Lending and Borrowing I

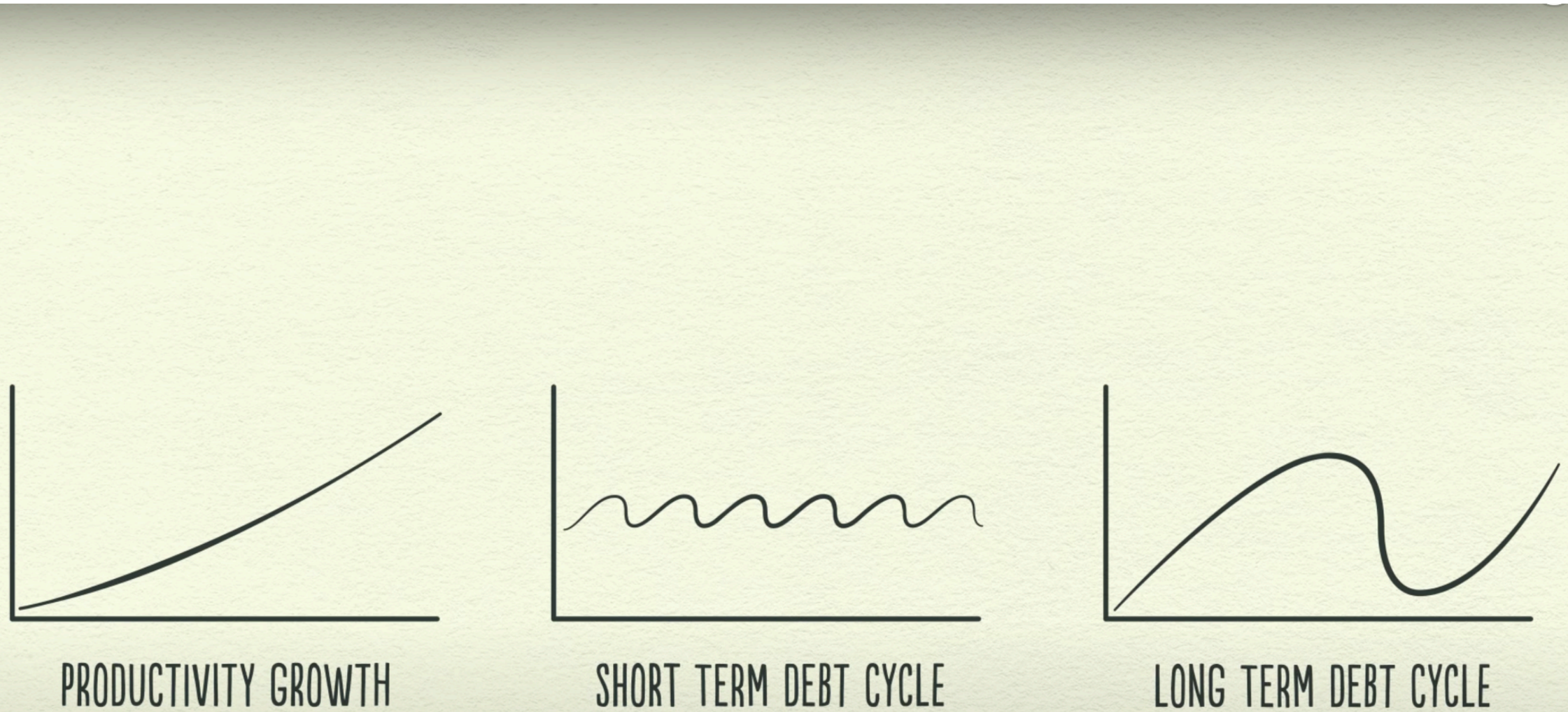
Instructor: Paruj Ratanaworabhan

Source: “Lending and Borrowing” by A. Gervais, UCB DeFi course

Why Lending?

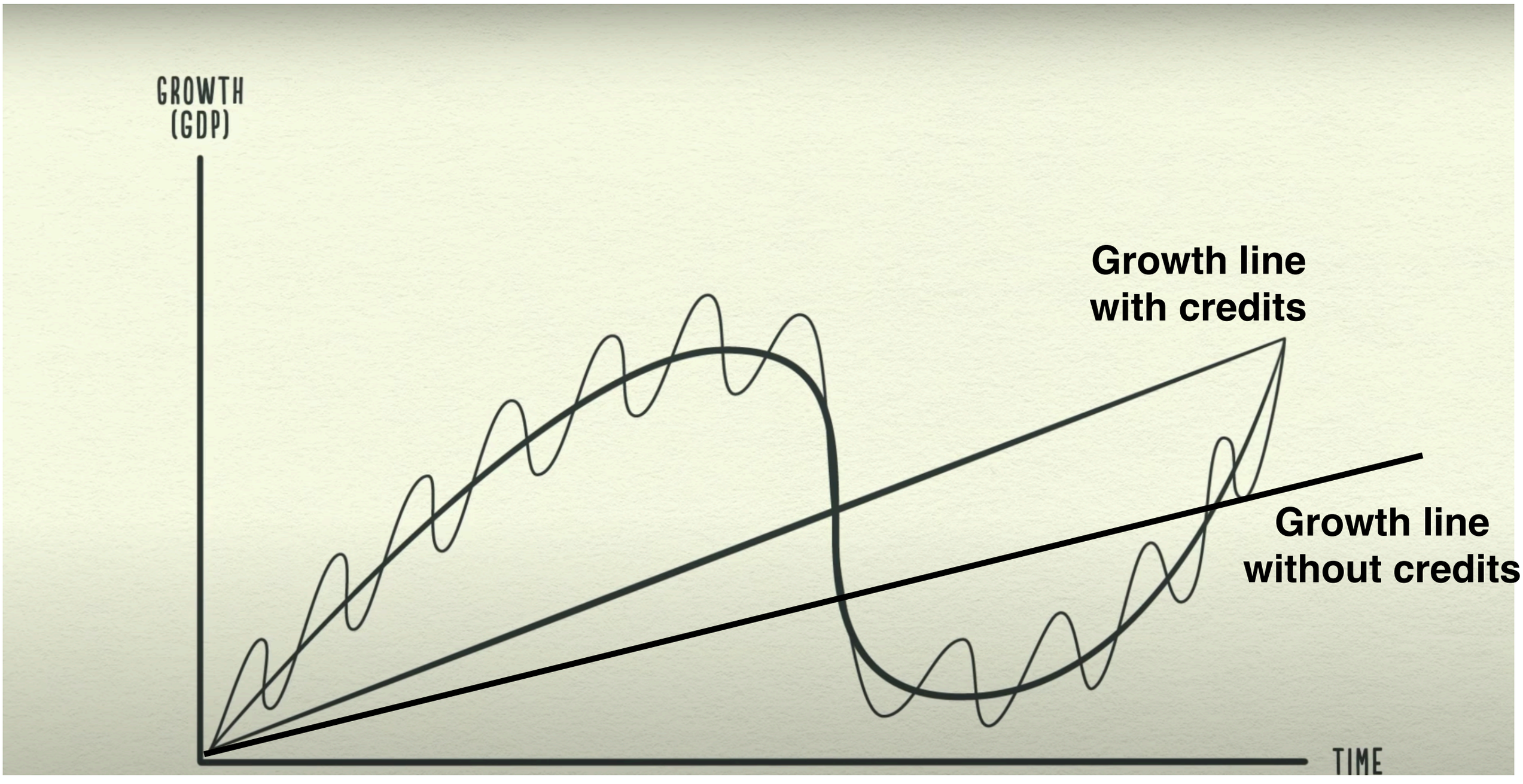
- There are rich people who have money
- There are not-so-rich people who have ideas and know-how
- There are not-so-rich people who want to buy cars and houses
- The rich lends to the not-so-rich to spur economic and productivity growth

How the Economic Machine Works?

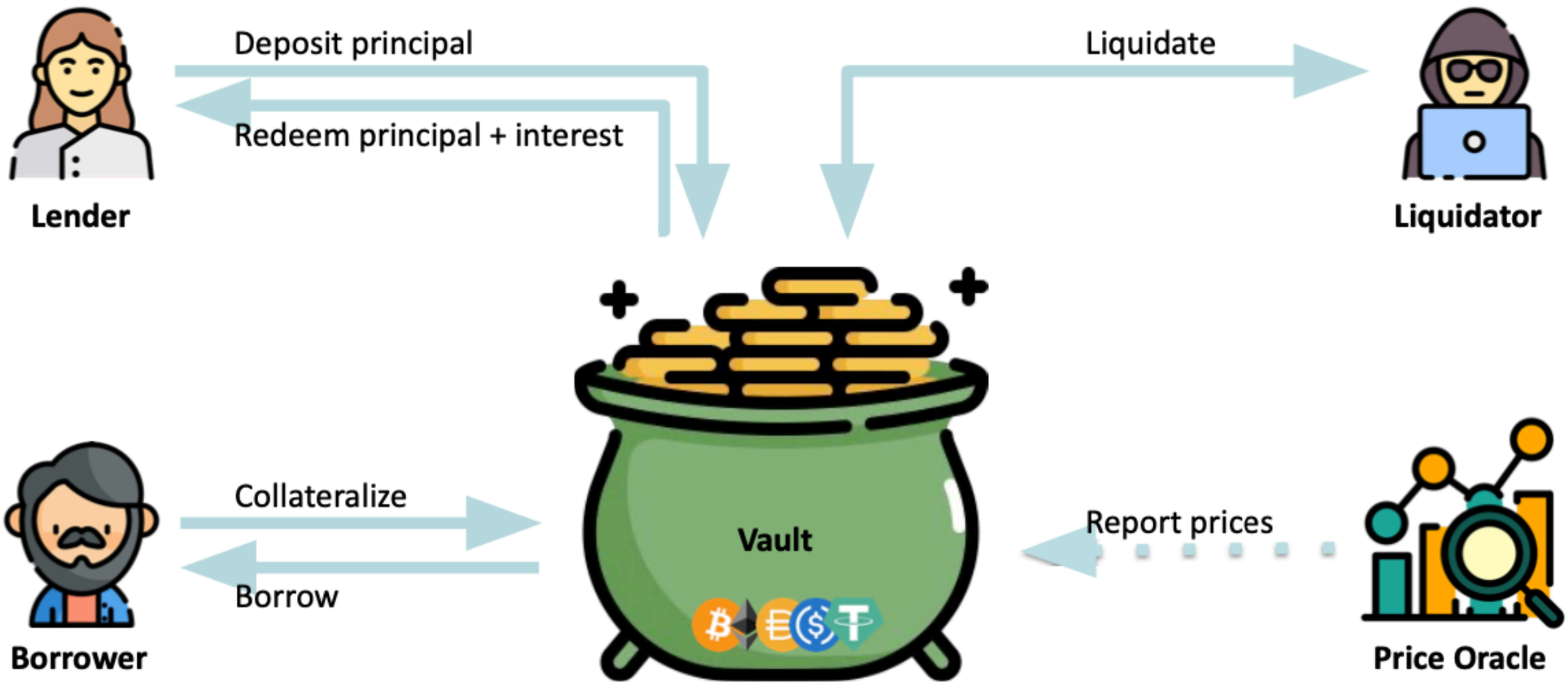


https://www.youtube.com/watch?v=PHe0bXAIuk0

Credit VS Growth



On-Chain Lending & Borrowing



Leverage == A debt multiplier

Assets	Market size	Total borrowed	Deposit APY	Variable Borrow APR	Stable Borrow APR		
DAI	$ 1.55B	$ 1.2B	2.77 % (1.09 % APR)	3.89 % (1.41 % APR)	11.95 %	Deposit	Borrow
Gemini Dollar (GUSD)	$ 38.17M	$ 30.64M	3.89 % (2.40 % APR)	5.39 % (2.99 % APR)	–	Deposit	Borrow
USD Coin (USDC)	$ 5.59B	$ 4.18B	2.27 % (0.93 % APR)	3.32 % (1.26 % APR)	10.66 %	Deposit	Borrow
USDT Coin (USDT)	$ 1.15B	$ 1.04B	9.02 % (2.83 % APR)	10.99 % (3.15 % APR)	18.99 %	Deposit	Borrow
Wrapped ETH (WETH)	$ 4.51B	$ 206.35M	0.02 % (0.54 % APR)	0.56 % (0.63 % APR)	3.70 %	Deposit	Borrow
WBTC Coin (WBTC)	$ 1.58B	$ 96.71M	0.04 % (1.24 % APR)	0.75 % (1.07 % APR)	3.94 %	Deposit	

Sushiswap USDC/ETH	16.86 %	Alpha APR Borrow APY	22.98 % -14.55 %	FARM
Yield Farming Sushiswap MKR/ETH	18.44 % 7.28 %	Yield Farming Trading Fee Alpha APR Borrow APY	9.75 % 3.80 % 13.37 % -8.47 %	FARM
Yield Farming Sushiswap ETH/USDT	46.83 % 15.48 %	Yield Farming Trading Fee Alpha APR Borrow APY	19.02 % 19.38 % 22.98 % -14.55 %	FARM
Yield Farming Sushiswap DAI/ETH	49.25 % 16.46 %	Yield Farming Trading Fee Alpha APR Borrow APY	20.95 % 19.88 % 22.98 % -14.55 %	FARM
Yield Farming Curve 3pool	17.47 % 4.26 %	Yield Farming Trading Fee Alpha APR Borrow APY	22.48 % 7.45 % 46.74 % -58.20 %	FARM

7×leverage

Curve pools $

Pool	Base APY	Rewards APY	Volume
tricrypto CRYPTO V2 [?] USDT+wBTC+WETH	2.61%	+2.27%→5.67% CRV	$15.2m
3pool USD DAI+USDC+USDT	1.08%	+3.16%→7.90% CRV	$226.1m
ust USD UST+3Crv	5.72%	+3.77%→9.42% CRV	$21.9m
bbtc BTC BBTC+sbtcCrv	0.53%	+3.13%→7.81% CRV	$9.5m
sUSD USD DAI+USDC+USDT+sUSD	0.48%	+2.74%→6.86% CRV +2.04% SNX	$8.7m
lusd USD LUSD+3Crv	1.04%	+6.17%→15.43% CRV	$8.7m
alusd USD alUSD+3Crv	0.78%	+1.85%→4.64% CRV +11.18% ALCX	$5.8m
tricrypto2 CRYPTO V2 [?] USDT+wBTC+WETH	2.88%	+0.00%→0.00% CRV	$4.8m
seth ETH ETH+sETH	2.19%	+2.02%→5.06% CRV	$3.8m
steth ETH ETH+stETH	2.91%	+0.15%→0.37% CRV +6.03% LDO	$2.6m

See All Pools | My Dashboard

Terminology

- Collateral
  - Assets that serve as a security deposit
- Over-collateralization
  - Borrower has to provide
    value(collateral assets) > value(granted loan)
- Under-collateralization
  - *value(collateral) < value(debt)*
- Liquidation
  - If value(collateral) <= 150% x value(debt)
  - Anyone can liquidate the debt position

Health Factor

$$Health\ Factor = \frac{\sum Value\ of\ Collateral_i \times Liquidation\ Threshold_i}{Total\ Value\ of\ Debts}$$

Borrowing Capacity

- $0 < Liquidation\ Threshold < 1$
- The **liquidation threshold** provides a “secure” margin
- When the health factor declines below 1, a borrowing position becomes liquidatable

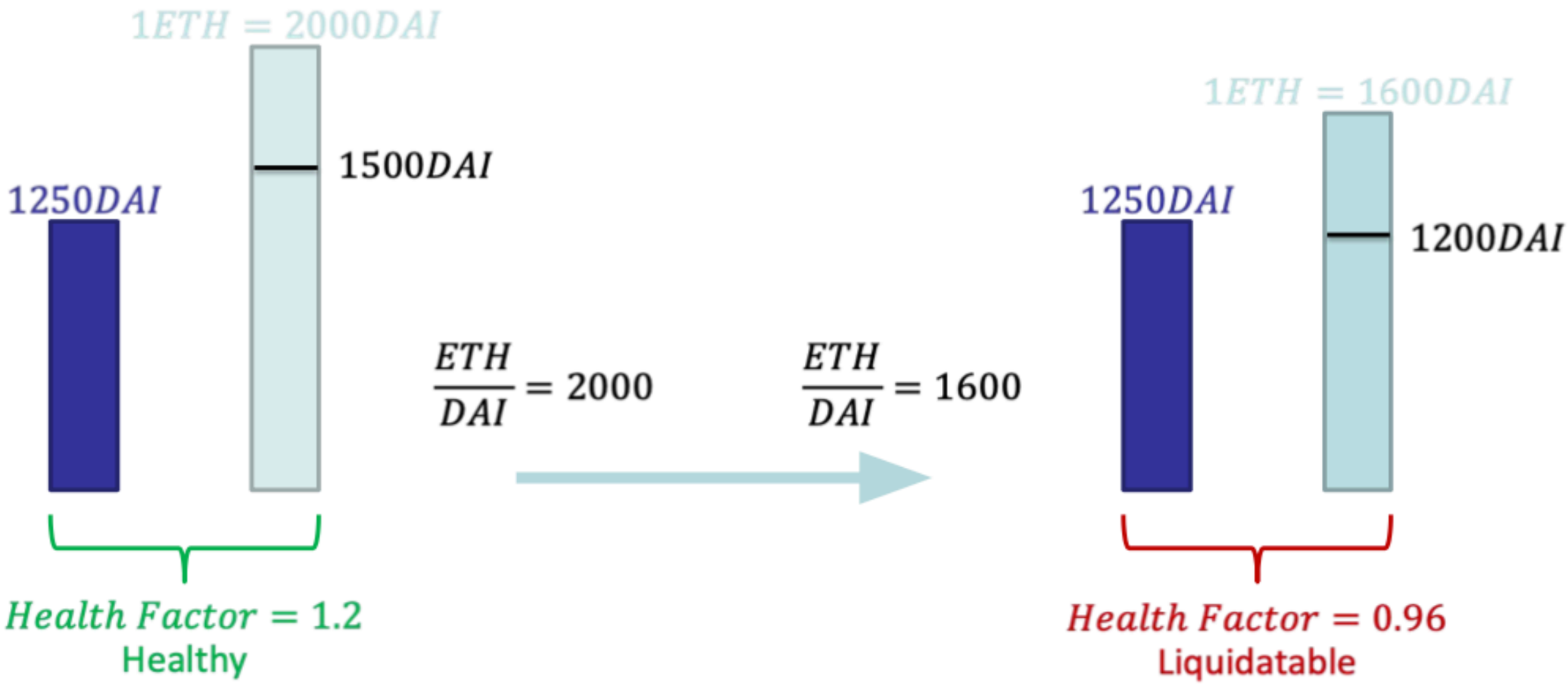
Health Factor

Debt

Collateral

Borrowing Capacity

$Liquidation\ Threshold = 0.75$



Terminology

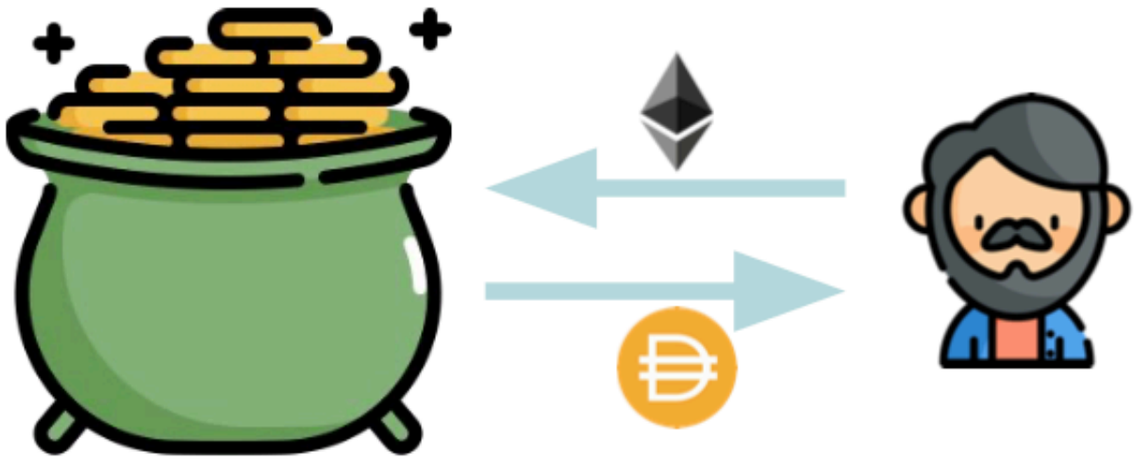
- **Liquidation Spread** LS: bonus, or discount, that a liquidator can collect when liquidating collateral

$$Value\ of\ Collateral\ to\ Claim = Value\ of\ Debt\ to\ Repay \times (1 + LS)$$

- **Close Factor** CF: the maximum proportion of the debt that is allowed to be repaid in a single fixed spread liquidation

$$Value\ of\ Debt\ to\ Repay < CF \times Total\ Value\ of\ Debts$$

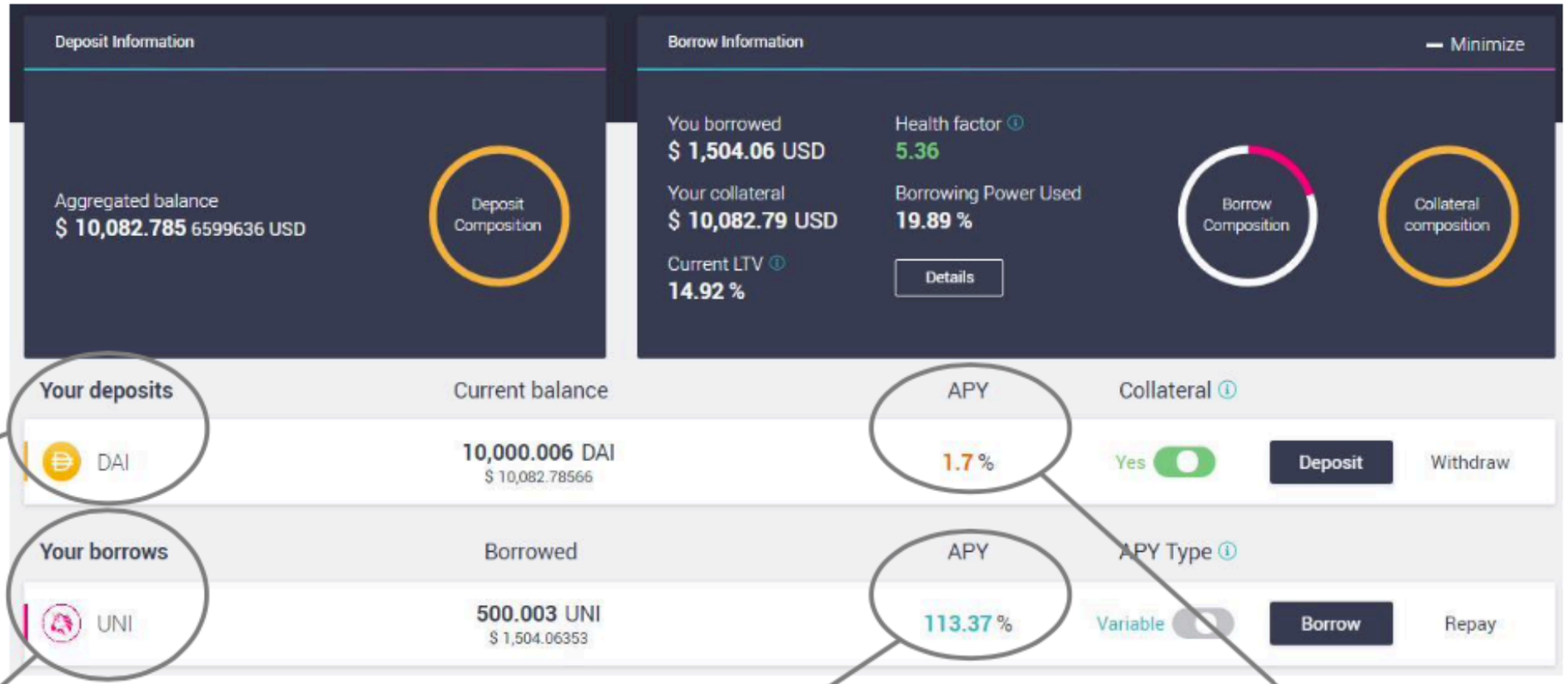
Over-collateralized Borrowing



- E.g., the borrower collateralizes ETH and borrows DAI
- The value of ETH exceeds the value of DAI
- The borrower can use the borrowed DAI arbitrarily/freely

Over-collateralized Borrowing

Aave Dashboard Screenshot



DAI is deposited as collateral

UNI is borrowed

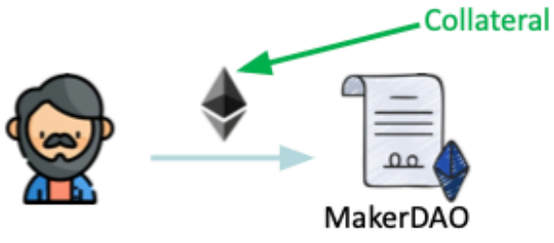
The borrowing interests the borrower needs to pay

In Aave, the collteral is also lent out. Hence the borrower can also earn interests.

Over-collateralized Borrowing

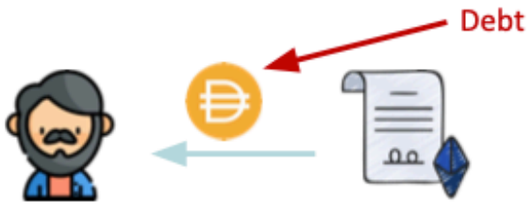
Stablecoin

Step 1



ETH deposited to open CDP

Step 2

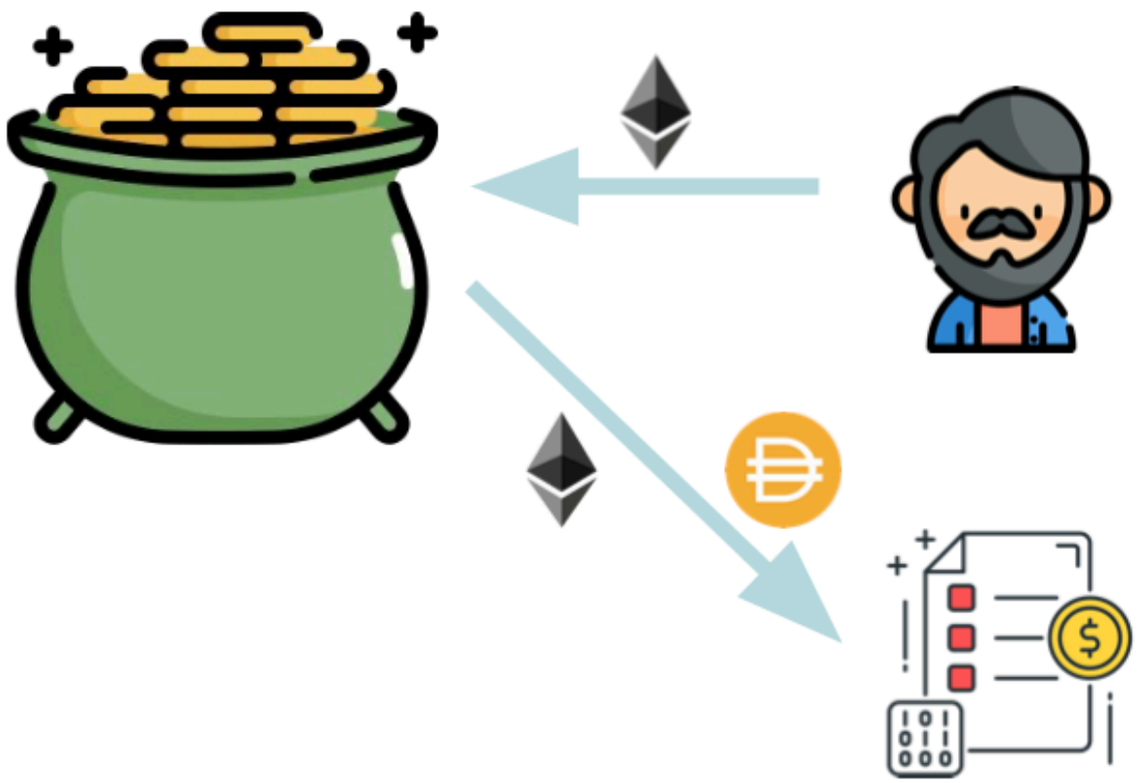


Draw DAI

Step 3

Pay back DAI to unlock ETH

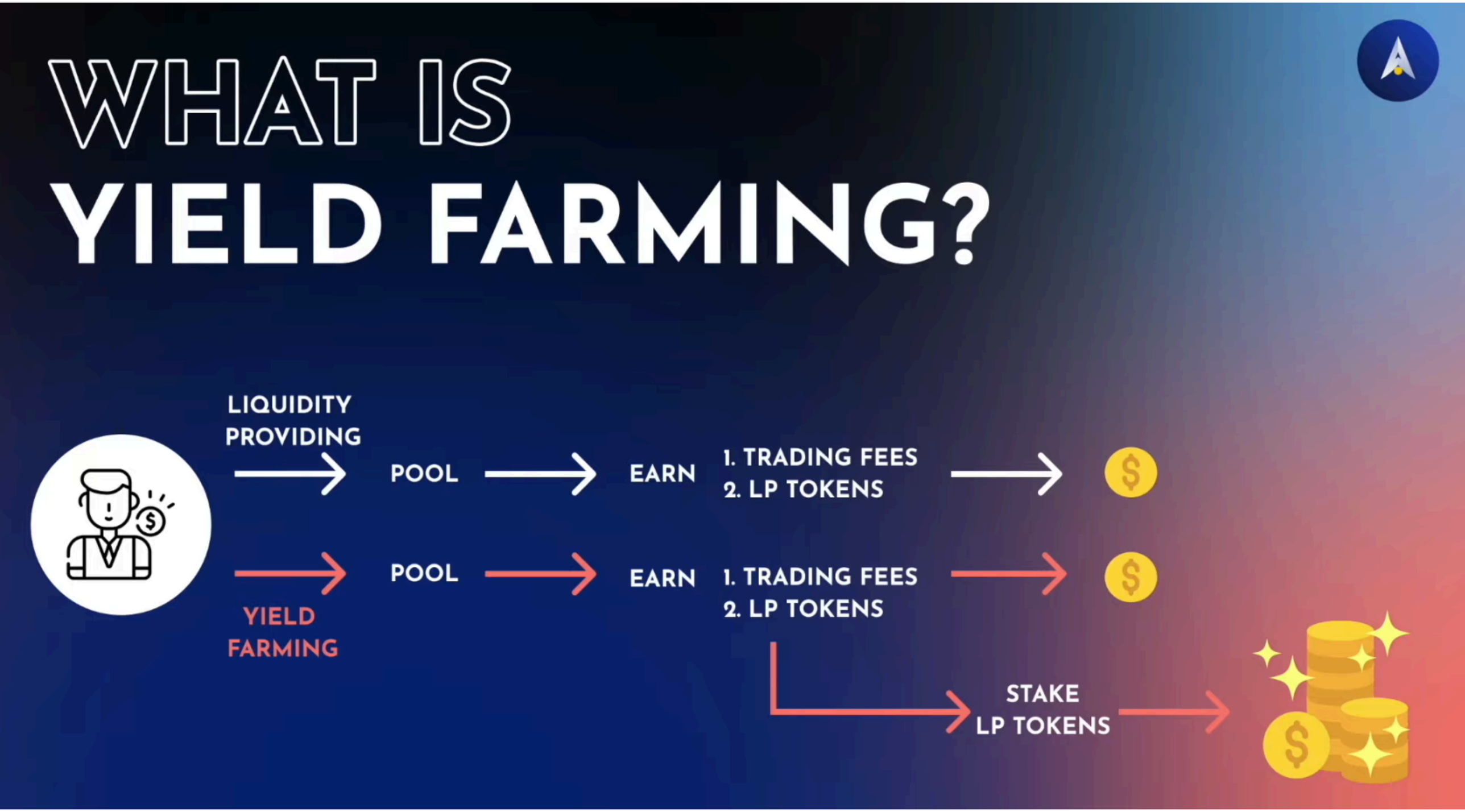
Under-collateralized Borrowing

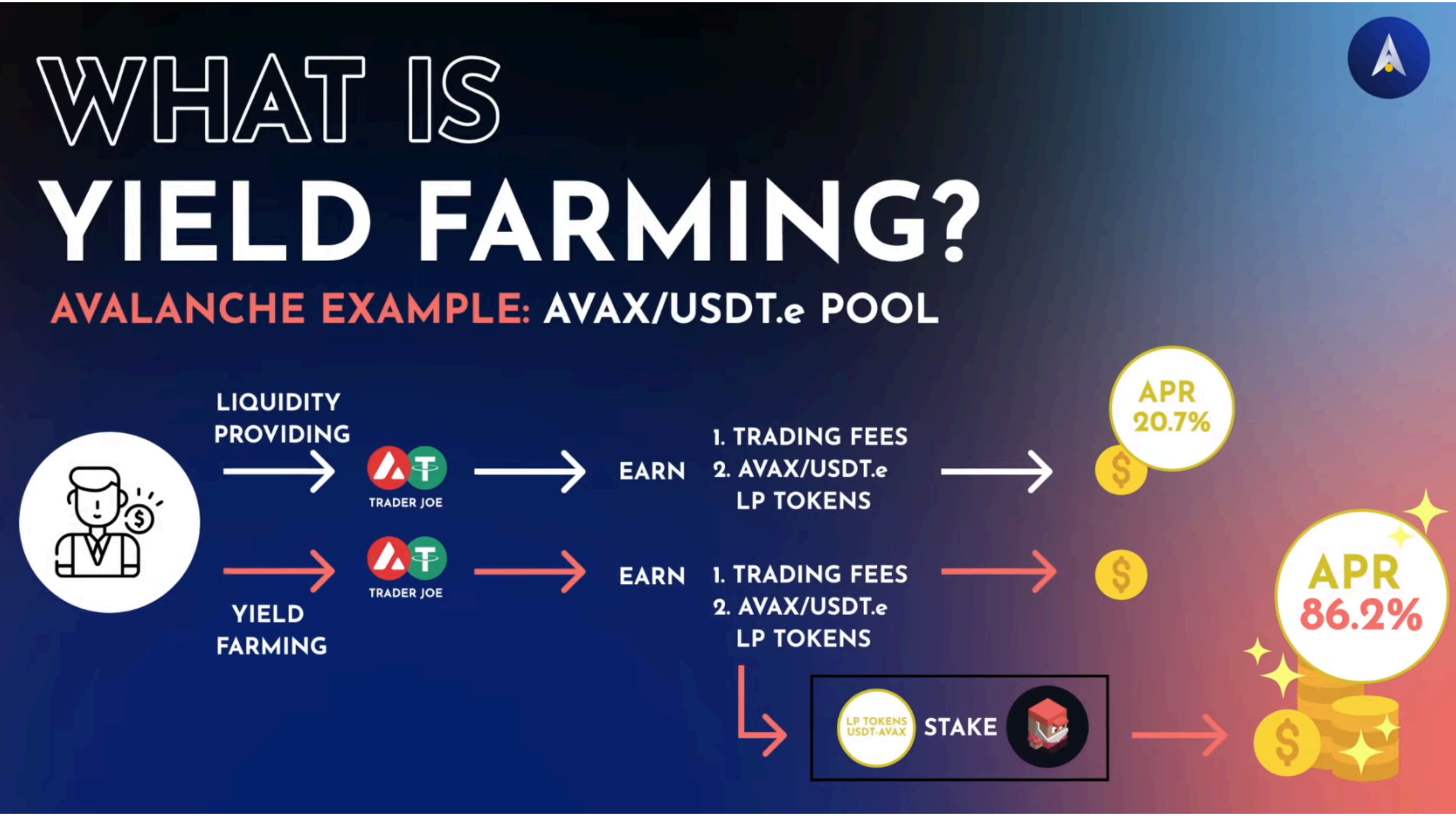


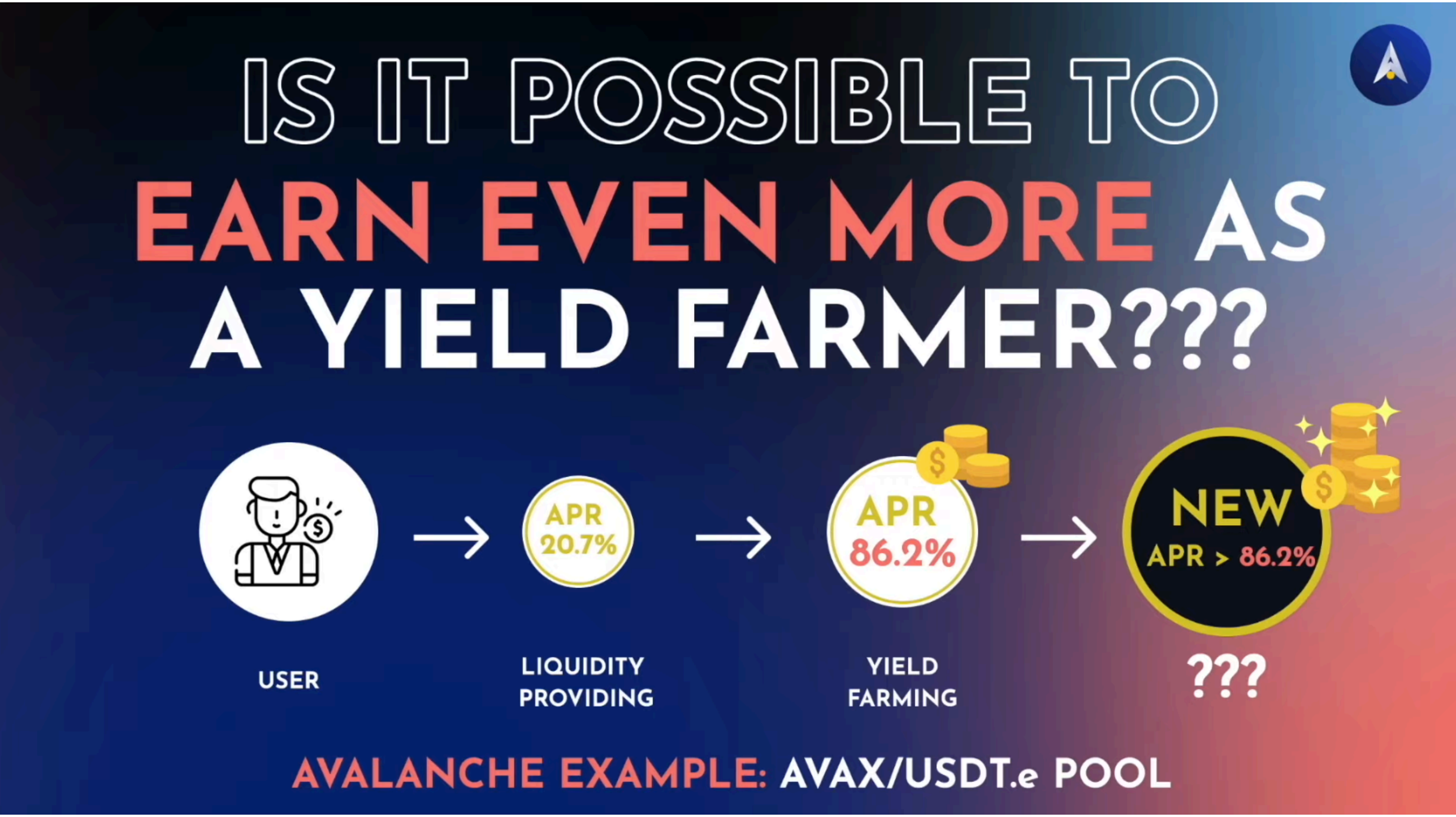
- E.g., the borrower collateralizes ETH and borrows DAI
- The value of DAI (debt) can exceed the value of ETH (collateral)
- The collateralized ETH and borrowed DAI <u>are restricted to be used with pre-designed smart contracts</u>. Those are typically farming contracts.
- The vault remains in control of all assets.

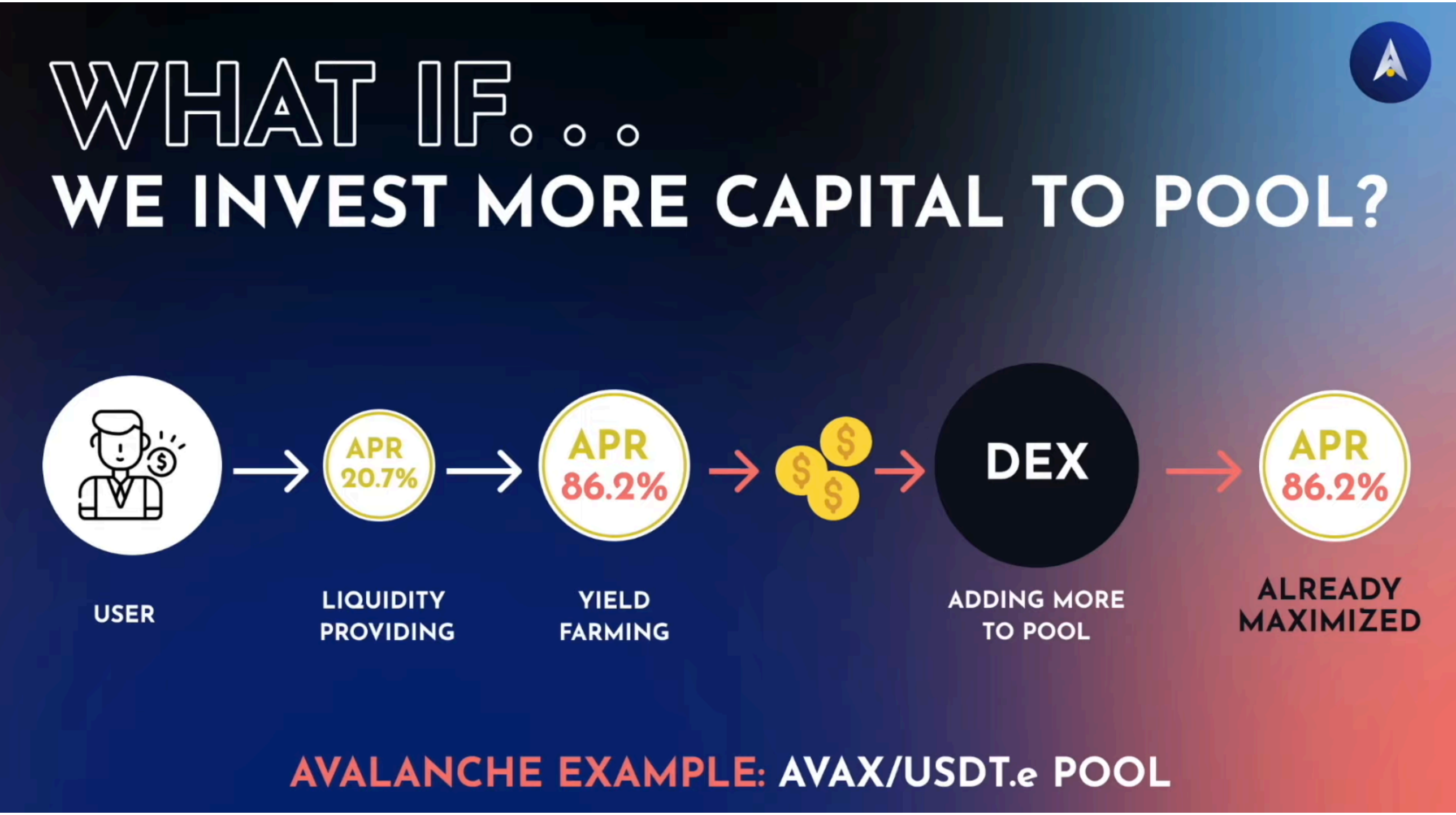
An example of under-collateralized lending platform: Alpha Homora V2

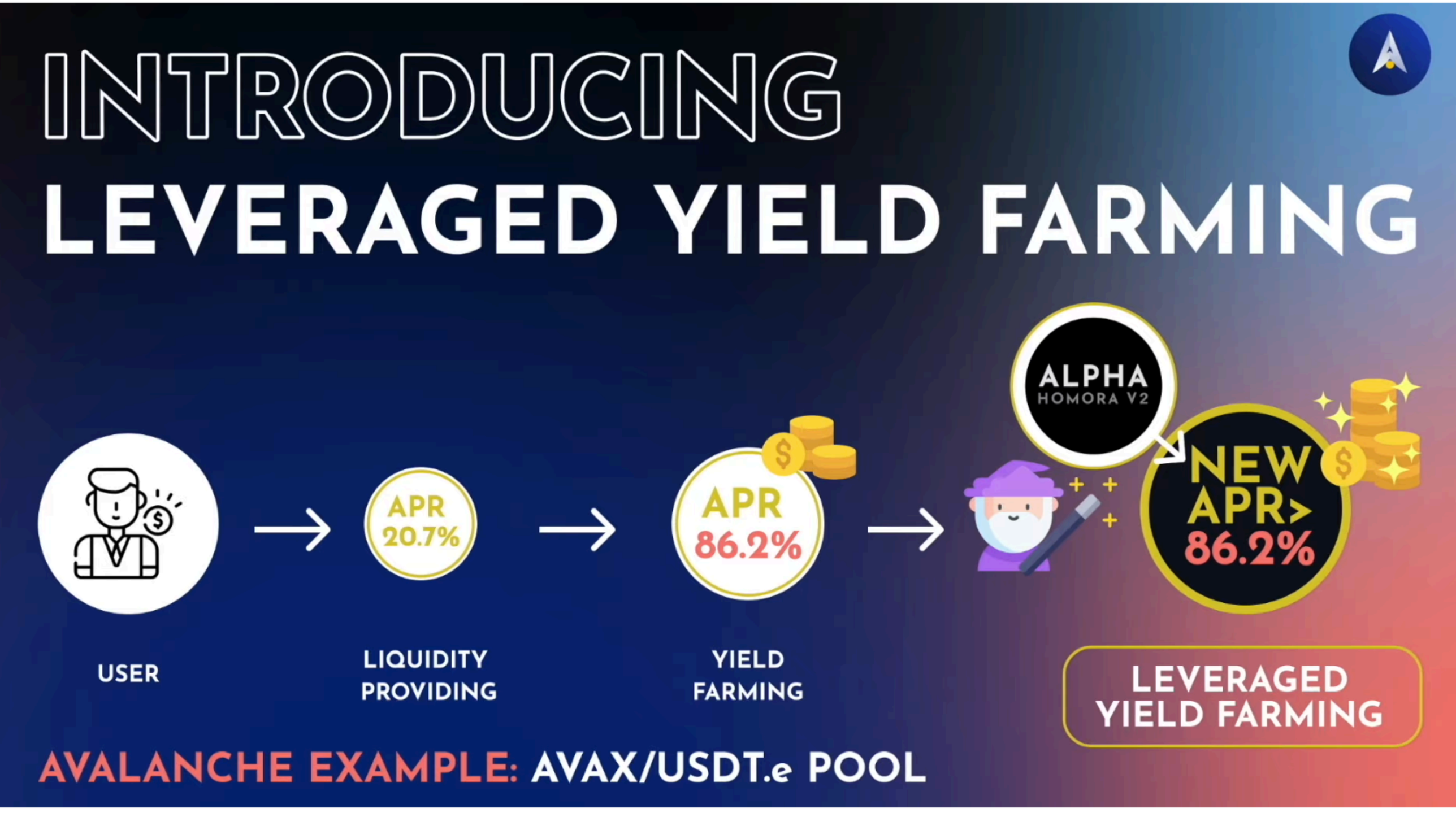
homora-v2.alphafinance.io


WHAT IS
YIELD FARMING?
LIQUIDITY
PROVIDING
POOL
EARN
1. TRADING FEES
2. LP TOKENS
YIELD
FARMING
POOL
EARN
1. TRADING FEES
2. LP TOKENS
STAKE
LP TOKENS


WHAT IS
YIELD FARMING?
AVALANCHE EXAMPLE: AVAX/USDT.e POOL
LIQUIDITY PROVIDING
TRADER JOE
EARN
1. TRADING FEES
2. AVAX/USDT.e LP TOKENS
APR 20.7%
YIELD FARMING
TRADER JOE
EARN
1. TRADING FEES
2. AVAX/USDT.e LP TOKENS
LP TOKENS USDT-AVAX
STAKE
APR 86.2%


IS IT POSSIBLE TO
EARN EVEN MORE AS
A YIELD FARMER???
APR
20.7%
APR
86.2%
NEW
APR > 86.2%
USER
LIQUIDITY
PROVIDING
YIELD
FARMING
???
AVALANCHE EXAMPLE: AVAX/USDT.e POOL


WHAT IF...
WE INVEST MORE CAPITAL TO POOL?
USER
APR 20.7%
LIQUIDITY PROVIDING
APR 86.2%
YIELD FARMING
DEX
ADDING MORE TO POOL
APR 86.2%
ALREADY MAXIMIZED
AVALANCHE EXAMPLE: AVAX/USDT.e POOL


INTRODUCING
LEVERAGED YIELD FARMING
ALPHA
HOMORA V2
NEW
APR>
86.2%
APR
20.7%
APR
86.2%
USER
LIQUIDITY
PROVIDING
YIELD
FARMING
LEVERAGED
YIELD FARMING
AVALANCHE EXAMPLE: AVAX/USDT.e POOL

EXAMPLE :
LEVERAGED YIELD FARMING

WITHOUT
ALPHA HOMORA

SUPPLY:
$100 USDT.e + AXAX

TRADER JOE

YIELD FARM
WITH $100

APR
86.2%

WITH
ALPHA HOMORA

ALPHA HOMORA V2

SUPPLY: $100 USDT.e

BORROW: $150 AVAX
$50 USDT.e

COMBINE TO $300
COLLATERAL ASSET (3X)

ALPHA HOMORA V2 → TRADER JOE

YIELD FARM
WITH $300
= 3X ON APR 86.2%

NEW
APR
258.6%

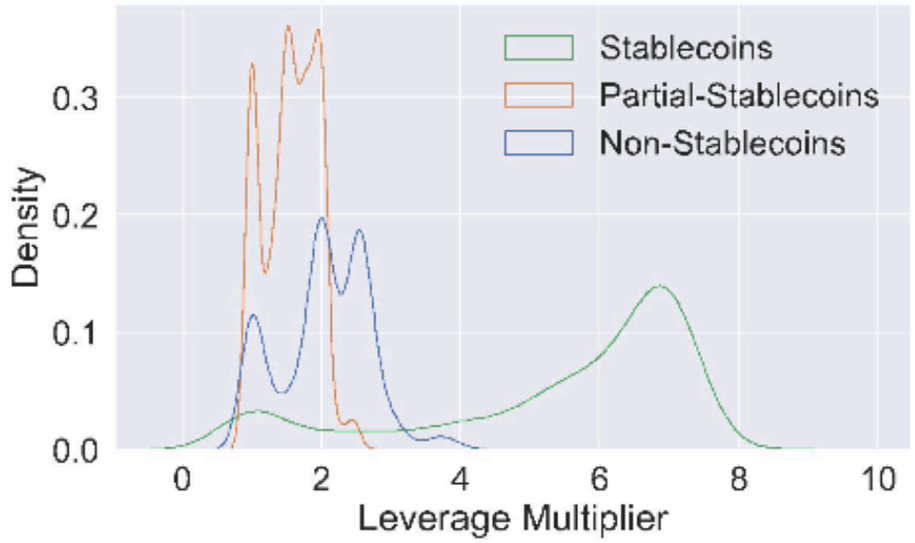
Alpha Homora Stat

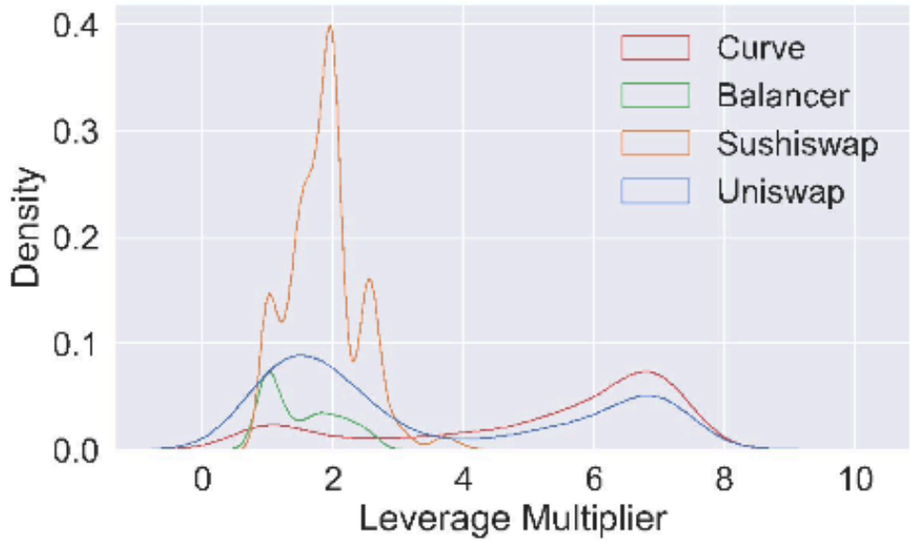
- Opened Positions (October 2020 – August 2021)
  - 3800 borrowers
  - 10,430 leverage positions

- Leverage multipliers
  - AHv1: 2.01x
  - AHv2: 3.07x

- Stablecoin leverage multipliers
  - 5.39x

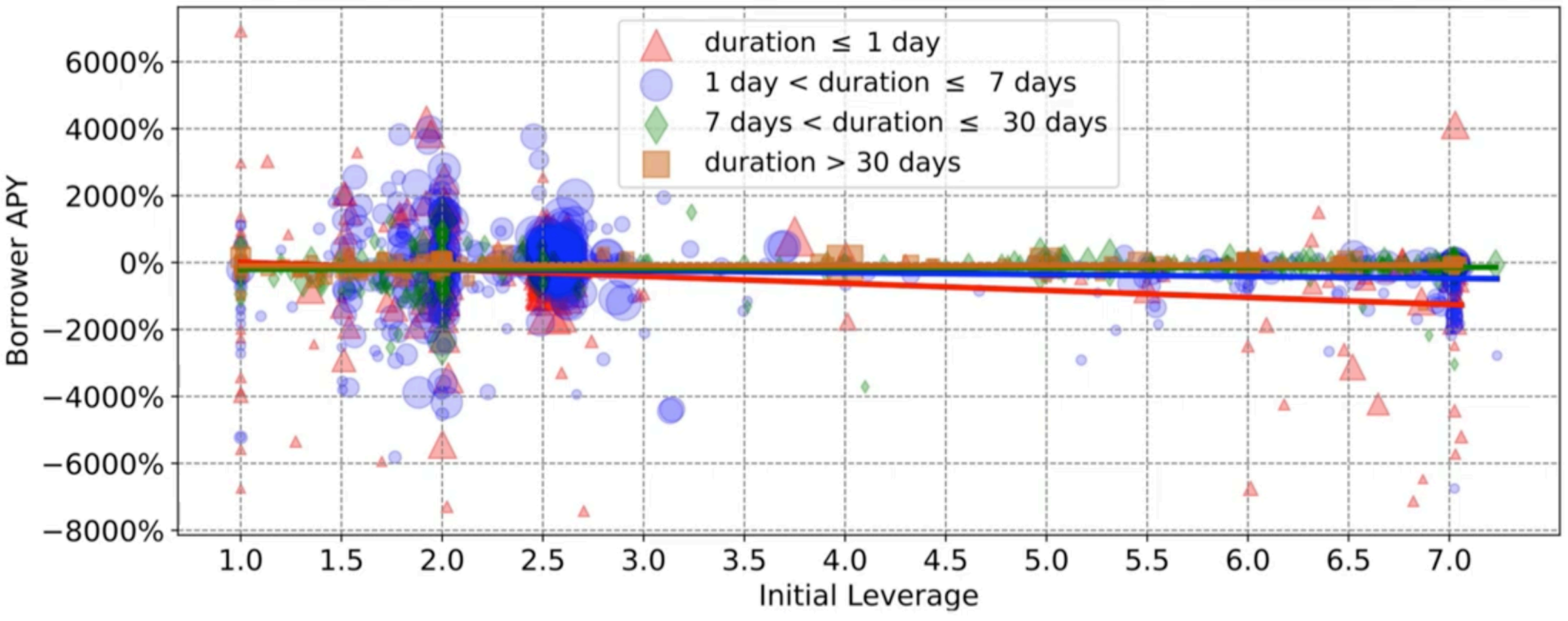
How are borrowers choosing leverage multipliers?





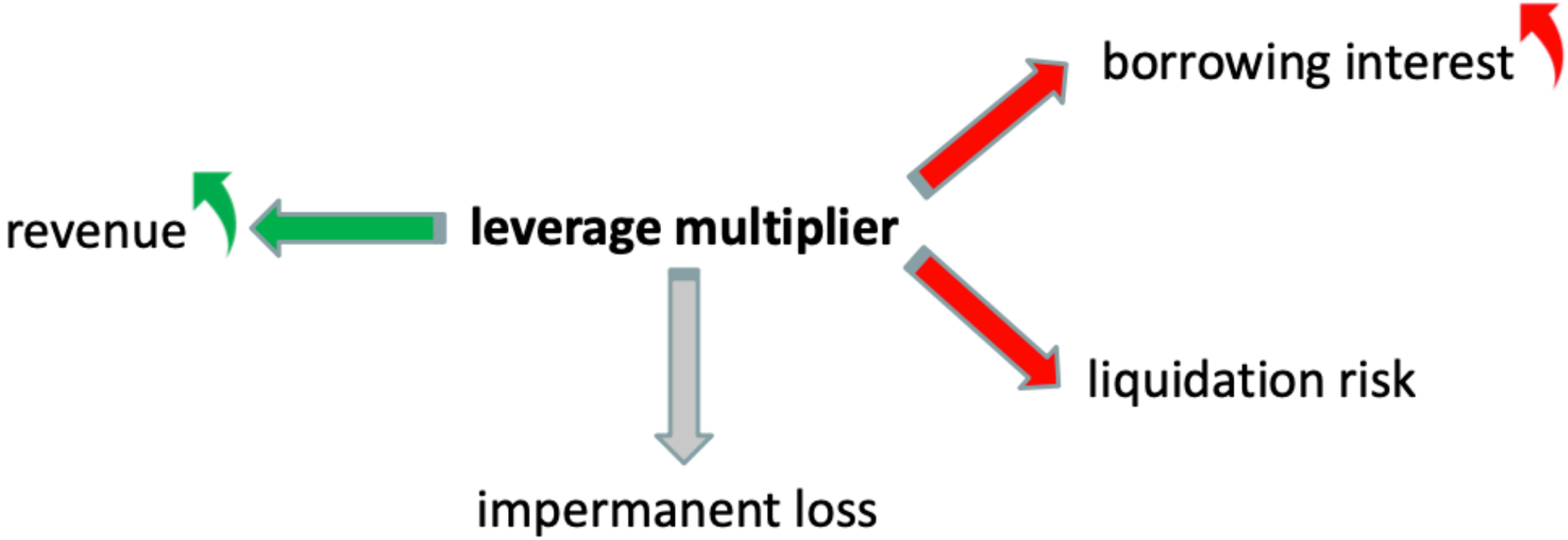
- Distributions of leverage multipliers in Alpha Homora V2 (2581 positions).

APY under Leverage



APY under Leverage

Why does leverage not amplify APY in practice?



Liquidation Mechanics

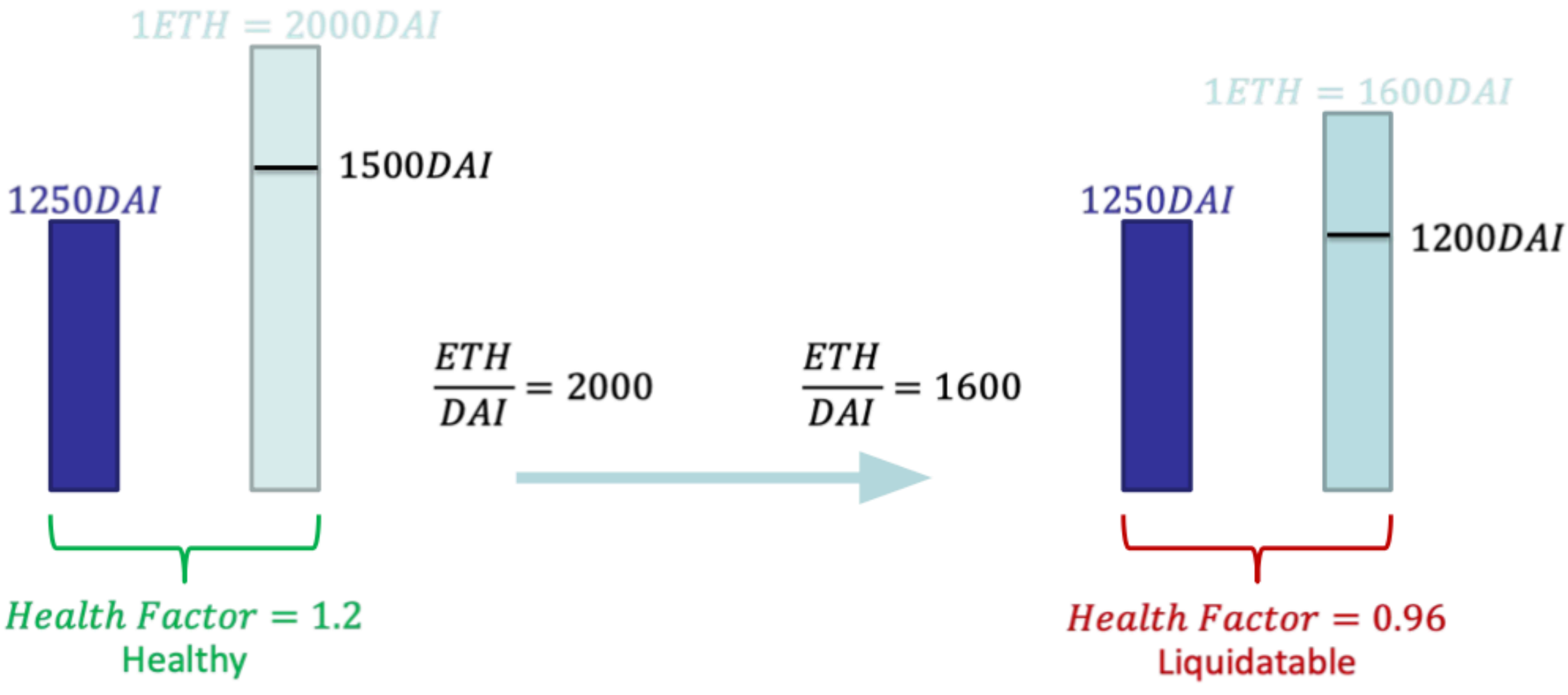
Health Factor

Debt

Collateral

Borrowing Capacity

$Liquidation\ Threshold = 0.75$



Fixed Spread Liquidation

Debt

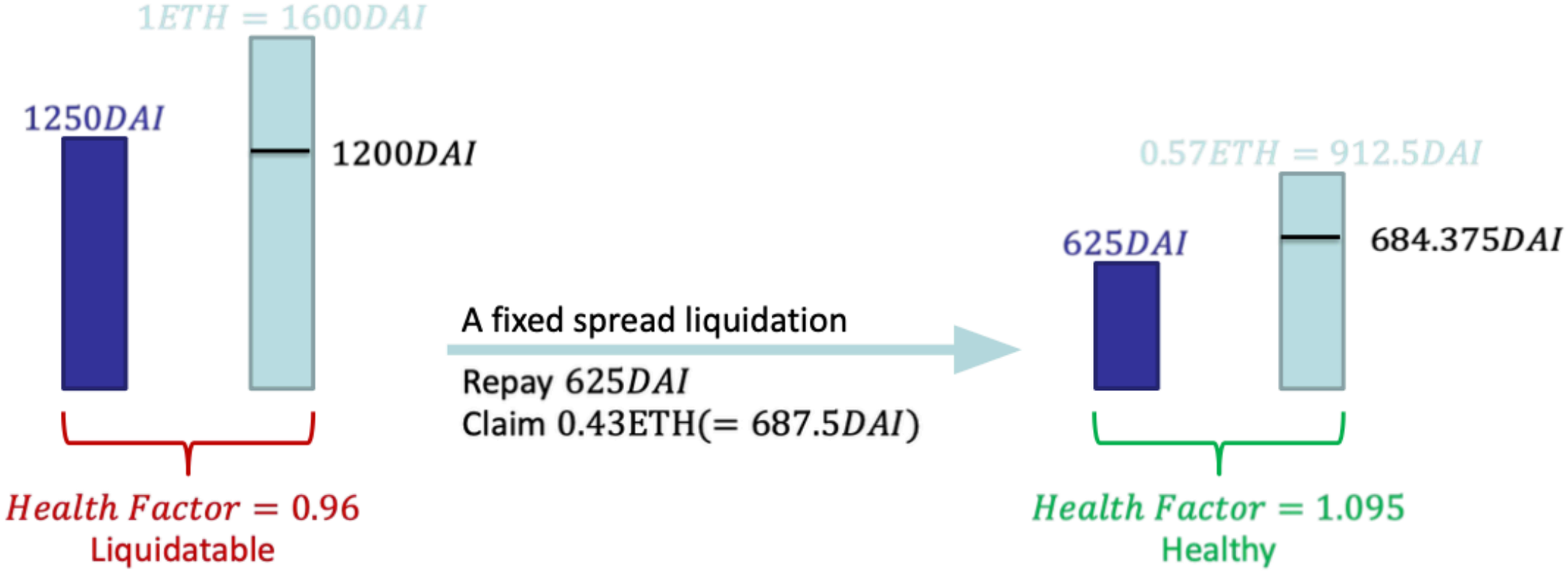
Collateral

Borrowing Capacity

$Liquidation\ Threshold = 0.75$

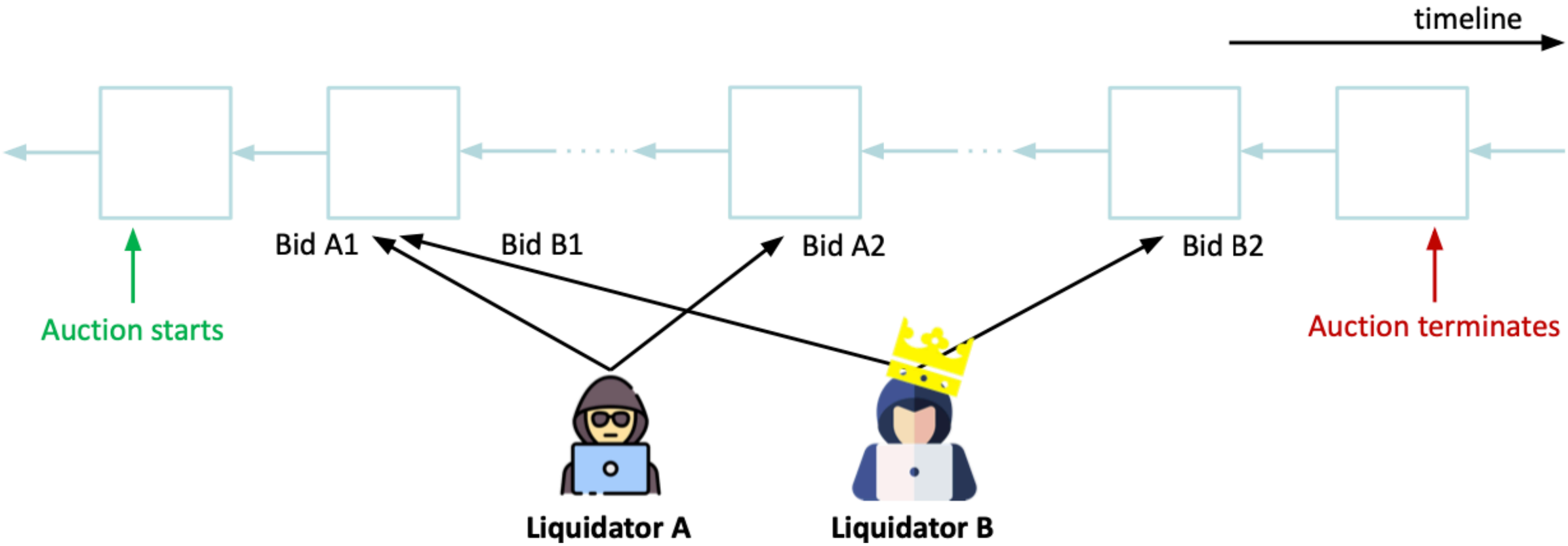
$Close\ Factor = 0.5$

$Liquidation\ Spread = 0.1$



Auction Liquidation

- Various liquidators bid over time until the auction terminates
- Requires multiple blockchain transactions.



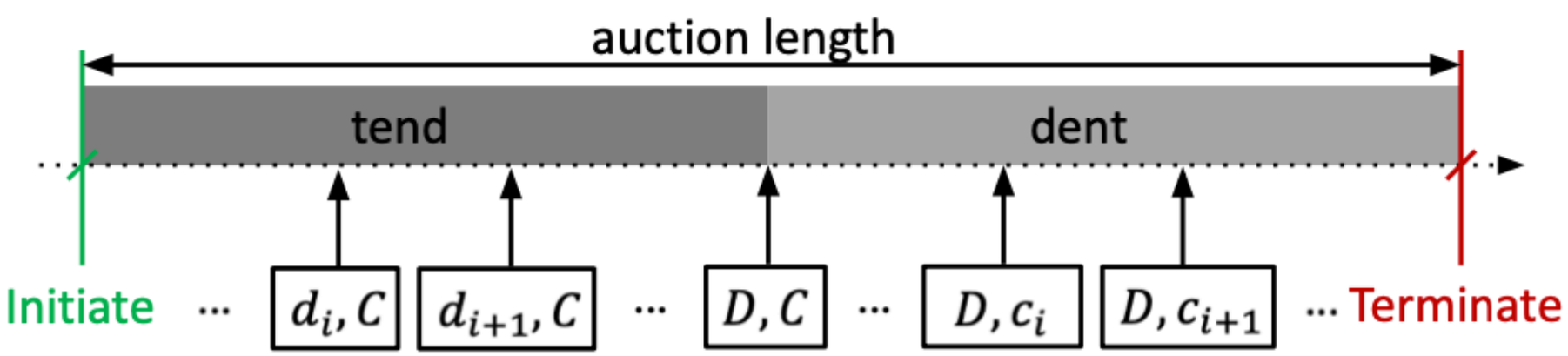
Auction Liquidation

- English Auction
  - bidders outbid each other increasingly
- Dutch Auction
  - auction begins with a high asking price and the price lowers until the auction terminates

Auction Liquidation

MakerDAO tend-dent English auction (Day one — April 2021)

- A position with D debt and C collateral



$d_{i+1} > d_i$

$c_{i+1} < c_i$

Bid — debt to repay, collateral to claim

Auction Liquidation

MakerDAO Dutch auction (April 2021 — Present)

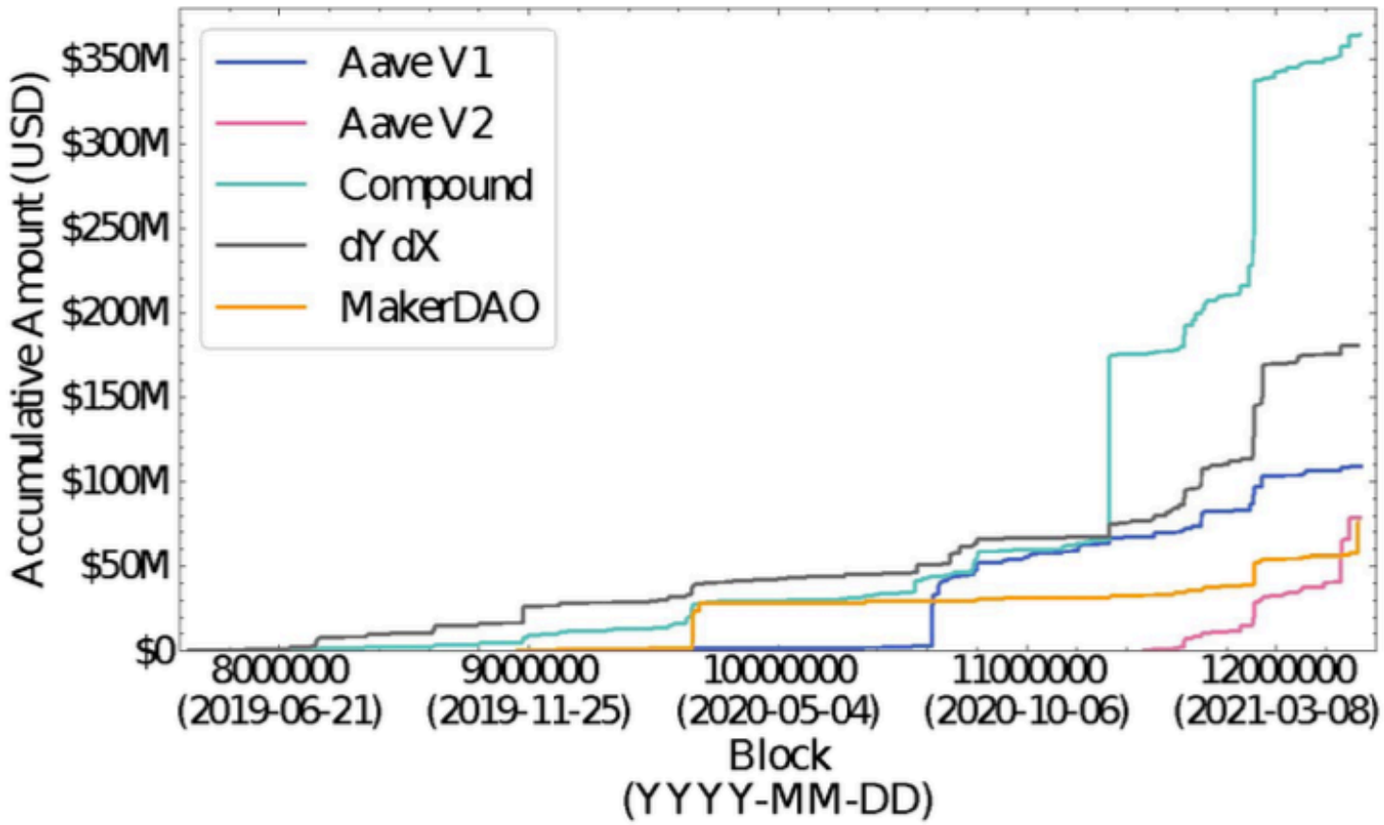
- **Instant Settlement**
  - Unlike English auction which are operated in multiple transactions, the MakerDAO Dutch auction is settled instantly in one atomic transaction.

- **Flash Lending of Collateral**
  - No upfront DAI (i.e., the debt) is required (i.e., a flash loan used specifically for MakerDAO liquidations).

- **Price as a Function of Time**
  - Collateral price decreases over time □ nobody can get the collateral for free by accident

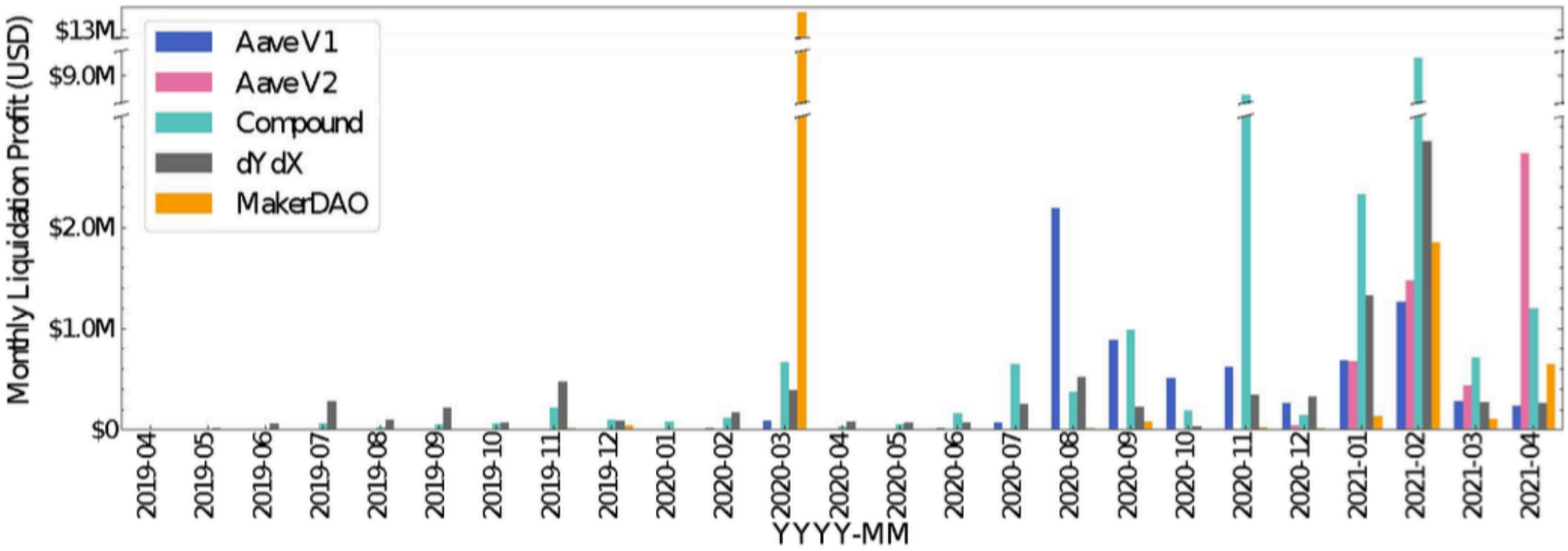
Liquidation Statistics

- April 2019 - April 2021 (2 years)
- Aave (V1 & V2), Compound, dYdX, and MakerDAO
- 28138 successful liquidations
- 807.46M USD of collateral sold through liquidations



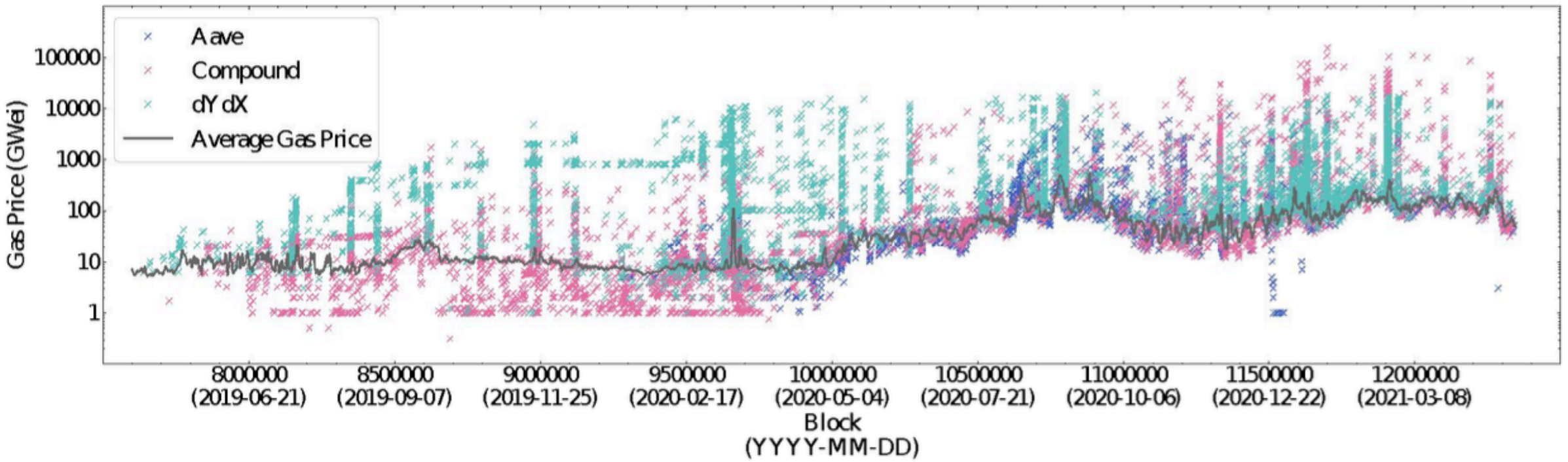
Liquidation Statistics

- Total profit: 63.59M USD
- MakerDAO outlier in March 2020, caused by bot failure.



Liquidation Statistics

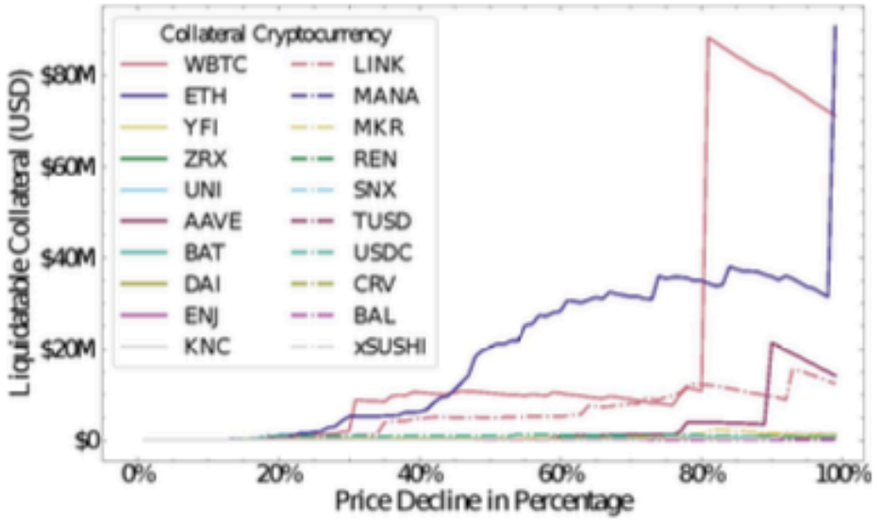
- Liquidators typically pay significant gas fees, indicating severe competition.



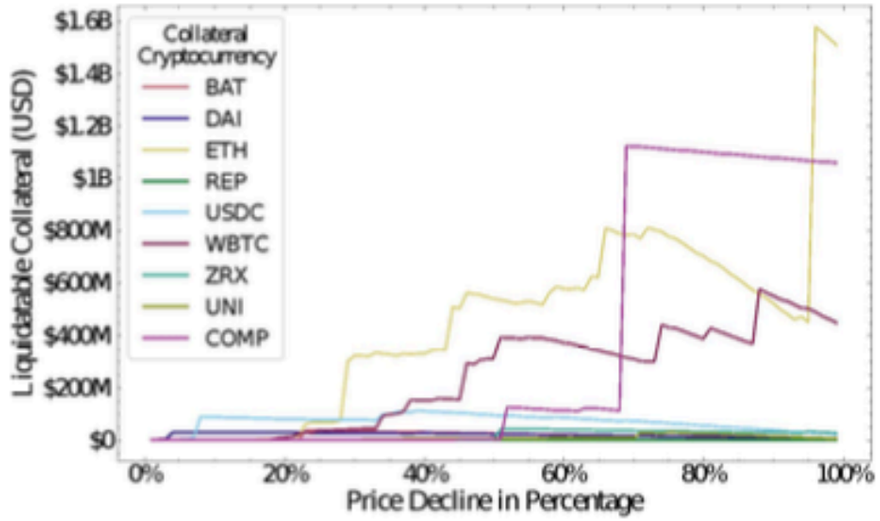
Liquidation Statistics

- Liquidation Sensitivity
  - liquidated collateral upon a hypothetical price decline.

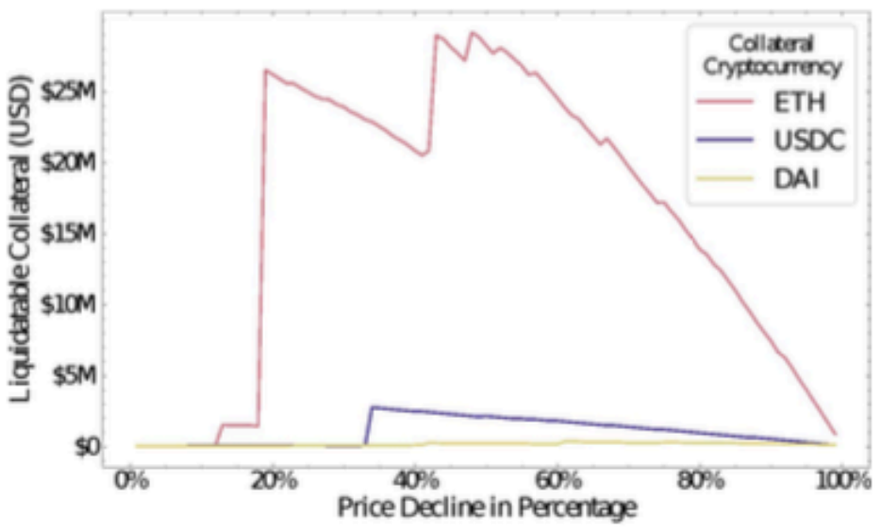
Aave



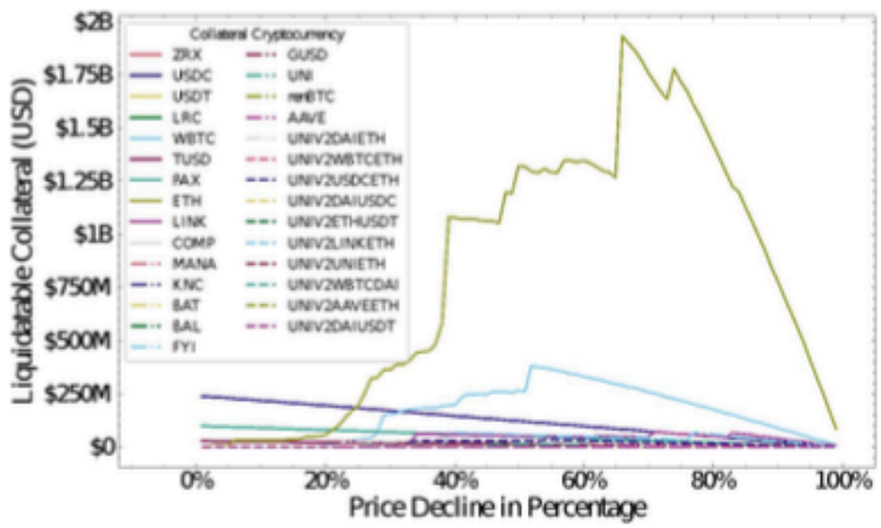
Compound



dYdX



MakerDAO



What We Have Learned

- The importance of lending
- On-chain lending
  - Over-collateralized
  - Under-collateralized
- Associated risk
  - Liquidation
  - Impermanent loss
- Liquidation mechanics