COMMENTS ON "CONSULTATIVE DOCUMENT – FUNDAMENTAL REVIEW OF THE TRADING BOOK: OUTSTANDING ISSUES" ISSUED BY THE BASEL COMMITTEE ON BANKING SUPERVISION

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1. Background and summary

This document is an answer to the request for comments in the "Consultative Document – Fundamental review of the trading book: outstanding issues", as invited by the Basel Committee on Banking Supervision (BCBS).

The comments below are technical in nature and related to risk factors definition and sensitivity computation. One of the stated goal of the consultative document is that "the approach should facilitate consistent and comparable reporting of market risk across banks and jurisdictions". It is my opinion that in the current form of the document it would be very difficult to achieve *constant and comparable* results as some elements are either imprecise or incoherent with standard market practice.

The comments are on the first part of the risk measurement process, consisting in the computation of the sensitivities to risk factors. The second part of the risk process, the aggregation between the individual risk factors, can be analyzed only once the first part has been fully clarified.

2. Computation method for PV01

Related to: 3. Definition of the risk factors and the sensitivities – (c) Definition of sensitivity – 20. For GIRR risk factors, the sensitivity is defined as the PV01

The approach proposed in the document is a "sensitivity-based approach (SBA)". The definition of sensitivity for GIRR is given in the document by

$$s_{i,r_t} = \frac{V_i(r_t + 1\text{bp}, cs_t) - V_i(r_t, cs_t)}{1\text{bp}}.$$

This definition does not match the standard definition of sensitivity as the mathematical partial derivative of the value function with respect to one of the input. The definition above refers to one approximation of the derivative. The approximation is computed by a finite difference method, also called "bump and recompute" method. From a theoretical point of view, the formula proposed is only one of the numerous possible approximation of the sensitivity.

Apart from the theoretical problem described above, which is certainly minor with regard to the general goal of capital computation, the proposed approach has major practical drawbacks. Not only the proposed formula may lead to numerical instabilities when the value itself is computed by complex numerical schemes, but in general its implementation leads to a very slow procedure. With the proposed approached each interest rate instrument will need to be valued at least 10 times and most likely between 20 and 40 times; it has to be revalued for each risk factor.

Efficient implementation, like Algorithmic Differentiation, can compute all the (10 to 40) sensitivities in less than 4 times the time required for one valuation. The description of Algorithmic Differentiation can be found in standard text books like

Griewank and Walther (2008) or Naumann (2012). In case of model calibration, the efficiency features can be further improved as demonstrated in Henrard (2014). In a lot of libraries, the computation of sensitivities is achieved through similar methods. Requesting banks to use a potentially unstable and more time consuming method, like the finite difference approach described by the formula, is certainly not a target of the Fundamental Review of the Trading Book.

Moreover for some libraries this approximated method may not be available. It would require significant development time to achieve a less effective method to compute the required sensitivity by the proposed method.

Suggestions:

- Rephrase point 20 to require the sensitivity to be computed as the partial derivative, in the mathematical sense, of the instrument value with respect to the relevant rate.
- Leave the implementation and approximation choices on how to compute those numbers to the implementing institutions.
- Potentially mention the formula proposed in the current draft as an acceptable implementation choice.

As a general rule, being more explicit on the goal of the procedure and less prescriptive on the means would improve the regulation. The implementation validation by the regulators can check that the goals are effectively achieved. If one institution can achieve that goal in a more efficient way that the way imagine at the time of writing the regulation, this should be seen as a positive aspect of the implementation, not as a bypass of the regulation.

3. Scaling factor for PV01

Related to: 3. Definition of the risk factors and the sensitivities – (c) Definition of sensitivity – 20. For GIRR risk factors, the sensitivity is defined as the PV01

The definition of sensitivity for GIRR is given in the document by

$$s_{i,r_t} = \frac{V_i(r_t + 1\text{bp}, cs_t) - V_i(r_t, cs_t)}{1\text{bp}}.$$

The result is called "PV01" in the title but the number described by the formula is the sensitivity with respect to the risk factor r_t *not rescaled by a basis point*. It appears that a scaling factor is missing somewhere in the document.

Take the example of a 5-year swap with a notional of 1 millions. The sensitivity to the 5-year Ibor rate will be roughly (ignoring discounting and day count convention) 5,000,000. For a 5-year vertex, the risk weight is $RW_k = 100$. The weighted sensitivity is then $WS_k = RW_k * s_k \simeq 500,000,000$. If this is the only position of the bank (no netting or diversification), the capital requirement will be

$$K_b = \sqrt{{WS_k}^2} \simeq 500,000,000.$$

It is doubtful that it is the intention of the committee to require such a level of capitalization for a relatively small transaction.

Suggestions:

- Add a scaling factor of one basis point ($\times 0.0001$) in the definition of sensitivity.

In the same point, the sensitivity is defined by reference to "1 basis point". There is no indication of the day-count convention associated to that rate. Different instruments, even in the same currency, may have different day count conventions. Should the convention be uniform for all risk factors? Can the day count be selected by the reporting bank? Changing the day count in the computation can change the final result by several percentage points. This would hinder the comparison between reports.

Suggestions:

- Clarify the day count to be used for the "one basis point".

4. Curve vertices

Related to: (a) Definition of the delta and curvature risk factors - 11. GIRR risk factors

The delta should be computed for interest rate using standard vertices for all curves. The first vertices are 0.25 years and 0.5 years for all curves. The risk factors at those vertices should be market rate, as indicated in point 20.

There is no market instrument related to the 6 months IBOR rate of maturity close to 0.25 years. How should the short term vertices be interpreted for curves with tenor longer that the vertices?

Even if the sensitivity was computed to a zero-coupon rate, its value for vertices shorter than the curve IBOR tenor would be arbitrary as explained in (Henrard, 2014, Section 3.1).

Suggestions:

- Indicate that for curve related to Ibor indices, the first vertex of the curve is the tenor of the index. The curves related to longer tenors will have less vertices at the short term.

5. Implied volatility

Related to: (b) Definition of the vega risk factors - 18. Implied volatility

Related to: (c) Definition of sensitivity for each asset class - 26. Sticky delta

The item (18) mention explicitly the term structure of *implied volatility* and the use of *strike* to compute a *moneyness*.

Implicitly the committee thus recommend to use a conventional formula with which a volatility is implied from a price. There is no indication of which formula to use. A fairly standard approach would be to use a Black-Scholes-like (Black and Scholes (1973)) formula from a log-normal model of the underlying and use the formula volatility as the varying parameter. This approach would not be suitable for interest rate instruments as the forward rates and strikes can be negative, especially in today's very low rate environment. A possible alternative is to use a Bachelier-like (Bachelier (1900)) formula. This would remove the negative rate problem but at the same time would not be the best approach for equity prices and foreign exchange rates that are alway positive. Using a log-normal or normal model will provide very different deltas, e.g. see Henrard (2005) for an analysis of the question in the case of swaptions.

The use of strike in the definition of vega risk raised a direct question. What vega risk should be computed for instruments without natural strike dimension (STIR futures, CMS, in arrears, volatility swap, ...)?

For the first-order sensitivity of instruments subject to optionality, it is indicated that a *sticky delta* approach should be used. A *sticky something* approach indicates that the conventional formula is used and the parameters of that formula are changing dependent on the instrument to be analyzed (see above for the conventional formula). The *sticky something* part referenced to the fact that the implied parameter are kept constant for a subset of instrument linked by a common *something*.

There is no explicit formula to compute which options have an identical delta. The delta depends on the volatility and by a sticky delta requirement, one implicitly links the volatility to the delta. Obtaining the valuation for options with a forward different from the current one requires solving a system of two equations with two unknown. Even if not infeasible, this is adding a level of complexity to the generation of sensitivities.

For some instruments, the notion of implied volatility and sticky behavior is ill-defined. The implied volatility with one of the models above is defined only for instruments for which the price can be written as function of a unique underlying. By opposition, for interest rate instruments a full term structure may be required. What approach should be used in those cases? This question is not restricted to exotic instruments. Even a simple STIR futures requires a convexity adjustment. It is a standard market practice to compute that adjustment using a one factor extended Vasicek model. What is the notion of delta and strike in this case and by extension what is the sticky delta hypothesis?

Suggestions:

- If implied volatility related figures have to the computed, indicate which base model should be used. The base model proposed should be compatible with the fact that equity prices and foreign exchange rates are always positive but interest rates can be positive or negative.
- If the base model relies on a single underlying, indicate what approach should be used for instrument priced with a full term structure model, in particular for interest rate instruments.

References

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