IS THERE A FUTURE IN PERPETUAL FUTURES?

Eugenio Duron-Carielo

The Leonard N. Stern School of Business

Glucksman Institute for Research in Securities Markets

Faculty Advisor: Professor David Yermack

April 27, 2022

Overview:

In this paper, we examine the history of perpetual futures and the current use of perpetual futures in cryptocurrency. Perpetual futures were initially proposed as a derivative for illiquid assets like human capital and real estate. However, as computer processing power and technology improved, perpetual futures in cryptocurrency were developed. Cryptocurrency perpetual futures seem to offer a novel instrument with relatively low fees and no expiration date. Current volume for perpetual futures exceeds the volume of the spot market for Bitcoin. Perpetual futures offer large amounts of leverage to entice investors, but given the high volatility of cryptocurrency markets, many of these trades are often liquidated. We analyze the impact of leverage on liquidity in cryptocurrency perpetual futures, and analyze the fees collected by the exchanges for these trades. Exchanges have continued to implement new rules lowering the maximum leverage allowed on their specific exchange, but it is still unclear whether exchanges have implemented sufficient protections to prevent mass liquidations of traders' positions as investors could misunderstand the risk of high leveraged positions. Some exchanges have reduced investors' maximum permitted leverage after facing scrutiny from the media, with Binance recently preventing new customers from trading above 20x leverage for the first 60 days after opening their account. Furthermore, some exchanges, like Binance, have limited the amount of capital available at certain leverage positions. We propose three changes for exchanges to implement to further protect investors in cryptocurrency perpetual futures.

I. History and Description of Perpetual Futures

The Origins of Perpetual Futures

Although considered a new asset by some, perpetual futures were initially proposed by Robert Shiller in 1992. Shiller proposed perpetual futures to create derivative markets for illiquid assets, such as human capital and real estate. Shiller observed that traditional futures tend to have concentrated volume in contracts with short-term expiration dates, while further dated contracts lacked sufficient liquidity. Shiller's perpetual futures would pay dividends or rents to long/short holders depending on the underlying price indices for that future. These perpetual derivatives would allow for the hedging of assets with fair market values that are difficult to determine, and a single contract for a specific rent "can be adopted as a standard through time," as the contract would not expire.[1]

However, Shiller's proposal was different from the actual usage of perpetual futures in cryptocurrency. While Shiller did foresee the usage of margin in perpetual futures, he did not predict 125x leverage, as is currently seen in major crypto derivative exchanges. Furthermore, Shiller's perpetual futures were designed for assets that are difficult to measure. As Shiller wrote "[i]n deciding...whether to establish a market in perpetual futures rather than conventional futures, one must assess which is easier to measure: the true asset price or the dividend on the asset. If the former, then conventional futures contracts should suffice; if the latter, perpetual futures."[2]

[1] Shiller, Robert. "Measuring Asset Values for Cash Settlement in Derivative Markets: Hedonic Repeated Measures Indices and Perpetual Futures." Cowles Foundation Discussion Paper No. 1036. November 1992. pg. 6 "Also, with perpetual contracts, any given contract does now grow shorter-term with time, and so a single contract can't be adopted as a standard through time."
[2] Shiller (1992), pg. 25

Shiller envisioned perpetual futures usage for commercial real estate, human capital, and farms. For example, commercial real estate transactions are "relatively infrequent," and thus, Shiller proposed a "perpetual futures contract based on some measure of rents on commercial property."[3] Since rents are often negotiated for a contract over a period of years, Shiller proposed a present value of the average of the cashflow in rents collected. This index would then be traded as a perpetual future, with daily dividends from the rent index paid from the shorts to the longs at daily resettlements.

What is a Perpetual Future?

Perpetual futures in cryptocurrency have recently made headlines due to their large-scale adoption and the widely reported BitMEX scandal.[4] In their current use, cryptocurrency perpetual futures provide a unique structure to derivative contracts. Cryptocurrency perpetual futures allow for significant leverage, low trading commission fees, and have no expiration date.

Leverage allows an investor to borrow from the exchange to invest in a specific asset. For example, an initial investment of $100 with 20x leverage allows an investor to open a position with a market value of $2,000. Leverage amplifies the gains or losses, and as a result, an amplified loss can cause a liquidation of the position.

As seen in Figure 1, most traders use leverage when trading cryptocurrency perpetual futures.[5] This 2020 Binance study shows 79% of Binance's customers traded with more than 20x

[3] Shiller (1992), pg. 30 "Transactions of commercial real estate are relatively infrequent."; Shiller Pg. 31 "It may be more advantageous to create a perpetual futures contract based on some measure of rents on commercial property."
[4] Indictment charging BitMEX and its CEO for illegally operating an unregistered derivatives trading platform and violating anti-money laundering regulations. Shevchenko, Andrey. "CFTC Charges BitMEX with Illegally Operating Derivatives Exchange." *Cointelegraph*, 1 Oct. 2020, cointelegraph.com/news/cftc-charges-bitmex-with-illegally-operating-derivatives-exchange; Ciralsky, Adam. "The Rise and Fall of Bitcoin Billionaire Arthur Hayes." *Vanity Fair*, 4 Feb. 2021, www.vanityfair.com/news/2021/02/the-rise-and-fall-of-bitcoin-billionaire-arthur-hayes.
[5] "Leverage and Derivatives: Overview of Binance Futures in 2019." *Binance Blog*, www.binance.com/en/blog/all/leverage-and-derivatives-overview-of-binance-futures-in-2019-421499824684900356. Accessed 9 Apr. 2022.

leverage, with 19.6% using over 100x leverage. Of those customers, high leverage was most popular among retail traders.

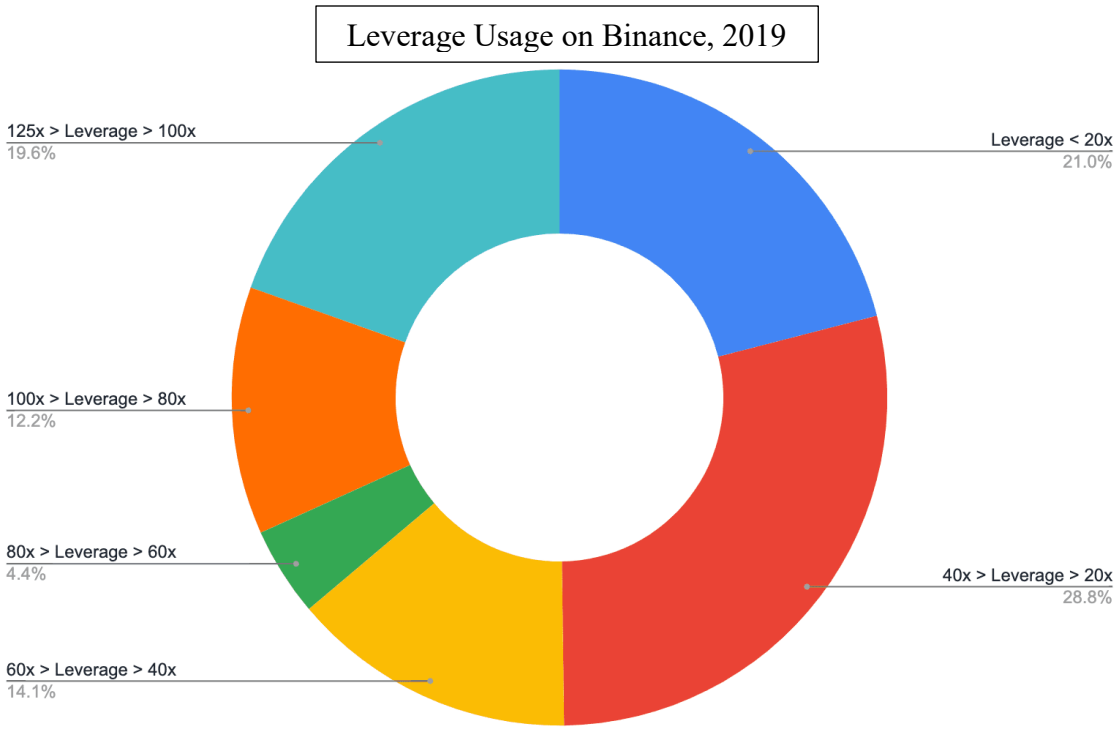

Figure 1, Leverage Usage on Binance, Data as of 1 Jan. 2020.[6]

Perpetual futures, which were first traded on BitMEX, attempt to merge the advantages of spot markets and traditional futures markets. These unique futures attempt to provide lower commissions and higher leverage without the need to roll over the perpetual futures contract. Unlike perpetual futures, traditional futures have an expiration date. The expiration date in traditional futures allows for arbitrage opportunities should the price not converge by the expiration date.

Other products similar to perpetual futures, like contracts for difference, already exist, but do not have the safety of the existing exchanges. For example, contracts for difference (CFD) are

[6] Binance Blog, www.binance.com/en/blog/all/leverage-and-derivatives-overview-of-binance-futures-in-2019-421499824684900356. Accessed 9 Apr. 2022.

contracts in which the seller is paid by the buyer the difference between the current value of an underlying asset and the value at contract time. Like perpetual futures, contracts for difference allow for leveraged tracking of an underlying asset for an undetermined amount of time. CFD's do not have an expiration date, so they are often compared to perpetual futures. These contracts cannot be traded in the US since CFD's are mostly over-the-counter products, which carry additional counterparty risk coupled with different quantities of leverage. Perpetual futures, however, are traded on offshore exchanges and the contracts are uniform as they have no expiration date and allow varying amounts of leverage traded within that specific exchange. Perpetual futures use two mechanisms to ensure that these futures are priced accurately in the markets. These mechanisms, which serve different purposes, are called "funding rates" and "mark price."

Funding Rates

Perpetual futures track the spot price through the funding rate mechanism. This mechanism is necessary in perpetual futures as there is no expiration date.[7] Funding rates are the amount of money which traders receive or are charged at every interval. Although most exchanges correct the divergence between perpetual futures every eight hours, some do so at other intervals.[8] If at this predetermined time the price of the perpetual future is below the spot market, the holders of the short position in the perpetual future pay "rents" or the funding rate to the holders of the long position, or vice versa.[9] Through this mechanism, traders are encouraged to purchase the long position (or short the position) in the perpetual future, by financially

[7] "Introduction to Binance Futures Funding Rates." *Binance*, https://www.binance.com/en/support/faq/360033525031. Accessed 6 Feb. 22.
[8] The exchange Kraken has a funding rate of four hours. See, "A Quick Primer on Funding Rates." *Kraken*, 15 Nov. 2019, https://blog.kraken.com/post/3075/quick-primer-on-funding-rates. Accessed 6 Feb. 22.
[9] "Introduction to Binance Futures Funding Rates." *Binance*.

motivating traders through "rents" to move the price of a perpetual future to the spot price.[10] Furthermore, the calculation of the funding rate is affected by the mark price.[11]

Mark Price:

Unlike traditional futures where the price of the future is the basis to determine margin requirements, in perpetual futures, the mark price functions as the mechanism to determine the margin requirements for traders.[12] The goal of this mechanism is to avoid liquidation at times when there is low liquidity in specific contracts, high volatility, or when there are connectivity or outage issues in the spot markets.[13] The main driver of the Mark Price is the "Price Index," which is a calculated price from major spot market exchanges, including Huobi, Bittrex, BitMEX, FTX, among others, weighed by their relative volume.[14]

The Mark Price ensures traders are not unnecessarily liquidated.[15] For example, during small price divergences between the spot market and the perpetual markets, margin requirements are based on the price of the perpetual future. When there are large divergences between the spot and perpetual markets, the spot market is used to determine margin requirements.[16] This mechanism protects traders from flash crashes in perpetual contracts, and traders are therefore only liquidated if the spot market moves in an adverse direction to that of the traders' position.[17] Furthermore, the Mark Price mechanism also discourages bad actors from manipulating the

[10] "A Beginner's Guide to Funding Rates." *Binance Blog*, www.binance.com/en/blog/futures/a-beginners-guide-to-funding-rates-421499824684900382. Accessed 6 Feb. 2022.
[11] A copy of Binance's full calculation of the funding rate, mark price, and price index can be seen in Appendix A.
[12] "Liquidation Protocol." *Binance*, www.binance.com/en/support/faq/360033525271. Accessed 6 Feb. 2022.
[13] "Mark Price in USDⓈ-Margined Futures." *Binance*, https://www.binance.com/en/support/faq/360033525071. Accessed 6 Feb. 22.
[14] "Mark Price in USDⓈ-Margined Futures." *Binance*.
[15] "Liquidation Protocol." *Binance*
[16] "Mark Price in USDⓈ-Margined Futures." *Binance*.
[17] "Mark Price in USDⓈ-Margined Futures." *Binance*.

market of perpetual futures in contracts with low liquidity as the Mark Price will be used to determine margin requirements for the traders of the contract with limited liquidity.[18]

Perpetual Futures in Crypto:

Perpetual futures in cryptocurrency function by exchanging "rents", or the funding rate, at specified intervals between the long and short holders of the contract. The BTC/USD perpetual futures are the most popular product by volume, and these contracts have continued to increase in volume in recent years, as shown in Figure 3 and Figure 4. Binance dominates the market of perpetual futures in Bitcoin and handles approximately 20% of the total volume as shown in Figure 2. Although there is no data displaying only perpetual futures, roughly 90% volume in cryptocurrency futures contracts occur in perpetual futures for the offshore exchanges.[19]

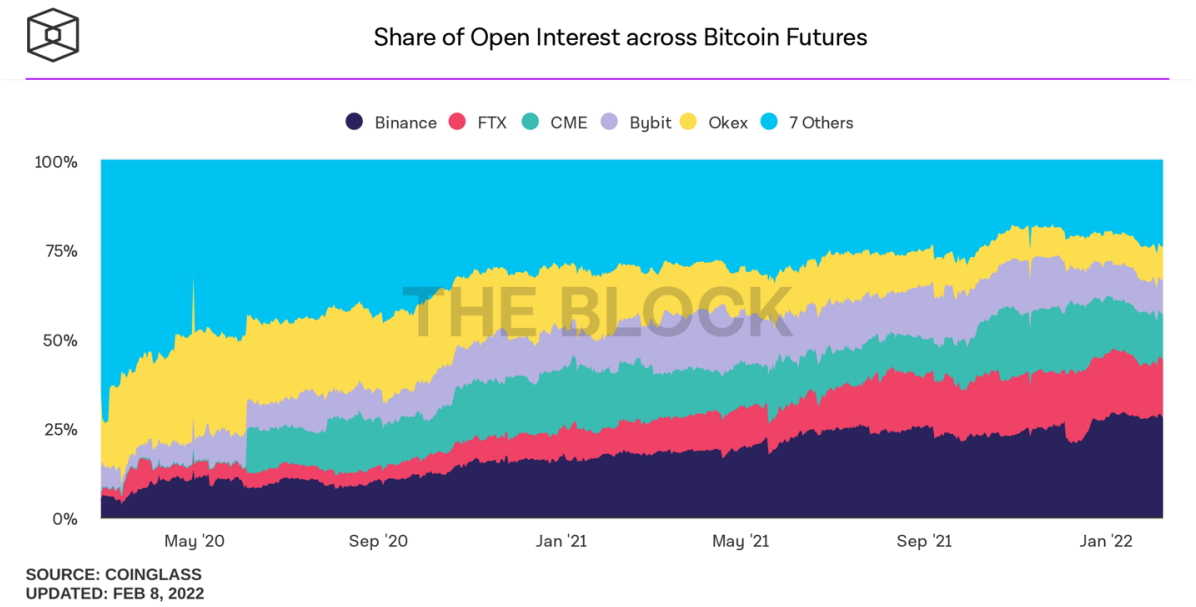

Figure 2, Share of Open Interest across Bitcoin Futures[20]

[18] "Mark Price in USDⓈ-Margined Futures." *Binance*.
[19] See Coinalyze.net displaying the 24H liquidations in both traditional and perpetual futures. "Bitcoin (BTC) Liquidations." *Coinalyze*, https://coinalyze.net/bitcoin/liquidations. Accessed 9 Apr. 22.
[20] "Share of Open Interest across Bitcoin Futures." *The Block*, https://www.theblockcrypto.com/data/crypto-markets/futures/share-of-open-interest-across-bitcoin-futures-monthly. Accessed 6 Feb 22.

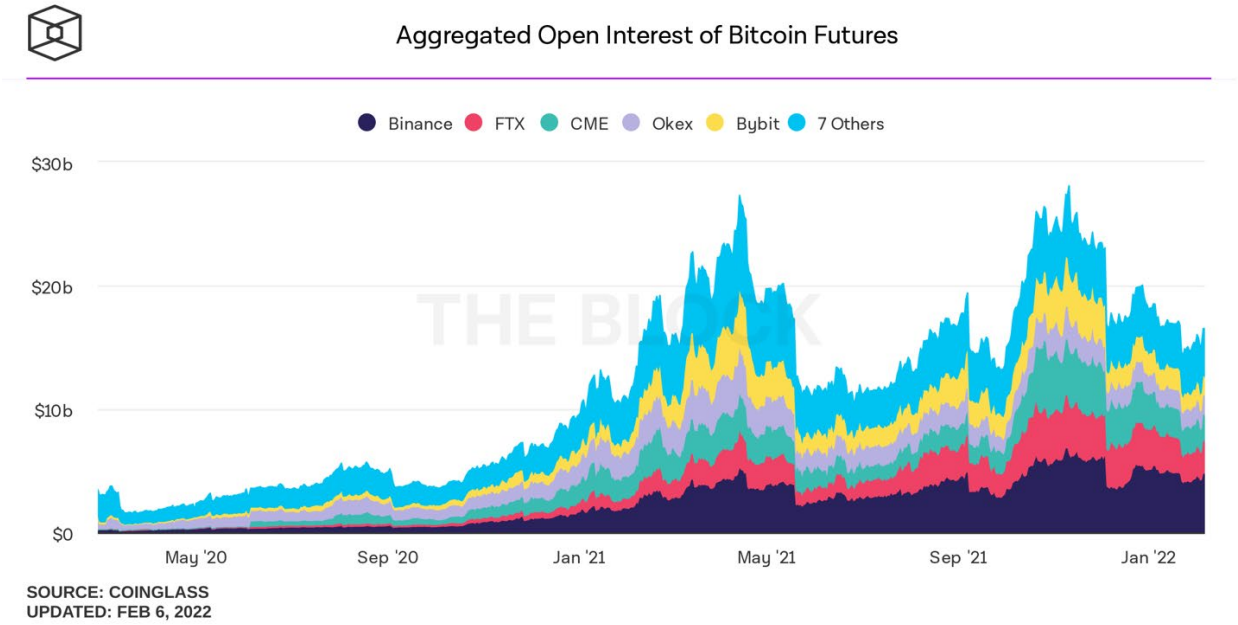

Figure 3, Aggregated Open Interest of Bitcoin Futures[21]

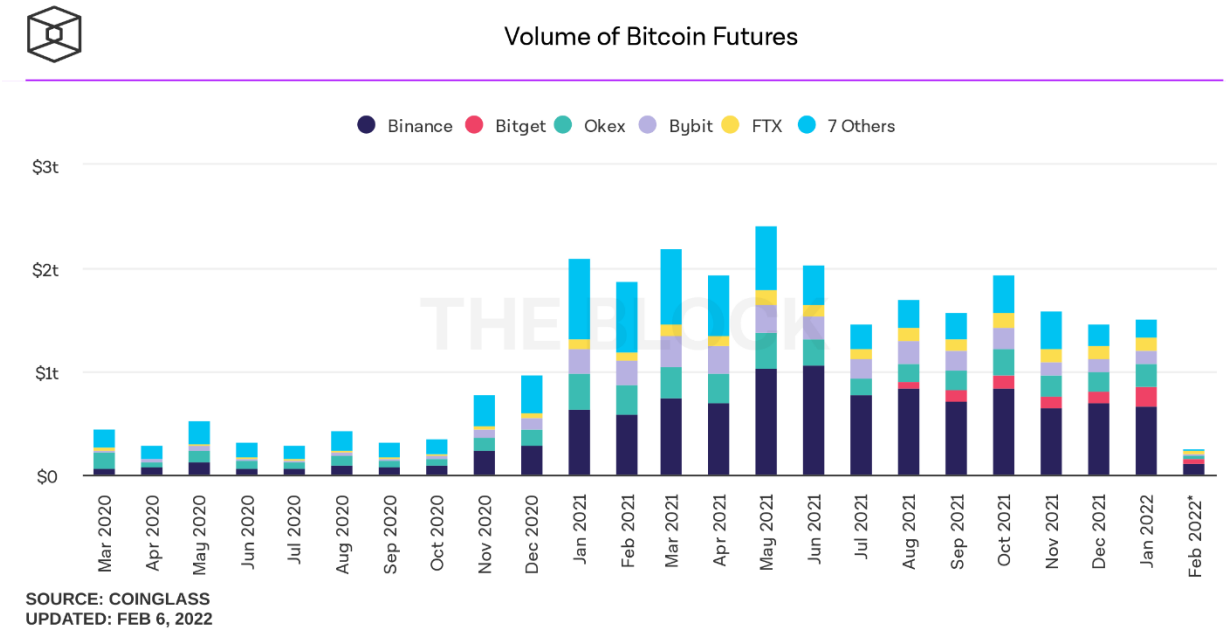

Figure 4, Volume of Bitcoin Futures[22]

[21] "Aggregated Open Interest of Bitcoin Futures." *The Block*, https://www.theblockcrypto.com/data/crypto-markets/futures/aggregated-open-interest-of-bitcoin-futures-daily. Accessed Feb 6. 22.
[22] "Volume of Bitcoin Futures" *The Block,* https://www.theblockcrypto.com/data/crypto-markets/futures/volume-of-bitcoin-futures-monthly. Accessed 6 Feb. 22.

II. Investor's Risks and Benefits in Cryptocurrency Perpetual Futures

Exchange Specific Risk:

Cryptocurrency trades and transactions are novel, and with any new product, risk is involved. There are hundreds of cryptocurrency exchanges that operate offshore, which can increase the risk for traders because they are not provided the same protections as exchanges that are regulated in the United States. For example, some exchanges have ceased operations; others have been shut down by regulators.[23] Some active exchanges, however, have been known to go offline during periods of high volatility. On May 19, 2021, Binance experienced an outage that prevented traders from exiting their positions or from decreasing their leverage for about an hour.[24] Binance is currently facing a lawsuit for this incident. Coupled with large amounts of leverage, exchange outages can quickly wipe out investments in a matter of seconds. It can be expected that smaller exchanges also face these difficulties at a greater scale. Cryptocurrency perpetual futures are not available to trade in the United States, and thus, many investors rely on offshore exchanges to trade these products.

Current Protections for Traders in Cryptocurrency Perpetual Futures

Exchanges have produced other protections for traders such as insurance funds, and auto-deleveraging. Insurance funds function as a mechanism to protect traders during flash crashes when positions are not exited before their liquidation price. With insurance funds, traders are not

---

[23] Cocks, Tim. "S.Africa Crypto Exchange Brothers Disappear after Client Cash Vanishes, Lawyers Say." *Reuters*, 26 June 2021, www.reuters.com/technology/safrica-crypto-exchange-brothers-disappear-after-client-cash-vanishes-lawyers-2021-06-25;
Browne, Ryan. "Turkish Crypto Exchange Boss Goes Missing, Reportedly Taking $2 Billion of Investors' Funds with Him." CNBC, 26 Apr. 2021, www.cnbc.com/2021/04/23/bitcoin-btc-ceo-of-turkish-cryptocurrency-exchange-thodex-missing.html.; Cho, Kyungji. "Many of South Korea's Small Crypto Exchanges Set to Disappear." *Bloomberg*, 15 Sept. 2021, *https*://www.bloomberg.com/news/articles/2021-09-15/many-of-south-korea-s-small-crypto-exchanges-set-to-disappear?sref=mv3pSk2B

[24] Browne, Ryan. "Cryptocurrency Traders Seek Damages from Binance after a Major Outage Cost Them Millions." *CNBC*, 19 Aug. 2021, www.cnbc.com/2021/08/19/cryptocurrency-traders-seek-damages-from-binance-after-major-outage.html.

personally responsible if their position is not liquidated. In a situation where a position is not liquidated, the insurance fund would cover the losses beyond the balance in the trader's account.

Similarly, auto-deleveraging functions when the insurance fund is empty or insufficient to cover the losses. Auto-deleveraging tries to maintain the orderbook balanced and sells off trades by winning traders to cover liquidations not covered by the insurance fund in the event of a flash crash.

Exchange Revenue from Fees

Maker vs. Taker fees

Perpetual futures are actively traded on Binance, and Binance's volume represents approximately 20% of the cryptocurrency futures, the single largest share. To profit on these trades, Binance charges trading fees for every transaction on its platform. Binance's main fees are maker fees and taker fees.[25]

Maker fees are fees that are paid when placing a limit order below or above the market price of the specific contract. Maker fees are generally lower than taker fees as exchanges tend to prefer limit orders due to their nature of adding liquidity to the order book. Both fees depend on the 30-day volume of the individual trader, or "VIP Level", as seen in Figure 5.[26] Maker fees on Binance start at 0.02% and can be as low as 0%.[27] To trade at the lowest fee, users must have a 30-day trade volume exceeding 750,000BTC.[28]

[25] "Trade Crypto Futures: How Much Does It Cost?" *Binance Blog*, www.binance.com/en/blog/futures/trade-crypto-futures-how-much-does-it-cost-421499824684902239. Accessed 6 Mar. 2022.
[26] VIP Level = f (30-day volume, BNB balance). BNB is a coin issued by Binance that runs on Binance blockchain.
[27] "Trade Crypto Futures: How Much Does It Cost?" *Binance Blog*.
[28] "Trade Crypto Futures: How Much Does It Cost?" *Binance Blog*.

Level	30d Trade Volume (BTC)	&/or	BNB Balance	Maker/Taker	Maker/Taker BNB 10% off
VIP 0	< 250 BTC	or	≥ 0 BNB	0.0200%/0.0400%	0.0180%/0.0360%
VIP 1	≥ 250 BTC	&	≥ 50 BNB	0.0160%/0.0400%	0.0144%/0.0360%
VIP 2	≥ 2500 BTC	&	≥ 200 BNB	0.0140%/0.0350%	0.0126%/0.0315%
VIP 3	≥ 7500 BTC	&	≥ 500 BNB	0.0120%/0.0320%	0.0108%/0.0288%
VIP 4	≥ 22500 BTC	&	≥ 1000 BNB	0.0100%/0.0300%	0.0090%/0.0270%
VIP 5	≥ 50000 BTC	&	≥ 2000 BNB	0.0080%/0.0270%	0.0072%/0.0243%
VIP 6	≥ 100000 BTC	&	≥ 3500 BNB	0.0060%/0.0250%	0.0054%/0.0225%
VIP 7	≥ 200000 BTC	&	≥ 6000 BNB	0.0040%/0.0220%	0.0036%/0.0198%
VIP 8	≥ 400000 BTC	&	≥ 9000 BNB	0.0020%/0.0200%	0.0018%/0.0180%
VIP 9	≥ 750000 BTC	&	≥ 11000 BNB	0.0000%/0.0170%	0.0000%/0.0153%

Figure 5, Binance Maker/Taker Fees. Accessed 6 Mar. 2022. [29]

Taker fees are fees that are paid when a market order is placed. Since these market orders remove liquidity from the market, these fees are higher than the maker fees.[30] Taker fees start at 0.04% and can be as low as 0.017%. To trade at the lowest fees, users must meet the 30-day volume requirements.[31]

[29] The price of 1 BNB is not equivalent to the price of 1 BTC.
[30] "Trade Crypto Futures: How Much Does It Cost?" *Binance Blog*.
[31] "Trade Crypto Futures: How Much Does It Cost?" *Binance Blog*.

For a user that does not meet the 30-day volume minimum purchasing a long position for 1 BTC/USD contract at $45,000 and closing the position at $45,500, the maker/taker fees would be 0.02%/0.04%. Total fees for an open-close transaction could range from $18.10 - $36.20 as shown below.

The equation to calculate the fees is as follows:[32]

- Fee to Open = (Contract Quantity x Entry Price) x Trading Fee Rate
- Fee to Close = (Contract Quantity x Exit Price) x Trading Fee Rate

Fee to open at $45,000 / BTC	Fee to close at $45,500 / BTC	Total Fee
Taker: (1 x $45,000) x 0.04% = $18.00	Taker: (1 x $45,500) x 0.04% = $18.20	$36.20
Taker: (1 x $45,000) x 0.04% = $18.00	Maker: (1 x $45,500) x 0.02% = $9.10	$27.10
Maker: (1 x $45,000) x 0.02% = $9.00	Maker: (1 x $45,500) x 0.02% = $9.10	$18.10
Maker: (1 x $45,000) x 0.02% = $9.00	Taker: (1 x $45,500) x 0.04% = $18.20	$27.20

Exchanges Benefit from All Transactions

Binance receives a significant amount of revenue from trading fees imposed on those that use the Binance platform. As seen in Figure 6, roughly 30% of Binance's total volume (including all coins, products, and spot) is derived from BTC perpetual future contracts.

[32] "Trade Crypto Futures: How Much Does It Cost?" *Binance Blog*.

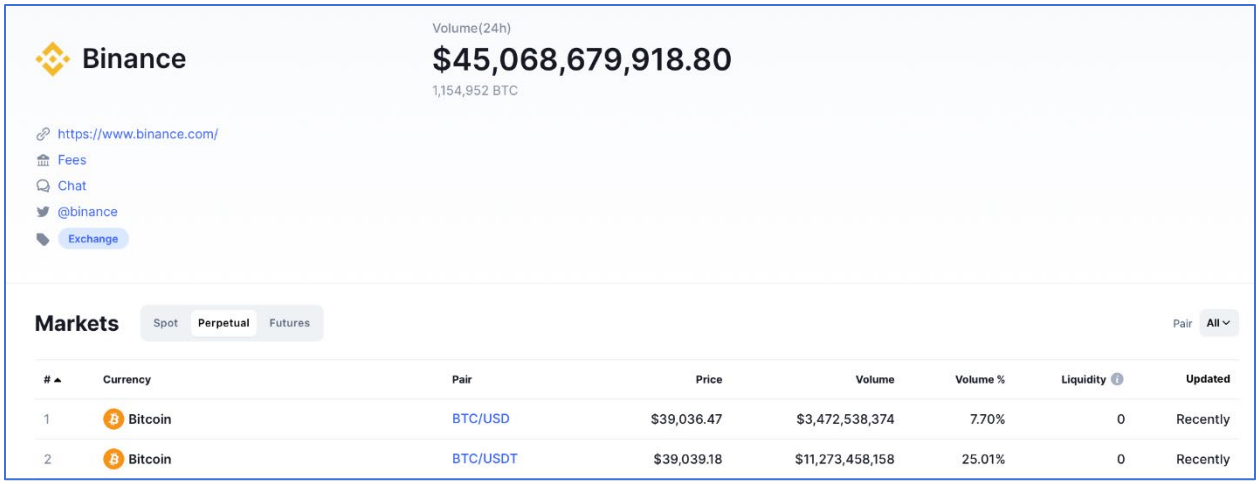

Figure 6, CoinMarketCap BTC Perp Vol on 6 Mar. 2022.[33]

On March 6, 2022, assuming an average BTC price of $39,037.03, roughly 377,729 BTC contracts were traded during the day. Assuming the average trader falls within the VIP3 category of fees, and assuming 75% of the contracts were makers and 25% of the contracts were takers, Binance collected revenue of approximately $3.9 million in 24-hours. Holding this volume and price constant over 30 days, Binance would collect revenues of approximately $119.4 million.

However, Binance would benefit from more volume by VIP 0 users, as those users pay higher maker/taker fees. VIP 0 users are those trading less than 250 BTC per 30 days and are thus more likely to be beginner investors. For example, if instead all of the traders within the 24-hour window on March 6, 2022, were VIP 0 traders, Binance would collect revenues of approximately $5.1 million in a 24-hour period, and approximately $154.8 million over thirty days assuming constant volume and price. The impact in VIP status directly affects Binance's bottom line – representing a change of approximately $35.4 million per month. For a trader to change their status from VIP 0 to VIP 1, the trader must trade more than 250 BTC in 30 days. If BTC is trading at $40,000, and the trader opens 250 positions in BTC, the trader paying the

[33] "Binance Trade Volume and Market Listings." *CoinMarketCap*, coinmarketcap.com/exchanges/binance/?type=perpetual. Accessed 6 Mar. 2022.

lower maker fee would at a minimum generate $2,000 in fees for Binance in those 30 days. As an exchange, Binance collects revenue and stands to profit regardless of whether the trader profits, or whether the trader is quickly liquidated as seen in the 125x leverage simulation. Binance fees must be paid upfront and are taken from the trader should the trader be liquidated.

Liquidations:

Positions in perpetual futures are liquidated often due to the amount of high leverage used for these trades. Although there is no perpetual futures specific liquidation data available, roughly 90% of daily liquidations in cryptocurrency futures contracts occur in perpetual futures.[34] Figure 7 shows the total daily number of liquidations per exchange. Figures 8 and 9 show the daily long and short liquidations by exchange.

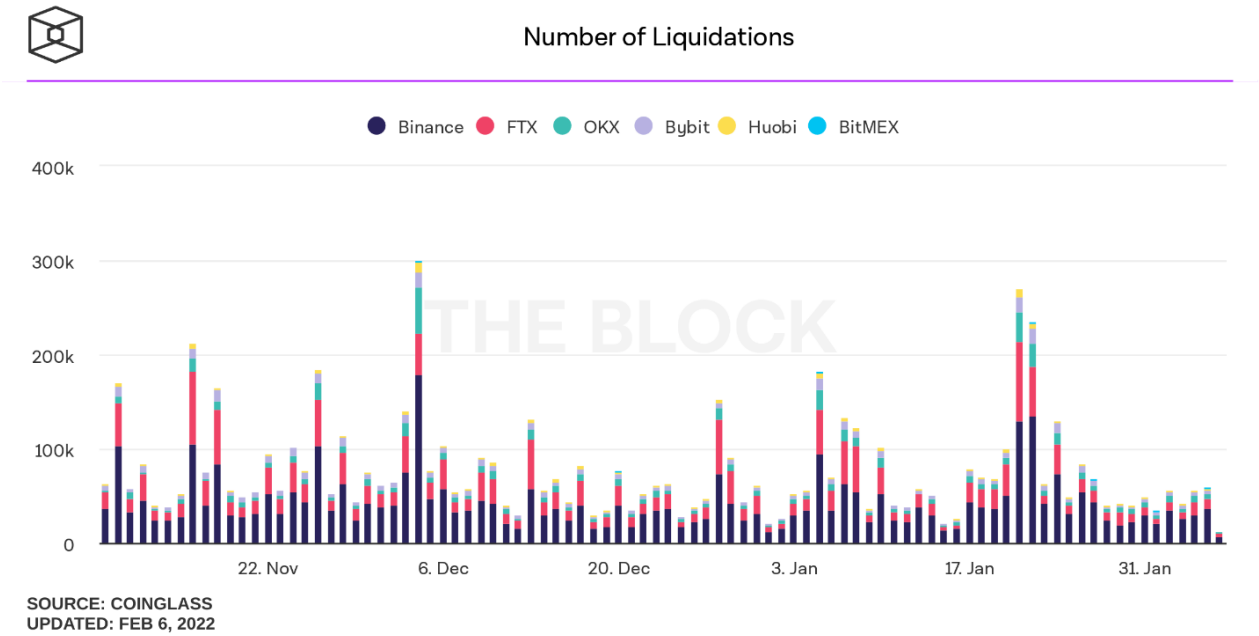

Figure 7, Number of Liquidations on Future Exchanges[35]

[34] See Coinalyze.net listing the total daily liquidations for BTC future contracts as well as the share of perpetual liquidations in the past 24H. https://coinalyze.net/bitcoin/liquidations

[35] "Number of Liquidations." *The Block,* https://www.theblockcrypto.com/data/crypto-markets/futures/number-of-liquidations. Accessed 6 Feb. 22.

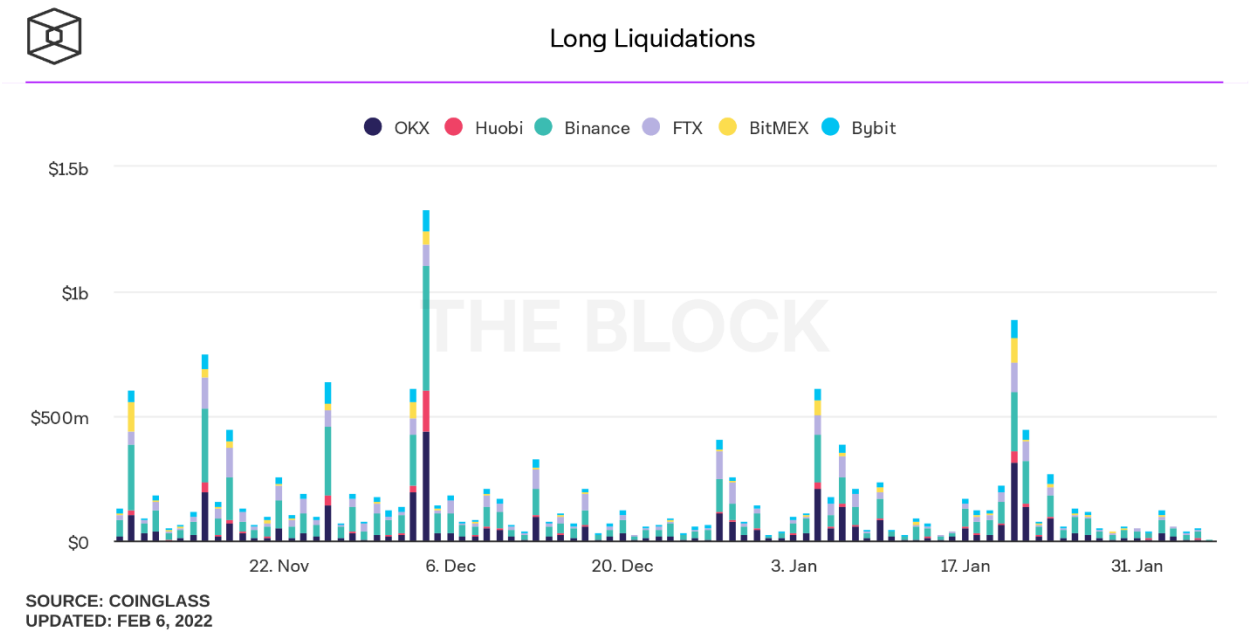

Figure 8, Daily Long Liquidations[36]

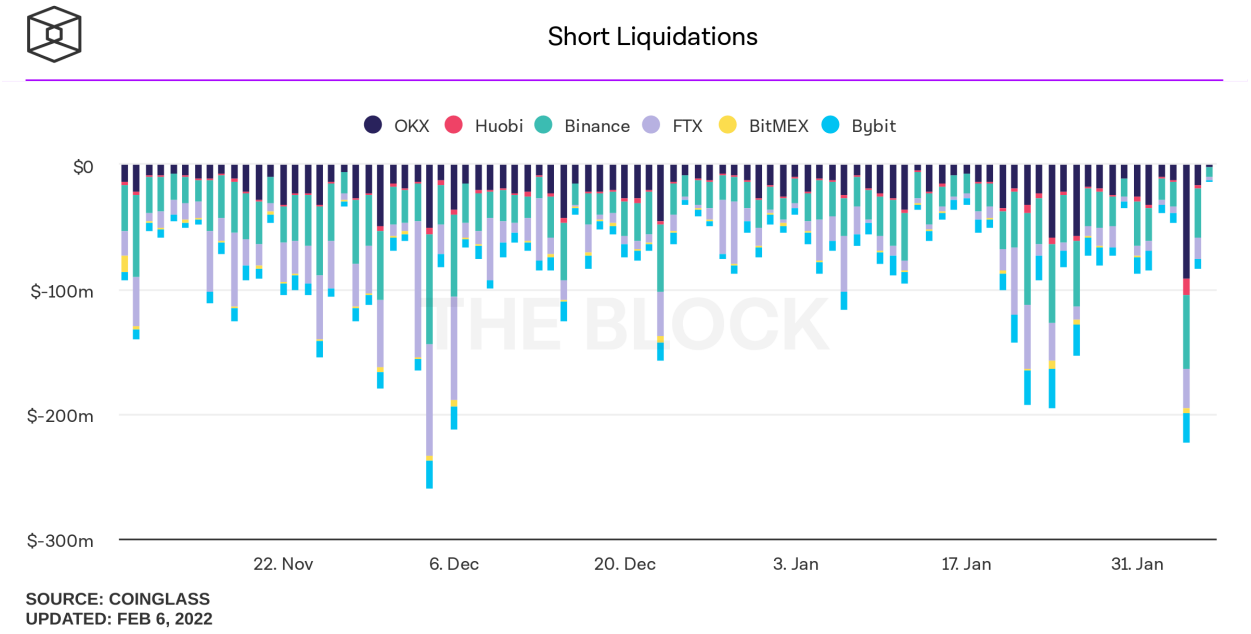

Figure 9, Daily Short Liquidations[37]

[36] "Long Liquidations." *The Block,* https://www.theblockcrypto.com/data/crypto-markets/futures/long-liquidations. Accessed 6 Feb. 22.
[37] "Short Liquidations" *The Block,* https://www.theblockcrypto.com/data/crypto-markets/futures/short-liquidations. Accessed 6 Feb. 22.

Liquidation Simulations

To further explore the liquidation risk for perpetual futures in exchanges with high leverage availability a simulation was conducted for leverage amounts of 125x, 75x, and 25x. In this simulation, the price of the BTC/USD perpetual future was gathered for every second for every date between 1/1/20 and 12/31/20. Then randomized entry and exit points were generated. The program would then either exit at the exit point or at the liquidation point, depending on whether the account balance reached the liquidation point below the maintenance margin of 50%. All trades used the minimum amount required to purchase 1 BTC/USD coupled with its respective leverage. For all trades, the entry point was entered into at the maker fee, and the closing point was entered into at the taker fee. The fee percentage used for these trades is the equivalent to the VIP0 rate as shown in Figure 5. These trades were then simulated for 10,000 iterations for each 125x, 75x, and 25x leverage. Figure 10 displays the results of the simulation in a histogram.

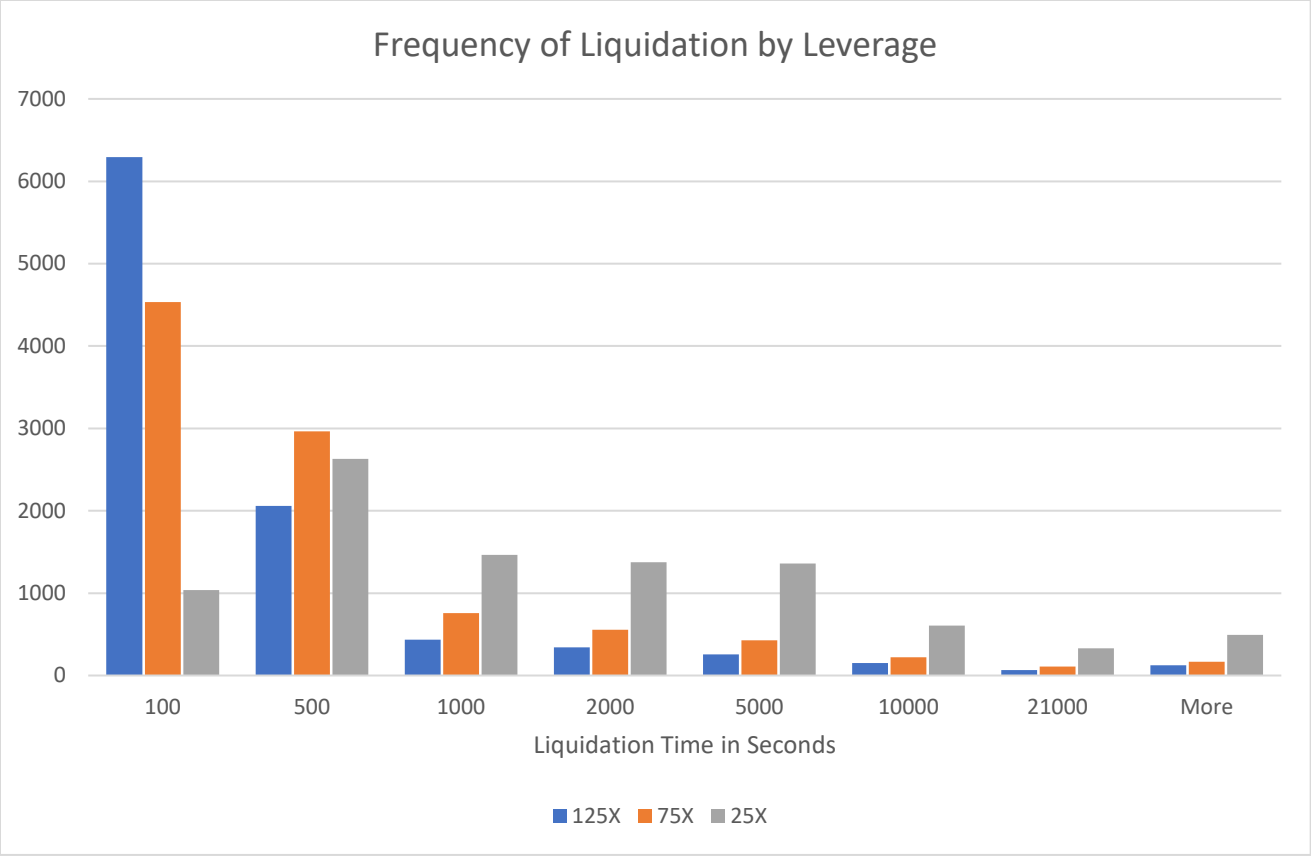

Figure 10

For the simulation with 125x leverage, 98.32% of all trades were liquidated. The average liquidation time for each trade was 1,350.56 seconds, or roughly 22 minutes and 30 seconds. The median liquidation time was 46 seconds. Furthermore, 83.5% of all liquidated trades were liquidated within the first 500 seconds. The average loss if the trade was liquidated was $224.56. The average profit for non-liquidated trades was $9,232.96. For comparison, there is a 2.63% chance in choosing the correct number in a casino roulette table. In roulette, casinos pay out 35 to 1 for choosing the correct number. If instead the investor had placed a $224.56 bet on a number in roulette, the bettor has a 2.63% chance of winning $7,859.60. With these odds, an investor would have an expected profit (loss) of ($65.67) in a perpetual cryptocurrency investment at 125x leverage and would have an expected profit (loss) of ($11.82) on a roulette table. Now this is not to suggest that gambling is more profitable than investing in

cryptocurrency perpetual futures. This simulation was made with 10,000 randomized entry/exit points. However, the low median time until liquidation coupled with the high probability of loss and minimal probability of a large gain does seem to suggest that trading cryptocurrency perpetual futures with high amounts of leverage resembles gambling as opposed to a sound investment strategy.

The simulation with 75x leverage liquidated 97.30% if all trades, with an average liquidation time of 1,835.75 seconds, or roughly 30 minutes 35 seconds, and a median liquidation time of 117 seconds. This lower level of leverage increased the liquidation time, as 78.98% of all trades were liquidated in less than 500 seconds.

Lastly, in the simulation with 25x leverage, 92.95% of all trades were liquidated. The average liquidation time was 5,543.79 seconds, roughly 92 minutes 24 seconds. The median liquidation time was roughly 13 minutes 10 seconds. In this simulation, only 36.68% of all trades were liquidated in less than 500 seconds.

While in all simulations more than 90% of all trades were liquidated, one constant throughout all simulations was the revenue generated by the exchange. For the 125x, 75x, and 25x, the revenues generated by the exchange's maker/taker fees for 10,000 entry/exit points were $295,705.51; $295,222.03; $294,997.79 respectively. While investors are often liquidated in a matter of minutes, exchanges can profit significantly by offering investors the ability to highly leverage their trades.

III. The Need for Potential Regulations to Further Protect Investors

Although often misused and misunderstood, perpetual futures in cryptocurrency do bring a novel product that benefits investors. Although cryptocurrency perpetual futures deviate from the original proposed use by Robert Shiller in 1992, perpetual futures allow for leveraged

positions in cryptocurrency that do not expire and provide significant liquidity to the market. These contracts allow for small investors to take large positions with leverage. Furthermore, exchange traded perpetual futures have the security of being traded on an exchange – and investors can choose their preferred exchange. These products should not be banned outright, as this just allows for exchanges to operate offshore in less regulated arenas. These products should be embraced by US regulators, but with certain conditions that protect investors.

Investors should be protected for two reasons. First, many retail investors have likely never been exposed to high levels of leverage available at their disposal. With large amounts of leverage, it is easy for investors to misjudge how much time they will have before their investment gets liquidated. Second, with the rising price of BTC in the past few years, it is possible investors misunderstand the risk in highly leveraged positions. While some would argue gambling should be regulated even more to protect gamblers, in gambling there is a presumption of the odds being against the gambler. Gamblers know the house has the upper hand, but with perpetual futures, there is an underlying presumption of the rising prices of cryptocurrency that could cause investors to misunderstand the risk involved in high leveraged positions.

Proposed Regulations to Further Protect Investors

(1) Exchanges should lower their maximum leverage for new traders for a pre-determined amount of time and disclose the probability of liquidation at high levels of leverage.

Binance has already started to limit their maximum leverage for new traders. On July 26, 2021, Binance updated its trading rules to limit leverage to 20x for all accounts within 60 days of opening the account.[38] However, as seen in the simulations conducted,

[38] "Updates on Rules of Binance Futures Leverage for New Accounts (2021–07-27) | Binance Support." *Binance*, www.binance.com/en/support/announcement/d6457e23eb2e42f2b9c3ce44f46f9a6d#:%7E:text=With%20immediate%20effect%2C%20leverage%20levels,accounts%20opened%20within%2030%20days. Accessed 9 Apr. 2022.

a large share of investors can still be liquidated in a short amount of time even at the lower levels of leverage. Exchanges should disclose the probability of liquidation at certain leverage ranges assuming the volatility these products have experienced in the past continue. Educating investors on the probability of liquidation will permit these investors to make better informed decisions on their investment. Although Binance has taken some steps to protect investors by limiting the amount of leverage for new accounts, other exchanges have not followed and continue to allow new investors to trade at high levels of leverage.

(2) Exchanges need transparent trading fees to avoid confusing traders.

Exchanges do not make it explicitly clear what the trading fees are on perpetual futures. Binance, Kraken, and Bybit all use a tiered system of maker/taker percentage fees.[39] Fees for each exchange decrease as the volume traded by the user increases. This system encourages perpetual futures traders to increase their volume which in turn earns the exchanges more revenue. To avoid confusion and an increased pressure to trade, exchanges should establish, fixed, upfront, and transparent fees for all perpetual futures traders.

(3) Exchanges need stronger know your customer (KYC) requirements.

Binance and other exchanges have implemented stronger KYC rules including facial recognition, valid ID, proof of residence, KYC questionnaires, and other tools.[40] However, illicit users have already found a way to circumvent the rules by using fake IDs

[39] "Fee Schedule." *Kraken*, support.kraken.com/hc/en-us/articles/360048917612-Fee-schedule. Accessed 9 Apr. 2022; "Fee Rate." *Binance*, www.binance.com/en/fee/futureFee. Accessed 9 Apr. 2022.
[40] "Verification Level Requirements." *Kraken*, support.kraken.com/hc/en-us/articles/201352206-Verification-level-requirements. Accessed 9 Apr. 2022; "Moving Crypto Forward with Updated KYC Policies on Binance." *Binance Blog*, www.binance.com/en/blog/community/moving-crypto-forward-with-updated-kyc-policies-on-binance-421499824684902779. Accessed 9 Apr. 2022.

and paying for verified accounts.[41] For these exchanges to be permitted in the United States, they must proactively enhance their KYC requirements and have robust anti-money laundering (AML) policies that will appease regulators. KYC requirements for all customers will protect all investors by ensuring the investors have the required capital to trade these risky assets. Kraken, for example, allows margin trading for U.S. clients that have more than $10M in assets invested. However, this is a self-certified questionnaire, and it only applies to U.S. investors.

Regulators in onshore markets should develop additional regulations so that offshore exchanges, should they ever seek regulatory approval, can develop under proper regulation status. By exiling the exchanges, it is not the exchanges that are getting hurt, but rather the traders. These exchanges should be regulated to prevent the "house always win" casino model adopted by these offshore exchanges, as evidenced by the profits from the exchanges and the high probability of being liquidated in the leverage simulations conducted. The exchanges have made significant steps to appease regulators and have shown they are willing to work with regulators to establish protections for traders. Instead of banning perpetual futures, the regulators should look for ways to adopt these products, with certain protections for investors. However, investors should be protected as it is likely they misunderstand the risk accompanied by the high levels of leverage offered by most exchanges. It is possible perpetual futures could expand towards other commodities that are cash settled. Investors could benefit from an increase in liquidity, an increase in leverage, and a reduction in rollover fees. The future of perpetual futures

[41] Baydakova, Anna. "For $200, You Can Trade Crypto With a Fake ID." *Coindesk*, 19 Oct. 2021, www.coindesk.com/policy/2021/10/19/for-200-you-can-trade-crypto-with-a-fake-id.

depends on whether regulators and exchanges can find the right balance between the protections for traders and the incentives for exchanges to offer these novel products.

APPENDIX

Binance calculation of the funding rate: [42]

"Funding rates are calculated using the following formula:

Funding Amount = Nominal Value of Positions × Funding Rate

(Nominal Value of Positions = Mark Price x Size of a Contract)

Please note that Binance takes no fees from funding rate transfers as funding fees are transferred directly between traders.

Funding payments occur every 8 hours at 00:00 UTC; 08:00 UTC and 16:00 UTC for all Binance Futures perpetual contracts. Traders are only liable for funding payments in either direction if they have open positions at the pre-specified funding times. If traders do not have a position, they are not liable for any funding. Moreover, traders who close their positions prior to the funding time will not pay or receive any funding.

There is a 15-second deviation in the actual funding fee transaction time. For example, when a trader opens a position at 08:00:05 UTC, the funding fee could still apply to the trader (either paying or receiving the funding fee).

There are two components to Funding Rates: the Interest Rate and the Premium. The Premium is the reason why the price of the perpetual contract will converge with the price of the underlying asset.

Binance uses a flat Interest Rate, with the assumption that holding cash equivalent returns a higher interest than the BTC equivalent. The difference is stipulated to be 0.03% per day by default (0.01% per funding interval since funding occurs every 8 hours) and may change depending on market conditions, such as the Federal Funds Rate.

There may be a significant difference in price between the perpetual contract and the Mark Price. On such occasions, a Premium Index will be used to enforce price convergence between the two markets. The Premium Index history can be viewed here. It is calculated separately for every contract:

Premium Index (P) = [Max(0, Impact Bid Price - Price Index) - Max(0, Price Index - Impact Ask Price)] / Price Index

Impact Bid Price = The average fill price to execute the Impact Margin Notional on the Bid Price

[42] "Introduction to Binance Futures Funding Rates." *Binance*, https://www.binance.com/en/support/faq/360033525031. Accessed 6 Feb. 22.

Impact Ask Price = The average fill price to execute the Impact Margin Notional on the Ask Price

The Impact Margin Notional (IMN) for USDT-Margined Contracts is the notional available to trade with 200 USDT worth of margin (price quote in USDT); for Coin-Margined Contracts, it is the notional available to trade with 200 USD worth of margin (price quote in USD). IMN is used to locate the average Impact Bid or Ask price in the order book.

Impact Margin Notional (IMN) = 200 USDT / Initial margin rate at maximum leverage level. For example, the maximum leverage of the BTCUSDT perpetual contract is 125x, and its corresponding Initial Margin Rate is 0.8%, then the Impact Margin Notional (IMN) is 25,000 USDT (200 USDT / 0.8%), and the system will take an IMN of 25,000 USDT every minute in the order book to measure the average Impact Bid/Ask price."

Binance Price Index Computation: [43]

The underlying contract for the Perpetual Contract is the 'true' value of the Contract, and an average of the prices on the major markets constitutes the "Price Index" which is the primary component of Mark Price.

The Price Index is a bucket of prices from the major Spot Market Exchanges. The Price Index for USD©-M futures contracts derives prices from Huobi, Okex, Bittrex, HitBTC, Gate.io, Bitmax, Poloniex, FTX, MXC.

Single price source deviation: When the latest price of a certain exchange deviates more than 5% from the median price of all price sources, the exchange weight will be set to zero for weighting purposes.

Multi price source deviation: If more than 1 exchange shows greater than 5% deviation, the median price of all price sources will be used as the index value instead of the weighted average.

Exchange connectivity problem: If we can't access the data feed for an exchange and this exchange has trades updated in the last 10 seconds, we can take price data from the last result and use it for index calculation. If one exchange has no updates for 10 seconds, the weight of this exchange will be zero when calculating the weighted average.

Last Price Protected: When it is unable to obtain a stable and reliable source of reference data for "Price Index" and "Mark Price", for those contracts that have a single source of Price Index, the Price Index will not be updated. We will use a mechanism called "Last Price Protected" to update the Mark Price until it is back to

[43] "Mark Price in USD©-Margined Futures." *Binance*, https://www.binance.com/en/support/faq/360033525071. Accessed 6 Feb. 22.

normal. The “Last Price Protected” is a mechanism that the matching system temporarily switches to the latest transaction price of the contract itself within a certain limit as reference for Mark Price, to calculate unrealized profit and loss and liquidation call level, in order to avoid unnecessary liquidation.”

Binance calculates their Mark Price using these Price Indexes in the following way: [44]

Mark price is defined as the median of 3 prices:

Mark price = Median (Price 1, Price 2, Contract Price)

By definition, if Price 1 < Price 2 < Contract Price, then take Price 2 as Mark price.

In addition,

Price 1 = Price Index × (1 + Last Funding Rate × (Time Until Funding /8))

Price 2 = Price Index + Moving Average (30-minute Basis)

where the Moving Average (30-minute Basis) is defined as:

Moving Average ((Bid1+Ask1)/2- Price Index)

measured every minute in a 30-minute interval.

[44] “Mark Price in USDⓈ-Margined Futures.” *Binance*, https://www.binance.com/en/support/faq/360033525071. Accessed 6 Feb. 22.