

Eurex Clearing Prisma

Portfolio-based risk management



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Delivering innovation
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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. We were first to introduce both real-time risk calculation and real-time risk-data provision, and we continue to set industry standards in risk management.

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

Eurex Clearing Prisma maintains reliable counter cyclical margin levels in even the most challenging situations through a transparent and risk-sensitive methodology. It also delivers synergies through risk netting effects for listed, OTC and between listed and OTC positions.

It also promises flexibility when introducing new products as well as opportunities for greater capital efficiency, all with the robustness and reliability the market has come to expect from Eurex Clearing. As with everything we do, Eurex Clearing Prisma has been developed in conjunction with customers around the world to enable maximum benefits – and to ensure regulatory compliance – for all market participants. It is a solution that prioritizes safety, efficiency and integrity.

Eurex Clearing Prisma calculates combined risks across all markets cleared by Eurex Clearing. Cleared products that share similar risk characteristics are assigned to the same so-called Liquidation Group, which results in more comprehensive risk calculations enabling cross margining across positions within any Liquidation Group. Our margining method and default management process are closely aligned.

Eurex Clearing is optimizing post-trade activity for all market participants – so you can be prepared for new regulations, respond faster to challenging market conditions and feel confident that you are clear to trade.

About Eurex Clearing

Eurex Clearing is one of the leading central counterparties globally – assuring the safety and integrity of markets while providing innovation in risk management, clearing technology and client asset protection. We clear the broadest scope of products under a single framework in Europe – both listed products and OTC – and offer the world's widest spectrum of eligible collateral.

Eurex Clearing serves about 200 Clearing Members in 19 countries, managing a collateral pool of EUR 49 billion and clearing trades valued at EUR 11 trillion every month.

Eurex Group is comprised of Eurex Exchange, the International Securities Exchange, the European Energy Exchange, Eurex Clearing and Eurex Repo.

Eurex Group is owned by Deutsche Börse AG (Xetra: DB1).

www.eurexclearing.com

Introduction to Eurex Clearing Prisma

Eurex Clearing's Prisma methodology¹ features concepts that build on existing principles and procedures in order to achieve enhanced precision and maximize use of collateral. The following section explains, among others, Liquidation Groups, a key element of the portfolio-based margining system that enables Eurex Clearing to deliver synergies such as cross margining. It also describes 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

A Clearing Member's portfolio typically features a heterogeneous structure, size and/or complexity. Given this complexity, and due to the general handling principles laid out in our default management process, it is usually impossible to liquidate an entire portfolio in one single transaction. Therefore, Eurex Clearing has introduced the concept of Liquidation Groups and calculates risk on this level. Cleared products that share similar risk characteristics are assigned to the same Liquidation Group. This allows for a more comprehensive portfolio risk calculation and finally also enables cross margining across Liquidation Groups as long as offsets can be realized during the default management process. Therefore, Eurex Clearing has closely aligned its margining method with its default management process.

A complete Liquidation Group split can be hedged by Eurex Clearing, priced by Clearing Members and then be auctioned within a reasonable period of time.

General principles for Liquidation Groups:

- Portfolio risk margin offsets are only granted within pre-defined Liquidation Groups.
- Each Liquidation Group has a fixed holding period that reflects the time estimated to analyze, hedge and liquidate the respective products. A pre-defined holding

period can be between two to five days, depending on the Liquidation Group, and is at the same time the basis for the margin calculation.

Currently nine Liquidation Groups are established with respective holding period assumptions (see figure below). Which instruments are assigned to which Group can be found on the Eurex Clearing website: www.eurexclearing.com > **risk-management** > **risk-parameters**.

Liquidation Groups with holding periods

Liquidation Group	Holding period (days)
Listed Equity (Index) Derivatives	● ● ●
Listed Fixed Income	● ●
OTC Interest Rate Derivatives	● ● ● ● ●
Asian cooperations KOSPI/TAIFEX	● ●
Commodity (Index) Derivatives	● ● ●
Precious Metal Derivatives	● ● ●
Property Futures	● ● ●
FX Derivatives	● ●
IRS Constant Maturity Futures	● ●
Bond	● ●

Default management

As one of the world's leading Clearing Houses, we play an important role in the global effort to maintain stability in financial markets. We recognize our responsibility to help mitigate systemic risks should the default of a Clearing Member occur. We managed the financial crisis effectively, not least because we had robust procedures in place to deal with a Clearing Member default and were prepared to act when the need arose. We maintain our readiness to act in similar situations by continuously updating our safeguards and introducing innovative product offerings that increase the safety of our clients and of the Clearing House.

¹ Please visit the Eurex Clearing Prisma User Guide, which is available on Eurex Clearing's website www.eurexclearing.com, for more detailed information on specific topics.

Default procedures

Aware that each default scenario is unique, we maintain flexibility in our procedures in order to accommodate the individual features of each default consistent with local and global regulatory standards. Our procedures provide a transparent and adjustable framework that is applied depending on the circumstances of the scenario at hand.

The default management process is designed in a way which enables Eurex Clearing to handle portfolios in different Liquidation Groups individually. While it is likely that the liquidation with respect to different Liquidation Groups is likely to be conducted overlapping in time, the concrete measures applied can differ.

Despite the individual nature of every situation, explicit trigger events for a Clearing Member's default have been defined, regardless of product or cleared market. In the case that 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 our principle objectives is to protect customers and to minimize the impact on clients and their positions. We are committed to ensuring that clients and their positions can be transferred to a new, solvent Clearing Member quickly and smoothly, wherever possible.

Our risk management and clearing procedures have proved to be robust even in times of acute distress in financial markets. However, the crisis also highlighted that in the event of a Clearing Member default greater transparency and legal certainty with respect to the treatment of client positions and assets are critical to ensure the highest degree of protection for our Clearing Members and their customers. As one part of our continuous efforts to optimize our default management processes, we address the segregation and portability needs of our customers to help better prepare for a default event.

Default management process

Our default management process is comprised of set procedures designed to facilitate the orderly liquidation of even large and 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 with respect to any relevant matter of the default management process, most importantly hedging of the portfolio and the 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

Overview – default management process



Management Committee is convened. Default Management Committees will be convened in case of a Clearing Member default and for regular default simulations (once or twice 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.
- **Independent sale:** In order to grant 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 particular portfolios.

Lines of defense

We guarantee the fulfillment of every transaction in every market for which we provide clearing services. To ensure that we are able to keep this promise, we set up a multi-level safety system called our "lines of defense". While the mainstay of this safety system is the margin which Clearing Members have deposited as collateral for open positions, our lines of defense consist of several additional layers of financial resources, namely:

- the defaulted Clearing Member's Clearing Fund contribution,
- own resources of Eurex Clearing and the
- Clearing Fund contributions of all other non-defaulted Clearing Members.

Segmented Clearing Fund

Eurex Clearing maintains a segmented Clearing Fund, consisting of multiple Liquidation Group-specific Clearing Fund segments (CFS), and the sum of all CFSs is the overall Clearing Fund.

When liquidating a particular portfolio, only funds of the CFS assigned to the respective Liquidation Group can be used to cover losses, unless there is a known surplus from other Liquidation Groups for which the default management process has already been finished. As such, the segmentation of the Clearing Fund ensures that those Clearing Members' contributions are used first, which have been active in the Liquidation Group(s) that losses arise from. Meanwhile, the segmentation still maintains the capital efficiencies of one joint Clearing Fund, as compared to multiple asset class specific Clearing 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 Clearing Fund, i.e. Eurex Clearing's right to request Clearing Members to re-fill their Clearing Fund contributions once they have been utilized, is capped. In any crisis situation, each Clearing Member is only obliged to provide additional funds, up to an amount of two times its pre-funded Clearing Fund contribution.

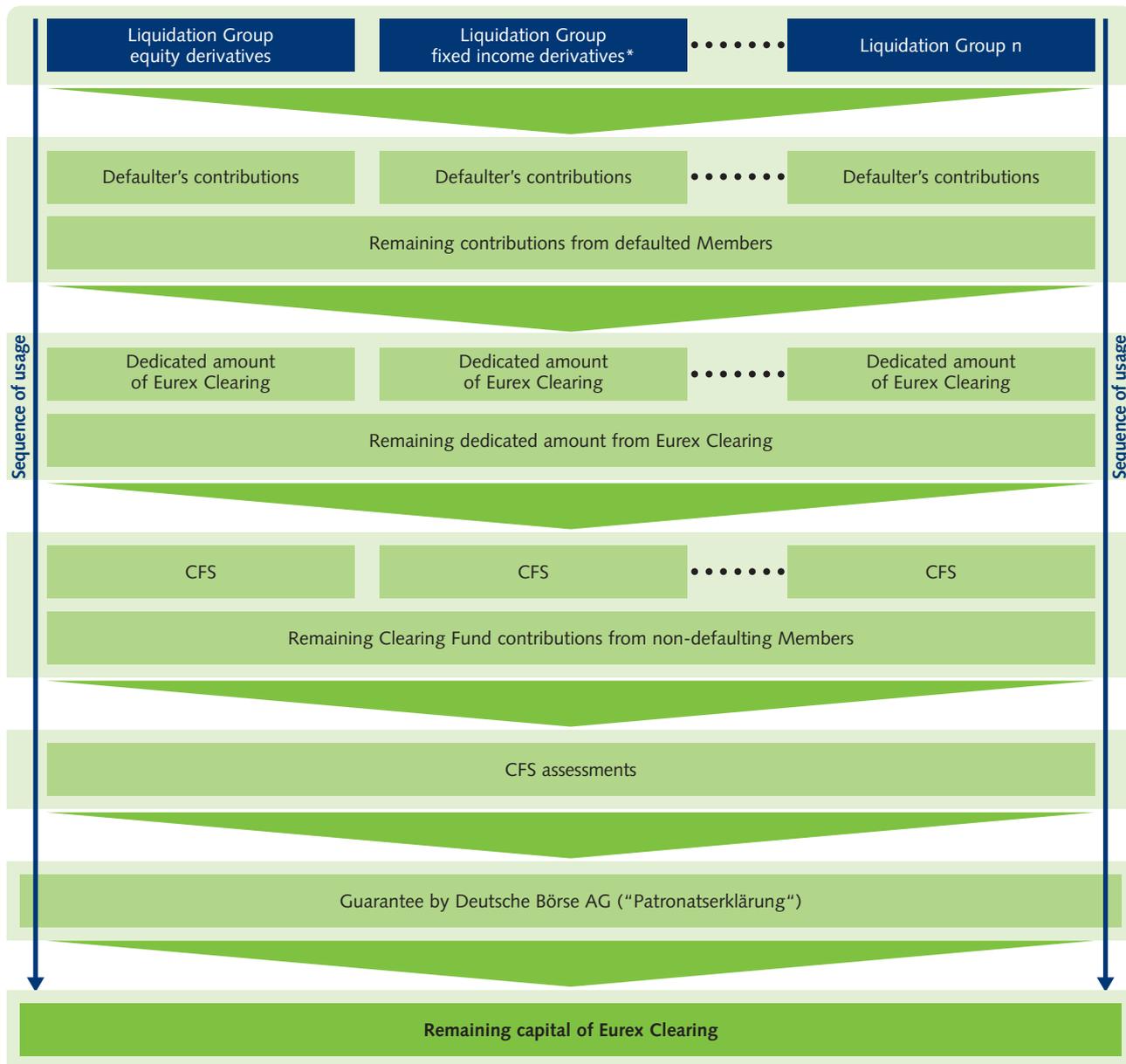
In the event of a default, these layers are applied in the order illustrated on the next page. This way, the lines of defense help protect the marketplace as a whole and play an important role in preventing a domino effect.

As a matter of last resort, Eurex Clearing has implemented the possibility for one Liquidation Group to be closed at the end of the lines of defense, while all other Liquidation Groups remain unaffected. This additional recovery option serves to minimize contagion risk to the maximum possible extent.

Setting new standards in transparency

When a Clearing Member defaults, we are careful to ensure that we take all possible steps to protect confidentiality, while we simultaneously recognize our responsibility to inform our stakeholders and the general public of the incident. In the event of a Clearing Member default we have implemented a clear communication guideline that is strictly supervised by Eurex Clearing's management and a policy to keep stakeholders informed at all times.

Lines of defense – sequence of usage by Liquidation Group



* Listed interest rate derivatives and OTC interest rate derivatives

Key aspects of our policy include the immediate creation of a system accessible news board message after an official regulator announcement or a self-declaration by the defaulting Member. It consists of publishing information on the Eurex Clearing website, daily press statements, the distribution of circulars, and conference calls held with the members of our clearing committees and the risk committee.

Margin components

Margin requirements aim to cover potential losses arising during the liquidation of a portfolio of a defaulted Clearing Member. According to the “defaulter pays” scheme, margins should be sufficient in order to cover the losses also in unfavourable market conditions and need to cover two components:

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

Both the backward- and forward-looking margin components are described in detail in this section. After providing an in-depth discussion of each margin component, this section then proceeds to describe how Eurex Clearing Prisma aggregates the different forward-looking components to create a comprehensive risk profile for determining the initial margin requirement of each Clearing Member.

Backward-looking components: mark-to-market margin

The Eurex Clearing Prisma calculation approach begins by considering two backward-looking margin components: the premium margin which allows for the deposit of collateral and the variation margin (including price alignment interest for swaps) that is calculated on a daily basis to exchange profits and losses and which has to be deposited in cash.

Premium margin

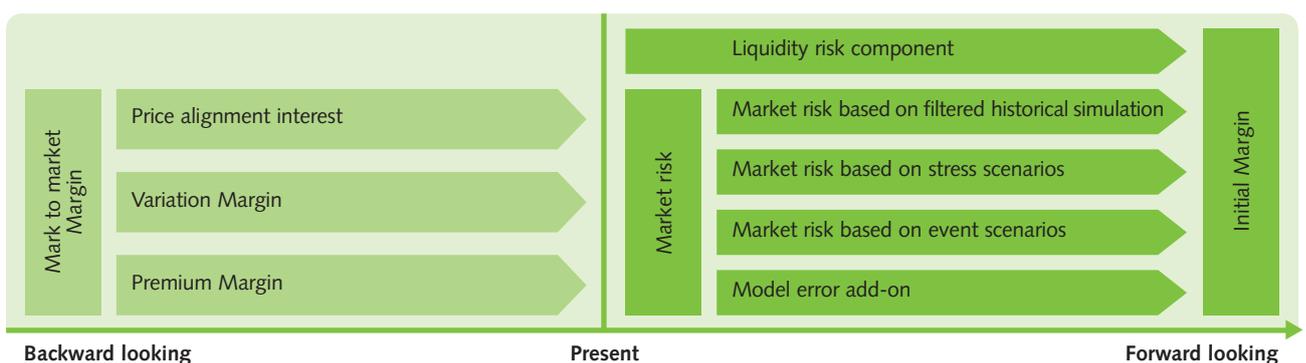
Premium margin must be deposited by the seller of an option, if the transaction results in an open position. It covers the potential loss that could be incurred if the seller was forced to liquidate the position today. The premium margin is continuously adjusted, i.e. if prices fluctuate so that the potential loss upon liquidation increases, the seller will be obliged to deposit additional premium margin.

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

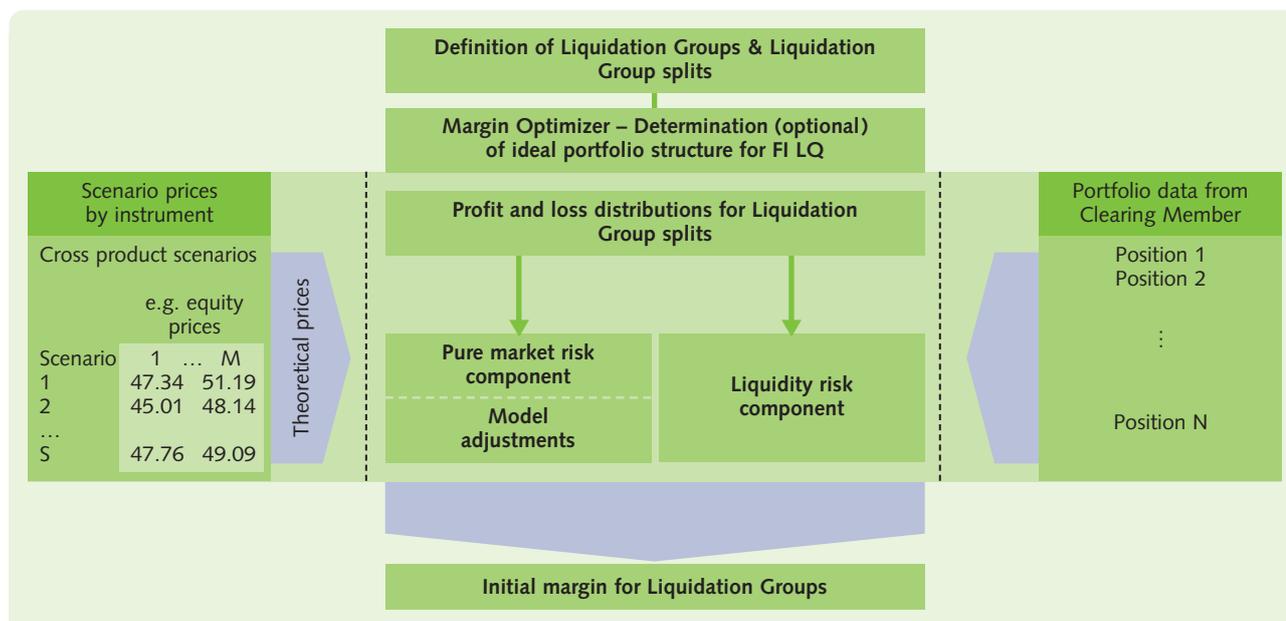
Variation margin

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 which are not premium-style margined products. To exchange profits and losses that arise due to the price fluctuations of open positions Eurex Clearing asks for cash collateral that is settled on a daily basis in the respective product currency, also known as variation margin.

Eurex Clearing Prisma margin components



Methodology overview



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

Price alignment interest

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

Eurex Clearing will charge/pay interest using the overnight interest rate of the corresponding currency on cumulative variation margin received/paid for products.

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 components: initial margin

The forward looking component called initial margin (IM) collateralizes potential future exposure making use of the default management's assumption regarding the holding period.

The Eurex Clearing Prisma initial margin calculation is the result of a simulation-based, value-at-risk (VaR) methodology that uses

- Filtered historical scenarios
- Stress period scenarios
- Dedicated event scenarios
- Adjustments to account for correlation breaks, compression and illiquidity

As the initial margin is a forward-looking margin component, it quantifies an estimate of future potential losses over the holding period of all Clearing Members' Liquidation Groups at a pre-defined and appropriate confidence level. The initial margin is calculated by taking into account potential correlation and netting effects for positions within a Liquidation Group. Initial margin figures for different Liquidation Group splits and Clearing Member position accounts are then aggregated to a single margin amount.

The initial margin consists of two main subcomponents:

- Market risk
- Liquidity risk

Both components are calculated using profit and loss distributions for the Liquidation Group based on a set of different scenario prices for the underlying instruments.

Margin optimization for listed and OTC interest rate derivatives

Before calculating the individual margin components within the fixed income derivatives Liquidation Group, the Clearing House uses a Margin Optimizer process to determine the ideal portfolio structure by optionally combining fixed income and money market derivatives and IRD, thereby enabling cross margining. Fixed income derivatives (e.g. Euro-Bund Futures) and money market derivatives (e.g. EURIBOR Futures), which hedge the interest rate risk of the IRD positions, are allocated to the IRD Liquidation Group split which is correspondingly also called "IRD+FI split". This allocation aims to reduce the interest rate sensitivities of the IRD portfolio as far as possible. The Margin Optimizer also ensures that based on this allocation no adverse effects from the increased liquidation horizon occur.

Market risk component

The market risk component is designed to hold on a confidence level of 99% for listed products and 99.5% for OTC derivatives and it is calculated based on:

75% of filtered historical scenarios with three years look back period and 25% stress period scenarios. The stress scenarios are included to ensure stability and avoid procyclicality. The pure market risk component, i.e. without the model adjustments, is calculated based on the tail risk measure Value-at-Risk. It is individually applied on the profit and loss distributions of the historical and the stress period scenarios.

All historical scenarios are updated on a daily basis with the latest risk factor returns and the new current price information available leading to a new set of 750 historical prices every day.

Subsamples

The scenario prices are divided into several subsamples to avoid artificial statistical effects resulting from overlapping time periods that would violate the assumptions of the calculated risk figures. Therefore each risk figure is calculated on scenario subsample level and subsequently aggregated to an overall risk figure. The number of subsamples depends on a Liquidation Group's holding period.

In addition to Filtered and Stress period historical scenarios, so-called Event Risk scenarios are part of Prisma's market risk component: They are estimated based on exogenous event scenarios modelling sudden independent market events. In contrast to the filtered-historic and stress-period scenario sets, the event-risk scenario set is not split into subsamples and is purely based on simple n-day returns. Also, it is not a VaR measure that is used to assess the risk, but a sum of worst N scenario losses, with N being again an exogenous parameter.

The graphic on page 11 illustrates how Eurex Clearing calculates the market risk component of a portfolio by applying filtered historical and stress period scenarios as well as event scenarios.

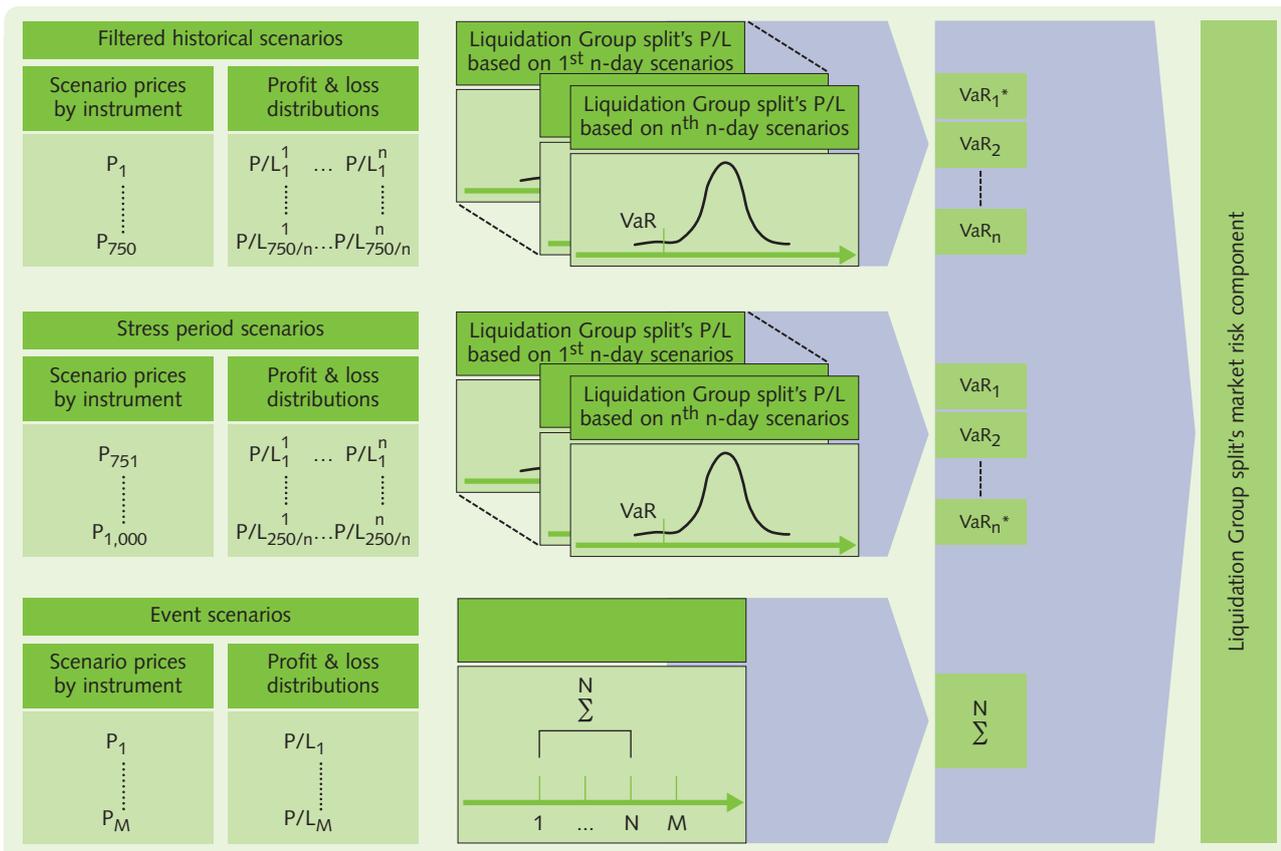
Based on the scenario prices, the profit or loss for each product is calculated by comparing the calculated scenario price to the current neutral price. The profit and loss figures for each product within a Liquidation Group are then aggregated for each scenario individually. Therefore, risk offsets within the Liquidation Groups are automatically considered.

Model adjustments

In order to mitigate model risk inherent in the calculation of the tail risk measures, three model adjustments are calculated and added to the pure market risk component:

- The correlation break adjustment completes the simulation for the worst-case breaks in correlation.
- The compression adjustment amends the simulation by pricing effects where a data compression approach has been chosen applicable to products which are sensitive to volatility.
- The Long Option Credit compensates a long option dominated portfolio and provides a credit in case the initial margin exceeds the premium margin.

Overview – market risk calculation



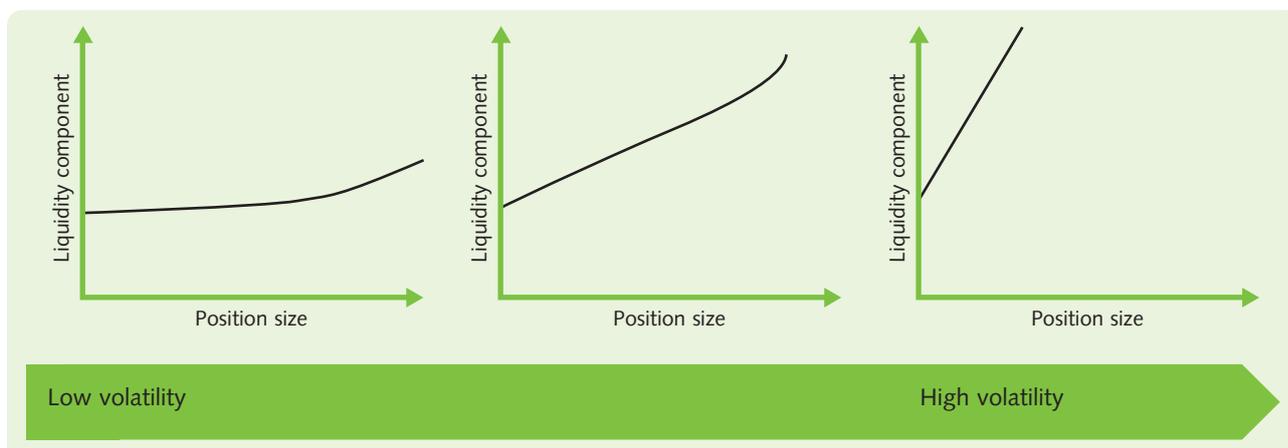
* The maximum of filtered historical, stress period and event scenarios is considered.

Liquidity risk component

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

- The liquidity risk component depends on the relative size of the position. The liquidity risk component is a function of the position size and the total market capacity, which can be characterized by means of daily traded volume or open interest of a financial instrument.
- The liquidity risk component depends on the current level of market risk in the respective product, i.e. the higher the volatility of an instrument's price, the higher the premium.
- Even for small position sizes, the liquidity risk component is not zero. In reality, trading does not actually occur at mid prices, but at bid or ask prices. Therefore the minimum liquidity component is defined by the liquidity premium.
- Market capacities and liquidity risk components are product-specific and unevenly distributed across product subgroups, i.e. for options the market capacities and bid-ask spreads depend on their moneyness and time to expiry.

Liquidity risk depictions



The illustration above shows the liquidity risk component's dependence on the position size and the market risk of three positions with different risk profiles. For all three positions the liquidity risk component is non-zero even for a small position size (i.e. on the left hand side of each graph) and grows with an increasing position size. The liquidity risk component for a position carrying a higher market risk increases at a faster rate relative to the liquidity risk component for positions with a smaller market risk.

Specific treatment for swaps products

Interest rate derivatives are treated differently from other instruments due to product specific requirements and market conventions. The liquidity risk adjustment is calculated by currency according to the expected transaction costs of the swaps required to hedge the Clearing Members' portfolio.

Cross margining allocation algorithm for interest rate derivatives

In order to allow for capital efficient margining, a cross margining allocation algorithm for interest rate derivatives has been developed. This algorithm is based on the combination of IRD positions, listed fixed income and money market derivatives to offset interest rate sensitivities. The offset is calculated on maturity buckets which assign instruments to the respective parts of the yield curve.

For each maturity bucket, the appropriate number of futures and/or options is calculated and if available – allocated to the Interest Rate Derivatives (IRD) and Fixed Income (FI) Liquidation Group split.

This process optimizes the portfolio (Liquidation Group's) in order to increase capital efficiency.

Aggregating forward-looking components

The Eurex Clearing Prisma methodology takes both backward- and forward-looking risk components into consideration in forming a complete risk picture. This section exclusively covers the elements of the forward-looking risk components – the initial margin – as backward-looking components have been covered previously and are partly settled in cash on a daily basis.

The total initial margin component for a single Liquidation Group consists of the aggregated market risk components over all scenario subsamples, including the respective model adjustments and Liquidation Group specific liquidity risk components.

Margin optimization via cross margining



* The Margin Optimizer optionally associates listed derivatives positions with swaps positions, enabling collateral and margin efficiencies. Within each Liquidation Group split portfolio margin is applied.

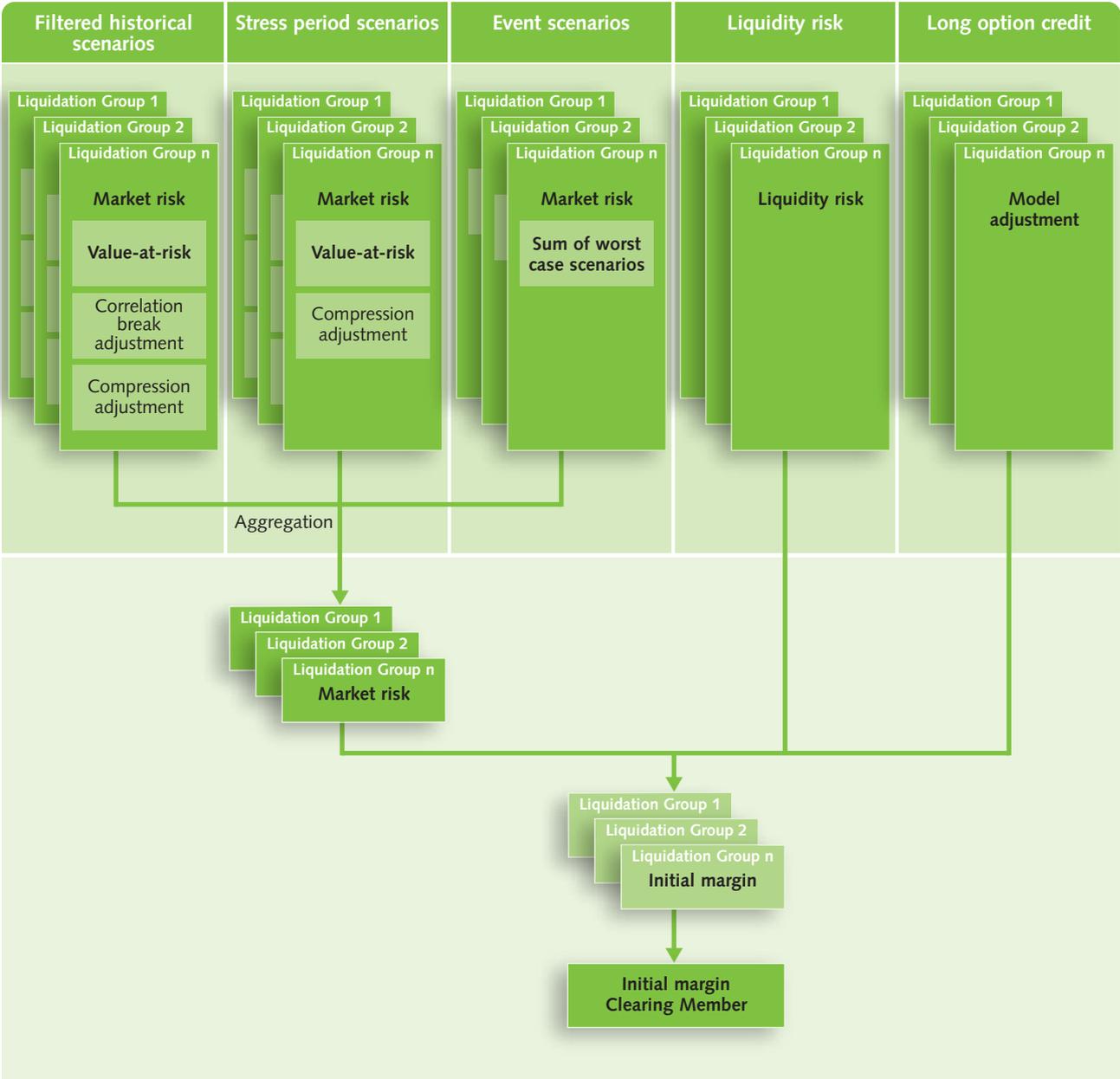
The value-at-risk figures for each subsample of the filtered historical and the stress scenarios are aggregated by taking the mean value-at-risk figures of the subsamples separately for the filtered historical and the stress scenarios, including the relevant model adjustments.

In contrast to the filtered-historic and stress-period scenario sets, the additional event-risk scenario set is not split into subsamples and is purely based on simple N-day returns. It is not a VaR measure, but a sum of scenario losses.

The resulting three values for the stress-, the filtered historical, and the event risk scenarios need to be aggregated as well. This is done by taking the maximum of the filtered historical value-at risk, the sum of worst-N scenario losses for the event risk, and a scaled stress value-at-risk. The scaling ensures the appropriate statistical confidence level of the stressvalue-at-risk.

The graphic on page 14 depicts how the initial margin for a Clearing Member is determined.

Initial margin calculation by Clearing Member and Liquidation Group



Aggregation

The beforementioned aggregation of FHS, SP and ER ensures that FHS is floored by the scaled SP component, while simultaneously taking sudden independent market events into account.

This calculation is performed for each Liquidation Group and the result can differ by Clearing Member and position account, i.e. in one instance it can be the value from the filtered historical scenario and in another instance it can be the value from the stress period scenarios or the exogenous event scenarios from event risk component. The value selected will be the most favorable for the safety of the Clearing House and the marketplace.

Initial margin

The initial margin per Liquidation Group is determined by combining the market risk component with the liquidity risk component. This approach is followed for each individual Liquidation Group that is contained within the Clearing Member’s portfolio and is applied to an individual position account.

The consolidated initial margin for each Clearing Member results from the sum of all initial margin results by Liquidation Group.

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