Reserve Methodologies to Account for Inflation

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Agenda

- Future Expected Inflation
- Adjusting Traditional Methods
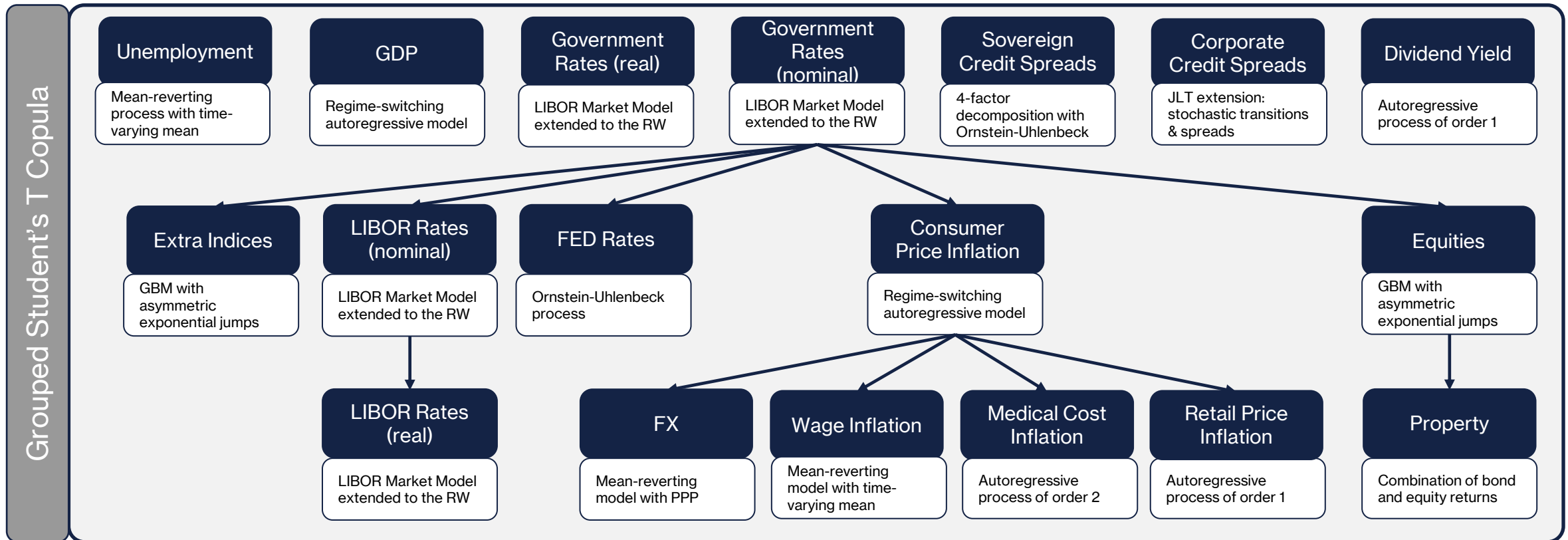
Future Expected Inflation

Economic Scenario Generator

Sample Structure, can be tied to your company's capital model

Grouped Student's T Copula

Unemployment	GDP	Government Rates (real)	Government Rates (nominal)	Sovereign Credit Spreads	Corporate Credit Spreads	Dividend Yield
Mean-reverting process with time-varying mean	Regime-switching autoregressive model	LIBOR Market Model extended to the RW	LIBOR Market Model extended to the RW	4-factor decomposition with Ornstein-Uhlenbeck	JLT extension: stochastic transitions & spreads	Autoregressive process of order 1

Extra Indices	LIBOR Rates (nominal)	FED Rates	Consumer Price Inflation	Equities
GBM with asymmetric exponential jumps	LIBOR Market Model extended to the RW	Ornstein-Uhlenbeck process	Regime-switching autoregressive model	GBM with asymmetric exponential jumps

LIBOR Rates (real)	FX	Wage Inflation	Medical Cost Inflation	Retail Price Inflation	Property
LIBOR Market Model extended to the RW	Mean-reverting model with PPP	Mean-reverting model with time-varying mean	Autoregressive process of order 2	Autoregressive process of order 1	Combination of bond and equity returns

Economic variables modeled in a cascade structure. In addition, dependencies between variables and economies are applied via a copula that enables different degrees of tail dependency.
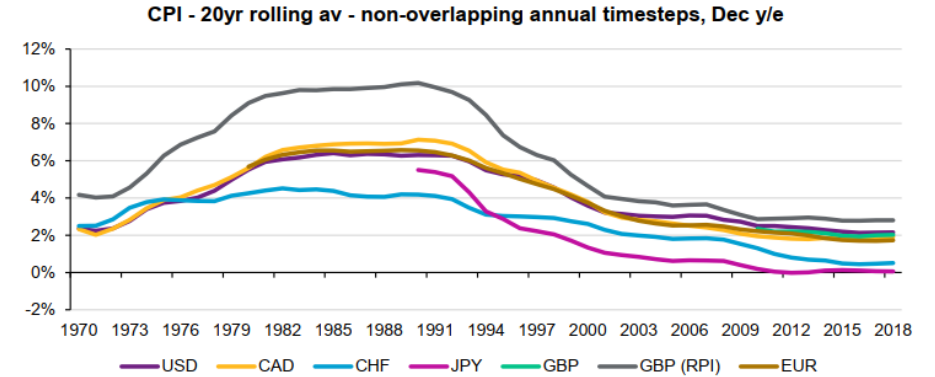
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Expert Judgment Overlay of ESG: CPI

Long-term normative means

- CPI across developed countries has shown common trends since 1970. There was a period of higher inflation covering 20 year periods ending in the 1980s to early 1990s, followed by declining inflation thereafter.

- The Federal Reserve has a statutory mandate from Congress to promote stable prices. The Federal Open Market Committee (FOMC) has stated that in its judgement inflation of 2%, as measured by annual change in the price index for personal consumption expenditures (PCE), is most consistent over the longer run with the Federal Reserve's statutory mandate. CPI is structurally higher than PCE and we believe that the FOMC target for inflation is broadly consistent to CPI increases of around **2.5% p.a.**

CPI - 20yr rolling av - non-overlapping annual timesteps, Dec y/e

Legend: USD, CAD, CHF, JPY, GBP, GBP (RPI), EUR

Year	As Of	US CPI (average over 4 quarters)
	03/31/2022	8.5%
1	12/31/2022	8.3%
2	12/31/2023	5.3%
3	12/31/2024	2.8%
4	12/31/2025	2.5%
5	12/31/2026	2.5%
6	12/31/2027	2.5%

*'Average over 4 quarters' reflects the average quarterly price index across each calendar year compared to prior calendar year's average quarterly price index for the period ending as shown. Therefore, for 12/31/2023, the US CPI is an average across calendar year 2023 compared to average across 2022.

Short-/medium-term normative means

- We have considered the Consensus Economics forecasts from April 2022.

- These are based on predictions by researchers and journalists for economic variables for different economies. Consensus Economics ensures accuracy and completeness of the data.

Volatility and percentiles

- We expect somewhat higher volatility when CPI is higher. Therefore, with the increase in short-term inflation expectations in recent months, our projections also incorporate a higher short-term volatility.

Forecasting Inflation

Indexing Claims Inflation Based on Economic Inflation

	T1	T2	T3
CPI	CPI_{T1}	CPI_{T2}	CPI_{T3}
Wages	W_{T1}	W_{T2}	W_{T3}
Legal	L_{T1}	L_{T2}	L_{T3}
Medical	Med_{T1}	Med_{T2}	Med_{T3}
Materials	Mat_{T1}	Mat_{T2}	Mat_{T3}

✕

	General Liability
CPI	$Weight_1$
Wages	$Weight_2$
Legal	$Weight_3$
Medical	$Weight_4$
Materials	$Weight_5$

+

	General Liability
Social Inflation	X%

=

Claim Cost Inflation by T1, T2, etc.

General econometric indices	✕	Insurance coverage weightings	+	Insurance specific adjustment	=	Insurance coverage specific forecast

Considerations for Claims Inflation Assumptions

- What are the economic cost drivers of various classes?

- How dependent are the ultimate costs on inflation through the time in which the claim is closed, as opposed to when the claim occurs?

- How is social inflation expected to change as economic inflation changes?

- To what extent do my actuarial assumptions already incorporate higher inflationary periods?
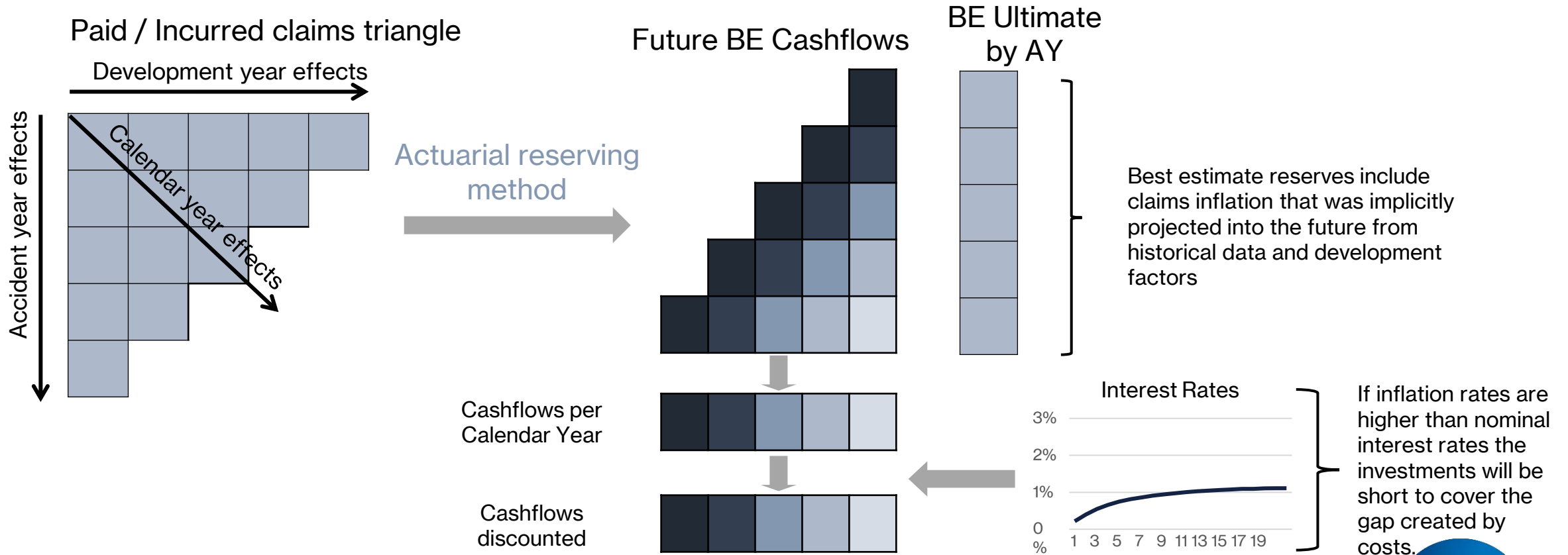
Adjusting Traditional Methods

Approach 1: "Standard" Reserving

- Implicit consideration of historical claims inflation – suitable if past inflation is assumed to be constant and equal to future one

Paid / Incurred claims triangle

Development year effects

Accident year effects

Calendar year effects

Actuarial reserving method

Future BE Cashflows

BE Ultimate by AY

Best estimate reserves include claims inflation that was implicitly projected into the future from historical data and development factors

Cashflows per Calendar Year

Cashflows discounted

Interest Rates

3%

2%

1%

0%

1 3 5 7 9 11 13 15 17 19

If inflation rates are higher than nominal interest rates the investments will be short to cover the gap created by costs.
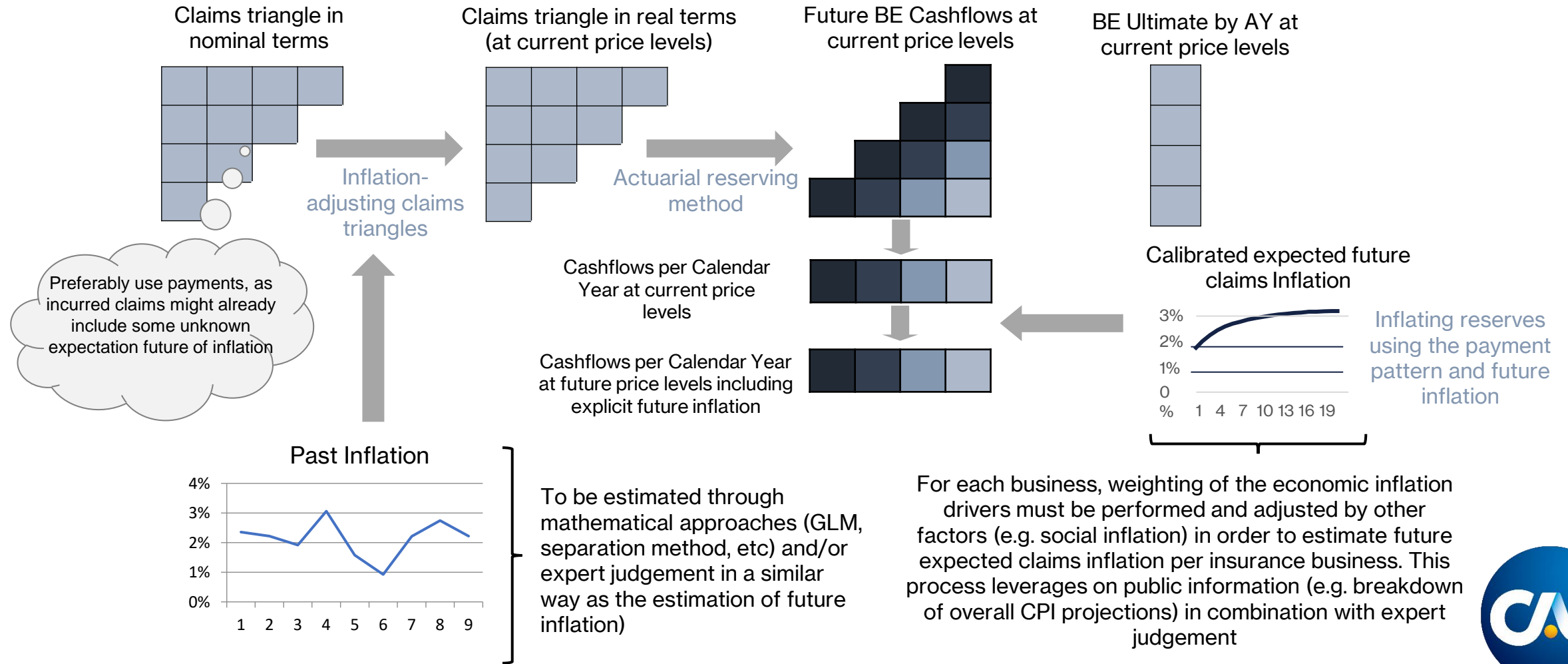
This approach is easy and might be sufficient in calm market environments. However, it is inadequate if future claims inflation deviates materially from past levels! It doesn't facilitate the business to react appropriately to changes in the market environment.
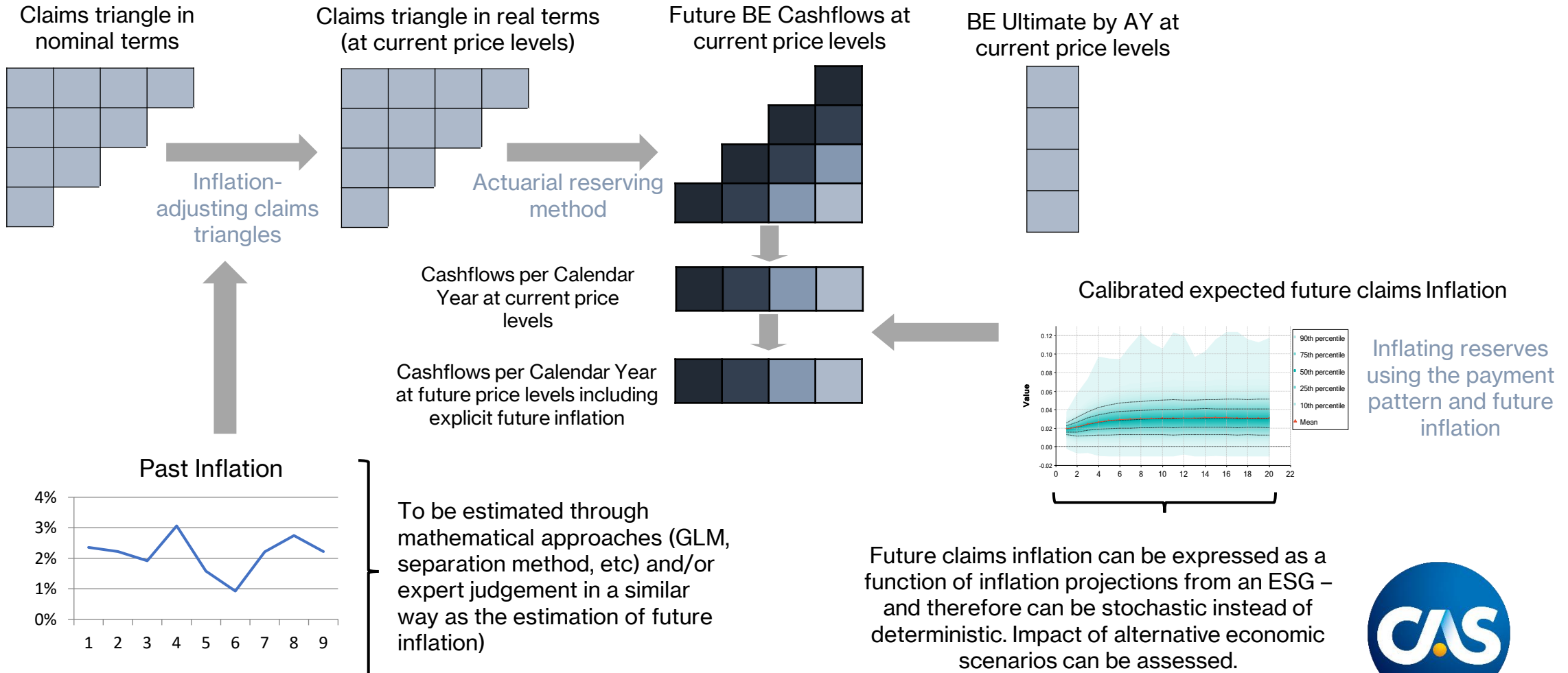
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Approach 2: Account for Inflation Explicitly (1)

- Explicit consideration of historical claims inflation – suitable if past inflation is not constant - and future expected inflation

Claims triangle in nominal terms

Claims triangle in real terms (at current price levels)

Future BE Cashflows at current price levels

BE Ultimate by AY at current price levels

Inflation-adjusting claims triangles

Actuarial reserving method

Cashflows per Calendar Year at current price levels

Cashflows per Calendar Year at future price levels including explicit future inflation

Calibrated expected future claims Inflation

Inflating reserves using the payment pattern and future inflation

Preferably use payments, as incurred claims might already include some unknown expectation future of inflation

Past Inflation

To be estimated through mathematical approaches (GLM, separation method, etc) and/or expert judgement in a similar way as the estimation of future inflation)

For each business, weighting of the economic inflation drivers must be performed and adjusted by other factors (e.g. social inflation) in order to estimate future expected claims inflation per insurance business. This process leverages on public information (e.g. breakdown of overall CPI projections) in combination with expert judgement
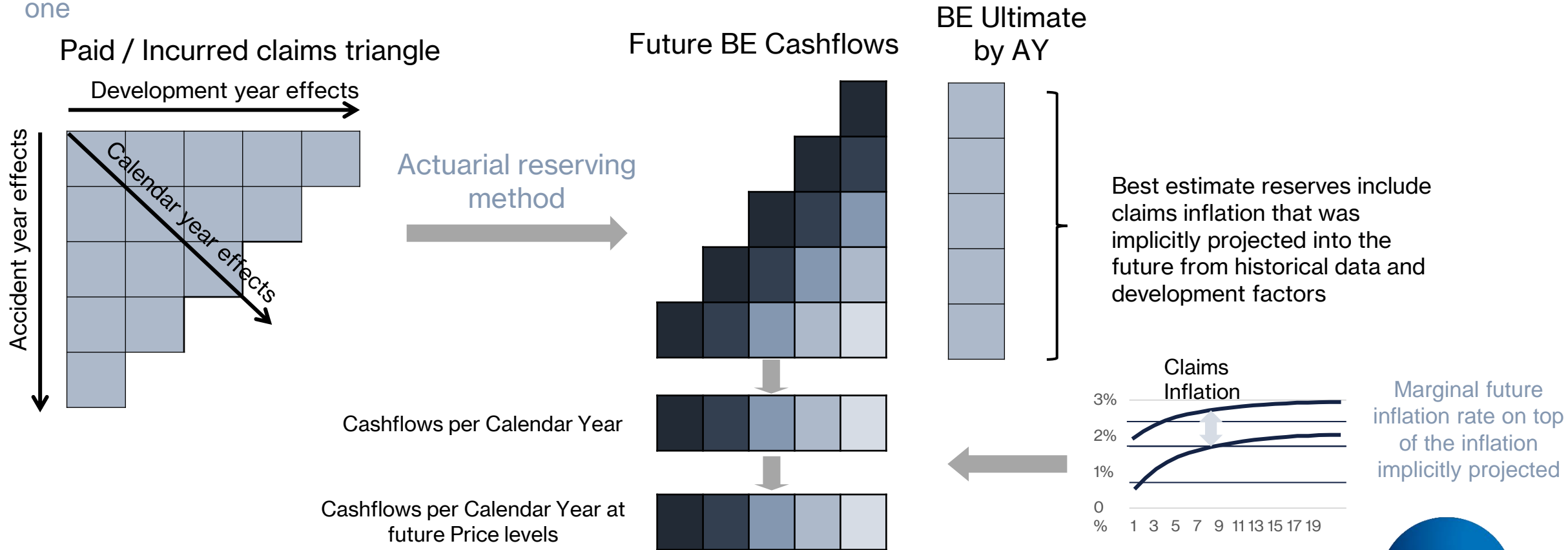
Approach 2: Account for Inflation Explicitly (2)

- Explicit consideration of historical claims inflation – suitable if past inflation is not constant - and future expected inflation

Claims triangle in nominal terms

Claims triangle in real terms (at current price levels)

Future BE Cashflows at current price levels

BE Ultimate by AY at current price levels

Inflation-adjusting claims triangles

Actuarial reserving method

Cashflows per Calendar Year at current price levels

Cashflows per Calendar Year at future price levels including explicit future inflation

Calibrated expected future claims Inflation

Inflating reserves using the payment pattern and future inflation

Past Inflation

To be estimated through mathematical approaches (GLM, separation method, etc) and/or expert judgement in a similar way as the estimation of future inflation)

Future claims inflation can be expressed as a function of inflation projections from an ESG – and therefore can be stochastic instead of deterministic. Impact of alternative economic scenarios can be assessed.

Approach 3: "Standard" Reserving Plus Change in Future Inflation

- Implicit consideration of historical claims inflation – suitable if past inflation is assumed to be constant but different to future one

Paid / Incurred claims triangle

Future BE Cashflows

BE Ultimate by AY

Development year effects

Accident year effects

Calendar year effects

Actuarial reserving method

Best estimate reserves include claims inflation that was implicitly projected into the future from historical data and development factors

Cashflows per Calendar Year

Cashflows per Calendar Year at future Price levels

Claims Inflation

3%
2%
1%
0 %

1 3 5 7 9 11 13 15 17 19

Marginal future inflation rate on top of the inflation implicitly projected

This approach is a mix of the previous two approaches. Historical inflation is assumed to be constant and implicitly considered in the projection. However, future cashflows are inflated by marginal (+ or -) future inflation on top of past historical rates implicitly projected. Therefore, this approach still requires estimation of future claims inflation for each business.

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Approach 3: Steps to Inflation Study

Project Impacts of Inflation on Unpaid Losses using Workers Compensation as an example

Step 1: Estimate historical inflation underlying our development patterns based on published inflation indices
- Estimate which indices weigh into claim cost (i.e. CPI, Wage, Medical, Construction, Legal) by line of business
- Dependency on payment date (known as the alpha factor)
- Social inflation
- Leverage factor to reflect attachment points for the excess business

Workers Compensation
- Determination of claim costs is split between Indemnity and Medical Payments

	Indemnity	Medical
CPI		
Wages	100%	
Legal		
Medical		100%
Materials		

✗

	Indemnity	Medical
Weight	40%	60%

✗

	Indemnity	Medical
Alpha	15%	100%

For this Workers Compensation example, we assumed no social inflation and no leverage factor required for primary business

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Approach 3: Steps to Inflation Study

Project Impacts of Inflation on Unpaid Losses using Workers Compensation as an example

Step 2: Determine the implicit inflation assumptions in development selections
- Consider experience period underlying selections as well as experience period underlying any benchmark patterns
- Weight between experience and benchmarks

Workers Compensation
- We apply the weights from Step 1 x Historical Inflation Indices (for this example, from the Department of Labor) = History by Calendar of WC Claim Cost Inflation
- Using this as basis and weighing if we are using a benchmark with years of higher levels of inflation, we select our "normative" claim inflation expectation baked within our history and within our traditional reserving methodologies

Approach 3: Steps to Inflation Study

Project Impacts of Inflation on Unpaid Losses using Workers Compensation as an example

Step 3: Determine mean of modelled future inflation assumptions
- We create projections of future annual claims inflation rates per segment based on our historical claims analysis and the US price, wage and medical inflation projections from our Real World economic scenario generator (ESG) STAR
- In a stochastic analysis, we take into account social inflation with a Normally distributed error term for the segments for which we believe this to be a claims cost driver
- Construction and Legal are not available directly in the ESG model, therefore we perform a regression analysis on CPI, Wage, and Medical to project future Construction and Legal indices
- We use the weights from Step 1 to determine the appropriate future claims inflation projections

Workers Compensation
- We again apply the weights from Step 1 x Projected Future Inflation Indices = Projected Future Claims Inflation for WC

Approach 3: Steps to Inflation Study

Project Impacts of Inflation on Unpaid Losses using Workers Compensation as an example

Step 4: Determine the 'Delta' factor between inflation from history Step 2 and mean of modelled inflation in Step 3

- Delta equals the difference between Step 3 inflation and Step 2 inflation
- That delta factor is used to inflate projected future cashflows of unpaid losses using the payment pattern without an inflation adjustment
- The resulting factor is the unpaid loss loading factor

Workers Compensation Example

	T1	T2	T3	T4	T5	T6
Normal Claims Inflation	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Projected Claims Inflation	5.1%	4.9%	4.2%	3.6%	3.5%	3.4%
Excess Claims Inflation	1.7%	1.5%	0.8%	0.2%	0.1%	0.0%
Excess Inflation x Alpha	1.1%	1.0%	0.6%	0.2%	0.1%	0.0%

Approach 3: Steps to Inflation Study

Project Impacts of Inflation on Unpaid Losses using Workers Compensation as an example

Step 5: Determine Ultimate Loss Loading for Inflation

- We review the implied ultimate loss adjustment factor from the unpaid inflation loss adjustment factor and assumed percent unpaid
- Discussions with the claims department are important to understand if current case reserve levels reflect higher levels of inflation, generally assumed this has not manifested for casualty lines
- We also determine the impact of inflation on exposures, which helps mitigate the impacts on the current accident year

Workers Compensation

For this example, the economic inflation load is 24.9 or 2.5% of the unadjusted loss reserves

	Total Unpaid Losses	T1	T2	T3	T4	T5	T6+
Claim Payments (Normal Inflation Scenario)	1,000.0	150.0	250.0	200.0	100.0	50.0	250.0
Claims Excess Inflation		1.011	1.022	1.028	1.030	1.030	1.030
Inflated Claim Payments	1,024.9	151.7	255.5	205.6	103.0	51.5	257.6
Economic Inflation Load	24.9	1.7	5.5	5.6	3.0	1.5	7.6

Practical Considerations for Claims Inflation

- The extent to which higher inflation is being included in case reserve levels
- Possibility for lag in inflationary impact on losses and loss expenses
  - For example, medical fee schedules in Workers Compensation as well as attorney rates which are subject to negotiated agreements
- Impact of higher exposure trends for certain lines
  - Would not impact older years
- How to incorporate adjustments into reserve estimates
  - Could be explicit additional adjustment
  - Could adjust development patterns and initial expected loss ratios
- Reliability of payment patterns becomes more important even in lines where reported methods are relied upon
- How to adjust methodologies over time

Bibliography

- Conning, "A User's Guide to Economic Scenario Generation in Property/Casualty Insurance." Casualty Actuarial Society, CAS Research Papers, October 2020
  - See Chapter 7 for inflation specifications

- Gault et al, "A Structural Simulation Model for Measuring General Insurance Risk." Casualty Actuarial Society E-Forum, Summer 2010
  - See Section 4 for a discussion of the alpha factor

- Friedland, J.F., Estimating Unpaid Claims Using Basic Techniques, Casualty Actuarial Society, Third Version, July 2010
  - See Chapter 6 for tips on detecting inflation in a claims triangle
  - See Chapter 8 for impact of inflation and trend on IELRs