ETH Funding Rates: A Data-Driven Study and Its Effects on USDe's Financial Safeguards

Ethena Labs

November 2023

1 Introduction

Ethena is a synthetic dollar protocol on Ethereum which aims to provide the first censorship resistant, scalable, onchain form of money: USDe. USDe maintains its stability via delta hedging staked Ethereum collateral, eliminating exposure to any fluctuations in value of the collateral backing the synthetic dollar. USDe will be fully backed by Ethereum LSTs, specifically Lido stETH on launch. Ethena will utilize both centralized and decentralized derivative exchanges to place hedges for every dollar of notional worth of stETH.

Yield will be generated from both the stETH collateral and the short ETH perpetual futures position, which on average has been paid to the short side historically. In instances where the combined yield from both positions is negative, the insurance fund sitting alongside USDe will step in and cover any funding payments due.

The purpose of this study is to stress test scenarios where USDes insurance fund is drained. We will examine a range of variables including: adverse funding rates and stETH yields, various take rates, execution costs, notional size of USDe and different levels of growth. The aim of those simulations will be to arrive at a $ size of the insurance fund that we are confident can withstand the most extreme outcomes of each simulation.

2 Background

2.1 Centralized Liquidity

Previous attempts at delta neutral stablecoin have failed to scale to support a market capitalization in the billions of dollars. Those scalability issues were as a result of an exclusive use of decentralized exchanges for their delta hedges, which from a liquidity standpoint, are insignificant in comparison to centralized exchanges. For context, centralized derivative exchanges have 96% of the open interest for ETH contracts. In order to scale into the billions, a delta neutral stablecoin must have access to the liquidity.

Ethena introduces a novel mechanism to access centralized liquidity, storing collateral with custodian partners like Copper and Fireblocks, with no collateral being held on the exchange itself. This minimizes counterparty risk to exchanges - in the event of an exchange failure Ethena can simply redelegate its collateral to another exchange via the custodian.

2.2 Sources of Yield

Perpetual futures pay a funding rate in order to incentivize positions that counter current market demand. Funding rates function to account for the difference between the futures contract price and the price of the underlying. Historically, thanks to a demand for long-side leverage in crypto, perpetual futures have paid the funding rate to the short side.

Combining the short ETH perpetual future yield with stETH allows the protocol to generate returns when sum of both sources of yield is positive. The insurance fund will earn a portion of this yield on positive days to further capitalize the fund. When the combined yield is negative, the insurance fund will be drawn down to cover the payments. Our previous research shows that the combined yield of stETH and short ETH funding is positive on 89% of days.The purpose of this study will be to ensure the insurance fund can withstand the most extreme drawdowns on those 11% of days.

2.3 Sizing

Throughout this analysis we will be testing out different sizes for both the insurance fund and the supply of USDe. As the supply of USDe increases, the notional amount of hedges that will be placed increases which will impact the yield paid or received. We will outline the impact each variable has on yield for different sizes of the USDe supply, with instances of both linear and exponential growth. Our starting point for USDe supply at launch is $100m. Our insurance fund sizes we will be testing are $5m, $10m and $20m.

3 Funding Rates

3.1 Methodology

In this study we will use funding rate data since inception (March 2021) on the exchanges examined, which can be found in the appendix. An open interest weighted funding rate is used to ensure an accurate representation of the market rate. Ethena will be constantly running internal checks on the makeup of our hedging positions, aiming to stick closely to the open interest share per exchange and not drifting too far over time from the OI weighted funding rate.

As the protocol will be generating yield from stETH positions as well as short ETH positions, we will use the combined yield of both for this analysis. The combined yield since 2021 has averaged 10-12% annualized, and 12.2% annualized so far in 2023.

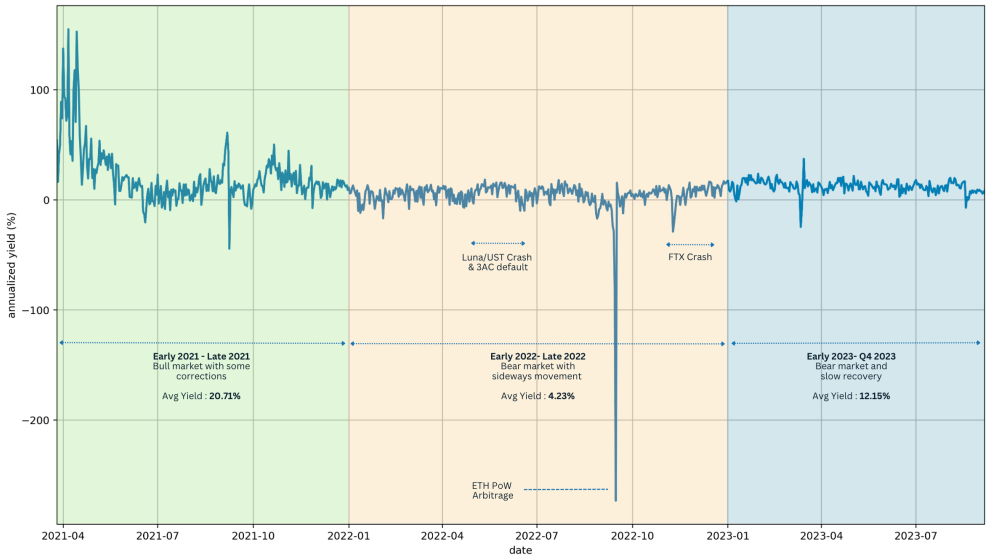

Figure 1: USDe Floating Yield (ETH OI Weighted Perpetual Funding Yield + stETH Yield

As the purpose of this analysis is to stress test the insurance fund by testing over the most extreme outcomes of different variables, a recurring theme throughout this analysis will be charting the effect different funding rate scenarios have on the balance of the insurance fund. Using past values for funding rates, we have established two bear scenarios; a conservative one and an aggressive one, as well as a neutral scenario for funding rates.

	Standard Regime	Conservative Regime	Aggressive Regime
mean	11.626	9.626	7.626
min	-273.190	-275.190	-277.190
25%	5.462	3.462	1.462
50%	10.380	8.380	6.380
75%	14.920	12.920	10.920
max	155.060	153.060	151.060

Table 1: USDe Floating Yield Regimes Stats Table

Both the bearish funding rate and very bearish funding rate scenarios subtract 2% and 4% annualized from the standard funding rate respectively. The standard funding rates are the actual observed funding rates to date.

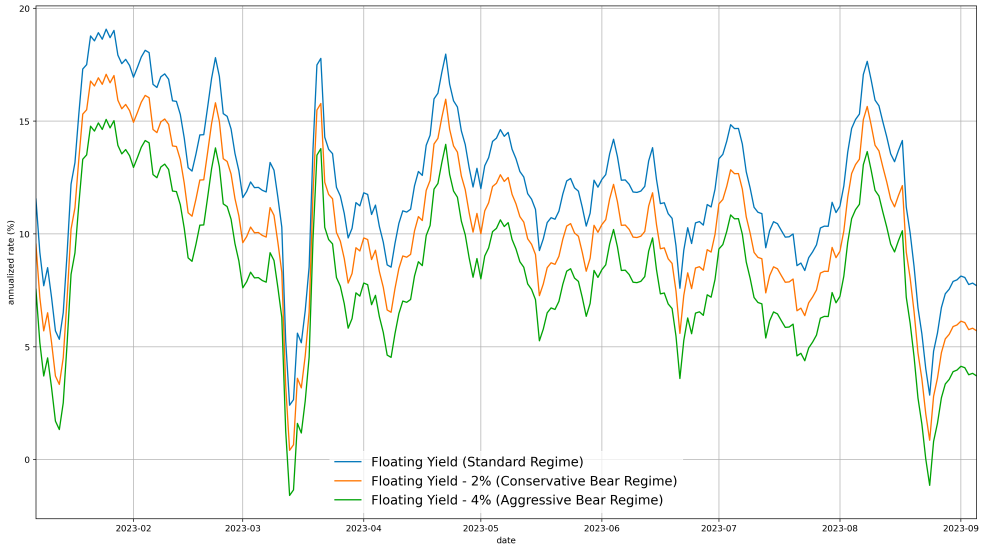

Figure 2: USDe Floating Yield Regimes, 7-day Moving Average

Unfortunately, the ETH Proof of Work arbitrage in September 2022, saw funding rates dip as low as -300% annualized, which makes it tough to visualize the rest of the funding rates and polluted the data set for a one-off event.

The ETH Proof of Work (PoW) arbitrage trade happened as a result of the ETH PoW airdrop, where ETH holders would be rewarded with a token for simply holding spot ETH in most cases. This led a large amount of traders to take up not only a long spot ETH position, but also a short ETH perpetual futures position or futures position to eliminate their ETH price exposure while still remaining eligible for the airdrop.

This delta neutral trade led ETH funding to drop to its lowest levels ever for a short period of time. Once the airdrop was rewarded, those traders closed their shorts and funding reverted back to a positive level soon after. Below we have broken down funding rates by quarter, as well as taking moving averages, to give a better picture of bullish and bearish periods for funding rates since 2021.

3.2 Data exploration

3.2.1 Moving averages

Below we have charted both the 7 day and 30 day moving average for the open interest weighted funding. Both charts show funding hovering around 10% consistently.

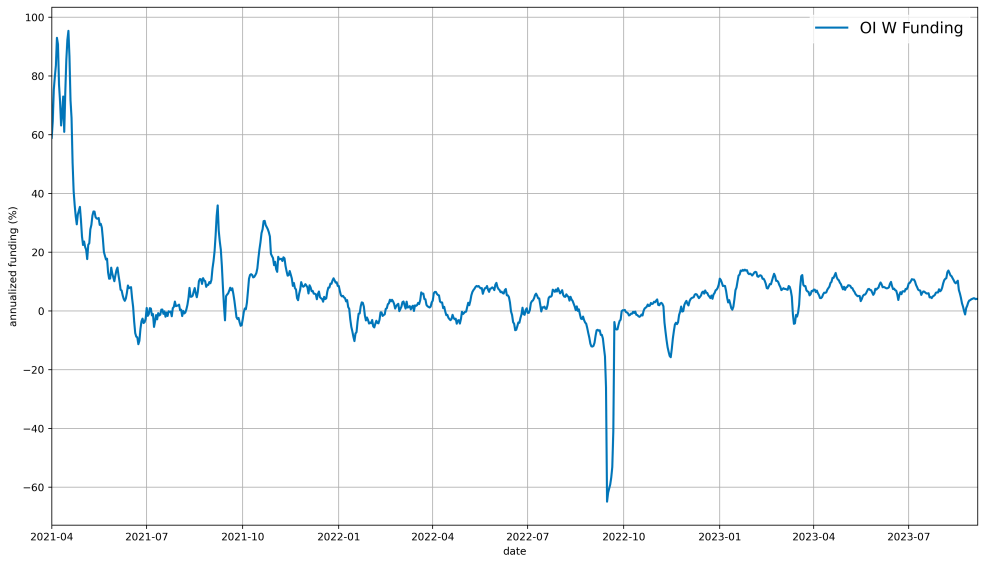

Figure 3: ETH Open Interest Weighted Perpetuals Funding Rates, 7-day Moving Average

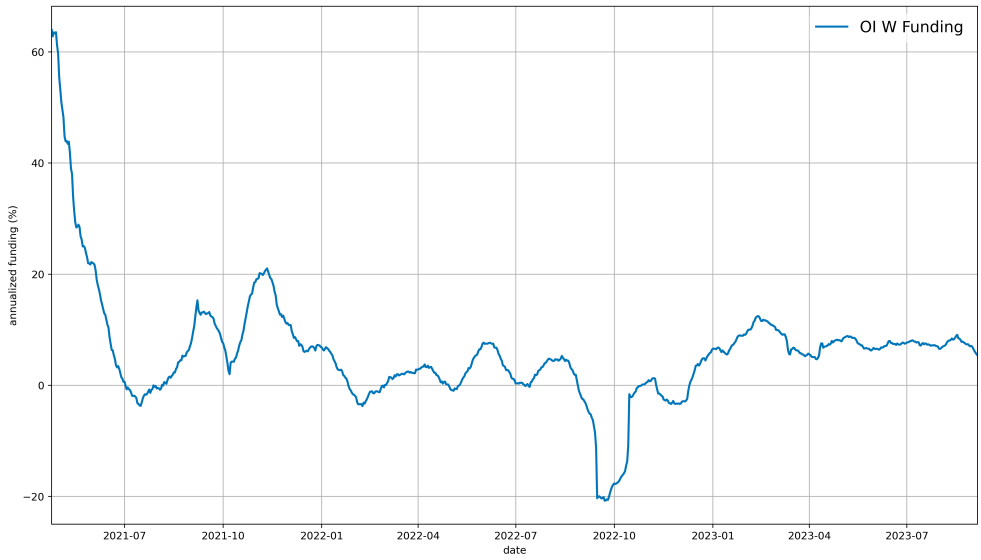

Figure 4: ETH Open Interest Weighted Perpetuals Funding Rates, 30-day Moving Average

3.2.2 Quarterly View

Funding rates in Q4 2021 reflected the strong bullish demand in the space, with long positions paying shorts 40% annually to go long ETH futures. As a bear market began in 2022, we can see funding rates regularly dipped below zero, however they did not persist negative and regularly flipped positive.

Q4 21 & Q1 22

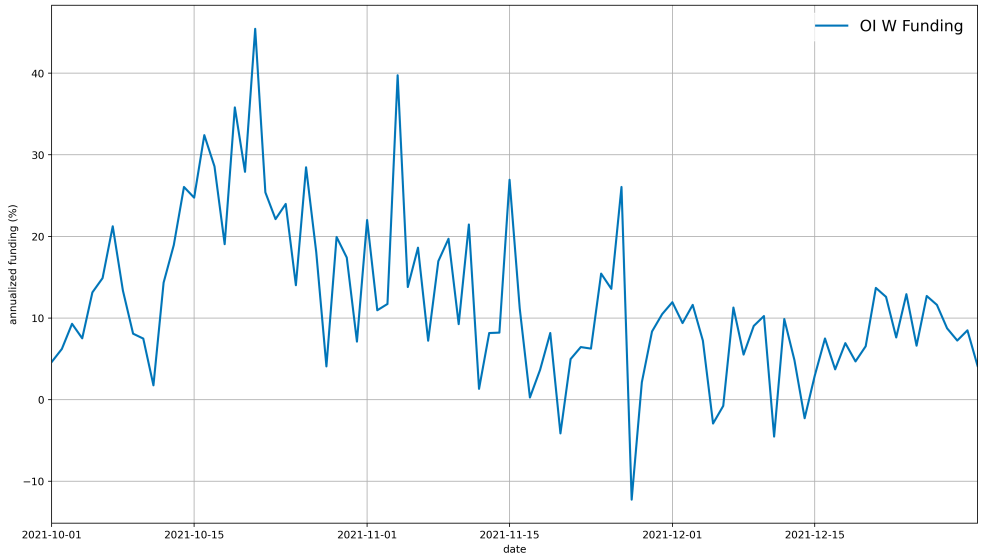

Figure 5: ETH Open Interest Weighted Perpetuals Funding Rates, Q4 2021

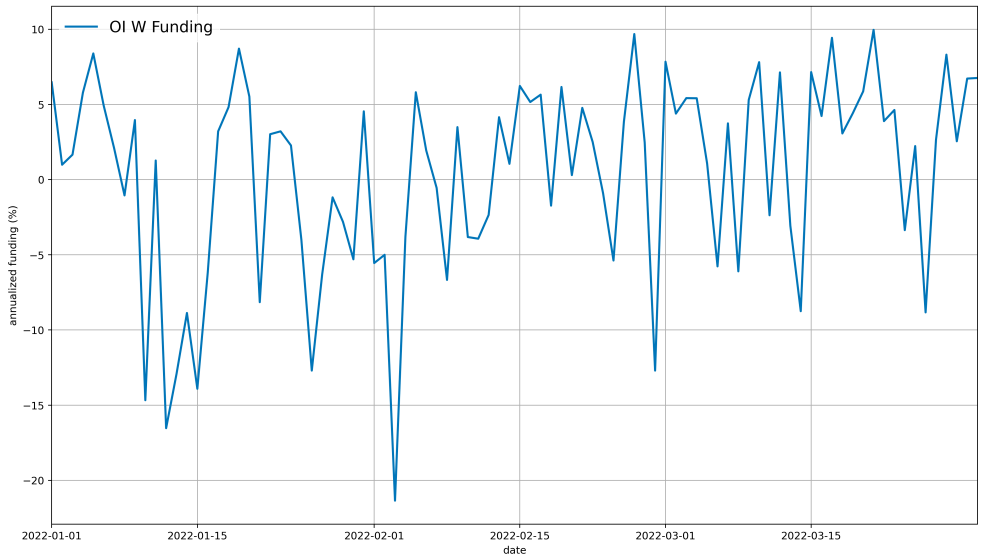

Figure 6: ETH Open Interest Weighted Perpetuals Funding Rates, Q1 2022

Q2 22 & Q3 22

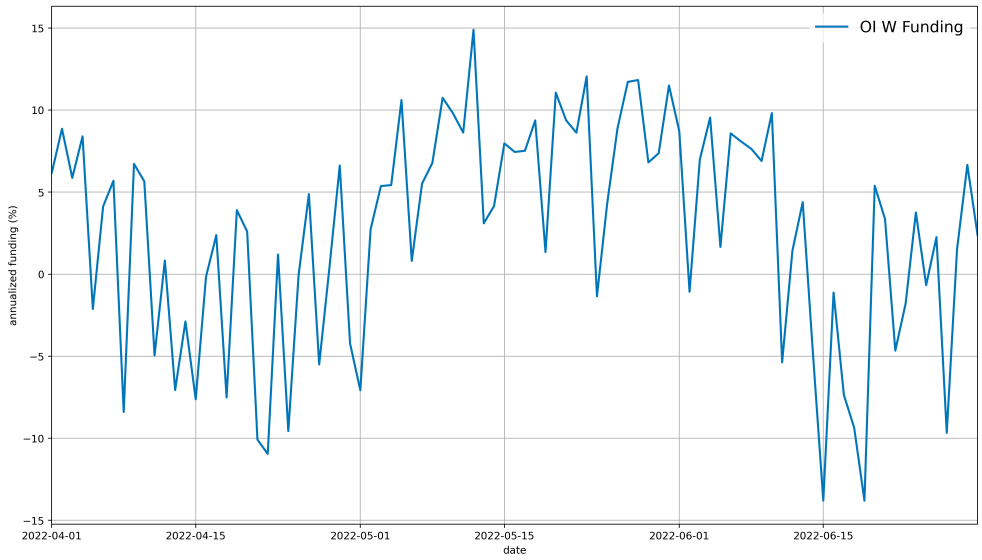

Figure 7: ETH Open Interest Weighted Perpetuals Funding Rates, Q2 2022

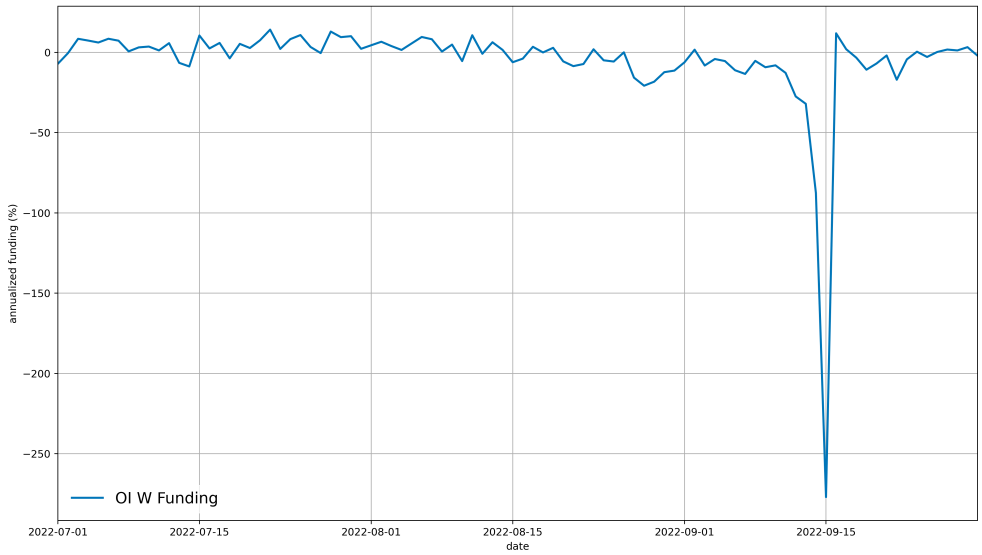

Figure 8: ETH Open Interest Weighted Perpetuals Funding Rates, Q3 2022

Luna/3AC Collapses Q2 22

The collapse of Luna and 3AC in Q2 2022 had a surprisingly muted impact on ETH funding rates during that period. During the Luna collapse, funding rates never dipped negative, and were negative for only 4 days during the 3AC fallout before bouncing between positive and negative for a handful of days.

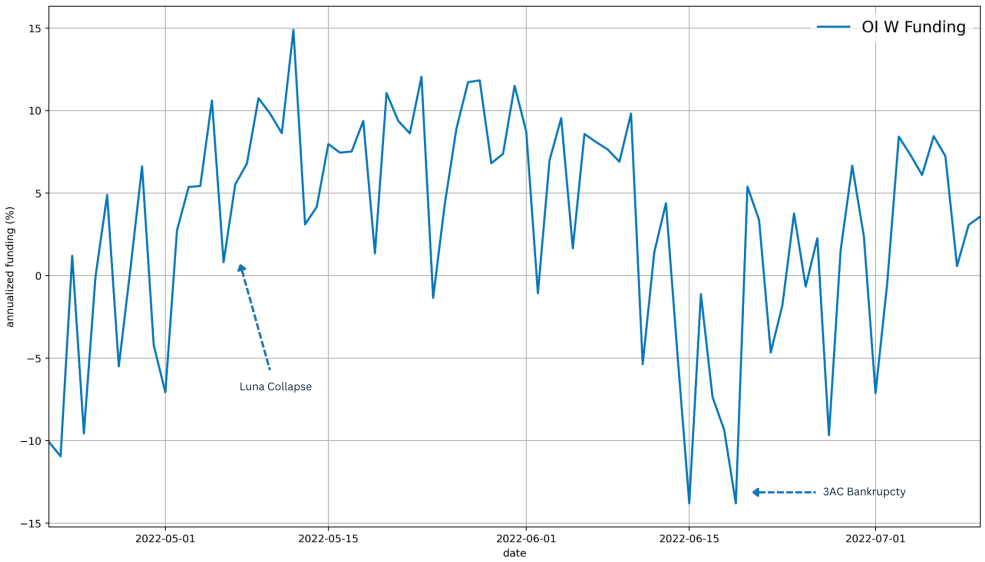

Figure 9: Zoom on Open Interest Weighted Perpetual Funding During Luna & 3AC Collapse

FTX Collapse Q4 22

The collapse of FTX is a perfect example of how funding rates react during an exchange failure. We can see they dipped lower than -30% annualized, but reverted quite quickly to a positive value.

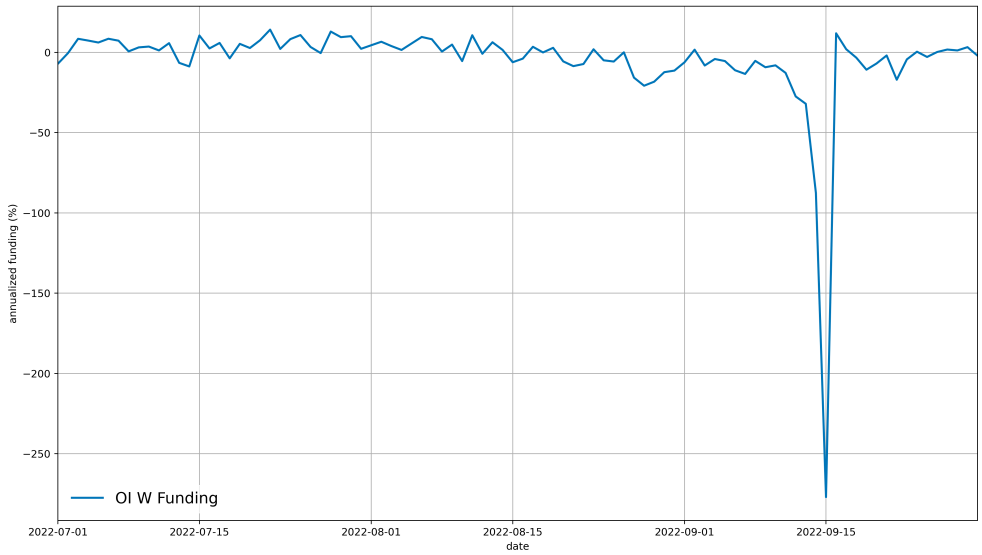

Figure 10: ETH Open Interest Weighted Perpetuals Funding Rates, Q4 2022

YTD 23

2023 has been a broadly consistent period for funding, with very few negative spikes downwards and a consistently hovering around 8%.

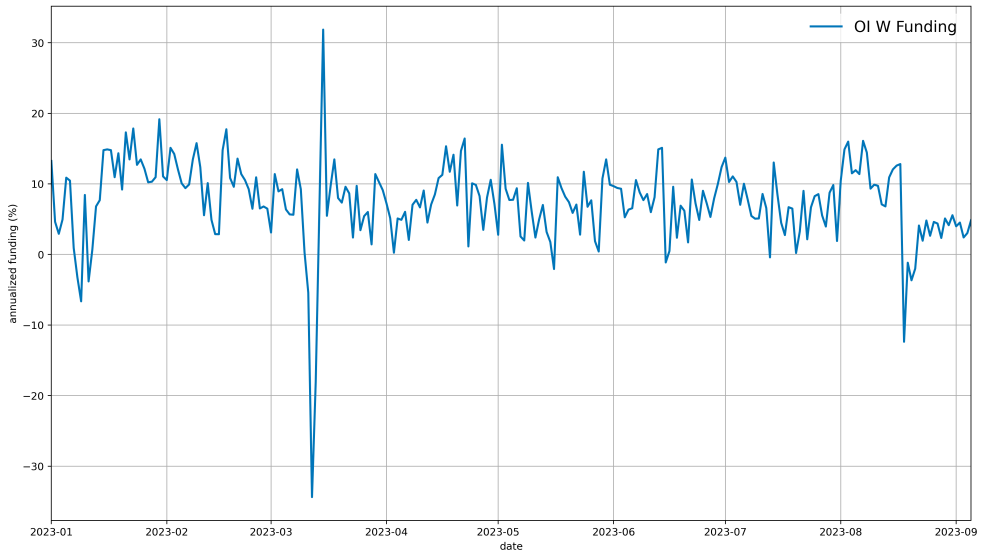

Figure 11: ETH Open Interest Weighted Perpetuals Daily Funding Rates, YTD 2023

3.2.3 Distributions

Funding rates skew positive thanks to a number of factors, but largely due to both a supply demand imbalance, with more demand to go long, and positive funding rates on some of the biggest derivative exchanges (Binance, Bybit). Those long biased skews can be viewed in both charts below.

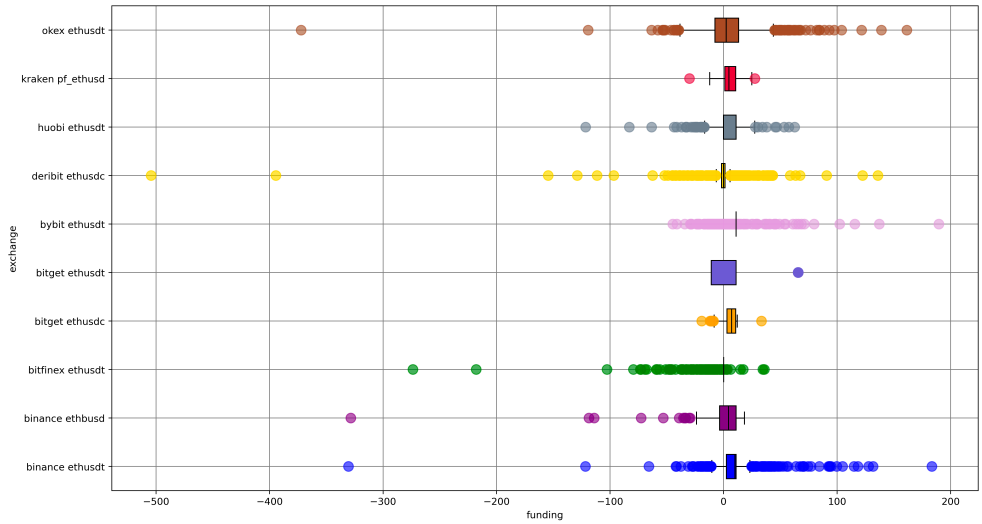

Figure 12: ETH Linear Perpetual Futures Funding Rates Distributions

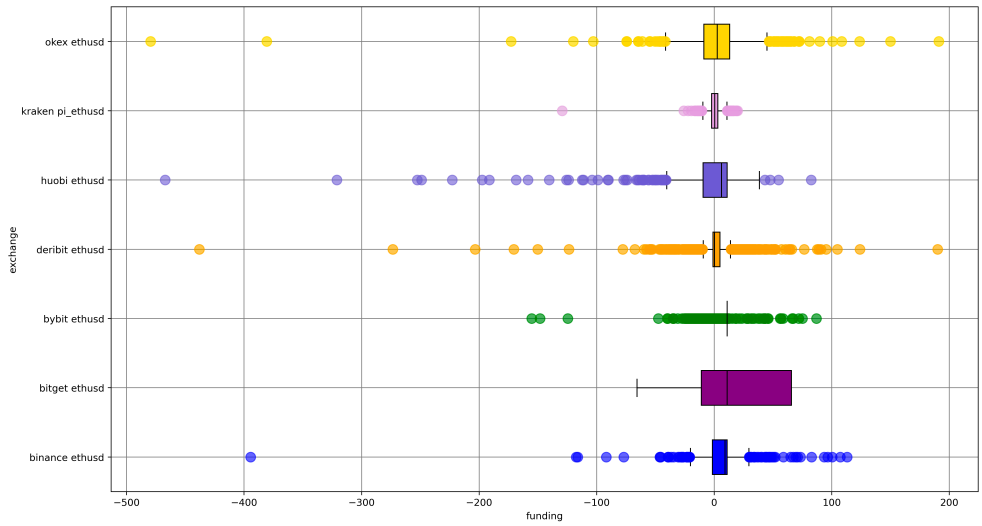

Figure 13: ETH Inverse Perpetual Futures Funding Rates Distributions

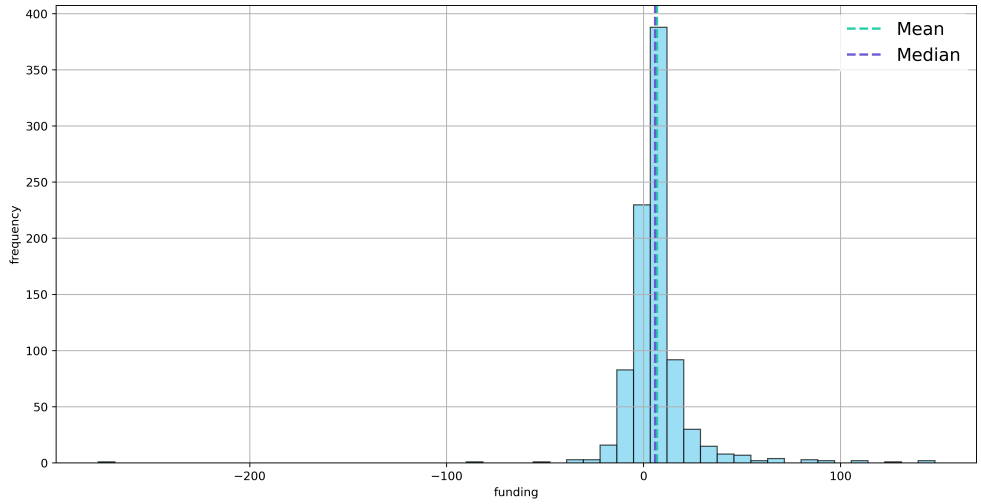

Figure 14: Distribution of Daily ETH Open Interest Weighted Perpetuals Funding Yields

3.2.4 Stats Table

	The Merge	USDC Depeg	FTX Crash	Luna & 3AC
count	31	32	61	83
Mean	-13.258	6.675	6.880	7.946
Min	-273.190	-8.150	-28.840	-9.810
25%	-7.395	4.677	3.210	5.125
50%	-1.580	8.445	8.710	9.370
75%	4.375	10.762	11.950	12.400
Max	15.670	13.770	17.070	18.500

Table 2: Descriptive Stats of Funding Rates During Key Events

	Early '21	Late '21	Full Year '21	Post C19 '21-'22
count	67	153	261	646
mean	47.005	13.795	21.357	11.413
min	-4.100	-44.290	-44.290	-273.19
25%	25.805	6.890	8.120	3.425
50%	37.520	13.010	14.920	9.130
75%	56.510	19.910	28.370	14.295
max	155.060	61.150	155.060	155.060

Table 3: Descriptive Statistics of Funding Rates During Bull Regimes

4 Simulations

4.1 Assumptions Overview

Throughout the simulations in the rest of this report we will be testing different variables to determine their impact on the insurance funds solvency. If the insurance fund goes bankrupt for a certain size, we know to increase the sizing to cover the impact of that variable. The variables we will be testing are:

- **Take Rates**: On days when the combined yield between stETH and futures funding rate is positive, the insurance fund will be capitalized with a percentage of that yield. We test out the effects of a 50%, 20% and 10% take rate for the insurance fund.

- **Growth Curves**: Allowing the insurance fund more time to capitalize itself with a slow growth curve of USDe helps the fund grow in size before having to make big payments on a large notional of USDe. We test out the effects of both early and late exponential growth, as well as testing out linear growth in other parts of our analysis.

- **Growth Sizes**: The payments to settle funding rates will be dependent on the supply of USDe that needs to be hedged. We tested the impact on the insurance fund of a growth to $1bn, $2bn and $3bn over a two and a half year timeframe.

- **Funding Rates**: As mentioned earlier, we will be testing out the difference funding rates make, using historical funding rates, bearish funding rates and very bearish funding rates to simulate outflows from the insurance fund.

4.2 Sample Scenario

Below we have charted a very atypical scenario for the USDe insurance fund to start. Using a starting amount of $10m for the insurance fund, using historical funding rates observed in the last cycle, with 50% keep rates, 50 bps transaction costs for the insurance fund and a growth of TVL from $100m to $5bn over nearly 3 years. We can see the insurance fund grow in this scenario from $10m to $140m.

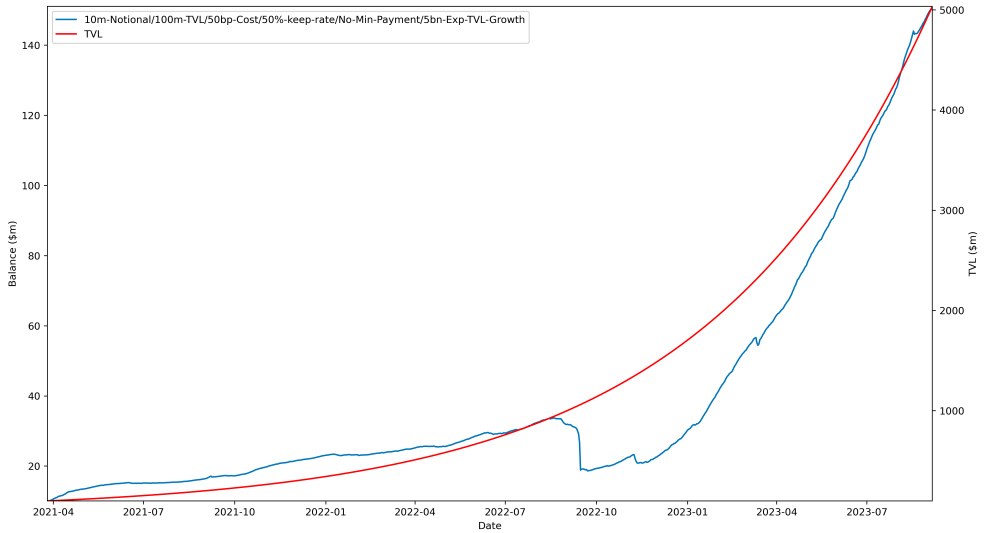

Figure 15: Insurance Fund Behavior with 10m initial notional, 50bps cost, 50% keep rates, no minimum yields and an initial TVL of 100m growing to 5b over the period

The rest of the analysis will aim to stress test the insurance fund with more bearish projections for both funding rates and growth, as well as testing out different take rates. Throughout the analysis we will test out scenarios based on three different final TVL sizes, $1bn, $2bn and $3bn using different types of growth curves.

4.3 Effect of Keep Rates

On days when the protocol is earning a positive yield, the insurance fund will be capitalized with a percentage of the yield earned. It is worth noting this is only on positive days, on negative yielding days the insurance fund will be paying out 100% of yields due.

Below we examine the impact of different take rates, namely 10%, 20% and 50% of yields going to the insurance fund, each with different funding rate scenarios and USDe growth rates.

A linear growth model will be used for our take rate test here. Later on in our analysis, we will simulate scenarios with different growth curves.

4.3.1 Balance at 50% Take Rate

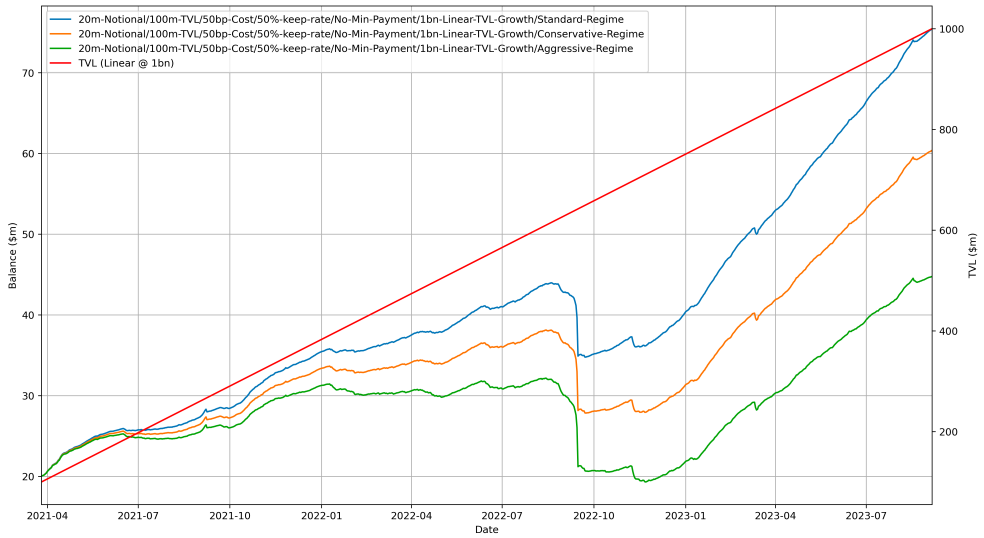

Figure 16: Insurance Fund Behavior with 20m initial notional, 50bps cost, 50% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 1b over the period

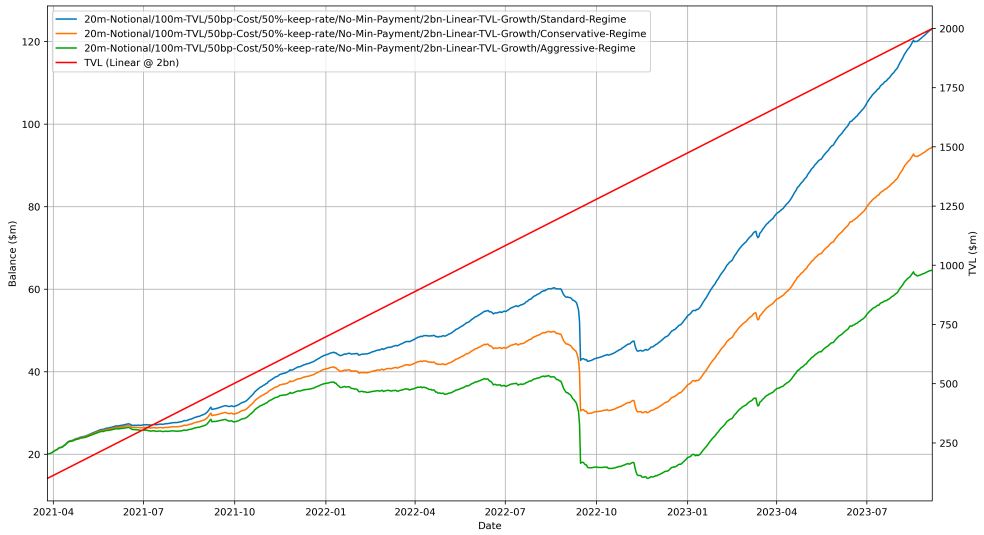

Figure 17: Insurance Fund Behavior with 20m initial notional, 50bps cost, 50% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 2b over the period

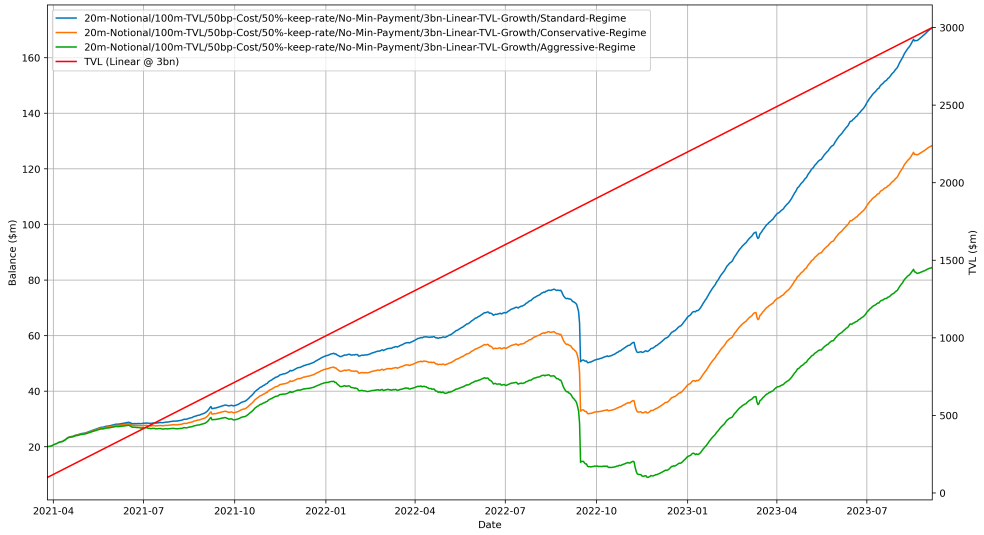

Figure 18: Insurance Fund Behavior with 20m initial notional, 50bps cost, 50% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 3b over the period

Takeaway: 50% take rate seems more than sufficient to handle negative payments out of the insurance fund even in our very bearish funding rate scenarios, assuming a linear growth. We can see that the lowest a $20m insurance fund hit was just above $10m, which would indicate that if a 50% rate was used an insurance fund size of $10m would likely be sufficient to cover any payments.

4.3.2 Balance at 20% Take Rate

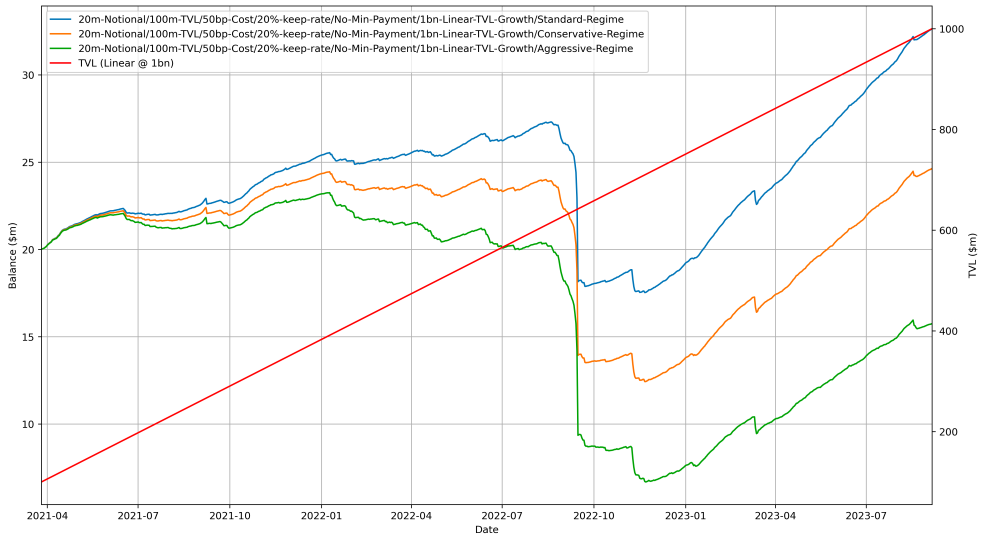

Figure 19: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 1b over the period

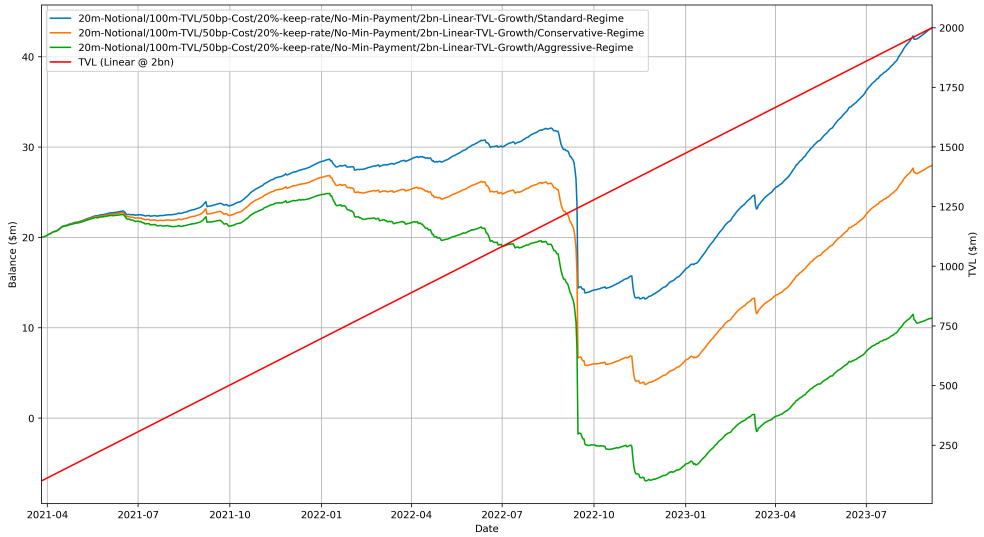

Figure 20: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 2b over the period

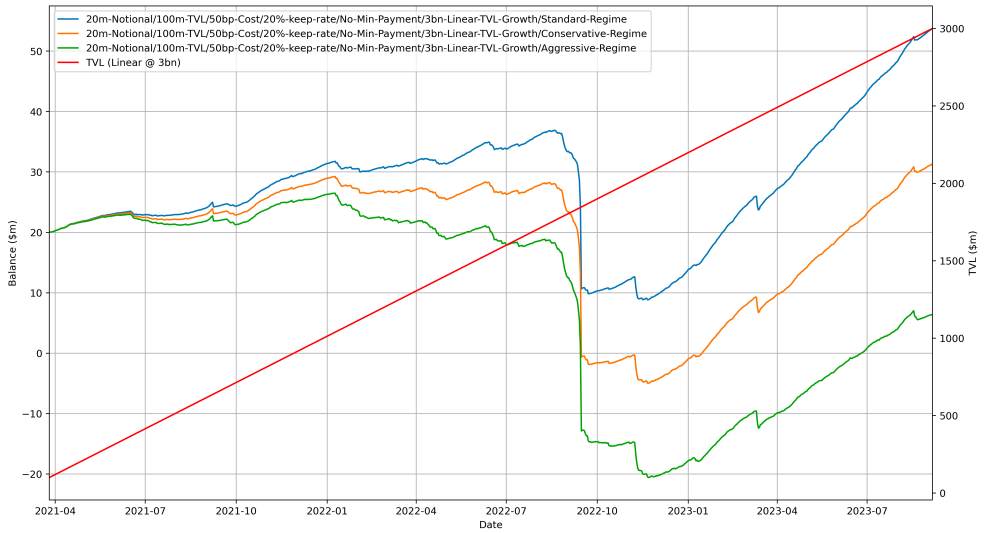

Figure 21: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 3b over the period

Takeaway: A 20% take rate puts significantly more stress on the outflows from the insurance fund, particularly at a larger size. We can see that a $20m sized insurance fund was enough to cover a linear growth to $1bn over 2.5 years, however we would need a $30m fund to cover a growth to $2bn in supply, and just over $40m to cover growth to $3bn. If we are looking to capitalize the insurance fund sufficiently in the first year or so before USDe grows into the billions, $20m insurance fund seems more than enough at a 20% take rate, especially when we consider the chances of an ETH PoW arbitrage type trade happening again.

4.3.3 Balance at 10% Take Rate

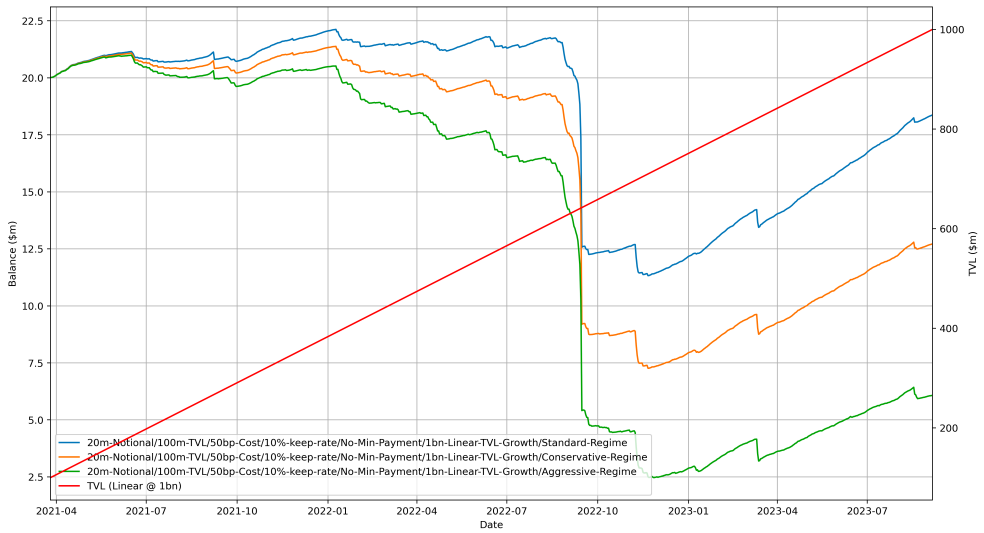

Figure 22: Insurance Fund Behavior with 20m initial notional, 50bps cost, 10% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 1b over the period

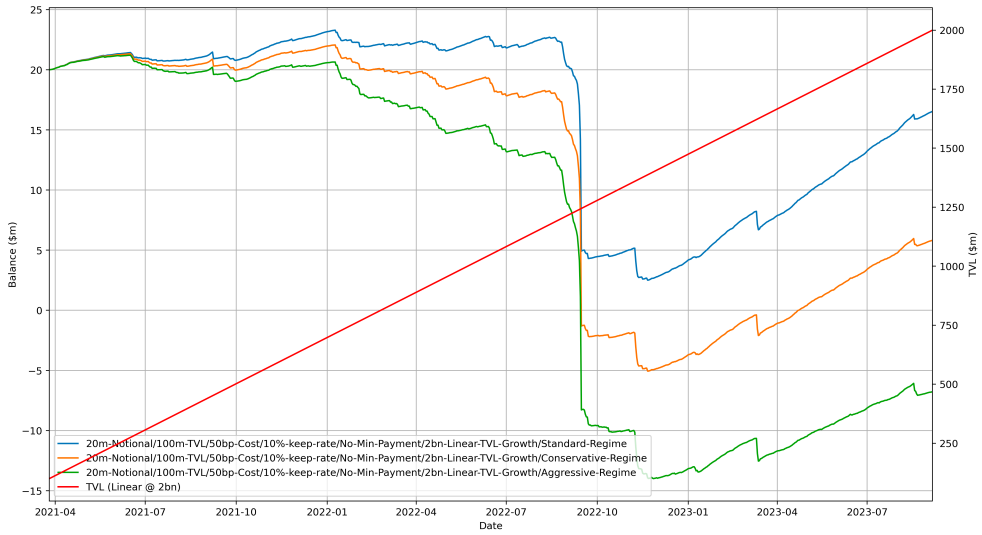

Figure 23: Insurance Fund Behavior with 20m initial notional, 50bps cost, 10% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 2b over the period

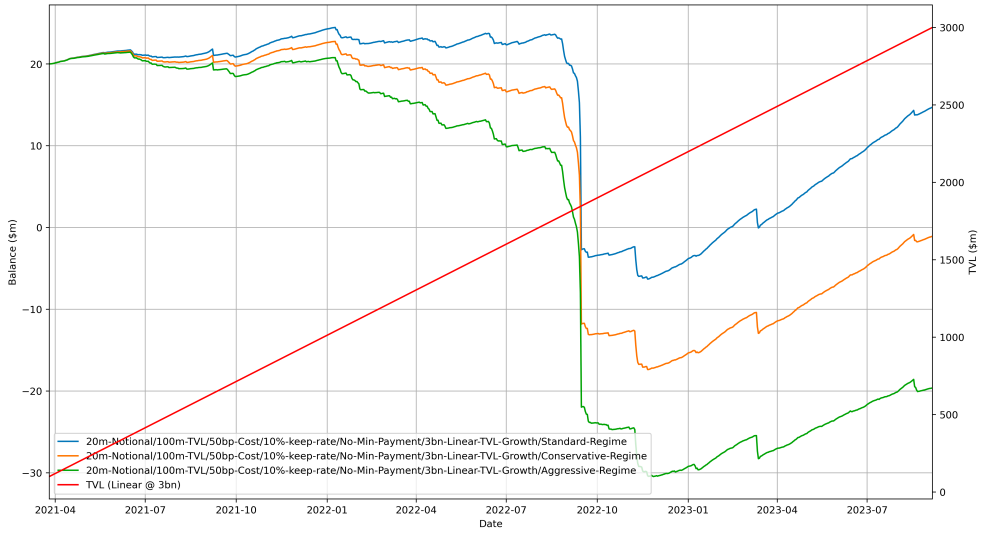

Figure 24: Insurance Fund Behavior with 20m initial notional, 50bps cost, 10% keep rates, no minimum yields and an initial TVL of 100m growing linearly to 3b over the period

Takeaway: As expected, a 10% take rate puts intense stress on the insurance fund. However, under a linear growth assumption to $1bn over 2.5 years, a $20m insurance fund size covers the ETH PoW black swan event and any other payments needed for negative funding. Again, a larger insurance fund is needed if we are to model out more aggressive growth scenarios, with a $50m fund size needed to cover $3bn in TVL at a 10% keep rate.

4.4 Effect of Growth Curves

Up until this point in the analysis, we have assumed a straightforward linear growth for the supply of USDe, using the rationale that it will take time to build trust, brand awareness and integrate with various partners. However, there is a non-zero chance that the yield on offer attracts significant interest at an early stage on Ethenas launch and it is important we model the impact that might have on the insurance fund. With less time to capitalize itself, the insurance fund may be faced having to pay larger funding amounts at an early stage which would be a drain on a smaller sized fund.

We also need to test out the scenario where there is exponential growth at a later stage in the protocols life, perhaps after more USDe use cases are built out and demand increases. For both scenarios of exponential growth, we have kept take rates at a constant 20% to both save the amount of charts used, but also use a take

rate we see as a sustainable longer term rate for the insurance fund.

4.4.1 Early Exponential Growth

4.4.1.1 $1b TVL Growth

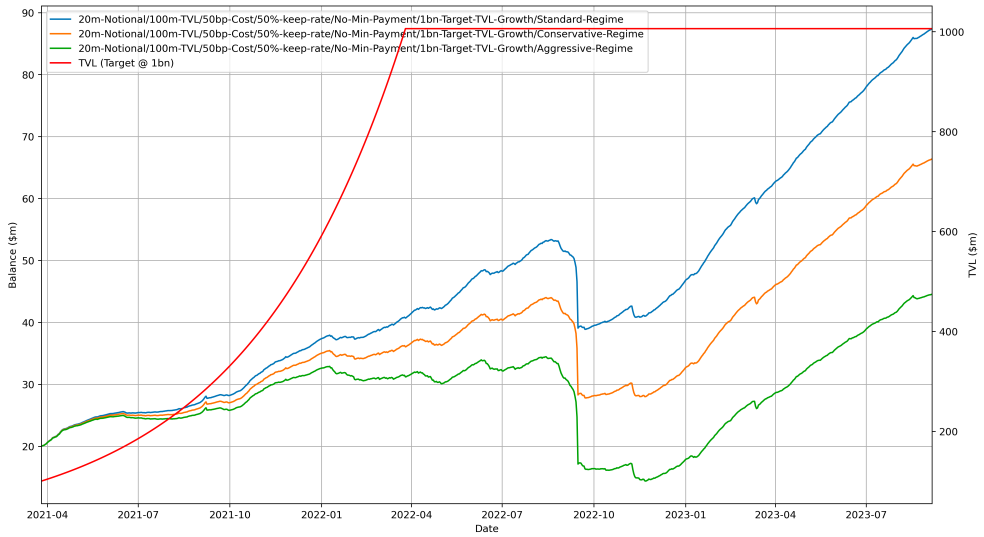

Figure 25: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing to 1b in a year

4.4.1.2 $2b TVL Growth

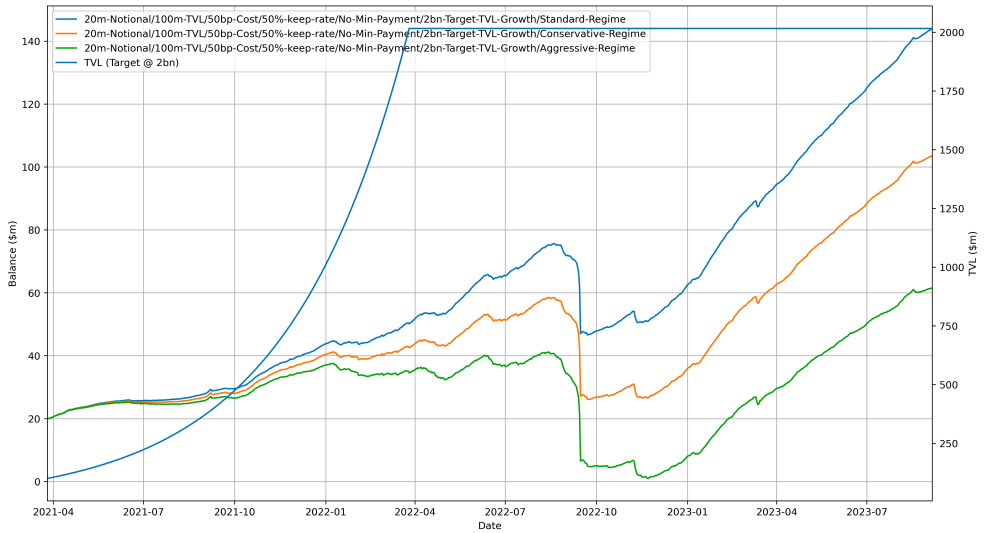

Figure 26: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing to 3b in a year

4.4.1.3 $3b TVL Growth

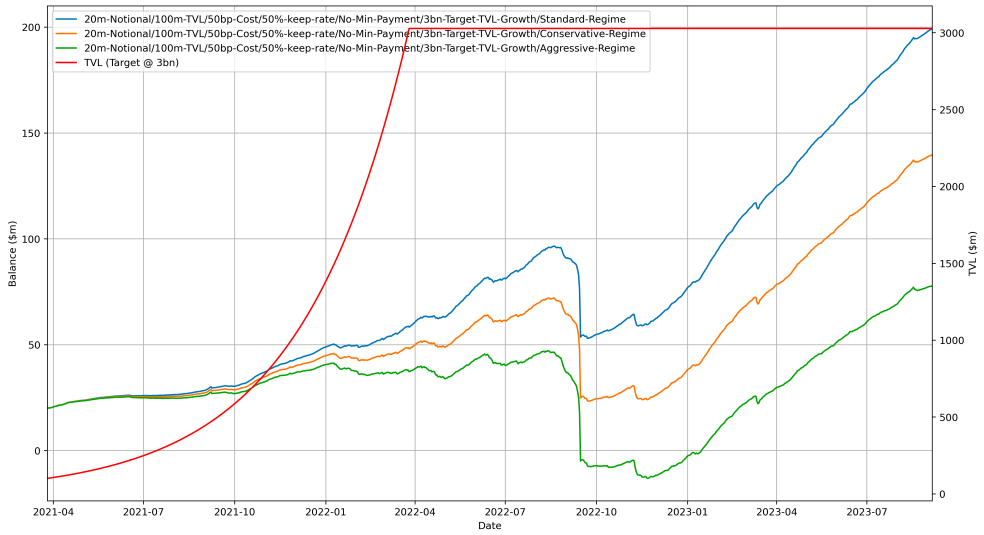

Figure 27: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing to 3b in a year

Takeaway: Forecasting a more rapid growth in TVL for USDe results in the payments being larger in size during the ETH PoW event and any negative funding in between. A $20m fund just about goes bankrupt when TVL grows to $1bn after only a year at a 20% keep rate due to the size of the hedges by the time the black swan event comes around in September 2022.
Encouragingly, due to the positive mean of funding rates, we can see if the fund is sized to survive a black swan event like this, it will almost certainly bounce back and grow larger, with our simulations showing a reversion to a size larger than before the black swan event in all scenarios.

4.4.2 Late Exponential Growth

Below we have modeled the impact of a more immediate growth curve for USDe. sDAIs launch saw it attract over $1bn in supply offering up a c.8% yield, so we have used that figure as the basis for USDe growth over the first year when yields on offer may be similar, attracting $1bn within the first year. For the rest of the time period, we have assumed zero growth with the justification that perhaps the protocol finds an equilibrium balance where the supply growth is capped.

4.4.2.1 $1b TVL Growth

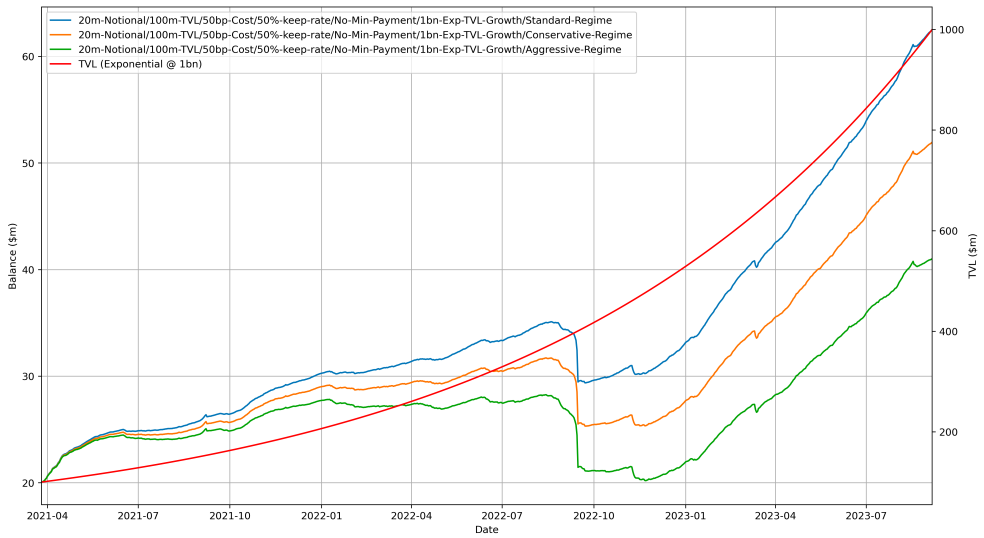

Figure 28: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing to 1b over the period

4.4.2.2 $2b TVL Growth

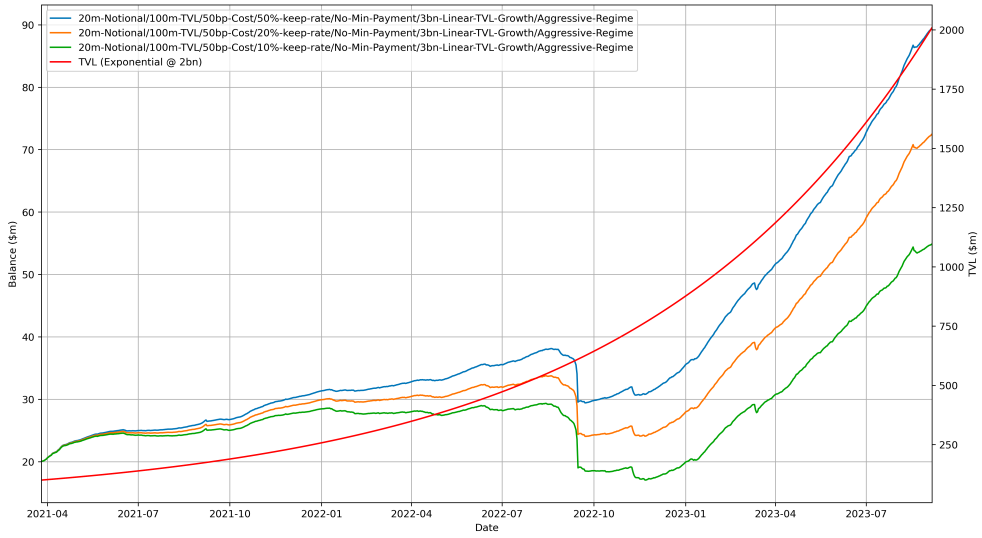

Figure 29: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing to 3b over the period

4.4.2.3 $3b TVL Growth

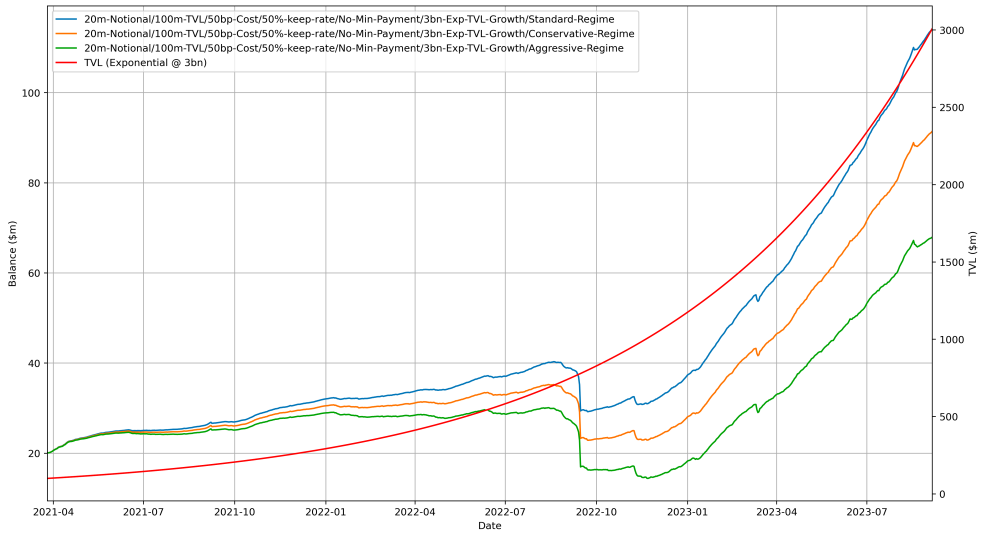

Figure 30: Insurance Fund Behavior with 20m initial notional, 50bps cost, 20% keep rates, no minimum yields and an initial TVL of 100m growing to 3b over the period

Takeaway: A later stage exponential growth curve means the size of payments are smaller in the early stages of the protocol, meaning any black swan events in the early days are easily handled by a $20m insurance fund size at a 20% take rate. This would support the idea of growth caps on USDes supply, allowing the insurance fund time to capitalize itself to a large enough size over time in a more gradual and predictable manner. By the time a black swan event were to occur in that scenario, the insurance fund would be sized to hopefully cover any large outflows.

4.5 Effect of Sustained Yield

An alternate approach would be the following; rather than using the full stream of historic data we have also constructed a scenario analysis based on distinct regimes.

We assume a $20m starting insurance fund analyzing a 2yr projection period of linear growth from zero to

$1bn of TVL and a flat 20% take rate.

The funding rate regime is the variable that we have changed here using observed periods of both negative and bearish funding in the past, and we hold the average funding rate over that period constant for the quarter. The funding rates we have used as constants for bearish/bullish quarters are listed below:

- From 20/08/2022 to 20/11/2022, the combination of funding rates and staked ETH yield averaged -3.16%, this period was the most extreme one as it had many outliers, including the ETH PoW event mentioned earlier.

- From 26/02/2023 to 26/05/2023, the combination of funding rates and staked ETH yield averaged 11.92%, this period was moderately bullish.

- Using these average values, we construct 3 forward-looking scenarios over a period of 2 years:
  - One with a bull regime, having 6 quarters of positive yields and 2 quarters of negative ones.
  - One with a neutral regime, having 4 quarters of positive yields and 4 quarters of negative ones.
  - One with a bear regime, having 2 quarters of positive yields and 6 quarters of negative ones.

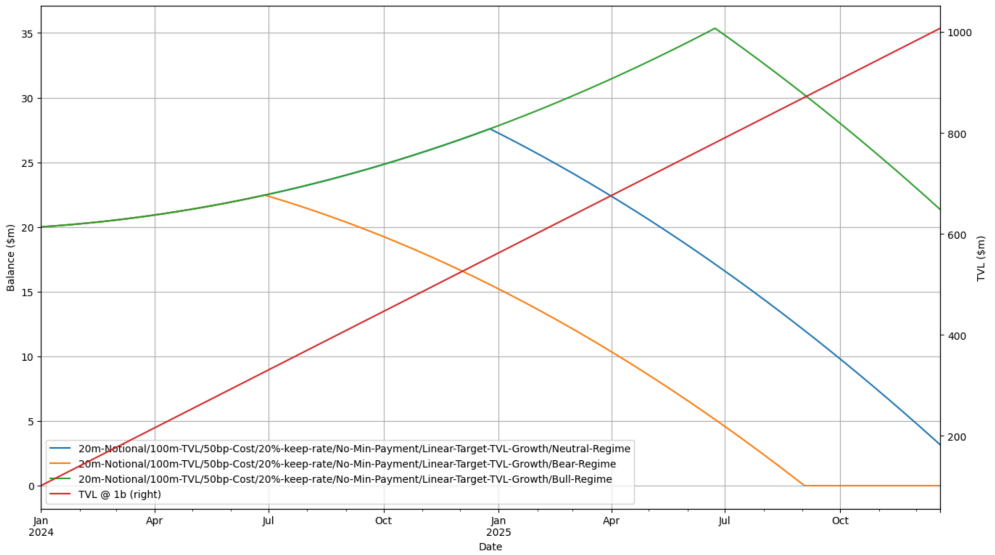

Figure 31: Insurance Fund Behavior with a 20m notional, 50bp costs, 20% keep rate, no minimum payments and an initial TVL of 100m growing linearly to 1b over a period of 24 months

We can see that the bearish regime, starting with 2 periods of positive funding with consecutive quarters of bearish funding after, bankrupts a fund size of $20m after 1 year and 9 months. The length of time it takes the insurance fund to go bankrupt illustrates the slow nature of the process - here it took nearly 5 consecutive quarters of deeply negative funding to bankrupt the insurance fund.

We have only ever seen one quarter over the last 3 years that has averaged a negative value for ETH funding rates and the chances of consecutive quarters of negative funding is an extremely unlikely scenario.

4.6 Summary of Backtest Takeaways

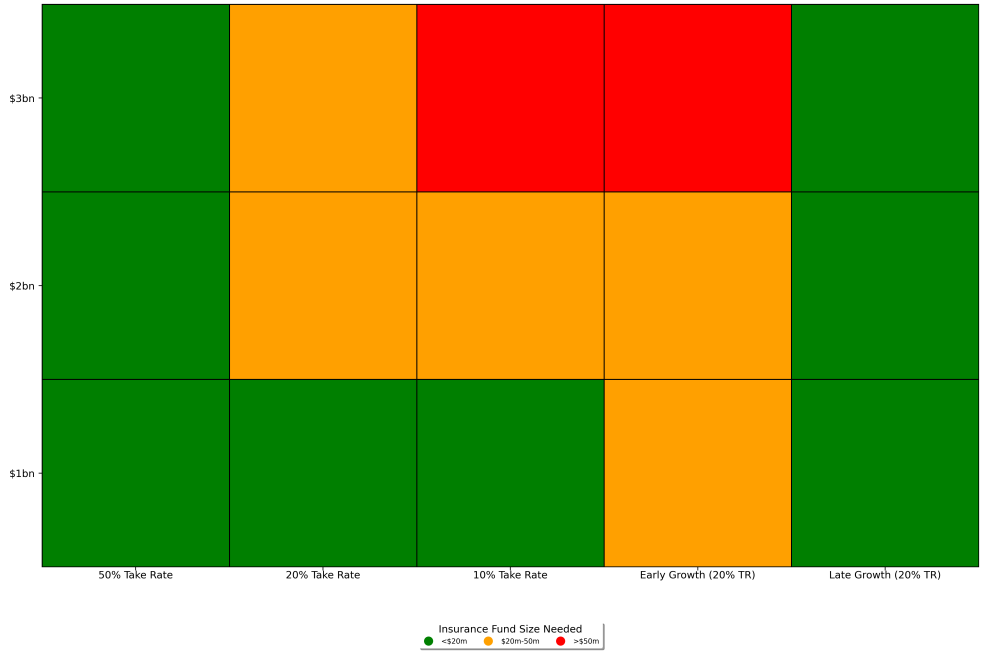

Figure 32: Insurance Fund Size Needed by Growth Scenario and Take Rate

5 Conclusion

Looking at the summary matrix above a few things stand out:

1. A 50% take rate is very safe for a $20m fund and would lead to a well capitalized insurance fund in almost all scenarios and levels of growth.
2. 20% and 10% take rates should be safe enough to support a growth in TVL to $1bn. Any larger growth and either the take rate may need to be increased or the size of the insurance fund will need to be increased from $20m.
3. Early exponential growth can be dangerous for the solvency of the insurance fund if a black swan event were to occur before the insurance fund has had a chance to capitalize itself via positive funding.
4. Late exponential growth is considerably safer as it affords the insurance fund more time to grow.
5. Perhaps supply caps may be a useful way to ensure the insurance fund can grow sufficiently, or a flexible approach will need to be taken with regards to adjusting take rates and insurance fund size depending on growth of TVL.