

Systemic Fragility in Decentralized Markets

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Automated Collateralized Lending

Lenders

- Deposit crypto into a pool
- Interest paid is a function of ratio of borrowers to lenders
- Withdraw at any time

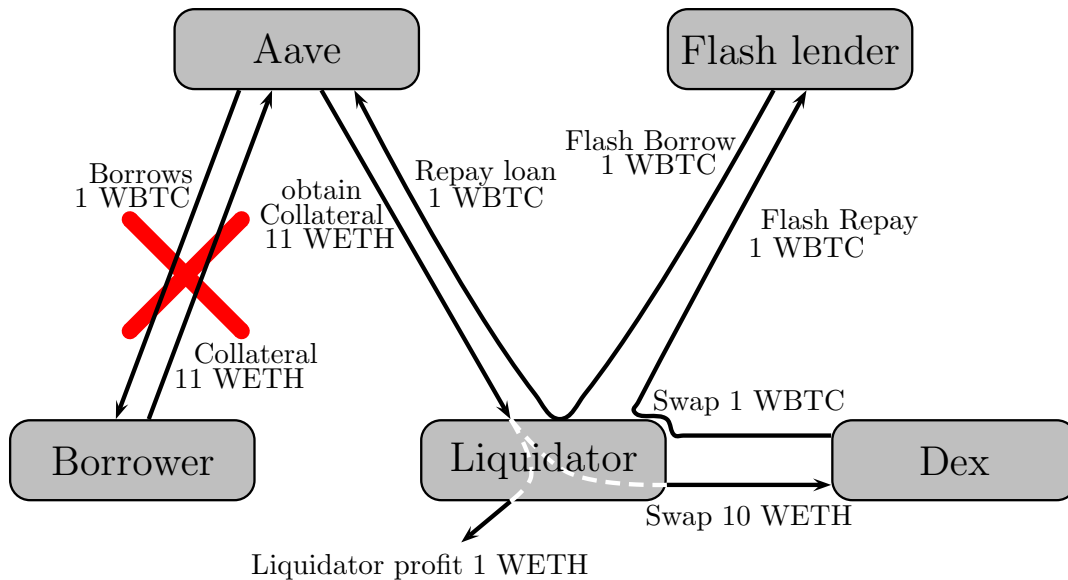


- Floating rate transfers run risk to borrowers.
- Liquidations done by profit maximizing 3rd party traders.

Borrowers

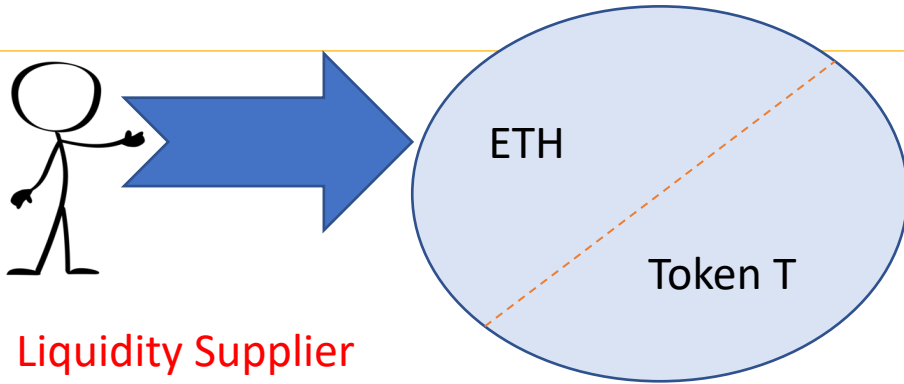
- Deposit crypto collateral into a smart contract
- Pay high frequency floating rate
- Liquidated if LTV is too high

Liquidation Mechanics



- If the value of debt is sufficiently high relative to collateral, liquidators may repay debt, seize some or all of the collateral.
- Liquidators receive collateral at a discount.
- Market value of debt/collateral determined by average of on-chain prices “oracle”

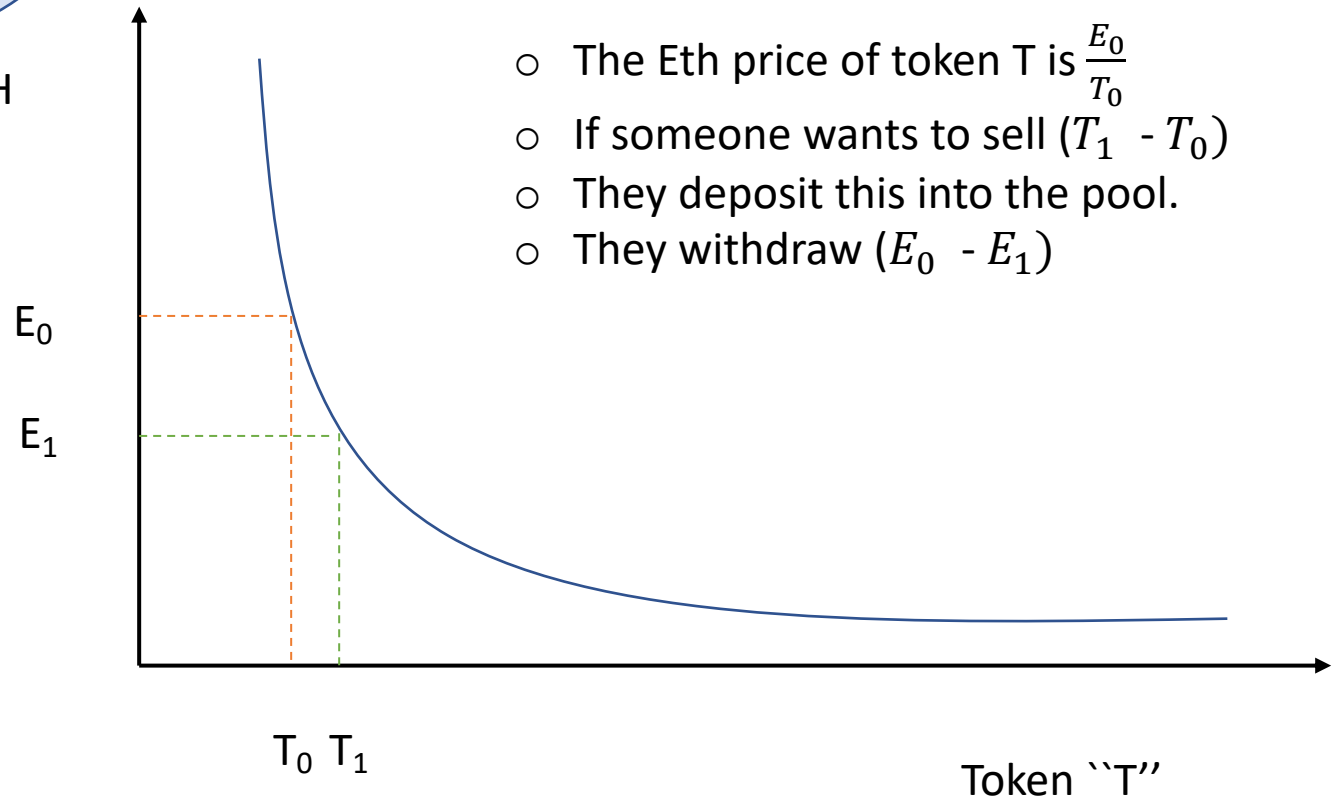
Decentralized Exchange (DEX)



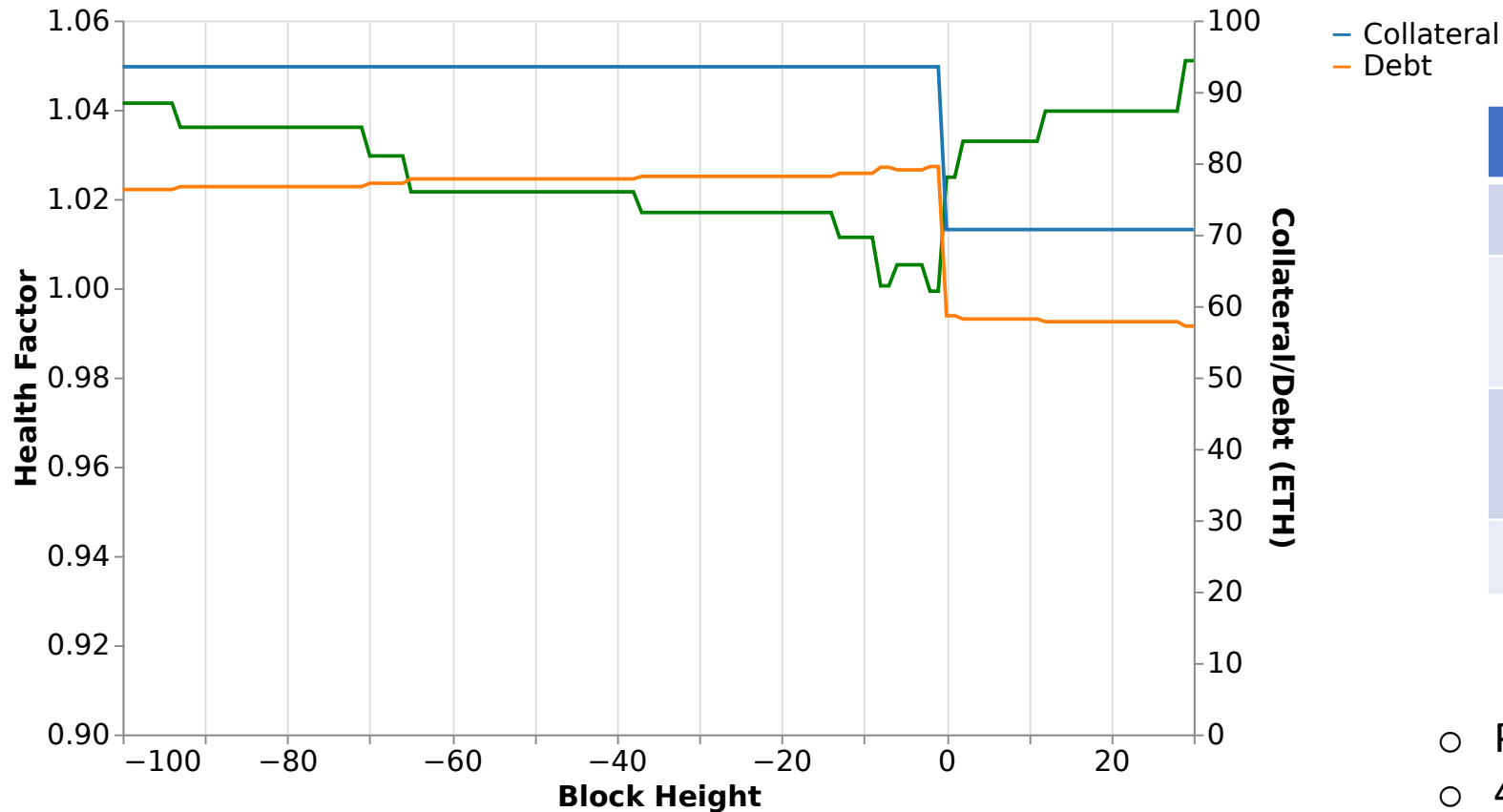
Liquidity Demander exchanges ETH for T
Price impact is **deterministic**

- **Liquidity Supplier** adds ETH, T
- Proportion given by pool
- Receives a liquidity token

ETH



Liquidation: May 12, 2022 USDT Loan vs ETH



Action	USDT	ETH
Pay Debt	-39,330.04	
Obtain Collateral		22.80
Swap ETH for USDT	39,330.04	-21.50
Pay Gas fee		- 0.85

0.45

- Profit 0.45 ETH approx. \$878.76
- 42 other loans on the same day

Data

- 42,324 liquidations from Aave and Compound from Sept 25, 2018 to May 16, 2022
 - 40 distinct collateral tokens and 44 distinct debt tokens
 - Total dollar value: \$2,487,543,097
 - Average liquidation amount \$64,765 with median \$3,587
- Trading data from 8 different decentralized exchanges e.g., Uniswap
- Trading data from Binance (off chain market)

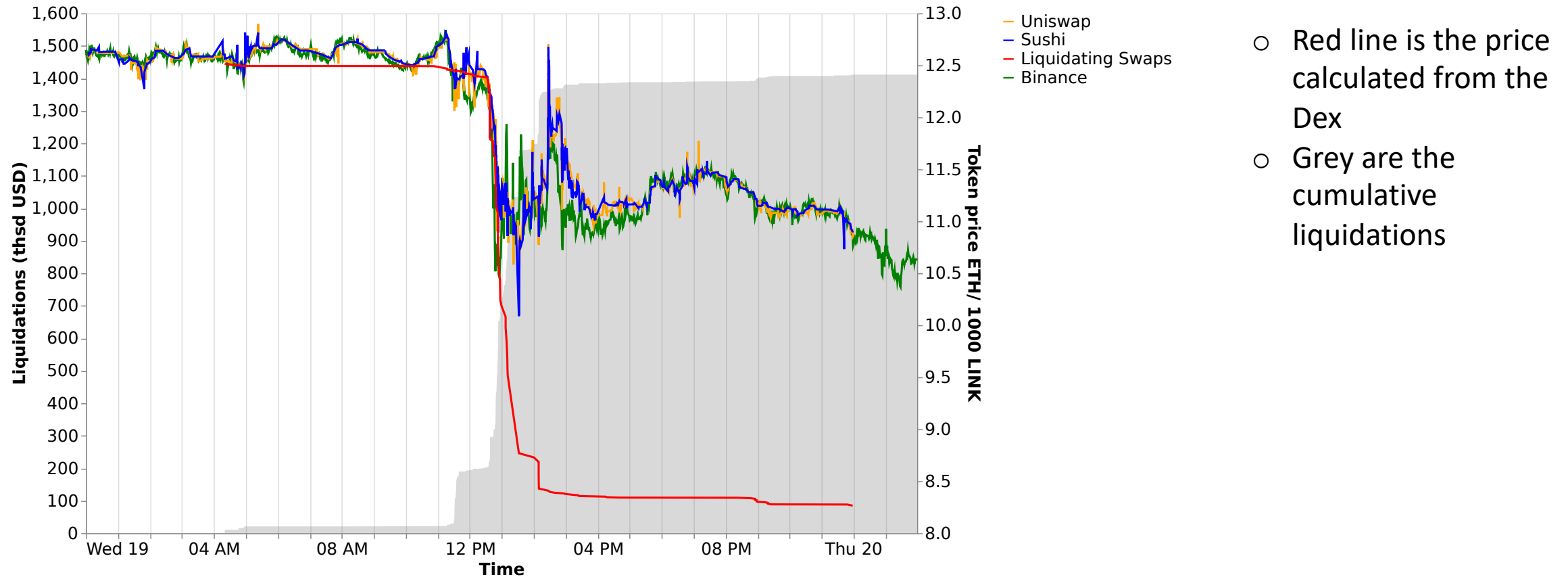
Most popular token pairs

	Collateral		Debt Token	Num. Liq.	Amount USD	Amount ETH
WETH	Wrapped Ether	USDC	USD Coin	6,287	518,773,703	267,019
WETH	Wrapped Ether	USDT	Tether USD	3,952	398,853,641	180,786
WETH	Wrapped Ether	DAI	Dai Stablecoin	5,078	333,387,258	306,990
WBTC	Wrapped BTC	USDC	USD Coin	1,211	162,090,711	69,783
WBTC	Wrapped BTC	USDT	Tether USD	697	124,277,693	51,375
LINK	ChainLink Token	USDC	USD Coin	2,351	85,400,856	49,354
WBTC	Wrapped BTC	DAI	Dai Stablecoin	797	58,693,780	33,513
LINK	ChainLink Token	USDT	Tether USD	1,283	52,097,818	28,281
WETH	Wrapped Ether	WBTC	Wrapped BTC	129	49,183,070	30,326
USDC	USD Coin	USDT	Tether USD	120	39,887,094	18,931

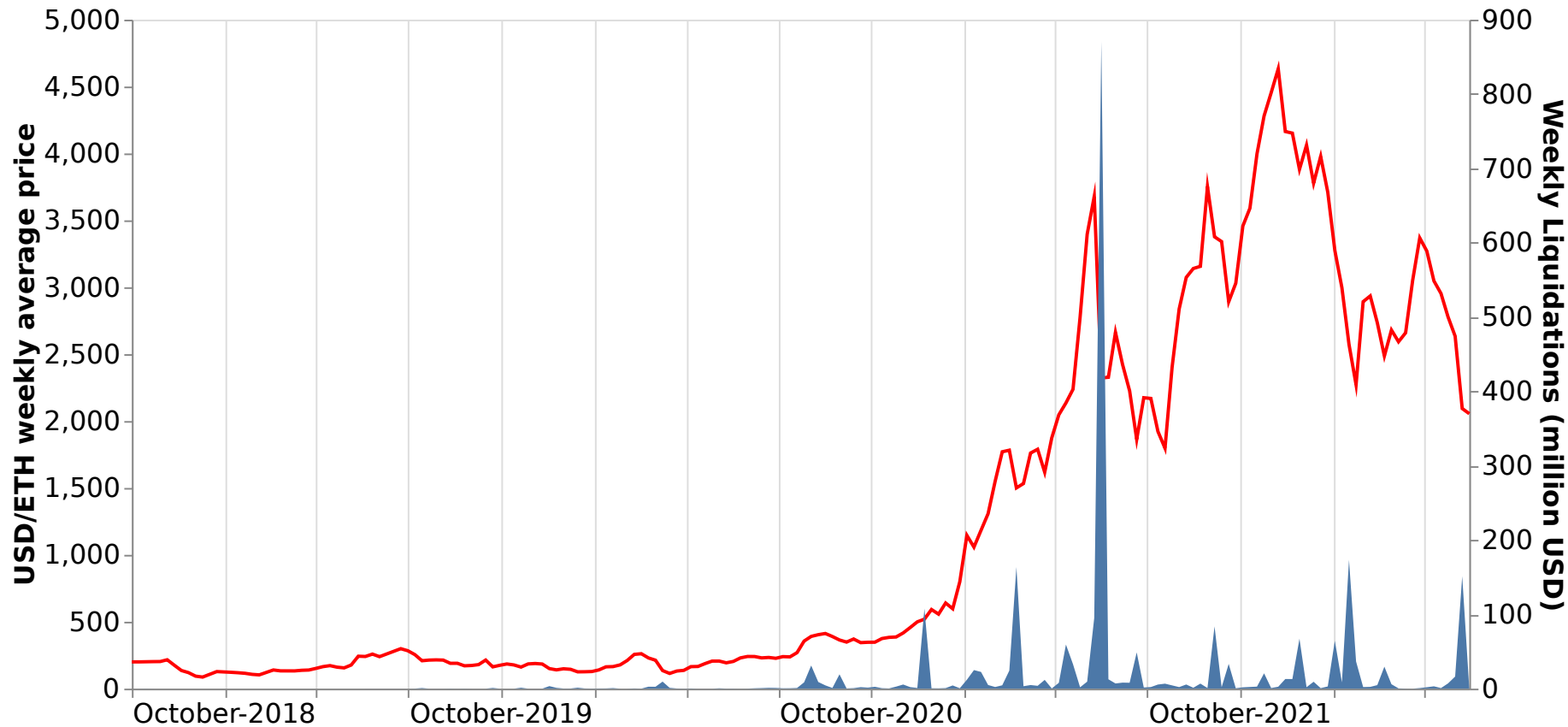
We document

1. Deleveraging trades lead to permanently lower prices
 - Trades affect prices including off chain
2. Negative Feedback loops
 - Trades lead to lower collateral prices
 - More collateral is liquidated
3. Measurable effect on collateral return distributions
 - Liquidated collateral has heavier tails
4. Plausibly strategic behavior of loan liquidators.
 - Evidence that liquidators trade to push positions into liquidation.

180 Liquidations of LINK on May 19, 2021

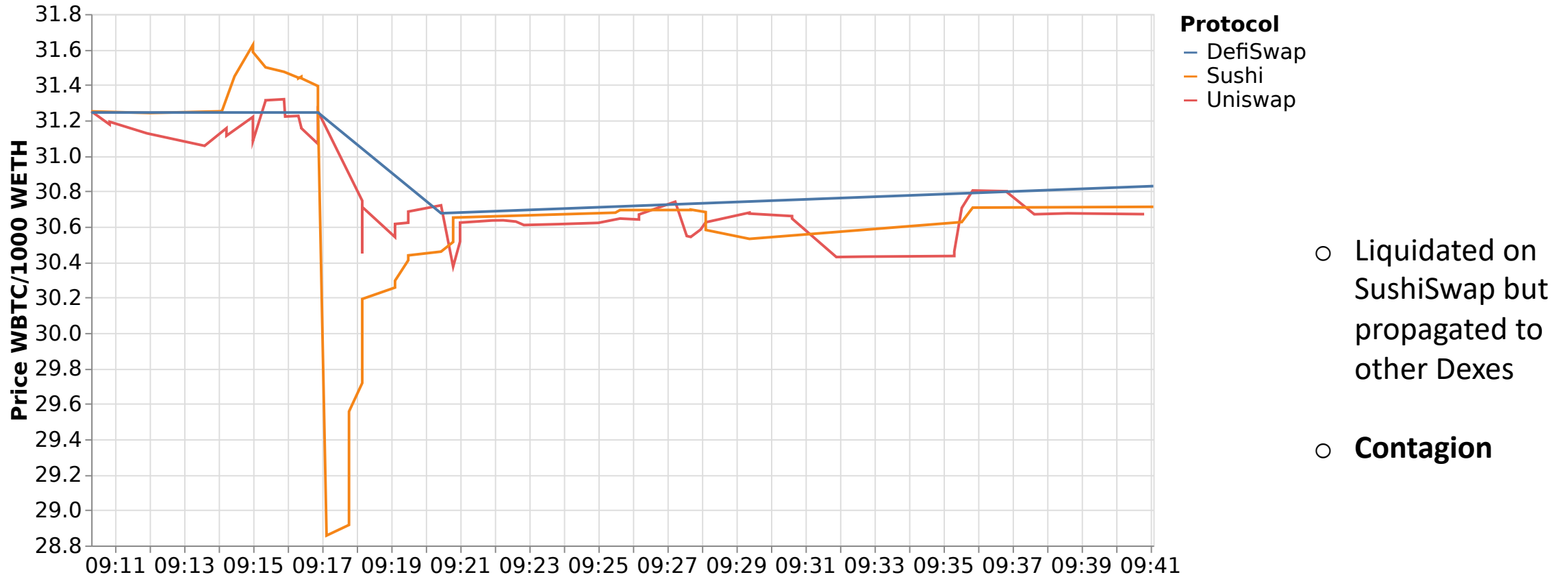


Liquidations occur in waves

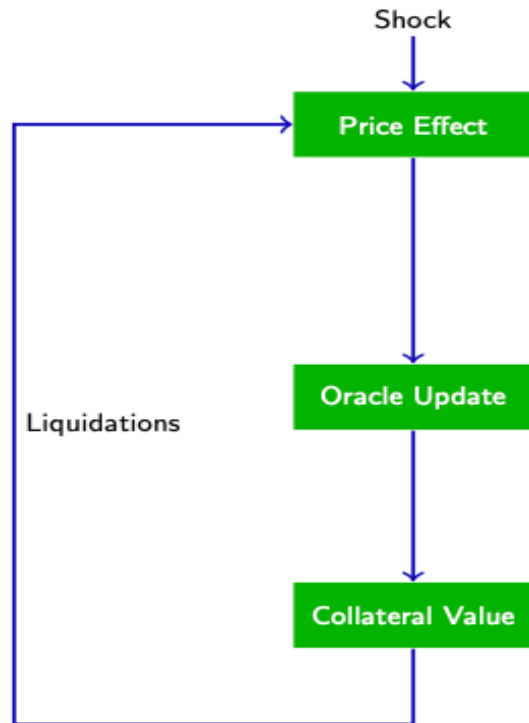


- Wave= liquidation within 1 hr of same collateral token
- Average Wave with 5 liquidations over two hours.

Liquidation of \$20million WBTC on Feb 23, 2021

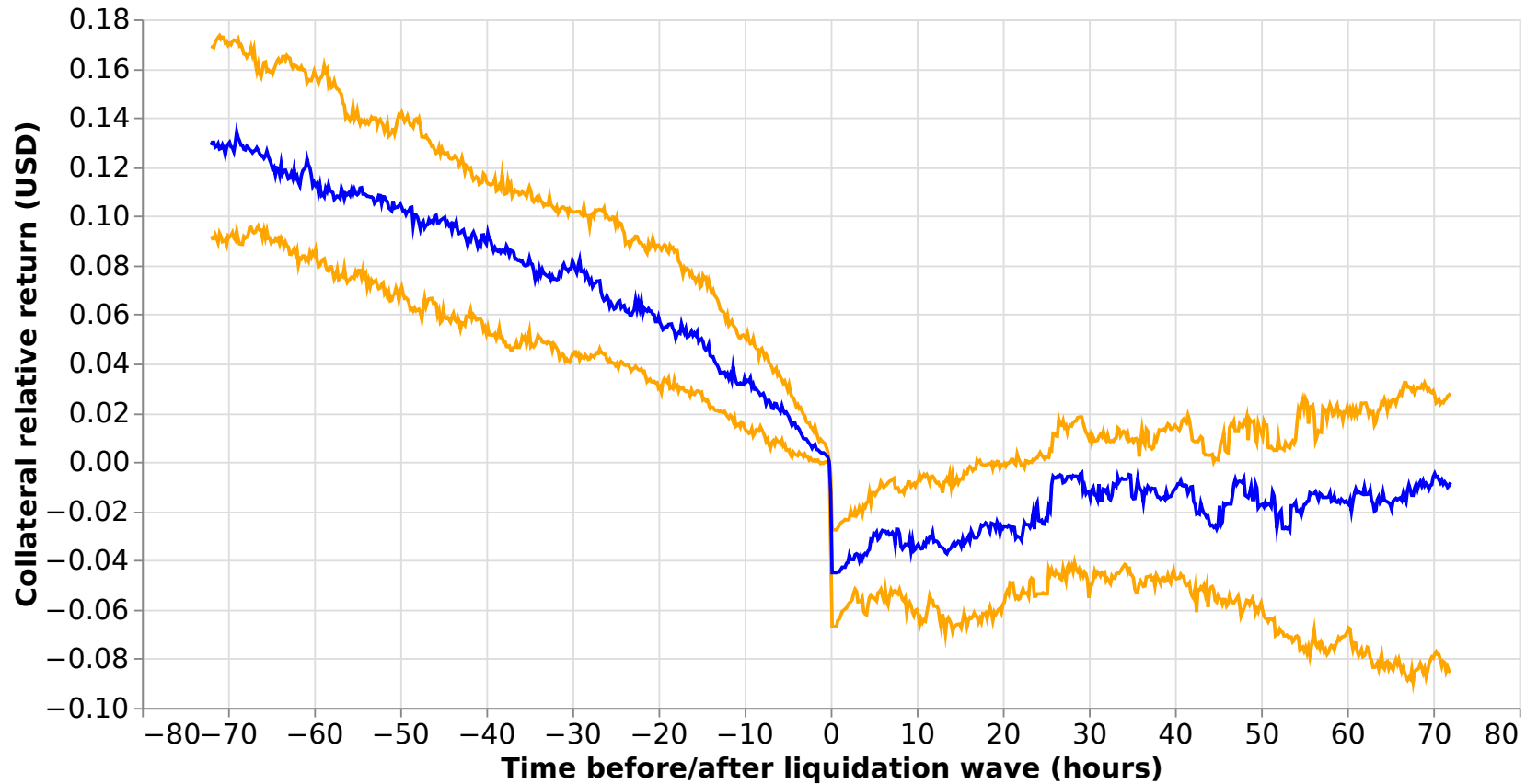


Information feedback loops



- Propagation across exchanges affect oracle prices
- Leads to further liquidations
- Blockchain is a closed information system
- Systemic Fragility

Long term price impact



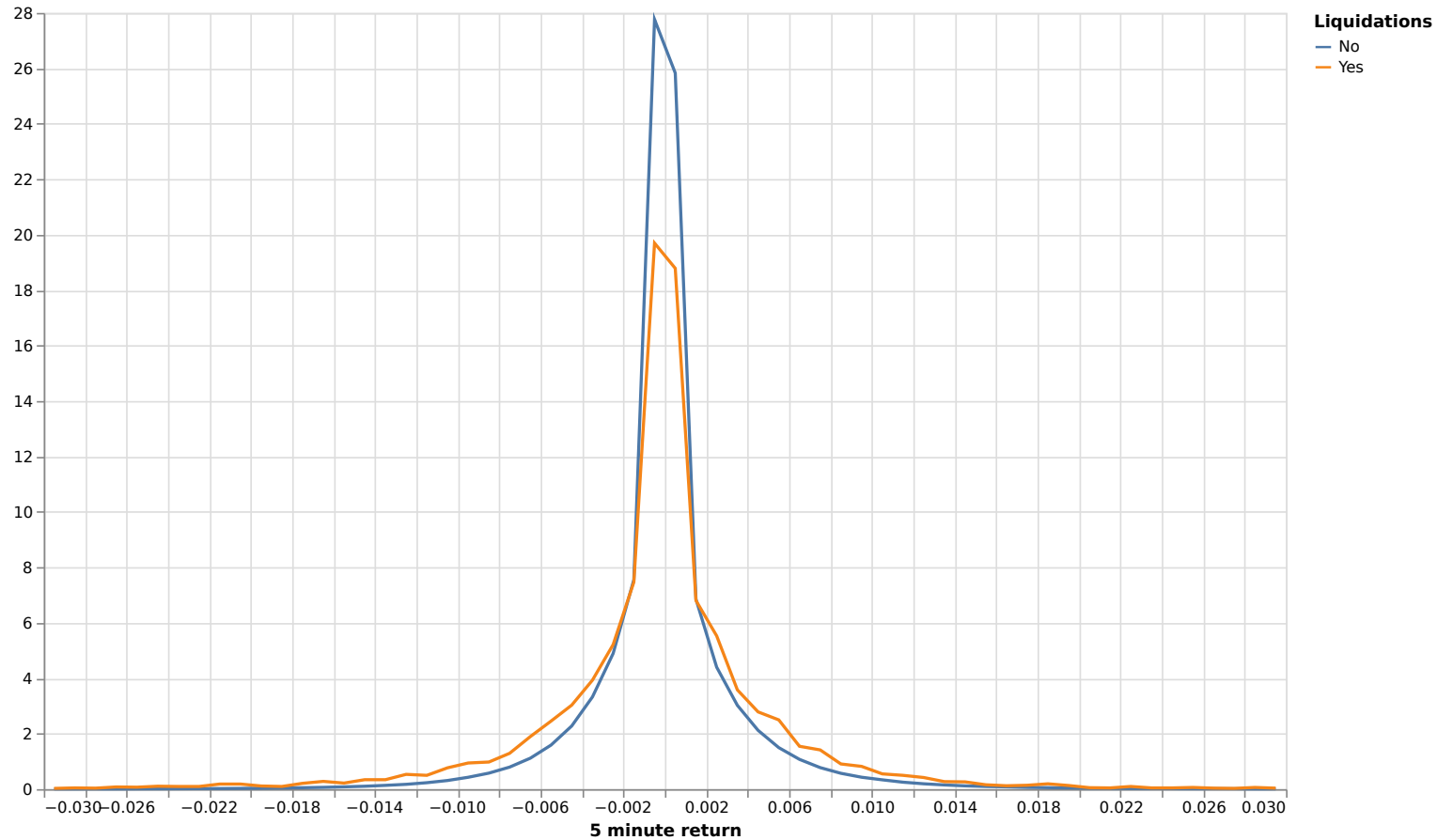
- Return of the collateral token in USD
- Calculated relative to the start of the wave
- Sample of 227 waves with at least 20 liquidations.
- Median and 33% and 66% quantiles

Long Term price impact

- Collateral liquidations are liquidity trades and should not have a permanent price impact.
- Consistent with notion that in incomplete markets, leverage can increase prices. (Geanakoplos + Fostel and Geanakoplos)
- More optimistic agents buy more of the asset which increases price of collateral asset

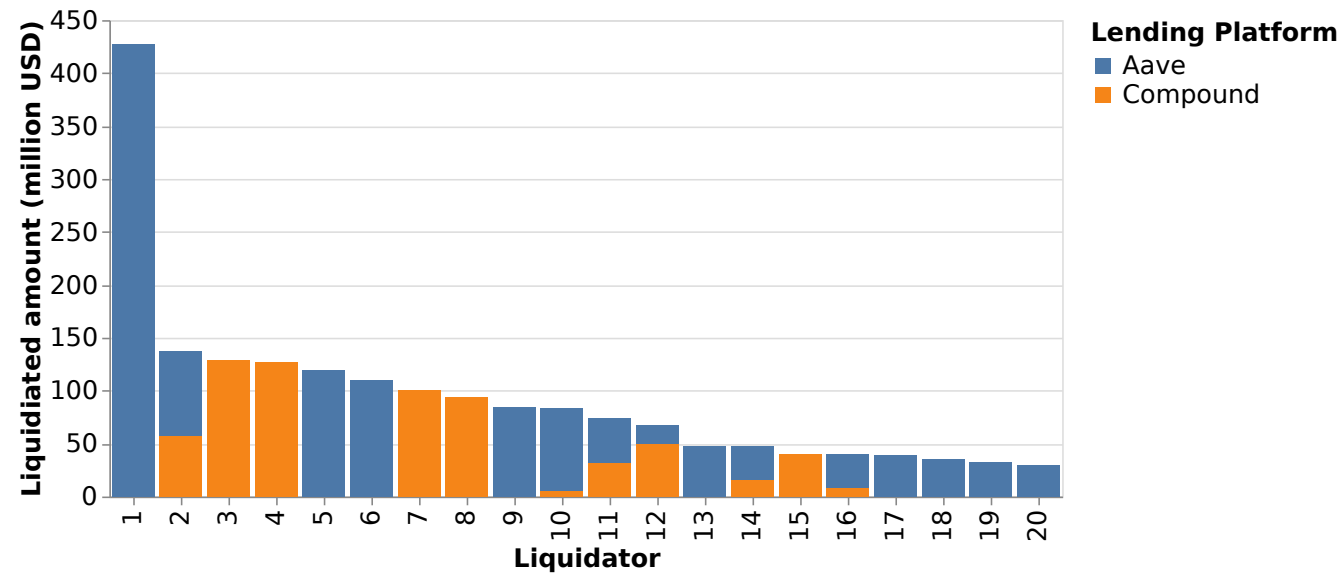
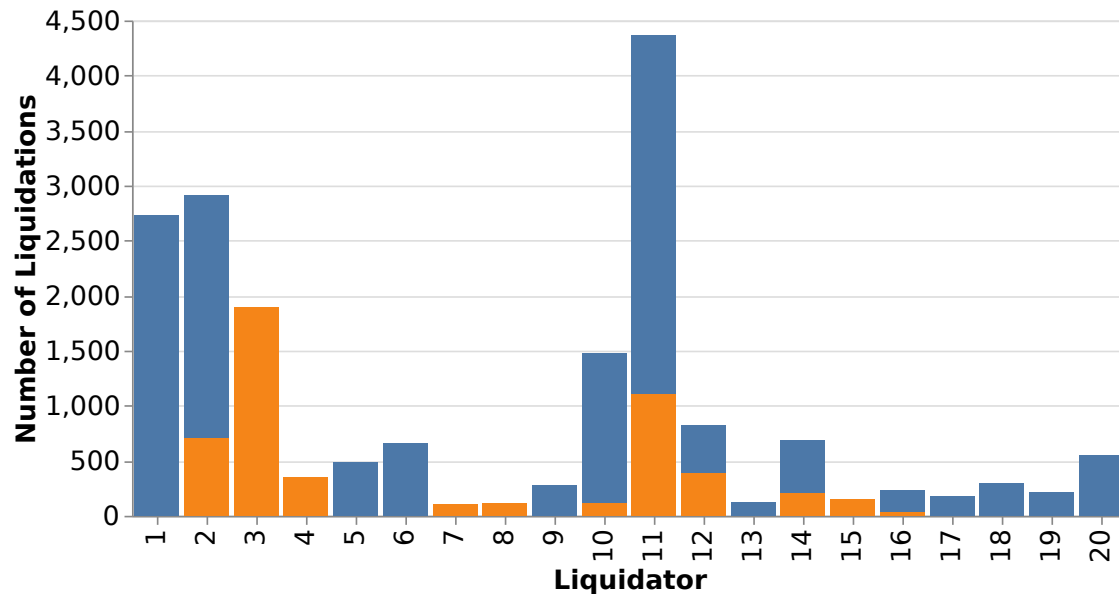
- → Deleveraging reduces the price.

Real Effects of Liquidations



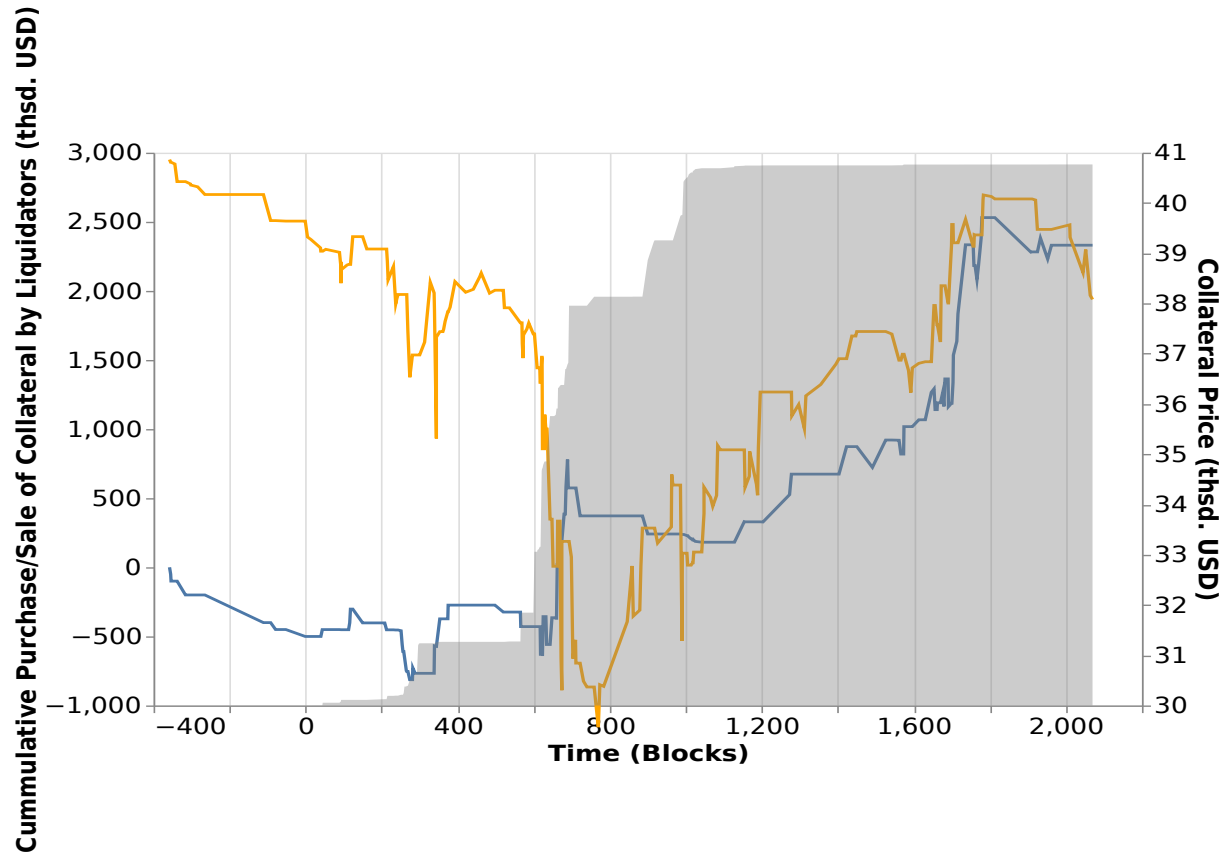
- 2 million 5 minute returns
- 16 collateral assets
- Liquidation return: at least one liquidation in a 5 minute interval
- Distributions are statistically different

Liquidators and their Incentives



- Observe 1,004 liquidators addresses
- Top 20 liquidated 75% of the collateral

May 19, 2021 USD 60 million WBTC liquidated



- 147 Loans liquidated
- Liquidator sold WBTC → price fell → liquidations
- In a larger sample of 11,046 liquidations observe 67.44% reduce their position in the collateral before the wave.

Conclusion

- Aave and Compound have a novel design to mitigate intermediation risk.
- Profit maximizing liquidators have an incentive to liquidate (perhaps excessively) but this mitigates credit risk.
- Price impact of liquidations propagates across exchanges (including off-chain) and is permanent.
- Negative feedback and potentially predatory liquidations
- Risk has migrated from intermediaries to market.