Modeling the risks within the protocol Aave, with an application to portfolio allocation

Louis Latournerie*[1,2]

[1]Ecole Polytechnique – Ecole Poytechnique – France
[2]ENSAE – ENSAE – France

Abstract

Decentralized Finance (DeFi) lending and borrowing protocols enable portfolio managers to take leveraged long and short positions on digital assets without centralized intermediaries, but expose them to a distinctive form of risk: on-chain liquidation triggered by debt and collateral value fluctuations. In this paper, we adapt the classical Markowitz portfolio optimization framework to account explicitly for liquidation risk within DeFi protocols, with a particular focus on Aave-v3. We provide a detailed formalization of Aave's lending, borrowing, and liquidation mechanisms, grounded in the protocol's open-source implementation. We introduce a proportional collateral seizure (PCS) liquidation rule that ensures feasibility and analytical tractability in multi-asset settings. Using an asymptotic expansion under small asset variance, we derive a semi-explicit formulation of the portfolio optimization problem, making it suitable for effective numerical implementation. Numerical experiments illustrate how incorporating liquidation risk significantly alters optimal allocations and the effective risk-return trade-off. Our results highlight the necessity of integrating protocol-specific liquidation dynamics into quantitative portfolio construction in DeFi.

*Speaker