Appendix-2

Indicative methodology for computing ΔEVE

Banks have been provided with flexibility to develop their own system to compute ΔEVE. However, it is expected that banks' systems and parameters used to compute ΔEVE are not significantly different from the methodology and process provided in this Appendix. Wherever, significant deviation is considered desirable by banks, a well-reasoned argument for the same should be recorded and made available to RBI when requested.

2. Steps involved in computation:

2.1 The steps involved in measuring banks' ΔEVE for IRRBB would generally be following:

Step 1. Interest rate-sensitive banking book positions are allocated to one of three categories (i.e. amenable, less amenable and not amenable to standardisation).

Step 2. Determination of slotting of cash flows based on repricing maturities.

This is a straightforward translation for positions amenable to standardisation.

For positions less amenable to standardization, they are excluded from this step.

For positions with embedded automatic interest rate options, the embedded interest rate option is stripped out from the process of slotting of notional repricing cash flow. The optionality should be treated together with other interest rate options as per Step 4 given below.

For positions that are not amenable to standardisation, there is a separate treatment for:

(a) Non-Maturity Deposits (NMDs) – According to separation of core and non-core cash flows via the approach described in subsequent paragraph of this Appendix.

(b) Behavioural options (fixed rate loans subject to prepayment risk and term deposits subject to early redemption risk) – Behavioural parameters relevant to the position type may rely on a scenario-dependent look-up table provided in subsequent paragraph of this Appendix.

Step 3: Determination of ΔEVE for relevant interest rate shock scenarios for each currency. The ΔEVE is measured per currency for all six prescribed interest rate shock scenarios.

Step 4: Add-ons for changes in the value of automatic interest rate options (whether explicit or embedded) are added to the EVE changes. Automatic interest rate options sold are subject to full revaluation (net of automatic interest rate options bought to hedge sold interest rate options wherever permitted or possible) under each of the six prescribed interest rate shock scenarios for each currency. Changes in values of options are then added to the changes in the EVE measure under each interest rate shock scenario on a per currency basis.

Step 5. IRRBB EVE calculation. The ΔEVE under the standardised framework will be the maximum of the worst aggregated reductions to EVE across the six prescribed interest rate shocks in Appendix 1.

3. Cash flow bucketing

3.1 Banks may project all future notional repricing cash flows arising from interest rate-sensitive assets[1], liabilities[2], and off-balance sheet items onto 19 predefined time buckets (indexed numerically by k) as given in Table 3 below into which they fall according to their repricing dates.

3.2 Banks may deduct commercial margins and other spread components from the notional repricing cash flows, using a prudent and transparent methodology, if they consider it appropriate to do so.

3.3 Floating rate instruments are assumed to reprice fully at the first reset date. Hence, the entire principal amount is slotted into the bucket in which that date falls, with no additional slotting of notional repricing cash flows to later time buckets (other than the spread component which is not repriced).

[1] Assets which are not deducted from Common Equity Tier 1 (CET1) capital and which exclude (i) fixed assets such as real estate or intangible assets and (ii) equity exposures in the banking book.
[2] Liabilities (including all non-remunerated deposits), other than CET1 capital under the Basel III framework.

Table 3

Indicative table for maturity schedule for notional repricing cash flows repricing at t^{CF}

Time Bucket								
Short-term rates	Overnight (0.0028 Y)	Overnight < t^{CF} <= one month (O/N-1 month) (0.0417Y)	1-month < t^{CF} <= 3 months (0.1667 Y)	3 months < t^{CF} <=6 months (0.375 Y)	6 months < t^{CF} <= 9 months (0.625 Y)	9 months < t^{CF} <= 1 year (0.875 Y)	1 year < t^{CF} <= 1.5 years (1.25Y)	1.5 year < t^{CF} <= 2 years (1.75Y)
Medium-term rates	2 years < t^{CF} <= 3 years (2.5Y)	3 years < t^{CF} <= 4 years (3.5Y)	4 years < t^{CF} <= 5 years (4.5Y)	5 years < t^{CF} <= 6 years (5.5Y)	6 years < t^{CF} <= 7 years (6.5Y)			
Long-term rates	7 years < t^{CF} <= 8 years (7.5Y)	8 years < t^{CF} <= 9 years (8.5Y)	9 years < t^{CF} <= 10 years (9.5Y)	10 years < t^{CF} <= 15 years (12.5Y)	15 years < t^{CF} <= 20 years (17.5Y)	t^{CF} > 20 years (25Y)		

The number in brackets is the time bucket's midpoint.

3.4 All notional repricing cash flows associated with interest rate-sensitive assets, liabilities and off-balance sheet items, for each currency, are allocated to the prescribed time buckets (henceforth, denoted by $CF_{i,c}$ (k) under interest rate shock scenario i and currency c) based on their amenability to standardisation.

4. Process for positions that are amenable to standardisation

4.1 Notional repricing cash flows can be slotted into appropriate time buckets based on their contractual maturity, if subject to fixed coupons, or into the next repricing period if coupons are floating. Positions amenable to standardisation fall into two categories:

4.1.1 Fixed rate positions: Such positions generate cash flows that are certain till the point of contractual maturity[3]. All coupon cash flows and periodic or final principal repayments should be allocated to the appropriate time buckets based on their contractual maturity.

4.1.2 Floating rate positions: Such positions generate cash flows that are not predictable past the next repricing date other than that the present value would be

[3] Examples are fixed rate loans without embedded prepayment options, term deposits without redemption risk and other amortising products such as mortgage loans.

reset to par. Accordingly, such instruments can be treated as a series of coupon payments until the next repricing and a par notional cash flow at the appropriate time bucket into the next reset date bucket.

4.2 Positions amenable to standardisation include positions with embedded automatic interest rate options where the optionality (whether sold or bought) should be ignored for the purpose of slotting of notional repricing cash flows. That is, the stripped-out embedded automatic interest rate option must be treated together with explicit automatic interest rate options.

5. Process for positions that are less amenable to standardisation

For explicit automatic interest rate options, as well as embedded automatic interest rate options[4] that are separated or stripped out from assets or liabilities (i.e. the host contract), the methodology for automatic interest rate options is described in subsequent paragraph of this Appendix.

6. Process for positions not amenable to standardisation

Positions not amenable to standardisation include (i) Non Maturity Deposits (NMDs), (ii) fixed rate loans subject to prepayment risk and (iii) term deposits subject to early redemption risk.

6.1 Treatment of NMDs

Banks may first separate their NMDs according to the nature of the deposit and depositor. Banks should then identify, for each category, the core and non-core deposits, up to the limits specified in Table 4. Finally, banks should determine an appropriate cash flow slotting for each category, in accordance with the average maturity limits specified in Table 4.

Table 4

Caps on core deposits and average maturity by category

	Cap on proportion of core deposits (%)	Cap on average maturity of core deposits (years)
Retail/transactional	90	5
Retail/non-transactional	70	4.5
Wholesale	50	4

[4] An example of a product with embedded automatic interest rate options is a floating rate mortgage loan with embedded caps and/or floors. Any behavioural option position with wholesale customers that may change the pattern of notional repricing cash flows are considered as embedded automatic interest rate option.

(a) NMD categories

NMDs must be segmented into retail and wholesale categories. Retail deposits are defined as deposits placed by an individual person. Deposits made by small business customers (with total aggregate deposits up to Rs. 7.5 crores) and managed as retail exposures are considered as having similar interest rate risk characteristics to retail accounts and thus can be treated as retail deposits. Retail deposits should be considered as held in a transactional account when regular transactions are carried out in that account (e.g., when salaries are regularly credited) or when the deposit is non-interest bearing. Other retail deposits should be considered as held in a non-transactional account. Deposits from legal entities, sole proprietorships or partnerships are captured in wholesale deposit categories.

(b) Separation of NMDs

Banks should distinguish between the stable and the non-stable parts of each NMD category using observed volume changes over the past 10 years. The stable NMD portion is the portion that is found to remain undrawn with a high degree of likelihood. Core deposits are the proportion of stable NMDs which are unlikely to reprice even under significant changes in the interest rate environment. The remainder constitutes non-core NMDs.

Banks are required to estimate their level of core deposits using this two-step procedure for each deposit category, and then to aggregate the results to determine the overall volume of core deposits subject to imposed caps as shown in Table 4.

(c) Cash flow slotting

NMDs should finally be slotted into the appropriate time bucket. Non-core deposits should be considered as overnight deposits and accordingly should be placed into the overnight time bucket.

Banks should determine an appropriate cash flow slotting procedure for each category of core deposits, up to the maximum average maturity per category as specified in Table 4.

6.2 Treatment of positions with behavioural options other than NMDs

6.2.1 The treatment set out in this paragraph applies only to behavioural options related to retail customers. Where a wholesale customer has a behavioural option that may change the pattern of notional repricing cash flows, such options must be included within the category of automatic interest rate options[5].

6.2.2 The standardised framework is applied to fixed rate loans subject to prepayments and term deposits subject to early redemption risk. In each case, the customer has an option, which, if exercised, will alter the timing of banks' cash flows. The customer's exercise of the option is, among other factors, influenced by changes in interest rates. In the case of the fixed rate loan, the customer has an option to repay the loan early (ie prepay); and for a fixed-term deposit, the customer may have an option to withdraw their deposit before the scheduled date.

6.2.3 The optionality in these products is estimated using a two-step approach. Firstly, baseline estimates of loan prepayments and early withdrawal of fixed-term deposits are calculated given the prevailing term structure of interest rates. In the second stage, the baseline estimates are multiplied by scenario-dependent scalars that reflect the likely behavioural changes in the exercise of the options.

6.3 Fixed rate loans subject to prepayment risk

6.3.1 Prepayments, or parts thereof, for which the economic cost is not charged to the borrower, are referred to as uncompensated prepayments. For loan products where the economic cost of prepayments is never charged, or charged only for prepayments above a certain threshold, the standardised framework for fixed rate loans subject to prepayments set out below must be used to assign notional repricing cash flows.

6.3.2 Banks may determine the baseline conditional prepayment rate (CPR) for each portfolio p of homogeneous prepayment-exposed loan products denominated in currency c, under the prevailing term structure of interest rates. The CPR for each portfolio of homogeneous prepayment- exposed loan products denominated in currency c, under interest rate scenario i, is given as:

$$CPR_{i,c}^{p} = \min(1, \gamma_i \cdot CPR_{0,c}^{p})$$

[5] An example of such an option would be a puttable fixed coupon bond issued by the bank in the wholesale market, for which the owner has the right to sell the bond back to the bank at a fixed price at any time.

where ($CPR^{p}_{0,c}$) is the (constant) base CPR of a portfolio of homogeneous prepayment-exposed loans given in currency *c* and given the prevailing term structure of interest rates. γ_i is a multiplier applied for scenario as given in Table 5.

6.3.3 Prepayment speeds vary according to the interest rate shock scenario. The multipliers γ_i reflect the expectation that prepayments will generally be higher during periods of falling interest rates and lower during periods of rising interest rates.

Table 5

CPRs under the shock scenarios

Scenario number *(i)*	Interest rate shock	γ_i (scenario multiplier)
1	Parallel up	0.8
2	Parallel down	1.2
3	Steepener	0.8
4	Flattener	1.2
5	Short rate up	0.8
6	Short rate down	1.2

6.3.4 The prepayments on the fixed rate loans must ultimately be reflected in the relevant cash flows (scheduled payments on the loans, prepayments and interest payments). These payments can be broken up into scheduled payments adjusted for prepayment and uncompensated prepayments:

$$CF^{P}_{i,c}(k) = CF^{S}_{i,c}(k) + CPR^{p}_{i,c} \cdot N^{p}_{i,c}(k-1)$$

Where $CF^{S}_{i,c}(k)$ refers to the scheduled interest and principal repayment, and $N^{p}_{i,c}(k-1)$ denotes the notional outstanding at time bucket k – 1. The base cash flows (i.e. given the current interest rate yield curve and the base CPR) are given by *i*=0, while the interest rate shock scenarios are given for *i*=1 to 6.

6.4 Term deposits subject to early redemption risk

6.4.1 Term deposits lock in a fixed rate for a fixed term and would usually be hedged on that basis. However, term deposits may be subject to the risk of early withdrawal, also called early redemption risk. Consequently, term deposits may only be treated as fixed rate liabilities and their notional repricing cash flows slotted into the time buckets up to their corresponding contractual maturity dates if it can be shown that:

- the depositor has no legal right to withdraw the deposit; or

- an early withdrawal results in a significant penalty that at least compensates for the loss of interest between the date of withdrawal and the contractual maturity date and the economic cost of breaking the contract.

6.4.2 If neither of these conditions is met, the depositor holds an option to withdraw and the term deposits are deemed to be subject to early redemption risk. Further, if banks issue term deposits that do not meet the above criteria to wholesale customers, they must assume that the customer will always exercise the right to withdraw in the way that is most disadvantageous to banks (i.e. the deposit is classified as an automatic interest rate option).

6.4.3 Banks may determine the baseline term deposit redemption ratio TDRR, applicable to each homogeneous portfolio p of term deposits in currency c and use it to slot the notional repricing cash flows. Term deposits which are expected to be redeemed early are slotted into the overnight time bucket (k=1).

6.4.4 The term deposit redemption ratio for time bucket *k* applicable to each homogeneous portfolio *p* of term deposits in currency *c* and under scenario *i* is obtained by multiplying $TDRR_{0,c}^{p}$ by scalar u_i that depends on the scenario *i*, as follows:

$$TDRR_{i,c}^{p} = \min(1, u_i \cdot TDRR_{0,c}^{p})$$

The values of scalar u_i are given in the following table.

Table 6

Term deposit redemption rate (TDRR) scalars under the shock scenarios

Scenario *(i)*	Interest rate shock scenarios	Scalar multipliers u_i
1	Parallel up	1.2
2	Parallel down	0.8
3	Steepener	0.8
4	Flattener	1.2
5	Short rate up	1.2
6	Short rate down	0.8

6.4.5 The notional repricing cash flows which are expected to be withdrawn early under any interest rate shock scenario *i* are described as:

$$CF_{i,c}^{p}(1) = TD_{0,c}^{p} \cdot TDRR_{i,c}^{p}$$

Where $TD_{0,c}^{p}$ is the outstanding amount of term deposits of type *p*.

7. Automatic interest rate options

7.1 This paragraph describes the method for calculating an add-on for automatic interest rate options, whether explicit or embedded[6]. This applies to sold automatic interest rate options. Banks have a choice to either include all bought automatic options or include only automatic options used for hedging sold automatic interest rate options:

a) For each sold automatic option *o* in currency *c*, the value change, denoted $\Delta FVAO_{i,c}$, is calculated for each interest rate shock scenario *i*. The value change is given by:

   i. an estimate of the value of the option to the option holder, given:

      a. a yield curve in currency c under the interest rate shock scenario i; and

      b. a relative increase in the implicit volatility of 25%;

   minus

   ii. the value of the sold option to the option holder, given the yield curve in currency c at the valuation date.

b) Likewise, for each bought automatic interest rate option *q*, banks must determine the change in value of the option between interest rate shock scenario *i* and the current interest rate term structure combined with a relative increase in the implicit volatility of 25%. This is denoted as $\Delta FVAO^{q}_{i,c}$.

c) Banks' total measure for automatic interest rate option risk under interest rate shock scenario *i* in currency *c* is calculated as:

$$KAO_{i,c} = \sum_{0=1}^{n_c} \Delta FVAO^{o}_{i,c} - \sum_{q=1}^{m_c} \Delta FVAO^{q}_{i,c}$$

Where n_c (m_c) is the number of sold (bought) options in currency *c*.

[6] The most important automatic interest rate options likely to occur in the banking book are caps and floors, which are often embedded in banking products. Swaptions, such as prepayment options on non-retail products, may also be treated as automatic interest rate options, as, in cases where such options are held by sophisticated financial market counterparties, the option holder will almost certainly exercise the option if it is in their financial interest to do so. Any behavioural option positions with wholesale customers that may change the pattern of notional repricing cash flows are considered as embedded automatic interest rate options for the purposes of this sub-paragraph.

7.2 If the bank chooses to only include bought automatic interest rate options that are used for hedging sold automatic interest rate options, the bank must, for the remaining bought options, add any changes in market values reflected in the regulatory capital measure of the respective capital ratio (i.e. CET1, AT1 or total capital) to the total automatic interest rate option risk measure $KAO_{i,c}$.

8. Determination of change in EVE for each currency for all six-prescribed interest rate shock scenarios

The change in economic value of equity under scenario *i* and currency *c* is calculated for each currency, as follows:

a) Under each scenario i, all notional repricing cash flows are slotted into the respective time bucket k € {1, 2, ….,K} . Within a given time bucket k all positive and negative notional repricing cash flows are netted[7] to form a single long or short position, with the cancelled parts removed from the calculation. Following this process across all time buckets leads to a set of notional repricing cash flows $CF_{i,c}(k)$, k € {1,2,….,K}[8].

b) Net notional repricing cash flows in each time bucket k are weighted by a continuously compounded discount factor:

$$DF_{i,c}(t_k) = \exp\left(-R_{i,c}(t_k) \cdot t_k\right)$$

that reflects the interest rate shock scenario i in currency c as set out in Appendix 1, and where t_k is the midpoint of time bucket k. This results in a weighted net position, which may be positive or negative for each time bucket. The cash flows should be discounted using either a risk-free rate[9] or a risk-free rate including commercial margin and other spread components (only if the bank has included commercial margins and other spread components in its cash flows).

c) These risk-weighted net positions are summed to determine the EVE in currency c under scenario i (excluding automatic interest rate option positions):

[7] Intra-bucket mismatch arises as notional repricing cash flows with different maturity dates but falling within the same time bucket, are assumed to match perfectly. This is mitigated by introducing a high number of time buckets (i.e. K=19)

[8] Note that depending on the approach taken for NMDs, prepayments and products with other embedded behavioural options, the notional repricing cash flows may vary by scenario i (scenario-dependent cash flow products).

[9] The discounting factors must be representative of a risk-free zero coupon rate. An example of an acceptable yield curve is Zero Coupon Yield Curve published by the benchmark administrator.

$$EVE_{i,c}^{nao} = \sum_{k=1}^{K} CF_{i,c}(k) \cdot DF_{i,c}(t_k)$$

d) Then, the full change in EVE in currency c associated with scenario i is obtained by subtracting $EVE_{i,c}^{nao}$ from the EVE under the current interest rate term structure $EVE_{0,c}^{nao}$ and by adding the total measure for automatic interest rate option risk $KAO_{i,c}$ as follows:

$$\Delta EVE_{i,c} = \sum_{k=1}^{K} CF_{0,c}(k) \cdot DF_{0,c}(t_k) - \sum_{k=1}^{K} CF_{i,c}(k) \cdot DF_{i,c}(t_k) + KAO_{i,c}$$

e) Finally, the EVE losses $\Delta EVE_{i,c} > 0$ are aggregated under a given interest rate shock scenario i and the maximum loss across all interest rate shock scenarios is the EVE risk measure.

$$\text{Standardised EVE risk measure} = \max_{i \in \{1,2,\ldots,6\}} \left\{ \mathbf{max} \left(\mathbf{0}; \sum_{c:\Delta \mathrm{EVE}_{i,c}>0} \underbrace{\Delta \mathrm{EVE}_{i,c}}_{\textit{loss in currency c}} \right) \right\}$$