

# Structural Pricing of XVA Metrics for Energy Commodities OTC Trades



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## ABSTRACT

The global financial crisis revealed that no economic entity can be considered *default-free* any more. Because of that, both banks and corporate firms have to deal with bilateral Counterparty Credit Risk (CCR) in their OTC derivatives trades. Such evidence implies the fair pricing of these risks, namely the Credit Valuation Adjustment (CVA) and its counterpart, the Debt Valuation Adjustment (DVA). Despite the more commonly used reduced-form approach, in this work the random default time is addressed via a structural approach à la Black and Cox (1976), so that the bankruptcy of a given firm is modelled as the first-passage time of its equity value from a predetermined lower barrier. As in Ballotta et al. (2015), I make use of a *time-changed* Lévy process as underlying source of both market and credit risk. The main advantage of this setup relies on its superior capability to replicate non null short-term default probabilities, unlike pure diffusion models. Moreover, a numerical computation of the valuation adjustments for bilateral CCR in the context of energy commodities OTC derivatives contracts has been performed. Since the mainstream approach typically used in practical settings is to evaluate derivatives in terms of the cost of their respective hedging strategies, the pricing of CCR metrics implicitly relates to the way these strategies are financed. Within the numerical section of the present work, the role played by funding costs and their impact in widening bid-ask spreads have been assessed. A similar reasoning has been applied for the investigation of the cost of funding Initial Margins (IM), typically effective on top of Variation Margins (VM) when trading under Central Clearing Counterparties (CCPs). As the Initial Margin Valuation Adjustment (MVA) is concerned, it is here showed that, differently from what can happen for FVAs, no *Offsetting Effect* can materialize. As a consequence, in aggregate terms IMs can cause systemic liquidity effects. The computed XVA metrics are relative to energy commodities OTC derivative trades. After all, my aim is to improve of the structural first-passage framework along several directions as well as test its robustness. Since typically commodity trades are not clearable under Central Clearing Counterparties (CCPs), it is worthy to assess the effect of bilateral Collateral Support Annex (CSA) agreements on CVA/DVA metrics. Moreover I introduce within my CCR modelling, the impact of state-dependent stochastic recovery rates. Furthermore, in order to stress-test my framework, I investigate the effects on CCR measures of multiplicative shocks to the two major drivers in the game: credit and volatility. Finally I propose an alternative balance-sheet calibration based on hybrid market/accounting data which is well suited in the commodity context in the light of small and medium size

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of corporations usually operating in the EU commodity derivatives market for risk-management purposes.

**Keywords:** Counterparty Credit Risk, Lèvy Processes, Jumps, First-passage Models, Fourier Pricing, COS, CVA, DVA, FVA, XVA, MVA, Energy Commodities. Hedging, Funding Costs, Funding Spread, Bid-Ask Spread, Transaction Costs, Central Clearing, Collateral, Sensitivity Analysis, Stress Testing, Recovery Risk, Accounting Data.