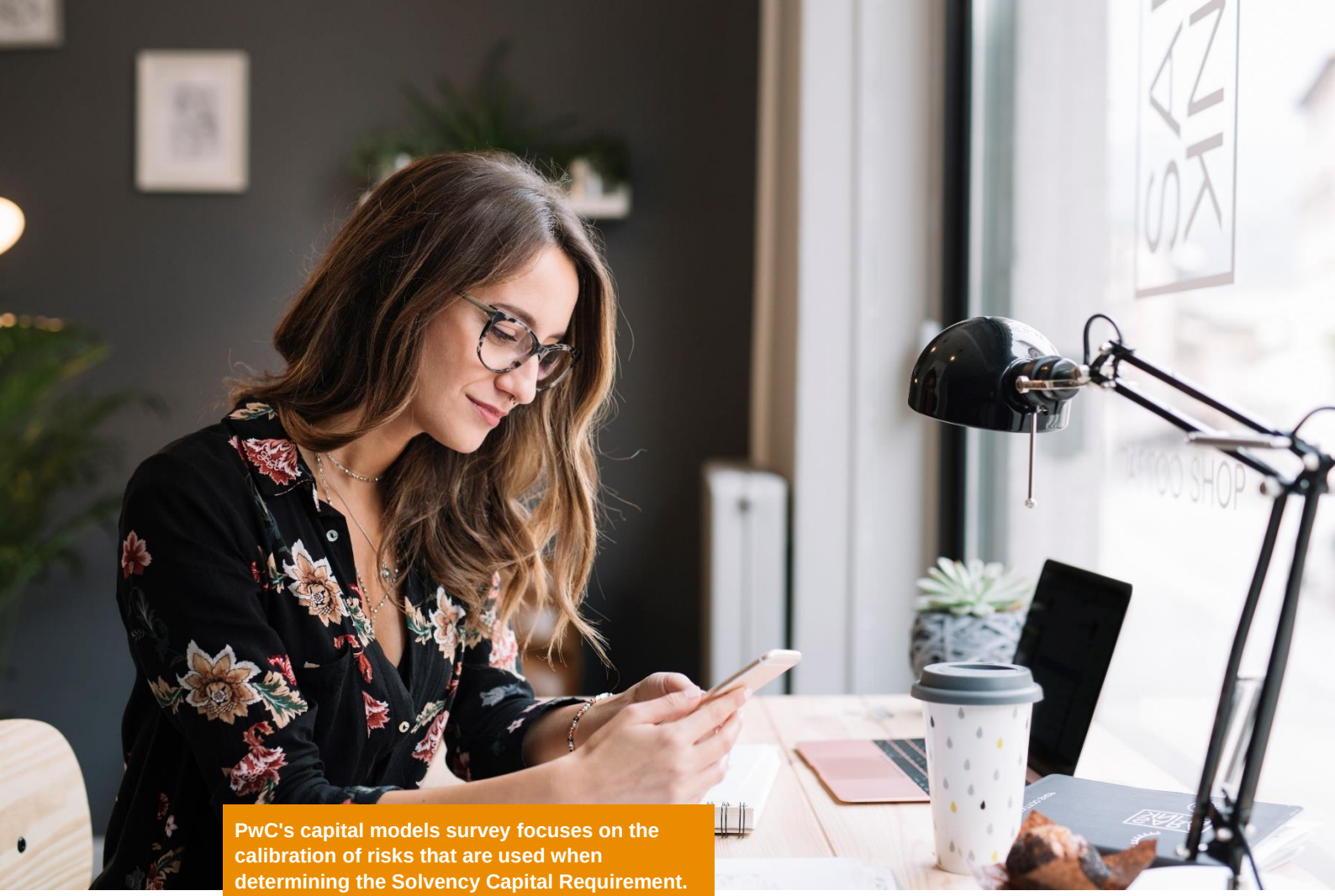
PwC Solvency II Life Insurers' Capital Model Survey

Summary report

February 2021

pwc



PwC's capital models survey focuses on the calibration of risks that are used when determining the Solvency Capital Requirement. This survey covers Internal Model and Partial Internal Model life insurance companies in the UK.

Participants

We would like to express our thanks to the following firms which took part in our survey:

- AEGON UK
- AVIVA UK Life
- Just Retirement Limited
- Legal & General Group Plc
- NFU Mutual
- Phoenix Group
- PIC
- Rothesay Life Plc
- Royal London Mutual Insurance Society Limited

Contents

1. Introduction

Welcome to the 2020 life insurers' Solvency II capital models survey. This report aims to capture aspects of the methodology and the stresses applied in the year-end 2019 capital models across a wide range of risks and any changes in the calibrations over 2019, in order to help your business compare its model and assumptions with peers in the market. This can provide valuable insights at a time when many insurers continue to be in discussion with their regulators over planned model changes.

The survey covers the evaluation of capital for the majority of risks, drawing on information from nine of the UK's largest life insurers. Each year we determine specific questions on selected 'hot topics'. For 2020 we have considered the expected impact of the infectious disease caused by severe acute respiratory syndrome coronavirus 2 (COVID-19), the approach taken to transitional measures on technical provisions, and other considerations which include modelling of the Consumer Price Index (CPI), the latest updates to the PRA's Supervisory Statement SS3/17, and the implications of moving away from the London Inter-Bank Overnight Rate (LIBOR). We capture information on a wide range of risk calibrations and compare it to the results collected in recent years of this survey.

The survey covers a diverse range of UK participants, all of which are currently using either an approved internal model or a partial internal model. Where there is not an approved internal model, or where the standard formula is used for certain risks within a partial internal model, we asked for information on an economic capital calibration as it stood at 31 December 2019.

Our thanks go to the firms which took part for kindly sharing their time and their insights.

Regards,

Andrew James and Ainsley Normand
PwC
PricewaterhouseCoopers LLP
7 More London Riverside
London SE1 2RT
Telephone +44 (0) 2075 835000

Andrew James
Director
M: +44 (0)7725 706317
E: andrew.james@pwc.com

Ainsley Normand
Associate Director
M: +44 (0)7841 011242
E: ainsley.m.normand@pwc.com

Purpose and use of this report

This report has been prepared to be shared with the public. We accept no liability (including for negligence) to you or anyone else in connection with this report. The report should be read in its entirety; reading individual sections in isolation may result in misinterpretation.

The report contains information obtained from survey participants. We have not sought to establish the reliability of the information or otherwise verify the information so provided. Accordingly, no representation or warranty of any kind (whether express or implied) is given by PwC to any person as to the accuracy or completeness of the report.

This report is a summary of the detailed PwC survey which covers aspects of the methodology and the stresses applied in the year-end 2019 capital models across a wide range of risks and any changes in the calibrations over 2019. The survey considers Internal Model and Partial Internal Model life insurance companies in the UK. Participants have received a more detailed version of this report, however the key messages summarised here are consistent with the detailed report.

In some areas, not all participants responded to the questions asked. This will have been for various reasons, e.g. where participants employ the standard formula calibrations to calculate a capital requirement or where the question is not relevant to the participant's business. In these instances, the total number of responses is less than nine; however, we have ensured that results disclosed in this report are always from a sufficiently credible set of responses. Where we have received an insufficient number of responses to meet this objective, we have refrained from disclosing quantitative results.

Compliance with TAS requirements

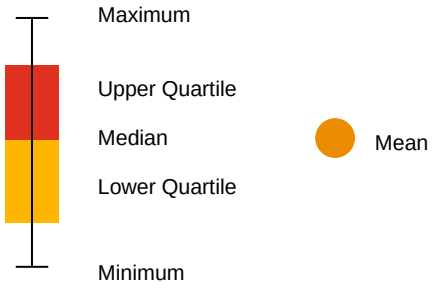
The Financial Reporting Council ('FRC') requires actuaries to comply with Technical Actuarial Standards ('TASs') for various types of actuarial work. We also believe that it is normally appropriate to apply the requirements of the TASs to other work conducted by actuaries. Given the nature of the work, however, we have not attempted to follow the requirements of the TASs on this assignment. You will need to consider the impact of this limitation on your interpretation of our work and results.

Materiality

We have defined materiality as a capital component that is above 5% of the total diversified SCR. This definition is applied consistently throughout the report.

Key to trend graphs

For all of the graphs that show trends over this and previous years of our survey, the dates represent the year-end to which the calibration corresponds (rather than the year in which the survey was published) and the following key applies:



In certain areas where we received limited data, we show only the maximum, minimum and mean.

2. Key messages

In this section we summarise the key themes emerging from the results provided by our participants.

2.1. Material risk exposures

Credit, longevity, persistency and equity risks remain the highest individual contributors to participants' undiversified and diversified Solvency Capital Requirement ('SCR'). While we again asked for less information on these risks in the survey this year, they continue to be the largest sections of the report. We also consider the calibration of less material market and life risks as well as the aggregation of all risks.

2.2. Result highlights

In line with the last few years of the survey, we continue to see stability in the calibrations that are provided by participants. The main changes in the results this year in comparison to last year are caused by the update to data used within the calibrations as well as the change in participants that have responded to each question.

Over 2020 the insurance industry has been significantly impacted by COVID-19 and hence this year we asked for information about how participants propose to make allowance for its effects within the capital model calibrations. Only a small number of participants intended to amend their existing model calibrations at the time the survey was carried out. There is no consensus on whether the recent experience has contradicted or supported existing risk correlations, however most participants intend to review correlations over 2021, with a focus on pandemic and market risk interactions.

Credit risk continues to be a subjective and highly material market risk, with varied approaches observed between participants. There is little consensus in how the calibrated spread stresses have changed over the year, either in direction or in magnitude, but the average stress for a 10-year A-rated bond has decreased significantly for financial bonds (largely due to changes made by one participant) and decreased slightly for non-financial bonds. Updates to the calibrations for other market risks are largely due to refreshing the data on which they are based.

Longevity risk calibrations have generally been refreshed this year based on updated data, rather than methodology changes. However, longevity risk continues to be the most material life insurance risk across the participants within the survey. The average overall longevity stress applied by participants at age 65 has decreased for both males and females. However, this change is driven by the change in participants responding to the survey, rather than by a number of participants making significant changes to their existing calibrations. The changes seen this year continue the recent pattern of small fluctuations around a fairly stable level with no obvious trend, as did the average change in expectation of life from the longevity trend stress.

3. Hot topics

Within this section we present our findings on a number of 'hot topics' included in our survey this year: the expected impact of COVID-19, the approach taken to transitional measures on technical provisions, the modelling of CPI, the treatment of illiquid, unrated assets within matching adjustment portfolios (SS3/17), and the implications of moving away from LIBOR.

3.1. COVID-19

While much of the survey collected information about year-end 2019 calibrations, we also asked participants a range of questions on their intentions in respect of COVID-19 and the expected impacts on their business. This included their views on the appropriateness of the internal model, impact on credit risk, and impacts on other risks.

3.1.1. Appropriateness of the internal model

A small proportion of participants indicated that they were considering making changes to their internal model calibration as a result of COVID-19, either as a capital add-on or by revising certain risk calibrations. We also asked participants whether the recent external events support or contradict the correlations between risks that were assumed as at December 2019. Of the responses received, there was no conclusive view between participants, however a majority stated that they plan to review existing correlations, with a specific focus on pandemic and market risk interactions.

3.1.2. Impact of COVID-19 on credit risk

Participants provided the average credit rating of the bonds in their matching adjustment portfolios as at end December 2019 and again at the most recent available date (typically 30 June 2020), expressed using Solvency II Credit Quality Steps, weighted by the market value of the bonds. Most participants had an average rating of 2 and there was no change in the average ratings between the two dates that were provided by participants.

We also asked whether participants had seen an increase in downgrades or defaults within their portfolios as a result of COVID-19. Most participants responded that they had and that it had typically been the utility and transportation industries which have been most impacted. Participants were responding with a range of approaches, including regular monitoring of credit ratings or actively derisking their portfolios.

When asked at what level they currently define their corporate bond stresses within the internal model, the majority of participants distinguish between Financial and Non-financial bonds. Given that different industries may face very different risk profiles in the current environment, we asked if participants are considering making any changes to the granularity of their credit spread calibration. None had plans to do so at the time the survey was carried out.

Just under half of the participants stated that they had to rebalance the matching adjustment portfolio to meet the matching requirements due to the impact of COVID-19 on their fixed interest assets.

Lastly, we asked if participants were considering making any changes to the determination of the matching adjustment offset under stress. Some participants were considering such changes, but their plans were generally not specifically influenced by COVID-19.

3.2. Transitional measure on technical provisions

Since the implementation of Solvency II on 1 January 2016, firms have been allowed (subject to PRA approval) to apply a transitional measure on technical provisions (TMTP) to dampen the initial impact of any increase in net technical provisions. This impact is measured relative to the more onerous of the Solvency I Pillar 1 or Pillar 2 bases and is reduced over a period of 16 years. The TMTP can be applied to business which also uses either the matching or the volatility adjustment.

Most respondents currently have a TMTP. The TMTP as a percentage of SCR varies considerably between survey participants (between about 25% and 100%); this is a wider range than observed last year and shows that the TMTP continues to be a material contributor to the overall solvency ratio for many participants.

We would expect all participants to have performed at least two recalculations since 2016 given the biennial Solvency II requirement, however most participants have reset the TMTP more than twice, with one participant having performed seven recalculations.

The PRA stated in March 2020 that market movements since end December 2019 met the threshold for a material change in risk profile, so they were accepting applications for a TMTP recalculation at end March, as a result of COVID-19 market turbulence. None of the participants told us that they applied for a recalculation at that time.

3.3. Other Considerations

3.3.1. Consumer Price Index Modelling

We asked participants whether and how they model the Consumer Price Index (CPI) and about the potential implications of the recent Government consultation on the reform of the Retail Price Index (RPI) methodology. Most participants confirmed that they use CPI in their modelling.

All respondents that use CPI in their modelling use it to model liabilities and a small proportion also stated that they use CPI to model assets that are linked to CPI. When asked if they use a 'wedge' relative to the RPI curve when modelling CPI, all participants that responded confirmed that they did.

We also asked participants whether they consider the impact of the recent government consultation on the reform of the RPI methodology on their inflation risk calibration. All participants that responded are considering this, with most having changed either their best estimate or stressed CPI wedge assumption.

3.3.2. Illiquid, unrated assets within matching adjustment portfolios (SS 3/17)

For this section we asked participants questions related to SS 3/17 (specifically the new section 4 and the expanded requirements in section 2) which sets out the PRA's expectations in respect of firms investing in illiquid, unrated assets within their Solvency II matching adjustment portfolios.

The majority of participants stated that they had not had to make changes to their processes as a result of the more prescribed requirements around risk identification and internal rating assessments. None of the respondents consider the changes in the requirements to have been a deterrent for investing in income-producing real estate assets.

3.3.3. LIBOR transition and its implications

In this section we asked participants questions focused on the move away from LIBOR and the implications for internal model calibrations, as the widespread use of LIBOR is expected to end by December 2021 in the UK.

In January 2020 EIOPA issued a discussion paper on IBOR transitions and the potential use of a blended risk-free rate was highlighted. We asked participants how they plan to allow for stresses if a blended risk-free curve exists. Of those that responded, most participants confirmed they do not have any imminent plans at this stage and will wait for further details to become available.

A small proportion of participants either model Sterling overnight index average (SONIA) stresses within their internal model or allow for the basis risk that exists between LIBOR and SONIA through an out of model adjustment. The majority of respondents have not yet decided on the source to use in place of IBOR outside the UK.

4. Equity release mortgages

Illiquid unrated assets such as equity release mortgages (ERM) have been increasingly used in recent years by life insurers with large annuity books to optimise their capital position under Solvency II. Given the subjectivity involved in valuing and managing ERMs and the materiality of this asset class, such assets have been receiving an increased amount of regulatory scrutiny over recent years.

There has been increased regulatory focus on ERMs over the past few years, which highlights the importance of ensuring that the relevant risks are properly modelled in the base and stressed valuations. Within the letter from David Rule 'Solvency II: Equity release mortgages' released on 10 December 2018, it was stated that ‘restructured equity release mortgages are a suitable asset to back annuities as part of an appropriately diversified portfolio’. Several insurers have restructured their ERMs, splitting the cashflows into loan notes with different levels of security. Valuation of these loan notes can be particularly challenging.

We asked participants for a range of quantitative and qualitative information on their current calibrations, data and the methodology for their base and stressed assumptions.

- In line with prior year, participants’ 1-in-200 property level stresses sit within the range 20% to 33%. The property volatility stress is typically an addition to the best-estimate volatility assumption of between 4% and 9%.

Changes in approach over the year

A few participants noted that they made changes related to the calibration of risks related to ERMs during 2019, which were split between simply refreshing the data, changing the methodology or doing both of these things.

4.1. Property growth

The most common approach adopted by participants to set their best estimate property growth assumption is to use a margin over RPI, with the margin ranging between about 0.5% and 0.8% p.a.

We also asked participants to provide their 1-in-200 property growth assumptions. Reductions applied to the best estimate growth rate varied between 1.6% p.a. and 3.0% p.a.

4.2. Property level

The range of 1-in-200 calibrated property level stresses for ERMs lies between 20% and 33%. This is slightly narrower than in last year’s survey (19% to 36%), mainly reflecting the change in participants that responded to this question.

4.3. Property volatility

The range of assumed property volatility in base conditions lies between 13% and 15%. This is very similar to what we saw in last year’s survey (12% to 15%). The range of additions to the volatility assumption under stress is from 4% to 8% which is slightly narrower than prior year’s survey (4% to 10%) as a result of receiving fewer responses this year.

4.4. NNEG Model

Most participants stated that they use a real-world, rather than risk-neutral, calibration for their NNEG model, with another option being to use both methodologies and set the valuation to be equal to the lower of the two.

We also asked participants the value of NNEG as a proportion of the total fair value of their ERM portfolio and responses ranged from 5% to 18%. This is narrower than the range of responses received last year (2% to 30%), although this is mainly due to the change in mix of those responding to this question.

5. Market risk

Solvency II states that the market risk module of the standard formula shall reflect the risk of loss or adverse change in the financial situation resulting, directly or indirectly, from fluctuations in the level and in the volatility of market prices of assets, liabilities and financial instruments. It shall properly reflect the structural mismatch between assets and liabilities, in particular with respect to duration. Similar considerations would be expected to inform market risk calibrations of an internal model.

In this section, we consider various components of market risk. For each risk, we asked participants for a range of quantitative and qualitative information on their risk calibrations as applied in their Solvency II internal model, with a focus on the credit risk elements.

5.1. Credit risk

Changes in approach over the year

The majority of participants noted that they made changes to the credit risk calibration (encompassing both spread risk and transition and default risk) over 2019. Of these, just over half of the participants stated that the change was due only to refreshing the data used within the calibration. The other participants made methodology changes as well as refreshing the data used. The effects on the strength of the resulting calibration varied in size and direction.

5.1.1. Credit spread

Solvency II defines spread risk as the risk arising from the sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of credit spreads over the risk-free interest rate term structure.

- The majority of participants model credit spread risk separately from transition and default risk.
- Considering all participants in each year of the survey, the average 1-in-200 increase in spread for a 10-year A-rated **financial** bond (390bps) has decreased by 12bps (2018: 402bps). The average 1-in-200 increase in spread for a 10-year A-rated **non-financial** bond (253bps) has decreased by 6bps (2018: 259bps).

Methodology

Treatment of credit transition and default

The majority of participants indicated that they model spread separately from transition and default.

Assets other than corporate and sovereign bonds

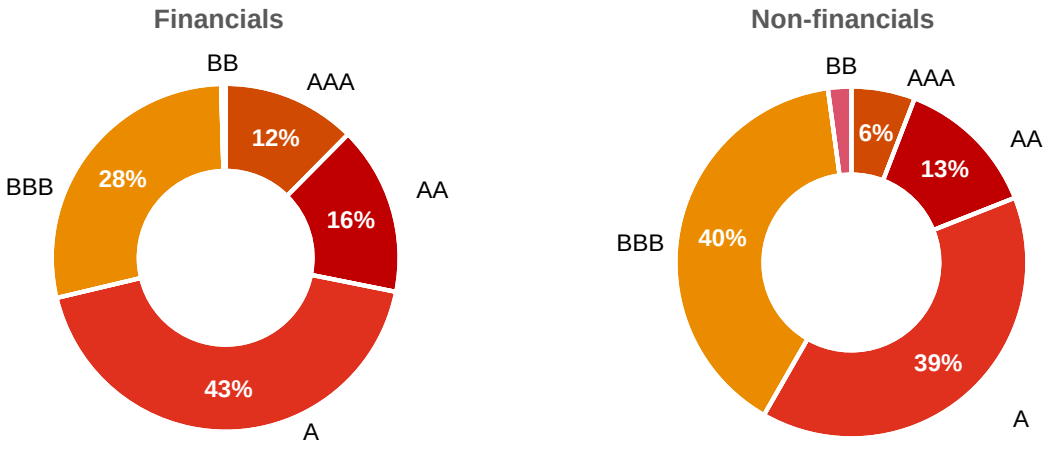
Most participants indicated that they hold fixed interest assets other than corporate and sovereign bonds. We observe that the majority of assets held were in infrastructure loans, equity release and commercial mortgages.

Results

We asked participants for details of their calibrated credit spread stresses by sector (financial / non-financial) and credit rating. The summarised results can be seen in Figures 5.2 and 5.3, in each case combined with equivalent data from the last five years of this survey to show the movement over time.

To set the results in context, we also present information on the average split of the bond portfolio by credit rating, separately for financial and non-financial corporate bonds. Figure 5.1 shows that the stresses for A-rated financial bonds are of most relevance overall, while for non-financial bonds there are material holdings of both A- and BBB-rated bonds.

Figure 5.1: Average exposure to financial and non-financial corporate bonds

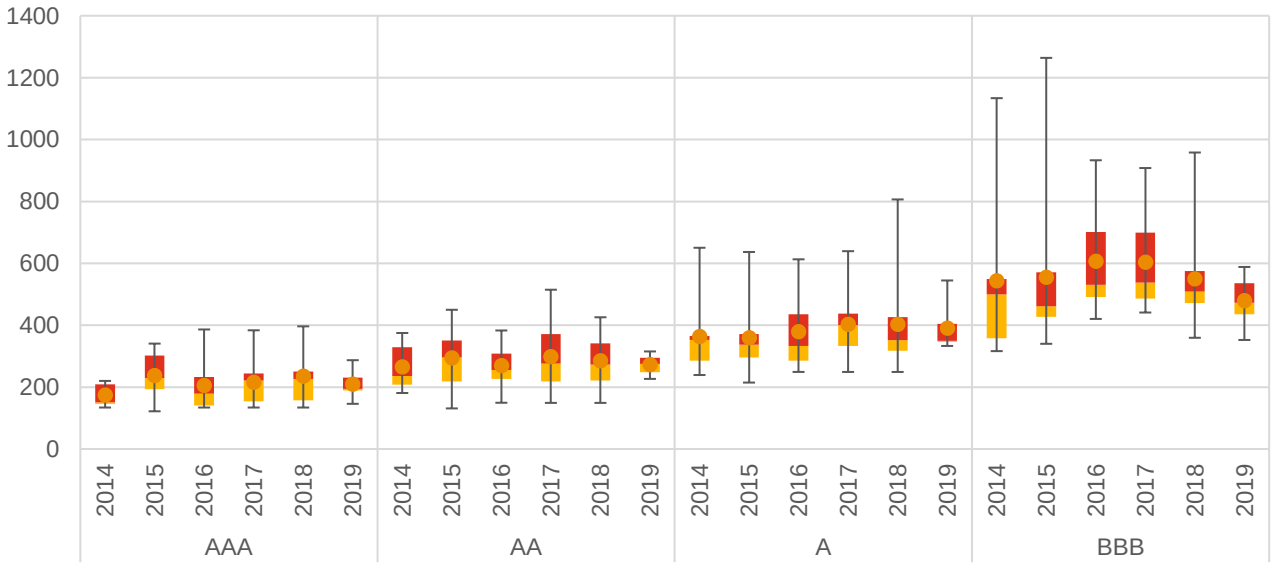


Financial corporate bonds

The following graph shows the stresses for **financial corporate bonds** only. As expected, there is a general increase in calibrated stress as bond rating decreases.

There is no consistent trend in the calibrated stresses over time as modelling evolves. This year there appears to be some evidence of convergence to a narrower range of stresses, although this may simply be a result of the smaller number of participants. The lack of trend is perhaps to be expected given the range of modelling approaches and differences in the composition of asset portfolios, resulting in different combinations of term and rating being more important to different participants.

Figure 5.2: 10 year, 1-in-200 calibrated basis point yield increase for credit spread by credit rating for financial corporate bonds.

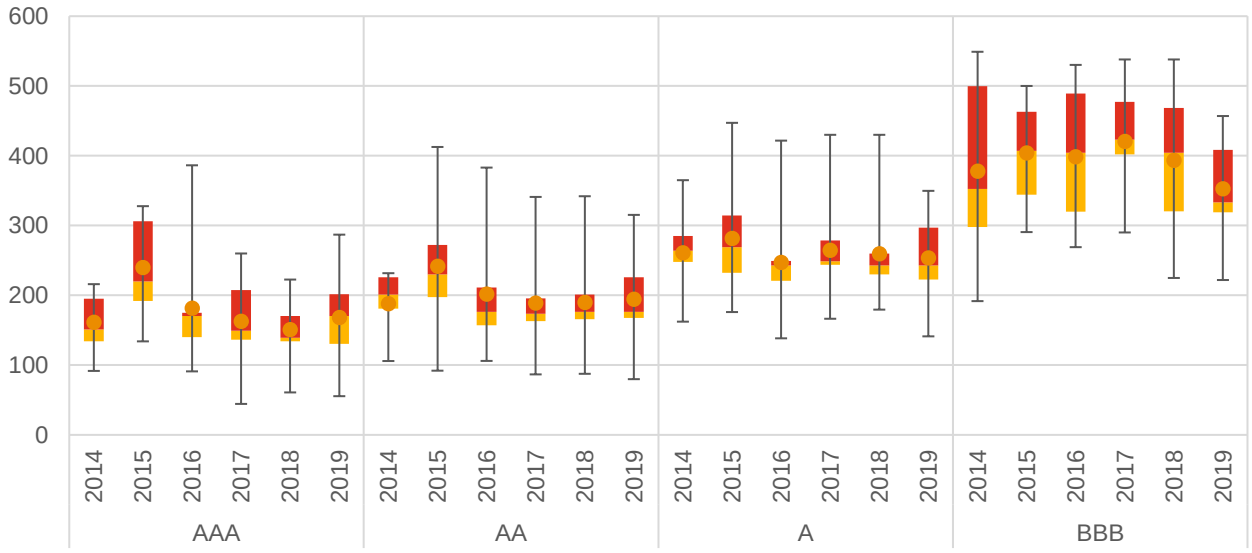


Non-financial corporate bonds

The following graph illustrates the calibrated stresses for non-financial corporate bonds only.

There is no consistent trend in the calibrated stresses over time, nor evidence of convergence to a narrower range of stresses as modelling evolves. As for financial bonds, this is perhaps to be expected given the range of modelling approaches and differences in the composition of asset portfolios, resulting in different combinations of term and rating being more important to different participants.

Figure 5.3: 10 year, 1-in-200 calibrated basis point yield increase for credit spread by credit rating for non-financial corporate bonds.



5.1.2. Credit transition and default

Losses can also arise from the sensitivity of the values of assets and liabilities to changes in market assessments of the risk of future migration and/or default. Before the advent of Solvency II, insurers generally focused on modelling credit risk holistically, focusing on spread changes to reflect movements in total return/value. The matching adjustment calculation and associated split of transition and default risk from spread risk, combined with regulatory pressure, led to a number of insurers choosing to reflect spread, transition and default elements separately within their modelling.

Most participants indicated that the risk of transition and default is modelled separately from credit spread risk in their internal model, with the remaining participants modelling transition and default together but considering each separately when determining their calibrations.

The following graphs illustrate the calibrated stresses for the **combined** credit risk stress (incorporating spread risk and the risk of transition and default) separately for **financials and non-financials** over the past two years of the survey.

Figure 5.4: Calibrated basis point yield increase for combined credit risk stress by credit rating for financial corporate bonds (10 year term, 1-in-200).

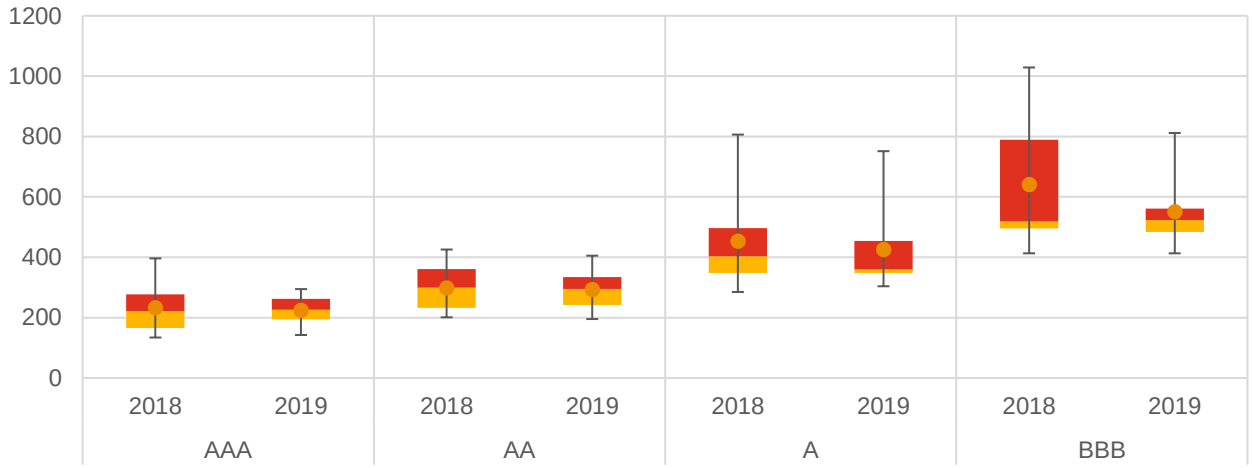
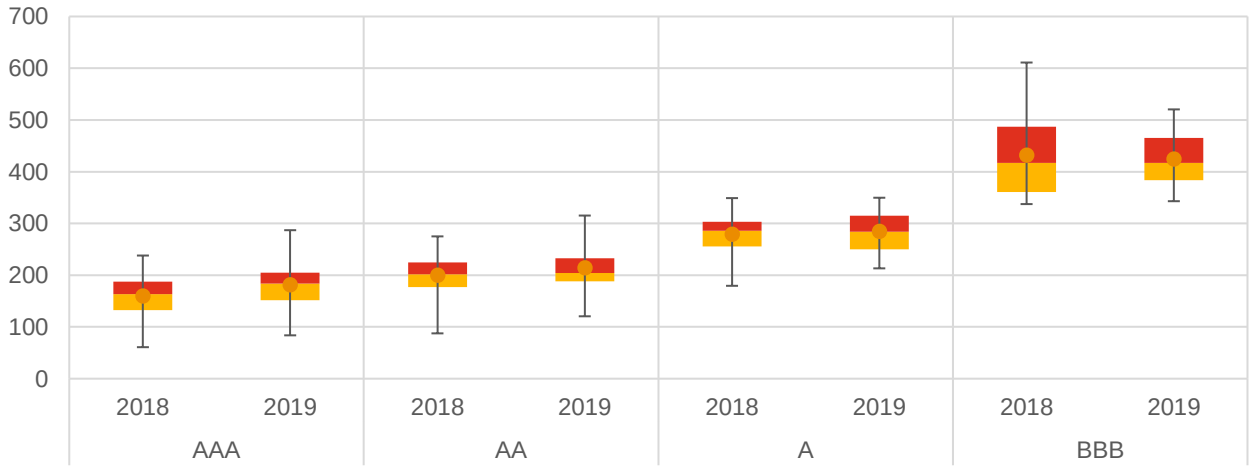


Figure 5.5: Calibrated basis point yield increase for combined credit risk stress by credit rating for non-financial corporate bonds (10 year term, 1-in-200).



5.2. Equity

Solvency II defines equity risk as that arising from the sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of market prices of equities. A number of participants in this year's survey have no exposure to equity risk so do not contribute to observations in this section.

Changes in approach over the year

Around half of the participants noted that they made changes to the equity risk calibration over 2019, which was broadly evenly split between simply refreshing the data, changing the methodology or doing both of these things. The changes generally resulted in a stronger calibration or had a broadly neutral effect.

Results

We asked participants for two sets of calibrated stresses for equity level and volatility risk – those applying to a portfolio of UK equities and those applying to the whole equity portfolio. The majority of participants that provided both their UK and whole portfolio stress apply a higher stress to their UK portfolio than their whole portfolio. The average difference between the UK and whole portfolio stress is 4%.

For the whole portfolio stress, the movements in the calibrated stresses over the past six years for equity level stresses and three years for equity one-year volatility stresses are shown in Figure 5.6 and Figure 5.7 respectively, in each case based on all data received in the year in question. The quartile information has been removed for 2019 due to the limited number of responses that were received. The mean has remained relatively stable over the most recent years for the level stress but has increased for the volatility stress. Both the reduction in the range of the level stress and the increase in the average volatility stress are mainly because of changes in the participants that responded to the question this year.

Figure 5.6: 1-in-200 calibrated basis point equity level stresses (whole portfolio).

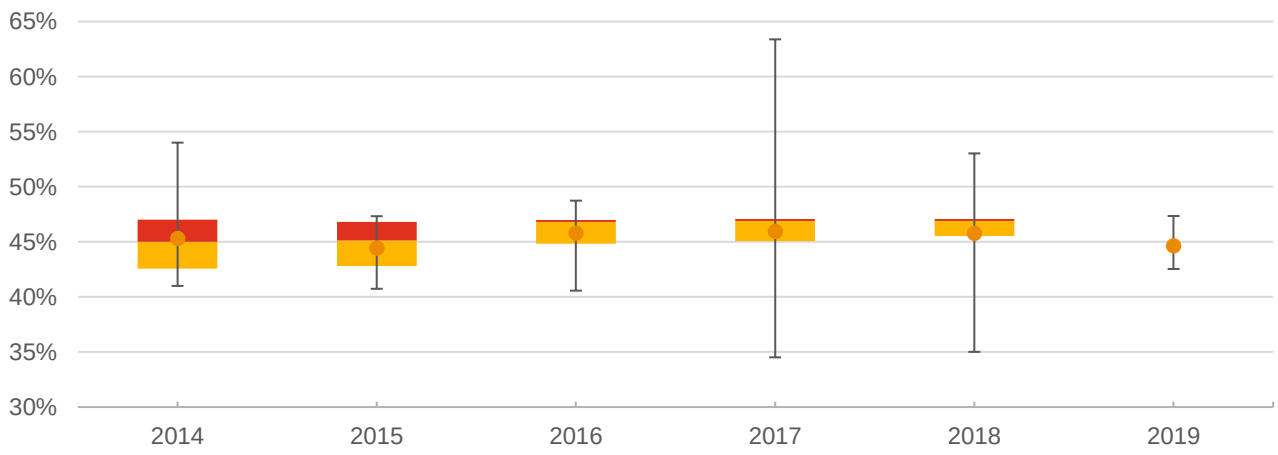
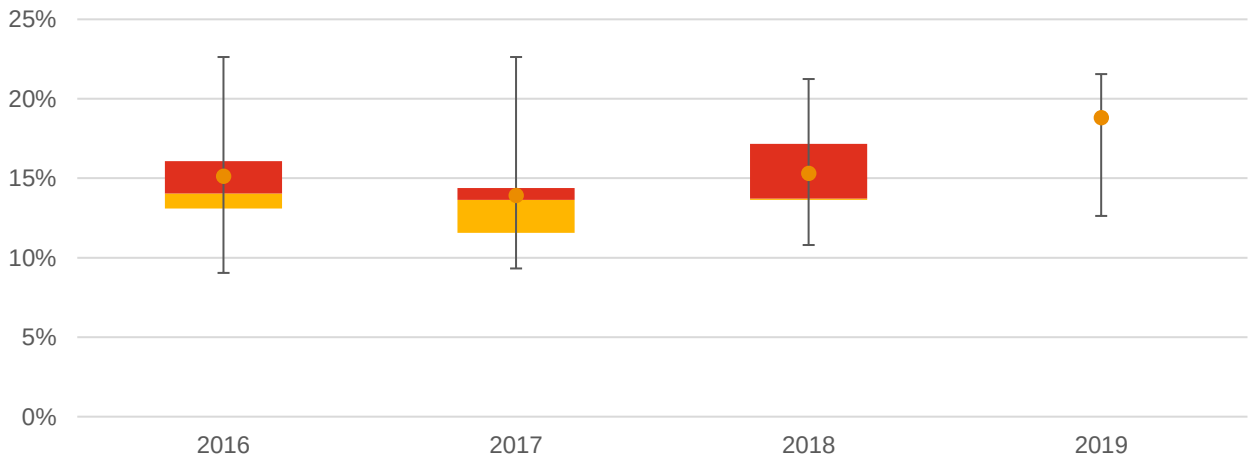


Figure 5.7: Trend in 1 year 1-in-200 calibrated basis point equity volatility stresses (whole portfolio).



5.3. Interest rate

Solvency II defines interest rate risk as the risk of loss or adverse change in the value of assets and liabilities due to unanticipated changes in interest rates and volatility.

- The magnitude of stresses is generally higher for upward than for downward stresses and tends to decrease for longer terms, but there is little consensus on the variability by term.
- The mean for the 1-in-200 calibrated interest rate up stresses has decreased across all terms with decreases in mean ranging between 0.1% and 0.2%. The mean for the 1-in-200 calibrated interest rate down stresses has decreased by 0.2% in magnitude since last year at all terms.

Changes in approach over the year

Almost all participants noted that they made changes to the interest rate risk calibration over 2019. The majority of these updated the data used to set the calibration, in some cases in combination with changes to methodology. A small minority made only methodology changes. The impact of the changes on the strength of the calibration varied across participants in size and direction.

Results

We asked participants for the upward and downward changes in the risk-free zero-coupon bond spot yield for varying terms calibrated at the 1-in-200 level. The results are summarised and compared to those obtained in prior year surveys in Figure 5.8 and Figure 5.9 below, in each case based on all data received in the year in question. The downward stresses are smaller in magnitude than the upward stresses for all participants, with the ratio between the two varying by term and varying markedly between different participants.

The mean has decreased in magnitude at all terms both for the interest rate up stresses and for the interest rate down stresses. This year the range of stresses for interest rate up has generally decreased slightly, whereas for interest rate down the range of stresses has increased markedly, primarily due to much lower interest rate down stresses being provided by one participant this year.

Figure 5.8: 1-in-200 calibrated interest rate up stresses.

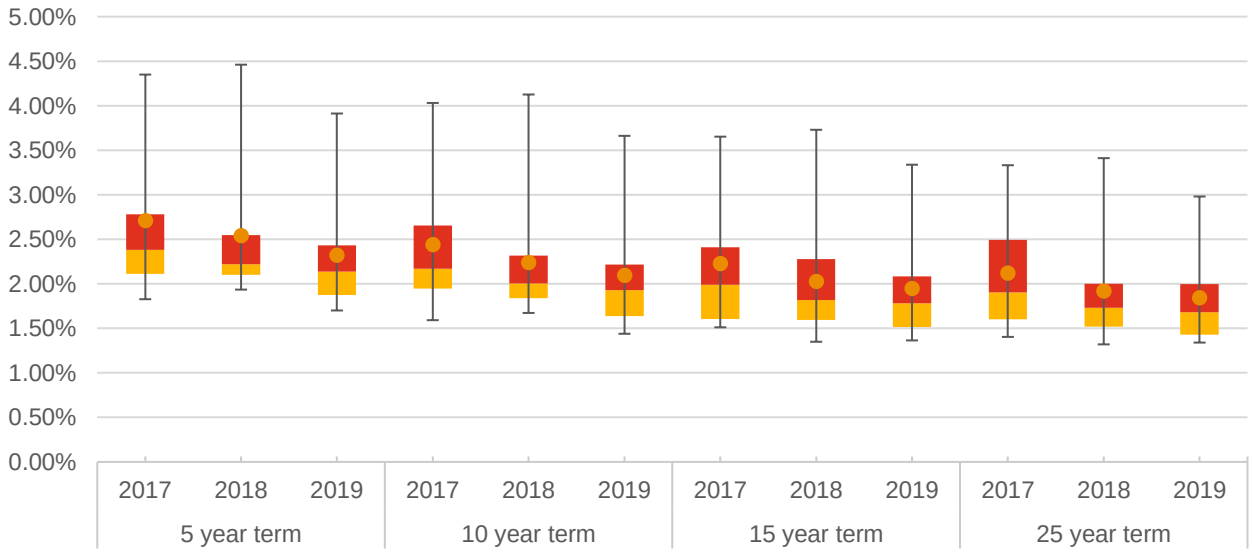
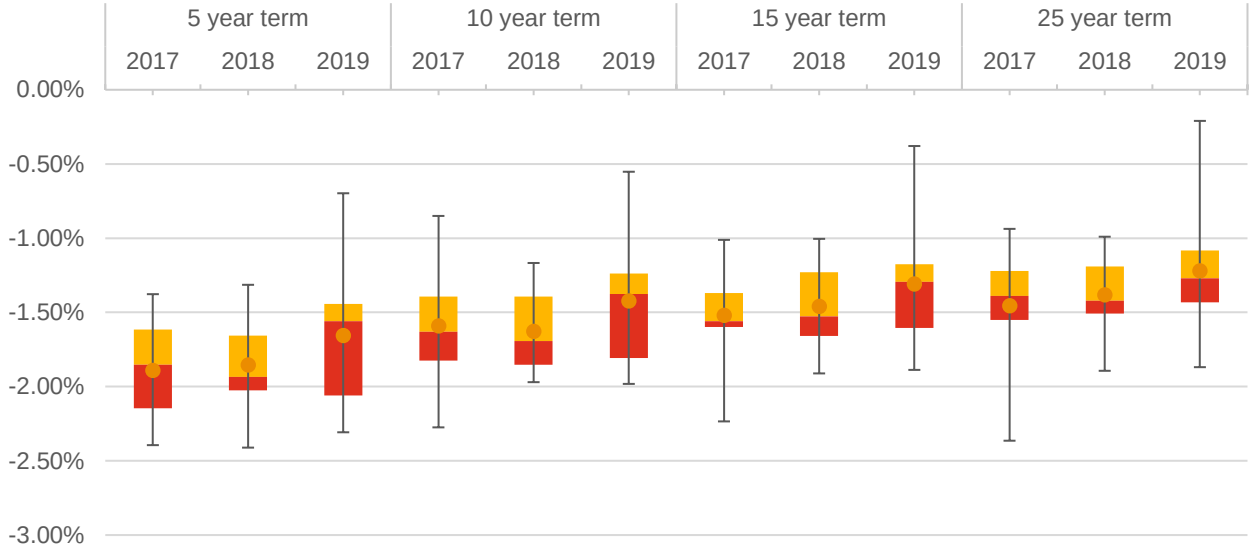


Figure 5.9: 1-in-200 calibrated interest rate down stresses.



5.4. Currency

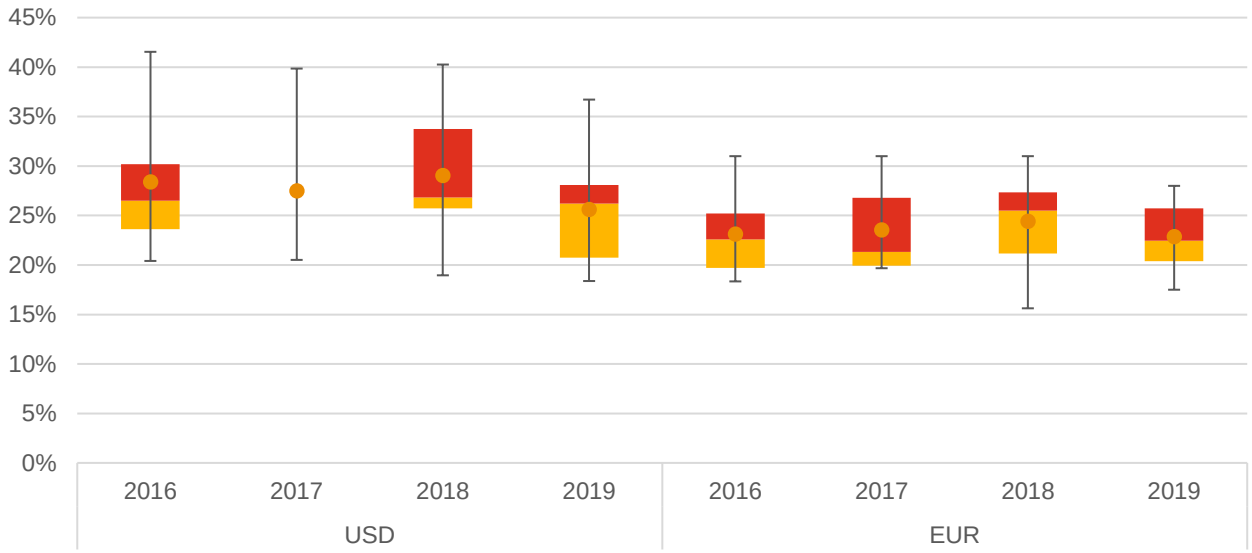
Solvency II defines currency risk as that arising from the sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of currency exchange rates.

Results

We asked participants for the calibrated stresses for each currency relative to GBP and received sufficient data to include the results for EUR and USD. Around half of the participants apply different stresses for USD and EUR.

The movements in the calibrated stresses over the past four years is shown in Figure 5.10 below, in each case based on all data received in the year in question. There is no consistent trend in the calibrated stresses over time. No quartiles are presented for USD in 2017 year due to the small number of responses received that year.

Figure 5.10: Calibrated 1-in-200 currency stresses.



5.5. Inflation

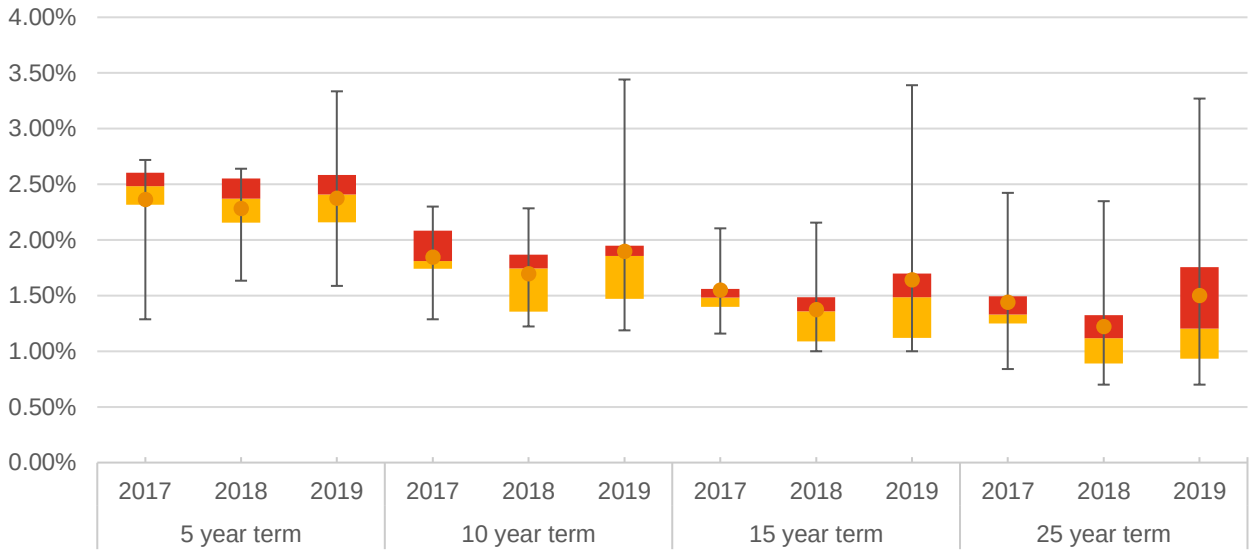
Changes in approach over the year

Around half of the participants noted that they made changes to the inflation risk calibration over 2019. Of these, around half made changes to the data used within the calibration, which resulted in either a broadly neutral impact ora generally weaker calibration. The remaining participants made methodology changes to the calibration but did not provide information on the impact of the changes on the risk calibration.

Results

We asked participants for the implied inflation spot yield, calibrated at the 1-in-200 level. The movement in the calibrated stresses over the past three years is shown in Figure 5.11 below, in each case based on all data received in the year in question. There is no consistent trend in the calibrated stresses over time. The range for this year has increased due to increases in the stress by one participant.

Figure 5.11: 1-in-200 calibrated inflation stresses.



5.6. Property

Solvency II defines property risk as the risk of loss or adverse change in the value of assets and liabilities due to unanticipated changes in the level or in the volatility of market prices of real estate.

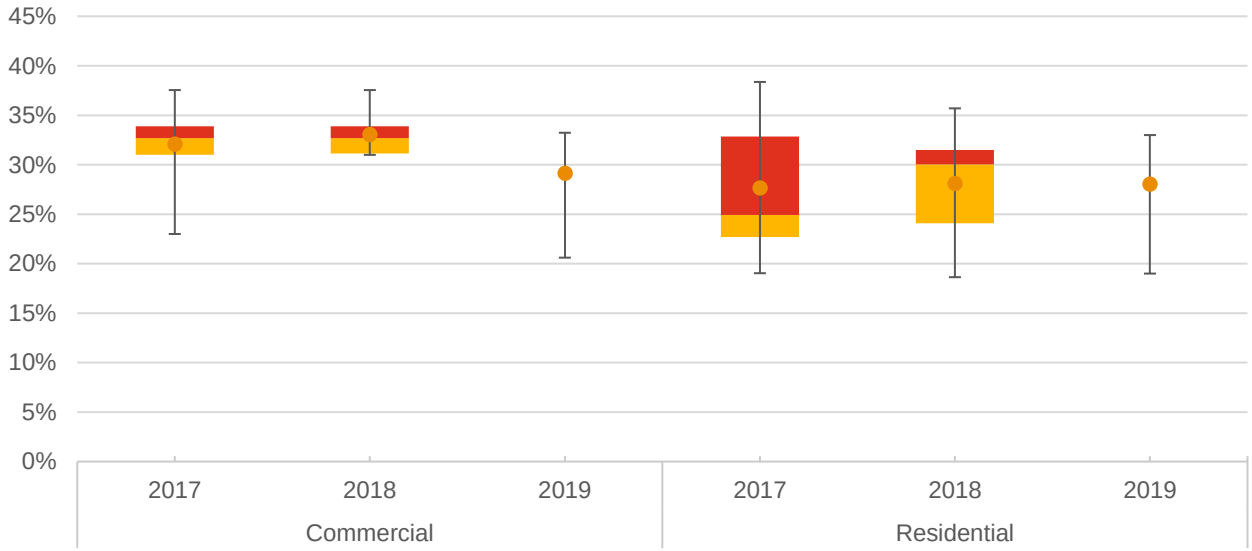
Changes in approach over the year

Fewer than half of the participants noted that they made changes to the property risk calibration over 2019. Of these, all stated that the change was only due to the refreshing of data used within the calibration and resulted in either a generally weaker calibration or a broadly neutral impact.

Results

The movement in the calibrated level stresses over the past three years is shown in Figure 5.12 below, in each case based on all data received in the year in question. No quartiles are presented for this year due to the smaller number of responses that we received.

Figure 5.12: Calibrated 1-in-200 property level stress for residential and commercial properties.



6. Life insurance risk

Solvency II states that the life underwriting risk module of the standard formula shall reflect the risk arising from life insurance obligations. Similar considerations would be expected to inform life insurance risk calibrations of an internal model.

In this section, we consider various components of life insurance risk. For each risk, we asked participants for a range of quantitative and qualitative information on their risk calibrations as applied in their Solvency II internal model.

6.1. Longevity

Longevity risk, as defined by Solvency II, 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 rates leads to an increase in the value of the insurance liabilities. Longevity risk affects contracts where benefits depend on the likelihood of survival, for example annuities, pure endowments and specific types of health contract.

- The average changes in expectation of life from the longevity base and trend stress have decreased from those observed last year.
- The average overall longevity stress applied by participants at age 65 has decreased from 3.00 to 2.58 years for males and from 2.90 to 2.51 years for females. This is primarily driven by the change in participants responding to the survey, rather than by individual companies making significant changes to their calibrations.

Changes in approach over the year

The majority of participants noted that they made changes to the longevity risk calibration over 2019, all of which were only the refreshing of data used within the calibration. The impact of the changes on the strength of the resulting calibration varied across participants in both size and direction.

Results

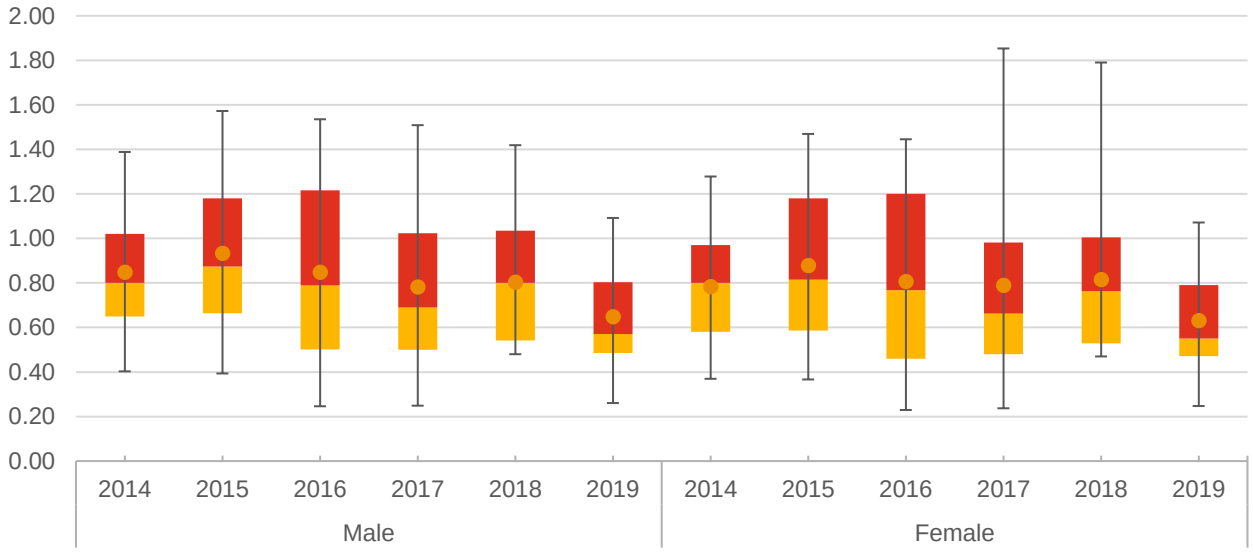
We asked participants for a range of quantitative information on their longevity risk calibration, as applied to immediate annuities, at a 1-in-200 level and combined it with equivalent data from the last five years of this survey to show the movement over time. None of the participants told us that they distinguish the stresses by smoker status and so the results below are all applicable to both smoker and non-smoker annuities.

Base stress

Figure 6.1 shows the impacts in years of the 1-in-200 longevity base stresses for 65-year-old male and female annuitants in this and the previous five years of our survey, in each case based on all data received in the year in question.

There is no evidence of a long-term trend in the impact of the stress, with only small increases or decreases in the mean observed from year to year until the larger decrease observed this year. We note that the range of stresses is narrower than last year, primarily due to the lack of response from some participants which were towards the upper end of the range last year.

Figure 6.1: Change in expectation of life (in years) for 65-year-old non-smoker under a 1-in-200 base longevity stress.

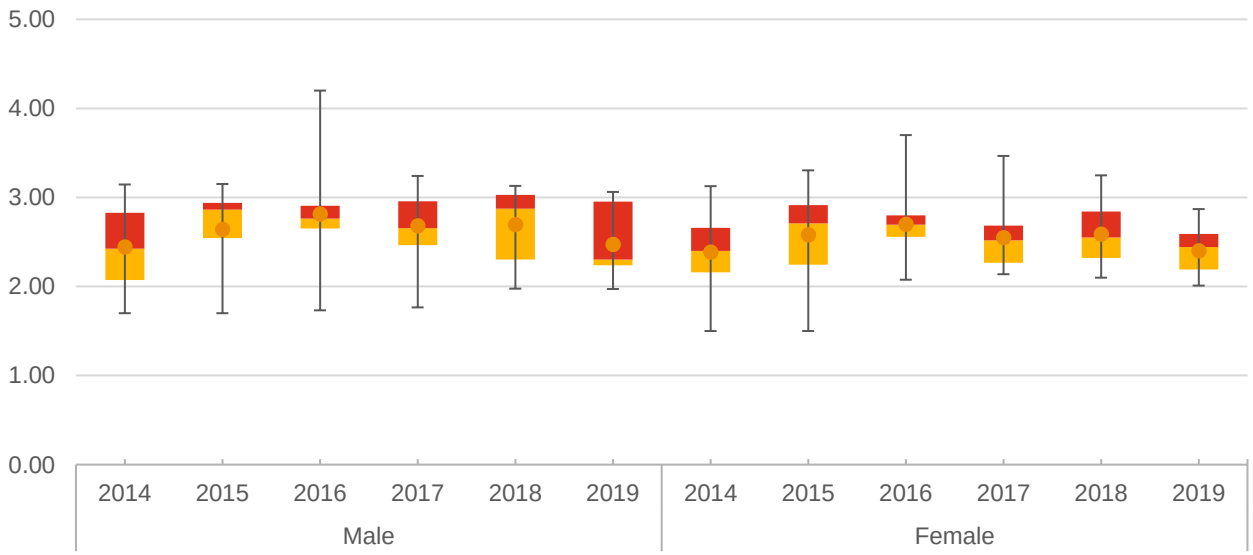


The average increase is 0.65 years for males and 0.63 years for females. These averages show a decrease compared to the average stresses disclosed in last year's survey, where the equivalent figures for males and females were 0.80 and 0.81 years respectively. This reduction is primarily caused by the change in participants in the survey this year, although one participant has reduced the magnitude of the stresses that they apply.

Trend stress

Figure 6.2 shows the impacts in years of the 1-in-200 longevity trend stresses for 65-year-old male and female annuitants in this and the previous five years of our survey, in each case based on all data received in the year in question. There is no obvious trend in the size of the trend stress.

Figure 6.2: Change in expectation of life (in years) for 65-year-old non-smoker under a 1-in-200 longevity trend stress.

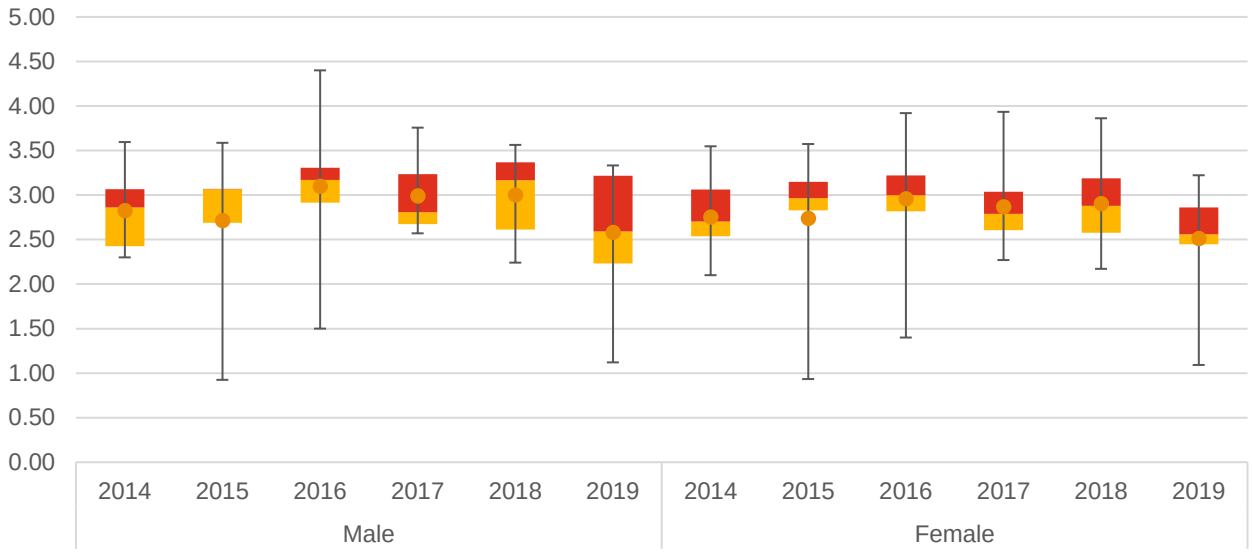


The average increase in expectation of life from a 1-in-200 trend stress is 2.47 years for males and 2.40 years for females. This is a decrease relative to the figures seen last year which were 2.69 years and 2.59 years respectively. As above, this reduction is primarily caused by the change in participants in the survey this year, although one participant has reduced the magnitude of the stress that they apply.

Overall 1-in-200 longevity stress

For most participants the effect of the overall longevity stress is the same as the impact of the combined 1-in-200 longevity base and trend stresses but, since not all participants use a two-risk-factor modelling approach, we have presented the final overall stress. Figure 6.3 shows the impacts in years of the overall 1-in-200 longevity stresses for 65-year-old male and female annuitants in this and the previous five years of our survey, in each case based on all data received in the year in question. As the trend stress is the more significant driver, the pattern is similar to that in Figure 6.2, as would be expected.

Figure 6.3: Change in expectation of life (in years) for 65-year-old non-smoker under an overall 1-in-200 longevity stress.



The average increase in expectation of life from an overall 1-in-200 longevity stress is 2.58 years for 65-year-old males and 2.51 years for 65-year-old females. Averaging across all the participants in each year, these averages show a decrease this year, with the corresponding figures last year being 3.00 for males and 2.90 for females. As highlighted for both base and trend stresses above, this reduction is primarily caused by the change in participants.

6.2. Persistency

Persistency risk, as defined by Solvency II, is the risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level or volatility of the rates of policy lapses, terminations, renewals and surrenders. A number of participants in this year's survey have no exposure to persistency risk so do not contribute to observations in this section.

- The average persistency level stress selected by participants is 42.9% (2018: 45.2%) for non-linked term assurances, 46.3% (2018: 49.7%) for unit-linked personal pensions and 49.8% (2018: 48.2%) for with-profit endowments.
- The average one-off stress selected by our participants is 18.3% (2018: 24.4%) for non-linked term assurance, 26.7% (2018: 27.9%) for unit-linked personal pensions and 23.3% (2018: 26.2%) for with-profits endowments.
- The movements from last year are driven by changes in the participants in the survey rather than by any individual participant making material changes.

Changes in approach since prior year

A very small number of participants made changes to the persistency risk calibration over 2019, refreshing the data and making some changes to expert judgements, resulting in a generally stronger calibration.

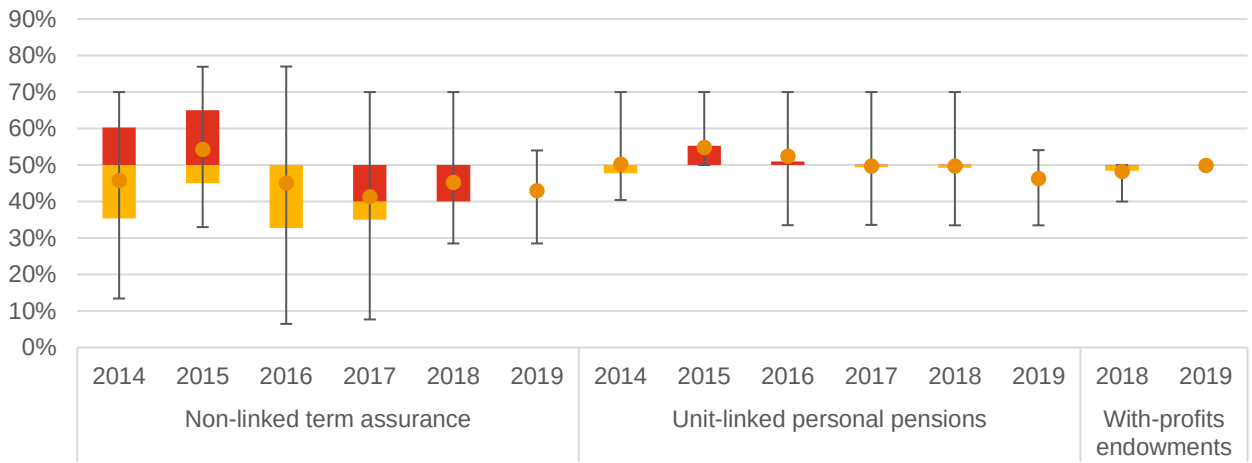
Results

We asked participants for a range of quantitative information on their persistency risk calibration at a 1-in-200 level. Recognising the differences in the persistency risk exposure of different product types, we asked for stresses as applied to non-linked term assurances, unit-linked individual personal pensions, unit-linked group personal pensions and with-profits endowments.

Level stresses

Figure 6.4 shows the magnitude of our participants' persistency level stresses for both non-linked term assurance and unit-linked personal pension business, combined with data from the last five years of our survey. It also presents the persistency level stress for with-profits endowments for two years. The graph is based on all data received for the year in question. We have removed the quartiles for this year as a result of the lower response rate.

Figure 6.4: Trend in the 1-in-200 level persistency stresses expressed as percentages for non-linked term assurance, unit linked personal pensions and with-profits endowments.



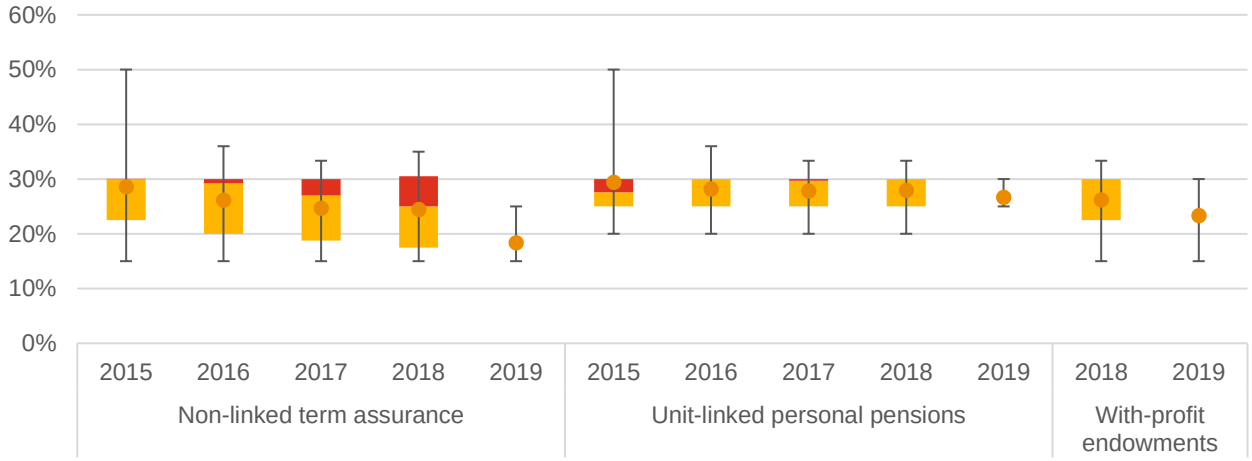
The results show that the average stress selected by participants is 42.9% (2018: 45.2%) for term assurances, 46.3% (2018: 49.7%) for individual unit-linked pensions and 49.8% (2018: 48.2%) for with-profits endowments. The changes in the averages are largely due to the change in participants in the survey this year, as the level stresses applied by participants which provided information in both years have remained much the same.

One-off stresses

Figure 6.5 shows the magnitude of our participants' one-off stresses for non-linked term assurance and unit-linked personal pension business, combined with data from the previous four years of our survey. It also presents the one-offl

stress for with-profits endowments for two years. The graph is based on all data received for the year in question. We have removed the quartiles for this year as a result of the lower response rate.

Figure 6.5: Trend in the 1-in-200 mass lapse stress expressed as percentage of current in-force business for non-linked term assurance, unit linked personal pensions and with-profits endowments.



The average one-off stress selected by our participants is 18.3% (2018: 24.4%) for non-linked term assurance, 26.7% (2018: 27.9%) for unit-linked personal pensions and 23.3% (2018: 26.2%) for with-profits endowments. We do not see any trends arising in the data and note that changes between 2018 and 2019 are primarily driven by changes in the participants in the survey.

6.3. Expense

Expense risk, as defined by Solvency II, 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 the expenses incurred in servicing insurance or reinsurance contracts.

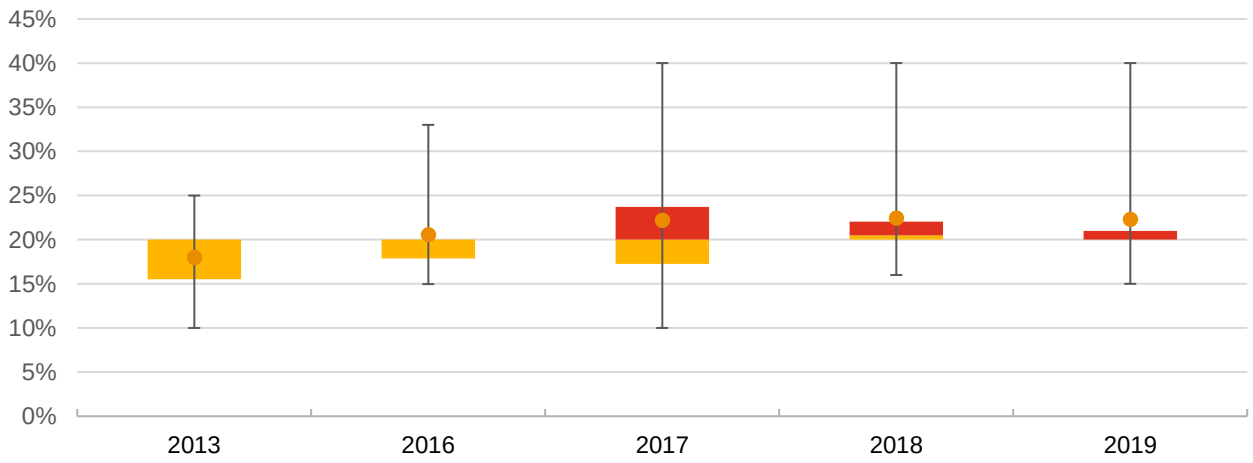
Changes in approach since prior year

A small number of participants noted that they made changes to the expense risk calibration over 2019. We received limited information on the nature of the changes and the associated impacts on the calibration.

Results

Our survey at year-end 2016 included expense risk for the first time since the year-end 2013 calibration. Figure 6.6 therefore shows the effect of the 1-in-200 expense level stress on the best estimate assumption over the past four years as well as at year-end 2013, in each case based on all data received in the year in question. There is litle overall change in either the range or the mean stress applied.

Figure 6.6: Impact of 1-in-200 expense level stress expressed as a percentage of best estimate maintenance expense assumptions.



Of those providing information on the level stress applied to investment expenses, there was a roughly even split as to whether or not to apply the same stress as for maintenance expenses.

6.4. Mortality

Mortality risk, as defined by Solvency II, 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 an increase in the mortality rate leads to an increase in the value of insurance liabilities. It affects predominantly protection contracts, such as term assurance.

Changes in approach since prior year

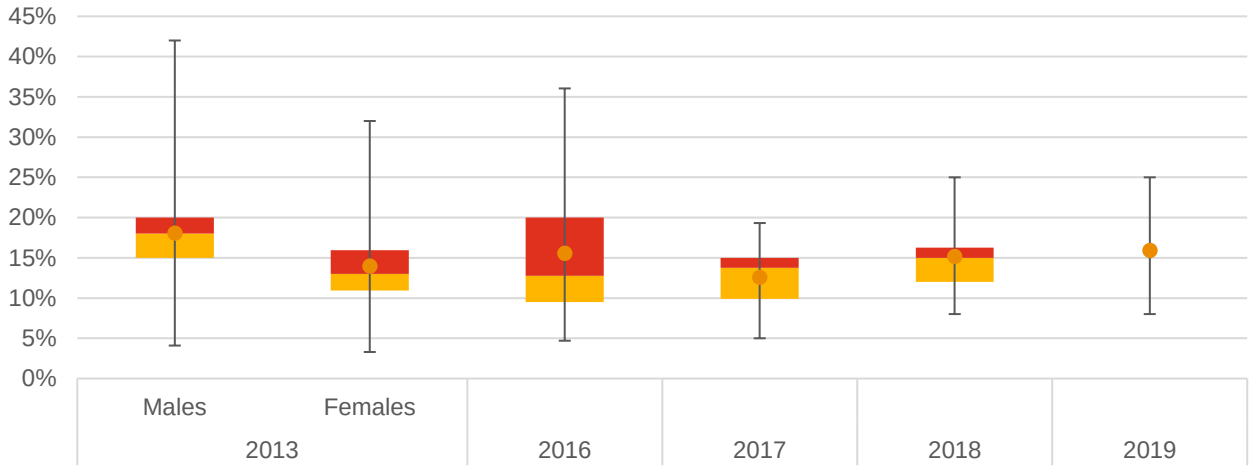
A very small number of participants made changes to their mortality risk calibration over 2019, refreshing the data used to set the calibration. The impact on the calibration was broadly neutral.

Results

Our survey at year-end 2016 included mortality risk for the first time since the year-end 2013 calibration and showed that all participants had removed any differentiation between males and females in the calibrated stresses. We also found no differentiation between ages or between smokers and non-smokers.

The base mortality stresses are presented in Figure 6.7, separately for males and females as at year-end 2013 but as a single stress applied to both genders in later years. The quartiles have been removed from the graph this year due to the limited number of responses that we received. The range of responses for the mortality base stress has remained consistent with our prior year survey (8%–25%).

Figure 6.7: 1-in-200 mortality one-off stresses (per mille)



The range for the mortality one-off stress has decreased slightly from 0.94–3.00 per mille last year to 1.00–3.00 per mille.

6.5. Morbidity

Morbidity risk, as defined by Solvency II, 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 disability, sickness and morbidity rates. It affects predominantly health contracts such as critical illness insurance and income protection.

Changes in approach since prior year

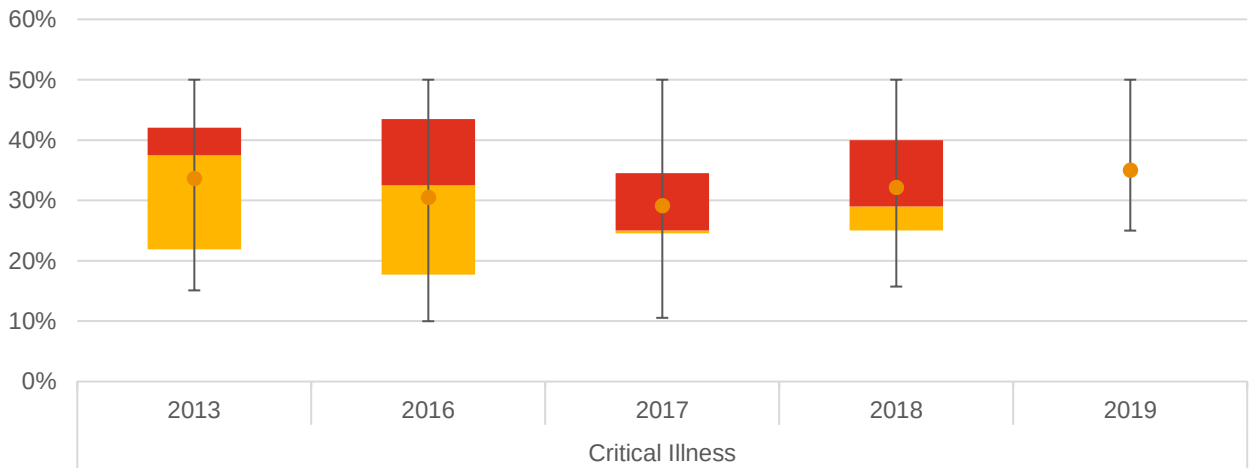
As with mortality, very few participants stated that they made changes to their morbidity risk calibration over 2019, refreshing the data used in the calibration. The impact of this was broadly neutral.

Results

Our survey at year-end 2016 included morbidity risk for the first time since the year-end 2013 calibration. The results for base morbidity stresses for critical illness policies are presented in Figure 6.8, for each of the last four years and for year-end 2013. We have not included the quartile information this year as we received an insufficient number of responses.

While the overall range of stresses has narrowed slightly from last year, this is caused by a change in the participants that responded to the survey this year.

Figure 6.8: 1-in-200 morbidity base stresses for critical illness.



For income protection:

- the range of responses received for inception rates was between 25% and 50%; and
- the range of responses received for recovery rates was between 22% and 25%.

No participant responding this year has changed any of the critical illness, inception rate or recovery rate stresses from last year.

7. Operational risk

Solvency II defines operational risk as the risk of loss arising from inadequate or failed internal processes, people and systems, or from external events (including legal risk).

- Operational risk, while material for a number of participants, is a smaller component of the SCR than life insurance or market risk for all participants.
- Process failure is the most common risk category included within participants' three most material risks. Process failure covers a broad range of actuarial processes, such as reinsurance and finance processes, execution and delivery failures, and system failures.

Changes in approach over the year

Just over half of the participants noted that they made changes to the operational risk calibration over 2019. Of these, all had refreshed the data used within the calibration and a very small number had also changed the methodology. The changes generally resulted in either a stronger calibration or a broadly neutral impact.

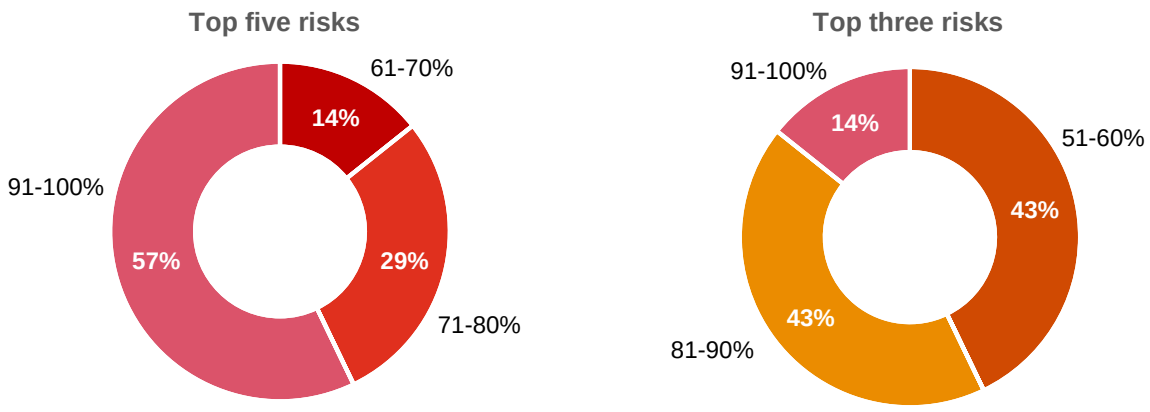
Methodology

We asked participants for the number of operational risk categories for which they hold capital. Firms tend to break down operational risk into homogeneous risk categories which represent different types of operational risk for modelling purposes. Each firm will have their own methods of categorising operational risk. The number of operational risk categories used by participants ranges between 6 and 24.

Largest risk categories

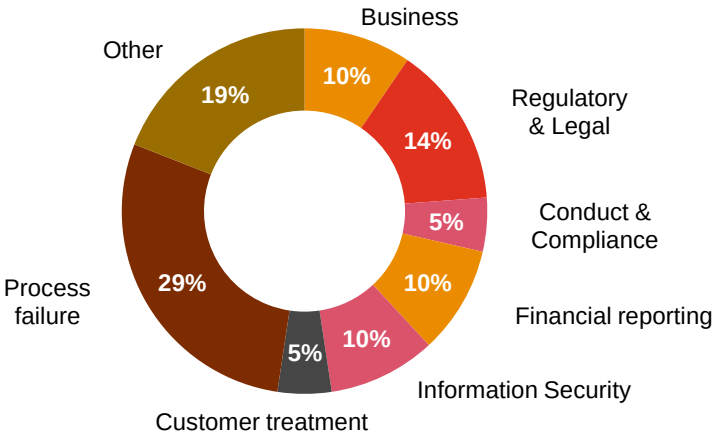
We asked participants how much of their total operational risk capital requirement arises from both their top five and top three risk categories. The results are shown in Figure 7.1. Note that no participants selected the ranges 81-90% for the top five risks or 61-80% for the top three risks.

Figure 7.1: Proportion of operational risk capital requirement arising from the top three and top five risk categories.



We also asked each participant to state their top three risk categories. The results varied but have been categorised into broad risk groups in Figure 7.2.

Figure 7.2: Top three risk categories



The most common top operational risk categories were process failure risks, regulatory and legal risks and “other” risks. Process failure covers a broad range of actuarial processes, such as reinsurance and finance processes, execution and delivery failures, and system failures. Other types of risks noted by participants were problems with internal fraud, employment practices and workplace safety, breaches of terms and conditions and financial crime.

8. Risk aggregation

This section considers the approaches participants use in aggregating their individual risks to determine the total SCR, including the resulting diversification benefit.

- The range of diversification benefits produced is broadly the same as last year – 29% to 69% compared to 28% to 69%.
- Dependency assumptions are broadly in line with those observed in last year's survey.

Changes in approach over the year

Fewer than half of the participants noted that they made changes to the aggregation over 2019, in each case as a result of refreshing the data, and the impact was broadly neutral for all.

Dependency between risks

We asked participants to provide their correlation matrices, together with a brief explanation of their sign convention. We have applied the following definitions for the various levels of dependency:

- High: 100% – 67%
- Medium: 66% – 34%
- Low: 33% – 1%
- Nil: 0%

We have separated the rest of this chapter into sections covering:

- Dependencies between market risks;
- Dependencies between life insurance risks;
- Cross-dependencies between market and life insurance risks.

Within each section, we report on the resulting dependency assumptions.

Market risks

The availability of data means that the setting of dependency assumptions is less subjective for correlations in normal times, but it becomes far more subjective in stressed conditions and is a key area requiring the application of expert judgement.

The majority of participants assume a medium or high correlation between **credit spread** and **equity** risks, similar to what we observed in previous surveys. These assumptions are also broadly consistent with the Standard Formula's prescribed high positive correlation (+75%).

Between **interest rate level** and **interest rate volatility** risk, correlations range from zero to medium, with the majority adopting either a zero or low correlation.

We note that there is more variation in assumed dependencies between market risks than in those between life insurance risks, which is a pattern we have seen in previous years' surveys.

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Life insurance risks

The setting of dependency assumptions between life insurance risks is highly subjective and is a key area requiring the application of expert judgement.

Dependency assumptions between pairs of life insurance risks are summarised below:

- All participants assume a zero dependency between **longevity trend** and **persistency level** risks.
- Participants mostly assume a low correlation between **longevity trend** and **longevity base** risks, with the remainder assuming a zero correlation.
- It was most common for participants to assume a low positive correlation between **expense base** and **expense trend** risks.

Aggregation between life insurance and market risks

As observed in previous years, all participants assume either low or zero dependency between **longevity** and **credit** risks and most participants assume low correlation between **persistency** and **credit** risks.