Mathematical formulas SWESTR

Trimming

Let:

$$T = \{(r_1, V_1), (r_2, V_2), (r_3, V_3), \dots, (r_N, V_N)\},$$
$$r_k \leq r_{k+1}\ \forall k = 1, \dots, N$$

be a set of transactions represented as an ordered, ascending by interest rate, list of pairs with interest rate and volume. This set can be partitioned into “rate buckets”, i.e. set of subsets of T where all transaction in a rate bucket has the same interest rate and rates are different between buckets, which can be represented in the same way as T:

$$T = \{RB_1, RB_2, RB_3, \dots, RB_M\} = \{(r_1^b, V_1^b), (r_2^b, V_2^b), (r_3^b, V_3^b), \dots, (r_M^b, V_M^b)\}$$
$$r_k^b < r_{k+1}^b\ \forall k = 1, \dots, M$$

Each rate bucket consist of a set of transactions with the same interest rate:

$$RB_k = \{(r_k^b, V_{k,1}), (r_k^b, V_{k,2}), (r_k^b, V_{k,3}), \dots, (r_k^b, V_{k,m_k})\}$$

where:

$$\sum_{i=1}^{m_k} V_{k,i} = V_k^b$$

Furthermore, let $0 < \beta < 1$ be the trim level, a.e. 25 percent in the case of the reference rate. The Riksbank uses the following method to trim off the bottom:

$$\alpha = \frac{\beta}{2}$$

percent of the sample volume. To trim off the top α percent of the sample volume each rate is multiplied by -1 and then the same algorithm is run again.

Define S_k to be the cumulative volume of the first k rate buckets:

$$S_k = \sum_{j=1}^{k} V_j^b,\ k \leq M$$

and define i_α as:

$$i_\alpha = \max_k S_k \leq S_M * \alpha$$

Once this index is computed the volume for each transaction should be adjusted according to:

$$\bar{V}_{k,j} = 0, \forall k \leq i_\alpha, \forall j = 1, \dots m_k$$
$$\bar{V}_{i_\alpha+1,j} = \left(1 - \frac{S_M * \alpha - S_{i_\alpha}}{V_{i_\alpha+1}^b}\right) * V_{i_\alpha+1,j}\,, \forall j = 1, \dots m_{i_\alpha+1}$$
$$\bar{V}_{k,j} = V_{k,j}, \forall k > i_\alpha + 1, \forall j = 1, \dots m_k$$

Normal calculation routine for reference rate

The below formulation of the normal calculation routine is somewhat more complicated than might seem necessary in order to create a natural flow of calculations since trimming is made on each subgroup of counterparties. The reference rate is computed as a volume weighted average of four individually computed volume weighted average rates after trimming. This corresponds to a simple volume weighted average.

Let I be the set containing the following subgroups of counterparties; Large banks and the Swedish national debt office (Riksgälden(RGK)), Other banks, Other financial institutions and Non-financial firms.

For $i \in I$ and day $t = \tau$ let;

N_i^τ be the total number of transactions for subgroup i at day τ,

$N^\tau = \sum_{i \in I} N_i^\tau$ be the total number of transactions at day τ,

$J_i^\tau = \{j_k\}_{k=1}^{N_i^\tau}$ be the index set for transactions in subgroup i at day τ,

V_j^τ be the volume for transaction $j \in \{1, 2, 3, \ldots, N^\tau\}$ at day τ after trimming on each subgroup,

$V_i^\tau = \sum_{j \in J_i^\tau} V_j^\tau$ be the total transaction volume for subgroup i at day τ,

$V^\tau = \sum_{i \in I} V_i^\tau$ be the total transaction volume at day τ,

r_j^τ is the interest rate for transaction $j \in \{1, 2, 3, \ldots, N^\tau\}$ at day τ,

$\varphi_i^\tau = \frac{V_i^\tau}{V^\tau}$ be the volume share for subgroup i at day τ,

$R_i^\tau = \frac{1}{V_i^\tau} \sum_{j \in J_i^\tau} V_j^\tau * r_j^\tau$ be the volume weighted rate for subgroup i at day τ.

Finally, we are ready to define the reference rate at day τ as:

$$R^\tau = \sum_{i \in I} \varphi_i^\tau * R_i^\tau$$

Alternative calculation routine for reference rate

Let all notations be defined as in the previous section and let $Repo^t$ be the repo rate at day t. The alternative computation method for the reference rate at day τ is then calculated as:

$$R_{alt.}^\tau = Repo^\tau + \frac{1}{3} \sum_{j=0}^{2} (R^{\tau-j} - Repo^{\tau-j})$$

In the special case when there is a technical issue which makes it impossible to retrieve transactions from the previous day (*j=0*), the Riksbank is unable to compute the reference rate according to above procedure, and thus, $R_{alt.}^\tau$ will be computed as:

$$R_{alt.}^\tau = Repo^\tau + \frac{1}{2} \sum_{j=1}^{2} (R^{\tau-j} - Repo^{\tau-j})$$