Historical Funding Rates - Implications for UXD's Insurance Fund

1 Introduction

UXD protocol is a decentralized stablecoin protocol on SOL which aims to solve the stablecoin trilemma, achieving decentralization, capital efficiency, and stability simultaneously. The protocol maintains its stability through an underlying delta-neutral position, implemented with the use of short perpetual futures contracts. The purpose of this analysis is to provide objective data regarding historical funding rates on perpetual futures and their relevant impact on UXD's initial insurance fund. UXD's insurance fund is used to pay out negative funding rates when such payments occur.

Historical spot and funding data is used to simulate the fund's hypothetical historical performance for two major cryptocurrencies: BTC (BTC) and SOL (SOL). Although data has been provided over the longest time period possible (back to 2017 for BTC, 2020 for SOL), UXD Protocol views early funding rates as quite volatile due to lower volumes and nascent adoption of SOL. UXD therefore views the early cases of very negative funding rates as quite misleading due to the extremely low overall volume at such times. However, for transparency and completeness, they are included in the analysis anyways.

This paper explores scenarios in which the insurance fund receives variable fractions of funding payments, given the funding rate is to be shared with stakeholders of UXD Protocol, and explores hypothetical insurance fund asset management performance across a variety of dates and market regimes. To increase the generalizability of the results, two scenarios are examined: a steadier-state, larger market cap scenario ($500m UXD outstanding) which corresponds to the longer-term, steadier-state behavior of the protocol as well as a tiered growth schedule (corresponding to UXD's implementation of minting caps) which better represents the initial period following the protocol's launch.

2 Background

2.1 The UXD Protocol

UXD protocol is a novel stablecoin on SOL which aims to be decentalized, capital efficient, and stable as a store of value. The protocol operates by maintaining a delta-neutral derivatives position on decentralized derivative exchanges. To mint UXD, a user deposits crypto assets into a smart contract which shorts an equal amount of perpetual futures contracts on a decentralized exchange, such as Mango Markets. This has the effect of hedging out exposure to the price movements of the underlying asset, ensuring that the value of the stablecoin's collateral is stable over time. Due to the relatively low gas fees and trading fees, the cost of setting up this position on the SOL blockchain is relatively inexpensive.

Perpetual futures contracts have associated funding rates, which serve the purpose of linking the derivative's price to that of the underlying asset. If the derivative's price is above the underlying asset's market price, holders who are long the perpetual futures contracts pay short holders according to this rate (known as a positive funding rate), which is updated multiple times each day according to a frequency chosen by the exchange. The converse is true when the derivative's price is below the underlying asset's market price. Although historically these rates have been positive on average, if they turn negative, it is holders of long positions who receive funding.

2.2 Insurance Fund

To account for the possibility of negative rates, UXD Protocol has an associated insurance fund, designated to pay out funding on the underlying positions if rates are negative. Capitalized with around $57 million at launch, the insurance fund will receive a portion of the funding payments when rates are positive. The purpose of this study is to understand the robustness of the insurance fund relative to different market conditions historically, as well as relative to different asset management return strategies for the insurance fund.

3 Data

This analysis begins by introducing the data used for the insurance fund analysis. While the focus of the discussion is on SOL, due to its relatively recent creation and rise to prominence, there is historical data available only for a limited period. Moreover, the early data is quite volatile, but it is included anyway for completeness. In order to provide a more rigorous picture, SOL data is supplemented with historical data from BTC, the crypto asset for which the longest historical funding rate data is available.

Hence, data for the analysis will come from two different perpetual futures: XBTUSD futures on BitMEX and SOLPERP futures on FTX. These were chosen due to their long history and high popularity. Underlying spot data for BTC and SOL were pulled from the Gemini and FTX exchanges respectively. All data used were pulled directly from exchanges using their publicly available APIs.

3.1 Spot Data

Here visualizations of the spot prices for SOL and BTC are provided for reference. As seen in Figures 1 and 2, both BTC and SOL have appreciated rapidly over the course of their history, especially in the past 12 months. It is important to keep these price movements in mind when evaluating the size of funding rates over the same period.

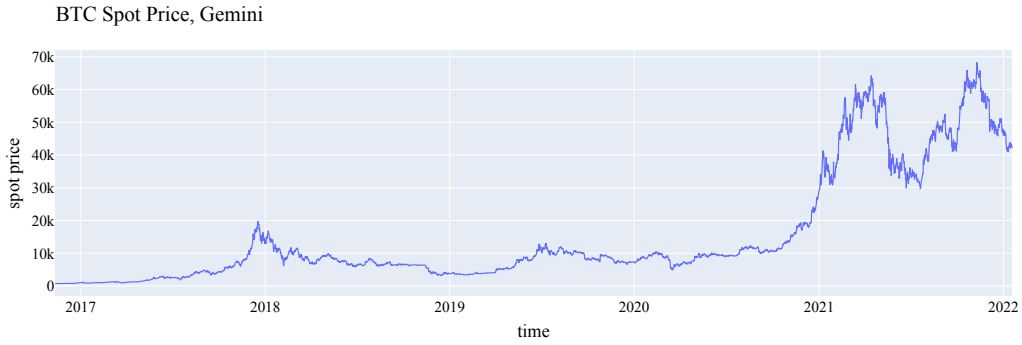

Figure 1: Historical prices of BTC

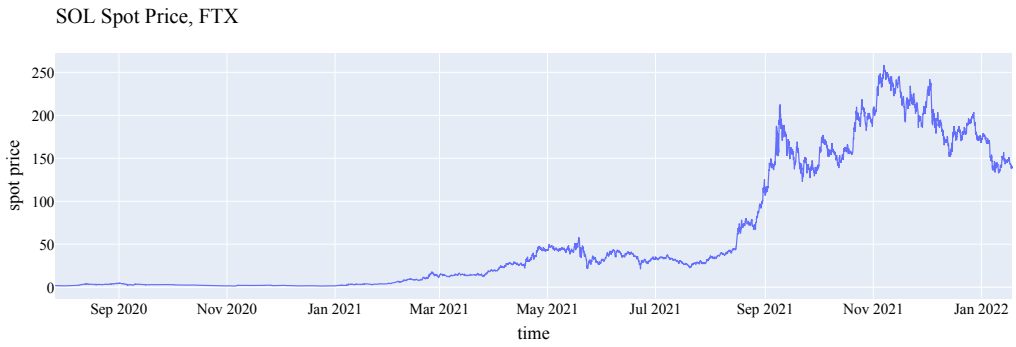

Figure 2: Historical prices of SOL

3.2 Funding Data

Below are the funding rates for the XBTUSD and SOLPERP perpetual futures, contained in Figures 3 and 4 respectively. Examining the XBTUSD rates, it is clear that the period from the introduction of BTC to mid-2018 is marked by substantial volatility. From this point onwards, however, funding rates become relatively more stable. The story for SOLPERP looks similar, with a period of increased volatility from inception until around May 2021, with volatility continuing to decrease through present.

It should also be noted that both funding rates appear to demonstrate behavior typical of a mean-reverting process. Namely, large drops in rates are generally followed by corresponding spikes in rates and vice versa. This trend also appears to extend to periods of predominantly negative and positive rates, which appear almost cyclical in nature.

A more direct comparison of rates is contained in the appendix, where the rate histories in APY terms are examined.

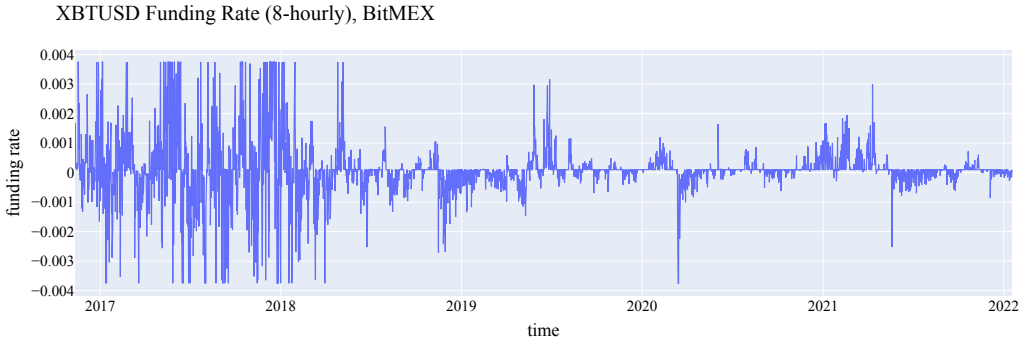

Figure 3: Historical funding rates of XBTUSD, paid every 8 hours

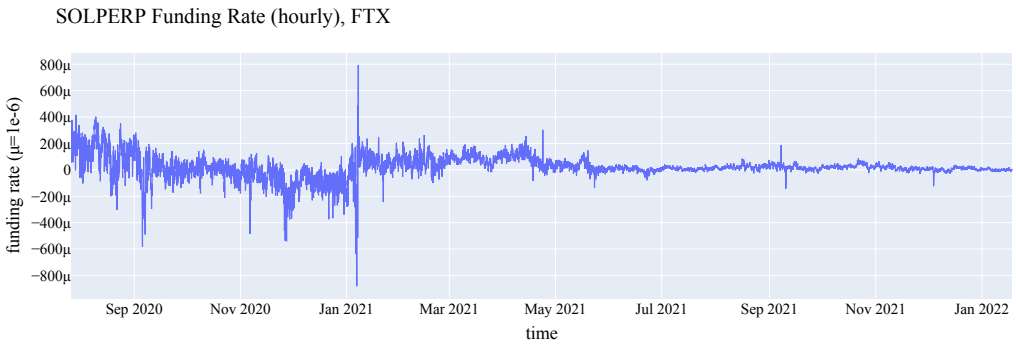

Figure 4: Historical funding rates of SOLPERP, paid every hour

4 Simulation Overview

4.1 Description

To simulate the historical balance of the insurance fund, several parameters are needed. The first inputs to the funding calculation are historical funding and spot data, which have been discussed in the previous section. Moreover, the analysis requires a starting balance for the insurance fund, the total amount of UXD outstanding over time, and a start date. In this analysis, the insurance fund's starting balance to is \$57M, which is the insurance fund's current size. \$500M is assumed to be the initial amount of UXD outstanding. As UXD's market cap will initially be lower and in the presence of positive funding rates the insurance fund will grow over time, it is expected that these estimates are conservative.

Besides these inputs, the analysis varies the percent of funding yields which are paid to the insurance fund, as well as varying rates of return on the asset management strategies underlying the insurance fund.

4.2 Calculation

The following is the calculation for the simulation of the insurance fund: Let I_0 be the initial balance of the insurance fund, M the total market cap of UXD, r_t the perpetual funding rate and time t, and s_t the underlying spot price at time t. At each time t, the short perpetual future position receives a funding payment $f_t = n_{perp} s_t r_t$. Hence, at time t: $I_t = I_{t-1} + f_t = n_{perp} s_t r_t$, where n_{perp} is the number of contracts of perpetual futures being shorted. This implies that the insurance balance at any time t can be calculated as follows: $I_t = I_0 + \sum_0^T f_t = I_0 + n_{perp} \sum_0^T s_t r_t$.

The above calculation applies to the scenario where the insurance fund receives 100% of funding payments and is held in stable assets which do not generate returns. Assuming the insurance fund pays when rates are negative but only receives a fraction u of the positive funding payments, then simply multiply positive payment amounts by u in our calculation. For further details about the calculation methods used, we invite readers to view the source code on GitHub [1].

5 Insurance Fund Balance from Given Start Date

In this section, the simulated insurance fund payments and balances for a fixed start date are displayed. The effects of choosing SOL or BTC as the underlying, as well as directing 100% vs 50% of the payments to the insurance fund are compared. For now, assume that the insurance fund generates no investment returns of its own.

For each of the simulations below, it is assumed that UXD has a market cap of \$500 million and a starting insurance fund size of \$57 million, held in stable assets. Additionally, it is assumed that the

[1] Data and code used can be found at: `https://github.com/gdewei/uxd_simulation`

underlying spot price is fixed, or equivalently, that the notional value of the short futures contracts is constant over time. Due to the historical correlation between spot returns and funding rates, this assumption should cause us to underestimate positive payments and overestimate negative payments. **This also has the added benefit of separating simulation outputs from the meteoric rise in value of SOL over the past year, which would bias the results towards a higher insurance fund balance.**

5.1 SOL

This section contains an analysis of simulation results using SOL as the underlying. Simulated funding payments and insurance fund balance are contained in Figures 5 and 6 respectively. Note that despite the volatility in rates in the first half of 2021, funding payments are almost uniformly positive. This is reflected in the value of the insurance fund, which grows from $\$57$ million to over $\$140$ million by the end of May 2021.

In line with the trend of decreasing magnitude and volatility of rates over the course of the year, there is a corresponding decrease in the magnitude of payments. These relatively stable payments then also result in a relatively moderate, stable growth in insurance fund balance.

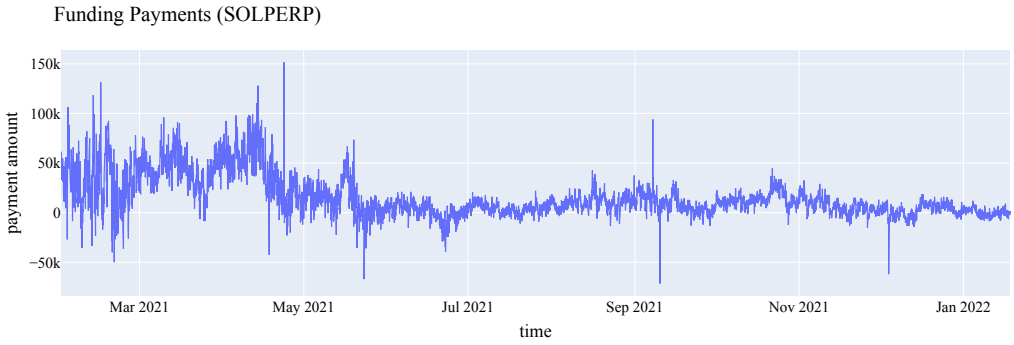

Figure 5: Simulated funding payments to the insurance fund

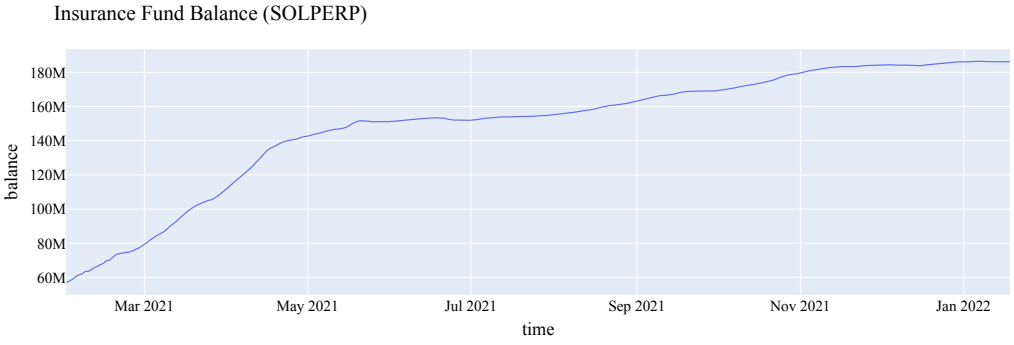

Figure 6: Simulated insurance fund balance, 100% of payments going to the insurance fund

Figure 7 contains results of the same simulation as before in the case where only 50% of the insurance payments are deposited into the insurance fund. This scenario is more representative of the steady state of the UXD protocol roadmap, where liquidity token holders receive a portion of the yields. Despite continuing to pay out 100% of the funding when rates are negative, the insurance fund continues to grow in value.

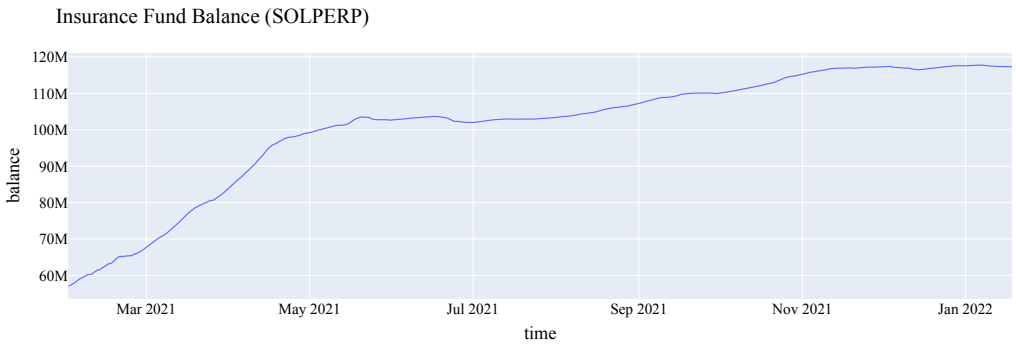

Figure 7: Simulated insurance fund balance, 50% of payments going to the insurance fund

5.2 BTC

In the case where the underlying had been BTC instead of SOL, Figures 8 and 9 contain simulated funding rates and insurance fund balance.

Funding payments were positive until mid-May 2021, after which they remained predominantly negative until mid-October. Similar to the case where SOL was the underlying, there is an almost doubling in the value of the insurance fund over the first few months of the year. Even during the period of negative rates, the fund loses only a relatively small amount, staying above $100 million before continuing to grow thereafter.

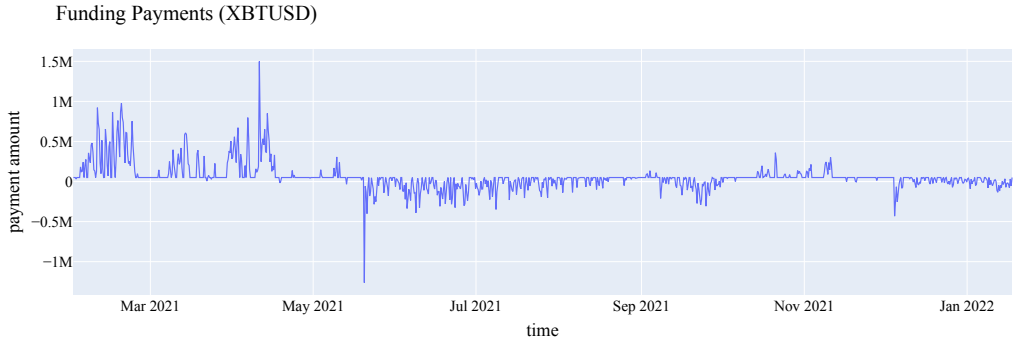

Figure 8: Simulated funding payments to the insurance fund

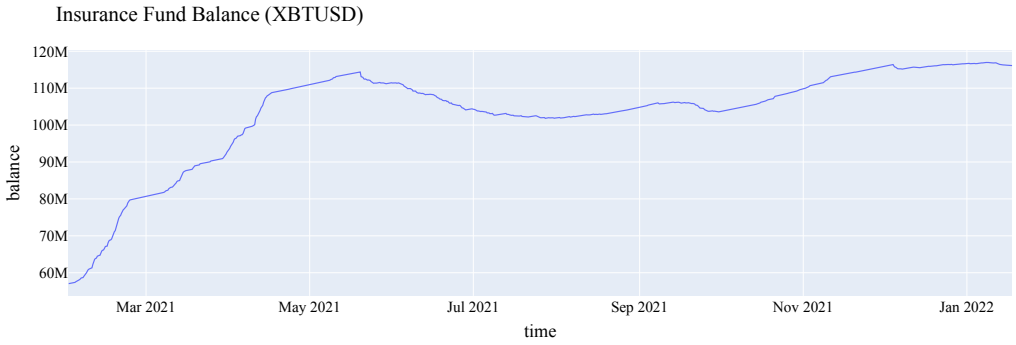

Figure 9: Simulated insurance fund balance, 100% of payments going to the insurance fund

In Figure 10, which assumes 50% of payments going to the insurance fund, there is a larger drop in the balance of the insurance fund following its initial rise. Even during this drop, which occurs over

the course of several months, the insurance fund loses a relatively small amount of only around $15 million.

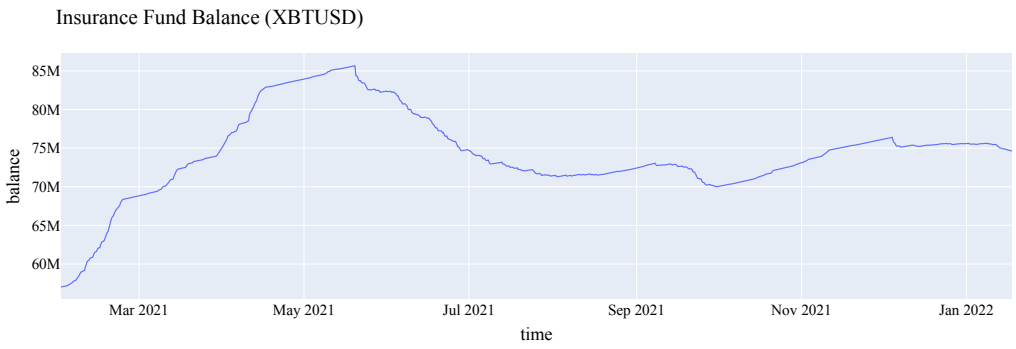

Figure 10: Simulated insurance fund balance, 50% of payments going to the insurance fund

6 Effects of Investment Returns

In the previous examples it was assumed that the insurance fund is held in stable, non-return-generating assets. However, the current section will consider scenarios where the funds are held in safe, decentralized assets which generate returns to the insurance fund.

Overall, these scenarios show similar trends as before. Positive investment returns have the effect of providing additional balance to the insurance fund to act as a buffer in the event of negative rates. Even in a hypothetical bear scenario where investments see constant 10% losses for the nine months of the period, the insurance balance does not decrease significantly, in the case of BTC, and even continues to increase in the case of SOL.

6.1 SOL

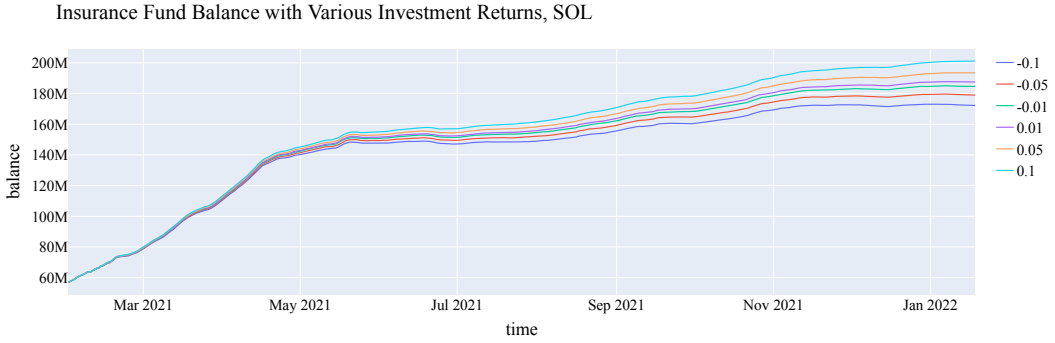

Figure 11: Simulated insurance fund balance under various return scenarios, SOL

6.2 BTC

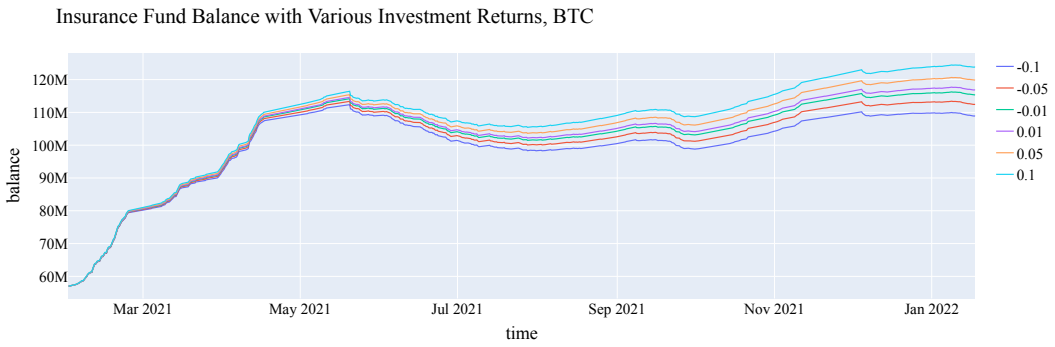

Figure 12: Simulated insurance fund balance under various return scenarios, BTC

7 Effects of Varying Start Date

Whereas in previous sections a fixed start date for our insurance fund simulation was assumed, the current section compares insurance fund performance across various start dates. By doing so, a broader picture of the behavior of the insurance fund across past historical conditions is able to be understood.

7.1 SOL

The analysis begins by examining simulated insurance fund balance in the case of SOL underlying. Overall, for the majority of start dates, including the entirety of 2021, the insurance fund stays above a balance $\$50$ million. During these periods, the value of the insurance fund continues to grow, reaching a maximum value of $\$200$ million for an early January start date.

Examining Figure 13, while there is a period between September and December of 2020 where the insurance fund does go bankrupt, this time also corresponds to a period of relatively high volatility and low market cap for SOL. During this time period, SOL's market cap ranged from $\$87$ million to $\$140$ million, compared to its current market cap of over $\$47$ billion. The fact that simulations run assume a UXD issuance of $\$500$ million casts further doubt on the generalizability of results from this period before January 2021.

Still, as shown in Figure 14, these periods of bankruptcy are not fast, overnight drops to zero. Rather, they correspond to slow decreases in value over the course of several weeks to months. This is important for UXD holders, as UXD as a stablecoin will remain fully collateralized until the point at which the insurance fund reaches zero. In the case of 50% funding payments to the insurance fund, the set of start dates corresponding to bankruptcy becomes larger but not markedly so. For both cases, however, all dates corresponding to bankruptcy occur before the end of 2020. As the market cap of SOL crossed $\$1$ billion USD in January 2021 and has continued to grow since, the results from this period as more representative of current market conditions.

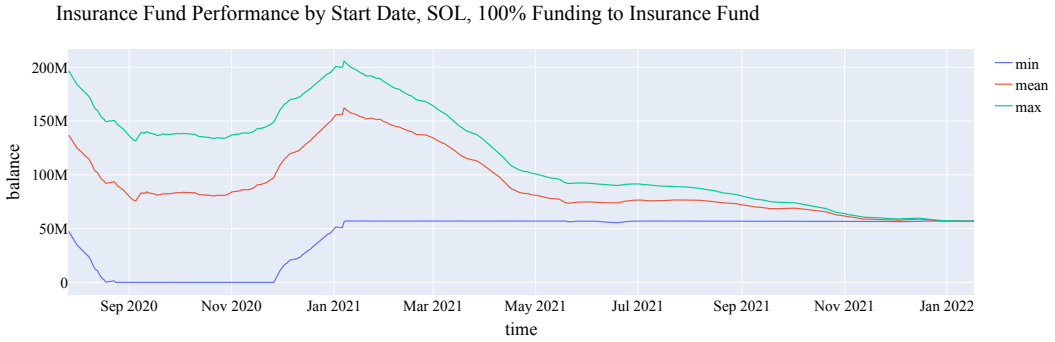

Figure 13: Insurance fund balance summary by start date, SOL

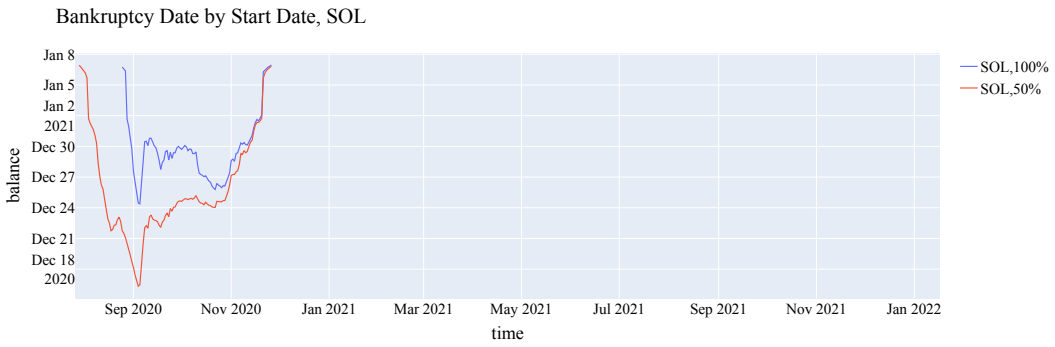

Figure 14: Date of bankruptcy by start date, SOL

7.2 BTC

Continuing the analysis in the case of BTC, a similar trend with the insurance fund balance in Figure 15. During most of start dates, the insurance fund sees large growth in balance, growing to over $300 million for a start date at the beginning of 2016. Furthermore, for much of the history balance of the insurance fund remains above its initial starting balance of $57 million.

As shown in Figure 16, bankruptcy cases do occur, as in the scenario with SOL underlying. However, simulated bankruptcy only occurs for start dates prior to the beginning of 2019. Even then, bankruptcy is a slow process, taking between several months and over a year to complete. Since then, the market cap of BTC has grown to $810 billion at the time of writing.

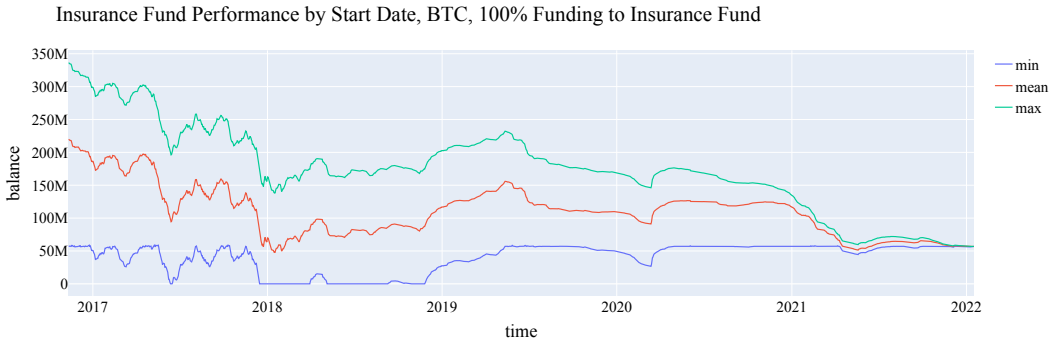

Figure 15: Insurance fund balance summary by start date, BTC

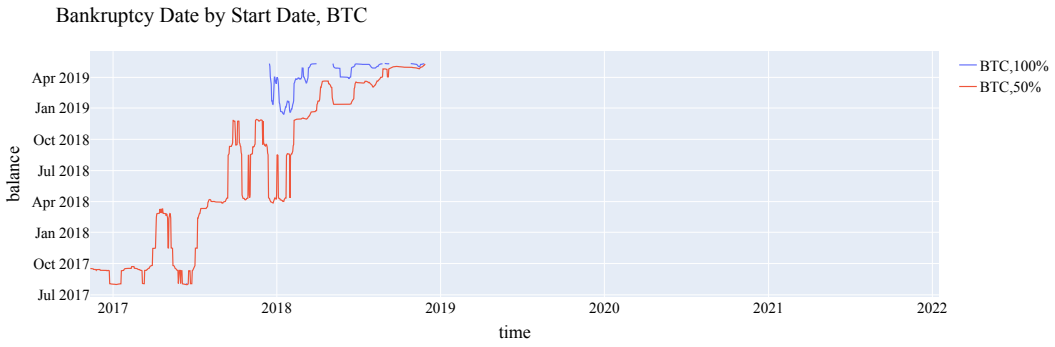

Figure 16: Date of bankruptcy by start date, BTC

8 Analysis of Growth Scenarios

In our analysis in previous sections, a steady $500 million market cap for UXD was assumed. A large, stable market cap provides information about the long-term, steady-state behavior of the protocol. However, it is instructive to understand he protocol's initial growth phase. Here, the effects of a growing, variable market cap on the balance of the insurance fund are examined.

For our simulations, the caps contained in the UXD protocol's release schedule are used. For a visual description of this schedule, please see Figure 17. After maintaining initial market cap of $1 million for several days, the market cap increases gradually before reaching $10 million. The cap then grows at a pace of $1.5 million per day until it reaches $25 million, where it stays before increasing by $2.5 million per day until it reaches $200 million. Finally, the cap increases linearly to $1 billion 1 year from launch.

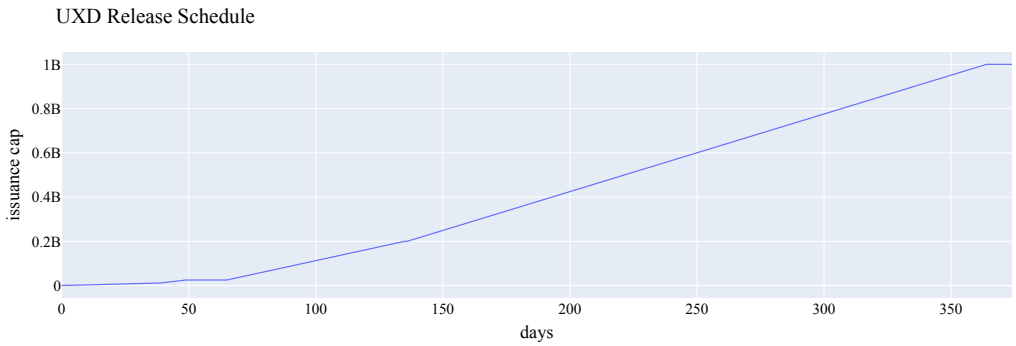

Figure 17: The UXD protocol issuance cap schedule

8.1 Fixed Start Date

In this section, the insurance fund balance is simulated under the assumption that the market cap of UXD follows the release schedule specified in the previous section.

8.1.1 SOL

Here, SOL is the underlying. Examining Figure 18, it can be seen that in contrast to the fixed market cap case, the magnitude of payments appears to gradually increase over time, despite the decrease in average magnitude in rates over the same period. This trend is due to the increasing market cap over the period and demonstrates the lower initial risk sensitivity of the staggered release schedule.

A consequence of the tiered release schedule's lower initial exposure to rates is lower funding payments into the insurance fund when rates are positive. Indeed, the final market cap in the tiered release scenario is just over $100 million, compared to the $180 million in the fixed scenario.

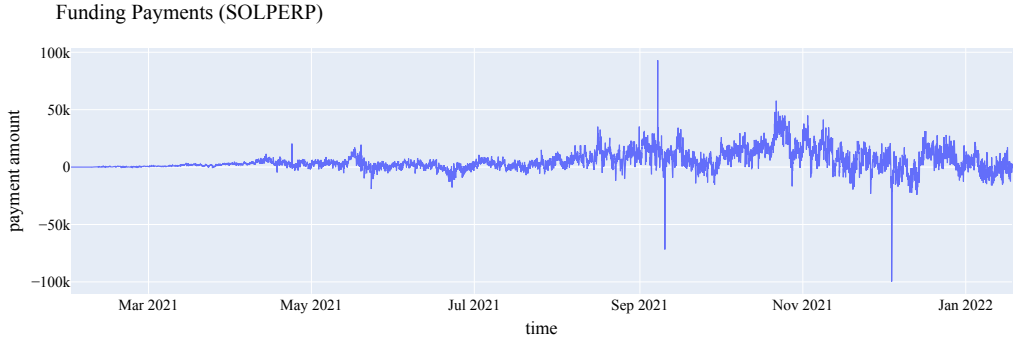

Figure 18: Simulated funding payments to the insurance fund

The two scenarios also result in different growth patterns for the insurance fund balance. Whereas in the fixed market cap scenario, Figure 5, a steady increase in balance until May 2021 was observed followed by a more gradual rise thereafter, in this scenario there is a more gradual gain followed by a more substantial rise starting around September 2021 as the market cap grows.

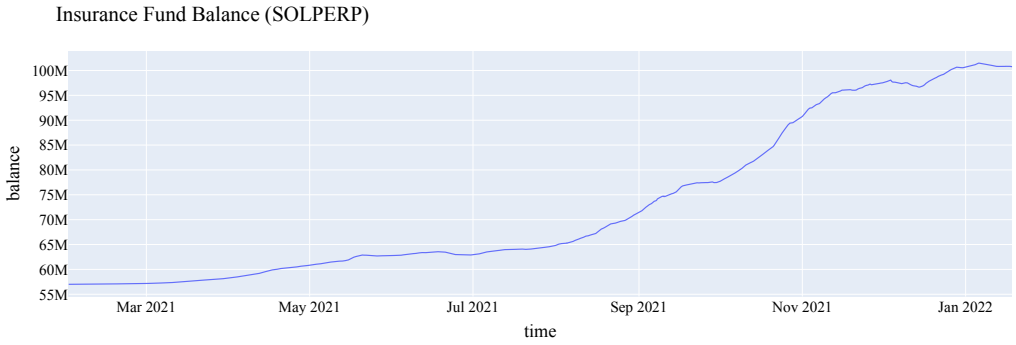

Figure 19: Simulated insurance fund balance, 100% of payments going to the insurance fund

In the case where only 50% of positive funding payments are deposited to the insurance fund, shown in Figure 20, the same trend as before is observed, albeit with a more moderate maximum balance. This pattern is expected, as the size of funding contributions to the insurance fund is lower in this case.

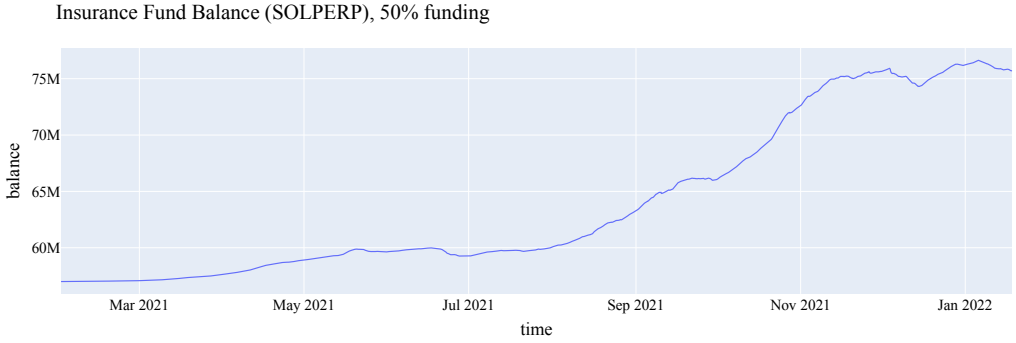

Figure 20: Simulated insurance fund balance, 50% of payments going to the insurance fund

8.1.2 BTC

Continuing the analysis for the case of BTC underlying, the funding payments follow a similar pattern as in the previous section. Funding payments are initially small in the first half of 2021 as the market cap size is lower but rise in magnitude over the course of the year as the market cap increases. This trend results in a more moderate minimum funding payment of under $500 thousand, less than half the size of the over $1 million minimum payment in the fixed scenario.

Comparing Figures 22 and 9, compared to the fixed large market cap scenario, in the gradual growth scenario the insurance fund balance sees overall lower volatility, relative initial flatness, and larger growth towards the end of the year as the market cap increases. Compared to the case with SOL underlying, the insurance balance growth is more moderate due to the lower average rates on BTC perpetual futures relative to SOL over this same period.

Figure 23, which contains the simulated insurance fund balances under the release schedule if only 50% of the positive funding payments were deposited into the insurance fund. Here, there is relatively little growth compared to the fixed market cap or SOL underlying scenarios. Indeed, since over the course of 2021 funding rates were on average lower for BTC than SOL, the only 50% of positive payments deposited into the insurance fund serves only to barely counteract the outflows from negative payments.

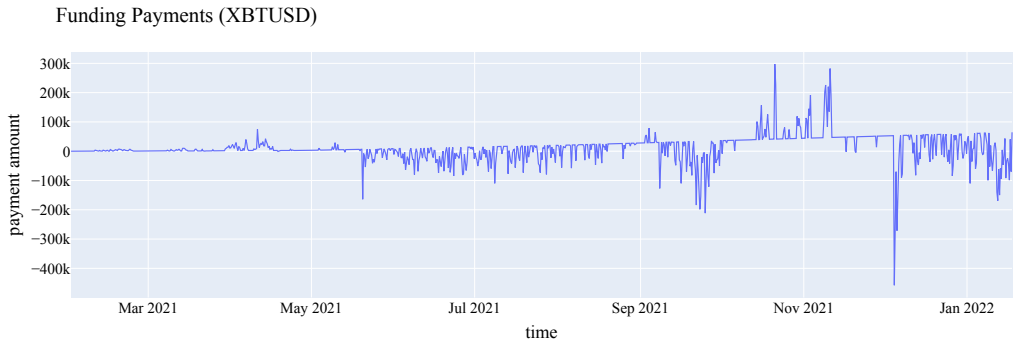

Figure 21: Simulated funding payments to the insurance fund

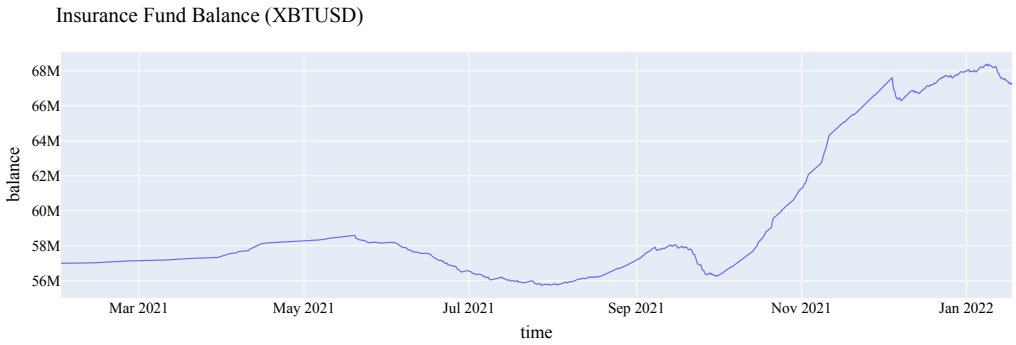

Figure 22: Simulated insurance fund balance, 100% of payments going to the insurance fund

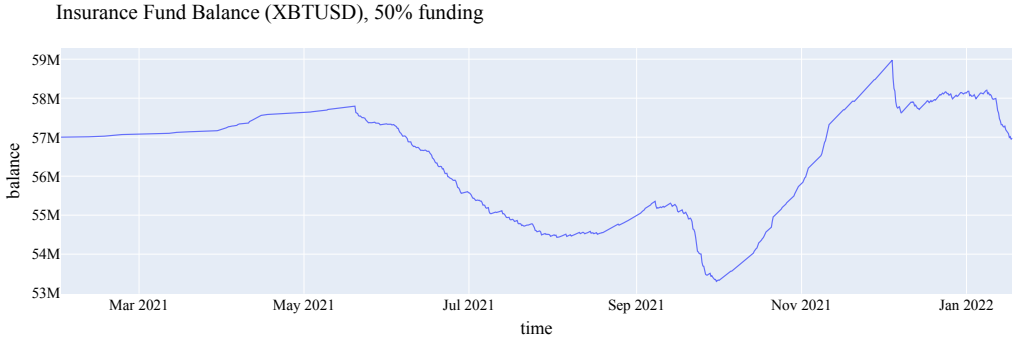

Figure 23: Simulated insurance fund balance, 50% of payments going to the insurance fund

8.2 Variable Start Date

A broader picture of insurance fund behavior assuming variable start dates is now provided.

8.2.1 SOL

In the case where SOL is the underlying, see less volatility in insurance fund balances than in the fixed market cap case (Figure 13). Although the insurance fund only achieves a maximum balance of $160 million over all dates, it also never drops below $40 million and therefore never goes bankrupt, in contrast to the large, fixed market cap scenario. **This shows the effectiveness of the tiered release schedule in mitigating risk.**

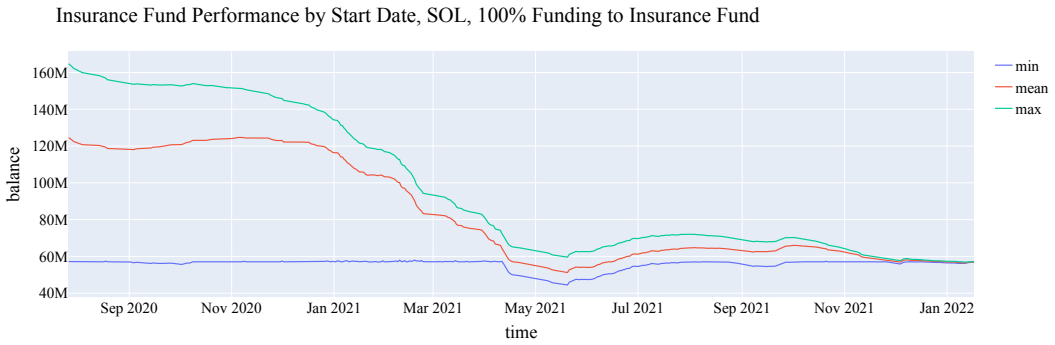

Figure 24: Insurance fund balance summary by start date, SOL

8.2.2 BTC

In the case of BTC underlying, the simulated insurance balances and bankruptcy dates under the insurance schedule are shown in Figures 25 and 26 respectively. As before, it is noted that earlier start dates result in higher average balances for the insurance fund due to the predominantly large, positive funding rates of the corresponding futures in 2017-2018. As before, there are large sections of 2018 for which the insurance fund goes bankrupt.

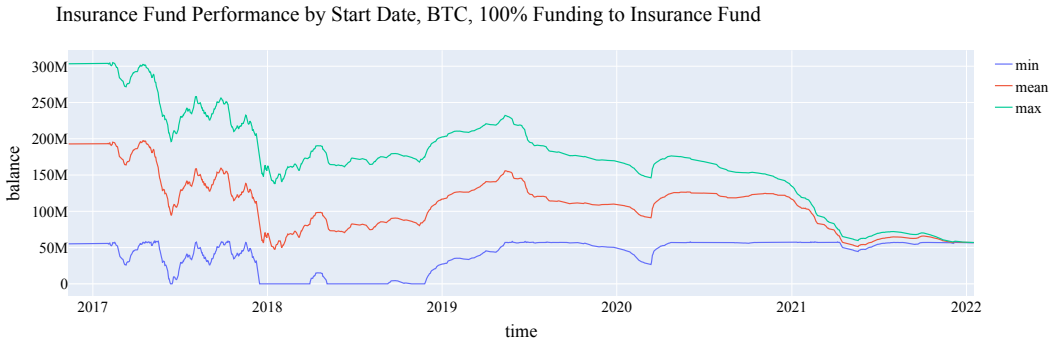

Figure 25: Insurance fund balance summary by start date, BTC

Comparing Figure 26 to the corresponding results for the fixed market cap scenario (Figure 16), it is clear that although the insurance fund goes bankrupt for many of the same start dates, it tends to take more time to do so when it does. In the case where 100% of the positive funding payments flow to the insurance fund, it takes roughly 3 months longer for the fund to go bankrupt. In the 50% case, there is a similar, albeit more moderate increases in survival time for the insurance fund.

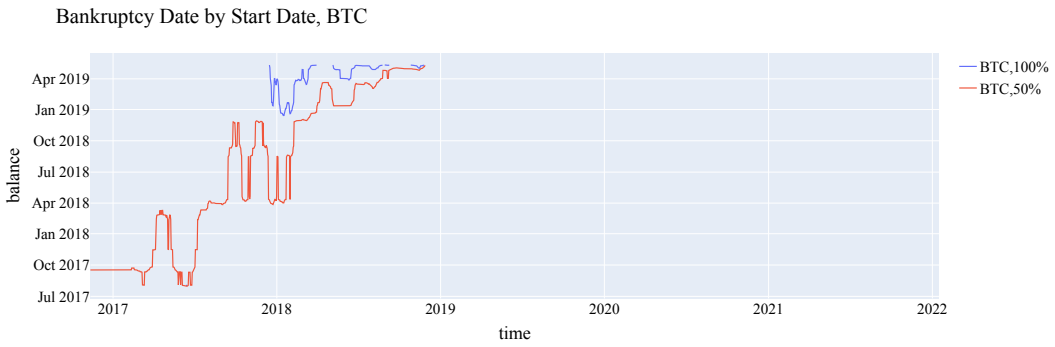

Figure 26: Date of bankruptcy by start date, BTC

9 Conclusion

In this paper UXD Protocol simulated the performance of the insurance fund using historical data. UXD Protocol considered scenarios with different underlying cryptocurrencies, variable fractions of income devoted to the insurance fund, and variable investment returns. Furthermore, UXD Protocol examined the effects of various historical start dates on the balance of the insurance fund and the protocol.

Notably, the performance of the insurance fund was generally positive and saw large gains in many scenarios. Although for some start dates the insurance fund's value was depleted, bankruptcy generally corresponded to times of much lower liquidity in the underlying. Interestingly, in such scenarios, the insurance fund saw gradual decreases in value due to the high frequency of funding payments.

UXD Protocol also analyzed the effects of implementing a tiered release schedule for the protocol, consisting of gradually increasing fixed issuance caps. This had the general effect of mitigating risk through reducing the volatility of the insurance fund balance. Moreover, it tended to both reduce the number of bankruptcy dates in the case of SOL while increasing time to bankruptcy in the case of BTC. As the launch of the protocol is a relatively sensitive period, the tiered release schedule is well-suited to reducing risk during this time.

A Appendix

A.1 Comparison of Funding Rates

In this section a deeper look at the historical behavior of SOLPERP and XBTUSD funding rates is provided. Figure 27 clearly shows the trend of decreasing volatility in SOLPERP's rates as it has become more liquid and widely adopted. The period of volatility until the end of January 2021 also corresponds to a period of relatively low adoption for SOL. On Jan. 31, 2021, for example, SOL had just crossed $1 billion in market cap, and had a spot price of just $4.26. This contrasts greatly with SOL's current market cap of over $47 billion and spot price of $136.4 at the time of writing. A major factor in the volatility of rates is liquidity, and all other factors equal, increased liquidity should have a stabilizing effect on rates in the future.

Examining Figure 29, it is clea that after an initial period of increased volatility until mid-2018, XBTUSD rates have become more stable. The figures also show that the rates have been positive on average over the course of the past year in the case of SOL and two years in the case of BTC. Even when rates have turned negative in the case of BTC, they have generally been bounded by an APY of -0.5.

These trends are reflected in the monthly volatility in funding rates. In both cases, there is a gradual decrease in volatility to a lower level.

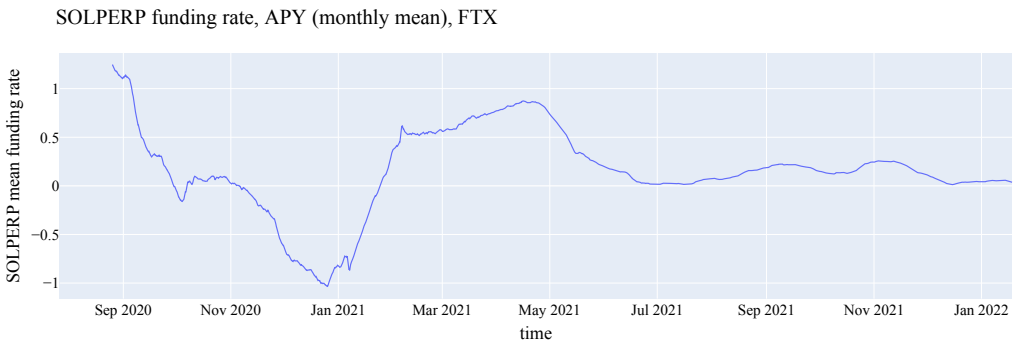

Figure 27: SOLPERP funding rates in APY terms, averaged over a 1mo. look-back

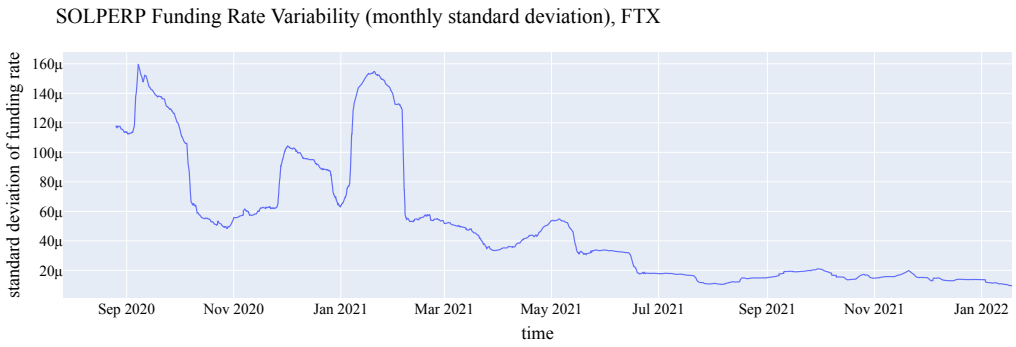

Figure 28: SOLPERP funding rate standard deviation over a 1mo. look-back

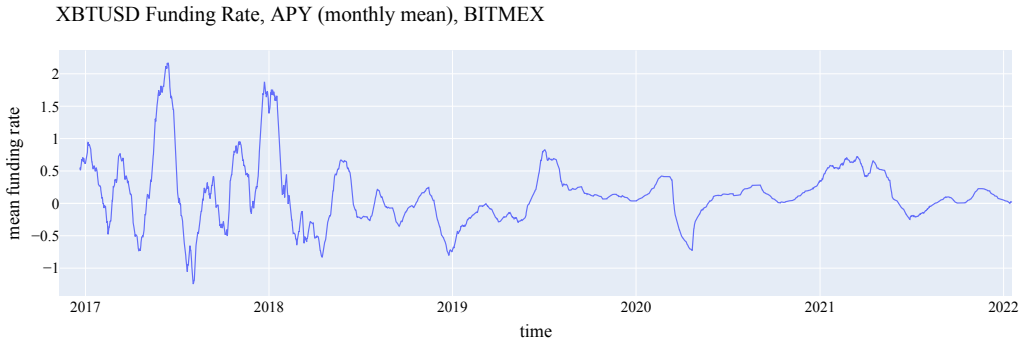

Figure 29: XBTUSD funding rates in APY terms, averaged over a 1mo. look-back

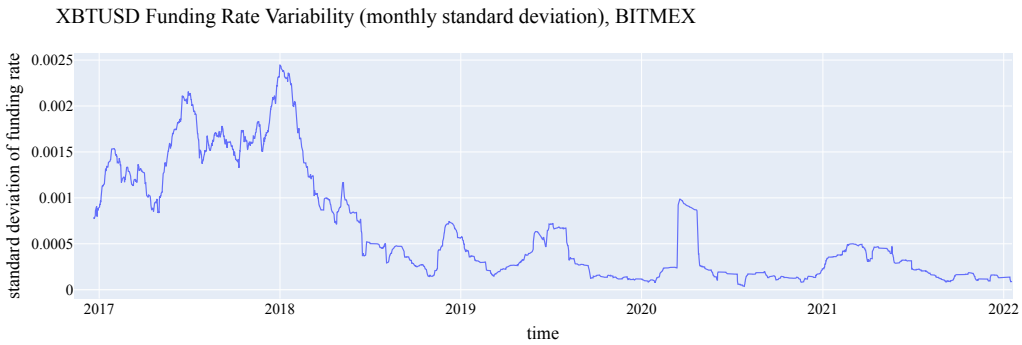

Figure 30: XBTUSD funding rate standard deviation over a 1mo. look-back

B Disclaimer and Risks

All decentralized stablecoins carry risks related to their usage and price stability. Please review UXD Protocol's Risks section in the docs for more information on potential risks. https://docs.uxd.fi/uxdprotocol/overview/risks

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