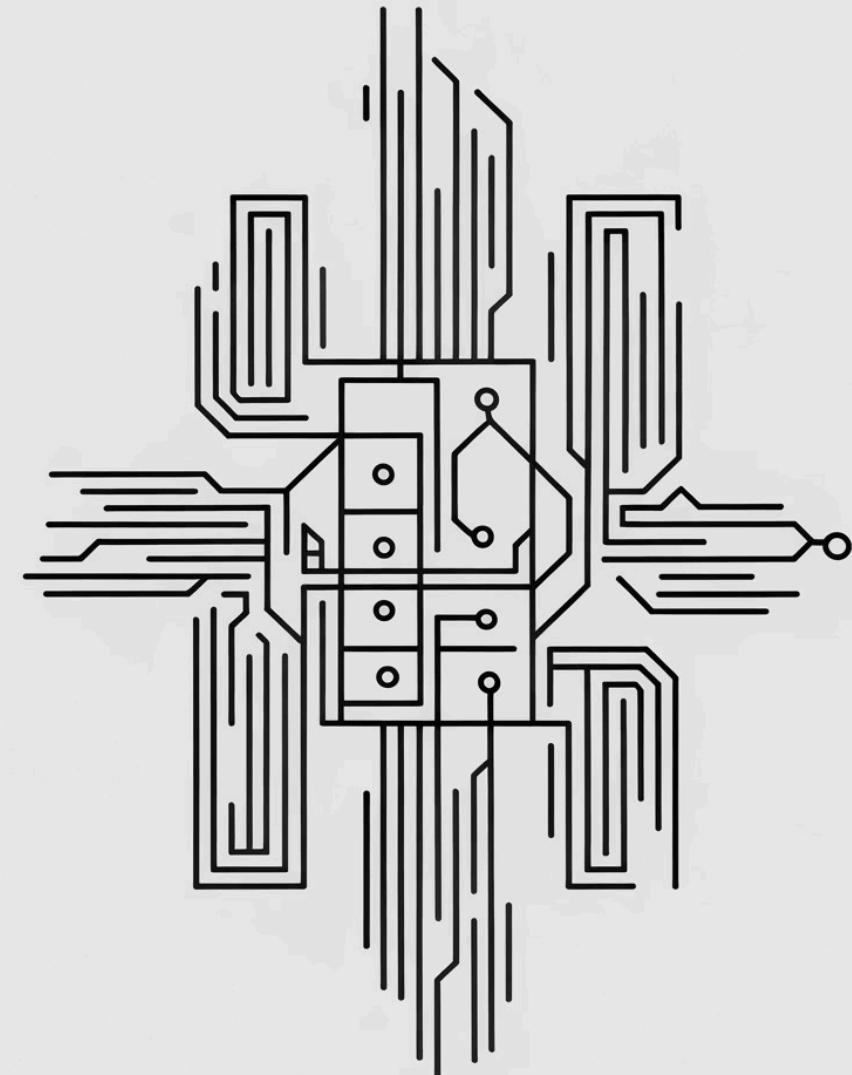


Interest Rate Efficiency in Leveraged Trading in BTC

Applied ML in Finance Course Project

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What Is Leveraged Trading?

How can someone trade more money than they actually have?



How Traders Use Leverage

How Traders Use Leverage

- Borrow extra funds to increase position size
- Example: \$100 capital → borrow \$200 → trade with \$300
- Gains amplify when price rises
- Losses amplify when price falls

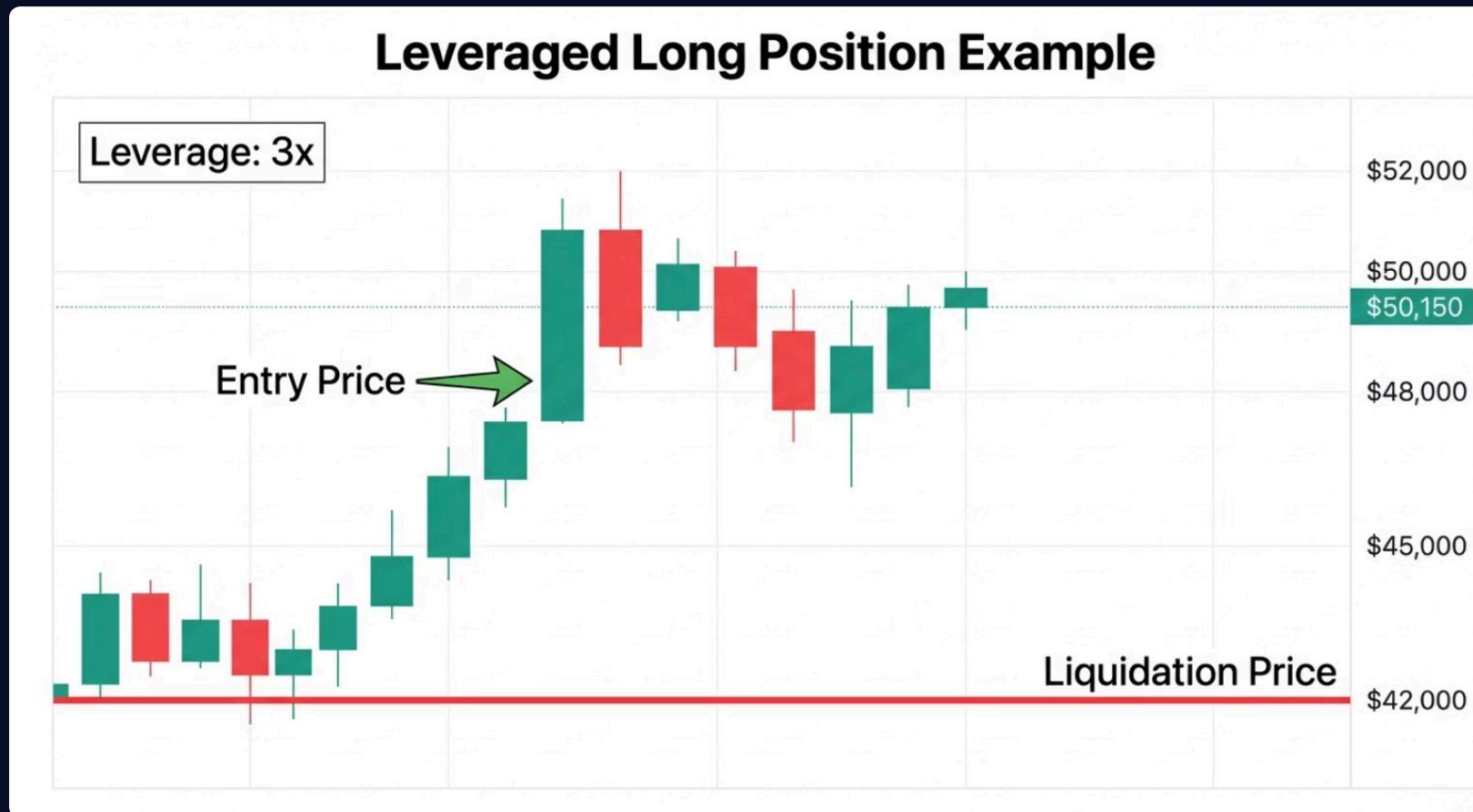
Why Liquidation Happens

- Exchange monitors trader's equity
- If losses approach loan amount, position is force-sold
- Trader's margin absorbs losses first
- Fees & liquidation costs → go to the exchange

Traders take on amplified risk. Liquidation protects the lender, not the borrower.



Example Leveraged Trade



Entry: \$48,000

Current: \$50,150

Position Size: \$300

Leverage: 3x

Capital: \$100

Borrowed: \$200

P&L: +13.44%

How Lending Mechanism Works

1

How Lending/Pool Mechanism Works

- Lenders supply assets to a shared pool
- Traders borrow from that pool to take leverage

2

What Lenders Earn

- Principal + prorated interest only
- Interest is modest (APR-based, often a few % per year)

3

What Protects Lenders

- Automatic liquidation engine closes risky trades early
- Lenders are repaid first
- Collateral & margin from trader + liquidation fees → go to exchange/insurance fund

Lenders earn stable, low-risk interest; traders bear the risk of large losses.



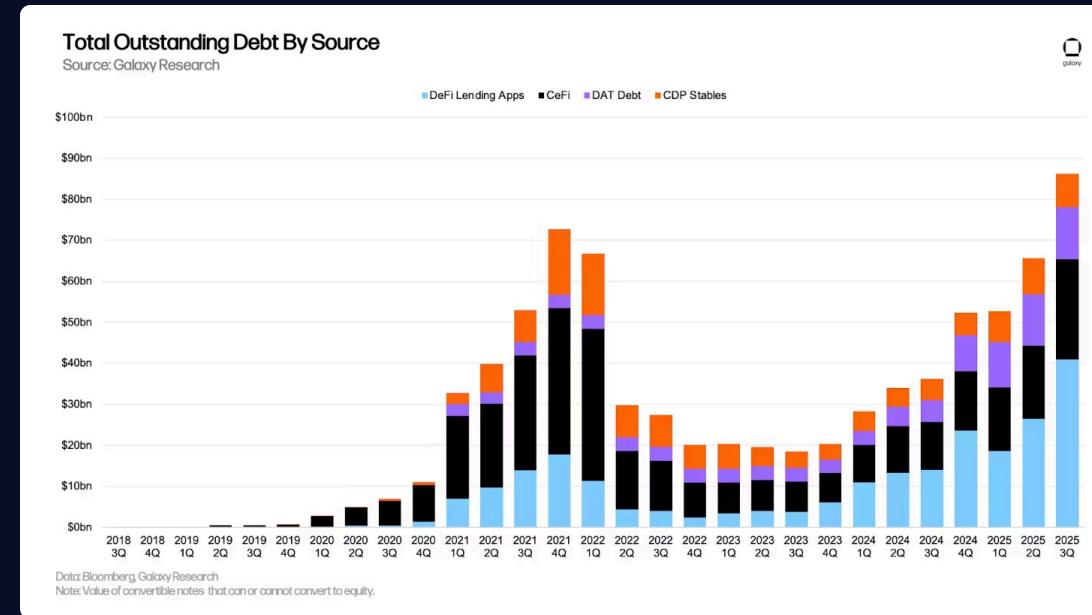
Crypto Lending & Leverage Market

Key Statistics

- Total crypto-collateralized lending reached \$73.6 billion in Q3 2025
- Outstanding loans on DeFi applications alone hit \$41.0 billion, up ~55% QoQ
- Average interest rates on stablecoin loans in many DeFi protocols hover around ~4.8% APR (2025)

What this means for Borrowers & Lenders:

- Lots of borrowing activity → many borrowers using leverage, increasing systemic exposure to volatility
- For lenders: large pools, deep liquidity; interest income depends on stable demand for borrowing
- Market remains highly sensitive to volatility → borrower risks remain high, but lender pools are big and diversified



The Problem:

Static Pricing:



Inefficient pricing



Misaligned risk/reward



One-size-fits-all rates

Driven by:



Extreme borrower demand



Liquidity risk/ thin markets



Internal Policy

Historical Downfalls

Black Thursday, March 12 2020

BTC collapsed \$7.9K - \$3.8K.

Over \$8B liquidated

Cause: Extreme leverage + thin liquidity + panic selling

Our model:

Reduces excessive leverage built-up in advance, forces de-leverage before a shock, weakens cascade dynamics.

China Ban + Elon Tweet Crash: May 18, 2021

BTC collapsed 43K - 30K in hours

\$8.5 - 10B liquidations in two days

Cause: OI + retail long leverage crowded on Binance/Bybit, extremely high estimated leverage ratio (ELR)

\$5.4B Longs Wiped: December 4, 2021

BTC collapsed \$52K - \$42K intraday

\$5.4B longs liquidated

Causes: Cascades triggered by overextended longs + thin weekend liquidity

Who, What, Why

Who

Lenders (institutions, CEX)
providing billions in capital

BTC market

What

Predicts volatility to better price
loans at a trade basis, protects
the market from large
casacades

Why

Lenders lose money and take
unnecessary risk by using static
rates. Adjusting to market
conditions allows for safer and
more profitable operations.

Data Collection & Preprocessing

Data Source

- 13+ years of Bitcoin 1-minute candle trading data from select exchanges.
- 121,914 hourly samples (January 2011 - December 2024).
- Includes: price, volume

Preprocessing

- Resampled price and volume data from 1-minute to hourly candles
- Separated data into train/validation/test sets using walk-forward methodology (preserving temporal order to avoid look-ahead bias).

Data Cleaning

- Handled missing values from exchange downtime and gaps in historical records.
- Ensured data adheres to fundamental rules and constraints that define Open, High, Low, and Close prices

Feature Engineering & Selection

Feature Categories

- Volatility Indicators (realized volatility, volume volatility)
- Return Metrics (return, return momentum)
- Regime Detection (trend strength, price position)
- Volume
- Time

Selection Methodology

Started with 6 base features, engineered 41 features through domain knowledge and statistical significance testing.

Selected features explain 31.14% of model variance.

Justification

These features capture the key drivers of volatility: multi-timeframe volatility, momentum, volume, market regime, temporal cycles. Each feature was validated against historical data to ensure predictive power.

Model Selection & Performance



Model Architecture

- **Volatility Prediction:** LightGBM trained on 13+ years of data to predict 24-hour volatility.
- **Revenue Optimization Opportunity:** Optimize liquidity pool to find revenue-maximizing rates.



Why LightGBM

- Faster training than XGBoost.
- Better handling of non-linear relationships in financial data.
- Interpretability: feature importance rankings.



Performance Metrics

- **Volatility Prediction:** $R^2 = 0.31$, MAE = 0.08, RMSE = 0.12.



Validation

- 5-fold temporal cross-validation (prevents data leakage).
- Walk-forward validation on unseen future periods.
- Stress testing on extreme volatility events (March 2020, May 2021, December 2022 crashes).
- Out-of-sample performance: Consistent 31% R^2 across different market regimes.

Trade by Trade Comparison

Platform	Daily Rate (%)	Daily Cost on \$10,000	Notes
Binance	0.071%	\$7.10	26% APR, hourly floating
Bybit	0.027-0.049%	\$2.70-\$4.90	10-18% APR, daily changes
OKX	0.027%	\$2.70	10% APR, periodic changes
Our Model Trade 1	0.3380%	\$33.80	ML volatility-based rate
Our Model Trade 2	0.2639%	\$26.39	ML volatility-based rate
Our Model Trade 3	0.2851%	\$28.51	ML volatility-based rate

Existing Rates (APR)

26%

Binance

Hourly Floating, occasional changes

10-18%

Bybit

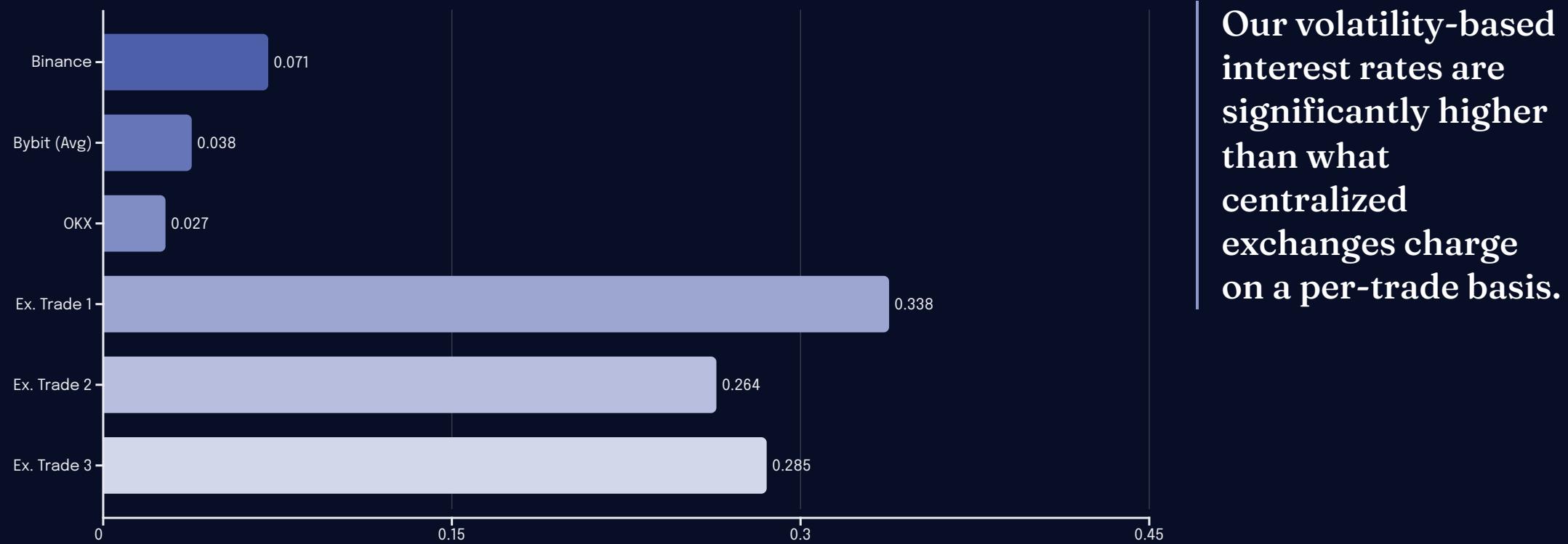
Daily, periodic changes

10%

OKX

Daily/hourly, periodic changes

Daily Rates Comparison (%)



Why Are Our Rates Higher?

- Centralized exchanges keep rates low to encourage leverage
- Cheap leverage → bigger positions, more liquidations
- More trading activity = higher platform volume
- Result: larger liquidation cascades and volatile price swings



Why Crypto Margin Lending Can Be Improved

Crypto Exchanges Do NOT Use Risk-Adjusted Pricing

01

Static or semi-static borrow rates

Unchanged for weeks/months

03

No link to liquidation probability

Risk not priced in real-time

05

No predictive modeling

No forecasting of stress conditions

02

No link to volatility

Costs don't rise with market instability

04

No link to open interest

Overleveraged with no deterrent

06

No use of interest rates as a risk-control tool

Relies only on liquidation engines

- Crypto margin lending is decades behind TradFi leverage is underpriced and unstable.

Why Crypto Exchanges Need Risk-Adjusted Interest Rates

Underpriced Crypto Leverage

- Lacks risk-based pricing (unlike TradFi).
- Causes excessive risk & fragility.

Enhances Market Stability

- Prevents violent liquidations.
- Ensures stable prices & higher volume.

Differentiated Risk Feature

- No exchange offers such dynamic risk pricing.
- Boosts competitive edge & trust.

Thank You
Questions?

P.S.

