MVP Manual

Margin Calculation for Cash and Repo Transactions on Bonds Markets

Risk Management Dept.

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Summary

Foreword

This document is a guide to the calculation of Initial Margins on cash and repo (both «*Classic*», and «*Sell-BuyBack*»[1]) bond transactions executed on Bonds Markets, for which CC&G acts as Central Counterparty.

The margining methodology foresees the following types of Initial Margins:

a) **Mark-To-Market Margins**, which re-evaluate on a daily basis the portfolio to the market;

b) **Additional Margins**, which evaluate the largest possible loss under the hypothesis of portfolio liquidation in the most unfavorable price/yield scenario reasonably possible.

The Margin calculation is separated for each settlement currency of the cleared instruments. Mark-To-Market Margins, Additional Margins and Initial Margins have to be separately calculated for each settlement currency. Initial Margins separately calculated must be then converted in Euro at the related exchange rate; the haircut applied to convert in Euro will depend on the specific currency.

Total Initial Margins are the sum of all of the converted Initial Margins.

a) Calculation of Mark-To-Market Margins

The calculation is based on the following steps:

Step 1. Retrieval of market prices

In order to re-evaluate positions at their current market value, "mark-to-market" prices are used; such prices are representative of market conditions at the end of the trading day.

1 The main difference between «Classic» and «Sell-BuyBack» Repos is in the management of coupons paid during the transaction. In «Classics», coupons paid on the bond during the term of the transaction are required to be paid on to the original seller upon receipt. Whereas in «Sell-BuyBacks» coupons are deemed to be paid to the buyer and reinvested at the repo rate until the termination of the transaction. The coupon amount plus the interest accrued from coupon payment date to transaction settlement date is then deducted from the cash to be received at the termination date.

Step 2. Selection of transactions to be included in calculation of Mark-To-Market Margins

The following positions are be included in calculation of Mark-To-Market Margins:

a) For cash transactions, all unsettled transactions as of Initial Margin calculation date;

b) For repo transactions, all transactions whose "cash" leg has already been settled and its "forward" leg is still unsettled as of margin calculation date.

Step 3. Calculation of the accrued coupon

The time interval to be considered in coupon accrual calculation changes according to the type of contract:

a) For cash transactions, the accrued coupon is calculated starting from the maturity date of the previous coupon until the settlement date; it is not necessary to update such calculation during the three days between the trade date and the settlement date given that the accrual can be considered irrelevant for margining purposes;

b) For repo transactions, the accrued coupon is calculated starting from the maturity date of the previous coupon until the first working day after Initial Margin calculation; in this case the accrual is considered relevant for margining purposes

The accrued coupon is calculated according to the "Euroland" market convention (act/act).

Step 4. Determination of *Repo interest*

Interests on repo transactions (*RI*) are calculated starting from the repo commencement date until the first working day after Initial Margin calculation; therefore:

$$RI = \frac{t \times TA \times RR}{36{,}000}$$

where t is number of days, TA is the traded amount (cash leg) and RR is the repo rate.

The repo interest amount is rounded to the unit.

Step 5. Determination of the Transaction Revaluated Amount

The Transaction Revaluated Amount of the instrument denominated in the related currency (*TRAx*) is equal to the nominal value (*NV*) of the traded security, revaluated at the current market price (*P*) as per Step 1 above, plus the accrued coupon (*AC*) calculated as per step Step 3 above. Therefore:

$$TRAx = (NV/100) \times (P + AC)$$

If the denominated currency (x) and the settlement currency (y) are not the same, TRAx has to be converted in the settlement currency (y), given the exchange rate (TCxy):

$$TRA = TRAx/TCxy$$

Step 6. Calculation of Mark-To-Market Margin per transaction

The Mark-To-Market Margin is equal to the difference between the transaction revaluated amount as per Step 5 above and the traded amount (cash leg); for repo transactions, the repo interest amount as per Step 4 above must also be taken into consideration.

Therefore:

a) cash transactions:

Mark-To-Market Margin= (TRA – Traded amount) × position sign[2];

b) repo transactions:

Mark-To-Market Margin= (TRA – Traded amount – RI) × position sign.

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[2] The buyer of a cash bond has a long position (+1), and the seller a short position (-1). The holder of a repo (sells bonds spot and buys them forward) has a long position (+1), the holder of a reverse repo (buys bonds spot and sell them forward) has a short position (-1). 3 In case of CCT the coupon is equal to 6 months gross RendiBot determined at the last auction before the beginning of the coupon accrual period plus a spread;in case of CCTeu the coupon is indexed to the 6M Euribor plus spread.

Step 7. Calculation of the Overall Mark-To-Market Margin for each single currency

The Overall Mark-To-Market Margin is equal to the sum of all the Mark-To-Market Margins calculated for each transaction.

Overall Mark-To-Market Margins = Σ Mark-To-Market Margins per each transaction.

A negative Mark-To-Market Margin is a debit for the member towards the CCP; a positive Mark-To-Market Margin is a theoretical credit for the member.

b) Calculation of Additional Margins

The methodology is based on the following steps:

Step 1. Selection, evaluation and classification of transactions to be included in Additional Margins calculation:

a) Selection of transactions

The following positions are evaluated (as in the case of the calculation of Mark-To-Market Margins):

a) For cash transactions, all unsettled transactions at Initial Margin calculation date;

b) For repo transactions, all transactions whose "cash" leg has already been settled and its "forward" leg is still unsettled.

b) Transaction evaluation

In order to obtain a single net balance for each security (identified by its ISIN code), long and short[2] positions are algebraically summed (at their re-evaluated countervalue), independently of the transaction type (cash or repo) from which they have arisen.

c) Classification of portfolio securities

Government Bonds

Net positions in Government bonds calculated at sub-step b) above are then divided in Classes, according to their sensitivity to interest rates fluctuations. The Classes are numbered from 1 to *n*. Duration is used as an indicator of such sensitivity (see Annex 3 - Duration Calculation).

Corporate Bonds

Net positions in corporate bonds calculated at sub-step b) above are then divided in Classes, according to their time to expiry. The Classes are numbered from *q* to *z*.

Since duration and time to expiry change every day it is necessary to reallocate daily securities in Classes.

Annex 1 provides an example of the classification.

Step 2. Determination of marginable positions

In order to take into consideration the opposite sensitivity to interest rate variations of positions of different signs, positions are reduced by a procedure that – keeping into consideration correlations between securities sorted by Duration/Time to expiry Classes – determines the “Marginable Positions” that is the unbalanced positions on which margins must be calculated.

In order to achieve such aim, a sequence of offsetting priorities is determined according to a specific list (see Annex 2 - Priority and Intra / Inter Class offset - Example); positions are offset within the same Class (*Intra* Class Priority) and subsequently among different contiguous Classes (*Inter* Class Priority). A Cross-Position Offsetting Factor is associated to each Priority.

Therefore, according to the established priority sequence, long and short positions within the same class are decremented by an amount equal to the Cross-Position Offsetting Factor applied to the smaller of he two positions.

Decremented Long Position Class n = Long Position Class n – [priority n Cross-Position Offsetting Factor × min (Long Position Class n; Short Position Class n)]

Decremented Short Position Class n = Short Position Class n – [priority n Cross-Position Offsetting Factor × min (Long Position Class n; Short Position Class n)]

When Inter Class Priorities are considered, both the long and the short position of one Class is decremented of an amount equal to pertinent *Inter* Class Cross-Position Offsetting Factor applied to he smaller between the position itself and the position of opposite sign of the other Class.

Decremented Long Position Class n = Long Position Class n – [priority nm Cross-Position Offsetting Factor × min (Long Position Class n; Short Position Class m)]

Decremented Short Position Class n = Short Position Class n – [priority nm Cross-Position Offsetting Factor × min (Long Position Class m; Short Position Class n)]

Decremented Long Position Class m = Long Position Class m – [priority nm Cross-Position Offsetting Factor × min (Long Position Class m; Short Position Class n)]

Decremented Short Position Class m = Short Position Class m – [priority nm Cross-Position Offsetting Factor × min (Long Position Class n; Short Position Class m)]

For each Class the results obtained by the application of Priority *n* Cross-Position Offsetting Factor is the starting point for the application of Priority *n+1* Cross-Position Offsetting Factor.

Countervalues are rounded to the nearest unit before and after each calculation.

Annex no.2 provides an example of a priority list.

Step 3. Calculation of Unadjusted Additional Margin

For each Class, long and short “Marginable Positions” – which have been obtained through the above described procedure – are compared and the largest (in absolute value) among them is multiplied by a coefficient (*Deposit Factor*) specifically established for that Duration Class.

Unadjusted Additional Margin per Class = Class Deposit Factor × Max (Long Marginable Position; Short Marginable Position)

The result is rounded to the nearest unit.

Unadjusted Additional Margins for each Duration Class are then summed up in order to obtain the total Unadjusted Additional Margins:

Total Unadjusted Additional Margins = Σ Unadjusted Additional Margin per each Duration Class

Step 4. Adjusted Additional Margins

Unadjusted Additional Margins as per step Step 3 above are multiplied by an *Adjustment Factor*, whose value can be set at member level, in order to obtain *Adjusted Additional Margins*.

Adjusted Additional Margins = Unadjusted Additional Margins × Adjustment Factor

Adjusted Additional Margins are rounded to the nearest unit.

All Additional Margins are always indicated with a positive sign.

c) Calculation of Initial Margins for each single currency

Initial Margins for each single currency are equal to the sum of Mark-To-Market Margins and Additional Margins related to the same currency. Should the amount Mark-To-Market Margins credit be larger than the amount of Additional Margin debits, Initial Margins separately calculated are set to zero.

Initial Margins separately calculated = Min (Mark-To-Market Margins – Adjusted Additional Margins;0)

a)

d) Calculation of Initial Margins in Euro

Initial Margins separately calculated must be then converted in Euro at the related exchange rate; the haircut applied to convert in Euro will depend on the specific currency:

Initial Margins € = Initial Margins separately calculated * TC * (1+H)

For each member, Total Initial Margins are the sum of all of the converted Initial Margins.
If Total Initial Margins are a debit for the member, calculation of Total Initial Margins can provide the following results:

a) if Total Initial Margins are larger than Total Initial Margins collected the previous day, members are compelled to deposit the difference;

b) if Total Initial Margins are smaller than the Total Initial Margins collected the previous day, the excess may be withdrawn by the member.

e) Determination of parameters

The parameters used by the Margins Calculation Procedure are periodically revised and, if the case, updated in order to keep into account market conditions, volatility trends and the evolution of financial instruments.

The parameters subject to periodical revision are:

⇒ Number of Classes;

⇒ Cross-Position Offsetting Factor;

⇒ Deposit Factor;

⇒ Adjustment Factor (at member level);

⇒ Duration Class "Borders";

⇒ Priority List;

Increasing Percentage (for fail positions).

Annex 1 - Classification and Deposit Factor - Example

GOVERNMENT BONDS

Class	Duration	Unit
I	(0-1]	months
II	(1-3]	months
III	(0,25-0,75]	years
IV	(0,75-1,25]	years
V	(1,25-2]	years
VI	(2-3,25]	years
VII	(3,25-4,75]	years
VIII	(4,75-7]	years
IX	(7-10]	years
X	(10-15]	years
XI	(15-30]	years
XII	Inflation Indexed Bonds	

Class	Margin Interval
I	0,70%
II	1,00%
III	1,10%
IV	1,20%
V	1,30%
VI	1,50%
VII	1,90%
VIII	2,20%
IX	3,60%
X	6,40%
XI	15,00%
XII	9,00%

CORPORATE BONDS

Class	Time to Maturity	Unit
XXXI	(0-3]	years
XXXII	(3-5]	years
XXXIII	(5-7]	years
XXXIV	(7-10]	years
XXXV	> 10	years

Class	Margin Interval
XXXI	4%
XXXII	6%
XXXIII	8%
XXXIV	10%
XXXV	30%

Annex 2 - Priority and Intra / Inter Class offset - Example

GOVERNMENT BONDS

Class	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
I Priority	10% 1											
II Priority		45% 2	25% 13									
III Priority		25% 13	50% 3	15% 14								
IV Priority			15% 14	70% 4	50% 15	35% 16						
V Priority				50% 15	75% 5	50% 17	40% 18					
VI Priority				35% 16	50% 17	75% 6	55% 19	45% 20	35% 21			
VII Priority					40% 18	55% 19	70% 7	60% 22	50% 23	35% 24		
VIII Priority						45% 20	60% 22	75% 8	60% 25	45% 26		
IX Priority						35% 21	50% 23	60% 25	80% 9	60% 27	30% 28	
X Priority							35% 24	45% 26	60% 27	85% 10	50% 29	
XI Priority									30% 28	50% 29	75% 11	
XII Priority												30% 12

CORPORATE BONDS

Class	IntraClass Offset
XXXI	10%
XXXII	10%
XXXIII	10%
XXXIV	10%
XXXV	10%

Annex 3 - Duration Calculation

a) Zero Coupon Bonds

The duration is, by definition, equal to the maturity of the bond.

b) Fixed Coupon Bonds

The duration or Macaulay's Duration (D) of a fixed coupon bond producing n cash flows $f_1, f_2, \ldots f_5, \ldots f_n$ at the maturities $t_1, t_2, \ldots t_5, \ldots t_n$ which may be reinvested at rate i, is represented by the following analytic expression:

$$D = \frac{\sum_{s=1}^{n} t_s f_s (1+i)^{-t_s}}{\sum_{s=1}^{n} f_s (1+i)^{-t_s}} \times \frac{1}{v}$$

Description of variable:

- ⇒ ***n*** is the number of the future cash flows (coupons and principal);
- ⇒ ***v*** is the annual frequency of coupons payments (i.e. 2 if semiannual);
- ⇒ t_s is the number of periods (or fraction) between the calculation date and the maturity day of f_s;
- ⇒ f_s is the amount of the periodical cash flow; it is equal to the coupon times the nominal value of the security, the last cash flow includes the principal, which is equal to the nominal value of the bond itself;
- ⇒ ***i*** is the internal rate of return (IRR); the IRR is the discount rate that when applied to futures cash flows produces the current market value of the bond. It is obtained by solving iteratively the following equation:

$$\sum_{s=1}^{n} f_s (1+i)^{-t_s} = P$$

where ***P*** is the current market value of the bond (dirty price).

All figures are rounded to the fourth decimal.

Below is an example of the duration at May 28, 2002 (settlement date May 31, 2002) of a BTP, final maturity October 1, 2003, annual coupon 4%, semiannual payout.

	date	t (in period)	Cash flows (f)	Discounted cash flows $f(1+i)^{-t}$	t x discounted cash flows $f(1+i)^{-t}$
calculation	31 May 2002				
First coupon	01 Oct 2002	0.6740	2	1.9732	1.3299
second coupon	01 Apr 2003	1.6740	2	1.9342	3.2379
Third coupon + principal	01 Oct 2003	2.6740	102	96.6899	258.5488
			sum	100.5973	263.1166
			Duration	1.3078	

The duration is equal to 1.3078 years (1 year and 113 days); the discount rate (IRR) is equal to 2.0195% per period (equivalent to 4.08% per annum); it has been derived from the bond dirty market price (99.94) on May 28, 2002.

c) Floating Rate Bonds

Macaulay's duration is not applicable to floating rate bonds. The price volatility of these bonds is very low; in fact – since future coupons are adjusted to market rates – in case of a drop (raise) of interest rates, gains (losses) on the capital account are offset by losses (gains) on the interest receivable account.

However such realignment of the bond price to market rates conditions is not perfect valid for CCTs, since the accruing coupon is predetermined[3] and its non-variability has necessarily an impact on the price of the bond (so-called "rigidity effect"), that will therefore show small variations in case of variations of interest rates.

The duration model for floating rate bonds are often too complex[4] to be a viable solution for operational applications. The duration of floating rate bonds can be reasonably assumed equal to the time to maturity of the second accruing coupon.

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3 In case of CCT the coupon is equal to 6 months gross RendiBot determined at the last auction before the beginning of the coupon accrual period plus a spread;in case of CCTeu the coupon is indexed to the 6M Euribor plus spread.

4 The complete modified duration formula (which takes into consideration also the spread s) for a floating rate bonds is the so-called Yawitz's Duration:

$$D_f = \frac{t_1}{(1+i)} + \frac{(s-fm)[1-(1+i)^{-n}]}{P \times i} \times \left[\frac{1+i}{i} - \frac{n}{(1+i)^n - 1}\right]$$

This formula takes into consideration both the already mentioned "rigidity effect" and the "rental effect" that is given by the difference between the spread (s) and the financial margin (fm), which represents the additional cost (compared to market yields) applied by the market to floating rates bonds.

d) Inflation-Indexed Bonds

Inflation-Indexed Bonds protect the purchasing power of the investor, in fact the bond principal is adjusted by a predetermined inflation index; the coupons paid by the bond are also indexed: the nominal coupon rate is applied on the adjusted capital.

The concept of duration does not have a straightforward application to inflation indexed bonds.

In fact it is not possible to determine mathematically the *nominal duration* of an Inflation-Indexed Bond, that is the sensitivity of its price to *nominal yields* changes; it possible to obtain empirically only a rough estimation.

For margining purposes, the unique characteristics of Inflation-Indexed Bonds qualify them as a fundamental asset class, having relatively high correlation with one-another and unusually low correlation with other assets classes, such as traditional bonds.

Therefore Inflation-Indexed Bonds are comprised in a Class of their own where no Inter-Class Cross-Position Offsetting Factors are applied.

Annex 4 - – Initial Margin Calculation of Fail Positions

Even for failed positions (like as for the ordinary ones), the Margin Calculation is separated for each settlement currency

Fail positions, only for the counterparty *in malis*[5], are margined for each single currency, with the same methodology described above, keeping these positions segregated from the ordinary ones and applying, to the fail positions only, an increasing percentage on margins for each day of fail.

Fail positions (net fail position for each security) therefore can not be reduced as described in Step 2 (neither inter Class nor intra Class) but are margined one by one independently from other positions in the same Class. Unadjusted Additional Margins, calculated as explained in Step 3, must be multiplied by an Increasing Percentage (parametric and equal for all fail positions independently from their Class) applied for each day of fail:

Unadjusted Additional Margin per fail transaction = (Class Deposit Factor × TRA) + (Class Deposit Factor × TRA × Increasing Percentage × number of days of fail)

In case of more of one fail on the same security in consecutive days the Increasing Percentage is applied for the number of days pertinent to each part of the fail:

e.g. on the day F there is a fail on the security A for 1,000, with an Increasing Percentage of 10% a Deposit Factor of 0,10%:

Unadjusted Additional Margin per fail transaction = (0,10% × 1.000) + (0,10% × 1.000 × 10% *× 1)*

If the next day the net fail position on the security A is 2,500, the Increasing Percentage is applied as follows:

Unadjusted Additional Margin per fail transaction = ((0,10% × 1.000) + (0,10% × 1.000 × 10% *× 2)) + ((0,10% × 1.500) + (0,10% × 1.500 ×* 10% *× 1))*

The result is rounded to the nearest unit. No increasing Percentage is applied to the counterparty *in bonis*.

In the calculation of the TRA the accrued coupon is not re-evalued for the days of the fail; the same is also for Repo that are considered, in case of fail, at the same way of cash transactions.

[5] The positions of the counterparty *in bonis* are margined without any difference from above.

Moreover, in case of fail for Repo, the cash leg (that is so margined only in case of fail) is margined separately and distinctively from the forward leg at the same way of two different cash transactions.

The Total Unadjusted Additional Margins for failed positions separately calculated are equal to the sum of Unadjusted Additional Margins for failed positions separately calculated and of Unadjusted Additional Margins for failed positions separately calculated:

> Even for failed positions (like as for the ordinary ones)**,** Initial Margins separately calculated must be then converted in Euro at the related exchange rate; the haircut applied to convert in Euro will depend on the specific currency.
>
> Initial Margins € = Initial Margins separately calculated / ((1-H) * TC)

Total Initial Margins for failed positions are the sum of all of the converted Initial Margins for failed positions.