PDE MODELS AND NUMERICAL METHODS FOR XVA COMPUTING

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Abstract

In this work we mainly address the modelling and numerical methods to compute the XVA (CVA, DVA and FVA) associated to counterparty risk in European option contracts. In all cases here treated, the XVA can be expressed in terms of expectations, thus leading to a (non)linear integral equation, or as the solution of a (non)linear partial differential equation (PDE). Depending on the model, the problem becomes linear or nonlinear.

First, we consider the model proposed in [1] that includes counterparty risk of the issuer and counterparty as well as funding costs, so that linear and nonlinear PDEs associated to one stochastic factor arise and we propose a complete PDE model and suitable numerical methods to solve them. Next, following the introduction of stochastic default intensities for issuer and counterparty proposed in [2] to obtain linear PDEs in higher dimensions, we consider linear and nonlinear PDEs associated to three stochastic factors. Moreover, assuming that the issuer has zero risk intensity (i.e. removing DVA), PDE models associated to two stochastic factors can be posed. Moreover, appropriate boundary conditions and suitable numerical methods are proposed. These methods are based on semilagrangian discretizations of the first order derivatives in time and space, and finite elements for the spatial discretization combined with fixed point iteration algorithms for the nonlinear case. Finally, several examples illustrate the performance of the PDE models and numerical methods [3].

References

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