NOTICE

NOTICE >> LCH.Clearnet SA Corporate Reference No.: 2012-027

RISK NOTICE

From:	Risk Department
Date:	20th March 2012
Markets affected:	Transactions on Debt Securities executed on Trading and Matching Platforms and on MTS Italy market

NOTICE ON VARIATION MARGIN METHODOLOGY

In accordance with Instruction IV.2-5, LCH.Clearnet SA indicates below the different steps of calculation of the Variation Margins.
Specific parameters for Forward Repo Margin and Intra-Day margin call timing are included in this Notice**.**
The algorithm used for the duration calculation is explained.

1. Variation Margins algorithm

The calculation of Variation Margins is based on the following steps:

STEP 1 RETRIEVAL OF MARKET PRICES

The determination of "Settlement Price" is defined in a dedicated Notice.

Timing for price capture:
- French bonds:
    - BTAN: available between 5.00 pm and 5.30 pm
    - BTF and OAT: available after 5.30 pm
- Italian bonds: after 4.30 pm
- Spanish bonds: after 4.30 pm

STEP 2 SELECTION OF TRADE LEGS TO BE INCLUDED IN CALCULATION OF VARIATION MARGINS

The following Trade Legs will be included in calculation of Variation Margins:

a) For sell and purchase Transactions, all unsettled Trade Legs at the Margin calculation date
b) For Repos, all Trade Legs whose Initial leg has already been settled and its Return leg is still unsettled at the Margin calculation date.

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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 sell and purchase 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 Repos Transactions, the accrued coupon is calculated starting from the maturity date of the previous coupon until the first working day after margin calculation; in this case the accrual is considered relevant for margining purposes

The accrued coupon will be calculated according to the "Euroland" market convention : Act/Act.

STEP 4 DETERMINATION OF *REPO INTEREST*

Case 1 : Fixed or floating rate Repo :

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

$$RI = \frac{t \times TA \times RR}{36000}$$

where *t* is number of days, *TA* is the traded amount and *RR* is the repo rate.

The repo interest amount is rounded to the nearest integer Euro.

Case 2 : All-in deal interests

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

$$RI = \frac{t \times TI}{RD}$$

where *t* is number of days, *TI* is the traded interest amount of the Repo and *RD* is the repo duration (in days).

The repo interest amount is rounded to the nearest integer Euro.

STEP 5 DETERMINATION OF THE TRANSACTION REVALUATED AMOUNT

The Transaction Revaluated Amount (*TRA*) is equal to the nominal value (*NV*) of the traded security, revaluated at the current market price (*P*) as per step1 above, plus the accrued coupon (*AC*) calculated as per step 3 above. Therefore:

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

In case of bond indexed on inflation rate, the Transaction Revaluated Amount (*TRA*) 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 3 above. This amount is multiplied by the inflation index $Iidx$ available for the intended settlement date.

Therefore:

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

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STEP 6 CALCULATION OF VARIATION MARGIN PER TRADE LEGS

The Variation Margin is equal to the difference between the Trade Legs revaluated amount as per step 5 above and the traded amount; for Repo Trade Legs , the repo interest amount as per step 4 above must also be taken into consideration.

Therefore:

a) Sell and purchase Trade Leg :

Variation Margin= (TRA – Traded amount) × position sign[1];

b) Repos Trade Leg:

Variation Margin= (TRA – Traded amount – RI) × position sign[2].

STEP 7 CALCULATION OF THE OVERALL VARIATION MARGIN

The Overall Variation Margin is equal to the sum of all the Variation Margins calculated for each Trade Legs.

Overall Variation Margins = Σ *Variation Margins per each Trade Legs.*

A negative Variation Margin is a debit for the member towards the CCP; a positive Variation Margin is a theoretical credit for the member.

[1] For sell and purchase Transactions, the buyer of securities has a long position (+1) and the seller of securities has a short position (-1)

[2] For a Repo, the buyer of Securities has a short position (-1) and the seller of Securities has a long position (+1)

2. Variation Margin Adjustment

The goal of the VM adjustment is to adjust the existing Variation Margin in order to take into account the remaining period of term repos, between calculation date and the maturity of the transaction.

The calculation follows the 8 steps described below.

STEP 1. RETRIEVAL OF MARKET DATA

The following market data are obtained through a data provider:

The daily Eonia rate is retrieved at 6:45 pm (Paris Time) from the European Central Bank.

Euribor rates are obtained at 11:30 am (Paris Time) from the European Banking Federation.

Eurepo rates are obtained at 11:30 am (Paris Time) from the European Banking Federation.

Eonia swap rates are obtained at 11:30 am (Paris Time) from the European Banking Federation.

The rates used in the calculation are obtained by linear interpolation between the two closest knot points of the reference yield curve.

STEP 2. SELECTION OF THE TRANSACTIONS TO BE INCLUDED IN THE ADJUSTED VARIATION MARGIN CALCULATION:

The following positions are evaluated (as in the case of the calculation of Variation Margins):

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

b) For repo transactions, all transactions whose 1st leg has already been settled and its 2nd leg is still unsettled.

STEP 3. DETERMINATION OF THE ADJUSTED REPO INTEREST

The adjusted repo interest of the transaction (RI') between the repo starting date and the maturity date is given by the following formula:

$$RI' = \frac{T \times TA \times RR}{360 \times 100}$$

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with

T the number of days between the starting date and the maturity date of the repo transaction,

TA the initial traded amount,

$\frac{RR}{100}$ the repo rate of the transaction in %.

- Indexed rate repos

In this case, RR is given by the following formula:

$$\frac{RR}{100} = \frac{(t+1) \times e_a}{T} + \frac{(T-t-1) \times e_s}{T} + s$$

With

t the number of calendar days between the starting date and calculation date

$t \in [\![0; T-1]\!]$, (this statement applies to the entire document)

e_a the average of the Eonia rate (in %) between the starting date and one business day after the calculation date

e_s the Eonia Swap Rate (in %) between one business day after the calculation date and maturity date.

s the negociated spread of the repo (in %)

STEP 4. DETERMINATION OF THE MARK-TO-MARKET REPO RATE

$\frac{RR'}{100}$ the Mark-To-Market repo rate (in %) between the calculation date plus one business day and the maturity date

RR' is estimated by linear interpolation of the European Banking Federation Eurepo rates.

STEP 5. DETERMINATION OF THE ADJUSTED TRANSACTION REVALUATED AMOUNT

The Transaction Revaluated Amount (*TRA*) is given by the following formula:

$$TRA = \frac{NV}{100} \times (P + AC)$$

With

NV the nominal value of the traded security

P the current market price

AC the accrued coupon

In case of inflation indexed bonds, the Transaction Revaluated Amount (*TRA*) is equal to the nominal value (*NV*) of the traded security, revaluated at the current market price (*P*), plus the accrued coupon (*AC*). This amount is multiplied by the relevant inflation index *Iidx*
Therefore:

$$TRA = \frac{NV}{100} \times (P + AC) \times Iidx$$

The Adjusted Transaction Revaluated Amount (TRA') is given by the following formula for both cash and repo transactions:

$$TRA' = TRA \times \left(1 + \frac{RR' \times (T - t - 1)}{360 \times 100}\right)$$

STEP 6. CALCULATION OF ADJUSTED VARIATION MARGIN PER TRANSACTION

The Adjusted Variation Margin is given by the following formula.

a) For cash transactions:

$$Adjusted\ Variation\ Margin = \frac{TRA' - TA}{1 + \frac{r \times (T - t - 1)}{360}} \times sgn$$

b) For repo transactions: Both Classic repos and Buy-Sell Back are considered separately.

Classic Repo Transactions:

$$Adjusted\ Variation\ Margin = \frac{TRA' - TA - RI'}{1 + \frac{r \times (T - t - 1)}{360}} \times sgn$$

With
r the Euribor rate (in %) between the calculation date and the maturity date of the repo.
sgn +1 for the holder of a repo (sell bond spot and buy it back forward),
-1 for the holder of a reverse repo (buy bond spot and sell it back forward).

Buy-Sell Back Repo Transactions:

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By definition of a Buy-Sell Back transaction, a corrective term should be considered in the valuation of the second cash leg. This additional term corresponds to the sum of all the coupons capitalization between the coupon payment dates and the maturity date of the transaction.

Regarding the initial transaction, this corrective term (C_0) will consider all the coupons that will drop between the first working day after the settlement date of the first leg and the maturity of the transaction. These coupons are capitalized using the initial repo rate RR.

$$C_0 = \sum_i C_i \times \left(1 + \frac{RR \times (T - t_i)}{360 \times 100}\right)$$

With $(T - t_i)$ the number of days from the coupon payment date to the settlement date of the second leg.
C_i the i[th] coupon

Regarding the revaluated transaction, this corrective term (C') will consider only the upcoming coupons that will drop between the first working day after the calculation date and the maturity of the transaction. These coupons are capitalized using the Mark-To-Market repo rate RR'.

$$C' = \sum_j C_j \times \left(1 + \frac{RR' \times (T - t_j)}{360 \times 100}\right)$$

With $(T - t_j)$ the number of days from the coupon payment date to the settlement date of the second leg.
C_j the j[th] coupon

As a result:

$$Adjusted\ Variation\ Margin = \frac{TRA' - C' - (TA - C_0 + RI')}{1 + \frac{r \times (T - t - 1)}{360}} \times sgn$$

With
r the Euribor rate (in %) between the calculation date and the maturity date of the repo.
sgn +1 for the holder of a repo (sell bond spot and buy it back forward),
-1 for the holder of a reverse repo (buy bond spot and sell it back forward).

STEP 7. CALCULATION OF THE OVERALL ADJUSTED VARIATION MARGIN

The Overall Adjusted Variation Margin is equal to the sum of the Adjusted Variation Margins on all transactions.

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STEP 8. VARIATION MARGIN ADJUSTMENT

The Variation Margin adjustment is the difference between the Adjusted Variation margin and the Variation Margin defined above:

$$Variation\ Margin\ adjustment = Adjusted\ Variation\ margin - Variation\ margin$$

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3. Forward Repo Margin (FRM)

a) For Forward Repo with an indexed rate:

FRM = TA * (EONIA + Risk Parameter + Spread) * NbOfDay / 36000

b) For Forward Repo with a fixed rate:
If the Return Leg is before or equal D+4 (calculation date + four open days):

FRM = TA * Fixed Rate * NbOfDay / 36000

Else

FRM = TA * (Fixed Rate + Risk Parameter) * NbOfDay / 36000

With:

- D is the day of the margin calculation
- TA is the Traded amount of the Transaction
- EONIA is the official EONIA rate of D-1
- Spread is spread of the Transaction for a Repo with an indexed rate
- Fixed Rate is the rate of the Transaction for a Repo with an fixed rate
- NbOfDay is the number of calendar days between the Initial Leg and the Return Leg
- Risk Parameter is defined in the following table in function of the number of days between D and the day of the Return Leg:

Band (calendar days)	**Risk Parameter**
[0-7 days[	1.05
[7-31 days[	1.16
[31-91 days[	2.47
[91-182 days[	3.82
[182-364 days[	4.27
>= 364 days	4.30

The FRM is calculated transaction by transaction.

The final amount of forward repo margin (FRM) is equal to the sum of the absolute values of all the forward repo margins transaction by transaction, after netting by ISIN code.

4. Intra-day Margin Call parameter

The session of Intraday Margin Call begins at 1.45 pm.

The threshold amount is set at 0 euros.

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5. Duration Calculation

5.1. ZERO COUPON BONDS

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

5.2. FIXED COUPON BONDS

The duration or Macaulay's Duration (*D*) of a fixed coupon bond producing *n* cash flows f_1, f_2,…f_5,…f_n at the maturities t_1, t_2,…t_5,…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.

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5.3. 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 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[1].

The duration model for floating rate bonds are often too complex 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 accruing coupon (t_1)[2]

5.4. BONDS INDEXED ON INFLATION RATE

BTPi's : Italian treasury inflation indexed bonds are considered into the class 012 whatever their duration.

OATi's : French treasury inflation indexed bonds are assigned to duration classes 101 to 111 and 113 upon their duration.

[1] 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 (s, equal to 0.30 or 0.15).

[2] 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.

6. Annex

Below is an example of the duration at September 28, 2011 (settlement date September 29, 2011) of a BTAN (Isin FR0117836652), final maturity January 15, 2015, annual coupon of 2.5%, and annual payout.

	date	*t (in period)*	Cash flows (f)	Discounted cash flows $f(1+i)^{-t}$	t x discounted cash flows $f(1+i)^{-t}$
Calcuation	**28 Sept 2011**				
First coupon	**15 Jan 2012**	**0.2957**	**2.5**	**2.4900**	**0.7363**
Second coupon	**15 Jan 2013**	**1.2977**	**2.5**	**2.4565**	**3.1879**
Third coupon	**15 Jan 2014**	**2.2971**	**2.5**	**2.4236**	**5.5671**
Forth coupon + principal	**15 Jan 2015**	**3.2964**	**102.5**	**98.0328**	**323.1525**
			Sum	**105.4029**	**332.6438**
			Duration	**3.1559**	

The duration is equal to 3.1559 years (3 years and 57 days); the discount rate (IRR) is equal to 1.361% per annum; it has been derived from the bond dirty market price (105.4053) on September 28, 2011.