

# Talk: Are Decentralized Prediction Markets Efficient? Evidence from Bitcoin Options

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**Abstract.** This talk presents an analysis of pricing efficiency in decentralized prediction markets, comparing market-implied probabilities from Polymarket with option-implied risk-neutral distributions from the derivatives market. Focusing on Bitcoin bets, the presentation outlines findings that while Polymarket prices broadly track these benchmarks, systematic mispricing arises from bet complexity, behavioral factors, and market frictions. We discuss how deviations are amplified in tail events, during high volatility, and following macroeconomic shocks. Ultimately, this talk highlights our broader, ongoing research into the informational efficiency and behavioral distortions of emerging decentralized betting ecosystems.

**Keywords:** Prediction Markets · Market Efficiency · Risk-Neutral Pricing · Crypto Derivatives · Behavioral Biases · Decentralized Finance

*Introduction.* Prediction markets are gaining traction as tools for forecasting and risk transfer, facilitating trades on the binary outcomes of real-world events. While their resemblance to financial derivatives is well-established, the rise of decentralized platforms like Polymarket—operating with distinct regulatory frameworks and liquidity dynamics—raises crucial questions about their pricing efficiency. This paper provides the first systematic comparison of market-implied probabilities from Polymarket’s central limit order book (CLOB) against benchmarks derived from option-implied prices (OIP) in the derivatives market. Leveraging the parallel existence of active betting on Polymarket and a liquid Bitcoin (BTC) derivatives market on Deribit, we analyze four primary bet structures: terminal value bets (*Above*, *Range*) and path-dependent bets (*Reach*, *Dip*). Our empirical evidence reveals that while Polymarket prices broadly track option-implied benchmarks, they exhibit systematic mispricing driven by bet complexity, market frictions, and behavioral biases. Simple directional bets (*Above* and *Range*) show high alignment with OIPs, whereas complex, path-dependent bets

(*Reach* and *Dip*) display significant deviations. Furthermore, we find that mispricing is most pronounced at contract inception and near expiration, and is systematically amplified during weekends and periods of high macroeconomic uncertainty. Crucially, we observe a distinct behavioral bias where low-probability tail events are persistently overpriced, indicating that decentralized prediction markets are shaped not just by informational efficiency, but by narrative-driven speculation and platform-specific risks.

*Polymarket Bets.* Polymarket operates a hybrid-decentralized CLOB for prediction markets, combining an off-chain matching engine with on-chain settlement on Polygon. Binary markets consist of fully collateralized "Yes" and "No" shares that total exactly 1.00 USDC. Prices range from  $[0.00, 1.00]$  USDC, directly representing the market-implied probability of an event. We identify four primary crypto bet types, all resolved via on-chain oracles (e.g., Binance data): **(1) Above Bets**, which act as European digital options on whether BTC exceeds a threshold at maturity; **(2) Range Bets**, double-barrier digital options on whether BTC finishes within a predefined interval; **(3) Reach Bets**, forward-looking knock-in barrier options triggering if BTC hits an upper threshold before expiry; and **(4) Dip Bets**, similar knock-in options for downward price movements.

*Data and Methodology.* We extract hourly floating-delta implied volatility (IV) surfaces for BTC options from Deribit (via Amberdata). We parametrically fit the IV smile and apply a generalized Breeden-Litzenberger (1978) formula to extract the Risk-Neutral Densities (RND). We use these RNDs to compute the Option-Implied Prices (OIP) for Polymarket events. Specifically, the OIP is computed by: integrating the upper part of the RND beyond the event threshold for **Above Bets**; integrating over the corresponding strike interval for **Range Bets**; and estimating the OIP using the standard reflection principle for Brownian motion for knock-in barrier events (**Reach** and **Dip**).

*Empirical Analysis.* Our sample spans 255 bets from March 2024 to May 2025. While CLOB and OIP pricing series track each other closely over time, correlation strength relies heavily on bet complexity. Simple directional bets (**Above**, **Range**) are highly aligned (mean correlations 0.97 and 0.83), whereas complex path-dependent bets (**Reach**, **Dip**) show weaker alignment (0.79 and 0.73), reflecting inefficiencies related to payoff structure.

*Behavioral Biases and Timing.* Prediction markets exhibit systematic behavioral distortions, particularly for extreme tail events. For highly improbable scenarios—such as BTC reaching \$200,000 or dipping below \$40,000—CLOB prices persistently exceed the near-zero OIPs, pointing to probability weighting or narrative-driven speculation. Furthermore, mispricing evolves dynamically over the bet lifecycle. **Above** and **Range** bets show a monotonic decline in mispricing (CLOB - OIP) from inception to expiration as information is efficiently

incorporated. In contrast, **Reach** and **Dip** bets display a U-shaped pattern: mispricing initially contracts but re-expands sharply near maturity, likely reflecting strategic repositioning and heightened belief dispersion as resolution nears.

*Conclusion.* This talk serves as a first preview of our broader, ongoing research into the pricing efficiency of decentralized prediction markets. By comparing Polymarket probabilities with option-implied risk-neutral distributions, we find that CLOB prices generally align well with benchmark probabilities for simpler directional bets. However, our analysis shows that deviations are most pronounced at the beginning of a bet's lifecycle and during weekends. In contrast, more complex bets display persistent overpricing, pointing to behavioral biases such as probability overweighting and overattention. Our initial findings suggest that while these markets are broadly efficient, their structure and user behavior generate systematic frictions. The full scope of our methodology, extended empirical analysis, and theoretical implications will be detailed in our upcoming paper.