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Fundamental Spreads and the Matching Adjustment in light of the HMT review of the Solvency II regime for UK firms

by the Matching Adjustment Working Party

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A research paper by the Institute and Faculty of Actuaries Matching Adjustment Working Party

Abstract

The Fundamental Spread (FS) component of the Matching Adjustment framework is a crucial aspect of the Solvency II review in the UK. The working party has reviewed the purpose of the FS and relevant literature and has looked at some potential "evolutionary" and "revolutionary" approaches that could be considered for any reform of the FS. This paper has considered this range of approaches against the objectives of the Solvency II review and from a public interest perspective, to add to the publicly available information on this topic.

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1 Executive Summary

The initial work for this paper began during the PRA's Quantitative Impact Study (QIS) in the summer of 2021. the working party sought to investigate Fundamental Spreads (FS) in light of the PRA's data gathering for potential policy options in the QIS.

The working party's aim was to investigate the interactions between spreads and risks retained by Matching Adjustment (MA) portfolios, and how any material interaction could be pragmatically accommodated within the MA framework forward pragmatic changes that could be implemented in the SII framework, considering HMT's objectives for the SII review. The working party revisited the intended purpose of the FS and articulated its understanding of the PRA's concerns with the current FS. This scene-setting was augmented by a review of relevant literature from a range of sources. In considering potential pragmatic changes, the working party considered those that are more "evolutionary" in nature, representing adjustments to the current framework, and those that are more "revolutionary" in nature, with more fundamental shifts in approach. The output of this work is this research paper.

Throughout our research and drafting, we have adjusted the work plan to accommodate new information and events as they arise, such as the HMT consultation paper, the PRA discussion paper (DP 2/22) and other regulatory publications and speeches.

Given the HMT consultation and Solvency II review are ongoing, there will necessarily be a cut-off to the information we can include in this paper to allow publication ahead of the closing date of HMT's consultation. We therefore accept that information presented, and comments made in this paper may be superseded by further HMT or PRA publications or announcements during the consultation period.

In conducting the work presented in this paper, the working party has considered the implications of relevant elements of Solvency II reform from a public interest perspective. In particular, we have considered an appropriate degree of policyholder protection, and the practicality / feasibility of differing approaches in interpreting what would be in the public interest.

The key conclusion of our work is that there is no "right" answer as to the methodology that should be used for setting the FS. As such, achieving the most theoretically correct methodology should not be to the detriment of it being practical to implement, explain, manage, and model.

1.1 Outline of paper

In **section 2**, we set out what the FS is trying to achieve, with reference to the Solvency II regulations.

In **section 3**, we set out our understanding of the PRA's concerns with the FS as currently formulated, based on the various PRA documents and speeches that have been published during and before the Solvency II review. We agree that the PRA has justifiable concerns over certain elements of the current FS methodology, such as limited risk sensitivity and the extent to which different assets should be treated differently.

In **section 4**, we present the summary of our literature review, which identified the following features:

- The PRA's preferred concept of a credit risk premium (CRP) is a common approach when considering the decomposition of asset spreads. This approach has significant academic research behind it but contains the following downsides:
    - It has no unique interpretation (the academic research estimating its size varies significantly) and different investors (in different circumstances) may have alternative views on its size / formulation.

    - There is no single, universally accepted method for deriving the level of credit risk premium at all times (e.g. the CRP is not a fixed proportion of spread in all market conditions).
    - Using a FS that moves materially with market credit spreads creates undesirable levels of volatility for insurers' balance sheets and is unlikely to be consistent with the concept of a "transfer value" for the liabilities.
    - We are aware that many firms' Internal Models for credit risk and IFRS17 discount rate allowances are driven by models for ratings migrations – hence moving away from ratings / downgrade-based approaches wholesale is likely to create additional work and cost for the industry, which may be unwarranted, given the above points.

- There are particular difficulties with quantifying credit risk for illiquid assets, including:
    - Academic research on credit risk understandably focusses on publicly traded assets and therefore it is (even) less clear how compensation for credit risk within the spreads of illiquid and / or more complex assets can be objectively derived.
    - Excessively prudent treatment of assets whose valuations are not publicly observable may serve to disincentivise firms' investment in such assets. This is likely to be to the detriment of UK Government ambitions to increase investment of annuity writers into productive finance.
    - A methodology based on credit ratings may be able to reflect more accurately the credit risk of individual assets as a result, albeit noting that credit rating analysis can be flawed.

- The current regulations already attempt to deal with the issue of compensation for uncertainty for insurance risks where a market value is unobservable via the Risk Margin, and a similar concept could be employed for credit. This is also likely to be consistent with the way an acquirer of an annuity portfolio might think about quantifying compensation required for the risks to be run post-acquisition.

We have considered how adjustments could be made to the existing FS to help address some of the PRA's concerns, to increase the risk sensitivity, and to better reflect the characteristics of different asset classes. The working party has considered how to align potential solutions to HMT's objectives for the Solvency II review. These are explored in **section 5**:

- These include moving to notched ratings, reflecting rating agency indicators, use of spread thresholds and expanding the FS asset class categories to align to a wider range of rating agency methodologies.

- We note that the current "Cost of Downgrade" (CoD) component lacks consistency with the way that firms act in practice and may be considered an unnecessary feature.

- Adjustments for "rating uncertainty" resulting from reduced scrutiny of the credit rating process (e.g. where only one agency has provided a rating, or for internally rated assets) are difficult to justify and may be better dealt with by qualitative risk management processes.

- A recent development to the debate includes using a FS based on average spreads over a medium-term time frame, but we note that this creates a "lag" in the recognition of changing credit conditions that may persist for some time after an event has occurred.

In **section 6**, we model different formulations of the FS, including the PRA's QIS A and B approaches, and the methodology presented by HMT using elements of the PRA's calibration, and compare these to the current FS "Status Quo". Our modelling is based on the immediate impact of FS changes to an annuity portfolio, 75% reinsured with no transitional measures or Risk Margin reforms. We note the following:

- A FS methodology based on a x^{th} percentile approach (we choose 85^{th} for illustration) might be one relatively simple alternative to current reform proposals and reflects how many insurance firms apply risk-based capital approaches for other purposes.
    - Such a method would be consistent with a margin over current estimate (MOCE) approach to the Risk Margin, and may be relatively easy for firms to adapt for the purpose of valuation under other metrics (e.g. the IFoA Future of Discounting Working Party has suggested such an approach for IFRS17 purposes[1]).
    - However, unadjusted, such an approach is likely to be relatively static over time and unlikely to respond to any great extent to perceived increases in market-implied levels of credit risk.
- Evolution of the current relationship between the FS and SCR requirements generated by modelling FS under stress has, to-date, not been explored in detail in the face of revised FS proposals.

In **section 7**, we conclude by performing a qualitative assessment of the different FS formulations modelled in section 6, based on a number of criteria. Based on the results of our assessment, we observe:

- The two FS formulations introduced in the PRA QIS exercise (commonly referred to as "QISA" and "QISB") are expected to introduce material volatility to balance sheets, which could give rise to procyclicality and reduce the extent to which annuity firms invest in long-term illiquid assets.
- The assessment of the index-spread or "XnZ" formulation (we have called this "QISC"), set out in the April HMT Consultation Paper and PRA Discussion Paper, is dependent on the choice of parameters. Based on the PRA's stated minimums, it would appear to result in a less stable balance sheet than the current approach, and it will make it less attractive for annuity firms to invest in long-term illiquid assets. It is also expected to materially reduce capital on day one.
- A x^{th} percentile-based approach might be one relatively simple alternative to the current FS formulation. The choice of percentile and calibration can be used to achieve the desired capital impact on day one, and it could be made more risk sensitive through a combination of the adjustments outlined in section 5.

[1] https://www.actuaries.org.uk/system/files/field/document/IFRS%2017%20default%20allowance%20-%20v0.5.pdf

2 Introduction – what is the Fundamental Spread trying to achieve?

The Fundamental Spread (FS) is used in the calculation of the discount rate for certain types of insurance liabilities (primarily annuities), where a firm has approval to apply it. The FS is an allowance for the credit risk of an asset – i.e. there is a probability that the income expected to be received from an asset is not realised. It can be thought of as a component of the credit spread (the return above risk-free) on an asset:

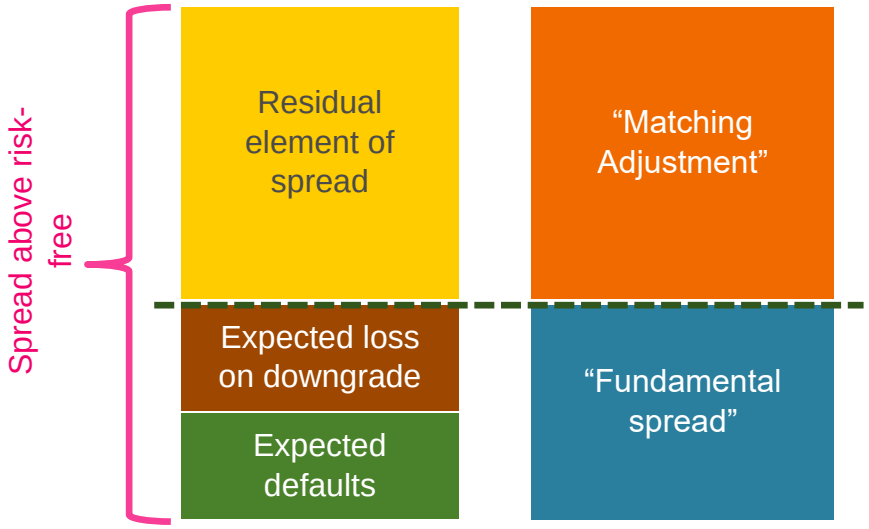


Figure 1: Illustrative Composition of Credit Spread and Matching Adjustment

With the UK having now left the European Union, HM Treasury are leading a review of Solvency II. One of the primary aspects of this review is the Matching Adjustment (MA).

The PRA issued a Quantitative Impact Study (QIS) to the insurance industry in the summer of 2021, which included alternative formulations of the FS. The FS is a key aspect of the MA. Its formulation has a profound effect on not just the size of the MA (and hence the size of the insurance liabilities), but also the sensitivity of insurers' balance sheets to credit spreads.

The MA was formally introduced to Solvency II as part of the Omnibus II Directive[2]. In the recitals of the Directive, it is clear that the intention is as a countercyclical measure to (largely) immunise the balance sheet from fluctuations in credit spreads:

> (31) Where insurance and reinsurance undertakings hold bonds or other assets with similar cash flow characteristics to maturity, they are not exposed to the risk of changing spreads on those assets. In order to avoid changes of asset spreads from impacting on the amount of own funds of those undertakings, they should be allowed to adjust the relevant risk-free interest rate term structure for the calculation of the best estimate in line with the spread movements of their assets…

This was seen in practice during early 2020 when the onset of the COVID-19 pandemic resulted in significant spread-widening. Insurance balance sheets were largely unaffected by this period of market stress.

[2] L_2014153EN.01000101.xml (europa.eu)

Article 77c of the Solvency II Directive goes on to give a more direct statement on what the FS should reflect by stating:

> (b)the matching adjustment must not include the fundamental spread reflecting the risks retained by the insurance or reinsurance undertaking;

A common articulation of this is that the FS should include an allowance for both expected defaults and uncertainty around those defaults.

The current FS methodology takes a backward-looking approach, using data on historic rating defaults / downgrades (supplemented by a floor based on 35% of the 30-year average spread) to calibrate an average or "through-the-cycle" estimate of the default and downgrade costs. Downgrade costs being an allowance for the cost of rebalancing assets back to the original rating following a "migration" to a lower credit quality.

The result of the current formulation is that the FS are very stable, meaning that changes in spreads on assets held by insurers are (almost 1:1) reflected in the liabilities and hence the (base) balance sheets of MA firms is stable. This dynamic helps to significantly reduce procyclicality, a key objective of Solvency II – as highlighted in the Omnibus II Directive extract above.

There could be other ways of calibrating the FS, such as replacing the Cost of Downgrade element with an explicit allowance for uncertainty. Some of these alternatives are likely to lead to a Matching Adjustment that behaves very differently to the MA currently in use.

In this paper we consider alternative calibrations, the evidence for them (by looking at both academic research and historic experience), the merits / challenges of each and alignment with the Solvency II principles.

3 PRA's concerns with the current Fundamental Spread

The SII review has three objectives that were set out by HM Treasury in its Call for Evidence[3]:

- *to spur a vibrant, innovative, and internationally competitive insurance sector;*
- *to protect policyholders and ensure the safety and soundness of firms; and*
- *to support insurance firms to provide long-term capital to underpin growth, including investment in infrastructure, venture capital and growth equity, and other long-term productive assets, as well as investment consistent with the Government's climate change objectives.*

The PRA, in its remit as the prudential regulator, has the following primary objectives[4]:

- *a general objective to promote the safety and soundness of the firms we regulate; and*
- *an objective specific to insurance firms, to contribute to ensuring that policyholders are appropriately protected.*

With a secondary objective:

- *to facilitate effective competition in the markets for services provided by PRA-authorised firms.*

The Governor of the BOE has been clear that the PRA's primary objectives take "pole position"[5]. As such, there has been much debate over the relative weights and potential conflict between HMT's objectives and those of the PRA in the context of the Solvency II review, in particular the emphasis placed on policyholder protection versus facilitating competition.

We set out below our interpretation of the PRA's concerns with the FS, as determined under the current (July 2022) MA framework. In 2020 and early 2021, through speeches by Charlotte Gerken[6,7], Anna Sweeney[8], and Sam Woods[9], the PRA indicated concerns or reservations it had with the current MA framework.

The main prudential regulatory concern appears to be the level of MA claimed by firms being too high, which implies FS that are too low. The PRA has a concern that firms could potentially bring forward as yet unearned profits and then dividend those profits away prematurely; the PRA believes that the MA should be earned risk-free, in line with Art 77c the current Solvency II Directive.

This concern arises largely as a result of the formulation of the FS under the current MA framework. Examples cited by the PRA can be summarised as:

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/927345/Solvency_II_Call_for_Evidence.pdf

[4] Prudential Regulation Authority Business Plan 2021/22 | Bank of England

[5] Reforming Solvency II: Delivering policyholder protection - speech by Andrew Bailey | Bank of England

[6] Life beyond Solvency II: a view from the top of the regulator - speech by Charlotte Gerken | Bank of England

[7] Developments in the PRA's supervision of annuity providers - speech by Charlotte Gerken | Bank of England

[8] Goldilocks and the three pillars: how much capital is just right? - speech by Anna Sweeney | Bank of England

[9] Brave new world - speech by Sam Woods | Bank of England

- The unobservable split between credit risk and illiquidity that contributes to an asset's overall spread.
- The retrospective nature and relative insensitivity of the current FS to spread levels, as the PRA believes that (elevated) spreads contain information on potential future risks or riskiness that should not be ignored.
- The FS basis risk between the corporate bonds used to calibrate the current FS and the increasing amount of "illiquids" or "real assets" that firms hold in their MA portfolios, which may have different default and downgrade experience, as well as other differing characteristics compared to the corporate bonds used in the current FS calibration.
- The amount and credibility of any data on those non-corporate bond assets that could be used to determine an alternate or bespoke FS, and the degree to which asset classes were sufficiently homogenous may present additional risks if a more granular FS were to be introduced.
- The uncertainty around whether a rating or credit quality step (CQS) has been correctly assigned to an asset, in particular for a firm's internally rated assets. The PRA notes that this is further compounded by any complexity or opacity introduced as a result of any structuring employed in order to obtain MA eligibility (or for another purpose).

In the QIS in the summer of 2021, the PRA tested two flavours of an alternative formulation of the FS – based on a "percentage of spread" approach, with a further valuation uncertainty for certain assets. At the time, this was generally seen as an unexpected development by industry, with little in the way of public explanation provided for the approaches used within the QIS itself.

The PRA subsequently followed up with a Charlotte Gerken speech[10] and an IFOA Life Conference presentation[11] that provided an articulation of the PRA's rationale for the QIS scenarios and, with hindsight, put the comments from earlier speeches into perspective. In the Life Conference presentation, the PRA noted that the FS must "*reflect the risks retained by the insurer, including all component of credit risk such as expected loss and uncertainty around it, which covers more than just historic default losses*". The PRA went on to say that the current FS may not be sufficient to cover all retained risk, and further notes that historic default losses and therefore the FS may be distorted by government intervention, i.e. through central bank or government action, the likelihood and / or instances of defaults was reduced, and that this government support may not always be available to soften future credit events.

More recently, in April 2022, the HMT published its consultation[12] and the PRA published its Discussion Paper DP2/22[13], alongside other PRA documents related to the Solvency II review. In these documents, the central proposal for the FS is the sum of the expected loss due to default (as in the current FS framework) and a credit risk premium (CRP) derived from an "index-spread" approach defined as:

CRP = X * (average spread for comparator index over n-years)
+ Z * (difference between spread of asset and the index)

[10] The PRA's role in improving the processes that support insurers' investment - speech by Charlotte Gerken | Bank of England

[11] Why the PRA is taking another look at the liquidity premium.pdf (actuaries.org.uk)

[12] Solvency II Review: Consultation - GOV.UK (www.gov.uk)

[13] DP2/22 – Potential Reforms to Risk Margin and Matching Adjustment within Solvency II | Bank of England

X, Z, and n are to be calibrated but the PRA has said that 35% should be the minimum level for the CRP, while 17.5%[14] might be appropriate for the Z parameter. The use of caps and floors is mentioned but is not discussed further. The PRA provides its rationale for assessing the design and minimum calibration of the CRP in its publications.

The valuation uncertainty present in the QIS has been removed from the latest proposals. Consequential impact of the index-spread approach on SCR is not discussed in detail, with the PRA expecting no material change in SCR as a result of its proposals. Internal ratings are not to be automatically penalised as the PRA sees this as potentially disincentivising firms to develop these processes.

At the time of writing, key themes in the discussions between industry and the PRA are:

- current and forward-looking uncertainty with respect to valuation;
- whether any uncertainty should be provisioned for within the best estimate / technical provisions or within risk capital;
- the reliability and responsiveness of (internal) ratings; and
- the level and sensitivity or volatility of MA / FS due to the unobservable nature of the building blocks of asset spreads.

There are also debates around what a spread actually tells us about an asset, what level of volatility would be expected to feature on the balance sheet of a long-term insurer, as well as whether the current MA / FS framework follows the "transfer value" concept for relevant blocks of liabilities.

[14] Competitiveness and productive investment: What parts do they play in the reform of insurance regulation? – speech by Charlotte Gerken

4 Working party review of research papers

We have reviewed a range of academic literature that investigates or models the decomposition of spreads on credit risky assets. We considered how the authors' various conclusions could be read across to inform the formulation of fundamental spreads under Solvency II. In particular, we looked at whether the papers support the hypothesis that the illiquidity premium does exist, and whether it can be expressed as a percentage of spread.

4.1 Summary

There is evidence of a link between spreads and realised losses, but this is not a fixed percentage over time. Calibrating structural models has many challenges and requires several approximations / simplifications.

Most literature accepted the premise that credit spreads can be decomposed into an allowance for expected credit losses, unexpected credit risk premia and illiquidity risk premia. Although most papers indicate some sort of correlation between spreads and credit losses, they also demonstrate that there is no fixed relationship between spreads and credit losses over time. In fact, the relationship can change significantly following periods of market stress.

The chart below illustrates credit risk as a proportion of spreads for the subset of the papers that we have reviewed where a figure (or range) can easily be implied or is explicitly quoted:

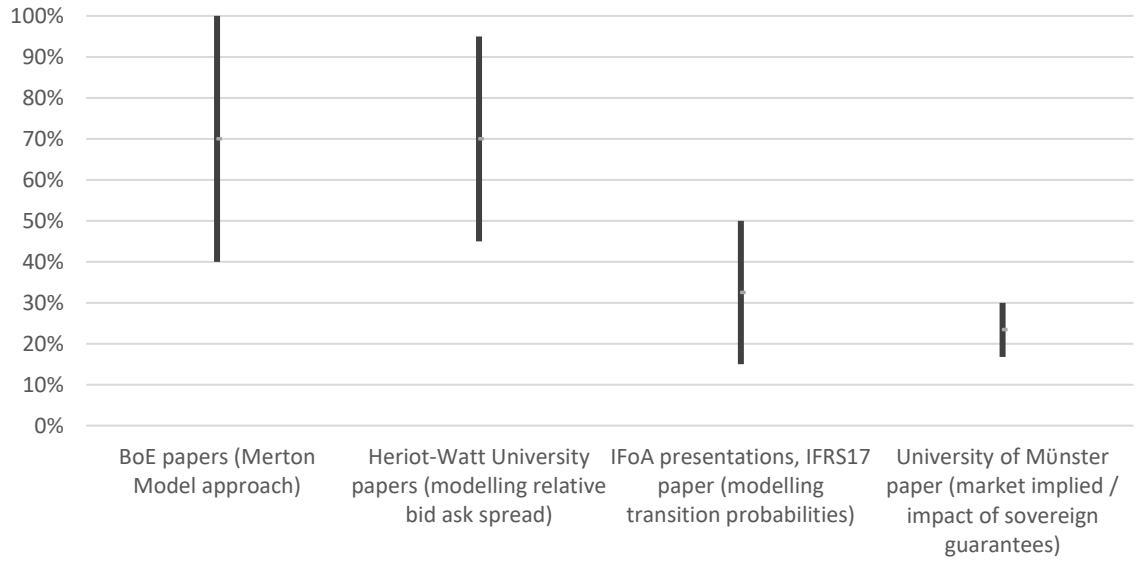


Figure 2: Credit Risk Premium (Expected + Unexpected) as % of Credit Spread

The approaches used to decompose spreads varied, ranging from historical default analysis, bid-ask spread modelling, option price modelling, or implying illiquidity or credit risk premia from market instruments. Most academic approaches were necessarily highly theoretical and relied on a number of assumptions, some of which may not reflect how insurers manage or trade their matching adjustment portfolios in practice. There was generally very little comment on how credit risk premia might differ between low and highly diversified portfolios.

We conclude that there is no single mechanical formulation of the FS that will give an accurate measure of the observed level of credit risk at any point in time, that is, the component of spreads attributable to illiquidity premium. Therefore, a practical formulation is needed which provides adequate policyholder

protection whilst avoiding any unintended consequences (such as the introduction of material balance sheet volatility – which may lead to procyclical investment behavior), spurious accuracy, or skewed investment incentives.

Below we set out some more detail on the main themes covered in the research:

4.1.1 Illiquidity premium hypothesis: does it exist or not?

There was broad consensus that, in general, an illiquidity premium exists for investment grade bonds. Reasons include, for example:

- compensation for illiquidity risk (e.g. price volatility, or uncertainty)
- compensation for transaction costs
- information asymmetry or skill (e.g. private vs public traded assets)
- availability of capital to deploy
- regulation or other structural factors

Some authors suggested that the implied illiquidity premium can be negative for high yield/non-investment grade assets (e.g. due to search for yield creating "excess" demand).

4.1.2 What approach is used to decompose credit spreads / determine the illiquidity premium?

The main approaches considered include:

- Structural models (i.e. deploying option-pricing techniques to model the behaviour of a company's debt and equity)
- Tractable trading models
- Relative bid-ask spread analysis (e.g. modelling the illiquidity premium as a function of bid-ask spreads
- Historical / market implied methods, such as:
    - CDS spread decomposition (e.g. considering differences between cash and CDS spreads)
    - Covered bond analysis (e.g. identifying risk-free assets that carry a spread due to being less readily tradable)

The table in section 4.2 groups research papers under these broad headings, with further details on each.

4.1.3 What evidence is there of spreads being indicator of expected loss?

The majority of papers indicate some sort of correlation between spreads and credit losses, where "credit loss" is typically decomposed into:

- Expected loss
- Uncertainty of credit loss
- Risk aversion or perceived uncertainty (either of which would impact the level of compensation needed for uncertainty of credit loss)

However, much of the literature concludes that credit spreads are not necessarily a reliable indicator of the exact size of illiquidity premium at any point in time (because the contribution from each of these other elements in difficult to observe, and modelling embeds an element of subjectivity).

4.1.4 What are the material assumptions made in the analyses?

Some of the key underlying assumptions are:

- Structural models are based on the idea that claims on the firm's assets can be valued using option-pricing methods. e.g. the probability of default on a firm's debt can be modelled by considering the

present value of the firm's assets and liabilities minus the value of a call option on the firm's surplus assets.

- That one can model behaviour of a rational investor wishing to optimise his/her wealth (i.e. all trading activity is "rational")
- That one can model the hypothetical spread on a perfectly liquid equivalent bond
- In some cases, it is assumed that one can infer illiquidity premia from market parameters, such as CDS spreads or bid-ask spreads

4.1.5 What are some of the key conclusions from the author(s)?

Historical default/recovery rates fail to explain the total level of actual investment grade credit spreads, and hence there is additional compensation – or risk premia – being paid to investors. In all cases, research suggests illiquidity premia vary over time (both in basis points and as a proportion of total credit spread). It tends to increase significantly when:

- there is financial turmoil
- lack of liquidity in money markets
- there is uncertainty for investors on the length of their investment horizon

Spreads and the compensation for credit risk are correlated; in particular where the definition of credit loss includes some compensation for uncertainty. Again, authors do not suggest that this compensation is fixed (either in basis points or as a proportion of total credit spread) through time.

4.2 Summary comments for research papers reviewed to date

See summary table starting overleaf.

Paper	Author	Illiquidity premium hypothesis; e.g. does it exist or not?	Approach used to decompose credit spreads / determine the illiquidity premium	Evidence of spreads being indicator of expected and/or unexpected loss	Material assumptions made in analysis	Key Conclusions from the author(s)
PRA papers						
Why the PRA is taking another look at the liquidity premium	PRA, 2021	Yes – although summarises PRA concerns about the way this is being allowed for under the current SII regime.	Two examples from other academic papers referenced: • Structural credit model (''Decomposing corporate bond spreads") • Using bid-ask spreads as a proxy for a measure of liquidity. ("Empirical Studies in Corporate Credit Modelling") Details the QIS scenario approach including Valuation uncertainty, credit risk premium and unexpected loss	Argues that the level of credit risk being flat and unchanging in different market conditions is not supported by referenced academic literature. States that these "are consistent with the message that the FS should not be flat irrespective of market spreads."	Details of reference academic analysis (not included in the PRA paper).	Context/explanation for current PRA thinking on FS and explanation of QIS scenarios.
Summary						
See listing below	Various academic, industry and investment manager views	Yes, broad consensus that illiquidity premium exists, and is generally always positive for investment grade bonds. Reasons include, for example: • compensation for illiquidity risk (e.g. price volatility, or uncertainty) • compensation for transaction costs • information asymmetry or skill (e.g. private vs public traded assets) • availability of capital	Main approaches considered: • Structural models (e.g. decomposing spreads using option-pricing methods) • Trackable trading models • Market implied methods, such as: ⇨ CDS spread decomposition (e.g. considering differences between cash and CDS spreads) ⇨ Covered bond analysis (e.g. identifying risk-free assets that carry a spread due to being less readily tradable)	Yes – the majority of papers indicate some sort of correlation between spreads and credit losses, where "credit loss" is typically decomposed into: • Expected loss • Uncertainty of credit loss • Risk aversion / perceived uncertainty	Some of the key underlying assumptions are: • That claims on the firm's assets can be valued using option-pricing methods. E.g. the PD on a firm's debt can be modelled by considering PV of the firm's assets less liabilities minus a call option on the firm's surplus assets. • That one can model behaviour of a rational investor wishing to optimise his/her wealth.	Liquidity premia vary over time, both in basis points and in proportion of total credit spread. It tends to increase significantly when: • there is financial turmoil; • drying up of liquidity in money markets; • there is uncertainty for investors on the length of the illiquidity interval Spreads and the compensation for credit risk are correlated; in particular where the definition of credit loss includes some compensation for uncertainty.

Paper	Author	Illiquidity premium hypothesis; e.g. does it exist or not?	Approach used to decompose credit spreads / determine the illiquidity premium	Evidence of spreads being indicator of expected and/or unexpected loss	Material assumptions made in analysis	Key Conclusions from the author(s)
		• regulation or other structural factors Some authors suggest that illiquidity premium can be negative for high yield/non-investment grade assets (e.g. due to search for yield)	• Relative bid-ask spread analysis (e.g. modelling the illiquidity premium as a function of bid-ask spreads) • Historic data analysis of default losses • Qualitative arguments and hypotheses	However, much of the literature concludes that credit spreads are not necessarily a reliable indicator of the exact size of illiquidity premium at any particular point in time.	• That one can model the hypothetical spread on a perfectly liquid equivalent bond. • That one can infer illiquidity premia from market parameters, such as CDS spreads or bid-ask spreads.	
Structural Models (using option-pricing methods)						
Decomposing corporate bond spreads	BoE, 2007	**Yes** Residual part of bond spread provides "compensation for all non-credit factors, including a premium for the relative illiquidity of the corporate bond market compared to the government bond market." The non-credit related residual components of corporate bond spreads backed out from the model move reasonably closely with direct, market-based measures of corporate bond liquidity conditions.	Structural credit risk model Merrill Lynch investment-grade and high-yield indices of corporate bond spreads, for bonds denominated in GBP, USD and EUR (option-adjusted spreads)	**Yes** (See Key Conclusions) However, paper notes: • the non-credit component of GBP spreads in the UK may have been influenced by regulation designed to alter the portfolio holdings of institutional investors (for example, Minimum Funding Requirement increased pension fund demand for UK government bonds in the late 1990s). • evidence that return-seeking behaviour – or the so-called 'search for yield' – may have eroded (or led to negative) illiquidity premium on high-yield corporate debt	Claims on the firm's assets can be valued using option-pricing methods. Uncertainty about a corporate issuer's asset value is estimated by looking at that issuer's equity return volatility. The estimates of credit-related risk premia are calculated using the market value of equity for the representative firm. If equity market investors were more optimistic about the outlook for corporate earnings than bond investors, for example, this could cause the model to underestimate compensation for credit-related default losses.	Credit and illiquidity risk premia both appeared to increase abruptly during the financial market turmoil in the second half of 2007. The model suggests that the compensation corporate bond investors require for bearing expected default losses increased substantially since mid-2007 – consistent with expectations among market participants of higher corporate default rates looking forward. And the rise in the second half of 2007 in fundamental uncertainty surrounding the value of some credit derivative instruments appears to have been reflected in corporate bond spreads as higher compensation for unexpected default losses. Alongside these increases, corporate bond illiquidity premia also appeared to rise in the second half of 2007 – consistent with the drying up of liquidity in money markets.

Paper	Author	Illiquidity premium hypothesis; e.g. does it exist or not?	Approach used to decompose credit spreads / determine the illiquidity premium	Evidence of spreads being indicator of expected and/or unexpected loss	Material assumptions made in analysis	Key Conclusions from the author(s)
Decomposing Credit Spread	BoE, 2005	**Yes**	Structural credit risk model (Leland and Toft, 1996)	**Yes**	Model uses forward-looking information on equity risk premia and equity value uncertainty	The actual spreads and the compensation for credit risk calculated are highly correlated. The component that compensates investors for expected default, which is the only credit risk compensation risk-neutral investors would require, is significantly more stable than the spreads they observe.
The myth of the credit spread puzzle	Feldhutter & Schaeffer, 2018	**Yes**	Black-Cox structural model. Default data is used to model bond prices.	Yes	Investment grade default data is too sparse and so an alternative is tested whereby default characteristics are inferred from all defaults (i.e. investment grade + sub-investment grade). Market value of debt is approximated by taking the face value of the debt – noting that it is default data for low rated bonds that drives the calibration.	Distribution of historical default rates for any investment grade rating is skewed. There is a strongly monotone relationship between actual less average model predicted price and bond illiquidity in speculative grade bonds (but not investment grade). It is suggested that the model underprediction for speculative-grade bonds is due to the presence of an illiquidity premium.
Is the credit spread puzzle a myth?	Bai, Goldstein & Yang, 2020	**Yes** for some assets	Jump-diffusion structural credit risk model	**Yes**	Use of market value of assets of a firm, Black Scholes option pricing assumptions.	The "credit spread puzzle" is explained by this paper as the conundrum that the difference between spreads on IG corps and risk-free assets are too large to be explained by standard diffusion based structural models of default. The paper concludes that the conundrum exists for IG corps (particularly short-term ones) because standard models do not appropriately allow for significant exposure to downside tail risk – which can be allowed for using a jump-diffusion structural model. The paper also shows that: • Book values are poor estimates of a firm's performance. • Using historical CDS spreads instead of estimated probabilities of default disproves that a firm's performance follows a geometric Brownian motion process.

Paper	Author	Illiquidity premium hypothesis; e.g. does it exist or not?	Approach used to decompose credit spreads / determine the illiquidity premium	Evidence of spreads being indicator of expected and/or unexpected loss	Material assumptions made in analysis	Key Conclusions from the author(s)
Tractable trading model						
Portfolio Choice with Illiquid Assets	Ang, Papanikolaou & Westerfield	Yes, due to: • difficulty in finding counterparties with whom to trade • specialised abilities required to trade and limited capital supply • systemic risks when financial intermediaries receive negative shocks and withdraw from market making.	Authors develop a tractable model of illiquidity, considering investors optimal allocation over liquid and illiquid assets They derive the risk premium associated with systematic liquidity crisis.	Authors take credit risk premium as given, and focus on illiquidity premia instead.	Following an approach similar to the ICAPM Merton (1973), the authors examine the investor's marginal value of wealth. One key assumption is that an illiquid asset can only be traded contingent on the arrival of a randomly occurring trading opportunity – a liquidity event – modelled as an i.i.d. Poisson process.	• Investors willing to pay 0.5% to 2% per annum over the actuarial probability of a crisis to receive liquid funds at onset of a deterioration of market liquidity. • Implied underinvestment required to compensate for liquidity risk relative to the Merton benchmark is substantial. • Infrequent trade is not sufficient by itself to generate large utility costs of illiquidity. • The effect of illiquidity on portfolio choice is dramatically larger when the length of the illiquidity period is uncertain • Utility cost of illiquidity is highest for agents that are unwilling to substitute across time (low elasticity of intertemporal substitution) but are willing to substitute across states (low risk aversion).
Bid-Ask Spread Models						
Empirical Studies In Corporate Credit Modelling; Liquidity Premia, Factor Portfolios & Model Uncertainty	Heriot-Watt University, 2017	**Yes.** The onset of the credit crunch caused the liquidity premium to rise from near-zero levels to approximately 50% of credit spreads (A rated)	Illiquidity premium a function of bid-ask prices and credit spreads.	**Yes -** within the economic cycle and in the context of the 2008/9 crisis, • short-term expected default probabilities have risen even if a bond's rating was unchanged. • investors' levels of risk aversion due to higher (perceived) levels of uncertainty have increased, pushing up risk premia.	Bid-Ask Spread is modelled and a liquidity proxy, the Relative Bid-Ask Spread (RBAS), is derived. The RBAS is a measure of a bond's illiquidity relative to bonds with identical characteristics. Liquidity premia extracted by computing the difference between a bond's observed spread with the hypothetical spread on a perfectly liquid equivalent bond, estimated by extrapolation	**Liquidity premia vary over time,** both in basis points and in proportion of total credit spread.

Paper	Author	Illiquidity premium hypothesis; e.g. does it exist or not?	Approach used to decompose credit spreads / determine the illiquidity premium	Evidence of spreads being indicator of expected and/or unexpected loss	Material assumptions made in analysis	Key Conclusions from the author(s)
				• increased uncertainty in what future default probabilities and recovery rates would be.		
Modelling the Liquidity Premium on Corporate Bonds	Heriot-Watt University, Partnership Assurance, 2014	**Yes**, but to some extent annuity writers are eroding their own illiquidity premium in public markets through increased BPA volume	Model the Bid-Ask Spread and derive a new liquidity proxy, the Relative Bid-Ask Spread (RBAS)	General observation that **neither observable market factors (i.e. CDS spreads) nor structural models are reliable indicators of liquidity premium.**	Liquidity inferred from the difference in yield to maturity of a bond relative to the yield on a hypothetical perfectly liquid bond with otherwise identical characteristics.	High correlation between market spreads and liquidity premium – but expected based on correlation between market spreads and bid-offer spread.
Evidence from historic data analysis						
The Credit Spread Puzzle – Evidence from a Quasi-Natural Experiment	University of Münster	**Yes** – "in favour of a **substantial non-credit risk component**". They observed the removal of sovereign guarantees in Germany in 2005 (i.e. bonds moved from credit risk free to credit risky). Looking between 2005-2015 they estimate c. 18% of the spread is credit risk, so c82% is non-credit risk. They don't speculate whether non-credit risk is necessarily all illiquidity risk.	Compare pre- with post-removal of sovereign guarantees spreads in Germany in 2005	**Yes, indirectly** – spreads increased following the removal of sub sovereign guarantees.	None – this is analysis of data to determine if statistically significant differences. As such, assumptions involved in t-tests are relevant but not directly applicable to testing if a non-credit risk element of spread exists.	There is a significant component of spread relating to non-credit risk
Simple Proxy Liquidity Premium	B+H, 2009	Yes, earning the liquidity premium has been a cornerstone of the insurance industry's business model and its ability to deliver cost effective fixed cash-flow products. The implicit savings of a buy-and-hold investment strategy have often been shared with consumers	• CDS negative-basis method • Structural model method (Merton model) • Covered Bond Method (e.g. spread on collateralised / risk-free bonds)	Proxy model using credit **spreads is good indicator for illiquidity premium** in UK, US and EUR markets.	By looking at number of different methods together we can have a better-informed view to judge the suitability of a simple proxy.	EIOPA (former CEIOPS) method to decompose spreads {= 50% x (credit spread – 40bps)} is a good proxy illiquidity premium

Paper	Author	Illiquidity premium hypothesis; e.g. does it exist or not?	Approach used to decompose credit spreads / determine the illiquidity premium	Evidence of spreads being indicator of expected and/or unexpected loss	Material assumptions made in analysis	Key Conclusions from the author(s)
Historic research conducted for the purposes of entry into new regulatory and reporting regimes						
Modelling and liquidity premium on corporate bonds and liquidity premium working party presentation	IFoA, 2014	Yes. This was a sessional event presented in advance of the original (European wide) Solvency II reforms. The first half of the presentation explains how an illiquidity premium can be derived using the relative bid-ask spread modelling methods (described above), while the second explains the appropriateness of the matching adjustment proposals under Solvency II.	The relative bid-ask spread modelling method (see paper Heriot-Watt papers above on modelling illiquidity premium)	Spreads not necessarily a reliable indicator as the derived illiquidity premium as % of spread varies over time and by asset type. In general, compensation for credit risk varies between 30%-55% of the credit spread.	See Heriot-Watt papers on modelling the illiquidity premium)	The paper is notable in that it addresses many of the questions we are currently revisiting. It concludes that calibration of MA suggests a higher illiquidity premium vs. that implied from academic research. The presenters conclude that: • The exact calibration of the MA is less of a concern since insurers are also required to hold capital in respect of the 1 in 200 stress on top of the MA allowance. • We do not have a universally accepted approach to calculation and application of liquidity premium. • Running alongside the various theoretical derivations, we see the impact of real-world influences, such as the impact on investment markets.
IFRS 17 – Default Model – Historic Calibration	IFoA, 2017	Yes – the paper is focussed on developing a credit model for the purpose of calculating the IFR17 discount rate, which assumes an illiquidity premium.	Uses a through the cycle (TTC), rather than point in time, approach to model credit risk. Decompose credit risk into expected and unexpected defaults, where unexpected due to unexpected credit event or mis-estimation of long term expected defaults. Unexpected defaults are calculated by fitting a model (Belkin implementation of Vasicek model) to transition matrices.	Not addressed directly, but we note that the derived allowance for default risk varies as % of spread for different calculation dates.	Belkin model calibration. The model is fairly simple and models the distribution of transition matrices using a single risk driver / modelled variable.	The paper concludes that the approach being used is consistent with IFRS17 standards. Output from the model indicates that expected defaults are c5-20% of credit spreads, while unexpected defaults contribute c5-35%. The percentage relating to credit risk is lower when spreads increase and vice versa.

5 Potential adjustments to the current Fundamental Spread approach

5.1 Introduction

Since the PRA finalised the QIS and qualitative questionnaire process, the working party has continued to progress its research on aspects of the MA framework. In particular, it has begun analysing various adjustments that could be made to the current FS that may help to achieve the HMT's and PRA's objectives in relation to its Solvency II review and the MA.

This section sets out various adjustments that could be made to the current FS and considers the relative pros and cons of each. Throughout this work, the working party is mindful of HMT's stated aims of:

1. Making the FS more credit risk sensitive;
2. Explicitly allowing for uncertainty around defaults and downgrades;
3. Whilst ensuring that any changes do not introduce material volatility onto insurers' balance sheets.

5.2 Summary of potential adjustments

The table below lists the ideas included in this paper and some of the key conclusions reached based on our research.

In assessing the impacts of these changes, we have assumed that the sub-investment grade cap has been removed; the reasons for its removal have been well documented elsewhere and we are supportive of this change.

Document section	Alternative formulation type	1. Increased credit risk sensitivity	2. Allows for uncertainty	3. Does not introduce BS volatility	Conclusions based on our research
5.3	Increase granularity of current FS by: - Notched ratings - Sector - Asset class				• By notch data available and sensibly helps with 1, 2, and 3 • By sector FS not feasible • By asset class (based on credit rating methodology) FS is possible and helps with 1, 2, 3 but quickly becomes complicated
5.4	Differentiated treatment for sustainable sectors				• ESG factors affecting credit risk should already be allowed for in credit rating assessments – no rationale for further adjustments
5.5	Differentiated treatment for internally rated assets and/or those not independently validated				• Internal ratings should not automatically be penalised, rather the emphasis should be on a robust framework and sufficient expertise
5.6	Differentiated treatment for assets only rated by one ECAI				• Not material and may penalise certain asset classes

Document section	Alternative formulation type	1. Increased credit risk sensitivity	2. Allows for uncertainty	3. Does not introduce BS volatility	Conclusions based on our research
5.7	Using rating agency Watch and Outlook status to assess higher probability of downgrade				• Allows for additional information in credit risk that addresses 1 & 2 • May introduce some balance sheet sensitivity (but not excessive volatility), as this reflects changes in the risk environment, so may be warranted
5.8	Using spread thresholds within a basket / sub-index				• Increased triggers achieves 1 • Does not allow for 2 explicitly but does recognise increased uncertainty, and introduces volatility / sensitivity to spreads, which may be warranted, but that is less than the PRA's index-spread approach.

Following consideration of the alternative formulations above we have identified the following changes to be the most theoretically and practically sensible that could be made as a package of changes to the current FS tables.

Example change	Rationale
Expand the current FS tables to be published by the more granular notch rating, rather than whole-letter rating or CQS.	Improve the precision of ratings by making use of more granular available data.
Allow for ECAIs' watch list designations to adjust the current FS tables to reflect increased credit risk.	Improve the precision of ratings by reacting to smaller changes in creditworthiness, ahead of rating upgrades / downgrades, by reflecting expected changes in the current assessment of credit risk.
Expand the categories of current FS tables from financial / non-financial to financial / non-financial / illiquid.	Reflect differences in observed probabilities of default of illiquid assets that typically exhibit different fundamentals and other aspects such as improved recoveries.
Measure heightened idiosyncratic risk by monitoring elevated spread of an asset versus a chosen basket/sub-index and use as a trigger to reassess FS.	Allows firms to respond quickly to potential changes in the risk environment and employ judgement-based (temporary) measures without a hard, automated link between spreads and FS. Challenges firms to consider whether the spread is arising due to economic risk.

5.3 Increase granularity of current FS

5.3.1 Rating notches

Using notch ratings (i.e. AAA, AA+, AA, AA-, …) provides a more granular assessment of the probability of default and a better reflection of the credit risk in a portfolio. Using letter ratings loses some information that could over- or under-estimate the risk. In practice notch ratings are the preferred rating method and indeed external credit assessment institutions (ECAIs) produce notched transition matrix data[15].

Advantages	Disadvantages
• Increasing the granularity of credit rating assessments clearly improves the precision of credit risk modelling and will make the FS more sensitive as assets will move between notch ratings more regularly than they move between credit ratings. • Using notch ratings reduces the size of step-change in default probabilities compared to letter ratings which will reduce the current incentive to invest towards the lower end of each big letter rating. For example, it is currently more efficient for firms to invest in single A- than BBB+ rated assets because the step change between current FS levels between CQS 2 and 3 is quite large compared to the difference in credit spreads. • The difference in credit risk is material (particularly for BBB notch ratings) and it is more appropriate to allow for this specifically. • Notch data is available to use and combining it into letter ratings intentionally loses some of that information.	• Increases complexity of the MA calculation and amount of FS data needed. • May require firms to increase the granularity of their internal ratings, if notches not currently used.

There are some other aspects to consider:

- Notch ratings may not be possible for sovereigns because there is an insufficient number of observations in each notch rating to provide credible information. For example, for sovereigns the average number of observations in 2020 by notch rating was 7 with a minimum of 2.
- This is more relevant for corporate bonds, where there is still a significant enough number of observations by notch rating to provide credible and reliable empirical probabilities of defaults. For example, in 2020 the average number of observations by letter rating was 500 versus an average of 206 by notch ratings.
- As part of producing the FS based on empirical default rates by notch rating, there may be some smoothing required to fill gaps for notches that may not have experienced defaults, either because of a lack of observations, ratings being withdrawn, or genuinely no defaults. An alternative may be to simply interpolate between the current CQS-based FS.
- If the FS is produced by asset class – an idea discussed in section 5.3.3 – then consideration will need to be given to the number of observations by notch rating for a particular asset class. Failing this, using corporate bond default probabilities by notch for illiquid assets will still provide a better reflection of the credit risk profile.

[15] For example, see here for long term average notch data from Fitch. Year-by-year data is a paid-for product. Other rating agencies produce similar data.

5.3.2 Sectors

Companies are allocated into sectors based on what best defines their business operations – for example, financials, energy, industrials, healthcare, etc. The credit risk may vary depending on the sector.

Our initial research suggests that ECAIs allow for sector specific risk within the rating published for a particular issuer or asset, although the specific approach may vary between ECAIs[16]. For example, each industry / sector is assigned a rating based on the ECAI's view on its riskiness which flows through the rating methodology and contributes towards the overall letter rating. It is our understanding that the reason for this is there is an insufficient number of issuers within a particular industry / sector to determine a credible assessment of the probability of default.

This means that, regardless of the industry / sector, we expect that the ratings produced should be (broadly) comparable and therefore producing FS tables by sector may not provide any additional benefit and may lead to "double-counting" of the risks associated for particular industries / sectors.

A more appropriate breakdown may be to consider differentiating by the different credit rating methodologies used by ECAIs – considered as part of section 5.3.3.

5.3.3 Asset classes

The idea here is that credit ratings may not be comparable across asset classes and therefore it may be suitable to allow for this via a separate FS treatment. For example, does an A-rated Secured Loan behave similarly to an A-rated Corporate Bond?

Based on our research, ECAIs rate different assets based on their credit fundamentals. If different asset classes exhibit different credit fundamentals that impact the credit riskiness of an asset, then the ECAI allows for this in the rating. For example, a loan secured against cash flows generated by a toll road is generally more secure (i.e. is more able to withstand adverse events) than an unsecured corporate bond, all else equal.

This is done by having a number of different credit rating methodologies that each cover a number of different asset classes that the ECAI views as having the same or similar credit fundamentals. Therefore, strictly speaking, it is more appropriate to consider ratings by credit rating methodologies rather than asset classes. For example, S&P[17] use the following broad credit rating methodologies:

- Non-financial corporates;
- Financial institutions;
- Insurance;
- Infrastructure;
- Sovereigns; and
- Structured finance[18].

Whilst we expect ratings to be broadly comparable across asset classes, it is not clear if this is always possible in practice given that ratings are based on the relative credit quality of an asset using a particular credit rating methodology and that relativity may vary depending on the credit

[16] For example, see page 16 of this for S&P's approach.

[17] Using the sections listed here. The methodologies can be broken down further, indeed S&P has a whole suite of credit rating models used to allow for bespoke treatment of assets. We also note that this list is similar across ECAIs, for example see the breakdown here from Fitch.

[18] Structured finance (i.e. RMBS, CMBS) is not very relevant for insurance companies, but we include it here for comparison purposes.

methodology used. Subsequently, we think credit ratings are not necessarily comparable between credit rating methodologies and there may therefore be some benefit in having FS tables by credit rating methodologies.

We have explored this by looking at the historic probabilities of default for each methodology[19]. The chart below compares the average default rates by asset class and credit rating over the past 20-30 years[20] published by S&P.

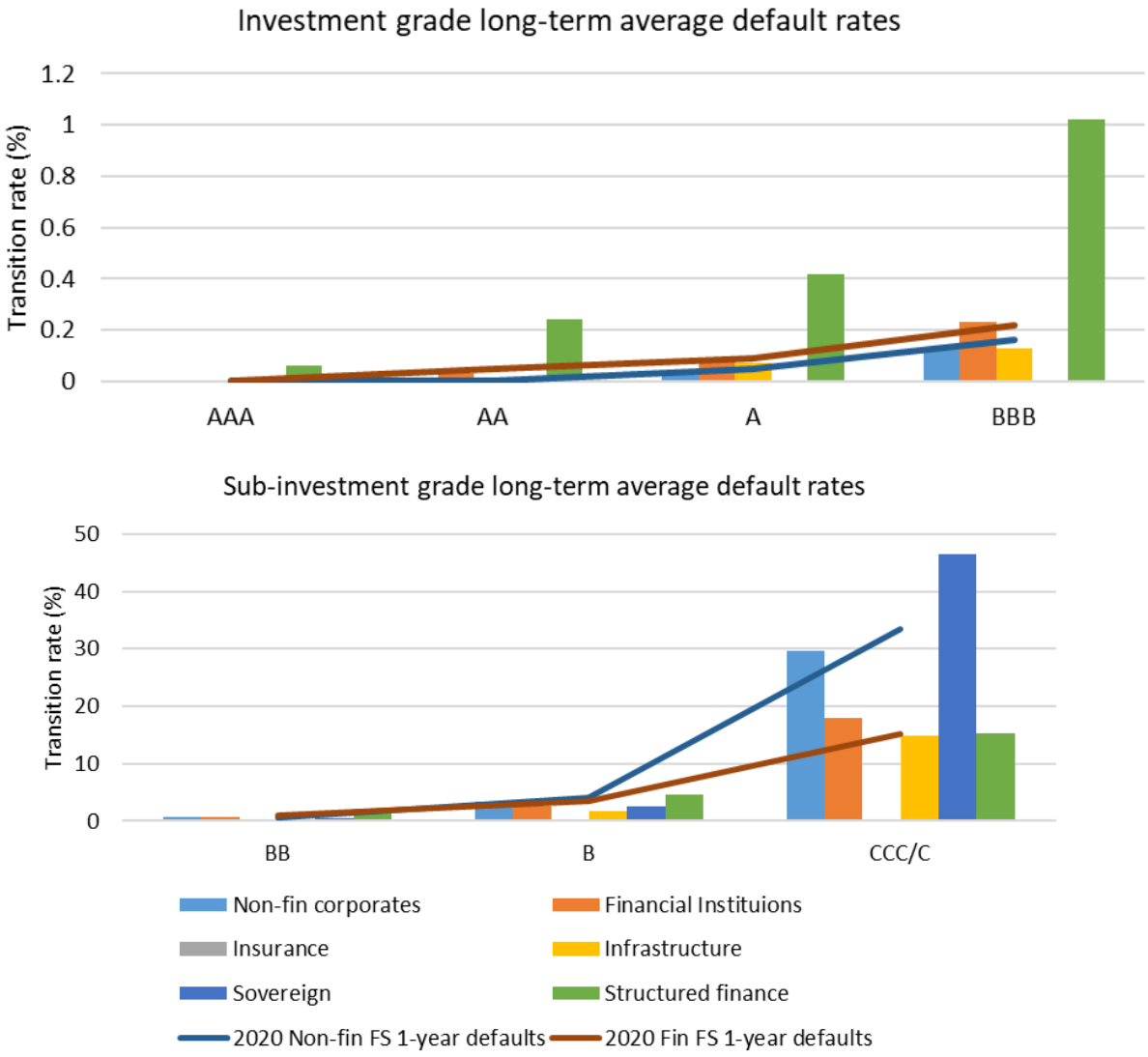


Figure 3: Average default rates by asset class and credit rating over the past 20-30 years using data published by S&P[21].

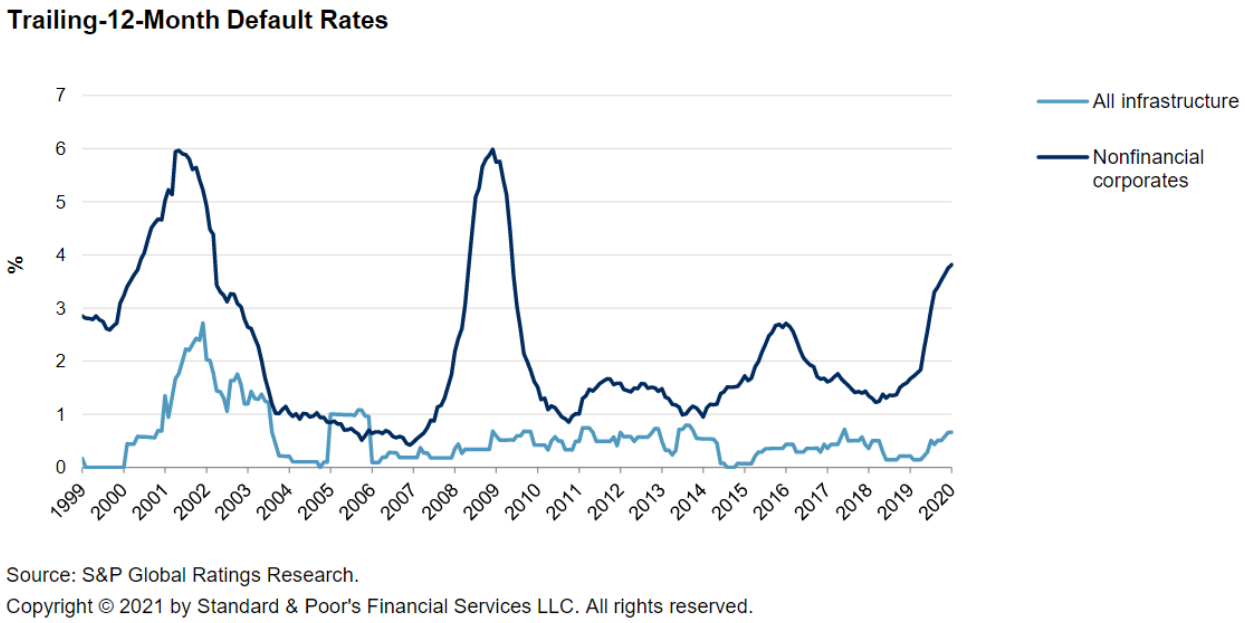
[19] For example, see table 7 here from S&P

[20] The period over which the data is averaged varies between asset classes based on the availability of data. All asset classes average over 1981-2020 other than Asia corporates and Global Sovereigns, which are 1993-2020 and 1975-2020 respectively.

[21] Note that average default data is not available publicly for insurance credit rating methodologies and we have excluded B and CCC default rates.

From this we can see that:

- There are material differences in long term average default rates by asset class, which suggests that credit ratings are not always comparable and therefore splitting the FS by credit rating methodology may be suitable.
- The difference is more pronounced as credit ratings reduce, so that there is greater uncertainty in the probability of default linked to a particular credit rating the lower the rating.
- Structured finance is the obvious outlier for investment grade ratings. We believe this is as a result of their poor performance during the global financial crisis (GFC) and concentration in certain sectors, although further research would be needed to confirm this and draw conclusions.
- For all ratings other than single A, infrastructure has a lower long term average default rate than non-financial corporates. Additionally, infrastructure assets performed much better than non-financial corporates during the GFC, as shown below, evidencing their overall resilience to macroeconomic effects compared to corporate bonds.



Source: S&P Global Ratings Research.

Figure 4: Rolling 12-month default rates for infrastructure and non-financial corporate bond assets produced by S&P from *https://www.spglobal.com/ratings/en/research/articles/211012-default-transition-and-recovery-2020-annual-infrastructure-default-and-rating-transition-study-12134731*

The table below considers the pros and cons of using FS tables by asset class / credit rating methodology.

Advantages	Disadvantages
• Better reflect the credit fundamentals of different asset classes in the FS, instead of using an equivalent corporate bond FS rating. • Improved synergies with firms' internal models (which are typically structured by asset classes that exhibit different credit fundamentals, though this will vary by firm).	• Reliance on firms' internal rating methodologies remains. • Depending on the number of asset class FS tables used, availability of data may be an issue. • Some asset classes may have less data – i.e. fewer assets or shorter history meaning any derived FS may be less robust.

Advantages	Disadvantages
• Helps to reduce uncertainty around defaults and downgrades by more accurately reflecting the credit risk fundamentals of different asset classes. • Should not introduce any additional volatility to firms' balance sheets. • More granular treatment means the FS is more credit risk sensitive as there is greater allowance for risks inherent in particular asset classes (rather than relying on corporate bonds).	

Based on the above, we do think that it may be sensible to consider the FS by asset class. However, we think that more investigation should be done into the number of credit rating methodologies to use – for example, given that the main credit fundamental difference between corporates and illiquid assets is additional security, a balanced end point may be to have FS tables for financial corporates, non-financial corporates, structured finance (subject to further research, as noted above) and illiquid assets.

5.4 Differentiated treatment for sustainable sectors

The idea here is that some assets in sustainable sectors (so called "green assets") may reflect lower risk under future downside scenarios and this could be allowed for in the FS through a separate allowance or a separate FS table.

Based on our research, ECAIs typically implicitly allow for some ESG related risks within the rating, for example we understand that the oil & gas industry rating has reduced to reflect the increased risk to financial performance from issuers in that sector. Where ESG factors do not affect the credit fundamentals of an asset or issuer, ECAIs do not allow for it in the rating. This makes sense as otherwise ratings are artificially adjusted based on factors that may not be relevant to the credit riskiness of an asset or issuer. Regardless of this, the table below considers the pros and cons of treating green assets differently in terms of FS.

Advantages	Disadvantages / alternatives
• From an environmental perspective, encourage investment in green assets to help with combatting climate change. • Encourage consideration of social and governance factors more actively as part of firms' investment decisions.	• This may require assets to be appropriately designated as sustainable to warrant the differentiated treatment. (This designation could be carried out by a public or private body.) Potential volatility as this classification is developed consistently across industries. • Some ECAIs have addressed ESG related information via a separate metric – for example, S&P produce an ESG score for each issuer – which allows investors to consider ESG factors for an issuer in its decision-making process but without blurring its view of the credit riskiness.

In conclusion, any approach to incentivise "greener" (or similar) assets by reducing the FS would need to be carefully considered because ESG factors do not necessarily make sense to include in an

assessment of credit fundamentals, and where it does make sense, we think that ECAIs may have already allowed for it in the credit rating methodology either explicitly or implicitly. It is also noted that any assessment of how "green" an asset is will involve a significant amount of judgement that does not easily translate into a FS adjustment.

If the Government wishes to encourage investment in more sustainable/climate friendly assets, then a preferable approach may be to include some form of Government guarantee or backing for these assets. This would genuinely improve the credit fundamentals of the assets and therefore warrant a lower FS as a result, which would be a more economically sound way of incentivising investment in these assets.

5.5 Differentiated treatment for internally rated assets and/or those not independently validated

Firms are allowed to carry out internal credit assessments on their assets to determine the rating or CQS, rather than engage an ECAI. Firms' internal assessments must produce a CQS that lies within the "*plausible range of CQSs that could have resulted from an issue rating given by an ECAI*" (PRA SS3/17[22]). Although the intention is for the ECAI and internal rating approaches to be broadly consistent, there are considerations that may warrant differentiated treatment for assets rated by each process.

	Positives	**Negatives**	**Other comments**
ECAI	• Independent assessment of rating • Transparent methodology • Large(r) ECAI are well-known and reputable • Expertise across a range of asset classes, which may aid consistency of assessment	• Reliance on ECAI may create broader, macro risks • Can be slow to react • Can be costly if firms have to externally rate each non-traded asset • May not necessarily have depth of expertise and data across all asset classes • May have too broad an approach, meaning result may not be tailored sufficiently to certain assets	• Separately supervised from an insurer – could be positive (if have additional scrutiny) or negative (if supervision is seen as less robust)
Internal Rating	• More able to react quickly as (normally) covering fewer assets and have fewer steps involved in making rating changes • More focussed on assets with most exposure / perceived most at risk by changing conditions • May have more specialist expertise on	• May be scepticism as to independence of the assessment (i.e. perceived positive bias in CQS results) • Requires review by PRA, auditors, etc. • Less access to wider resources / expertise than in the large(r) ECAIs or firms may not always have sufficient expertise	• PRA do review the internal rating framework (e.g. via MA applications) • Firms have independent rating/validation teams • SS3/17 places requirements on the Chief Actuary, Chief Risk Officer and Head of Internal Audit in the determination of internal ratings, through their Senior

[22] SS3/17 'Solvency II: Illiquid unrated assets' (bankofengland.co.uk)

	Positives	Negatives	Other comments
	relevant assets within a firm • May have more specific data and other experience from investing in particular asset classes		Manager roles and responsibilities • Spot-checks by having certain assets externally rated can help to ensure CQS results are broadly comparable.

It is clearly the case that neither process would be seen by all stakeholders as the "right answer". The tensions around sufficiency of data, specific expertise, and robustness of process (i.e. lack of bias) are commonplace in the regulatory regime, where there is a need for bespoke treatments or assessments. Issues around specificity of FS (such as the need for more granular FS tables) are better dealt with by other suggestions discussed by the working party.

Broadly speaking, by the PRA reviewing a firm's internal rating process and deeming this, and its outputs, to be sufficiently similar to those of an ECAI, should mean that the internal rating framework is fit for purpose. It may assist confidence in firm's internal rating processes if they were subject to spot checks, whereby the rating of one or more assets is / are independently assessed for consistency with ECAI and / or firms with similar exposures. This could be done by an ECAI or perhaps another third party (e.g. consultancy, or PRA even).

It does not necessarily follow that, just because a rating is assessed internally by a firm, that it is somehow deficient. A higher rating or lower FS may result due to a better understanding of the risks and the mitigations by a firm than may be the case were an ECAI to rate the asset, if the firm has access to more expertise and / or data. Conversely, a firm may produce a lower rating or apply higher FS if it has particular concerns based on its specific exposure; an ECAI may not necessarily reflect changes given the broader nature of their assessment (or perhaps not within the same timescale).

It is therefore not clear that there should be an automatic adjustment to the FS purely because the rating is produced through an internal rating process, however there may be reasons to do so in some circumstances; for example if the firm does not have sufficient expertise, the asset exposure has not been sufficiently stress-tested in a range of adverse scenarios, or is shown to be (consistently) mis-rated based on independent validation.

5.6 Differentiated treatment for assets only rated by one ECAI

Our initial analysis (based on one firm's MA portfolio) suggests that having a single ECAI rating occurs in less than 3% of public assets (privately traded assets tend not to be rated by an ECAI). This indicates that this issue is not particularly material, but more research may need to be performed to understand if this prevails in the broader universe of MA assets held by firms.

Our analysis suggests that this issue may be concentrated in certain asset classes. For example, from the issuers in the iBoxx social housing index, over half have just one ECAI rating.

Firms are already required to perform internal ratings for significant asset holdings (even when they may have ECAI ratings). A lower threshold could be applied to assets for which there is a single public ECAI rating, which requires firms to form an internal view of the rating on these positions when their exposures are smaller than those for which there are multiple ECAI ratings.

It should also be noted that firms are unlikely to be incentivised to hold too many assets with only one ECAI as it introduces more ratings volatility (as all rating changes are passed through to the CQS, rather than the buffering effect of using second best or similar approaches).

We have summarised these advantages / disadvantages in the table below:

Advantages	**Disadvantages / alternatives**
• Potential disincentive to rating agency arbitrage (i.e. employing an agency that is more likely to provide a higher rating). • Less scrutiny of the rating may suggest more uncertainty. • Simple to identify and implement.	• Firms already disincentivised from exposure to single ECAI ratings due to increased ratings volatility. • Small numbers of assets have single ECAI ratings, making this issue somewhat immaterial. • Could disincentivise investments in assets the government is seeking to encourage (e.g. social housing). • Firms are already required to perform internal ratings for significant holdings. A lower threshold of significant may be applied if only one ECAI rating is given for a particular asset.

Rather than necessarily automatically penalising firms for holding assets with just one ECAI, more emphasis could be put on exposures to assets rated by a single agency where they become material. This could either take the form of:

- Firms performing their own internal ratings
- Spot checking via independent validation

FS add-ons (e.g. by assuming the rating maps to a CQS a single notch lower) could be used where this has not taken place.

5.7 Using rating agency Watch and Outlook status to assess higher probability of downgrade

Additional information is available from rating agencies' watch status and outlook that could be used to assess a higher probability of downgrade and therefore higher FS.

Watch is a short-term modifier, while Outlook is over a longer time horizon and tends to incorporate wider views or influences. Our understanding of the key features of these statuses, based on our reading of the relevant rating agency publications, is summarised below.

We suggest that Outlook status may provide useful information covering more of the credit cycle and may influence overall investment strategy, some of which may already have been captured by the FS of the assets. Watch status is arguably more risk sensitive and useful over shorter time horizons, particularly in response to unfolding economic or political events and so could be useful to modify a "baseline" FS to incorporate (increased) risk signals.

Based on our reading of the materials, ideally credit rating information specific to the individual asset ("issuance" data) should be used, if available, as this relates specifically to the exposure of a firm holding that asset. However, "issuer" data reflects the creditworthiness of a company, so is less specific but will still provide additional information beyond the (notched) rating that can be used to prompt a review of or inform an opinion on the future riskiness of an exposure, and assist in determining whether the FS for that exposure should be modified. Outlook may be useful in an "emerging risk" context to inform future investment strategy. We note that it may be difficult to ensure consistency across less liquid / illiquid assets, given the bespoke nature of some of these assets.

Firm	Watch definition	Outlook definition	More on Watch	More on Outlook
Fitch	Watch - heightened probability of a rating change, and likely direction. Typically event-driven; generally resolved over a relatively short period. If event known but over 6m away, would likely attract watch status rather than outlook revision.	Direction likely to move over 1-2yrs.	Event can be anticipated or already have occurred; may be used where rating implications are clear but where triggering event exists (e.g. shareholder or regulatory approval); applies to entities or instruments. Only applied selectively.	Majority of outlooks are stable. Positive or Negative outlooks do not imply an inevitable change in rating. Also have "evolving" if there are competing positive and negative influences. Not applied over the short-term scale. Applied selectively to CCC->C ratings and not applied to defaulted ratings.
S&P	CreditWatch - there is at least a one-in-two likelihood, as a broad guideline, of a rating change or rating suspension or	Assign a positive or negative outlook generally when we believe that an event or trend has at least a one-in-three	Can be applied to issuer as well as issuance. Rating suspension or withdrawal generally linked to a lack of	Applied to issuer. Outlook generally is assigned as an ongoing component to long-term issuer credit ratings on corporate and government entities and some long-

Firm	Watch definition	Outlook definition	More on Watch	More on Outlook
	withdrawal within the next 90 days.	likelihood, as a broad guideline, of resulting in a rating change in two years for investment-grade credits and in one year for speculative-grade credits.	information. Can change / suspend rating without going on credit-watch first. Use "developing" credit-watch where future events are unpredictable (e.g. M&A with more than one potential suitor, where ratings of these are higher and lower than the company itself).	term issue credit ratings (except when the rating is on CreditWatch). Outlooks have a longer time horizon than CreditWatch listings and incorporate trends or risks that we believe have less-certain implications for credit quality. The shorter time frame for speculative-grade credits reflects their very nature: They are more volatile and more susceptible to nearer-term risks. An example of a developing outlook may be where a subsidiary is flagged for sale, or a government enterprise is identified for privatization, and the time period for such an action is more within the outlook period than the 90-day CreditWatch period.
Moody's	Watchlist - possible change in the short-term. Possible upgrade, downgrade or (rarely) uncertain. Removed from watchlist once rating confirmed.	Opinion regarding the likely direction of a rating over the medium term.		POS, NEG, STA and DEV (contingent on an event). Have "m" modifier if competing, differing outlooks. RUR = rating under review - overrides the outlook. NOO = no outlook.
AM Best	"Under Review" – potential for near-term change, typically within 6 months, following a recent event or abrupt change. Can be Positive, Developing or Negative implication to rating. Remains under review until AM Best makes final opinion.	Rating outlook determination is assigned in tandem with a Best's Credit Rating and other opinion types to supplement the opinion by providing an indication of the potential future direction of the opinion over an intermediate period, generally defined as 36 months.	Positive (Negative) indicates reasonable likelihood that Best's Credit Rating will be raised (lowered) as a result of AM Best's opinion of the recent event. Developing indicates further analysis is required before determining the final opinion.	Applied to entity, issuer or security. Outlook can be positive, negative, stable. Update outlooks annually but may revisit if necessary / prompted. Outlooks do not necessarily lead to change in opinion. Also have market segment outlook - expectation of market trends' influence on companies operating in the market over the next 12 months.

5.8 Using spread thresholds within a basket / sub-index

This idea involves using spread thresholds within a basket / sub-index to identify assets with an implied higher credit risk, that may warrant having a (temporary) limit placed on the MA that can be claimed for these assets.

Summary:

- This approach is based on similar methods that are already utilised by firms to note potential "problem" assets.
- Our understanding is that it is used only for traded assets where the spread is easily observable and therefore it is not a total portfolio allowance, however it may be possible to extend the approach to cover all or most assets in a portfolio.
- Each asset is assigned to a larger "grouping" of similar assets (same rating / sector / country / liquidity, etc) and the spreads of individual assets are tracked relative to those of the group / index.
- If the individual asset's spread rises significantly relative to (movement in) the index average, this could indicate a higher idiosyncratic risk and the asset could be considered to be more credit risky.
- A credit review of the asset would then follow. This would include a consideration of Prudent Person Principle (PPP) elements, as well as a quantitative FS review.
- The asset may need to be subject to an additional FS to account for the additional risk. It could be a specific (bps) amount, a proportion of the next (notched) rating's FS to reflect a probability of downgrade, or it could simply be assumed to be at a lower rating / credit quality step and pick up the applicable FS.
- The table below highlights some pros/cons of different approaches.

Broadly speaking, we appreciate the attractiveness and transparency of a standardised, purely formulaic approach. However, this may have significant unintended consequences under future economic conditions, and it may not be possible to obtain suitable data to cover the range of assets in scope. As such, we consider that there should be an element of judgement that is permitted to be applied to incorporate other factors that are not built-in to a more analytical or mechanical approach, and note that this may be seen to limit the sensitivity versus a purely formulaic approach.

As such, the "situational dependent" approach offers a balance of a relatively mechanical underpin, with the ability to overlay other factors or information to safeguard against extreme responses in light of unexpected economic conditions.

Approach	Pros	Cons	Other comments
Formulaic (same approach used by all firms)	• Transparent to all • Equal for all firms	• May not be sensitive / responsive enough for the specific exposures of the firm • Appropriate data for the range of assets may not be available • Would be resource drain on the central body that had to develop, publish and maintain the framework • Centrally-derived framework may require significant rework of	• Central body (assume regulator) sets and publishes the methodology and accompanying expectation / considerations / parameters • This is essentially the proposal put forward in the PRA's DP 2/22[23]

[23] DP2/22 – Potential Reforms to Risk Margin and Matching Adjustment within Solvency II | Bank of England

Approach	Pros	Cons	Other comments
		firms' models / MI in order to incorporate • May be slow to react if central body has to publish updated parameters / metrics • Our literature review indicates that there is no fixed link between spreads and credit losses over time	and HMT's April 2022 consultation paper[24]
Formulaic but bespoke to firm	• Transparent to those who need to see it (firm, regulator; elements may be shared publicly) • Bespoke to the exposures held • Should require least extensive rework or development of models / MI etc	• Would require approval by the regulator • Would require some sort of MI to assure regulatory compliance • Has the potential to be "gamed" or mis-applied • Even though it is more bespoke, not all conditions will have been covered in calibration, so may not perform in desirable way under certain (combinations of) conditions	• Would require regulatory approval of each firm's framework, with the firm operating within that, with some sort of regular and potentially ad hoc reporting to ensure appropriate application of the framework
Situational dependent	• "Best of both" approach -> could use formulaic approach as backstop / guide, with judgement overlay for more "accurate" assessment of risk • Allows for judgement and inclusion of information which may not be reflected in a formulaic approach • Responsive – timing is event or information-driven	• May be seen to be less robust (fear that upside bias is applied, meaning haircuts understated / MA overstated) • Would need to have procedures approved by regulator (as a minimum) • Could be too many exposures to do this for each, so may need to adopt some "broad brush" approach at times -> may be negative consequences of this; or just default to a formulaic approach	• Would need to consider what justification firms may need to show to regulators and other third parties in order to apply judgment, especially if "material" (to be defined) judgements were applied

If such an approach were to be implemented, care would need to be taken to avoid double-counting with any other changes. Specifically, it would not be appropriate to apply a penalty under this approach if the asset already had a penalty applied by virtue of being on ratings watch.

However, we see merit in an approach that identified "potentially heightened riskiness" assets based on an asset's idiosyncratic spread versus that of an appropriate index, and, if so judged, the asset's FS then temporarily raised, while the formal rating assessment is being revised. If used in conjunction with the "watching" approach (covered in section 5.7), perhaps using notched ratings, this could provide a

[24] Solvency II Review: Consultation - GOV.UK (www.gov.uk)

comprehensive risk-sensitive trigger to address suspected heightened riskiness, that is less reactive to spreads than the PRA proposals via the index-spread model.

Given the wide range of assets that insurers invest in, it is likely to be very challenging to come up with a reference index for all asset classes.

If the reference index is not set appropriately – for example if it is based on liquid corporate bonds – then the unintended consequence could be to make it far less attractive to invest in certain long-term assets. This would be at odds with one of HMT's key objectives for the SII review, namely to support insurance firms to provide long-term capital to underpin growth, including investment in infrastructure, venture capital and growth equity, and other long-term productive assets, as well as investment consistent with the Government's climate change objectives.

5.9 Additional points raised in discussions

5.9.1 Ratings as a determinant of credit risk

Ratings are applied at the asset level and involve scrutiny of individual assets and their credit fundamentals. Whilst they are not perfect, they are singularly focused on forming a view of creditworthiness. Credit spreads can be affected other structural and funding effects, including size of issuance, new issuance premia and domestic market bias. As a result, ratings appear to be the best solution available to assess the credit risk inherent in individual assets and are subject to regulatory oversight to ensure they are being used appropriately (ECAIs being regulated by FCA in UK and ESMA in the EU; PRA has powers to ensure internal ratings are appropriate).

5.9.2 Reliance on valuation methodologies

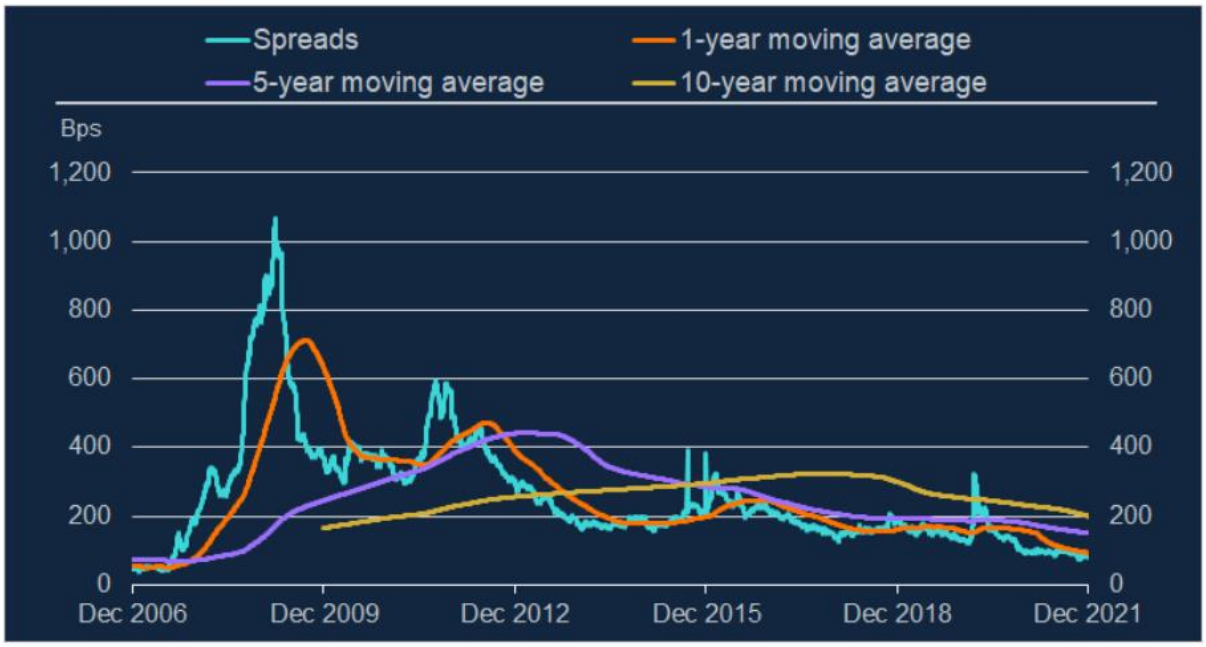
For many illiquid assets, there is no (regularly) traded market value that can be used for valuation purposes. As a result, firms tend to apply techniques such as use of comparators and indices. This means that valuations (and hence a credit deduction based upon the spread) may be less certain and harder to validate. Whilst there is already a strong framework for valuation methodologies under IFRS (including sign-off by audit committees, etc.), there is still more uncertainty in these valuations. This may be particularly true in relation to how the value moves over time and in times of stress where the underlying valuation assumptions may no longer hold.

5.9.3 Amending the Long Term Average Spread (LTAS) averaging period

Another potential alternative would be to modestly shorten the LTAS averaging period to make it more responsive to changes in credit spreads. The working party has not considered this explicitly, but we note that the recent HMT consultation paper considers an FS formulation including using historic credit spreads over a much shorter averaging period than the current LTAS.

One observation made by the working party is that medium term averaging of market credit spreads can result in odd outcomes over the credit cycle. Chart 7 of the Technical Annex to DP2/22 shows spread data and moving averages for A-rated financial bonds over the past 15 years.

Chart 7: Comparison of actual spreads on A-rated financial bonds to different moving averages of the spread over time



Source: PRA DP 2/22

We observe that the 5-year average going into the 2008/9 global financial crisis is at an historic low. By 2013, the crisis has subsided and credit spreads have returned to a more normal level. However, the moving average at this point is at an historic high – roughly three times the FS provision compared to the start of the crisis.

Our view is that this does not result in the outcome desired by the PRA – namely reflecting market expectations of credit risk – and is likely to create unwanted outcomes such as:

- Significant capital needing to be raised by MA firms during a time of market turmoil, albeit over an extended timeframe relative to a point-in-time spread-related FS; and
- Potential for pro-cyclical investment behaviour as firms may have sought to de-risk their asset portfolios as they foresaw the reduced MA efficiency / impact on solvency.

6 Potential alternative formulations of the Fundamental Spread

The working party has developed a desktop model to provide illustrative estimates of the potential day 1 regulatory balance sheet impacts and dynamics that might be observed for a hypothetical annuity portfolio under different formulations of the Fundamental Spread and under different stress scenarios. The results are sensitive to a number of assumptions (the key ones we have made are outlined in this paper), and in practice the actual impacts will vary by firm and depend on factors such as business mix, investment strategy, reinsurance strategy and risk profile.

***Disclaimer**: The analysis and results in this section have been produced and checked by the working party on a best-efforts basis. Results are for illustrative purposes only and not intended to provide, nor should they be interpreted as providing, any facts regarding, or prediction or forecast of, the likelihood that they will be representative of actual experience.*

The working party has performed some initial, illustrative analysis to understand the potential impact(s) on a hypothetical annuity writer ("Annuities Incorporated") of:

(i) The current FS ("Status Quo")

(ii) Removing the LTAS component of the current FS ("Remove LTAS")

(iii) (i) + Removing the CoD component of the current FS and replacing it with an explicit margin for uncertainty of defaults, based on:

- A structural model with a fixed volatility assumption ("Smoothed Merton Model"); and
- Calibration based on 85th percentile of losses ("85th Percentile")

(iv) The PRA's QIS scenarios ("QISA", "QISB")

(v) Proposals set out in HMT's April consultation document ("QISC")[25].

The analysis is work in progress, and the results are subject to further interrogation and review. We have also made a number of simplifying assumptions in our work which may not hold in practice

As such, any analysis contained in this document is subject to change and may not align with the results performed by individual firms as they analyse the impact of the QIS scenarios

The stress scenarios considered are:

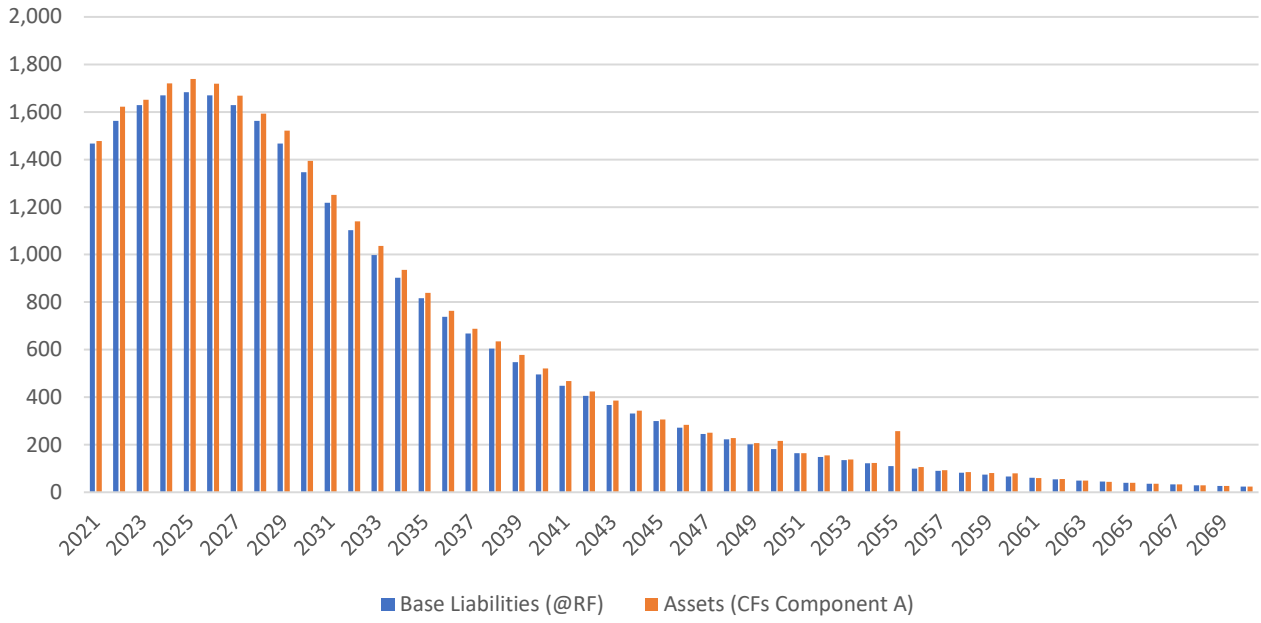
- "2008/09 Downgrades"
- "Spreads + 100bps" – the PRA's moderate spread widening scenario in the QIS
- "Spreads + 350bps" – the PRA's extreme spread widening scenario in the QIS
- "Spreads + 450bps" – the combination of the spread widenings in the two scenarios above
- "Downgrades + Spreads" – (i) 2008/09 transition matrix; then (ii) PRA's moderate spread widening scenario

[25] Assumed a Credit Risk Premium of 35% of historic spreads and that the 'historical average' period is 5-years. 'Z' factor has been ignored for the purpose of this analysis. More details on underlying assumptions below.

6.1 Overview of Annuities Incorporated

Technical Provisions	£25bn
% Longevity reinsured	75%
Asset mix	c20% Gilts, c52% Public Credit, c28% Private Credit
Valuation date	31 December 2020
Transitional Measure on Technical Provisions (TMTP)	No TMTP – All business is post 1 January 2016

The chart below plots asset vs. liability cashflows, where asset cashflows are net of the probability of default component of the current FS.



The make-up of the starting asset portfolio is as follows:

Term (years)	% of portfolio
0 to 5	22
6 to 10	23
11 to 20	24
20 to 50	30
Over 50	1

Credit rating	% of portfolio
AAA	23
AA	11
A	28
BBB	38

FS Definition	Portfolio spread (bps)	Fundamental Spread (bps)	Matching Adjustment (bps)
(i) Status Quo	122	45	77
(ii) Remove LTAS and BBB cliff	122	31	91
(iii)(a) Smoothed Merton Model	122	32	90
(iii)(b) 85th Percentile	122	28	94
(iv)(a) QISA	122	83	39
(iv)(b) QISB	122	52	70
(v) QISC	122	65	57

6.2 Some of the key assumptions used in our analysis

MA capping for sub investment grade assets	Under all of the alternatives to "Status Quo" we have removed the capping that is applied to the MA on sub-investment grade assets.
Corporate bonds	Sterling iBoxx used as proxy for corporate bonds
Private debt	Private debt modelled as corporate bonds + fixed spread
Own Funds	Portion of Own Funds is invested in credit assets
Management actions	No portfolio management actions or trading is assumed in any of the stress scenarios
Solvency Capital Requirement (SCR)	• For our modelling, we have considered Longevity SCR and Credit SCR only, aggregated using the Standard Formula correlation matrix. • The Credit SCR is based on Standard Formula spread risk stresses, and Standard Formula assumptions for MA dampening. • The SCR is the same across all definitions of FS, to be consistent with the PRA's instructions for the QIS exercise.
TMTP	We have assumed zero TMTP

6.3 Why have we considered a scenario which removes LTAS?

The working party can find no theoretical justification for the LTAS floor and note that LTAS as a biting constraint typically overrides the more considered Probability of Default and Cost of Downgrade calibrations.

6.4 Why have we removed the Cost of Downgrade (CoD) component?

This element of the current FS is considered too theoretical, and there is no clear justification for retaining it in a reformed MA regime. It is calculated using a complex approach with a number of simplifying assumptions (including, for example, trading management actions, cost of trading and downgrade assumptions) which are unlikely to hold in practice. A number of these assumptions, including for example the "Rc" factors used to imply trading costs or downgrade matrix used to imply trading activity, cannot easily be reproduced or validated. The CoD could therefore be replaced with something simpler.

6.5 Description of Merton Model calibration and why we have considered it

Structural models (e.g. Merton, Leland and Toft) model credit default as a put option on a firm's equity. A margin for uncertainty is broadly analogous to the concept of "time value" of such an option.

Structural models can be challenging to implement and require observable variables (e.g. implied equity volatility) to calibrate. There won't be enough data to use this approach for private credit markets, for example. In this instance, we have simplified our approach by referencing results from analysis performed by the Bank of England in its 2005 paper "Decomposing credit spreads".[26] Instead of using a market implied decomposition, we have assumed using a more average smoothed decomposition over time.

This approach (pre-smoothing) is consistent with previous Bank of England work on spread decomposition, allowing a margin for uncertainty to be explicitly isolated. With an appropriate choice of calibration parameters, it should also be possible to limit short-term volatility.

In particular, for our modelling, we have taken a simplistic approach by assuming this margin for uncertainty is a fixed 20bps (irrespective of duration, rating or asset class), and we have also assumed that this remains stable under the various stress scenarios. The 20bps was calibrated approximately, by observing an average of the Bank of England's historical spread decomposition analysis mentioned above.

6.6 Description of 85th Percentile Probability of Default calibration and why we have considered it

Here, we add an explicit margin for uncertainty to the Probability of Default (PD) component of the Fundamental Spread (FS) corresponding to the 85th percentile of the (default) loss distribution. The percentile approach has strong alignment with how firms are reflecting the "compensation of bearing credit risk component" in IFRS17 discount rates[27]. At this stage, the 85th percentile has been chosen simply for consistency with margin over current estimate (MOCE) calibrations being tested for the Risk Margin and – for simplicity – we have calibrated our model using historical default data.

We note that there are other approaches for calibrating credit risk distributions and do not comment further here as to whether the PRA would maintain a standardised approach or defer to firms to calibrate margins in a manner consistent with their own internal credit models and / or IFRS17. Use of distributions in this way is consistent with the way that insurers think about risk-based capital.

6.7 Assumptions for QISC

The HMT consultation document presents the following approach for calibrating the CRP component of the FS:

> Where CRP = X. (average spread for comparator index over n-years) + Z. (difference between the spread of an asset and that of the comparator index)

The parameters X, Z, n and any floors are not specified in the consultation paper – with HMT noting this could be calibrated to the preferred degree of sensitivity.

[26] Source: https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2005/decomposing-credit-spreads

[27] Further information can be found on the IFoA IFRS17 discount rate working party page: IFRS 17: Future of Discount Rates | Institute and Faculty of Actuaries, with an example of how the percentile approach can be used to calibrate an allowance for unexpected defaults set out in: IFRS 17 default allowance - v0.5.pdf (actuaries.org.uk).

For the purpose of our analysis, we have made the following assumptions:

- X = 35%. The PRA in Discussion Paper (DP2/22) consider that the CRP should be at least 35% of credit spreads on average through the cycle (informed by their review of academic literature).
- Z = 0%. This parameter is intended to address the basis risk between assets and the index, or the idiosyncratic risk where the individual credit spread is very different from the reference index, indicating additional risk. This could have a positive or negative effect on the CRP (this would depend on relative spread of the portfolio and the comparator index). We note that in a recent speech from Charlotte Gerken, the PRA proposed a calibration of 17.5%, which would mean that, on average, the CRP for illiquid assets would be below 35% of the illiquid asset spread. Without knowing the 'comparator index' we have excluded this component from our analysis. Including it would increase fundamental spreads compared to that shown in our analysis.
- n = 5 years. Chosen to align to QISA parameters. HMT notes this could be calibrated to a 'medium term' average to make the CRP 'relatively stable'.
- Comparator index (PRA refer to as 'reference index') – we have assumed this is in line with the '5-year average' spreads prescribed for the QISA exercise as summarised in the table below.

	5-year average spreads (bps)	
	Financials	**Non-Financials**
CQS 0	90	79
CQS 1	121	112
CQS 2	180	159
CQS 3	276	197
CQS 4	462	379
CQS 5	693	656
CQS 6	693	656

6.8 Modelling results

Alongside the reform proposals for the FS, the HMT consultation sets out reform proposals for the Risk Margin (a reduction of 60-70% for long-term life insurers) and an increase in flexibility to allow more investment in long-term assets. HMT has stated that the combined impact of the reforms could result in a release of possibly 10-15% of the capital currently held by the UK life insurance industry (including firms with and without an MA portfolio) when considered as a package. In the results presented here we have ignored the impact of Risk Margin reforms, or any impact of transitional measures. However, since the company is assumed to have largely reinsured longevity risk (similar to most of the industry, where they do not otherwise benefit from transitionals), Risk Margin reforms are not expected to have a significant impact on the conclusions of our modelling. In addition to showing the impact on coverage ratio and FS, we have also shown the change in Eligible Own Funds (Δ EoF) – which we understand to be what HMT and PRA refer to as "capital".

Coverage Ratio	**Status Quo**	**- LTAS/BBB cliff**	**Merton**	**85th**	**QISA**	**QISB**	**QISC**
Base	185%	204%	201%	207%	130%	175%	156%
2008/2009 downgrades	107%	149%	147%	130%	87%	124%	106%
Credit spreads + 100bps	189%	209%	206%	211%	118%	169%	156%
Credit spreads + 350bps	246%	269%	263%	265%	123%	111%	183%
Credit spreads + 450bps	245%	268%	262%	264%	122%	91%	178%
Downgrades + Spreads	101%	153%	151%	134%	77%	123%	107%
Fundamental Spread	**Status Quo**	**- LTAS/BBB cliff**	**Merton**	**85th**	**QISA**	**QISB**	**QISC**
Base	0.45%	0.31%	0.32%	0.28%	0.83%	0.52%	0.65%
2008/2009 downgrades	0.81%	0.40%	0.41%	0.60%	0.98%	0.67%	0.82%
Credit spreads + 100bps	0.46%	0.31%	0.32%	0.28%	0.95%	0.60%	0.69%
Credit spreads + 350bps	0.50%	0.29%	0.32%	0.29%	1.34%	1.42%	0.94%
Credit spreads + 450bps	0.51%	0.28%	0.32%	0.29%	1.35%	1.55%	0.98%
Downgrades + Spreads	0.92%	0.40%	0.42%	0.61%	1.10%	0.73%	0.86%
Δ EoF (vs. Status Quo / Base)	**Status Quo**	**- LTAS/BBB cliff**	**Merton**	**85th**	**QISA**	**QISB**	**QISC**
Base	0%	10%	9%	13%	-30%	-5%	-15%
2008/2009 downgrades	-28%	3%	3%	-12%	-42%	-17%	-29%
Credit spreads + 100bps	-5%	5%	4%	7%	-41%	-16%	-22%
Credit spreads + 350bps	-20%	-10%	-12%	-11%	-60%	-64%	-40%
Credit spreads + 450bps	-25%	-16%	-17%	-16%	-63%	-72%	-46%
Downgrades + Spreads	-39%	-2%	-3%	-16%	-53%	-25%	-35%

6.9 Observations – PRA's QISA/B scenarios

Under both of the original QIS exercise scenarios, we observe a reduction in coverage ratios (particularly severe for QISA). The analysis also shows material balance sheet sensitivity to downgrades and spread widening. There is a particularly severe reduction in coverage ratio (c.85% fall) under QISB under an extreme (+450bps) spread widening scenario.

Overall both formulations of the FS (QISA and QISB) lead to a materially more volatile balance sheet than the Status Quo.

6.10 Observations – Alternative formulations of the FS

6.10.1 Remove LTAS/BBB Cliff

- Base case Eligible Own Funds (EoF) improves to reflect removal of the LTAS floor.
- The changes in EoF (relative to the base case) in the credit spread widening scenarios are similar to the Status Quo.
- The reductions in EoF (relative to the base case) are less severe in the downgrade scenarios, given removal of the MA cap for sub-investment grade assets.
- Hence there is no material additional volatility introduced – in fact the volatility reduces somewhat due to the removal of the MA cap for sub-investment grade assets.

6.10.2 Smoothed Merton Model

- The Smoothed Merton Model approach uses a smooth historic, instead of market implied, volatility. Hence the implied Fundamental Spreads remain stable when spreads increase.
- Eligible Own Funds therefore moves in a similar fashion under the Smoothed Merton Model to what we observe when LTAS is removed – this is because the margin for uncertainty implied from the Smoothed Merton Model is of similar size to the current CoD component.
- In practice, the historic volatility could be updated to reflect raised levels of risk (e.g. triggered by equity volatilities or spreads moving beyond a certain threshold). In that case, the EoF results will become more volatile in the extreme stress scenarios.

6.10.3 85th Percentile Probability of Default

- Eligible Own Funds increases consistently across all scenarios (relative to Status Quo).
- The increases are of similar magnitude to what we see for Remove LTAS and the Smoothed Merton Model – because the margin for uncertainty is of a similar size.
- We see the same reductions in EoF under the downgrade scenarios compared to Status Quo – this is because the increase in the 85th percentile default rate, moving from investment grade to sub-investment grade, is similar in magnitude to the Status Quo scenario with sub-investment grade capping.
- However, the absolute levels of FS for sub-investment grade assets are still lower under the 85th percentile approach, compared to Status Quo with capping.
- In practice, the PDs could be made more risk sensitive by introducing spread or other triggers (as for the Smoothed Merton Model). There will also need to be some standardisation of the 85th percentile PD, such that it does not vary between different companies' Internal Model approaches.

6.10.4 HMT Consultation ("QISC")

- Eligible Own Funds reduces materially across all scenarios, apart from the scenarios involving downgrade stress where EoF is similar.

- The impact on EoF moving from base case to the downgrade scenarios is less severe under QISC compared to Status Quo due to the removal of the MA cap for sub-investment grade assets.
- There is an increase in the coverage ratio under the spread widening scenarios (which we don't see for QISA/B), but this is less pronounced than under the Status Quo – this is due to 1/5th of the widening of spread being reflected in an increased FS. (If higher spread levels were to be sustained for a longer period, more of the impact would flow into the '5-year average' metric leading to further increases in the FS.)
- The results do not capture the 'Z factor' contained within the HMT / PRA proposals, which adjusts the CRP to offset some of the difference between the spread of the asset and that of a comparator index. A 'Z factor' of greater than 0% would increase the total FS compared to that shown in the tables (given we've assumed a corporate credit index as comparator throughout), which in turn would reduce EoF.
- In the case of illiquid credit, if the comparator index does not reflect the characteristics of individual asset classes (for example, if the comparator index is based on traded credit) there could be materially more negative impacts in the spread widening scenarios than we show where, for example, illiquid spread increases lag that of credit spread increases. This is especially true industry wide, given 40-50% of MA portfolios are, on average, being invested in illiquid assets.

6.11 What does this all mean?

Compared to the QIS scenarios, the alternative formulations of the FS that we have tested:

- Lead to a modest increase in Eligible Own Funds.
- Do not introduce additional, material volatility as spread levels change
- Remove components which are somewhat theoretical and difficult to justify
- Are easier to explain
- Can be easily calibrated to achieve a desired level of overall FS

We highlight some specific observations for the 85th percentile formulation:

- The choice of distribution and percentile – this can be made consistent with typical IFRS17 approaches or the MOCE methodology under consideration for the Risk Margin – though a different percentile could be chosen
- The mean of the distribution could be calibrated to adjust historic default rates for any elevated expectations as implied from a spike in recent experience, movements in spreads (for example changing the percentile to reflect the level of spreads being observed in the markets) or rating opinions, which would:
    - Reduce the emphasis placed on historic data; and
    - Make the measure more risk-sensitive
- This calibration could be updated periodically, or in line with broader updates to Internal Model distributions/calibrations.
- The data available on defaults lends itself to a more granular calibration, and the ability to better allow for idiosyncratic risks associated with different types of asset or asset classes.

6.12 What the results might look like for Internal Model Firms

The results above are based on a Standard Formula calculation of the SCR. This leads to broadly the same level of SCR calculated across each formulation of FS. This is consistent with the PRA's expectation, as articulated in its Discussion Paper (DP2/22, Annex paragraph 104):

"The PRA intends to collect further information from firms on implications of any changes to the FS design and calibration for the SCR later this year. However, it is not the PRA's current expectation that such changes would necessarily lead to a material change in the level of SCR capital held by firms."

We also note that, in a recent speech[28] by Sam Woods, Deputy Governor for Prudential Regulation and CEO of the PRA, he explained the PRA's position that the SCR is not necessarily a substitute for a weak MA. In particular, he noted that the "…*risk of a weak MA is that capital resources could be over-stated, and strong capital requirements are no defense if the capital being used to meet those requirements is not sufficiently solid*."

To the best of our knowledge, the 1 in 200 view of the stressed level of FS has not been questioned during the course of the Solvency II review discussions. Consequently, one could expect that any changes to the base FS (i.e. the FS included in the Best Estimate Liabilities) may require the SCR (change in Own Funds under stress) to be re-evaluated. In particular, a higher base FS might be expected to result in a lower Credit Risk SCR (due to a narrower gap between the base FS and the 1 in 200 stressed FS).

Internal Models are more dynamic (than the Standard Formula) at adapting the level of SCR to changes in the base FS in this way.

We have therefore modelled a second set of results, assuming that the 1 in 200 view of the stressed FS spread remains equivalent to the 'Status Quo' for each scenario, and that the SCR is re-evaluated accordingly. This leads to a broadly similar level of 'BEL+SCR' to back the liabilities under each formulation of FS.

Coverage Ratio	**Status Quo**	**Remove LTAS/ BBB cliff**	**Merton**	**85th**	**QISA**	**QISB**	**QISC**
Base	185%	173%	173%	169%	270%	194%	216%
2008/2009 downgrades	107%	105%	104%	106%	109%	107%	107%
Credit spreads + 100bps	189%	175%	176%	172%	331%	213%	230%
Credit spreads + 350bps	246%	214%	217%	212%	255%	182%	489%
Credit spreads + 450bps	245%	212%	215%	210%	255%	110%	538%
Downgrades + Spreads	101%	100%	100%	100%	101%	101%	101%

This 'Internal Model view' has a significant impact on the coverage ratios. This demonstrates the importance of considering the merits of Solvency II reform proposals as a package, including how this impacts the evaluation of the SCR.

The results for QISC are similar to the Status Quo, other than the base coverage ratio being slightly higher and the increase in the coverage ratio when spreads widen being more extreme than what we see for the Status Quo.

[28] https://www.bankofengland.co.uk/speech/2022/july/sam-woods-speech-given-at-the-bank-of-england-solvency-ii-striking-the-balance

6.13 Policyholder protection

When considering the different formulations of the FS, all else being equal, the larger the resulting FS, the more capital insurers must hold for writing annuity business.

From a policyholder perspective, it is not straightforward to establish what the optimal level of capital is.

For existing customers, it could be argued that higher capital backing their annuity benefits leads to increased protection, however there are diminishing returns beyond a certain threshold.

For new policyholders, higher capital requirements result in lower annuity rates, which means lower guaranteed income in retirement. These less attractive rates may lead to fewer individuals choosing to take out an annuity and instead favouring alternative retirement options (e.g. drawdown) involving a greater retention of longevity risk in retirement.

There is therefore a balance to be struck between when considering the appropriate level of capital.

Furthermore, it is not just the absolute level of capital that is important when considering policyholder protection. As the results illustrate, some formulations of the FS may lead to a more volatile balance sheet than others. To the extent such volatility could lead to firms engaging in procyclical behaviour (for example needing to sell assets after spreads have widened) then it could be argued that this would be negative from a policyholder perspective.

The working party has not sought to opine on potential appropriate calibrations for the different formulations of the FS that we have considered. However, we note that the choice of calibration will determine how much capital firms are holding (e.g. whether it is more, less, or the same as the Status Quo).

7 Qualitative assessment of alternative formulations of the Fundamental Spread

Below we have performed a subjective, qualitative assessment of the alternative formulations of the FS covered in section 6. For this we have chosen a number of criteria, which include:

- Whether or not it would lead a release of day one capital, all else being equal. We have included this given that HMT and the PRA have commented that the proposed Solvency II reforms (when considered as a package) could release 10-15% of capital for the UK life industry (including firms with and without MA portfolios).
- The extent to which it captures the risks of different investments at different times ("risk-sensitivity"), reflecting on the PRA's stated concerns with the current FS (see section 3).
- Stability of Own Funds during times of market volatility, given that HMT have stated that any reforms to the FS should avoid introducing material volatility to the balance sheets of insurers.
- Whether or not it is transparent and easy to explain. As commented in section 6, the current Cost of Downgrade component is theoretical, hard to explain and difficult to justify.
- Impact(s) on policyholder security.
- Whether it will support long-term life insurers to invest in productive finance, and in turn support the growth of the UK economy, the UK Government's levelling up agenda and also to support the UK Government's climate change objectives.
- The extent to which it minimizes time, resource and cost to implement the changes.

Following the assessment, we have also commented on whether the potential adjustments to the current FS approach, as outlined in section 5, could be incorporated to improve the risk-sensitivity of the various alternative formulations.

7.1 Assumptions and limitations of our qualitative assessment

The assessment has been informed, in part, by the illustrative modelling performed in section 6. It is worth reiterating some of the key assumptions underlying this modelling, namely:

- Hypothetical annuity firm, Valuation date: 31 December 2020
- Asset mix: 20% gilts, 52% public credit, 28% private credit
- 75% of longevity risk reinsured
- No TMTP
- MA capping for sub investment grade ("sub-IG") assets removed for the alternative formulations

Note that our modelling has considered day one balance sheet impacts only. We have not performed an assessment of capital release or other potential impacts over time for the hypothetical annuity firm and its policyholders.

For QISA and QISB, the calibrations were provided by the PRA, and we have used these for our illustrative modelling.

To model the HMT proposals published at the end of April 2022 ("QISC"), we have selected a set of parameters which represent our understanding of the PRA's minimum requirements. Therefore, the calibration could be amended to give different outputs and impacts – some of these could release capital, however they may be well below the PRA's stated minimum.

7.2 Results of qualitative assessment

	Status Quo	**Remove LTAS & Sub-IG cap**	**Merton**	**85th %ile**	**QISA**	**QISB**	**QISC**
Criteria							
Releases day 1 capital	N/A	✓ (vs. Status Quo)	? (depends on calibration)	? (depends on calibration)	×	×	? (depends on calibration)
Stability of Own Funds when markets are dislocated	✓	✓	✓	✓	×	×	? (depends on calibration – in particular averaging periods)
Risk-sensitivity (see below)	× (but could be improved; see below)	× (but could be improved; see below)	× (but could be improved; see below)	× (but could be improved; see below)	✓ (could be excessive)	✓ (could be excessive)	✓ (could be excessive)
Encourages investment in productive finance, by recognising illiquidity premia	✓	✓	✓	✓	?	?	× (depends on calibration – in particular Z parameter and reference indices)
Transparent / Easy to explain	×	× (Cost of Downgrade component)	×	✓	✓	✓	?
Minimizes changes to systems/models etc.	✓	✓	×	? (could be aligned with IFRS17)	×	×	×

	Status Quo	**Remove LTAS & Sub-IG cap**	**Merton**	**85th %ile**	**QISA**	**QISB**	**QISC**
Policyholder security	✓ (Status Quo has operated effectively)	× (removing LTAS may require adding back in some element of uncertainty around defaults; without this, FS could be too low)	?	?	× (potential procyclicality and reduction in future investment could reduce propensity for future new business)	?	? (depends on calibration, but potential procyclicality and reduction in future investment could reduce propensity for future new business)
Can be made more risk-sensitive by:							
Add notching	✓	✓	? (depends on data availability)	✓	N/A	N/A	N/A
Increase granularity of asset sectors	✓	✓	×	✓	N/A	N/A	N/A
Add watch and outlook status	✓	✓	×	✓	N/A	N/A	N/A
Use idiosyncratic spread risk triggers	✓	✓	✓	✓	✓	✓	? (potentially, although not part of current proposals)

7.3 Closing remarks

Based on the results of our qualitative assessment above, we observe:

- The Status Quo has some difficult to explain/justify components, and could be made more risk sensitive through a combination of the adjustments outlined in section 5.
- Removing the LTAS floor and sub-IG capping from the Status Quo may require some additional element of uncertainty to be added back in, to ensure adequate policyholder protection.
- The Smoothed Merton Model does not appear to be a viable alternative. It is not sufficiently risk-sensitive, it is difficult to explain and it may require significant changes to systems and models. The impact on policyholder security is unclear.
- QISA and QISB are expected to introduce material volatility to balance sheets, which could give rise to procyclicality and reduce the extent to which annuity firms invest in long-term illiquid assets. They would also reduce capital on day one.
- The assessment of QISC is dependent on the choice of parameters. Based on the PRA's stated minimums, it would appear to result in a less stable balance sheet than the Status Quo, and will make it less attractive for annuity firms to invest in long-term illiquid assets. It is also expected to materially reduce capital on day one.
- A x^{th} percentile approach might be one relatively simple alternative to the Status Quo. The choice of percentile and calibration can be used to achieve the desired capital impact on day one, and it could be made more risk sensitive through a combination of the adjustments outlined in section 5. Potential alignment with firms' approaches under IFRS17 would also be helpful for management of the business.

Appendix

A. Credit rating methodology definitions

The following definitions are taken from S&P.

Credit rating methodologies	Description
Non-financial corporates	Includes all bonds not covered by the below methodologies.
Financial institutions	Includes: banks, brokers, finance companies, and fixed income funds.
Insurance	Includes: bond insurance companies, health insurance, life insurance, property & casualty, and speciality insurance.
Infrastructure	Includes: infrastructure corporates, project developers, project finance, corporate securitisations, utilities, and international public finance.
Sovereigns	Includes: government bonds, international public finance, sovereign finance, and US public finance (munis).
Structured finance	Includes: asset backed securitised (ABS), commercial mortgage-backed securities (CMBS), residential mortgage backed securitised (RMBS), structured credit, and covered bonds.

B. Data sources

Sources have been provided where referenced in the paper. In addition, for the purposes of modelling carried out in section 6 we have relied on the following data sources:

- Fundamental spreads and risk-free rates published on Bank of England website (https://www.bankofengland.co.uk/prudential-regulation/key-initiatives/solvency-ii/technical-information)
- Moody's Investor Service's 2020 Annual Default Study: "Annual default study: Following a sharp rise in 2020, corporate defaults will drop in 2021" (https://www.moodys.com/Pages/Default-and-Recovery-Analytics.aspx)
- S&P Market Intelligence, Iboxx index constituents and spreads (https://products.ihsmarkit.com/home/index.jsp#INDICES.HOME.home)

C. Modelling results – Standard Formula definition of SCR

Company: Annuities Incorporated, c£25bn Technical Provisions, 75% longevity reinsured
Asset mix: c20% Gilts, c52% Public Credit, c28% Private Credit
YE20 MA: 77bps

Coverage	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	185%	204%	201%	207%	130%	175%	156%
2008/2009 downgrades	107%	149%	147%	130%	87%	124%	106%
Credit spreads + 100bps	189%	209%	206%	211%	118%	169%	156%
Credit spreads + 350bps	246%	269%	263%	265%	123%	111%	183%
Credit spreads + 450bps	245%	268%	262%	264%	122%	91%	178%
Downgrades+Spreads	101%	153%	151%	134%	77%	123%	107%

BEL (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	24,913	24,548	24,580	24,461	25,969	25,100	25,461
2008/2009 downgrades	25,907	24,794	24,820	25,321	26,399	25,516	25,947
Credit spreads + 100bps	23,736	23,375	23,413	23,309	25,004	24,101	24,319
Credit spreads + 350bps	18,467	18,137	18,193	18,141	19,895	20,030	19,192
Credit spreads + 450bps	17,834	17,508	17,564	17,518	19,175	19,512	18,566
Downgrades+Spreads	24,910	23,607	23,640	24,108	25,422	24,434	24,775

Own Funds (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	3,544	3,909	3,878	3,996	2,488	3,357	2,996
2008/2009 downgrades	2,550	3,663	3,638	3,136	2,059	2,941	2,511
Credit spreads + 100bps	3,351	3,711	3,673	3,777	2,082	2,986	2,768
Credit spreads + 350bps	2,843	3,173	3,117	3,169	1,415	1,280	2,118
Credit spreads + 450bps	2,661	2,987	2,930	2,976	1,319	982	1,928
Downgrades+Spreads	2,177	3,480	3,446	2,978	1,665	2,652	2,312

SCR (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	1,915	1,918	1,927	1,935	1,915	1,915	1,915
2008/2009 downgrades	2,379	2,454	2,466	2,414	2,379	2,379	2,379
Credit spreads + 100bps	1,769	1,776	1,785	1,793	1,769	1,769	1,769
Credit spreads + 350bps	1,155	1,180	1,184	1,195	1,155	1,155	1,155
Credit spreads + 450bps	1,085	1,114	1,116	1,127	1,085	1,085	1,085
Downgrades+Spreads	2,164	2,271	2,283	2,230	2,164	2,164	2,164

Surplus (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	1,630	1,991	1,950	2,061	573	1,442	1,082
2008/2009 downgrades	171	1,209	1,171	722	320	562	132
Credit spreads + 100bps	1,582	1,935	1,888	1,984	313	1,217	999
Credit spreads + 350bps	1,688	1,993	1,933	1,974	260	125	963
Credit spreads + 450bps	1,575	1,873	1,813	1,849	234	103	843
Downgrades+Spreads	12	1,209	1,163	749	500	488	147

Fundamental Spread

	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	0.45%	0.31%	0.32%	0.28%	0.83%	0.52%	0.65%
2008/2009 downgrades	0.81%	0.40%	0.41%	0.60%	0.98%	0.67%	0.82%
Credit spreads + 100bps	0.46%	0.31%	0.32%	0.28%	0.95%	0.60%	0.69%
Credit spreads + 350bps	0.50%	0.29%	0.32%	0.29%	1.34%	1.42%	0.94%
Credit spreads + 450bps	0.51%	0.28%	0.32%	0.29%	1.35%	1.55%	0.98%
Downgrades+Spreads	0.92%	0.40%	0.42%	0.61%	1.10%	0.73%	0.86%

Δ EoF (vs. Status Quo / Base)

	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	0.0%	10.3%	9.4%	12.7%	-29.8%	-5.3%	-15.5%
2008/2009 downgrades	-28.0%	3.3%	2.6%	-11.5%	-41.9%	-17.0%	-29.2%
Credit spreads + 100bps	-5.5%	4.7%	3.6%	6.6%	-41.3%	-15.8%	-21.9%
Credit spreads + 350bps	-19.8%	-10.5%	-12.1%	-10.6%	-60.1%	-63.9%	-40.2%
Credit spreads + 450bps	-24.9%	-15.7%	-17.3%	-16.0%	-62.8%	-72.3%	-45.6%
Downgrades+Spreads	-38.6%	-1.8%	-2.8%	-16.0%	-53.0%	-25.2%	-34.8%

Δ EoF (vs. Base)

	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2008/2009 downgrades	-28.0%	-6.3%	-6.2%	-21.5%	-17.3%	-12.4%	-16.2%
Credit spreads + 100bps	-5.5%	-5.1%	-5.3%	-5.5%	-16.3%	-11.1%	-7.6%
Credit spreads + 350bps	-19.8%	-18.8%	-19.6%	-20.7%	-43.1%	-61.9%	-29.3%
Credit spreads + 450bps	-24.9%	-23.6%	-24.4%	-25.5%	-47.0%	-70.7%	-35.6%
Downgrades+Spreads	-38.6%	-11.0%	-11.1%	-25.5%	-33.1%	-21.0%	-22.8%

D. Modelling results – Internal Model definition of SCR

Company: Annuities Incorporated, c£25bn Technical Provisions, 75% longevity reinsured
Asset mix: c20% Gilts, c52% Public Credit, c28% Private Credit
YE20 MA: 77bps

Coverage	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	185%	173%	173%	169%	270%	194%	216%
2008/2009 downgrades	107%	105%	104%	106%	109%	107%	107%
Credit spreads + 100bps	189%	175%	176%	172%	331%	213%	230%
Credit spreads + 350bps	246%	214%	217%	212%	255%	182%	489%
Credit spreads + 450bps	245%	212%	215%	210%	255%	110%	538%
Downgrades+Spreads	101%	100%	100%	100%	101%	101%	101%

BEL (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	24,913	24,548	24,580	24,461	25,969	25,100	25,461
2008/2009 downgrades	25,907	24,794	24,820	25,321	26,399	25,516	25,947
Credit spreads + 100bps	23,736	23,375	23,413	23,309	25,004	24,101	24,319
Credit spreads + 350bps	18,467	18,137	18,193	18,141	19,895	20,030	19,192
Credit spreads + 450bps	17,834	17,508	17,564	17,518	19,175	19,512	18,566
Downgrades+Spreads	24,910	23,607	23,640	24,108	25,422	24,434	24,775

Own Funds (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	3,544	3,909	3,878	3,996	2,488	3,357	2,996
2008/2009 downgrades	2,550	3,663	3,638	3,136	2,059	2,941	2,511
Credit spreads + 100bps	3,351	3,711	3,673	3,777	2,082	2,986	2,768
Credit spreads + 350bps	2,843	3,173	3,117	3,169	1,415	1,280	2,118
Credit spreads + 450bps	2,661	2,987	2,930	2,976	1,319	982	1,928
Downgrades+Spreads	2,177	3,480	3,446	2,978	1,665	2,652	2,312

SCR (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	1,915	2,263	2,243	2,361	922	1,729	1,385
2008/2009 downgrades	2,379	3,497	3,487	2,970	1,884	2,755	2,336
Credit spreads + 100bps	1,769	2,115	2,089	2,195	629	1,405	1,202
Credit spreads + 350bps	1,155	1,483	1,436	1,494	554	702	433
Credit spreads + 450bps	1,085	1,411	1,363	1,416	516	894	359
Downgrades+Spreads	2,164	3,477	3,460	2,981	1,644	2,619	2,291

Surplus (£ million)	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	1,630	1,646	1,635	1,635	1,566	1,628	1,611
2008/2009 downgrades	171	166	151	167	175	187	175
Credit spreads + 100bps	1,582	1,596	1,584	1,582	1,453	1,581	1,566
Credit spreads + 350bps	1,688	1,690	1,681	1,674	861	578	1,685
Credit spreads + 450bps	1,575	1,575	1,567	1,560	803	89	1,569
Downgrades+Spreads	12	3	- 13	- 2	21	33	21

Fundamental Spread

	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	0.45%	0.31%	0.32%	0.28%	0.83%	0.52%	0.65%
2008/2009 downgrades	0.81%	0.40%	0.41%	0.60%	0.98%	0.67%	0.82%
Credit spreads + 100bps	0.46%	0.31%	0.32%	0.28%	0.95%	0.60%	0.69%
Credit spreads + 350bps	0.50%	0.29%	0.32%	0.29%	1.34%	1.42%	0.94%
Credit spreads + 450bps	0.51%	0.28%	0.32%	0.29%	1.35%	1.55%	0.98%
Downgrades+Spreads	0.92%	0.40%	0.42%	0.61%	1.10%	0.73%	0.86%

Δ EoF (vs. Status Quo / Base)

	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	0.0%	10.3%	9.4%	12.7%	-29.8%	-5.3%	-15.5%
2008/2009 downgrades	-28.0%	3.3%	2.6%	-11.5%	-41.9%	-17.0%	-29.2%
Credit spreads + 100bps	-5.5%	4.7%	3.6%	6.6%	-41.3%	-15.8%	-21.9%
Credit spreads + 350bps	-19.8%	-10.5%	-12.1%	-10.6%	-60.1%	-63.9%	-40.2%
Credit spreads + 450bps	-24.9%	-15.7%	-17.3%	-16.0%	-62.8%	-72.3%	-45.6%
Downgrades+Spreads	-38.6%	-1.8%	-2.8%	-16.0%	-53.0%	-25.2%	-34.8%

Δ EoF (vs. Base)

	Status Quo	Remove LTAS	Merton	85th	QISA	QISB	QISC
Base	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2008/2009 downgrades	-28.0%	-6.3%	-6.2%	-21.5%	-17.3%	-12.4%	-16.2%
Credit spreads + 100bps	-5.5%	-5.1%	-5.3%	-5.5%	-16.3%	-11.1%	-7.6%
Credit spreads + 350bps	-19.8%	-18.8%	-19.6%	-20.7%	-43.1%	-61.9%	-29.3%
Credit spreads + 450bps	-24.9%	-23.6%	-24.4%	-25.5%	-47.0%	-70.7%	-35.6%
Downgrades+Spreads	-38.6%	-11.0%	-11.1%	-25.5%	-33.1%	-21.0%	-22.8%