FRTB

HSBC Quant Academy

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Introduction

Risk Metric

- **The Banker's Dilemma**

  Higher risk leads to higher profits, but the entire banking system is built on a foundation of confidence and credibility. How do you encourage performance without risking collapse?

- **From Abstract Risk to Concrete Capital**

  The answer is to translate abstract risk metrics into a significant dollar amount of **Regulatory Capital**—a mandatory buffer a bank must hold to absorb unexpected losses and survive a crisis.

- **Alert Block: The Role of FRTB**

  The **Fundamental Review of the Trading Book** is the new global rulebook that sets a strict and complex framework for exactly how these risk calculations must be done.

Motivation

The Pre-Crisis Failure

The 2008 financial crisis proved that the existing rules for market risk capital were too slow, too reliant on awed models, and blind to illiquidity. Capital requirements did not increase until after catastrophic losses had already occured.

AI's Alegory: *In 2008, the world discovered Wall Street had built a fleet of Bugattis with the brakes of a bicycle. FRTB is the global mandate to install carbon-ceramic brakes on every car.*

Framework development

- **2012-2015**: The Basel Committee (BCBS) begins its fundamental review, responding to lessons from the 2008 crisis.
- **Jan 2016**: The first comprehensive version of the FRTB framework is published.
- **Jan 2019**: A revised and final version is published after industry feedback, with an initial target date of 2022 (later delayed).

Global Rollout Status

- **Live:** Japan, Canada, Switzerland, Hong-Kong, Singapore
- **Pending:** EU, UK, US (see RCAP dashboard | Bank for International Settlements)

FRTB's Core Principles

- **Stronger Boundary**

  A strict, economically-based line between the trading and banking books to end regulatory arbitrage.

- **Focus on Real Data**

  A deep scepticism of internal models, enforced by

  - **PLAT:** Risk models must explain actual P&L
  - **NMRF:** Capital penalty for risks that cannot be proven with observable market prices.

- **Credible Fallback**

  The risk-sensitive **Standardised Approach (SA)** acts as a robust capital floor and a punitive fallback for failing IMA tests.

- **Mandatory Crisis Viewpoint**

  Models must be calibrated using a 12-month period of significant financial stress, ensuring capital is adequate for crisis conditions, not just calm markets.

- **Better Risk Metric**

  Expected Shortfall (ES) replaces Value-at-Risk (VaR) to better capture the size of potential losses in a crisis.

Stronger Boundary

Trading Book vs. Banking Book

The Trading Book

- **Intent**: To profit from short-term price changes.
- **Time** Horizon: Short-term (e.g., 10 days).
- **Valuation**: Mark-to-Market.
- **Primary Risk**: Market Risk.

The Banking Book

- **Intent**: To hold assets to maturity.
- **Time Horizon**: Long-term (life of asset).
- **Valuation**: Accrual accounting.
- **Primary Risk**: Credit Risk.

Pre-Crisis Failure: Regulatory Arbitrage

The boundary between these books was weak. Banks could hide trading risks in the banking book to hold less capital. **The Fundamental Review of the Trading Book (FRTB)**'s job is to enforce a strict, permanent boundary.

PUBLIC

Digression: Time and Risk

Time Horizons

Over what period could we lose money, and how long would it take us to get out?

One-day losses do not tell the full story of the risk. Risk is therefore measured over a prescribed time horizon.

- **Short horizon**: Liquid trading positions that can be sold or hedged quickly.

Equity Type	Horizon	Example
Highly liquid large-cap	10 days	Major index constitueants
Mid-liquidity	20-40 days	Mid-cap, less traded names
Illiquid	60 days	small-cap, thin trading

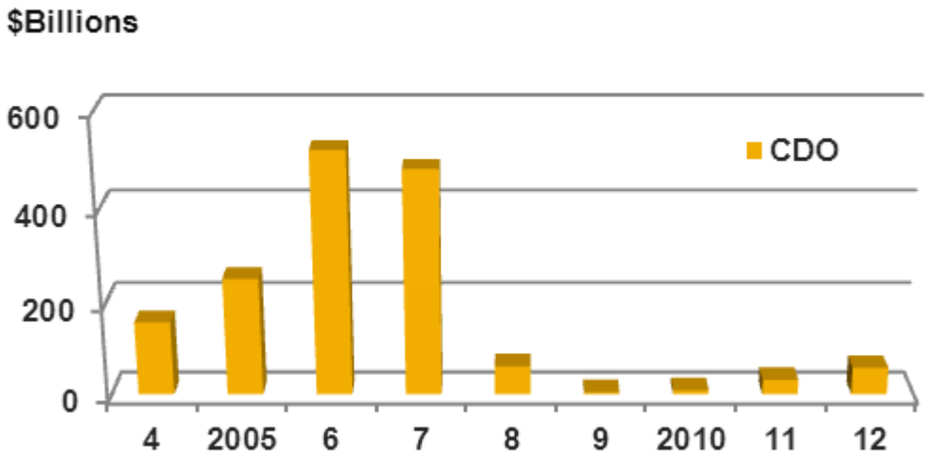
- **Long horizon**: Positions held to maturity

In modelling $\sqrt{n}$ rule or overlapping returns are used

Focus on Data

Case Study 1: The CDO Collapse

- **Originate-to-Distribute**: Banks originated risky loans, collected fees, and bundled them into CDOs, believing they had transferred the risk.
- **The Reclassification Arbitrage**: As the market soured in 2007, banks used their own internal models (*mark-to-model*), which proved disastrously wrong and/or reclassified their toxic CDOs from the trading book (where losses were immediate) to the banking book (where losses could be ignored) by simply declaring a change in *intent*.
- **The Market Disappears**: This created a *market that was not a market.* The assets were untradeable, their prices were fictional, and the risk was hidden rather than removed.



The volume of CDOs issued globally crashed during the subprime crisis but has recovered slightly. (source: Wikipedia)

FRTB Fix

- No tranfer between books
- Non-Modellable Risk Factors (NMRF): used their own internal models (*mark-to-model*), which proved wrong.

Case Study 2: The LIBOR Scandal

The LIBOR interest rate benchmark was based on banks' self-reported estimates, not actual transactions. This allowed for manipulation, undermining the integrity of trillions of dollars in derivatives.

- **Profit-Driven**: Traders at multiple banks coordinated via chat rooms to request specific LIBOR submissions from their own bank's submitters to benefit their shared derivative positions.
- **Reputation-Driven**: During the crisis, banks artificially lowered their submissions to project an image of financial strength and avoid any perception of weakness.

The scandal was discovered in 2012. This was proven fraud.

FRTB Fix

- A deep skepticism of any data that is not based on observable, arms-length transactions. This philosophy underpins the entire framework, from NMRF to model validation.

Data and Risk Factors

If a model is fed poorly observed prices, it gives a misleading picture of the risk it is meant to measure. Risk factors[1] that pass the modellability test can be used directly in the ES calculation. The remaining risk factors are capitalised less favourably, through the NMRF charge.

Modellability is determined based on the Risk Factor Eligibility Test (RFET) and the 7 Data Principles, restricting the data quality and data transformations.

RFET:

- **Real:** Actual prices, not quotes or interpolated values.
- **Arm's Length**: From genuine, unrelated third-party transactions.
- **Sufficiently Frequent:** A minimum number of trades must be observed
- **Representative**: The prices must be for the specific risk factor being tested.
- **Recent**

[1] Some risk factors are directly observable, such as spot prices. Others are latent, such as the volatility in Black-Scholes. Together, every input needed to revalue the portfolio is a risk factor.

7 Data Principles:

- **Principle two:** The data used must allow the model to pick up both idiosyncratic and general market risk.
- **Principle three**. The data used must allow the model to reflect volatility and correlation of the risk positions.
- **Principle six.** The data used to determine stressed expected shortfall must be reflective of market prices observed and/or quoted in the period of stress.
- **Principle seven**. The use of proxies must be limited, and proxies must have sufficiently similar characteristics to the transactions they represent.

Calculations

Two Paths: IMA vs. SA

Under FRTB, banks have two options for calculating their market risk capital. This choice is made at the level of each individual trading desk*.

Internal Models Approach (IMA)

- Banks use their own sophisticated internal models.
- Requires passing strict validation tests (e.g., PLAT).
- Can result in lower capital charges.
- High implementation cost.

Standardised Approach (SA)

- Banks use a regulator-prescribed, formulaic method.
- The only option if IMA tests are failed.
- Designed to be more punitive.
- Simpler to implement.

* **A trading desk** is a specialized team of traders within a bank responsible for buying and selling a specific category of financial products. Usually, there are highly focused desks, such as:

- **The Equity Derivatives Desk:** Trades options and futures on stocks and indices.
- **The FX Spot Desk:** Trades currencies (like EUR/USD) for immediate delivery.
- **The High-Yield Corporate Bond Desk:** Trades riskier corporate debt.

The IMA Equation: The Heart of FRTB Capital

FRTB Capital = ES + DRC + NMRF

- **ES (Expected Shortfall):** Capital for normal market risk, based on a blend of recent and stressed market data.
- **DRC (Default Risk Charge):** Capital for the *jump-to-default* risk of specific bond and stock issuers.
- **NMRF (Non-Modellable Risk Factors):** A punitive capital charge for risks that cannot be reliably measured with observable market data.

Stressed market data: For the Internal Models Approach the bank itself must perform the analysis to identify its most severe 12-month stress period since 2007 and use it to calibrate its Expected Shortfall (ES) model.

Hands-On Session

Toy Model

Comparing SA and IMA capital for a simple portfolio

- Download daily prices for an index since 2007 (e.g., S&P 500 or any other reasonable index like WIG 20). Our toy calculations assume that the portfolio coincides with the index. Reasonable?
- From the prices, calculate a time series of 1-day and 10-day returns.
- Calculate VaR at 99% and 97.5% ES, for 1-day and 10-day shocks (rolling window)
- Find the stress period for this portfolio
- Calculate the Final IMA Charge: max(Stress ES, Recent ES)

Would your model be acceptable?

In the SA, the risk weight (i.e., the required shock) depends on the specic characteristics of the equity. Here are the key buckets for equity delta risk:

- Large-Cap, Advanced Economy 30%
- Small-Cap, Advanced Economy 40%
- Large-Cap, Emerging Market 40%
- Small-Cap, Emerging Market 50%
- Other / Specic Sectors 50% - 60%

What would be the delta for our portfolio?

How do the above numbers compare to the actual market values?

ES Estimator

What is a good ES estimator?

- How can one define an ES estimator? What are requirements to define the estimator reasonably?
- Is the estimator conservative?
  - Bias, Probabilities
- Check the impact of 10-day overlapping returns
- What is the role of the stress period (think of a time series with clustering)

Reference: https://arxiv.org/abs/2510.05809

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