

# DeFi Derivatives

## What Are Perpetual Futures?

Day 6 of 10

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BSc Seminar: Digital Finance

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**BSc Seminar: Digital Finance**

# The \$80 Billion-a-Day Market You Never Heard Of



Perpetual futures trade **5× more** than all spot crypto combined.  
These instruments **do not exist in traditional finance**.

# Invented by Crypto, for Crypto

- Invented by BitMEX in 2016 (Arthur Hayes)
- Based on a 1993 idea by Robert Shiller
- **No expiry date** — trade forever
- **No physical delivery** — cash-settled
- Up to 100× leverage
- Available 24/7, 365 days a year

## Key Question

Why would a derivative with **no expiry** and **no delivery** dominate the market?

**Answer:** Simplicity.

One instrument, infinite duration, easy leverage access.

# Today's Agenda



# Outline

- 1 What Is a Perpetual Future?
- 2 The Funding Rate
- 3 Cash-and-Carry Arbitrage
- 4 Squeeth and DeFi Options
- 5 CEX vs. DEX Derivatives
- 6 Hands-On Exercise

# Traditional Futures vs. Perpetual Futures

Feature	Traditional Future	Perpetual Future
Expiry date	Monthly / quarterly	<b>Never</b>
Settlement	Delivery or cash at expiry	Continuous funding
Rolling needed	Yes (costs money)	No
Price anchor	Converges at expiry	Funding rate
Trading hours	Exchange hours	24/7
Typical venue	CME, ICE	Binance, dYdX

**Key insight:** A perp is like renting a futures position — you pay **rent** (the funding rate) instead of buying and holding to expiry.

# How Does the Price Stay Anchored?



- When perp trades **above** spot  $\Rightarrow$  longs pay shorts (discourages more longs)
- When perp trades **below** spot  $\Rightarrow$  shorts pay longs (discourages more shorts)
- This self-correcting mechanism replaces expiry-date convergence

# Worked Example: Funding Cost of a Long Position

## Given

BTC spot = \$60,000    BTC perp = \$60,300    Funding rate = 0.01% per 8 hours

You are **LONG 1 BTC perp**. Funding is positive  $\Rightarrow$  you pay.

- 1 **Per settlement:**  $\$60,300 \times 0.01\% = \mathbf{\$6.03}$  every 8 hours
- 2 **Daily cost:**  $3 \times \$6.03 = \mathbf{\$18.09}$  per day
- 3 **Annualized:**  $0.01\% \times 3 \times 365 = \mathbf{10.95\%}$  per year

## Incentive

This cost **pushes longs to close** and **attracts shorts**, pulling the perp price back toward spot.

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# What Is the Funding Rate?

## Simple Rule

**Funding rate** = how far the perp price is from spot price, settled every 8 hours.

**When funding is positive** ( $F > 0$ ):

- Perp trades above spot
- Market is **bullish**
- Longs pay shorts

**When funding is negative** ( $F < 0$ ):

- Perp trades below spot
- Market is **bearish**
- Shorts pay longs

Think of it as a **sentiment indicator**: high funding = market is overheated.

# When Funding Goes Extreme

## Very Bullish Market

BTC perp = \$61,000    BTC spot = \$60,000    Premium = 1.67% (clamped to 0.75%)  
Funding rate = 0.76% per 8 hours

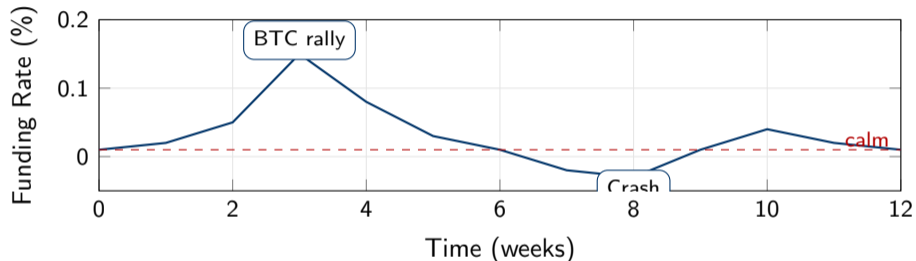
**Position:** \$100,000 LONG

- Per 8h:  $\$100,000 \times 0.76\% = \mathbf{\$760}$
- Per day:  $\$760 \times 3 = \mathbf{\$2,280}$
- Annualized:  $0.76\% \times 3 \times 365 = \mathbf{833\%}$

## Self-Correction

At 833% annualized cost, no one holds a long for more than hours. The market **forces itself to correct**. That is the entire point.

# Funding Rate as a Market Thermometer



**Reading the chart:** spikes = market overheated. Negative = panic selling. Near zero = calm.

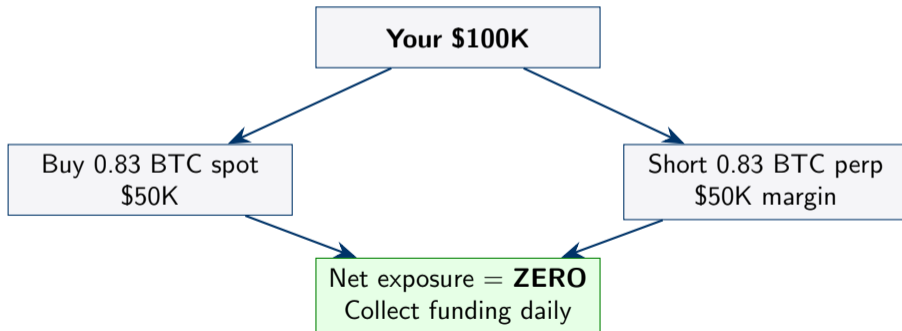
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# Cash-and-Carry: The “Free Money” Strategy

## The Idea

**Buy spot** + **Short perp** = collect funding with zero price risk.



# Cash-and-Carry: Doing the Math

## Setup

Capital = \$100K    BTC = \$60,000    Funding = 0.03% per 8h (you receive as short)

① **Daily funding income:**

$$0.833 \text{ BTC} \times \$60,300 \times 0.03\% \times 3 = \mathbf{\$45.19/\text{day}}$$

② **Annual income:**

$$\$45.19 \times 365 = \mathbf{\$16,494} \quad (\approx 16.5\% \text{ return})$$

③ **Price risk:**

If BTC rises 20%: spot gains \$10K, short loses \$10K. Net P&L from price = **\$0**.

**Historical returns:** 10–30% annualized (2021–2024).

This is the bread-and-butter of crypto quant funds.

# Cash-and-Carry: The Risks Are Real

## Why Doesn't Everyone Do This?

- ① **Exchange insolvency** — Remember FTX? Your spot BTC sits on the exchange.
- ② **Liquidation risk** — If BTC spikes fast, the exchange may liquidate your short *before* your spot gain is realized.
- ③ **Funding reversal** — If funding turns negative, you *pay* instead of receive.
- ④ **Capital lockup** — Money is stuck on the exchange for weeks or months.

**Lesson:** 16% yield comes with real risks. There is no truly free lunch.

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# Squeeth: The Option That Never Expires

## What Is It?

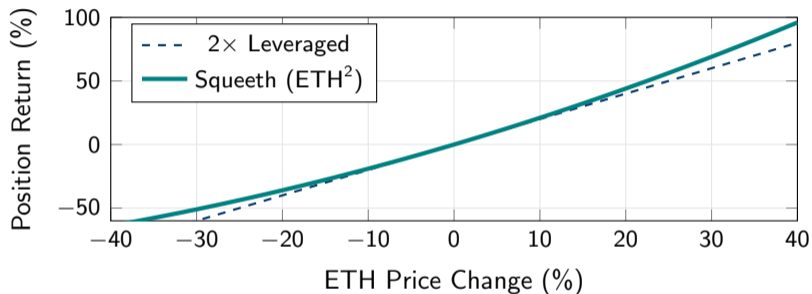
**Squeeth** = “Squared ETH.” A perpetual derivative that tracks **ETH<sup>2</sup>** instead of ETH. Introduced by Oyn in 2022.

## Why does this matter?

- Traditional options expire — you must constantly re-buy them
- Squeeth **never expires** — perpetual convex exposure
- Your gains accelerate on the upside (like an option)
- Your losses decelerate on the downside (like an option)
- The catch: you pay daily funding proportional to volatility<sup>2</sup>

**Analogy:** Imagine an option that never expires — it gives you a **curved payoff** instead of a straight line.

# Squeeth vs. 2× Leverage: The Curve Matters



**Key:** Squeeth **outperforms** 2× on the upside and **loses less** on the downside. That curve is called *convexity*.

# Squeeth: Worked Example

## ETH rises 10% to \$3,300:

- Squeeth return: +21%
- 2× leverage: +20%
- Squeeth wins by 1%

## ETH falls 10% to \$2,700:

- Squeeth return: −19%
- 2× leverage: −20%
- Squeeth loses 1% *less*

### The Cost of Convexity

Daily funding  $\approx$  volatility<sup>2</sup>

At 80% annual vol:

$$0.80^2/365 = 0.175\%/day$$

= **64%** per year!

You pay 64%/year for this “always-on option.” Worth it only if big moves happen.

# Option Vaults: Automated Option Selling

## Decentralized Option Vaults (DOVs)

Smart contracts that **sell options automatically** every week. Depositors earn premium income. Pioneered by Ribbon Finance (2021).

### How it works:

- 1 Deposit 10 ETH into vault
- 2 Vault sells weekly covered calls at a strike 5–10% above current price
- 3 If ETH stays below strike: vault keeps premium (~2–5% per week)
- 4 If ETH surges past strike: vault misses the upside

**Analogy:** Like selling insurance — steady income, but occasional large payouts.

**Typical yield:** 15–30% annualized (2022–2024).

**Risk:** Underperforms buy-and-hold in strong bull markets.

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# CEX vs. DEX: Where Do Derivatives Trade?

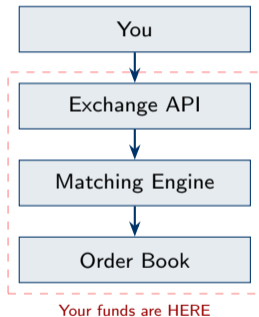
Feature	CEX (Binance)	DEX (GMX, dYdX)
Daily volume	~\$50B	~\$1–2B
Speed	~5 ms	~2 sec (block time)
Custody	Exchange holds	<b>You hold your keys</b>
KYC required	Yes	No
Max leverage	125×	100×
Counterparty risk	Exchange failure	Smart contract bug
Fees (taker)	0.02–0.05%	0.05–0.10%
Regulation	Licensed (varies)	Unregulated

**CEX** = like a bank (fast, deep, but you trust them with your money)

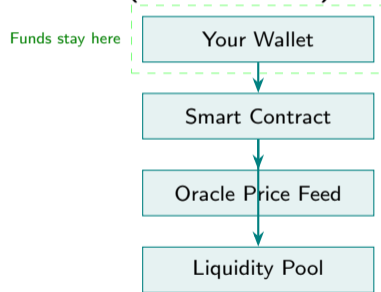
**DEX** = like a vending machine (always open, self-custody, but slower)

# Two Different Architectures

## CEX (Centralized)



## DEX (Decentralized)



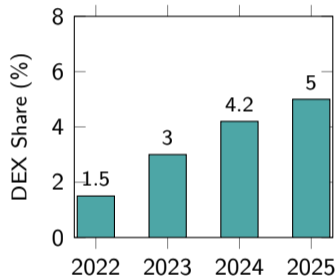
# The FTX Lesson: Why DEX Volume Is Growing

**November 2022:** FTX collapses overnight.

- \$8 billion in customer funds vanished
- Traders who held perps on FTX lost everything
- Not because of bad trades — because the *exchange* failed

**After FTX:**

- DEX perp volume grew from 1.5% to ~5% of total
- Self-custody demand surged
- “Not your keys, not your coins” became real



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# Exercise: Calculate Your Funding Costs

## Scenario

You open a **\$50,000 LONG** BTC perp position. Funding rate = **0.02%** per 8 hours (positive).

## Calculate:

- 1 How much do you pay per 8-hour settlement?
- 2 How much per day?
- 3 What is the annualized cost?
- 4 At what BTC price increase (in %) do you break even after 30 days?

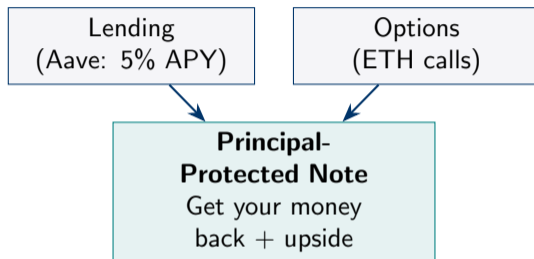
**Bonus:** Now imagine funding turns **negative** at  $-0.01\%$ . What happens to your position economics?

## Exercise: Solution

- ① **Per settlement:**  $\$50,000 \times 0.02\% = \$10.00$
- ② **Per day:**  $\$10.00 \times 3 = \$30.00$
- ③ **Annualized:**  $0.02\% \times 3 \times 365 = 21.9\%$
- ④ **30-day breakeven:** Total cost =  $\$30 \times 30 = \$900$   
Breakeven move =  $\$900/\$50,000 = 1.8\%$   
BTC must rise at least 1.8% in 30 days to profit.

**Bonus:** If funding =  $-0.01\%$ , you *receive* \$5/settlement. Your long position now *earns* money while you hold it!

# DeFi Structured Products: Building Blocks



Deposit \$9,500 in lending + \$500 in options = guaranteed \$10K back

**DeFi lets you build products that banks charge 2–3% fees for,**  
transparently, with code you can read.

## Day 6: Key Takeaways

- 1 **Perpetual futures** dominate crypto: \$80B/day, no expiry, funded by the funding rate
- 2 The **funding rate** is a self-correcting mechanism that anchors perps to spot — and doubles as a market sentiment indicator
- 3 **Cash-and-carry** arbitrage: buy spot + short perp = earn funding with zero directional risk (but real exchange risk)
- 4 **Squeeth** offers “option-like” payoffs that never expire — at a cost proportional to volatility squared
- 5 **DEX derivatives** are growing post-FTX, trading self-custody for slower execution and wider spreads

# Discussion Questions

- ① Why do perpetual futures trade  $5\times$  more volume than spot? What need do they serve?
- ② If cash-and-carry yields 15–20%, why doesn't everyone do it?
- ③ Should DeFi derivatives be regulated like traditional derivatives?
- ④ Would you trust a smart contract with \$100K, or prefer a centralized exchange? Why?

## Day 7: The Robot That Trades While You Sleep

- What is an AI agent vs. a chatbot?
- How AI agents trade DeFi autonomously
- LLM oracles: when AI resolves \$100M bets
- Smart wallets and programmable delegation
- The risks: hallucination, hacks, and alignment

# References I