LCH The Markets' Partner

ForexClear
Sovereign Risk Margin: SRM
Methodology Document

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1. Purpose

This document is a technical information specification for ForexClear's *Sovereign Risk Margin* ("*SRM*") add-on. This document provides full details of the *SRM* methodology, specifically focused on foreign exchange non-deliverable forward ("NDF") contracts.

2. Overview

ForexClear is a foreign exchange clearing service for inter-bank and client clearers. ForexClear currently clears OTC foreign exchange non-deliverable forward ("NDF") contracts.

Initial Margin ("IM") is calculated and collected in USD from each ForexClear member to cover the potential losses arising from that member's default over a specified close-out period under normal market conditions.

ForexClear Core IM is calculated using an Expected Shortfall ("ES") model reflecting a minimum confidence level of 99.7% consistent with LCH Board risk appetite, based on a holding period of five days for house accounts (seven days for client accounts where relevant).

A Stressed Value at Risk (SVaR) is calculated as an add-on to the IM and collected in USD from each ForexClear member to cover the potential losses arising from that member's default over a specified close-out period incorporating a stressed period in the historical lookback and accounting for regulatory portfolio diversification requirements. The SVaR acts as a floor to the Core IM model.

The ForexClear IM measure considers normal market trading conditions and does not account for the potential price risk due to a sovereign default event, or general country risk related to an unexpected currency regime change or large exchange rate moves often related to government intervention or periods of economic policy uncertainty.

Generally, the SRM accounts for aspects of additional market risk associated with holding a country's currency, beyond that captured within the IM.

For each currency pair in which a member has exposure, an amont of additional margin is calculated to reflect the related risk associated with that currency.

Note: In this paper, we assume that the quotation basis of all the non-deliverable currency pairs is USD/xxx which means that we will have "xxx" units of the non deliverable currency per 1 unit of USD.

3. Methodology

Beyond the price volatility covered within the IM, there are two main types of events that may materailly impact the sufficiency of margin cover held, and which we quantify separately:

1. Sovereign default risk (ie. currency depreciation due to country default).

2. Likelihood of Currency Action (ie. Currency apopreciation or depreciation due to high and volatile External Debt to FX reserve ratio).

3. General country risk (ie. currency appreciation or depreciation due to abrupt changes in economic or political circumstances, a change in currency regime, or other price-impacting factors not captured in core IM).

3.1 Sovereign default risk

The first SRM component relates to a ***default of a country*** on part or all of its debt.

Indeed, in such a case, foreign investment as well as foreign capital immediately stops which may potentially lead to a severe devaluation of the currency, as witnessed in the Argentinean crisis in 2001 and in the Russian crisis in 1998. The devaluation would then result in losses for holders of the devalued currency.

Given the fact that there are instruments in the market that reflect the credit quality of a country and provide an estimation of the probability of the country defaulting on its debt, we can quantify the potential losses of long positions on the currency of the defaulted country.

At an account level (member or client), the potential loss for long currency positions is based on:

- an assumed price shock;
- an implied probability of default of the underlying sovereign country; and
- the size of the position;

3.1.1 Shock factor

For each currency pair, we assume a potential currency devaluation factor of 50% against the USD currency in the event of a sovereign default.

Historical country default events and economic research indicates that it would be appropriate to assume a general default shock of 50% in the event of a country default. The 50% level has been calibrated in line with recent country default or near default estimation, as well as general recommendations from international monetary fund (IMF). The 50% devaluation factor is then used to calibrate Implied Volatility Surface 'post-default', based on annualised realised volatility estimates.

The devaluation factor will be reviewed on a regular basis by ForexClear Risk Management and the ForexClear Default Management Group, and in particular for the case of new currencies to be cleared.

3.1.2 Sovereign default probability

The country Credit Default Spread (CDS) gives insight into the level of risk associated with investing in a particular country.

Using the country's 5-year CDS spread, the probability of default is calculated using the closed analytical formula[1] shown below:

$$P_{T,i} = 1 - \mathrm{e}^{-\lambda \times \mathrm{T}} \quad (1)$$

where,

λ, hazard rate $= \frac{\mathrm{S}}{(1-\mathrm{R})}$

$P_{T,i}$ = probability of default at time *T* for currency pair *i*

T = maturity for which the probability of default would be calculated. In our case, *T* would be equal to 0.25

S = CDS spread for relevant sovereign

R = assumed recovery rate

[1] John C. Hull, Options, Futures, and Other Derivatives

3.1.3 SRM charge

The sovereign default-related charge is calculated at an aggregated level for each currency pair. In the event of a sovereign default, investors holding a long position in the non-deliverable currency will incur a loss stemming from the devaluation of this currency (ie. an appreciation of the base currency) whereas the investors holding short positions will not incur any loss caused by a sovereign default.

The SRM charge to account for this risk is measured as:

$$SRM_{i,default} = \begin{cases} -P_{T,default} \times \delta_i \times \frac{X_{i,default}}{Spot_i(1+X_{i,default})} + \left(\Gamma_i \times 0.5 \times {X_{i,default}}^2\right) + \left(\sum_t \upsilon_{i,t} \times r_{i,t}\right) & , \delta_i > 0 \\ 0 & , \delta_i \leq 0 \end{cases} \quad (2)$$

where,

$SRM_{i,default}$ = the SRM charge for currency pair *i* due to a sovereign default

$X_{i,default}$ = the uncovered devaluation factor due to a sovereign default (expressed as an appreciation of the base currency)

$P_{T,default}$ = CDS-implied probability of default at time *T*

δ_i = non-deliverable currency spot delta for currency pair *i*

$Spot_i$ = spot rate for currency pair *i* expressed as units of non-deliverable currency per 1 USD

Γ_i = Base currency gamma for currency pair *i*

$\upsilon_{i,t}$ = Vega for currency pair *i* and tenor *t*

$r_{i,t}$ = Implied Absolute volatility change required for ATM implied vol at tenor i and currency pair *i* to reach estimated implied volatility for currency pair *i* and tenor *t*

σ_i = = Implied volatility for currency pair *i*

3.1.4 Volatility Surface Calibration

Within the SRM default, we estimate an implied volatility surface post sovereign default, we then assess the absolute implied volatility increase required to reach this shocked surface. Below is the proposed volatility surface to be used. This volatility surface is calibrated based on realized volatilities due to a 50% spot rate shock.

Table 1 – Sovereign default simulated volatility surface

Tenor	CALL10	CALL25	ATM	PUT25	PUT10
O/N	1100%	1100%	1100%	1100%	1100%
1W	500%	500%	500%	500%	500%
1M	200%	200%	200%	200%	200%
3M	115%	115%	115%	115%	115%
...	...	...	...	...	...
2Y	40%	40%	40%	40%	40%

3.2 Likelihood of Currency Action

The third SRM component relates to the ***likelihood of currency action ('LCA')*** which is is designed to capture country specific liquidity crises that may arise when country debt ratios deteriorate and/or become unstable.

The LCA component of SRM is applicable to all Emerging Market currencies and is charged as a proportion '*K*' of uncovered stress losses.

3.2.1 Add-On Multiplier

Calibration of add-on multiplier K is based on past pattern of currency crises, such as Mexico (1994), South Korea (1997), Argentina (2001) and Brazil (1999, 2002) were currency devaluation was associated with an external debt to reserve ratio of 4.5x to 10x. Smaller single-digit currency depreciation with China (2015) and India (2011) were associated with an external debt to reserve ratio of 0.5x to 1.5x.

K values combine two principal macroeconomic effects and driven by:

- Debt ratio. The severity of a currency crisis has historically been driven by the ratio of external debt to reserves. For countries where this debt ratio is more adverse, a larger correction is observed when a country crisis unfolds

$$R_{(t)} = \frac{External\ Debt\ in\ \$_{(t)}}{FX\ Reserves\ in\ \$_{(t)}}$$

- Change in debt ratio. The probability of currency crisis has been associated with changes in the debt ratio in the 6-12 months leading up to the currency crisis. Change in debt ratio is the weighted relative change of short-term and long-term external debt ratio over 6 months:

$$Change\ in\ debt\ ratio = 75\% \cdot 6m\ change_{short-term\ debt} + 25\% \cdot 6m\ change_{long-term\ debt}$$

where $6m\ change = \frac{R_{(t)} - R_{(t-6m)}}{R_{(t-6m)}}$

Using most recent macroeconomic data, each country's debt ratio and change in debt ratio are calculated and K is calibrated based on the multiplier table below:

Table 2 – Group Risk LCA K factor matrix

		Change in Debt Ratio							
		<0%	0-5%	5-12%	12-22%	22-35%	35-55%	55-90%	90+%
Debt Ratio Level	<10%								
	10-50%			0.5%	1.0%	2.0%	3.5%	4.5%	5.0%
	50%-75%			1.0%	2.0%	4.0%	7.0%	9.0%	10.0%
	75%-100%			2.0%	4.0%	8.0%	14.0%	18.0%	20.0%
	100-150%			3.0%	6.0%	12.0%	21.0%	27.0%	30.0%
	150-200%			4.0%	8.0%	16.0%	28.0%	36.0%	40.0%
	200-250%			6.0%	12.0%	24.0%	42.0%	54.0%	60.0%
	250-300%			8.7%	16.2%	32.0%	56.0%	72.0%	80.0%
	300-350%			12.4%	22.1%	36.0%	63.0%	81.0%	90.0%
	350-400%			16.0%	27.9%	42.1%	70.0%	90.0%	100.0%
	400-500%			21.2%	33.6%	53.2%	77.0%	99.0%	100.0%
	500%+		5.4%	24.5%	41.7%	60.1%	84.0%	100.0%	100.0%

3.2.2 SRM Charge

The LCA related SRM charge is calculated at an aggregated level for each currency pair. The currency shock can be either a depreciation or appreciation depending on the direction of the market pressure toward the currency. The SRM charge to account for this risk is measured as follows:

Scenario 1: currency depreciation

$$SRM_{i,LCA\_D} = \begin{cases} -\delta_i \times \frac{X_{i,LCA,D}}{Spot_i(1+X_{i,LCA,D})} & , \delta_i > 0 \\ 0 & , \delta_i \leq 0 \end{cases} \quad (7)$$

where,

SRM_{i,LCA_D} = the SRM charge for currency pair *i* related to non-deliverable currency depreciation following country specific liquidity crises

$X_{i,LCA,D}$ = the uncovered shock factor related to LCA risk (expressed as an appreciation of the base currency)

δ_i = non-deliverable currency spot delta for currency pair *i*

$Spot_i$ = spot rate for currency pair *i* expressed as units of non-deliverable currency per 1 USD

Scenario 2: currency appreciation

$$SRM_{i,LCA\_A} = \begin{cases} -\delta_i \times \frac{X_{i,LCA,A}}{Spot_i(1+X_{i,LCA,A})} & , \delta_i < 0 \\ 0 & , \delta_i \geq 0 \end{cases} \quad (8)$$

where,

SRM_{i,LCA_A} = the SRM charge for currency pair *i* related to non-deliverable currency depreciation following country specific liquidity crises

$X_{i,LCA,A}$ = the uncovered shock factor related to LCA risk (expressed as an appreciation of the base currency)

3.2.3 Shock factor

Shock factors applied in the LCA component of SRM are the uncovered stress losses per currency pair. Whereby the stress losses are calculated based on the worst stress scenario ForexClear's stress testing suite, these losses are then offset by the per currency IM per unit notional.

3.3 General country risk

The last SRM component relates to ***general country risk*** which is not necessarily associated with a country's default, a pegged or manage currency or a likelihood of currency action.

This category of risk includes risks associated with potential government intervention, abrupt changes in fiscal or monetary policy, changes in international trading relationships, or general heightened levels of uncertainty and political instability, that may result in prolonged periods of currency volatility in excess of levels captured within the IM.

This type of risk also relates to currencies that have been subject to currency controls over the IM lookback period resulting in the time series data not exhibiting sufficient volatility that is representative of prevailing conditions.

3.3.1 Currency eligibility

The general country risk-related charge is applied on currencies that are exposed to potential currency volatility that is not adequately captured within the IM. For this purpose, the backtesting coverage of each currency pair at risk factor level over a 18-month period is considered and the SRM charge is applicable to any currency pair that performs below LCH risk appetite.

The general country risk-related charge is also applied on specific currencies that are exposed to a cap, floor, peg, fixed or corridor exchange rate.

3.3.2 Shock factor

The relevant shock factor for each applicable currency pair considers potential price risk not already captured within the core IM model.

Where applied, the shock factor provides a minimum margin cover level ("*TargetCoverage*") defined at the specific currency pair level over and above the core IM. Calibration of the *TargetCoverage* parameter for a given currency pair, *i,* takes into consideration the current IM level together with potential tail shocks (as represented by stress scenarios in the ForexClear stress testing suite) as follows:

$$TargetCoverage_i = IM_i \times 75\% + Stress_i \times 25\% \quad (3)$$

where,

IM_i = the current IM percentage (per notional) on a short/long FX spot contract for currency pair *i*

$Stress_i$ = the largest appreciation/depreciation shock in the ForexClear stress testing suite[2] for currency pair *i*

For currencies that are pegged or semi-pegged, the calibration of the *TargetCoverage* shock parameter takes into consideration applicable trading bands where relevant.

The relevant shock factor, $X_{i,general}$, is set as the difference between the *TargetCoverage* and the core IM level for a specific currency pair *i*:

$$X_{i,general} = TargetCoverage_i - IM_i \quad (4)$$

The SRM parameters are reviewed quarterly and is subject to review and approval by LCH Group Risk.

3.3.3 SRM charge

The general country risk-related charge is calculated at an aggregated level for each currency pair. The currency shock can be either a depreciation or appreciation depending on the direction of the market pressure toward the currency. The SRM charge to account for this risk is measured as follows:

Scenario 1: currency depreciation

Investors holding a long position in the non-deliverable currency will incur a loss stemming from the depreciation of this currency (ie. an appreciation of the base currency), whereas investors holding short positions will not incur any loss. The SRM charge to account for this risk is measured as:

$$SRM_{i,general\_D} = \begin{cases} -\delta_i \times \frac{X_{i,general,D}}{Spot_i(1+X_{i,general,D})} & , \delta_i > 0 \\ 0 & , \delta_i \leq 0 \end{cases} \quad (5)$$

where,

$SRM_{i,general\_D}$ = the SRM charge for currency pair *i* related to general country risk resulting in non-deliverable currency depreciation

$X_{i,general,D}$ = the shock factor related to general country risk (expressed as an appreciation of the base currency)

δ_i = non-deliverable currency spot delta for currency pair *i*

$Spot_i$ = spot rate for currency pair *i* expressed as units of non-deliverable currency per 1 USD

[2] Exclusive of concentration scenarios which aim to specifically stress concentration risk and illiquidity risk.

Scenario 2: currency appreciation

Investors holding a short position in the non-deliverable currency will incur a loss stemming from the appreciation of this currency (ie. an depreciation of the base currency), whereas investors holding long positions will not incur any loss. The SRM charge to account for this risk is measured as:

$$SRM_{i,general\_A} = \begin{cases} -\delta_i \times \frac{X_{i,general,A}}{Spot_i(1+X_{i,general,A})} & , \ \delta_i < 0 \\ 0 & , \ \delta_i \geq 0 \end{cases} \quad (6)$$

where,

$SRM_{i,general\_A}$ = the SRM charge for currency pair *i* related to general country risk resulting in non-deliverable currency appreciation

$X_{i,regime,A}$ = the shock factor related to general country risk (expressed as an depreciation of the base currency)

3.4 SRM charge by currency pair

The total SRM charge for each currency pair will be the sum of the charges that apply for both short and long positions, noting that for short positions the default risk-related SRM and the general country risk-related SRM potentially overlap and should therefore be viewed as non-additive.

The SRM charge for currency pair *i* is then calculated as follows:

$$SRM_i = \begin{cases} \min(SRM_{i,default}, SRM_{i,LCA\_D}) + SRM_{i,general} & , \quad \delta_i > 0 \\ \min(SRM_{i,LCA_A}) + SRM_{i,general} & , \quad \delta_i \leq 0 \end{cases} \quad (9)$$

where,

SRM_i = the total SRM charges for currency pair *i*

3.5 SRM charge for portfolio

The total *SRM* charge for a portfolio is the sum of the total SRM charge of each currency pair:

$$SRM_{portfolio} = \sum_i^n SRM_i \quad (10)$$