Modelling of claims inflation

A thematic review of Lloyd's Market capital modelling approaches for claims inflation

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List of abbreviations and acronyms

Acronym	Description
Agent	Lloyd's managing agent
BF	Bornhuetter-Ferguson method
BLM	Black lives matter
BoE	Bank of England
CALM	Committee of Actuaries in the London Market
CL	Chain ladder
CMS	Lloyd's Casualty Market Study
CPG	Capital Planning Group
CPI	Consumer Price Index
D&O	Directors and officers
EIOPA	European Insurance and Occupational Pensions Authority
ENID	Events not in data
ESG	Economic Scenario Generator
GDP	Gross domestic product
GDPR	General Data Protection Regulation
GIRO	General Insurance Research Organisation Committee
GL	General liability
IELR	Initial expected loss ratio
IMO	Internal Model Output
IPO	Initial public offering
ISO	Insurance Services Office
JEP	Joint exceedance probability
LCR	Lloyd's Capital Return
Med mal	Medical malpractice
MRC	Market, Reserving and Capital, Lloyd's
MS	Lloyd's Minimum Standards
NAIC	National Association of Insurance Commissioners
ONS	Office for National Statistics
P&L	Profit and Loss
PPO	Periodical Payment Order
PRA	Prudential Regulatory Authority
RDS	Realistic Disaster Scenario
RPI	Retail Price Index
RST	Reverse Stress Test
SST	Stress and scenario test
TP	Solvency II Technical Provision
ULR	Ultimate loss ratio
uSCR	Ultimate Solvency Capital Requirement
YoA	Year of account

1 Introduction

1.1 Foreword

Uncertainty around future claims cost is a risk that capital models for non-life (re)insurers need to take into account. Recently, inflation and its impact on insurance claim costs has been an evolving risk area. Social inflation in particular has been causing higher uncertainty due to trends in legislation and litigation that are difficult to forecast.

In recent years the level of economic inflation in the UK and US has been relatively stable and historically low. However, we are living in a period of supply chain disruption influenced by a global pandemic and heightened geo-political activity. This combined with other rising costs serves to create an increasingly uncertain economic outlook. Higher uncertainty should be reflected in capital by modelling higher volatility.

Whilst publicly available price inflation indices go some way to describe the change in cost of claims over time, they are in general only one contributing cost driver. Other factors that are not captured by, or do not carry much weight in these indices drive claims inflation. Court awards and changes in technology, healthcare and the social and legal environment can lead to significant and unpredictable increases in the cost of claims over time - both in the short and long term – and potentially far in excess of what is predicted by a price index. These factors can often be independent from price movements and therefore should be considered separately in claims inflation modelling.

The PRA 'Dear Chief Actuary' letters have raised concerns around inflation since 2016 and (re)insurers are expected to consider the impact of a range of inflationary assumptions, so that Boards are able to understand the sensitivity and materiality of these assumptions. The overall concern is that there may be an inadequate allowance for claims inflation within projected ultimate claim estimates. While this has been targeted at best estimate reserving practices, capital models are required to reflect this uncertainty in terms of the modelled volatility.

In light of recent trends, the Lloyd's Market Oversight Plan for 2021 includes a thematic review of inflation and inflation has been identified as one of the main risks to the capital setting process for Lloyd's syndicates. This thematic work is split into underwriting, reserving and capital workstreams. This report summarises work carried out by the capital modelling workstream. The work underpinning the reserving and underwriting workstreams has begun and are planned to be shared with the market in 2022.

1.2 Lloyd's capital modelling inflation thematic review

This report looks at a range of approaches used by the market to model the volatility and tail dependence associated with claims inflation risk. It highlights good practice approaches as well as areas that require improvement.

All managing agents were invited to complete a survey which collected high level details of inflation risk modelling. In addition, Lloyd's selected 12 agents to provide more detailed information about their modelling, parameterisation and validation approaches.

Our review has focussed on social inflation, one of several types of inflation affecting (re)insurers' liabilities. Capital models we have reviewed do not typically distinguish between individual sources of inflation unless they are material to the risk profile, so we have considered how social inflation has been considered within general claims inflation allowances.

1.3 Definition of inflation

We define claims inflation as the change in the expected claims cost level of a like for like policy over time. In this case like for like means having consistent policy wording, i.e. after allowing for changes in policy terms, coverage and exposure. This includes the cost for an individual claim (severity effects), but also changes in the likelihood of claiming (frequency effects). Claims inflation is the sum of pure inflation and excess inflation:

- **Pure inflation**: Changes in the average price of goods and services related to a basket of representative claims, due to changes in price level and / or utilisation. These prices include, for example, labour, energy, construction and care costs. Pure inflation in claim costs is equivalent to general economic inflation and is typically modelled using price and wage inflation indices from an ESG, licensed from an external model vendor.

- **Excess inflation**: Excess inflation refers to all ways in which (re)insurers' claims costs rise over and above general economic inflation and vary due to differences in the weighting of prices impacting claim costs compared to what is included in economic indices. It therefore captures the growth in costs associated with emerging risk from new materials, medicines and technologies, changes in the legal environment, evolving

social attitudes towards claiming and political developments, for example. We define the additive spread between pure inflation and the full extent of claims inflation from these additional cost drivers as excess inflation.

What we define here as excess inflation is often much more broadly referred to as 'social inflation'. For the purpose of this report however, we refer to social inflation as a subset of excess inflation, which more narrowly pertains to legislative and litigation changes which shape a (re)insurers' legal liabilities and claim costs[1].

Please note that when we refer to "inflation" in this report this means "claims inflation" – i.e. the sum of pure and excess inflation as defined above, unless otherwise stated.

1.4 Social inflation

Social inflation is the rising cost of claims resulting from increasing litigation, broader definitions of liability (excluding those caused by changes in policy terms and conditions), more plaintiff-friendly legal decisions and larger compensatory jury awards[2]. Drivers of social inflation are thought to be:

- Societal trends: Increasing public distrust of large corporations and widescale movements such as #MeToo and Black Lives Matter.

- Increases in litigation funding: The litigation funding industry has ramped up activity in the US, and increasingly outside of the US, and there is emergence of more firms being set up to fund tort activity.

- Increases in the number of litigated claims: With growth of the litigation industry it is becoming easier to finance high risk and costly court proceedings, escalating the number of claims being taken to court.

- Erosion of existing tort reform: While limits are in place in many US states to mitigate the size of jury awards, in recent years these are being challenged and reformed so that larger awards become possible. Plaintiff panels use this to their advantage by jurisdiction shopping, among other sophisticated targeting approaches. Defence panels have not been able to keep pace with this.

- Emerging concepts in tort law: Cyber, environmental and large multinational company liability torts are examples of emerging areas that are not fully defined by statute.

We refer to social inflation as the impact on claims from these trends, over and above that from pure inflation. Social inflation is a major contributor to the worsening of (re)insurance industry results for casualty business in the US. While this is an emerging issue driving up the cost of claims in the US, there are signs that countries such as the UK, Canada and Australia are also being affected and the extent of this could increase in the near future. This could be because these countries operate on a common law basis like in the US, where judicial precedents can be set.

1.5 Further uncertainties to consider

There are several areas of uncertainty that have not been explored in detail in this report but should be considered by agents as part of their modelling.

Excess inflation trends

This report puts a focus on social inflation trends, however agents should explicitly consider the range of trends that they are exposed to, such as increasing claim costs due to technology, advances in medical treatment (which can also increase life expectancy and therefore the cost of bodily injury awards), the impact of policy terms and conditions being broader than expected, weakening of case reserves, PPOs and structured settlements, increasing wages and care costs as well as other relevant trends. The model methodology, parameterisation and validation should have sufficient focus on specific trends that agents are most exposed to.

Frequency versus severity trends

If possible (and should the data allow for it), it is better to measure the impact of inflation for claim frequency and severity trends separately. However, in capital modelling we are interested in the aggregated impact of these on claim costs in a portfolio or across portfolios. In general, agents model inflation at the same level that claim costs are

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[1] [1] [Social inflation: Navigating the evolving claims environment, Darren Pain](#)

[2] [2] [Social inflation and emerging mass torts: now, next and beyond, Ernst & Young LLP](#)

generated, which is in aggregate. This leads to a risk that material frequency and severity trends are conflated in the model and its parameterisation. Therefore, material and emerging trends should be monitored separately through the risk management framework supporting the model, so that the modelling practice remains appropriate.

Reinsurance

Some models apply inflation to net losses. This method does not allow for the risk that an unanticipated spike in inflation could push gross losses over the attachment point for reinsurance cover, i.e. losses could be missing from the modelling of inwards reinsurance business. Equally, this method does not allow for losses above attachment points to develop below it if inflation turns out to be lower than expected. The compounding effect of inflation can also lead to a leveraged impact for reinsurers if inflation is above expectations consistently for a number of years and the cover is not indexed.

For inwards reinsurance business that is indexed, there is a risk that claims inflation that emerges is much higher than implied by the index specified in the policy terms. Indexation clauses also impact retained claims experience, for example where outwards reinsurance deductibles are indexed, resulting in more risk being retained than expected.

Mean reversion

A key assumption in ESGs is how the inflation rate evolves over time and what level it reverts to in the long-term. Again, because inflation has a compounding effect on losses the difference in capital projected by the same model can be significant depending on whether mean inflation is projected to drift or remain at the same level in the long-term.

Inflation in excess of pure inflation may not behave in the same way as a price index, where rises in elements of some claim costs could continue to accelerate rather than tend to a longer-term average (e.g. due to continuous advances in technology and ever increasing sophistication of medical treatments).

Mean reversion assumptions should be well understood and justified in the model documentation.

Balance of claim cost changes due to pure or excess inflation

Defining a split between pure and excess inflation is inherently subjective. Some components of claims inflation will be covered by a combination of price inflation and excess inflation while other components may be elements of excess inflation, which are entirely independent from pure inflation. If they are modelled separately, the expert judgment supporting how excess inflation is superimposed on top of pure inflation in the model should be thoroughly justified, documented and validated.

Price inflation trends

In the first part of 2021, price inflation has been a hot topic in the US and UK media. There has been an up-tick in CPI but it is believed to be short-term in nature. The increase in inflation expectations has driven longer-dated yields up but shorter-dated yields remain stable, supported by communication from central banks that interest rates are not expected to be increased.

Higher price inflation is expected given the economic shock caused by COVID-19, subsequent recovery and impacts from supply chain bottlenecks and fiscal stimulus measures. The impact is also expected to be more pronounced in the US compared to the UK and Europe, since COVID-19 is believed to have had a more pronounced impact on primary components of CPI in the US compared to other countries.

Given price inflation has been low and around the level targeted by central banks for several years now, capital modellers should consider whether volatility assumptions reflect that there is potentially more headroom for growth compared to periods where there have been higher levels of inflation.

Catastrophe risk

The inflation trends covered in this report (and social inflation in particular) could have knock-on impacts to loss costs from catastrophe events. Furthermore, the impact of demand surge and mass litigation events - which can be allowed for in external models for natural catastrophes and realistic disaster scenario analyses respectively - are out of scope of this report.

2 Executive summary

2.1 Key findings

Inflation risk is of particular concern for agents that underwrite long-tailed liabilities, where there can be long delays in claim notification and settlement. A range of approaches are used in models to capture this uncertainty, however we see limited evidence that agents adequately challenge the methods, assumptions and limitations in the modelling that have remained unchanged for many years. This can result in a passive approach to managing this risk, hindering responses to emerging trends such as social inflation. A lack of challenge is not surprising when inflation is embedded into models in a way that cannot easily be split out and quantified.

While we do not believe that there is necessarily an underestimation of the systemic risk related to inflation in the market, we believe that there is a lack of inflation-specific validation and therefore a risk that model allowances do not remain appropriate over time. For most agents, the difficulty seems to lie in using implicit allowances for excess inflation, which leads to limitations in quantifying and challenging the allowance. Where inflation risk is material improvements are required here so that the market can be more responsive to emerging trends and ensure allowances for inflation volatility remain appropriate.

If model allowances are implicit, then agents need to ensure that testing can still be carried out to demonstrate that these approaches adequately consider systemic inflation impacts across multiple insurance portfolios. Any testing performed should be commensurate with the level of exposure to inflation risk.

At a minimum, agents should document what has been reviewed, considered and assessed when making implicit allowances and whether model updates have been or will be made in response to this. To aid the assessment, we have highlighted common sources of inflation in capital models throughout the report (see Table 1 to 3 in sections 5 and 6). We encourage agents to think about how modelling of excess inflation volatility can be made more explicit, to make it easier to assess that the model adequately captures the risk, improve ease of testing and quality of communication around this risk.

2.1.1 Inflation allowances tend to be implicit

The amount of inflation allowed for in the model's expected claims and the level of volatility modelled around it is difficult to quantify, as evidenced by responses to our market questionnaire (see section 4.1.1.CALM survey for more detail about the survey and its response rate). In many cases, we have seen that approximate quantifications of inflation risk result in a modest impact on the capital requirement. This does not always align with the views of senior or risk management of inflation risk, which points to more effort being required to quantify the risk and/or more detailed validation to test model approaches. Lloyd's does not necessarily expect agents to implement explicit driver-based approaches, but validation should be used to provide more comfort on the chosen assumptions and a realistic range of inflation impacts on the overall capital distribution.

Inflation is a driver of dependency in the internal model (e.g. between market risk and insurance risk, between classes of business and between premium and reserve risk). Agents need to consider whether implicit inflation allowances are an appropriate way to capture these relationships.

Figure 1: CALM survey: Can inflation allowance be quantified?
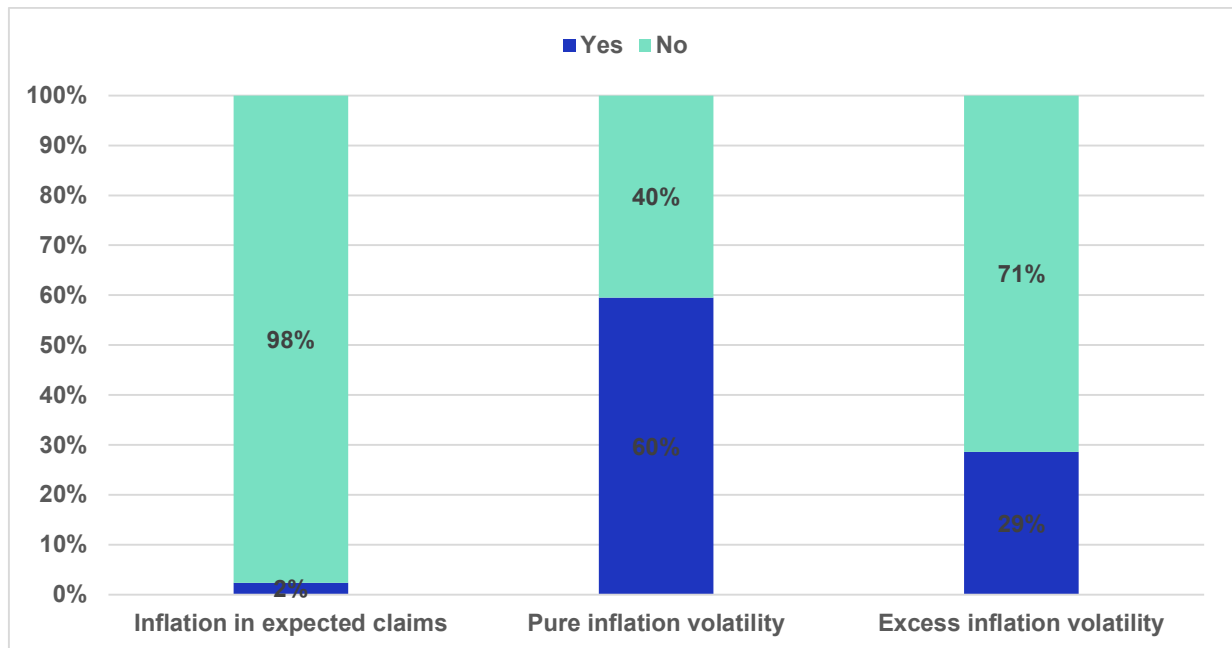
Inflation in expected claims

The amount of inflation captured in the best estimate reserve inputs and expected loss ratios used to be implicit for many syndicates. This was identified for reserves in the 2020 Lloyd's Casualty Market Study[3] and since then Lloyd's has updated the reserving minimum standards - MS8. Agents should now explicitly consider inflation assumptions in the IELR setting process. This includes validation of any inflation assumptions used as part of the business planning process that are relied upon for reserving. There is still a limitation across the market with respect to reserving projections relying on implicit inflation allowances. There should be more consideration of whether these implicit allowances are sufficient to reflect potential trends.

Inflation volatility

The majority of agents use an ESG to model uncertainty in pure inflation, however for excess inflation there is a reliance on allowances embedded in insurance risk assumptions which can often not be isolated. This means that quantifying and therefore managing excess inflation risk is difficult. Some agents use explicit drivers in addition to this method, which is a more effective way of quantifying the risk and creating a systemic dependency between portfolios. The use of explicit drivers for excess inflation is relatively limited.

Volatility in the capital model should reflect that the best estimate reserves could be underestimating the impact of potential trends.

2.1.2 More review and challenge of excess inflation assumptions should be evidenced

Inflation assumptions which have not been explicitly derived tend to be judgmental allowances in insurance risk volatility and dependency assumptions. The justification of these approaches and testing against data and scenarios should be improved. Analyses carried out by capital modelling teams to derive and assess the assumptions as well as tests included within validation plans should be enhanced.

We have outlined potential tests in the Validation section of this report. How testing is split between capital modellers and validators is up to agent discretion; but ownership of the inflation assumptions should be with capital model teams. Testing effort is expected to be proportionate to the view of materiality.

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[3] [3] Lloyd's Casualty Market Study, Lloyd's of London

2.1.3 Modelling is not proactive enough to incorporate emerging trends

Implicit modelling approaches used by agents make it difficult to allow for emerging trends. Many traditional actuarial methods rely on the assumption that past data is representative of the future – new and emerging trends are not catered for in these methods. This is noted by the PRA as a weakness in the modelling of reserve risk by non-life companies that have sought internal model approval in the UK. Trends might be considered when adjusting insurance risk parameters but there is a reliance on judgementally increasing volatility and model loss ratios to reflect the aggregate impact of these uncertainties.

Suggested enhancements are to consider a process to strip out the impact of material trends from claims data and assumptions, so that alternative assumptions could be overlaid and evaluated. The range of assumptions should be informed by internal experts, emerging risk committees and external studies, where possible. A less onerous approach would be to make better use of SSTs to challenge how well the model caters for trends. This is important to aid communication of uncertainty in social inflation and other emerging trends (e.g. climate change and cyber risk) which may be causing long-term changes to the claims environment.

2.1.4 Consistency in approach between teams requires improvement

Assumptions about inflation are required throughout the planning, reserving and capital modelling processes. In only a very limited number of reviews we looked at did agents demonstrate that these functions use a coordinated view. Agents could be making explicit assumptions in either of these functions but it is not clear that these are aligned and feed into a consistent inflation framework. Capital models should make reference to how chosen inflation assumptions compare to claims, planning and reserving allowances and what validation has been performed on these assumptions.

2.1.5 Validation of ESG inflation outputs should be improved

ESGs are in general used in the market to model price and wage inflation. The Solvency II requirements for external models outline that validation policies, processes and reports must cover ESGs to the same extent and standards as they do the rest of the internal model. Agents should also be able to explain how they use the ESG within the internal model and how the Board and senior management obtain comfort over its adequacy in reflecting risk profile and its limitations, including for inflation risk.

In many cases the assumptions in the ESG are not material to capital given that market risk often does not contribute materially to capital. Validation of the ESG can be proportionate to the amount of market risk the agent is exposed to. In many cases validation and capital teams rely on testing carried out by external model providers. Inflation indices from the ESG are usually not material to market risk – they are though applied to insurance risk losses. When validation of the ESG lies with investment teams, for example, inflation might not be reviewed in sufficient detail because is not material to investment risk. Proportionate validation should be carried out with respect to inflation indices and their impact on insurance risk.

How the link between inflation indices from the ESG and other sources of claims inflation has been modelled is important – if these have been modelled as independent then the impact of pure inflation from the ESG is likely to be low. In general validation could be improved by referencing testing of ESG inflation volatility against external data and assessing the range of inflation scenarios captured in the ESG output.

2.2 Next steps

2.2.1 The market's next steps

Our findings and recommendations cannot necessarily be considered for the 2022 YoA LCR submission given the timing of this report, unless work on inflation allowances is already underway. Lloyd's expectation is that agents with material exposure to claims inflation risk ensure there is an appropriate allowance for this risk in the capital requirement - just like for any other material risk. If agents identify in light of this report that they have material exposure to inflation risk AND there are deficiencies in the current modelling approach or the impact of inflation cannot be quantified, then there needs to be assurance that capital is not materially understated for the 2022 YoA

submission. This means that while a validation deep dive cannot necessarily be carried out this year, the validation test plan should for example include inflation specific sensitivity tests and SSTs. Where material uncertainties over the adequacy of capital persist, a capital load might be necessary to reflect the uncertainty.

In addition, agents should start to make plans for what kind of model investigations and validation testing will be needed over the next year, in time for the 2023 YoA LCR submission. Half of the CALM survey respondents noted that improvements to their claims' inflation modelling and validation are planned over the next 2 years, the recommendations in this report should be taken into account in this work.

The amount of effort put into inflation modelling should be guided by the principle of proportionality. Hence agents should as a first step identify if they are materially exposed to inflation risk. If that is the case, then the level of sophistication applied in the current modelling approach should guide model development and validation effort. In general, we would expect more work to be carried out by agents with material exposure to casualty and professional business relying on implicit allowances for excess inflation - compared to agents that have predominantly short-tailed exposure or already use a detailed inflation framework / modelling approach - in which case the above findings would be less relevant.

Even if the current methodology is detailed and explicit allowances are being made, there should be sufficient testing to demonstrate that inflation risk is contributing to capital in a meaningful way, for example via sensitivity and scenario testing.

Capital modelling and validation teams should place a focus on how well excess inflation trends are captured in the model and validated.

1 Agents should undertake a risk assessment to evaluate the current exposure to inflation risk against the risk profile. This should consider the prevalence of emerging trends such as social inflation. This can be led by the capital modelling team and independently assessed by the validation team.

2 This should be compared against current modelling allowances for inflation and agents should consider whether any of these could or should become more explicit. We do expect there to be some level of quantification of the model's allowance at this stage.

3 Validation teams should evaluate whether the existing test framework has enough explicit testing to identify limitations and potential improvements. This should include a review of the work and in particular quantification carried out by the capital modelling team. We expect testing suites to be enhanced so that robust challenge can be given to implicit inflation allowances where it could be material.

4 For agents with material exposure and deficiencies in the modelling and/or level of validation, a validation deep dive should be carried out in the next year if it has not already in the previous 3 years. The Validation section of the report provides examples of testing that could be performed.

5 Validation findings as well as assessment by the modelling teams should flow into future model development plans, to ensure that the capital requirement captures the risk around claims inflation appropriately. There should be a prioritisation to tackle the most significant issues first.

2.2.2 Lloyd's next steps

Ahead of the 2022 YoA LCR submission and over the course of the next year, Lloyd's will:

1 Provide feedback to the subset of agents that have been reviewed in detail for 2021 inflation related oversight activity.

2 Review and update the Capital Guidance to reflect outcomes of this thematic review, which includes adjusting requirements which the market finds difficult to achieve.

3 Put a focus on how claims inflation has been allowed for during deep dive reviews of agent models. Deep dives will be scheduled as part of the annual oversight process and discussed with agents.

4 Organise workshops in 2022 to discuss inflation scenario testing and other validation testing that agents have developed or plan to develop, if there is sufficient interest from the market.

5 Complete the underwriting and reserving workstream reviews of social inflation and share findings with the market.

3 Trends in claims inflation – social inflation

Social inflation is not a new phenomenon and has occurred in bouts throughout history. It can be triggered by high-profile events or shaped over time by evolution in emerging risk, legislation and the judicial environment. In the 1980s, the emergence of environmental hazard from asbestos led to significant strain on insurers' financial resources and a subsequent repricing of cover as well as triggering reforms to civil justice. In the early 2000s, the US insurance industry suffered from increased medical malpractice claims being taken through the judicial system as individuals sought compensation for injuries suffered during treatment. This similarly led to a strain on the industry which resulted in subsequent tort reforms to limit damage awards[4].

The rate of social inflation accelerates at times and/or can make sudden step changes, following a major event. Recent trends show signs that it is picking up pace again, with various high-profile movements and legal cases (#MeToo, Black Lives Matter and the opioid epidemic to name a few) garnering media spotlight and public interest. The number of claims being pursued through courts and the level of award have been increasing. Thus, the long-term implications in particular are key for (re)insurers to consider in order to manage future earnings volatility and solvency. Current drivers in frequency and severity trends are explored below.

3.1.1 Frequency trends

A class action is a type of lawsuit brought by a single, affected individual on behalf of a wider group of similarly affected individuals[5]. This type of lawsuit is common in the US and increasingly outside of the US, in Europe and Australia for example. A key risk to (re)insurance companies is where policies respond to class actions against insureds and where they are direct defendants in class actions. Claims arising from them are common in casualty business because multiple policyholders can be affected by the same issue and litigation companies have been aggressively pushing awareness of potential compensation opportunities. Class action trends can be a useful measure of how public sentiment and court activity is influencing the claims environment.

We have used publicly available class action data to provide some context to social inflation trends that have been observed in recent years. According to Cornerstone Research, the number of US securities class actions between 2017 and 2019 has doubled compared to the average of the previous 5 years.

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[4] [1] Social inflation: Navigating the evolving claims environment, Darren Pain

[5] [4] International Risk Management Institute, Inc

Figure 2: Number of securities class actions in the US (federal and state)[6]
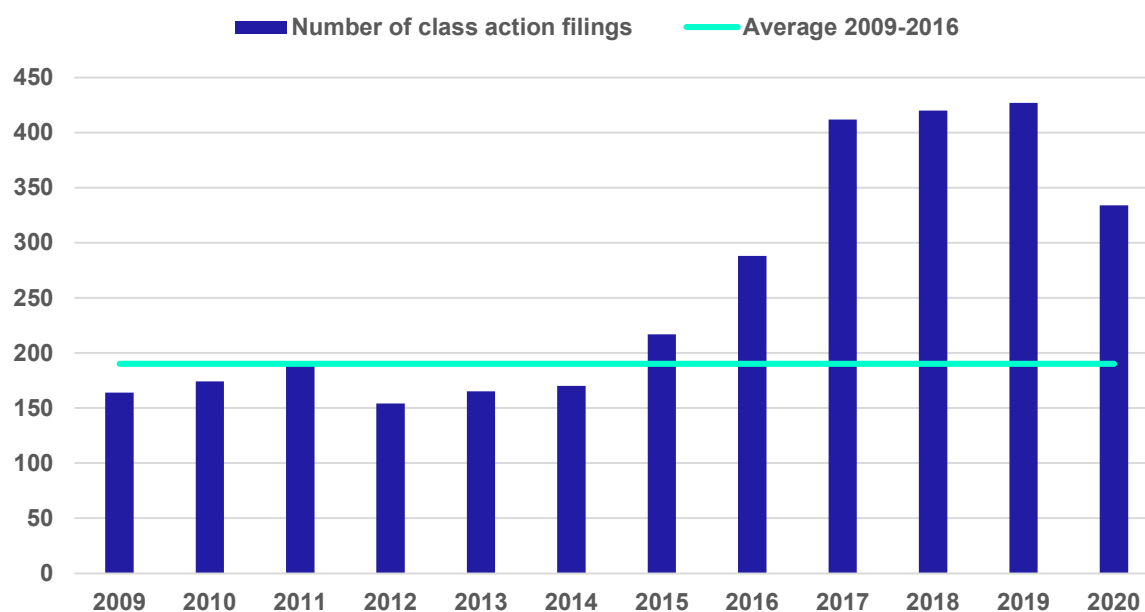
The data shows a clear escalation in the number of lawsuits being filed from 2015/2016. Cornerstone Research highlight that 2020 saw very large fluctuations in class action activity throughout the year compared to previous years, although activity was still at an elevated level compared to 2016 and prior.

One of the reasons for the dip in 2020 is credited by Cornerstone Research to a landmark decision on the Sciabacucchi case[7], in which the Delaware Supreme Court limited class action suits from shareholders against IPO companies to federal court, instead of federal and state court, reducing the ability of plaintiffs to sue across multiple jurisdictions. Another reason is the bounce back in stock market performance later in 2020, following the dip caused by the COVID-19 pandemic at the start of the year (thus reducing the incentive for claimants to sue company directors for poor performance). In Europe, the number of class actions has risen by 120% between 2018 and 2020[8], so the trend for (re)insurers is not just limited to claims arising from policies underwritten in the US.

There is also evidence that the absolute number of single large settlements (also referred to as 'nuclear' settlements, which are broadly defined as verdict settlements above $10m) has been increasing. A review of US cases reported to VerdictSearch (based on 200,000 claims reported) shows more than a 300% rise in the frequency of verdicts at or above $20 million in 2019 from the annual average from 2001 to 2010[9].

The Lloyd's Casualty Market Study[10] found that increased claims frequency is a trend impacting Lloyd's primary layer casualty business. In response line size and limit reductions are being implemented by the market.

3.1.2 Severity trends

Notably, as well as increasing numbers of class actions, the level of compensation award in the US has been increasing. The median of the top 50 bodily injury verdict settlements in the US has doubled in size between 2014 and 2018.

[6] [5] Securities Class Action Filings, 2020 Year in Review, Cornerstone Research

[7] [6] The Sciabacucchi effect: Delaware ruling on forum provisions is 'stabilizing' D&O insurance market, Alison Frankel

[8] [7] European class actions expected to rise as opt-outs become more popular, Cameron McKenna Nabarro

[9] [8] The Specter of Social Inflation Haunts Insurers, The Wall Street Journal

[10] [3] Lloyd's Casualty Market Study, Lloyd's of London

Figure 3: Median of the largest 50 single plaintiff bodily injury verdicts in the US[11]
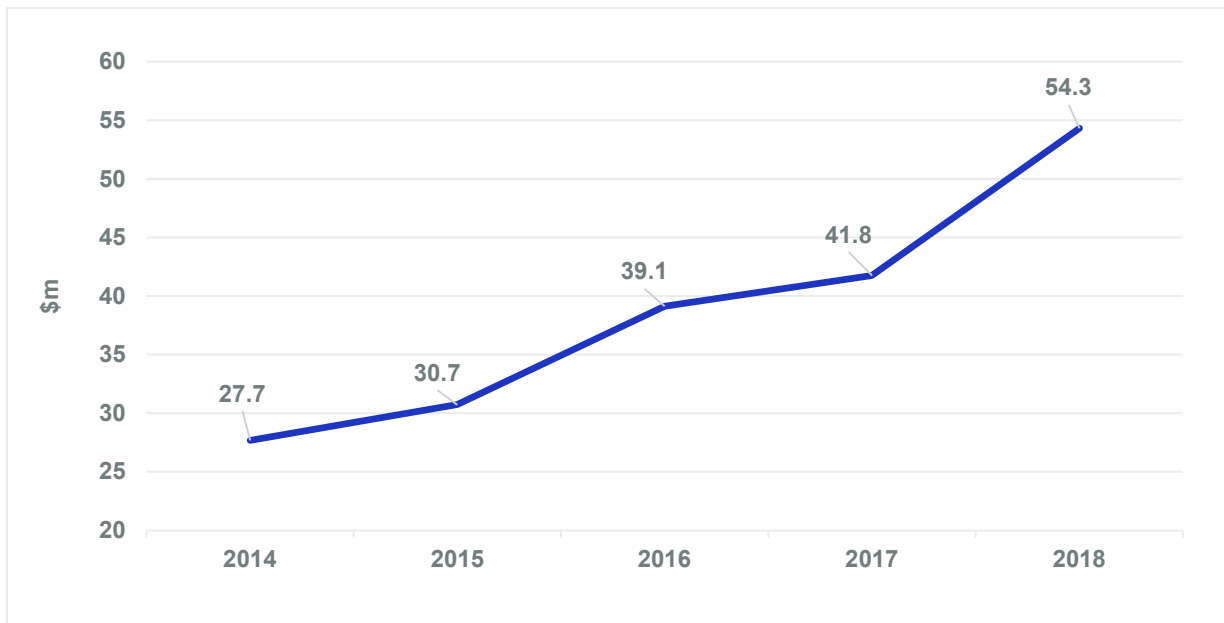
Similarly, data from Advisen shows that the median cost for a case involving a single-fatality has more than doubled since 2015 and tripled for sexual harassment cases.

Figure 4: Median cost of single-fatality and sexual harassment cases[12]
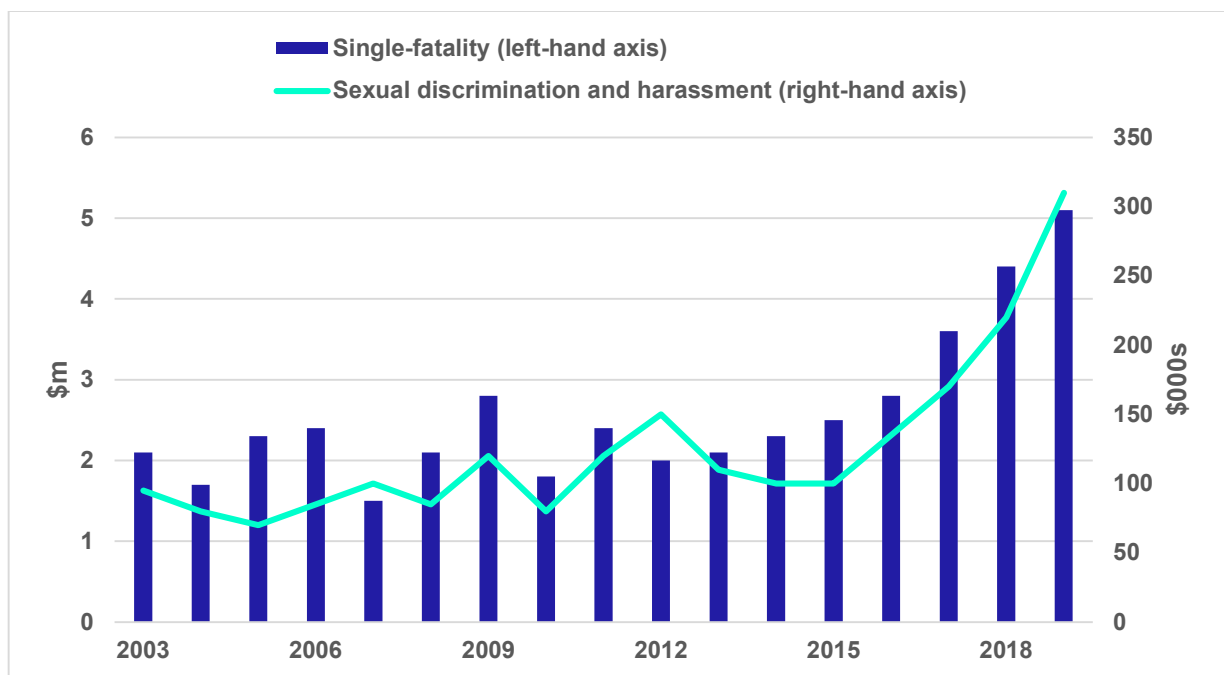
The Lloyd's Casualty Market Study[13] highlighted that the increase in severity of claims is causing concern for syndicates. Over the last few years, increasingly large claims settlements in the US have prompted the market to react by reducing line size as a means of mitigation. A large part of Lloyd's GL and D&O exposure is in high excess layers, where severity trends are prevalent. Outside of the US, Lloyd's has observed the market reducing line sizes on D&O business in Europe; but implementation has been slower than for US business.

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[11] [9] Data compiled by Shaub, Ahmuty, Citrin & Spratt

[12] [10] Social inflation by the numbers: Advisen Data Spotlight, Advisen

[13] [3] Lloyd's Casualty Market Study, Lloyd's of London

3.1.3 Class specific trends

Social inflation is expected to have an impact on the claims environment for many commercial insurance policies. Some of the classes where the effect has been most prevalent and substantiated by research to date are outlined below. It is expected that other classes are similarly being impacted and US tort activity will continue to influence social trends and claims experience outside of the US.

Commercial auto

Thomas Holzheu, chief economist at Americas Swiss Re, conjectures that commercial auto may be at the forefront of social inflation impacts but that this is spreading to GL, D&O and med mal professional liability products[14]. For commercial auto in recent years, there have been many instances of third parties seeking compensation from trucking companies due to injuries sustained in accidents and court awards have been in the 10s of millions of dollars. With the extent of awards being made, primary coverage is quickly eroded and the impacts are creeping into excess and umbrella policies.

D&O

According to a report by Milliman[15], there has been a significant increase in risk exposure in recent years. Three major risk areas have been identified. These are an increase in securities class action lawsuits (as illustrated in the figures above and due to investor incentive to sue in order to profit from the significant increase in settlement awards over recent years), social issues (such as #MeToo, gender discrimination and equal pay claims) and cyber security threats (such as data breaches and GDPR compliance issues). D&O insurers are particularly at risk to the ever-changing social environment. D&O premium rates have been increasing markedly in the market since 2019 but it remains to be seen whether this is sufficient to cover the extent of claims experience as it emerges. Most insurers expect rate increases to continue for the time being.

General liability

As highlighted earlier in the report, third party litigation funding is a component of social inflation. The cost of legal action is an important factor that plaintiffs must consider when deciding whether or not to pursue a case to trial. Third party litigation financing companies agree to cover some or all of the costs to pursue litigation in exchange for a share of the verdict settlement. In some cases, the plaintiff may not have to pay anything to the financier if the case is lost. This gives some plaintiffs financial resources they would not otherwise have access to and is another reason for increasing numbers of claims being pursued through legal systems. Claims experience in general liability business is linked to this trend.

The industry for financing is well established in the US, UK and Australia but has been growing significantly as well as expanding in other countries.

Medical malpractice

Richard Henderson, senior vice president of TransRe, collected and analysed internal and publicly available medical malpractice verdict data[16]. His analysis suggests that medical malpractice verdicts have been increasing in severity and there has been an increase in the number of nuclear verdicts over time, similarly to other casualty lines. While only a small proportion of malpractice claims are settled in court, the outcomes of these claims do impact the expected result of future verdicts and claims within the portfolio that do not go to trial.

3.1.4 Non-US trends

There are signs that litigation activity and pay-outs have been increasing outside of the US. Litigation in a number of European countries has been expanding the categories of compensation available to victims (for example with new

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[14] [11] Social inflation is spreading into US liability lines, Thomas Holzheu

[15] [12] Three rising trends in D&O insurance, Rachel Soich

[16] [13] Medical professional liability verdicts: what lies beneath? Richard Henderson

types of asbestos related claims going through courts in France and Belgium). Securities class actions and investor group led litigation has been increasing in Australia and Canada. In Australia this is being stimulated by a strict regime of disclosure for public companies and in Canada by investors targeting Canadian company branches where they are not able to pursue a case against those companies in the US. Furthermore, collective action mechanisms are becoming more available in Europe and future Directives could allow legal action to be made across borders in the European Union. Headline grabbing legal activity and precedents set in the US could also prompt higher litigation activity elsewhere.

3.1.5 A trend or short-term increase?

It should be noted that summary measures of trial activity may not be a reliable guide to the expected impacts of social inflation, because not all insurance claims are resolved through the legal system. Although particular casualty classes have been subject to increasing frequency and severity trends, it is not uncommon for trends to be dampened or mitigated over time. For example, changes to tort law and legislation can be made to restrict the ability of claimants to pursue certain types of claims through court and inflation can settle back to a long-term average rate. (Re)insurers can and have also managed inflation by increasing premium rates and using capital to absorb unexpected costs.

A significant uncertainty for (re)insurers is whether recent litigation activity represents an enduring shift to a significantly higher trend in claims growth that outstrips the estimates assumed when policies were originally underwritten. The full effect takes time to emerge and be adjusted for in policy pricing and claims reserving. The possibility that recent trends continue and potentially accelerate should be reflected in the assumptions underpinning inflation volatility in the internal model.

Persistent social inflation that goes unrecognised for years can lead to chronic under-reserving and under-pricing, especially since casualty classes have long claim development profiles and large claims may come to light slowly. An unexpected change in claims inflation has a leveraged effect on claim reserves because of its compounding effect. If inflation turns out to be only 2% higher than expected, then liabilities would increase by around 17% on a portfolio which is expected to be fully settled in 8 years[17].

3.2 COVID-19

The impact of the pandemic on inflation is uncertain and will vary by class of business. There are simultaneous supply and demand movements which could increase or decrease the cost of claims.

Fiscal response

Fiscal response to COVID-19 has been unprecedented, with the US government rescue plan exceeding 27% of GDP[18]. Similarly, large responses have been observed from other countries under democratic regimes. As support eases, the longer-term effects of the pandemic on the economy will emerge. Longer-tailed classes of business such as D&O and casualty are most exposed to increased claim frequency from businesses that delayed claim notification or can no longer fully sustain themselves. The impact will depend on mix of business; syndicates with more diverse exposure are less at risk than those concentrated in economically exposed classes.

Supply chain disruption

Data from the US Bureau of Labor Statistics and a survey of contractor executives suggests many contractors have experienced delays due to shortages in materials, parts or equipment[19]. If there is more reliance on overseas supplies, costs could increase and the current backlog of shipping container and freight traffic could become bigger, exacerbating inflationary effects. Disruption is affecting global supply chains and so the impact extends beyond the US into other territories. If these effects are transitory, the impact on short-tailed classes could be limited, with the

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[17] [1] Social inflation: Navigating the evolving claims environment, Darren Pain

[18] [14] Democracy and Fiscal-Policy Responses to COVID-19, Ceyhun Elgin

[19] [15] What's Behind The Materials Price Spikes? Jeff Yoders

shorter delay between premiums being charged and claims being paid out mitigating exposure to systemic inflation. The effect on longer-tailed classes is more difficult to mitigate.

Social inflation

Closures impacting the legal environment are making the legal process more complex. Even if a trial makes it to court, it could be years before it is put before a jury. Therefore, plaintiffs may be more willing to settle more quickly out of court - particularly where claimants are impatient or have cash-flow issues. The overall impact on social inflation is unclear because delays in the legal process could increase final settlement costs while faster, out-of-court agreements could lead to lower settlements.

Business interruption cases against insurers are ongoing and legislation could dictate how claims are to be settled. Lloyd's is exposed to court cases which have or are due to settle in the US, UK, Australia, Canada, South Africa and Ireland. There is further uncertainty due to push-back from the reinsurance industry as to how much of the cost it should be liable for, with potential for increased dispute risk.

A further threat is future waves of pandemic-related litigation for injury and other tort claims[20]. Social inflation could lead to permitting looser standards for allowing scientific testimony, defining a legal duty of care and for sanctioning of large awards. This could be an emerging inflation risk for GL, EL and professional lines insurance exposure.

A patchwork of COVID-19 related law changes and immunity protections in the US is confusing the legal landscape and making it difficult to anticipate impacts, in particular for medical malpractice.

There have also been some impacts which might lower expected costs, for example relaxation of the continuous disclosure regime in Australia. In May 2020 Australia's Federal Government introduced temporary changes to disclosure laws, which raised the standard necessary for plaintiffs to file cases against companies, officers and directors. These temporary changes may become permanent, in which case they could potentially slow growth of class action activity in the country.

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[20] [1] Social inflation: Navigating the evolving claims environment, Darren Pain

4 Review process

4.1 Data collection

Our review is based on an analysis of surveys completed by the CALM group and by managing agents selected by Lloyd's for inflation oversight activity. These are described in more detail below and the surveys are included in the appendices. We have also referred to information collected in the 2021 YoA focus area returns, which syndicates were required to submit with 2021 LCRs in September 2020.

4.1.1 CALM survey

The CALM survey was a short questionnaire with standardised answers shared with the market in April 2021. The survey covered the methodology, quantification and validation of inflation in capital models. We received 42 responses from 38 unique managing agents.

Each survey was mapped to a peer group, based on the risk profile of the most material syndicate under management. The peer group was allocated based on the mix of premium and reserves by Solvency II class, as reported in the 2019 year-end IMO templates, for 2020 YoA capital.

Figure 5: Distribution of respondents to CALM survey by peer group, compared to the market
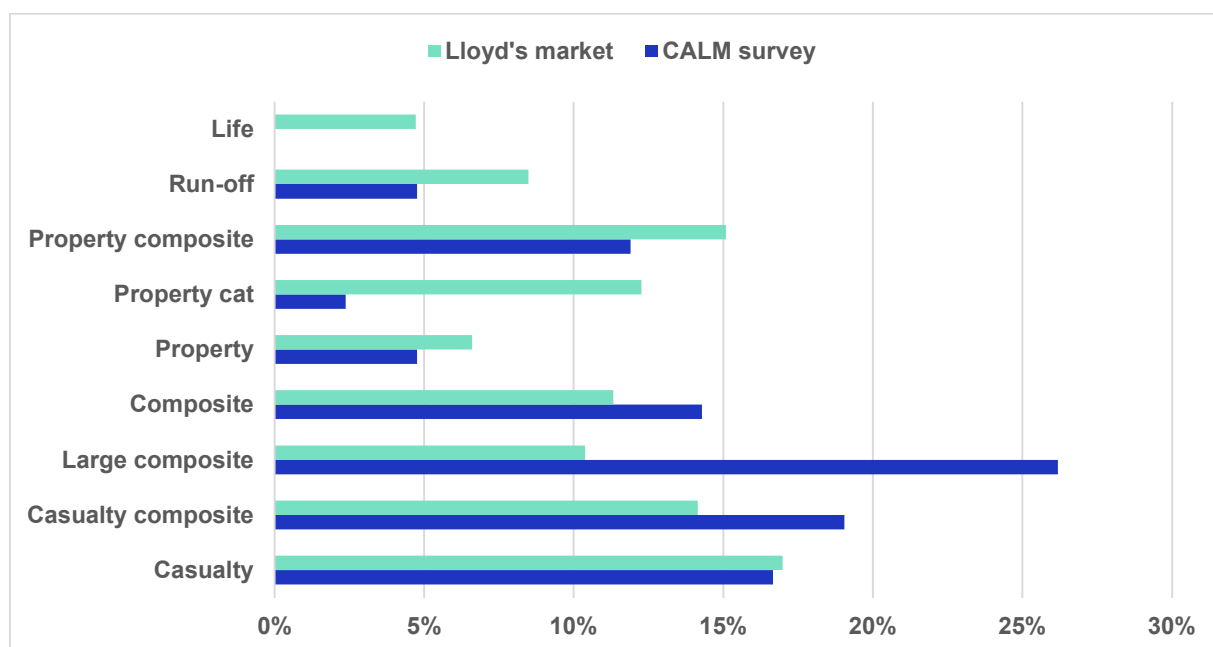
Our threshold for composite insurers to be categorised as large is prospective net premium and reserve volumes to both be greater than £500m. Property cat syndicates are under-represented but long-term inflation trends are less material to these syndicates. The life and run-off syndicates are often small – hence under-representation in these groups is unlikely to significantly change the main conclusions from our work. Overall we concluded that the responses received are representative of typical inflation modelling practices in the market.

We observed no meaningful differences in the survey results by peer group and therefore have presented results aggregated across the market.

There will be differences in how individual agents interpreted the questions and we understand that some responses did not fit into the survey options. We have tried to cater for this as far as possible.

4.1.2 Detailed questionnaires for inflation oversight agents

Lloyd's issued a more detailed questionnaire to 12 agents (who also completed the CALM questionnaire). These agents had been selected for inflation oversight activity based on the size of reserve risk relative to total capital and proportion of reserves in long-tailed classes, or for being identified by the Lloyd's Performance team for the thematic

review. The basis of the questionnaire was similar to the CALM survey, however responses required more comprehensive detail, documentation and validation testing for our review. This is included in the appendices.

4.1.3 2021 YoA focus area return

In the focus areas we asked for the impact on capital of removing excess inflation uncertainty from the model. The reporting was completed by syndicates that have casualty reserves contributing more than 50% to total reserves. We also collected information about what ESGs are used and whether overrides are made to the vendor models and output.

4.2 Review methodology

We used a combination of detailed submissions and CALM surveys to get an overview of the current state of modelling, good practice and common issues faced by the market. Our review of detailed questionnaires considered the following for pure and excess inflation separately:

- Methodology: Modelling approach, implementation by loss type, class and year, gross versus net considerations and modelling limitations.

- Parameterisation: Data sources and amount of history used, data adjustments and use of expert judgment.

- Dependency: How dependency effects are captured in the model by each modelling approach, dependency between inflation sources and how inflation creates systemic effects in the tail of the capital distribution.

- Validation: Use of inflation deep dives, explicit testing, variety of testing and gaps in testing.

This was supplemented by CALM survey responses which allowed us to assess the current state of modelling across the market. Our review was against the Lloyd's capital guidance and we have considered whether updates need to be made to amend the current requirements.

In the following sections we outline our findings and examples of best practice approaches that we observed in the review process. This is followed by a summary of validation approaches and further steps that are planned for future oversight.

5 Expected inflation

5.1 Recommendations

Claim and loss ratio inputs into the capital model should make allowances for pure and excess inflation expected over the modelled period. Only one agent from our CALM survey uses a process that overlays a consistent and explicit view of inflation across all these inputs. Our review has highlighted that improvement is needed in the following areas for syndicates where claims inflation is a material risk:

1 There should be more consistency in inflation assumption setting between planning, reserving and capital modelling processes.

2 Inflation assumptions should be more explicit when on-levelling data in the parameterisation process and where appropriate an inflation framework should be used, in particular for casualty business. Trends should be explicitly allowed for.

3 There should be more testing and validation of inflation assumptions in the on-levelling process and model inputs more generally. This refers to validation performed on plan setting and the reserving process. Validation can be focussed on the classes of business which are most exposed to the risk.

These are the current recommendations from a capital modelling perspective. More detailed recommendations may be provided by Lloyd's in the future with respect to planning loss ratios and reserving as these areas are explored further. **As a result of the Lloyd's Casualty Market Study[21], the minimum standard for reserving (MS8) was updated in 2021 to require explicit consideration of inflation in IELRs used in the reserving process**.

5.2 General findings

The most common approaches to capture inflation in expected claims are outlined in the table below, where we have also indicated whether agents typically use these to capture pure, excess or all types of inflation. This list is guided by our review of models in the study.

Table 1: Sources of inflation in expected claims

Source of inflation	Pure	Excess
Plan loss ratios	✓	✓
Uplifts to plan loss ratios before being used in the capital model	✓	✓
Best estimate reserve inputs	✓	✓
On-levelling data during parameterisation	✓	✓

The majority of agents uses loss ratios from the planning team and best estimate reserves from the reserving team as they are, which have an implicit allowance for inflation in them. It is not feasible to unwind the allowance for inflation in these mean assumptions if the processes used to set them do not consider inflation explicitly.

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[21] [3] Lloyd's Casualty Market Study, Lloyd's of London

Figure 6: CALM survey: Allowance for inflation in expected claims
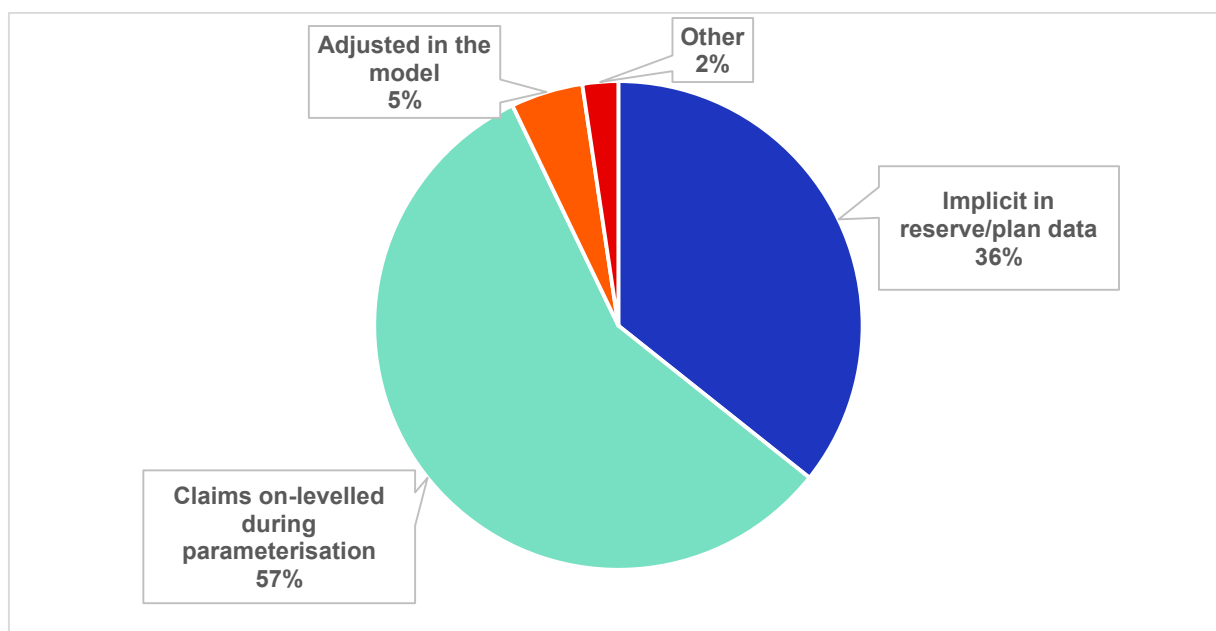
Most agents superimpose inflation onto loss data during premium risk parameterisation so that assumptions are on-levelled with trends expected over the model time horizon.

When agents rely on implicit inflation allowances, it is difficult to challenge the assumption. Without having a handle on the extent of expected inflation, it follows that assessing whether the amount of volatility modelled around it in the capital model is also very challenging.

Plan loss ratios

In order to maintain price adequacy, the level of planned premium should offset claims inflation in addition to changes in policy terms, coverage and exposure. There should be an allowance on top of policy and exposure changes for claim trends expected over the duration of claims exposure. This is captured via claims inflation assumptions incorporated into the final premium charged to customers.

Inflation - and in particular social inflation - in plan loss ratios needs to be appropriately allowed for in the SBF and will be an area of focus for CPG during the business planning process in 2021.

Uplifts to plan loss ratios before being used in the capital model

As per guidance from MRC[22], modelled loss ratios should be equal to or greater than planning loss ratios by class of business. Most agents apply loads to the plan to allow for uncertainty in achieving planned rates as well as other class specific uncertainties.

Some agents use single loads to capture an aggregate of uncertainties in a class. Unpicking inflation allowances is not possible in this case. In particular, 36% of respondents to the CALM survey noted that an allowance for social inflation is made in their expected claims (i.e. in best estimate reserves and / or model loss ratios). However, for many of them it would be difficult to assess the model impact of this. This is an example where planning, reserving and capital modelling can be disconnected on the topic of inflation.

It is not expected that inflation should be covered by an explicit load unless it is a material risk. However, there should be validation to demonstrate that loadings are appropriate in the context of inflation risk. This may be an onerous process when there are many model classes, so it is reasonable that validation is focussed on areas of the portfolio that are most exposed.

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[22] [16] Reserving Thematic Tests of Uncertainty – 2022 Process, Lloyd's of London

Best estimate reserve inputs

The basic chain ladder is often used to derive the best estimate reserves. A fundamental limitation of the method is that it projects forward past trends and can therefore underestimate development of events which have not occurred before. A chain ladder development pattern is an average trend. Although it incorporates inflationary effects, it assumes that future inflation will be the same as the historic average inflation and can mask features of the data that should be given more attention. These limitations should be understood and if a class of business is exposed to new or emerging trends like social inflation, for example, these should be considered more explicitly in the assumptions. Social inflation has also been observed historically, so it would be appropriate to assess the extent to which it is included in the observed data compared to future expectations.

Inflation is usually superimposed onto IELRs in an explicit way. This only partially recognises the effect of inflation when they are used in blended reserving methods (for example the BF). Additionally, this does not address the risk of potentially underrepresenting inflation in prior year reserves projected using other methods such as the CL. As mentioned before, inflation assumptions can have a leveraged impact on reserves, with small changes in inflation leading to material changes in the reserve projection.

Some syndicates do not consider claims inflation as part of the reserving process, due to data limitations or believing that inflation is captured in the rate charged for risk. Lloyd's updated the reserving minimum standard MS8 last year to state that syndicates are expected to consider inflation explicitly when setting IELRs.

The PRA's 'Dear Chief Actuary' letters highlight that loss ratio assumptions in the reserves, pricing and business planning can be lower than views used by claims teams. The reserving process should explicitly consider the range of assumptions used by different teams and uncertainty around the final selections should be captured in the volatility used in the capital model.

In summary, actuaries often rely on traditional methods when forecasting liabilities and risk (such as the chain ladder method), which (when unadjusted) assume that past data will be representative of future experience. These methods break down when faced with new or emerging trends that are not represented in data or fully understood. Therefore, bespoke thinking and modelling is required with regards to inflation.

On-levelling data used in parameterisation

On-levelling is the process used to adjust historic data to be on the same basis as the model period, in terms of planned exposure and expected trends in loss experience. This is allowed for in the roll-forward of the TPs and to adjust data that will be used to parameterise premium risk volatility.

Some agents apply trend adjustments to their data based entirely on expert judgement which is not fully documented or challenged by underwriters or validators. Furthermore, the materiality of the assumptions is often untested and assumptions can be used which are disconnected from allowances made in planning loss ratios or superimposed in the reserves.

Inflation adjustments should be explicit, particularly for casualty business, documented and sensitivity tested. They should also make reference to assumptions used by other teams. As with all areas of modelling, the rationale for the chosen methodology and assumptions should be documented and validated.

5.3 Best practice

Best estimate reserve inputs

The best approaches have explicit consideration for inflation such as:

Generalised linear models

Regression models can be fitted to claim triangles which use inflation as an independent variable. These allow the user to superimpose alternative views of inflation[23]. However, generalised linear models are difficult to apply, as they will not produce stable results without a sufficiently stable volume of credible data.

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[23] [17] Claims inflation: An emerging trend for non-life insurers, Dr Tobias Heinrich and Heike Klappach

Inflation-adjusted chain ladder

The 2020 GIRO claims inflation presentation[24] demonstrated that even modest inflation assumptions can lead to material increases in the reserves compared to the basic chain ladder.

Figure 7: Reserve projection with basic CL and inflation-adjusted CL for non-marine GL as at 2019 Q3
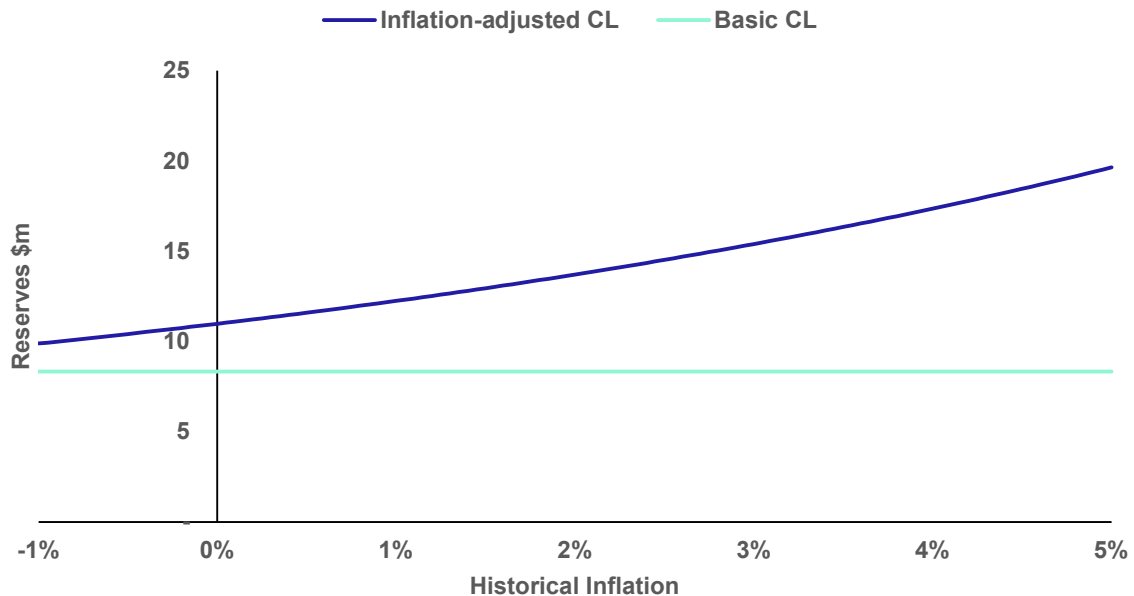
The chart shows the difference in projected reserves between the standard chain ladder and inflation-adjusted chain ladder under varying assumptions for non-marine general liability. As the inflation allowance increases, the difference between the methods increases exponentially. This method can be used in conjunction with scenario analysis to inform a range of outcomes and future volatility assumptions as well as test against the usual reserve parameterisation process. Polling from the GIRO presentation showed that no attendees had plans to use the inflation-adjusted chain ladder at the time, which may largely be due to the inherent subjectivity involved in estimating inflation already present in claims triangles before superimposing alternative assumptions.

Incorporating claim specific information

Using knowledge in the agency (for example monitoring of existing and potential claims on watchlists) supplemented by external data sources and intelligence on developing litigation outcomes is important to incorporate into the reserving process. This will better allow for the low frequency and high severity of claim awards impacting casualty business, compared to applying an average trend to claim triangles.

Enhancing use of internal and external data

Some agents work closely with claims teams to improve the quality and granularity of data that can be used to assess trends in their own experience. For example, constructing claim number and claim notification triangles can be used to separately analyse frequency and severity trends for specific classes of business[25].

It can be difficult to analyse inflation caused by changes in risk profile over time, for example due to changes in line size or even ambiguity in what constitutes a 'claim'. These can be explored through collecting and analysing more granular claims data.

A wide range of external data sources are available to consider for deriving assumptions. Some examples are referenced in the next section.

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[24] [18] Claims inflation trends within the Lloyd's and the London Market, Stavros Martis and Emma Stewart

[25] [18] Claims inflation trends within the Lloyd's and the London Market, Stavros Martis and Emma Stewart

Consistency between teams

Having feedback loops between pricing, reserving, claims and underwriting teams to share information and align the assumptions adds value to the process because it encourages discussion to bridge differences in opinion. It also creates consistency within the organisation (which is a development point previously raised by the PRA).

On-levelling data used in parameterisation

Selected on-levelling assumptions should reflect the nature of class of business and consider relevant external data. Examples of data used by agents includes:

- The Insurance Services Office: This is a source for actuarial, underwriting and claims information, which some agents use to derive inflation rates.

- CPI and wage indices: Some agents extract underlying data from the US Labour Bureau of Statistics / UK Office of National Statistics and construct a more relevant 'basket of goods' for their own products, to inform the range of inflation assumptions by class of business.

- Council of Insurance Agents & Brokers: An organisation that has published various studies on emerging trends, such as social inflation.

- Consultancies and brokers: Third party organisations can provide ranges of assumptions based on industry-wide analysis.

- Evolution of company level net combined ratios.

It is recommended that there is a framework for inflation setting built into the parameterisation process to document the trend applied across all classes. This would consider:

- different sources of inflation risk and extent of exposure by class, for example due to differences in jurisdiction, product life cycle and length of settlement delays;

- the relativity of assumptions applied between different types of casualty class (e.g. that the difference between assumption for primary and excess casualty classes is appropriate);

- internal expert views, such as class specific underwriters;

- alternatives considered, with reference to inflation observed in past data;

- large claims which are subject to legal challenge; and

- assumptions used by pricing, underwriting and reserving teams for the class of business.

For material classes, sensitivity of the class distribution and capital to the inflation assumptions should be documented.

6 Inflation volatility

6.1 Recommendations

Our review highlighted that much of the market relies on implicit allowances for inflation volatility; usually by considering it when setting insurance risk volatility and / or dependency parameters. The following improvements to the modelling process are recommended – recognising that any testing and model improvements should be proportionate to the materiality of inflation risk to the agent:

1 More review and challenge to understand the quantitative impact of the various inflation sources in the model. This should include:

- analysis of the impact on dependency and contribution at an appropriate level of granularity, such as by class of business and between risk categories;

- inflation specific SSTs; and

- reverse stress testing.

This can be aided by judgementally scaling volatility and dependency parameters - where exact adjustments are not possible - to assess the range of impacts inflation could have on capital. More detailed examples of tests are included in section 7.

2 An improvement in the level of testing applied to ESG scenarios and more challenge of the outputs. This includes backtesting of ESG inflation assumptions. More detail on the backtesting of the ESG can be found in section 7.4.

3 The modelling allowance for excess inflation reported in the 2021 YoA focus areas was relatively low across the market for casualty syndicates. Agents should consider whether the test results line up with the materiality of inflation risk to the business and the views of senior management and risk management.

4 Agents should consider using a framework that allows them to implement and test emerging trends in the model and to parameterise them as separate heads of damage (e.g. social inflation and medical inflation). This could be done by analysing these trends separately and using an explicit driver-based modelling approach where appropriate. For trends that are allowed for in aggregate with other uncertainties, SSTs should be used to improve communication of the risk to the Board.

6.2 Current modelling approaches

The CALM survey results highlighted that the majority of the market use an ESG to model pure inflation and insurance risk parameters (class level volatility and dependency parameters) to model excess inflation.

Figure 8: CALM survey – Methodologies used to model the volatility for pure, excess and social inflation
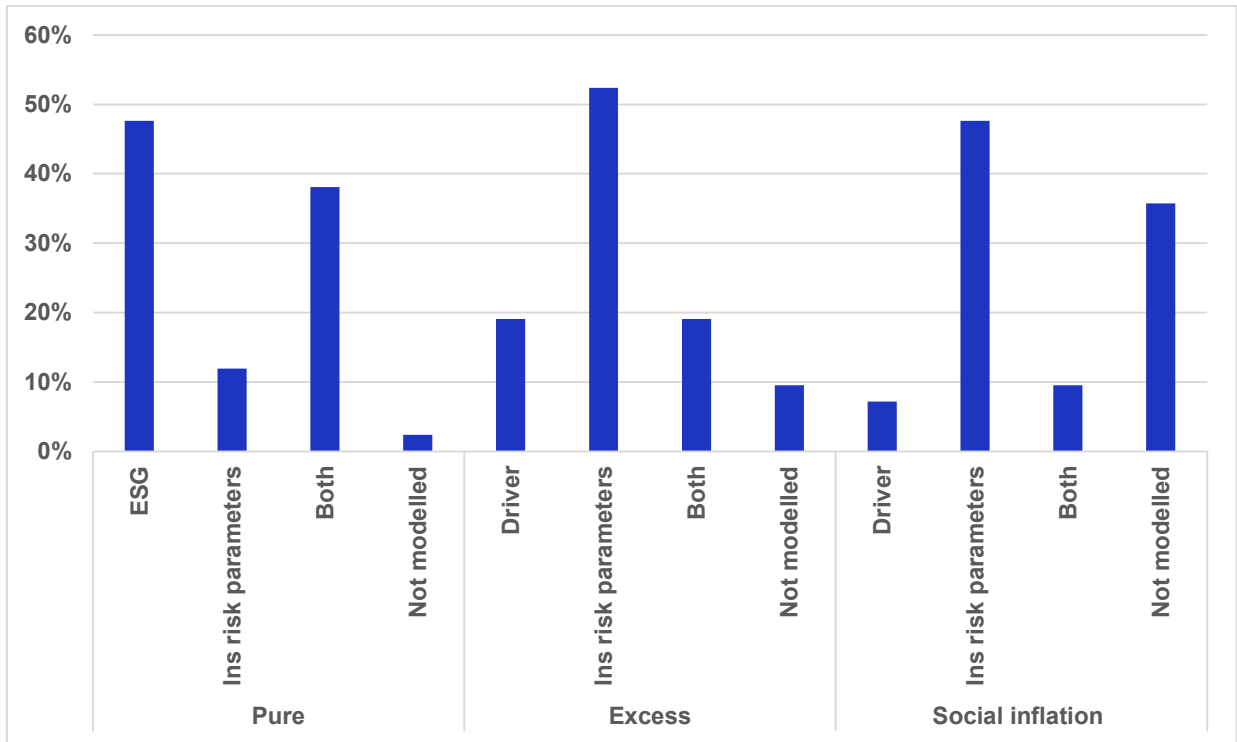
Observations for pure inflation modelling

Of all respondents to the CALM survey, 86% use an ESG to model pure inflation volatility, which is in line with numbers reported across the whole market in the 2021 YoA focus area return (where we asked whether an ESG is used at all). 14% of the market do not use an ESG and these are mainly property cat and run-off syndicates. However, there are also casualty syndicates that do not use an ESG and instead rely on insurance risk parameters and other drivers to capture the full extent of claims inflation.

Figure 9: CALM survey – Use of ESG inflation indices to model pure inflation volatility
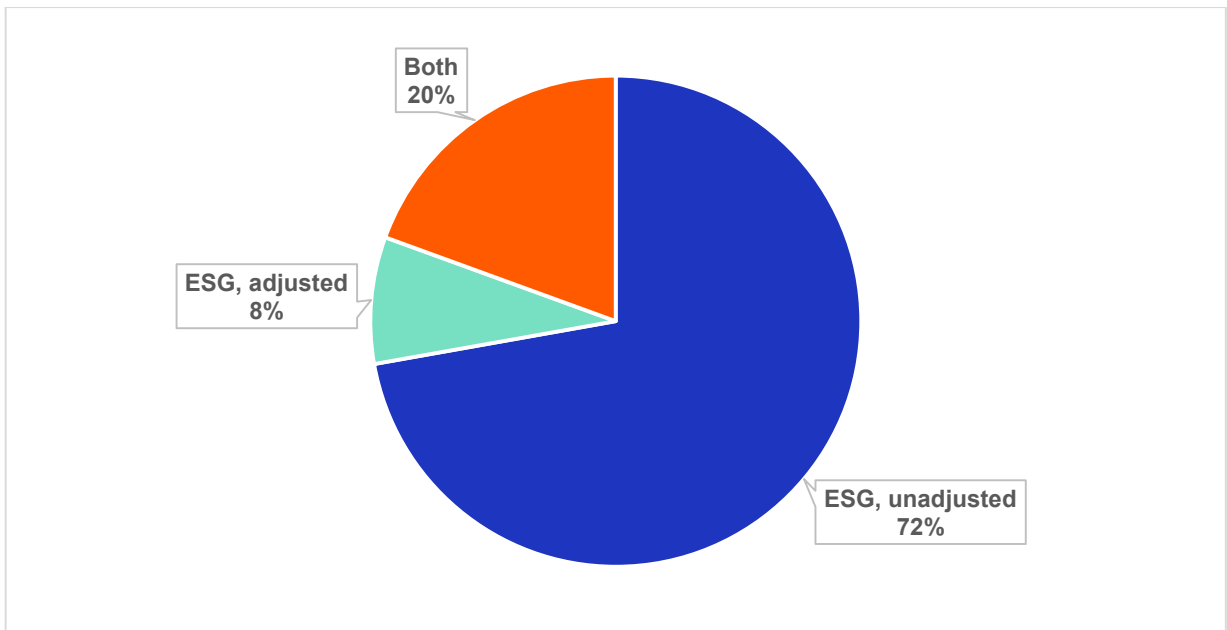
Of those CALM respondents that do use an ESG, 28% reported use of inflation indices which are adjusted in some way (e.g. where the mean or volatility assumptions are overridden). In the 2021 YoA focus area return we asked the market whether any overrides are made to ESG assumptions or outputs (in this case not only for inflation but for

other variables and to adjust mean reversion assumptions). 43% of ESG users in the market reported using overrides.

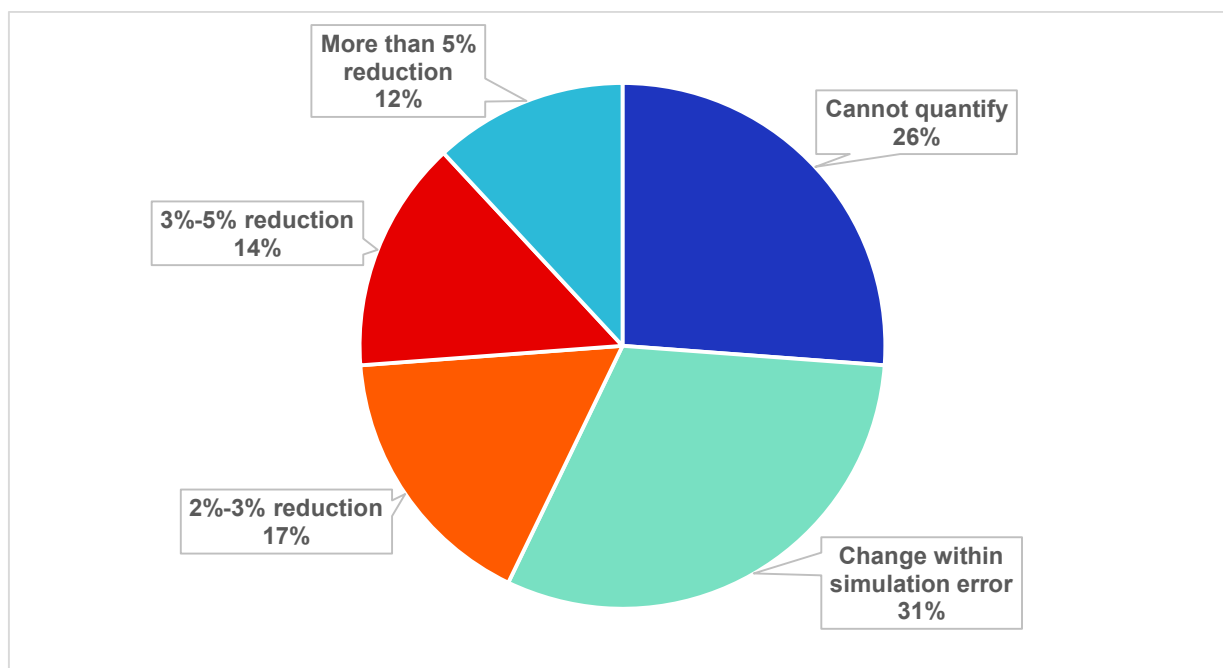**Figure 10: CALM survey – Expected impact on 2021 uSCR of removing pure inflation volatility**

57% of agents either cannot quantify pure inflation volatility or state that the impact is contained within simulation error. The difficulty in quantifying the impact for some agents is that although they use an ESG, they also rely on allowances made in insurance risk parameters. In general, this is an easy analysis to complete where only an ESG is used for pure inflation volatility because it is relatively straightforward to adjust ESG volatility.

Observations for excess inflation modelling

In Figure 8, the 'Both' bucket in each case is where agents use a combination of a driver and insurance risk parameters to capture the relevant inflation uncertainty. Social inflation is a type of excess inflation and the results for it are also implicit within the excess inflation figures in the chart.

The CALM survey results show that more than half the market rely on allowances for excess inflation volatility in insurance risk parameters alone. We note that large composites are the most likely to use a range of explicit inflation drivers to model excess inflation. Some smaller syndicates with a concentration of exposure in casualty and / or medical insurance also use explicit drivers to model inflation on top of or instead of ESG indices.

Agents are only able to quantify excess inflation through removal of explicit model allowances and approximation of implicit allowances by subjectively adjusting insurance risk parameters. We identified this difficulty in the 2021 YoA focus area data - where we asked casualty syndicates to report the impact of removing excess inflation from the model. With many allowances being implicit there were obstacles to completing the reporting and syndicates either made approximations and / or did not attempt to quantify excess inflation in full. A range of approaches were used to run the requested sensitivity test which included:

- approximating the allowance in volatility parameters by scaling them down or removing ENID loads;

- judgementally reducing dependency between classes, years and risk categories, to reflect inflation as a common driver;

- removing explicit inflation drivers or drivers which implicitly allow for inflation; and

- removing adjustments made to ESG inflation volatility (where the adjustments were in place to impose some excess claims inflation volatility in the model).

Some syndicates removed explicit drivers only and did not attempt to quantify implicit allowances, while others removed inflation volatility entirely because they do not model pure and excess allowances separately. Despite the range of approaches and difficulty in removing implicit allowances, the overall capital impacts were below Lloyd's expectation, with most sitting between a 0% and 6% reduction in uSCR. Some impacts were positive and / or within

model simulation error, and this has not been justified by modelling teams or challenged by validators. The impacts were also mostly independent of the size and mix of reserves, which indicates a limitation in the testing carried out with respect to how well the results reflect syndicate risk profiles.

The results for some agents were also out of line with how inflation volatility is presented in their risk framework. If it is considered a material risk in the risk ranking and perceived that way by the Board and in RST exercises, the model results should be aligned. If inflation is a material risk to the Board and model results do not demonstrate this, agents should consider why this is the case and make the necessary model updates (whether this means adding explicit drivers or carrying out more detailed work to quantify the allowance).

Although some of this testing was approximate in nature, it was a useful exercise that resulted in some agents creating new tests in their validation plans and it triggered further thought about how inflation can be tested in the future.

6.3 Insurance risk parameters

6.3.1 General findings

Below we have listed common methods agents use to capture inflation risk volatility in their capital models. This is specific to allowances made in insurance risk parameters. Other 'driver' based approaches are covered in a later section.

Table 2: Sources of inflation in insurance risk parameters

Source of inflation	Pure	Excess
Parameterisation approaches that rely on projecting data that has the impact of inflation implicitly included (e.g. bootstrap)	✓	✓
Parameterisation approaches built on scenario analyses or judgement	✓	✓
Uplifts to volatility parameters	✗	✓
Using inflation as a common driver to determine dependency between classes of business	✓	✓

Parameterisation approaches that rely on projecting data that has the impact of inflation implicitly included

Statistical parameterisation approaches (e.g. bootstrap) are a common way for agents to derive volatility assumptions and a standard limitation is that it is not possible to define the allowance for inflation uncertainty. This is because the effect of inflation is embedded within the data and therefore projections of it will only serve to forecast existing trends. This will not allow for new trends, although most agents adjust output parameters to allow for this.

Class level volatility diversifies against other risk and therefore the systemic effect of inflation is difficult to capture in this way and we see a lack of validation to test whether this is catered for in the parameterisation.

Parameterisation approaches built on scenario analyses and judgement

Some approaches are entirely expert judgment driven, for example by selecting a pre-defined high, medium or low volatility parameter based on class of business characteristics. Naturally there is no way to isolate the impact of different volatility drivers, such as inflation. Therefore, if inflation is a material risk, this approach has limitations and should at the very least be used in conjunction with more explicit allowances or be validated against inflation scenarios.

Uplifts to volatility parameters

Uplifts are often used as catch-all buffers for ENIDs and parameter uncertainty, to apply on top of statistically derived parameters. As noted earlier from market data, this method to model excess inflation uncertainty does not appear to have much impact on capital, whether or not this is due to uplifted volatility diversifying, or difficulty agents faced to strip out the impact of inflation in their uplifts. Therefore, validation of the approach should be improved by testing the

sensitivity of capital to chosen uplifts and how this stacks up against the emerging issues and uncertainties that are trying to be covered (such as higher frequency of court awards).

Using inflation as a common driver to determine dependency between classes of business

Inflation and tort costs are almost always considered by agents in the parameterisation of insurance risk dependencies - usually on a qualitative basis - so their effect on capital is implicit. For example, it is common to select class dependency factors based on a framework of high/medium/low dependency levels, where the strength is based on the number of factors - such as inflation - that are judged to impact the classes in a similar way. Excluding inflation from the assessment may not make a material difference to the final choice of dependency levels if there are enough other factors that are common between the classes. Therefore, although this method does allow for inflation, it is very difficult to quantify how much inflation as a factor on its own is impacting dependency and therefore overall capital.

Furthermore, many dependency frameworks are built on a basis that requires statistical inputs which are difficult to tie to real world effects (e.g. degrees of freedom in a t-copula). There is no way to isolate how individual common drivers affect capital unless they are included in the model as drivers.

As for allowances made in volatility parameters, we have not seen enough justification or validation of this method. Validation across the market could be improved by using more SSTs targeted at areas of the portfolio which are most exposed to excess inflation risk. See section 7 for more detail.

6.3.2 Best practice approaches

Parameterisation approaches built on scenario analyses and judgement

We have reviewed approaches that use real world inflation scenarios, amongst others, to determine loss distributions. Scenarios better allow for uncertainties that are not captured in the prior data and where data is not credible or detailed enough to use standard techniques. This approach has the added advantage that it can use more input from around the agency, to derive losses and their expected return periods. They can also more accurately reflect special features of the reserves and the potential outcomes for large and uncertain claims which are subject to legal dispute.

Scenario analyses can be applied to internal data on tort experience as well as externally available data (e.g. references covered in section 3 of the report) to test that the final loss distributions assign an appropriate probability to large claim settlements.

While this is a best practice approach, it is difficult - as it is for many other methods - to unwind how much volatility is arising from inflationary effects. However, if the parameterisation for a class is built on multiple possible scenarios, inflation specific ones can be removed to review the impact on the final distribution. The parameterisation scenarios can also be used to validate the final, empirically derived distribution.

Uplifts to volatility parameters

Many agents use standard parameterisation methods to derive volatility parameters. The process can be enriched by:

- Validating parameters against inflation scenarios developed by underwriters.

- Reviewing initial volatility parameters against output volatility with the effect of other drivers applied to losses (for example other inflation drivers).

This can be used both to quantify the effect of inflation and assess whether uplifts are needed to the chosen parameters. The analysis should ideally exclude the impact of non-inflation uncertainties which are being captured by expert judgments applied to volatility parameters.

Using inflation as a common driver to determine dependency between classes of business

A method we have seen is for class level dependency parameters to be derived using scores assigned to common drivers, which are weighted together to give an overall score that represents the strength of the relationship. The

overall score is used directly to calculate final parameters and can be adjusted to exclude the effect of individual drivers, such as inflation. This allows the agent to easily test the model's sensitivity to all drivers which are included in the dependency framework.

6.4 Explicit drivers

6.4.1 General findings

Common approaches using explicit drivers to model inflation risk are outlined below.

Table 3: Sources of inflation via use of explicit drivers

Source of inflation	Pure	Excess
Driver that shocks claim severity / frequency / inflation index	✗	✓
Inflation indices from the ESG	✓	✗
Inflation indices from the ESG, with adjustment	✓	✓

Driver that shocks claim severity / frequency / inflation index

Parameterising drivers which represent tail events is inherently difficult because the skewness of their effect means a small number of large claims drive experience. Therefore, data is sparse - and often censored - so significant judgement is required to overlay any approaches derived from statistical methods.

The effect of drivers on capital should be sensitivity tested and agents should also consider how drivers link to other risks, so that driver-based events are not independent and do contribute to capital.

A further complication arises where agents use out of the box models from platform vendors which do not offer the functionality that may be required for diver-based approaches as standard. In this case bespoke coding should be considered where appropriate.

Inflation indices from the ESG

Market risk, post diversification, is usually a small component of the capital requirement and therefore the approach to validate the ESG should be proportionate. The level of expertise in-house to perform detailed testing may not be available; so reliance on the external vendors is common and may be appropriate. However, there should be more specific testing of inflation if it is an important risk driver, which should include how it ties to other variables in the ESG and how it impacts the dependency between insurance risk and market risk. In particular the interaction from pure inflation from the ESG and excess inflation modelled in insurance parameters or other drivers should be considered.

The validation of the ESG is an area of development for the market. A common theme we have seen is capital and validation teams only reviewing or challenging the ESG assumptions at a very high level, with there being heavy reliance on the validation used by the main providers such as WTW and Moody's. Some validation reports comment on the movement in ESG variables between versions, however in most cases there is limited independent testing of:

• distributions compared to external data e.g. backtesting;

• assumptions in the tail;

• dependency assumed between ESG variables; and

• limitations in the types of economic scenarios that are present in the output.

Agents could also make more use of internal expertise from investment teams and ensure that inflation is in the scope of the validation (given that it is usually immaterial for investment risk, i.e. might not be a focus area of investment team analysis and validation).

ESG inflation distributions can under-represent the likelihood of meaningful increases in inflation compared to central bank forecasts, as they can be more weighted to recent experience where inflation has been low and stable.

ESGs may also make an inadequate allowance for hyperinflation and scenarios where inflation is high relative to interest rates, which can be assessed by stress and scenario testing.

Inflation indices from the ESG, with adjustment

There are challenges to make overrides to ESG variables, especially when output simulations rather than the model have been licensed. Some variables, such as inflation, may be simpler to adjust than others, however altering assumptions can lead to unintended movements in risk that require corrective adjustments to other parameters.

The link between inflation and interest rates in the ESG is a key one and can make it difficult to achieve meaningful dependency between market and insurance risk and dampen the effect of inflation volatility on insurance losses. Adjusting specific economic variables runs the risk of breaking dependency in the ESG (unless, for example, the variable's distribution is stretched by a fixed factor). Adjusting links in the ESG or making adjustments to get the desired outcome requires routine review and thorough validation to avoid issues in future model runs.

Using an explicit excess inflation driver might be a better way to create systemic losses that contribute to capital and can avoid the issue of having to adjust the dependency links in an ESG. If overrides are going to be made, agents should discuss them with the ESG vendors if possible. Engaging in discussion could make implementation of overrides easier and encourage vendors to build more end-user functionality into their platforms. Overrides should be validated and reviewed every time there is a version update.

6.4.2 Best practice approaches

Driver that shocks claim severity / frequency / inflation index

Best practice is to use specific drivers which are parameterised using input from around the agency and external data; which make reference to real world scenarios. Driver parameters should also consider the extent of inflation already allowed for in the model (e.g. in model loss ratios).

Examples of drivers used by agents:

- Social inflation:

  o as a scenario generated in the model which simultaneously uplifts premium and reserve losses across all years for exposed classes;

  o applied as a claims' inflation index parameterised from ESG medical inflation, which is overlaid as an extra tier of inflation over and above pure inflation.

- Systemic claims inflation driver: Generate scenarios which increase or decrease the inflation index from the ESG to mimic a systemic shock to inflation levels.

Other drivers are used, which implicitly model inflationary effects:

- Recessionary drivers: linking insurance losses to adverse movements in the GDP or asset/equity indices in the ESG, this method can improve the link between market risk and insurance risk for financial and professional classes of business.

- Mis-pricing drivers: as a stochastic scaling factor applied to large loss frequency and aggregate attritional losses to simulate underestimating the rate charged for future business.

- Reserve shocks: which stochastically scale reserves when triggered to mimic an event simultaneously impacting the reserves for casualty or financially exposed classes of business.

Driver-based approaches like these are better at creating a systemic link between classes of business from inflation which can be more easily adjusted compared to relying on insurance risk parameters alone. From the CALM survey results, many agents that use drivers also have an allowance within the insurance risk parameters. The drivers however ease the ability to validate and communicate the inflation effects that they are trying to capture.

Drivers and 'shocks' are usually modelled using skewed distributions such as the Pareto as well as being empirically derived with reference to expert judgment from underwriters, investment managers and external data sources such as ISO and US top court award statistics.

Some agents use entirely driver-based approaches whereby all of the most important common factors impacting classes of business are modelled explicitly. This is instead of more common dependency hierarchy/matrix methods. Individual trends can be parameterised and implemented explicitly as well as easily adjusted and removed for testing. This is a highly flexible approach for risk management and stakeholder communication.

Inflation indices from the ESG

The CALM survey results show that this is the most common approach to model pure inflation volatility, with 86% of respondents making use of an external vendor ESG to capture pure inflation volatility. Using an ESG has the advantage that it creates a link between market and insurance risks because assets and liabilities in the model will be impacted by the same economic variables. However, it is common that, depending on the risk profile, negative dependency can arise between market and insurance risks because of the relationship between inflation and interest rates in the ESG. This is commonly mitigated by linking other ESG variables to insurance risk (e.g. tying GDP to financial line losses). Agents are also able to leverage data, testing and expertise from the model vendors.

Good practice is for the ESG to be owned and reviewed regularly by an Investment team, who will monitor how appropriate the assumptions are compared to internal views of investment risk and utilise their experience to challenge them, including inflation into the scope of the validation.

Using an ESG alone to model claims inflation however is not appropriate because it is by design built on economic inflation assumptions. ESG inflation should be supplemented by other methods to capture excess effects.

Inflation indices from the ESG, with adjustment

It is common for adjustments to be made to variables in the ESG, including to inflation. The 2021 YoA focus areas indicated that 42% of the market make overrides to ESG parameters or outputs.

With respect to inflation, adjustments we see include:

- Increasing mean inflation to be more representative of history and inflation levels post the 2008 financial crisis.

- Increasing inflation volatility to put less weight on the stability in levels observed in recent years and allow for the fact that current low levels of price inflation might mean there could be more headroom for future inflation levels to increase.

These approaches make reference to expertise from internal investment teams, the ESG providers and financial data from external providers such as Bloomberg.

7 Validation

7.1 Recommendations

A common theme we have observed is that validation testing is implicit - i.e. claims inflation is not tested or deep dived explicitly but only in conjunction with premium and/or reserve risk testing, in the same way that many models rely on implicit allowances for excess inflation volatility. Most notably, improvement is needed in the following areas:

1 The validation effort should be proportionate to the materiality of the risk, where materiality is informed by risk ranking. The risk ranking here should not only be informed by model outputs - in particular when the impact of claims inflation cannot be isolated. Agents should also make qualitative considerations, based on the nature of the classes written and their geographical exposure. This analysis is not always carried out and in general the depth of validation testing requires improvement across the market.

2 There should be more challenge of the adequacy of implicit inflation allowances, particularly for excess inflation risk.

3 Agents should make greater use of quantitative testing such as SSTs, RSTs and sensitivity tests. The suite of tests involved should be determined by materiality considerations as well as the modelling approach to claims inflation.

We do not expect many changes to the validation process from agents with low exposure to the risk or those that already use a comprehensive inflation testing framework. Additional work will be required from those which have previously relied on implicit testing and coverage of the inflation. All agents need to assess how commensurate their testing is with the risk and make plans to improve the validation process where necessary. As mentioned above, this should be carried out with reference to a risk ranking.

We expect the validation to be focussed on excess inflation trends (whether they are modelled separately from pure inflation or not), and SSTs, sensitivity tests and RSTs to be tailored to these.

7.2 General findings

As per the figure below, the majority of the market (70%+) cover inflation implicitly when reviewing insurance risk or have not reviewed it in detail at all. The quality of claims inflation testing in insurance risk deep dives is variable and in general we have seen minimal explicit testing, beyond switching inflation drivers on and off. The inflation deep dives we did look at were qualitative in nature by focussing on methodology and did not often employ inflation specific scenario tests or quantitative reviews of the impact.

Figure 11: CALM survey: Frequency of inflation risk deep dives
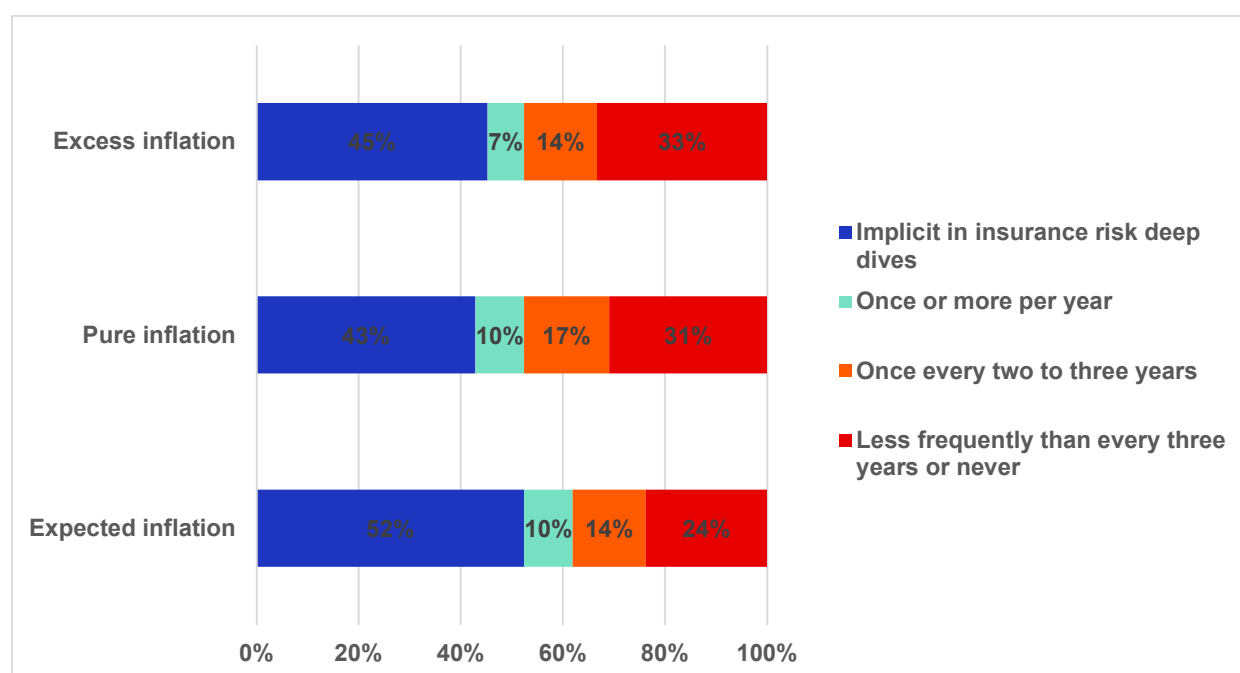
Some agents state that although they do not carry out deep dives into inflation, there are detailed assessments carried out by their pricing, reserving and underwriting teams. While this does test the average assumptions and is in

line with our recommendations in this report to consider consistency with other areas, the detailed assessments in general only cover average inflation – not necessarily test whether the model is adequately capturing adverse inflation movements. So the work can be relied on, however capital considerations need to be wider.

Half of the CALM survey respondents noted they have short to medium term plans to develop the inflation modelling approach and a small number of agents referenced that the validation test plan is being expanded this year to improve quantification of claims inflation and validation challenge.

It will depend on the modelling methodology and parameterisation process as to how claims inflation is allowed for, and how the quantification of the impacts can be obtained. Where quantification of the impact is less certain, more emphasis should be placed on scenario testing or challenging the modellers to make the risk more explicit if that is appropriate.

7.3 Validation approach

It should be noted that some of the approaches and recommendations below could be included as part of the parameterisation process – and that some examples which have been called "validation" here could actually be carried out to support first line justification and derivation of parameter choices. For example, scenarios could be developed as part of a parameterisation approach to test and justify the selected parameters. The line between justification by the first line or validation by the second line should be clarified in the validation policy and will depend for example on whether validation is carried out internally or externally. In any case, it should be ensured that the validation tests and checks are set up independently and that pass/fail criteria are defined by the validator.

Overall, the amount of validation should be proportionate to the level of claims inflation risk the syndicate is believed to be exposed to, given its risk profile. Therefore, it is recommended that validation starts with an assessment of materiality of exposure to claims inflation by class and in aggregate across the business (or by reviewing existing assessments by the first line), and then looks to quantify the allowance of claims inflation to assess the appropriateness of this.

The approach to validate claims inflation should follow the general validation and escalation processes set out by the agent. Findings should be raised where deficiencies are identified through validation. In the short term, if the current capital impact from claims inflation is deemed to be too low, capital add-ons might be necessary to ensure an appropriate level of capitalisation. Validation findings should be prioritised for model development in line with the validation process, so that more material findings are addressed first.

Where claims inflation is deemed to be a material risk Lloyd's expects validators to carry out an inflation specific deep dive. If an inflation deep dive has not been carried out in the last 3 years or the last deep dive falls short of the approaches outlined in this report then this should be prioritised ahead of the 2023 LCR submission. Deep dives should consider the range of testing approaches outlined below.

7.3.1 Materiality assessment and risk ranking

As with all other risks a proportionate approach should be taken to validate claims inflation. The first step should therefore be to establish the materiality of claims inflation risk given the risk profile. Existing risk identification and risk ranking exercises should aid this assessment. Validators should not solely rely on capital model outputs, especially when there are limitations in being able to quantify inflation. It is important to ensure that the risk ranking from the capital model is in line with the expectation of the validators and senior management. As highlighted at the end of section 6.2, model output does not always reflect expectations.

Materiality is obviously driven by claims exposure from different classes (exposure comprising business to be written as well as claims reserves) – but validators should also consider the level of exposure to various claims inflation sources, given the nature of the business written and geographical exposure. For example, validators should assess how exposed the class in question is to e.g. pure inflation or if other sources like social inflation are more important. This should aid in the development of an appropriate test schedule, as testing should concentrate on the classes which are most exposed to the greatest uncertainty in claims inflation.

Finally, validators should consider the nature of claims inflation effects and which are material to be captured in the capital model. In general effects will be more material if they are systemic, i.e. could impact multiple classes at once, and if they represent a long-term trend rather than being a transitory in nature (which could be captured in individual class level volatility picks).

For an agent that writes limited D&O busines and D&O is not an important contributor to capital it is possibly not worth defining a scenario test covering the BLM movement – given the effect is likely to diversify and findings are unlikely to be material. This might be different if the agent plans to expand D&O business in the future. If the agent has a large proportion of casualty reserves and reserve risk is a material contributor to capital, then scenario tests should be run to make sure the capital distribution captures potential deteriorations and the risk that the allowance for inflation in the mean reserves is understated.

It might be helpful for validators to set up a framework by class capturing the materiality, exposure to different sources of inflation and assessment of potential trends.

In general, where exposure to claims inflation is deemed to be material, there should be a greater breadth and depth of validation testing performed.

7.3.2 Validation testing programme

This section will outline some approaches to validation and some specific testing that can be carried out. The examples here in general would form part of a deep dive test schedule for claims inflation testing – agents are not expected to carry out all the tests below annually. Moreover, as mentioned above the principle of proportionality should be applied and agents should assess which testing is most relevant to their risk profile.

The testing should place focus on excess inflation trends. While testing of the ESG is required and should be in line with the agent's validation policy and general requirements for use of an external model, testing excess inflation allowances is in general more material and weaker in the market.

Qualitative review

The methodology and parameter adjustments made to the model to capture claims inflation should be reviewed and understood by the validator, and the appropriateness assessed. Any model and/or parameterisation limitations and improvements should be tracked and fed into future model development. Qualitative reviews should consider whether the methodology is granular and detailed enough to adequately capture the risk, perform value-adding validation activity and communicate model results to the Board.

Qualitative reviews should also consider whether the chosen methodologies are appropriate to model the nature of the trends the business is exposed to. For example, it is appropriate to model trends which are systemic in nature through a mechanism that creates dependency between classes of business (e.g. by using a driver that simultaneously shocks losses from multiple classes or increasing the dependency between affected classes through other means). If systemic effects are modelled via adjustments to insurance risk volatility this may be less appropriate and require challenge to the modelling team and/or a greater breadth of quantitative validation testing.

Quantification of impact

The impact of claims inflation should be quantified as far as possible in a practicable way.

Where implicit allowances have been made, the impact of these should be quantified, but this may not be straightforward:

- If a scoring system has been used to consider different types of dependency drivers between classes for instance, the model could be run using the lowest score for inflation risk.

- Alternative parameterisations for insurance risk volatility could be applied. Rather than re-running the parameterisation process with inflation-adjusted data, which would be onerous, an approximate approach to judgementally scale parameters might be necessary.

- Validators could consider running sets of adjustments through the model in order to quantify a realistic range of impacts (e.g. a low estimate where ESG inflation volatility is switched off, insurance risk volatilities are scaled down, class level dependency is reduced and inter-risk dependency is reduced).

Where quantification is not complete or is highly subjective, a greater breadth of testing should be carried out.

Where explicit adjustments or drivers are used these should be removed and/or switched off. If inflation is modelled explicitly, for example using inflation drivers, sensitivity or other testing should still be used to demonstrate that the model is operating as intended. Using multiple forms of dependency structures within complex models can lead to

dependencies applied at one stage in the model being broken in subsequent stages. It is therefore important to check, for example, that modelling systemic excess inflation leads both to increase in relevant individual class volatility and dependency between classes.

7.4 Example validation tests

The following sections should be read in conjunction with Lloyd's validation guidance[26], which sets out expectations for the different types of validation tests mentioned below. These are examples of tests that we expect to be included in the test plan, for agents with material exposure.

For quantitative testing, validation should review the impact of different assumptions to:

- Output linear and rank dependency between classes
- JEPs between classes
- Contribution of classes to insurance risk
- Contribution of each risk category to capital.

Sensitivity testing

Varying the explicit inflation assumptions can help to assess how sensitive the model is to these assumptions and whether this is expected for the risk profile. In a sensitivity test the results should be compared against an expected size and direction of impact. Further validation should be caried out where the validator's expectation is not matched by the model output.

Sensitivity tests can be applied to the ESG inflation risk series (to test pure inflation) and/or adjustments to insurance risk parameters. For example, inflation risk could be removed, inflation risk volatility could be adjusted and the mean of inflation risk could be adjusted.

Sensitivity type II tests

Plausible alternative claims inflation rate assumptions could be used in the model to improve understanding of uncertainty in the selected assumptions. These can also be combined in order to assess the impact of an SST. Here are some examples we have seen from the market:

- Flex the standard deviation of inflation indices used from the ESG; increasing the volatility is a simple way to mimic the impact of additional excess inflation volatility in the model.
- Defining mild, medium and high inflation levels which are superimposed onto the ESG inflation distributions applied to insurance claims (i.e. uplift inflation from the ESG at some or all durations to simulate a stressed economic environment/simulate an inflation shock).
- Use alternative inflation indices from the ESG, e.g. apply medical or wage inflation in place of price inflation or apply alternative currency weightings.
- Parameterise alternative inflation indices to use on top of or in place of ESG inflation.
- Assuming an amount of expected inflation in the payment pattern by year for the reserves, superimpose alternative assumptions by year to test a range of inflationary scenarios.

Stress and scenario testing

SSTs have a wide range of application in non-life insurance. They are a key tool for testing assumptions underpinning the business plan and capital model, highlighting where risks associated with the plan may be outside of the risk appetite and where risk is not adequately captured in capital forecasting.

It is important to spend sufficient time to identify scenarios and make sure they are easy to communicate; this adds value to the process. Scenarios should take into account the specific risk profile of the business, be well reasoned and be relevant; thinking about only extreme scenarios which are less realistic can make them less useful for

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[26] [19] Internal Model Validation Guidance, Lloyd's of London

engaging with senior management. Using a collaborative approach involving a range of functions and senior management across the business to identify and design the tests is recommended.

The definition of SSTs should be clear and unambiguous in terms of the risk event involved, the time horizon and whether the definition should capture second-order risks (for example in an inflation scenario targeted at reserve risk whether there should be a knock-on impact to premium risk due to mis-pricing). When designing an SST around inflation, inspiration can be taken from external information and events which could have a significant impact on the business (for example refer back to the social inflation trends highlighted in section 3).

SSTs should be assigned a probability to aid the ranking of them, put the impacts into context and to enable review of them against the internal model. This is clearly a challenging and subjective task, which should be performed independently from the internal model process with input from relevant business functions. This will make the testing most useful and encourage discussion to understand the gap between internal, independently assessed results and the model output. Differences may highlight inconsistencies in the approach to define probabilities as well as differences in the view of the same risk, both of which should be explored.

Significant challenges to the SST process include how to translate them into model parameters and also how to recognise the diversification effects between risk categories that are affected. Care should be taken so that these aspects are not ignored in the SST definition and there is sufficient detail in the test to challenge the model. If it is difficult to fully adhere to an SST definition when assessing it in the internal model, the limitations should be communicated in the results. Otherwise the testing will be less meaningful and nuances in a carefully crafted test definition could be lost.

SSTs can be repeated regularly (for example annually) and help to give insights when there have been major changes in the risk profile, for example due to a change in mix of business or duration of claims exposure. While repetition can improve familiarity of the tests with senior management, care should be taken that the exercise does not become too formulaic and there is continual review of the assumptions and their relevance to the risk profile. Understanding how the SST results change over time and whether this reflects perceived changes in risk profile is something else to consider in each iteration of the testing.

Below are observations from SSTs taken from market validation reports:

- Inflation assumptions can be varied from mild to medium to hyperinflation levels, with corresponding adjustments made to investment returns.

- Increased loss scenarios can be designed to impact all classes to test the tail effect of inflation risk, and also to a subset of classes based on senior management's view of the most at risk areas of the portfolio (e.g. a social inflation scenario only applied to US casualty classes).

- Scenarios can be designed specifically around known or potential frequency or severity trends, to test that aggregate losses in the model sufficiently capture these.

- Scenarios can be designed as single large events which have not occurred before, such as major court awards or a series of large awards impacting casualty business – a current topic is how business interruption cover and limits should respond for COVID-19 impacted business chains, which could be settled by the legal system in the UK.

- In the SST design, inflation can be specified and vary by year.

- Calibration of the testing parameters (such as what classes are affected, by what trend and by how much) should involve input from not just the validation team, but from underwriters, claim managers, reserving actuaries and senior stakeholders who have a good holistic understanding of the risk profile.

Examples of SSTs that agents carry out include:

- Increase frequency of large losses to represent trends in increasing numbers of nuclear settlements and increasing numbers of claims going through courts of law (e.g. PPI claims, claims driven by socially motivated movements such as #MeToo).

- Increase large loss severities to allow for inflation in the size of court awards, which show a significant increasing trend as evidenced earlier in the report.

- Stress the strength of dependency between classes and subsets of classes (e.g. between med mal, D&O, excess casualty and professional liability classes which are exposed to trends in the legal system) or adjust explicit inflation drivers in the dependency framework.

- Stress volatility parameters which include an implicit allowance for inflation in them or adjust explicit inflation loads. Volatility adjustments could be informed by deteriorations due to inflation observed in history (e.g. reserve deteriorations from sub-prime mortgage lending).

- Use an inflation-adjusted chain ladder or GLM to project a stochastic range of reserving outcomes under different inflation assumptions.

SSTs can be used to test the impact of plausible but severe assumptions or combination of assumptions on the capital distribution. A failure of a test can indicate that certain combinations of risk are not adequately captured in the model or occur too infrequently, in which case further work should be carried out to assess appropriateness of the test design and/or the model parameterisation.

Cornerstone Research[27] provide various breakdowns of their class action filing data, such as into major trends (e.g. sexual harassment, opioid and COVID-19 related filings) as well as median disclosed losses by year. These could be used to inform trends to test in the model. Agents would need to consider the extent to which individual and cross-class impacts are possible from potential trends. For example, the #MeToo movement had a prevalent impact on D&O claims experience, while the opioid crisis led to losses across product liability, D&O as well as health and professional indemnity insurance because claimants were able to pursue compensation from different parts of the supply chain used by pharmaceutical companies. How a trend could impact different classes of business should be considered in the SST design.

Reverse stress testing

Defining an RST involves identifying scenarios which could result in failure or unviability of the business. It is important for senior management to agree on the definition of failure to be investigated (e.g. whether this is based on event losses breaching the uSCR or events which result in a liquidity strain). Management should have a view of what could cause failure, however it is defined, as well as opportunities for growth and profit.

A starting point can be to consider combinations of events that could occur at low return periods (e.g. 1 In 10 or 1 in 20). This could be based on capital model allocation, if the model is sufficiently reliable here (although it should be kept in mind that making too much use of capital model output at the start could invalidate the test, which is ultimately aimed at independently testing that the tail of the capital distribution appropriately captures expected scenarios for business failure or unviability). Investigating these events could uncover combinations of plausible risks to examine. When considering how the strength of these events could be made more extreme and lead to failure, care should be taken to think about the non-linear relationship between the overall probability of failure and probability of individual events i.e. the effect of diversification. This needs to be articulated in the test design so that individual events and the aggregation of events can be assigned a probability of occurrence.

It can be useful to think about whether similar impacts would be seen across a range of scenarios which resemble the ones under consideration and to test the impact of chosen scenarios using different exposures in the capital model (for example assuming the reserves or underwriting exposure to a key class of business is different).

As per the Lloyd's validation guidance for RSTs, senior management should be involved in deriving events and their estimated return periods for comparison against the internal model. The RST design should specify the loss impact and probability of the RST events for each risk category, considering aggregation effects; second order losses stemming from the main events; objective pass/fail criteria that clarifies how individual risk category and overall risk results are treated; and enough detail to make the test useful, such as what classes of business are impacted and for how long.

For example, the primary risks from a prolonged spike in inflation could be adverse reserve development for material long-tailed classes and the emergence of under-pricing for new business. Secondary impacts could be a fall in investment return and increased exposure to reinsurance default risk.

Lloyd's acknowledges that this is a particularly challenging test to implement given the granularity used in current modelling practices. However, agents are encouraged to think about how an RST could be applied in their models.

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[27] [5] Securities Class Action Filings, 2020 Year in review, Cornerstone research

Backtesting

For pure inflation risk, the ESG inflation rate risk distributions can be backtested against historic inflation rate data by currency. The Bank of England, for example, provides a projection of future price inflation in its monetary policy.

**Figure 12: Bank of England price inflation projection[28]**
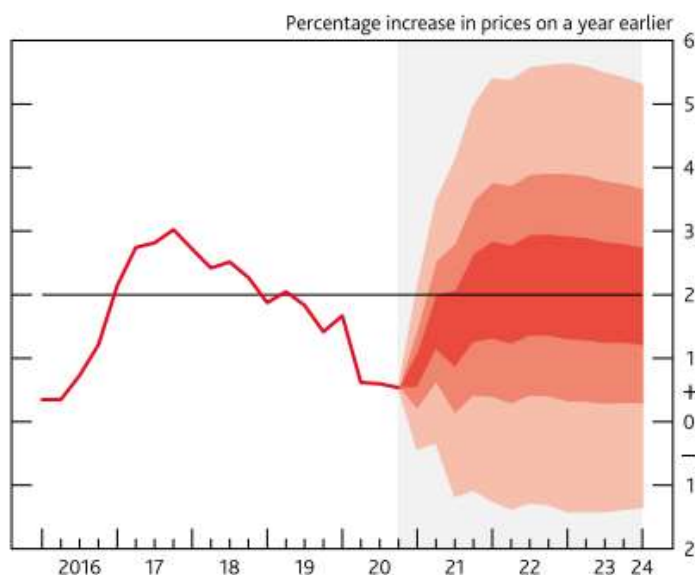
The fan chart depicts the probability of various outcomes for CPI inflation in the future. If economic circumstances identical to today's were to prevail on 100 occasions, the Monetary Policy Committee's best collective judgement is that inflation in any particular quarter would lie within the darkest central band on only 30 of those occasions. The fan chart is constructed so that outturns of inflation are also expected to lie within each pair of the lighter red areas on 30 occasions. In any particular quarter of the forecast period, inflation is therefore expected to lie somewhere within the fans on 90 out of 100 occasions. The remaining 10 out of 100 occasions inflation can fall anywhere outside the red area of the fan chart. See BoE policy for more detail.

For inflation to increase to 5% (i.e. 3% deviation above expected inflation), the projection puts this at a 95% confidence interval or as a 1 in 20 year event. This can be tested against ESG output for UK price inflation. We noted that some 2020 Q2 ESG distributions we saw modelled this as a much more remote event. Therefore, testing such as this is a valuable exercise to carry out.

The chart below shows how realised inflation (UK RPI from the ONS) compares to what the market expected the year before, based on spot curves for inflation from the BoE. This shows how different expectations can be and directly reflects the risk that claims inflation turns out to be different to what is assumed. The chart shows there have been two instances since the mid-80s for inflation to be 3% higher than expected.

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[28] [20] Monetary Policy Report – May 2021, Bank of England

Figure 13: Actual realised inflation (ONS data) versus prior year expectation (UK implied inflation spot curve, one year prior, BoE)
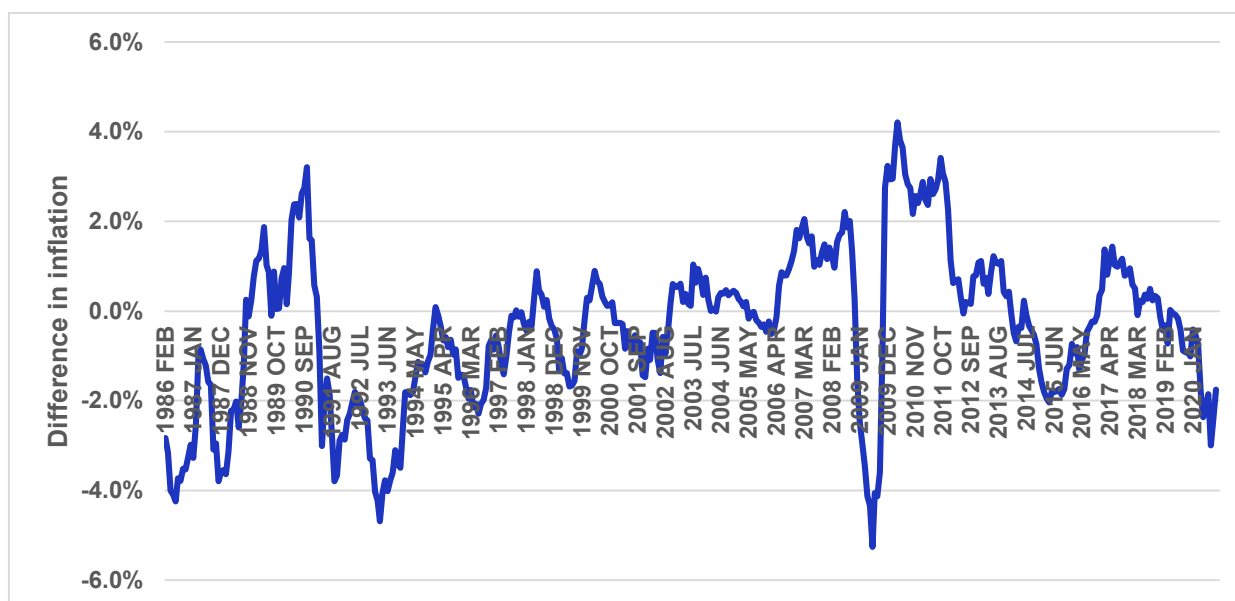
Agents should consider the length of history used by providers to parameterise inflation (which can go as far back as the 1970s for some but be a shorter timeframe for others).

For claims inflation more generally, US tort activity data (e.g. Schedule P and surplus lines data) and company level net combined ratios can provide measures of inflation and market cycle activity to compare against the model. Backtesting data should be specific to the syndicate risk profile and if US data is being used to test non-US exposure, for example due to availability of data/as a simplification, this should be justified.

P&L attribution

The P&L attribution allows prior capital model run outputs to be compared to actual resultsok for the most recent prior calendar year-end. The exercise is carried out at the major business unit level and ideally by class of business. Therefore, it can be used to assess sources of material loss at the class level and the impact of changes in inflation over the year.

8 Appendix A: CALM survey

MANAGING AGENCY

Please select agency name here

Comment

1. How is expected inflation allowed for in the model (i.e. inflation in mean claims)?

Please select an answer

Comment

2. How is "pure" inflation volatility (i.e., price/wage inflation) modelled?

Bespoke inflation model	ESG indices, which may vary by currency or are weighted by currency	ESG indices which are weighted together (e.g. between price and wage inflation) or adjusted	Captured within the dependency structure between classes/years	Captured within the volatility assessment for class level parameters

Comment

3. What is the impact of switching off "pure" inflation in the model, across all currencies (i.e. how would your 2021 uSCR be impacted if you switched it off?)

Please select an answer

Comment

4. How is volatility in claims inflation that is in excess of "pure" inflation modelled?

Explicit driver for specific sources of inflation (like medical, legal costs etc.)	As a common driver used to determine class/year correlation parameters	Captured in the class level volatility parameterisation	Other	Not modelled

Comment

6. Have you made any specific allowance in your model for "social inflation"? By social inflation we mean the increase in claims costs potentially arising due to changes in the behavioural pattern of plaintiffs, resulting in increasing court awards.

Yes - specific allowance in expected claims from Reserving/Pricing teams	Yes - within our volatility parameterisation	Yes - within our dependency parameterisation	Yes - we have a specific social inflation driver in the model	No

Comment

7. Can you quantify the impact of inflation in your model easily?

Yes - for inflation implicit within claims data	Yes - for "pure" inflation	Yes - for excess inflation	For excess claims inflation this would be a very onerous exercise for us.	No

Comment

8. How often has there been an explicit inflation risk deep dive?

For inflation implicit within claims data inputs	For "pure" inflation	For excess inflation
Please select an answer	Please select an answer	Please select an answer

Comment

9. Have you had any validation findings on inflation risk modelling recently?

Please select an answer

Comment

10. Is inflation modelling on your list for model development?

Please select an answer

Comment

9 Appendix B: Detailed questionnaire

1. Approach to Inflation Modelling

Description

Please signpost documents containing documentation of your approach to inflation modelling. This should include economic price inflation as well as the modelling of claims inflation in excess of economic price inflation. If your approach varies by class please provide documentation on the approach for any material classes. Please also provide documentation on the parameterisation of inflation, in particular claims inflation in excess of economic price inflation.

Please note from the capital guidance (section 7.3.8): "Managing agents should be clear in their documentation how the uncertainty around "pure" inflation has been captured (e.g. by applying inflation indices from the ESG to insurance claims), how additional inflation has been captured (e.g. making allowance for the fact that an index like RPI is not representative for claims inflation) and how any other claim trends have been accounted for. "

The documentation provided should outline in particular:
- Which sources of claims inflation have been considered (e.g. economic price inflation, medical inflation, social inflation, legal inflation, other excess inflation drivers)
- The modelling methodology for each source
- The parameterisation approach for each source (e.g., vendor model, claims inflation studies, reserving/claims teams, expert judgement)
- Treatment of inflation in the data used for parameterisation
- All expert judgements involved
- How parameterisation treats the potential for inflation allowance overlapping between drivers and class level volatility and dependency assumptions, if at all
- At what level each inflation allowance has been applied - is there any difference in approach by class; between attritional/large/cat/PPO claims; currencies; underwriting and reserve risk; is it applied to RI retentions and/or other risk types such as operational, market or credit risk losses as a common driver?
- How systemic impacts across years, loss types, classes and risk types are allowed for
- How differences in frequency and severity trends are treated, both in the parameterisation and within the model itself
- Where multiple sources of inflation are modelled, how dependency between them is considered
- Known limitations in inflation modelling.

2. Appropriateness of Inflation Modelling

Description

Please provide documentation showing why you are comfortable that you have sufficient allowance for claims inflation in your model. This can include justification of your modelling approach/parameterisation/expert judgement (from the first line) and validation of your approach (second line). Please include any validation tests that you have carried out with regards to inflation (this could include any appendices you might not have sent with your LCR submission or prior validation reports if relevant; if the tests are already supplied in the 2021 Validation report, please signpost to the relevant sections/tests).

Please note from the capital guidance (section 7.3.8): "Since claims inflation is an important driver for deteriorations of insurance risk across classes, this needs to be appropriately captured in the model. These effects should be modelled explicitly and should create dependency between classes and years, ensuring the systemic nature of the effect is captured. " and "At a minimum, managing agents must document the method selected to capture this dependency, the material expert judgements and assumptions, and the resulting impact on capital. Managing agents who do not model this explicitly on grounds of materiality must provide appropriate justification in taking this approach."

3. Validation of Inflation Modelling

Description

Please provide analysis and outcomes from your most recent deep dive into claims inflation. If there hasn't been an inflation specific deep dive:
- Refer us to other risk category detailed/deep dive tests that covered inflation risk implicitly and / or explicitly;
- Please outline how Risk Management get comfortable with inflation risk and the adequacy of this in the model. This can include model development and testing that is planned for the future

4. Quantification of Inflation Impacts

Description

You have provided a sensitivity test to show the impact of claims inflation on your SCR to Lloyd's as part of your focus area return. Please provide details of further quantifications you have carried out. This should include the impact on uSCR of inflation as a whole (including economic price inflation) and the impact of individual claims inflation drivers other than economic price inflation. This can be in the form of sensitivity testing. You can signpost to validation reports that have this information.

Please note from the capital guidance (section 6.3.2): " If systemic effects (e.g. inflation, mispricing or the uncertainty on premiums) are captured by an uplift in volatility, then managing agents should:
•Explicitly state the size of the uplift for this effect – it is NOT sufficient to include a generic uplift for all effects discussed in this section.
•Run a sensitivity test excluding the effect.
•Validate the impact."

5. Claims Inflation Sensitivity Test Follow up

Description

As part of the focus area return you provided a sensitivity test on future claims inflation. Please provide further information around this test as detailed below.

Please provide further model outputs if feasible, e.g. the impact by risk category; by class for any liability and economically exposed classes; the impact on output correlations with and without the inflation.

It would also be useful to see how tail dependency in your model changes when different sources of claims inflation are removed. Please provide this on a best efforts basis - i.e. model outputs that are readily available. If this is not feasible, please include any validation tests that you have carried out with regards to tail impacts of inflation in insurance risk.

10 Appendix C: References

All of the referenced materials were available at the time of publishing this report in August 2021.

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[2] Ernst&Young LLP (2021); *Social inflation and emerging mass torts: now, next and beyond* [online]; Ernst&Young LLP; Available from: https://www.pathlms.com/cas/courses/28173/webinars/18798

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[9] Data compiled by Shaub, Ahmuty, Citrin & Spratt (2019); [online]; Available from: https://www.casact.org/sites/default/files/presentation/annual_2019_presentations_c-57_stevens.pdf

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[13] Henderson, Richard (2019); *Medical professional liability verdicts: what lies beneath?* [online]; Captive International; Available from: https://www.captiveinternational.com/contributed-article/medical-professional-liability-verdicts-what-lies-beneath

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