COMPATIBL

Regulations, sensitivities and adjoints

Using AAD for FRTB and FRTB-CVA

Adjoint algorithmic differentiation (AAD) has performed effectively and at lightning speed in regulatory calculations. With questions about its use largely resolved, support for AAD-based methodologies is growing, says Alexander Sokol, head of quant research at CompatibL

Adjoint algorithmic differentiation (AAD) transforms a software program that calculates a result into a program that can simultaneously calculate the sensitivities of the same result – avoiding the computationally inefficient 'bump and reprice' approach. With bump and reprice, the computational cost is proportional to the number of sensitivities, but with AAD the computational cost is a fixed multiple of the computational cost of the original calculation, irrespective of the number of sensitivities.

Alexander Sokol

The latest regulations for the market risk capital charge – FRTB finalised in the Basel Committee on Banking Supervision Document 352 (BCBS 352)[1] – and the credit valuation adjustment (CVA) capital charge – FRTB-CVA for which the latest Consultative Document is BCBS 325[2] – provide the option of using a sensitivities-based standardised approach (SA) for computing regulatory capital. For FRTB, SA is both an alternative and the basis of a floor for the internal model approach (IMA). This means that sensitivities-based calculation will have to be performed by all trading desks, including those using IMA. For FRTB-CVA, IMA is not available, leaving sensitivities-based SA as the most risk-sensitive method and far superior to the Basic CVA framework.

Sweeping consequences

The use of the best available technique – namely AAD – for the massive computational effort of calculating sensitivities in FRTB and FRTB-CVA may seem like a no-brainer, except for the peculiar way in which the current FRTB and FRTB-CVA documents define sensitivities. Paragraph 67a of FRTB, which defines delta for the general interest rate risk, states: "PV01 is determined by calculating the change in the market value of the instrument as a result of a 1 basis-point shift in the interest rate r at vertex t of the risk-free yield curve in a given currency, divided by 0.0001 (0.01%)". Likewise, Paragraph 67g defines FX delta via a finite 1% relative shift: "The sensitivity is calculated by taking the value of a 1 percentage point change in exchange rate, divided by 0.01 (1%)." The FRTB-CVA document uses similar definitions, with a reduced number of buckets per curve.

The use of finite shifts to define something called a 'sensitivity' is a drafting ambiguity with far-ranging consequences. "Regulatory sources say they didn't mean to outlaw AAD. One regulator who spoke to *Risk.net* on condition of anonymity agrees FRTB appears to restrict the use of the technique, but says this was not an intentional move by supervisors," writes Nazneen Sherif (see pages 10–11).

While considerable performance gain can be expected from the use of AAD for both FRTB market risk and FRTB-CVA, it is in FRTB-CVA where the performance advantage of AAD is especially striking. The CVA figure depends on hundreds of curves for each netting set – and for larger netting sets, thousands of curves. Even with the reduced number of buckets per curve in FRTB-CVA compared with FRTB, the total number of sensitivities for each netting set will, on average, exceed 1,000. For this calculation, AAD is likely to provide at least a 100-fold acceleration in performance.

The International Swaps and Derivatives Association (Isda) standard initial market model (Simm), which shares many of its definitions with FRTB, provides an example of how this ambiguity can be resolved. The Isda Simm methodology[3] provides several alternative definitions of sensitivities to choose from, one of which is to use a small or infinitesimal shock size. This alternative definition is fully compatible with AAD.

As the regulation for the market risk has been finalised – with BCBS 352[1] – the change in definitions can no longer be made within the document itself. Nevertheless, considering the high level of publicity surrounding the issue of using AAD for FRTB – with prominent articles and conference presentations arguing in favour of clarification permitting its use – it is highly likely that this issue will be addressed in subsequent frequently asked questions (FAQs) and/or technical guidance issued by country supervisors. According to a senior regulator quoted by Sherif, an FAQ addressing this issue is already being considered by the Basel Committee trading book group.

At the time of writing, FRTB-CVA is still a draft, and the regulators still have an opportunity to address AAD in the final version of the document. Such clarification may involve a similar definition to that adopted by the Simm model.

With the rapidly growing support for the use of AAD in regulatory capital calculations, banks that implemented the AAD technology will be well positioned to take on the challenge of FRTB and FRTB-CVA.

Contact

Alexander Sokol • Head of Quant Research
E info@compatibl.com
www.compatibl.com

[1] *www.bis.org/bcbs/publ/d352.htm*
[2] *www.bis.org/bcbs/publ/d325.htm*
[3] *Version R1.0, September 1, 2016 www2.isda.org/attachment/ODY2OA==/ISDA_SIMM_vR1.0_(PUBLIC).pdf*