FRTB Deep Dive

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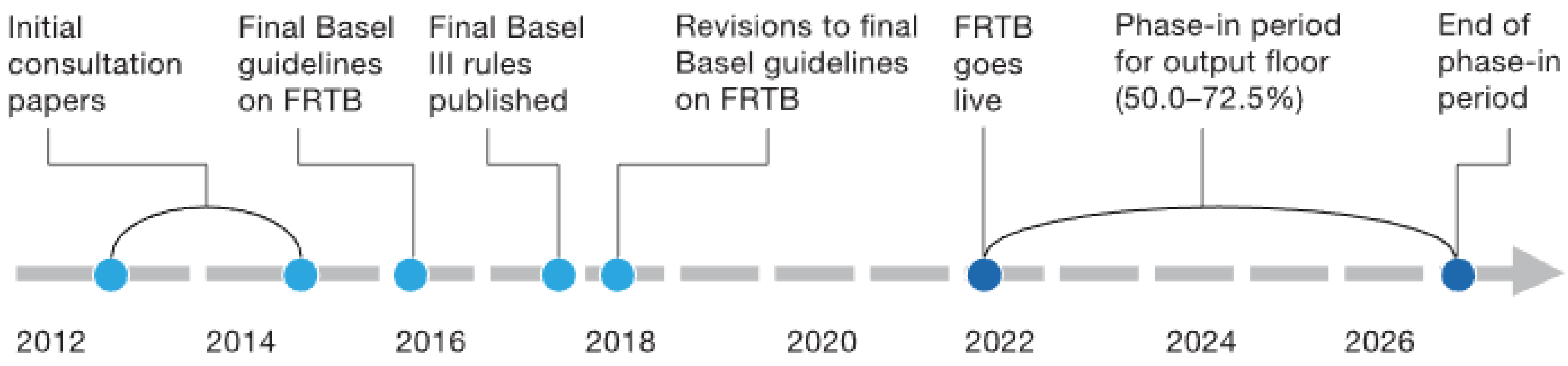
FRTB – Prospective time lines

Fundamental Review of the Trading Book (FRTB) timeline



Source: International Monetary Funds

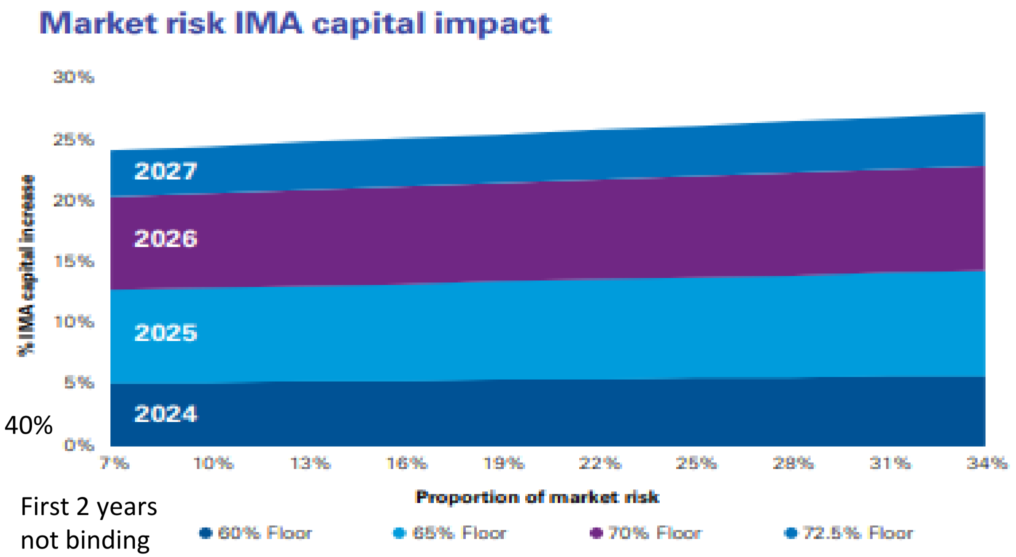
FRTB – Short Introduction

- Relative gains of IMA over SA
  - Lower charges relative to SA charges
  - Synergies: opportunity to upgrade Data Model in bank-wide system
  - Clear data lineage for the whole front-to-back trading risk-data flow
  - Integrating data across different silos (credit risk, market risk, finance, operational)
  - Maintain product offering

- Relative costs of IMA
  - Interpretation of the regulation
  - Design of IMA architecture
  - Implementation

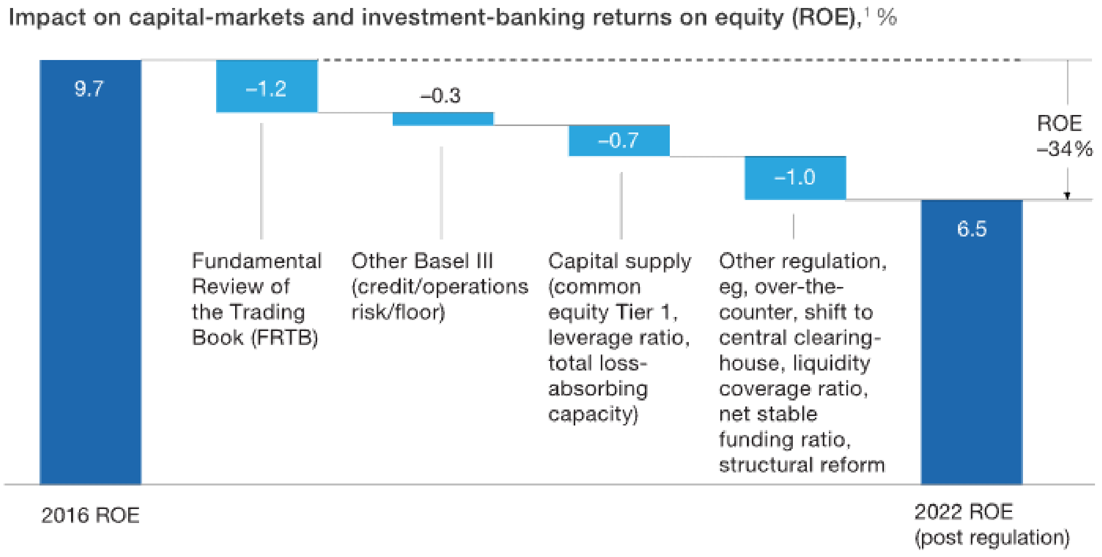
- Whether to invest in IMA? Cost of implementing IMA lower than:
  - Static one-year gain of IMA over SA, or
  - Discounted future gains of IMA over SA until Basel “V”

Impact of FRTB



No floor = 40% reduction

First 2 years not binding



Source: KPMG charge impact study

Source: McKinsey ROE impact study

Overview of topics

- **Main changes in Basel IV**
- **Tradeoff between SA and the IMA**
- **Overview SA + challenges**
- **Overview IMA + challenges**
- **Q & A**

FRTB – main tradeoff SA vs IMA

- **Introduction** - January 2016, the Basel Committee on Banking Supervision (BCBS) releases the Standards for Minimum Capital Requirements for Market Risk; also known as The Fundamental Review of the Trading Book (FRTB).

- **Risk Weighted Assets** – Aim of this new regulation is to specify and determine the minimum levels for the Market Risk Capital charges. Such that these charges reflect the potential loss from trading book positions under adverse market scenarios.
- **Main tradeoff: SA vs IMA?** – Or, Standardized Approach vs Internal Models Approach? Not a clear-cut choice as under Basel II. This choice needs to be re-evaluated for FRTB. Notwithstanding the improvements in both methods since Basel II, the potential advantages of the IMA is difficult to evaluate due to the many complexities in using IMA.

- **Challenges of IMA** – Requires assessment and approval by supervisor; P&L Attribution and back-testing eligibility tests for trading desks to use IMA; risk factor classification and associated charges; significant extensions to existing IMA framework and compared to SA. Still requires the implementation of SA.
- **Advantages of IMA** – SA is likely to result in materially higher charges than IMA for most trading desks.

Enhancements of FRTB to existing risk framework

Regulatory boundary between trading and banking book	• New defined list of instruments presumed to be included in the trading book or banking book. Deviation requires explicit approval from supervisor. • Strict limits on the movement of instruments between the books after initial designation. Should a re-designation be approved a capital benefit will not be allowed.
From VaR to ES	• The new risk measure for market risk according to the FRTB is the Expected Shortfall (ES). • ES is a coherent risk measure, whereas Value-at-Risk (VaR) is not due to the missing sub-additivity feature. • Banks must calibrate the ES to periods of significant market stress. • This new metric will help to capture the tail risk and so maintain adequate capital during periods of significant market stress
Revised standardised approach	• Significant charges with introduction of Sensitivities-based methodology. • The revised standardised approach will act as a floor to the internal models approach.
Inclusion of market illiquidity	• Varying liquidity horizons included in the internal models approach. Relevant for ES and Stressed ES charges. • Replaces the static 10-day liquidity horizon currently assumed in the VaR framework.
Revised approach to approval for internal models	• Supervisors will review the use of internal models at firm-wide and desk level. • More rigourous model approval process using both quantitative and qualitative test criteria. • Underlying regulatory goal: align front office pricing systems with risk management models

Overview SA

The revised Standardised Approach or SA

Overview of the revised SA

Capital charge components	Definitions
1 Sensitivities-based charge	The bank must determine the relevant sensitivities based upon regulatory pre-defined shifts for the relevant risk factors
a Linear risk • **Delta** risk • **Vega** risk (options only)	• **Delta**: A risk measure based on sensitivities of a bank's trading book positions to regulatory Delta risk factors. • **Vega**: A risk measure that is also based on sensitivities to regulatory Vega risk factors to be used as inputs to a similar aggregation formula as for Delta risks
b Non-linear risk • **Curvature** risk	• **Curvature**: A risk measure which captures the **incremental risk** not captured by the Delta or Vega risk of price changes in the value of an option. • Two stress scenarios per risk factor have to be calculated and the worst scenario loss is aggregated in order to determine curvature risk.
2 Default risk charge	A risk measure that captures the jump-to-default risk in three independent capital charge computations.
3 Residual risk charge	A risk measure to capture residual risk, i.e. risk which is not covered by components 1 and 2.

FRTB Definitions

	Definitions
Risk class	Definitions of 7 risk classes for the Sensitivities-based method (explicit definition provided on next slide): GIRR · Equity · Commodity · FX · CSR (non-SEC) · CSR (SEC) · CSR (CTP)
Risk factor	• Variable (e.g. a given vertex of a given interest rate curve or an equity price) within a pricing function; decomposed from trading book instruments; • Risk factors are mapped to a risk class.
Risk position	• Main input which enters the risk charge computation; • Delta and Vega risks: sensitivity to a risk factor; • Curvature risk: worst loss of two stress scenarios.
Bucket	• Set of risk positions which are grouped together by common characteristics.
Risk charge	• Amount of capital a bank should hold as a consequence of the measured risks; • Computed as an aggregation of risk positions first at the bucket level, and then across buckets within a risk class defined for the Sensitivities-based method.

GIRR Trading Desk Example

1 Sensitivities-based charge
- a Linear Delta & Vega
- b Non-Linear Curvature

2 Default risk charge

3 Residual risk charge

IR trading desk (example)	Pricing models	Risk factor objects	Risk factors require classification
10Y EUR12M Libor Swap, fix-for-float	Cash flow model	• Discount curve • Forward curve	• **Zero rates, EONIA discount curve** • Zero rates, EUR12M forward curve
Receiver Swaption, 5Y mat, on a 10Y EUR6M Libor Swap	Black '76 model	• Discount curve (for swaption) • Discount curve (for swap) • Forward curve • Black volatility cube (e.g. SABR)	• Zero rates, EONIA discount curve, to discount optionality (different for cash settled) • Zero rates, EONIA discount curve, used for the swap, • Zero rates, EUR6M used for the swap • Black volatilities / SABR parameters to represent the Black Volatility cube (dim: tenor/maturity/strike)
10Y EUR6M IR Cap	Bachelier model for caplets	• Discount curve • Forward curve • Black forward volatility surface	• Zero rates, EONIA discount curve • Zero rates, EUR6M used to infer Libor rates for caplets • Bachelier forward volatilities, volatility surface (dim: strike/maturity)
XCCY Swap EUR6M vs FCCY-XM + spread	Cash flow model	• Discount curves • Forward curves • Spread • FX Spot	• Zero rates, EONIA discount curve • **Zero rates, EUR6M forward curve** • FX spot • Zero rates, Foreign discount curve • Zero rates, Foreign forward curve • Spread

Standardised Approach 7 Risk Classes

1 Sensitivities-based charge
a Linear Delta & Vega
b Non-Linear Curvature

2 Default risk charge

3 Residual risk charge

7 Risk Classes	Risk Buckets	Risk Weights	Risk Correlations
GIRR (General interest rate risk)	Each bucket represents an individual currency exposure to GIRR.	• Risk weights (RW) depending on vertices ranging from 0.25 years to 30 years; • Risk weights range from 1.5% to 2.4%.	Correlations between two sensitivities depend on equality of buckets, vertices and curves.
Equity	• Buckets depend on market capitalization, economy (emerging or advanced) and sector; • Total of 11 buckets (e.g. consumer goods and telecommunication).	• Differentiation between risk weights to equity spot price and equity repo rate • Risk weights for equity spot price ranges from 55% to 70%.	Correlation between two sensitivities for the same bucket (but related to different equity issuer names) depend on market cap and economy and range between 7.5% and 25%.
Commodity	Eleven buckets are defined for commodity (e.g. energy, freight, metals, grains & oilseed, livestock and other agriculturals).	• The risk weights depend on the commodity buckets (which group individual commodities by common characteristics); • Risk weights range from 20% to 80%.	Correlation between two sensitivities (same bucket) are defined by a multiplication of factors related to the commodity type, vertices and contract grade / delivery location.
FX (Foreign exchange)	No specific FX buckets	A unique relative risk weight equal to 30% applies to all the FX sensitivities or risk exposures.	A uniform correlation parameter equal to 60% applies to FX sensitivity or risk exposure pairs.

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Standardised Approach 7 Risk Classes

1 Sensitivities-based charge
a Linear Delta & Vega
b Non-Linear Curvature
2 Default risk charge
3 Residual risk charge

--- Table continued from previous slide ---

7 Risk Classes	Risk Buckets	Risk Weights	Risk Correlations
Credit Spread Risk (CSR) Non-securitisation	16 buckets defined based on credit quality and sector	• Risk weights are the same for all vertices within each bucket; • Risk weights range from 0.5% to 12%.	Correlations between two sensitivities depend on equality of buckets, vertices and curves.
CSR correlation trading portfolio (CTP)	The same bucket structure as for CSR non-securitization applies.	• Risk weights are the same for all vertices within each bucket; • Risk weights range from 2% to 16%.	Correlation between two sensitivities for the same bucket (but related to different equity issuer names) depend on market cap and economy and range between 7.5% and 25%.
CSR non-correlation trading portfolio (n-CTP)	25 buckets defined based on credit quality and sector.	Risk weights range from 0.8% to 3.5%.	• Correlations between sensitivities within the same bucket and securitization tranche depend on names and vertices of the sensitivities, and related curves; • Separate rules “other sector” buckets.

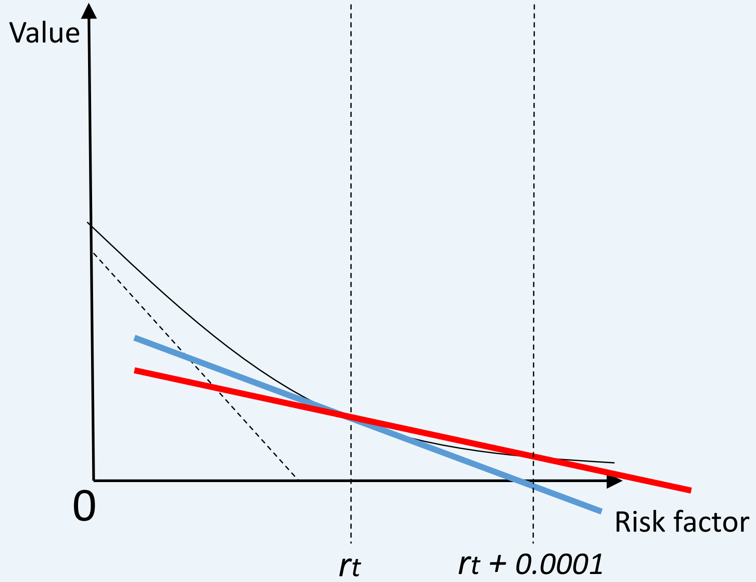
Standardised Approach

1 Sensitivities-based charge
a Linear Delta & Vega
b Non-Linear Curvature
2 Default risk charge
3 Residual risk charge

What are the sensitivities?

$$s_{k,r_t} = \frac{V_i(r_t + 0.0001, cs_t) - V_i(r_t, cs_t)}{0.0001}$$

Theoretical sensitivity: $\frac{dV_i(r_t, cs_t)}{dr_t}$



Standardised Approach

1 Sensitivities-based charge: a Linear Delta & Vega; b Non-Linear Curvature | 2 Default risk charge | 3 Residual risk charge

Linear Risk calculation	Supervisory requirements	Details
1 Assignment of positions to risk classes, buckets and risk factors.	All positions ➔ Risk Class ➔ Bucket ➔ Risk Factor	• Delta and Vega risks are computed with the same aggregation methods on all relevant risk factors. • Separate calculation (no diversification benefit recognized)
2 Calculation of the risk factor's sensitivities.	$s_{k,r_t} = \frac{V_i(r_t + 0.0001, cs_t) - V_i\ (r_t, cs_t)}{0.0001}$	• The sensitivities are defined by the regulator. • Sensitivities for each risk class are expressed in the reporting currency of the bank.
3 Calculation of weighted sensitivities per bucket via given supervisory RW.	$WS_k = RW_k s_k$	The corresponding RW are defined by the regulator.
4 Aggregation of weighted sensitivities per bucket.	$K_b = \sqrt{\sum_{k=1}^{n} WS_k^2 + \sum_{k=1}^{n-1}\sum_{l=k+1}^{n} \rho_{kl} WS_k WS_l}$	The risk position for bucket *b*, K_b, must be determined by aggregation of the weighted sensitivities to risk factors within the same bucket with the prescribed correlation coefficients.
5 Aggregation of capital charge on risk class level.	$RC = \sqrt{\sum_{b=1}^{m} K_b + \sum_{b=1}^{m-1}\sum_{c=b+1}^{m} \gamma_{kl} S_b S_c}$	• The risk charge is determined from risk positions aggregated between the buckets within each risk class. • S_b and S_c are the sums of the weighted sensitivities associated with the corresponding buckets *b* and *c*.

Standardised Approach

1 Sensitivities-based charge
a Linear Delta & Vega
b Non-Linear Curvature
2 Default risk charge
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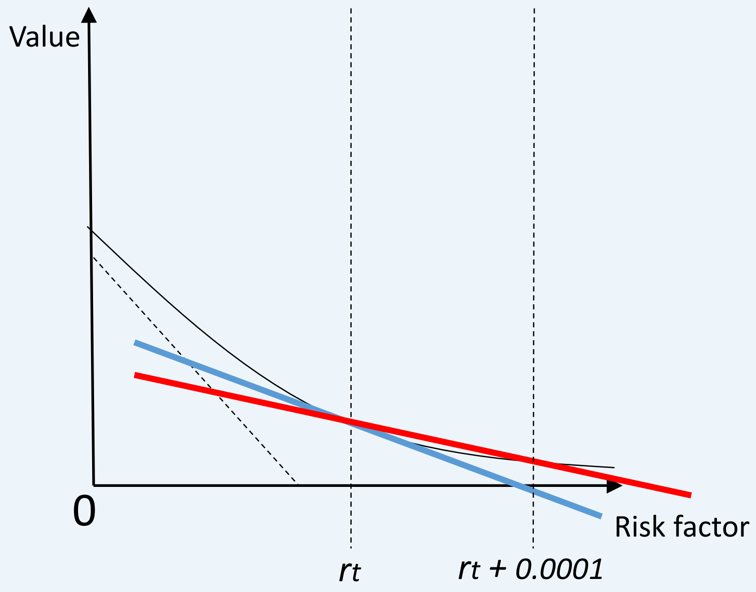
Caveat sensitivities, under the standardized approach

$$s_{k,r_t} = \frac{V_i(r_t + 0.0001, cs_t) - V_i\ (r_t, cs_t)}{0.0001}$$

Theoretical sensitivity: $\frac{dV_i(r_t, cs_t)}{dr_t}$



Standardised Approach

1 Sensitivities-based charge: a Linear Delta & Vega; b Non-Linear Curvature | 2 Default risk charge | 3 Residual risk charge

Non-Linear Risk calculation	Supervisory requirements	Details
1 Finding a net curvature risk charge CVR across instruments to each curvature risk factor k	$$CVR_k = -min\begin{bmatrix}\sum_i \left\{V_i\left(x_k^{(RW^{(curvature)}+)}\right) - V_i(x_k) - RW_k^{(curvature)} s_{ik}\right\} \\ \sum_i \left\{V_i\left(x_k^{(RW^{(curvature)}-)}\right) - V_i(x_k) + RW_k^{(curvature)} s_{ik}\right\}\end{bmatrix}$$	• Only the risk positions with explicit or embedded options • Two stress scenarios are to be computed per risk factor (an upward shock and a downward shock) • The worse potential loss of the two scenarios, after deduction of the Delta risk positions, is the outcome of the first scenario
2 Assignment of positions to risk classes, buckets and risk factors.	$$K_b = \sqrt{\max\left(0, \sum_k \max(CVR_k, 0)^2 + \sum_k \sum_{k \neq l} \rho_{kl} CVR_k CVR_l \psi(CVR_k, CVR_l)\right)}$$	• ψ is a function that returns 0 if both arguments have negative signs. • In all other three cases ψ returns 1.
3 Assignment of positions to risk classes, buckets and risk factors.	$$RC_{Curvature} = \sqrt{\sum_b K_b^2 + \sum_b \sum_{c \neq b} \gamma_{bc} S_b S_c \psi(S_b, S_c)}$$	

Standardised Approach

1 Sensitivities-based charge — a Linear Delta & Vega; b Non-Linear Curvature | 2 Default risk charge | 3 Residual risk charge

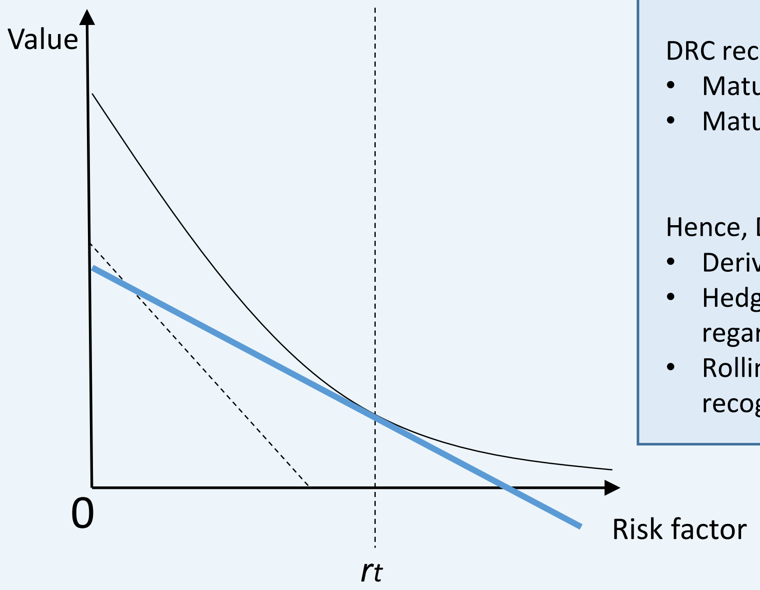
DRC calculation	Supervisory requirements	Details
1 Calculation of gross JTD positions	$JTD\ (long) = \max(LGD\ x\ notional + P\&L, 0)$ $JTD\ (short) = \min(LGD\ x\ notional + P\&L, 0)$ $P\&L = market\ value\ - notional$	• The jump-to-default (JTD) risk is computed for each instrument separately. JTD risk is a function of notional amount (or face value) and market value of the instruments and prescribed Loss given Default (LGD) figures.
2 Calculation of net JTD positions	e.g. Non-securitization: long bond position and short equity position to the same obligor $netJTD = Bond_{long} - Equity_{short}$	• The net JTD risk positions are calculated by using specified offsetting rules.
3 Hedge benefit recognition	$W_{ts} = \frac{\sum netJTD_{long}}{\sum netJTD_{long} + \sum \lvert netJTD_{short} \rvert}$	In order to recognize hedging relationship between long and short positions within a bucket, a hedge benefit ratio is computed and applied to discount the hedge benefits.
4 Bucket allocation and calculation of weighted net JTD positions and default capital charge (DRC)	e.g. for non-securitization and securitization non-correlation trading portfolio (NCTP) $DRC_b = \max[\sum_{i \in long} RW_i netJTD_i - W_{ts} \sum_{i \in short} RW_i \lvert netJTD_i \rvert, 0]$	• JTD positions are allocated to buckets and weighted. For non-securitization risk weights are prescribed and for securitization risk weights are to be computed applying the banking book regime. • For non-securitization and securitization NCTP the overall capital charge is the simple sum of the bucket level risks. For the correlation trading portfolio capital charge is the sum of positive bucket level risks and half of the negative bucket level risks.

Standardised Approach

DRC Caveat I: Rolling Hedges

Derivative, maturity > 1 Year

Theoretical sensitivity: $\frac{dV_i(r_t, cs_t)}{dr_t}$



← Position + Hedge →

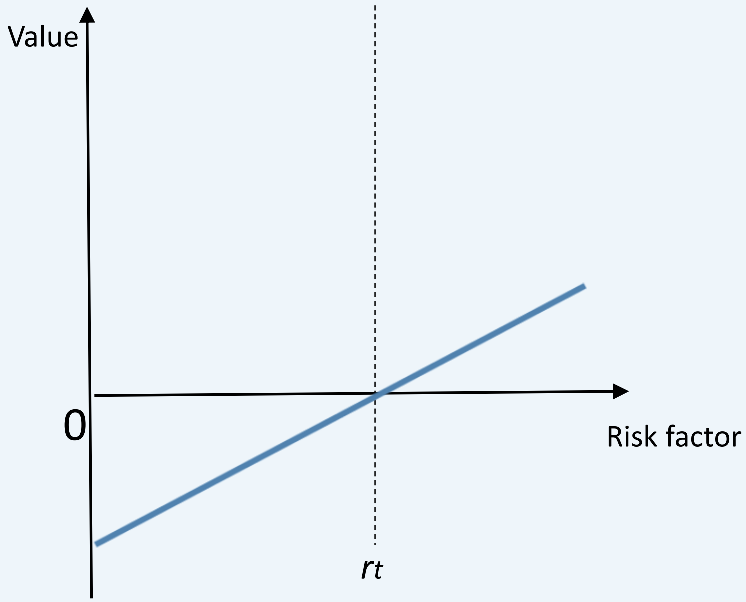
DRC recognizes only maturities = {3M, [1Y, ∞]}

- Maturity >= 1 year, implies position weight 1
- Maturity < 1 year, implies position weight 1/4

Hence, DRC implications:

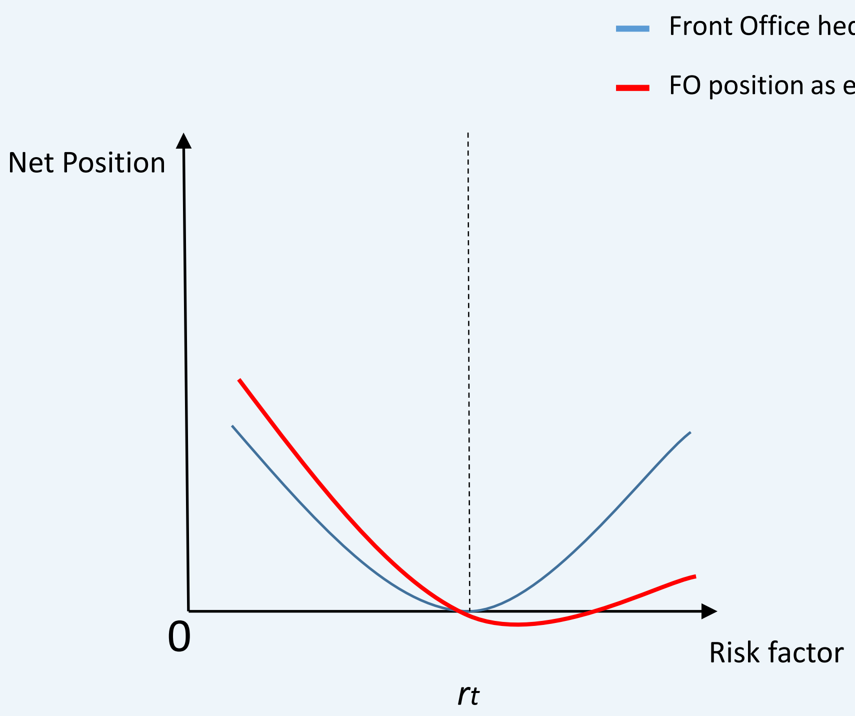
- Derivative position ← receives weight 1
- Hedge position → receives weight 1/4, regardless of actual maturity
- Rolling hedges are therefore not fully recognized as valid hedge in the DRC

Hedge position (futures in underlying), maturity < 1 Year



Standardised Approach

DRC Caveat I: Rolling Hedges



🡐 Net Position

DRC recognizes only maturities = {3M, [1Y, ∞]}

- Maturity >= 1 year, implies position weight 1
- Maturity < 1 year, implies position weight 1/4

Hence, DRC implications:

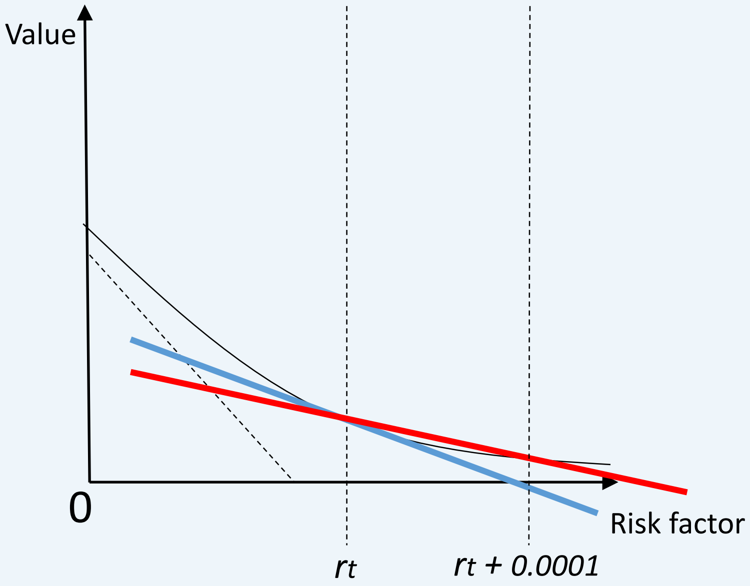
- Derivative position receives weight 1
- Hedge position receives weight 1/4, regardless of actual maturity
- Rolling hedges are therefore not fully recognized as valid hedge in the DRC

Standardised Approach

Caveat sensitivities, under the standardized approach

$$s_{k,r_t} = \frac{V_i(r_t + 0.0001, cs_t) - V_i\,(r_t, cs_t)}{0.0001}$$

Theoretical sensitivity: $\frac{dV_i(r_t, cs_t)}{dr_t}$



"Look-through approach"

Example: Equity Index Options

- Jump-to-default calculation: Drill-down to index constituents and shock these to gauge DRC charge for index options
- Accumulation of errors, due to approximating Sensies (see graph)
- Requires constituent weights.

Standardised Approach

1 Sensitivities-based charge: a Linear Delta & Vega; b Non-Linear Curvature | 2 Default risk charge | 3 Residual risk charge

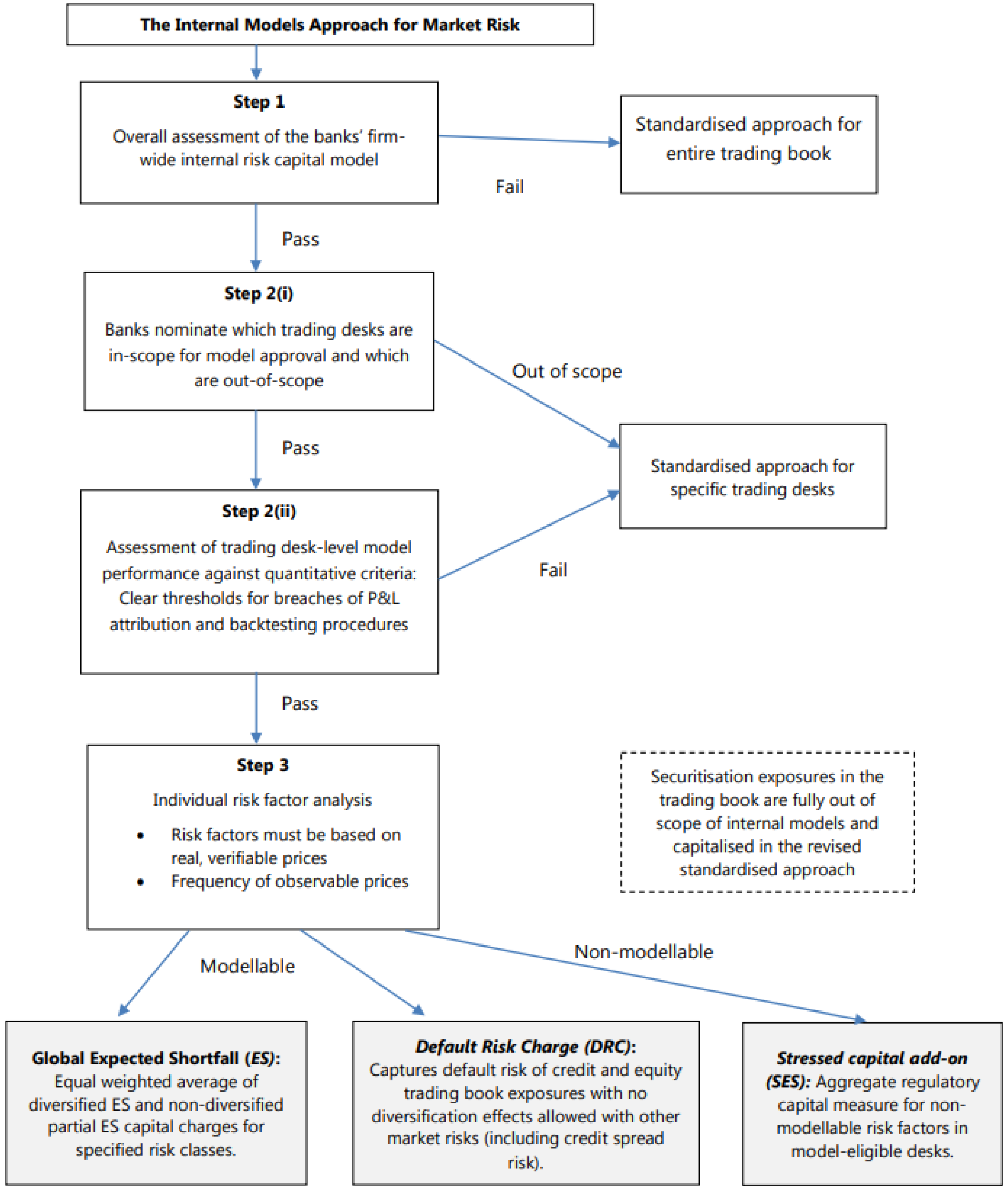
Residual Risk Add-On	Details
Calculation	• The residual risk add-on is the simple sum of gross notional amounts of the instruments bearing residual risks. • RW = 1.0% for instruments with an exotic underlying (e.g. longevity risk, weather or natural disasters) • RW = 0.1% for instruments bearing other residual risks.

Criteria for instruments bearing other risks

Instruments subject to Vega or Curvature Risk capital charges in the trading book and with pay-offs that cannot be written or perfectly replicated as a finite linear combination of Vanilla options with a single underlying equity price, commodity price, exchange rate, bond price, CDS price or interest rate swap.	Instruments which fall under the definition of the correlation trading portfolio (CTP), except for those instruments which are recognized in the market risk framework as eligible hedges of risks within the CTP.
A non-exhaustive list of other residual risks types and instruments that may fall within the criteria.	The following risk types by itself will not cause the instrument to be subject to the residual risk add-on.
Gap risk, correlation risk and behavioural risk	Smile risk (a special form of the implicit volatility risk of options) or dividend risk arising from a derivative instrument

The Internal Model Approach or IMA

Overview IMA



Trading desk eligibility to use IMA

Assessments	Concrete action and requirements	Required infrastructure/tools
1 **Bank level** nomination of trading desks in scope for IMA	*…banks must nominate which trading desks are in-scope for model approval and which trading desks are out-of-scope. Banks must specify in writing the basis for the nomination* [183b, p. 56]. Out-of-scope nomination cannot be based on SA charges being less than the IMA-based charges.	• Provide motivation for nomination of trading desk for IMA approval. • Desks out of scope will be capitalized according to the SA.
2 **Trading desk level** eligibility tests	Basel aims with the tests below for an alignment between FO systems and the IMA. Simplified risk management systems may not reflect all material risks, and large differences with the FO systems results in failing at least one of the tests. Failing implies the trading desk to fall back to the SA for at least 1 year.	• Upon failing one of the below tests, the bank can resubmit a request for approval for the trading desk to use IMA after 12M.
a P&L attribution assessment	Assess the materiality of differences between the bank's risk management models, Risk-Theoretical P&L (RTPL), and valuation models in FO, Hypothetical P&L (HPL). Some degree of difference between RTPL and HPL is allowed, but differences should not be significant. The bank can choose between two statistical test metrics to measure differences in P&L. Furthermore, the revision to the standard remarks on the use of proxy data: *If risk factors are represented by proxy data in the ES model, the proxy data representation of the risk factor – not the risk factor itself – must be used in the RTPL* [Principle 7, d436, p. 32]	• Maintain database with historical quotes for HPL and risk factor values for RTPL, at least dating back 12M. • Capacity to calculate test metrics • Report test metrics quarterly • Ensure proxy methodologies derive from the risk management models
b Backtesting	*The backtesting assessment is considered to be complementary to the P&L attribution assessment when determining the eligibility of a trading desk for the IMA. The backtests to be applied compare whether the observed percentage of outcomes covered by the risk measure is consistent with both a 97.5% and 99% level of confidence* [App B. II., pp. 71 - 72].	• Capacity to backtest for risk measures: VaR, ES…

Trade desk eligibility: Nomination for IMA

Nomination of trading desks in scope for internal model approval

- *…banks must nominate which trading desks are in-scope for model approval and which trading desks are out-of-scope. Banks must specify in writing the basis for the nomination. Banks must not nominate desks to be out-of-scope due to standardised approach capital charges being less than the modelled requirements. Desks that are out-of-scope will be capitalised according to the standardised approach on a portfolio basis* (183b, p. 56)

Trading desk eligibility to use IMA

1 Trade desk nomination for IMA | 2 Trading desk level eligibility tests: a P&L Attrib. | b Backtesting

P&L attribution assessment

Aim of the P&L attribution test:

Assess the materiality of differences between bank's risk management models (Risk-Theoretical P&L) and valuation models (Hypothetical P&L) used in the front office.

Risk-Theoretical P&L (RTPL):

RTPL denotes *the daily desk-level P&L that is predicted by the valuation engine of the risk management model using all risk factors used in the risk management model* [p26 d436, ref]. Risk factors include here also Non-Modellable Risk Factors.

Hypothetical P&L

HPL *must be calculated by revaluing the positions held at the end of the previous day using the market data of the present day, i.e. using static positions* [p25 d436, ref]. Not taking into account intraday trading nor new or modified deals.

Some degree of difference between HPL and RTPL is allowed, but differences should not be significant. Significant differences are inferred with the following statistical tests along the hypothesis:

Hypothesis: HPL = RTPL

1. Spearman correlation of the ranks between the RTPL and the HPL

   Rejection of Hypothesis → Desk falls back to SA

2. Test metric of the likeness between the RTPL and HPL. The bank can choose between 2 alternatives:
   - I. Kolmogorov –Smirnov, **OR**
   - II. Chi-squared.

   Rejection of Hypothesis → Desk falls back to SA

- The sample for the computation of both test metrics should comprise of at least 250 business days of observations of the RTPL and HPL obtained from the past 12M.
- Banks are required to estimate and report these metrics for each trading desk at a quarterly frequency.

Trading desk eligibility to use IMA

1 Trade desk nomination for IMA

2 Trading desk level eligibility tests

a P&L Attrib.

b Backtesting

P&L attribution assessment

P&L Attribution assessment

Hypothesis: HPL = RTPL

1. Spearman correlation of the ranks between the RTPL and the HPL
2. Test metric of the likeness between the RTPL and HPL. The bank can choose between 2 alternatives:
   - I. Kolmogorov –Smirnov (KS), **OR**
   - II. Chi-squared.

A trading desk is in the Green zone if both (i) the Spearman correlation metric is above 0.852; **and** (ii) the KS (Chi-squared) distributed test statistic is below 0.083 (14).

A trading desk is in the Amber zone if it is neither allocated to the Green or the Red zone.

- Desk still in scope for IMA and capitalized accordingly.

A trading desk is in the Red zone if the correlation metric is less than 0.75 or if the KS (Chi-squared) distributed test metric is above 0.095 (18).

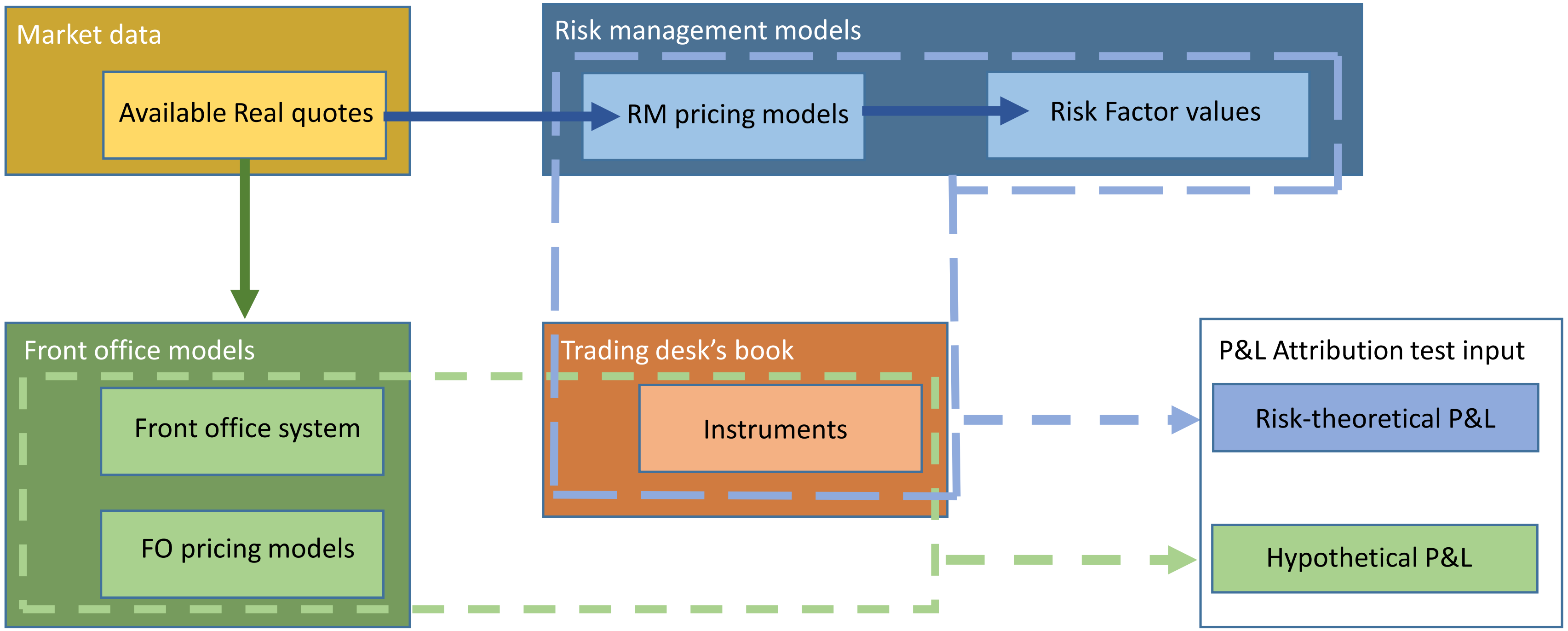
- Desk falls back to SA and capitalized accordingly.

For all desks in scope to remain eligible at the bank level to use IMA, a minimum of 10% of the bank's aggregated market risk charges must be based on positions held in desks that are eligible to use IMA.

Trading desk eligibility to use IMA

P&L attribution assessment

Simplified presentation of the P&L attribution assessment. First, inference of Risk Factor Values from Available Real quotes with the RM pricing models. Then value the trading desk's book with the RM pricing models and prevailing risk factor values. The HPL is obtained with the valuation of the trading desk's book based on Available Real quotes in the Front office models.

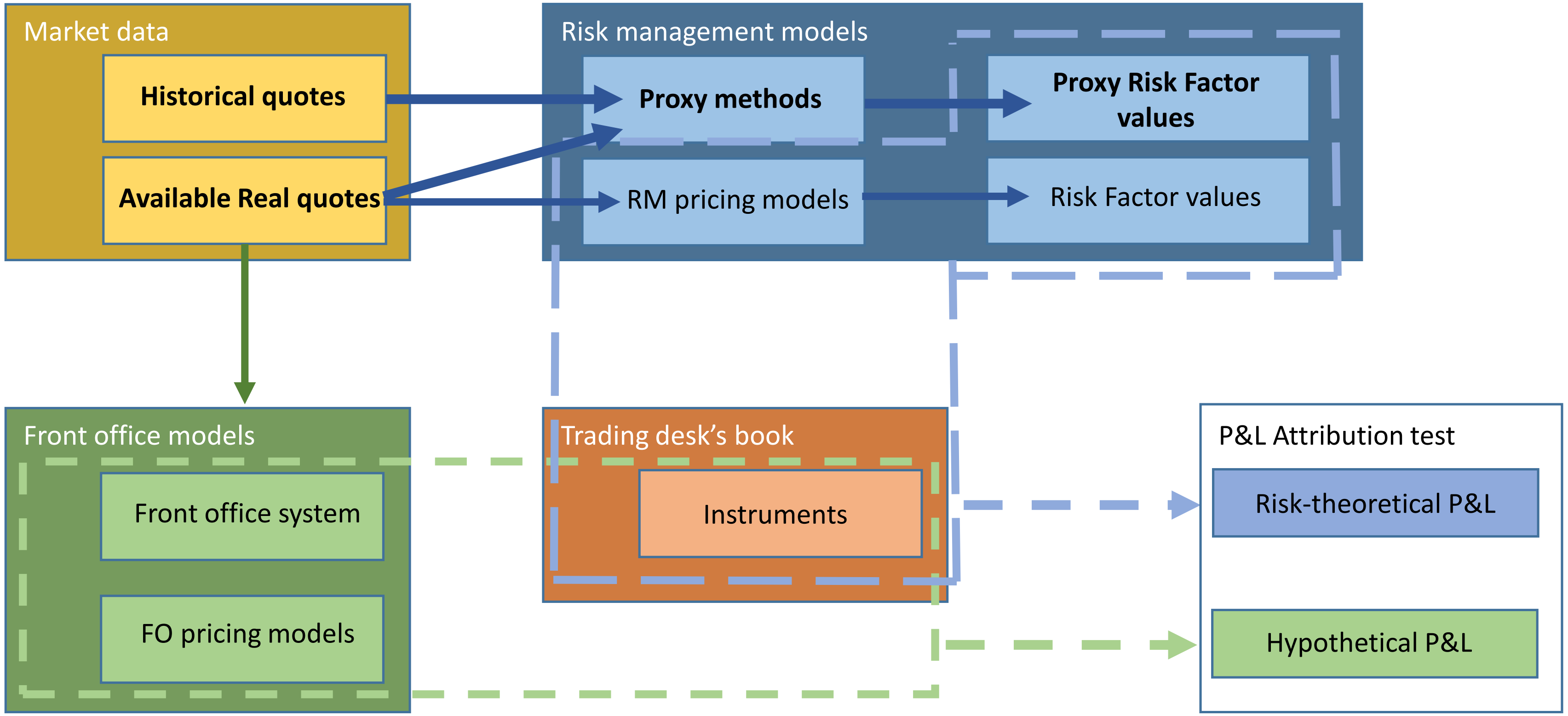


RTPL different from HPL as a result of:

- Differences between FO and RM pricing models
- Differences methods for Risk Factor inference, e.g. type of instruments used in curve construction
- Differences in settings, e.g. degree of granularity in grid points for curve and volatility surface specification
- Differences in interpolation choices to infer Risk Factor values not directly linked to Available Real quotes, e.g. interpolation along a strike dimension to obtain an implied volatility

Trading desk eligibility to use IMA

P&L attribution assessment



RTPL different from HPL as a result of (in addition to previous list):

- Proxy Risk Factor values can result in significantly different valuation of Instruments and thereby RTPL. Regardless whether FO and RM pricing models are the same.

Example with insufficient Available Real quotes to identify all relevant Risk Factor values. In this case, Proxy Risk Factor values are required and obtained with Proxy methods to value the Trading desk's book. The Proxy Risk Factor values then augment the Risk Factor values inferred from Available Real quotes and with the RM pricing models produce the Risk-theoretical P&L. If Proxy Risk Factor values can not be directly obtained from Available Real quotes, e.g. through interpolation along a tenor/strike/maturity dimension, Historical quotes can be warranted. Note that the use of Historical quotes and Proxy methods in the context of P&L Attribution can be subject to regulatory approval as the same Proxy Risk Factor values should be used in the evaluation of Expected Shortfall.

Trading desk eligibility to use IMA

1 Trade desk nomination for IMA

2 Trading desk level eligibility tests

a P&L Attrib.

b Backtesting

P&L attribution assessment

Main takeaways for P&L attribution assessment

Trading desk eligibility

- Assess the materiality of differences between bank's risk management models and valuation models used in the front office
- Significant differences between the RTPL and HPL renders the trading desk ineligible for IMA.

Ways to alleviate differences between RTPL and HPL:

i. Align FO and RM pricing models and functionalities
ii. Align bucket specification for risk factor generation, e.g. bootstrap curves, volatility surfaces at the same granularity of grid points (tenor/strike/maturity points)
iii. Apply similar set of instruments in the inference of risk factors, e.g. use the same set of instruments in the bootstrapping of curves
iv. Apply similar settings, non-Risk factor parameters, e.g. number of simulations in an Monte Carlo engine
v. Ensure proxy methodology derives from risk management's models, i.e. avoid ad-hoc approaches to impute missing risk factor values that result in large differences between RTPL and HPL

A trading desk is in the Green zone if both (i) the Spearman correlation metric is above 0.852; **and** (ii) the KS (Chi-squared) distributed test statistic is below 0.083 (14).

A trading desk is in the Amber zone if it is neither allocated to the Green or the Red zone.

- Desk still in scope for IMA and capitalized accordingly.

A trading desk is in the Red zone if the correlation metric is less than 0.75 or if the KS (Chi-squared) distributed test metric is above 0.095 (18).

- Desk falls back to SA and capitalized accordingly.

For all desks in scope to remain eligible at the bank level to use IMA, a minimum of 10% of the bank's aggregated market risk charges must be based on positions held in desks that are eligible to use IMA.

Trading desk eligibility to use IMA

1 Trade desk nomination for IMA

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Backtesting Assessment

Aim of the Backtesting assesment:

Assess whether the current day's static Value-at-Risk is in line with the number of negative P&L exceedances for the past 12 months.

Backtest input

Required data

- Each desk's one-day static VaR measure (calibrated to the most recent 12M data, equally weighted), i.e. VaR evaluated for yesterday's book with last year's data
- Last 12 month's one-day actual P&Ls
- Last 12 month's hypothetical P&Ls

Backtest procedure

At the trading desk level calculate the 1-day static value-at-risk

i. at the 97.5th PCTL, and
ii. at the 99th PCTL of the most recent 12 month's business days

If the trading desk experiences

i. more than 12 smaller P&L values (actual or hypothetical P&L) than the 99thPCTL, or → Desk falls back to SA
ii. more than 30 smaller P&L values (actual or hypothetical P&L) than the 97.5th PCTL in the most recent 12-month period → Desk falls back to SA

Caveats

- The desk's positions must continue to be capitalized using the SA until de desk no longer exceeds the above thresholds over the prior 12M.
- Severe fluctuation in portfolio composition can result in failure

IMA Risk factor analysis

Analysis stages	Concrete action and requirements	Required infrastructure/tools
1 Relevant risk factor identification	Based on instruments currently held in the trading desk's book identify the relevant risk factors	• Map between instruments and corresponding pricing models. • Map between pricing models and risk factors.
2 RF Modellability classification	For each identified risk factor in Step 1, execute the following steps to classify the risk factor as modellable or non-modelallable within a designated bucket: quotes can represent multiple risk factor values, i.e. bucket [par. 185b, p. 59]	• Bucket spec per risk factor, i.e. tenor and tenor-strike(-maturity) buckets. E.g. for zeros and volatilities resp.
a Observability check	Classify a risk factor as modellable if 24 observable *Real* quotes have been observed in the past 12M, with max 1 month diff. between 2 quotes. A *Real* quote qualifies as: i) actual transaction; ii) verifiable quote through arms-length party; iii) obtained from committed quote; iv) in some cases, obtained via vendor.	• Database with historical quotes, at least dating back 12M. • Map between quotes and risk factor buckets (via pricing models).
	Apply steps 2b and 2c below to refine RF classification (conservative approach)	
b Modellability for derived risk factors	*Risk factors derived solely from a combination of modellable risk factors are modellable* [par. 183c, p. 58]. To obtain a modellable risk factor value which derives beyond a real quote also from other risk factors, then these risk factors should be modellable. A swaption volatility, deriving from a swaption quote and relevant curves, requires modelable zeros on the curves up to relevant tenors.	• Augment map between quotes and risk factor buckets with derived risk factors and risk factors directly derived from quotes.
c Non-modellability propagation	*A combination between modellable and non-modellable risk factors will be a non-modellable risk factor* [fn. 40, p. 58]. A stripped/bootstrapped risk factor can derive from risk factors from different buckets, e.g. a 10-year zero derives from a 5-year zero via coupons of the underlying swap. A non-modellable 5-year zero then renders the 10-year zero non-modellable (despite sufficient quotes).	• Map between risk factor buckets to account for risk factor dependencies across buckets. Flag risk factors in bucket non-modellable if associated buckets fail the Observability Check.

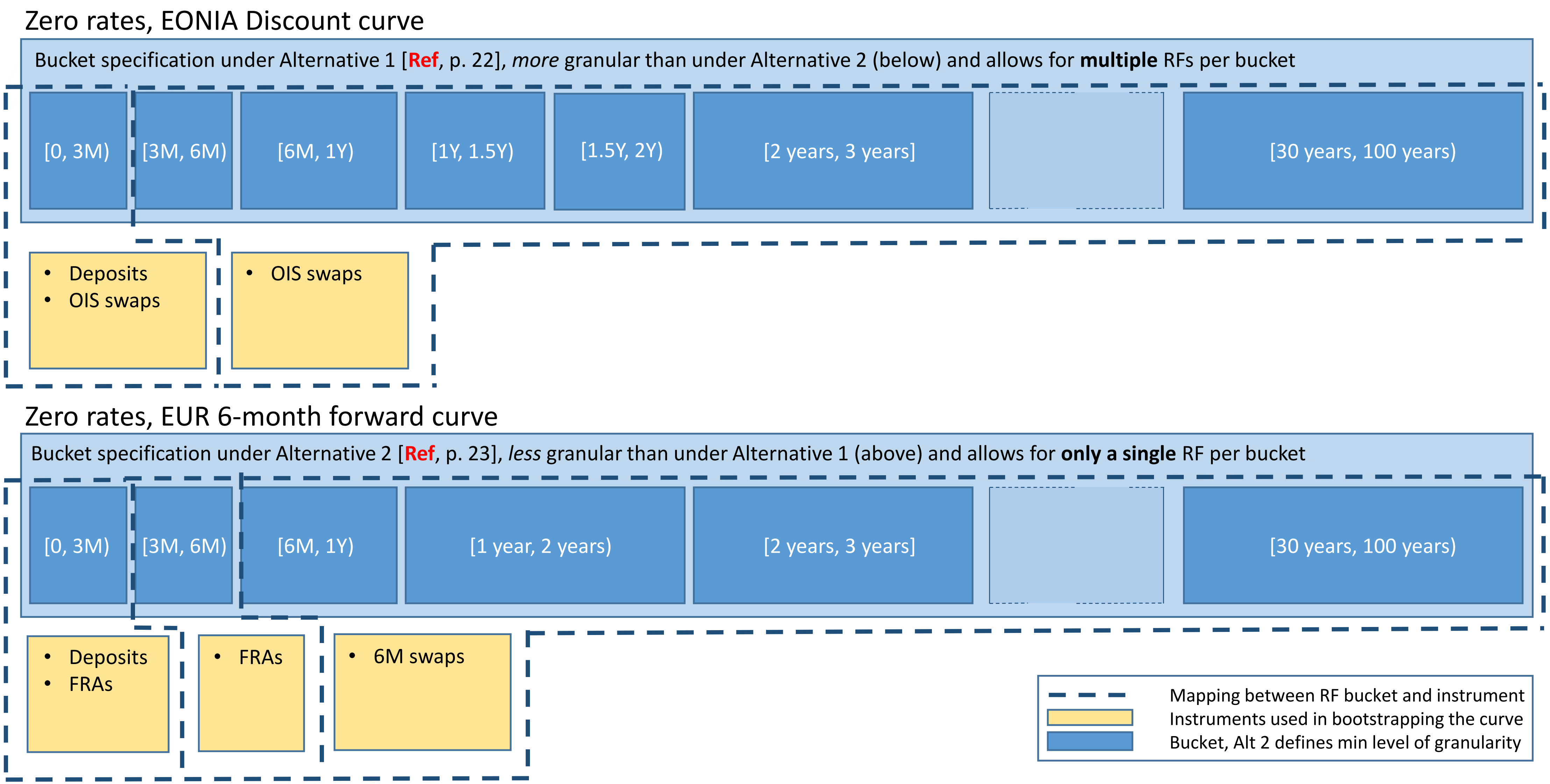
IMA Risk factor analysis

1 Risk factor Identification

2 RF Modellability classification
- a Obs. check
- b Derived RF
- c NM propagation

IR trading desk (example)	Pricing models	Risk factor objects	Risk factors require classification
10Y EUR12M Libor Swap, fix-for-float	Cash flow model	• Discount curve • Forward curve	• **Zero rates, EONIA discount curve** • Zero rates, EUR12M forward curve
Receiver Swaption, 5Y mat, on a 10Y EUR6M Libor Swap	Black '76 model	• Discount curve (for swaption) • Discount curve (for swap) • Forward curve • Black volatility cube (e.g. SABR)	• Zero rates, EONIA discount curve, to discount optionality (different for cash settled) • Zero rates, EONIA discount curve, used for the swap, • Zero rates, EUR6M used for the swap • Black volatilities / SABR parameters to represent the Black Volatility cube (dim: tenor/maturity/strike)
10Y EUR6M IR Cap	Bachelier model for caplets	• Discount curve • Forward curve • Black forward volatility surface	• Zero rates, EONIA discount curve • Zero rates, EUR6M used to infer Libor rates for caplets • Bachelier forward volatilities, volatility surface (dim: strike/maturity)
XCCY Swap EUR6M vs FCCY-XM + spread	Cash flow model	• Discount curves • Forward curves • Spread • FX Spot	• Zero rates, EONIA discount curve • **Zero rates, EUR6M forward curve** • FX spot • Zero rates, Foreign discount curve • Zero rates, Foreign forward curve • Spread

IMA Risk factor analysis



IMA Risk factor analysis

Zero rates, EONIA Discount curve

Count number of Real quotes per bucket: #Real quotes < 24 ➔ Non-Modellable; Real quotes >= 24 ➔ Modellable

[0, 3M)	[3M, 6M)	[6M, 1Y)	[1Y, 1.5Y)	[1.5Y, 2Y)	[2 years, 3 years]		[30 years, 100 years)
30	35	40	35	33	40		32

Insufficient Real quotes observed for the forward curve's [2Y, 3Y) bucket. We cannot classify the corresponding zero rates as modellable.

Zero rates, EUR 6-month forward curve

[0, 3M)	[3M, 6M)	[6M, 1Y)	[1 year, 2 years)	[2 years, 3 years]		[30 years, 100 years)
25	33	35	39	23		26

quotes ➔ Modellable vs. Non-Modellable
Bucket

IMA Risk factor analysis

1 Risk factor Identification

2 RF Modellability classification: a Obs. check; b Derived RF; c NM propagation

Zero rates, EONIA Discount curve

Count number of Real quotes per bucket: Real quotes < 24 ➔ Non-Modellable; Real quotes >= 24 ➔ Modellable

[0, 3M)	[3M, 6M)	[6M, 1Y)	[1Y, 1.5Y)	[1.5Y, 2Y)	[2 years, 3 years]		[30 years, 100 years)
30	35	40	35	33	22		32

The zero rates in bucket [2Y, 3) of the forward curve derive via the underlying swap's valuation from the zero rates of the discount curve. *Risk factors derived solely from a combination of modellable risk factors are modellable* [par. 183c, p. 58]. Notwithstanding sufficient observations, a conservative interpretation of this statement can lead to non-modellability in the forward curve's zero rates as illustrated.

Zero rates, EUR 6-month forward curve

[0, 3M)	[3M, 6M)	[6M, 1Y)	[1 year, 2 years)	[2 years, 3 years]		[30 years, 100 years)
25	33	35	39	25		26

quotes ➔ Modellable vs. Non-Modellable

Bucket

IMA Risk factor analysis

1 Risk factor Identification

2 RF Modellability classification

a Obs. check

b Derived RF

c NM propagation

Zero rates, EONIA Discount curve

Count number of Real quotes per bucket: Real quotes < 24 ➔ Non-Modellable; Real quotes >= 24 ➔ Modellable

[0, 3M)	[3M, 6M)	[6M, 1Y)	[1Y, 1.5Y)	[1.5Y, 2Y)	[2 years, 3 years]		[30 years, 100 years)
30	35	40	35	33	40		32

The zero rates in bucket [2Y, 3) of the forward curve derive via the underlying swap's coupons with fixing dates in the [1Y, 2Y) non-modellable bucket from the non-modellable zero rates of a preceding bucket. *A combination between modellable and non-modellable risk factors will be a non-modellable risk factor* [fn. 40, p. 58]. Notwithstanding sufficient observations, a conservative interpretation of this statement can result in non-modellability to propagate to subsequent zero rates in buckets for longer maturities.

Zero rates, EUR 6-month forward curve

[0, 3M)	[3M, 6M)	[6M, 1Y)	[1 year, 2 years)	[2 years, 3 years]		[30 years, 100 years)
25	33	35	20	25		26

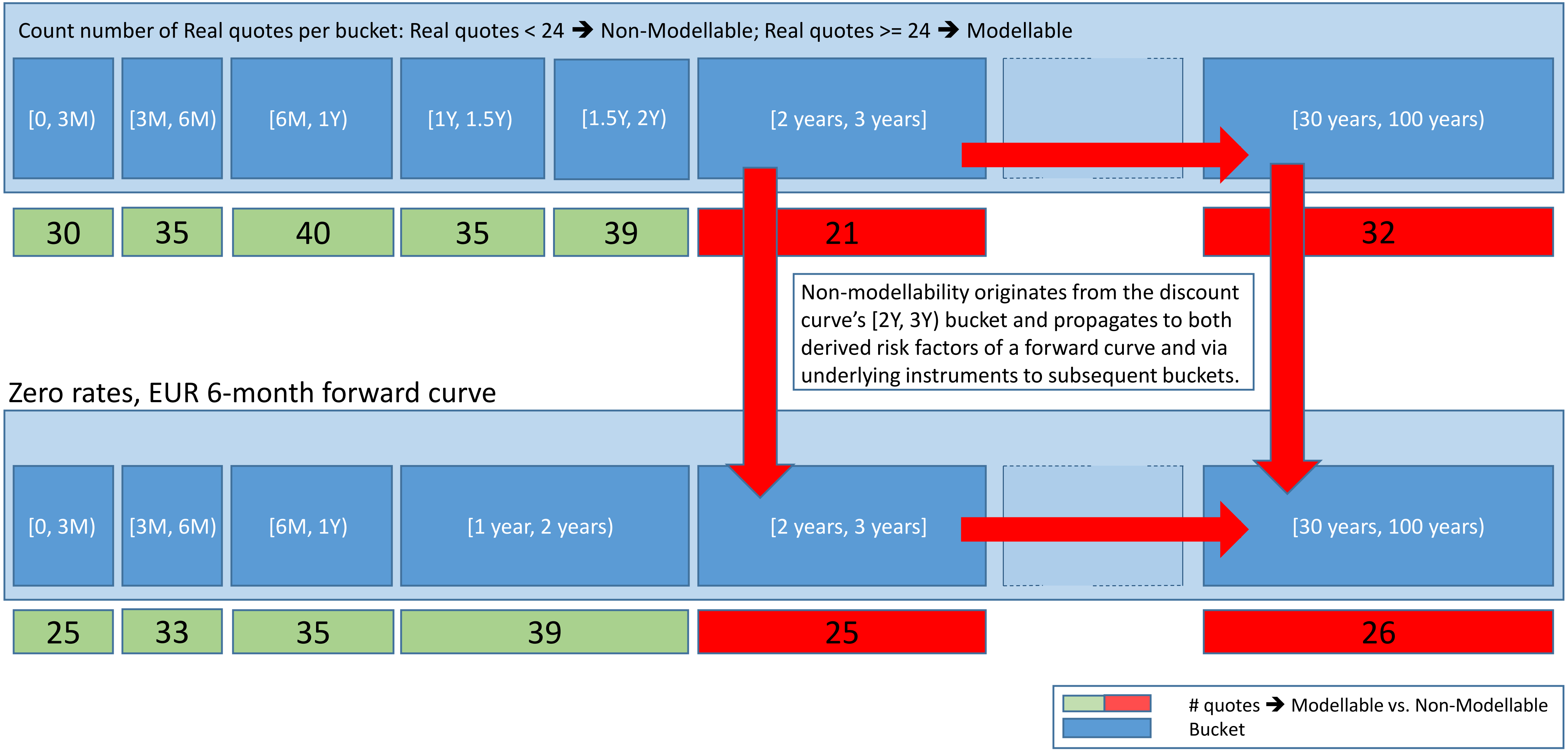
quotes ➔ Modellable vs. Non-Modellable

Bucket

IMA Risk factor analysis

1 Risk factor Identification
2 RF Modellability classification
a Obs. check
b Derived RF
c NM propagation

Zero rates, EONIA Discount curve



Thank you!

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