

Eurex Clearing Prisma

Portfolio-based risk management



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Eurex Clearing Prisma: Delivering innovation with portfolio-based risk management

Eurex Clearing is a leader in clearing technology and state-of-the-art customer solutions. It was first to introduce both real-time risk calculation and real-time risk-data provision. Moreover, Eurex Clearing continues to set industry standards in risk management.

With its portfolio-based risk management approach – Eurex Clearing Prisma – Eurex Clearing offers an innovative way to help customers maximize collateral efficiency.

Eurex Clearing Prisma was developed in close harmony with customers worldwide to enable maximum benefits and ensure regulatory compliance for all market participants. Furthermore, it maintains reliable counter-cyclical margin levels in even the most challenging situations by utilizing a transparent and risk-sensitive methodology.

In addition to delivering synergies by reflecting risk netting effects for listed, OTC and between listed and OTC positions, it also provides flexibility when introducing new products and opportunities for enhancing capital efficiency. Eurex Clearing Prisma offers all this with the robustness and reliability the market expects. It is a solution providing safety, efficiency, and integrity.

Eurex Clearing Prisma calculates risks across all derivatives markets cleared by Eurex Clearing. Cleared products with similar risk characteristics and aligned default management processes are assigned to the same liquidation group and splits therein, resulting in more comprehensive risk calculations and enabling portfolio margining across positions within a split and cross margining across splits within a liquidation group.

Eurex Clearing optimizes post-trade activity for all market participants – better preparing you for new regulations so you can respond promptly to challenging market conditions and feel confident that you are clear to trade.

About Eurex Clearing

Eurex Clearing is a leading global central counterparty – assuring the safety and integrity of markets while providing innovation in risk management, clearing technology and client asset protection. Eurex Clearing clears the broadest scope of products under a single framework in Europe – both listed products and OTC – and offers the world's broadest spectrum of eligible collateral.

www.eurexclearing.com

Introduction to Eurex Clearing Prisma

Eurex Clearing's Prisma methodology¹ features concepts building on existing principles and procedures to achieve enhanced precision and maximize the use of collateral. This section begins by explaining liquidation groups and splits, detailing key elements of the portfolio-based margining system which enable Eurex Clearing to deliver synergies such as portfolio and cross margining. This explanation is then followed by a description explaining how the default management process is designed to accommodate the concept of liquidation groups. In a subsequent section, the brochure explains the margin calculation method.

Liquidation Groups and Splits

A clearing member's portfolio typically features a heterogeneous structure, size and/or complexity. Given this complexity and the general handling principles laid out in Eurex Clearing's default management process, it is usually impossible to liquidate an entire portfolio in a single transaction. Therefore, Eurex Clearing has introduced the concept of liquidation groups and splits and calculates risk at those levels. Cleared products with similar risk characteristics are generally assigned to the same liquidation group and specifically to splits therein carrying, amongst others, information about the margin period of risk (MPOR). Provided that offsets can be realized during the default

management process, this structure allows for a more comprehensive portfolio risk calculation within a split and ultimately enables cross margining across liquidation group splits. With this process, Eurex Clearing Prisma closely aligns the margining methodology with the default management process.

A complete liquidation group split can be hedged by Eurex Clearing, priced by clearing members, and consequently auctioned within a reasonable time frame.

General principles for liquidation groups and splits:

- Portfolio margin offsets are only granted within pre-defined liquidation groups and splits.
- Each liquidation group split has a dedicated, fixed margin period of risk reflecting the time estimated to analyze, hedge, and liquidate the respective positions. The margin period of risk ranges between two to five days and is the basis for the margin calculation.

The list of current liquidation groups and splits and their margin period of risk are listed in the table below. Multiple splits per group currently only exist for the Fixed Income and OTC liquidation group. Which instruments are assigned to which group can be found on the Eurex Clearing website: www.eurex.com > **clear** > **services** > **risk-parameters**.

¹ Please visit the Eurex Clearing Prisma User Guide, available on the Member Section, for more detailed information on specific topics.

Table 1: Liquidation Groups & Splits and MPOR

Liquidation Group and Splits		MPOR (days)
PEQ01	Listed Equity (Index) Derivatives	3
PFI01	Listed Fixed Income and Money-Market Derivatives	2
	OTC Interest Rate Derivatives	5
PNF01	Non-Deliverable Forwards	5
PAC01	Asian Cooperation KOSPI	2
PCM01	Commodity (Index) Derivatives	3
PPM01	Precious Metal Derivatives	3
PFX01	Foreign Exchange Derivatives	2
PAF01	Asian Cooperation KRW Foreign Exchange Derivatives	2
PCB01	Corporate Bond Derivatives	2
PEF01	Derivatives on Fixed Income ETFs	2
PEQCO	Collateral Index Derivatives	3
PRS01	Related Security Spread Index Derivatives	3
PCY01	Crypto Derivatives	3

Default management

As one of the world's leading clearing houses, Eurex Clearing plays a vital role in the global effort to maintain stability in financial markets. Eurex Clearing recognizes its responsibility to help mitigate systemic risks should the default of a clearing member occur. With all past default events, Eurex Clearing successfully liquidated the defaulted clearing member's portfolio within the defaulter's resources. It was mainly thanks to the robust procedures that Eurex Clearing had in place in dealing with a clearing member default that Eurex Clearing was prepared to act when the need arose. Eurex Clearing maintains its readiness to act by continuously updating its safeguards and introducing innovative product offerings that optimize the clients' safety as well as protect the clearing house.

Default procedures

Aware that each default scenario is unique, Eurex Clearing maintains flexibility in its procedures to accommodate the individual features of each default. The procedures provide a transparent and adjustable framework that is applied depending on the circumstances of the scenario at hand and consistent with local and global regulatory standards.

The default management process is designed to enable Eurex Clearing to individually handle portfolios in various liquidation groups. As it is expected that the liquidation for different liquidation groups is likely to be conducted overlapping in time, the concrete measures applied can vary.

Despite the individual nature of every situation, explicit trigger events for a clearing member's default have been defined, regardless of the product or cleared market. If a clearing member has been declared to be in default, the clearing member's proprietary positions and its client positions may be treated differently.

Client positions

When a clearing member defaults, one of Eurex Clearing's principal objectives is protecting customers and minimizing the impact on clients and their positions. Eurex Clearing is committed to ensuring that clients and their positions can be transferred to a new, solvent clearing member quickly and smoothly, wherever possible.

The risk management and clearing procedures have proven to be robust, even in times of acute distress in financial markets. Clients have access to a broad range of segregation types, offering

Figure 1: Default Management Process



various degrees of asset protection and portability. Highly segregated Clearing Models, client preparedness and multiple clearing relationships foster a high porting likelihood.

Default management process

Eurex Clearing's default management process is a set of procedures designed to facilitate the orderly liquidation of even the largest and most complex portfolios.

The following briefly describes key components of the default management process:

- **Default Management Committees:** Default Management Committees (DMCs) advise and assist the clearing house concerning any relevant matter of the default management process, most importantly, hedging the portfolio and preparation of auctions. Each DMC is staffed with professional employees of pre-selected clearing members. They have sufficient trading and risk expertise in the products belonging to the respective liquidation group(s) for which the Default Management Committee is convened. Default Management Committees will be convened in the event of a clearing member default in addition to regular default simulations (at least once per year).
- **Hedging:** The purpose of hedging within the default management process is to enable Eurex Clearing to reduce market and potential

cash-flow risks. Furthermore, hedging reduces the portfolio's sensitivity to market moves and stabilizes it for auctions. Hedging can be executed with independent trades or in a Mandatory Hedging Auction.

- **Independent sale:** In granting sufficient flexibility during a default situation, positions or groups of positions can be sold independently to individual members, i.e., positions of the defaulted clearing member are re-established by the clearing house either on-exchange or OTC as an alternative to the auction process.
- **Auction process:** The liquidation group-specific auction process is the main component of the default management process. An auction enables Eurex Clearing to rapidly transfer risk in bulk to willing absorbers, establishing fair market prices for the respective portfolios.

Lines of defense

When a default occurs, Eurex Clearing becomes liable for all the payments relating to any contract entered into by the defaulted party. Additionally, Eurex Clearing may face losses when entering into hedging or replacement transactions. These losses are born by the "lines of defense." While the mainstay of this safety system is the margin that clearing members have deposited as collateral for open positions, these lines of defense consist of several additional layers of financial resources, namely:

- the defaulted clearing member's Default Fund contribution
- Eurex Clearing's own resources
- Default Fund contributions of all other non-defaulted clearing members.
- Further contributions of Eurex Clearing and the non-defaulted clearing members (Assessment of the Default Fund, aka Recovery Cash Calls)

Segmented Default Fund

Eurex Clearing maintains a segmented Default Fund, consisting of multiple liquidation group-specific Default Fund segments (DFS). The sum of all DFSs is the overall Default Fund.

The segmentation of the Default Fund ensures that the contributions used first are from those clearing members' who have been active in the liquidation group(s) where losses arise. Meanwhile, the segmentation still maintains the capital efficiencies

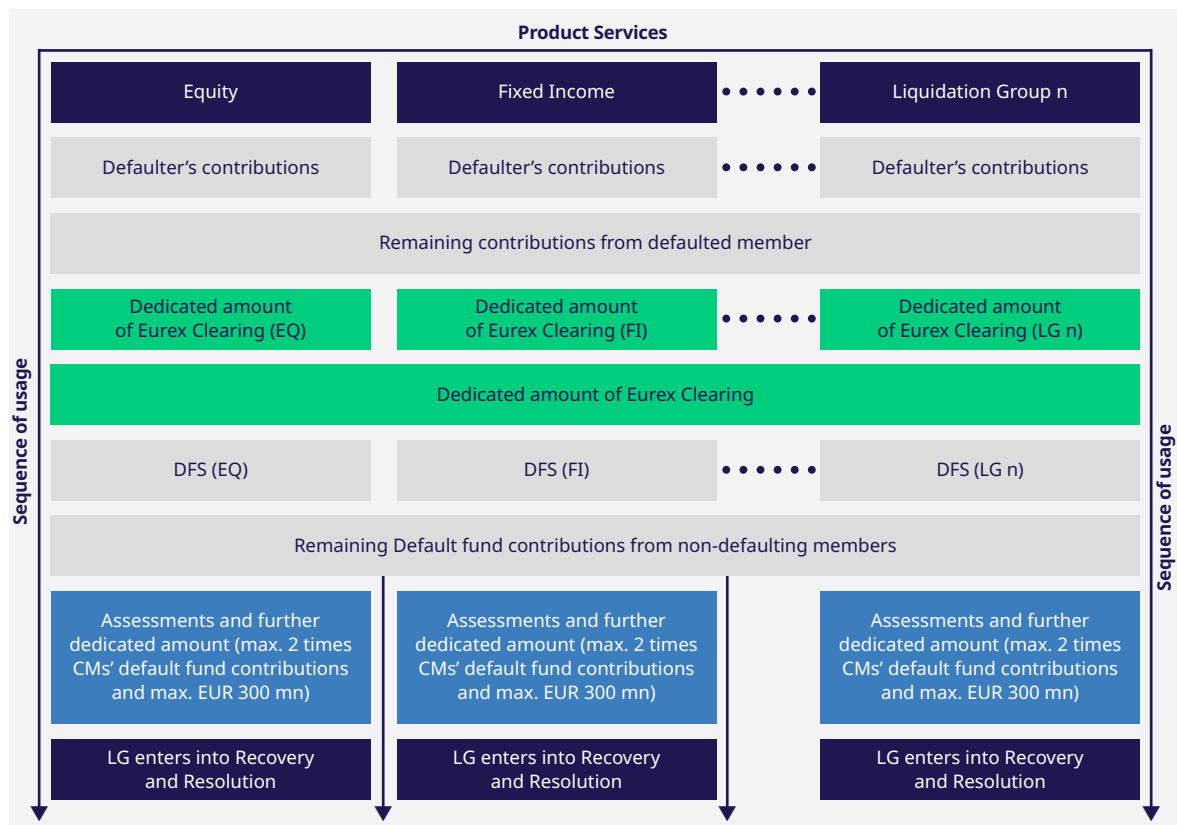
of one joint Default Fund compared to multiple asset class-specific Default Funds.

Assessments

Eurex Clearing ensures that the liability of a clearing member towards the clearing house is limited. As such, Eurex Clearing's right to assess the Default Fund, i.e., Eurex Clearing's right to request clearing members to replenish their Default Fund contributions once utilized, is capped. In any crisis, each clearing member is only obliged to provide additional funds, up to two times its pre-funded Default Fund segment(s), corresponding to the asset class(es) driving the excess losses.

In the event of a default, defense layers are applied in the order illustrated in Figure 2. These lines of defense are designed to help protect the marketplace and play a key role in preventing a domino effect.

Figure 2: Lines of defense – sequence of usage by Liquidation Group



Margin components

Margin requirements aim to cover potential losses arising from liquidating a defaulted clearing member's portfolio. According to the "defaulter pays" scheme, margins should be sufficient to cover the losses also in unfavorable market conditions and need to cover two components:

- Mark-to-market margin (backward-looking margin components)
- Initial margin (forward-looking margin components)

Backward and forward-looking margin components are depicted in Figure 3 and described in detail in this section. After providing an in-depth discussion of each margin component, the aggregation of the different forward-looking components into initial margin requirement of each clearing member is described.

Backward-looking components: mark-to-market margin

Eurex Clearing Prisma considers product-specific backward-looking margin components: premium margin, which allows for the deposit of collateral and variation margin (including price alignment interest for OTC trades) calculated daily to exchange profits and losses, which needs to be deposited in cash.

Premium margin

The seller of an option must deposit a premium margin if the transaction results in an open position. It covers the potential loss incurred if the seller would be forced to liquidate the position today. The premium margin is continuously adjusted, i.e., if option prices fluctuate so that the potential loss upon liquidation increases or decreases, the seller will be obliged to deposit more [less] premium margin respectively.

Premium margin is calculated for all positions in option products that are subject to "premium-style margining." This involves those options for which the premium is paid in full at the time of purchase (e.g., equity options). Premium margin covers the costs or profits that would arise upon liquidating all positions of a specific product at their respective closing prices.

Variation margin

On a mark-to-market basis, Eurex Clearing settles the trading day's profits and losses of all open positions held in a position account in cash. This approach applies to all derivatives that are subject to "futures-style margining". To exchange profits and losses arising due to price fluctuations of open positions, Eurex Clearing asks for cash collateral that is settled daily in the respective product currency, also known as variation margin.

Figure 3: Eurex Clearing Prisma margin components

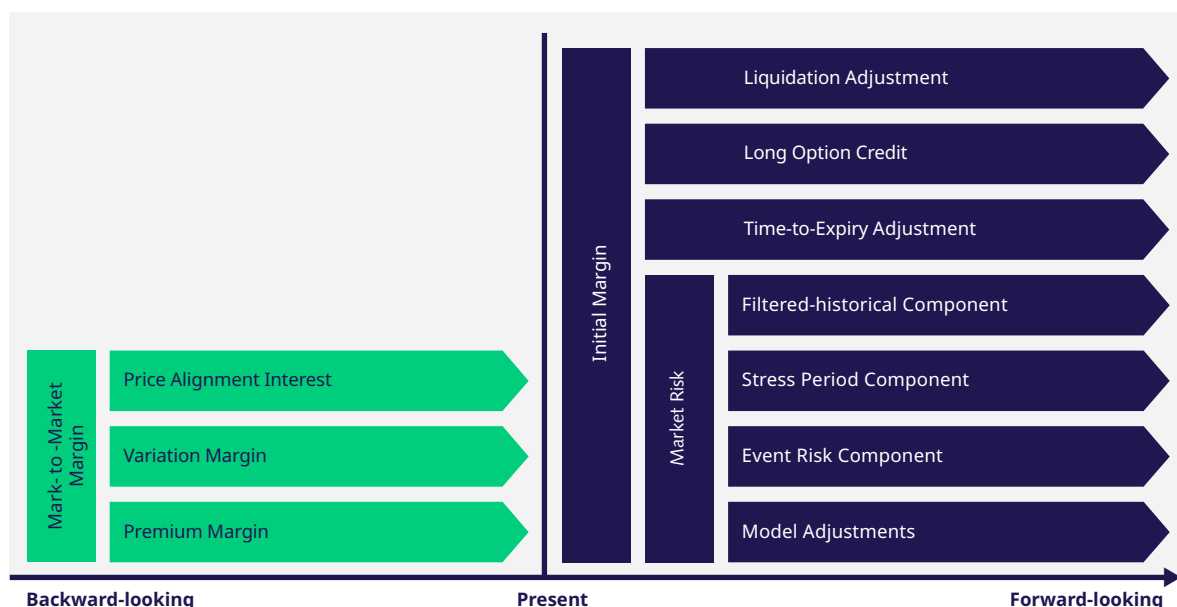
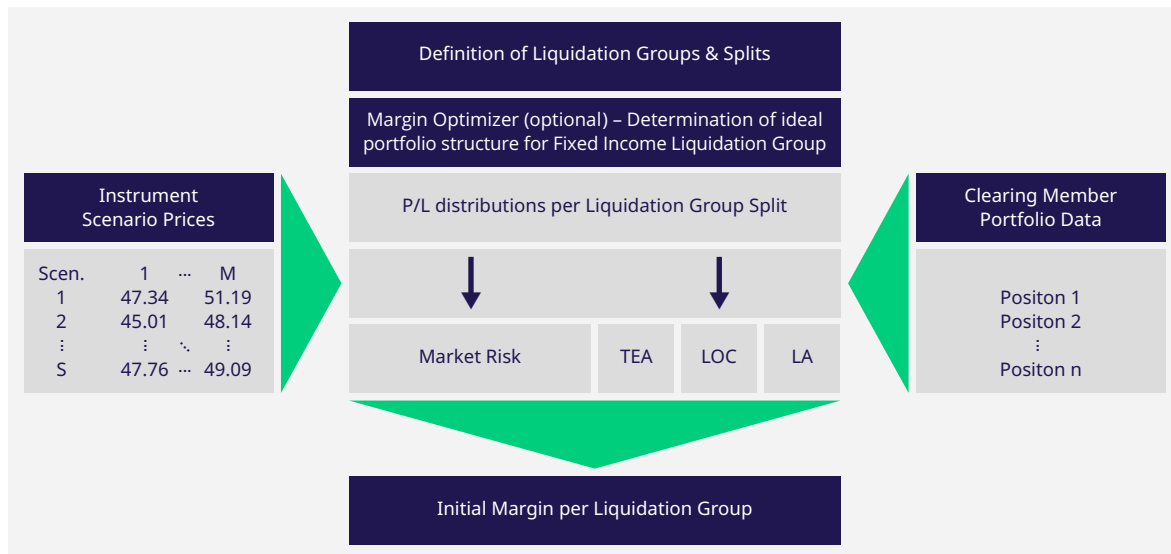


Figure 4: Methodology



The owner of a long position purchased at a lower price than the daily closing price (settlement price) is credited with the difference between the two prices. In contrast, the owner of the related short position must pay that difference.

Price alignment interest

Price alignment interest (PAI) serves as another cash-based margin component in addition to variation margin and is only applicable to products within Eurex Clearing's OTC derivatives offering. It minimizes the impact of daily cash variation margin payments on the pricing of OTC derivatives compared to non-cleared, i.e., without daily price alignment.

Eurex Clearing charges/pays interest using the overnight interest rate of the corresponding currency on the cumulative variation margin received/paid. The price alignment interest is applied separately to each trading currency on a portfolio basis and is settled daily, analogous to variation margin.

Forward-looking component: initial margin

The forward-looking margin is called initial margin (IM). It estimates the potential future exposure of clearing members' portfolios in alignment with the default management assumptions. More precisely, it employs the decomposition into liquidation groups and splits and also reflects the respective margin period of risk and the pre-defined confidence level. The initial margin of a clearing member's position account is aggregated across the respective liquidation group splits.

Initial margin consists of two main components:

- Market risk
- Liquidation risk

Market risk component

The market risk component targets a confidence level of 99% for listed products and 99.5% for OTC derivatives. The pure market risk components, i.e., without model adjustments, are calculated based on 75% of filtered-historical scenarios with a three-year lookback period, 25% stress period scenarios, and an optional additional set of event risk scenarios. The filtered-historical component ensures model reactivity in light of changing overall market volatility. The stress period component is included to ensure margin stability and to counter procyclicality, while the event risk component is to cover idiosyncratic risks from sudden independent market events for certain types of products. The tail risk measure Value-at-Risk is applied to the profit and loss distributions of the historical and the stress period sample. In contrast, the event risk component is assessed based on the sum of worst "n" scenario losses.

All historical scenarios are updated daily with the latest risk factor and price information available, leading to a daily updating sample. Stress period- and event risk scenarios are recalibrated on a predefined frequency.

Based on simulated scenario prices, scenario profit and losses are calculated for each instrument by calculating the difference with respect to its neutral scenario price. By aggregating such scenario profit and losses in a suitable currency across positions allocated to liquidation group splits allows to naturally reflect risk offsetting effects within such splits.

Figure 5 illustrates the calculation and aggregation of the market risk components of a portfolio across the filtered-historical, stress period, and event risk components.

Model adjustments

In order to mitigate model risks inherent to the estimation of potential future exposure, the following model adjustments are included and accompany the pure market risk component.

Some model adjustments only apply to some types of products and might therefore only pertain to some liquidation groups splits.

- Correlation break adjustment (CBA) assesses further statistical variability within the filtered-historical component.
- Compression model adjustment (CMA) accounts for data compression techniques applied within risk factor modeling, such as the modeling of implied volatility.
- Long option credit (LOC) compensates long option-dominated portfolios by providing a margin credit if initial margin exceeds premium margin.
- Time-to-Expiry adjustment (TEA) accounts for changes in the risk profile due to positions expiring or resetting of fixings during the simulated margin period of risk.

Liquidation risk component

The liquidation risk component is designed to capture the potential additional costs when liquidating portfolios, including possible adverse price movements. The most important characteristics are listed below:

Figure 5: Market risk calculation

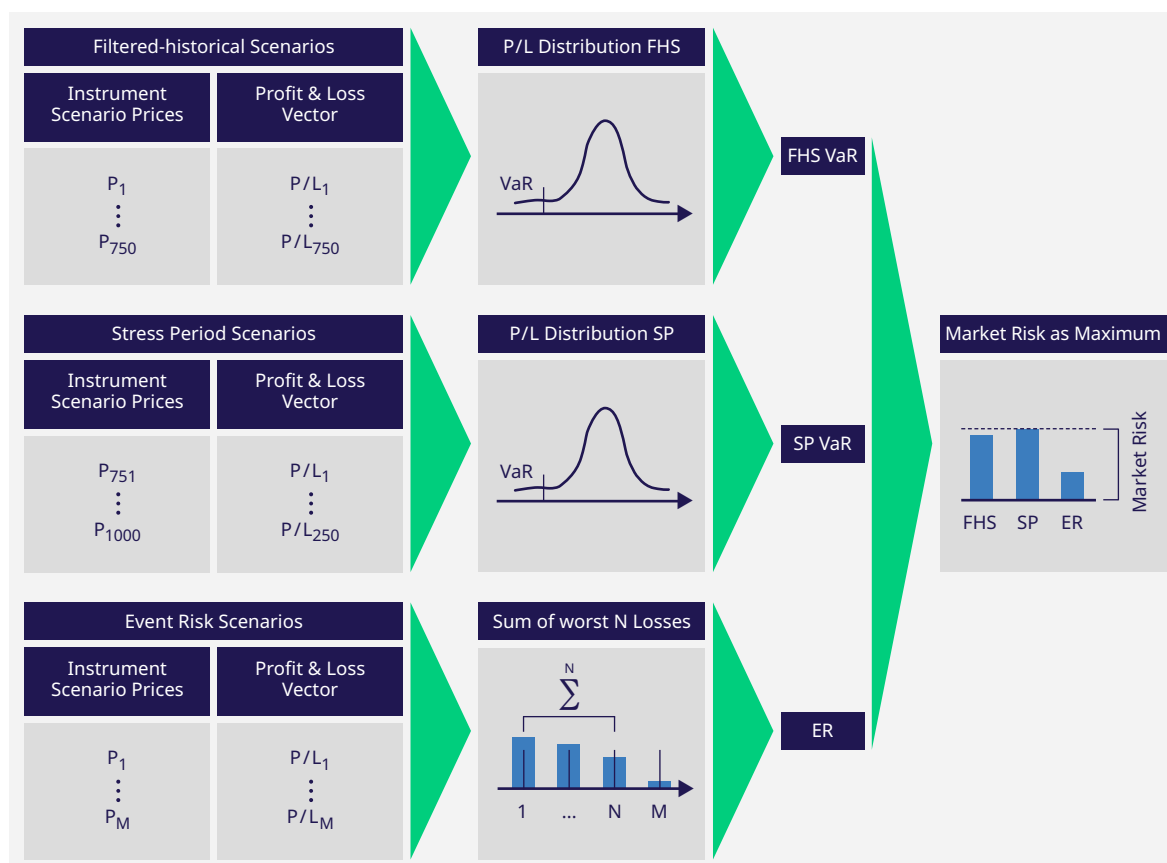
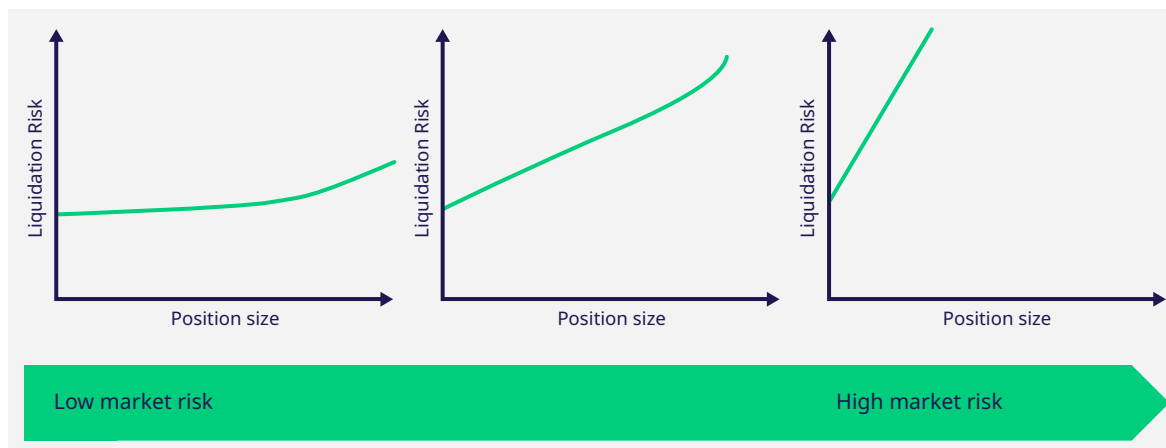


Figure 6: Liquidation risk dynamics



- The liquidation risk component is a function of the relative position size and the market capacity, which can be characterized using daily traded volume or open interest of a financial instrument.
- The liquidation risk component depends on the current level of market risk of the respective product, i.e., the higher the market risk of an instrument's price, the higher the premium.
- Market capacities and liquidation risk components are product-specific and unevenly distributed across product subgroups, i.e., for options, the market capacities depend on their moneyness and time to expiry.

Figure 6 depicts the liquidation risk component's dependence on the position size and the market risk of three positions with different risk profiles. The liquidation risk component grows with increasing position size for all three positions. It increases faster for a position carrying a higher market risk than for positions with smaller market risk.

Specific treatment for swaps products

Due to product-specific requirements and market conventions, OTC interest rate derivatives are treated differently from exchange-traded instruments. The liquidation risk component is calculated by currency according to the expected transaction costs of swaps required to hedge the clearing members' portfolio.

Aggregating forward-looking components

The total initial margin component for positions within a single liquidation group split consists of the market risk, as an aggregate over respective risk measures sets as well as respective model adjustments and the liquidation risk components.

Aggregation of market risk component

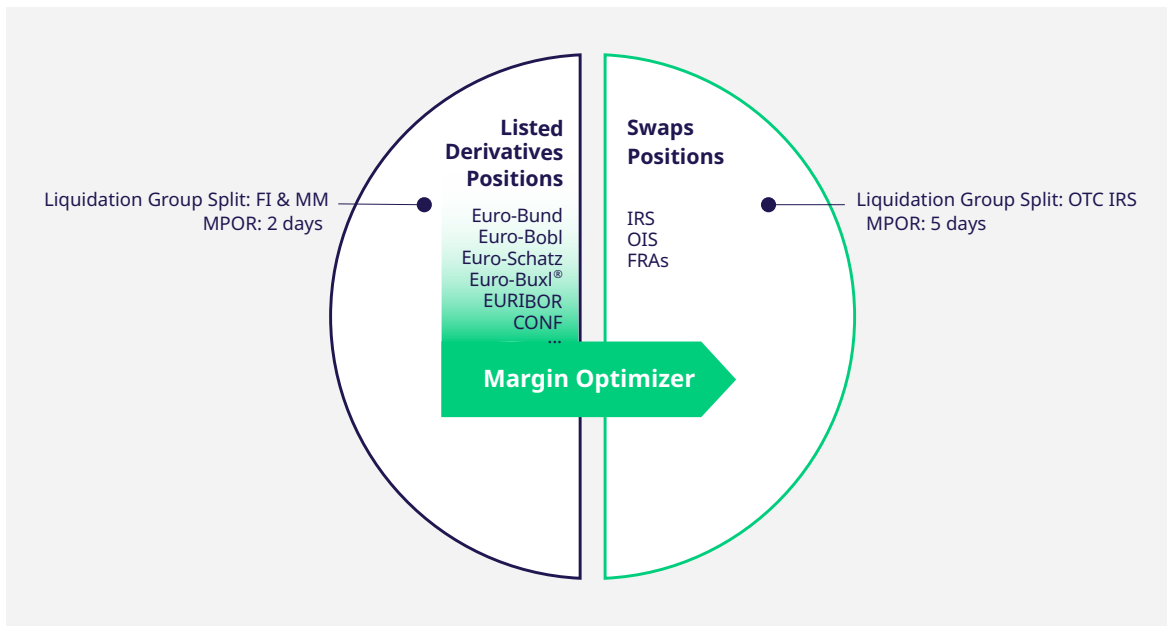
The filtered-historical and the stress period components are aggregated, including the relevant model adjustments. The resulting three values of the filtered-historical, the stress period, and the event risk measures are thereafter aggregated by taking the maximum of all three, as depicted in Figure 5. The aggregation ensures that the filtered-historical component is floored by the stress period- as well as the event risk component.

The result can naturally differ per clearing member and risk account. In one instance, it can be determined by the filtered-historical component. In another, it can be the stress period or the event risk component. The selected component is the most favorable for the safety of the clearing house and, consequently, the whole market.

Aggregation of initial margin

The initial margin per liquidation group split is determined by combining the market risk component with the remaining model adjustments and the liquidation risk component. This approach is performed for all positions of a clearing member's risk account per liquidation group split and subsequently summed to the level of the liquidation group. The consolidated initial margin for a clearing member's risk account is the sum of initial margins across liquidation groups.

Figure 7: Margin optimization via cross-margining



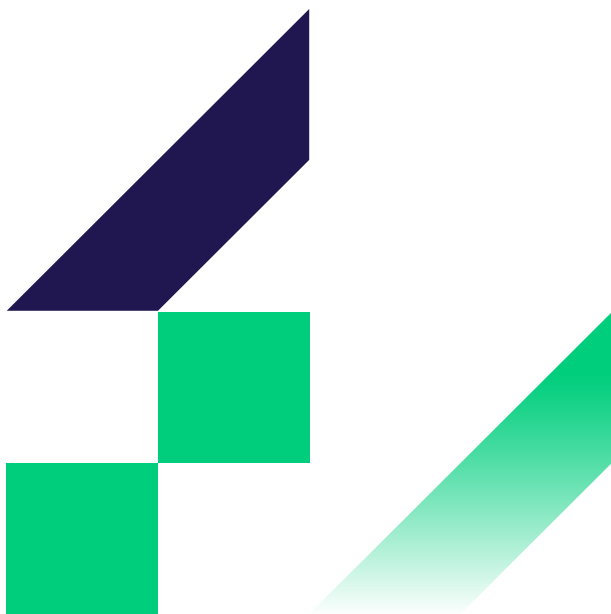
Cross-margining allocation algorithm for listed and OTC interest rate derivatives

A cross-margining allocation algorithm for fixed-income, money market and interest rate derivatives allows for capital-efficient margining.

Before calculating the individual margin components for the two liquidation group splits containing exchange-traded fixed income and money market derivatives on the one hand and OTC interest rate derivatives on the other, an optional cross-margining algorithm determines the ideal portfolio structure by combining positions in exchange-traded fixed income

(e.g., Euro-Bund Futures) and money market derivatives (e.g., EURIBOR Futures) with those in OTC interest rate derivatives (IRD) as depicted in Figure 7, thereby enabling cross-margining. This allocation aims to reduce the interest rate sensitivities of the positions within the IRD Liquidation Group Split as far as possible. The algorithm assigns the appropriate number of futures and/or options to maximize the offset of the IRD position.

Based on this allocation, the Margin Optimizer also ensures that no adverse effects from the increased margin period of risk occur.



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