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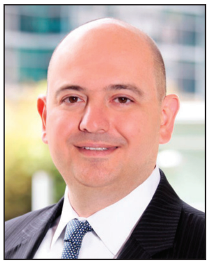
Cryptocurrency Options Pricing: Bridging Academic Literature and Application in Legal Practice



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Recent developments in cryptocurrency derivatives markets have led to the launch and rapid growth of options and option-like contracts. Options, and other contingent instruments more broadly, can be used to establish leveraged economic exposure to cryptoassets, hedge or manage risks, align the incentives of developers and capital providers in cryptoprojects, and contribute to the price-discovery process of the underlying assets.

As cryptocurrency derivatives markets, particularly those for options, continue to expand, valuation and pricing models for these contracts are becoming increasingly important. The disputes that emerged after the collapses of such crypto-entities as FTX, Three Arrows Capital and Genesis underscore the need for reliable and robust valuation methodologies across a range of cryptoassets.

Further, as cryptocurrency assets continue to be used for transactional purposes and as investment instruments, bankruptcy estates (potentially including non-crypto estates) will likely encounter not only cryptoassets but also derivatives that provide synthetic exposure and economic leverage to these assets. Given the still-nascent nature of cryptocurrency as an asset class (relative to more established financial markets), the robustness of crypto option-pricing models and the economic assumptions embedded within them are likely to become areas of contention among parties and their experts in litigation.

Since valuation of crypto options pricing is likely to play an increasing role in bankruptcy or restructuring matters, as well as other litigation, a clear understanding of option-pricing tools and their limitations is essential for courts and practitioners. With this in mind, this article examines key considerations in the pricing of cryptocurrency options and option-like contracts.

The article first reviews existing approaches traditionally used for valuing options on financial and real assets, then surveys the option-pricing academic literature in the cryptospace. It concludes with a summary of key economic considerations that are relevant to assessing competing valuation frameworks in litigation and bankruptcy matters.

Developments in Cryptocurrency Derivatives Markets

Crypto options are analogous to traditional finance options, except that the underlying assets are cryptoassets (*e.g.*, cryptocurrency tokens or crypto token-related contracts).[2] As in traditional markets, crypto options can be used for hedging purposes and providing leveraged economic exposure to price movements of the underlying cryptoassets.

The market for exchange-listed cryptocurrency options has grown rapidly in the last two years. Recent market data indicate that global monthly trading volume in crypto options increased by approximately 50 percent from 2024-25, with both centralized crypto-exchanges and established traditional exchanges such as the CME and the CBOE reporting strong growth.[3] For example, the CME reported that the third quarter of 2025 "saw record-breaking activity in the crypto market, with combined crypto futures and options volume exceeding $900 [billion], reaching an all-time high."[4]

Over the same period, the average daily open interest on the CME reached $31.3 billion across crypto futures and options,[5] with open interest in Bitcoin (BTC) and Ethereum (ETH) options reaching approximately $5 billion and $1 billion, respectively, toward the end of the third quarter of 2025.[6] Globally, combined open interest in BTC and ETH options has exceeded $60 billion.[7] Notably, growth

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2 Many exchange-listed crypto options are written on futures contracts referencing the underlying cryptocurrency rather than on the tokens themselves. In this article, the phrases "crypto options" or "options on cryptocurrencies" are used as general shorthand to refer to options on cryptocurrency tokens or on such crypto-token-related instruments as futures.

3 "Crypto Options," Crypto (June 5, 2025), crypto.com/en/research/crypto-options-may-2025 (unless otherwise specified, all links in this article were last visited on Dec. 22, 2025).

4 "Crypto Insights: October 2025," CME Group (Oct. 13, 2025), cmegroup.com/newsletters/quarterly-cryptocurrencies-report/2025-october-cryptocurrency-insights.html.

5 *Id.*

6 "Total BTC Options Open Interest," CoinGlass, coinglass.com/pro/options/OpenInterest.

7 *Id.*

in crypto options — and crypto derivatives more broadly — is increasingly driven by institutional investors.[8]

At the same time, the composition of the market is evolving. While options on major cryptocurrencies, such as BTC and ETH, continue to dominate option volume and open interest, a growing number of alternative cryptocurrencies (called "altcoins") are beginning to feature option-like contracts. While liquidity in these altcoin products remains comparatively thin, their emergence reflects continued diversification of market infrastructure and investor interest within the broader digital-asset ecosystem.

As cryptomarkets mature and crypto options and option-like contracts proliferate, industry practitioners, litigants, regulators and bankruptcy courts are encountering valuation questions more frequently. It is important to revisit the analytical tools used to value these instruments. In traditional financial markets, the valuation of options and other contingent claims has long relied on quantitative models that translate assumptions about market behavior, such as price volatility and interest rates, into an estimate of value.

Unlike more established asset classes, cryptocurrencies can exhibit higher volatility, fragmented liquidity, and other price patterns and market microstructure features that might differ markedly from those of equities or commodities. These features suggest that courts and experts analyzing crypto options might need to carefully evaluate and articulate what option valuation methodology is appropriate and weigh the tradeoffs between more complex models and traditional, relatively simpler frameworks, both of which require expert judgment in selecting and supporting modeling inputs.

Option Valuation in Traditional Asset Classes

The traditional tools for valuing options are well-established. The Black-Scholes model, developed in 1973,[9] has served as the widely accepted foundational framework for decades. Its contribution was to provide a simple closed-form formula for pricing European-style options (*i.e.*, options that can only be exercised at, but not before, expiration) under certain assumptions, such as constant volatility, normally distributed returns and smooth price paths.

As markets evolved, researchers introduced models intended to reflect more complex market dynamics. For example, stochastic volatility models[10] allow volatility to vary over time — a feature observed in financial markets, particularly during periods of stress. Price-jump models[11] allow for the possibility of sudden, discrete movements in the underlying asset price, such as sudden spikes or crashes.

In some cases, more complex models or case-specific facts might necessitate a Monte Carlo simulation. This approach generates thousands of potential price paths and is useful for valuing instruments whose payoffs depend on the full trajectory of the underlying asset rather than just the terminal price. Collectively, these models/tools relax certain Black-Scholes assumptions and might better accommodate instruments whose payoff structures or risk profiles are more complex.

The valuation of cryptocurrency options remains an evolving area for both practitioners and researchers.

However, there is a tradeoff between the simplicity and computational ease of Black-Scholes and the added complexity of alternative frameworks. Although greater complexity could help yield more refined estimates (though in some instances with only marginal incremental precision), it might require additional assumptions, more extensive data and greater analytical effort.

Experts evaluating options and option-like contracts have long grappled with the methodological choice question. Even in the context of the widely used Black-Scholes model, the choice of modeling inputs and the manner in which the model is implemented can be highly contested.

For example, in *In re Tesla Inc. Securities Litigation*, a key aspect of the dispute centered around measuring the impact of certain alleged misstatements by Elon Musk on the value of Tesla options. The plaintiff's expert used the Black-Scholes framework to construct the "but-for" option prices (*i.e.*, the value of Tesla options had the alleged misstatements not occurred). The court accepted the use of Black-Scholes, noting that the "counterfactual world is marked by educated guesses and well-informed assumptions. As a result, some form of modeling must be used to derive counterfactual prices."[12]

However, instead of comparing the but-for option prices to the actual market prices of Tesla options at the time, the plaintiff's expert generated a set of theoretical prices for synthetic option-based instruments using his valuation model. The defendants argued that using theoretical data when actual market prices were available could lead to economically unreliable results. Specifically, the defendants noted instances where the estimated damages from the expert's model appeared to exceed the actual investments by certain class members. As a result of this criticism, the plaintiff's expert ultimately agreed to adjust his calculations.[13]

Option Valuation Challenges in Cryptocurrency Markets

The same market dynamics that motivated the development of more complex option-valuation models in established asset classes are also present in cryptocurrency markets, and in

8 *See, e.g.*, CME Group, *supra* n.4 ("The third quarter of 2025 marked a period of significant expansion and increased institutional involvement in the crypto market.... This heightened activity was further emphasized by record-breaking market participation.... This indicates a substantial broadening of the Crypto derivatives market beyond a select group of participants.").

9 Fischer Black & Myron Scholes, "The Pricing of Options and Corporate Liabilities," *Journal of Political Economy* 81(3), 637-54 (1973).

10 *See* Steven L. Heston, "A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options," *Rev. of Fin. Studies* 6 (2), 327-343 (1993) (Heston model).

11 *See, e.g.*, S.G. Kou, "A Jump-Diffusion Model for Option Pricing," *Mgmt. Science*, 48(8), 1086-1101 (2002).

12 *In re Tesla, Inc. Securities Litigation*, Case No. 3:18-cv-04865-EMC (N.D. Cal.), "Final Pretrial Conference Order," Doc. 508 (filed Dec. 7, 2022), p. 44.

13 *Id.* at 46-47.

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many settings can appear even more pronounced. For example, empirical studies have documented that cryptocurrency prices experience rapid and large swings in volatility, sudden price jumps, volatility clustering, heavy-tailed return distributions, and liquidity conditions that vary across trading venues and over time.[14] Further, in cryptomarkets, fragmented prices across trading venues, possible delays in price alignment, and the presence of multiple liquidity pools might introduce additional challenges for options pricing. These complexities could be even more pronounced in times of market disruption, including times surrounding the failure of major crypto platforms.

These characteristics do not preclude the use of Black-Scholes, but they mean that its application in the crypto context requires careful consideration. Experts and courts might need to evaluate whether alternative or augmented models could be considered alternatives to or in conjunction with the Black-Scholes model, so as to provide a more accurate value estimate for the economic environment and the specific cryptoasset at issue.

In recent years, academic researchers have examined whether cryptomarket features justify departing from, or adjusting, the standard Black-Scholes framework when valuing cryptocurrency options. Much of this work parallels earlier research in other asset classes, where models that allow for departures from normal price behavior, such as time-varying volatility or price jumps, have been shown to improve pricing accuracy under certain conditions.[15]

Applied to cryptocurrencies, some studies find that similar models can capture the large and sudden movements observed in cryptocurrency prices, and also help explain how option prices vary across different strike prices and maturities.[16] Other studies evaluate models designed to capture volatility clustering and show that they can produce option values that are close to observed market prices.[17] More recently, the literature has expanded to include machine-learning techniques that employ high-frequency crypto-option data.[18]

The academic literature suggests that crypto options can be especially sensitive to modeling assumptions. A notable theme across the literature is the dispersion in model outputs when applied to the same crypto option. Black-Scholes remains a benchmark for practitioners and academic research, with many studies often comparing Black-Scholes values to those generated by more complex models. The resulting price differences might be large enough to affect trading decisions, risk-management practices or portfolio valuations. This dispersion mirrors the methodological sensitivities already observed in traditional derivatives markets, but the effect can be heightened in crypto because the underlying assets can display more extreme price movements, volatility and heterogeneous behavior.[19]

As crypto options become more prevalent, and bankruptcy matters start to involve more digital-asset derivatives, courts and practitioners might increasingly face crypto-related disputes in which the choice-of-valuation model meaningfully shapes the estimated economic value of a position or claim. These options (and their volatility) might be relevant to evaluating solvency, quantifying claims and determining distributions.

To date, empirical and practitioner-oriented research has primarily focused on BTC and ETH, largely due to their relatively established markets and the availability of empirical data. As options on other cryptoassets develop, the performance of existing models might need to be continuously reassessed. New data environments might also invite further methodological innovation. Accordingly, the valuation question is likely to evolve alongside market structure, with continued development in both model design and empirical calibration as the crypto derivatives markets continue to grow.

Conclusion

The valuation of cryptocurrency options remains an evolving area for both practitioners and researchers. Although recent academic work has introduced increasingly sophisticated modeling frameworks, greater complexity does not necessarily always equate to more reliable or more defensible valuations.

As in traditional asset classes, the suitability of any model depends on how well its economic assumptions align with the characteristics of the instrument and the market in which it trades, as well as the context in which the model is employed. Even within widely accepted frameworks such as Black-Scholes, competing input choices — particularly in markets characterized by fragmentation and heterogeneous trading venues — can lead to materially different outputs.

For courts and practitioners, these considerations highlight how disputes involving cryptoderivatives will likely hinge on the economic reasonableness of the assumptions, calibrations and data used to implement a model, in addition to the selection of the model itself. However, the expert's role is not merely to produce numerical estimates but to articulate why a chosen methodology and corresponding implementation are appropriate for the facts at issue, to explain the implications of alternative modeling choices, and to assist the trier of fact in understanding how valuation uncertainty should be weighed. As crypto-derivative markets continue to evolve, these judgments will only become more central to litigation involving digital asset instruments. abi

14 *See, e.g.*, Olivier Scaillet, Adrien Treccani & Christopher Trevisan, "High-Frequency Jump Analysis of the Bitcoin Market," *Journal of Fin. Econometrics* 18(2), 209-32 (2020).

15 For time-varying cryptocurrency volatility models, *see, e.g.*, Ai Jun Hou, Weining Wang, Cathy Y.H. Chen & Wolfgang Karl Härdle, "Pricing Cryptocurrency Options," *Journal of Fin. Econometrics* 18(2), 250-79 (2020). For research modeling cryptocurrency price jumps, *see, e.g.*, Jovanka Lili Matic, Natalie Packham & Wolfgang Karl Härdle, "Hedging Cryptocurrency Options," *Review of Derivatives Research* 26, 91-133 (2023).

16 *See, e.g.*, "Pricing Cryptocurrency Options," *id.* at 250-79.

17 *See, e.g.*, Pierre J. Venter, Eben Mare & Edson Pindza, "Price Discovery in the Cryptocurrency Option Market: A Univariate GARCH Model," *Cogent Econs. & Fin.* 8(1), 1803524 (2020).

18 *See, e.g.*, Alessio Brini & Jimmie Lenz, "Pricing Cryptocurrency Options with Machine Learning Regression for Handling Market Volatility," *Econ. Modelling*, 136, 106752 (2024).

19 *See, e.g.*, "High-Frequency Jump Analysis of the Bitcoin Market," *supra* n.14 at 209-32.