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RISK METHODOLOGY

IN STANDARDIZED OTC DERIVATIVES MARKET

Contents

1 General provisions

This risk methodology applied on the Standardized OTC Derivatives Market (hereinafter the Methodology) has been designed in accordance with the Clearing Center's Clearing Rules for the market (hereinafter the Clearing Rules) to set out the procedure for definition/calculation of risk parameters, calculation value of Standartised OTC Derivative Contracts (the "Contract") and values used to ensure the sufficiency of Collateral posted by the Clearing Member.

The Methodology is published on the Clearing Center's website.

The Methodology uses the following terms and definitions:

Clearing Center – Bank National Clearing Centre (Joint-stock company).

Portfolio – totality of outstanding Contracts concluded by certain Clearing Member.

Pool – the Contract parameter defining the currency of the CSA, i.e. the variation margin currency: RUB, USD or EUR.

Settlement value – the value of a Contract or a Portfolio of Contracts as determined in accordance with Section 3 hereof.

Variation margin – variation margin for exchange-traded standartised derivative contracts and OTC derivative contracts.

Any terms not specifically defined herein shall have the meanings ascribed to them by the Clearing Rules, Specifications, and regulatory acts of the Bank of Russia.

2 Collateral adequacy

2.1 Collateral assessment

Collateral is assessed as follows:

$$\text{Collateral assessment} = \sum_{FX_j} \text{Funds}_{FX_j} \times X_{FX_j/RUB} + \text{Risk Netting},$$

where:

Funds_{FX_j} – the clearing member's collateral in the currency FX_j recorded in the relevant cash collateral registers tied to one settlement account;

RiskNetting – the component related to netting between exchange risk and collateral as determined in Clause 2.3.1.4.

$X_{FX_j/RUB}$ – exchange rates determined in Clause 3.

2.2 Margin calculation

The size of the Margin Requirement is determined as follows:

$$\text{Margin Requirement} = \text{Initial Margin} - \text{Mark-to-Market position},$$

where:

Initial Margin – a part of the margin requirements that covers possible costs of the Clearing Center if Collateral on the settlement account would be used and the member for which the margin requirement is determined would be expelled from clearing membership.
Mark-to-market position – a part of the margin requirements that covers adjusted NPV of the Clearing Member's Portfolio:

$$Mark - to - market\ position = \sum_{FX_j}(NPV_{FX_j} - VM_{FX_j}) \times X_{FX_j/RUB},$$

where

NPV_{FX_j} – the sum of NPVs of Contracts from the relevant *FX_j* pool, where *FX_j* is one of the following currencies: RUB, USD and EUR.
VM_{FX_j} – the total Variation Margin paid/received by the Clearing Member for the Contracts of the relevant *FX_j* pool.

If a Clearing Member's Order/Offer has been matched, the Margin Requirement is determined as follows:

$$\text{Margin Requirement} = \text{Margin Requirement}(P + Order),$$

Where
P – the Portfolio of the Clearing Member;
$Order$ – the Order/Offer entered, but not filled.
If an Order/Offer cannot be matched, the margin requirement remain unchanged.

2.3 Initial Margin Calculation

The IM consists of the following components:

1. Market risk (*MarketRisk*)
    a. Interest rate risk
        i. Shift-Twist-Butterfly factor model,
        ii. Correction for errors in the Shift-Twist-Butterfly model,
        iii. Correction for errors in the interest rate model,
    b. Currency risk,

    c. Volatility risk.
2. Liquidity risk (*LiquidityRisk*),
3. Credit risk (*CreditRisk*).

Thus, Initial Margin for a Portfolio can be defined as a sum of components:

$$IM = IM[MarketRisk] + IM[LiquidityRisk] + IM[CreditRisk]$$

2.3.1 Market risk

2.3.1.1 Risk factors

Risk factors are values that specify the movement of the Contract's NPV in the model described in Section 5.

The following risk factors are included into the model:

1. Exchange rates of foreign currencies to RUB $X_{FXj/RUB}$:
    a. USD/RUB : $X_{USD/RUB}$,
    b. EUR/RUB: $X_{EUR/RUB}$.
2. Interest rate curves (IR):
    a. Overnight rates: OIS,
    b. Basis spreads to Mosprime rates: Rate Basis Spread (3m Mosprime vs. OIS + spd),
    c. Basis spreads to XCCYrates: XCCY Basis Spread (OIS + spd vs. 3m $ Libor),
    d. LIBOR term structure,
    e. EURIBOR term structure.
3. Curves of the term structure of volatility:
    a. ATM straddle volatility,
    b. Risk reversal volatility,
    c. Butterfly volatility.

Thus, the risk factor space consists of:

- Exchange rates $X_{USD/RUB}$ and $X_{EUR/RUB}$;
- Interest rate curves: $IR_i = \left(IR_i^j\right),\ i = OIS, RateBasis, XCCYBasis, LIBOR, EURIBOR$;
- Volatility curves: $FXVL_i = (FXVL_i^j)$, i= ATM Straddle USD/RUB, Risk Reversal USD/RUB, Butterfly USD/RUB;

  where index j runs over "liquidity points" of every curve.

2.3.1.2 Delta margining. Market risk components

Any change of the Portfolio NPV may be represented as follows:

$$\Delta P \approx \sum_i \langle P.Delta[IR_i], \Delta IR_i\rangle + \sum_i \langle P.Delta[FXVL_i], \Delta FXVL_i\rangle + \sum_i \langle P.Delta[FX_i], \Delta FX_i\rangle$$

Where

$P.Delta[C_i]$ – vectors of sensitivity of the Portfolio's NPV to a 1 bp change in the relevant risk factor curve or exchange rate ($C_i = IR_i, FXVL_i, FX_i$),

The j[th] component of $P.Delta[C_i]$ vector is determined as follows:

$$P.Delta[C_i]^j = NPV\left(C_i^j + 1bps\right) - NPV(C_i^j)$$

The $IM[MarketRisk]$ market component of the Initial Margin is represented as follows:

$$IM[MarketRisk] = IM[MarketRisk][IR] + IM[MarketRisk][FXVL] + IM[MarketRisk][FX],$$

where summands in the right represent interest rate risk, volatility risk and currency risk, respectively.

2.3.1.3 Interest rate and volatility risks

The $IM[MarketRisk][IR]$ component of interest risk and $IM[MarketRisk][FXVL]$ component of volatility risk are calculated on the basis of the Shift-Twist-Butterfly model of risk factor curves for interest rates and volatility curves. Every $IM[MarketRisk][\mathrm{C}]$ ($\mathrm{C} = IR, FXVL$) component is represented as follows:

$$IM[MarketRisk][\mathrm{C}] = IM[MarketRisk][\mathrm{C}][Model] + IM[MarketRisk][\mathrm{C}][ModelError],$$

where:

$IM[MarketRisk][\mathrm{C}][Model]$ – the model component,

$IM[MarketRisk][\mathrm{C}][ModelError]$ – correction for errors in the model (this summand is considered if such errors have a significant impact on the Initial Margin).

2.3.1.3.1 Model component

Components $IM[MarketRisk][\mathrm{C}][Model]$ of the Initial Margin are calculated using the VaR methodology for a portfolio of instruments. In this case, the following assumptions are made:

- Risk factor curve evolutions used in the model are mutually independent
- Changes in the risk factor curves are characterized by three major components: $shift$, $twist$, and $butterfly$.

Given the above assumptions:

$$IM[MarketRisk][\mathrm{C}][Model] =$$

$$= \sqrt{\sum_i \langle P.Delta[\mathrm{C}_i], Shift_i\rangle^2 + \langle P.Delta[\mathrm{C}_i], Twist_i\rangle^2 + \langle P.Delta[\mathrm{C}_i], Butterfly_i\rangle^2}$$

where $Shift_i$, $Twist_i$, and $Butterfly_i$ specify scenarios for the curves along the major components with predetermined probability:

$$Shift_i = f_i\, \sigma_{i\,shift}\, shift_i \ ,$$

$$Twist_i = f_i\, \sigma_{i\,twist}\, twist_i \ ,$$

$$Butterfly_i = f_i\, \sigma_{i\,butt}\, butterfly_i$$

where $shift_i, twist_i, butterfly_i$ are normalized vectors defining the profiles of major components: $\|shift_i\|_\infty = \|twist_i\|_\infty = \|butterfly_i\|_\infty = 1$, $(\|x\|_\infty = \max x_j)$, $\sigma_{i\,shift,twist,butt}$ – volatility of the relevant components of interest rate changes, f_i - volatility multiplier of the i^{th} curve (derived from the confidence probability level IM and the risk assessment horizon). The $Shift_i$, $Twist_i$, and $Butterfly_i$ risk parameters (vector values) are determined in Section 6.

To define certain additive components of $IM[MarketRisk][\mathrm{C}]$, the following values are calculated:

$$M[MarketRisk][\mathrm{C}_i][Shift] = \langle P.Delta[\mathrm{C}_i], Shift_i\rangle^2 / IM[MarketRisk][Model][\mathrm{C}] \ ,$$

$$IM[MarketRisk][\mathrm{C}_i][Twist] = \langle P.Delta[\mathrm{C}_i], Twist_i\rangle^2 / IM[MarketRisk][Model][\mathrm{C}],$$

$$IM[MarketRisk][\mathrm{C}_i][Butterfly] = \langle P.Delta[\mathrm{C}_i], Butterfly_i\rangle^2 / IM[MarketRisk][Model][\mathrm{C}],$$

$$IM[MarketRisk][\mathrm{C}][Model] = \sum_i \sum_{c\in\{Shift,Twist,Butterfly\}} IM[MarketRisk][\mathrm{C}_i][c]$$

2.3.1.3.2 Correction for errors in the Shift-Twist-Butterfly model

In assessing $IM[MarketRisk][C]$, the following assumptions are made: risk factor curves are mutually independent and moves in the curves are explained only by the three components, shift, twist and butterfly. Therefore, e.g., there are nonempty Portfolios, for which

$$IM[MarketRisk][\mathrm{C}_i] = 0,$$

i.e. these are the following Portfolios:

$$P\colon \langle P.Delta[\mathrm{C}_i], shift_i\rangle = \langle P.Delta[\mathrm{C}_i], twist_i\rangle = \langle P.Delta[\mathrm{C}_i], butterfly_i\rangle = 0.$$

Correction for errors related to such facts are defined as follows:

$$MinIM[\mathrm{C}_i][ErrorSTB] = f_i\, \sigma_i^{ErrorSTBC} \sum_j |P.Delta[\mathrm{C}_i]^j|$$

Risk parameters $\sigma_i^{ErrorSTBC}$ are determined by the unexplained dispersion portion when principal components $shift_i$, $twist_i$, $butterfly_i$, are defined as well as by possible correlation between the curves.

The component $IM[MarketRisk][IR_i][ErrorSTB]$ of the Initial Margin is determined as follows ($x^+ = x$, if $x \geq 0$, $x^+ = 0$, if $x < 0$):

$$IM[MarketRisk][\mathrm{C}_i][ErrorSTB] =$$

$$= \left(MinIM[\mathrm{C}_i][ErrorSTB] - \sum_{c \in \{shift, twist, butterfly\}} IM[MarketRisk][\mathrm{C}_i][c]\right)^+$$

2.3.1.3.3 Correction for errors in the interest rate model

The risk factor model is based on the market data in liquidity spots $(1W, 2W, 1M, \dots, 5Y)$. The curves' values at interim points are interpolated using such data. Therefore, their estimates and, hence, prices and risks of the relevant Contracts may differ from NPV.

In terms of the Portfolios, this implies, for example, the existence of nonempty Portfolios, for which $P.Delta[C_i]^j = 0$, and, therefore, zero components of the market risk described above.

Let us determine values including possible convexity of curves in intervals between liquidity points:

$$MinIM[\mathrm{C}_i][ModelError\mathrm{C}] = f_i \sigma_i^{ErrorModelC} \sum_t \sum_{Deal(t) \in P} \sum_j \left| Deal(t).Delta[\mathrm{C}_i]^j \right|.$$

where $\sum_{Deal(t) \in P}$ means summation of all Contracts from the portfolio P with contract expiration date t,

risk parameter $\sigma_i^{ErrorModelC}$ represents volatility assessment, i.e. the curve change component in local intervals between liquidity points.

Components of the Initial Margin $IM[MarketRisk][\mathrm{C}_i][Error\mathrm{C}]$ are determined as follows:

$$IM[MarketRisk][\mathrm{C}_i][Error\mathrm{C}] =$$

$$= \left(MinIM[\mathrm{C}_i][Error\mathrm{C}] - \sum_{c \in \{shift, twist, butterfly, ErrorSTB\}} IM[MarketRisk][\mathrm{C}_i][c]\right)^+$$

2.3.1.3.4 Aggregate components of interest rate and volatility risks

Summarizing all components of the interest rate risk and volatility risk, we finally have:

$$M[MarketRisk][IR] = \sum_i \sum_{c \in \{Shift, Twist, Butterfly, ErrorSTB, ErrorIR\}} IM[MarketRisk][IR_i][c]$$

$$IM[MarketRisk][FXVL] = \sum_i \sum_{c \in \{Shift, Twist, Butterfly, ErrorSTB, ErrorFXVL\}} IM[MarketRisk][FXVL_i][c]$$

2.3.1.4 Currency risk

$IM[MarketRisk][FX]$ is determined as follows:

$$M[MarketRisk][FX] = \sum_{FX_j} IM[MarketRisk][FX_j]$$

$$IM[MarketRisk][FX_j] = -\min_{-FX_jRate \leq \delta \leq FX_jRate} (\mathrm{NPV}(X_{FX_j/RUB}(1+\delta)) - \mathrm{NPV}(X_{FX_j/RUB}))$$

where $IM[MarketRisk][FX_j]$ is the minimum movement of the Portfolio value on the set of FX_j/RUB exchange rate scenarios with other risk factor remaining unchanged: $X_{FX_j/RUB} \to X_{FX_j/RUB}(1+\delta)$, where δ parametrises scenarios of the relevant exchange rate and changes from $-FX_jRate$ to $+FX_jRate$, where FX_jRate – the risk rate for FX_j.

$$\mathrm{RiskNetting} = IM[MarketRisk][FX] +$$

$$+\sum_{FX_j} \min_{-FX_jRate \leq \delta \leq FX_jRate} (\mathrm{NPV}(X_{FX_j/RUB}(1+\delta)) - \mathrm{NPV}(X_{FX_j/RUB}) + \delta \times X_{FX_j/RUB} \times Funds_{FX_j})$$

2.3.2 Liquidity risk

This component of the Initial Margin has been designed to cover possible costs associated with market liquidity risk.

The market component of the Initial Margin is determined on the assumptions about perfect liquidity of financial instruments: the default procedures may be implemented within one trading day after the relevant decision was made.

We introduce the component $IM[Liquidity]$, which takes into account the potential increase in the time period for performance of the default procedure due to limited liquidity of the Contracts ($\mathrm{C} = IR, FXVL$):

$$IM[Liquidity] =$$

$$= \sum_j l_{FX_j} IM[MarketRisk][FX_j] + \sum_{j,c} l_{j,c} IM[MarketRisk][\mathrm{C}_j][c]$$

$$l_{FX_j} = (\sqrt{Time_{FX_j} + AddTime_{FX_j}} - \sqrt{Time_{FX_j}})/\sqrt{Time_{FX_j}}$$

$$l_{C,j,c} = (\sqrt{Time_C + AddTime_{C,j,c}} - \sqrt{Time_C})/\sqrt{Time_C}$$

$$AddTime_{FX_j} = \left(\frac{|P.Delta[FX_j]|}{L_{FX_j}} - 1\right)^+, c = Shift_j, Twist_j, Butt_j$$

$$AddTime_{C,j,c} = \left(\frac{|\langle P.Delta[C_j], c\rangle|}{L_{C,j,c}} - 1\right)^+, c = Shift_j, Twist_j, Butt_j$$

$$AddTime_{C,j\ ,ErrorSTB} = \left(\frac{\max_i |P.Delta[C_j]^i|}{L_{C,j\ ,ErrorSTB}} - 1\right)^+$$

$$AddTime_{j\ ,ErrorC} = \left(\frac{\max_{i,t} \left|Deal(t).Delta[C_j]^i\right|}{L_{j\ ErrorC}} - 1\right)^+$$

where $Time_{FX_j}$, $Time_{IR}$ and $Time_{FXVL}$ are the risk assessment horizons for the relevant risk factors and risk parameters L_{FX_j}, $L_{IR,j,c}$, $L_{FXVL,j,c}$ determine the maximum absolute values in RUB of sensitivity ratios $P.Delta$, which may be hedged within one trading day without influencing materially the Contracts' prices. The risk parameters are set by the Clearing Center.

2.3.3 Credit risk

The component $IM[Credit]$ has been designed to treat credit worthiness of Clearing Members when the Initial Margin is calculated. This component is calculated on the basis of the assumption of even distribution of expected losses of the Clearing Centre in the default procedure performed in respect of the Clearing Members:

$$IM[Credit] = CreditQuality(IM[MarketRisk] + IM[Liquidity]),$$

If the risk parameter $CreditQuality$ determined individually for every Clearing Member is nonzero, its value is communicated individually to such every Clearing Member.

3 NPV

The settlement value of a Portfolio is generally determined by calculating its NPV as the sum of net present values of cash flows discounted by the curve of the relevant FX pool FX_i:

$$NPV_{FX_i}(Portfolio) = \sum_{FX_j} \sum_{FX_j\ cash\ flows} DF_{FX_j}(t) CF_{FX_j}(t) X_{FX_j/FX_i}$$

where:

$DF_{FX_j}(t)$ – the discount factor for payments in the FX_j currency,

$CF_{FX_j}(t)$ – the amount of payments in the FX_j currency; positive $CF_{FX_j}(t)$ shows the amount of the Clearing Center's obligation, negative $CF_{FX_j}(t)$ shows the amount of the Clearing Member's obligation. Floating flows in OIS and XCCY swaps are derived from the relevant forward curves calibrated on market data, while conditional flows in FX options are determined through the Vanna-Volga method.

X_{FX_j/FX_i} – the exchange rate of the currency FX_j against the currency FX_i. Currencies FX_j and FX_i run over the set of USD, EUR and RUB. Exchange rates X_{FX_j/FX_i} are calculated as follows: current relevant fixings (calculated under the Moscow Exchange Fixings Methodology) are set to be $X_{USD/RUB}$ and $X_{EUR/RUB}$; exchange rate $X_{EUR/USD}$ is calculated as the cross rate: $X_{EUR/USD} = X_{EUR/RUB}/X_{USD/RUB}$; reverse exchange rates are calculated as per the following formulas: $X_{FX_j/FX_i} = 1/X_{FX_i/FX_j}$, exchange rates X_{FX_j/FX_j} are set to one; unless otherwise stated, these exchange rates are used as currency pairs rates in Collateral evaluation and in other cases set forth in the Clearing Rules.

The formulas given below are applicable in particular cases such as OIS, IRS, XCCY and FX swaps, forwards, futures contracts and options on USD/RUB.

3.1 NPV (OIS)

The Settlement Value of the Interest Rate Swap Contract with OIS code is determined as follows:

$$NPV_{RUB}(OIS) = Notional\left(\sum_{floating} DF_{RUB}(t_j)\beta_j CompoundedRuonia(t_j) - \sum_{fixed} DF_{RUB}(t_i)\alpha_i\, c_{fixed}\right) + DF_{RUB}(t_{pr})premium_{RUB}$$

$$NPV_{USD}(OIS) = Notional\left(\sum_{floating} DF_{USD}(t_j)Y(t_j)\beta_j CompoundedRuonia(t_j) - \sum_{fixed} DF_{USD}(t_i)Y(t_j)\alpha_i\, c_{fixed}\right) + DF_{USD}(t_{pr})premium_{USD}$$

where α_i, β_j are relevant Ratios for calculation of days in the Interest rate Period,

$CompoundedRuonia(t)$ is the expected in the said Interest rate Period accumulated rate, calculated along the forward overnight curve,

c_{fixed} is the Fixed Rate under the Contract.

The calculation of the Settlement Value of the Contract includes outstanding coupon payments and outstanding premium.

The values $premium_{RUB}$ and $premium_{USD}$ are connected with an exchange rate $X(t_{pr})$.

3.2 NPV (IRS)

The Settlement Value of the Interest Rate Swap Contract with IRS code is determined as follows:

$$NPV_{RUB}(IRS) = Notional \left(\sum_{floating} DF_{RUB}(t_j)\beta_j FwdCurve(t_j) - \sum_{fixed} DF_{RUB}(t_i)\alpha_i\, c_{fixed} \right) + DF_{RUB}(t_{pr}) premium_{RUB}$$

$$NPV_{USD}(IRS) = Notional \left(\sum_{floating} DF_{USD}(t_j)Y(t_j)\beta_j FwdCurve(t_j) - \sum_{fixed} DF_{USD}(t_i)Y(t_j)\alpha_i\, c_{fixed} \right) + DF_{USD}(t_{pr}) premium_{USD}$$

where α_i, β_j are relevant Ratios for calculation of days in the Interest rate Period,

$FwdCurve(t)$ is the forward curve rate (determined in accordance with clause 5.5 of the Methodology) for the said Interest-Rate Period,

c_{fixed} is the Fixed Rate under the Contract.

The calculation of the Settlement Value of the Contract includes outstanding coupon payments and outstanding premium.

The values $premium_{RUB}$ and $premium_{USD}$ are connected with an exchange rate $X(t_{pr})$.

3.3 NPV (XCCY)

The Settlement Value of the Cross Currency Swap Contract with IRS code is determined as follows

$$NPV_{RUB}(XCCY) = Notional_{USD} \sum_{floating} DF_{RUB}(t_j)X(t_j)\beta_j FwdCurve(t_j) + Notional_{USD}X(T)DF_{RUB}(T) - Notional_{RUB} \sum_{fixed} DF_{RUB}(t_i)\alpha_i\, c_{fixed} - Notional_{RUB}DF_{RUB}(T) + DF_{RUB}(t_{pr}) premium_{RUB}$$

$$NPV_{USD}(XCCY) = Notional_{USD} \sum_{floating} DF_{USD}(t_j)\beta_j FwdCurve(t_j) + Notional_{USD}DF_{USD}(T) - Notional_{RUB} \sum_{fixed} DF_{USD}(t_i)Y(t_j)\alpha_i\, c_{fixed} - Notional_{RUB}DF_{USD}(T)Y(t_j) + DF_{USD}(t_{pr}) premium_{USD}$$

If the obligation of one party to the Contract to transfer ownership of currency to the second party in the amount of the Nominal Amount set for the second party, and the obligation of the second party to pay the first party the Nominal Amount set for the first party have not yet been performed, the above formula is supplemented with the following:

$$NPV_{RUB}(FrontNotionalPayment) = -Notional_{USD}X(T_0)DF_{RUB}(T_0) + Notional_{RUB}DF_{RUB}(T_0)$$

$$NPV_{USD}(FrontNotionalPayment) = -Notional_{USD}DF_{USD}(T_0) + Notional_{RUB}DF_{USD}(T_0)Y(T_0)$$

where α_i, β_j are relevant Factor for calculation of days in the Interest rate Period,

$FwdCurve(t)$ is the forward curve rate for a given Interest Rate Period,

c_{fixed} is the Fixed Rate under the Contract,

$X(t)$ is the forward rate USDRUB, T is the Contract expiration date, T_0 is the effective date of the Contract. The amount includes outstanding coupon payments and outstanding premium. The values $premium_{RUB}$ and $premium_{USD}$ are connected with an exchange rate $X(t_{pr})$.

3.4 NPV (FX Swaps, FX forwards and FX futures)

The Settlement Value of the FX Swap, FX Forward or FX Futures Contract is determined as follows:

$$NPV_{RUB}(FX\ Swap) = Notional \times \left(SwapForwardRate - X(T)\right) \times DF_{RUB}(T) + DF_{RUB}(t_{pr})premium_{RUB}$$

$$NPV_{USD}(FX\ Swap) = Notional \times (SwapForwardRate \times Y(T) - 1) \times DF_{USD}(T) + DF_{USD}(t_{pr})premium_{USD}$$

If the obligation of one party to the FX Swap Contract to transfer ownership of currency to the second party in the amount of the Nominal Amount set for the second party, and the obligation of the second party to pay the first party the Nominal Amount set for the first party have not yet been performed, the above formula is supplemented with the following:

$$NPV_{RUB}(FrontPayment) = -Notional \times \left(SwapSpotRate - X(T_0)\right) \times DF_{RUB}(T_0)$$

$$NPV_{USD}(FrontPayment) = -Notional \times (SwapSpotRate \times Y(T_0) - 1) \times DF_{USD}(T_0)$$

where $X(t)$ is the forward rate USDRUB,

T is the Contract's expiration date,

T_0 is the Contract's effective date,

$SwapForwardRate$ is the forward rate in the swap/forward/futures,

$SwapSpotRate$ is the Contract's underlying rate.

The calculation of the Settlement Value of the Contract includes outstanding coupon payments and outstanding premium. The values $premium_{RUB}$ and $premium_{USD}$ are connected with an exchange rate $X(t_{pr})$.

3.5 NPV (FX option)

The settlement value of FX options is derived through the Vanna-Volga method. For the option buyer:

$$NPV_{FX_i}(Vanilla) = OptionValue_{FX_i} - NPV_{FX_i}(Premium),$$

where $OptionValue_{FX_i}$ – the option's settlement value of the option, i.e. the value calculated by the Vanna-Volga method, $NPV_{FX_i}(Premium)$ - the net present value in the premium currency. For the option seller, $NPV_{FX_i}(Vanilla)$ has the opposite sign. The settlement value of the option strategy is the amount of settlement values of $Vanilla$ Contracts in the Portfolio.

The Vanna-Volga method is used to infer the Black-Scholes implied volatility from quotes of three available instruments: the ATM Straddle, Risk Reversal and Butterfly with a given maturity (the ATM Straddle strike is determined subject to a 50% forward Delta; instruments Risk Reversal and Butterfly Vanilla with a 25% forward Delta). The method is based on the construction of locally replicating portfolios whose associate hedging costs are added to corresponding Black-Scholes prices (i.e. are used as a Black-Scholes price adjustment) so as to produce smile-consistent values. In the Black-Scholes model, the payoff of a European call is determined by the function $C^{BS} = C^{BS}(t, K, S_t, DF_{RUB}, DF_{USD}, T, \sigma)$, where t – the moment at which the price is determined, K – the option strike, $S_t = X_{FX_j/RUB}$, the exchange rate at time t, DF_{RUB}– the RUB discount factor (cross currency–adjusted), DF_{USD} – the USD discount factor, T – maturity time, σ – the market volatility. In the model, the option price is determined as follows:

$$C_{VV} = C_{BS} + x_p(K)\big(C_{MKT}(K_p) - C_{BS}(K_p)\big) + x_o(K)(C_{MKT}(K_o) - C_{BS}(K_o)) + x_c(K)\big(C_{MKT}(K_c) - C_{BS}(K_c)\big),$$

where $C_{MKT}(K_i)$ – the market option prices for relevant strikes which can be definitely recovered from the ATM Straddle, Risk Reversal and Butterfly, $C_{BS}(K_i)$ – the options prices for the relevant strikes in the BS model, $x_i(K)$ – the weight, i=p,o,c –the index denoting the strike.

$$x_p(K) = \frac{\nu(K)}{\nu(K_p)} \frac{ln\frac{K_o}{K} ln\frac{K_c}{K}}{ln\frac{K_o}{K_p} ln\frac{K_c}{K_p}}$$

$$x_o(K) = \frac{\nu(K)}{\nu(K_o)} \frac{ln\frac{K}{K_p} ln\frac{K_c}{K}}{ln\frac{K_o}{K_p} ln\frac{K_c}{K_o}}$$

$$x_c(K) = \frac{\nu(K)}{\nu(K_c)} \frac{ln\frac{K}{K_p} ln\frac{K}{K_o}}{ln\frac{K_c}{K_p} ln\frac{K_c}{K_o}}$$

where $\nu(K), \nu(K_i)$ – the options' Vega ($Vega(K) = \nu(K) = \frac{\partial C_{BS}}{\partial \sigma}$).

3.6 Option strategies

3.6.1 Straddle

This strategy consists of buying a call option and buying a put option, both of them have similar direction to the Order. The Variation Margin currency is the same for both options and is specified in the Order/Offer. The notional value of the options is the notional value specified in the Order/Offer:

$$\text{ATM Straddle} = \text{Call(FX Pair, Expiry, Notional, ATM Call Strike)} +$$

$$+\text{Put(FX Pair, Expiry, Notional, ATM Put Strike)}$$

From this point onward, this denotes that the strategy consists of appropriate options. Sign "+" means that the option has the same direction to the strategy. Buying the Straddle means buying a call option and buying a put option with the parameters specified.

3.6.2 Risk Reversal

$$\text{RR} = \text{Call(FX Pair, Expiry, Notional, RR Call Strike)} - \text{Put(FX Pair, Expiry, Notional, RR Put Strike)}$$

3.6.3 Butterfly

$$\text{BF} = \text{Call}\left(\text{FX Pair, Expiry,} \frac{\text{Notional}}{2}, \text{ATM Call Strike}\right) + \text{Put}\left(\text{FX Pair, Expiry,} \frac{\text{Notional}}{2}, \text{ATM Put Strike}\right) -$$

$$-\text{Call}\left(\text{FX Pair, Expiry,} \frac{\text{Notional}}{2}, \text{BF Call Strike}\right) - \text{Put}\left(\text{FX Pair, Expiry,} \frac{\text{Notional}}{2}, \text{BF Put Strike}\right)$$

3.7 Distribution of option premiums

The option premiums are generally distributed:

$$\text{Strategy} = \sum_{j=1}^{N} \text{Vanilla}_j \ , \qquad \text{Vanilla}_j = \text{Call/Put}$$

Therefore, the premium on the strategy equals the amount of premiums on options in the strategy. Let $\text{Vanilla}_j.\text{TV}$ be the theoretical premiums on atomic call and put. Then, the theoretical price of the strategy:

$$\text{Stategy. TP} = \sum_{j} \text{Vanilla}_j\text{. TP}$$

The premium on the strategy Strategy. P specified in the Order/Offer is distributed among atomic options as follows:

$\text{Vanilla}_j\text{. P} = \text{Vanilla}_j\text{. TP} + \frac{\alpha}{N}(\text{Strategy. P} - \text{Stategy. TP})$, where α=1, if the position in the relevant option Vanilla_j is long (expressed as a positive value in the strategy), and α= - 1, if the position in the relevant option Vanilla_j is short (expressed as a negative value in the strategy).

3.8 Variation margin

The Variation Margin under the Contract is determined in accordance with the Contract Specifications. The Settlement Value for a Contract from the FX_i pool is $NPV_{FX_i}(t)$. The NPV is zero for Contracts settled (obligations not performed by the Clearing Member are not included in the trade structure).

Thus, $\text{Variation Margin}_{FX_i}(t) = NPV_{FX_i}(t) - NPV_{FX_i}(t-1)$,

where $NPV_{FX_i}(t-1)$ is set to zero if the day t is the Contract execution date.

4 Risk factor curves model

4.1 Market data

The model's input parameters consist of the following sets of market data:

1. Exchange rates:
   a. USDRUB spot
   b. EURRUB spot
2. Interest rates:
   a. Ruonia:
      i. Ruonia
      ii. RUB OIS: 1W, …, 1Y
   b. Mosprime:
      i. Mosprime1M, Mosprime3M, Mosprime6M,
      ii. FRA Mosprime3M: 3Mx6M, 6Mx9M
      iii. IRS Mosprime3M: 1Y, 2Y, 3Y, 4Y, 5Y
   c. FX curve:
      i. FX Swaps: TN,1W,..,1Y
      ii. USDRUB XCCY: 1Y, 2Y, 3Y, 4Y, 5Y
   d. Libor:
      i. Libor1M, Libor3M, Libor6M
      ii. FRA Libor3M: 3Mx6M, 6Mx9M
      iii. IRS Libor3M: 1Y, 2Y, 3Y, 4Y, 5Y

   e. Euribor:
      i. Fixing Euribor1M, Euribor3M, Euribor6M

   ii. FRA Euribor3M: 3M×6M, 6M×9M
   iii. IRS Euribor3M: 1Y, 2Y, 3Y, 4Y, 5Y
3. Volatility surface:
   a. ATM Straddle: 1W, …, 2Y
   b. Risk Reversal: 1W, …, 2Y
   c. Butterfly: 1W, …, 2Y

The Bloomberg codes used to download quotes for the above-mentioned instruments are given in Appendix 1 hereto.

4.2 The model

The model is a set of parameters and algorithms to assess the settlement value of derivative financial instruments. The following aggregate of factors is used in this Methodology as the parameter space:

1. FX rates
   a. USDRUB,
   b. EURRUB,
2. US dollar curves
   a. Discount curve,
   b. Libor spot curve,
3. EUR curves
   a. Discount curve,
   b. Euribor spot curve,
4. RUB curves
   a. Discount curve,
   b. Overnight curve,
   c. Mosprime curve.
5. Volatility term structure curves
   a. ATM Straddle curve,
   b. Risk Reversal curve,
   c. Butterfly curve.

4.3 Model calibration

The general approach to the model calibration is to determine values of risk factors at which settlement values of instruments with respect to which the model is calibrated correspond with market prices.

4.4 FX curves

The foreign currency spot curves are curves for which the present value of all instruments FRA3M×6M, FRA6M×9M, IRS1Y, IRS2Y, IRS3Y, IRS4Y, IRS5Y equals zero. Discount curves for foreign currencies are constructed on the relevant spot curves. Forward curves are constructed as the implied rate curves on the relevant discount curves.

4.5 RUB curves

4.5.1 Discount curves

The RUB discount curve is a curve with the zero present value of all cash flows from every instrument in the set comprising FX swaps with maturities up to one year and USDRUB underlying asset and XCCY swaps (Libor3M vs Fix) with maturities ranging from one year to five years, provided that the Libor spot curve constructed according to Section 5.4 hereof is used to discount USD cash flows and calculate relevant forward rates.

4.5.2 OIS curve

The OIS curve is a curve for which the present value of all cash flows from every instrument in the set comprising overnight index swaps (OIS) on RUONIA, equals zero.

4.5.3 Mospime curve

The Mosprime curve is constructed in a similar way to FX curves on a set with Mosprime3M as the underlying asset.

4.6 Volatility curves

The volatility curves are three curves ATM Straddle, Risk Reversal and Butterfly constructed on quotes of the relevant instruments.

4.7 Spread calculation

The spread is calculated by wording the rouble section of the interest rate model that has been already build and agreed in terms of underlying curves and spreads. The purpose of such decomposition is to highlight common and specific risk factors for the instruments in question.

Spread calculation is made through the search of fair (in the context of the model) implied quotes for the relevant instruments constituting swaps involving exchange of two floating rates. The spread is a value added to one of the floating rates to make the value of the swap equal zero.

The role of the underlying curve is played by the OIS curve. The following spreads are reviewed:

1. OIS + spread vs. Mosprime 3m (Rate Basis Spread)
2. OIS + spread vs. 3m $ Libor (Cross Currency Basis Spread)

5 Calculation of risk parameters

5.1 Statistical risk parameters

Statistical risk parameters are set by the Clearing Center. In the symbols below, the i index refers to the risk factor curves:

$\mathrm{i} = \mathrm{OIS}, \mathrm{RateBasis}, \mathrm{XCCYBasis}, \mathrm{Libor}$, EURIBOR, ATM Straddle , Risk Reversal and Butterfly, and the c index refers to the principal movement components of the relevant curves:

$c = shift, twist, butterfly$.

Risk parameter	**Symbol**
Volatility multiplier of the i[th] risk factor curve	f_i
Scenario parameters for $Shift_i$ components	$Shift_i^j$
Scenario parameters for $Twist_i$ omponents	$Twist_i^j$
Scenario parameters for $Butterfly_i$ components	$Butterfly_i^j$
Shift-twist-butterfly error volatility	$\sigma_i^{ErrorSTB}$
Model error volatility	$\sigma_i^{ErrorModel}$
FX_j exchange rate liquidity ratio	L_{FX_j}
Liquidity ratio of the risk factor curve component	$L_{i,c}$
Currency risk assessment horizon for FX_j	$Time_{FX_j}$
Volatility risk assessment horizon	$Time_{FXVL}$
Interest rate risk assessment horizon	$Time_{IR}$
Member's creditworthiness rate	$CreditQuality$
Ratio connecting the currency risk rate and discount rate	$FXRiskToDiscount$
Ratio of the Price Corridor width to the Initial Margin	k
The currency risk rate	FX_jRate

5.2 Currency risk rates

The FX_jRate rates are determined by the relevant collateral rates applicable in the Moscow Exchange FX Market. Such collateral rates are calculated in accordance with the Moscow Exchange Risk Parameters Methodology of the FX Market and Precious Metals Market.

5.3 Contract price limit

The Contract's price is within the established limit if its absolute settlement value does not exceed the product of certain ratio and the Initial Margin for such Contract:

$$|NPV| \leq k \cdot IM$$

Where the k risk parameter is set by expert opinion.

6 Appendices

6.1 Calculation of present value of the Contract

The present value of an instrument is the value of the Contract concluded on the terms of the same Specification and with the same set of parameters, except the premium under the Contract and Spreads which are set to zero and with the same NPV.

In its turn, in the context of the set of instruments in question (determined by the Specifications), the value of the Contract means such Fixed Rate that NPV of the Contract equals the said value.

6.2 Calculation of the IM credit component

This Appendix contains explanations on determination of credit component of the Initial Margin $IM[Credit]$. This component is characterized with the risk parameter $CreditQuality$, individualized for each Clearing Member. This indicator is calculated by the Clearing Centre as follows:

$$CreditQuality = \max(\sigma \ln \frac{\pi\, \sigma\, pd}{\varphi} \;, 0)$$

where the parameters π, σ, pd, ϕ are interpreted as follows::

π – probability that during the default procedure the Clearing Centre's losses will exceed the value $IM[MarketRisk] + IM[LiquidityRisk]$ (i.e. 1 – π = confidence probability of determination of the market component of the Initial Margin).

σ – downward estimate of expected value of relative excess of the Clearing Center's loss over the Initial Margin $IM[MarketRisk] + IM[LiquidityRisk]$.

ϕ – expert risk parameter limiting the value of expected loss of the Clearing Centre for the Portfolio of each Clearing Member relative to the size of its Initial Margin.

pd – indicator of the Clearing Member's credit quality, interpreted as probability of the Clearing Member's default (default of the Clearing Member on its obligations to the Clearing Centre).

Below is the explanation of the above expressions for $CreditQuality$.

Let $CCPLoss_m$ be the random variable equal to the Clearing Centre's losses on the Portfolio of the m - nd Clearing Member. This value may be expressed as follows:

$$CCPLoss_m = d_m(Loss_m - IM)^+$$

where
$Loss_m$ is the loss of the m - nd Clearing Member ($Loss_m > 0$ – loss, $Loss_m < 0$ - profit),
IM –Initial Margin of the Clearing Member's Portfolio ($IM > 0$)
$d_m = \begin{cases} 1, & in \text{ case of default of the m} - \text{nd Member} \\ & 0, \text{otherwise} \end{cases}$ - indicators of the members' defaults

$(\cdot)^{+} = \max(\cdot\,,0)$.

Given:

$$IM = IM_0(1 + k_m)$$

where IM_0 is a part of the Initial Margin determined without consideration for credit quality of the Clearing Member ($IM_0 = IM[MarketRisk] + IM[LiquidityRisk]$), k_m- "premium" for the Clearing Member's credit quality ($k_m = CreditQuality$).

Having normalized the random value $Loss_m$, we get:

$$CCPLoss_m = IM_0\, d_m(\delta - (1 + k_m))^{+}, \qquad \delta = \frac{Loss_m}{IM_0}$$

We have to note that $CCPLoss_m$ is affected only by the behavior of δ at its extremums: $\delta > 1 \iff Loss_m > IM_0$, because otherwise $CCPLoss_m = 0$. Pursuant to the extreme value theory, distribution of the "tail" of δ can be approximated using the generalized Pareto distribution. Given the foregoing, and having conducted necessary calculations, we may show that mathematical expectation of $CCPLoss_m$ has the following downward estimate:

$$E(CCPLoss_m) \leq IM_0\, \pi\, pd_m \,\frac{\sigma}{(1 - \xi)\left(1 + \frac{\xi}{\sigma} k_m\right)^{\frac{1}{\xi} - 1}}$$

where

$\pi = P(Loss_m > IM_0)$ is the probability of excess of the Member's losses $Loss_m$ over the Initial Margin,

$pd_m = E(d_m\, | Loss_m > IM_0)$ – probability of default of the Member m provided that: $Loss_m > IM_0$.

σ and ξ are parameters of the generalized Pareto distribution approximating the "tail" of the distribution δ:

ξ-degree of diminution of the "tail" of the distribution δ,

σ-scale parameter, such that, with approximation accuracy, the expected value of relative excess of the Clearing Member's losses over the Initial Margin equals:

$$\frac{\sigma}{1-\xi} = E(\delta - 1\, |\delta > 1) = E\left(\frac{Loss_m - IM_0}{IM_0}\, | Loss_m > IM_0\right),$$

If $k_m = 0$, then:

$$E(CCPLoss_m) \leq \pi\, pd_m \,\frac{\sigma}{1 - \xi}$$

Thereafter, for simplification purposes, let us set $\xi = 0$ (rapid diminution of the "tail" of the distribution δ). Then we finally get:

$$E(CCPLoss_m) \leq IM_0\, \pi\, pd_m\, \sigma \exp\left(-\frac{k_m}{\sigma}\right)$$

Thus, the k_m "premium" leads to a decrease of the Clearing Centre's expected loss $\exp\left(-\frac{k_m}{\sigma}\right)$ times.

On the other hand, the Clearing Centre earns profit in form of a commission fee on the positions of m-nd Clearing Member pro rata to the volume of the concluded Contracts and, correspondingly, in crude approximation, pro rata to IM_0: $CCPProfit_m \sim IM_0$. The breakeven performance of the Clearing Centre is equivalent to the following condition:

$$E(CCPLoss_m) \leq CCPProfit_m.$$

Therefore, it is natural to limit the value of expected loss as follows:

$$E(CCPLoss_m) \leq \varphi\, IM_0$$

where φ is an expert ratio, which, on the basis of breakeven performance of the Clearing Centre, must be lower than the share of commission fee from the size of the Initial Margin.

Based upon the above, we derive the necessary precondition for feasibility of the last condition:

$$k_m \geq \sigma \ln \frac{\pi\, pd_m\, \sigma}{\phi}.$$

The indicator σ, just as the distribution of the "tail" δ, generally speaking, depends on the structure of the member's Portfolio, but due to certain linearity of instruments relative to risk factors it is limited from above by a certain constant depending on the relevant indicators for the distribution of "tails" of risk factors. Therefore the indicator σ may be the same for all Portfolios of the Clearing Members.

6.3 The Bloomberg codes for interest rate derivatives, FX options and fixings

Term	Ruonia		Mosprime			USDRUB Curve		Libor			Euribor			ATM	RR	BF
	Fixing	OIS	Fixing	FRA	IRS	FX Swaps	XCCY	Fixing	FRA	IRS	Fixing	FRA	IRS	FX Option	FX Option	FX Option
SPT	RUONIA Index	-	-	-	-	RUBTN Curncy	-	-	-	-	-	-	-	USDRUBVON Curncy	USDRUB25RON Curncy	USDRUB25BON Curncy
1w	-	RRSO1Z Curncy	-	-	-	RUB1W Curncy	-	-	-	-	-	-	-	USDRUBV1W Curncy	USDRUB25R1W Curncy	USDRUB25B1W Curncy
2w	-	RRSO2Z Curncy	-	-	-	RUB2W Curncy	-	-	-	-	-	-	-	USDRUBV2W Curncy	USDRUB25R2W Curncy	USDRUB25B2W Curncy
3w	-	-	-	-	-	-	-	-	-	-	-	-	-	USDRUBV3W Curncy	USDRUB25R3W Curncy	USDRUB25B3W Curncy
1m	-	RRSOA Curncy	MOSKP1 Index	-	-	RUB1M Curncy	-	US0001M Index	-	-	EUR001M Index	-	-	USDRUBV1M Curncy	USDRUB25R1M Curncy	USDRUB25B1M Curncy
2m	-	RRSOB Curncy	-	-	-	RUB2M Curncy	-	-	-	-	-	-	-	USDRUBV2M Curncy	USDRUB25R2M Curncy	USDRUB25B2M Curncy
3m	-	RRSOC Curncy	MOSKP3 Index	RRFR0CF Curncy	-	RUB3M Curncy	-	US0003M Index	USFR0CF Comdty	-	EUR003M Index	EUFR0CF Comdty	-	USDRUBV3M Curncy	USDRUB25R3M Curncy	USDRUB25B3M Curncy
6m	-	RRSOF Curncy	MOSKP6 Index	RRFR0FI Curncy	-	RUB6M Curncy	-	US0006M Index	USFR0FI Comdty	-	EUR006M Index	EUFR0FI Comdty	-	USDRUBV6M Curncy	USDRUB25R6M Curncy	USDRUB25B6M Curncy
9m	-	RRSOI Curncy	-	-	-	RUB9M Curncy	-	-	-	-	-	-	-	-	-	-
1y	-	RRSO1 Curncy	-	-	RRSWM1 Curncy	-	RRUSSW1 Curncy	-	-	USSA1 Curncy	-	-	EUSW1V3 Curncy	USDRUBV1Y Curncy	USDRUB25R1Y Curncy	USDRUB25B1Y Curncy
2y	-	-	-	-	RRSWM2 Curncy	-	RRUSSW2 Curncy	-	-	USSA2 Curncy	-	-	EUSW2V3 Curncy	-	-	-
3y	-	-	-	-	RRSWM3 Curncy	-	RRUSSW3 Curncy	-	-	USSA3 Curncy	-	-	EUSW3V3 Curncy	-	-	-
4y	-	-	-	-	RRSWM4 Curncy	-	RRUSSW4 Curncy	-	-	USSA4 Curncy	-	-	EUSW4V3 Curncy	-	-	-
5y	-	-	-	-	RRSWM5 Curncy	-	RRUSSW5 Curncy	-	-	USSA5 Curncy	-	-	EUSW5V3 Curncy	-	-	-

6.4 Interest rates applicable to the VM

CSA	IR
USD	FEDL01 Index
EUR	EONIA Index

6.5 Decomposition of the Initial Margin

Components		Market risk factors											
		FX			IR					USDRUBVol			
		USD	EUR	CNY	OIS	Rate basis	XCCY basis	Libor	Euribor	ATM	RR	BF	Итого
Market risk	Shift												
	Twist	-	-	-									
	Butterfly	-	-	-									
	Correction for STB model errors	-	-	-									
	Correction for errors in risk factor curve model	-	-	-									
Liquidity risk													
Creditworthiness													
Total													