Accrue Finance - InvEngine

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Abstract **–** Accrue Finance is a decentralized lending protocol. This whitepaper explores the unique architecture of Accrue Finance, highlighting its features and accessibility. Furthermore, it addresses challenges such as reentrancy risks and liquidity, details about the implementation of dynamic interest rate models that adjust to market conditions. This document details the technical structure of the InvEngine - the name given to the smart contract - as well as the strategies for future integration into the DeFi ecosystem.

1. INTRODUCTION

In the contemporary financial landscape, innovation and disruption are driven by the continuous development of technologies. At the heart of this progress, Accrue Finance emerges as a decentralized lending protocol, designed to redefine the lending experience in the DeFi (Decentralized Finance) space. This whitepaper presents a comprehensive overview of the inner workings of Accrue Finance, outlining its architecture, features, and the added value it brings to the DeFi ecosystem.

The protocol is designed to provide a secure, transparent, and accessible platform for users worldwide, enabling them to participate in lending and borrowing activities efficiently and confidently.

The fundamental basis for the complete operation of Accrue Finance is rooted in its smart contract framework, detailed in this document, which ensures the faithful execution of lending and borrowing operations, while offering protection against common risks such as insufficient liquidity. This whitepaper details each component of the protocol, including asset management, interest rate models, reward and liquidation mechanisms, and risk mitigation strategies, providing a complete view of the internal

workings that Accrue Finance brings to the DeFi market.

As we move forward to the subsequent chapters, we will explore the depth and complexity of the InvEngine, as we have named the smart contract responsible for the protocol's operation, including its technical architecture, decentralized governance, integration strategies with other DeFi protocols, and our roadmap for the future. We are confident that Accrue Finance will not only meet the current expectations of the DeFi market but also pave the way for new possibilities and innovations in the field of decentralized finance.

2. Supplying Assets

The core of Accrue Finance revolves around the asset supply procedure, a vital component that allows users to deposit crypto assets as collateral to participate in lending and borrowing activities. This process is fundamental to the functionality of the protocol, creating a decentralized financial ecosystem where users can earn interest on their deposited assets while contributing to the overall liquidity of the system. It's worth noting that only pre-configured tokens can be deposited and act as collateral. Any attempt to deposit unlisted tokens will be promptly refused by the contract.

2.1 How the Supply Process Works

When a user supplies assets to Accrue Finance, their deposit is automatically converted into collateral for the user within the protocol, and in exchange, the user receives invTokens, representing their share in the liquidity pool. The invTokens are crucial for the reward mechanism, as they allow users to receive the accumulated interest from the protocol. The asset supply process is designed to be straightforward, secure, and efficient.

2.1.1 Asset Deposit: Users deposit tokens into Accrue Finance, which are then locked in the protocol's smart contract. This initial deposit is essential for establishing the user's position in the system.

2.1.2 Conversion into Wrapped Tokens (invTokens): Once deposited, the assets are automatically converted into corresponding invTokens. This conversion is based on the ratio of the deposited value to the total value in the liquidity pool.

If it is the first supply, then this is how the amount of invTokens to be minted is calculated:

$$inv_{mint} = a - min_{liquidity}$$

On the other hand, if the deposit is not the first supply of the token in the protocol, then this is the formula used to calculate the amount of tokens to be minted.

$$inv_{mint} = \frac{(a * inv_{ts})}{t_{dp}}$$

2.1.3 Interest Earning: With the assets now in the liquidity pool, users begin to accumulate interest based on market rates and the proportion of their assets in the pool. These interests are adjustable and reflect the dynamic conditions of the market.

The supply of assets in Accrue Finance not only benefits individual users with the potential for earning interest but also reinforces the health and stability of the ecosystem as a whole. By increasing the available liquidity, it allows for a higher volume of lending and creates a more stable and reliable environment for decentralized financial operations.

3. Borrowing Assets

The asset borrowing process is a crucial facet of the protocol, providing users with the ability to take out loans against their deposited collateral. This functionality is essential for increasing financial flexibility and offering leverage opportunities within the DeFi ecosystem, while maintaining a secure and reliable framework.

3.1 Asset Borrowing Mechanics

The borrowing process is designed to be intuitive, efficient, and secure, enabling users to quickly access funds based on their collateral:

3.1.1 Collateral Evaluation: Before a user can borrow, their deposited collateral is appraised. This assessment determines the maximum value the user can borrow, ensuring that the loan remains within safe limits. This will be determined by calculating the average of all the lending factors of the tokens that the user is utilizing as collateral.

3.1.2 Asset Selection for Borrowing: Users choose the asset they wish to borrow from the available liquidity pool. The variety of offered assets depends on the composition of the liquidity pool at the time of borrowing. Assets that can be deposited as collateral and eventually borrowed will be initially defined by the Accrue Core Team and later the decision to list new tokens will be handed over to the community through governance.

3.1.3 Interest Rates and Terms: Loans are accompanied by interest rates, which vary according to the asset and market conditions. These rates are transparent and updated in

real time, ensuring that users are always aware of the associated costs.

3.1.4 Loan Agreement: When the user makes a borrow, the assets are transferred to the user's wallet, who then commits to repaying the principal amount plus the accumulated interest.

3.1.5 Risk Management: The InvEngine implements risk management mechanisms, such as the requirement of a minimum health factor and the possibility of liquidation, to protect both borrowers and asset providers.

4. Risk Management

Effective risk management and the implementation of a robust liquidation mechanism are critical to maintaining the integrity and stability of the protocol. The protocol has been meticulously designed to address situations where a user's loan value exceeds their collateral threshold. In such circumstances, Accrue Finance facilitates the partial or total liquidation of the outstanding loan in exchange for the user's collateral, at a market price adjusted by a liquidation discount. This mechanism motivates a network of arbitrageurs to act promptly, reducing the borrower's exposure and decreasing the risks to the protocol.

This approach to liquidation and risk management contributes significantly to the stability of the DeFi ecosystem. By implementing a system that protects both borrowers and liquidity providers, it promotes a safer and more robust lending environment.

4.1 Risk Management (InvEngine)

4.1.1 Continuous Collateral Assessment: The InvEngine constantly monitors the value of collaterals to ensure they meet loan requirements. This includes the assessment of market factors and the volatility of assets.

4.1.2 Health Factors and Safety Margins: The protocol establishes 'health factors' that indicate the financial stability of a borrower. These factors help to prevent premature liquidation and ensure there are adequate safety margins.

$$total_{cv} = \sum_{i}^{n} \frac{(cv_i * lt_i)}{1^{18}}$$

$$health_{factor} = \frac{total_{cv} * 1e18}{total_{userBorrowUSD}}$$

Where:

$total_{cv}$: Total sum of collateral values in USD multiplied by their respective liquidation thresholds.

cv_i: Asset collateral value in USD.

lt_i: Liquidation threshold.

5. Repay debt

The repayment of loans is a critical step in the lending cycle that highlights the efficiency and security of the system. This process begins with the careful monitoring of debts by the users, which includes both the principal and the accrued interest. The platform facilitates the viewing of this information, allowing users to make informed decisions about when and how much to repay.

A distinctive feature of the repayment process is the flexibility offered to users. They have the freedom to choose between settling the total debt or making partial payments. This adaptability is essential as it aligns with the different financial capabilities of users, ensuring that repayment is not a burden but a manageable action within their economic conditions.

The calculation of interest in real-time is a critical aspect of the system. It ensures that users are always aware of the exact amount due, including compound interest calculated based on the duration of the loan. This system of constant interest updates is an example of the transparency and precision the protocol offers.

When it comes to the execution of repayment, the process is streamlined. Funds are transferred from the user to the protocol, immediately reducing the outstanding debt. The completion of repayment has a direct impact on the collateral. Once the loan is fully paid, the collateral is released and returns to the full control of the user.

Beyond user functionalities, the repayment of loans has significant implications for the overall health of the system. It not only protects the interests of liquidity providers, ensuring that their assets are returned, but also maintains the fluidity and stability of the liquidity pool.

5.1 Repay & fees

The interest payment mechanism in the InvEngine's repayment process is structured to prioritize the settlement of accrued interest before any principal amount of the loan is

reduced. This system is designed to maintain the financial health of the protocol and ensure fair treatment for both borrowers and liquidity providers.

When a user initiates a repayment, the system first checks the total amount of interest due accumulated on the loan. This value reflects the interest that has accrued since the inception of the loan or since the last payment. The structure of the interest payment works as follows:

5.1.1 Payments Less Than the Interest Due: If the repayment amount is less than the interest due, the payment is entirely allocated to cover the accrued interest. In this scenario, no amount of the payment is applied to the loan's principal. This means that while the user continues to pay off a portion of the interest, the principal amount of the loan remains unchanged.

5.1.2 Payments Covering the Interest and Part of the Principal: When the repayment amount exceeds the interest due, the excess is then applied to the loan's principal. This approach ensures that all accrued interest is paid first, and any remaining amount reduces the principal amount of the loan.

5.1.3 Debt and Interest Updates: After each repayment, the user's debt balance is updated to reflect any reduction in the principal amount, and the amount of interest due is recalculated based on the new remaining balance.

This interest prioritization system ensures that liquidity providers in the protocol are adequately compensated for the risks associated with providing funds for loans. Moreover, it provides a clear and predictable framework for borrowers, enabling them to understand how their payments are applied and to plan their repayments accordingly.

The interest prioritization approach also serves to protect the integrity of the liquidity pool. By ensuring that interest is paid first, the protocol maintains a steady flow of income to the pool, contributing to its stability and long-term reliability. This strategy is essential for maintaining a balance between the needs of borrowers and the expectations of liquidity providers, thereby ensuring the sustainability of the ecosystem.

6. Interest Rate Model

Accrue Finance introduces a model for determining interest rates, known as the

InvInterestRateModel. This model is a key piece in the lending market architecture of Accrue Finance, playing a crucial role in maintaining a dynamic balance between lenders and borrowers. Unlike other models that calculate rates per block, Accrue Finance's *InvInterestRateModel* calculates interest rates per second, reflecting market changes in real-time and offering a more granular and responsive approach.

The model uses a set of parameters to determine the interest rate. These include the annual base rate, multiplier, and jump multiplier. The inflection point is a critical element, acting as a threshold where the interest rate calculation adjusts to reflect different levels of market utilization. This mechanism ensures that interest rates are sensitive to current market conditions, increasing or decreasing according to the ratio between loans and available liquidity.

Another aspect of the model is the introduction of a smoothing factor. This approach helps to moderate abrupt variations in interest rates caused by market fluctuations, providing a more stable and predictable experience for users. The model also establishes maximum and minimum limits for interest rates, ensuring that they remain within an acceptable range and avoiding extremes that could destabilize the market.

The market utilization rate is another key component in setting interest rates. This rate is determined by the relationship between the total borrowed and the total available liquidity. Adjusting interest rates according to the utilization rate helps to maintain a balance between supply and demand, encouraging lending when there is abundant liquidity and discouraging it when liquidity is scarce.

For a detailed description of the formulas used in calculating the borrow rate in Accrue Finance's *InvInterestRateModel,* let's break down each step of the process.

6.1 Calculation of the Utilization Rate:

$$utilization = \frac{total_{borrow}}{total_{liquidity}}$$

In this formula:

- **totalBorrow** represents the total amount of assets currently borrowed from the market.
- **totalLiquidity** refers to the total amount of assets in the market.

This utilization rate is a key factor in determining the interest rates for borrowing within the Accrue Finance's

InvInterestRateModel, as it reflects the current demand for loans relative to the supply of available funds.

6.2 Determination of the Preliminary Rate

If the utilization rate (Utilization) is less than the inflection point:

$$preliminar_{rate} = baseRate_{perYer} + (\frac{utilization * multiplier_{perYer}}{1^{18}})$$

If the utilization rate is greater than the inflection point:

$$utilization_{excess} = utilization - inflection_{point}$$

So:

$$preliminar_{rate} = baseRate_{perYer} + (\frac{inflection_{point} * multiplier_{perYer} + utilization_{excess} * jump_{multiplierPerYer}}{1^{18}})$$

6.3 Adjustment of the Rate Within the Maximum and Minimum Limits

$$adjusted_{rate} = \max(\min(preliminary_{rate}, maxRate_{perYer}), minRate_{perYear})$$

This step ensures that the calculated rate does not exceed the predefined limits.

6.4 Smoothing of the Final Rate

$$final_{\boldsymbol{rate}} = (\frac{adjusted_{rate} * smoothing_{factor} + baseRate_{perYer} * (PRECISION - smoothing_{factor})}{1^{18}})$$

This formula calculates a weighted average between the adjusted rate and the annual base rate, using the smoothing factor.

These formulas together form the basis of the loan rate calculation in the Accrue Finance interest rate model, ensuring that the rate reflects current market conditions and is adjusted in a responsive and stable manner.

In this way, the calculation of interest rates is a continuous function that considers the balance between the supply and demand for funds. The rates are determined by the model described above. This rate is then divided by

the number of seconds in a year to determine the interest rate per second, reflecting the continuous and real-time nature of the loan market.

7. Supply Rate

The supply rate, is a key element in the loan ecosystem, acting as an indicator of profitability for those who deposit their assets. This concept is intrinsically linked to the dynamics of supply and demand in the loan market and is calculated in a way that continuously and accurately reflects current market conditions.

The supply rate is determined by the loan pool's utilization rate, which is the ratio between the total capital loaned and the total assets available for lending. When the demand for loans increases, the utilization rate rises, leading to an increase in the supply rate. This occurs because a larger volume of loaned assets generates more interest, allowing the platform to offer better returns to those who provide liquidity. Conversely, low demand for loans results in a lower supply rate, reflecting the smaller amount of interest generated by the loaned capital.

$$supply_{rate} = borrow_{interestRate} * utilization * (1 - reserve_{factor})$$

To calculate the supply rate, the platform first determines the annual interest rate. This rate is then divided by the number of seconds in a year, providing the interest rate per second. The supply rate is adjusted at this pace, reflecting real-time market fluctuation.

An important aspect of this calculation is the consideration of the reserve factor. A portion of the generated interest is set aside as a reserve, a safety measure to cover potential losses and ensure the system's stability. This means that the net supply rate is slightly lower than it would be if all the generated interest were distributed to liquidity providers. However, this practice ensures the system's long-term sustainability by balancing the need for attractive rewards with risk management.

8. Governance Structure

Initially, the Accrue Protocol will operate under a centralized management system, where key decisions, such as selecting the interest rate models for individual assets, will be centrally made. However, there is a planned progression towards a governance model fully controlled by the community and stakeholders. The current administrative capabilities include:

- The capacity to introduce new tokens into the protocol.
- The discretion to alter the interest rate models applicable to various markets.
- The responsibility to modify the oracle address.

This centralized governance model is designed to gradually cede all strategic decision-making authority to the holders of the ACCRUE tokens, marking a complete shift to community-based governance in the future.

The transition to a decentralized governance model is scheduled to take place within the first two months. This timeframe has been strategically chosen to ensure there is ample opportunity for a fair distribution of ACCRUE tokens, the governance tokens, in the market. This approach is designed to establish an equitable foundation for community involvement and stakeholder representation in the governance process, ensuring that a diverse and representative group of token holders can participate in the decision-making for the protocol's future.

On the other hand, until full decentralized governance is fully implemented, all initial decisions will be derived from a multi-signature wallet.

9. Summary

Accrue Finance is a decentralized lending protocol. The whitepaper details its architecture, features, and value proposition. It emphasizes secure asset supply, efficient borrowing, robust risk management, flexible debt repayment, and a dynamic interest rate model. The protocol calculates interest rates per second, reflecting real-time market changes. The supply rate is determined by the utilization rate of the loan pool, with a reserve factor for stability. Initially centralized, governance will transition to the community within two months, promoting equitable token distribution.

10. References

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