Introduction to Interest Paying Perpetual Swap

Jake Yoon

CEO & Founder
OPTION POOL

February 2020

1 Introduction

The growth of the cryptocurrency derivatives market is truly remarkable. The average trading volume is growing 40% month to month, and the total trading volume of 2019 has become 13 times bigger than the 2018's volume[1]. This great success has been driven by so-called Bitcoin perpetual swaps. (or, CFD, Contract for difference)

A contract for differences (CFD) is a financial contract that pays the differences in the settlement price between the open and closing trades. CFDs allow traders to trade in the price movement of securities and derivatives. Essentially, CFDs are used by investors to make price bets as to whether the price of the underlying asset or security will rise or fall.[2]

CFDs are prevalent in FX and commodity trading, as many brokers offer CFDs to the general public. In the crypto space, it is called a perpetual swap, since it has no maturity date like vanilla Bitcoin futures and only settles when the user closes his/her position or forced liquidation when the user fails to meet the margin requirement. Large crypto-currency exchanges like Binance and Bitmex are actively selling their perpetual swap products and generating billions of dollars worth of the daily trading volume. Bitcoin perpetual swaps are by far the most popular crypto derivative in the market today.

However, we have found that there are some issues with perpetual swap products

[1] data from contractmarketcap.com

that can be potentially harming investors. We will address those issues in this paper and propose a better solution to those problems.

2 Problems of current perpetual swap products

2.1 Failed to reflect the true financial cost of the positions

Most of the CFDs, including all crypto perpetual swap products, pay and charge interests daily. It is often called overnight financing or funding costs, which is an interest payment to cover the financial cost of maintaining your position overnight.[1] The basic rule is that if your position has incurred financial costs, you will pay for that. On the contrary, if your position has made an interest income, you will receive the payment.

The problem with the current crypto perpetual swaps is that the exchanges arbitrarily set financial costs related to maintaining the position. Hence, the interest paid or received does not always reflect the actual financial cost of maintaining the positions.

Funding Calculation

More information about the funding rate is available in the Perpetuals Guide.

	Interest Base	Interest Quote
Symbols	.XBTBON8H	.USDBON8H
Rates	0.03%	0.06%

Figure 1: Interest rates used in Bitmex[2]

For example, Bitmex uses a daily interest rate of 0.03% (which is, 11.57% in annualized compound interest rate) for borrowed Bitcoins. There is no clear explanation on their website why they set Bitcoin's interest rate as 0.03% per day other than they have decided to fix the Bitcoin's interest rate due to the extreme volatility. The exchanges should not arbitrarily set Bitcoin's interest rate because Bitcoin has no centralized authority to control its circulating volume as well as its interest rate.

Furthermore, Bitmex uses 0.06% daily interest rate for borrowed USDs, which in annualized rate, 24.47% per annum. This is an unreasonably high-interest rate for any USD related positions, considering that at the time of the writing, the 10-year US government bond yield is less than 2% per year. Only if it's the case that the borrower has significant credit risk, 24.47% per year can be justified.

[2]https://www.bitmex.com/app/contract/XBTUSD

However, Bitmex also claims that their matching engine is so efficient that they can liquidate any position before its loss exceeds the margin requirement. In other words, losses from the market are only deducted from the margins paid by position holders, and all borrowers will always be able to pay back what they borrowed from the other side of positions. This leads to the conclusion that there is no credit risk implied in the system according to what Bitmex claims.

Binance also sets their Bitcoin interest rate as 0.03% per day, again, without a clear logic to why it has to be 0.03%, and they do not even mention about USD interest rate.

2.2 Change of investing trend: active to less active

The market trend is shifting towards the less active investment strategies, in late 2010s high-frequency trading firms reported a substantially declined profit from their activity. In eight years, high-frequency traders in the US have seen revenue from the equity markets collapse from a peak of $7.2 billion to below $1 billion in 2017 for the first time since the financial crash, according to estimates from consultancy firm TABB Group.[5]

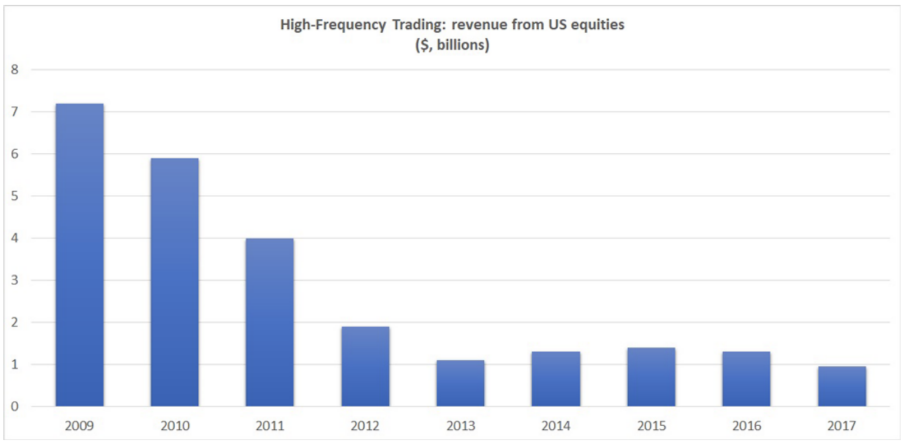

Figure 2: Declining trend in high-frequency trading revenue[3]

The reason for this trend is mainly due to increased competition in the market since the trading volume has not decreased during the same period.[3] Modern trading is about trading bots trading against pre-programmed trading bots. Crypto derivatives market is by no means exception to this trend; every major crypto derivatives exchange platform offers an API system that their uses can

[3]https://www.ig.com/au/trading-strategies/high-frequency-trading-explained–why-has-it-decreased–181010

submit orders electronically. Not only the competition in the market is fiercer, but also the price movement is becoming more randomized, which makes it difficult to discern any predictable pattern in the market since there are fewer and fewer human traders.

However, the majority of crypto derivative exchanges are failing to adjust to this trend and still only focus on promoting the most active investing strategies by offering more and more leverages on their perpetual swaps. Giving users more leverage can be a good thing in the customers' choice perspective, but giving high leverage to inexperienced users is only likely to result in their bankruptcy. Since the competition in the market is getting ferocious and every professional trader is equipped with cutting edge computers and mathematics, sending inexperienced users into this battlefield is no different from sending untrained soldiers into a rain of machine-gun bullets.

2.3 Conflict of interests and ethical issues

It is a well-known fact that CFDs, including perpetual swap products, are highly speculative and involves substantial financial risk.[4] Most of the government-regulated CFD brokers are displaying the percentage of users having a loss in their accounts on the website.

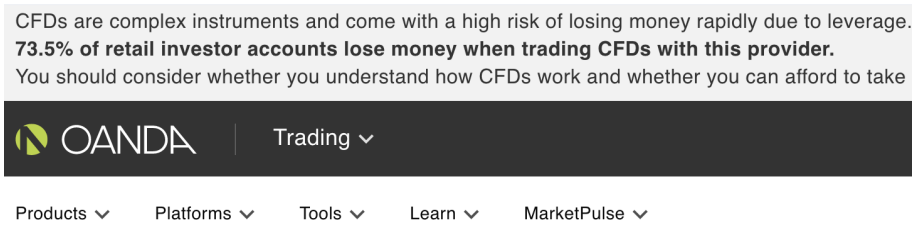

Figure 3: User warning example[4]

The percentage of users having losses in their account is usually in between 65% to 75%, depending on the CFD broker. It would be unethical if a broker keeps encouraging new users to use short-term (typically less than a day) trading strategy on their platform, knowing that even the most advanced high-frequency trading firms are struggling to make profits out of the market. Unfortunately, that is currently happening on almost all CFD providers to increase their trading fee revenue. **The only reasonable way for average users to make money from the market is to follow the market index by taking the position for a long term, or earn stable interest income by holding onto an interest-paying position.**

[4] https://www.oanda.com/rw-en/trading/cfds/

This problem exacerbates when a CFD broker becomes the counter-party of the trades. Some unscrupulous Bitcoin perpetual swap providers mention on their terms of service that they are the counter-party of all trades. This can be a severe conflict of interest situation since the users' loss directly becomes the platform's profit, while the platform has control over the market price and the liquidity.

3 Interest Paying Perpetual Swap

3.1 Structure

Interest Paying Perpetual Swap(IPPS) is a newly proposed financial product by OPTION POOL exchange, which has a linear profit structure like vanilla futures, no expiration, swap interest settled three times a day, and the relevant interest rates determined by the market's demand and supply.

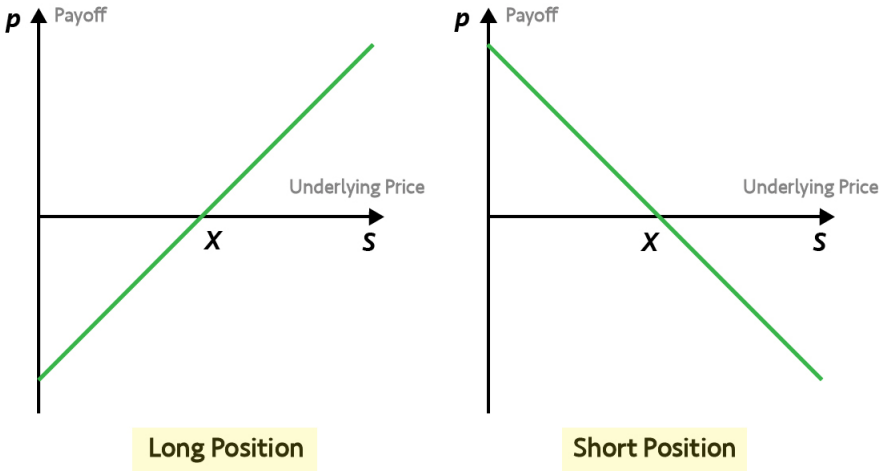

Figure 4: Profit structure example

This product is designed to eliminate market inefficiency by having Bitcoin's interest rate decided by its swap market's demand and supply. Also, we would like to encourage users to adapt to a less active investing scheme by enabling them to earn stable interest income just by holding onto a position since it is a much more suitable strategy for average investors in this highly competitive market. At the same time, it still provides sufficient leverage to professional traders to satisfy the active and short-term investing demand.

Profit and loss calculation is the same as the other linear future products, and for professional traders, leverages are allowed up to 100 times of the initial margin.

The main difference with other perpetual swaps (or CFDs) is the calculation method of funding rate.

3.2 Funding rate and implied Bitcoin interest rate

The funding rate is the daily settlement of the difference in interest rates of base currency (in this case, Bitcoin), and quote currency (in this case, USD). For a reasonable USD interest rate, LIBOR + 2% is used in the calculation considering that the implied credit risk of the swap is insignificant since the platform will liquidate positions that do not meet the margin requirement. For Bitcoin's interest rate, it is a little bit more complicated than USD's interest rate since there is no central bank controlling Bitcoin's interest rate. We will derive the funding rate and implied Bitcoin's interest rate from the prices of swap and spot trading.

Implied Bitcoin interest rate is the currently implied Bitcoin's interest rate in the prices of the swap and the spot. We will precisely define the implied Bitcoin interest rate as follows.

Definition 1 *Implied Bitcoin interest rate is a Bitcoin interest rate that makes arbitrage between the swap and the spot unprofitable.*

Before deriving the implied Bitcoin interest rate, we will assume that there exists an intrinsic (e.g., funding rate) or extrinsic (e.g., market maker) force that stimulates the swap market to converge to the spot price. Also, we assume that a Bitcoin banking system with no credit risk exists so that anyone can deposit their Bitcoin and earn interest income without considering the default risk. The calculation is as follows.

Suppose, the following market situation

$$\text{Spot} : \$8450.50/\text{BTC}$$

$$\text{Swap} : \$8550.50/\text{BTC}$$

we can think of the following arbitrage strategy in this market situation,

1. Sell 1 swap (at $8550.50)
2. Borrow $8450.50 USD
3. Buy 1 BTC at the spot (at $8450.50)
4. Deposit 1 BTC to earn interest income

In this case, the delta of our portfolio is effectively zero, which means our portfolio value is not directly affected by the Bitcoin price fluctuation. Also, from our assumption, we know that the swap price will eventually converge to the

spot price. If so, the price difference (in this case: \$100) will be our profit. Finally, we have to consider the opportunity costs of assets that were involved in this trade. (we borrowed USD, and bought BTC) Nevertheless, we will not consider the opportunity cost of the margin used for the swap order since its amount is irrelevant to the size of interest payment. (i.e., the interest payment only depends on the notional of the swap)

Let's name our variables as follows,

$$\begin{cases} \Delta = \$100 & \text{price difference} \\ m = \$8450.50 & \text{spot price} \\ \delta & \text{discount rate} \\ r & \text{Bitcoin interest rate} \\ \hat{r} = \text{LIBOR} + 2\% & \text{USD interest rate} \end{cases}$$

the sum of expected interest payment from the Bitcoin we bought at the spot market is, (in present value)

$$\sum_{i=1}^{t} mr(\frac{1}{1+\delta})^i$$

the sum of expected interest payment for the USD we borrowed is, (in present value)

$$\sum_{i=1}^{t} m\hat{r}(\frac{1}{1+\delta})^i$$

then, the total profit (Π) from the arbitrage is,

$$\Pi = \Delta + m(r - \hat{r}) \sum_{i=1}^{t} (\frac{1}{1+\delta})^i$$

let $\tilde{r} = r - \hat{r}$, then

$$\Pi = \Delta + m\tilde{r} \sum_{i=1}^{t} (\frac{1}{1+\delta})^i$$

we would like to know $\tilde{r}$ that makes this arbitrage unprofitable, (note that the interest payment term t becomes infinity by the definition of the implied Bitcoin interest rate)

$$\Pi = \Delta + m\tilde{r} \sum_{i=1}^{\infty} (\frac{1}{1+\delta})^i = 0$$

calculating the infinite sum,

$$\Pi = \Delta + \frac{m\tilde{r}}{\delta} = 0$$

rearrange with respect to $\tilde{r}$,

$$\tilde{r} = -\frac{\Delta\delta}{m}$$

substitute back with $\tilde{r} = r - \hat{r}$, then we have the implied Bitcoin interest rate r

$$r = -\frac{\Delta\delta}{m} + \hat{r}$$

for example, let $\delta = 0.05$, and $\hat{r} = 4\%$,

$$r = -\frac{\$100 \times 0.05}{\$8450.50} + 4\% = 3.941\%$$

Although 3.941% a year may seem low considering the volatility of the Bitcoin price, this rate was calculated under the assumption of a risk-free borrower. Hence, we can think of it as a Bitcoin's version of government bond yield.

Now, let's precisely define the funding rate. The funding rate is the settlement of the difference in the interest rate but also serves a significant role as an intrinsic force that maintains the swap price close to the spot price. Since perpetual swaps neither have maturity nor settle in the sense of the traditional future, they need a robust intrinsic mechanism that maintains their prices close to the spot prices.

Definition 2 *The funding rate is defined as*

$$\dot{r} = -\frac{\Delta\delta}{m}\alpha$$

By comparing $\dot{r}$ with the interest rate difference $\tilde{r}$, we can see the main difference is the acceleration factor α. In the strong bullish or bearish market, the swap will likely trade on a significant premium or discount on the spot price. To guarantee the swap market's convergence to the spot price, we have the acceleration constant α, which is the number of funding terms that the premium or discount is persisting in a row.

Let's calculate the funding rate with the above example.

$$\dot{r} = -\frac{\$100 \times 0.05}{\$8450.50} = -0.0591\%$$

Here, the negative funding rate means the implied Bitcoin interest rate is lower than the current USD interest rate, which makes the long position holders pay interests to the short position holders. Also, note that the funding rate swaps a year worth of interest payment in each funding term (8 hrs). If this premium level and the spot price continues, then the second term's funding rate will be -0.1182%, and the third term's funding rate will be -0.1773%.

To help you understand the mechanism, let's suppose a more realistic example when $\Delta = -\$15$,

$$\dot{r} = -\frac{-\$15 \times 0.05}{\$8450.50} = 0.0089\%$$

which in simple annualized return, 9.745%. This result means the actual Bitcoin interest payment is 13.745% per year when the USD interest rate is 4%. The actual interest payment on Bitcoin may exceed its implied interest rate in order to guarantee the convergence of the swap market to the spot market. Remember that the definition of implied Bitcoin interest rate is the rate at which the swap market will not converge to the spot price. Also, note that a simple annualized return was used in the expression. The interest payment does not compound after interest since the interest amount only depends on the notional of the swap and does not depend on the previously paid interest amount. The maximum annualized return is capped at $\pm 547.5\%$.

3.3 Implications

The history of the cryptocurrency market always has been an endeavor to expand from a tech-savvy niche market to the general public. The same principle applies to the crypto derivatives market. Until now, crypto derivative providers have been focusing on the most avid traders in the market. Although it's billions of dollars worth of daily trading volume, active day-traders are still a tiny portion of the real potential market.

In the above examples, we have proposed an arbitrage strategy that a user can earn stable interest income while not taking any market risk from the Bitcoin price fluctuation. In a real-life scenario, it would be possible to make 20-50% annualized return while carrying a small market risk using a reasonable level of leverage. There are already several Bitcoin lending and borrowing market that enables this arbitrage strategy, and we are also planning to add a collateralized Bitcoin lending market on OPTION POOL shortly. We believe this Interest Paying Perpetual Swap(IPPS) will dramatically lower the investors' entry barrier to the crypto derivatives market since it opens a new way of earning a leveraged interest without having to engage in short-term trading actively.

Not only are we trying to reach a larger audience, but also we would like to

promote this less-active investment scheme to average investors. We think it is iniquitous to let ordinary investors hemorrhage all their money by luring them in the illusion of earning an irrationally high return in the short-term day trading.

4 Conclusion

In this paper, we have proposed Interest Paying Perpetual Swap (IPPS). IPPS is a newly introduced financial product by OPTION POOL exchange, which has a linear profit structure like vanilla futures, no expiration, swap interest settled three times a day, and the applicable interest rates determined by the market's demand and supply. This product is designed to eliminate market inefficiency by having Bitcoin's interest rate decided by its swap market's demand and supply. Also, we would like to encourage users to adapt to a less active investing scheme by enabling them to earn stable interest income just by holding onto a position since it is a much more suitable strategy for ordinary investors in this highly competitive market. At the same time, it still provides sufficient leverage to professional traders to satisfy the active and short-term investing demand. We believe IPPS will be a game-changer in the crypto derivatives market, which will dramatically lower its entry barrier for the ordinary investors as well as serving the need of professional investors.

References

[1] City Index by Gain capital. Overnight trade financing. URL `cityindex.co.uk/trading-academy/trading-with-city-index/overnight-funding-explained`.

[2] James Chen. Contract for differences, 2020.01.20. URL `investopedia.com/terms/c/contractfordifferences.asp`.

[3] Pascal Paumard Jean-Philippe Serbera. The fall of high-frequency trading: A survey of competition and profits. *Research in International Business and Finance*, 36(20):271–287, 2016. doi: https://doi.org/10.1016/j.ribaf.2015.09.021.

[4] Trevir Nath. Risks with contracts for differences, 2018.05.22. URL `investopedia.com/articles/active-trading/110714/contract-difference-cfd-risks.asp`.

[5] Joshua Warner. High-frequency trading explained, 2018.10.10. URL `ig.com/en/trading-strategies/high-frequency-trading-explained--why-has-it-decreased--181010`.