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Actuaries Institute

Interest Rates and Inflation in Property/Casualty Insurance

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Low Interest Rates and Increasing Inflation: The Silent Killer in Property / Casualty Insurance?

Prof. Dr. Michael Radtke

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„Inflation – the monster under the bed“

Bloomberg Business, 8 Sept 2011

> “Inflation could well be the monster under the bed,” Sullivan said today at an Insurance Insider conference in London, billed as his first public speech since he left as chief executive officer of American International Group Inc. Rising prices “can be more deadly to an insurer’s economic health than defaults, earthquakes, winter storms, or tsunamis.”

Insurance Newslink, 5 Oct 2014

> The P&C insurance industry is less sensitive to the interest rate environment than the life segment. Fitch notes, however, that the low rate environment has caused declines in investment earnings, so higher interest rates would be a moderately positive event. As the insurance pricing environment becomes more competitive, a growing investment contribution to P&C earnings would be favourable.
>
> Fitch's stress case scenario would have mixed implications for life insurers, although not enough to cause massive disintermediation effect on the sector given unrealized gains in the bond portfolios. For the P&C segment, a greater risk is an unexpected rise of inflation causing claim expensive to grow and profitability to decline.

Swiss Re Sigma, Oct 2010

> Inflation, listed as the top concern for 28 percent of the risk managers, ranked ahead of credit losses and counterparty risk.

„Longer-term inflation risks“

Zurich Annual Report 2012

in Japan, New Zealand and Australia in 2011, as well as a favorable underlying loss experience in 2012 including a 4.3 percentage points improvement from the inclusion of Zurich Santander. These improvements were offset to some extent by a higher frequency of large losses and lower levels of favorable development of reserves established in prior years, following an inflation adjustment which increased the reserves for motor third party liability in Argentina. The higher expense ratio was mainly driven by higher commissions from the inclusion of Zurich Santander and growth in other higher commission products in Latin America, as well as higher other underwriting expenses linked to

FT, 30 April 2015

Axa Investment head urges advisers heed portfolio inflation risk

Advisers should be aware of potential inflation risks affecting portfolios, with a gradual increase in break-even inflation rates on the cards, Chris Iggo has warned.

The chief investment officer of fixed income at Axa Investment said: “We still see longer-term inflation risks, given that break-evens are still below the desired central bank inflation rate of approximately 2 per cent for the Consumer Price Index. This is true for the US and the eurozone, and for the UK.”

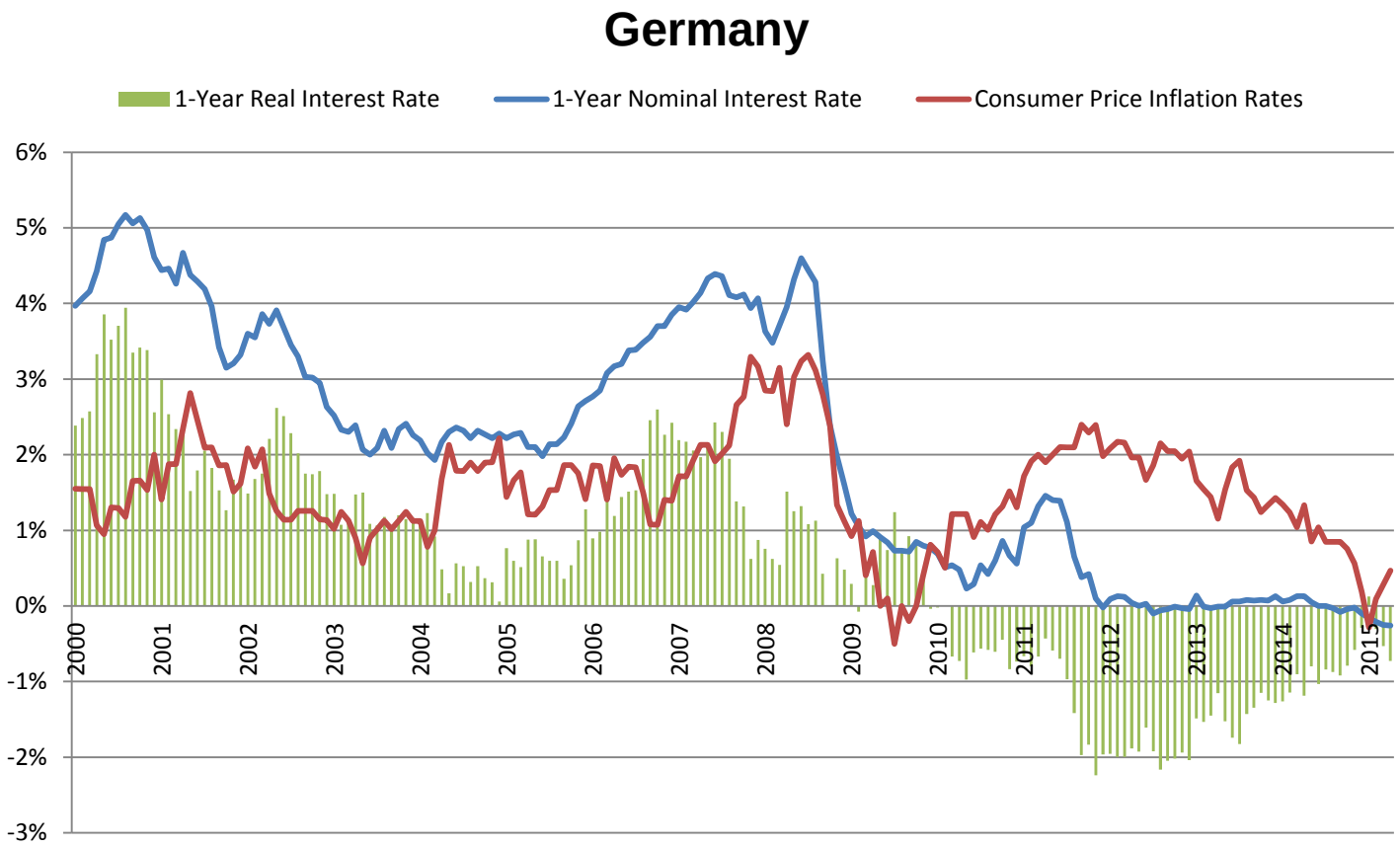
FT, 1 Aug 2014

Shares in Axa have fallen more than 12 per cent since the start of the year amid fears that chronically low inflation will keep eurozone interest rates lower for longer. Low rates hit insurers' ability to earn from their large fixed-income holdings.

How does inflation impact non-life insurance liabilities?

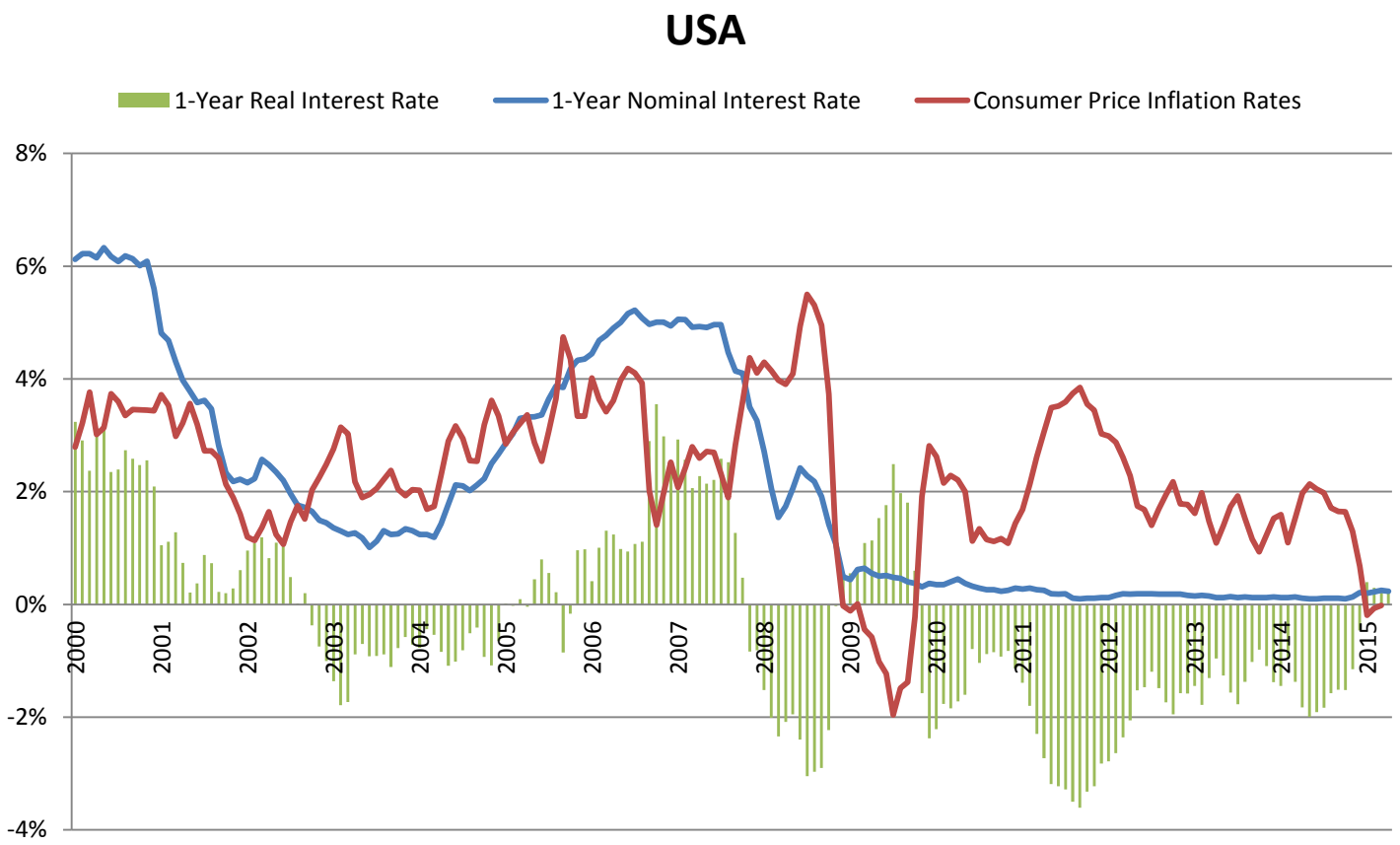
You can manage only risks you have understood!

The other side of the coin: CPI vs interest rate



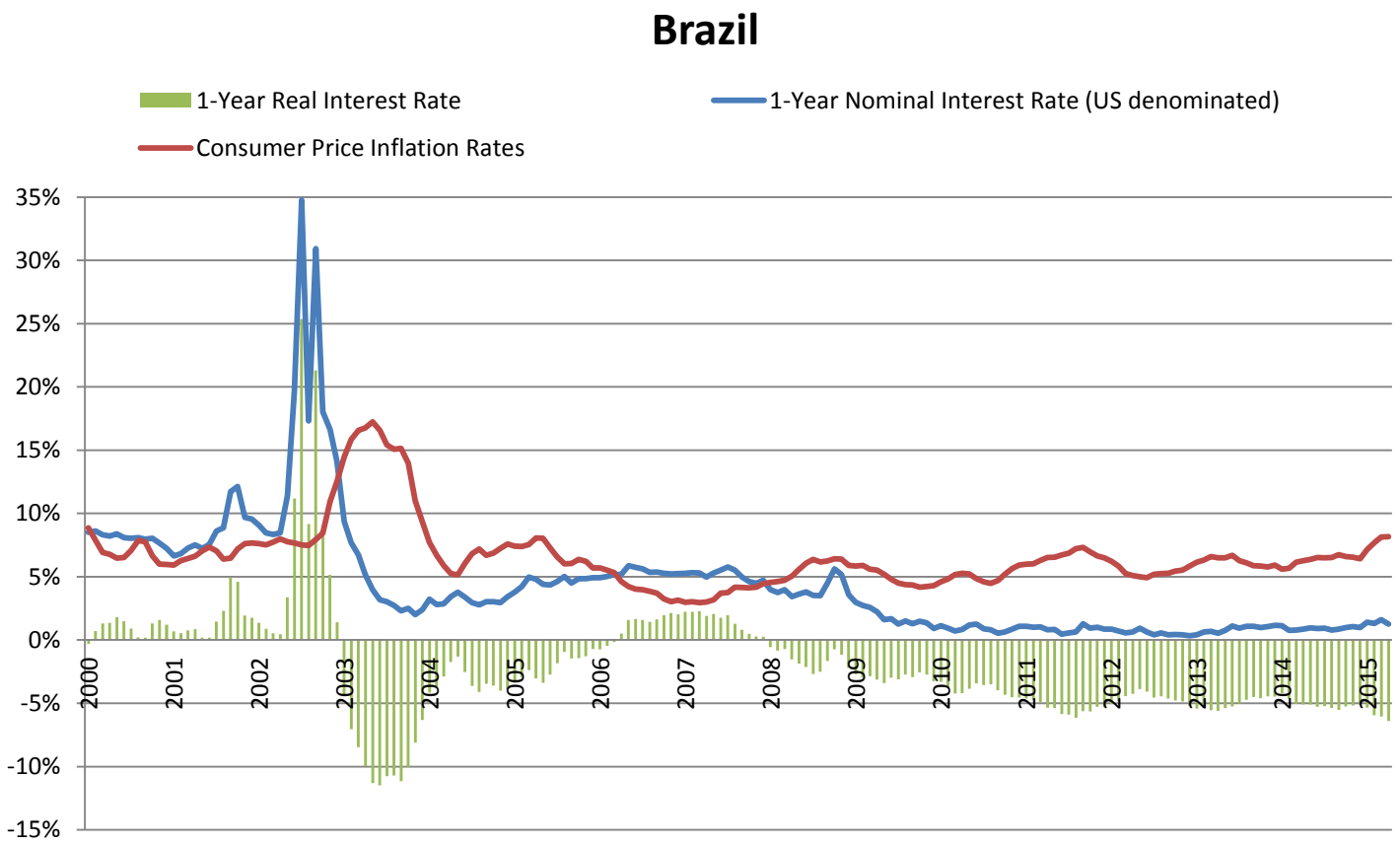
Real interest rates are calculated via the Fisher equation
Source: Statistisches Bundesamt, Bundesbank

Similar picture for the US – until quite recently



Real interest rates are calculated via the Fisher equation
Source: U.S. Department of Labor, Federal Reserve

In Brazil, consistent negative real interest rate



Real interest rates are calculated via the Fisher equation
Source: Bloomberg

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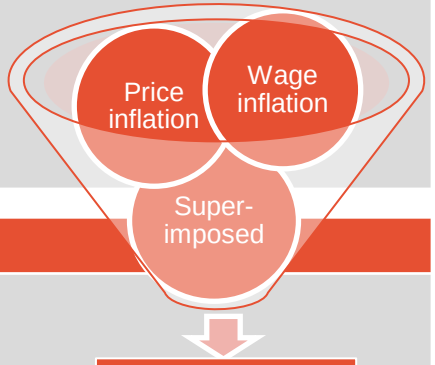
What is claims inflation in a portfolio?

Economic perspective

- Claims inflation = **Change in average price** of goods or services related to a specific **basket of representative claims**
- Due to **change in price level and/or change in utilisation**
- **Explicit cost drivers:**
  - Medical cost and cost of care
  - Loss of income
  - Construction costs
  - Labor costs
  - Energy costs
  - Legal costs

→ **Official price and wage inflation drive elements of claims inflation**



Claims inflation versus economic inflation

- **Implicit claim cost drivers:**
  - Litigiousness
  - Legislative changes
  - Economic conditions
  - Social factors
- Additional **technical claim cost drivers:**
  - Length of claim settlement
  - Legal obligations for insurers to incorporate inflation in their calculations (e.g. Ogden Tables in UK, Tribunale Tables in Italy)

→ Additive spread between claims inflation and price & wage inflation is called "**superimposed inflation**" (can be pos or neg)

- These effects of changes in **utilisation and quality improvements are explicitly excluded in official inflation** indices

→ Depending on the portfolio, dependencies between claims inflation and price & wage inflation might not exist

Claims reserving perspective

- Claims inflation = **Change in per claim costs** in a specific portfolio
- Due to **change in severity and/or change in frequency**
- Affects the development factors alongside the diagonals (i.e. in **calendar year direction**)
- Might lead to under- or over-estimated claims reserves

Data and mathematical methods need to be enriched with expert judgment

Historical external changes

- Legislative changes resulting in an increase or decrease of legal expenses
- New medical diagnostic guidelines
- Jury decisions and court interpretations
- Increase in structured annuities
- Introduction of inflation target by Central Bank
- Change in FX rate policy

Historical internal changes

- Portfolio cleansing
- Change in business strategy
- Changes in the Claims department
- New claims handling software

Examples for factors that affect changing claim costs

Insurance market specifics

- Claims get regulated by the insurer independent of fault of driver
- Claims get regulated with specific tables that include assumptions on inflation
- Market cycle

Internal reserving practice

- Claims inflation is not accounted for explicitly
- Or: average historic claims inflation is estimated (e.g. 3%)
- Or: triangles are inflation-adjusted

Claims culture

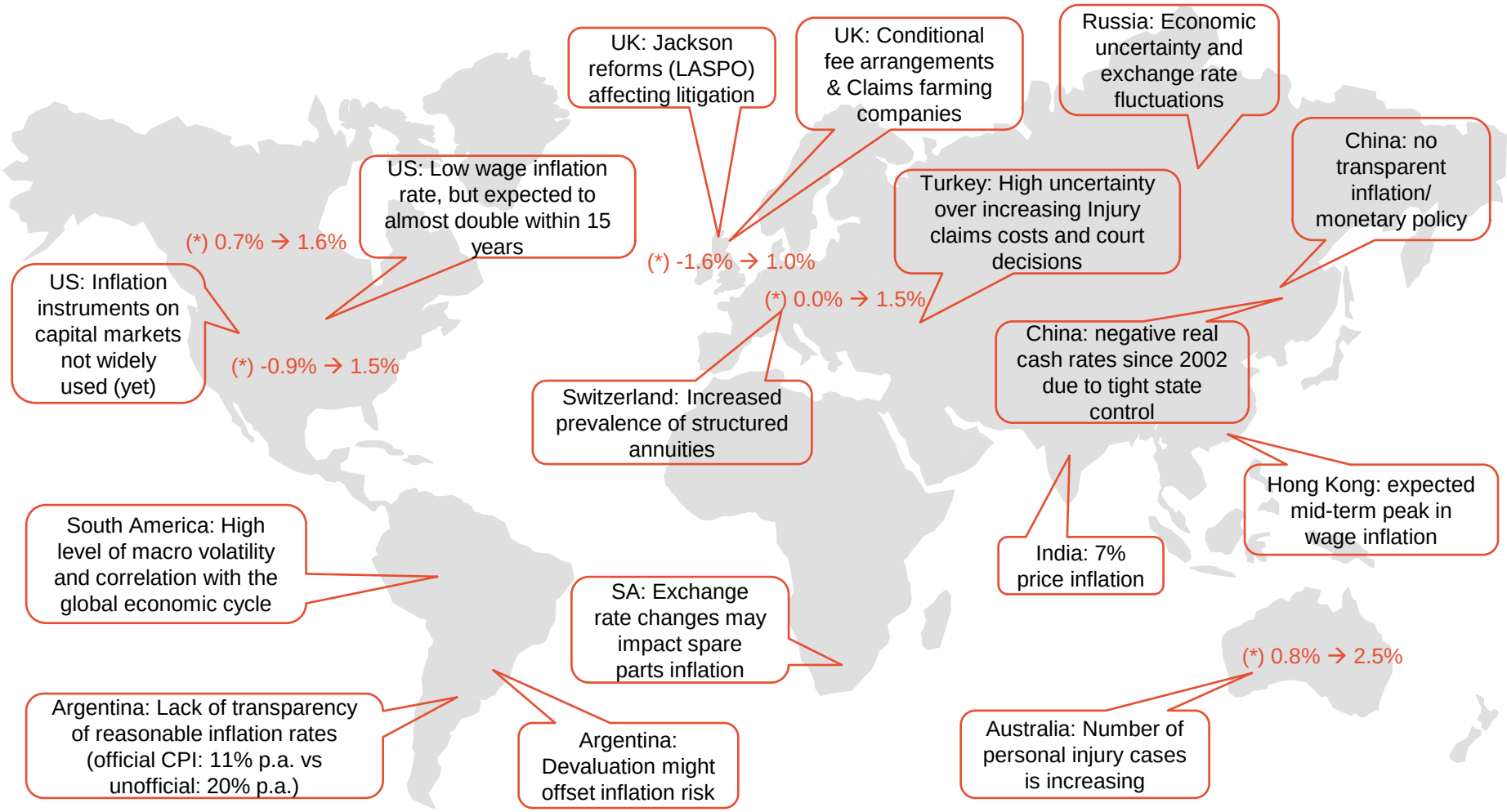
- Increase in awareness on accessibility of compensation through, e.g., social networks
- Strong lobbying from whiplash victim associations
- Increased litigiousness sparked by simplified court rules

Superimposed inflation

- Court cases
- Legislative changes
- Changes in the medical condition of claimants
- Changes in the public attitudes
- Climate change
- Improved risk management (e.g. fire safety, car security, rules for alcohol consumption in vehicles, …)

Take portfolio characteristics, the market and respective changes into account and separate these from the claims inflation effect, if possible.

Markets that are worth a closer look



(*) Company view on real cash rates as at end 2014 and long-term

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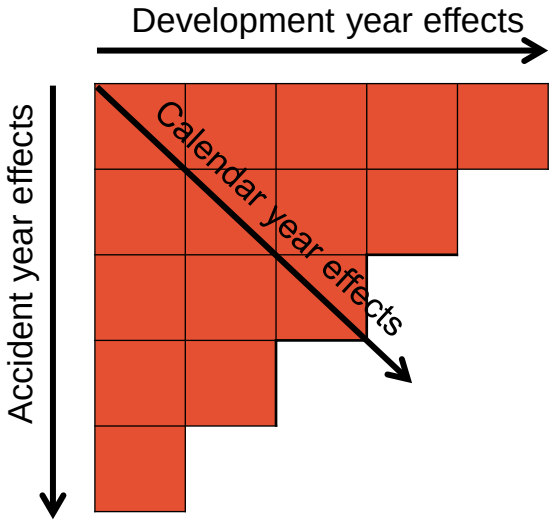
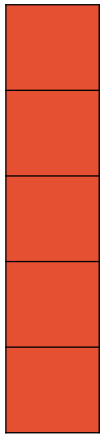
Status Quo:
Account for claims inflation implicitly

Paid / Incurred claims



(1) Development model

Ultimates



Pro

- Easy and possibly sufficient approach in calm market environments

Con

- Inadequate if future claims inflation deviates from levels seen in the past
- Inflation impact (level and risk) standalone cannot be quantified
- Thus business cannot react appropriately to changes in market environment

Ultimates include claims inflation that was implicitly projected into the future from historical data

→ Increase in claims reserve (both level and volatility)

Estimating the Inflation on Accident Year Basis

The steps in detail:

1. Calculation of best estimates for ultimates for claims numbers, paid claims resp. incurred claims applying standard triangulation methods
2. Calculation of the average claim size (paid resp. incurred) for each accident year on the basis of the ultimates
3. Use the claims averages to calculate the rates of change from accident year to accident year and thus determine claims indices

Starting data	• Paid Claims resp. Incurred Claims triangle • Claims number triangle
Interim results	• Ultimates for the above triangles per accident year
Final results	• Payment averages per accident year • Claims index calculated from the claims averages • Logarithmic change rates of the claims indices

Using this method the claims inflation in the portfolio will thus be equated with the change in the claims averages from accident year to accident year. This provides an approximate picture of the inflation in the claims portfolio

A Simple Example

Given:

Claims payment triangle				
	0	1	2	3
0	100	140	160	170
1	105	142	158	
2	110	152		
3	115			

Claims number triangle				
	0	1	2	3
0	12	14	15	20
1	10	11	12	
2	8	9		
3	6			

Use chain ladder method:

Claims payment triangle				
	0	1	2	3
0	100	140	160	170
1	105	142	158	168
2	110	152	171	182
3	115	158	179	190
CL	1,38	1,13	1,06	

Claims number triangle				
	0	1	2	3
0	12	14	15	20
1	10	11	12	16
2	8	9	10	13
3	6	7	7	10
CL	1,13	1,08	1,33	

Calculate claims index:

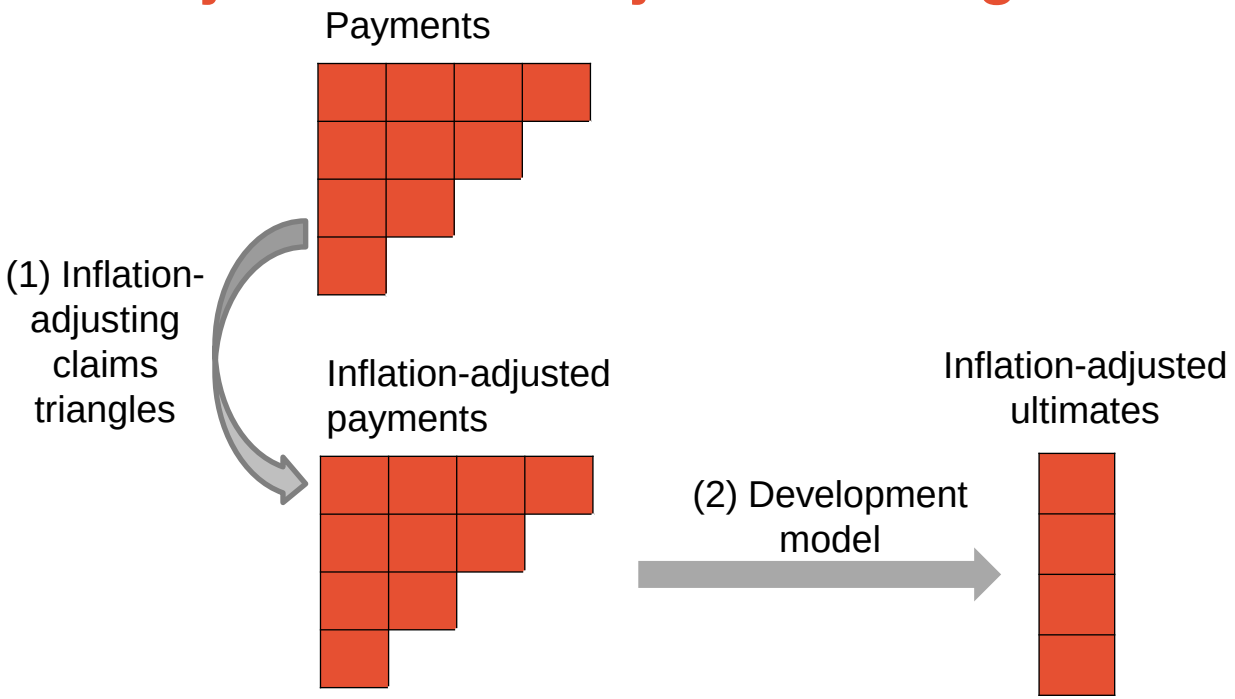
Ultimate claims payment
170
168
182
190

Ultimate claims number
20
16
13
10

Payment average
8,50
10,49
14,05
19,39

Payment average index, base year 1 = 100
81,01
100,00
133,93
184,78

Next Steps:
1: Projections on adjusted triangles



Basis

- Payments, as incurred claims may include some unknown expectation of inflation

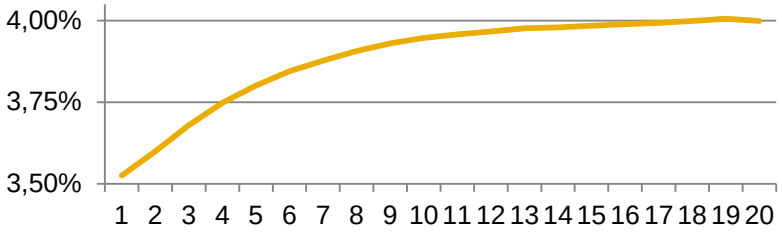
Pro

- Separation of inflation effect (arising from market developments) from pure claims development effect
- Hence foundation for deriving appropriate management actions

2: Inflating the cash flows

Deterministic or stochastic view on cash flows and inflation possible

(3) Expected claims inflation development



(4) Combining the two effects that are assumed to be independent

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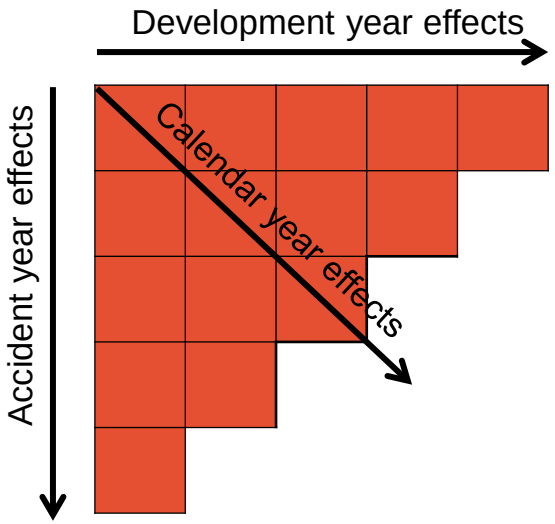
Estimating the Inflation on Calendar Year Basis: Separation Method

Paid / Incurred claims



In this method, calendar year effects in the historic development are separated from the development of the claim numbers by origin period i, $i \in 0, \ldots, n$, and the development of the claims by development period k, $k \in 0, \ldots, n$.
We assume the following holds:

$$E\left[Paid_{i,k}\right] = \nu_i * \lambda_{i+k} * \vartheta_k$$

where

- ν_i: parameter for origin period effect, taken to be the $Best\ Estimate\ Ult\ Number_i$, hence known
- λ_{i+k}: parameter for calendar period effect, unknown
- ϑ_k: parameter for development year effect, unknown

Parameter Calculation in the Separation Method

- Using normalized paid amounts, for $p \in 0, \dots, n$, we get:

$$\sum_{i=0}^{p} E\left(Av\ Paid_{i,p-i}\right) = \sum_{i=0}^{p} \frac{E\left(Paid_{i,p-i}\right)}{BE\ Ult\ Number_i} = \sum_{i=0}^{p} \lambda_p * \vartheta_{p-i}$$

$$\sum_{i=0}^{n-k} E\left(Av\ Paid_{i,k}\right) = \sum_{i=0}^{n-k} \frac{E\left(Paid_{i,k}\right)}{BE\ Ult\ Number_i} = \sum_{i=0}^{n-k} \lambda_{i+k} * \vartheta_k$$

- With the constraint $\sum_{i=0}^{n-k} \vartheta_k = 1$, we can derive the following two marginal sums equations for $p \in 0, \dots, n$:

$$\sum_{i=0}^{p} \hat{\lambda}_p * \hat{\vartheta}_{p-i} = \sum_{i=0}^{p} E\left(Av\ Paid_{i,p-i}\right)$$

$$\sum_{i=0}^{n-k} \hat{\lambda}_{i+k} * \hat{\vartheta}_k = \sum_{i=0}^{n-k} E\left(Av\ Paid_{i,k}\right)$$

- Thus, the parameter estimates are

$$\hat{\lambda}_p = \frac{\sum_{i=0}^{p} E\left(Av\ Paid_{i,p-i}\right)}{1 - \sum_{k=p+1}^{n} \hat{\vartheta}_k}$$

$$\hat{\vartheta}_p = \frac{\sum_{i=0}^{n-p} E\left(Av\ Paid_{i,p}\right)}{\sum_{i=0}^{n-p} \hat{\lambda}_{n-i}}$$

- The method then assumes that the calendar period effect λ_p, indexed with base year $i = 0$, is an indicator for the claims inflation of a portfolio.

Prof. Dr. Michael Radtke

A Simple Example for the Separation Method

Given:

Claims payment triangle				
	0	1	2	3
0	100	140	160	170
1	105	142	158	
2	110	152		
3	115			

Claims number triangle				
	0	1	2	3
0	12	14	15	20
1	10	11	12	
2	8	9		
3	6			

Standardisation of the incremental payments using the expected number of claims:

Claims payment triangle - incremental				
	0	1	2	3
0	100	40	20	10
1	105	37	16	
2	110	42		
3	115			

Claims number triangle				
	0	1	2	3
0	12	14	15	20
1	10	11	12	16
2	8	9	10	13
3	6	7	7	10

CL	1,13	1,08	1,33	

Claims payment triangle normalized increases				
	0	1	2	3
0	5,00	2,00	1,00	0,50
1	6,56	2,31	1,00	
2	8,49	3,24		
3	11,74			

Determine the parameters $\hat{\lambda}_p$ und $\hat{\vartheta}_p$

	0	1	2	3
$\hat{\lambda}_p$	7,14	9,51	12,16	16,48
$\hat{\vartheta}_p$	0,7	0,2	0,07	0,03

$$\hat{\lambda}_3 = \frac{0,50 + 1,00 + 3,24 + 11,74}{1} = 16,48 \qquad \hat{\vartheta}_3 = \frac{0,50}{16,48} = 0,03$$

$$\hat{\lambda}_2 = \frac{1,00 + 2,31 + 8,49}{1 - 0,03} = 12,16 \qquad \hat{\vartheta}_2 = \frac{1,00 + 1,00}{16,48 + 12,16} = 0,07$$

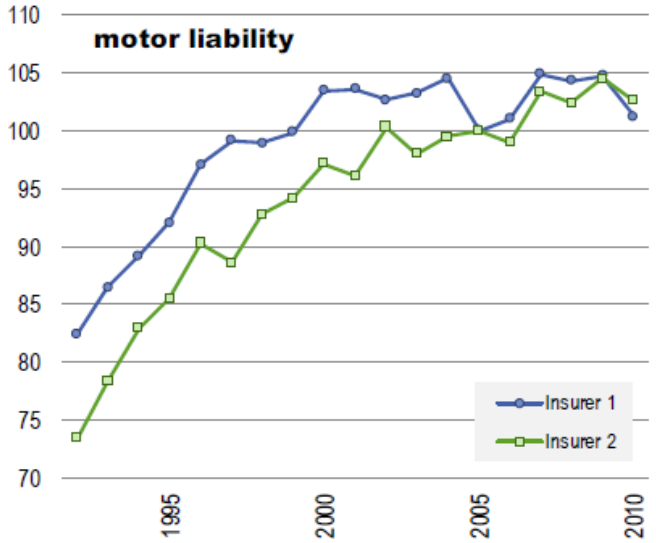
$$\hat{\lambda}_1 = \frac{2,00 + 6,56}{1 - (0,03 + 0,07)} = 9,51 \qquad \hat{\vartheta}_1 = \frac{2,00 + 2,31 + 3,24}{16,48 + 12,16 + 9,51} = 0,2$$

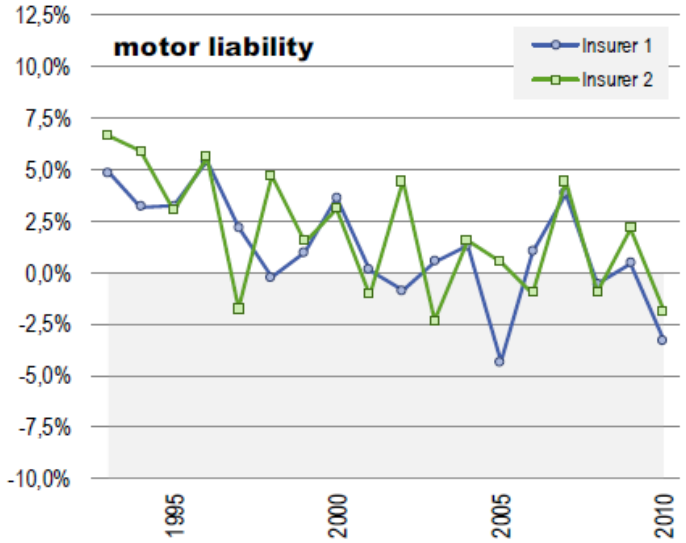
$$\hat{\lambda}_0 = \frac{5,00}{1 - (0,03 + 0,07 + 0,2)} = 7,14 \qquad \hat{\vartheta}_0 = \frac{5,00 + 6,56 + 8,49 + 11,74}{16,48 + 12,16 + 9,51 + 7,14} = 0,7$$

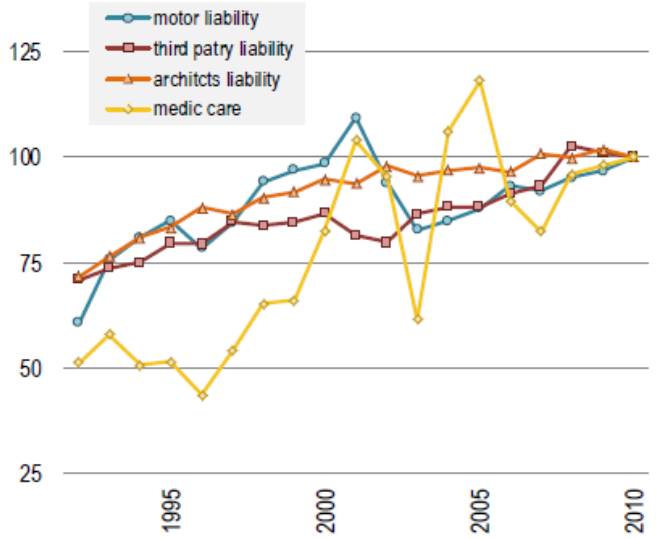
Calculate the claims index:

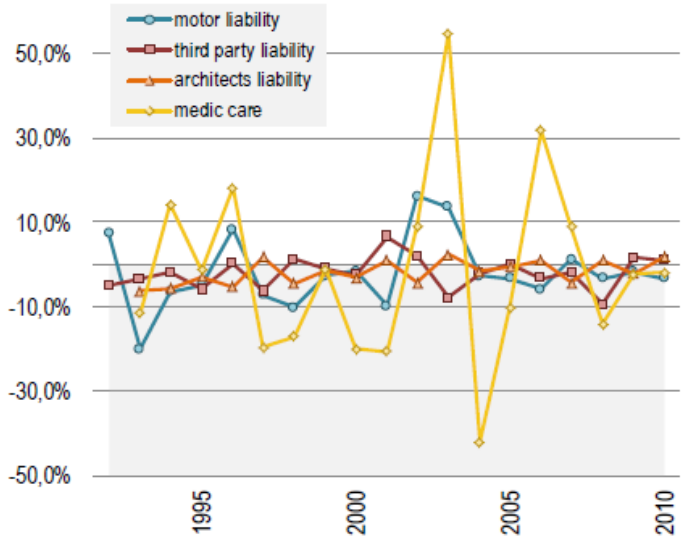
Index of $\hat{\lambda}_p$ with base year 1 = 100
75,08
100,00
127,87
173,29

Calculation for some Real German Portfolios







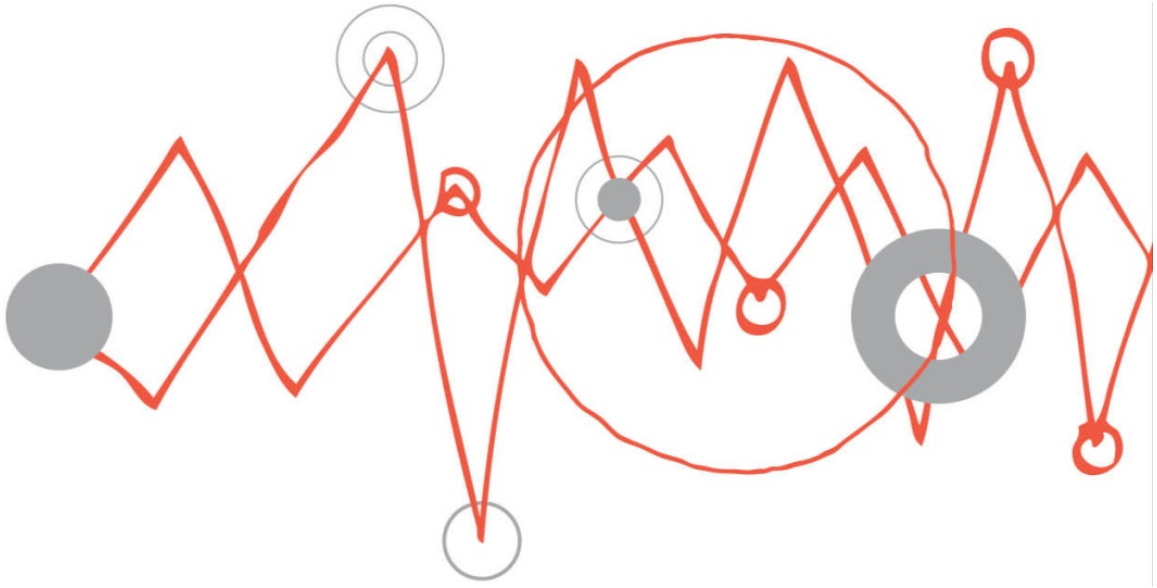


A Summary of the Methodology

Up to now we estimated the average historical claims inflation rate that is believed to be implicitly projected into the future – we call this **"implied rate"**.

An **"inflation scenario"** is defined to be the deviation from this implied rate.

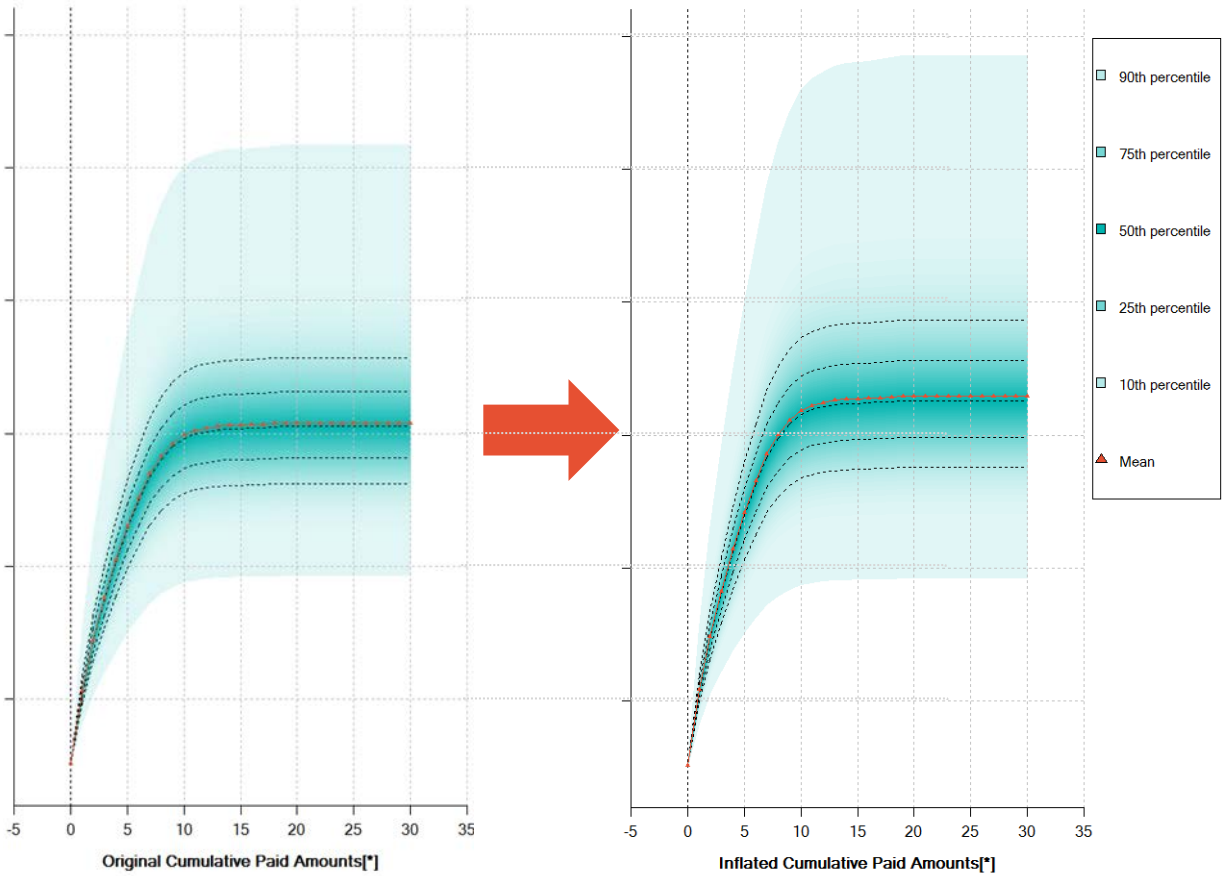
1. We calculate **best estimate cash flows** based on latest paid amounts, ultimate claims and payment patterns
2. These best estimate cash flows are then **inflation-adjusted** using the implied rate
3. We can define a number of views on future claims inflation development, by varying the parameters for each source of uncertainty
4. These **views** (i.e. the corresponding inflation index) are then **applied** to the inflation-adjusted best estimate cash flows



Further step:
Moving to a full stochastic approach

A stochastic approach can answer the following questions:

- How does inflation contribute to reserve risk?
- Will interest compensate for inflation assuming some dependency?
- How does inflation as a joint driver reduce the diversification between segments in one economy?
- How does inflation affect the group aggregation over more than one economy?
- How should inflation be considered in the business strategy?



An explicit allowance for claims inflation can increase the mean of the future cash flows as well as their volatility

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Using a dashboard as monitoring and reporting tool

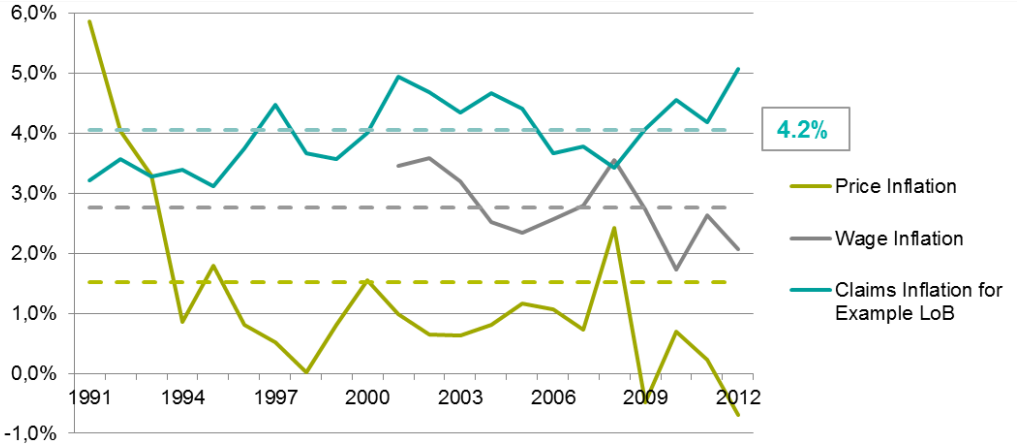
Methods deployed

- **Mathematical algorithms** applied to historical claims data (e.g. separation method, General Linear Models)
- Analysis of official **historical economic inflation** and their dependencies to the estimated claims inflation
- Taking into account **other calendar year effects** (see previous slide)
- **Expert judgement**

Methods deployed

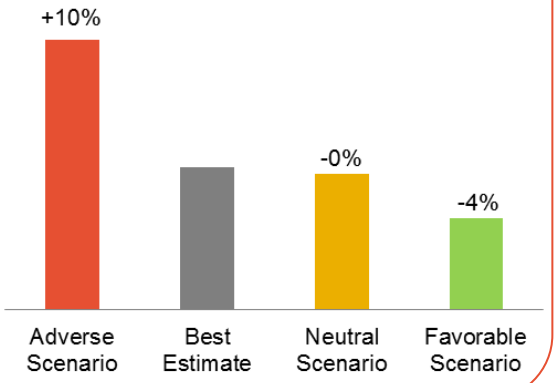
- **Regression** based on projections in economic scenario generators and calibrated on history
- Taking account o**f planned legal and governmental changes**
- **Stressing superimposed inflation**

Estimation of "how much" inflation is already implicitly included in the cash flow projections



Evaluation of the impact of claims inflation scenarios on case reserves

- Inflation spike due to Central Bank intervention
- Linear combination of price and wage inflation and construction costs, with weights estimated from history
- Favourable short-term development with a min of -1%, then reverting to long-term mean



Conclusion

We deduce a claims inflation rate of **4.2%** to be implicitly included in the best estimate outstandings.

Conclusion

Claims reserves are under-estimated by **10%** in an adverse scenario.

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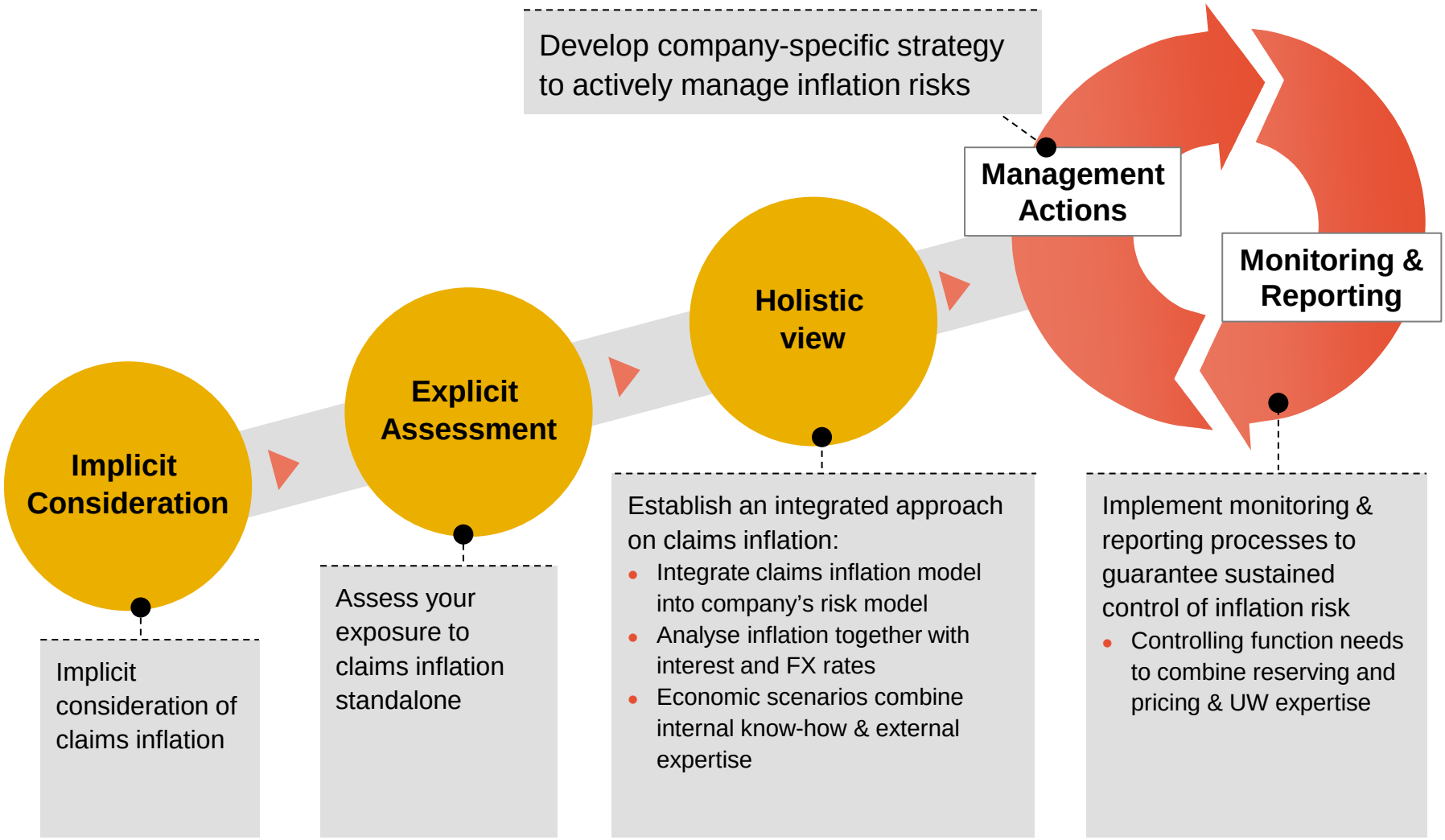
Understanding and Modelling Inflation – the Roadmap



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