MovER: Stabilize Decentralized Finance System with Practical Risk Management

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***Abstract*—Decentralized Finance (DeFi) suffers from various financial risks nowadays. This paper presents MovER, a novel stablecoin system based on modern risk management, consisting of a diversified collateral framework with corresponding stabilizing/clearing mechanism. Moreover we build a powerful all-round risk evaluation framework on the basis of thought on the probability theory and mathematical statistics.**

***Index Terms*—DeFi, blockchain, stablecoin, risk management**

I. Introduction

It is far-reaching for a cross-chain blockchain ecosystem to build a unified stablecoin system. However, most stablecoin systems, such as MakerDAO, rely on the Ethereum too much, and have no ability to include diversified cross-chain assets (BTC) into its collateral framework, which makes the system suffer from serious single point of risk. Especially almost all stablecoin and DeFi systems omit traditional financial risk management methodology and never learn lessons from modern financial world. MovER makes the stablecoin system on a cross-chain ecosystem called MOV, including the balance sheet, qualified collateral, stabilizing/clearing mechanism and systemic risk control.

Many stablecoin systems depend upon community voting adjusting system risk parameters, which lack of scientific guidance. They also never distinguish between market risks and operational risks. For all we know, MovER may be the first stablecoin system based on classic modern financial risk management models, introducing JLT model, LDA (loss distribution approach), volatility models and VaR calculation. And the setting of key parameters is established under the guidance of these models, forming a trinity risk control system of experience, data and model.

II. System Overview

A. Qualified Collateral Framework

The cross-chain system provides a diversified source of mortgage assets for the collateral framework of stablecoin systems. We choose four types of digital assets which have different liquidity risks and market risks, and also the correlation risks among them should not be high. Haircut rate is an important tool to evaluate mortgage risks of assets, following classical VaR (value-at-risk) calculation. Taking into account the unique law of value of the cryptocurrency market, new factors should be added into the formula, such as the liquidity of mortgage assets.

$$\mathcal{L}(x) = \frac{\int_a^b \frac{M^2(x)}{V(x)G(x)}dx}{b-a} \tag{1}$$

$\mathcal{L}(x)$ represents the calculation of the liquidity factor in the interval $[a, b]$ under the influence of the market volatility variable x, related with the liquidation speed V, the liquidation amount M, and the market affordability (the ratio of the liquidation amount to current market depth G).

B. Stability Mechanism and Risk Liquidation

We set up a three-level clearing system:

- Level 1: external arbitrageurs are encouraged to participate in the liquidation process, autonomously connecting other trading market;
- Level 2: immediately freeze the system and let MovER itself become the largest market arbitrageur;
- Level 3: the risk bond is initiated when the black swan occurs.

The risk bond is a kind of credit bond issued in time of crisis to maintain system stability via the absorption of liquidity to tighten stablecoins supply. As the market picks up, stablecoins will be issued to repurchase bonds, giving profits to creditors.

III. Practical Risk Management

Risk management(Fig. 1) is the core module of MovER, consisting of external risk models and internal risk models.

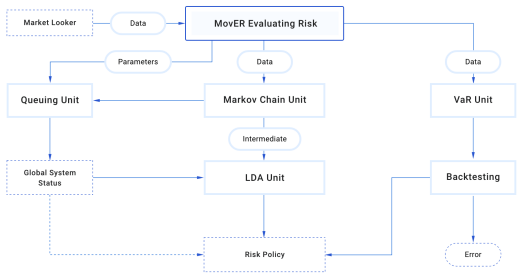

Fig. 1. Risk management framework of MovER.

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A. Internal Risk Model Based on Markov Chain

We expand Jarrow-Lando-Turnbull (JLT) model [1] which is a kind of Markov chain rating-based credit risk model widely adopted by modern financial risk management, and treat the loan liquidation process as a finite state-space Markov chain, to reflect the quality and trend of loans in the stablecoin system. Here we adopt an aperiodic time-homogeneous, continuous-time Markov chain, and define the finite state-space:

$$S = \{s : Safe, d : Danger, r : Repay, c : Clean\} \quad (2)$$

Among them, Repay (active repayment) and Clean (passive liquidation) belong to absorbing state, while Safe and Danger are non-recurrent state. Stablecoin loans are in Safe when created. As the real-time mortgage rate exceeds the minimum liquidation mortgage rate, it turns to Danger.

Define p as the transition probability between two state. In accordance with Markov chain theory and the generator matrix, the absorbing probability from Safe to Repay is $\frac{p_{sr}+p_{sd}p_{dr}}{1-p_{sd}p_{ds}}$, and the absorbing probability from Safe to Clean is $\frac{p_{sc}+p_{sd}p_{dc}}{1-p_{sd}p_{ds}}$ [2].

Further integrated with queuing theory and birth-death process, there is birth rate λ and death rate κ, so we can predict the total amount of loans in system at time t:

$$\mathbb{E}(N(t)|N(0) = 0) = \frac{\lambda}{\kappa}\left(1 - e^{-\kappa t}\right) \quad (3)$$

According to the expected amount of loans and the absorbing probability matrix at time t, we can further predict the amount of loans eliminated at time t and the amount of liquidated loans:

$$C_t = \lambda t - \frac{\lambda}{\kappa}\left(1 - e^{-\kappa t}\right), NC(t) = C_t\frac{p_{sc} + p_{sd}p_{dc}}{1 - p_{sd}p_{ds}} \quad (4)$$

Next by means of Markov transition matrix, we adopt survival analysis to describe the change of global status when changing Stabilization Fee Ratio (SFR) or Liquidation Mortgage Rate (LMR). This work assists us in adjusting SFR and LMR accurately. For example, it can estimate how much loan eliminating rate could increase with the rise of SFR.

Mortgage rate is closely related to the default rate. In a stablecoin system, the default can be deemed as the passive liquidation of mortgage assets. If the clearing mechanism handles default with shortest time response, it can reduce liquidation loss to the minimum. When extreme market risks occur or system has a large operational risk, enormous losses happen. For the relationship among mortgage rate, system losses and the probability of default, a conditional loss distribution approach (LDA) [3] is constantly adopted. It is also one of the most important tools to adjust the system minimum LMR.

The proportion of liquidated loans obeys a Gamma distribution as each loan has different risk feature. Complete loss distribution should include loss frequency distribution and loss severity distribution. In cryptocurrency market, loss amount (loss severity) presents a more obvious heavy-tailed distribution, thus it is reasonable to adopt combination distribution, such as lognormal-GPD.

B. External Risk Models

Volatility forecasting techniques are chosen to evaluate external market risks by establishing a systematic VaR calculating and backtesting [4] framework. As cryptocurrency market presents obvious fat tails and volatility clustering, VaR models need to be coordinated with complex distribution or higher-order stochastic simulation methods (such as CVaR, GARCH-family models, filtered historical simulation and Monte Carlo simulation [5]) in order to avoid underestimating the small-probability events. As we found, t distribution is more suitable for Bitcoin market. Finally, be not subject to model risks.

IV. Evaluation

We compared three kinds of VaR calculation: historical VaR, parametric VaR and Monte Carlo VaR (TABLE I).

TABLE I
100 Days 95% VaR Prediction Values

Historical VaR	Parametric VaR		MonteCarlo VaR	
	w/ ES	*w/o ES*	*w/ ES*	*w/o ES*
-0.07500812	-0.9295108	-0.7413511	-0.745923	-0.7467911

The VaR value -0.9295108 means we have 95% confidence that over the next 100 days BTC asset will not lose more than 92%. By contrast, historical VaR responds to risks dully, while Monte Carlo VaR has better do a large number of calculations to cover more paths. For the longer-term VaR prediction, we tend to Monte Carlo Simulation with larger data set and calculation.

V. Conclusion

We set up a systematic risk management system MovER for stablecoin field, providing all-round financial parameters guidance at all times. Evaluation shows classic risk management tools can also play an efficient effect on cryptocurrency market. In our view, professional risk management should be widely adopted by DeFi industry as soon as possible.

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