

# FRTB Accelerator Interpretation and Implementation of BCBS 457

SBM CSR non-Sec

3.1

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## 0.0.1 CSR non-Sec

This section describes how the CSR non-Sec risk-class is implemented and how the BCBS 457 specification is interpreted.

Also covered here is the specialization of the data, calculations, and configuration for the CSR non-Sec risk-class, including:

- The data model, which describes the data used for the calculations and how it is structured, and how the data model is represented in the:
  - input files
  - datastore

– cube

- The calculations, both in the ETL and at query time
- The parameters used in the query time calculations
- How the accelerator is configured for CSR non-Sec

### Data Model (Core)

This section describes the data used for the CSR non-Sec calculations, including how the data is structured.

For CSR non-Sec, the **Curve** (Underlying) refers to the relevant issuer credit spread curves (bond and CDS) [\[MAR21.9\]\(1\)](#).

Each of these curves has a **Curve Name, Bucket, Credit Quality, Sector**, and for covered bonds a **Covered Bond Rating**.

The **Risk Factor** is used to identify sensitivities. However, it is not used directly in the calculations, instead the **Curve, Curve Type**, and tenor fields are used (as appropriate for the risk-measure). This means that multiple **Risk Factor Names** may be used for the same risk-factor.

Additionally, for each **Bucket** a canonical **Credit Quality Category** and **Sector Category** are identified.

| Field             | Key | Risk Measure | Description  |
|-------------------|-----|--------------|--|
| As-of Date        | Y   | All          | Timestamp (at close of business) for the data (T-1)              |
| Trade ID          | Y   | All          | A unique identifier for the trade (or position)                  |
| Risk Factor Name  | Y   | All          | A unique identifier for the risk-factor (not including vertices) |
| Risk Class        | Y   | All          | “CSR non-Sec”  |
| Risk Measure      | Y   | All          | “Delta”, “Vega”, or “Curvature”                                  |
| Sensitivity Tenor | Y   | Delta        | The tenor in the credit spread curve                             |

| Field                      | Key | Risk Measure | Description  |
|----------------------------|-----|--------------|--|
| Option Maturity            | Y   | Vega         | The maturity of the option   |
| Sensitivity                |     | Delta & Vega | The sensitivity value $s_k$  |
| Shock Up/Down              |     | Curvature    | The up and down shocked prices.  |
| Sensitivity Currency       |     | All          | Currency in which the sensitivity or shocked price is expressed.       |
| Risk Weight                |     | Curvature    | Risk weight used for the shocked prices                                |
| PV Applied                 |     | Curvature    | Has the PV been subtracted from the shocked prices?                    |
| Optionality                |     | Delta        | Should the Delta sensitivity be included in the Curvature Calculation? |
| Interpolated Sensitivities |     | Delta & Vega | Sensitivities interpolated to the prescribed vertices                  |

## Sensitivities

**Risk Factor [MAR10.9]** The **Risk Factor** is used to identify sensitivities. However, it is not used directly in the calculations, instead the **Curve**, **Curve Type**, and tenor fields are used (as appropriate for the risk-measure). This means that multiple **Risk Factor Names** may be used for the same risk-factor.

| Field            | Key | Risk Measure | Description   |
|------------------|-----|--------------|---|
| As-of Date       | Y   | All          | Timestamp (at close of business) for the data (T-1) |
| Risk Factor Name | Y   | All          | A name for the risk-factor (not including vertices) |
| Risk Class       | Y   | All          | “CSR non-Sec”                                       |
| Risk Measure     | Y   | All          | “Delta”, “Vega”, or “Curvature”                     |

| Field                   | Key | Risk Measure | Description   |
|-------------------------|-----|--------------|---|
| Sensitivity Tenor       | Y   | Delta        | The time to maturity of the traded instrument (Delta) |
| Option Maturity         | Y   | Vega         | The maturity of the option (Vega)                     |
| Curve Name (Underlying) |     | All          | Name of the relevant issuer credit spread curve       |
| Curve Type              |     | Delta & Vega | “Bond” or “CDS” (Delta and Vega)                      |

For Curvature, the risk-factor is the same as the underlying.

**Implementation notes (vectors of vertices):**

- The risk-factor name spans all tenors/maturities, so it represents multiple [MAR10.9] risk-factors.
- In the input files (default file format), multiple vertices and sensitivities may either be provided on the same row or different rows.
- In the datastore, we use vectors to store the sensitivities for all tenors.
- In the cubes, we use analysis hierarchies to expand the vectors.

**Curve** The **Curve** (Underlying) refers to the relevant credit issuer spread curves (bond and CDS) [MAR21.9](1).

| Field                   | Key | Description   |
|-------------------------|-----|---|
| As-of Date              | Y   | Timestamp (at close of business) for the data (T-1) |
| Curve Name (Underlying) | Y   | Name of the issuer credit spread curve              |
| Risk Class              | Y   | “CSR non-Sec”                                       |
| Bucket                  |     | 1-18  |

| Field               | Key | Description                             |
|---------------------|-----|---|
| Credit Quality      |     | “IG”, “HY”, or “NR”                     |
| Sector              |     | The relevant sector of the curve        |
| Covered Bond Rating |     | “high” for AA- and above covered bonds. |

## Calculations

This section describes the data manipulation and calculations applied to the sensitivities from the input files.

First, the ETL (Extract, Transform, Load) layer will apply some transformations as the data is loaded from the input files into the datastore.

Once the data is loaded into the datastore, it is available in the cube. The sensitivities in the cube may be partially aggregated upon commit to the datastore for BITMAP and LEAF aggregate providers. The remainder of the sensitivity aggregation is performed by ActivePivot at query time.

Then, also at query time, the post-processors calculate the capital charge from the aggregated sensitivities.

**ETL (Reference Implementation)** The ETL (Extract, Transform, Load) layer provided with the FRTB Accelerator , using the default file format, will perform the following transformations when data is loaded from the input files into the datastore.

### 0.0.2 Risk Factor Name

If the risk-factor name is not included in the input file (using the default file format), a name is generated as follows:

- Delta: Curve Name + Curve Type
- Vega: Curve Name + Curve Type
- Curvature: Curve Name

### 0.0.3 Normalisation

In the default file format, each row of the sensitivities' files contains the sensitivity as well as a description of the risk factor and curve. The data normalisation splits this information across three stores in the datastore, as described in the data model above.

### 0.0.4 Vectorisation

For efficiency, Delta and Vega sensitivities are stored in vectors. The entries of the vectors represent the tenors/maturities of the risk factors.

In the default file format, we allow sensitivities to be provided as either single values or as vectors. During the ETL, sensitivities are grouped together into vectors.

### 0.0.5 Interpolation

For compatibility with risk engines, Delta and Vega sensitivities may be loaded for any tenor/maturity. During the ETL, these sensitivities are interpolated to match the tenors/maturities in the specification.

**Query Time (Core)** For the CSR non-Sec risk class, there are three main chains of post-processor calculations: Delta, Vega, and Curvature.

## 0.1 Delta and Vega

The calculation steps for Delta and Vega are the same:

1. The calculations start by applying currency conversion to the aggregated raw sensitivities from the cube to get the Sensitivities.
2. The risk-weights are applied to get the Weighted Sensitivities (per risk-factor).

3. The (rho) correlations are then used to calculate the Risk Position (per bucket).

4. The Risk Positions are combined across all buckets to calculate the Risk Charge.

In the bookmarks' folder "ActiveViam FRTB" -> "Basel Framework" -> "SBM", there are bookmarks "CSR non-Sec Delta" and "CSR non-Sec Vega" which contain tabs that walk through these calculation steps and include the measures mentioned here.

## 0.2 Curvature

For Curvature, the calculation steps are:

1. Start with vectors of shocked prices indexed by risk-weight (per risk-factor).
2. The risk-weight then determines which Shock Up/Down Prices we want, subtracting the trade **PV** if necessary.
3. The delta sensitivities are filtered sensitivities from the Delta calculations, and aggregated per Curvature risk-factor.
4. These are then combined to calculate the CVR Up/Down (per risk-factor).
5. The Risk Position Up/Down are calculated per bucket.
6. The greater of the up and down risk-positions is identified by the Risk Position Scenario, and used for the Risk Position (per bucket).
7. The Risk Positions are combined across all buckets to calculate the Risk Charge.

The bookmark "ActiveViam FRTB" -> "Basel Framework" -> "SBM" -> "CSR non-Sec Curvature" contains tabs that walk through these calculation steps and includes the measures mentioned here.

**Delta/Vega Sensitivities** The **Delta/Vega Sensitivities** measures are the  $s_k$  in [MAR21.4](1) and (2).

For each **Sensitivity Currency**, the **Interpolated Sensitivities** are converted to the reference currency using the IFxRates API (supplied by the reference implementation). After this currency conversion, the values are aggregated for each **Risk Factor**.



**Delta Sensitivities Long/Short** The **Delta Sensitivities Long/Short** measures are the Positive or Negative **Delta Sensitivities**.

The Positive or Negative determination is made at the **Curve Name**, **Curve Type** and **Tenor** levels.

**Curvature Scenario Up/Down PV.CCY** The **Scenario Up/Down PV.CCY** measures are vectors of shocked prices indexed by risk weight.

For each **Sensitivity Currency**, the **Shock Up/Down** prices are converted to the reference currency using the IFxRates API. After this currency conversion, the values are aggregated for each **Risk Factor**.

**Delta/Vega/Curvature Risk Weight** The **Delta/Vega/Curvature Risk Weight** measures are  $RW_k$  in [MAR21.4](3) and  $RW_k^{(Curvature)}$  in [MAR21.5](2)(e).

For Delta and Curvature, following [MAR21.53], the values are looked up based on the configuration for the **Risk Factor's Bucket**. For Covered Bonds (bucket 8), when **Covered Bond Rating** is "high" an alternative risk weight may be looked up instead.

For Vega, following [MAR21.92], the value is looked up based on the configuration for the **Risk Class** (and its liquidity horizon).

**Delta/Vega Weighted Sensitivities** The **Delta/Vega Weighted Sensitivities** measures are  $WS_k$  in [MAR21.4](3).

For each **Risk Factor**  $k$ , the **Delta/Vega Sensitivities** measures are multiplied by the **Delta/Vega Risk Weight**.

**Curvature Delta Sensitivities** The **Curvature Delta Sensitivities** measure is  $s_{ik}$  in [MAR21.5](2)(f).

For each Curvature **Risk Factor**  $k$ , it is all the **Delta Sensitivities** with the same **Curve Name** as the risk factor, filtered by **Optionality**.

**Curvature Shock Up/Down Prices** The **Curvature shock-up/down prices** measures are  $V_i \left( x_k^{RW^{(Curvature)} \pm} \right) - V_i(x_k)$  in [MAR21.5](2).

Using linear interpolation, the shocked prices corresponding to the **Curvature Risk Weight** are determined from the **Curvature Scenario UP/Down.CCY** vectors. And, if **PV Applied** is not true/yes, the trade **PV** is subtracted.

**Curvature CVR Up/Down** The **Curvature CVR Up/Down** measures are  $CVR_k^\pm$  in [MAR21.5](2).

The **Curvature Delta Sensitivities** are multiplied by the **Curvature Risk Weight** and subtracted from/added to the **Curvature Shocked Up/Down Prices** (respectively).

**Delta/Vega Risk Position Double Sums** The **Delta/Vega Risk Position Double Sums** measures are the  $\sum_k \sum_l WS_k \cdot WS_l$  intermediate values that were requested for the 2017 and 2018 QIS exercises.

Within each **Bucket** (except the “other” bucket), each pair of **Risk Factors**, is categorised according to:

- Delta
  - Same or different **Curve Name**
  - Same or different **Tenor**
  - Same or different **Curve Type**
- Vega
  - Same or different **Curve Name**
  - Same or different **Curve Type**
  - Combinations of **Option Maturities**

Within each category, the pairs of **Delta/Vega Weighted Sensitivities** are multiplied together and summed.

**Implementation Note:** This calculation has been optimised so that it is performed with  $O(N)$  (linear) time complexity, where  $N$  is the number of **Risk Factors**.

**Delta/Vega Risk Position Correlations** The **Delta/Vega Risk Position Correlation** measures are  $\rho_{kl}$  in [MAR21.4](4).

Within each **Bucket** (except the “other” bucket), and for each category of **Risk Factor** pairs (see Delta/Vega Risk Position Double Sums) the values are looked up from the configuration for [MAR21.54], [MAR21.55], and [MAR21.94].

**Note:** The  $\rho_{kl}^{(Delta)}$  in [MAR21.94] does not include  $\rho_{kl}^{(tenor)}$  in [MAR21.54](2) and [MAR21.55](2) as the Vega **Risk Factors** are not differentiated by the Delta **Sensitivity Tenor**.

**Delta/Vega Risk Position** The **Delta/Vega Risk Position** measures are  $K_b$  in [MAR21.4](4).

For each **Bucket** (except the “other” bucket), the **Delta/Vega Risk Position** is calculated from the **Delta/Vega Weighted Sensitivities** and **Delta/Vega Risk Position Correlations** using the formula in [MAR21.4](4).

For the “other” bucket, the **Delta/Vega Risk Position** is calculated as the sum of the absolute values of the **Delta/Vega Weighted Sensitivities** (as per [MAR21.56]).

**Implementation Note:** This calculation has been optimised so that it is performed with  $O(N)$  (linear) time complexity, where  $N$  is the number of **Risk Factors**.

**Curvature Risk Position Up/Down** The **Curvature Risk Position Up/Down** measures are  $K_b^{\pm}$  in [MAR21.5](3).

Within each **Bucket** (except the “other” bucket), the **Curvature CVR Up/Down** values are combined using the formula in [MAR21.5](3).

For the “other” bucket, the **Curvature Risk Position Up/Down** is calculated as the sum of the positive **CVR Up/Down** values.

**Implementation Note:** This calculation has been optimised so that it is performed with  $O(N)$  (linear) time complexity, where  $N$  is the number of **Risk Factors**.

**Curvature Risk Position Scenario** Within each **Bucket**, the **Curvature Risk Position Scenario** measure identifies which of the **Curvature Risk Position Up** and **Curvature Risk Position Down** values is the greater.

**Curvature Risk Position** The **Curvature Risk Position** measure is  $K_b$  in [MAR21.5](3).

Within each **Bucket**, it is the greater of the **Curvature Risk Position Up** and **Curvature Risk Position Down** values.

**Delta/Vega Risk Charge** The **Delta/Vega Risk Charge** measures are Delta and Vega in [MAR21.4](5).

They are calculated by combining the **Delta/Vega Risk Positions** (and aggregated **Delta/Vega Weighted Sensitivities**) over all **Buckets** according to [MAR21.4](5).

**Curvature Risk Charge** The **Curvature Risk Charge** measure is Curvature risk in [\[MAR21.5\]\(4\)](#).

It is calculated by combining the **Curvature Risk Positions** (and aggregated **CVR Up** or **CVR Down** values) over all **Buckets** according to [\[MAR21.5\]\(4\)](#).

### Input Files (Reference Implementation)

This section describes how the input files containing the sensitivities and mappings are used for the CSR non-Sec risk class

The sensitivities are loaded from the Delta, Vega, Curvature, or [CRIF](#) sensitivity files.

The mapping of **Sector** and **Rating** to **Bucket** is loaded from the [CSR non-Sec Buckets](#) file. A description of these buckets is loaded from the [CSR non-Sec Bucket Descriptions](#) file.

**SBM\_Delta\_Sensitivities\*.csv** The Delta Sensitivity Data is loaded from the **Delta** files.

The following table lists the fields in the file format that is used for the CSR non-Sec risk-class. See the [Delta](#) file format documentation for details on the file format. See Data Model (Core) for a description of the data model.

| Data Model Field     | File Column        | Notes   |
|----------------------|--------------------|---|
| As-Of Date           | AsOfDate           |   |
| Trade ID             | TradeID            |   |
| Sensitivity Currency | DeltaCcy           |   |
| Sensitivities        | DeltaSensitivities | May be single value or vector, with the same number of entries as Tenors                        |
| Risk Class           | RiskClass          | "CSR non-Sec"   |
| Sensitivity Tenor    | SensitivityDates   | May be single value, vector, or empty; if empty, treated as the prescribed tenors: 0.5;1;3;5;10 |

| Data Model Field    | File Column    | Notes   |
|---------------------|----------------|---|
| Risk Factor Name    | RiskFactor     | (Optional) If not present, generated during ETL                                     |
| Curve Type          | RiskFactorType | “Bond” or “CDS”   |
| Curve Name          | Underlying     |   |
| Bucket              | Bucket         | 1-18  |
| Credit Quality      | CSRQuality     |   |
| Sector              | CSRSector      |   |
| Optionality         | Optionality    | Should this sensitivity be included in the Curvature calculations (‘Y’) or no (‘N’) |
| Covered Bond Rating | CSRRating      | (Optional) For covered bonds, “high” for rating AA- or above; otherwise “low”       |

**SBM\_Vega\_Sensitivities\*.csv** The Vega Sensitivity Data is loaded from the **Vega** files.

The following table lists the fields in the file format that is used for the CSR non-Sec risk-class. See the [Vega](#) file format documentation for details on the file format. See Data Model (Core) for a description of the data model.

| Data Model Field | File Column       | Notes   |
|------------------|-------------------|---|
| As-Of Date       | AsOfDate          |   |
| Trade ID         | TradeID           |   |
| Risk Class       | RiskClass         | “CSR non-Sec”   |
| Option Maturity  | OptionMaturity    | May be single value, vector, or empty; if empty, treated as the prescribed maturities: 0.5;1;3;5;10 |
| Sensitivities    | VegaSensitivities | May be single value or vector, with the same number of entries as maturities                        |

| Data Model Field     | File Column    | Notes   |
|----------------------|----------------|---|
| Sensitivity Currency | VegaCcy        |   |
| Risk Factor Name     | RiskFactor     | (Optional) If not present, generated during ETL |
| Curve Type           | RiskFactorType | “Bond” or “CDS”                                 |
| Curve Name           | Underlying     |   |
| Bucket               | Bucket         | 1-18  |
| Credit Quality       | CSRQuality     |   |
| Sector               | CSRSector      |   |

**SBM\_Curvature\_Sensitivities\*.csv** The Curvature Sensitivity Data is loaded from the **Curvature** files.

The following table lists the fields in the file format that are used for the CSR non-Sec risk-class. See the [Curvature](#) file format documentation for details on the file format. See Data Model (Core) for a description of the data model.

| Data Model Field | File Column   | Notes   |
|------------------|---------------|---|
| As-Of Date       | AsOfDate      |   |
| Trade ID         | TradeID       |   |
| Risk Class       | RiskClass     | “CSR non-Sec”                                   |
| Risk Factor Name | RiskFactor    | (Optional) If not present, generated during ETL |
| Shock Up         | Shift_Up_PV   |   |
| Shock Down       | Shift_Down_PV |   |

| Data Model Field     | File Column  | Notes   |
|----------------------|--------------|---|
| Sensitivity Currency | CurvatureCcy |   |
| Risk Weight          | RiskWeight   | (Optional)  |
| PV Applied           | PV Applied   | Has the Trade PV already been subtracted from the shocked PVs ('Y') or no ('N') |
| Curve Name           | Underlying   |   |
| Credit Quality       | CSRQuality   |   |
| Sector               | CSRSector    |   |
| Bucket               | Bucket       | 1-18  |

## Config Files

This section describes the reference implementation configuration used for the CSR non-Sec risk class

| Data Model Field | Property             | Reference                                      |
|------------------|----------------------|--|
| As-Of Date       | as-of-date.level     | AsOfDate@Date@Dates                            |
| Trade ID         | trade.level          | TradeId@Trades@Booking                         |
| Risk Class       | risk-class.level     | RiskClass@Risk Classes@Risk                    |
| Risk Measure     | risk-measure.level   | Risk Measure@Risk Measures@Risk                |
| Bucket           | csr-ns.buckets.level | CSR non-Sec Bucket@CSR non-Sec Buckets@Buckets |

| Data Model Field        | Property                                 | Reference  |
|-------------------------|--|--|
| Risk Factor Name        | risk-factors.level                       | Risk Factor@Risk Factors@Risk  |
| Sensitivity Tenor       | vertices.level                           | Vertex@Vertices@Risk   |
| Option Maturity         | csr-ns.vega.option.maturity              | Vertex@Vertices@Risk   |
| Curve Name              | csr.underlying.level                     | Underlying@Underlying@Market Data  |
| Curve Type              | csr.basis.level                          | Risk Factor Type@Risk Factor Types@Risk  |
| Credit Quality          | csr-ns.market-data.quality.level         | CSR Quality@CSR Quality@Market Data  |
| Sector                  | csr-ns.market-data.sector.level          | CSR Sector@CSR Sector@Market Data  |
| Covered Bond Rating     | csr-ns.market-data.rating.level          | CSR Rating@CSR Rating@Market Data  |
| Credit Quality Category | csr-ns.market-data.rating.category.level | CSR non-Sec Rating Category@CSR non-Sec Rating Category@Market Data  |
| Sector Category         | csr-ns.market-data.sector.category.level | CSR non-Sec Sector Category@CSR non-Sec Sector Category@Market Data  |
| PV Applied              | csr-ns.pv.applied.level                  | PVApplied@PVApplied@Currencies   |
|                         | csr-ns.delta.double-sums.levels          | Name@CSR non-Sec Delta Double Sums@Double Sums, Tenor@CSR non-Sec Delta Double Sums@Double Sums, Basis@CSR non-Sec Delta Double Sums@Double Sums |



| Data Model Field | Property                       | Reference   |
|------------------|--------------------------------|---|
|                  | csr-ns.vega.double-sums.levels | Name@CSR non-Sec Vega Double Sums@Double Sums, Basis@CSR non-Sec Vega Double Sums@Double Sums, Maturity1@CSR non-Sec Vega Double Sums@Double Sums, Maturity2@CSR non-Sec Vega Double Sums@Double Sums |

## frtb-config.properties

### Datastore (Reference Implementation)

This section describes how the [SA datastore schema](#) is used for the CSR non-Sec risk class.

The schema starts with the TradeBase store, which is an index of all the facts in the SA Cube. The **TradeBase** store has references to the risk-factor descriptions and sensitivities.

### 0.2.1 Risk Factor Descriptions

The risk-factor description starts with the RiskFactorDescription store, which contains the description of risk-factor independent of the curve, and a reference to the UnderlyingDescription store for a description of the curve.

The **UnderlyingDescription** store references the CSRBucketDesc store for the bucket descriptions.

## 0.2.2 Sensitivities

The sensitivities stores contain the sensitivity values, they are referenced from the **TradeBase** store.

| Risk Measure | Sensitivity Store |
|--------------|-------------------|
| Delta        | Delta             |
| Vega         | Vega              |
| Curvature    | Curvature         |

**TradeBase** The **TradeBase** store is the base store in the SA Cube Schema. Each row in this table represents a fact in the SA Cube.

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [TradeBase](#) store documentation for details on the store. See Data Model (Core) for a description of the data model.

| Data Model Field | Store Field  | Notes                           |
|------------------|--------------|---------------------------------|
| As-Of Date       | AsOfDate     |                                 |
| Trade ID         | TradeId      |                                 |
| Risk Factor Name | Risk Factor  |                                 |
| Risk Class       | RiskClass    | “CSR non-Sec”                   |
| Risk Measure     | Risk Measure | “Delta”, “Vega”, or “Curvature” |

**RiskFactorDescription** The RiskFactorDescription store contains the description of risk-factor.

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [RiskFactorDescription](#) store documentation for details on the store.

| Data Model Field | Store Field      | Notes                           |
|------------------|------------------|---------------------------------|
| As-Of Date       | AsOfDate         |                                 |
| Risk Factor Name | Risk Factor      |                                 |
| Risk Class       | RiskClass        | “CSR non-Sec”                   |
| Risk Measure     | Risk Measure     | “Delta”, “Vega”, or “Curvature” |
| Curve Name       | Underlying       |                                 |
| Curve Type       | Risk Factor Type | “Bond” or “CDS”                 |

**UnderlyingDescription** The **UnderlyingDescription** store contains the description of the curve.

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [UnderlyingDescription](#) store documentation for details on the store.

| Data Model Field | Store Field | Notes         |
|------------------|-------------|---------------|
| As-Of Date       | AsOfDate    |               |
| Curve Name       | Underlying  |               |
| Risk Class       | RiskClass   | “CSR non-Sec” |
| Bucket           | Bucket      |               |
| Credit Quality   | CSRQuality  |               |

| Data Model Field    | Store Field | Notes           |
|---------------------|-------------|-----------------|
| Sector              | CSRSector   |                 |
| Covered Bond Rating | CSRRating   | “high” or “low” |

**Delta** The **Delta** store contains the Delta sensitivities.

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [Delta](#) store documentation for details on the store.

| Data Model Field           | Store Field                       | Notes  |
|----------------------------|-----------------------------------|--|
| As-Of Date                 | AsOfDate                          |  |
| Trade ID                   | TradeId                           |  |
| Risk Factor Name           | Risk Factor                       |  |
| Risk Class                 | RiskClass                         | “CSR non-Sec”                                  |
| Risk Measure               | Risk Measure                      | “Delta”  |
| Sensitivities              | DeltaSensitivities                | Vector-valued. Same size as Sensitivity Tenors |
| Sensitivity Tenors         | SensitivityDates                  | Vector-valued                                  |
| Sensitivity Currency       | Ccy                               |  |
| Interpolated Sensitivities | DeltaSensitivities - Interpolated | Vector-valued. Indexed by prescribed Tenors    |
| Optionality                | Optionality                       | ‘Y’ or ‘N’                                     |

**Vega** The **Vega** store contains the Vega sensitivities.

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [Vega](#) store documentation for details on the store.

| Data Model Field           | Store Field                      | Notes  |
|----------------------------|----------------------------------|--|
| As-Of Date                 | AsOfDate                         |  |
| Trade ID                   | TradeId                          |  |
| Risk Factor Name           | Risk Factor                      |  |
| Risk Class                 | RiskClass                        | “CSR non-Sec”                                  |
| Risk Measure               | Risk Measure                     | “Vega”   |
| Sensitivities              | VegaSensitivities                | Vector-valued; Same size as Sensitivity Tenors |
| Sensitivity Tenors         | OptionMaturity                   | Vector-valued                                  |
| Sensitivity Currency       | Ccy                              |  |
| Interpolated Sensitivities | VegaSensitivities - Interpolated | Vector-valued; Indexed by prescribed Tenors    |

**Curvature** The **Curvature** store contains the Curvature shocked prices.

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [Curvature](#) store documentation for details on the store.

| Data Model Field | Store Field | Notes |
|------------------|-------------|-------|
| As-Of Date       | AsOfDate    |       |
| Trade ID         | TradeId     |       |

| Data Model Field     | Store Field   | Notes                                   |
|----------------------|---------------|---|
| Risk Factor Name     | Risk Factor   |   |
| Risk Class           | RiskClass     | “CSR non-Sec”                           |
| Risk Measure         | Risk Measure  | “Curvature”                             |
| Shock Up             | Shift_Up_PV   | Vector-valued. Same size as Risk Weight |
| Shock Down           | Shift_Down_PV | Vector-valued. Same size as Risk Weight |
| Risk Weight          | RiskWeight    | (optional) Vector-valued                |
| PV Applied           | PVApplied     | ‘Y’ or ‘N’                              |
| Sensitivity Currency | Ccy           |   |

**CSRNonSecBucket** The **CSRNonSecBucket** store is used by the ETL to populate the Bucket.

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [CSRNonSecBucket](#) store documentation for details on the store.

| Data Model Field        | Store Field     | Notes         |
|-------------------------|-----------------|---------------|
| As-Of Date              | AsOfDate        |               |
| Bucket                  | Bucket          | 1-18          |
| Credit Quality Category | Rating Category |               |
| Sector Category         | Sector Category |               |
| Risk Class              | RiskClass       | “CSR non-Sec” |

**CSRBucketDesc** The **CSRBucketDesc** store provides canonical descriptions for the CSR non-Sec [buckets](#).

The following table lists the fields in the store that are used for the CSR non-Sec risk-class. See the [CSRBucketDesc](#) store documentation for details on the store.

| Data Model Field | Store Field    | Notes  |
|------------------|----------------|--|
| As-Of Date       | AsOfDate       |  |
| Credit Quality   | Credit Quality | Must match Credit Quality in UnderlyingDescription store |
| Sector           | Sector         | Must match Sector in UnderlyingDescription store         |
| Bucket           | Bucket         | 1-18   |
| Risk Class       | RiskClass      | “CSR non-Sec”  |

### Cube Schema (Reference Implementation)

The following table lists the levels and hierarchies in the Cube schema that are used in the CSR non-Sec data model.

| Data Model Field | Cube Level/Hierarchy               | Notes                        |
|------------------|------------------------------------|------------------------------|
| As-Of Date       | <a href="#">AsOfDate</a>           | Slicing Hierarchy            |
| Trade ID         | <a href="#">TradeId</a>            |                              |
| Risk Class       | <a href="#">Risk Class</a>         | “CSR non-Sec”                |
| Risk Measure     | <a href="#">Risk Measure</a>       | “Delta”, “Vega”, “Curvature” |
| Bucket           | <a href="#">CSR non-Sec Bucket</a> |                              |
| Risk Factor Name | <a href="#">Risk Factor</a>        |                              |

| Data Model Field                    | Cube Level/Hierarchy                          | Notes   |
|-------------------------------------|---|---|
| Sensitivity Tenor / Option Maturity | <a href="#">Vertex</a>                        | Analysis Hierarchy                                |
| Curve Name                          | <a href="#">Underlying</a>                    |   |
| Curve Type                          | <a href="#">Risk Factor Type</a>              |   |
| Credit Quality                      | <a href="#">CSR Quality</a>                   |   |
| Sector                              | <a href="#">CSR Sector</a>                    |   |
| Covered Bond Rating                 | <a href="#">CSR Rating</a>                    |   |
| Credit Quality Category             | <a href="#">CSR non-Sec Rating Category</a>   |   |
| Sector Category                     | <a href="#">CSR non-Sec Sector Category</a>   |   |
|                                     | <a href="#">CSR non-Sec Delta Double Sums</a> | Levels for the Delta Double Sums and Correlations |
|                                     | <a href="#">CSR non-Sec Vega Double Sums</a>  | Levels for the Vega Double Sums and Correlations  |

### Configuration (Core)

This section describes how the calculations are configured for the CSR non-Sec risk class

**Bucket Risk Weights** Maps Buckets to Risk Weights.

The file **CSR\_BucketsRiskWeights\_NONSEC\*.csv** is loaded into the **CSRBucketsRiskWeight** store.



| Data Model Field     | File Column | Datastore Column | Notes         |
|----------------------|-------------|------------------|---------------|
| Bucket               | Bucket      | Bucket           | 1-18          |
| $RW_k$ in [MAR21.53] | Risk Weight | RiskWeight       |               |
| Risk Class           |             | RiskClass        | “CSR non-Sec” |

**Inter-Bucket Correlations** Maps Bucket x Bucket to  $\gamma_{bc}^{(sector)}$  correlation.

The file **CSRNS\_Bucket\_Correlations\*.csv** is loaded into the **CSRBucketCorrelations** store.

| Data Model Field                       | File Column | Datastore Column | Notes         |
|--|-------------|------------------|---------------|
| Bucket $b$                             | Bucket X    | Bucket X         | 1-18          |
| Bucket $c$                             | Bucket Y    | Bucket Y         | 1-18          |
| $\gamma_{bc}^{(sector)}$ in [MAR21.57] | Correlation | Correlation      |               |
| Risk Class                             |             | RiskClass        | “CSR non-Sec” |

**Vertices** The list of CSR non-Sec Delta Tenors and Vega Option Maturities.

The file **Vertices\*.csv** is loaded into the **Vertices** store.

| Data Model Field | File Column | Datastore Column | Notes |
|------------------|-------------|------------------|-------|
|                  | Index       | Index            | 0-4   |

| Data Model Field                    | File Column  | Datastore Column | Notes   |
|-------------------------------------|--------------|------------------|---|
| Sensitivity Tenor / Option Maturity | Vertex       | Vertex           | 0.5;1;3;5;10<br>Delta Tenors in <a href="#">[MAR21.9](1)(b)</a><br>Vega Option Maturities in <a href="#">[MAR21.9](2)</a> |
| Risk Class                          | Risk Class   | RiskClass        | “CSR non-Sec”   |
| Risk Measure                        | Risk Measure | Risk Measure     | “Delta” or “Vega”   |

**Vega Liquidity Horizons** The file **Vega\_Liquidity\_Horizons\*.csv** is loaded into the **VegaRiskWeights** store.

| Data Model Field                                       | File Column | Datastore Column  | Notes         |
|--|-------------|-------------------|---------------|
| Risk Class   | Risk Class  | RiskClass         | “CSR non-Sec” |
| $LH_{\text{risk class}}$ in <a href="#">[MAR21.92]</a> | Vega LH     | Liquidity Horizon | “120”         |

**Miscellaneous Parameters** The file **FRTBParameters\*.csv** is loaded into the **FRTBParameters** store.

| Parameter  | Parameter Name                            | Default Value |
|--|---|---------------|
| $\rho_{kl}^{(name)}$ in <a href="#">[MAR21.54]</a>                                 | sa.csr-nonsec.delta.rho-name.correlation  | 0.35          |
| $\rho_{kl}^{(tenor)}$ in <a href="#">[MAR21.54]</a> and <a href="#">[MAR21.55]</a> | sa.csr-nonsec.delta.rho-tenor.correlation | 0.65          |
| $\rho_{kl}^{(basis)}$ in <a href="#">[MAR21.54]</a> and <a href="#">[MAR21.55]</a> | sa.csr-nonsec.delta.rho-basis.correlation | 0.999         |

| Parameter  | Parameter Name  | Default Value |
|--|---|---------------|
| $\rho_{kl}^{(name)}$ in <a href="#">[MAR21.55]</a>                                       | sa.csr-nonsec.delta.rho.index.correlation                                 | 0.8           |
| $\gamma_{bc}^{(rating)}$ in <a href="#">[MAR21.57]</a>                                   | sa.csr-nonsec.delta.gamma-rating.correlation                              | 0.5           |
| Use alternative risk weight for highly rated covered bonds in <a href="#">[MAR21.53]</a> | sa.csr-nonsec.delta.risk-weight.covered-bonds.use-high-rating-alternative | true          |
| Alternative risk weight for highly rated covered bonds in <a href="#">[MAR21.53]</a>     | sa.csr-nonsec.delta.risk-weight.covered-bonds.high-rating-alternative     | 0.015         |
| $RW_{\sigma}$ in <a href="#">[MAR21.92]</a>  | sa.vega.rw  | 0.55          |
| $\alpha$ in <a href="#">[MAR21.93]</a> (1)(a)  | sa.vega.rho-option-maturity.alpha   | 0.01          |