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Supervisory Statement | SS13/13

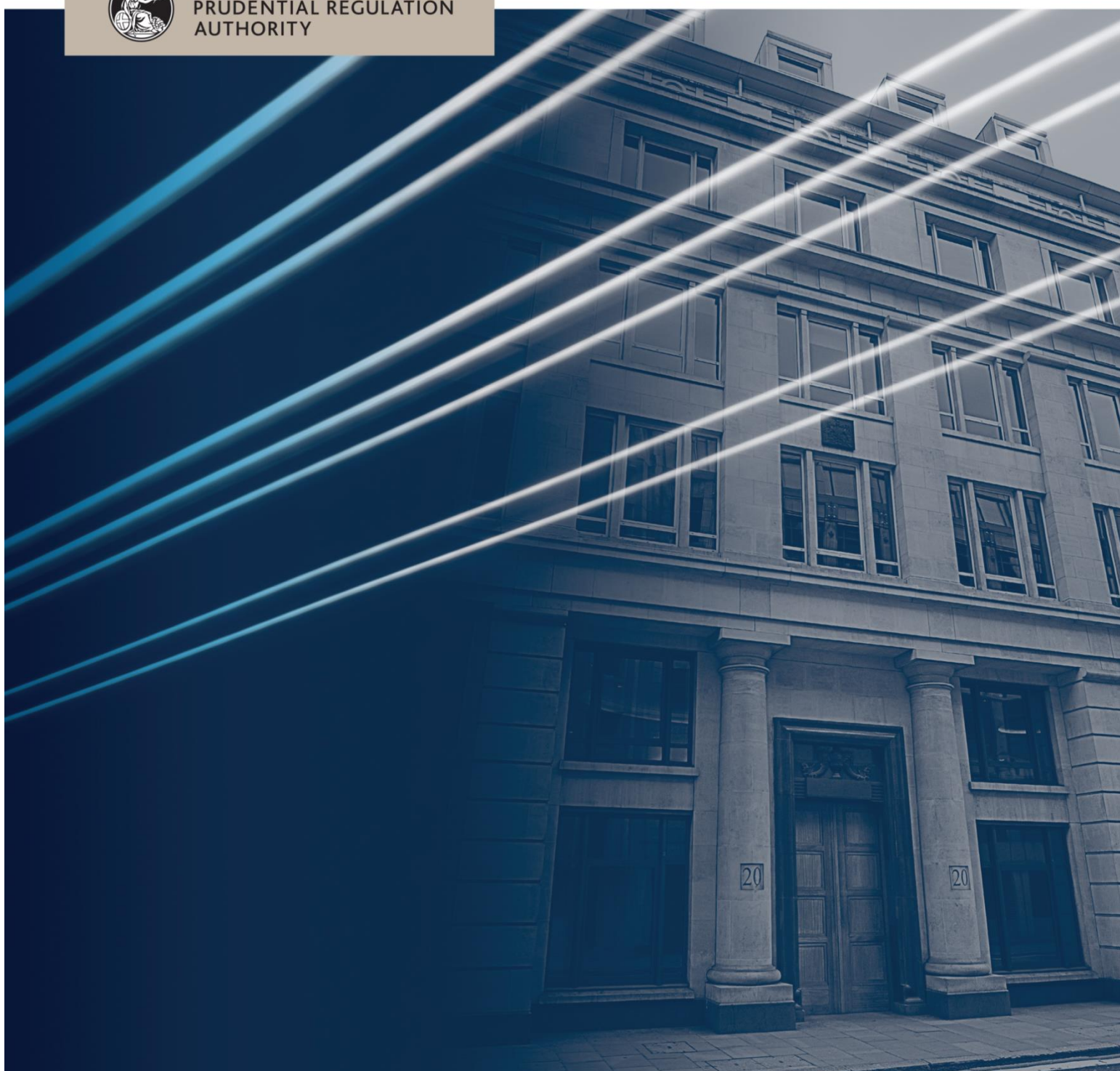
# Market risk

October 2014

(Updated July 2016)



BANK OF ENGLAND  
PRUDENTIAL REGULATION  
AUTHORITY



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## 1 Introduction

**Update 7 July 2016:** This statement was updated to amend the expectations on the validation of firms' risks not In VaR (RNIV) frameworks and reporting of extensions and changes to firms' RNIV frameworks, and also provides clarification on the PRA's reporting requirements around Internal Model Approach (IMA) model changes and extensions. In addition, the process for informing the PRA with regard to non-compliance has been clarified. There are changes to paragraphs 2.2, 9.16, and 12.1. Paragraphs 2.10 to 2.12, and paragraph 12.3 are new. In addition, Chapters 3A and 3B have been added in a way to maintain the integrity of the numbering of the chapters and paragraphs in the previous version of this statement.

Additionally amendments were made to bring attention to the PRA's expectations for firms applying for: the use of own estimates of delta in the standardised approach for options; the use of sensitivity models under Article 331 of the Capital Requirements Regulation (CRR); and the exclusion of positions from the calculation of net open currency positions under Article 352(2) of the CRR. The amendments clarify the criteria expected of firms to satisfy the standards set out in the relevant CRR articles. These revisions are found in paragraphs 3.1, 3.2, and Chapters 3A and 3B.

The policy contained in this supervisory statement has been designed in the context of the current UK and EU regulatory framework. The PRA will keep the policy under review to assess what changes would be required due to intervening changes in the UK regulatory framework, including as a result of the referendum on 23 June 2016.

1.1 This supervisory statement is aimed at firms to which CRD IV applies.

1.2 It sets out the Prudential Regulation Authority's (PRA's) expectations of firms in relation to market risk and should be considered in addition to requirements set out in CRD IV Articles 325–377, the Market Risk Part of the PRA Rulebook and the high-level expectations outlined in 'The PRA's approach to banking supervision'.<sup>1</sup>

1.3 This statement details the PRA's expectations with regard to the following:

- Material deficiencies in risk capture by an institution's internal approach.
- Standardised approach for options.
- Netting a convertible with its underlying instrument.
- Offsetting derivative instruments.
- Exclusion of backtesting exceptions when determining multiplication factor addends.
- Derivation of notional positions for standardised approaches.
- Qualifying debt instruments.
- Expectations relating to internal models.
- Value-at-Risk (VaR) and stressed VaR (sVaR) calculation.

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<sup>1</sup> [www.bankofengland.co.uk/pr/Pages/supervision/approach/default.aspx](http://www.bankofengland.co.uk/pr/Pages/supervision/approach/default.aspx).

- Requirement to have an internal incremental risk charge (IRC) model.
- Annual SIF attestation of market risk internal models.

## 2 Material deficiencies in risk capture by an institution's internal approach

2.1 This chapter sets out the PRA's requirements for the calculation of additional own funds for the purposes of implementing CRD Article 101, which applies where a firm has permission to calculate own funds requirements for one or more categories of market risk under CRR Part 3 Title IV Chapter 5. It requires firms to identify any risks which are not adequately captured by those models and to hold additional own funds against those risks. The methodology for the identification of those risks and the calculation of those additional own funds for VaR and sVaR models is referred to as the 'RNIV framework'.

2.2 Firms are responsible for identifying these additional risks, and this should be seen as an opportunity for risk managers and management to better understand the shortcomings of the firm's models. Firms are expected to validate the appropriateness of the RNIV framework.

### Scope of the Risks not in VaR (RNIV) framework

2.3 The RNIV framework is intended to ensure that own funds are held to meet all risks which are not captured, or not captured adequately, by the firm's VaR and sVaR models. These include, but are not limited to, missing and/or illiquid risk factors such as cross-risks, basis risks, higher-order risks, and calibration parameters. The RNIV framework is also intended to cover event risks that could adversely affect the relevant business.

### Identification and measurement framework

2.4 The PRA expects firms to systematically identify and measure all non-captured or poorly captured risks. This analysis should be updated at least quarterly, or more frequently at the request of the PRA. The measurement of these risks should capture the losses that could arise due to the risk factor(s) of all products that are within the scope of the relevant internal model permission, but are not adequately captured by the relevant internal models.

### Identification of risk factors

2.5 The PRA expects firms to, on a quarterly basis, identify and assess individual risk factors covered by the RNIV framework. The PRA will review the results of this exercise and may require that firms identify additional risk factors as being eligible for measurement.

### Measurement of risk factors

2.6 Where sufficient data are available, and where it is appropriate to do so, the PRA expects firms to calculate a VaR and sVaR metric for each risk factor within scope of the framework. The stressed period for the RNIV sVaR should be consistent with that used for sVaR. No offsetting or diversification may be recognised across risk factors included in the RNIV framework. The multipliers used for VaR and sVaR should be applied to generate an own funds requirement.

2.7 If it is not appropriate to calculate a VaR and sVaR metric for a risk factor, a firm should instead measure the size of the risk based on a stress test. The confidence level and capital horizon of the stress test should be commensurate with the liquidity of the risk factor, and should be at least as conservative as comparable risk factors under the internal model approach. The capital charge should be at least equal to the losses arising from the stress test.

## Reporting of RNIV

2.8 Firms that are required to compute RNIV should complete FSA005 — in addition to the MRK IM COREP reporting template — for the relevant rows. When submitting FSA005, firms are advised to complete the fields as follows:

- populate the table under element 63, filling in both fields in each row;
- element 64 should be the total of all values entered in 63 column B; and
- in order for the form to validate, the value entered in 64 should also be entered in 61 and 62.

2.9 Firms that are required to compute RNIV should complete the MKR IM COREP reporting template in addition to FSA005, and include the own funds required in their COREP reporting. The components of RNIV should be included within C24.00 as follows:

- RNIV from VaR should be added to [C24.00, {c030}, r010] and [C24.00, {c040}, r010];
- RNIV from sVaR should be added to [C24.00, {c050}, r010] and [C24.00, {c060}, r010]; and
- RNIV from stress tests should be added to [C24.00, {c050}, r010] and [C24.00, {c060}, r010].

## Extensions and changes to the RNIV framework

2.10 The PRA expects firms to notify all model extensions and changes to the RNIV framework and the pro-forma available on the Bank's website at [www.bankofengland.co.uk/pr/Pages/authorisations/crr/applying.aspx](http://www.bankofengland.co.uk/pr/Pages/authorisations/crr/applying.aspx) should be submitted.

2.11 The PRA considers material changes to the RNIV framework to be when the extension or change implies either: 1) a capital impact of 5% or more of the total market risk capital requirements, including RNIV capital, or 2) a capital impact of 10% or more of the total RNIV component in line 64 of FSA005 in accordance with paragraph 2.8 . The PRA expects to be pre-notified for material extensions or changes to the RNIV framework and to be notified following the occurrence of any other non-material extensions or changes.

2.12 See Chapter 9 for the process around extensions and changes to IMA models under CRR.

## 3 Standardised approach for options

3.1 Firms that need to use own estimates of delta for the purposes of the standardised approach for options, should provide the PRA with confirmation that they meet the minimum standards set out below for each type of option for which they calculate delta. Firms should only provide this confirmation if they meet the minimum standards. Where a firm meets the minimum standards, they will be permitted to use own estimates of delta for the relevant option. Firms should read the requirements for the granting of the permissions set out in CRR Articles 329, 352, and 358, as appropriate, before applying for any of these permissions.

3.2 If a firm has a permission under any of these Articles but ceases to be able to provide assurance with regard to a particular option type which is currently within its permissions, a capital add-on may be applied and a rectification plan agreed. If a firm is unable to comply with the rectification plan within the mandated time-frame, further supervisory measures may



be taken. This may include variation of permissions so that they are no longer allowed to trade those particular types of option for which they do not meet the minimum standards.

### **Minimum standards**

3.3 The level of sophistication of the pricing models, which are used to calculate own estimates of delta for use in the standardised approach for options, should be proportionate to the complexity and risk of each option and the overall risk of the firm's options trading business. In general, it is considered that the risk of sold options will be higher than the risk of the same options when bought.

3.4 Delta should be recalculated at least daily. Firms should also recalculate delta promptly following significant movements in the market parameters used as inputs to calculate delta.

3.5 The pricing model used to calculate delta should be:

- based on appropriate assumptions which have been assessed and challenged by suitably qualified parties independent of the development process;
- independently tested, including validation of the mathematics, assumptions, and software implementation; and
- developed or approved independently of the trading desk.

3.6 A firm should use generally accepted industry standard pricing models for the calculation of own deltas where these are available, such as for relatively simple options.

3.7 The IT systems used to calculate delta should be sufficient to ensure that delta can be calculated accurately and reliably.

3.8 Firms should have adequate systems and controls in place when using pricing models to calculate deltas. This should include the following documented policies and procedures:

- clearly defined responsibilities of the various areas involved in the calculation;
- frequency of independent testing of the accuracy of the model used to calculate delta; and
- guidelines for the use of unobservable inputs, where relevant.

3.9 A firm should ensure its risk management functions are aware of weaknesses of the model used to calculate deltas. Where weaknesses are identified, the firm should ensure that estimates of delta result in prudent capital requirements being held. The outcome should be prudent across the whole portfolio of options and underlying positions at a given time.

## **3A Sensitivity Models for Interest Rate Risk**

3A.1 Firms intending to use sensitivity models to calculate the positions on derivative instruments covered in Articles 328 to 330 of the CRR are expected to demonstrate that they meet the requirements for granting of the relevant permission by providing the PRA with confirmation that they meet the minimum standards set out in paragraphs 3A.3 to 3A.9 below. Where a firm meets the minimum standards, it will be permitted to use sensitivity models to calculate the positions referred to in those Articles and may use them for any bond which is

amortised over its residual life rather than via one final repayment of the principal. Firms should read CRR Article 331 before applying for this permission.

3A.2 If a firm has permission under any of these Articles but ceases to be able to provide assurance with regard to a particular position which is currently within its permissions, a capital add-on may be applied and a rectification plan agreed. If a firm is unable to comply with the rectification plan within the mandated time-frame, further supervisory measures may be taken.

### **Minimum standards**

3A.3 Firms should indicate the instruments for which net sensitivity positions are used and the currencies in which those positions are denominated. In addition, for the product scope requested firms should:

- confirm that the interest rate risk is managed on a discounted cash-flow basis; and
- briefly indicate any growth plans for the exposures.

3A.4 Firms should confirm that all models generate positions which have the same sensitivity to interest rate changes as the underlying cash flows.

3A.5 The sensitivities should be assessed with reference to independent movement in sample rates across the yield curve, with at least one sensitivity point in each of the maturity bands and appropriate to produce accurate valuation changes based on the assumed interest rate changes as set out in Table 2 in Article 339 of the CRR.

3A.6 The sophistication of all pricing models used should:

- be proportionate to the complexity and risk of the instruments and the nature of the business;
- be based on appropriate assumptions that have been assessed and challenged by suitably qualified parties independent of the development process;
- have been independently tested, including validation of the mathematics, assumptions, and software implementation; and
- have been developed or approved independently of the trading desk.

3A.7 The frequency of independent testing of the accuracy of the pricing model and guidelines for the use of unobservable inputs, where relevant, should be documented. The responsibilities of the various areas involved in the calculation should be clearly defined and documented.

3A.8 Risk management functions should be aware of weaknesses in the model used to calculate sensitivities to interest rate changes, and where weaknesses are identified a prudent amount of additional capital should be held against the relevant exposures.

3A.9 Firms should confirm that sensitivities to interest rate changes can be recalculated promptly following significant movements in inputs used to calculate sensitivities. IT systems used to calculate sensitivities to interest rate changes should be sufficient to ensure that sensitivity positions can be calculated accurately and reliably.

### **3B Calculation of the overall net foreign exchange position**

3B.1 Firms intending to exclude from the calculation of net open currency positions any positions which are taken in order to hedge against the adverse effect of the exchange rate on its ratios in accordance with Article 92(1) are expected to demonstrate that they meet the requirements for granting of the relevant permission by providing the PRA with confirmation that they meet the minimum standards set out in paragraphs 3B.3-3B.9 below. Firms should read CRR Article 352 before applying for this permission.

3B.2 If a firm has a permission under any of these Articles but ceases to be able to provide assurance of a particular position which is currently within its permissions, a capital add-on may be applied and a rectification plan agreed. If a firm is unable to comply with the rectification plan within the mandated time frame, further supervisory measures may be taken. This may include a variation of permissions so that the firm is no longer allowed to exclude those hedging positions from the calculation of net open currency positions for which it does not meet the minimum standards.

#### **Minimum standards**

3B.3 Firms should confirm that the structural foreign exchange (FX) positions are deliberately taken in order to protect capital adequacy ratios against adverse movements in FX rates and are of a non-trading or structural nature.

3B.4 Firms should confirm that mismatches resulting in an open position are avoided as far as possible and that positions are accounted for so that capital ratios are protected.

3B.5 Firms should confirm that they consider and avoid any residual risks arising from structural FX positions as far as possible.

3B.6 Firms should confirm that policies and procedures are clearly articulated and are made available to the board and to regulators on an annual basis. The structural FX hedging strategy should be clearly articulated to investors and included in Pillar 3 disclosures.

3B.7 Firms should confirm that books containing structural FX positions are segregated from other trading activities.

3B.8 Firms should confirm that traders' remuneration structures do not in any way incentivise the structural FX positions becoming a profit centre.

3B.9 Oversight of the structural FX positions should be carried out by the appropriate committees of the boards of both the foreign entity and the group on at least a quarterly basis.

### **4 Netting a convertible with its underlying instrument**

4.1 For the purposes of CRR Article 327(2), the netting of a convertible bond and an offsetting position in the instrument underlying it is permitted. The convertible bond should be:

- treated as a position in the equity into which it converts; and
- the firm's equity own funds requirement should be adjusted by making:

(1) an addition equal to the current value of any loss which the firm would make if it did convert to equity; or

- (2) a deduction equal to the current value of any profit which the firm would make if it did convert to equity (subject to a maximum deduction equal to the own funds requirements on the notional position underlying the convertible).

## 5 Offsetting derivative instruments

5.1 CRR Article 331(2) states conditions that should be met before firms not using interest rate pre-processing models can fully offset interest rate risk on derivative instruments. One of the conditions is that the reference rate (for floating rate positions) or coupon (for fixed rate positions) should be 'closely matched'. The PRA would normally consider a difference of less than 15 basis points as indicative of the reference rate or coupon being 'closely matched' for the purposes of this Article.

## 6 Exclusion of overshootings when determining multiplication factor addends

6.1 The PRA's starting assumption will be that all overshootings should be taken into account for the purpose of the calculation of addends. If a firm believes that an overshooting should not count for that purpose, then it should seek a variation of its VaR model permission in order to exclude that particular overshooting. The PRA will then decide whether to agree to such a variation.

6.2 One example of when a firm's overshooting might properly be disregarded is when it has arisen as a result of a risk that is not captured in its VaR model, but against which capital resources are already held.

## 7 Derivation of notional positions for standardised approaches

### Futures and forwards on a basket or index of debt securities

7.1 These should be converted into forwards on single debt securities as follows:

- (1) futures or forwards on a single currency basket or index of debt securities should be treated as either:
  - (a) a series of forwards, one for each of the constituent debt securities in the basket or index, of an amount which is a proportionate part of the total underlying the contract according to the weighting of the relevant debt security in the basket; or
  - (b) a single forward on a notional debt security; and
- (2) futures or forwards on multiple currency baskets or indices of debt securities should be treated as either:
  - (a) a series of forwards (using the method described in 1(a)); or
  - (b) a series of forwards, each one on a notional debt security to represent one of the currencies in the basket or index, of an amount which is a proportionate part of the total underlying the contract according to the weighting of the relevant currency in the basket.

7.2 Notional debt securities derived through this treatment should be assigned a specific risk position risk adjustment and a general market risk position risk adjustment equal to the highest that would apply to the debt securities in the basket or index.

7.3 The debt security with the highest specific risk position risk adjustment within the basket might not be the same as the one with the highest general market risk position risk adjustment. A firm should select the highest percentages even where they relate to different debt securities in the basket or index, and regardless of the proportion of those debt securities in the basket or index.

#### **Bonds where the coupons and principal are paid in different currencies**

7.4 Where a debt security pays coupons in one currency, but will be redeemed in a different currency, it should be treated as:

- (i) a debt security denominated in the coupon's currency; and
- (ii) a foreign currency forward to capture the fact that the debt security's principal will be repaid in a different currency from that in which it pays coupons, specifically:
  - (a) a notional forward sale of the coupon currency and purchase of the redemption currency, in the case of a long position in the debt security; or
  - (b) a notional forward purchase of the coupon currency and sale of the redemption currency, in the case of a short position in the debt security.

#### **Interest rate risk on other futures, forwards and swaps**

7.5 Other futures, forwards, and swaps where a treatment is not specified in Article 328 should be treated as positions in zero specific risk securities, each of which:

- (i) has a zero coupon;
- (ii) has a maturity equal to that of the relevant contract; and
- (iii) is long or short according to the following table:

<b>Instrument</b>	<b>Notional positions</b>		
Foreign currency forward or future	A long position denominated in the currency purchased	and	A short position denominated in the currency sold.
Gold forward	A long position if the forward or future involves an actual (or notional) sale of gold	or	A short position if the forward or future involves an actual (or notional) purchase of gold.
Equity forward	A long position if the contract involves an actual(or notional) sale of the underlying equity	or	A short position if the contract or future involves an actual (or notional) purchase of the underlying equity.

#### **Deferred start interest rate swaps or foreign currency swaps**

7.6 Interest rate swaps or foreign currency swaps with a deferred start should be treated as two notional positions (one long, one short). The paying leg should be treated as a short position in a zero specific risk security with a coupon equal to the fixed rate of the swap. The receiving leg should be treated as a long position in a zero specific risk security, which also has a coupon equal to the fixed rate of the swap.

7.7 The maturities of the notional positions are shown in the following table:

	Paying leg	Receiving leg
Receiving fixed and paying floating	The maturity equals the start date of the swap.	The maturity equals the maturity of the swap.
Paying fixed and receiving floating	The maturity equals the maturity of the swap.	The maturity equals the start date of the swap.

### Swaps where only one leg is an interest rate leg

7.8 For the purposes of interest rate risk, a firm should treat a swap (such as an equity swap) with only one interest rate leg as a notional position in a zero-specific-risk security:

- (a) with a coupon equal to that on the interest rate leg;
- (b) with a maturity equal to the date that the interest rate will be reset; and
- (c) which is a long position if the firm is receiving interest payments and short if making interest payments.

### Foreign exchange forwards, futures and CFDs

7.9 A firm should treat a foreign currency forward, future, or Contracts for Difference (CFDs) as two notional currency positions as follows:

- (a) a long notional position in the currency which the firm has contracted to buy; and
- (b) a short notional position in the currency which the firm has contracted to sell.

7.10 The notional positions should have a value equal to either:

- (a) the contracted amount of each currency to be exchanged in the case of a forward, future, or CFD held in the non-trading book; or
- (b) the present value of the amount of each currency to be exchanged in the case of a forward, future, or CFD held in the trading book.

### Foreign currency swaps

7.11 A firm should treat a foreign currency swap as:

- (a) a long notional position in the currency in which the firm has contracted to receive interest and principal; and
- (b) a short notional position in the currency in which the firm has contracted to pay interest and principal.

7.12 The notional positions should have a value equal to either:

- (a) the nominal amount of each currency underlying the swap if it is held in the non-trading book; or
- (b) the present value amount of all cash flows in the relevant currency in the case of a swap held in the trading book.

### **Futures, forwards, and CFDs on a single commodity**

7.13 Where a forward, future or CFD settles according to:

- (1) the difference between the price set on trade date and that prevailing at contract expiry, then the notional position should:
  - (a) equal the total quantity underlying the contract; and
  - (b) have a maturity equal to the expiry date of the contract; and
    - (i) the difference between the price set on trade date and the average of prices prevailing over a certain period up to contract expiry, then a notional position should be derived for each of the reference dates used in the averaging period to calculate the average price, which:
      - (a) equals a fractional share of the total quantity underlying the contract; and
      - (b) has a maturity equal to the relevant reference date.

### **Buying or selling a single commodity at an average of spot prices prevailing in the future**

7.14 Commitments to buy or sell at the average spot price of the commodity prevailing over some period between trade date and maturity should be treated as a combination of:

- (1) a position equal to the full amount underlying the contract with a maturity equal to the maturity date of the contract, which should be:
  - (a) long, where the firm will buy at the average price; or
  - (b) short, where the firm will sell at the average price; and
- (2) a series of notional positions, one for each of the reference dates where the contract price remains unfixed, each of which should:
  - (a) be long if the position under (1) is short, or short if the position under (1) is long;
  - (b) equal to a fractional share of the total quantity underlying the contract; and
  - (c) have a maturity date of the relevant reference date.

## **8 Qualifying debt instruments**

8.1 CRR Article 336(4)(a) states that positions listed on a stock exchange in a third country, where the exchange is recognised by the competent authorities, qualify for the specific risk own funds requirements in the second row of the table in CRR Article 336.

8.2 For the purposes of this rule, the PRA recognises the following stock exchanges in third countries:

- Australian Securities Exchange Limited.
- Bermuda Stock Exchange.

- Bolsa Mexicana de Valores.
- Bourse de Montreal Inc.
- Channel Islands Stock Exchange.
- Chicago Board of Trade.
- Chicago Board Options Exchange.
- Chicago Board of Trade (CBOT).
- Chicago Stock Exchange.
- Dubai Financial Market.
- EUREX (Zurich).
- Euronext Amsterdam Commodities Market.
- Hong Kong Exchanges and Clearing Limited.
- ICE Futures US, Inc.
- Indonesia Stock Exchange.
- Johannesburg Stock Exchange.
- Kansas City Board of Trade.
- Korea Exchange.
- Kuala Lumpur Stock Exchange.
- Minneapolis Grain Exchange.
- NASDAQ OMX PHLX.
- National Association of Securities Dealers Automated Quotations (NASDAQ).
- National Stock Exchange India.
- New York Stock Exchange.
- New York Mercantile Exchange Inc (NYMEX Inc.).
- New Zealand Exchange.
- NYSE Liffe US.
- NYSE MKT.
- Osaka Securities Exchange.



- Shanghai Stock Exchange.
- Singapore Exchange.
- SIX Swiss Exchange AG.
- South African Futures Exchange.
- Stock Exchange of Mumbai.
- Stock Exchange of Thailand.
- Taiwan Stock Exchange.
- The Chicago Mercantile Exchange (CME).
- Tokyo Financial Exchange.
- Tokyo Stock Exchange.
- Toronto Stock Exchange.

## 9 Expectations relating to internal models

9.1 CRR Article 363 states that permission for an institution to use internal models to calculate capital is subject to competent authorities verifying compliance with:

- the general requirements;
- requirements particular to specific risk modelling; and
- requirements for an internal model for incremental default and migration risk.

9.2 The standards that the PRA expects to be met to consider that an institution is compliant with these requirements are set out below.

### High-level standards

9.3 A firm should be able to demonstrate that it meets the risk management standards set out in CRR Article 368 on a legal entity and business line basis where appropriate. This is particularly important for a subsidiary undertaking in a group subject to matrix management, where the business lines cut across legal entity boundaries.

### Categories of position

9.4 A VaR model permission will generally set out the broad classes of position within each risk category within its scope. It may also specify how individual products within one of those broad classes may be brought into or taken out of scope of the VaR model permission. These broad classes of permission are as follows:

- (1) Linear products, which comprise securities with linear pay-offs (such as bonds and equities), and derivative products which have linear pay-offs in the underlying risk factor (such as interest rate swaps, forward-rate agreements, and total return swaps).

- (2) European, American and Bermudan put and call options (including caps, floors, and swaptions) and investments with these features.
- (3) Asian options, digital options, single barrier options, double barrier options, look back options, forward starting options, compound options and investments with these features.
- (4) All other option based products (such as basket options, quantos, outperformance options, timing options, and correlation-based products) and investments with these features.

### **Data standards**

9.5 The PRA expects a firm to ensure that the data series used by its VaR model is reliable. Where a reliable data series is not available, proxies or any other reasonable value-at-risk measurement may be used when the firm can demonstrate that the requirements of CRR Article 367(2)(e) are met. A firm should be able to demonstrate that the technique is appropriate and does not materially understate the modelled risks.

9.6 Data may be deemed insufficient if, for example, it contains missing data points, or data points which contain stale data. With regard to less-liquid risk factors or positions, the PRA expects the firm make a conservative assessment of those risks, using a combination of prudent valuation techniques and alternative VaR estimation techniques to ensure there is a sufficient cushion against risk over the close out period, which takes account of the illiquidity of the risk factor or position.

9.7 A firm is expected to update data sets to ensure standards of reliability are maintained in accordance with the frequency set out in its VaR model permission, or more frequently if volatility in market prices or rates necessitates more frequent updating. This is in order to ensure a prudent calculation of the VaR measure.

### **Aggregating VaR measures**

9.8 In determining whether it is appropriate for an institution to use empirical correlations within risk categories and across risk categories within a model, the PRA expects certain features to be observed in assessing whether such an approach is sound and implemented with integrity. In general, the PRA expects a firm to determine the aggregate VaR measure by adding the relevant VaR measure for each category, unless the firm's permission provides for a different method of aggregating VaR measures which is empirically sound.

9.9 The PRA does not expect a firm to use the square root of the sum of the squares approach when aggregating measures across risk categories or within risk categories unless the assumption of zero correlation between these categories is empirically justified. If correlations between risk categories are not empirically justified, the VaR measures for each category should simply be added in order to determine its aggregate VaR measure. However, to the extent that a firm's VaR model permission provides for a different way of aggregating VaR measures:

- (1) that method applies instead; and
- (2) if the correlations between risk categories used for that purpose cease to be empirically justified then the firm must notify the appropriate regulator at once.

### Testing prior to model validation

9.10 A firm is expected to provide evidence of its ability to comply with the requirements for a VaR model permission. In general, it will be required to demonstrate this by having a back-testing programme in place and should provide three months of back-testing history.

9.11 A period of initial monitoring or live testing is required before a VaR model can be recognised. This will be agreed on a firm by firm basis.

9.12 In assessing the firm's VaR model and risk management, the results of internal model validation procedures used by the firm to assess the VaR model will be taken into account.

### Backtesting

9.13 For clarity, the back-testing requirements of CRR Article 366 should be implemented as follows:

- If the day on which a loss is made is day  $n$ , the value-at-risk measure for that day will be calculated on day  $n-1$ , or overnight between day  $n-1$  and day  $n$ . Profit and loss figures are produced on day  $n+1$ , and back-testing also takes place on day  $n+1$ . The firm's supervisor should be notified of any overshootings by close of business on day  $n+2$ .
- Any overshooting initially counts for the purpose of the calculation of the plus factor even if subsequently the PRA agrees to exclude it. Thus, where the firm experiences an overshooting and already has four or more overshootings for the previous 250 business days, changes to the multiplication factor arising from changes to the plus factor become effective at day  $n+3$ .

9.14 A longer time period generally improves the power of back-testing. However a longer time period may not be desirable if the VaR model or market conditions have changed to the extent that historical data are no longer relevant.

9.15 The PRA will review, as part of a firm's VaR model permission application, the processes and documentation relating to the derivation of profit and loss used for backtesting. A firm's documentation should clearly set out the basis for cleaning profit and loss. To the extent that certain profit and loss elements are not updated every day (for example certain reserve calculations) the documentation should clearly set out how such elements are included in the profit and loss series.

### Planned extensions and changes to the Internal Model Approach model

9.16 In accordance with CRR Article 363(3), the PRA expects a firm to provide and discuss with the PRA details of any significant planned changes to the Internal Model Approach model before those changes are implemented. These must include detailed information about the nature of the change, including an estimate of the impact on capital requirements. The PRA expects firms to submit the pro-forma for all internal model extensions or changes when submitting an application for approval, a pre-notification or post-notification in accordance to Delegated Regulation (EU) 529/2014 as amended by Delegated Regulation (EU) 2015/942. For the avoidance of doubt, the assessments of materiality that determine whether a model change is an application, pre-notification or post-notification should be carried out without incorporating capital requirements from the RNIV framework. See Chapter 2 for the process around extensions and changes to the RNIV framework. The pro-forma can be found on the Bank's website at [www.bankofengland.co.uk/pr/Pages/authorisations/crr/applying.aspx](http://www.bankofengland.co.uk/pr/Pages/authorisations/crr/applying.aspx).

### **Bias from overlapping intervals for ten-day VaR and sVaR**

9.17 The use of overlapping intervals of ten-day holding periods for the purposes of CRR Article 365 introduces an autocorrelation into the data that would not exist should truly independent ten-day periods be used. This may give rise to an underestimation of the volatility and the VaR at the 99% confidence level. To obtain clarity on the materiality of the bias, a firm should measure the bias arising from the use of overlapping intervals for ten-day VaR and sVaR when compared to using independent intervals. A report on the analysis, including a proposal for a multiplier on VaR and sVaR to adjust for the bias, should be submitted to the PRA for review and approval.

## **10 Stressed VaR calculation**

10.1 CRR Article 365 requires firms that use an internal model for calculating their own funds requirement to calculate at least weekly a sVaR of their current portfolio. When the PRA considers a firm's application to use a sVaR internal model, the PRA would expect the following features to be present prior to permission being granted as indicative that the conditions for granting permission have been met.

### **Quantile estimator**

10.2 The firm should calculate the sVaR measure to be greater than or equal to the average of the second and third worst loss in a twelve-month time series comprising of 250 observations. The PRA expects as a minimum that a corresponding linear weighting scheme should be applied if the firm use a larger number of observations.

### **Meaning of 'period of significant financial stress relevant to the institution's portfolio'**

10.3 The firm should ensure that the sVaR period chosen is equivalent to the period that would maximise VaR given the firm's portfolio. There is an expectation that a stressed period should be identified at each legal entity level at which capital is reported. Therefore, group-level sVaR measures should be based on a period that maximises the group-level VaR, whereas entity-level sVaR should be based on a period that maximises VaR for that entity.

### **Antithetic data**

10.4 The PRA expects firms to consider whether the use of antithetic data in the calculation of the sVaR measure is appropriate to the firm's portfolio. A justification for using or not using antithetic data should be provided to the PRA.

### **Absolute and relative shifts**

10.5 The PRA expects firms to explain the rationale for the choice of absolute or relative shifts for both VaR and sVaR methodologies. In particular, statistical processes driving the risk factor changes need to be evidenced for both VaR and sVaR.

10.6 The following information is expected to be submitted quarterly:

- analysis to support the equivalence of the firm's current approach to a VaR-maximising approach on an ongoing basis;
- the rationale behind the selection of key major risk factors used to find the period of significant financial stress;
- summary of ongoing internal monitoring of stressed period selection with respect to current portfolio;

- analysis to support capital equivalence of up-scaled one-day VaR and sVaR measures to corresponding full ten-day VaR and sVaR measures;
- graphed history of sVaR/VaR ratio;
- analysis to demonstrate accuracy of partial revaluation approaches specifically for sVaR purposes (for firms using revaluation ladders or spot/vol-matrices). This should include a review of the ladders/matrices or spot/ vol-matrices, ensuring that they are extended to include wider shocks to risk factors that incur in stress scenarios; and
- minutes of Risk Committee meeting or other form of evidence to reflect governance and senior management oversight of stressed VaR methodology.

## 11 Requirement to have an internal IRC model

11.1 CRR Article 372 requires firms that use an internal model for calculating own funds requirements for specific risk of traded debt instruments to also have an internal incremental default and migration risk (IRC) model in place. This model should capture the default and migration risk of its trading book positions that are incremental to the risks captured by its VaR model.

11.2 When the PRA considers a firm's application to use an IRC internal model, the PRA expects that the following matters would be included as demonstrating compliance with the standards set in CRR Article 372.

### Basis risks for migration

11.3 The PRA expects the IRC model to capitalise pre-default basis risk. In this respect, the model should reflect that in periods of stress the basis could widen substantially. Firms should disclose to the PRA their material basis risks that are incremental to those already captured in existing market risk capital measures (VaR-based and others). This must take actual close-out periods during periods of illiquidity into account.

### Price/spread change model

11.4 The price/spread change model used to capture the profit and loss impact of migration should calibrate spread changes to long-term averages of differences between spreads for relevant ratings. These should either be conditioned on actual rating events, or using the entire history of spreads regardless of migration. Point-in-time estimates are not considered acceptable, unless they can be shown to be as conservative as using long-term averages.

### Dependence of the recovery rate on the economic cycle

11.5 To achieve a soundness standard comparable to those under the IRB approach, LGD estimates should reflect the economic cycle. The PRA therefore expects firms to incorporate dependence of the recovery rate on the economic cycle into the IRC model. Should the firm use a conservative parameterisation to comply with the IRB standard of the use of downturn estimates, evidence of this will be required to be submitted in quarterly reporting to the PRA, bearing in mind that for trading portfolios, which contain long and short positions, downturn estimates would not in all cases be a conservative choice.

## 12 Annual SIF attestation of market risk internal models

12.1 The PRA expects an appropriate individual in a Significant Influence Function (SIF) role to provide to the PRA on an annual basis written attestation that the firm's internal approaches for which it has received a permission comply with the requirements in Part 3 Title IV of the CRR, and any applicable market risk supervisory statements.

12.2 Firms should agree the appropriate SIF for providing this attestation with the PRA, noting that the PRA would not expect to agree more than 2 SIFs to cover all the firm's market risk internal models as described in Part 3 Title IV of the CRR.

12.3 Where a firm is unable to provide an attestation under paragraph 12.1 or at any time has ceased to comply with the requirements in Part 3 Title IV of the CRR, then the firm is expected to notify the PRA of that fact pursuant to Fundamental Rule 7 of the PRA Rulebook for CRR firms and to do one of the following:

- (1) present the PRA with a credible plan for a timely return to compliance; or
- (2) demonstrate to the satisfaction of the PRA that the effect of non-compliance is immaterial.