Models and numerical methods for XVA pricing in multicurrency derivatives.

Authors:

- Íñigo Arregui, Universidade da Coruña and CITIC (arregui@udc.es)
- Roberta Simonella, Unipolsai Assicurazioni S.p.A, Bologna (roberta.simonella@libero.it)
- Carlos Vázquez, Universidade da Coruña and CITIC (carlosv@udc.es)

Abstract: In this work, we propose appropriate models to compute the total valuation adjustments (XVA) in a multicurrency setting by means of dynamic hedging methodologies. In this way, we extend previous works in the single currency setting (see [**?**] and the references therein). Besides the stochastic evolution of the assets in different currencies, the presence of stochastic intensities of default and the consideration of constant or stochastic exchange rates are assumed when computing the XVA associated to European options contracts. These models can be formulated in terms of (non)linear parabolic partial differential equations (PDEs) or in terms of expectations.

When the number of stochastic factors is not greater than two, we propose a Lagrange-Galerkin scheme for solving the PDEs, combined with fixed point techniques for the nonlinear problems [2]. For problems that include more than two underlying stochastic factors (assets, intensities of default, and/or stochastic FX rates), we propose the use of Monte Carlo simulations applied to the formulations based on expectations, combined with a Picard method and the more efficient Multilevel Picard iteration (MPI) scheme for the nonlinear cases [**?**]. We apply these techniques to different European style option.

References:

[1] Iñigo Arregui, Beatriz Salvador, Daniel Ševčovič, Carlos Vázquez. Total value adjustment for European options with two stochastic factors. Mathematical model, analysis and numerical simulation, Computers and Mathematics with Applications, 76 (2018), 4 725-740.

[2] Iñigo Arregui, Roberta Simonella, Carlos Vázquez. Models and numerical methods for XVA pricing under mean reversion spreads in a multicurrency framework, Communications in Nonlinear Science and Numerical Simulation, 130 (2024) Article Nr. 107725..

[3] Roberta Simonella, Carlos Vázquez. XVA in a multi-currency setting with stochastic foreign exchange rates, Mathematics and Computers in Simulation, 207 (2023) 59-79.