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SA-CCR: Implications and Challenges of the New Regulation

Lorena Corna

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Executive Summary

In light of the revised regulatory frameworks for market and counterparty risks, the author gives an overview on the Standardised Approach for Counterparty Credit Risk (SA-CCR) and its implementation issues in a bank Risk framework. The approach presented by the Basel Committee on Banking Supervision on March 2014 required a study performed by the European Banking Authority concerning the mapping of derivative transactions to risk categories and the correction of regulatory formulas in the current context of negative interest rates. Although the new regulation solves some shortcomings of the current standard approach to CCR, *e.g.* partially recognizing netting benefits coming from margining and hedging, a few features still need particular attention in order to properly measure the risks associated to the instruments in scope of the regulation. In particular, as also pointed out by EBA, a significant impact on the final capital requirement (the EAD) can derive from the methodology employed to identifiy the primary risk driver of each transaction. After revising the methodologies proposed by EBA, a case study is presented, based on a portfolio including cross currency swaps, and an alternative methodology, aimed at assessing the materiality of each risk driver of the transaction, is proposed. The details on the latter are left to a future publication.

About the Authors

Lorena Corna:
Business Analyst.
As Business analyst she currently works within the Risk IT dedicated team of a big pan-European Bank. In particular, she follows the backtesting model for Counterparty Credit Risk.

Email: **lorena.corna@iasonltd.com**
LinkedIn: **https://goo.gl/dq5yBd**

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SA-CCR: Implications and Challenges of the New Regulation

Lorena Corna

In March 2014, in order to substitute the Current Exposure Method and the Standardised Method, the Basel Committee presented a new approach for measuring the exposure at default (EAD) named *Standardised Approach for Counterparty Credit Risk* (SA-CCR, [1]). In scope of the proposed regulation, there are OTC derivatives, exchange-traded derivatives and long settlement transactions. The SA-CCR comes from the need to overtake the lacks of non-internal methods: it distinguishes margined and unmargined derivative transactions, it recognizes some netting benefits, it can be easily and simply implemented and, moreover, it would reduce the discretion of banks and national authorities.
The EAD, under SA-CCR, is calculated at netting set level and it is given by a multiple of the effective expected positive exposure. The latter is the sum of replacement cost (RC) and potential future exposure (PFE), in formula:

$$EAD = \alpha \cdot (RC + PFE), \tag{1}$$

where $\alpha = 1.4$ (as in internal model method).
In order to properly consider the netting benefits, the Basel Committee defines the concept of hedging set as following: *A "hedging set" under the SA-CCR is a set of transactions within a single netting set within which partial or full offsetting is recognised for the purpose of calculating the PFE add-on* [1].
Moreover, the Basel Committee established that, for the same netting set, the EAD for a margined netting set cannot be higher than the EAD for unmargined netting set (paragraph 129, [1]).
With SA-CCR, for each derivative transaction within a netting set, the bank has to determine the primary risk factor (or factors) and assign it to one (or more) of the following five asset classes:

- Interest Rate
- Foreign Exchange
- Credit
- Equity
- Commodity

Furthermore, the European Commission proposed to introduce a new risk category named "other risk" (article 277, [4]).

Among these risk categories, the basis transactions and volatility transactions represent distinct hedging sets in their corresponding asset classes with modified supervisory factors.
As stated before, one advantage of SACCR is the distinction of margined and unmargined transaction. This characteristic is reflected in the calculation of replacement cost (RC).
For netting sets not subject to a margin agreement, the replacement cost represents the loss that would occur if counterparty default and close-out happened immediately.
If there is a collateral other than variation margin, the former represents an indipendent collateral

amount (ICA) that can be posted or received by the bank. Therefore, the net indipendent collateral amount (NICA) is defined as *"any collateral (segregated or unsegregated) posted by the counterparty less the unsegregated collateral posted by the bank"* [1]. Accordingly, for unmargined trades the replacement cost is given by:

$$RC = \max\{V - C; 0\}, \tag{2}$$

where V is current mark to market value of transactions and C represents the net haircut collateral held by the bank calculated with NICA metodology.
For margined trades, the replacement cost corresponds to the loss when a counterparty defaults at present or at a future time, supposing that the close-out and replacement of transactions occur instantaneously. As a consequence, the replacement cost for a netting set subject to margin agreement is calculated as following:

$$RC = \max\{V - C; TH + MTA - NICA; 0\}, \tag{3}$$

where V and C are the same as in the unmargined case, TH is the non negative threshold and MTA is the minimum transfer amount.
The second component of EEPE is given by potential future exposure (PFE), which depicts the worst exposure in one year from calculation date (in the unmargined case) or in the margin period of risk (in the margined case). The PFE is given by the product between a multiplier and an aggregate add-on component.
The multiplier depends on the replacement cost:

- If RC is positive, the multiplier is equal to one;
- If RC is zero the multiplier is calculated as following:

$$multiplier = \min\left\{1; Floor + (1 - Floor) \cdot \exp\left(\frac{V - C}{2 \cdot (1 - Floor) \cdot AddOn^{aggregate}}\right)\right\},$$

  where the floor is equal to 5%.

The $AddOn^{aggregate}$ is the sum of add-ons for each asset class and it will be described in detail in the following section.

1. Risk Framework

1.1 Metrics computation

The calculation of add-ons, summarized in figure 1, is the result of the methodology prescribed for each asset class, nevertheless some aspects are shared.

Given a netting set, the first step is the computation of *adjusted notional*. This computation depends on the asset class:

- Interest rate and credit derivatives: the adjusted notional for a derivative transaction i is the product of trade notional in domestic currency and the supervisory duration SD_i defined as:

$$SD_i = \frac{\exp(-0.05 \cdot S_i) - \exp(-0.05 \cdot E_i)}{0.05},$$

  where S_i is the start date and E_i is the end date of trade floored by ten business days. If the trade is ongoing, the parameter S_i is equal to zero.

- Foreign exchange derivatives: the adjusted notional is equal to the notional of foreign leg converted in domestic currency. If both legs are in foreign currency, both notionals will be converted and the maximum should be taken.

- Equity and commodity derivatives: the adjusted notional is the product of current unit price of stock or commodity and the number of units referenced by the trade.

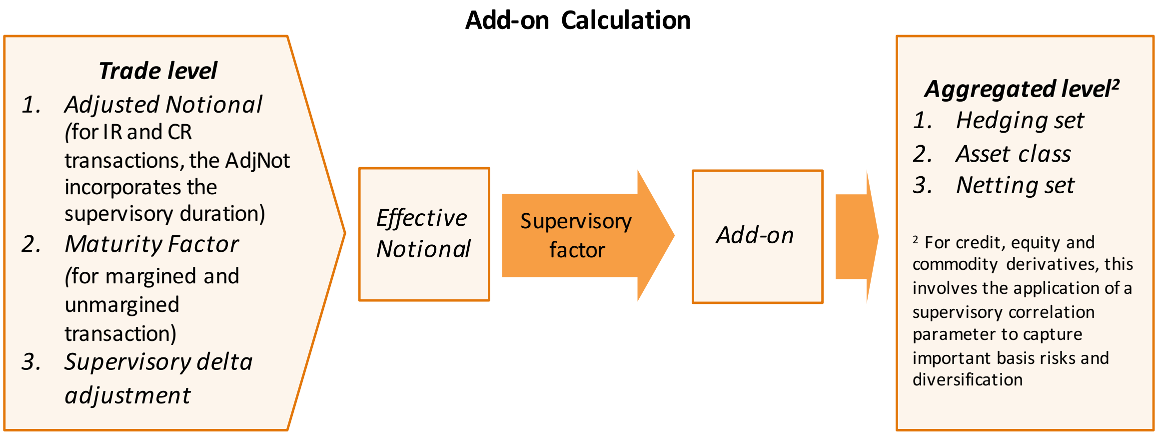

FIGURE 1: *General addon calculation*

At paragraph 158 of [1] the rules to determine the notional, if the latter is not clearly defined or it is not fixed until maturity, can be found.
A *maturity factor* (MF) is applied to the adjusted notional; in the calculation of PFE, the difference of margined and unmargined netting set is reflected on this parameter:

- For an unmargined transaction i, the maturity factor is given by:

$$MF_i^{unmargined} = \sqrt{\frac{\min\{M_i; 1year\}}{1year}},$$

  where M_i is the maturity of transaction expressed in years floored by 14 calendar days (*i.e.* 10 business days).

- For a margined transaction i, the maturity factor is given by:

$$MF_i^{margined} = \frac{3}{2}\sqrt{\frac{MPOR}{1year}},$$

  where $MPOR$ refers to the Margin Period of Risk of the transaction (paragraph 164, [1]).

Moreover, a *supervisory delta adjustment* is applied to the adjusted notional: the latter would reflect the direction of the derivative transaction and its non-linearity. Three cases are considered:

- Options: the Basel Committee specifies the following formula:

$$\delta = sign \cdot type \cdot \phi\left(type \cdot \frac{\ln\left(\frac{P}{K}\right) + 0.5 \cdot \sigma^2 \cdot T}{\sigma \cdot \sqrt{T}}\right),$$

  where $type$ is -1 for put option and +1 for call option and $sign$ is -1 for sold option and +1 for bought option; P is underlying price; K is strike price and T is the latest contractual exercise date of option and, finally, the supervisory volatility σ is specified on the basis of risk category and the nature of the underlying instrument (table 1).
  In the context of negative rates, an adjustment of supervisory delta formula established by Basel Committee is needed: EBA suggests to add a λ shift in above formula in order to move the interest rate inside positive area [3]. This parameter should satisfy some critical aspects: λ shift depends on interest rate of specific jurisdiction and it should progressively reduce until zero when the interest rates become positive. In order to guarantee an uniformity across the European Union, EBA proposed two options:

  – λ is defined with EBA RTS for each EU currency and regularly updated;

- λ is quoted on the relevant market and therefore automatically updated for the pertinent jurisdiction.

Furthermore, the Basel Committee defines the calculation of effective notional for digital options in [2]: in this case the digital payoff z is approximated with a collar combination of European options of the same type (call or put) with the strikes equal to $0.95K_z$ and $1.05K_z$. Therefore, the effective notional is separately evaluated for all the European option of the collar combination, thanks to the above formula.[1]

- CDO tranches: the supervisory delta adjustment is given by

$$\delta = sign \frac{15}{(1+14A) \cdot (1+14D)},$$

where $sign$ is equal to +1 for purchased CDO tranches and -1 otherwise, A is the attachment point and D id the detachment point.

- Other instruments: δ is equal to +1 if the transaction is long in the primary risk factor or it is equal to -1 if the transaction is short in the primary risk factor.

The product of adjusted notional, maturity factor and supervisory delta adjustment is equal to the *effective notional amount*. The latter is subject to a *supervisory factor*, defined for each asset class, in order to obtain the addon. As stated in section , for basis and volatility transaction, the supervisory factor is multiplied by one-half and five respectively.

1.2 Metrics aggregation

We now present the specific rules for the addon calculation for each asset class. Once all the add-ons at asset class level have been obtained, the aggregated add-on is equal to the sum of asset class add-ons.

Interest rate derivatives

In this asset class, the hedging set is represented by the currency and it is split in three time buckets: i) maturity smaller than 1 year, ii) maturity between 1 and 5 years and iii) maturity larger than 5 years. The SA-CCR recognises full offsetting benefit within maturity buckets.
Given a netting set, for each transaction i the effective notional D_{jk} for maturity bucket k of hedging set j is calculated as follows:

$$D_{jk} = \sum_{i \in (j,k)} \delta_i \cdot AdjN_i \cdot MF_i \tag{4}$$

where δ_i is the supervisory delta adjustment, $AdjN_i$ is the trade-level adjusted notional amount and MF_i is the maturity factor. After that, bucket aggregation of the effective notional $EffN$ is performed: for each hedging set j, partial offsetting benefit is recognized across buckets $k = 1, 2, 3$ with the following formula:

$$EffN_j = \left[(D_{j1})^2 + (D_{j2})^2 + (D_{j3})^2 + 1.4 \cdot D_{j1} \cdot D_{j2} + 1.4 \cdot D_{j2} \cdot D_{j3} + 0.6 \cdot D_{j1} \cdot D_{j3} \right]^{\frac{1}{2}}.$$

Nevertheless, if a bank can not admit offset across maturity bucket, the above formula become: $EffN_j = |D_{j1}| + |D_{j2}| + |D_{j3}|$.
After that, the add-on at hedging set level is calculated as

$$AddOn_j = SF_j \cdot EffN_j.$$

The asset class add-on is obtained by summing hedging set add-ons.

[1]The Basel Committee specifies that the absolute value of the digital option effective notional cannot exceed the ratio of the digital payoff to the relevant supervisory factor.

Foreign exchange derivatives

The effective notional is calculated for each hedging set j, represented by the currency pair, with the same formula for interest rate derivatives (4). The hedging set add-on is given by:

$$AddOn_j = SF_j \cdot |D_j|,$$

and the asset class add-on is obtained by summing hedging set add-ons.

Credit derivatives

The effective notional is computed for each hedging set j, represented by all the credit transactions with the same entity, via the formula (4) and the hedging set add-on is calculated with the formula:

$$AddOn_j = SF_j \cdot D_j, \tag{5}$$

where SF_j for single name entities is defined by the reference name's credit rating whereas for index entities is based on index grade (*i.e.* investment or speculative).
In order to recognize a partial offsetting among the entity level add-ons, a single factor model is used, where the risk of this asset class is split in two elements:

- *Systematic component*, where a full offset is allowed
- *Idiosyncratic component*, where no offsetting benefit is recognized.

The degree of offsetting benefit is established with the correlation factor and the asset class add-on is then given by the following formula:

$$AddOn = \left[\left(\sum_j \rho_j \cdot Addon_j \right)^2 + \sum_j \left(1 - \rho_j^2\right) \cdot \left(Addon_j\right)^2 \right]^{\frac{1}{2}}, \tag{6}$$

where the first term is the systematic component, the second term is the idiosyncratic component and ρ_j is the correlation factor defined in table 1.

Equity derivatives

The effective notional is calculated for each hedging set j, represented by single names or indices, with the formula (4) and the hedging set add-on is computed with formula (5).
For each reference entity a single factor model is used, in order to identify the systematic component (where offsetting is allowed) and the idiosyncratic component like for credit derivatives.
The asset class add-on is given by formula (6) as well.

Commodity derivatives

For commodity derivatives, the Basel Committee defines four typologies of commodities within which stable meaningful joint dynamics can be found: i) energy, ii) metals, iii) agricultural and iv) other commodities. However, this categorization does not recognize the specific peculiarities of commodities such as location and quality: if banks reveal a significantly exposure to the basis risk of different products with the proposed categorization, the national supervisor can require to banks a more refined definition of commodities.
Taking a single netting set, full offset in the same typology of commodity and a partial offset among four classes of commodities are recognized.
For trades of commodity type k in hedging set j, the effective notional is given by:

$$D_{kj} = \sum_{i \in (k,j)} \delta_i \cdot AdjN_i \cdot MF_i$$

Therefore, the add-on at commodity type level is the product of above effective notional and the proper supervisory factor definend in table 1.

For each hedging set, the Committe again distinguishes between systematic and idiosyncratic components through a single factor model. The add-on at hedging set level is calculated as:

$$AddOn_j = \left[\left(\rho_j \cdot \sum_k Addon_k \right)^2 + \left(1 - \rho_j^2 \right) \cdot \sum_k \left(Addon_k \right)^2 \right]^{\frac{1}{2}},$$

where $\rho_j$is the correlation factor for hedging set j defined in table 1. Finally, the add-on for commodity asset class is the sum of above hedging set add-ons.

Asset Class	Subclass	Supervisory factor	Correlation	Supervisory option volatility
Interest rate		0.50%	N/A	50%
Foreign exchange		4.0%	N/A	15%
Credit (single name)	AAA	0.38%	50%	100%
	AA	0.38%	50%	100%
	A	0.42%	50%	100%
	BBB	0.54%	50%	100%
	BB	1.06%	50%	100%
	B	1.6%	50%	100%
	CCC	6.0%	50%	100%
Credit (index)	Inv. Grade	0.38%	80%	80%
	Spec. Grade	1.06%	80%	80%
Equity	Single name	32%	50%	120%
	Index	20%	80%	75%
Commodity	Electricity	40%	40%	150%
	Oil/Gas	18%	40%	70%
	Metals	18%	40%	70%
	Agricultural	18%	40%	70%
	Other	18%	40%	70%

TABLE 1: *Table of supervisory parameters*

Asset Class	Hedging Set (HS)	Offsetting Benefit
Interest rate	*Currency*. Further classification into three buckets: • maturity < 1 year, • 1 year < maturity < 5 years, • maturity > 5 years.	Full offset in the maturity bucket and partial offset across buckets.
Foreign Exchange	*Currency pair*.	Full offset in the same HS, no offset among different HS.
Credit and Equity	Single HS for each asset class.	Full offset for the same entity, partial offset among different entities.
Commodity	4 commodity categories: • energy, • metals, • agricultural, • other commodities.	Full offset for the same category, partial offset among different categories.

TABLE 2: *Summary of hedging sets for each asset class*

2. Mapping of derivative transactions

The Basel Committee established that the allocation of derivative transactions to each asset class is made by their primary risk driver: the latter would be the most material risk driver of the transaction and should be assessed using sensitivities and volatilities of the underlying instruments.
Furthermore, if the derivative transaction cannot be assigned to only one risk category, then it must be allocated to each asset class with the same position. About this point, the European Banking Authority (EBA) suggested to define a cap on the number of risk categories to which a single derivative transaction can be allocated [3].
Nonetheless, Basel Committee did not define a methodology in order to perform the mapping of derivative transactions to risk classes and the European Commission in [4] indicated EBA as a responsible to devise a methodology to mapping the derivative transactions in one (ore more) risk category.
In order to perform this activity, EBA suggests a three-step approach for the identification and classification of risk factors:

- Qualitative approach,
- Quantitative approach,
- Fallback approach.

2.1 Qualitative approach

In some cases the assessment of the materiality of risk drivers is simple, *e.g.* in the case of derivative transactions with a single risk driver or several risk drivers referring unambiguously to the same risk category, or for structured products related to a single asset class. In these cases, it is not required to outline any process for the identification of risk factors and EBA proposed a list with the aim of mapping risk category, primary risk factor and instruments.
On the other side, consider for example the case of a cross currency swap (CCS): a priori it could be assigned to foreign exchange or interest rate asset classes based on the impact of the relevant risk factors to the exposure. Therefore, in addition to the above mentioned list, a quantitative method to map transactions to asset classes should be defined.
If the CCS is assigned to the foreign exchange class, the previously described rules can be applied in a straightforward way. Instead, if the CCS is associated to the interest rate asset class, the hedging set currency has to be defined. In particular, when both the legs of the CCS are denominated in currencies other than the domestic currency, the logic for the identification of the hedging set currency needs to be defined in such a way that the hedging purpose of the instrument is correctly taken into account.
In this case, the Basel Committee requires to convert the notional amount in domestic currency (paragraph 157, [1]) while computing the trade level adjusted notional. For a cross currency swap, we deem that it would be more pertinent to use the currency of the receive leg as hedging set currency.
In table 3 a specific example of netting set including two interest rate swaps, in EUR and USD, together with three CCS on EUR/USD is considered. The transactions included in the netting set come from a real portfolio and were chosen so that they have different maturities, typologies (payer or receiver, fix vs float or fix vs fix or float vs float) and margining details. The impact on the EAD, due to different assignment[2] of the CCS to IR or FX asset classes, is assessed: as it can be shown applying BCBS rules to the two scenarios, the EAD change is of the order of 13%. This is already a significant variation, however, since only the PFE (through the aggregated Add-On) affects the risk factor mapping, and since the RC contribution dominates the EAD in our example, it is more appropriate to analyze the separate impact on the PFE part of the exposure. If we concentrate on the PFE alone, we see that, for our netting set example, the impact is of the order of 159%, with a higher PFE in the case where the CCS number 5 is included in the IR asset class. The huge impact on

[2] In this case study we applied the procedure, described in section 2.2, proposed by EBA and relying on market sensitivities.

Netting set							
Trade	**Nature**	**Maturity**	**Ccy**	**Notional (in USD)**	**Pay Leg**	**Receive Leg**	**Market value (in EUR)**
1	CCS	08/03/27	EUR/USD	300,000,000	FLOAT	FLOAT	40,193,566
2	Swap	08/03/47	USD	300,000,000	FIX	FLOAT	19,930,075
3	CCS	08/03/47	EUR/USD	300,000,000	FIX	FIX	22,985,605
4	Swap	08/03/47	EUR	276,192,230	FLOAT	FIX	-15,624,345
5	CCS	19/02/19	EUR/USD	200,000,000	FLOAT	FIX	16,111

Specifications of margin agreement	
Margin frequency	Monthly
Threshold	Null
Minimim Transfer Amount	5,000,000
Indipendent Amount	Null
Net collateral currently held by the bank	-68,810,000

Foreign exchange risk		Interest rate risk	
If all the CCSs are in FX class		*If quantitative analysis assigned the trade n. 5 in IR class**	
Alpha	1.40	Alpha	1.40
Replacement Cost	136,311,011	Replacement Cost	136,311,011
Multiplier	1.00	Multiplier	1.00
AddOn_{aggr}	11,708,366	AddOn_{aggr}	30,346,977
PFE	11,708,366	PFE	30,346,977
EAD	**207,227,128**	**EAD**	**233,321,183**

*In this case, we proposed to use the currency of the receive leg as hedging set currency

TABLE 3: *Cross currency swap: an example of derivative transactions with ambiguous primary risk driver*

this kind of products, largely traded by banks indeed, strongly indicates that a careful quantitative assessment of the materiality of each risk driver should be identified and adopted for transactions such as CCS as well. In the following section we describe the solution proposed by EBA in [3] to this problem and elaborate on the possibility to exploit alternative solutions.

2.2 Quantitative approach

When the qualitative approach fails, the sensitivities and underlying volatility must be taken into account in order to identify the primary risk driver and map each transaction to one or more risk categories. In order to perform that, EBA indicates 3 steps:

- Qualitative identification of all the risk drivers of the transaction,
- Assessment of the materiality of each risk driver of the transaction through the comparison of all sensitivities and volatility,
- Identification of the most material among these material risk drivers.

Concerning the second point, EBA proposed four options:

1. Defining a threshold above which 'any risk driver whose associated sensitivity is higher than X% of the sensitivity of the main risk driver is deemed material'. In this case we have not a cap concerning the numerosity of material risk drivers.
2. A multistep approach:
   - first, calculate all the sensitivities s_i for $(i = 1, \cdots, N)$ of an instrument and set $S_N = \sum_i^N |s_i|$,
   - then, rank them in terms of relative relevance obtaining a sequence a_i where $a_1 = \max(|s_1|, \cdots, |s_i|, \cdots, |s_N|)$,
   - finally, calculate the ratio $\frac{a_1}{S_N}$: if it is greater than Y% the primary risk driver is found, otherwise compute the ratio $\frac{(a_1+a_2)}{S_N}$ and we compare with Y%, and so on in order to determine one or more risk categories to which assign the transaction.

   Also in this option, we have not a cap concerning the numerosity of material risk drivers but it depends on the calibration of Y.
3. Including volatility into I or II, e.g. weighting sensitivities by FRTB-SBA RWs.

4. Using the SA-CCR PFE and assess the materiality of sensitivities to a risk class relatively, by comparing PFEs with the highest PFE; or assess the materiality by considering the coverage of total PFE.

2.3 Fallback approach

When the quantitative approach fails or cannot be implemented, the presumption is that all identified risk factors would be deemed material. Therefore the transaction is allocated to all risk categories to which its risk factors belong.

3. Conclusion

In 2014, the Basel Committee introduced a more risk-sensitive approach for CCR named Standardised Approach for Counterparty Credit Risk (SA-CCR). In 2017, the European Banking Authority presented a discussion paper regarding the potential implementation issues of it. In particular EBA highlights two points.

The first point concerns the correction of supervisory delta in context of negative rates: EBA proposed a shift parameter in order to move the interest rate into positive area.

The second point of the discussion paper regards the mapping of derivative transactions to risk categories: EBA proposed a three-step approach based on primary risk driver and sensitivities for complex products. About this topic, we analyzed an hybrid derivative like a cross currency swap, that could be assigned to FX class or IR class, and the relative impact on EAD.

The assessment based on market sensitivities (*i.e.* greeks) could introduce a change in the EAD from day to day with “artificial” impact on the EAD. For this reason, we are currently analyzing an alternative methodology, that can be found useful for more sophisticated banks, based on **Global Sensitivity Analysis** [5]. The idea is to compute the so called Sobol’ sensitivity indices, instead of market sensitivities, in order to have a more stable and precise estimation of the risk associated to these transactions. We plan to present the details of this methodology, as well as some concrete applications, in a forthcoming paper.

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