Lecture 6: Lending and Stablecoins

Guillermo Angeris

June 2022

Outline

Admin stuff and recap

Lending

Stablecoins

Outline

Next week

- Last two lectures will be done by:
- Tarun Chitra on staking and staking derivatives
- Theo Diamandis on optimal order routing
- Next lecture will be remote (!)

A quick announcement

Recap

- Previous lecture we talked about oracles
- At least one implementation (there are many)
- And also talked about MEV
- We will see how this comes into play in lending !

Outline

Types of lending

- Many types of lending
- In fact, loans are a very general type of object
- In this lecture we will deal with overcollateralized loans

Loan interface

- As usual, start with an interface

```
loan(amountA: uint, amountB: uint)

repay()

liquidate(priceTo: uint)
```

- `loan` and `repay` are self-explanatory
- We will explain `liquidate` later

Overcollateralized loans

- User has amount q_A of token A
- Price of A with respect to B is p at time of borrowing
- User places q_A and can request any amount q_B of B up to

$$q_B \leq \frac{pq_A}{\eta}$$

- Here, $\eta > 0$ is known as the *collateral ratio*
- When $\eta \geq 1$ we say the loan is *overcollateralized*

Overcollateralized loans (cont.)

- We say the system is *solvent* if sum of loans and collateral have nonnegative value

$$pq_A - q_B \geq 0$$

- Clearly holds for p

Overcollateralized loans (cont.)

- We say the system is *solvent* if sum of loans and collateral have nonnegative value

$$pq_A - q_B \geq 0$$

- Clearly holds for p
- What happens if the price changes to $p' > p$?

Overcollateralized loans (cont.)

- We say the system is *solvent* if sum of loans and collateral have nonnegative value

$$pq_A - q_B \geq 0$$

- Clearly holds for p
- What happens if the price changes to $p' > p$?
- What if $p' < p$?

Liquidations

- We allow anyone to *liquidate* the loan in the following scenario
- If the price at some other time p' satisfies

$$q_B > \frac{p' q_A}{\eta}$$

  we allow anyone to liquidate all loans up to that price
- Liquidator is able to purchase q_A at a discount price $\alpha p'$
- Here $0 < \alpha \leq 1$ is the *discount factor*

Solvency

- Given that a liquidation happens at price p', then the net flow is

$$\alpha p' q_A - q_B \geq \alpha p' q_A - \frac{p q_A}{\eta} = q_A \left(\alpha p' - \frac{p}{\eta} \right)$$

- System is therefore solvent so long as

$$p' \geq \frac{p}{\alpha \eta}$$

  when liquidation happens

- Since this should be satisfied for $p' \geq p$ then we have

$$\alpha \eta \geq 1$$

Tradeoffs

- Note that there is a tradeoff between α and η
- The discount α incentivizes liquidators
- The collateral ratio η denotes the protocol's 'efficiency'
- But $\alpha\eta$ denotes the 'safety margin' (larger is better)

Miner extractable value questions

- What happens if price p is manipulated?
- What happens if a miner (or searcher) causes liquidations and takes them?
- What is the price of manipulation for the oracle?
- When is the tradeoff worth it?
- How much does it cost to sell the token?

Miner extractable value questions

- What happens if price p is manipulated?
- What happens if a miner (or searcher) causes liquidations and takes them?
- What is the price of manipulation for the oracle?
- When is the tradeoff worth it?
- How much does it cost to sell the token?
- Hard questions! Especially for 'long-tail' assets

Undercollateralized loans?

- Undercollateralized loans are not (easily) possible
- They require additional assumptions
- For example, users can create any number of wallets
- And users can always walk away with money

Current instances

- A number of protocols implement lending markets
- In Ethereum: Aave, Compound
- In Solana: Solend, Oxygen, Port Finance
- A very large number of other implementations...

Outline

What are stablecoins?

- A *stablecoin* is an on-chain asset that is approximately pegged to some currency (USD, *e.g.*)
- Many different versions of this idea
- Very useful in practice, esp. in volatile markets
- Will use taxonomy in Klages-Mundt, et al. 2020.

‘Custodial’ stablecoins

- ‘Custodial’ stablecoins are issued by a trusted authority
- There are a few possibilities within this umbrella
- (Fractional) reserve funds
- Central bank digital currency (CBDC)

(Fractional) Reserve funds

- A *reserve fund* simply issues one 'on-chain' dollar for every dollar held
- Allows anyone (or specific party) to redeem reserves or create dollars
- Arbitrage ensures that prices are generally aligned
- *Fractional* reserve funds hold some proportion of dollars (or other very liquid approximant) but < 1

Central bank digital currency (CBDC)

- A *central bank digital currency* or CBDC are an on-chain stablecoin issued by a legal authority
- This authority is legally allowed to create the currency in a usual sense
- Has 'governmental backing' in the same sense as normal dollars

Noncustodial stablecoins

- There are *noncustodial* stablecoins
- These use basic on-chain mechanics and oracles to ensure prices are aligned
- Sometimes called ‘algorithmic’ stablecoins

Noncustodial stablecoins

- There are *noncustodial* stablecoins
- These use basic on-chain mechanics and oracles to ensure prices are aligned
- Sometimes called ‘algorithmic’ stablecoins
- Not all are made the same :)

Noncustodial stablecoins (cont.)

- Several kinds
- We'll describe two simple (very different) mechanisms
- But encourage you to read more!
- See *Stablecoins 2.0: Economic Foundations and Risk-based Models* by Klages-Mundt, et al, 2020

Debt-issued tokens

- Recalling the overcollateralized mechanism above, what happens if B is a token made by the protocol
- And p is the price of A with respect to USD?
- What would we expect the price of B to be?

Debt-issued tokens

- Recalling the overcollateralized mechanism above, what happens if B is a token made by the protocol
- And p is the price of A with respect to USD?
- What would we expect the price of B to be?
- Homework problem!

A ‘simple’ mechanism

- Say we have a token A
- Protocol has a measure of price of A in USD, p
- The protocol lets you trade $1/p$ of A to get 1 ‘sDollar’
- The protocol also lets you trade 1 ‘sDollars‘ for $1/p$ of A

A 'simple' mechanism (cont.)

- Let q_A be the total amount of A in reserves, q_s be total amount of outstanding stable
- Protocol is solvent so long as

$$pq_A - q_s \geq 0$$

- What if price p increases?

A 'simple' mechanism (cont.)

- Let q_A be the total amount of A in reserves, q_s be total amount of outstanding stable
- Protocol is solvent so long as

$$pq_A - q_s \geq 0$$

- What if price p increases?
- If price p decreases?

A 'simple' mechanism (cont.)

- Let q_A be the total amount of A in reserves, q_s be total amount of outstanding stable
- Protocol is solvent so long as

$$pq_A - q_s \geq 0$$

- What if price p increases?
- If price p decreases?
- What if the protocol is allowed to create and burn assets A?

Next lecture

- We will talk about how proof of stake interacts with economics
- A bit different than the threads we've been following here
- Reminder: will be virtual!
- (Same link as usual)