

Investment Risk Appendix

1. This is the Investment Risk Appendix to the Board's Determination under Section 175(5) of the Act in respect of the 2022/23 Levy Year. It sets out the methodology and formulae for schemes to perform a Bespoke Stress Calculation, whether on a voluntary basis or as required under Rule D3 for schemes which meet the Investment Stress Threshold. The resulting stressed asset value represents the Submitted item 'BespokeStr' as set out in section 3.2 of the Transformation Appendix.
2. This Appendix does not cover the calculation of investment risk using the standard approach that will be carried out by the PPF on behalf of schemes that are not required to and do not opt to carry out a Bespoke Stress Calculation. The PPF's standard stress approach is as set out in the Transformation Appendix.
3. Where a scheme's investments do not exactly match those set out in this Appendix, schemes should apply an approach that best gives effect in that situation to the general approach laid down by the Levy Rules and this Appendix.

Definitions and Interpretation

The definitions set out below are for the purposes of this Investment Risk Appendix only.

- (a) "Asset Date" is the effective date of the most recently audited accounts for the Scheme available at the time the Bespoke Stress Calculation is Submitted.
- (b) "Bespoke Stress Calculation" is the calculation of stressed asset values in accordance with this Appendix.
- (c) "CDD01" of a portfolio is the sensitivity of the portfolio value to a one basis point (or 0.01 per cent) change in credit spreads.
- (d) "Credit Derivatives" are arrangements where a Scheme has entered into a contract with another party to pay or receive a series of payments (or one single payment) whose amounts are determined by the future movement of credit spreads or a credit event.
- (e) "Derivative Investment Holdings" are Equity Derivatives, Interest Rate Derivatives, Inflation Derivatives and Credit Derivatives (all as defined in this Appendix).
- (f) "Emerging Markets" are those countries classified as being emerging markets or frontier markets by MSCI in its Global Equity Indices on the website <https://www.msci.com/market-cap-weighted-indexes> as at the Asset Date.
- (g) "Equity Derivatives" are arrangements where a Scheme has entered into a contract with another party to pay or receive a series of payments (or one single payment) whose amounts are determined by the future movement of equity markets.

- (h) "IE01" of a portfolio is the sensitivity of the portfolio value to a one basis point (or 0.01 per cent) change in inflation.
- (i) "Inflation Derivatives" are arrangements where a Scheme has entered into a contract with another party to pay or receive a series of payments (or one single payment) whose amounts are determined, in whole or part, by the future movement of inflation rates.
- (j) "Initial Stressed Value of Assets" is the aggregate asset value after carrying out Stage 1 of the Bespoke Stress Calculation.
- (k) "Interest Rate Derivatives" are arrangements where a Scheme has entered into a contract with another party to pay or receive a series of payments (or one single payment) whose amounts are determined by the future movement of interest rates.
- (l) "Intrinsic Value" of an option is the value that would be realised if the option were to expire immediately.
- (m) "Investment Grade" denotes a credit rating of either BBB- or higher by Standard & Poor's or Fitch Ratings, or a credit rating of Baa3 or higher by Moody's Investors Service.
- (n) "Notional exposure" of a derivative contract is defined to be the economic exposure of the position at the date of inception, adjusted in line with the index return relevant to the underlying asset / index from the date of inception to the Asset Date.
- (o) "PV01" of a portfolio is the sensitivity of the portfolio value to a one basis point (or 0.01 per cent) change in interest rates (spot curve if available; otherwise, par curve).
- (p) "Sub-Investment Grade" denotes a credit rating of BB+ or below awarded by Standard & Poor's or Fitch Ratings, or a credit rating of Ba1 or below awarded by Moody's Investors Service.

Bespoke Stress Calculation

4. Schemes must carry out a Bespoke Stress Calculation when required to do so by Rule D3.2. Rule D3.3 sets out the Board's intended approach where the required information is not provided. For the avoidance of doubt, Schemes not required to carry out a Bespoke Stress Calculation may choose to do so as provided for in Rule D3.4 of the Determination.
5. A Scheme's Bespoke Stress Calculation should be carried out with an effective date as at the Asset Date. It should be based on the unstressed value of a Scheme's assets as at the Asset Date and as reported in the Scheme's audited accounts, less the value of any ABC Arrangement as reported in those accounts. This unstressed asset value is defined as 'BespokeUnstr' in section 3.2 of the Transformation Appendix and must be Submitted along with the results of the Bespoke Stress Calculation. Asset values and exposures broken down by asset class should be taken as at the Asset Date from information in the Scheme's audited accounts (supplemented if necessary by information from the Scheme's asset managers).

6. The Bespoke Stress Calculation is formed of three stages, and adjusts BespokeUnstr to BespokeStr¹ by (i) applying specified refined asset stresses to non-derivative investment holdings and (ii) applying specified risk factor stresses to derivative holdings:
- (a) Stage 1 consists of applying the refined asset stresses set out in paragraph 7 to all non-derivative investments, and then including the unstressed market value of the Derivative Investment Holdings in the Initial Stressed Value of Assets. For the avoidance of doubt, any assets held in an ABC Arrangement should be excluded for the purpose of this calculation.
 - (b) Stage 2 consists of applying the risk factor stresses set out in paragraph 17 to Derivative Investment Holdings.
 - (c) Stage 3 is the amalgamation of the results of Stage 1 and Stage 2.

Stage 1 - Asset stresses

7. The asset classes in the below table should be used when carrying out a Bespoke Stress Calculation. For equities and bond investments, portfolios should be broken down and mapped to one or more of the refined asset stresses below. The value of assets in each asset class as at the Asset Date should then be increased or decreased as appropriate by the corresponding asset stress percentage.

Asset class	Refined asset class description	Maturity	Refined asset stress
Equities	UK quoted equities	N/A	-19%
Equities	Overseas developed market quoted equities	N/A	-16%
Equities	Emerging Market quoted equities	N/A	-16%
Equities	Unquoted/private equity	N/A	-19%
Property	Property	N/A	-5%

¹ Both 'BespokeUnstr' and 'BespokeStr' are defined in the Transformation Appendix.

Asset class	Refined asset class description	Maturity	Refined asset stress
Hedge funds	Hedge funds	N/A	-3%
Commodities	Commodities	N/A	-14%
Fixed interest government bonds	Short maturity	0 to 5 years	+2%
Fixed interest government bonds	Medium maturity	5 to 15 years	+6%
Fixed interest government bonds	Long maturity	Over 15 years	+15%
Inflation-linked bonds	Short maturity	0 to 5 years	+1%
Inflation-linked bonds	Medium maturity	5 to 15 years	+5%
Inflation-linked bonds	Long maturity	Over 15 years	+18%
Fixed interest non-government bonds	UK short- and medium-dated investment grade	0 to 15 years	+2%
Fixed interest non-government bonds	UK long-dated investment grade	Over 15 years	+5%
Fixed interest non-government bonds	Overseas short- and medium-dated investment grade	0 to 10 years	+2%
Fixed interest non-government bonds	Overseas long-dated investment grade	Over 10 years	+5%
Fixed interest non-government bonds	Global sub-investment grade	All maturities	-6%
Cash and net current assets	Cash and net current assets	N/A	0%
Annuities	Annuities	N/A	+16%
Insurance funds	Insurance funds	N/A	-19%
Other	Other	N/A	-19%

8. No asset stresses should be applied to Derivative Investment Holdings in Stage 1; but the unstressed market values² of these investments should be included in the Initial Stressed Value of Assets calculated in Stage 1.
9. The resulting asset value following the application of the above stresses (i.e. the Initial Stressed Value of Assets) therefore represents the stressed value of physical assets plus the unstressed market value³ of any Credit Derivatives, Equity Derivatives, Inflation Derivatives and Interest Rate Derivatives.

Equities - Emerging Markets

10. For the avoidance of doubt, Schemes with equity investments in Emerging Markets do not need to strip out any allocation to Emerging Markets from their overseas equities allocations and stress the Emerging Markets allocation separately, given that the relevant stress factors are identical.

Bonds

11. Fixed interest government bond, fixed interest non-government bond and inflation-linked bond portfolios should be split into subsets based on maturity in line with the table at paragraph 7 above. Furthermore, fixed interest non-government bond portfolios should be split into subsets according to whether the bonds are UK or overseas and investment or sub-investment grade.
12. Fixed interest bonds issued by overseas governments, including Emerging Markets governments, should be treated as fixed interest government bonds.

² The market value can be positive or negative, and should take into account any premiums due to be paid.

³ As above for 2.

Liability Driven Investment (LDI) Strategies

13. LDI strategies that do not include non-government bonds may be stressed by either:
- (a) treating them as a combination of physical assets and derivatives (with the asset stresses applied to the cash and bond components, and the risk stresses applied to the derivatives); or
 - (b) using interest rate (“PV01”) and inflation (“IE01”) sensitivities for all the assets within the LDI strategy. All elements can then be assessed together in accordance with the sections on Interest Rate Derivatives and Inflation Derivatives in Stage 2 of this Appendix.
14. For LDI strategies that include fixed interest non-government bonds, approach (a) above should be used.

Stage 2 - Risk factor stresses

15. Schemes that have adopted investment strategies involving any of the derivatives (a) to (d) below must carry out additional analysis of the impact of risk factor stresses on their derivative positions. Derivative positions can be held on a segregated basis or through pooled funds.
- (a) Equity Derivatives;
 - (b) Interest Rate Derivatives;
 - (c) Inflation Derivatives;
 - (d) Credit Derivatives.
16. Only derivatives that are held as part of the trustees’ long-term investment strategy should be included. For the avoidance of doubt, short-term derivative positions that are intended to be unwound and not rolled over within six months of the Asset Date should not be included in the risk factor stress analysis.
17. Risk factor stresses are set out in the table below. Interest rate and inflation risk factor stresses are applicable to par or spot swaps rates as well as government bond yields.

Risk factor	Credit	Interest rates	Inflation	UK Equity	Non-UK Developed Equity	Emerging Market Equity
Risk factor stress	+38bps	-75bps	-14bps	-19%	-16%	-16%

18. The derivation of the Interest rate and Inflation risk factor stresses was altered for 2018/19 and subsequent Levy Years. We produced nominal rate and real rates stress factors and derived the interest rate and inflation stress factors from these, as follows:
- Interest rates stress factor = nominal rate stress factor
 - Inflation stress factor = nominal rate stress factor – real rates stress factor
19. It should be noted that for the 2022/23 Levy Year, this approach has resulted in a negative Inflation stress factor.

- 20. The stress calculation should reflect only the change in Intrinsic Value for any option contract; and for any other derivative, the standard measures of risk factor sensitivity applicable to that strategy (e.g. PV01, IE01, CDD01).
- 21. For the avoidance of doubt, for any Derivative Investment Holdings that are exposed to more than one risk factor, the impact of each applicable risk factor stress should be assessed separately, and the total aggregated.
- 22. The Initial Stressed Value of Assets (as calculated at paragraphs 8 and 9 above, before adjusting for the derivative stress) should include the market value of the derivatives – which can be positive or negative – as well as taking into account all related liabilities (e.g. any premiums due to be paid).

Equity derivatives
Equity futures

23. The calculation of the stress impact for an equity futures portfolio is as follows:

$$N \times d_equity$$

Input parameters

Calculation date	Asset Date
Notional exposure of futures position at the calculation date	N
Equity risk factor stress (this is different for UK, non-UK developed and Emerging Markets)	d_equity

Adjustment to be applied to Initial Stressed Value of Assets

- 24. The Initial Stressed Value of Assets should be adjusted at Stage 3 by the amount of the stress impact calculated in paragraph 23 as follows:
 - (a) If the Scheme’s position is as the buyer of equities futures contracts, then the absolute value of the stress impact should be deducted;
 - (b) If the Scheme’s position is as the seller of equities futures contracts, then the absolute value of the stress impact should be added.
- 25. Equity forward contracts and equity total return swaps should be valued in a similar way to equity futures.

Equity options

26. The calculation of the stress impact for an equity options portfolio is as follows:

Equity put option

(1) Calculate current Intrinsic Value

$$\text{Value}_I = \max [0, E \times (S - P) \div P]$$

(2) Calculate stressed level of index

$$P_{\text{stress}} = P \times (1 + d_{\text{equity}})$$

(3) Calculate stressed Intrinsic Value of option

$$\text{Value}_S = \max [0, E \times (S - P_{\text{stress}}) \div P]$$

(4) Calculate stress impact to apply

$$\text{Equity}_{\text{stress}} = \text{Value}_S - \text{Value}_I$$

Equity call option

(1) Calculate current Intrinsic Value option

$$\text{Value}_I = \max [0, E \times (P - S) \div P]$$

(2) Calculate stressed level of index

$$P_{\text{stress}} = P \times (1 + d_{\text{equity}})$$

(3) Calculate stressed Intrinsic Value of option

$$\text{Value}_S = \max [0, E \times (P_{\text{stress}} - S) \div P]$$

(4) Calculate stress impact to apply

$$\text{Equity}_{\text{stress}} = \text{Value}_S - \text{Value}_I$$

Input parameters

Calculation date	Asset Date
Strike price of option	S
Level of the underlying index at the calculation date	P
Notional option exposure at the calculation date	E
Equity risk factor stress (this is different for UK, non-UK developed and emerging markets)	d _{equity}

Adjustment to be applied to Initial Stressed Value of Assets

27. The Initial Stressed Value of Assets should be adjusted at Stage 3 by the amount of the stress impact calculated in paragraph 26 as follows:

- (a) if the Scheme has bought the option, the Equity_stress should be added, so that the Initial Stressed Value of Assets is increased for a put option and reduced for a call option.
- (b) if the Scheme has sold the option, the Equity_stress should be deducted, so that the Initial Stressed Value of Assets is reduced for a put option and increased for a call option.

Interest Rate Derivatives
Swaps contracts

28. The calculation of the stress impact for an interest rates swaps portfolio is as follows:

$$PV01 \times d_rates$$

Input parameters

Calculation date	Asset Date
PV01 of the portfolio at the calculation date	PV01
Interest rate risk factor stress	<i>d_rates</i> (basis points)

Adjustment to be applied to Initial Stressed Value of Assets

29. The Initial Stressed Value of Assets should be adjusted at Stage 3 by the amount of the stress impact calculated in paragraph 28 as follows:

- (a) for Schemes receiving the fixed leg of an interest rate swap, the absolute value of the stress impact should be added;
- (b) for Schemes paying the fixed leg of an interest rate swap, the absolute value of the stress impact should be deducted.

Gilt derivatives

30. Gilt derivatives include gilt repos, gilt futures and gilt total return swaps.

31. The calculation of the stress impact for a gilt derivatives portfolio is as follows:

$$PV01 \times d_rates$$

Input parameters

Calculation date	Asset Date
PV01 of the portfolio at the calculation date	PV01
Interest rate risk factor stress	<i>d_rates</i> (basis points)

Adjustment to be applied to Initial Stressed Value of Assets

32. The Initial Stressed Value of Assets should be adjusted at Stage 3 by the amount of the stress impact calculated in paragraph 31 as follows:

- (a) where the synthetic exposure is a long position in gilts, the absolute value of the stress impact should be added;
- (b) where the synthetic exposure is a short position in gilts, the absolute value of the stress impact should be deducted.

Swaptions contracts

33. The Intrinsic Value for in-the-money swaptions should be calculated as the value of the swap contract assuming the swaption expires immediately and that the swap rate is the forward rate.

34. The impact of the interest rate risk factor stress should be calculated using similar principles to those used elsewhere in this Appendix.

Inflation Derivatives

35. In applying the risk factor stresses to an Inflation Derivative portfolio, the impacts of the inflation risk factor stress and the interest rate risk factor stress should be calculated independently of each other and aggregated as follows.

36. The calculation of inflation stress impact (ISV) is as follows:

$$IE01 \times d_inf$$

37. The calculation of interest rate stress impact (IRSV) is as follows:

$$PV01 \times d_rates$$

Input parameters

Calculation date	Asset Date
IE01 of the portfolio at the calculation date	IE01
PV01 of the portfolio at the calculation date	PV01
Market value of inflation derivative contract	Value
Inflation risk factor stress	<i>d_inf</i> (basis points)
Interest rate risk factor stress	<i>d_rates</i> (basis points)

Adjustment to be applied to Initial Stressed Value of Assets

Step 1: Applying the inflation stress

38. The Initial Stressed Value of Assets should be adjusted at Stage 3 by the amount of the stress impact calculated in paragraph 36 as follows:

- (a) for a Scheme (or pooled fund on a Scheme’s behalf) whose inflation derivative position is as the receiver of the inflation-linked payments, the absolute value of ISV should be deducted;
- (b) for a Scheme (or pooled fund on a Scheme’s behalf) which is paying inflation-linked payments, the absolute value of ISV should be added.

Step 2: Applying the interest rate stress

39. The Initial Stressed Value of Assets should be adjusted at Stage 3 by the amount of the stress impact calculated in paragraph 37 as follows:

- (a) if the market value of the inflation derivative contract is positive, then the absolute value of the IRSV should be added;
- (b) if the market value of the inflation derivative contract is negative, then the absolute value of the IRSV should be deducted.

Credit Derivatives

40. The calculation of the stress impact for a Credit Derivative Portfolio is as follows:

$$CDD01 \times d_credit$$

Input parameters

Calculation date	Asset Date
CDD01 of the portfolio at the calculation date	CDD01
Credit risk factor stress	<i>d_credit</i> (basis points)

Adjustment to be applied to Initial Stressed Value of Assets

41. The Initial Stressed Value of Assets should be adjusted at Stage 3 by the amount of the stress impact calculated in paragraph 40 as follows:

- (a) if the Scheme has bought credit protection, the absolute value of the impact of the stress should be added;
- (b) if the Scheme has sold credit protection, the absolute value of the impact of the stress should be deducted.

Stage 3 – Amalgamation of results

42. The stressed asset value, BespokeStr, is calculated as at the Asset Date as the sum of:

- (a) the Initial Stressed Value of Assets; and
- (b) the net impact of the risk factor stresses set out in Stage 2 of this Appendix upon the value of Derivative Investment Holdings.