LIQUIDATIONS
deep dive

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BAD DEBT ??

debt that cannot be fully repaid by selling the borrower's collateral.

If protocol requires , $1.25 for every borrow of $1 , and user has only backed his debt 1:1 with collateral , will it be considered bad debt ? No

In order to Protect protocol from bad debt, we employ liquidation techniques.

GLOSSARY

KAMINO :
- explaination of borrow factor
- mathematical explanation of LTV, borrow capacity
- liquidation penalty and dynamic liquidation penalties with examples
- liquidations, full/,partial/,self liquidations,
- How gas costs affect liquidator profits ?

AAVE :
- liquidity threshold
- weighted average liquidity threshold
- Health factor
- Abstractive overview of how partial and hard liquidations are handled

FLUID VAULT V1:
- abstractive overview of how it is cost efficient
- Abstractive Overview of - Turning traders into liquidators without letting them know
- advantages && disadvantages

crvUSD:
- Abstractive Overview of LLAMMA (Lending-Liquidating AMM Algorithm)
- advantages && disadvantages

SHORT DISCUSSION :
- which systems were efficient ...!
- My new CABAL Liquidation System

KAMINO FINANCE

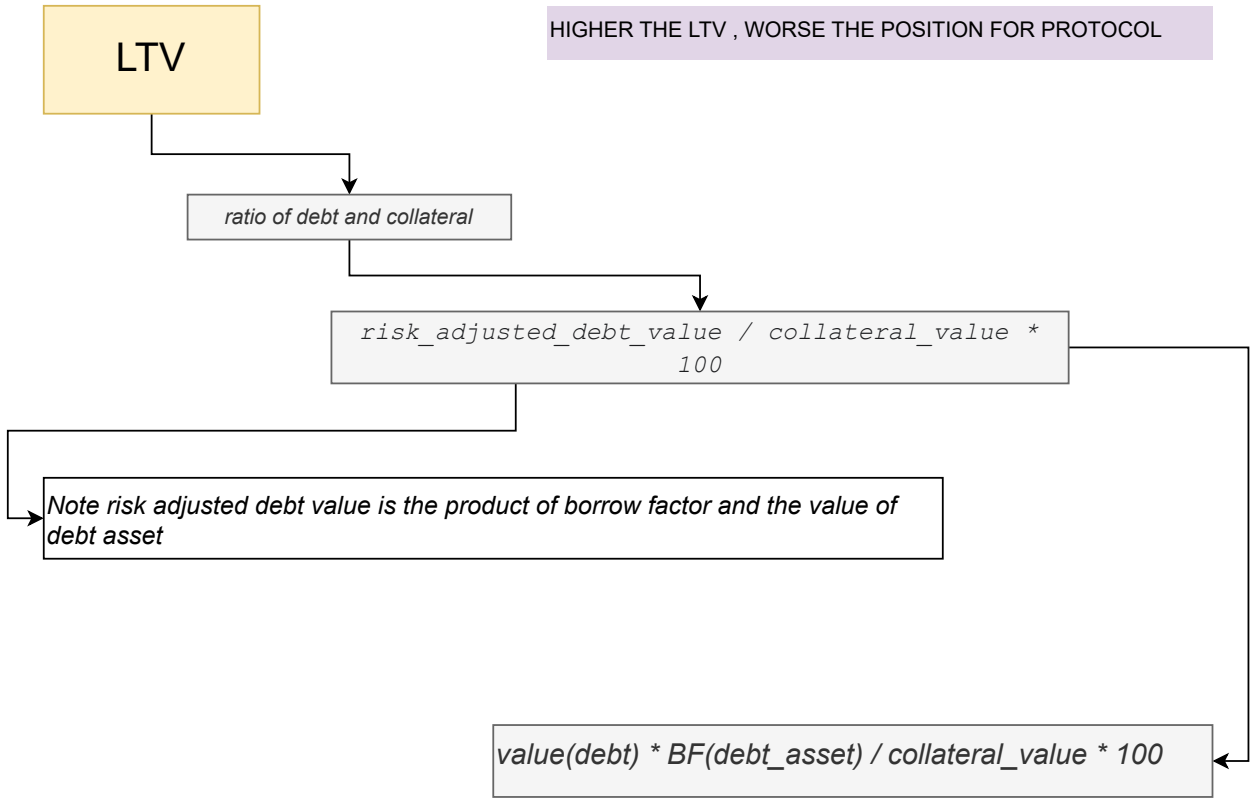
BORROW FACTOR

" Borrow factors (BFs) are risk-adjusted borrow values assigned to each asset on K-Lend. This determines the borrowing capacity of a debt asset within a loan, based on its Asset Risk Score. "

Example :

USDC is deemed a less risky asset than BONK.
- USDC BF == 1
- BONK BF == 2

Note : these are assigned by governance



EXAMPLE

Lets give example of usdc and bonk, where alice puts $100 eth as collateral and alice takes $20 worth of debt:

- usdc
LTV = $20 USDC * 1 BF / $100 ETH * 100
LTV = 20%

- bonk
LTV = $20 BONK * 2 BF / $100 ETH * 100
LTV = 40%

Notice how the LTV changes depending on the borrow factor: even though the debt amount is the same ($20), different borrow factors produce different effective LTVs.

""" Note these
- LTV = Current position health
- Max LTV = Borrowing limit of your position - gives a buffer between Liquidation LTV
- Liquidation LTV = The LTV at which your position becomes eligible for liquidation

Note that Max LTV is set by governance, example SOL has Max LTV of 80%, different assets can have different LTVS

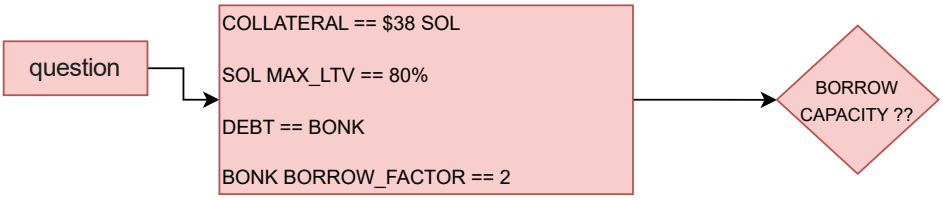
Suppose alice took Sol as debt, since sol has max_ltv of 80%, therefore until his LTV remains under 80% his position is safe, as the LTV crosses this threshold , he is eligible for liquidations """

BORROW CAPACITY

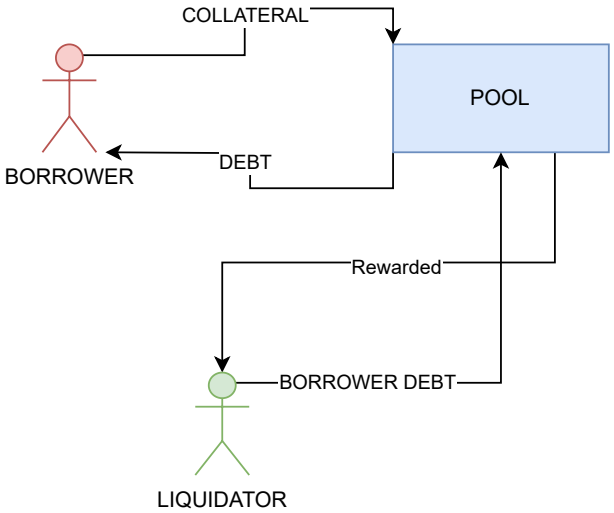
""" K-Lend combines LTV and BF to express a weighted borrowing capacity based on the asset composition of a position. This allows the protocol much more flexibility in assessing the risk of each position on the platform. """

borrow capacity gives the dollar value of how much of debt can be taken at a given value of collateral

(Collateral Value * Collateral MAX_LTV) / Debt Borrow_Factor



LIQUIDATIONS



FULL/ HARD LIQUIDATION

PARITAL / SOFT LIQUIDATION

SELF LIQUIDATION

HOW DO LIQUIDATORS MAKE MONEY

LIQUIDATION PENALTIES

- penalties imposed on borrowers for having bad position

- act as rewards for liquidator

- often in ranges of 5%-10% of debt settled by liquidator

DYNAMIC LIQUIDATION PENALTIES

- Kamino employes dynamic liquidation penalties
- i.e -> worse the position ltv, more the liquidation penalties

- example of dynamic liquidty penalties from kamino:
SOL -> 5% - 10%
BONK -> 5% - 25%

- read more : https://docs.kamino.finance/products/borrow-lend/position-risk-and-liquidations#liquidation-penalty-parameters

EXAMPLE

- for example liquidator repays $10 from your debt

- assuming your collateral == $100, and liquidity penalty is 10%

- first liquidator will get $10 of assets from your collateral , (equivalent to how much debt he repaid in debt asset)

- then he will get 10% of repaid debt from your collateral
*- i.e --> 10% * 10$ == $1*

- liquidator total == $11 collateral_asset

- your collateral will now be $100 - $11 ==> $89

HARD LIQUIDATION

- Also known as full liquidations

- all the collaterals are diluted in repaying user debt and liquidators rewards

EXAMPLE

- suppose you usdc has max_ltv of 80%

- your current ltv == 85%

- debt : $85 usdc ; collateral : $100 eth

- liquidator will pay $85 usdc on your behalf to the pool

- pool will give $85 of eth to liquidator plus

- all remaining collateral will also be given to liquidator as rewards

- therefore, liquidator gets $100 eth, profiting 15$

- while you just hold $85 usdc as settled debt, at the loss of $15

After a hard-liquidation: - The loan is **closed** permanently. You cannot repay or recover any part of your collateral. - The position is effectively over — your only remaining asset is the borrowed crvUSD. - Even if the market later recovers, the collateral is not returned.

PARTIAL LIQUIDATION

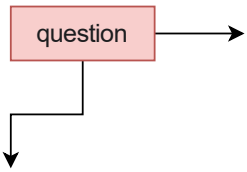
- also known as soft liquidation
- instead of closing entire borrower's position, portion of debt is repaid,

EXAMPLE

- user has borrowed $85 usdc with $100 eth
- LTV_0 = 85% allowed max_ltv == 80%, eligible for liquidation

- since it is just slighty above threshold, he wont be liquidated hardly
so it is up to the protocol on how much partial liquidation is allowed at different levels

so ,
- liquidator will pay 40% of 85 to pool
- liquidator --> $34 ---> pool
- assuming liquidity penalty is 10%
- he will get $34 worth of eth collateral back + 10% * $34 (borrowers eth collateral as rewards for liquidator)
- liquidator gets :: $34.4 == $34 + $3.4
- users debt === $85 - $34 ==> $51
- users collateral === $100 - $34.4 ==> $65.6
- LTV_1 = $51/$65.6 ==> 77.74%



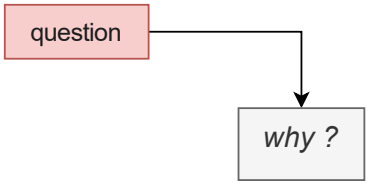
what will happen if liquidator instead of paying 40% of debt , he just pays the exact undercollateralized debt ?
i.e liquidator only liquidates $5 , wouldn't just debt come back to 80$ usdc ??

liquidator pays $5 usdc
liquidator == 5 + 0.5 --> $5.5 eth
user debt == $85 - $5 = $80 usdc
user collateral == $100 - $5.5 = $94.5
LTV === $80/$94.5 ==> 84%

So that is why protocols need to be very precise with these levels. so that liquidations calls are efficient.

SELF LIQUIDATION

when borrower himself liquidates his position

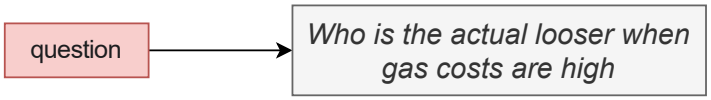


LIQUIDATORS VS GAS COSTS

- Assume liquidator gets $5 as liquidation bonus for liquidating a position "X"

- but gas costs are $50

- so for liquidating position X you are loosing $45



despite having low gas fees sometimes liquidatons can still be unprofitable
- assume position Y has 100% ltv
- that is for each $1 debt there is equivalent $1 collateral
- if liquidator takes this position, he will only get invested capital back
- and will loose amount paid in gas costs
- because there are no more collaterals that can be penalized with liquidation penalty

AAVE

LIQUIDITY THRESHOLD

- how much of your collateral counts as the borrowable value
- borrowing power of collateral

- liquidity threshold of 80% means: For every $100 worth of collateral, you can borrow $80 worth of debt

- these liquidity thresholds can vary per assets according to their risk factors

- note that governance sets these liquidity threshold parameters for each assets

- suppose :
- sol has 80% liquidity threshold, that means for $100 worth of sol you can borrow $80 worth of debt asset
- bonk has 60% liquidity threshold, that means for $100 worth of bonk you can borrow $60 worth of debt asset

WEIGHTED AVERAGE LIQUIDITY THRESHOLD

ratio of summation of liquidity thresholds of different assets and the no of collateral assets

sum of LTs of collateral asset / total no of collateral assets

- suppose you put $50 sol + $50 bonk as collateral

- since both assets have different lts, therefore, we calculate their weighted average

==> assuming sol has 80% lt and bonk has 60% lt
walt ==> 80% + 60% / 2
==> 140%/2
==> 70%

that means $70 of your collateral from ($50 sol and $50 bonk) will be counted as borrowing power, in simpler terms you can borrower $70 dollar worth of against this collateral composition

So, LT VS WALT -->
$100 sol ------> $80 borrowing power (LT)
$100 bonk ------> $60 borrowing power (LT)
$50 sol + $50 bonk ----> $70 borrowing power (WALT)

That is why aave considers weighted average lts, because your position are allowed to have combined collateral composition.

HEALTH FACTOR

$$H_f = \frac{\sum Collateral_i \; in \; ETH \times Liquidation \; Threshold_i}{Total \; Borrows \; in \; ETH}$$

(Total Collateral Value * Weighted Average Liquidation Threshold) / Total Borrow Value

EXAMPLE

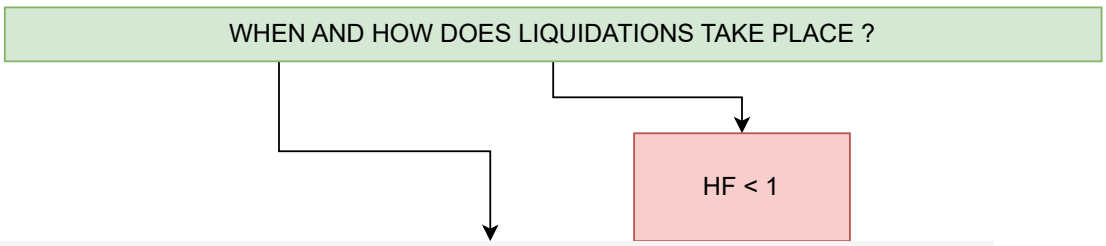
- alice put $50 bonk and $50 sol as collateral

- alice takes $20 usdc as debt

- taking 70% as WALT from previous sections example

*- HF = $100 * 70% / $20*

- HF = 3.5



PARTIAL VS FULL LIQUIDATION ?

- CLOSE_FACTOR_HF_THRESHOLD < HF < 1 ------> DEFAULT_LIQUIDATION_CLOSE_FACTOR gets liquidated
- HF < CLOSE_FACTOR_HF_THRESHOLD --------> MAX_LIQUIDATION_CLOSE_FACTOR

- CLOSE_FACTOR_HF_THRESHOLD = 0.95 //@VALIDATE
- DEFAULT_LIQUIDATION_CLOSE_FACTOR = 50%
- MAX_LIQUIDATION_CLOSE_FACTOR = 100%

FLUID VAULT T1

- the liquidation process --> cost-effective and highly efficient

- full soft liquidatio, just enough to keep position in safer bounds

- low fees as low as 0.1%

- Now you might ask if liquidation penalties are as low as 0.1% , how are liquidations even profitable?

- multi-poisition liquidation to combat gas costs

- dex aggreagator integration: traders act as liquidators, due to the presence of arbitrage opportunity in fluid's virtual pool, where collateral assets being in surplus than debt asset are cheaper as compared to market prices

VISUALIZING DEX AGGREGATOR STYLE LIQUIDATION

Note both liquidation routes are open simulataneously, that means both traders and liquidators can liquidate positions

ADVANTAGES

- low fee

- gas effective ---> multi-position liquidation

- no need for liquidation tracking --> dex aggregator intergration

DIS-ADVANTAGES

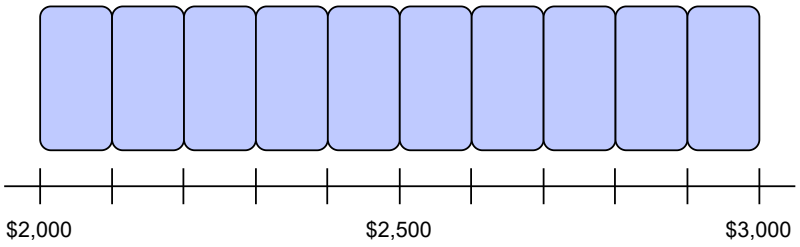
- supports only single collateral types

- low penalty means low liquidator rewards

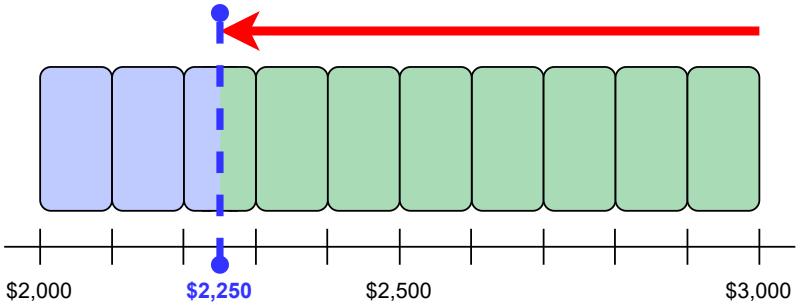
- can't fine tune positions to prevent frequent liquidations due to volatility

crvUSD

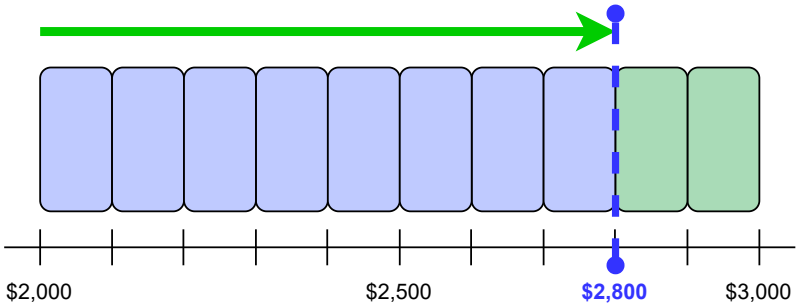
ETH Collateral is split evenly into the chosen number of Bands (N) in the **Soft Liquidation Range**



Soft-liquidation: As ETH Price decreases, ETH is converted to crvUSD through each band



De-liquidation: As ETH Price increases, crvUSD is swapped back to ETH through each band



LLAMMA (Lending-Liquidating AMM Algorithm)

- the borrower can choose between 4 and 50 bands.
- The collateral is then distributed equally across all selected bands
- Together, these bands make up the full liquidation range.
- hard liquidations triggered when health == 0%
- self liquidations are supported to allow users to save liquidation penalties

EXAMPLE

- alice creates debt position with 10 bands

- bands span from $2000 - $3000

- i.e , $100 per band

- alice's collateral == $100 ETH @3100

- alice's debt == $80 crvUSD

- now lets abstract away, liquidity threshold, health factors and penalties....

- suppose ETH drops to $2900

- band no 10 of alice will get liquidated (converted into crvUSD), taking away $10 eth collateral + liquidation penalties

- Now alice's collateral would be:
- y0 == $100 ETH - $10 ETH - penalty

- Eth rises to $3100 again

- alice is now outside of liquidation range

- so the earlier liquidated amount $10 crvUSD will be again converted into ETH and added to alice's position as collateral

- but considering slippage and fees, alice's actual collateral would be:
- y1 == y0 + ($10 ETH - (slippage + amm_fees))

*" This continuous buying and selling between the collateral asset and crvUSD leads to **losses**, due to price movement, fees, and rebalancing inefficiencies. Losses can occur both when the price decreases and when it increases, but only while the loan is inside the liquidation range."*

DISADVANTAGES

- liquidations and deliquidations accumulate losses : penalty, amm_fees, slippage

- dependence on arbitragers for pool rebalancing

- single collateral and debt restriction, ETH <-> USDC

RESEARCH: How arbitrages rebalance pools ? how is then positions liquidated and deliquidated accordingly? how will this system work when the price of debt asset will rise ? since crvUSD is stablecoin, this will require extra research to find out !

https://resources.curve.finance/crvusd/advanced-liquidation/

DISCUSSION

Which protocol Do you feel has the better liquidation mechanism?

What if we benchmark these mechanisms against historical data of their behaviour to different market risks ? How did these systems behave when gas costs were high? when liquidity was low ? when volatily of debt asset or collateral asset was out of control ?

what are your thoughts about this system

crvUSD style banded liquidations , 4-50 bands per liquidation range

Only liquidations and no deliquidations

moderate liquidation penalty of 3%-7%

hard liquidation beyond certain Health factor or LTV

Multi Position liquidation mechanism for minimizing liquidator's gas costs and keeping overall process efficient and fast

Dex integration for adding traders as secondary liquidators