Institute and Faculty of Actuaries

Information for Actuaries Valuing Periodical Payment Orders

A Helpful Handbook

by the IFoA Periodical Payment Orders Working Party

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Abstract

Periodical Payment Orders (PPOs) have challenged actuarial professionals as they rose to prominence as a new means of settling third-party liability claims, consisting of regular payments in the future, usually for a claimant's lifetime.

This paper explores how this new settlement method has brought about new risks to consider for actuarial professionals working in Motor and Casualty insurance, or any other line where a claim for future periodical payments may arise. Life contingencies have entered the space of general insurance in a new way. In addition, actuarial professionals have investment risk to consider, and for PPOs the inflation risk is unusual, significant and not currently fully hedgeable.

The paper highlights methods that could be considered for setting important assumptions, including mortality, indexation, investment return and PPO settlement propensity.

For reserving actuaries, the paper explains that the nature of the liabilities does not lend itself to triangulation. Cash flow techniques are needed and actual versus expected results can be analysed for discount-rate unwinding and mortality profit for example. Scenario testing will be important to understand the sensitivity of the results and to explain them to senior management.

Stochastic modelling is considered in the Capital Modelling section, amongst other significant considerations for actuarial practitioners working with PPOs in this field.

Pricing is also affected, as PPOs are a proportion of large loss loadings.

The paper also touches briefly on reporting requirements. This is to help provide some basic background for actuaries interacting with those undertaking financial reporting.

Keywords

PPO, Periodical Payment Order, variable order, valuation, reserving, pricing, capital modelling, risk, mortality, propensity, inflation, indexation, investment return, discounting, cash flow, scenario testing, stochastic modelling, IFRS, Solvency II, reinsurance, reporting.

Important note

This paper is intended to provoke thought regarding actuarial work involving PPOs. It has been written by a collection of actuarial professionals with extensive experience working with PPOs.

The paper has not been written to provide professional guidance or advice for any process, actuarial practitioner or other associated professional. We simply could not provide the sufficient detail required to cover every possible situation involving PPOs.

The PPO Working Party hopes that reading the paper will help provide avenues of enquiry around the key considerations for actuarial professionals working with PPOs, whether new to PPOs and in need of sign-posting, or experienced practitioners wishing to add depth to their thoughts on the area. However, the Working Party cautions that such papers can quickly become out of date and even generic statements may not apply to individual firms or situations. The Working Party does not intend to provide guidance and could not do so effectively through this medium. The Working Party instead encourages actuaries to continue to develop their technical and professional skills in relation to PPOs, and apply their own judgement to their own challenges, and hopes this paper can be of help to actuarial professionals as they do this. PPOs generate complex liabilities that have far-reaching implications for organisations exposed to them and practitioners should seek-out additional support if needed.

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1 Summary and recommendations

1.1 Summary

A member of the PPO Working Party at a meeting in 2014 asked, “what do we actually mean when we say a PPO”? The members then challenged themselves to define what a PPO is, in a single sentence. They approached this from the point of view of the inception of an insurance policy, on which a PPO may later arise. After debate and deliberation, they arrived at:

‘A PPO is a contingent, deferred, whole-life, wage-inflation-linked, guaranteed, impaired-life annuity, where the identity of the annuitant and the size of the annual payments are unknown at policy inception.’ (Periodical Payment Orders Working Party, 2014c, p. 5)

Seemingly exhaustive, even this does not fit all PPOs. For example, some are indexed to the Retail Prices Index (RPI) rather than wage inflation and not all PPOs are for the whole life of the claimant. This definition does, however, set out the main challenges for actuarial professionals working with PPOs.

This paper consolidates the skills and experience of a wide range of actuarial practitioners who, in aggregate, have many years of experience learning about PPOs as they lead thought on this new area. This paper is not professional guidance or advice. Instead, this paper sets out ideas to provoke thoughts on assessing risk, modelling it and communicating it for actuarial professionals working in reserving, capital modelling and pricing.

It starts with a discussion of the background to PPOs and the risks associated with them, before moving on to specific discussions of the issues they present for data gathering and assumptions setting, best estimate valuations, capital modelling, pricing and financial reporting.

The Courts Act 2003 and subsequent court decisions defined the current form of PPOs, igniting a new challenge for general insurance practitioners. Not simply annuities, and certainly not general insurance risks, PPOs still provide a challenge today, especially for those encountering them for the first time and also for more experienced practitioners.

This new settlement method has brought about new risks to consider for actuarial professionals working in motor and casualty insurance, or any other line where a claim for future economic loss may arise in the UK.

Life contingencies have entered the sphere of general insurance in a new way. PPO claimants, upon whose life the payments are contingent, typically have brain and spinal injuries. The measurement of impairments to life expectancy from these conditions had not been explored extensively by actuarial professionals previously, and, due to lack of data, actuarial research is currently in the early stages of development. This makes it an even greater challenge for general insurance actuaries unfamiliar with longevity risk. There is risk from the level of mortality, projected trends and the inherent volatility of sometimes very small portfolios, where the difference between the life expectancy and the actual survival period can be very different.

As a relatively new settlement method, the propensity of PPOs is highly uncertain and presents a risk in itself.

Other risks, more common to life insurance, are important for PPOs owing to the very long expected duration of typical cases. Actuarial professionals have investment risk to consider, and for PPOs the inflation risk is unusual, significant and not currently fully hedgeable. There are two inflationary pressures acting: the indexation of periodical payments; and the inflation acting on the initial payment amount between the loss date and date of sealing the order, which has additional considerations beyond indexation reference, such as the attitude to which future losses should be included to indemnify the claimant.

Some PPOs also have an unusual risk written into them. They can allow for a change in the annual payment separately to periodical indexing, where a predefined event triggers the right for these amounts to be reassessed. This is often referred to as a variable PPO.

Long durations also pose further risks from the extended time periods: the length of exposure to counterparty default risk is longer; and administration is over longer timescales and may have implications in setting claims-handling reserves for expenses.

Being complex and relatively novel, additional operational risk arises from the existence of PPOs. PPOs require additional data to be captured.

General considerations for gathering data and setting assumptions for PPO valuation models highlight that economic assumptions are likely to be linked to each other, and cannot be set in isolation. Other assumptions may also be interlinked. This paper highlights methods that could be considered when setting mortality assumptions, some of which may become more feasible as time progresses and more data becomes available, both internally and from external sources such as industry data and other jurisdictions.

From a reserving perspective, it is important to remember that the nature of the liabilities does not lend itself to triangulation. On top of bespoke general insurance methods, for example determining propensities for claims to settle as PPOs, it is important to value the PPO amount using cash-flow techniques. Cash-flows allow for more explicit discounting as well as the timing and value of reinsurance recoveries. Keeping track of what proportion of PPOs is already reserved for in claims system estimates and accompanying projections is also an important challenge that the reserving actuary must overcome.

Models can be constructed with different levels of complexity. Regardless of whether a relatively straightforward deterministic cash-flow model or a complex stochastic model is used, it should allow for reinsurance arrangements that are in place, mitigating risk by transferring it. This can be a complex area to understand, as it is common for treaties to have indexation clauses that will interact with the periodical payments.

No estimate would be complete without checking the sensitivity of the calculation and applying real-world scenarios to highlight risks.

Common to chain ladder reserving, but determined very differently, the actual-versus-expected results can be analysed for discount rate unwinding and mortality profit, for example.

The paper also explores the basic considerations for modelling a range of possible outcomes in the capital modelling section. Stochastic modelling is considered, with the need to balance parsimony with sophistication. Again, stress and scenario testing is an important consideration for validating models that have been created, especially since PPOs present accumulations of risks, dependencies between them and may need to capture behaviour over relatively long time-horizons compared to other general insurance risks.

Pricing is another area in which PPOs should be considered. Large-loss loadings may need adapting to allow for PPOs. Estimates of the propensity and uplift can be made to help assess this aspect, not forgetting key interactions such as those between reinsurance and capital. Pricing PPOs is obviously a more significant issue for inwards reinsurers of motor and other casualty business.

Common to all actuarial work, but essential in a growing, fairly new liability, is the importance of clear communication. This includes informing users on the limitations of work. For example, a capital model under a one-year time horizon may give a much reduced sense of the level of risk to ultimate. The clarity and straightforwardness of communication is essential in gaining buy-in when taking decisions which lead to increased liabilities or acknowledgment of higher risk in a firm. Both of these may be essential for a firm's long-term financial strength.

Consequently, the paper also touches briefly on reporting requirements. This is to help provide a start for actuaries interacting with those undertaking financial reporting. The main learning is that PPOs can again lead to new requirements. These requirements may differ for different financial statements, with two obvious and common distinct types being statutory and regulatory returns. Furthermore, it is important for those working in reserving, pricing and capital modelling to understand how their work will affect the financial results of their company or client if they are a consultant. Increased communication with financial reporting professionals may be needed to aid understanding on both sides. Requirements will vary depending on each reporting basis and the sanctions and consequences of inaccurate financial statements can be very severe.

This paper is just a starting point for actuarial professionals working with PPOs. With the valuation of PPOs often being highly sensitive to the assumptions, it is important that practitioners continue to build their skills in order to gain a comprehensive understanding of the liabilities. PPOs will evolve as a settlement method over time, so actuarial practitioners will need to stay aware of developments arising and act on them accordingly.

Given the long-term nature of the liabilities, professionalism and ethics are also very important. Most people reading this paper have a strong chance of retiring before the liabilities they model are run off. The long-term implications for the adequacy of the reserves and the business strategy should be considered when working with PPOs, as the claimants, fellow employees and company shareholders may all be depending on practitioners responsibly innovating to accurately model these relatively new liabilities for many years to come.

1.2 Recommendations

As with any new area, the recommendations for actuarial practitioners working with PPO liabilities revolve around increasing their knowledge of the nature of the liabilities and informing their stakeholders about PPO risks in the context of the firm's wider business.

This includes the actuarial practitioner:

- increasing their knowledge on the features and risks of PPOs, and we hope they find this paper useful as a starting point;
- considering the most appropriate method of modelling PPOs in context of the business model and risk profile of the firm. Depending on materiality, this will normally mean using cash flow models, which are uncommon in general insurance;
- communicating the risks of PPOs to key stakeholders including the administrative, management or supervisory body of the firm;
- keeping up to date with developments in the external environment, for example the impact of legal changes; and
- proactively working with connected practitioners and in particular life-insurance actuaries to support each other, for example supplying cash flows and risk information to asset management teams, working with accounting practitioners preparing financial statements involving PPOs, or working with claims professionals to understand the nature of the liabilities.

In order to provide future generations with greater mortality data on PPOs, we urge insurers to start classifying large losses and PPOs using the PPO Injury Classification developed by the PPO Working Party and industry partners. The classification is of the severity of claimants' injuries and the degree of future care they may require. Please see section 11 for a link to both further information and the classification system itself.

PPOs also challenge an actuarial practitioner's professionalism with a requirement to balance stakeholders' needs against a background of very long duration liabilities which exist to support individuals that have suffered life-changing injuries and need care for the rest of their lives.

Continued professional development in this area is therefore important, in terms of keeping up to date with thought leadership on technical actuarial modelling of PPOs, keeping abreast of changes in the external environment and continuously taking into account the principles of the Actuaries' Code.

2 Document organisation and scope

2.1 Document organisation

All actuarial professionals can benefit from the background covered in section 3 and description of risks in section 4.

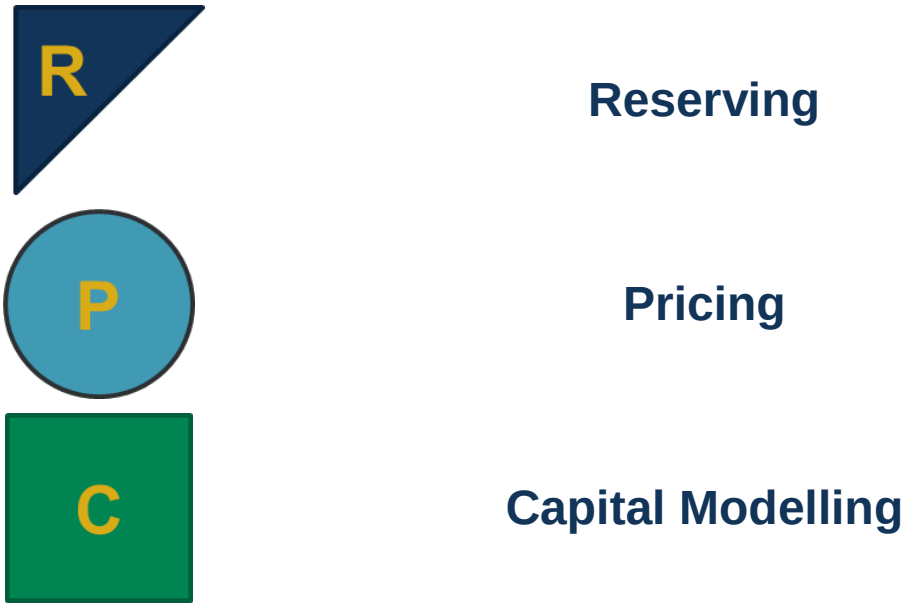
Specifically, **reserving** topics are covered in:

- Section 5 investigating data requirements and assumption setting;
- Section 6 exploring valuation techniques; and
- Section 9 regarding reporting.

For **pricing** practitioners, on top of the background and risk overview there is a dedicated discussion of pricing issues in section 8. In addition, section 5, covers assumption setting in more detail.

There is also separate discussion of the issues which arise for those working in **capital modelling** in section 7. In addition, section 5, explores data requirements and assumption setting for PPO models in general in more detail. Section 9 includes regulatory reporting.

To highlight which area is being covered in each section, we have used the following icons at the start of each section:



2.2 Scope

This paper is primarily intended to cover the valuation of PPO liabilities in reserving, capital and pricing modelling. Although assets are commented on in regards to the risks of assets and liabilities moving independently, the paper is not intended to cover considerations on the asset side of the balance sheet such as detailed exploration of appropriate investment strategies and asset-liability management. Further information on this can be found elsewhere including in a paper written by the PPO Working Party (Periodical Payment Orders Working Party, 2014a).

In addition, the starting point of the paper is to assume that any large loss metrics used to build up PPO reserves have been reserved for adequately. This paper does not seek to discuss methods to project large losses in general.

The paper is specifically focussed on PPO liabilities arising from UK insurance policies, and does not discuss similar liabilities which may arise in other jurisdictions. While there is a bias towards the considerations relevant to direct insurers, the majority of the issues discussed are equally applicable to reinsurers.

3 Background

A PPO is an alternative means of settlement of a claim compared to a traditional lump sum. A PPO can be used to settle a claim for future liabilities that are due to be met by regular payments, in place of, or in combination with, a lump sum.

3.1 Legislative background

In the UK, before PPOs, structured settlements had been in use since 1989 (Williams, et al., 2005, p. 5). With structured settlements, part of a claim is settled as a lump sum and part as a recurring payment. The Damages Act 1996 (Her Majesty's Stationary Office, 1996) gave the courts the power to order a structured settlement, if both parties agreed. Section 100 of the Courts Act 2003 (Her Majesty's Stationary Office, 2003a) was implemented on 1 April 2005 and permitted courts in England, Wales and Northern Ireland to impose periodical payments as part of a settlement, even if neither party consented to it. The explanatory notes to the Act set out the aim of the legislation, 'to promote the widespread use of periodical payments as the means of paying compensation for future financial loss in personal injury cases' (Her Majesty's Stationary Office, 2003b, p. 224).

Whilst Scots law at present differs in regards to the *imposition* of PPOs from that of England and Wales, the Scottish Government has stated that they intend to 'provide Scottish courts with a power to impose a periodical payment order and to vary such orders in the future' (The Scottish Government, 2013). In practice the imposition by courts of PPOs has not been extensively exercised, with only about 6% of the cases decided upon by the court being settled by way of a PPO, based on insurance industry data at the end of 2013 (Periodical Payment Orders Working Party, 2015a). This implies that most PPOs are agreed out of court before being sealed.

Since the landmark Thompstone case (Court of Appeal, 2008) and stock market crash in 2008, PPO settlements have become commonplace. The Thompstone judgement allowed index linking of the annual payments to care workers' wage inflation instead of the historically lower RPI, making PPOs more attractive to claimants. At present it appears that they will remain an important method of settlement in the future. The Ministry of Justice's second Discount Rate Consultation Paper for use with the Ogden tables issued on 12 February 2013 asks whether there are any issues relating to the "possible encouragement of the use of periodical payments" or whether the present level of usage of PPOs "is appropriate and no change is necessary" (Ministry of Justice, 2013).

Further information on the legal background can be found in earlier papers from the PPO Working Party, including the 2010 GIRO Paper (Periodical Payment Orders Working Party, 2010).

The legal framework that defines PPOs has changed over the years. Further changes in the future can clearly have profound effects on the propensity of claims to settle by means of a PPO and their subsequent value.

3.2 Features of a PPO

The description of the features of a PPO that follows is based on the PPO Working Party's 2010 GIRO Paper (Periodical Payment Orders Working Party, 2010).

Although PPOs can be used to settle any claim resulting from future economic loss, most orders awarded to date are for a subset: future care costs, with case-management costs frequently included. Large future care costs tend to arise as a result of brain and spinal injuries. Typically, claims settling with PPOs include an initial lump sum element to cover large upfront expenses, such as setting up appropriate accommodation, as well as future economic losses not settled as a periodical payment. It is quite common for economic loss and loss of earnings to be settled by lump sums rather than periodical payments. This gives flexibility in award levels.

The amount of the periodical payment will reflect the level of the future economic loss covered by the order and the needs of the individual claimant. The initial award is adjusted in future periods in line with changes to a specified index or survey, as detailed below.

The length of time a PPO specifies payments to continue will vary by head of damage. The claimant is generally eligible for future care costs for the remainder of their life. The payments in the order can be structured to reflect the changing needs of the claimant. An example is a stepped PPO: this will include a specified change to the award, at an identified future date. The change in payment amount could be to reflect the ageing of key carers, such as parents or spouses, or a greater need for care in old age. Economic loss or loss of earnings is likely to be paid up until retirement, or death if earlier. In cases where there is a fatality, periodical payments to dependants are likely to be set up until each dependant reaches a particular age.

Where there is uncertainty in the future course of a condition, the PPO may be a variable order, which either allows claimants to seek additional payments if a pre-specified trigger event occurs as a result of the original accident or the potential to reduce the amount if the condition improves in a pre-specified way. This is different to a lump sum settlement alternative, where such protection is not usually part of the settlement.

The size of the award will take into account any contribution made by the local authorities. Where there are such payments, some insurers decide to pay all of the costs and require monies paid by the local authority to be repaid, whilst others pay the amount net of local authority funding. In the latter scenario, the PPO may include a review clause or indemnity guarantee against the possibility statutory funding is reduced or withdrawn at a later date.

A PPO is typically set up as an annual or semi-annual payment, payable in advance. To receive the payment, the claimant or claimant's representative must provide proof of life, usually at least annually. On the claimant's death, overpayment can be returned to the insurer, though due to the sensitive nature of such requests, insurers may need to assume differently.

Indexation

So far we have described the payments in real terms at the point of settlement. In practice, payments are index-linked in nominal terms. The Courts Act 2003 originally allowed for payments to inflate annually, in line with the RPI index. This would allow insurers to match the liability by purchase of an RPI-linked annuity or other RPI linked assets. Since the Thompstone case (Court of Appeal, 2008) where this feature was successfully challenged, wage-based indices can be used instead. A number of indices have since been used. This made PPOs more desirable, as wages should be a better proxy for inflation of the care costs, which in the past have typically increased faster than prices.

The most popular index in use so far is that selected by the judge in the Thompstone case: the Annual Survey of Hours and Earnings (ASHE). This is undertaken annually by the Office for National Statistics (ONS). The survey includes a number of sub-codes, detailing the level of earnings for specialised professions at a number of percentiles. PPOs have generally provided for the cost of care. These have usually been linked to sub-code 6115 of ASHE: care assistants' and home carers' earnings. These workers will typically be those helping claimants with a combination of their personal needs, mobility and meal preparation. A percentile is selected in the order, consistent with the experience and hence remuneration of the carers required. ASHE reports in a number of formats, such as hourly earnings and annual earnings. PPOs settled to date have typically been linked to the hourly earnings rate. For example, the 80th percentile of the provisional 2015 estimate for gross hourly pay for sub-code 6115 was £10.38 per hour, from an estimated population of 835,000 care employees (Office for National Statistics, 2016b). This is lower than the 80th percentile for all employees of £19.75 per hour, from an estimated population of 25 million employees (Office for National Statistics, 2016a)

Sub-code 6115 of the ASHE has not been straightforward to index payments. It is a survey rather than an index, and is consequently less stable as it averages over a less complete sample. Furthermore, in 2010 the ONS as part of its ten-year review of categories sub-divided 6115 into 6145 and 6146, relating to care assistants and home carers salaries and senior care worker salaries respectively. Realising the importance of the category the ONS continued to publish ASHE 6115 on the old basis. While the ONS has committed to publish it for the foreseeable future, the index may not be available for the full duration of PPOs in payment (Office for National Statistics, 2011).

It is possible for other indices to be named in orders, where agreed by both parties or imposed by the judge. These may be different ASHE sub-codes that relate to the nature of the award. In addition, awards have been made linked to RPI or in some cases a fixed annual increase has been agreed.

Relatively smaller costs included in the annual payment, such as case management costs, may have indexation applied at the same level as the principal head of damage or with reference to a different, more appropriate index.

The processing and updating of the annual amount following the publication of the survey, the costs of ascertaining any further medical reports and obtaining proof-of-life checks are continuing costs that are in addition to the payments themselves.

Table 1 – Example PPO claim breakdown

This table shows a possible breakdown of a PPO with no adverse features, which could be for example a complex pre-accident medical history. The example case is for a person aged 22-year-old at the time of the accident, who now has tetraplegia having suffered a complete spinal injury at the C4/C5 vertebrae (PPO Injury Category S2). Settlement took two years, so there are two years of past losses. Future losses assumed to age 70 on an impaired life expectancy basis. The impaired age impacts the non-PPO future losses which were calculated using a 2.5% discount rate multiplier. Amounts are additional costs beyond those incurred if the accident had not occurred.

Indemnity	*Amount (£000s)*
Lump-sum based payments	
General damages and interest	275
Special damages	
Gratuitous care	40
Case management	50
Paid care	70
Earnings	40
Vehicle purchase	50
Equipment	75
Miscellaneous	100
Future Losses	
Earnings	450
Accommodation costs	645
Therapies	95
Aids and equipment	475
Motoring expenses	240
Electronic aids	200
Holidays	200
Costs and NHS Charges	550
TOTAL Lump Sum	3,555
Periodical payments for life	
Care (based on c. 12,000 hours p.a.)	215
Case management	15
TOTAL Annual Payment p.a.	230

This table highlights that a practitioner should not only consider the PPO risk, but where a claim is unsettled, there are risks that any one of the heads of damage could be affected by legal changes or developments in the prevailing claims environment. There remains the risk that additional heads of damage could emerge.

3.3 Prevalence of PPOs

In the UK, at the time of writing, there are PPO settlements in payment for motor, public liability, employers' liability and clinical negligence claims. In theory PPOs can arise on any policy where there is an element of liability cover, including household cover. In practice low liability limits might limit the attractiveness of PPOs compared to lump sums. A lump sum is a discounted value of future payments and once invested may provide a total sum that is greater than the limit of indemnity after the settlement, assuming lump sums are discounted at positive rates of interest. A PPO payment stream is not discounted and so will reach the limit sooner.

There is wide variation in the prevalence of PPOs both by class of business and by insurer. The propensity for a large claim to settle as a PPO has been higher to date on motor than on employers' liability and public liability products. This may be due to motor cover being unlimited in the UK and the previously discussed limits of indemnity for Employers' Liability and Public Liability.

The prevalence of PPOs is also highly influenced by the market environment. As PPOs are indexed, if there are concerns that inflation may be higher than is embedded within the Ogden discount rate then a PPO may be preferred, all else being equal. Also, as the claimant receives the payments periodically, rather than a discounted lump sum, PPOs may be preferred if the investment returns embedded within the Ogden discount rate are higher than is achievable on the investment markets for the claimant's attitude to risk. Consequently, it can be seen that the attractiveness of a PPO to a claimant will also be heavily dependent on the Ogden discount rate, which can be at odds with short-term economic conditions and concerns.

Other jurisdictions outside of the UK settle claims using various forms of periodical payments. The exact nature varies by country and also by product within the country. An annual amount that increases with inflation is paid in some countries and in others the required care costs are reimbursed. The PPO Working Party plans to publish a website provides its understanding of how several different jurisdictions settle claims soon. This will be available on the Working Party's website, as provided in section 11.

3.4 Initial actuarial response

Since the introduction of PPOs, actuaries have continued to develop the sophistication of their models used for reserving, capital modelling and pricing for PPOs.

In reserving, the initial response was to use life techniques to value settled PPOs for the purpose of setting the reserves. Alongside this, models for capital analyses have developed in more recent years as consideration of the impact of these long-term liabilities on capital requirements has increased. Developments in pricing of direct business for PPOs has been slower, as large-loss loadings are often very uncertain, as they are from an unknown third party and actual experience is volatile.

Reserving models of PPOs have developed over time. The distortion that PPO claims introduced to claims triangles forced practitioners to separate out these claims and consider

them independently. The emerging changes to the regulatory environment, namely Solvency II, crystallises this requirement.

Initial reserving models generally used an annuity certain approach, typically taking into account:

- Life expectancy – based on medical evidence to provide the expected length of payments;
- Future inflationary and stepped increases;
- Future investment returns; and
- Indexation clauses within the reinsurance treaties.

The approach to potential future PPO claims was more varied. Many relied on claims handlers' or solicitors' advice to identify future PPOs, based on the severity or type of claim. The approach to calculate reserves for future PPOs used a combination of expected future numbers of large claims, the proportion of large claims expected to settle by way of a PPO, and the uplift to cover the higher PPO costs arising from real discount rates being lower than that prescribed to value lump-sum settlements, namely the discount rate prescribed for use with the Ogden tables, currently at 2.5% p.a. Allowances for pure IBNR PPOs (those that at the point of valuation have not yet been reported) were not common historically, but have become a consideration in more recent years. A loading is often applied either in conjunction with the potential future PPOs currently identified as large claims or separately.

Over time, the models of PPO liabilities have moved from an annuity certain basis, to approaches using probability-weighted mortality, and adjusted life tables. Whilst we can only speculate as to the reasons for this, it is likely that the possibility that over time, if the claimant lived longer than initially expected, the two reserve estimates would materially diverge may have contributed to the trend. When cases do live beyond their life expectancies, probability-weighted mortality would more accurately reflect the reserve required and the expected reinsurance recovery.

3.5 Growth in PPO reserves

Each year, newly settled PPOs are added to prior years' PPOs already in payment. At present there have been few deaths amongst PPO claimants since 2008, when PPOs first became a commonly used method of settlement. This is in line with expectations. It will be many decades until the flow of new settlements is balanced by older PPOs ceasing to be paid. This means that the majority of individual insurers should expect that their PPO reserves will grow over time, and this should be reflected in their business plans. As the proportion of reserves held for PPOs grows relative to overall claims reserves, general insurers' balance sheets may start to look more and more like those life insurers (Periodical Payment Orders Working Party, 2014a).

4 Risks

4.1 Overview

The risk profile of PPOs has features that are not typically seen in other general insurance liabilities, or that are not seen to the same degree. It is important that this is communicated clearly by actuarial practitioners. A firm's administrative, management or supervisory body need to understand the risks their firms are exposed to, recognising both the current risk profile and how this might change in the future. This will enable them to make informed decisions about their risk appetite, risk mitigation strategies, and ultimately make a risk and reward assessment of their participation in business lines which can be affected by PPOs.

We consider the risk profile of PPOs below, with a focus on risks that are either not present, or are less significant, for more typical general insurance liabilities. The risks we shall discuss in this section are:

- Longevity risk;
- Propensity risk;
- Inflation risk and indexation risk;
- Interest rate risk and other market risks;
- Variable orders;
- Counterparty credit risk;
- Operational and expense risk; and
- Additional considerations.

This is by no means an exhaustive list of all risks that an insurer with PPO liabilities should consider, but provides a structured way in which to consider the key risks arising from PPOs. Actuarial practitioners working on PPOs may wish to engage with colleagues responsible for an insurers risk identification processes and ensure that PPOs are being appropriately considered.

Furthermore, although discussions of risk often revolve around the downside, there may be material upside risks on PPOs. Claimants may survive for shorter periods than expected, propensities may fall, and inflation may be lower than expected. With such long-tail risks, at a relatively early stage in there emergence as a settlement method, PPO valuations are likely to be materially different from the ultimate result, and this could be in either direction.

4.2 Longevity risk

Longevity risk is the risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level, trend, or volatility of mortality rates, where a decrease in the mortality rate leads to an increase in the value of insurance liabilities (European Insurance and Occupational Pensions Authority, 2009, p. 5).

Once a claim is settled as a PPO, the term of future payments is contingent on the claimant's survival. The longer the claimant lives, the more the insurer has to pay. This introduces longevity risk, which is not a typical feature of general insurance liabilities. Longevity risk is a common feature of annuity contracts, and consequently data and research on longevity is available. However, PPOs have characteristics that would be considered atypical for conventional annuities and hence have their own longevity considerations. In particular, PPO claimants are typically significantly younger than conventional annuitants. The average PPO claimant is around 35-40, but claimants can be in their teens or younger (Periodical Payment Orders Working Party, 2015a). In addition, the nature of their injuries means that they often have an impaired and hence reduced life expectancy compared with the standard population.

Impaired lives referred to in the context of life insurance products do not typically involve brain and spinal injuries. The term instead usually refers to people who have chronic conditions, such as heart disease, diabetes or cancer and usually the products are for older lives than PPOs. This makes PPO longevity risk unusual and uncertain, and consequently risk transfer to a third-party may be significantly more difficult and costly.

Longevity risk can be decomposed in a number of ways. For the purposes of the discussion in this paper, longevity risk has been split into three sub-risks:

- **Level risk**: the risk that the base mortality rates have been estimated incorrectly at the outset.
- **Trend risk**: the risk that expected future mortality changes have been estimated incorrectly.
- **Volatility risk**: the risk that, even when the base mortality rates and mortality trend have been estimated correctly, individual life spans could still deviate from the average life expectancies.

Level risk

Level risk in the context of longevity risk refers to the risk that the estimated current mortality rates for a specific individual are incorrect.

This risk is influenced by the approach taken to estimate base mortality rates for PPO claimants. There are three broad approaches that could be adopted:

- Estimating a set of *standard* mortality rates for the entire population of *potential* PPO claimants, ignoring the impact of their injuries. Allowances for the impact of their injuries on life expectancy then need to be applied on a claimant-by-claimant basis.
- Estimating mortality rates individually for each claimant, utilising the available medical information.
- Estimating a set of mortality rates for the entire cohort of PPO claimants (or some relevant subsets) taking into account the impact of their injuries.

Estimates of standard mortality rates for the pool of potential PPO claimants

A typical starting point for producing base mortality rates will be to consider those derived from a suitably large and representative cohort of individuals, for example the population of a specific geographical region, such as England and Wales. Despite the large sample sizes involved, these mortality rates are still subject to estimation error. In particular, at very old ages there are very few data points and the mortality rates will consequently be fitted to sparse data.

Selecting an appropriate base table is itself a matter of expert judgement. There are a number of different mortality rates predicting the mortality of various population cohorts in the UK. There is no guarantee that any single set of mortality rates will appropriately describe the population of potential PPO claimants, even before consideration of the enhanced mortality caused by their injuries. Actuarial practitioners should consider the scope of adjustments: do they cover potential biases towards the demographics of PPO claimants, socio-economic differences between PPO and lump-sum-only and so on? If not allowed for, how much risk does this introduce?

Estimates of individual impairment for PPO claimants

Claimants who are awarded PPOs will typically have suffered significant and quite specific brain or spinal injuries (Periodical Payment Orders Working Party, 2010, p. 70), which means that it is often the case that the claimant is expected to have higher mortality relative to a member of the general population.

Often during the course of a claims settlement, medical opinions are sought on behalf of both the insurer and the claimant in order to determine the estimated life expectancy of the claimant, taking into account the injuries sustained. Brain and spinal injuries can often be very specific to the individual, and consequently estimates of the level of impairment to life expectancy often vary significantly between different medical practitioners. Given that insufficient volumes of PPOs (or indeed large bodily injury claims) have been tracked over a sufficiently long period, there is no clear body of data from which we can fully understand the true level of impairment attaching to any particular level of injury. Estimates given by either side may therefore

fundamentally under- or overestimate the levels of impairment. It is not uncommon for the two sides to have differing medical views on life expectancies. Actuarial practitioners should be mindful of the risk that, given the small body of research on which medical professionals are reliant in forming their estimates, the potential for this estimation error to be systematic is high. Furthermore, the impact of potential future changes in mortality rates (see the section on Trend risk below) may not be considered fully in any initial life expectancy assessments provided by medical professionals.

As discussed in section 5.5, there are also a number of different technical methods which can be used to adjust mortality rates for unimpaired lives to allow for impairment (Periodical Payment Orders Working Party, 2010, p. 71), each of which have advantages and disadvantages that the actuarial practitioner should be aware of.

As PPO claimants continue to age, it is not necessarily the case that the original assessment of impairment – even if correct – will continue to be appropriate. The claimant's medical condition may change over time such that either their mortality improves or deteriorates relative to the original assessment. The ability for an insurer to obtain up to date medical information on the claimant will depend on the terms of the court order. In cases where it is not possible to obtain updated medical information, actuarial practitioners should consider carefully how to reflect original medical information that could be significantly out of date. In cases where there is the possibility to reassess life expectancy, there are often limitations concerning either the number of times or the circumstances in which it can occur. These will need to be considered on each case before updates are sought - they may be even more important over the many years of run-off for reinsurance and indeed corporate transactions.

Estimates of mortality rates specific to PPO claimants

In order to mitigate the risks associated with reliance on medical opinions, an alternative approach is to construct a set of mortality rates that are suitable for the whole population of PPO claimants, or relevant subsets. This implicitly takes into account the impact of their injuries on mortality rates.

This approach does however have significant challenges gaining sufficient data. When life insurers estimate mortality rates for their annuity portfolios, they have access to industry-wide mortality rates and often have statistically significant death data of their own to fit appropriate mortality base rates. However, there are no specific sets of mortality rates readily available for PPO claimants or for individuals subject to the type of severe brain and spinal injuries typically suffered by PPO claimants in the UK. The number of PPO claimants in the UK is very low compared to the number of annuities written by life insurers, and it is likely to be many years until there are sufficient data points to enable any statistically robust set of mortality rates to be produced and even then, there may be insufficient data.

There are datasets available from other countries that can be analysed and used to help estimate mortality rates for individuals subject to the types of severe brain and spinal injuries typically suffered by PPO claimants (Periodical Payment Orders Working Party, 2014b, p. 142). This, however, introduces additional basis risks due to a mismatch in relation to geographical and socio-economic factors, between the specific nature of injury types, and in the mixes of claimants by age and sex.

Trend risk

Trend risk refers to the uncertainty in estimating the future trends in mortality rates. General population mortality has been subject to significant improvement over time, and most forecasts anticipate further improvement in the future (Office for National Statistics, 2016e). As well as allowing for the expected level of improvement in the future, actuarial practitioners need to consider the uncertainty associated with estimating future mortality rates.

Forecasting future mortality improvements for the general population is a subjective exercise, relying heavily on expert judgements. As previously commented, PPO claimants are often much younger than typical annuitants, introducing the need to forecast mortality improvements significantly further into the future than required by most life insurers and for a greater range of ages.

Future mortality could easily become lower both suddenly and beyond projected trends, for example if a cure for dementia was found or cancers eliminated. The opposite effect is also straightforward to conceive: world wars, lethal pandemics or the failure of antibiotics would all increase mortality. Not each would affect PPO claimants in the same way as the general population. An illustration is war and a failure of antibiotics, with the former unlikely to directly affect claimants, as they would not be fit enough to fight, and the latter may affect them more, as being bed-bound with more frequent visitors for care can increase infection rates.

Additionally, focusing on PPO claimants, medical advances related to specific brain or spinal injuries could suddenly significantly increase life expectancies for PPO claimants. Changes in social care regimes may also change mortality trends for PPO claimants.

Any error in estimating future mortality improvements could be applicable to large proportions, or indeed to all of the PPOs within a portfolio, therefore the importance of this risk increases as the number of PPOs increases.

Volatility risk

Volatility risk could also be referred to as process risk or statistical risk and refers to the inherent risk from any random process. In this case, the risk that, even with a perfect estimate of the expected current and future mortality rates for a given claimant, the claimant lives longer or shorter than anticipated.

The latest PPO Working Party survey (Periodical Payment Orders Working Party, 2015a, p. 5) identified around 400 PPOs in the market, and even with a large market share it is likely that the total number of PPOs will be below 100 for most large insurers. At this level, volatility risk can be significant. This risk becomes more acute the smaller the total number of PPOs an insurer has, or in cases where there are particularly large individual PPOs that dominate the total PPO liabilities for an insurer. This risk is relatively peculiar to PPOs, as life insurers will typically have portfolios of lives that are several orders of magnitude larger as well as access to the life reinsurance market.

4.3 Propensity risk

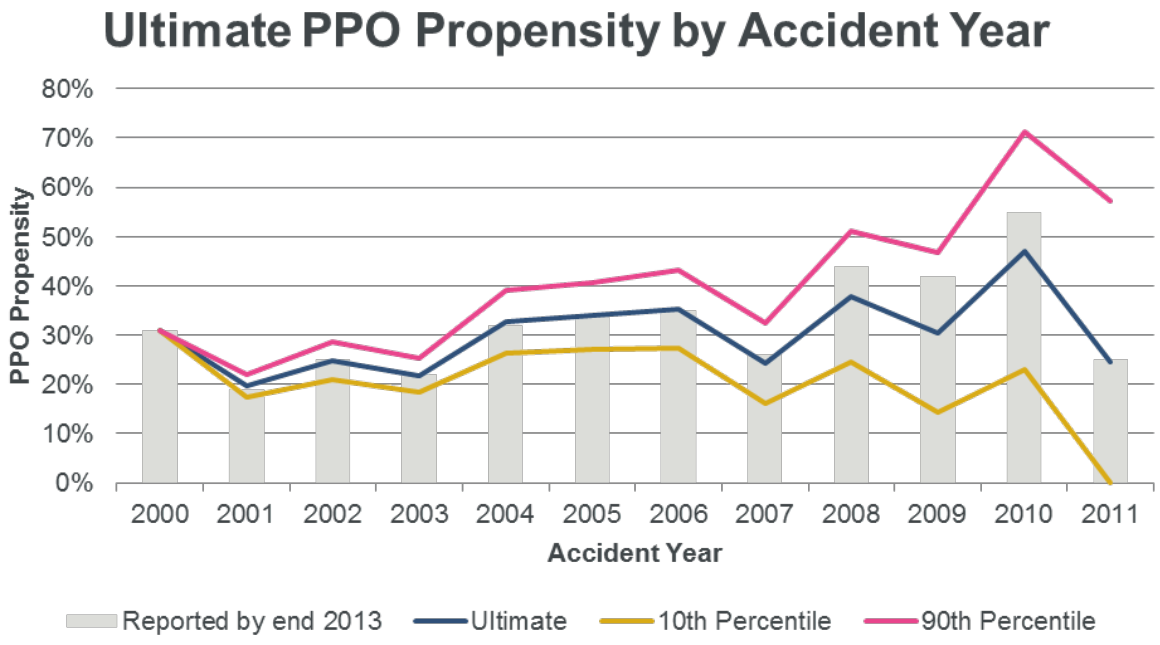
Propensity risk refers to the uncertainty associated with the future propensity for individual claims to settle by way of a PPO, rather than a lump-sum settlement.

Whilst dependent on the assumptions adopted when valuing PPOs, at the time of writing it is typically the case that a PPO settlement has a higher expected cost than a lump sum settlement on equivalent terms (Periodical Payment Orders Working Party, 2015a). This is a result of the current market-consistent real rates of return being significantly lower than the 2.5% p.a. real discount rate for lump-sum settlements. The risks associated with a lump sum settlement are also largely extinguished at the point of settlement, whereas the risks associated with a PPO settlement will continue until the death of the claimant. An increase in the propensity for claims to settle as PPOs will therefore tend to have an adverse effect on both a firm's best-estimate liabilities and its capital requirements.

Propensity can be affected by a number of factors. These include, but are not limited to:

- Changes arising from court precedent, for example the Thompstone case (see section 3.1);
- Changes in the discount rate prescribed for use with the Ogden tables used in valuing lump sum settlements;
- Changes in the wider economic environment, which may influence the perceived value of a PPO settlement compared to a lump sum award;
- Changes in social trends influencing claimants' preferences or changes in the claims handling practices of the insurer.

Figure 1 - Potential accident year PPO Propensities



This graph shows the propensity for a claim above £1m (in the 2011 settlement year, indexed at 7%) to settle with a PPO, based on data as at the end of 2013. It shows a very approximate

chain-ladder estimate of a potential expected ultimate position together with the corresponding approximate 10th and 90th percentiles using Mack variability and assuming a normal distribution capped at 100% and collared at 0%. (The actual percentiles may be much wider due to the low volume of condensed data used to estimate the percentiles.) Source: (Periodical Payment Orders Working Party, 2014b).

For an insurer settling low numbers of large bodily injury claims, the inherent risk of whether or not specific large bodily injury claims do, or do not settle as PPOs can also be significant, even if the rate could be predicted with certainty.

At the time of writing the discount rate for lump-sum settlement is 2.5% p.a. Compared to a market consistent valuation a lump sum valued using a 2.5% p.a. real rate of return would seem to give a lower economic value, all things considered. The table below highlights the impact of different discount rates. The table shows the difference in the Ogden discount factor (7th edition) for a 35 year old male. For a negative 1.5% factor, the reserve for cost of care would be 200% higher, and thus a lump sum with this discount rate would change the relative economic attractiveness significantly, thus highlighting the importance of this assumption to PPO propensity.

Table 2 – Impact of different discount rates

Discount rate	-1.5%	-1.0%	-0.5%	0.0%	0.5%	1.0%	1.5%	2.0%	3.0%
Relativity to rate of 2.5% p.a.	200%	153%	116%	86%	62%	42%	25%	12%	-10%

There is a considerable degree of uncertainty over the value of the discount rate used to value lump sums in the future.

4.4 Inflation and indexation risk

Inflation risk refers to the risk that the future indexation of payments under a PPO award differs from that anticipated.

As with many other features of PPOs, it is not the case that actuarial practitioners can rely solely on the experience of annuity providers writing index-linked annuities, as there are significant differences between the indexation arrangements for PPOs compared to typical annuity products.

First and foremost, future payments for PPOs tend to be linked to a percentile of ASHE 6115, although other indices are also used (Periodical Payment Orders Working Party, 2015a). ASHE 6115 is an ONS survey of the wages for care assistants and home carers (Office for National Statistics, 2013). If we consider traditional index-linked annuities, these tend to be linked in some way to price inflation (RPI, or a function of RPI such as Limited Price Inflation). Whilst there is a deep and liquid market in RPI-linked assets, there are not currently any investment products widely available that provide a return linked to general wage inflation, let alone changes in the wages of a specific percentile of a specific sector of employment. Therefore, there do not appear to be assets at present that can be used to completely match liabilities that are linked to ASHE 6115 (Clarke, et al., 2013).

The consequence of this is that, given the long duration of PPO liabilities, uncertainty in the level of ASHE 6115, or any other indexation method other than RPI, is typically a material risk to an insurer with PPO liabilities, which is very difficult to mitigate.

The levels of RPI and ASHE 6115 depend on the relative supply of and demand for products and services and care assistants' labour respectively. Phenomena such as these are impossible to predict accurately over a very long timeframe. Care workers' wage inflation could be materially different from general wage inflation in the future, especially since it is an area of the economy that has the potential to be distorted by the actions of the state. This gives insurers a challenge in selecting values for ASHE 6115 in valuing PPO liabilities and also in matching those liabilities with suitable assets.

When considering the risk from ASHE 6115 linkage, actuarial practitioners may in some cases choose to deconstruct the indexation into the RPI component and the difference between the ASHE survey and RPI. Where the RPI component of the liabilities is well-matched with RPI-linked assets in the firm's current asset portfolio and future investment strategy, the RPI inflation risk can be considered in a more traditional way and any mitigation from liability matching considered. When analysing the risks inherent in the difference between ASHE indices and RPI, actuarial practitioners may consider the general level of wages in the economy compared to RPI and the extent to which the trends in care workers' wages may differ from those of the general population.

ASHE 6115 has historically been the most common survey to which PPOs are linked. As explained in the Background section, in 2012 the ONS stopped publishing ASHE 6115 within the main body of the ASHE data, and reclassified the index in two parts. At some point, the ONS may stop producing the ASHE 6115 data, and although many PPOs have a formula in the order to adjust for previous and future basis changes, there is uncertainty as a result. What is a similar survey or index, when the original is so specific? There is a risk of indexation basis change across the portfolio if ASHE 6115 were to be discontinued.

For PPOs not yet in payment, insurers are also exposed to another source of inflation risk between the valuation date and the date of settlement. Future award levels may differ from those awarded historically, for example due to changes in the structure of care regimes proposed, or changes in the scope of costs covered by PPOs. For those settling out of court especially, there are also influences from the relative negotiating powers of the claimants' and defendants' representatives. This source of inflation is similar to but not the same as typical large claims inflation, and is easy to overlook when so much focus is on the indexation of the periodical payment award once in payment. An example of a source of inflation to the initial amount is allowing for support for carers to assist with holidays, on top of regular home care assuming no support.

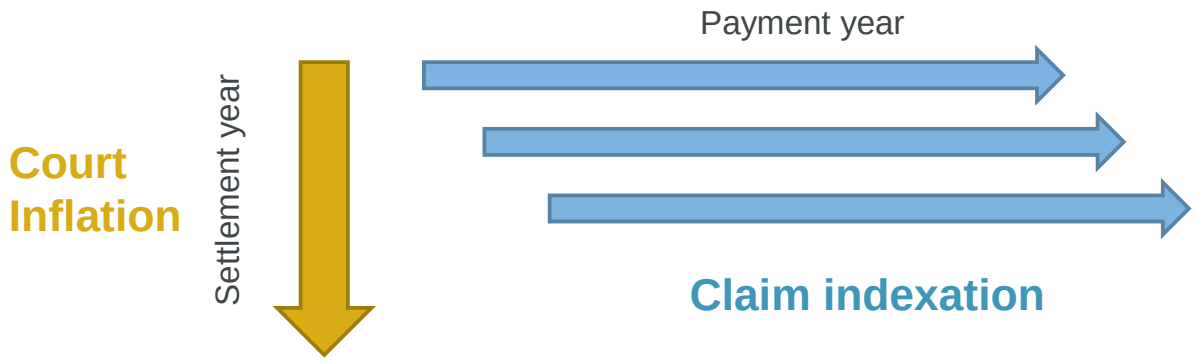


Figure 2 – Impact of inflation on PPO awards

This diagram shows the interaction of the two types of inflation risk described above on the size of annual PPO payments.

4.5 Interest rate risk and other market risks

Interest rate risk

Interest rate risk refers to the risk associated with a change in the value of PPO liabilities due to changes in the level or shape of the yield curve used to value them. Given the extremely long duration of PPO liabilities, the impact of small changes in the yield curve can be extremely significant (Periodical Payment Orders Working Party, 2014b, p. 89).

Actuarial practitioners should take time to understand the yield curve(s) used to discount PPO liabilities under the different reporting bases used by the insurer, and how these respond relative to changes in the market value of assets used to back PPO liabilities. For example, under Solvency II the choice of discount rate is largely prescribed by regulation whereas under IFRS there is more scope for management to apply expert judgement. This may mean that a firm's exposure to interest rate risk manifests itself differently under different reporting bases.

Liabilities associated with younger PPO claimants may not run-off for many decades, well beyond the duration of the longest dated fixed interest assets available. This introduces re-investment risk – the uncertainty surrounding the price of assets when you need to re-invest matured assets in the future.

The asset-liability matching techniques typically used by life insurers and large pension funds to manage similar risks are more difficult to deploy for PPOs, since the cash flows are much more uncertain. This is due to the unusual inflation indices used to index future payments, and the high level of longevity risk, especially for insurers with a small number of PPOs facing high longevity volatility risk. For PPOs not yet settled, there is also the underlying insurance risk of whether the claim will settle as a PPO. Further complications may arise from technical elements of the reporting basis, such as the presence of the volatility adjustment or matching adjustment under Solvency II.

Historically, there has often been a strong correlation between movements in interest rates and movement in actual inflation rates and future inflation expectations, so actuarial practitioners should consider the extent to which interest rate risk interacts with inflation risk (see section 4.9, dependencies).

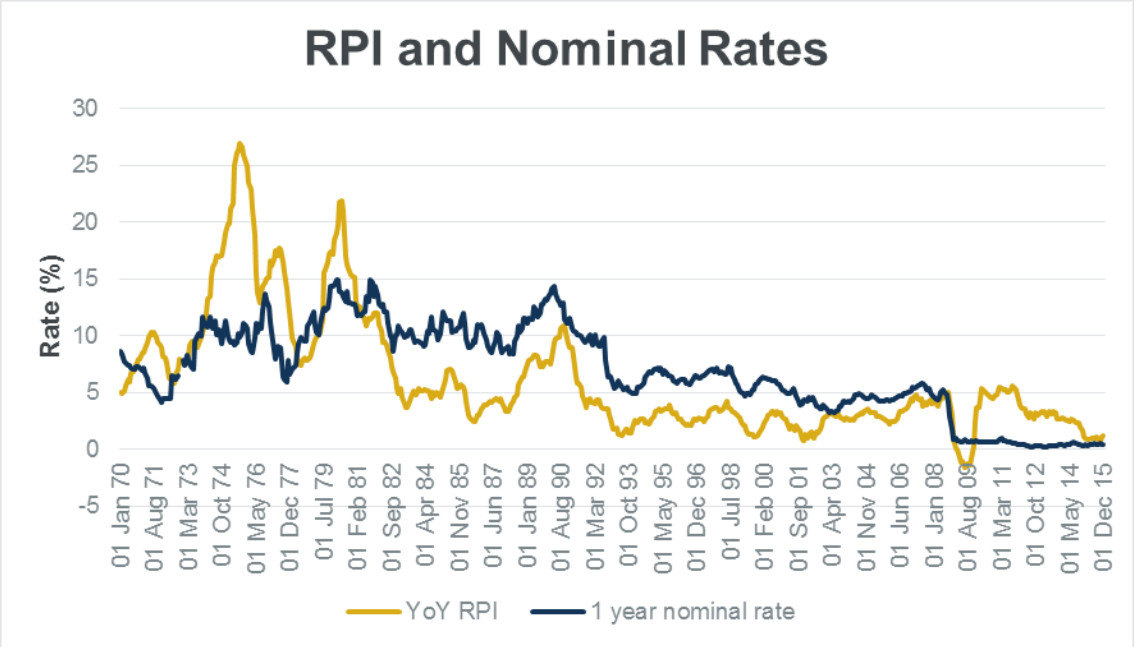


Figure 3 – Relationship between inflation and interest rates

This diagram shows the historical trend in actual RPI and actual nominal interest rates over 1-year. (YoY: Year-on-year) Sources: (Bank of England, 2016b) and (Office for National Statistics, 2016d)

Other market risks

While PPOs do not, in themselves, introduce additional market risks to an insurer, changes in investment strategy introduced to reflect the characteristics of PPOs have the potential to either increase exposure to existing market risks or introduce new market risks to an insurer.

For example, investments in inflation-linked assets, corporate debt, property, infrastructure debt, equities, hedge funds or derivatives may be outside the traditional investment portfolio of a general insurer. These types of investments may be selected to increase returns, but there will be a trade-off between risk and return. Utilising a more complex asset-liability management strategy may require enhanced capital modelling capabilities to be developed, or changes in a firm's risk management framework to accommodate new sources of risk.

4.6 Variable orders

PPOs which are variable orders give even greater uncertainty as to the amount of future payment amounts. This is because variable orders allow the annual award to be revalued to reflect changing care needs of the claimant, linked to the development or improvement of specified medical conditions.

There is very little past experience and information available (Periodical Payment Orders Working Party, 2015a, p. 37) either to estimate the proportion of variable orders which might be triggered as a consequence of changing medical conditions or to address the average level of award increase, or decrease, resulting from a variable order being triggered. When valuing future PPOs, consideration would also be required of the proportion of future PPOs that might be variable, including whether they could be specified for different conditions or scenarios than currently specified.

Whilst it is generally anticipated that the triggering of variable orders will lead to an increase in award levels, it is possible for a variable order to result in a reduction in the award level. This would be possible in the event of a pre-specified improvement in a claimant's medical condition, which reduces their care requirement. Furthermore, changes in award levels may indicate that the claimant's future mortality may have also changed in the opposite direction. For example, a deterioration in a claimant's condition triggering the variation, may increase annual payments amounts but reduce life expectancy.

4.7 Counterparty credit risk

Counterparty credit risk refers to the potential for an insurer to suffer financial loss due to the failure of another party to meet its obligations as they fall due. The most notable exposure is often to reinsurers, but other sources of potential exposure can arise.

Reinsurance default

PPOs may interact with an insurer's reinsurance arrangements either through proportional arrangements, individual excess of loss reinsurance protection or portfolio level arrangements. Consequently an insurer may have an expectation of material reinsurance recoveries associated with PPOs, potentially due over an extended period of time.

Even for the most highly capitalised and financially strong reinsurers, it is hard to assess the probability of default over many decades. There are major elements of PPO risks which cannot be diversified as the number of claimants increase. Whilst the risk from volatility may decrease for longevity risk, the overall risk from trends and inaccuracies in the mortality basis does not; neither does exposure to external influences on propensity; or the level of ASHE 6115. Consequently there is additional systemic risk that several reinsurers with significant PPO exposures (or other significant exposure to similar risks such as annuities) could experience financial distress at the same time. Where such reinsurers' business is focused on motor or casualty, the firms may have very little incentive to remain a going concern if a risk event unfolds. If there is little option to reinvigorate these businesses due to lack of diversification and no direct responsibility to the claimants, winding-up the business may be the most beneficial option for their key stakeholders except insurers. Consequently, insurers that rely

heavily on reinsurance for lines exposed to PPO settlement will need to bear this in mind, as these defaults would leave them exposed in-full to the liability and its associated risks.

Whilst credit ratings provided by credit rating agencies can be used as a mechanism to help understand the credit risk of a specific reinsurer, this process relies heavily on expert judgement. There is limited empirical data on /the rate of default for reinsurers over the time horizons relevant when considering PPOs.

Other sources of counterparty credit risk

Credit risk also has the potential to arise in scenarios where an insurer is only partially liable for meeting obligations to a PPO claimant (for example, when it has written a co-insurance share of the original insurance policy or where liability has been apportioned between a number of parties covered by different insurance policies). In such cases, it is likely that legal advice would be required to understand the impact on the insurer's liabilities in the event that other parties to a PPO award were to default on their obligations to the claimant. The outcome in this scenario will depend on the wordings of the individual orders as well as other relevant legal principles.

Depending on the investment strategy adopted by an insurer, they may also be exposed to counterparty credit risk associated with either physical investments or derivative contracts used to match PPO liabilities. The long duration of PPO liabilities may lead to a firm investing in assets with a longer duration than has been typical for general insurers, introducing an increased level of counterparty credit risk. In particular, investment in long-dated government or supranational debt may require an insurer to consider the possibility (even for counterparties with very strong credit ratings) of the issuers not meeting their obligations as they fall due.

4.8 Operational and expense risk

Operational risk refers to the risk of failure of people, processes or systems leading to an increased level of cost for an insurer, either through higher direct expenses, or regulatory censure. Expense risk refers to the risk of a firm's future expenses being different than anticipated.

Whilst general insurers are used to considering operational and expense risk, a liability which requires payment on a regular basis over many decades is different to typical general insurance liabilities.

PPOs are still fairly new, so the chance of errors by people, processes and systems not designed for this settlement method is high. It is important to consider the differences in claims handling requirements, system requirements, data requirements, reporting requirements and actuarial modelling requirements that are introduced by PPOs. Reinsurance wordings may be complex surrounding recoveries on PPOs and therefore, require greater attention by insurers. After taking into account the current control framework, actuarial practitioners should consider any residual operational risks faced by insurers when managing PPO liabilities, and look to continually increase the robustness of the control framework.

The long-term nature of PPO liabilities means that the level of expense provisions which need to be set aside to cover on-going claims handling expenses needs to be carefully considered, alongside the risk that actual expenses differ from those projected.

4.9 Additional considerations

Model and parameter risk

Model risk refers to the risk that the selected model is inappropriate, and parameter risk refers to the risk that the selected parameters are inappropriate.

It is important to be aware of the significant level of expert judgement inherent in setting assumptions for PPOs and the risk that either the parameters selected, or the models used may not be appropriate. Given the relative immaturity of PPO modelling, and the lack of historical data on which calibrations can be based, this risk is likely to be significant for the foreseeable future.

It is therefore even more important than usual that the assumptions contained in and the outcome of any modelling undertaken is:

- Carefully considered by modellers;
- Robustly challenged and validated through peer review;
- Well documented; and
- Carefully communicated to stakeholders.

Top-down validation activity (such as scenario testing or sensitivity testing) is likely to be particularly important given the challenges with determining robust bottom-up calibrations.

Further to this, it is important that those managing PPO liabilities continually develop their technical skills and professional considerations.

Dependencies

With many general insurance liabilities, the impact of adverse economic scenarios (for example a fall in the yield curve used to discount liabilities) is not directly linked to the risk of a claim being larger than expected.

However, for PPOs, interest rate risk can compound with other risk factors to a significant degree. For example, the longer that claimants live the higher the impact is of lower than expected investment return and the lower that future investment returns are, the higher the impact is of future inflation being higher than anticipated. These are only a sample of dependencies across risks associated with PPOs.

It is possible to envisage a number of scenarios with compounded risks. This type of thought exercise is useful to help identify key risks to the business, variables that should be linked in models and may even be required by the regulator.

Change in risk profile over time

Another important difference to typical general insurance liabilities is that, for most firms, PPO liabilities will continue to increase until the number of deaths starts to balance the number of new cases (Periodical Payment Orders Working Party, 2014a). Consequently, actuarial practitioners may wish to consider both the current risk profile and the likely shape of the risk profile in years to come.

5 Data requirements and assumptions

5.1 Overview

As with any actuarial exercise, it is important to consider the purpose to which the model will be put to ensure its construction and parameterisation are adequate. For PPOs this is particularly important. There are many assumptions that are very uncertain at this point. This does not stop a reasonable model being created, as long as the practitioner remains focused on the outputs required.

Evaluation of PPOs involves quantifying both settled PPOs in payment, and possible future settlements, known as “PPO IBNR”. For settled PPOs, the identity of the PPO annuitant and the terms of the award are known. Possible future settlements may come from a number of sources, claims which the insurer knows are potential PPOs, claims the insurer is not aware will be large, claims the insurer is not yet aware of and claims that will happen in the future on business the insurer has already written. Consideration will need to be given to all of these. Clearly, the less mature the claim, the less data is available to quantify it, and the more one must rely upon general statistics relevant to the class of business, judgement, and the firm’s past experience. For modelling claims that are expected to arise in the future, which will always be the case in pricing, the practitioner would need to consider whether the observed distribution of PPO claimants is a fair representation of what the future claims environment might experience.

As well as making assumptions about the profile of the portfolio of PPOs to be settled, we need to make assumptions about future indexation, investment return, and mortality.

Whilst there is often no prescription as to what these assumptions should be, key assumptions should be made explicit, and there should be evidence that these assumptions are reasonable. As the actual future out-turn is uncertain, it is worth flexing the assumptions to see how much this changes the expected pay-out and using these to inform the end users of the modelling. After all, in many cases, risks associated with PPOs will not be overly familiar to stakeholders beyond initial training within general-insurance-focussed business, but because of their long durations they may affect the running of the company for many years in the future.

5.2 Claim data

The quantification of known PPO claims will almost invariably be by a cash flow model. This will require:

- The payment schedule as set out by the PPO which includes the:
    - First annual payment amount.
    - Frequency of payment.
    - Any planned steps to payments.
- Where payment amounts, steps and indexation vary by head of damage then these will need to be separated.
- The future life expectancy, determined by reference to:

  - The age of the claimant.
  - The sex of the claimant.
  - The claimant's impairment to life (usually from accompanying medical evidence and expressed as an adjusted life expectancy).

- The indexation method (ASHE, RPI or other referenced index).
- Any variable orders or other special features of the PPO.
- The currency payments will be made in.
- Details of any coinsurance and reinsurance applicable to the claim together with the lump-sum components and property damage elements of the claim to test if a recovery can be made.

The extent of data available will depend on the closeness of the party to the claimant, with the direct insurer handling the claim having the most information, through to reinsurers which may have less information available to them. The terms of reinsurance policies now generally require that insurers provide details of all claims identified as potential PPOs so this issue is becoming less important.

Quantification of future potential PPOs should take account of the following data:

- An exposure measure to help determine likely future numbers of PPOs.
- PPO propensity for the class and insurer, linked to that exposure.
- An indication of whether the claimant population is different to the market claimant population for the class (in order to determine likely claimant characteristics).
- Details of claims close to settlement which may settle as PPOs.

An assumption of court award inflation may need to be made separately to assumptions on indexing the annual payments if models project PPOs that commence in the future. PPOs are generally linked to indices and surveys once an award has been made whereas the initial level of awards has other pressures such as changing attitudes of the courts towards the necessary level of care.

5.3 Indexation of annual amounts

PPOs are typically inflation-linked to provide the required level of protection intended at settlement. Often the reference to index payments is a percentile of the ASHE 6115 sub-code, as this relates specifically to wage inflation of care workers in the UK. Inflation linking using ASHE 6115 has led to both increases and decreases in the payments over the years since PPOs were introduced from a mixture of inflation and deflation of care workers' wages. The common use of this index, as opposed to RPI, gives additional complexity. There have been some orders that give periodical payments under more than one head of damages, with the different sections being linked to different indices. There have been investments linked to RPI available for some time, allowing the possibility of using the assets to value the liability directly using economic scenario generators (ESGs). There are no known investments that can be used to obtain a price for ASHE from securities data at the time of writing. It should be noted that orders are indexed at different percentiles and that ASHE 6115 is not the only reference for indexing, reducing the likelihood of there being an asset match in the future.

Therefore, forecasts of the expected future inflation will need to be made, which is not a straightforward exercise. Whilst some forecasts for wage inflation do exist these are not necessarily in line with ASHE 6115. In addition, the link between the indexation and the investment return assumption needs to be considered so the assumptions are consistent and coherent. A failure to treat investment return and inflation consistently will seriously jeopardise the robustness of any model output. A simple example of not being consistent would be excluding a period of unusual inflation but not investment returns over the same period if using historical data to set assumptions.

The indexation assumption is an important variable. Ignoring reinsurance, it defines the future cash flows in nominal terms, which is important for cash flow and general business planning. Considering reinsurance, where treaties are indexed, the inflation will affect the level of coverage provided in nominal terms. Consequently for direct insurers a robust projection is needed for an accurate determination of reassurance assets, and therefore the net of reinsurance balance sheet position. For reinsurers, it is obvious this assumption will materially affect their reserve value.

The purpose of the model may restrict or guide the indexation assumption, because of influences from both external factors, such as Solvency II, and internal factors which may include the company's accounting policies.

If a term-structure-dependant investment assumption is chosen, perhaps because of a portfolio of gilts over varying terms, then a term-structure-dependent inflation assumption should also be selected.

A formal assumption linking inflation with investment returns will be needed for any model that is stochastic; however, it is important to note that we are not aware of any investment product available to match this inflationary measure precisely.

Regardless of the basis, the practitioner should test the reasonableness of the assumption used. The reasonableness can be tested by looking at historical inflation levels, current market-consistent expectations of future inflation and future economic reasoning in respect of the projected inflation rate. These are considered below, and along with those for investment returns were published at early stages in the 2015 CIGI presentation (Periodical Payment Orders Working Party, 2015b).

Historical analysis

The reliability of historical analysis is limited by the volume of data, given the relatively young age of the ASHE survey, and that it is produced only annually.

This limitation may be addressed by considering a less volatile, but closely linked, inflation index. For example, the Health and Social Work component of the Average Weekly Earnings index could be considered. This has the benefit of being compiled from millions of data returns rather than just thousands, which smooth volatility as well as benefitting from a longer history. Adopting this approach gives the breadth of data missing from the ASHE series, but if used for stochastic outputs, a volatility adjustment will have to be made to allow for additional volatility if the indexation method is more volatile than the reference index.

This is not the only comparison that can be made. The difference between ASHE 6115 and RPI or interest rates can also be considered. Obviously, it is valuable only if the comparison helps to explain and project trends with greater confidence.

Any evaluation of past inflation needs to incorporate an understanding of any atypical periods within the data set, as well as an understanding of how investment returns responded during this time to ensure that the real rate of return is not distorted. As with any historical information analysis, judgement is also required on what period is relevant to estimating future inflation.

Market-consistent views

RPI-linked investments provide a common source of information which is already used to parameterise ESGs to give a view of future inflation by term. This is directly relevant for the smaller proportion of PPO claims linked to RPI but further consideration is needed for those associated with other indices.

For these cases, the RPI-based output must then be transformed to give an appropriate assumption for the indexation of each individual PPO. Whilst it is commonly ASHE 6115 which is used, it may also be other sub-groups of ASHE, as well as different percentiles of the particular survey. Therefore, further consideration may be required on whether or not there is a need to consider more than just this popular measure. This decision will need to be based upon the materiality of the existing inflation profile of the companies' PPOs, as well as any future projection.

Wages and prices are economically linked; therefore, any wage index can be compared to the components of RPI that are relevant. For example, for ASHE 6115, links to medical services can be evaluated against the respective RPI components. However it must be remembered that PPOs typically cover the future cost of care, which is different to medical supplies or even possibly medical services. Otherwise, a historical approach of the gap between RPI or interest rates and ASHE 6115 could be used to account for the difference. This approach may be more appropriate as it does not require an assumption over whether the RPI components chosen mirror the index in question. However, there are still complications to this approach given the limited available history for the ASHE indices. An alternative might be to link wages and RPI, but allow for the greater volatility that would be expected under ASHE. Either way, it is important to note that past inflation may not be a good guide to future inflation.

Once a link to RPI is established, market views of view of RPI from swap curves (or interest rates if used) can be considered to allow a market-consistent view of inflation to be established. It must again be remembered that although convenient and seemingly objective, market-based views of inflation are less robust than interest rates, because the market in long-term RPI swaps is less deep and liquid than the markets for other financial instruments. These may at any time be distorted by imbalances in supply and demand and hence may no longer give an accurate view of future inflation levels.

Future economic expectations

Future assumptions can be compared with the economic outlook provided by other linked inflationary pressures. For example, at the time of writing in the UK the Consumer Prices Index (CPI) is targeted at 2% by the Bank of England.

Again, if the future economic assumption is not the indexation method, a link to it will need to be considered and modelled. It must be borne in mind that such links can break down, especially in more extreme scenarios, as was seen in the 2007 economic credit crunch between RPI and CPI. Further uncertainty now arises from the recent referendum in favour of the UK leaving the European Union, commonly referred to as Brexit.

5.4 Investment return

The purpose of the valuation (and the method used to choose the inflation assumption) will influence the appropriate investment-return assumption. It may be prescribed or a natural complement to the indexation assumption. If a rate other than the risk-free rate is used, the latter should also be determined and compared to the rate used. In addition, as with inflation, more generally any assumption needs testing for reasonableness. The practitioner should have a reasonable degree of confidence that the investment return (or at least the margin above inflation) is achievable given the company's long-term investment objectives and assets purchased.

The assumption should reflect the assets held by the company or expected to be held by the company. The past performance of these assets and their market-implied price should be considered. Whether or not there is a sub-portfolio of assets dedicated to PPO liabilities will affect the ability to identify the assets to use in setting the rate. For example, if only government bonds were held and the strategy was to only hold government bonds until the liabilities are exhausted it would be unfeasible to justify discounting above the rate implied by those bonds for a valuation exercise. This would recognise future investment income that is not expected to be received.

In order to sense check the rate chosen where it exceeds the risk free rate it is important to consider future investment strategy. For example a pricing exercise may assume that a proposed portfolio will have a higher return and lower value of PPOs to set the technical premium. However in reserving for the risk or modelling capital, there will need to be consideration of how likely the company is to move to the proposed portfolio which may affect the level of investment return that can be assumed. For reserving actuaries, it will be important to consider the strategy resulting from Asset-Liability Modelling exercises as well as the company's risk tolerance to different asset classes.

There should also be consistency between the investment-return assumption and future indexation of the payments, as discussed within the inflation section above. Ignoring the impact on indexed reinsurance limits and other indexed cash flows outside the PPOs, it is the reasonableness of the real rate of return that determines how robust the final impact of discounting will be. Reasonableness will depend on the assets that the company holds and their expected returns. Again, sensitivity testing of the investment return assumption is advisable to capture the sensitivity of the model and resulting impact on the reserves and capital requirements to changes in real returns.

Different investment assumptions may be required for different valuation bases and the practitioner should investigate the up-to-date requirements of Solvency II, IFRS, or any other

reporting bases used, as well as any other regulations or guidance to the financial reporting relevant to the reporting basis.

Any stochastic model will most likely require an assumption between the level of inflation and the investment return. Even if an ESG is used, the practitioner should be aware of the level of real return implied by the difference. For any models relying on the reasonableness of the volatility modelled, any limitations as a result of the selected methodology are important to understand and document. The specific limitations will depend on the use and type of model.

Technical considerations are also required for the rate chosen. The rate assumed will not affect the actual amount paid gross of investment returns – it affects the timing of their recognition. However, when evaluating the outputs of models, higher discount rates make cash flows in the distant future increasingly less significant. This may mask long term risks expected to emerge later on, by devaluing them. However, lower, and especially negative rates, increase the perceived value of risk in the long term.

As for inflation, investment returns can be determined and checked for reasonableness by considering three main viewpoints: historical analysis, current market-consistent rates and future prospects for investment returns over the duration of the liabilities. These are considered in more detail below.

Historical analysis

Starting with the risk-free rate, there is data on long-term government instruments that can be analysed as a proxy to evaluate them.

As with any exercise looking backwards, not all history may be relevant to the future run-off period. Also for long durations, the number of debt investments available to estimate a risk-free rate diminishes rapidly. More data is however available for shorter-duration assets, which may be more robust, but then an adjustment is needed to make it appropriate and relevant to the liabilities involved.

If a risk-free rate is used, an organisation may want to add an amount to allow for the illiquidity premium to recognise that it may hold on to such assets to maturity under most scenarios. If there were no intent and no potential need to sell the corresponding asset then it could be argued that 100% of the liquidity premium could be allowed for.

If, conversely, assets that are not risk-free are analysed then any expected losses must be deducted to return to a risk free rate. For example, if corporate bonds were used as the basis of the analysis then a reduction to the rate could be applied to remove the element of the return associated with the expected default.

Analysis of other investment classes may be needed where rates are based on the asset mix expected to match the liabilities. For example if equities are deemed partially suitable to match then it would be useful to look back at the excess return of equities compared to risk-free rates to validate any additional return allowed for. Again it will be important to remove any expected default. Furthermore, practitioners should check if rules allow discounting above the risk-free rate for the exercise being undertaken. Where rates above a risk free rate are used, the implications of doing so in regards to uncertainty and timing of excess return recognition should

also be considered. An example of where this may be less provocative for PPO valuation is in pricing, as long as care is taken to ensure elements of investment returns are not double counted in pricing models and the additional volatility is properly considered in the capital charged.

Market-consistent views

Traditional risk-free yield curves based on market instruments can be used to determine the nominal risk-free rate. The shortcomings with this approach arise from the market being less active in long-dated instruments, as longer-term rates may be extrapolated.

Therefore, care must be taken to ensure that at long durations of the yield curve, which are important in PPO valuation, there are not distortions from current market conditions or judgment applied by others in calibrating the long-term durations. The terminal rates of yield curves have relatively little market data and more judgment is employed by those producing the curves, and this judgement may not be clear to the actuarial practitioner using the curve.

Illiquidity premium may need to be considered separately if it is deemed a suitable addition to the risk-free rate.

Market-consistent views may not be available for all asset classes being analysed, for example property or private equity.

Market-consistent yield curves also have the limitation that they represent the market's view of average returns, and if a stressed scenario is being discounted this mean view may not be appropriate as the stressed conditions may be expected to alter the view of future returns.

Future economic expectations

To project the future economic outlook there are models from various organisations that may be considered. The future risk-free interest rates will depend on the future prospects of the country's economy; its fiscal and monetary policies and the discipline and attractiveness of its currency relative to others.

Regardless of the future measure considered, adjustments may be needed for a rate suitable to value PPOs which removes allowances for any expected defaults or the addition of an illiquidity premium if considered more appropriate.

5.5 Mortality

Another key assumption, and one infrequently encountered in general insurance, is mortality.

This is a critical assumption, defining the value of payment, directly affecting the valuation, as well as the assumed timing affecting any discounting performed. As the mortality assumption applies to similar lives, the risk of systematic inaccuracy accumulates across the portfolio of PPOs, as well as the volatility from individual cases living longer or shorter than expected.

There are several modelling options for applying mortality. The simplest approach is to be deterministic and define the expected lifetime of those PPOs already in payment. This

information is generally provided by experts but even then it is highly subjective, may not be robust and there is the possibility of bias in the experts' views.

Most of the readily available expert views are for determining lump sum settlement amounts. This introduces obvious bias. The claimants' experts would seek a view to support a long life expectancy for a large lump sum award, whereas the insurers would have the opposite inclination, so long as the estimate is reasonable. Bearing in mind these contrasting standpoints on mortality, the question becomes what should be the policy in consistently determining the life expectancy?

Beyond the known uncertainty, there is also a risk that medical advances could restore the claimant's life expectation to near-normal levels, and further that historically observed improvements in mortality persist. There is also the risk that reserves are overstated, if claimants' morbidity reduces life expectancy compared to experts' opinions or if general improvements reverse. Please see section 4.2 for more details.

To allow for the possibility of individual claimants dying before or after their life expectancies a life table can be used. This requires basic consideration of which life tables to select, amongst other assumptions.

The base life tables present the first assumption: what population to base the mortality experience on? There are not yet any available tables for the impaired lives of PPO claimants that are known about publically. Life insurance tables are available but unlikely to be suitable as they are presented. They are for insured populations which differ fundamentally to PPO claimants. Insured lives self-select and are subject to health underwriting and tend to be predominantly from the more-affluent section of the population. Annuitants and pensioners tables are also likely to be from more affluent lives, as they have had the disposable income to save. Annuitants may also self-select and therefore may be of better-than-average health. Furthermore, as the attitude to saving may be linked to health this could also affect the mortality.

PPO claimants in contrast are generally third parties, injured by the insured, so selection does not apply at inception of the policy. However the claimant generally decides whether to pursue a PPO or not, so has some choice in the settlement and therefore may have different mortality to those choosing a lump-sum alternative. Additionally, any traditional annuity-based life tables are calibrated to older claimants, the typical annuity purchaser. PPOs are different in that the annuities often apply not only to impaired lives, but to impaired lives who are considerably younger than conventional annuitants. Case law already uses life tables based on the general population for lump-sum settlement using the Ogden tables.

For PPO IBNR, further assumptions could be made on the links between life expectancies at the point of claiming compared to the profile of the exposure. For example, a motor insurer with more than the standard market share of young drivers would be expected to have higher life expectancies (as the claimants would be expected to be younger owing to passenger liability). This may be even more relevant in future pricing models, where life expectancy modelling may be linked to risk and rating factors. For reserving purposes, the profile of the stock of large losses may be an even more powerful indicator of the PPO IBNR as time progresses and cases are updated with more information.

Essentially, to choose a mortality basis, the actuarial practitioner should select the one that most represents the population of PPO claimants they are analysing. Once a table is selected that is similar it is very likely to need adjusting. Also more than one table may be needed, as the same mortality for spinal injuries and brain injuries seems unlikely.

Firstly any tables that have select mortality, where mortality differs depending on the time between an initial event (usually the purchase of a life insurance policy) and the valuation date need careful consideration. The select mortalities, where the probabilities of death vary depending on the time since an insurance contract commences, are unlikely to be useful: the PPO claimant will have suffered the injury some time before their PPO commences.

Secondly to reduce the life expectancy for impairments will need an assumption. The PPO Working Party (Periodical Payment Orders Working Party, 2010, p. 71) identified three potential mechanisms of doing so. The adjustments can be applied to a life individually or to a collection of lives:

- A: applying a multiple to the base mortality;
- B: adjusting the age x of the base table; and
- C: adding a variable to mortality.

A PPO claimant's mortality, $q'_{x,t}$, where *x* is the age at which the individual PPO was sealed and *t* is the number of years since the date of the order can be linked to base table's mortality $q_{x,t}$ .The variables *A*, *B* and *C* represent the represent different ways in which adjustments can be applied to modify the mortality for an impaired PPO claimant's life

$$q'_{x,t} = A \times q_{x+B,t} + C$$

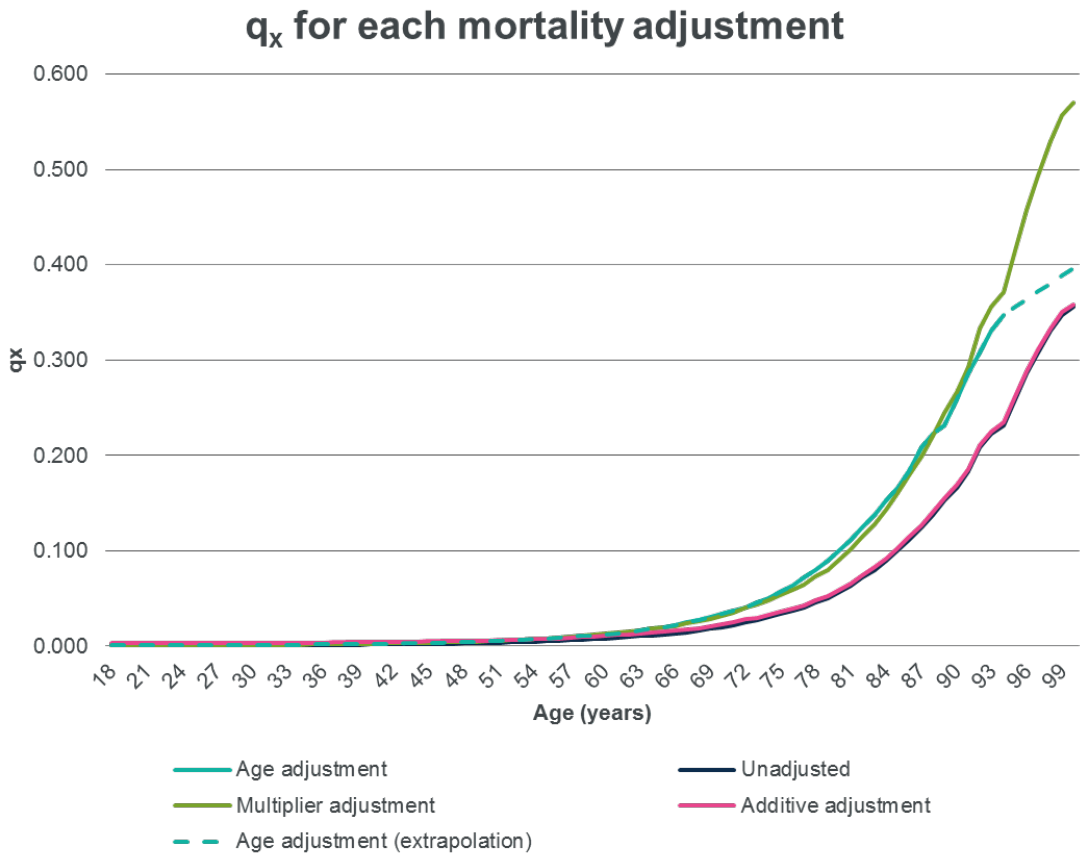


Figure 4 – Estimated q_x rates under different mortality adjustment methods

This graph shows the different q_x rates that are generated under the methods described above. They all represent a claimant aged 18 with an estimated life expectancy of 56 years, a reduction of 5 years relative to the equivalent unimpaired life expectancy. Source: (Office for National Statistics, 2016f).

To increase complexity the three constants (*A*, *B* and *C*) could be made to be dependent on the number of years since the date of the order, and multiple adjustments could be applied simultaneously. In practice this will be limited by the quantity of data available to parametrise such models.

The significance if the three potential mechanisms are discussed below. Advice from a medical professional may be useful in understanding the appropriateness to mortality projections of using such adjustments.

A: applying a multiple to the base mortality

$$q'_{x,t} = \boldsymbol{A} \times q_{x+B,t} + C$$

In life insurance, this type of adjustment is used for impairments due to illnesses such as heart disease or diabetes and is familiar to life underwriters who term it the “k-rating” method that is for conditions that deteriorate over time.

Using a multiplier to increase mortality has a larger effect in older years, where mortality is higher. This may be appropriate to a PPO claimants' state of health, if their condition is expected to increase their risk of death increasingly throughout their lives. This may be the case for claimants with reduced mobility and fitness.

If a claimant is younger than the accident hump, this approach will increase this, even though the chance to engage in risky behaviour may be limited by their condition and care regime.

More materially, each condition may introduce new hazards into the claimant's life that would require their own "accident hump".

B: adjusting the age x of the base table

$$q'_{x,t} = A \times q_{x+\boldsymbol{B},t} + C$$

This "age rating" method has been used as an approach in the life industry for a long time, particularly as it was administratively convenient.

This method assumes that the reduction in life expectancy occurs because the PPO claimant experiences the same mortality as someone older than them.

It is obvious that mathematically this is difficult to link into the pattern of mortality different conditions PPOs are awarded for. An important limitation to consider is that, for young claimants especially, increased mortality at young ages cannot be easily modelled as there is much less difference between the mortality of a 25 year-old and a 20 year-old than there is between a 65 year-old and 60-year old. An additional limitation is that it truncates the tail of the mortality curve five years earlier than a multiplicative or additive adjustment would, which would have implications for modelling the volatility.

C: adding a variable to mortality

$$q'_{x,t} = A \times q_{x+B,t} + \boldsymbol{C}$$

This could be seen to capture the excess mortality more explicitly. For cases with increased additional mortality closer to the accident this could be factored in, however a key limitation is that the more complex the function the more data needed for objective calibration. Data however will be limited for many years to come.

A constant addition requires less data. It assumes the PPO claimant has a constant additional risk of death from their condition. This is reasonable in the case of ventilated patients where the risk of fatal infection may be higher amongst other potential accidents leading to death as well as other conditions.

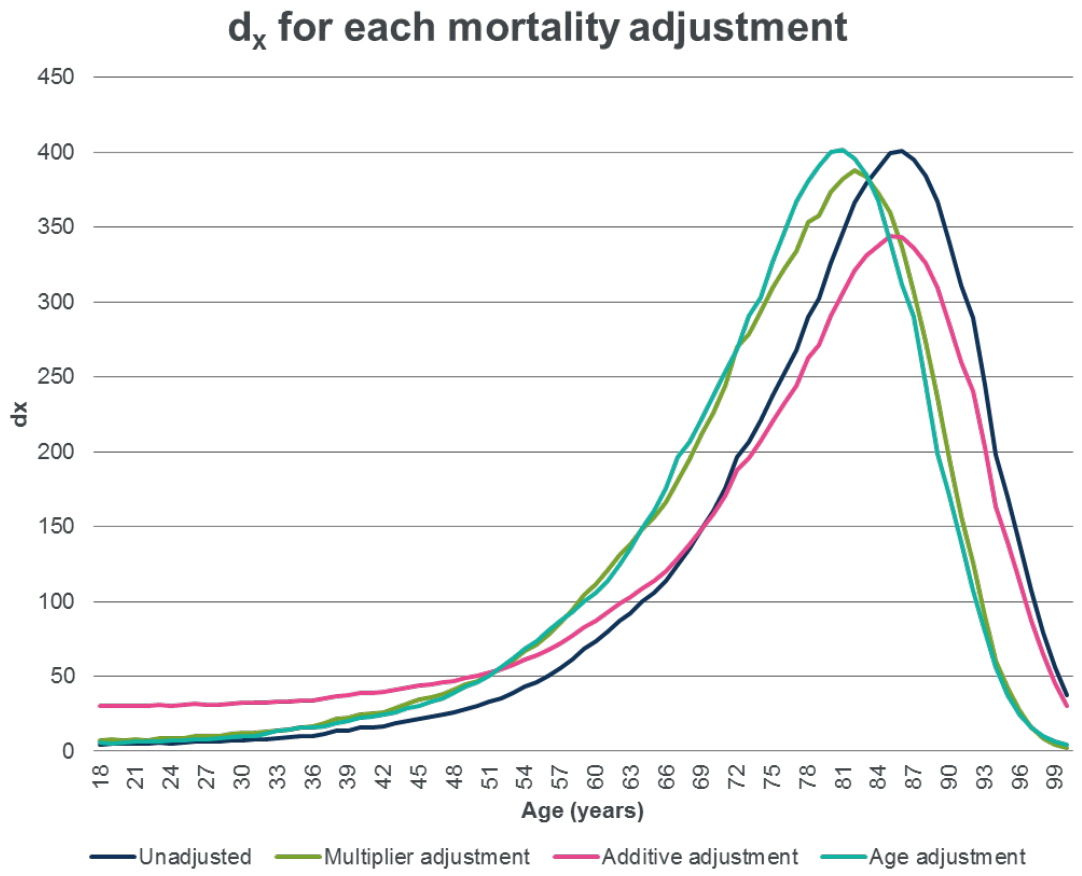


Figure 5 – Estimated d_x rates under different mortality adjustment methods

This graph shows the different d_x rates per 100,000 lives that are generated under the methods described above. Consistently with figure 5.1, they all represent a claimant aged 18 with an estimated life expectancy of 56 years, a reduction of 5 years relative to the equivalent unimpaired life expectancy. Source: (Office for National Statistics, 2016f).

Methods A and C share the disadvantage that they can produce mortality rates that are above 100% at advanced ages.

Mortality is complex area that is likely to become more complicated as time elapses and more data becomes available to start to allow more sophisticated mortality analysis. This data should be monitored; there are other territories in the world where equivalents to PPOs have been in place for a longer period of time. Where expertise goes beyond the practitioners' knowledge or skill it may be necessary to seek external advice and where life actuaries are readily available within larger firms, it may be best to gather their input for this key assumption.

In order to provide future generations with greater mortality data on PPOs, we urge insurers to start classifying large losses and PPOs using the PPO Injury Classification developed by the PPO Working Party and industry partners. In the future PPO life tables by injury type may then become available.

5.6 Propensity

The frequency of PPO claims is highly uncertain. Catastrophic injury is fortunately not common in the UK, and so there are not that many PPO claims to analyse compared to other types of losses. This sparseness of data, along with the drivers of propensity being complex and linked to the external environment, makes determining the assumption challenging.

Using a propensity, or transition rate, of a claim to settle as a PPO allows for the exposure to the risk of a PPO to be allowed for. The greater the number of open and expected IBNR large claims, the more PPOs possible.

For some time, headline rates of PPO propensity have been output by the annual survey on PPOs conducted by the PPO Working Party. However, as always, care is needed when applying market data to a particular book.

Firstly, most of the headline rates are by settlement year, which is an uncommon reporting basis for actuarial analysis. Should an accident year reporting basis be used, the rates will need to be translated to an accident year basis, or the claims to a settlement basis, to be applicable. For an underwriting year reporting basis, again a transformation would be needed. Consider a simple example where for a single underwriting year, four large losses are notified in every one of the first three settlement years, one of which always settles at the end of the third year from the notification year as a PPO and the remaining three always settle on a lump sum basis at the end of the first, second and third years from their notification. At outset and at ultimate, the PPO propensity is 25%, but for example, for future settlements at the close of the third settlement year the PPO propensity would be 40%.

Figure 6 – Comparison of settlement period and accident period propensity

This graph illustrates the distorting impact that different settlement delays for PPOs can have on settlement-year metrics when compared with underwriting-year metrics using the example in the text above. (SY: Settlement Year)

Secondly, PPO propensity is thought to vary by various risk factors. When performing a valuation, the appropriateness of any survey or market benchmark needs to be verified. The further away the profile of the book being valued from the market, the more unreliable the market rate will be. Factors that appear to affect propensity from the PPO Working Party's survey include, but are not limited to:

- Class of business;
- Size of claim; and
- Age of claimant.

Clearly some factors may be linked to the underwriting profile of the business being valued. For example, both the class of business and any corresponding limits that may affect the PPO propensity will be known. Furthermore, the age of the claimant may be partially determined by the profile of the book. For example, younger drivers tend to travel with other younger drivers, so when there is a crash there is an aggregation of exposure to risk. In this circumstance a higher PPO propensity may be expected.

At the point of claim more will be known about the potential PPO, which could be factored into estimates of the propensity.

More generally there are wider and external factors than can affect propensity assumptions. Those working with PPO liabilities should be aware of the insurer's stance towards settling PPOs, and its historical propensity rates. It will be important to keep up to date with any changes in claims handling practices that could impact propensity in the future. It is also very important to understand the way that data is recorded both within and outside of the claims handling systems. As a result of small number of claims involved, it is likely that at least some important information is captured manually.

In the wider economic context Ogden discount rates for traditional lump sums play a big role in the propensity of large claims to settle by PPO. The difference between the Ogden discount rate and the investment returns available to claimants to invest their lumps sums affects the value of PPOs relative to lump sums. Even without factoring in the lower risk to the claimant generally from PPOs, when PPOs are more valuable their propensity can expected to be higher. The Ogden rate is set by the Lord Chancellor and practitioners should be mindful of any consultations to change the rate, as the outcome is likely to change rates and therefore affect the level of the propensity assumption.

This sentiment can be applied to the economic environment more generally. Higher investment returns, all other things being equal, will favour lump sums, and low rates will favour PPOs. Low and negative ASHE index rates may make PPOs seem less attractive, whereas spikes in care costs picked up by the index would make them seem more attractive, even though these changes in the past may have limited relevance to the future changes that will affect the amounts claimants are paid. Rates may also be affected by the advice received by claimants during settlement, which itself may depend on regulation and the attractiveness of PPOs to those providing that advice.

Overall there is a lot to consider, and the key thing will be to monitor any rates chosen to ensure they continue to remain effective assumptions for the model's purpose.

6 Reserving

6.1 Overview

As with the assumptions, the techniques used to value PPOs need to be appropriate to the purpose to which the model will be put. Models need not be overly complex, but should be able to provide a usable and communicable output.

Straightforward closed-form models producing only a point estimate may be entirely appropriate for reserving and forecasting management accounts. The higher potential transparency of using a point estimate may help with understanding the inherent risks associated with these liabilities, especially if used in conjunction with scenarios and stress testing, which is becoming increasingly necessary as the desire of stakeholders in the insurance industry to understand risk becomes greater. However, such a model may make investigating and communicating uncertainty more challenging.

The model is likely to need to be able to output the cash flows as well as the reserve. This will be useful for asset-liability modelling.

Further choices involve whether or not to apply Ogden factors (annuity multipliers) at an appropriate discount rate to the annual PPO amounts, or whether to index and discount the future cash flows explicitly. If the former is chosen, there are the complexities of how to allow for stepped payments and whether this approach would systematically over- or underestimate the PPOs' reserve value? One challenge with Ogden factors is that they are unlikely to accurately reflect the difference between gross and net claims, which is important for reserves for bad-debt risk.

The practitioner must also be mindful of market practice, the size of their current and potential future PPO stock, as well as to what extent stakeholder expectations should be considered.

6.2 Failure of standard triangulation

This section deals with the challenges associated with using a triangle-based approach in the valuation of PPOs (Periodical Payment Orders Working Party, 2015b, pp. 10-11). However, there are some areas where a triangle analysis may be useful, and we will discuss these below.

A key assumption of the standard triangle method is that the past development of claims is a good estimate of future development to their ultimate position. To understand why a triangle approach might be challenging, it is important to first consider how PPO claims number development has been impacted by the external environment historically.

Before the Courts Act of 2003, PPOs were in effect allowed in the form of structured settlements. For reasons that we can only speculate on, the use of these was limited, although it is worth noting that both the claimant and insurer had to agree to the structured settlement, and the courts had no ability to override the decision. Hence any projection of future PPO claim numbers based solely on the triangle history would understate the number or proportion of large losses settling as PPOs, as the period prior to 2003 would be included in the development. In addition, depending on the size of the triangle, there are likely to be periods

where there are no PPOs, resulting in the need for manual adjustments. This gives evidence to suggest a paid or incurred chain ladder or Bornhuetter Ferguson method would be inappropriate.

Another consideration that has a calendar year effect on the development history is the linking of the PPO annual payments to an earnings index, following the judgement in Thompstone vs Thameside (Court of Appeal, 2008), which resulted in the more widespread use of PPOs. Therefore, the period prior to 2009 would have fewer settled PPOs than recent experience, which may give too low an estimate of prior assumptions whereas the sudden increase in settlement in the diagonal when the change occurred may overstate the development factors from the affected period onwards, if it is not excluded as an outlier, and this may overstate PPO numbers in recent periods. In general, the use of triangle-based methods becomes at least more complicated when there are diagonal effects.

Whilst we have considered how triangulation is likely to result in the frequency of PPO claims being misestimated, it is almost certain that the severity would be incorrect using triangulation rather than cash flow methods.

Even under the assumption that it was possible to construct a 50-year triangle containing a high volume of PPOs, there would still be limitations. Firstly, there are likely to be child claimants who may still survive beyond 50 years, so an assumption as to the size of the tail factor would need to be made, despite future survival being uncertain; this factor could be considerable. Secondly, over any lengthy period, there are likely to be advances in medical techniques that would increase the future life expectancy of PPO claimants. In addition, changes in vehicle safety and waiting times for medical assistance at the crash site may further increase the proportion of severely injured individuals who survive motor accidents and thereby go on to make claims for lifetime support, invalidating the assumption of historical experience being a guide to future development. Finally, simple triangulation methods assume implicitly that future inflation is consistent with historical inflation, which over a short period may not be inappropriate, but over the length of these liabilities is unlikely to be borne out in practice, therefore requiring the practitioner to make an explicit assumption as to future inflation. Changes in inflation may therefore cause the valuation estimate to be over- or understated.

In addition to the arguments that the past experience may not necessarily provide a good guide to the future experience, using standard triangle methods requires sufficient volume of data on which to project. Whilst the number of settled PPOs across the industry is in the hundreds, at a company level the volume is likely to be significantly smaller, which creates more volatility in the patterns and requires more judgment to be used. As a result standard triangle methods are less appropriate.

Where claims volumes are larger, for example for reinsurers or large direct insurers in the future triangulation may be useful for frequency analysis so long as adjustments are made for changes in development discussed in the paper and allowance made for future expected changes. This would however require that PPO amounts are frozen at a single point in time by capitalising them with an appropriate set of assumptions. If this is not done any changes to assumptions will be projected forward at the same rate, and change the size of losses evaluated.

Impact on triangles used to project losses that are not PPOs

Furthermore, it is important to note that large loss allowances are typically volatile themselves. Therefore any adjustments to triangles to remove PPOs need to be done carefully and in a manner that is harmonious with the PPO model in use.

For example, a propensity model cannot work if claims with a PPO are stripped out of large loss triangles, as the exposed to risk is reduced to the non-PPO losses rather than all potential PPO losses.

However to analyse lump-sum-only large-loss severity, PPOs do need to be excluded. PPOs may have a different underlying severity to other large losses. If settled PPOs were included then the payments to date would continue to increase the severity, as they are no longer discounted.

This is further complicated by the fact that if settled PPOs were excluded from the reserving triangle, then there would still be potential PPOs within the data. This may not be material if there is a not a different claim handling philosophy and claims development pattern before agreement of a PPO were identical. If not practitioners may need to leave enough development time to reduce the chance of PPOs being in the data or use claims departments views of which may settle as a PPO.

The solution to analysing lump-sum only settlements will depend on the way PPOs develop to settlement and how it interacts with PPO reserving, and consequently will be specific to each firm.

6.3 Deterministic – without triangulation

A truly deterministic model has many limitations. Trivial situations would be required: for example where the claimant has a long life expectancy, low reinsurance excess point and limited indexation, so that both the amounts paid and their timings are constrained.

A truly deterministic model does not use a life table. And, having no allowance for stochastic mortality, for example, will lead to the tricky situation of deciding whether or not to re-establish a reserve at the point the payments were expected to cease if the claimant remains alive. Whilst common sense suggests that a reserve should be re-established, it could instead be offset by continuing to hold reserves on death of a claimant ahead of when payments were expected to cease. Recalculating expected future lifetimes each year would get round this problem, though having stochastic mortality simply by using life tables would avoid this completely.

Reinsurance also presents a conundrum with a deterministic model. If the claimant is expected to die just before the PPO reaches the reinsurance threshold the model would give zero recovery, even though there is a chance that they may live longer and a recovery may be made. Again, if the claimant lives longer than expected should a reinsurance asset be established? A deterministic model without a life table applied will tend to understate the reinsurance recoveries.

However, a simple deterministic model capturing the features of the PPO and its reinsurance forms the centre of calculation engines of any stochastic model. Therefore, it will be explained to build up the consideration for PPO models in general.

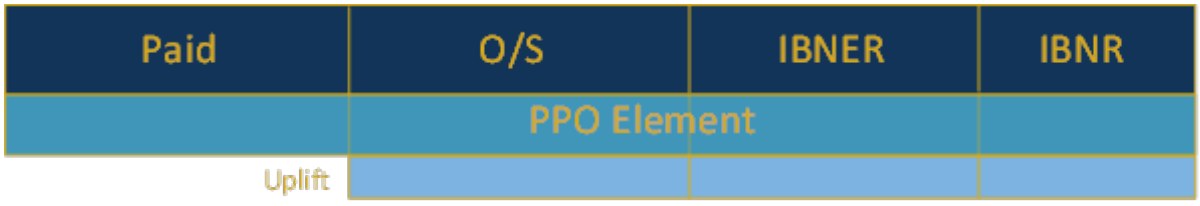
The basic form of the common deterministic models used involves a starting point of projecting large losses using standard methods. Often large losses are defined as losses greater than £1m on a lump sum basis (indexed to a particular point in time). Very few losses below £1m have historically been settled on a PPO basis, so the losses above £1m could be considered as a potential exposure to risk.

Often, this projection will be based on incurred chain ladder projections (backed by paid chain

ladder projections), or a frequency-severity approach. For these projections, both settled and potential PPOs are normally included within the projections, with all future payments valued on a consistent basis (that is discounted at the prevailing Ogden rate of 2.5%, though other rates are sometimes used within claims processes).

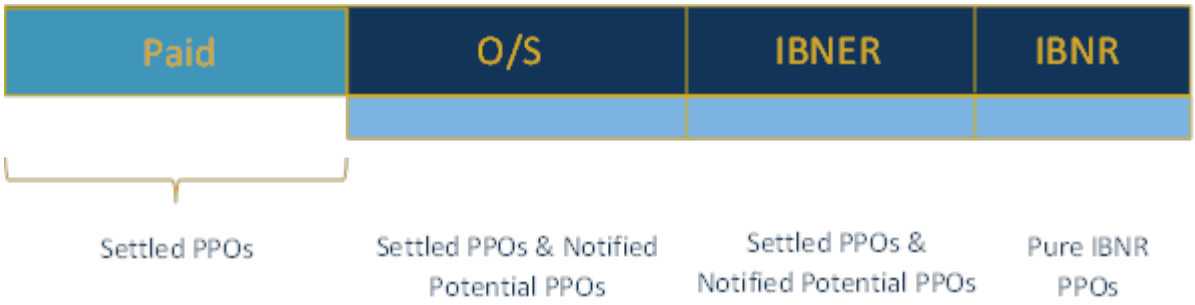
A portion of these claims projected have already settled as, or will settle as a PPO.

For claims that settle as PPOs, under current economic conditions and Ogden rates, the present value of future payments based on a PPO valuation basis is likely to be higher than the reserve based on the standard Ogden lump sum rate, as the net effective discount rate used for valuing PPOs would be lower than the Ogden rate. This means that an uplift will be required.



One of the more subjective areas in which actuaries are involved is in calculating the uplift. The components of the uplift can be estimated by considering claims in each of the three key

stages – settled PPOs (but still in payment), notified potential PPOs (which will include notified claims that are currently small and large claims not currently expected to become PPOs) and PPOs arising from true Incurred But Not Reported claims.



A deterministic model could then involve considering each of these elements in turn using a formula of the form of $propensity \times percentage\ uplift$.

Settled PPOs

These are normally valued on an individual claim by claim basis. As they are settled as a PPO, the propensity is clearly 100%.

The future payment stream is normally modelled using a cash flow projection running for the future expected lifetime of the claimant and allowing for the payments' indexation under the order. These cash flows can then be discounted back, firstly at a rate commensurate with the net effective rate held in the reserves (normally the Ogden rate) to get to the lump sum equivalent, and secondly using the valuation rate selected for the modelling exercise. The difference between the two gives the uplift.

Alternatively, the payment streams can often be valued using standard actuarial annuity functions. However, the complications arising from stepped payments together with widespread availability and competency in spreadsheets means that annuity functions are rarely used in practice. The existence of reinsurance at a level where recoveries would be expected would render annuity functions inappropriate for calculating the net position, as a correct implementation of the typical indexation clauses will not be possible.

Notified potential PPOs

The propensity of notified claims to become PPOs can be estimated by looking at the proportion of large losses that have become PPOs as discussed in the data requirements and assumptions section.

As noted previously, the propensity of PPO claims is normally viewed on a settlement-year basis. Statistics need to be aligned across origin periods.

In some cases, a separate team (normally a large-claims team) may highlight claims which it believes are likely to settle as PPOs. This is usually based on specific information known about the claimant; for example, whether the desire for a PPO settlement has been expressed, type

of injury, age of claimant, firm of solicitors dealing with the case, size of claim and so on, or a separate model may exist to identify such potential PPOs.

If using this information directly, the actuarial practitioner will need to assume that a proportion of these 'likely PPOs' will become PPOs. This proportion, which may be 100%, should be estimated based on the prior success in identifying such cases and using any evidence available as to the veracity of their selections. The actuary may need to review the reasons for the selections, or the model used, to assist in estimating this figure. If the proportion of potential PPOs settling as PPOs is 100%, allowances may need to be made for PPOs that have not been identified, unless such an identification process is perfect.

Where likely PPOs are highlighted, the actuarial practitioner will need to consider whether additional PPOs may arise from claims which are not highlighted as likely PPOs. This will include PPO claims arising from notified claims which are not currently large enough to be considered explicitly.

The other part of the equation, the uplift, can be calculated using various methods, from a blanket percentage uplift to an uplift calibrated from the cash flow model of the particular company's mix of PPOs, if there has been enough PPOs to generate sufficient data for the latter.

It is possible to use a cash flow approach, similar to settled PPOs, for cases where a PPO is likely if enough details required for the valuation are known. In some cases, the details of a claimant (such as life expectancy) and the potential PPO amounts will not be known, or will be difficult to estimate with any certainty. Benchmark factors using either the insurer's own claims' profile or the Working Party survey could be used, though the actuarial practitioner will need to be satisfied that such benchmarks are appropriate.

Using the benchmark, the uplift can be estimated from a cash flow model using parameters which represent the nature of the insurer's portfolio: one or a series of model points. These would be expected to include the future life expectancy, initial periodical payment amount, the delay until settlement, and so on. Alternatively, the figures calculated for the likely and settled PPOs with sufficient data to project using a cash flow model, could be used as a benchmark for the uplift. The actuarial practitioners will need to be satisfied that the nature of these PPOs are in line with likely future cases, which is challenging unless there is a large volume of settled cases, or likely cases where the characteristics are near certain.

Note that the uplift for potential PPOs will not be expected to be the same for settled PPOs valued on an economic basis. This is because the outstanding term on settled PPOs will be expected to be different to that for notified potential PPOs, even if all other characteristics are assumed to be the same.

The propensity and uplift figures could be applied directly to the total projected reserve for potential PPOs. In this case, the specific uplift calculated will be from the assumptions used to set the company's case reserves for potential PPOs, to the assumptions used to value PPOs. Consequently the reserve for settled PPOs will need to be removed from reserves before applying these factors. Depending on the calculation of the uplift, the reserve for the associated lump sum may or may not need to be deducted also.

The reserve for large loss IBNR will in some cases be indistinguishable from the IBNER for large losses, for example where incurred chain ladder projections are used. In these cases, any allowance for Pure IBNR PPO will automatically be included within the allowance for other potential PPOs as part of the uplift to the “IBNER”. Where it is possible to split IBNER and Pure IBNR, a specific Pure IBNR allowance should be made as discussed in the section that follows.

Pure IBNR PPOs

As noted above, the IBNR PPO amount may already be included within the uplifted projections. In other cases, a similar benchmark-based approach to that discussed above can be used for IBNR PPOs.

The actuarial practitioner will need to consider whether an adjustment to the propensity and uplift factors are needed to allow for trends or any changes in the profile of pure IBNR cases.

Reserves for losses arising from unearned premium

Where reserves are set up for losses arising from premium that has not yet been earned and exposed to risk, classically referred to as the Unexpired Premium Reserve (UPR), it is important to take into account the effect of PPOs.

If assumptions to value these liabilities do not include an allowance for PPOs, it will understate the liability in the usual case where PPOs have a higher cost than lump-sum settlements. This may be especially important if the reserves are set using the planned loss ratios and where an additional liability may be required on top of the UPR if the loss ratio then exceed 100% (often referred to as the unexpired risk reserve (URR)).

6.4 Understanding the basis of projection

Similarly to classic chain ladder reserving, understanding the data being used is vital to having a robust projection. An example in triangle-based chain ladder projections could be as simple as using annual factors mid-year on a growing portfolio without any adjustment and consequently potentially underestimating reserves.

PPO reserves are no different in this regard. It is necessary to understand the data, claims’ case reserving philosophy and any changes. For example, we have described uplifts. What if claims teams had moved all reserves to higher multipliers, say using a real rate on the Ogden tables of -0.5% p.a. to reflect lower investment returns? Then both the PPO and non-PPO reserves would need adjusting, the former to the firms chosen rate for financial accounting purposes, and the latter to the rate for the jurisdiction in which the lump sum claim is expected to settle.

There may be more subtleties that challenge a simple uplift-propensity approach. Actuarial practitioners must take the time to understand the large losses being projected.

6.5 Moving beyond a simple deterministic model

Firstly, deterministic models could be made more complex.

Modelling more detail

It is not unknown for example for cases below £1m to settle by means of a PPO. Where an actuarial practitioner wishes to make explicit allowances for smaller losses that might become PPOs, they should carefully consider the extent to which the progression of small losses into large losses has already been allowed for within standard projection techniques and whether there is any risk of double counting such losses.

At the time of writing, there is evidence that propensity varies with claim size (Periodical Payment Orders Working Party, 2015a). Actuarial practitioners could consider breaking down their claims into bands for the purposes of estimating propensity, or for comparing to benchmark rates. This would be particularly important for excess of loss reinsurers, where the analysis is further complicated as system reserves will usually be for the reinsurer's share, so the claims may need to be converted into a gross claim before application of propensities.

Allowing for probability

In the deterministic cash flow models described so far, expected lifetimes have been set out as a fixed figure, where the cash flows continue for a period and then stop. Alternatively, the payments could allow for expected mortality gradually over the course of the future projection by using a mortality table.

Incorporating outwards reinsurance is a relatively simple addition to a cash flow modelling approach. Actuaries should allow for the indexation on the retention in a way that is consistent with the gross projections and the terms of the reinsurance treaty. The uplift net of reinsurance will normally be a lower figure than the gross uplift. Appropriate allowance for reinsurance will only be possible when using a mortality table, rather than an annuity certain approach.

For inwards excess of loss writers, the actuary needs to be aware of the strength of case estimates posted by cedants. In some cases, reserves are held on a basis other than the rate used in the Ogden tables for lump sums. Some allowance may need to be made for this variation amongst cedants (for example case estimates may need to be adjusted in advance) to ensure that the uplift is appropriate.

Whilst the propensity of claims to settle as PPOs is measured based on all claims being indexed to a point in time, the actuary should be mindful of the effective index date of the outstanding claims data and consider whether the indexation on past claims (or the benchmark being used) would provide a biased estimate. For many smaller or well diversified insurers, the additional accuracy provided by considering this point of detail may well be immaterial, but for larger or mono-line motor insurers, this consideration may be important.

6.6 Stochastic models

As mentioned in the previous section, the most obvious stochastic feature that can be incorporated into models is the use of life tables. Models can be made more complex allowing for probability in other assumptions and when this applies to most variables the model will often move towards Monte Carlo methods.

Section 7 on capital modelling provides more information on stochastic modelling. This does not mean that for other valuation purposes stochastic models should be avoided, they may even be required in some circumstances to allow the model to capture the risk features with enough accuracy to be of value and not be misleading. A good example if this is cost-benefit analysis of reinsurance coverage.

6.7 Other features of PPOs to value

Variable orders or PPOs with indemnity or reverse-indemnity guarantees have embedded options and guarantees.

Variable orders are highly challenging to estimate as there is little data on progression of medical states of health associated with them or the level of the possible change in periodical payments. It is however clear that an estimate may need to be made to satisfy the reporting basis. Under Solvency II for example, variations following from variable orders may be treated as an Event Not In Data. Either way, an approximate likelihood of triggering a variable order and the potential severity impact would be a starting point. This may require interactions with claims functions to estimate potential levels and likelihoods, until such a time as market data becomes available as a further reference point to benchmark against.

For indemnity and reverse indemnity guarantees, the order may be clearer over the change in level of the PPO, but again on a case-by-case basis, estimations of the potential likelihood of an event at each time period and the associated cost could be used to estimate their impact.

6.8 Reinsurance

It is important to consider outwards reinsurance when PPOs are valued. The net of reinsurance position may be different to the gross position.

If a cash flow model is used to value the gross cost of a PPO then the reinsurance treaty can be applied directly to the gross cash flows to calculate the recoveries due at each payment date. For future payments, this will be the expected recovery, which depends on the inflation assumption.

Most reinsurance contracts for UK insurers have an indexation clause, and this may be specific to PPOs. The indexation of the retentions and limits is generally calculated by using specified indices. It is typical that national wage inflation is applied up until a PPO's settlement date, and then from settlement onwards, the relevant index is the one that the PPO is linked to.

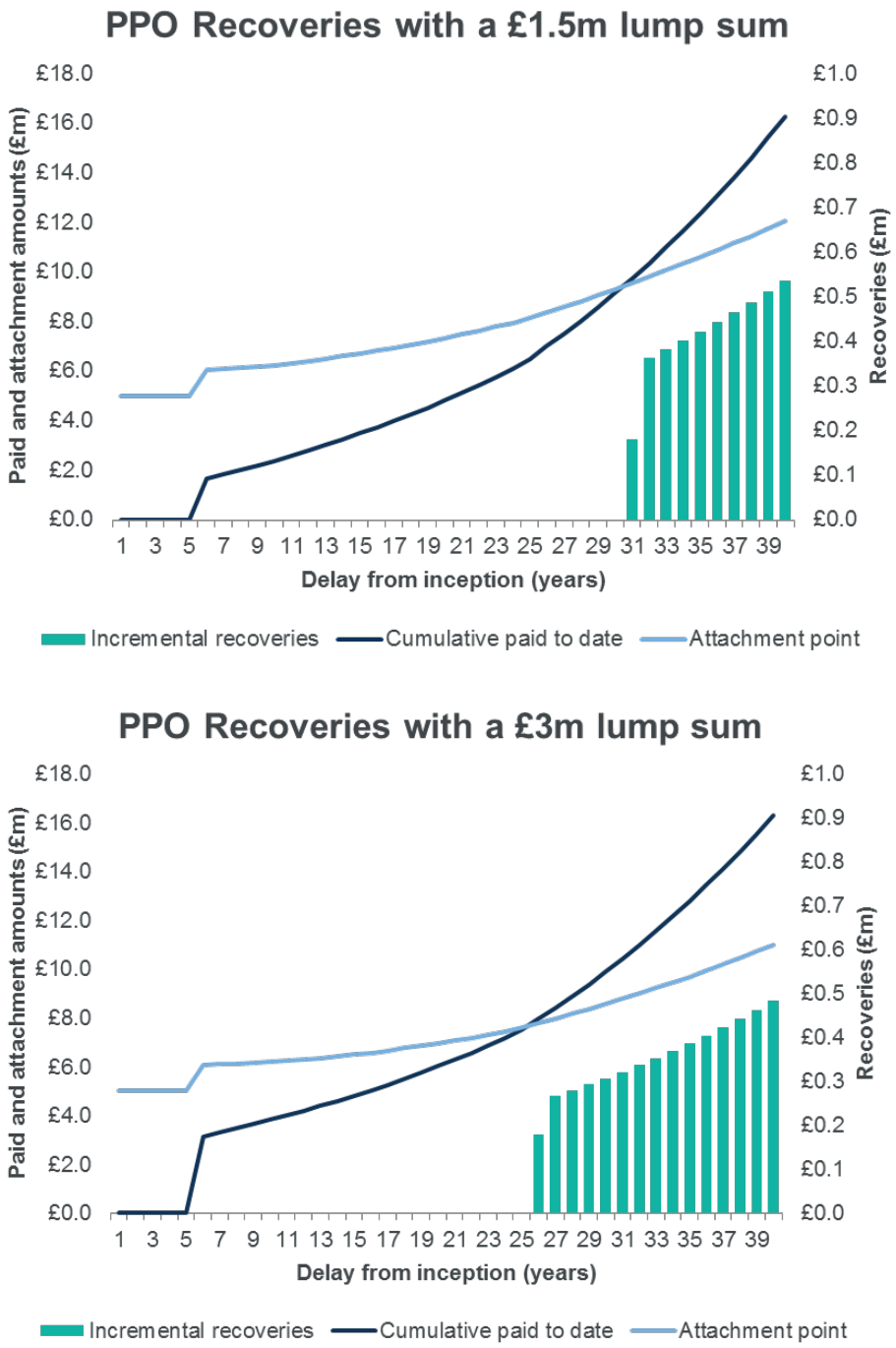


Figure 7 - Reinsurance indexation

These graphs show the effect of changing the balance between the size of the lump sum and annual periodical payments on the indexation of treaty limits assuming both inflation of the lump sum and indexation of the periodical payments is at 4% p.a. for an excess of loss treaty with unlimited cover attaching at £5m, with an indexation clause. The PPO with an accompanying £3m lump sum has a periodical payment amount of £150k in contrast to the PPO with a £1.5m lump sum and a £167k periodical payment, both giving the same paid to date after 40 years.

The indexation clause affects the value of recoveries. Under a typical indexation clause, the split of the claim between the lump sum element and the regular payments will affect the amount recoverable under the policy. The amount recovered from reinsurers for an individual PPO also depends on both the timings and sizes of the periodical payment, even in the absence of other payments.

The risk of a reinsurer defaulting is greater under the increasing presence of these long term liabilities, so it is a significant consideration for insurers. The credit default risk of reinsurance bad debt needs to be considered for recommending and setting reserves and allowed for in capital requirement calculations. Several approaches are possible:

- Margin in the credit default swaps market, where available;
- The rating attributed by one or more rating agencies;
- Regulatory reported solvency position; or a
- Detailed consideration of the reinsurer's position by the insurer.

Consideration could be given to the historical failure rates of reinsurers of different ratings and sizes, but a sufficiently long period of historical data may not be available.

Capitalisation clauses are becoming increasingly common in reinsurance contracts. These specify that at a certain period of time, typically linked to either the date of the PPO settlement or inception of the treaty, the reinsurer will pay the insurer a lump sum in order to crystallise the reinsurer's liabilities to the insurer in respect of that PPO. At this point, any risks previously mitigated by the treaty revert to the insurer. The period before capitalisation varies dependant on the nature of the clause and the length of time taken to agree the PPO. The size of the lump sum for capitalisation need not necessarily represent the expected cost of the PPO. Treaties specify calculations using agreed assumptions and methodology, which may be different from economic principles as a commercial consideration in setting treaties' price levels. Insurers' demand for capitalisation clauses will depend on the availability of traditional non-capitalised reinsurance, the difference in reinsurance prices between the two options and the risk appetite of the insurer. An insurer taking a capitalisation clause should consider prior to purchase what their strategy is regarding investing the cash they receive. Credit risk will be higher for companies without capitalisation clauses (all else being equal) as these insurers will not be dependent on reinsurers over the lifetime of the PPO.

A further complication is that an individual insurer may have part of their reinsurance purchased on a capitalised basis and the rest on a non-capitalised basis. This may create an additional complexity modelling reinsurance assets.

Also when reserving, insurers will need to take account of the correct treaties for each risk, as excess points may have changed, or the proportion of the reinsurance with capitalisation clause. This will need to be taking into account when the reinsurance recoveries are assessed.

When considering the reinsurance purchase, the insurer should model the capital required at different attachment points. This should then be compared against the price of the various attachment points, to assess the best return on capital, subject to an acceptable amount of risk. Taking PPOs into account may change the optimum attachment point.

6.9 Stress testing

After any valuation of the neutral estimate of PPOs, similarly to any valuation exercise, stress and scenario tests can be used to:

- Give consideration to alternative base scenarios other than those presented as the best estimate;
- Identify the key sensitivities and assumptions;
- Help communicate the level of risk and uncertainty to a firm's administrative, management or supervisory body;
- Help validate and provide context to the capital model or any stochastic approach; and
- Link to any risk registers kept.

In addition, consideration of stresses on the key assumptions and alternative scenarios both deterministically and stochastically may enable practitioners to better understand, and where possible, quantify, the level of parameter and model uncertainty and not just the sample error.

Stress and scenario tests should be considered that explore the key assumptions. Key assumptions include, but are not limited to, propensity, inflation and life expectancy. Where PPO valuations are discounted an obvious additional key assumption is the investment return assumption.

Propensity

Changes in legislation, legal precedent or claimant preferences may cause a change in overall PPO propensity. For instance, a change in legislation could lead to all claims with a regular cost of care element being settled as PPOs. Propensity is also impacted by the economic environment, for example changes in investment rates and levels of asset returns.

Consideration could also be given to any events that may lead to an accumulation in PPO settlements, for example a coach crash.

Practitioners should also consider the potential for interaction with any Ogden provisions. Were the Lord Chancellor to revise downwards the discount rate to be used with Ogden tables from its current level (assuming no change in available asset yields), this may shift claimant preferences away from PPO settlements towards lump sums, as the lower discount rate would give rise to higher lump-sum payments. Here it would be incomplete to show the upside of the change in PPO propensity without at least noting the increase in liabilities for lump-sum cases from the change in Ogden rate. There may also be a decrease in capital requirement as lump sums are more certain. Similar considerations are needed for the opposite scenario.

Inflation

The level of inflation impacting PPO settlements can be decomposed into two parts:

- Court award inflation of proposed periodical payments before an order is agreed; and
- Indexation of the periodical payments after the order is sealed.

The level of court award inflation will affect the size of initial annual payment awarded to claimants. A one-off inflationary shock on the initial annual payment could be considered on all future PPOs as a potential stress or scenario.

As mentioned, the majority of PPOs have been linked to an indexation method, such as ASHE 6115, to preserve their real value over time. Any step change in wage inflation affecting ASHE 6115 over the lifetime of the PPO should be considered as a one-off shock to understand the potential impact on the reserves.

There is also the risk of the overall rate being wrong over the long term, which can have a significant impact on any valuation. Varying the rate in combination with considering the effect on the investment return assumptions used is also important.

Longevity

Whilst individual cases will live for longer or shorter than expected, one-off medical advances could also lead to a sudden improvement in future life expectancy for all settled PPOs and future potential PPOs. These aggregations of longevity risk can be quantified in a scenario. A possible reason for this could be a cure for spinal injuries. Shocks in the other direction could be considered, for example widespread resistance to antibiotics as some claimants are more vulnerable to infection as a result of their injuries.

There are currently no appropriate life tables for PPO claimants and there is insufficient market data at present from which to derive confidently an accurate adjustment for impaired lives. Sensitivities could be performed on the underlying mortality assumptions to assess the likely impact of changes in these assumptions.

When constructing different scenarios, practitioners should be mindful to ensure coherence between the various assumptions that underpin them.

Possible stresses could be looking at a different approach to mortality, for example the impact of changing the shape of the mortality curve, while still maintaining the same life expectancy. This can cause impacts on capital as the value of discounted cash flows at specific duration would change.

6.10 Actual-versus-expected results

Techniques to value PPOs make a number of assumptions about the future, including inflation, investment returns, mortality, and assumptions on the profiles of future settlements, and so on. As assumptions for some of these elements will represent events far in the future, they may not be updated as frequently as general insurance reserves, which are often updated multiple times a year.

As the years go by, the assumptions will be replaced with the actual experience and gradually unwind. If the original assumptions start to look questionable and were to remain unchanged, the valuation basis will diverge continually from actual experience and large surpluses or deficits may arise in the future when assumptions are changed.

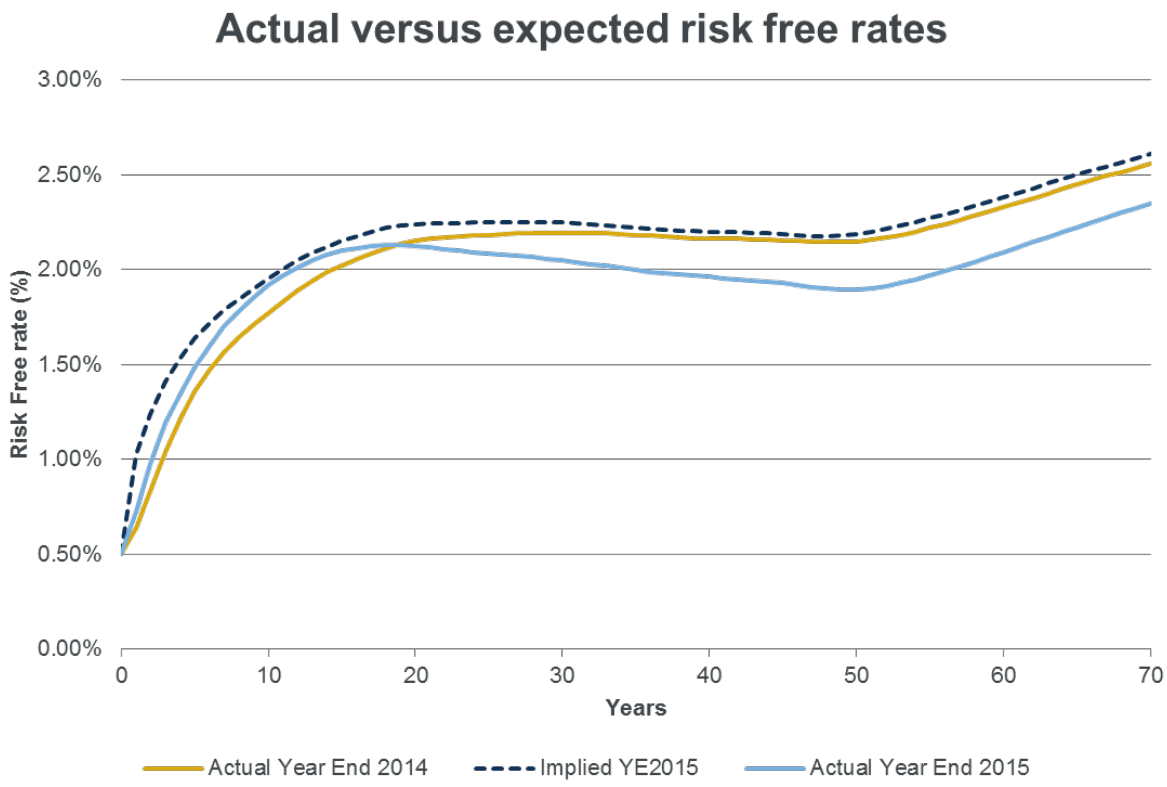
The more unfamiliar aspects which are likely to be common to most models are described below, but ultimately how PPO reserves unwind depends on the model used to construct them.

In practice it will be up to the model owner to establish a framework to analyse the surplus and deficit from actual experience versus modelled expectations. It is very important that actuarial practitioners monitor the performance of their PPO models wherever possible using actual-versus-expected analysis, as this will often illuminate areas that may need further work either by updating assumptions or the models. Communicating actual-versus-expected analysis effectively will help the firm's administrative, management or supervisory body understand the issues surrounding PPO valuation and risk, and give more confidence that the liabilities are robustly calculated.

Unwinding of the discount rate

To the extent that PPO reserves are valued on a discounted basis, there will be an unwinding of the discount at each future valuation point. This represents the expected amount of investment return on the PPO reserves embedded within the discounting assumptions since the last valuation point. The magnitude of the discount-rate unwind will depend on the underlying investment return assumptions, and hence this need for assumed investment return to be achievable over the course of the run-off of the liabilities. Actual versus expected levels of investment return should be considered over time, since deviations from expected may point out the need to update assumptions and will lead to a surplus or deficit. If the assumptions are updated there of course will be a further and potentially larger surplus and deficit as a consequence.

Figure 8 - Unwinding of the yield curve



The graph above shows the EIOPA risk-free rates. This 2014 year-end risk-free rates curve has enough information embedded within it to imply the expected risk-free rates curve at future time periods. This enables insurers to carry our projections to investigate what their liabilities or capital may look like at future points in time. When future risk-free rates curves are published, insurers are then able to compare the actual risk-free rates curve to what was expected. Source: EIOPA - European Insurance and Occupational Pensions Authority, https://eiopa.europa.eu/ (European Insurance and Occupational Pensions Authority, 2016).

Valuation models that update based on the last indexed payment may offset or compound any unwinding, should the level of ASHE inflation differ from that assumed in the valuation. Valuation models that have fixed payment schedules in nominal amounts may smooth the magnitude of the discount rate unwind from year to year, but the difference between this valuation compared to one using the last known payment may become very large, and pose a substantial risk in itself. This is one important reason why models should allow for the latest actual paid amounts.

More generally, for positive investment returns, the discounted reserve will increase even if actual yields match expected. This is because investment returns are used until near full run-off to fund the increase in reserve as the payments become closer to being made. This may need to be explained to planning teams to ensure that changes in the level of the required investment returns to fund any changes in the size of the discounted liabilities are allowed for.

Mortality profit

Each year, regardless of the mortality basis chosen, the claimant will either survive to the end of the period or die during it. As the reserve required for future payments is contingent on survival, death would result in a release of reserves. This is often referred to in life insurance circles as a negative death strain at risk (DSAR).

For a PPO payable annually in advance at the start of the year, the death strain at risk at the end of the year is the benefit payable on death (nil) less the amount of the reserve required to be set up at the end of the specified year.

During any year, a certain amount of death strain can be expected to unwind, assuming that the mortality basis used allows for the chance of the claimant's death in the year. For a group of PPOs, the sum of the probabilities of death in the year applied to the corresponding death strains at risk for every PPO gives the expected death strain (EDS). The actual death strain (ADS) is the sum of the death strains at risk for each PPO claimant that has died.

Mortality profit is the expected death strain at risk less the actual death strains at risk. It represents the amounts gained or lost through the differences between the unwinding of the mortality assumptions and the mortality experienced during the year.

The mechanism for calculating the mortality profit will depend on the PPO valuation model used. For example, for an annuity certain model:

- It is assumed that there is no chance of death until the end of a claimant's life expectancy so no regular mortality deficit;
- Any early deaths generate a mortality profit, as the reserve at the end of the year is not needed (and the reserve held just before death will be released);
- Any late deaths will generate a mortality deficit each subsequent year they survive and the amount will depend on the action required to establish an arbitrary reserve.

As models become more complex, so do the considerations. For example if a life table is used then there will be a small mortality loss each year until the death of the claimant, which corresponds to the expected amount not released from death in the preceding year. Conversely, in the year in which the claimant dies there will be a profit arising from the release of the reserve.

Using a stochastic model will require these calculations to be embedded and reproduced on fixed pseudo-random runs to generate the surpluses and deficits that arise from the difference between the simulated and the expected experience.

In addition to the above, profits or losses on mortality can also arise from changing the mortality basis. As these change future cash flows simultaneously, such changes can be large in magnitude.

Model points

The use of model point for future PPO profiles could also lead to a valuation strain if not updated. Actuarial practitioners will need to monitor the profile of settlements in their own book and external information to ensure that the models points used remain relevant.

The alternative model of case-by-case modelling however does not avoid this type of risk. With such a model, it is possible that the actual profile of the PPOs settled in the future materially mismatches the average of the cases, especially for smaller books where the inherent volatility is expected to be high.

7 Capital Modelling

C

As well as undertaking best estimate valuations of PPO liabilities (see section 6), actuarial practitioners will often be called upon to consider and quantify the range of possible outcomes for PPO liabilities. This may be in a regulatory capital context or as part of the insurers wider risk management framework.

In this section, two broad types of analysis are considered - simulation techniques and scenario testing – both of which can be applied to PPOs in order to understand the range of possible outcomes.

As with the other sections in this paper, the intent is not to give a comprehensive guide to how to undertake capital modelling for PPOs, but rather to highlight the additional considerations relevant when quantifying the risks associated with PPOs.

PPOs recognised on the balance sheet have a longer expected duration than lump-sum settlements. For firms writing new business, and even many of those who have exited affected business lines, there will be an inevitable delay until the rate of deaths starts to approach the number of cases newly settling as a PPO. As a consequence, the liabilities will accumulate on the books of firms as the number of cases increase and this will have a corresponding impact on the capital requirements for PPOs.

PPOs can provide diversification benefits to insurers, as they are different to other general insurance risks. However, the accumulation over time of PPO liabilities poses difficult questions around the changing mix of insurers' liabilities between PPOs and other liabilities. If PPO liabilities start to dominate balance sheets, then diversification benefits will diminish. Similarly, the impact over time of PPOs on a firm's investment strategy and resultant asset mix may also impact capital requirements associated with assets.

7.1 Stochastic modelling

This section considers some of the challenges associated with building a simulation based model for PPOs. In order to model a range of reasonable outcomes for PPO liabilities to measure risk, there are a number of new risk areas to consider and validation issues to overcome, especially for those who have previously exclusively modelled general insurance liabilities.

Model design

Given the complexity inherent in PPOs, and the relative immaturity of their presence within general insurer balance sheets, there is limited convergence in modelling approaches between firms.

The impact of the high degree of complexity of PPO risk is that a careful balance is required between model parsimony and model sophistication. An overly complex model that tries to allow for all possible PPO risks is unlikely to be usable, with resultant practical challenges in calibration, validation and the communication of outputs. On the other hand, an overly simple model that ignores a key PPO risk is unlikely to stand up to validation and introduces the risk of misleading the users of the model in respect to the potentially material long-term risks that PPOs present.

One starting point could be to consider how to replicate the firm's best estimate valuation model with a stochastic parameter set, and then consider what simplifications can be made without significantly impacting the robustness of the outputs.

Furthermore, the relative materiality of the different risks outlined in section 4 can vary significantly between firms. For example, a small monoline UK motor insurer with exposure to perhaps a handful of PPOs is likely to be significantly more exposed to longevity volatility risks than a large multiline multinational insurer with over a hundred PPOs. Similarly, insurers with low reinsurance retentions are likely to be more exposed to reinsurance credit risk and the impact of any differences in reinsurance coverage over time, for example, changes in indexation clauses or the introduction of a capitalisation clause. Larger insurers will tend to be more exposed to the systemic risks associated with economic factors and longevity risk which have the potential to impact all PPOs.

These differences in risk profile mean that a one-size-fits-all approach is inappropriate. Actuarial practitioners therefore need to make sure that any model is designed with the specific insurers risk profile in mind. Consequently, it will be valuable to conduct a thorough risk identification exercise before commencing modelling in order to agree which risks are considered to be material to the insurer.

Although certain risks will be specific to PPOs they do not exist in isolation, so it is important for any PPO model to be appropriately linked to other components of the firm's overall capital model. For example, there is a clear link to asset modelling owing to the economic nature and importance of inflation and interest rate risks to PPO liabilities. Similarly, as PPOs arise from the underlying large bodily injury claims experience of a firm, it is important to consider the links to underwriting and reserve risk components.

Finally, as with any model, the design should give consideration to the intended uses of the model.

Inevitably, an iterative approach is likely to be required. The initial model design may be subject to ongoing refinement following each validation cycle, following a significant change in the firm's risk profile, following a request for extended use of the model or following improvements in modelling capability.

Calibration

The calibration of any PPO model is challenging owing to the lack of extensive historical data on many of the key risks including ASHE 6115, the mortality of seriously injured claimants and PPO propensity. These challenges are further exacerbated by the very long time horizons involved. Consequently, any calibration will inevitably rely on expert judgement to a significant degree.

For many of the model's parameters, the data gathered by the annual PPO Working Party survey provides a useful starting point, which modellers can use to inform their assumptions. Depending on the internal data available, a firm's own experience may also help in setting parameters, particularly expected values. In some areas, there may be external data from research that can be adapted in order to support the calibration of certain parameters. For example, available research into the longevity risk of annuitants could be used as a starting point for considering the range of possible outcomes for the longevity of PPO claimants.

Below we consider some of the specific issues that can emerge in relation to calibrating the key assumptions.

Longevity Risk

To appropriately allow for all the types of longevity risk discussed in section 4.2, it is likely to be necessary to consider in detail both the parameter risk (what is the probability of a given claimant dying in each future year) and the process risk (given that probability, are they dead or alive in each future year).

Where reliance is placed on publicly available calibrations (such as the EIOPA Standard Formula calibration) significant care is required to ensure that the calibration is appropriate for PPO claimants. This is because the majority of actuarial research into longevity risk modelling has been concerned with the experience of pensioners who are much older, less likely to be subject to significant impairment, and may exhibit different socio-economic characteristics than a typical PPO claimant.

Inflation Risk

As discussed extensively elsewhere in this paper, a particularly unusual feature of PPOs is the widespread use of ASHE based indexation (most commonly percentiles of the ASHE 6115 index). The approach to calibration in this area will be dependent on the choice of model design. The two main options are to calibrate an ASHE index directly or to calibrate a price index (such as RPI or CPI) and then separately calibrate the basis risk between ASHE and the price index chosen. In addition practitioners must be mindful of the proportion of orders linked to ASHE 6115, as firms with a small number of PPOs may have a significant proportion of their liabilities exposed to other indices, introducing basis risk between different ASHE indices.

Model practitioners should also consider the difference between attempting to calibrate the expectation of future inflation (which is particularly important when adopting a 1-year Value at Risk approach to assessing capital requirements) and attempting to calibrate future actual out-turns of ASHE or price inflation.

In modelling the expectation of future inflation, a key data source is historical data on the market price of inflation-linked assets, for example index-linked bonds or RPI-linked derivatives. As well as a number of commercial vendors who provide historical market data, the Bank of England also currently publishes historic time series of UK government bond nominal yields, real yields and implied inflation (Bank of England, 2016b). The history of such data is limited, and given the absence of ASHE-linked assets, will be of direct use only in calibrating price inflation. Significant expert judgement inferences are required to extend a calibration based on assets linked to price inflation to a calibration of ASHE expectations.

In modelling the actual out-turns of ASHE or price inflation, more historical data becomes available. The ONS publishes historical data for both ASHE (Office for National Statistics, 2016c) and price inflation (Office for National Statistics, 2016d), as well as additional data on more generic wage inflation stretching further back. Even longer time series data can be obtained from research papers covering historical prices and wages. Inevitably the longer these time series become, the less statistically robust the data is. As with the use of any external data, significant care should be taken by the actuarial practitioner in considering the appropriateness, accuracy and completeness of the data for the purpose intended.

Even with reliable historical data, calibrating a robust and coherent time series of actual out-turns is extremely challenging given that economic variables such as inflation tend to exhibit significant serial correlation over time, mean reversion behaviour and correlation with other economic variables. There are a number of third-party vendor models available which specifically focus on building ESGs for use in stochastic modelling.

It is also important that any inflation calibration is conducted together with the calibration of other economic variables, particularly interest rates. In view of the time periods involved it is particularly important that an internally consistent set of financial assumptions are applied.

Interest Rate Risk and Other Market Risks

Many of the considerations relevant to inflation risk are relevant when calibrating either future yield curves or future investment returns of specific asset classes. There is, however, significantly more historical data available, as well as a number of existing third party vendor ESGs and market standard calibrations such as the Solvency II Standard Formula (European Insurance and Occupational Pensions Authority, 2014b, pp. 140-144).

Any calibration used will need to be consistent with, and linked to, the modelling of the impact of changes in interest rates or other economic variables on the value of assets.

Counterparty Default Risk

The key requirements for calibrating counterparty default risk are to estimate a probability of default, and then estimate the loss that could be suffered given a default.

In considering the probability of default, an obvious starting point is to undertake a calibration linked to some form of objective third party assessment of the counterparty's creditworthiness, such as an external credit rating. This should take account of both the probability of default now and the probability of default at all future time periods. The very long time horizons involved with PPOs mean that even where the current credit worthiness of a counterparty is such that the estimated probability of default over the next 12 months is well beyond the return period at which capital requirements are assessed, the potential for a long-term degradation in credit quality that leads to a future default should be quantified. The impact of a deterioration in credit quality (that falls short of a default) should also be considered owing to the impact this might have on bad debt provisions.

In considering the loss given default, the calibration needs to consider the size of the liabilities in each scenario and additionally consider the impact of the firm's likely ranking against competing creditors.

Historical data on default experience that is specific to reinsurers is thankfully limited, but more generic data on default experience is readily available. For example, the European Securities and Markets Authority publish historical data on default experience for different credit rating agencies (European Securities and Markets Authority, 2016).

Considering tail dependencies is important in determining counterparty default risk for several reasons. Firstly, consideration should be given to the possibility that multiple reinsurers experience distress at the same time. Alternatively, there is the possibility that an underlying deterioration in PPO experience increases the likelihood of a default of one or more reinsurers. Calibrating such relationships is likely to rely on a significant degree of expert judgement.

Validation

Due to the inevitable reliance on expert judgement within the calibration itself, good quality validation and challenge of a PPO model is extremely important. Also, independent validation (which is a requirement for a Solvency II Internal Model) is also particularly useful in providing alternative perspectives and opinions that can improve the quality of the model.

The validation techniques that are likely to be particularly useful for a PPO model include:

- Stress and scenario testing (see section 7.3 below);
- Sensitivity testing of key parameters;
- The outputs of any profit and loss attribution or other back-testing exercise when used to identify un-modelled risks;
- Stability testing to understand the sensitivity of the model outputs to simulation error;
- Peer review from other individuals with a detailed knowledge of PPOs (including both actuarial and other specialists); and
- Interrogation of simulation output to ensure that the simulations driving adverse outcomes are related to the risks the insurer believes to be most material.

The outputs of any profit and loss attribution or other back-testing exercise in validating output distributions is likely to be of limited value given the small number of data points and the growth of PPOs over time.

Other common validation techniques that are likely to be more challenging at the current time, owing to a lack of available data, include:

- Benchmarking to industry data, which is challenging given the impact of differences in risk profiles between insurers and lack of commonly accepted modelling techniques; and
- Benchmarking to Standard Formula calibrations, noting the EIOPA model does not explicitly consider PPOs (see section 7.2. below).

Communication of results

More than for most other risks in general insurance, the firm's administrative, management or supervisory body should be made aware that there is a significant risk that the eventual outcome will differ (perhaps materially so) from that initially expected.

Practitioners should be mindful of the significant degree of expert judgement inherent in setting assumptions that are applied over very long time intervals. Parameter and model risk are therefore both likely to be significant, and consequently practitioners should be careful to communicate the uncertainty inherent in any estimate of the capital requirements associated with PPOs.

PPOs arguably provide diversification benefits to insurers, as they are different to other risks in general insurance. However, the accumulation over time of PPO liabilities poses difficult questions around the changing mix of insurers' liabilities between PPOs and other liabilities.

A particular factor to note is the very different nature of the diversification benefit that PPOs provide for the portfolio of risks of a typical general insurer. A large part of the apparent diversification benefit is likely to be due to the very different duration of PPO liabilities and the degree of independence of the long term financial assumptions' risks described in section 4 compared to other shorter term underwriting or reserving risks. Although the PPOs in any one year might be immaterial, because of their cumulative nature, over time they could dominate the risks on the firm's balance sheet and the diversification benefits will consequently reduce.

This issue can become evident when considering the Solvency II Risk Margin (see below).

Uses of stochastic models

A comprehensive and well-validated stochastic model for PPOs will be useful to an insurer in many areas, which are outlined below.

Capital Modelling

The most obvious use of a good quality stochastic model is in the estimation of the firm's capital requirements. This may be in a regulatory context for firms with approval to use a Solvency II Internal Model or Partial Internal Model, or in support of management's own assessment of risk.

Furthermore, given the limitations of EIOPA's Standard Formula as it relates to PPOs (see section 7.2), a good quality stochastic model will be important in order to demonstrate the appropriateness, or otherwise, of the Standard Formula approach.

As well as providing an indication of the current capital requirements arising from PPOs, it may be possible to extend the model to provide a forecast of future capital requirements, especially for the insurers who expect their PPO liabilities to increase in size.

Reserving

The mean value of the stochastic future liability cash flow projections could also be used in the determination of the best estimate for the purposes of setting reserves (see section 6.6).

It may also be used to explore the effect of regulatory requirements on the reserve value, for example the Solvency II Volatility Adjustment or Matching Adjustment.

Solvency II Risk margin

The Solvency II Risk Margin requires a firm to estimate the SCR necessary to support their obligations over their lifetime, and then quantify the cost of providing this amount of capital (The European Parliament and The Council of the European Union, 2014, p. 95). Actuarial practitioners may want to use a capital model to help them understand the likely future SCR associated with PPOs in order to determine the corresponding Risk Margin. While a number of simplified methods for projecting future SCR are permitted, they must be justified with reference to the nature, scale and complexity of risks (European Insurance and Occupational Pensions Authority, 2014b, pp. 90-96).

Given their long-tail nature, PPOs are particularly important in the context of the Risk Margin (Prudential Regulation Authority, 2015a). The Risk Margin for PPOs could be very significant in relation to the insurer's Technical Provisions and overall solvency position.

Pricing

While a best estimate loading can be determined from a valuation exercise, the additional costs of supporting capital requirements associated with PPOs (for example, SCR and Risk Margin in a Solvency II context) are also be important for pricing practitioners to understand in order to make appropriate allowance for risk and uncertainty, especially given that this has the potential to be significantly higher than the equivalent risk and uncertainty for lump-sum settlements.

A stochastic model could also be used to help understand the impact of PPOs on profitability, both in extreme scenarios and at more frequent return periods.

Reinsurance

A stochastic model allows the quantitative investigation of alternative reinsurance structures. This includes typical investigations into cost-benefit analysis of different excess limits, but also helps in exploring the effects on capital and profitability of capitalisation clauses or other features of reinsurance coverage.

Reinsurance wordings themselves can be diverse. Just considering capitalisation clauses, these can vary with respect to:

- Discount rates;
- Mortality bases (that may not align to the insurer's valuation basis); and
- Time periods at which the annuity payments are settled as a lump sum by the reinsurer (for example, at the point of court award or a defined number of years afterwards).

Each reinsurance wording variation will lead to a different risk profile for both the insurer and the reinsurance providers.

Investment Strategy

A good quality PPO model will also enable the insurer to consider the impact of changes in investment strategy on both the risks associated with PPOs and its overall risk profile. What-if analysis could be undertaken as to the impact of a change in investment strategy on the exposure to interest rate risk, other market risks and inflation risk.

This may assist the insurer in identifying alternative assets that provide a better match to long-term PPO liabilities than the cash and fixed interest securities traditionally held by general insurers.

7.2 Solvency II Standard Formula

An alternative approach to quantifying the range of possible outcomes in relation to PPO liabilities could be to consider estimates arising from the Standard Formula SCR calculation. If considering the use of the Standard Formula SCR for determining regulatory capital requirements, actuarial practitioners should be aware that the PRA requires firms to demonstrate that the assumptions underpinning the Standard Formula are appropriate for their risk profile (Bank of England, 2016a), and furthermore PPOs have been specifically highlighted by the PRA as an area that non-life insurers need to carefully consider (see (Orr, 2015, p. 10) or (Prudential Regulation Authority, 2015a)). In forming an opinion on the appropriateness of the Standard Formula, it is important to understand the assumptions which underpin the Standard Formula modules. These are outlined in EIOPA's technical guidance (European Insurance and Occupational Pensions Authority, 2014c).

In performing an assessment under the Standard Formula for a non-life insurer, calculations may be required under a wider range of Standard Formula modules than conventional non-life insurance liabilities. In particular, PPOs are considered an example of annuities stemming from non-life insurance obligations and consequently classified as life insurance liabilities and subject to assessment under the Life Underwriting Risk module (European Insurance and Occupational Pensions Authority, 2014b, p. 65).

Section 4 considers in detail the extent to which risks associated with PPOs differ from risks associated with conventional non-life liabilities, or from conventional life insurance annuities.

7.3 Stress and scenario testing

Stress and scenario testing in a capital modelling context can, amongst other things, be used to:

- Give consideration to alternative assumption sets and the impact these might have on the best estimate valuation or capital requirements;
- Identify the key assumptions to which the valuation of PPO liabilities are most sensitive;
- Help communicate the level of risk and uncertainty to the firm's administrative, management or supervisory body;
- Help validate and provide context to the outputs of a stochastic model;
- Assist in risk identification processes; and
- Enable practitioners to better understand, and where possible quantify, the level of parameter and model error.

Stress and scenario tests should therefore be designed to help explore the sensitivity of the valuation to uncertainty in the risks associated with PPOs (which are detailed in section 4).

The types of testing that could be undertaken include:

- Flexing model parameters with reference to the range of reasonable best estimates or the range of possible outcomes for each parameter. This is typically referred to as sensitivity testing;
- Creating 'real world' scenarios for the external environment, and considering the impact these would have on the valuation of PPO liabilities. This is typically referred to as scenario testing; and
- Reverse stress testing, whereby consideration is given to the outcomes for PPO liabilities that would be required to lead the firm to be unable to meet a key business objective (for example, the inability to pay planned dividends, or to continue to write new business).

In all cases, it is likely that the exercise will be of most value when there is engagement from areas outside the actuarial department, for example claim handlers or underwriting professionals.

Propensity

Examples of scenarios that could be considered in the context of propensity risk include:

- Legislative change or legal precedent could lead to the mandatory use of a PPO settlement method in certain circumstances or re-opening of settled lump sums and their re-settlement as PPOs (see for example (Prudential Regulation Authority, 2015b, pp. 16-17)); and
- Changes in the discount rate used with the Ogden tables, which may impact both propensity alongside the reserves required for lump-sum settlements. Generally, the expectation is that a reduction in the discount rate would decrease propensity because this would increase the amounts awarded in lump-sum settlements.

The second example highlights that it is likely that any changes to propensity need to be considered in conjunction with the impact on large bodily injury claims experience more generally because a claim that settles by way of a PPO cannot also settle as a traditional lump-sum settlement.

Inflation

Consideration of scenarios that might impact ASHE and other related inflation measures will be particularly important, and could include:

- The impact of a step change in the initial levels of annual awards, which would have an impact on the cost of both future PPOs and future lump sum awards;
- A period of significant price inflation, for example that experienced in the UK in the 1970s; and
- A period of significant real wage growth, either for the economy in general or specifically for the care workers who underpin the ASHE 6115 indices used for most PPOs.

It is likely to be the case that any changes to inflation expectations needs to be considered in conjunction with the potential impact of the given scenario on the yield curve used to discount liabilities. Additionally, the impact of any changes on the valuation of inflation-linked assets should be considered.

Given the sensitivity of PPO valuations to small changes in economic assumptions, it is important to articulate to the firm's administrative, management or supervisory body the impact that even a small difference in economic assumptions could have on the valuation.

Longevity

Examples of scenarios that could be considered in the context of longevity risk include:

- A one-off medical advance that leads to a sudden improvement in future life expectancy for a significant subset of PPO claimants (both existing and future). For example, the potential for significant improvements in the options available for treating spinal injuries. This may also impact the size of future awards, and the propensity for claims to settle by way of a PPO.
- More generic medical advances that lead to an improvement in future life expectancy for the whole population, including PPO claimants (for example the development of a cure for certain types of dementia).
- The impact of adopting different technical methods to the allowance for impairments to mortality for seriously injured claimants (see section 5.5).
- The impact of any systemic bias in the mortality estimates for PPO claimants (either in the choice of base mortality table or estimates of mortality impairment).

Given the limited availability of market data from which to derive suitable estimates for the mortality rates for PPO claimants, sensitivity testing will be particularly important in quantifying parameter error.

Interest rates

Examples of scenarios that could be considered in the context of the yield curve used to discount liabilities are:

- The impact of wider economic conditions on yield curves, for example, a recession in the Eurozone or the US, leading to a 'safe-haven' status for Sterling assets;
- The impact of changes in the insurer's regulatory basis for setting discount rate assumptions (for example gaining or losing approval to use a Volatility Adjustment); and
- The impact of a change in the insurer's investment strategy on its future investment return, in conjunction with the impact on exposure to other risks.

As noted above, it is likely to be the case that any changes to yield curves need to be considered in conjunction with the potential impact of the given scenario on inflation expectations. As well as the impact on PPO liabilities, the impact of any changes in yield curves on the valuation of assets should be considered.

Again, small changes in economic assumptions can cause large changes in the value of PPOs and it is important to explore and communicate this effectively.

8 Pricing

PPOs are at least as relevant for pricing as they are for reserving. If the PPO reserves are not accurate, the primary impact will be incorrect timing of the recognition of the profit and loss with the ultimate amount paid being the same if no management actions are taken. Incorrect pricing however will change the ultimate losses of the company.

The methodology for calculating uplifts is the same for pricing as for reserving. However, some of the assumptions may differ in pricing compared to reserving. Thus we do not duplicate detailed explanations of the calculations here and instead highlight key areas where assumptions might be different. For a more detailed consideration of PPO modelling (from the point of view of reserving) see section 6.

At present, when allowing for PPOs in pricing the main objective is to determine a relationship between lump-sum and PPO claims. This requires two assumptions:

- Propensity - the proportion of claims that will result in PPOs; and the
- PPO uplift - the uplift to the cost of a lump sum claim from both additional costs and the additional cost of risk, as payments under PPOs are more uncertain.

The current economic value of a PPO, discounted at risk free rates, is higher than the Ogden value for the cost of care element. This is due to the discount rate set for use in the Ogden tables for lump-sum settlements being higher than many reasonable outlooks for the yields on available assets that might back PPOs. This alone could cause a business that appeared to have a profitable combined operating ratio to become unprofitable, as the motor market in the UK is mature and highly competitive.

In future, there may be opportunities for pricing to become more sophisticated in its approach to allowing for PPOs in terms of identifying rating factors and deferential costs for different claimants. However, these are dependent on the maturity of large loss modelling, which is a challenge in itself not least because they involve third-parties unknown at the point of sale and very specific circumstances of the incident giving rise to the loss amount, as well as the relatively small number of large losses resulting in any analysis having limited statistical credibility and extreme challenges in applying to the level of traditional rating factors.

8.1 Propensity

When deciding on the propensity for cases to settle as PPOs, a company can choose a single assumption across pricing and reserving, or allow each of the teams to derive their own assumptions independently. Where separate assumptions are used, teams should investigate differences between assumptions to strengthen their overall understanding. Either way, it is important to consider historical ratios between the volume of settled lump sums and PPOs in addition to current and projected future trends. It is also worth considering that the PPO settlement propensity varies by size of loss according to historical market data (Periodical Payment Orders Working Party, 2015a, p. 8).

8.2 PPO uplift

Calculating the additional cost of a PPO over a lump sum claim is crucial in pricing PPOs. This depends on a number of factors discussed below.

Discounting and inflation

An assumption for the discount rate will need to be determined since it is difficult to see a case for valuing PPOs in pricing without discounting. Insurance losses that are not paid immediately will sit on the balance sheet as a liability, backed by assets that are earning investment income. The well-known and unsurprising economic impact is that insurance underwriting profit is subsidised by investment income. PPO liabilities are expected to be on the balance sheet for a long duration.

Without discounting, assumptions would be conservative, leading to hefty loadings giving rise to loss of business and the potential for anti-selection if competitors discount their reserves. The same situation may arise if rates used to set reserves are not understood. If a firm has a discounting policy that is relatively prudent to the rest of the market and is not known about in pricing, the loadings may be larger than the rest of the market and again expose the firm to anti-selection.

However, the inflation rates and investment returns are important assumptions for valuing PPOs, and in real terms if PPOs are indexed with too little inflation or if investment return are not met, then more cash will be needed in the future than allowed for in the pricing basis, placing strain on future business models.

As well as inflation affecting the nominal size of projected payments once an order commences, inflation across settlement years will affect the size of the initial annual amounts.

Reinsurance

For an insurer, the level and type of reinsurance cover strongly affects the size of the uplift. For a company with a low deductible buying reinsurance cover without a capitalisation clause, the key impact of PPOs on the large loss load will be on credit risk, indexation of the deductible, and the costs of administering the PPOs.

Insurers with a high deductible on their reinsurance treaties and reinsurers will need to understand where in the portfolio claims will come from and what the additional cost will be, since they will be exposed to propensity, inflation, impairment and longevity risk to a much greater degree.

Indexation

Indexation of treaty limits and deductibles is an important concern, affecting both the insurer and reinsurer. Indexation of deductibles and limits can be done in several ways and this will be set out in the indexation clause of the reinsurance contract. The main types are full index clause (FIC) and severe inflation clause (SIC). The main difference between the two is that a FIC applies inflation from the policy's inception date whereas a SIC applies inflation only when the inflation since inception breaches a certain trigger point.

The indexation will affect how a claim interacts with different layers of a reinsurance treaty, and this may make one type more or less preferable to another. It may also determine the level of complexity with which an insurer wishes to model the PPO uplift for pricing purposes as it may affect the level of risk retained.

Capitalisation

Another important factor in determining the PPO load is the capitalisation clause. Whether the reinsurance is on a capitalised basis or not affects how the insurer and reinsurer will determine the price since the clause will determine how much of the risk is retained by each party. Capitalisation clauses are discussed further in section 6.7 of this paper.

Capital

The last key consideration is capital and the associated loadings in pricing. Capital is needed for risk until the liability is extinguished. For lump-sum claims, payment is soon after settlement and hence the capital is held for a relatively short period. Under a PPO, capital must be held until the claimant dies. Given that all the risks associated with lump-sum settlement are also present, the range of possible outcomes is much wider and associated required capital is much higher. Consequently the cost of capital for PPOs, and the extent to which this may exceed the additional investment return potentially available on the assets held to back the liabilities, must also be considered as part of the pricing exercise.

Section 7 considers capital modelling in more detail.

Other considerations

The clarity of communication of all of these assumptions is vital. It should include what assumptions are made and the impact of varying them.

Furthermore as in any pricing exercise, the inclusion of underwriting information should not be ignored. For example, links may be made between the age of the claimant and PPO propensity as well as other potential characteristics, however the small volume of PPO claims may make attribution to individual pricing cells challenging, due to lack of data quantity. Where this is undertaken, the actuary should ensure that the factors are discussed with underwriting and appropriately documented. .

9 Financial reporting

PPOs create a number of challenges in regards to financial reporting, not least because until the emergence of PPOs, the use of discounting in general insurance financial reports was often absent or immaterial.

As the liabilities are projected over the long term, those contributing to financial reporting requirements conducting actuarial work may find that they are unfamiliar with regulations and have a greater number to consider. Furthermore, the reporting may require breaking down actual versus expected development in different ways. For example, statements that are discounted commonly require an indication of how much of a financial movement is expected from discounting unwinding and how much is from a change in the value of the undiscounted cash flows.

With all financial reporting bases, it will be important that the assumptions used and their implications are made clear to the firm's administrative, management or supervisory body. Furthermore, the Technical Actuarial Standards (TASs) may require it. An example at the time of writing is the Insurance TAS's requirements on explaining the discount rate used (Financial Reporting Council, 2010, p. 13).

Reinsurance assets have similar considerations to the gross recoveries. However what is unusual and may require further thought is the often even greater duration of the recoveries, for example on Excess of Loss treaties. Depending on the reporting requirements, an allowance for potential reinsurance default may be material and necessary, or may even be prohibited. Also it is important that assumptions used to calculate the gross liability, are aligned to those used to calculate the recovery to ensure the net position is correct. For example, it would be difficult to explain differing mortality bases between the two.

PPO reporting will require consideration of rules, regulations and principles that may be unfamiliar to those preparing them. Those calculating the amounts may find it useful to engage with accountants and other experts in financial reporting to determine the requirements. As PPOs may also be unfamiliar to all parties involved, good communication between actuarial functions and reporting functions is highly important and should minimise misunderstanding.

The comments that follow are the PPO Working Party's interpretation of the rules as they apply to PPOs and the actuarial practitioner should consider the rules independently alongside any company accounting practice when adopting any guidance. Furthermore, the reporting bases described below are not exhaustive. Entities may be exposed to a multitude of reporting bases enforced over varying jurisdictions where legislation and regulations may differ. Sanctions for improper reporting can be very severe. In addition, the descriptions below are the current requirements in 2016; these will also evolve over time.

9.1 Aligning valuation bases

An additional challenge for actuaries reporting on PPOs is to align valuation bases as far as possible.

Aligning valuation bases and techniques across a company can be complex given the number of different requirements needing to be met depending upon the purpose of the reporting. PPO volumes continue to constitute a growing proportion of balance sheets for organisations with exposure to motor and casualty insurance, and the understanding of PPOs by practitioners in these businesses continues to mature

As reserving teams reflect on these developments, including drawing parallels with life insurance, emerging reporting requirements may increase to better inform stakeholders.

However, the different valuation reporting bases are not mutually exclusive and there is an element of overlap between them.

One simple way to align reporting is to use a single model. In practice, this may be overly complex and instead the challenge may be to align the neutral estimates under different bases. As will become clear from reading about some common bases below, many hurdles can be overcome by the PPO model being explicit and using a cash flow approach. This allows compliance across a multitude of standards, by enabling flexibility and supporting disclosure requirements.

Even where models have been fully rationalised and prepared for multiple assumptions to meet each basis' requirements, some planning will be useful to meet the financial reporting outputs. This may involve communicating with accounting, financial control and planning teams amongst others. An example is expenses: under common UK accounting practices firms often set up a claims handling reserve, with the aim of provisioning for the run off of claims over the long-term which, as well as matching the long-term reporting of claims costs. However, regulatory reporting may not require separate disclosures and may need expense strain versus lower premium than planned considered instead. Therefore flexibility will be important.

A key difference between reporting bases that can be easy to implement, but difficult to rationalise is the discount rate used to value PPOs. If models are constructed to use yield curves, it is possible to switch in and out a number of bases. However, determining the basis is less simple. In some cases it is either prescribed in value or by a fairly rigid procedure, which is more likely to be the case for regulatory reporting. For accounting returns designed for the current and potential future owners of the business the same rate may not be appropriate. The rate should always be low enough to be reasonably achieved, as discounting recognises future investment income immediately. Choosing a higher than justifiable rate puts the claimants primarily at risk of the company running out of funds, and is also disadvantageous to future shareholders as this understates the value of liabilities and increases the risk of institutional failure.

A lower rate can also be damaging. It may distort the view of the company's potential for future investors and if translated into pricing raises prices for consumers. Consequently a one-size-fits all approach, whilst simpler, may not be appropriate. If more than one rate is chosen across financial reports, it will be important to be mindful of the rates used and clearly communicate them to the firm's administrative, management or supervisory body.

Solvency must be considered. If a single discount rate were used, lowering rates for management accounts without considering regulatory accounts for example may make the

organisation insolvent. If more than one rate is required, it should be clear why. In addition, if the regulatory rate is lower than that used in the general accounts this will still limit business activities as capital constraints will prevent the payment of surplus to the owners regardless of how much earnings are recognised.

9.2 Statutory reporting bases

Accounting treatment under UK GAAP

FRS 102 replaced old UK GAAP for accounting periods beginning on or after 1 January 2015 (Deloitte Touche Tohmatsu Limited, 2016a). Another standard, FRS 103 sets out the accounting requirements for an insurance contract (Deloitte Touche Tohmatsu Limited, 2016b). This formally replaces the ABI Statement of Recommended Practice on Accounting for Insurance Business (Association of British Insurers, 2006). The relevant FRSs, together with a company's own accounting practices, form the basis for UK GAAP treatment. Reporting actuarial practitioners will have to work with accounting colleagues to shape the UK GAAP treatment in line with FRS 103 and other principles established by existing practice.

FRS 103 allows an insurer to change its accounting policies for insurance contracts if, and only if, the change makes the financial statements more relevant to the economic decision-making needs of users and no less reliable, or more reliable and no less relevant to those needs.

The FRS permits an insurer to continue, but not introduce:

- Measuring insurance liabilities on an undiscounted basis;
- Using excessive prudence; and
- Using future investment margins (for example by using the estimated return on the insurer's assets).

It also allows improvements to accounting policies similar to IFRS 4 Phase I. It allows insurers to reflect current market interest rates and recognises changes in those liabilities in profit or loss. However, if an insurer does so, it shall continue to apply current market interest rates consistently in all periods to all these liabilities until they are extinguished.

As FRS 103 allows general insurers to continue with their existing accounting practices, it is important to understand what these are likely to be.

Previously the ABI SORP, which was withdrawn for accounting periods on, or after 1 January 2015 was applicable.

Conventionally, general insurance liabilities are not discounted, and this is reflected in the accounting treatment of PPOs under the ABI SOPR. Implicit discounting is prohibited by the Companies Act 1985. In practice this may arise if too simplistic an approach has been taken; for example, referencing the Ogden tables at difference interest rates to provide a PPO uplift, without considering the nature of cash flows and maybe even omitting to disclose that discounting has been applied in the accounts, if this is overlooked.

Under the ABI SORP, explicit discounting of claims provisions is permissible if certain conditions are met. The conditions set out within ABI SORP to permit discounting include a:

- Long settlement delay: This needs to be at least four years on average between the accounting date and the settlement date, which is expected to be tested every accounting period.
- Application to a whole category: Explicit discounting should normally be adopted by reference to whole categories of claims (with similar characteristics but not solely by length of settlement pattern) rather than to individual claims.
- Data being available to create a rate of settlement model: A reliable and back-tested model is expected. Furthermore UK GAAP expects cash flows to be modelled gross and net of reinsurance to allow for any delay in receiving the reinsurance recoveries.
- Match to suitable assets: As well as being specified in the SORP, the Companies Act 1985 indicates that discounting should be applied only where assets (excluding those attributable to shareholders' funds) are available which are appropriate in magnitude and nature to cover the liabilities being discounted.

The discount rate used should take into consideration the returns achieved on the assets backing the liabilities over the period in question, as well as to what extent this level of returns would remain relevant in the future. The discount rate used should not exceed the rate expected to be earned by the assets which need to aim to closely match the magnitude and nature of the PPOs. In particular, the discount rate should not exceed the rate which could be justified by considering the performance of such assets over the preceding five years, or the year preceding the balance sheet date.

When discounting is adopted, disclosures must be made within the notes to the financial statements which quantify it, allowing users to understand the reliance on discounting. Practitioners will have to be careful when using uplift approaches that they include the full impact of discounting and not just the uplift. Another area to be careful in identifying discounting is within accounting margins.

To fulfil the disclosure requirements accountants are likely to require the following information from those discounting PPOs:

- The categories of claims that have been discounted and the criteria adopted for estimating the period that will elapse before the claims are settled;
- The methods used to discount;
- The size of the discount effect in order to state the total amount of the technical provisions before discounting;
- The amount of unwinding of the discount rate;
- The average period to settlement; and
- The rate of investment return.

The IFRS Foundation and IASB are undertaking a project to provide a single principle-based standard to account for all types of insurance contracts (IFRS Foundation and IASB, 2016), which PPOs will be subject to, where the insurer or re-insurer is taking insurance risk.

Accounting treatment under IFRS 4 Phase I

The first phase of this project was released in March 2004, IFRS 4 Insurance Contracts, as an interim Standard (International Accounting Standards Board, 2004). A key consideration for

the first phase is that it permits insurers to retain most aspects of their previous accounting basis (IFRS Foundation, 2012). This is why UK GAAP may affect those calculating PPO liability values for accounts until Phase II is implemented. To reiterate, the text below gives highlights and summaries of IFRS 4 but is not intended to be exhaustive nor give advice.

In contrast to UK GAAP, IFRS 4 moves towards discounting technical provisions. Changes to accounting bases from UK GAAP to IFRS 4 can be made where as a result, the financial statements are more relevant and no less reliable, or more reliable and no less relevant to the previous basis. In particular, an insurer cannot introduce the measurement of insurance liabilities on an undiscounted basis, although it may continue using accounting policies that involve using an undiscounted basis.

Consequently PPOs can continue to be reserved on an undiscounted basis under IFRS 4 if they have already been so under UK GAAP. However, if they are already being reported on a discounted basis, moving to an undiscounted basis would not be permissible under IFRS 4.

The discount rate should reflect only characteristics of the insurance contract liability and be updated each reporting period. Factors which are not relevant to the liability should be removed (IFRS Foundation, 2012, p. 24). The Standard allows insurers to update yield curves in reference to current market rates, but does not require this unless an insurer has already done so. Once this method is chosen for a set of liabilities it cannot be revoked until the liabilities are extinguished.

Again clear communication with accountants will be necessary, as IFRS 4 is even more extensive in the relationship between assets and liabilities. Good communication will aid the organisation in drawing up relevant financial statements with respect to PPOs.

Although IFRS does require the impairment of reinsurance assets to be recognised, this is only when objective evidence is received. This would mean that allowances for general default over the lifetime of the contract may not be permissible.

Accounting treatment under IFRS 4 Phase II

The following section is very likely to be out of date shortly after the paper's publication, as IFRS 4 Phase II is currently being published. We hope the summary of the current position will however give both advanced warning and provoke thought and perhaps even feedback to shape how PPOs are reported on.

Phase II proposes that claims provisions are assessed using the following four building blocks for the future cash flows:

- They are unbiased (including inflation) and based on a probability-weighted average;
- They reflect the time value of money, that is they are discounted;
- They include a risk adjustment for the effects of uncertainty around the amount and timing of the cash flows; and
- Together with appropriate reporting lines there is a provision to eliminate any gain at inception of the contract, the residual margin.

This amounts to making discounting mandatory. This is in contrast to the current UK GAAP rules and more prescriptive than the IFRS 4 Phase I rules. The requirement to discount also gives the requirement to unwind the discount rate. This may be operationally complex as initial proposed rules expect firms to use the original valuation rates, which will differ by reporting year to unwind the liabilities, but update the rates to set the reserve in line with market rates. However the burden of discounting will be shared with non-PPO liabilities as all will need to be discounted and unwound if the standard is enacted as currently proposed. Consequently early work on PPOs may help smooth the transition to IFRS 4 in this area.

When IFRS 4 Phase II is implemented, the treatment of PPOs is expected to be much more similar to their treatment under Solvency II that the accounting treatment is now.

However, it will not be the same as the two sets of financial reports do not share the same purpose. The key differences are:

- The addition of the residual margin in IFRS 4; and
- The discount rate approach is principle-based and must reflect the characteristics of the liabilities, using either a 'top-down' or 'bottom-up' approach.

A top-down approach in this context is taking the firm's investment return and adjusting for any duration mismatches and allowing for default and other changes to give an expected return on an appropriate equivalent portfolio of matching assets.

A bottom-up approach is starting with the market-based risk-free rate information and allowing for additional margins that a firm may expect to earn on an appropriate equivalent portfolio of matching assets, for example liquidity premium. The fundamental difference to Solvency II on this seemingly similar approach is that it is principles-based and does not require, for example, complex matching-condition rules to be used.

As mentioned this area is evolving, but the key principle is that the valuation is intended to be more economic than current accounting standards. It is clearly an area in which any practitioner calculating PPO reserves for accounts would find value in keeping their knowledge up to date.

9.3 Regulatory reporting bases

Regulatory reporting bases often have a different purpose from statutory accounts, being designed to prove that the insurer can meet the policyholders liabilities as they fall due whereas statutory bases are often focused on providing a true and fair view to existing and future potential investors in the company.

Regulatory reporting and treatment under Solvency II

Regulatory reporting requirements typically require both neutral estimates and measures or scenarios that are more adverse. This increases the requirements for clear disclosure, not least because for Solvency II the emphasis is on the short-term, whereas the key risks of PPOs operate over a long time horizon.

However, in calculating the technical provisions, the risk margin element will need to take account of the SCR over the future lifetime of the claimant. The very long-term nature of the risk suggests a large increase in the risk margin compared to a traditional lump sum.

In addition, under Solvency II, allowance for reinsurance credit risk will need to be made within the SCR and hence within the cost-of-capital component of the balance sheet for valuation purposes.

The implementation of Solvency II occurred at the time of writing this paper. Particular reporting requirements of Solvency II are still uncertain, and specific interpretations are likely to change as the new regulation settles in.

There are however already some reporting areas that do have clear implications (European Insurance and Occupational Pensions Authority, 2015, pp. 22-49):

- PPOs will normally be annuities stemming from non-life obligations;
- Settled PPO claims (that is, PPO claims sanctioned by the Court and not expired) need separating from other PPO claims;
- Disclosure information is a mixture of discounted and undiscounted information; and
- Information can be detailed, requiring counts and changes in reserve provisions across reporting points and reinsurance splits with distinctions between inwards and outwards reinsurance (Bank of England, 2015a, pp. 140-150).

When providing non-life internal-model outputs to the PRA (see PRA's supervisory statement SS25/15), reserve and premium risk outputs relating to PPOs are to be shown separately (Bank of England, 2015b).

The discounting that can be used still has some ambiguity. When discounted figures are to be provided, these can be discounted at least at the risk free rate as provided by the regulator. There may be scope to further increase this rate by making use of the matching adjustment (MA) or volatility adjustment (VA). However, as discussed in the risk section it may be a challenge to find assets that sufficiently match the unique scope of PPO liabilities. Furthermore, it is likely that both financial conditions with and without the adjustment may need to be published, which may make the adjustments less attractive in practice.

9.4 Valuation at Lloyd's

Lloyd's valuation principles for discounting are currently aligned to the regulatory reporting basis in force before Solvency II, found in GENPRU 2.2 (Financial Conduct Authority, 2010). The relevant rule is that amongst other exceptions, discounting is permitted only on 'annuity liabilities' and PPOs are in Lloyd's valuations deemed to be annuities at the time of writing.

The deferment period, or time between the valuation date and the point payments are due to commence should not be discounted. This means that reserves for claims due to be paid by way of a PPO in the future can be discounted only from the point payment is due to begin.

Excluding the effects of inflation-linking, PPOs can include changes in the payment schedule over time. These can be explicitly set out within the court award in the form of stepped

payments, in which case the full payment schedule is known (with each payment contingent on claimant survival).

PPOs can also be variable orders, stating specific conditions within the court award on which the case can return to court for the PPO payments to be renegotiated, for example, a medical deterioration. With variable orders it is not known whether the specified conditions will occur, whether the variable part of the order will come into action, or what the PPO payments will be revised to if the case does return to court.

If the PPO has undefined or uncertain payment changes in the court order, for example a variable order as explained above, then that contingent part: that is, any part of the annuity over and above the current level, cannot be discounted, as it is a contingent event and may not occur. On the other hand, as the real quantum of step payments are known from the outset, any part of the annuity over and above, or below, the current level can be discounted.

At Lloyd's, a significant proportion of the PPO reserve relates to inwards reinsurance, and this can cause further complications. Cedants often do not inform their reinsurers explicitly whether they have themselves discounted the reported outstanding amount or not. Lloyd's Valuation of Liability Rules allow cedants to advise discounted reserves to the market. The Lloyd's Reinsurance Claims Group issued guidance in early 2013 detailing the information and data that should be obtained from the reinsured for reserving purposes.

At the time of writing, as a result of the combination of both the complexity of the valuation rules and the current low discount rate environment, discounting is of minimal benefit to the market and often does not outweigh the time it would take to do the discounting calculations. Those valuing PPOs will clearly have to be mindful that it is possible that the current environment will revert to historical norms and then the impact of discounting may be of greater financial consequence.

As well as initial valuation, reserves are subject to Statements of Actuarial Opinion which should include information on PPOs.

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11 Further reading

The Institute and Faculty of Actuaries Periodical Payment Orders (PPOs) Working Party have a website listing a selection of past presentations and documents at the following address online:

https://www.actuaries.org.uk/practice-areas/general-insurance/research-working-parties/periodical-payment-orders-ppos

The PPO Working party specifically draws your attention to the proposed standards for Injury Classifications. This is explained at the link below:

https://www.actuaries.org.uk/documents/ppo-injury-categorisation

With the classifications in the document at the following location:

https://www.actuaries.org.uk/documents/ppo-injury-categorisation-excel

For further developments on IFRS 4 Phase 2, there is another Institute and Faculty of Actuaries Working Party: IFRS 4 Phase II for General Insurance:

https://www.actuaries.org.uk/practice-areas/general-insurance/research-working-parties/ifrs-4-phase-ii-general-insurance

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13 Glossary of terms

ASHE	Annual Survey of Hours and Earnings
AWE	Average Weekly Earnings
CPI	Consumer Prices Index
EIOPA	European Insurance and Occupational Pensions Authority
ESG	Economic Scenario Generator
FCA	Financial Conduct Authority
GAAP	Generally Accepted Accounting Principles
IASB	International Accounting Standards Board
IFoA	Institute and Faculty of Actuaries
IFRS	International Financial Reporting Standards
ONS	Office for National Statistics
PPOs	Periodical Payment Orders
PRA	Prudential Regulation Authority
RPI	Retail Prices Index
SCR	Solvency Capital Requirement under the Solvency II regime
TAS	Technical Actuarial Standard

Administrative, management or supervisory body – has the meaning attributed to it within Article 40 of the Solvency II Directive (The European Parliament and The Council of the European Union, 2014, p. 64).