Interest Rate Rules in Decentralized Finance: Evidence from Compound

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Abstract

We study the fundamentals of interest rate rules on the decentralized finance protocol Compound. Interest rates are set by the governance of the protocol, and are based on the utilization of an asset: which is the ratio of a cryptocurrency that is borrowed to its total supply in the protocol. We discuss factors that determine the slope parameters of interest rate rules. Slope parameters are typically higher for more volatile cryptocurrencies. We argue liquidation risk can explain the cross-sectional variation in interest rate rules. We also draw parallels between these rules to the demand for loanable funds in traditional money markets.

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1 Introduction and Motivation

DeFi is a blockchain based form of finance that runs on smart contracts and does not need a centralized financial intermediary, such as a market maker or a bank. Lending platforms running on the Ethereum blockchain, such as Compound, set interest rates and allocate funds automatically through algorithms. They allow users to deposit multiple collateral types, for example ETH and Wrapped Bitcoin (WBTC), and borrow multiple currencies, such as stablecoins like DAI and USDC. Benefits include the instantaneous settlement of contracts, and minimizing counterparty risk for lenders, so reducing the likelihood that any party involved will default. This is done through a system of smart contracts where borrowers are required to post sufficient collateral.

A unique feature of decentralized lending protocols is that interest rates are determined algorithmically by the utilization in the market, which is calculated as the ratio of total borrowing to total supply. This is in contrast to traditional money markets where the interest rate is typically set exogenously by monetary policy. In this paper we will discuss interest rate rules on the Compound protocol. We will show that parameters governing the rule, such as the sensitvity of interest rates to utilization, are typically higher for more volatile cryptocurrencies. We also draw parallels between these interest rate models and models of demand for loanable funds in traditional money markets.

Empirical work on lending protocols has focused on understanding market efficiency, such as uncovered interest rate parity, the behavior of liquidations during risk-off events, the dynamics of the COMP governance token, and theoretical work on the stability of interest rate rules [4, 8, 11, 3, 6, 1, 9, 14, 7, 2, 13, 10]. Within this literature, our paper shows that interest rate rules differ between risky cryptocurrencies and stablecoins.

In section 2 we outline interest rate rules on Compound. Section 3 discusses sources of risk that explain the interest rate rule parameters, and compares the algorithmic setting of interest rates to traditional money markets. Section 4 concludes.

2 Interest rate rules

Collateralized lending markets like Compound allow users to borrow and lend in multiple currencies by tapping into liquidity pools of multiple assets. Users supply a collateral asset, and can borrow a fraction as tokens in another asset that is based on the collateral factor of a given asset. Each market has separate interest rate curves on borrowing and lending that is based on the relative utilization (ratio of borrowing to lending) of that asset. The supply and borrow interest rates are compounded every block. [1]

One key feature of governance is to vote on interest rate rules.[2] Parameters like the base-rate and slope of the interest rate model are chosen by voters as part of the governance protocol. The interest rate model for borrowing rates is given by the piece-wise equation (1).[3] a_0 is the base rate, and is the rate corresponding to zero utilization. The slope parameter $b_0 > 0$ measures the sensitivity of interest rates to utilization. The utilization rate u is used as an input parameter to a formula that determines the interest rates. Interest rates are determined by the utilization percentage in the market. Utilization is calculated as the ratio of total borrowings to total supply of the asset. All else equal, a positive slope parameter implies higher utilization leads to higher interest rates. An additional feature of the interest rate model is the kink, in which the slope parameter changes for utilization above a threshold rate $\bar{u}$, typically 80 per cent. The kink makes interest rates more sensitive to a higher utilization rate, $b_1 > b_0$.

$$i_L = \begin{cases} a_0 + b_0 u, u \leq \bar{u} \\ a_0 + b_0 \bar{u} + b_1 (u - \bar{u}), u > \bar{u} \end{cases} \tag{1}$$

Deposit rates i_D is a function of utilization and borrowing rates. θ captures the fraction of interest income that is in a reserve buffer managed by the interest rate protocol.

$$i_D = u i_L (1 - \theta) \tag{2}$$

In Panel A of Figure 1, we plot the utilization percentage of the 6 principal cryptocurrencies offered in the Compound protocol. The sample period is from August 5th 2020 to October 22nd, 2022. Utilization rates of stablecoins (USDC, Tether and DAI) are systematically higher than risky cryptocurrencies (ETH, ZRX and WBTC). In Panel B, we plot the interest rate model for currencies on the Compound platform. Interest rate rules for more volatile cryptocurrencies typically have a higher slope parameter. Figure 2 estimates the slope parameters for each currency. Stablecoins have an average slope parameter of approximately 0.07 to 0.10. In contrast, risky cryptocurrencies like WBTC and ZRX have an average slope

[1] Blocks are measured approximately 15 seconds on Ethereum therefore producing approximately continuous compounding.

[2] Governance token COMP used to vote on interest rate rule parameters. To create a proposal a user requires at least 100,000 COMP tokens. A user with 100 COMP can initiate a proposal but require community to support through delegating tokens. All proposals are first discussed publicly in an official governance forum, are written in smart contracts.

[3] For a discussion of alternative interest rate models on other protocols like Aave, we refer readers to [4]. While the functional forms may vary, other protocols typically posit interest rates as a positive function of utilization.

parameter of approximately 0.3. Therefore a 1 per cent increase in utilization raises interest rates of stablecoins by 7 to 10 basis points, and risky cryptocurrencies by 30 basis points, all else equal. We now turn to factors that determine the cross-sectional variation in interest rate rule parameters.

3 Discussion

Interest rate rules for more risky assets typically have higher slope parameters. Parameters like the slope of the interest rate model are chosen by voters as part of the governance protocol. While higher utilization rates will increase net interest income to the protocol, it will also increase systemic risks in the protocol, such as liquidations, which are when individuals become over-leveraged and borrow too much relative to the collateral they post on the protocol. Liquidation risk has systemic effects in the pricing of collateral assets [6, 3, 13]. If liquidations trigger fire sales of collateral, and the protocol does not have sufficient net interest income, the protocol will mint governance tokens (COMP) to repay the debt. This will result in a devaluation of the governance token and incur losses for users of the protocol.[4]

Second, the interest rate schedule in equation (1) shows that slope parameters are higher after a threshold rate of utilization. This feature has parallels to models for excess reserves in traditional money markets. In [12], the authors find that in money markets the interest rate schedule becomes steeper when excess reserves are smaller, and model excess reserve balances with a logistic function. When utilization is high, excess reserves of the protocol, which we define as the difference between the collateral supplied and the amount that is borrowed, diminishes. Therefore, the non-linear kink in the Compound interest rate model helps preserve excess reserves in the protocol.

4 Conclusion

DeFi lending platforms like Compound, running on Ethereum, allow users to deposit various types of collateral and borrow multiple currencies. Smart contracts help minimize counterparty risks, and interest rates are determined algorithmically by market utilization. The parameters of the interest rate rule, such as the slope parameter, are typically higher for more volatile cryptocurrencies. Differences in interest rate rules are due to the role of liquidation risk. The interest rate model parallels traditional money markets' demand for loanable funds.

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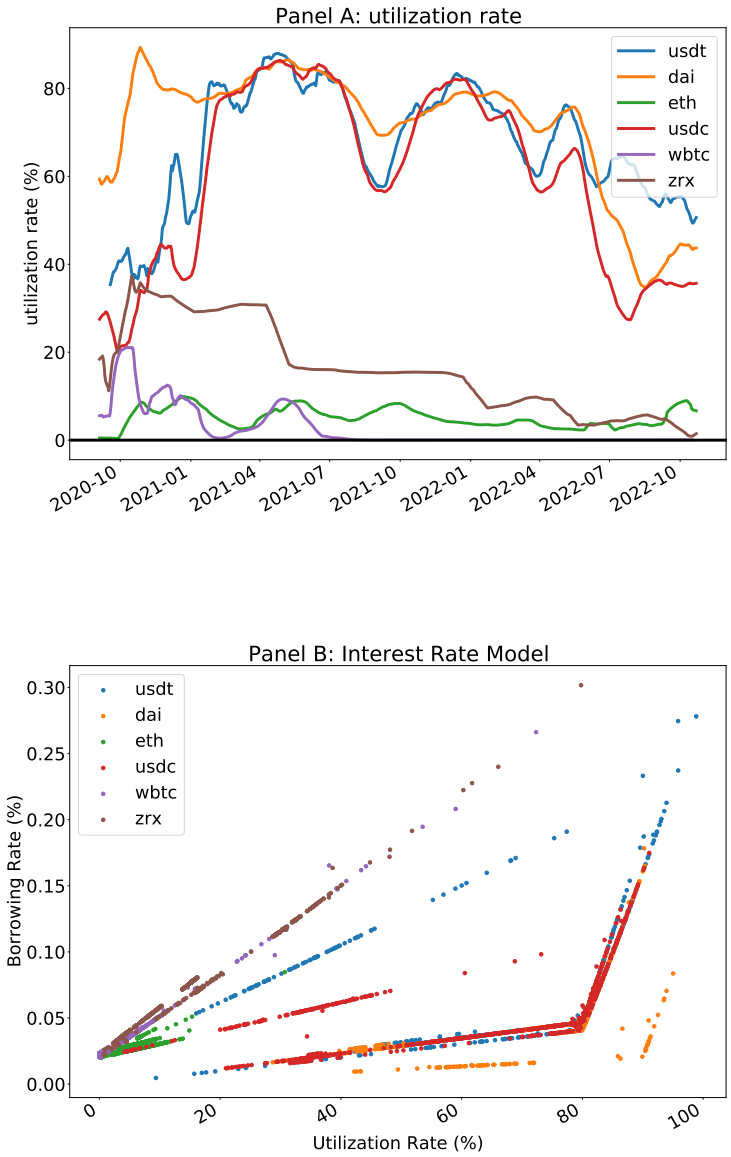
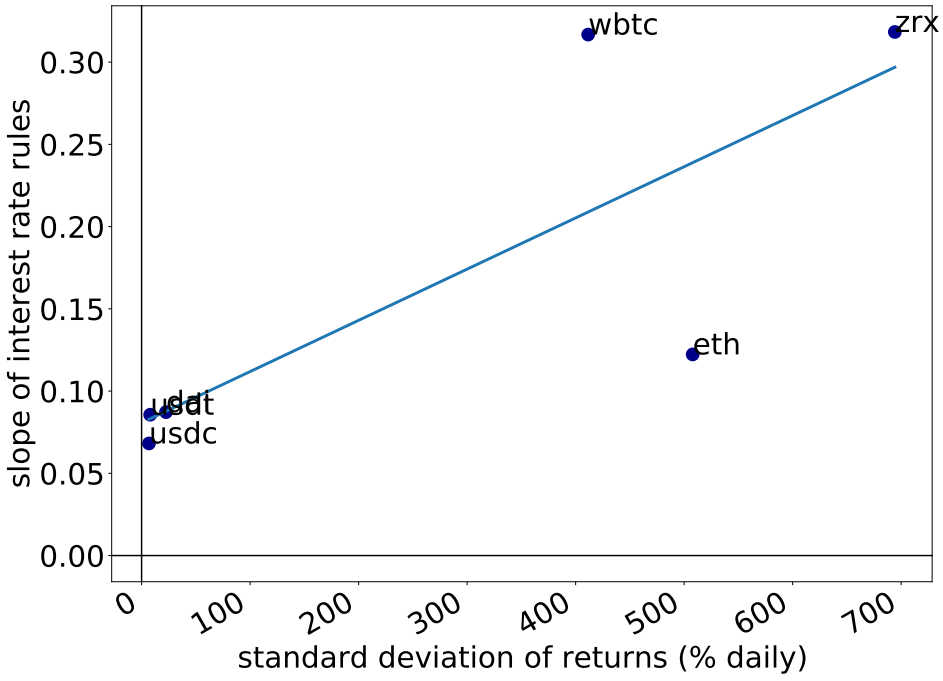
A Appendix



Note: Figure top panel presents utilization rates (in percentage points) on multiple assets, calculated as a historical rolling average over the last 30 days. Bottom panel plots interest rate models on multiple assets, in which borrowing rates are determined as a function of the utilization rate, Source: Compound API. Sample period is from August 5th, 2020 to October 22nd, 2022.

Figure 1 Utilization Rate and Interest Rate Rules.



Note: Figure plots slope of interest rate rules as a function of the standard deviation of daily returns. Source: Compound API and Cryptocompare. Sample period is from August 5th, 2020 to October 22nd, 2022.

Figure 2 Slope parameters of interest rate rules and cryptocurrency volatility.