Ormi: A permissionless decentralized credit protocol

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Abstract

Ormi is a decentralized permissionless credit protocol for issuing undercollateralized loans without requiring real world identities. Borrowers on Ormi will be able to take out crypto loans with undercollateralized positions based on the borrower's web3 native reputation without Know-Your-Customer (KYC) verifications. Ormi's identity and credit profile mechanism is based on W3C's decentralized identifier (DID) and verifiable credential (VC) standards and interoperable with other web3 protocols that adapt similar standards. Hence, an individual reputation from another protocol can be ported into Ormi to qualify for undercollateralized lending positions. To secure an undercollateralized loan, Ormi's default risk reduction mechanism performs Sybil-control onboarding, dynamic partial-collateralization with slashing penalty, and a publicized deny-list to incentives borrowers behave honestly. Ormi's debt restructuring mechanism employs a smart treasury that can inflate its governance tokens without devaluation to finance the defaulted debt deficit. Ormi employs kinked dynamic interest rate to incentives liquidity provision from lenders. Ormi's monetary policy is governed by a Decentralized Autonomous Organization (DAO), consisting of Ormi governance token holders, whose monetary policies have direct impact on inflation target, default risk toleration and interest rates of the protocol.

I. Introduction

Credit may arguably be the oldest form of money, predating written language itself. It is loosely defined simply as a promise to pay back at a future time. Credit money is created anytime when two parties enter into an agreement for future payment of present goods/services. Unlike coinage or fiat money, credit money does not always require state or central government authorities' decrees. Credit money is de facto the most prevalent and decentralized form of money. Even in the most unbanked regions today, credit money exists in quotidian situation when a neighbor simply owes you a favor for a gift or help that you have bestowed in the past. In modern developed economic systems, credit is often systematized in the forms of commercial and sovereign debts/loans such as corporate and government bonds and consumer credits such as mortgage and credit cards. Most of these credit loans are essentially secured by the borrower's reputation and identity and may be enforced via physical force should borrowers default (i.e. court, military, violence). Assessments of an entity's credit worthiness are at best estimations with no method is completely default-proof, i.e. a loans issued on credit always contain default risk. Although credit/unsecured/undercollateralized loans are the norm in the physical world, in the blockchain decentralized finance (DeFi) world, to date there has been no widely adopted permissionless credit/undercollateralized lending solutions. Popular lending protocols such as Aave [1], Compound [2], and MakerDAO [3] requires overcollateralization (i.e. >100% collat-

eral to secure the loan, and often up to 150%) for a user to borrow a different type of assets or tokens. Existing undercollateralized lending protocols such as Maple [4] and Goldfinch [5] exclusively rely on real world identities, KYC verification or lending to institutions. In other words, they are not permissionless where anyone with a crypto wallet address may qualify for a credit or undercollateralized loan. The main reason that attempts at truly permissionless undercollateralized loans have fallen short is that DeFi generally lacks:

1. Identity and reputation.
2. Enforcement of reputation.
3. Debt restructuring mechanism.

Ormi fills this protocol and infrastructure gap in DeFi and web3 by creating a truly permissionless decentralized credit protocol where users will be able to borrow crypto assets without the need to overcollateralize, and without relying on real-world identities or legal contracts for managing default risks. The main innovations Ormi brings to the DeFi ecosystem is the novel mechanism of securing undercollateralized loans via default risk reduction and debt restructuring.

Table 1: *Lending Protocol Comparisons*

Protocol	Under-collateralized	Permission-less
Compound, Aave	F	**T**
Maple, Goldfinch	**T**	F
Ormi	**T**	**T**

II. Lending protocol overview

Every lending system consists of two components:

1. Mechanism for supplying/maintaining liquidity.
2. Mechanism for securing the loan.

Popular lending protocols such as Aave and Compound incentives liquidity provider to provide liquidity to an asset pool via dynamic interest rates based on that asset's supply and demand (i.e. if more people borrowing a certain asset (e.g. DAI) and the available DAI in the pool is near zero, the protocol increases the interest rate/yield to attract lenders to provide more DAI liquidity to the pool so more loans can be facilitated and a bank run on DAI pool will not occur). The initial version of Ormi adopts the same liquidity provision model. Note that whatever liquidity mechanisms for overcollateralized lending protocol can equally apply to any undercollateralized lending protocols, as the key difference between over/under-collateralized lending is the mechanism for securing the loan. Due to the pseudonymous nature of crypto addresses and open access nature of DeFi lending protocols, loans that are overcollateralized have been the only practical methods to deal with borrower default (i.e. borrower who defaults loses the same or more value than the collateral). For a loan that is undercollateralized, a borrower who defaults generally gains more value than the collateral. The main challenges that face securing an undercollateralized loan is the incentive to discourage borrower from defaulting in the first place and a system to recover the default amount. In short, securing an undercollateralized loans contains two mechanisms: default risk reduction and debt restructuring. Ormi Protocol's key innovation is this novel mechanism for reducing default risk combined with a guarantee to restructure the debt should a borrower defaults on the undercollateralized loan, thus enabling a more capital efficient frontier for DeFi.

III. Mechanism for liquidity provision and interest rate strategy

The initial version of Ormi adopts the same kinked interest rate mechanism to incentives liquidity as Aave, as historical data has shown the robustness of such model against bank runs and illiquidity for protocols with relatively large amount of Total Value Locked (TVL) [6].

i. Variable Interest Rate Strategy

Ormi's variable interest rate strategy follows a kinked rates model as seen in Aave and Compound protocol. The interest rate rises sharply at some defined threshold as a function of utilization rate to incentivize more liquidity supply from lenders, as an effort to decrease utilization rate and increase reserve ratio (1).

Note that borrower default will also contribute negatively to the to the amount of available capital, which will in turn decrease reserve ratio and increases utilization rate.

$$R_v = \begin{cases} R_{v0} + \frac{U}{U_{optimal}} \cdot R_{slope1} & \text{if } U \leq U_{optimal} \\ R_{v0} + R_{slope1} + \frac{U - U_{optimal}}{1 - U_{optimal}} \cdot R_{slope2} & \text{if } U \geq U_{optimal} \end{cases} \tag{1}$$

ii. Stable Interest Rate Strategy

Ormi also supports stable interest rate strategy similar to that of Aave, where the borrower pays for a premium to lock in a stable rate adjustment until utilization rate is above $U_{optimal}$ at which point a stable rate rebalance occurs.

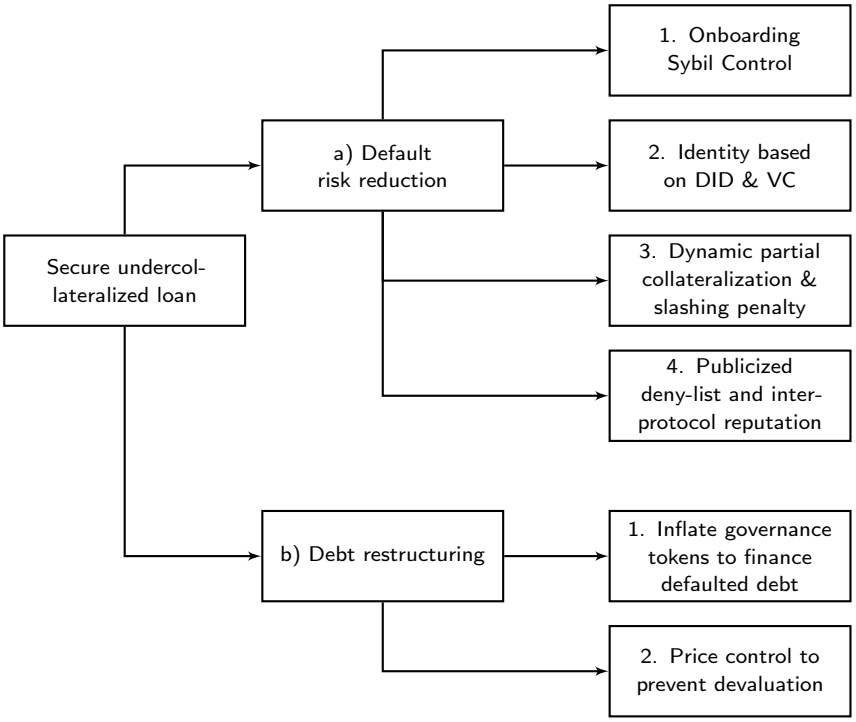
iii. Fixed Interest Rate Strategy

Ormi Protocol architecturally is compatible with fixed interest rate where a borrower or lender locks into a fixed interest/yield for a specific amount of time. The exact implementation of fixed rate yield/interest rate is beyond the scope of this paper and the initial version of Ormi Protocol.

IV. Mechanism for securing undercollateralized loan

The two key components for securing an undercollateralized loan is done via a combination of default risk reduction (Sybil-control onboarding, on-chain reputation system, and partial collateralization/slashing penalty) and debt restructuring system (inflation of governance tokens to finance default debt deficit and automatic price control to achieve inflation without devaluation) (Fig 1). Default risk reduction mechanism is to vet every borrower to be credit worthy relying only on web3 native reputation and credentials without KYC or connections to real world identities, thus removing censorship and regional access restrictions, and making undercollateralized DeFi loans truly permissionless and openly accessible. As with any traditional finance unsecured loans, even the best attempt at identifying credit-worthy individuals never eliminates default risk. To handle defaulted debt, Ormi's debt restructuring mechanism essentially covers the deficit with its treasury and inflation of its governance token while deny-listing, slashing, and penalizes defaulted individual. In the Section VI, more discussion will be devoted to the feasibility and sustainability of such debt restructuring mechanism.

Figure 1: *Mechanism for securing undercollateralized loan*



V. Default Risk Reduction

The first part of securing an undercollateralized loan is to use web3 native reputation to incentivizes users to behave honestly. At the time of writing, there has been neither interoperable way to recognize a reputable wallet address nor for protocols to attest the reputation of an address, and little experimentation has been done on a pseudo-anonymous individual's behavior when endowed with an undercollateralized loan or credit. Hence extra precaution must be taken when allowing a pseudo-anonymous individual access to credit. The problem becomes even more difficult as individual wallet address can be easily created to represent new identities to attempt fraud a credit/undercollateralized lending protocol. To secure an undercollateralized loan in such adversary environment, default risk can never be eliminated it can only be reduced. Ormi's default risk reduction system contains the following four components to achieve reasonable default risk reduction:

1. Sybil control for onboarding
2. Reputation system built on decentralized identifier and verifiable credentials
3. Dynamic partial collateralization and slashing
4. Publicized deny list

i. Onboarding Sybil Control

The essence of onboarding Sybil control is to request every borrower to provide some Proof of Hard-to-Forge-Resource. There are numerous options to achieve this Sybil control: this could be an address with more than half a year of active on-chain history; an address with total cumulative gas fee above a certain pre-defined threshold; a social graph of an address' relation to other trustworthy accounts; or even

web2 social media verification. The list goes on. The main goal of a borrower providing these Proof of Hard-to-Forge-Resource as an onboarding check is simply to eliminate spam or Sybil accounts. From an undercollateralized lending protocol's perspective, a rogue user may try to defraud the protocol once or twice by defaulting, but the user would not be able to replicate this attack path repeatedly, because the time and financial cost of coming up with these Proof of Hard-to-Forge-Resource is greater than the portion of the undercollateralized loan that is unsecured. This Anti-Sybil onboarding in combined with partial collateralization, slashing penalty, and dynamic collateral ratio (which will be expanded in section iii) form fairly robust incentive for borrowers to behave honestly.

It should be noted that various existing projects have embarked on deploying more formal machine learning models to analysis on-chain activities (i.e. participation in existing DeFi protocols or DAO governance) to result in a credit score. The effectiveness or usefulness of such on-chain credit score has yet to prove itself, because past on-chain behavior does not necessarily correlate to how an account will behave given an unsecured loan.

Another potential approach to Sybil control onboarding is to accept a credential, from protocols such as Play-to-Earn games or web3 native learning protocols such as RabbitHole [7], as users of such protocol have spent significant amount of time building up their reputation and profile. Should these protocols vet and sign to attest an account's legitimacy, whether in the form of a verifiable credential or Non-Fungible Tokens (NFT), Ormi protocol is willing to consider issuing undercollateralized loans to these accounts. This is akin to certificates and credential documents (e.g. driver's license, credit report) in the physical world. These inter-protocol credentials should form the basis of interoperable cross-protocol web3 reputation at a future time.

In the initial version of Ormi, anti-Sybil onboarding mechanism will be a proof of half a year of active address in combination with cumulative gas fee spent for a particular address. Ormi protocol will also be compatible with other Sybil control credential providers such as credit scoring analysis protocols or inter-protocol verifiable credentials.

ii. Decentralized Identifier and Verifiable Credential

Decentralized identifier (DID) [8] and verifiable credential (VC) [9] technologies form the basis of Ormi's identity and reputation systems used for default risk reduction. Decentralized identifier is a new type of identifier that enables verifiable and decentralized digital identity. Ormi supports various DID methods that comply with the W3C DID standards. A DID is used as an identifier for the Ormi reputation system rather than simple wallet address is because a DID can serve as a more expressive identifier where additional metadata such as cryptographic material, verification methods, and service endpoints are attached to its associated DID Document.

Verifiable credentials is a standardized and generalized digital credential that are universally verifiable across the digital world that is cryptographically secure, privacy preserving and machine verifiable. Additionally, zero-knowledge proof (e.g. zk-SNARK) can be added to VCs to further enhance privacy and safety by preventing linkability and data exposure. Verifiable credential by design is tightly coupled with DIDs, and Ormi rely on such verifiable credentials on as the basis for credit history/reputation. Additionally, the reputation or loan activity issued as a verifiable credential can be packaged in the format of an NFT abiding by ERC-721 [10] or ERC-998 [11], ERC-1155 [12] standards.

iii. Dynamic Partial Collateralization and Slashing Penalty

Due to the pseudonymous nature of wallet addresses and the lack of reputation infrastructure across protocols, zero-collateral loan theoretically encourages malicious defaulting behaviors. In the initial version of Ormi, partial collateralization is required to further disincentives borrower from maliciously defaulting], in other words, all borrowers are required to have some âskin in the gameâ. All borrowers regardless of existing on-chain reputation starts with overcollateralization (i.e. 110%), only upon repayment or maintaining such position without liquidation for a pre-determined amount of time can this borrower then qualify for undercollateralized lending positions. The collateral ratio decreases linearly given each reputation milestone met (e.g. maintaining existing borrowing position for a period of time without liquidation). The collateral ratio exponentially increases should the existing borrowing position is not maintained (e.g. liquidation/non-repayment after loan duration) accompanied by slashing/liquidation of collateral. These dynamic collateral ratios combined with partial collateralization should be sufficient to incentives borrower to behave honestly, although it does not eliminate default risk.

iv. Deny-listing and Inter-protocol Reputation

In lieu of default risk reduction mechanism above, should a borrower maliciously default and never repays the debt, Ormi protocol then denies associated borrower's addresses for any loans unless that borrower redeems itself by paying back the defaulted debt plus cumulative interests to date. The malicious borrower's associated DID and wallet addresses are added to a deny-list and published openly. At present, a published deny-list is the best way of informing other protocols of rogue accounts. This approach of course is not enforceable and relies on other protocol's good will to block rogue addresses. As on-chain reputation and identities evolve more in web3 in the coming years, we can see more effective way to enforce the deny-list of malicious addresses/DIDs.

v. Default Risk Reduction Summary

With the above four mechanisms: 1. Anti-Sybil onboarding 2. Reputation built on DID and VC 3. Dynamic partial collateralization and slashing. 4. Publicized deny list. Ormi protocol should achieve reliable default risk reduction and anti-Sybil defense in a pseudo-anonymous, permissionless web3 environment. The exact default loan this mechanism will prevent can only be found out via experimentation in real environment. Ormi protocol aims achieve to 10%-30% default rate based on the above four mechanisms. The following section will discuss more in detail how debt restructuring works given that borrowers default.

VI. Debt Restructuring

Throughout human history, outstanding debt that cannot be repaid often is restructured or in many cases simply wiped. This can be found in ancient examples such as Babylonians periodically cancelling all debts and Mosaic Law's year of Jubilee. Modern day examples include Greece's sovereign default in 2015, where EU bailout programs had to be enacted and debt repayment terms were modified. The way to restructure debt is numerous from re-negotiating payment schedule to simply forgive the debt.

In many situations when the debt is not restructured or forgiven, the debtor often faces physical consequence such as court, prison, debt peonage (ancient time), and in the case of sovereign defaults, military invasion (although rarely happens in modern times).

Lender entities in the physical world can often resort to both methodologies (debt restructuring or physical consequence) to handle borrower default, but in pseudo-anonymous

web3 environment, due to the lack of web3 native reputation infrastructure, the only tangible way to deal with default debt is via debt restructuring. However, as reputations become more enforceable across web3 protocols or the development of web3 court system is invented. Ormi protocol can leverage such systems to enable even lower collateral ratio as default risk is further reduced.

i. Inflation of Governance Tokens to Finance Debt

The main mechanism for debt restructuring is for protocol to cover the default deficit via minting additional governance token to be sold to cover the default amount without devaluating the governance token price. The target inflation rate is from 2%-10% annually as existing DeFi protocols with inflationary tokenomics, Compound at 4% a year and Curve at 10% a year, Ampleforth can be up to 9% a day has shown that controlled inflation does not necessarily devaluate token price. We can call the total amount of protocol inflated token will be used to finance the default deficit called default deficit pool. The total amount of undercollateralized positions is always less than the total default deficit pool. Inevitably, some borrowers on Ormi will not be able to take out a loan with undercollateralized position if all the amount of default deficit pool is outstanding or used up.

ii. Inflation Without Devaluation and Price Control

The four mechanisms for inflation value control are the following:

1. Loan interest repayment in governance token
2. Staking to reduce governance token circulation supply
3. Protocol owned liquidity/value
4. Balancer Smart Pool to perform automatic buy-back

ii.1 Repayment of Loan Interest in Governance Token

The repayment of interests on the loan will be made in governance token to create a natural demand and market for Ormi governance token. This is akin in Modern Monetary Theory âtax drives moneyâ, a sovereign government issues fiat and demands tax to be paid in such fiat to generate market and demand, hence value for fiat. This also follows the model pioneered by MakerDAO of repaying stability fee of CDP with Maker's governance token, MKR.

ii.2 Staking to Reduce Governance Token Circulation Supply

Ormi's governance token staking and lockup mechanism is to reduce the circulating supply of governance token to maintain its valuation. Staked Ormi governance token receives 20% of all loan interests, hence qualifying for protocol's cash flow. Staking periods varies from days to 2 years with longer duration yielding longer yield.

ii.3 Protocol Owned Liquidity Value

Ormi implements protocol owned liquidity/value as pioneered by OlympusDAO. The purpose of protocol owned liquidity is to give a hard floor price to Ormi's governance tokens. Via Ormi's bonding program, bonders purchase Ormi at discounted price with qualified assets (i.e. ETH, DAI). This effectively introduces multiple assets to Ormi's treasury, and Ormi protocol acts as a buyer of last resort, to enable circulating Ormi token market cap never falls below to that of treasury, hence giving certain hard backing to Ormi governance tokens. During periods when Ormi token is traded at a premium far above treasury back, Ormi may actively buys more assets with gov-

ernance token to increase treasury diversity and assets.

ii.4 Balancer Smart Pool Automatic Buy-back

A Balancer Smart Pool AMM forms the backbone of Ormi's smart treasury and regulates Ormi governance token's issuance and buy-back rate by the protocol. As Ormi's treasury asset increases via bonding, Ormi's Balancer Smart Pool automatically performs buy-back to rebalance treasury, hence creating more demand and driving up value for governance token. [place holder link.]

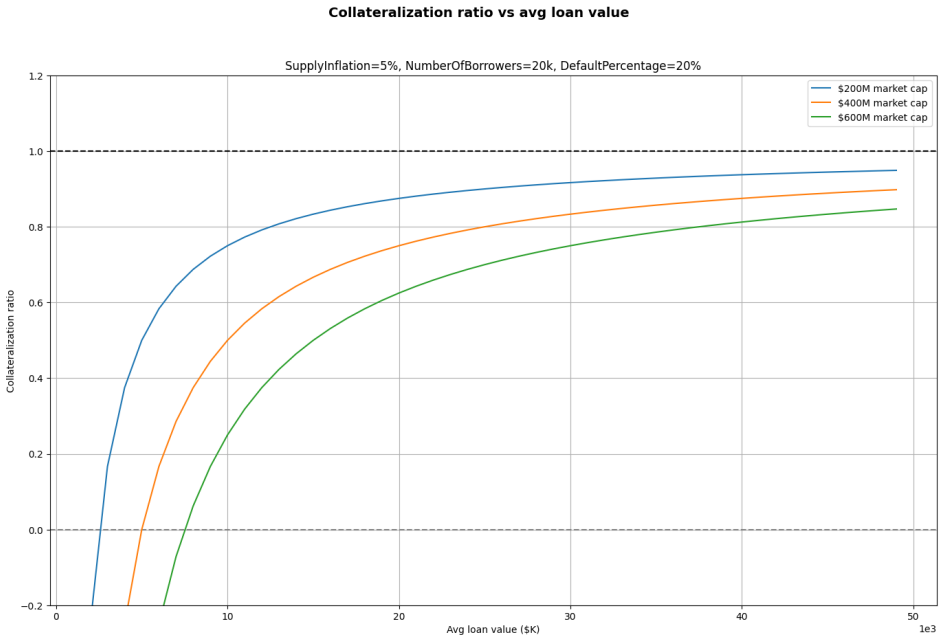
iii. Inflation Calculation

Given above token valuation control mechanism, the protocol should be able to achieve certain threshold of inflation without devaluation to finance debt deficit. Below goes into more detail to demonstrate the amount of debt can be financed via inflation.

$$AvgDebtRestructureAmnt = \frac{CirculatingTokenMarketCap \cdot InflationPercent}{NumberOfBorrowers \cdot DefaultPercent} \tag{2}$$

$$MinAvgCollateralRatio = \frac{AvgLoanAmnt - AvgDebtRestructureAmnt}{AvgLoanAmnt} \tag{3}$$

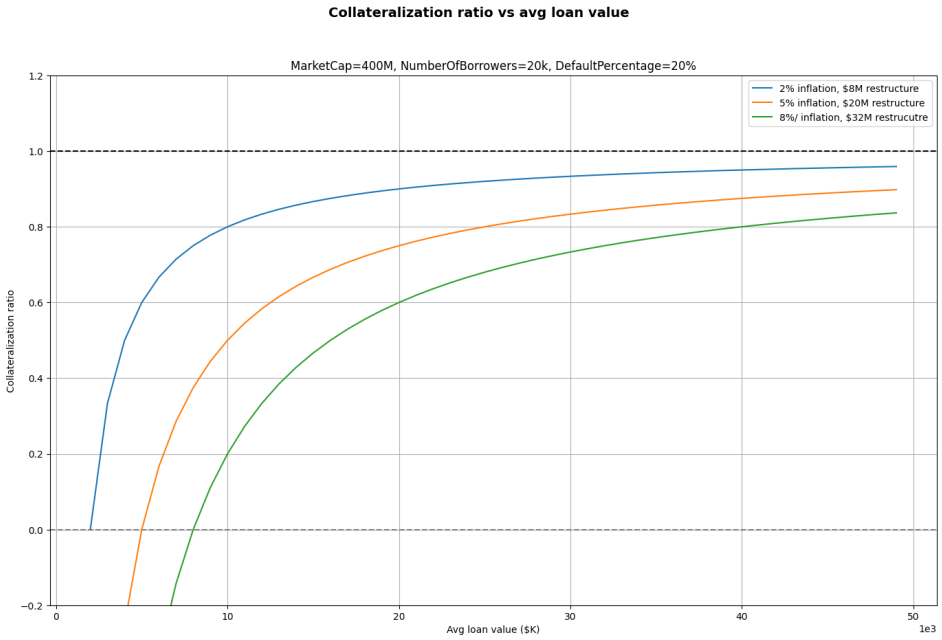
The first equation above gives a link between inflation rate to average amount of debt can be restructured if assuming every borrower takes the same amount of debt. In this case debt means the portion of the loan that is not backed up by collateral. The second equation gives the average collateral ratio needed for the borrower, assuming that borrowers have the uniform amount of loan, hence uniform collateral ratio. Given the above two equations we can model a simplified model of collateralization ratio vs average loan value the variable being the inflation percentage and market cap, assuming each borrower take on equal amount of loan and the collateral ratio is identical for all borrowers.



(4)

Figure 1 holds constant inflation percentage at 5%, number of borrowers at 20,000 and assuming 20% of borrowers will default. On the X-axis is the average loan amount, for a $200M circulating market cap, with each borrower with $10,000 loan the minimum required collateral ratio is about 78% to avoid liquidation, and with higher circulating market cap at $400M with same parameter borrower can afford up to almost 50% collateralization ratio!

Figure 2 holds circulating market cap at $400M, number of borrowers to be 20,000 and default percentage to be 20%. By adjusting inflation rate from 2% to 8%, for an average loan amount of $10k, we can have minimum collateralization ratio roughly from 80% (2% inflation) to 20% (8% inflation). If we apply the above model to the existing circulating market cap of Aave (at $2Billion), we would effectively get average 80% collateral ratio on average for Aave borrowers given a 20% default rate and 10% token inflation, which Aave already has (token emission rate 550 per day, which comes down to 10% per year).



(5)

This model above shows significant improvement to 100% collateral ratio to avoid liquidation threshold hence enabling greater capital efficiency in the DeFi frontier.

iv. Further Discussion on Inflation

The above inflation tokenomics made various assumptions about holding variables such as number of borrowers or loan amount constant. In reality, the number of loan size per borrowers will vary, hence the protocol can allow lower collateral ratio for user with smaller loan size (average retail borrowers) to enhance borrower experience. In other words, it is more beneficial for the protocol to allow more borrowers with smaller loan size than fewer borrowers with large loan size.

v. Market Volatility

During bear market or strong volatility, when the above inflation mechanism cannot be properly used to finance debt deficit, the inflation target percentage will be lowered, hence fewer number of loans will be qualified for undercollateralized positions. This is similar to traditional finance, when the market and economy is in turmoil or contracting, asset prices falling, credit becomes rare (higher collateralization ratio) and expensive (higher interest rate). On the opposite, when the economy is booming, asset prices are increasing, credit becomes abundant (lower collateralization ratio) and cheap (lower interest rate). In summary, Ormi protocol can always resort back to overcollateralization should protocol can no longer finance undercollateralized lending position.

vi. Insurance and Risk Tranches

An additional mechanism for debt restructuring Ormi can employ is insurance or credit default swap contracts whether via a third-party or implemented natively. Similarly, in the future versions of the protocol, multiple credit tranches may be created where the most risky tranche will have the highest interest rate with no debt restructuring coverage from the protocol and the least risky tranche will have lower interest rate with loans have higher collateral ratios and default risk is covered by protocol's debt restructuring mechanism.

VII. Ormi DAO and Governance

Following the launch of the mainnet, Ormi will uphold its commitment to decentralization through fine tuning of various parameters such as inflation rate and loan duration to allow more undercollateralization while reducing default risk and maintaining safety and introduce additional features to further evolve Ormi system and the DeFi ecosystem. Governance will be on-chain with rights represented by holders of Ormi governance tokens.

VIII. Conclusion

Ormi protocol heralds in a new chapter of DeFi's efficient frontier by offering credit/undercollateralized loans in a permissionless web3 native way without relying on real world identities or KYC. Ormi's key innovation is its default risk reduction and debt restructuring mechanism enables securing undercollateralized loans in the pseudo-anonymous web3 environment a reality, hence unlocking a new frontier for decentralized finance, social and identity infrastructures. Ormi protocol is designed to be flexible and extensible where further web3 social or credit score protocols can be easily integrated to reduce default risk and improve Ormi protocol's capital efficiency. Ormi's liquidity layer is fully compatible and integrable with existing DeFi protocols. Ormi will uphold its commitment to decentralization following the launch of the mainnet. Credit is the most ancient form of money; and Ormi protocol endeavors to bring credit natively to web3.

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