Methods Used for Liquid Treasury Token Parameters

Xitadel Financial Engineering Team

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Abstract

In the rapidly evolving landscape of Web 3 industry, overcollateralized crypto LTTs will become innovative instruments for fund raising. However, unlike traditional LTTs, these financial products lack evaluations from established credit rating agencies, introducing challenges in assessing their creditworthiness. By compensating for the absence of conventional credit ratings, financial models play a pivotal role in fostering informed investment decisions and promoting confidence.

Our sophisticated financial model meticulously determines three critical parameters for overcollateralized crypto LTTs: the liquidation ratio, LTT size, and interest rate. This comprehensive approach ensures a robust assessment of each parameter, enhancing overall LTT stability and investor appeal. Over 1TB of traditional financial (stocks, ETFs, options) and crypto trading data is meticulously analyzed with well recognized financial models.

1 Three Important Parameters

1.1 Liquidation Ratio

The liquidation ratio is a critical parameter that determines the threshold at which the collateral backing the LTT is liquidated to cover potential losses. A well-calibrated liquidation ratio ensures that the LTT remains adequately secured, protecting investors from defaults due to market volatility. Setting this ratio too high may lead to unnecessary liquidations during minor market fluctuations, while setting it too low could expose investors to increased risk. Therefore, determining an optimal liquidation ratio is essential for maintaining the LTT's financial stability and investor confidence.

1.2 LTT Size

The LTT size, or the principal amount of the LTT, significantly influences its liquidity and marketability. Larger LTT issuances can attract investors seeking substantial investment opportunities, thereby enhancing market liquidity. However, excessively large LTT sizes may saturate the market, potentially leading to pricing inefficiencies and disastrous result when liquidation happens. Conversely, smaller LTT sizes might not appeal investors enough and could suffer from lower liquidity, making them harder to trade. Thus, determining an appropriate LTT size is crucial for balancing investor demand and market liquidity.

1.3 Interest Rate

The interest rate offered on the LTT directly affects its attractiveness to potential investors. A competitive interest rate compensates investors for the risks associated with the LTT, including credit risk and market volatility. Setting the interest rate requires a careful assessment of prevailing market rates. An interest rate that is too high may raise concerns about the issuer's financial health, while one that is too low might not provide sufficient incentive for investment. Therefore, accurately determining the interest rate is vital for ensuring the LTT's competitiveness and appeal in the market.

2 Liquidation Ratio

Various financial models are applied to measure adequate Liquidation ratio.

2.1 1. Market Impact

Liquidating large collateral positions can significantly affect market prices. Assessing this impact is crucial to be regarded as safe investment by guaranteeing principal as much as possible.

2.1.1 I. Kyle Lambda

Introduced by Albert Kyle, this metric quantifies the price impact per unit of traded volume, providing insights into market liquidity and the potential cost of large trades.

$$r_{i,n} = \lambda_i \cdot S_{i,n} + \epsilon_{i,t}$$

- $r_{i,n}$: Percentage stock return in period.
- $S_{i,n}$: Signed square-root dollar volume, calculated as the signed sum of the square root of trade volumes.
- λ_i: Kyle's Lambda, representing the market impact.
- $\epsilon_{i,t}$: Error term or noise in the model.
- $r_{i,n}$: Percentage stock return in period.

2.1.2 II. Optimal Execution of Portfolio Transactions

This model assists in determining optimal execution strategies that balance market impact and execution risk. By modeling the trade-off between the urgency of liquidation and the associated costs, it helps in minimizing the overall execution cost.

$$S_k = S_{k-1} + \sigma \tau^{1/2} \xi_k - \tau g(\tau \eta_k)$$

- S_k: The current price.
- S_{k-1}: The previous price.
- σ: The volatility.
- τ: The time interval.
- η_k: A liquidity or demand-related term.
- ξ_k: An error term.

2.1.3 III. Bloomberg Transaction Cost Analysis Reference

Bloomberg's TCA tools offer empirical data on transaction costs, aiding in estimating the market impact of liquidating specific asset volumes. Referencing their model, we are currently developing better model on market impact.

2.1.4 IV. Limitation

Although considering market impact is important, it has a limit. The excessive amount of collateral after liquidation will exacerbate the market and it could trigger a market collapse, similar to the death spiral experienced during the Luna incident.

2.2 Game Theory

As only considering market impact has limit, we apply game theory to establish a framework ensuring the repayment of principal and interest. It will be strategic dominance for foundation to repay their debts.

$$TLT \cdot PD \cdot ODAD + PN < ((TLT + MC) \cdot OD \cdot P) - IR \cdot PN$$

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- TLT: Token Leftover in Treasury
- PD: Price after Default
- $ODAD$: OTC Discount after Default
- PN: Principal
- MC: Minimum collateral
- P: Current price (without impact from default)
- OD: OTC Discount
- IR: Interest Rate

When default or liquidation happens, it is a strongly negative signal for market. As a foundation reserves a substantial amount of its governance tokens, other than used for collateral, in treasury. To preserve left-over tokens' value, the foundation needs to prevent default.

2.2.1 OTC Discount Estimation

In the equation, OTC discount rate is very crucial. OTC discounts can be referred from public disclosure of OTC deals in history. However, not all token have a history of OTC deals. We need to estimate it.

2.2.2 Black Scholes Equation

Traditionally used for option pricing, this model can be adapted to estimate OTC discount. Optimal price for put option with strike price as current price in 6 months maturity can be considered as OTC discount which OTC deal maker should be satisfied. In Black Scholes equation, measuring volatility is very important. Various methods, ranging from traditional daily volatility measures to advanced machine learning models, have been utilized to estimate the most accurate volatility for each token.

2.2.3 Updated Black Scholes Equation

Multiple approach were made to develop Black Scholes equation, as it started in 1970s. One of the most developed and recent approaches, which considers market impact, is incorporated into our financial model.

2.3 Agent-Based Interactive Discrete Event Simulation (ABIDES)

ABIDES is an agent-based market simulation framework that provides a high-fidelity virtual exchange for studying trading dynamics and risk. It enables tens of thousands of simulated trading agents to interact with a centralized exchange agent in real-time The simulator incorporates realistic market microstructure features such as configurable network latencies between agents and an order message system modeled after NASDAQ's ITCH/OUCH protocols. By faithfully reproducing limit order book mechanics and timing, ABIDES offers a controlled environment to evaluate how complex agent behaviors impact market outcomes. This makes it a powerful tool for risk estimation, allowing practitioners to pose "what-if" scenarios in silico that would be impossible or impractical to test in live markets.

2.3.1 Role in Risk Estimation and Market Impact Analysis

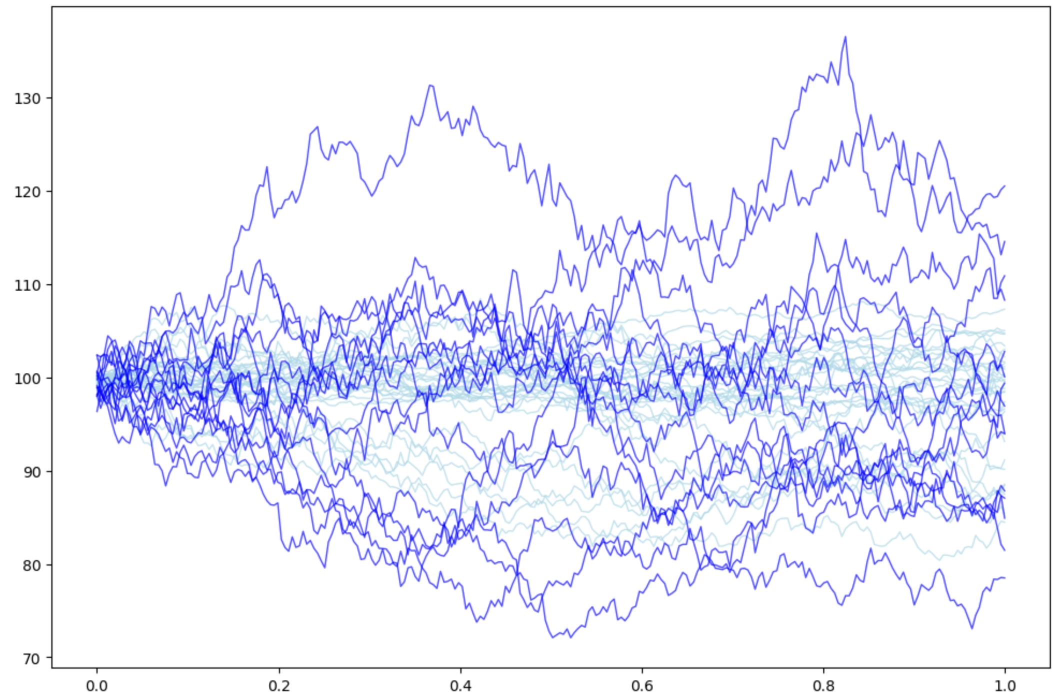
A key application of ABIDES is to assess market impact and liquidity risk associated with large trades or rapid liquidations. Traditional market modeling techniques (e.g. historical backtests or static impact formulas) often struggle to capture the dynamic feedback of a sizeable order on the market. In contrast, ABIDES can simulate a baseline trading day with numerous background agents (representing typical market liquidity providers and takers) and then introduce a large experimental order to gauge its effect on prices. Because the simulation offers perfect repeatability and control, one can isolate the impact of that order by comparing scenarios with and without the large trade – a level of experimental insight unattainable from historical data alone. For example, researchers used ABIDES to model the intraday execution of a single "impact" agent that aggressively buys a fraction of the available order book (parameterized by a greed factor g) at a specific time. The resulting price trajectories showed a clear perturbation: the large buy generated an immediate uptick in price relative to the no-impact baseline, followed by a gradual mean reversion as other agents adjusted. These simulations highlighted that larger orders create disproportionately higher price displacement but with diminishing returns per unit volume – consistent with the concave (sublinear) nature of market impact costs observed empirically. In fact, a common stylized model posits $\Delta P \propto \sqrt{Q}$ (the square-root law of price impact) for a trade of size Q, reflecting that doubling the trade size tends to increase impact by a factor less than two. ABIDES experiments support this intuition: as the impact agent's order size grew, the total price change increased while the profit (or price improvement) per share decreased, indicating non-linear impact scaling. By logging detailed trade and quote data, ABIDES also makes it straightforward to perform statistical analyses on many simulated trials. For instance, aggregating the outcomes of multiple impact-event simulations at various times and market conditions can yield a distribution of price effects, helping risk managers estimate the expected slippage and variance when unwinding large positions. Such insights into liquidation impact are invaluable for setting prudent liquidation ratios and understanding the market liquidity risk under stress scenarios.

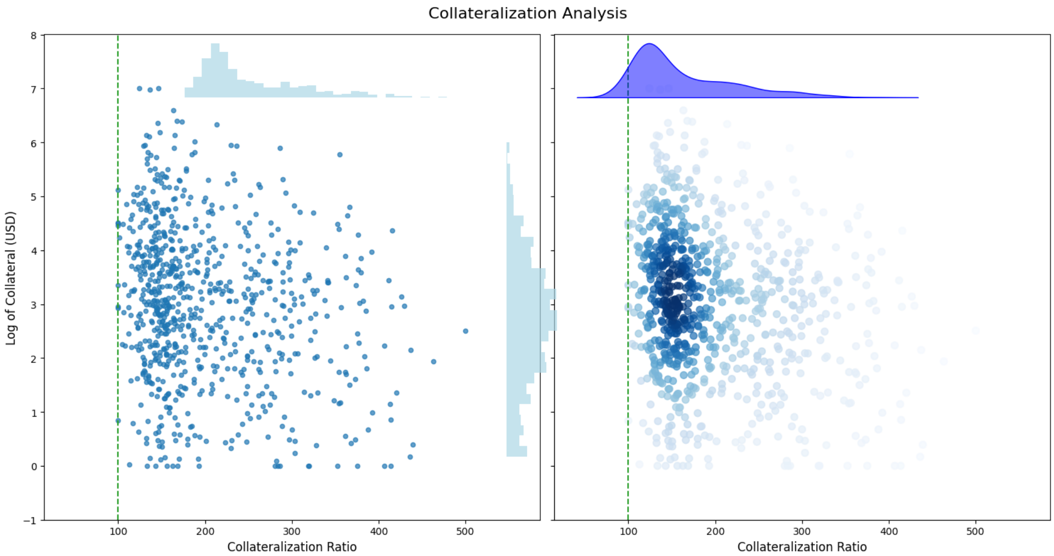
2.3.2 Recent Improvements and Methodologies

The ABIDES platform has seen continuous development to enhance its realism and analytical capabilities. One notable improvement is the integration of learning agents and reinforcement learning methodologies within the simulation. ABIDES was designed to accommodate not just fixed rule-based traders but also adaptive, AI-driven strategies, addressing the long-standing critique that agent-based models require exogenously defined behaviors. An extension called *ABIDES-Gym* wraps the simulator in an OpenAI Gym interface, enabling researchers to train and evaluate reinforcement learning trading agents directly in a multi-agent market environment. This means one can develop machine learning-based agents (for example, an execution algorithm that learns to minimize impact cost) and study their interactions with other market participants under realistic conditions. Additionally, recent methodology research has focused on calibrating ABIDES simulations to real market data to ensure validity of the outcomes. Techniques for statistically rigorous calibration of the simulator's numerous parameters (such as agent behavior distributions and order arrival rates) have been proposed. By tuning the simulation to match historical market patterns and "stylized facts," analysts can increase confidence that ABIDES scenarios faithfully reflect true market responses.

2.3.3 Comparison to Traditional Modeling

In a financial risk context, ABIDES complements traditional modeling techniques like historical VaR simulations, closed-form market impact models, and exchange replay tools. Unlike closed-form models (e.g. linear impact models) that apply a static formula, an ABIDES simulation organically generates market impact as an emergent result of supply-demand imbalance and strategic agent reactions. Likewise, compared to pure historical replay, ABIDES offers interactive dynamics: agents in the simulation can adapt their orders in response to a large trade, which mirrors how real liquidity providers might adjust spreads or inventory when faced with a sudden liquidation. This interactivity provides a more nuanced risk estimation. For example, if a trader needs to liquidate a large position, a historical analysis might assume average past liquidity, whereas ABIDES can *simulate* the event and show how the order book could thin out or prices gap until equilibrium is restored. Such scenario analysis augments risk metrics like the liquidation ratio by quantifying potential market impact under stress. Importantly, ABIDES-based insights are used in conjunction with traditional measures—serving as a “safe sandbox” to test strategies and gauge risks before applying them to live trading. In summary, the ABIDES agent-based framework elevates risk estimation and market impact analysis by marrying high-resolution market microstructure modeling with advanced AI-driven agent behavior, yielding a richer understanding of liquidity risk than traditional techniques alone.





3 LTT Size

3.1 Value at Risk

The size of an overcollateralized LTT issuance is significantly influenced by market impact, which refers to the effect that large trades can have on asset prices. When large amount of tokens are dropped in the market at instance, market could collapse. If this kind of black-swan events occur, the outcome cannot be accurately predicted. So the LTT size is limited to avoid disastrous event. However, predicting black swan events is inherently impossible, as their defining characteristics are extreme rarity, unpredictability, and significant impact. By using VaR 95,99, our model takes conservative LTT size for each token.

4 Interest Rate

4.1 Reference of Lending Protocol, Web 2 Interest Rate

The initial step in setting the interest rate involves direct negotiations between the LTT issuer and potential investors. Issuers, who provide collateral to secure the LTT, aim to offer an interest rate that is attractive to investors while minimizing their own cost of borrowing. The quality and value of the collateral play a significant role in these discussions; higher-quality collateral can justify a lower interest rate due to reduced risk, whereas lower-quality collateral may necessitate a higher rate to compensate investors for increased risk. This negotiation process is crucial in aligning the interests of both parties and establishing a foundation for the LTT's pricing.

4.2 Negotiation with Foundation

Beyond individual negotiations, the interest rate for a collateralized LTT is influenced by current market interest rates, including benchmarks such as government LTT yields and central bank rates. These rates serve as a reference point, ensuring that the LTT's interest rate is competitive within the broader financial landscape. For instance, if prevailing interest rates are high, the LTT's rate must be set accordingly to attract investors. Conversely, in a low-interest-rate environment, the LTT's rate would be adjusted downward. This alignment with market rates ensures that the LTT remains appealing to investors relative to other available investment opportunities.