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Summary

- Given the unique attributes of the bitcoin futures market, one can construct trading strategies to generate risk-free profits by entering a long spot, short futures, delta-neutral position.
- In pursuing these trades, our backtesting analysis shows a strategy of converting accrued BTCs immediately rather than holding on to them generates superior risk-adjusted return. The strategy can also be applied to other crypto assets with perpetual futures, such as ETH, SOL, etc.

The unique attributes of the bitcoin futures market often serve as fertile ground for implementing risk-free trading strategies. In this report, we analyze two different strategies involving funding fee arbitrage, aiming to identify the most optimal approach.

Perpetual Futures

Perpetual futures, often referred to as perpetuals, are derivatives that enable traders to speculate on the future value of an asset. They resemble standard futures, but lack a predefined expiry date, allowing them to be held indefinitely.

Without a proper mechanism, the price of a futures contract may deviate from the spot price. In a traditional futures contract, the settlement of the futures price at expiration aligns with the spot price, with arbitragers playing a crucial role in preventing price divergence.

Since perpetuals don't have an expiry date, they have a different mechanism to prevent price divergence. Below is a brief description of how the mechanism works:

- They are periodically settled (typically every 8 hours) through a mechanism known as the funding rate.
- If the perpetual price is higher than the spot price (meaning the perpetual is at a premium), the funding rate becomes positive. As the gap increases, so does the rate. In such scenarios, long position holders pay a fee to short position holders.

- Conversely, if the futures price falls below the spot price (meaning the perpetual is at a discount), the funding rate turns negative, and holders of short positions pay a fee to those with long positions.
- Under no arbitrage conditions, the funding rate remains slightly positive when prices are level. For example, the default funding rate on the Binance exchange is 0.01% for 8 hours. Refer to this study, Fundamentals of Perpetual Futures by He et al. https://arxiv.org/pdf/2212.06888.pdf, for more detail.

Exploring Funding Fee Statistics

In a bull market, the funding rate usually remains positive and often sharply increases as a result of widening price divergence. On the other hand, in a bear market, the funding rate often becomes negative, as illustrated in Figure 1 and Table 1.

Figure 1: BTC price vs funding rate in the Binance COIN-M market

Source: Binance, Presto Research
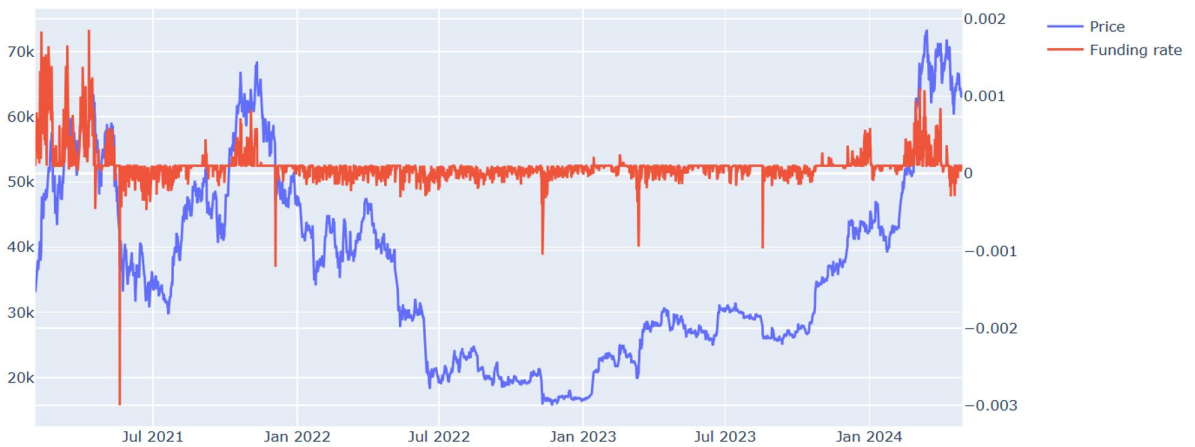
Table 1: Funding rate stats

Dates	Positive funding count	Negative funding count	Annualized average funding rate (%)
20210201-20211231	877	123	20.521194
20220101-20221231	716	377	1.777063
20230101-20231231	928	165	7.463404
20240101-20240504	347	28	18.893226

As shown in Table 1, the annualized average funding rate is positive and notably high, especially in 2021 and 2024, though it appears mediocre during the 2022 bear market period. Given these statistics, trading strategies can be designed to generate risk-free profits by entering a delta-neutral position. Two types of strategies will be evaluated.

Strategy 1: Simple Holding

A simple holding arbitrage strategy in the Binance COIN-M market involves purchasing a certain amount of BTC on the spot market and simultaneously shorting an equivalent amount of the perpetual contract. The BTC acquired on the spot market serves as the collateral for the short position. The funding fee is then accumulated in BTC. The profit and loss (PNL) at time t of this strategy can be broken down as follows:

$$PNL_t = PNL_t^{funding} + PNL_t^{basis} + PNL_t^{mark-to-market} - TransactionCost_t$$

, where $PNL_t^{funding}$ and $TransactionCost_t$ are self-explanatory, PNL_t^{basis} comes from the change in the difference between the spot and perpetual prices, and $PNL_t^{mark-to-market}$ results from the price movement of the accrued BTC.

The outcome of deploying this simple strategy with 1,000,000 USDT (30.268269 BTC) on February 1, 2021, is illustrated in Figure 2 and Table 2.

Figure 2. Simple holding arb   Source: Presto Research
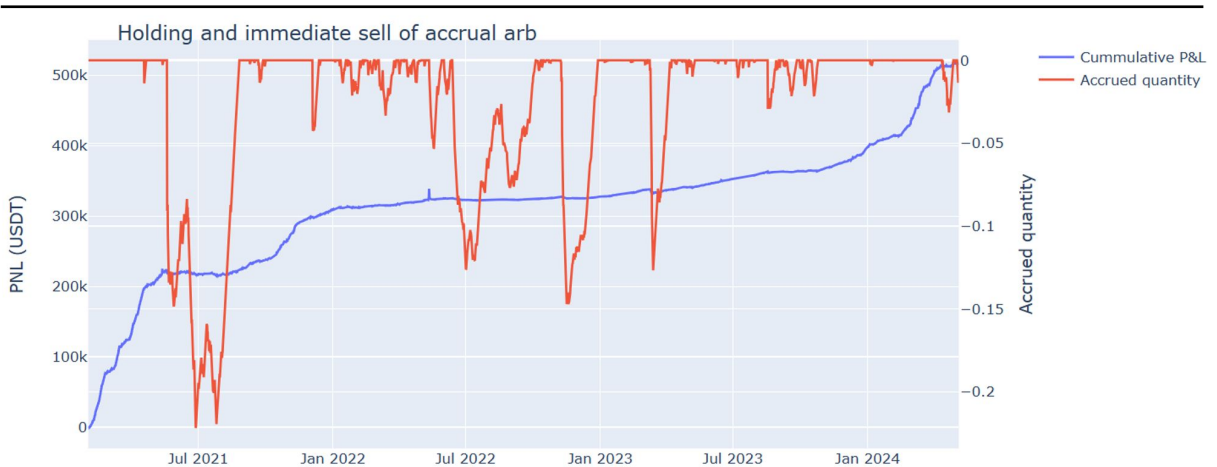

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Table 2. Stats of simple holding arb

Dates	Annualized return (%)	Sharpe ratio	MDD (%)	Daily turnover (%)	Return per trade (%)
20210201-20211231	28.932312	1.960632	11.833619	0.600406	13.202169
20220101-20221231	-16.978291	-1.559864	18.231264	0.000000	N/A
20230101-20231231	25.313257	2.949858	3.860164	0.000000	N/A
20240101-20240504	89.186348	2.865243	14.947054	0.000000	N/A
All	20.328161	1.362013	26.445446	0.168322	33.087463

Strategy 2: Holding Immediate Sell of Accrual

A straightforward way to stabilize the profits involves immediately selling the BTC accrued from the funding fee. The result of this simple strategy can be seen in Figure 3 and Table 3.

Figure 3. Holding and immediate sell of accrual arb

Source: Presto Research

Table 3. Stats of holding and immediate sell of accrual arb

Source: TradingView, Presto Research

Dates	Annualized return (%)	Sharpe ratio	MDD (%)	Daily turnover (%)	Return per trade (%)
20210201-20211231	33.969006	10.368673	1.042758	0.694450	13.401360
20220101-20221231	1.835339	1.017442	1.652833	0.005098	98.641670
20230101-20231231	6.920873	6.602926	0.780735	0.019376	97.858582
20240101-20240504	34.594097	10.850798	0.523535	0.094600	100.189034
All	15.881560	6.710052	1.652831	0.211972	20.526873

This strategy's annualized return is less than that of Strategy 1, but it boasts a much higher Sharpe ratio and significantly reduced MDD, making it highly attractive. Concerns might arise about the accrual frequently becoming negative, potentially triggering liquidation. However, with the margin ratio consistently above 99%, liquidation would not have been triggered at any point during the simulation period.

Conclusion

The two simple funding fee arbitrage strategies we have assessed are not only applicable to BTC, but can also be extended to other crypto assets such as ETH, SOL, etc. Using the full quantity of spot holdings to back the short positions in the perpetual market is not capital efficient. By appropriately managing the margin, the remaining amount might be deposited in lending markets for additional earnings, thus enhancing returns. Another enhancement could involve entering the arbitrage position when the funding rate exceeds a certain threshold and exiting when the rate turns negative. As the basis tends to decrease when the funding rate is negative, there is potential to profit from these basis changes. This concept is subject to further research.

About Presto

Preso Labs is a quantitative trading firm, established in Singapore in 2014. We are a team of competition-winning researchers, engineers and finance professionals who enjoy solving most challenging real-world problems in finance. Trading around $3 billion daily, we are one of the most active cryptocurrency traders globally. We provide liquidity provisioning and OTC execution services to blockchain projects, in addition to proprietary trading. Presto Research is a research unit within Presto Labs, providing crypto market intelligence drawn from the collection of Preso Lab's world-class experts in quant trading, web3, and TradFi.

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