

Measurement of capital charge for market risks in respect of interest rate derivatives and options (Vide paragraph 4.7)

A. Interest rate derivatives

The measurement system should include all interest rate derivatives and offbalance-sheet instruments in the trading book, which react to changes in interest rates, (e.g. forward rate agreements (FRAs), other forward contracts, bond futures, interest rate and cross-currency swaps and forward foreign exchange positions). Options can be treated in a variety of ways as described in B.1 below. A summary of the rules for dealing with interest rate derivatives is set out in the Table at the end of this section.

1. Calculation of positions

The derivatives should be converted into positions in the relevant underlying and be subjected to specific and general market risk charges as described in the guidelines. In order to calculate the capital charge, the amounts reported should be the market value of the principal amount of the underlying or of the notional underlying. For instruments where the apparent notional amount differs from the effective notional amount, banks must use the effective notional amount.

(a) Futures and forward contracts, including forward rate agreements

These instruments are treated as a combination of a long and a short position in a notional government security. The maturity of a future or a FRA will be the period until delivery or exercise of the contract, plus - where applicable - the life of the underlying instrument. *For example, a long position in a June three-month interest rate future (taken in April) is to be reported as a long position in a government security with a maturity of five months and a short position in a government security with a maturity of two months.* Where a range of deliverable instruments may be delivered to fulfill the contract, the bank has flexibility to elect which deliverable security goes into the duration ladder but should take account of any conversion factor defined by the exchange.

(b) Swaps

Swaps will be treated as two notional positions in government securities with relevant maturities. *For example, an interest rate swap under which a bank is receiving floating rate interest and paying fixed will be treated as a long position in a floating rate instrument of maturity equivalent to the period until the next interest fixing and a short position in a fixed-rate instrument of maturity equivalent to the residual life of the swap.* For swaps that pay or receive a fixed or floating interest rate against some other reference price, e.g. a stock index, the interest rate component should be slotted into the appropriate repricing maturity category, with the equity component being included in the equity framework. Separate legs of cross-currency swaps are to be reported in the relevant maturity ladders for the currencies concerned.

2. Calculation of capital charges for derivatives under the standardized methodology

(a) Allowable offsetting of matched positions

Banks may exclude the following from the interest rate maturity framework altogether (for both specific and general market risk);

- Long and short positions (both actual and notional) in identical instruments with exactly the same issuer, coupon, currency and maturity.
- A matched position in a future or forward and its corresponding underlying may also be fully offset, (the leg representing the time to expiry of the future should however be reported) and thus excluded from the calculation.

When the future or the forward comprises a range of deliverable instruments, offsetting of positions in the future or forward contract and its underlying is only permissible in cases where there is a readily identifiable underlying security which is most profitable for the trader with a short position to deliver. The price of this security, sometimes called the "cheapest-to-deliver", and the price of the future or forward contract should in such cases move in close alignment.

No offsetting will be allowed between positions in different currencies; the separate legs of cross-currency swaps or forward foreign exchange deals are to be treated as notional positions in the relevant instruments and included in the appropriate calculation for each currency.

In addition, opposite positions in the same category of instruments can in certain circumstances be regarded as matched and allowed to offset fully. To qualify for this treatment the positions must relate to the same underlying instruments, be of the same nominal value and be denominated in the same currency. In addition:

- for futures: offsetting positions in the notional or underlying instruments to which the futures contract relates must be for identical products and mature within seven days of each other;
- for swaps and FRAs: the reference rate (for floating rate positions) must be identical and the coupon closely matched (i.e. within 15 basis points); and
- for swaps, FRAs and forwards: the next interest fixing date or, for fixed coupon positions or forwards, the residual maturity must correspond within the following limits:
 - less than one month hence: same day;
 - between one month and one year hence: within seven days;
 - over one year hence: within thirty days.

Banks with large swap books may use alternative formulae for these swaps to calculate the positions to be included in the duration ladder. The method would be to calculate the sensitivity of the net present value implied by the change in yield used in the duration method and allocate these sensitivities into the time-bands set out in Table 2 in Section B.

(b) Specific risk

Interest rate and currency swaps, FRAs, forward foreign exchange contracts and interest rate futures will not be subject to a specific risk charge. This exemption also applies to futures on an interest rate index (e.g. LIBOR). However, in the case of futures contracts where the underlying is a debt security, or an index representing a basket of debt securities, a specific risk charge will apply according to the credit risk of the issuer as set out in paragraphs above.

(c) General market risk

General market risk applies to positions in all derivative products in the same manner as for cash positions, subject only to an exemption for fully or very closely matched positions in identical instruments as defined in paragraphs above. The various categories of instruments should be slotted into the maturity ladder and treated according to the rules identified earlier.

Table - Summary of treatment of interest rate derivatives

Instrument	Specific risk charge	General Market risk Charge
Exchange-traded future - Government debt security - Corporate debt security - Index on interest rates (e.g. MIBOR)	No Yes No	Yes, as two positions Yes, as two positions Yes, as two positions
OTC forward - Government debt security - Corporate debt security - Index on interest rates (e.g. MIBOR)	No Yes No	Yes, as two positions Yes, as two positions Yes, as two positions
FRAs, Swaps	No	Yes, as two positions
Forward Foreign Exchange	No	Yes, as one position in each currency
Options - Government debt security - Corporate debt security - Index on interest rates (e.g. MIBOR) - FRAs, Swaps	No Yes No No	

B. Treatment of Options

1. In recognition of the wide diversity of banks' activities in options and the difficulties of measuring price risk for options, alternative approaches are permissible as under:

- those banks which solely use purchased options* will be free to use the simplified approach described in Section I below;
- those banks which also write options will be expected to use one of the intermediate approaches as set out in Section II below.

2. In the **simplified approach**, the positions for the options and the associated underlying, cash or forward, are not subject to the standardised methodology but rather are "carved-out" and subject to separately calculated capital charges that incorporate both general market risk and specific risk. The risk numbers thus generated are then added to the capital charges for the relevant category, i.e. interest rate related instruments, equities, and foreign exchange as described in Sections B to D. The *delta-plus method* uses the sensitivity parameters or "Greek letters" associated with options to measure their market risk and capital requirements. Under this method, the delta-equivalent position of each option becomes part of the standardised methodology set out in Section B to D with the delta-equivalent amount subject to the applicable general market risk charges. Separate capital charges are then applied to the gamma and vega risks of the option positions. The **scenario approach** uses simulation techniques to calculate changes in the value of an options portfolio for changes in the level and volatility of its associated underlyings. Under this approach, the general market risk charge is determined by the scenario "grid" (i.e. the specified combination of underlying and volatility changes) that produces the largest loss. For the delta-plus method and the scenario approach the specific risk capital charges are determined separately by multiplying the delta-equivalent of each option by the specific risk weights set out in Section B and Section C.

· Unless all their written option positions are hedged by perfectly matched long positions in exactly the same options, in which case no capital charge for market risk is required

I. Simplified approach

3. Banks which handle a limited range of purchased options only will be free to use the simplified approach set out in Table A below, for particular trades. As an example of how the calculation would work, if a holder of 100 shares currently valued at Rs.10 each holds an equivalent put option with a strike price of Rs.11, the capital charge would be: Rs.1,000 x 18% (i.e. 9% specific plus 9% general market risk) = Rs.180, less the amount the option is in the money (Rs.11 – Rs.10) x 100 = Rs.100, i.e. the capital charge would be Rs.80. A similar methodology applies for options whose underlying is a foreign currency or an interest rate related instrument.

Table A *Simplified approach: capital charges*

Position	Treatment
Long cash and Long put Or Short cash and Long call	The capital charge will be the market value of the underlying security ¹ multiplied by the sum of specific and general market risk charges ² for the underlying less the amount the option is in the money (if any) bounded at zero ³
Long call Or Long put	The capital charge will be the lesser of: (i) the market value of the underlying security multiplied by the sum of specific and general market risk charges ³ for the underlying (ii) the market value of the option ⁴

1. In some cases such as foreign exchange, it may be unclear which side is the "underlying security"; this should be taken to be the asset which would be received if the option were exercised. In addition the nominal value should be used for items where the market value of the underlying instrument could be zero, e.g. caps and floors, swaptions etc.
2. Some options (e.g. where the underlying is an interest rate or a currency) bear no specific risk, but specific risk will be present in the case of options on certain interest rate-related instruments (e.g. options on a corporate debt security or corporate bond index; see Section B for the relevant capital charges) and for options on equities and stock indices (see Section C). The charge under this measure for currency options will be 9%.
3. For options with a residual maturity of more than six months, the strike price should be compared with the forward, not current, price. A bank unable to do this must take the "in-the-money" amount to be zero.
4. Where the position does not fall within the trading book (i.e. options on certain foreign exchange or commodities positions not belonging to the trading book), it may be acceptable to use the book value instead.

II. Intermediate approaches

(a) Delta-plus method

4. Banks which write options will be allowed to include delta-weighted options positions within the standardised methodology set out in Section B - D. Such options should be reported as a position equal to the market value of the underlying multiplied by the delta.

However, since delta does not sufficiently cover the risks associated with options positions, banks will also be required to measure gamma (which measures the rate of change of delta) and vega (which measures the sensitivity of the value of an option with respect to a change in volatility) sensitivities in order to calculate the total capital charge. These sensitivities will be calculated according to an approved exchange model or to the bank's proprietary options pricing model subject to oversight by the Reserve Bank of India¹.

5. Delta-weighted positions with *debt securities or interest rates as the underlying* will be slotted into the interest rate time-bands, as set out in Table 2 of Section B, under the following procedure. A two-legged approach should be used as for other derivatives, requiring one entry at the time the underlying contract takes effect and a second at the time the underlying contract matures. For instance, a bought call option on a June three-month interest-rate future will in April be considered, on the basis of its delta-equivalent value, to be a long position with a maturity of five months and a short position with a maturity of two months². The written option will be similarly slotted as a long position with a maturity of two months and a short position with a maturity of five months. Floating rate instruments with caps or floors will be treated as a combination of floating rate securities and a series of European-style options. For example, the holder of a three-year floating rate bond indexed to six month LIBOR with a cap of 15% will treat it as:

- (i) a debt security that reprices in six months; and
- (ii) a series of five written call options on a FRA with a reference rate of 15%, each with a negative sign at the time the underlying FRA

takes effect and a positive sign at the time the underlying FRA matures³.

1. Reserve Bank of India may wish to require banks doing business in certain classes of exotic options (e.g. barriers, digitals) or in options "at-the-money" that are close to expiry to use either the scenario approach or the internal models alternative, both of which can accommodate more detailed revaluation approaches.

2. A two-months call option on a bond future, where delivery of the bond takes place in September, would be considered in April as being long the bond and short a five-months deposit, both positions being delta-weighted.

3. The rules applying to closely-matched positions set out in paragraph 2 (a) of this Annex will also apply in this respect.

6. The capital charge for *options with equities as the underlying* will also be based on the delta-weighted positions which will be incorporated in the measure of market risk described in Section C. For purposes of this calculation each national market is to be treated as a separate underlying. The capital charge for *options on foreign exchange and gold positions* will be based on the method set out in Section D. For delta risk, the net delta-based equivalent of the foreign currency and gold options will be incorporated into the measurement of the exposure for the respective currency (or gold) position.

7. In addition to the above capital charges arising from delta risk, there will be further capital charges for *gamma* and for *vega risk*. Banks using the delta-plus method will be required to calculate the gamma and vega for each option position (including hedge positions) separately. The capital charges should be calculated in the following way:

(i) for **each individual option** a "gamma impact" should be calculated according to a Taylor series expansion as:

$$\text{Gamma impact} = \frac{1}{2} \times \text{Gamma} \times \text{VU}^2$$

where VU = Variation of the underlying of the option.

(ii) VU will be calculated as follows:

- for interest rate options if the underlying is a bond, the price sensitivity should be worked out as explained. An equivalent calculation should be carried out where the underlying is an interest rate.
- for options on equities and equity indices; which are not permitted at present, the market value of the underlying should be multiplied by 9%¹;
- for foreign exchange and gold options: the market value of the underlying should be multiplied by 9%;

(iii) For the purpose of this calculation the following positions should be treated as **the same underlying**:

- for interest rates² each time-band as set out in Table 2 of the guidelines;³
- for equities and stock indices, each national market;
- for foreign currencies and gold, each currency pair and gold;

(iv) Each option on the same underlying will have a gamma impact that is either positive or negative. These individual gamma impacts will be summed, resulting in a net gamma impact for each underlying that is either positive or negative. Only those net gamma impacts that are negative will be included in the capital calculation.

(v) The total gamma capital charge will be the sum of the absolute value of the net negative gamma impacts as calculated above.

(vi) For **volatility risk**, banks will be required to calculate the capital charges by multiplying the sum of the vegas for all options on the same underlying, as defined above, by a proportional shift in volatility of $\pm 25\%$.

(vii) The **total capital charge** for vega risk will be the sum of the absolute value of the individual capital charges that have been calculated for vega risk.

1. The basic rules set out here for interest rate and equity options do not attempt to capture specific risk when calculating gamma capital charges. However, Reserve Bank may require specific banks to do so.

2. Positions have to be slotted into separate maturity ladders by currency.

3. Banks using the duration method should use the time-bands as set out in Table 3 of the guidelines.

(b) Scenario approach

8. More sophisticated banks will also have the right to base the market risk capital charge for options portfolios and associated hedging positions on *scenario matrix analysis*. This will be accomplished by specifying a fixed range of changes in the option portfolio's risk factors and calculating changes in the value of the option portfolio at various points along this "grid". For the purpose of calculating the capital charge, the bank will revalue the option portfolio using matrices for simultaneous changes in the option's underlying rate or price and in the volatility of that rate or price. A different matrix will be set up for each individual underlying as defined in paragraph 7 above. As an alternative, at the discretion of each national authority, banks which are significant traders in options for interest rate options will be permitted to base the calculation on a minimum of six sets of time bands. When using this method, not more than three of the time-bands as defined in Section B should be combined into any one set.

9. The options and related hedging positions will be evaluated over a specified range above and below the current value of the underlying. The range for interest rates is consistent with the assumed changes in yield in Table 12 of Section B. Those banks using the alternative method for interest rate options set out in paragraph 8 above should use, for each set of time-bands, the highest of the assumed changes in yield

applicable to the group to which the time-bands belong¹. The other ranges are $\pm 9\%$ for equities and $\pm 9\%$ for foreign exchange and gold. For all risk categories, at least seven observations (including the current observation) should be used to divide the range into equally spaced intervals.

¹ If, for example, the time-bands 3 to 4 years, 4 to 5 years and 5 to 7 years are combined, the highest assumed change in yield of these three bands would be 0.75.

10. The second dimension of the matrix entails a change in the volatility of the underlying rate or price. A single change in the volatility of the underlying rate or price equal to a shift in volatility of $+ 25\%$ and $- 25\%$ is expected to be sufficient in most cases. As circumstances warrant, however, the Reserve Bank may choose to require that a different change in volatility be used and / or that intermediate points on the grid be calculated.

11. After calculating the matrix, each cell contains the net profit or loss of the option and the underlying hedge instrument. The capital charge for each underlying will then be calculated as the largest loss contained in the matrix.

12. In drawing up these intermediate approaches it has been sought to cover the major risks associated with options. In doing so, it is conscious that so far as specific risk is concerned, only the delta-related elements are captured; to capture other risks would necessitate a much more complex regime. On the other hand, in other areas the simplifying assumptions used have resulted in a relatively conservative treatment of certain options positions.

13. Besides the options risks mentioned above, the RBI is conscious of the other risks also associated with options, e.g. rho (rate of change of the value of the option with respect to the interest rate) and theta (rate of change of the value of the option with respect to time). While not proposing a measurement system for those risks at present, it expects banks undertaking significant options business at the very least to monitor such risks closely. Additionally, banks will be permitted to incorporate rho into their capital calculations for interest rate risk, if they wish to do so.
