inflation, NOT frequency/exposure/other impacts

Extract from "Claims Inflation Uses and Abuses: Paper Prepared for GIRO 2005"

When considering claims inflation, it is important to separately consider the frequency and severity of claims. Total claims inflation is clearly the combination of the trends in frequency and severity, but very different factors drive the trends in these two elements. Consequently, it is only by looking at them in isolation from one another that the actuary can fully understand what is going on.





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Technical Reserving Focus: Matching Nominal Claim Payments, Claims Severity Inflation and modelling

20 September 2019

Reserving & Claims Severity Inflation

Aim: Explicitly incorporate Claims Severity Inflation into reserving analysis

Assume Claim Severity Inflation underlying Nominal Payments is:

- Fixed at a particular point in time (e.g. payment or accident date)
- Estimated based on an inflation index associated with the above time

Model: Paid development factor model (chain ladder)

Extension: Cape Cod Loss Ratio Estimate, Incurred claims, Reserve risk

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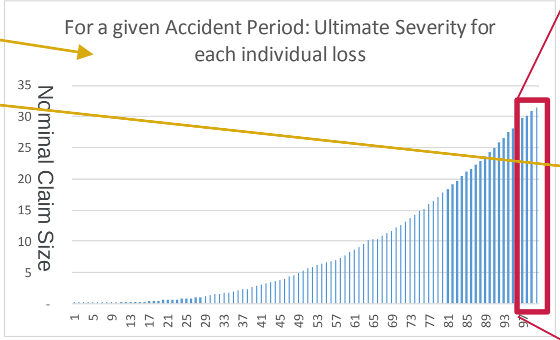
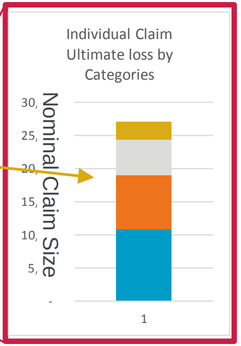
Severity amounts for each claim can be broken down into categories to align to inflation indices (1 of 7)

- In the example, claim frequency is 100
- Individual claims broken into 4 categories
- Claim cashflow broken out by category





	Dev Year									
	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.7
2		1.8	1.8	1.8							5.4
3				4.1	4.1						8.1
4				1.6	1.6	1.6	1.6	1.6	1.6	1.6	10.9
All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

Illustrative categories / *inflation index*:

- Allocated Loss Adjustment Expenses / *Wages*
- Legal Fees / *Legal Costs/Wages*
- Indemnity cost / *Wages + Court inflation, GDP*
- Property Damage / *Building Costs index*
- Business Interruption / *CPI*
- Fixed benefit / *None or per Terms & Conditions*

Category splits ideally directly driven by data, but may be assumption based.

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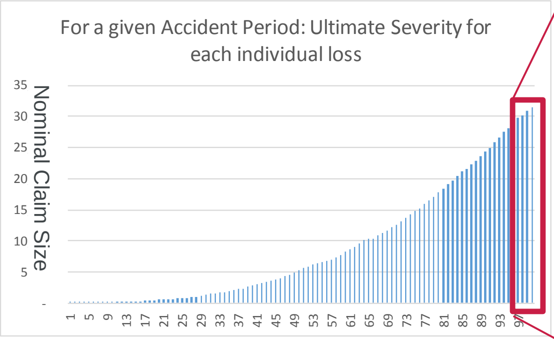
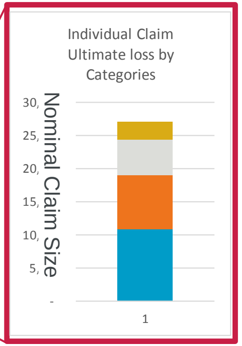
Categories / Claim Severity Inflation indices associated to payments for on-levelling purposes (2 of 7)

- Payments correspond to Claims Severity Inflation
- Generalise to aggregate paid claim triangle
- Can further generalise to any cash-flow model





AY	1	2	3	4	5	6	7	8	9	10	Total
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2											
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6											
7											
8											
9											
10											

	Dev Year										
	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.7
2		1.8	1.8	1.8							5.4
3				4.1	4.1						8.1
4				1.6	1.6	1.6	1.6	1.6	1.6	1.6	10.9
All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

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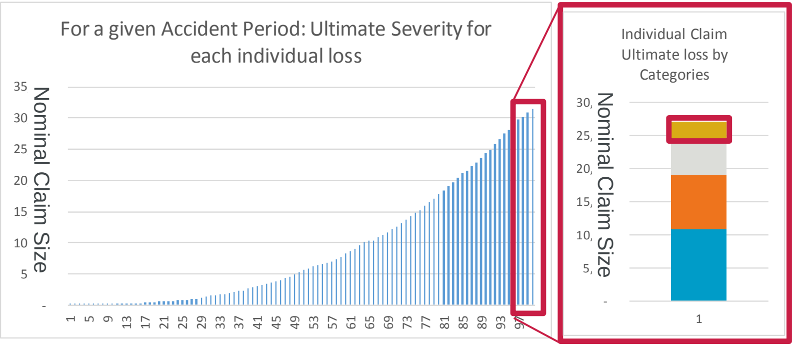
On-level cashflows; Claims Severity Inflation: Calendar Year / Accident Year / Development Year (3 of 7)

- Category payments underlying Claims Severity Inflation fixed @ calendar year timing
- Category examples; legal fees, ALAE costs etc.
- i.e. Cash settled @ same calendar year level



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On-level of cashflows; Claims Severity Inflation:

Calendar Year / **Accident Year** / Development Year **(4 of 7)**

- Category payments underlying Claims Severity Inflation fixed @ accident year timing
- Category examples; indemnity using Share price
- i.e. Cash settled @ same accident year level

AY	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	2.3	4.4	12.1	18.0	19.8	21.6	23.4	25.3	27.1	27.1
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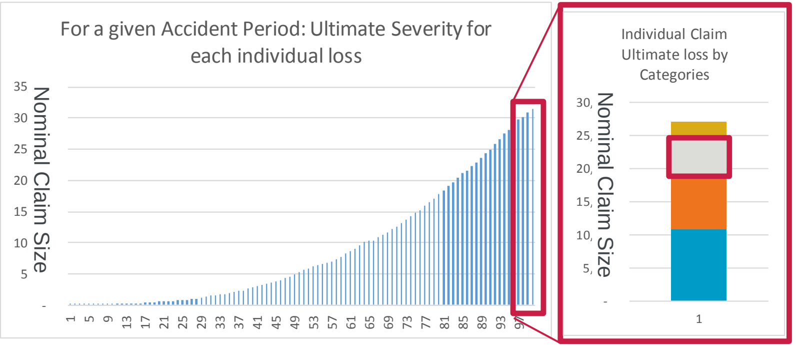

	Dev Year										
	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.7
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All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

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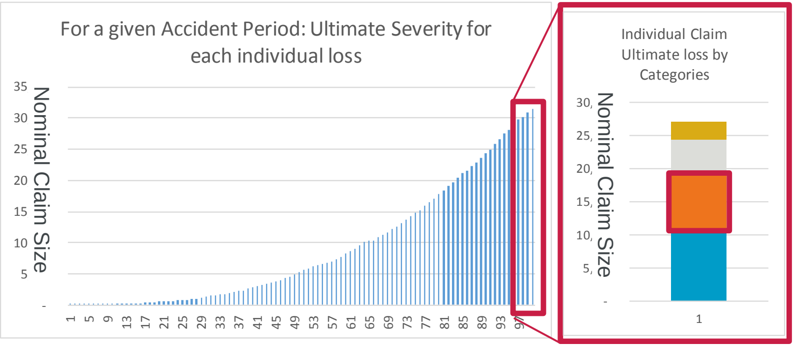
On-level of cashflows; Claims Severity Inflation: Cal Year / Accident Year / Development Year+ (5 of 7)

- Category payments underlying Claims Severity Inflation fixed @ development year timing
- i.e. Cash settled @ same development year level



May require extension to allow for accident year

AY	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	2.3	4.4	12.1	18.0	19.8	21.6	23.4	25.3	27.1	27.1
2											
3											
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6											
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8											
9											
10											

	Dev Year										
	1	2	3	4	5	6	7	8	9	10	Total
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All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

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On-level of cashflows; Claims Severity Inflation: Inflation Protected & Gearing (6 of 7)

Category may not respond to changes in claims severity inflation e.g. due to losses at limits, outwards reinsurance protection, indexing. Equally where there are SIRs / Excess layers the ground-up inflation may be amplified (e.g. Ogden)

AY	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	2.3	4.4	12.1	18.0	19.8	21.6	23.4	25.3	27.1	27.1
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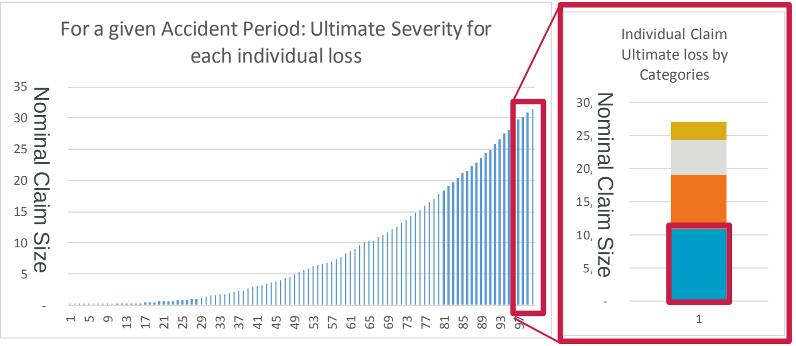

	Dev Year										
	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.7
2		1.8	1.8	1.8							5.4
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All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

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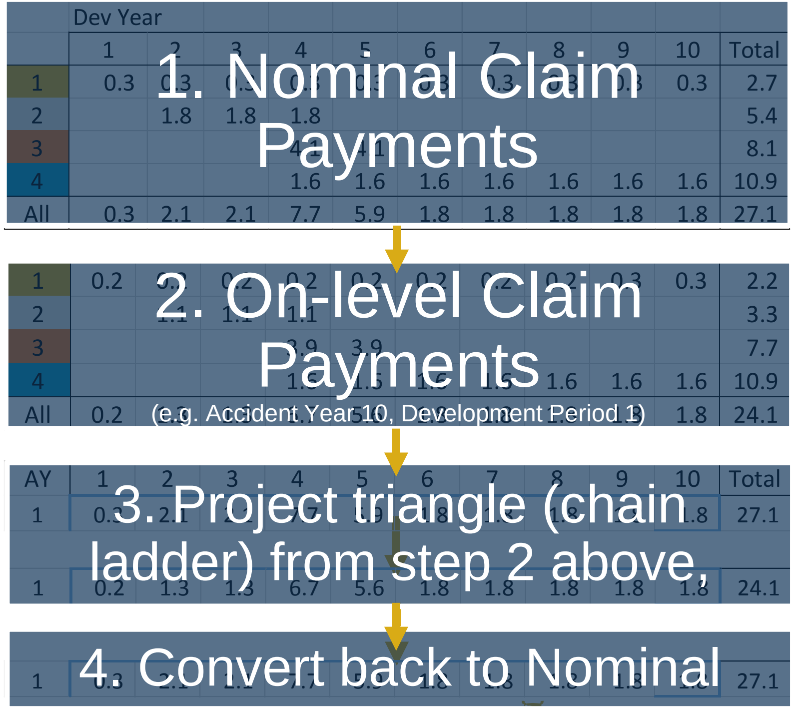
Applying the paid development factor method to estimate ultimate claims (7 of 7)

We now take the following steps:

1. Begin with our incremental nominal paid claims triangle
2. Apply Claims Severity Inflation to each cell to on-level all historical payments to a common period (e.g. AY10 / Development Period 1)
3. Estimate future cash flows (and ultimate claims) from the on-levelled cumulative triangle (i.e. Chain Ladder)
4. Reverse the process on our completed incremental on-level paid triangle by re-applying the inverse of the Claims Severity Inflation for each cell including future estimated increments



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Technical Reserving Focus: estimate cape cod loss ratio using same claims severity inflation as paid development factor model

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Harmonise Paid Development factor model and Loss Trend Factors in loss ratio on-levelling

Aim: Explicitly incorporate Claims Severity Inflation into reserving analysis (Paid development factor (chain ladder)) ✓

Extension: Cape Cod Loss Ratio Estimate; @ Claims Severity Inflation consistent with our paid pattern. ✓

1. Take past & future (estimated) cashflows by accident year / development period & explicit Claims Severity Inflation
2. Then re-value the cashflows to be consistent with the latest accident year.
3. Add any additional impacts (e.g. frequency) to the on-levelling
4. Then on-level ultimate claims for the purpose of cape cod loss ratio selection.

Accident Period	Premium (1)	Premium rates (2)	Premium On-level to latest Accident Period (3)	Ultimate Clams (4)	On-level Clams Factor (4)	On-level Clams (6)
1	25.9	2.0%	25.3			
2	26.9	2.0%	25.8			
3	27.3	1.0%	26.2			
4	27.4	-2.0%	26.8			
5	27.4	-2.0%	27.3			
6	27.6	-2.0%	28.1	16.9	1.093	18.3
7	26.7	-5.0%	28.6	17.7	1.070	18.5
8	27.0	-1.0%	29.2	18.7	1.047	19.1
9	28.7	3.0%	30.2	19.5	1.024	18.9
10	30.5	5.0%	30.5	20.8	1.000	21.8

AY	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	2.3	4.4	12.1	18.0	19.8	21.6	23.4	25.3	27.1	27.1
2											
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<u>Accident Period on-levelling vs. Development Patterns</u>
Some Claims Severity Inflation categories have a marginal impact on the development patterns, but may have a larger impact on the on-levelling from one accident period to the next
<u>We can also project to future accident periods based on expected claims severity inflation</u>

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Example of application

Paid Development Pattern & Cape Cod

Two claim categories:

Category 1: Impacts Calendar Period; 25% of payments

Category 2: Impacts Accident Period; 75% of payments

Category 1: Calendar Year impacts: 2% past, 4% future, impacts 25% of the cashflow (1 of 6)

	Dev Year										
	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.7
2		1.8	1.8	1.8							5.4
3				4.1	4.1						8.1
4				1.6	1.6	1.6	1.6	1.6	1.6	1.6	10.9
All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

On-level 25% of the incremental nominal paid claims triangle using the below factors:

- Payments made in the ‘diagonal 10’ are all at the same claims severity inflation rate as Accident Period 1, Development Period 1
- Payments prior to ‘diagonal 10’ need to be inflated by 2% p.a. (as relative nominal values were lower)
- Payments post to ‘diagonal 10’ need to be deflated by 4% p.a. (as relative nominal values were lower)

AY	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	2.3	4.4	12.1	18.0	19.8	21.6	23.4	25.3	27.1	27.1
2											
3											
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7											
8											
9											
10											

Example cashflow: Allocated Loss Adjustment Expenses / Lawyer Costs

Accident Period	1	2	3	4	5	6	7	8	9	10
1	20%	17%	15%	13%	10%	8%	6%	4%	2%	0%
2	17%	15%	13%	10%	8%	6%	4%	2%	0%	-4%
3	15%	13%	10%	8%	6%	4%	2%	0%	-4%	-8%
4	13%	10%	8%	6%	4%	2%	0%	-4%	-8%	-11%
5	10%	8%	6%	4%	2%	0%	-4%	-8%	-11%	-15%
6	8%	6%	4%	2%	0%	-4%	-8%	-11%	-15%	-18%
7	6%	4%	2%	0%	-4%	-8%	-11%	-15%	-18%	-21%
8	4%	2%	0%	-4%	-8%	-11%	-15%	-18%	-21%	-24%
9	2%	0%	-4%	-8%	-11%	-15%	-18%	-21%	-24%	-27%
10	0%	-4%	-8%	-11%	-15%	-18%	-21%	-24%	-27%	-30%

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Category 2: Accident Year impacts: 2% past, 4% future, impacts 75% of the cashflow (2 of 6)

AY	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	2.3	4.4	12.1	18.0	19.8	21.6	23.4	25.3	27.1	27.1
2											
3											
4											
5											
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7											
8											
9											
10											

On-level the 75% of the incremental nominal paid claims triangle using the below factors:

- Payments made in accident year 1 are unchanged
- Payments made in accident year 2 onwards are increased by the AY cumulative factor
- Beyond accident year 10 we would use 4%, which might be relevant for next year's business planning for example, or 3-year views.

	Dev Year										
	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.7
2		1.8	1.8	1.8							5.4
3				4.1	4.1						8.1
4				1.6	1.6	1.6	1.6	1.6	1.6	1.6	10.9
All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

Example cashflow: Indemnity loss cost

Accident Period	Claims Severity Inflation	Cumulative Trend
1	2.0%	1.195
2	2.0%	1.172
3	2.0%	1.149
4	2.0%	1.126
5	2.0%	1.104
6	2.0%	1.082
7	2.0%	1.061
8	2.0%	1.040
9	2.0%	1.020
10	2.0%	1.000

<u>This is only the Accident Period Claims Severity Inflation component of the trend</u>
This applies to 75% of our cashflows. Any additional impacts for say frequency would have to be added on top
<u>NOTE: The Calendar Year also impacts Category 1 in the Accident Period direction</u>

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What impact did increasing claims severity inflation from 2% to 4% have on % paid development? (3 of 6)

The below table shows the paid % developed based on the traditional chain ladder, on the triangle adjusted for Claims Severity Inflation, and then with Claims Severity Inflation added back in.

For Accident Period 10: The impact is 0.2% on the paid % developed / 1% in ultimate claim estimates / **1.2% on claim reserves**.

*Sense check: (4%-2%) x 25% x 2.8 res duration = **c. 1.2%***

Accident Period	% paid developed traditional (1)	% paid developed CSI removed (2)	% paid developed CSI Added (3) = (2) with +CSI
1			
2			
3			
4			
5			
6			
7	71.4%	72.0%	71.3%
8	60.8%	61.4%	60.6%
9	46.6%	47.2%	46.4%
10	18.4%	18.7%	18.2%

<u>Not a particularly large change</u>
The increase to claims severity inflation of +2% only really impacts the calendar year payments which applies to 25% of the payments.
<u>So in the example the Paid development factor method is not particularly sensitive to this adjustment</u>
Each accident year has it's own development pattern, although we consider this an expected cashflow

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What impact did increasing claims severity inflation from 2% to 4% have on our cape cod loss ratio? (4 of 6)

The below table shows the cape cod loss ratio based on (1) traditional basis; (2) Claims Severity Inflation adjusted pattern & on-level factors; (3) Claims Severity Inflation adjusted on-level factors & traditional pattern. Notice the increase to on-level factors from (1) to (2)

For Accident Period 10: The impact is 0.7% on the loss ratio / **1% in ultimate claim estimates**

Sense check: (4%-2%) x 25% x 3.2 ult duration x (1 – paid % dev) = ***c. 1%***

Cape Cod Calc		On-level factors & pattern Traditional (1)		On-level factors & pattern CSI Added (2)		On-level factors CSI added in & pattern traditional (3)	
Accident Period	On-levelled Premium						
1	24.6						
2	24.7						
3	24.9						
4	25.6						
5	26.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	26.3	1.082	63.5%	1.092	63.6%	1.092	63.5%
7	27.1	1.061	68.1%	1.070	68.4%	1.070	68.2%
8	27.4	1.040	70.2%	1.047	70.6%	1.047	70.4%
9	27.7	1.020	69.5%	1.024	70.0%	1.024	69.9%
10	28.0	1.000	67.5%	1.000	68.3%	1.000	68.2%

The largest impact to the loss ratio in the example is from the different estimation of the on-level factor
<u>So in the example the Paid development factor method is not particularly sensitive to this adjustment</u>

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What impact did increasing claims severity inflation from 2% to 4% have on Unpaid Claim Reserves? (5 of 6)

The below table shows the unpaid claim reserves based on (1) traditional basis; (2) Claims Severity Inflation adjusted pattern & on-level factors; (3) Claims Severity Inflation adjusted on-level factors & traditional pattern.

In total for all accident years: The impact is 1.1% unpaid claim reserves

Sense check: expect less than our 1.2% impact on accident period 10 due to flat future claim severity inflation

Accident Period	Unpaid claims traditional (1)	Unpaid claims Pattern & Loss Trend adj (2)	Unpaid claims only Loss Trend adj (3)	Method Selection (4)
1	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]
6	2.8	2.8	2.8	Paid DFM
7	4.5	4.6	4.5	Blended
8	6.4	6.5	6.5	Blended
9	9.4	9.5	9.4	Blended
10	15.6	15.8	15.8	IELR
Total	42.9	43.4	43.2	
% vs. (2)	-1.1%	0.0%	-0.5%	

A 1.1% difference to reserves *may appear 'spurious'* given the increase in assumption volume

But…

- On-level factors and paid development factors use a consistent inflation assumption
- The impact of a 2% future inflation increase over and above the history was 1% to reserves (paid duration of c. 2.5) arguably material
- Impact of mis-estimation & volatility are high

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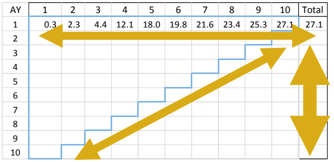
What impact did increasing claims severity inflation from 2% to 4% have on Business Planning Loss Ratio? (6 of 6)

The below is an estimate for next years loss ratio, for example, for business planning purposes

In this example, the traditional loss ratio is 65.6% vs. the adjusted loss ratio of 68.1%

A material impact from the accident year claims severity inflation (Category 2 @ 75%)



Cape Cod Calc

Accident Period	On-levelled Premium	Loss Ratios: On-level factors & pattern Traditional (1)		Loss Ratios: On-level factors & pattern CSI Added (2)		Loss Ratios: On-level factors CSI added in & pattern traditional (3)	
1	24.6						
2	24.7						
3	24.9						
4	25.6						
5	26.1						
6	26.3						
7	27.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	27.4	1.040	70.2%	1.047	70.6%	1.047	70.4%
9	27.7	1.020	69.5%	1.024	70.0%	1.024	69.9%
10	28.0	1.000	67.5%	1.000	68.3%	1.000	68.2%
11 (1)	28.4	1.020	65.6%	1.024	66.6%	1.024	66.5%
11 (2)	28.4	1.040	66.9%	1.048	68.1%	1.048	68.0%

<u>What happens in a lines of business where we use loss ratio for the latest 3 years?</u>

- Claims Severity mis-estimation would lead to 3 or more loss ratio point on the latest year
- A underwriting / reserving cycle would emerge

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Ideas for Estimating Future Claims Severity Inflation

20 September 2019

Thoughts on converting future economic indicators to future claims severity inflation

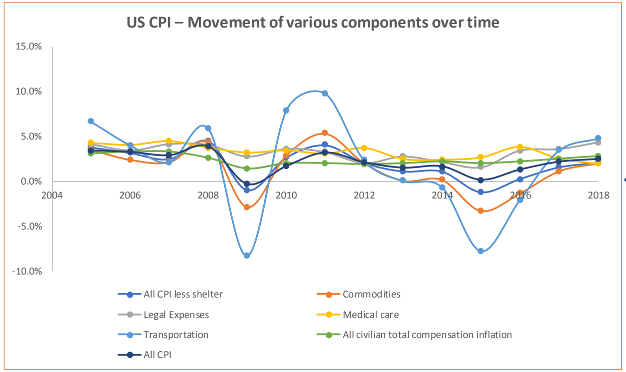
External views on future claims severity inflation may not be available for your relevant inflation index.

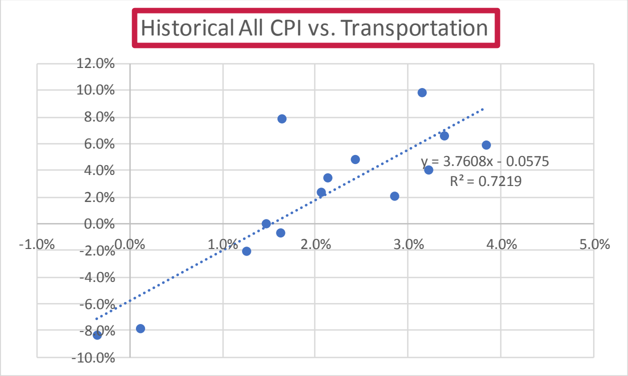
An example of a simple regression analysis is shown to the right between US All CPI and the Transportation inflation index.

It is now possible to use the regression model to estimate future Transportation costs. Results in a gradient 3.76 vs. CPI, intercept (0.0575), R squared 0.7219

US

Calendar year	All CPI less shelter	Commodities	Legal Expenses	Medical care	Transportation	All civilian total compensation inflation	All CPI
2005	3.8%	3.5%	4.1%	4.2%	6.6%	3.1%	3.4%
2006	3.2%	2.4%	3.4%	4.0%	4.0%	3.3%	3.2%
2007	2.5%	2.1%	4.1%	4.4%	2.1%	3.3%	2.9%
2008	4.5%	4.3%	4.0%	3.7%	5.9%	2.6%	3.8%
2009	-1.0%	-2.9%	2.7%	3.2%	-8.3%	1.4%	-0.4%
2010	2.6%	2.9%	3.6%	3.4%	7.9%	2.0%	1.6%
2011	4.0%	5.3%	3.2%	3.0%	9.8%	2.0%	3.2%
2012	2.0%	2.0%	2.0%	3.7%	2.3%	1.9%	2.1%
2013	1.1%	0.0%	2.8%	2.5%	0.0%	2.0%	1.5%
2014	1.1%	0.1%	2.1%	2.4%	-0.7%	2.2%	1.6%
2015	-1.3%	-3.3%	1.6%	2.6%	-7.8%	2.0%	0.1%
2016	0.2%	-1.4%	3.4%	3.8%	-2.1%	2.2%	1.3%
2017	1.5%	1.1%	3.6%	2.5%	3.4%	2.5%	2.1%
2018	2.1%	2.0%	4.3%	1.9%	4.8%	2.8%	2.4%
Mean	**1.9%**	**1.3%**	**3.2%**	**3.2%**	**2.0%**	**2.4%**	**2.1%**
Standard Dev	**1.7%**	**2.5%**	**0.8%**	**0.7%**	**5.2%**	**0.6%**	**1.2%**





Different types of inflation exhibit different volatility: High: Transportation / Commodities; Low: Medical care, Wages and Legal Expenses

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Example Future Indices: Publicly available sources; generally trending upwards

Example future views of economic inflation indices shown below. The Transportation column shows the extension to the linear regression shown on the previous slide.

SPF: Survey of Professional Forecasters

BOE: Bank of England

RBA: Reserve Bank of Australia

Likely you will have own internal view, e.g. from ESG, Investments team etc… of various indices of use, which may include CPI, Wage Inflation and GDP

Trickier to find more bespoke long-term forecasts, but wealth of historical indices

Key to understand if estimate is mean or median

	CPI for Countries/Regions underlying each currency					Sources used					
Calendar year	USD	EUR	GBP	CAD	AUD	USD	EUR	GBP	CAD	AUD	Transportation
2014	1.6%	0.4%	1.5%	2.0%	2.5%						-0.7%
2015	0.1%	0.0%	0.0%	1.1%	1.5%						-7.8%
2016	1.3%	0.2%	0.7%	1.4%	1.3%						-2.1%
2017	2.1%	1.5%	2.6%	1.6%	1.9%						3.4%
2018	2.4%	1.7%	2.6%	2.3%	1.7%						4.8%
2019	**1.9%**	**1.3%**	**1.7%**	**2.1%**	**1.8%**	SPF	SPF	BOE	Royal bank of Canada	RBA	**1.4%**
2020	**2.1%**	**1.4%**	**1.9%**	**2.2%**	**1.8%**	SPF	SPF	BOE	Royal bank of Canada	RBA	**2.1%**
2021	**2.2%**	**1.5%**	**2.2%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.5%**
2022	**2.2%**	**1.7%**	**2.4%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.3%**
2023	**2.2%**	**1.7%**	**2.4%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.3%**
2024	**2.3%**	**1.7%**	**2.4%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.9%**
2025	**2.3%**	**1.7%**	**2.4%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.9%**
2026	**2.3%**	**1.7%**	**2.4%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.9%**
2027	**2.3%**	**1.7%**	**2.4%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.9%**
2028	**2.3%**	**1.7%**	**2.4%**	**2.2%**	**2.0%**	SPF	SPF	BOE	Trading Economics	RBA	**2.9%**

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What really makes up your Claims Severity Inflation Index? Focus US CPI Transportation Weights

Seasonal Adjustments
Geographical Differences
Parsimony / Noise error
Missing Geographies/Itmes
Technology Adjustments
Revisions
Tax

Sub-index	Weight
Transportation	16.704
Transportation Services	5.940
Transportation Commodities less motor fuel	6.568
Motor Fuel	4.196

Area	2016	2017	2018
Mid-West	-2.8%	2.4%	3.8%
South	-1.3%	4.2%	4.2%
West	-2.7%	3.7%	6.3%
New York-Newark-Jersey City	-2.1%	2.7%	3.5%
Chicago-Naperville-Elgin	-3.1%	2.4%	2.5%
Atlanta-Sandy Springs-Roswell	-1.3%	5.7%	6.5%
Alaska	-1.7%	2.4%	7.0%

Transportation	16.704
Private transportation	15.518
New and used motor vehicles[2]	6.921

Transportation commodities less motor fuel[11]	6.568
New vehicles	3.684
New cars and trucks[5, 6]	
New cars[6]	
New trucks[13, 6]	
Used cars and trucks	2.392
Motor vehicle parts and equipment	0.379
Tires	0.225
Vehicle accessories other than tires[5]	0.155
Vehicle parts and equipment other than tires[6]	
Motor oil, coolant, and fluids[6]	

Energy	7.748
Energy commodities	4.373
Fuel oil	0.108
Motor fuel	4.196
Gasoline (all types)	4.108

Transportation services	5.940
Leased cars and trucks[14]	0.615
Car and truck rental[5]	0.118
Motor vehicle maintenance and repair	1.129
Motor vehicle body work	0.056
Motor vehicle maintenance and servicing	0.639
Motor vehicle repair[5]	0.369
Motor vehicle insurance	2.353
Motor vehicle fees[5]	0.540
State motor vehicle registration and license fees[5]	0.276
Parking and other fees[5]	0.246
Parking fees and tolls[5, 6]	
Automobile service clubs[5, 6]	
Public transportation	1.186
Airline fares	0.738
Other intercity transportation	0.165
Intercity bus fare[7, 6]	
Intercity train fare[7, 6]	
Ship fare[5, 6]	
Intracity transportation	0.275
Intracity mass transit[11, 6]	

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Other Extensions; incurred claims, reserving risk, reserve committee/board reporting

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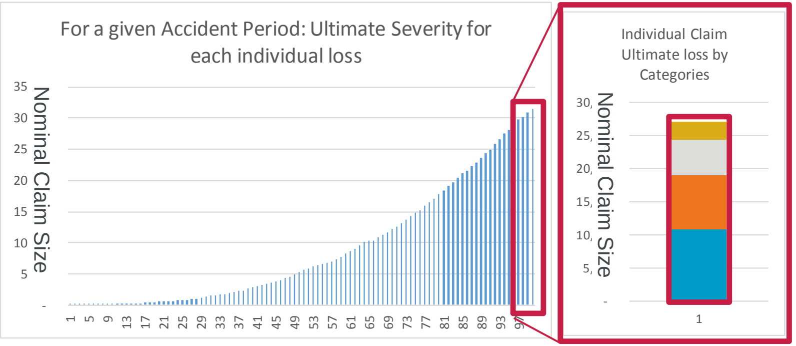
What about Incurred Claims? Reserving Actuaries may give more credibility to incurred in selections

Difficult to generalize as depends case reserve philosophy:

- Initial ’Auto-reserve’ may include explicit inflation assumption
- Judgement of claims handler: Mode / Median / Mean?
- Third Party Reliance: Lead Insurer / Cedant / MGA / DUA etc…
- Signal reserves
- Frequency of claim adjustment: Regular / Anchoring / Materliaty



	Dev Year - Incremental Case Reserve Movements										
	1	2	3	4	5	6	7	8	9	10	Total
1	3.0	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.8)	-
2	6.0	(1.8)	(1.8)	(1.8)						(0.6)	-
3	9.0			(4.1)	(4.1)					(0.9)	-
4		10.0		(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(0.7)	-
All	18.0	7.9	(2.1)	(7.7)	(5.9)	(1.8)	(1.8)	(1.8)	(1.8)	(3.0)	-

	Dev Year - Incremental Payments										
	1	2	3	4	5	6	7	8	9	10	Total
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.7
2		1.8	1.8	1.8							5.4
3				4.1	4.1						8.1
4				1.6	1.6	1.6	1.6	1.6	1.6	1.6	10.9
All	0.3	2.1	2.1	7.7	5.9	1.8	1.8	1.8	1.8	1.8	27.1

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Impact on Reserve Risk: Reserve Risk Example and ESG link

An example approach to incorporate into Reserve Risk:

1. We complete our reserve risk analysis on the triangle adjusted for Claims Severity Inflation, e.g. Mack / ODP etc…
2. We maintain the accident year / development period cashflows for each simulation
3. Then overlay simulated claims severity inflation, for example, using our simple regression on top of the an ESG output

This can be further extended to premium risk, as we have linked this assumption to our loss trend factors.

	CPI	ESG			Claims Severity Inflation			
Calendar year	USD	Percentile X	Percentile Y	Percentile Z	Best Estimate	Percentile X	Percentile Y	Percentile Z
2014	1.6%				-0.7%			
2015	0.1%				-7.8%			
2016	1.3%				-2.1%			
2017	2.1%				3.4%			
2018	2.4%				4.8%			
2019	1.9%	0.900%	2.900%	3.900%	1.4%	-2.4%	5.2%	8.9%
2020	2.1%	1.0%	3.2%	4.3%	2.1%	-2.0%	6.3%	10.4%
2021	2.2%	1.0%	3.4%	4.6%	2.5%	-2.0%	7.0%	11.5%
2022	2.2%	0.9%	3.5%	4.8%	2.3%	-2.6%	7.2%	12.1%
2023	2.2%	0.8%	3.6%	5.0%	2.3%	-2.9%	7.6%	12.9%
2024	2.3%	0.8%	3.8%	5.3%	2.9%	-2.7%	8.5%	14.2%
2025	2.3%	0.7%	3.9%	5.5%	2.9%	-3.1%	8.9%	14.9%
2026	2.3%	0.6%	4.0%	5.7%	2.9%	-3.5%	9.3%	15.7%
2027	2.3%	0.5%	4.1%	5.9%	2.9%	-3.9%	9.7%	16.4%
2028	2.3%	0.4%	4.2%	6.1%	2.9%	-4.2%	10.0%	17.2%

<u>The table just shows an example output</u>

- ESG models using 100 years experience would include some extreme outcomes
- Can explicitly incorporate internal view on inflation consistently

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How can you report to Reserve Committees / Board: Example Embedded Claims Severity Summary Statistic

For reporting, how can you summarise the view for say a line of business?

- Within your loss trend selections, i.e. between accident periods
- Within your reserves;
- Compared to your future expectation;

The ‘one’ statistic concept of ‘embedded’ claims severity inflation; *A weighted average’ based on a discounted cashflows type approach*

	$000s		Embedded Claims Severity Inflation p.a			(Str) / Release $000s	
Line of Business	**Claim Reserves (1)**	**Reserve Duration (2)**	**Implied by History (3)**	**Estimated Best (4)**	**Estimated @ 75th percentile (5)**	**Estimated Best (6) (vs. (1) @ (4))**	**Estimated @ 75th percentile (7) (vs. (1) @ (5))**
LOB 1	10,000	3.20	1.5%	1.7%	2.0%	(75)	(172)
LOB 2	20,000	3.00	1.6%	2.0%	3.0%	(228)	(838)
LOB 3	15,000	2.00	0.1%	0.1%	0.2%	-	(9)
LOB 4	2,000	6.00	2.0%	1.0%	2.0%	117	-
Total	**47,000**	**2.85**	**1.1%**	**1.3%**	**1.8%**	**(186)**	**(1,020)**

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Some leaving thoughts, Discussion & Questions

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Can Claims Severity Inflation Assumptions be consistent through Actuarial Function & Organisation?

Can you have ‘true’ consistency? Is it proportionate?

Granularity question; Pricing -> Reserving -> Capital

Computation complexity, Currency, Cat Demand Surge

Interaction with premium rates, claim frequency etc…

Using internal claims data, how claims actually settle

No surprise reserving; TORP GIRO 2017; is everyone on the same page in your organisation?

Inflation is a concept of averages and not directly observable

Importance of GDP / Growth as a measure / interest rates

Paid claim definition (accrual / cash etc…)

accident year to underwriting year conversion

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Questions

Comments

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