Fixed Income - Parameters Methodologies used in Margin calculations

MANUAL

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Foreword

This document describes the SPAN-like methodology (MVP) used to determine the parameters used for Initial Margin Calculation for cash and repo contracts on government bonds[1] and for cash contracts on corporate bonds traded on markets where Euronext Clearing is about to intervene as Central Counterparty.

The document is preceded by an executive summary followed by a detailed description of the methodology, containing the underlying assumptions and the applicative details. The document ends with a description of the margin parameters update and modification procedure.

[1] Please note that starting from 20 June 2022, initial margins for sovereign bonds issued by Italy, Spaign, Ireland and Portugal are computed using the FIRE (Fixed Income Risk Engine) methodology. MVP methodology continues to apply to corporate bonds and sovereign bonds issued by countries different from the above-mentioned (Classes 31-35). For further details ref to the methodological notes on the website VAR-based risk model | euronext.com section.

1. Description of the methodology

1.1 Peculiarities of Fixed Income Securities

In order to determine the largest price variation for a fixed income security, its main peculiarities must be recalled.

1.1.1 THE PULL TO PAR PHENOMENON

Whereas the price of an equity instrument may be assumed to follow a random walk and therefore it is not possible to determine *a priori* which will be the price of a given stock at a given future date, the price of a bond converges to the parity at maturity (so called "*pull to par phenomenon*").

1.1.2 THE ROLL DOWN PHENOMENON

The volatility of a stock is a function of the square root[2] of the time interval on which it is measured, that volatility over a time horizon of *n* days is equal to $\sqrt{n}$ times the one-day volatility: $\sigma_{ng} = \sqrt{n}\sigma_{1g}$ To the opposite the volatility of a bond converges to zero as the time to maturity decreases (so–called "*roll down phenomenon*").

The above-mentioned phenomena preclude the recourse to analysis of price variations of the bond itself since the price variation patterns of a bond having a certain time to maturity τ is completely unrelated to the price variation patterns of the same bond at a different point in time in which its time to maturity was τ +t.

[2] The apparently anti-intuitive relation linking volatility to the square root of time derives from the following considerations: The two-day return of a security is equal to: $ln\left(\frac{P_{t+2}}{P_t}\right)$, which, using the properties of logarithms may be written as: $ln\left(\frac{P_{t+2}}{P_t}\right) = ln\left(\frac{P_{t+2}}{P_{t+1}}\right) + ln\left(\frac{P_{t+1}}{P_t}\right)$. That is the two-day return is the sum of the two one-day returns. The two-day standard deviation $\sigma_{t+2}$is equal to: $\sigma_{t+2} = \sqrt{\sigma_{t+1}^2 + \sigma_t^2 + 2\sigma_{t+2}\sigma_{t+1}\rho_{t+2,t+1}}$. Under the assumption that returns follow a random walk, the correlation term ρt+2,t+1 is equal to zero. If moreover it is assumed that returns are identically distributed across time (independent and identically distributed returns), then $\sigma_{t+1} = \sigma_t$ and therefore $\sigma_{t+2} = \sqrt{\sigma_{t+1}^2 + \sigma_t^2} = \sqrt{2}\sigma_t$.

a) Cashflow Mappings Methodology

To measure the risk of a bond is therefore necessary to use analytical instruments that may indicate the functional relationships of the bond price with the risk factors to which it is exposed; such task may be fulfilled by mapping the cashflows produced by the bond.

The simplest and most immediate type of mapping is the principal mapping, in which the bond risk is associated with the time to maturity of its principal payment only, without considering any other information regarding the other characteristics of the bond, in other words, not taking into consideration the coupons paid by the bond during its life. A more advanced type of mapping is the duration mapping, in which the risk is associated with the bond duration[3], a quantity that allows bond with coupons to transform into an equipollent zero–coupon bond, allowing thus the comparison between bonds with different coupon rates and between bonds with coupon and zeroes.

It is worth mentioning that both principal mapping and duration mapping identify a single risk factor for each bond, respectively equal to the zero–coupon yield for maturity equal to the time to maturity of the bond and to the zero–coupon yield for maturity equal to the bond duration. Both methodologies consider as fungible the cash flows originated by the same bond at different points in time and do not consider, within the same bond, the imperfect correlation of yields along the curve.

A more advanced type of mapping, the so-called "cashflow mapping" allows to keep into account also the decorrelation along the zero–coupon curve, as it takes into consideration the risk of each single future cash flow produced by the bond, discounted at the proper rate.

[3] The *duration D* is equal to the weighted average of the maturities t_i of the various cash flows CF_i, using as weights the present values (discounted at rate y) of the amounts due; k is the number of coupon per year. $\boldsymbol{D = \frac{1}{k}\sum_{i=1}^{n} \frac{CF_i(1+y)^{-t_i} t_i}{CF_i(1+y)^{-t_i}}}$.

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2. Methodologies for determining marging parameters

2.1 Corporate Bonds

2.1.1 CLASSES SPECIFICATIONS

Due to the reduced liquidity of corporate bonds, a not very granular classes structure has been adopted for these instruments.

Therefore, 5 classes have been identified taking into consideration the maturities on the medium and long term (3,5,7,10 and 10 years +).

2.1.2 INTRA–CLASS AND INTER-CLASS OFFSET FACTORS

Corporate bonds price takes in account the *risk free* rates shape and the single issuer financial condition, considering the specific *pay-off* for each corporate bond. As a consequence, is not possible *a priori* to determine a correlation between the corporate bonds prices fluctuations related to the corporate bonds Classes.

In order to take into account of the part related to the ZCB curve shape, an Intra-Class Offset Factor (conservatively set at maximum value equal to the lower value calculated for ZCB curve) may be applied to each corporate bonds class, subject to Internal Risk Committee approval. No Inter-Class Offset Factor is applied.

Figure 4 provides an example of Classes and corresponding Margin Intervals for corporate bonds.

FIGURE 1: CLASSES AND MARGIN INTERVALS – EXAMPLE

Corporate bonds

Classe	Vita residua	Unità
XXXI	(0-3]	years
XXXII	(3-5]	years
XXXIII	(5-7]	years
XXXIV	(7-10]	years
XXXV	>10	years

Classe	Intervallo del margine
XXXI	9,00%
XXXII	11,00%
XXXIII	13,00%
XXXIV	17,00%
XXXV	30,00%

2.1.3 PROCEDURES FOR MARGIN PARAMETERS REVIEW

Margin parameters are monitored and - if necessary - modified, basing on the periodic back test results and, in general, on the market conditions and volatility trends.

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