

# CRYPTO LITIGATION AND MARKET EFFICIENCY

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*This paper investigates, for the first time in the literature, the factors that should matter to courts in determining whether a crypto market is “efficient,” meaning that prices are sufficiently responsive to information. Based on new empirical evidence and a series of event studies, we recommend a new judicial framework for assessing market efficiency in crypto litigation.*

*Market efficiency tests based on event studies have played an important role in other areas of litigation, particularly securities litigation, where courts frequently rely on what have become known as the “Cammer factors.” Academics have not yet assessed the extent to which market efficiency factors should vary for crypto assets versus securities. We fill this gap.*

*First, we provide a background framework for understanding the existing legal approaches courts use to assess market efficiency. We survey and address academic criticism of the Cammer factors and explain the rationale behind their continued use.*

*Second, we conduct 452 event studies of new listings of cryptocurrency tokens and document the variance of important efficiency-related variables in our sample. We discuss the implications of these empirical findings for event study methodologies in litigation involving crypto assets.*

*Finally, we recommend modified factors for courts to adopt in crypto versus securities cases. We show how an adjusted crypto version of the Cammer factors could provide a framework for courts to use in assessing market efficiency in cryptocurrency litigation. Our analysis of market efficiency also provides insights and a roadmap for researchers and policymakers who seek to assess the use of market efficiency factors in litigation more generally.*

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## INTRODUCTION

One of the key presumptions in securities litigation is the notion that markets are “efficient,” meaning that, in general, market prices adjust rapidly to new information.<sup>1</sup> Determinations of market efficiency have been important, and sometimes even determinative, in securities litigation.<sup>2</sup>

Many scholars have criticized various judicial approaches to assessing market efficiency in the securities context, some sharply.<sup>3</sup> Others have expressed skepticism about the use of event studies<sup>4</sup> based on market efficiency assumptions in securities cases. Nevertheless, courts continue to follow precedents that rely both on event studies and on market efficiency-related tests based on a range of observable market factors.<sup>5</sup>

The most commonly cited and influential test of market efficiency is known as the “*Cammer* factor” test.<sup>6</sup> The *Cammer* factor test focuses on five

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<sup>1</sup> Numerous scholars have debated the different meanings of the term “efficiency,” particularly as adopted by judges, given that judicial tests of market efficiency historically have been less demanding than tests used by financial economists. For example, Professor Donald Langevoort has described the early evolution of judicial philosophies from “efficiency-as-justification” to “efficiency-as-prerequisite,” citing cases beginning in the 1970s that only “implicitly” recognized economic theories of efficient markets. See Donald C. Langevoort, *Information Technology and the Structure of Securities Regulation*, 98 HARV. L. REV. 747, 779 n.137 (1985) (referencing the evolution of courts adopting the fraud-on-the-market theory). Financial economists often trace discussion of market efficiency to the efficient market hypothesis and research on the extent to which market prices reflect available information. See, e.g., Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. FIN. 383 (1970) (reviewing research on expected return models to assess how market prices adjust to reflect information).

<sup>2</sup> Most recently, courts have looked to expert analyses of market efficiency in assessing “price impact” questions at the class certification stage when a plaintiff seeks to utilize a presumption of reliance via a fraud-on-the-market theory, and a defendant seeks to rebut the presumption of reliance by showing lack of “price impact.” See, e.g., *Goldman Sachs Grp. v. Ark. Tchr. Ret. Sys.*, 594 U.S. 113, 121–22, 124–26 (2021) (discussing the requirement that a defendant must show by a preponderance of the evidence that the alleged misstatements had no price impact to rebut the presumption of reliance).

<sup>3</sup> The strongest critic in the academic literature has been Professor J.B. Heaton. See, e.g., J.B. Heaton, *Kill Cammer: Securities Litigation Without Junk Science*, 11 WM. & MARY BUS. L. REV. 417, 417 (2020) (calling securities litigation a “hotbed of junk science”); see also Alon Brav & J.B. Heaton, *Market Indeterminacy*, 28 J. CORP. L. 517, 535 (2003) (labeling the use of event studies by courts as “inexpert at best, erratic at worst”). Other scholars have criticized the use of event studies in securities litigation. See Brad M. Barber, Paul A. Griffin & Baruch Lev, *The Fraud-on-the-Market Theory and the Indicators of Common Stocks’ Efficiency*, 19 J. CORP. L. 285, 290 (1994) (criticizing the variability of judicial approaches).

<sup>4</sup> The event study is a statistical tool commonly used by academics and practitioners to estimate the causal effect of a particular event on securities prices. See, e.g., Jill E. Fisch, Jonah B. Gelbach & Jonathan Klick, *The Logic and Limits of Event Studies in Securities Fraud Litigation*, 96 TEX. L. REV. 553 (2018) (explaining and critiquing the use of event studies).

<sup>5</sup> See, e.g., *Sjunde AP-Fonden v. Goldman Sachs Grp.*, No. 18-CV-12084, 2024 U.S. Dist. LEXIS 64060, at \*14–17, 37–38 (S.D.N.Y. Apr. 5, 2024) (assessing empirical evidence of “price impact” based on event study submissions by experts).

<sup>6</sup> See generally *Cammer v. Bloom*, 711 F. Supp. 1264 (D.N.J. 1989). The *Cammer* Court derived the factors from a contemporary securities fraud treatise by commentators Bromberg and Lowenfels. See generally 4 ALAN R. BROMBERG & LEWIS D. LOWENFELS, 4 SECURITIES

variables as proxies for market efficiency: trading volume, analyst coverage, exchange trading, market capitalization, and evidence of causality.<sup>7</sup> Some courts have expanded the *Cammer* factors to include other tests and evidence as well.<sup>8</sup>

As part of the judicial analysis of market efficiency, courts look to expert witnesses to assess the *Cammer* factors and to apply event studies to make various determinations.<sup>9</sup> “Price impact” evidence and analyses have become particularly important since 2021 after the Supreme Court’s decision in *Goldman Sachs*, and courts, litigants, and expert witnesses have been active in this area recently.<sup>10</sup>

Much of the analysis of market efficiency-related issues centers on the use of event studies.<sup>11</sup> Event studies are commonly used to assess the effect of

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FRAUD AND COMMODITIES FRAUD § 8.6 (1988). Historically, the Second Circuit has heard the largest amount of securities fraud cases, although in 2023 securities class action filings in the Ninth Circuit surpassed those in the Second Circuit. Cornerstone Research, *Securities Class Action Filings 2023 Year in Review*, STAN. L. SCH. (2023), <https://securities.stanford.edu/research-reports/1996-2023/Securities-Class-Action-Filings-2023-Year-in-Review.pdf> [<https://perma.cc/CPQ3-TZC2>].

<sup>7</sup> The first four factors serve as “indirect indicia” of market efficiency, while event studies provide more direct evidence of causality. See *In re Petrobras Sec.*, 862 F.3d 250, 276 (2d Cir. 2017). The Second Circuit has held that “a plaintiff seeking to demonstrate market efficiency need not always present direct evidence of price impact through event studies.” *Waggoner v. Barclays PLC*, 875 F.3d 79, 97 (2d Cir. 2017). Nationwide, courts rely on the factors to varying degrees. See, e.g., *Carpenters Pension Tr. Fund of St. Louis v. Barclays PLC*, 310 F.R.D. 69, 78–86 (S.D.N.Y. 2015) (applying the *Cammer* factors, but noting the factors are “[n]ot [d]ispositive”); *Shupe v. Rocket Cos.*, No. 21-CV-11528, 2024 U.S. Dist. LEXIS 177472, at \*31–32 (E.D. Mich. Sept. 30, 2024) (applying the *Cammer* factors in addition to the three other *Krogman* factors discussed *infra*); *Angley v. UTi Worldwide Inc.*, 311 F.Supp. 3d 1117, 1121–22 (C.D. Cal. 2018) (relying on the first four *Cammer* factors and three *Krogman* factors).

<sup>8</sup> In 2001, the court in *Krogman v. Sterritt* also considered a security’s bid-ask spread and the number of insider investors relevant when assessing market efficiency. See *Krogman v. Sterritt*, 202 F.R.D. 467, 477–78 (N.D. Tex. 2001). Empirical research has supported these other factors as proxies for market efficiency. See O. Miguel Villanueva & Steven Feinstein, *Stock Price Reactivity to Earnings Announcements: The Role of the Cammer/Krogman Factors*, 57 REV. QUANT. FIN. & ACCT. 203, 222 (2021) (concluding that as bid-ask spread narrows, a security’s reactivity percentage, and perhaps its efficiency, rises consistently). But see Bajaj et al., *Assessing Market Efficiency For Reliance On The Fraud-on-the-Market Doctrine After Wal-Mart and Amgen*, in 26 RESEARCH IN LAW AND ECONOMICS, THE LAW AND ECONOMICS OF CLASS ACTIONS 161, 185 (James Langenfeld ed., 2014) (questioning whether public float overlaps with the market capitalization factor).

<sup>9</sup> Many securities fraud class actions typically involve a plaintiff’s expert producing a market model to suggest that a security’s price movement was statistically significant on dates in which material information was disclosed. A defendant’s expert will then raise issues with the model the plaintiff’s witness proposed. A court may reject these criticisms depending on the already-proffered indirect evidence of market efficiency and the merits of the criticisms themselves. See, e.g., *In re Nio, Inc.*, Sec. Litig., No. 19-CV-1424, 2023 U.S. Dist. LEXIS 138011, at \*41–42 (E.D.N.Y. Aug. 8, 2023) (rejecting as insufficient the defendant expert’s criticisms of the plaintiff expert’s model’s as inconsistent with the class time period, arbitrary with respect to the selected dates chosen for the event study, and probative of a finding of “inefficiency”).

<sup>10</sup> See *Goldman Sachs*, 594 U.S. at 121–22, 124–26; see also *Sjunde AP-Fonden*, 2024 U.S. Dist. LEXIS 64060, at \*11–24.

<sup>11</sup> See *Teamsters Loc. 445 Freight Div. Pension, Fund v. Bombardier Inc.*, 546 F.3d 196, 207 (2d Cir. 2008) (noting “[e]vidence that unexpected corporate events or financial releases

public disclosures on security prices and to estimate potential damages to the company's shareholders from the revelation of negative information.<sup>12</sup> Since *Basic v. Levinson*,<sup>13</sup> event studies have become ubiquitous in securities litigation, and there is a large legal literature that describes the use of event studies in traditional securities markets.<sup>14</sup>

In this paper, we focus on the question of how event study methods<sup>15</sup> and considerations of market efficiency, which are commonly used in securities litigation, can be generalized to markets for cryptocurrencies and cryptocurrency assets. We show that—with some slight methodological changes to accommodate differences in market structure—one can adapt the event study methodology from securities markets to estimate causal effects in crypto markets.<sup>16</sup>

We propose a methodology for courts, litigants, and experts to use in assessing market-efficiency-related issues in cases that involve cryptocurrencies, following four steps.<sup>17</sup> First, construct the time-series of prices for

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cause an immediate response in the price of a security has been considered the most important *Cammer* factor,” and “the essence of an efficient market and the foundation for the fraud on the market theory” (internal quotation marks omitted). *But see* *Bell v. Ascendant Solutions, Inc.*, 422 F.3d 307, 316 (5th Cir. 2005) (rejecting an event study because of methodological issues).

<sup>12</sup> Scholars debate the effectiveness of event studies in demonstrating market efficiency. *See* O. Miguel Villanueva, *Whither the Event Study in Security Litigation?*, SSRN 4–6 (Jul. 11, 2024) (unpublished manuscript) <http://dx.doi.org/10.2139/ssrn.4892348> [<https://perma.cc/E5AB-FLJZ>] (arguing the event study is important insofar as it is sufficient but not necessary to proving market efficiency compared with the neither sufficient nor necessary indicia factors); Fisch, Gelbach & Klick, *supra* note 4, at 617 (identifying event study methodological issues such as “non-normality” responses, “two-sided” significance testing, the 95% confidence interval, and stock price volatility); Alon Brav & J.B. Heaton, *Event Studies in Securities Litigation: Low Power, Confounding Effects, and Bias*, 93 WASH. U. L. REV. 583, 605–08 (2015) (discussing confounding and signal-to-noise problems in event studies in securities class actions).

<sup>13</sup> *See Basic Inc. v. Levinson*, 485 U.S. 224, 241–49 (1988) (discussing the fraud-on-the-market presumption of reliance in securities litigation); *Dura Pharm., Inc. v. Broudo*, 544 U.S. 336, 342–46 (2005) (same); *Erica P. John Fund, Inc. v. Halliburton Co.*, 563 U.S. 804, 811–12 (2011) (same); *Halliburton Co. v. Erica P. John Fund, Inc.*, 573 U.S. 258, 278–82 (2014) (same).

<sup>14</sup> *See, e.g.*, Fisch, Gelbach & Klick, *supra* note 12.

<sup>15</sup> *See generally* DORON KLIGER & GREGORY GUREVICH, *EVENT STUDIES FOR FINANCIAL RESEARCH* (2014); John J. Binder, *The Event Study Methodology Since 1969*, 11 REV. QUANTITATIVE FIN. & ACCT. 111 (1998) (describing changes and continuities in event studies across academic fields since 1969); Mark L. Mitchell & Jeffrey M. Netter, *The Role of Financial Economics in Securities Fraud Cases: Applications at the Securities and Exchange Commission*, 49 BUS. LAW. 545 (1994).

<sup>16</sup> We advance Menesh Patel’s initial framework for applying fraud on the market theory to cryptocurrency transactions by articulating what cryptocurrency *Cammer* factors could look like. *See generally* Menesh S. Patel, *Fraud on the Crypto Market*, 36 HARV. J. L. & TEC. 171 (2022).

<sup>17</sup> Courts have cautiously adopted time series in conducting event studies for securities fraud class actions in a three-step model prepared by experts, who calculate damages attributable to misrepresentations or omissions. This model typically does three things. First, it measures the artificial inflation in stock price due to alleged misrepresentations. Second, it creates a time series of the difference between the actual price and the estimated price that a stock would have traded at had there been a full disclosure since the beginning of the class period. Third, it calculates per-share damages by determining the difference between price inflation on the dates plaintiffs bought the shares and the inflation on the date they were sold (subtracting inflation due

the respective cryptocurrencies using volume-weighted prices across all exchanges and using end-of-day prices to compute daily returns.<sup>18</sup> Second, estimate the relation between daily returns of the particular cryptocurrency and the daily return for the overall cryptocurrency market prior to the event.<sup>19</sup> Third, use the estimated relation prior to the event to compute the “unexpected” or “excess” return<sup>20</sup> on the day of the event. Fourth, conduct a statistical test for whether the excess return on the day of the event is statistically different from zero.<sup>21</sup>

We apply this modified event study methodology to study how cryptocurrency prices react to the announcement of new cryptocurrency listings, particularly new token listings on centralized exchanges. We focus on new token listing announcements at three of the largest centralized exchanges: Kraken, Binance, and Coinbase.<sup>22</sup> We find that 12% of new listing announcements on Kraken, 33% of new listing announcements on Binance, and 51% of new listing announcements on Coinbase are associated with large, statistically significantly positive one-day increases in crypto prices.<sup>23</sup> Among those new listing announcements with statistically significant price increases, the average one-day excess return is 27% on Kraken, 45% on Binance, and 42% on Coinbase.<sup>24</sup> These findings suggest that new listing announcements are an important driver of crypto prices.

As noted above, one of the key assumptions of the event study is the notion of market efficiency—the idea that public information is quickly impounded into prices.<sup>25</sup> To assess the validity of this assumption, courts have

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to non-disclosure or broader market factors). See *In re Novo Nordisk Secs. Litig.*, No. 17-CV-00209, 2020 U.S. Dist. LEXIS 16240, at \*11–12 (D.N.J. Jan. 31, 2020); *Wilson v. LSB Indus.*, No. 15-CV-7614, 2018 U.S. Dist. LEXIS 138832, at \*48 (S.D.N.Y. Aug. 13, 2018).

<sup>18</sup> Volume-weighted prices are particularly useful in the cryptocurrency context. See Khaled Mokni et al., *On the efficiency and its drivers in the cryptocurrency market: the case of Bitcoin and Ethereum*, 10 FIN. INNOVATION 3 (2024) (explaining how Bitcoin and Ethereum are easier to trade compared with other cryptocurrencies because their higher trading volumes and liquidity levels prevent individual investors from significantly affecting market prices).

<sup>19</sup> This relation is basically the “beta” for a stock. See ZVI BODIE, ALEX KANE, & ALAN J. MARCUS, *ESSENTIALS OF INVESTMENTS* ch. 7 (9th ed. 2010).

<sup>20</sup> See *infra* note 137 (defining excess return).

<sup>21</sup> The test calculates a probability statistic using the observed excess return on the event day divided by the standard deviation of a distribution of possible abnormal returns. The statistic is measured against a significance level or the probability that the excess return occurred without a price impact. If this statistic exceeds the level (usually 5% but also used at 1%, 2.5% or 10%), the excess return is a “statistically significant” indicator of price impact. See Brav & Heaton, *supra* note 12, at 592–93.

<sup>22</sup> See Top Cryptocurrency Spot Exchanges, COINMARKETCAP (2025), <https://coinmarketcap.com/rankings/exchanges> [<https://perma.cc/666W-9WRS>].

<sup>23</sup> See *infra* Part IV.

<sup>24</sup> See *id.*

<sup>25</sup> See Eugene F. Fama, *Efficient capital markets: II*, 46 J. FIN. 1575, 1575 (1991) (“A weaker and economically more sensible version of the efficiency hypothesis says that prices reflect information to the point where the marginal benefits of acting on information (the profits to be made) do not exceed the marginal costs.”).

adopted the “*Cammer* factors.”<sup>26</sup> The *Cammer* factors are five factors courts consider when assessing whether the market for a particular security is sufficiently efficient such that inferences from an event study are meaningful.<sup>27</sup> Beyond generalizing the event study methodology to crypto markets, we also offer a crypto equivalent of the *Cammer* factors. There are important differences between securities markets and crypto markets, and these differences need to be considered when assessing whether an event study is appropriate.<sup>28</sup> We offer five “*Cammer*-like crypto factors” for assessing the appropriateness of an event study in crypto markets.

Cryptocurrencies and cryptocurrency assets are a massive market, arguably in the trillions of dollars, depending on which assets are included and how they are measured.<sup>29</sup> Although cryptocurrency assets are a relatively new asset class, many legal cases in crypto markets adopt similar themes, approaches, language, and analyses from traditional securities markets (for example, insider trading, pump and dumps, and misrepresentation).<sup>30</sup>

The similarities between cryptocurrency and securities markets suggest that courts might find event studies useful in litigation involving cryptocurrency assets. The crypto-equivalent of event studies and the crypto-equivalent of the *Cammer* factors could provide a relevant, and perhaps helpful, framework for courts to use in analyzing causal effects in crypto markets.

Nevertheless, we recognize that event studies are not without flaws, particularly as utilized in litigation.<sup>31</sup> Accordingly, we are careful to tie our

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<sup>26</sup> See generally *Cammer*, 711 F. Supp.

<sup>27</sup> Cf. Bajaj et al., *supra* note 8, at 181 (2014) (noting a “drastic event” price reaction on a single date does not alone prove that the security traded in a market “that was sufficiently efficient to incorporate the effect of all prior statements at issue throughout the relevant class period”).

<sup>28</sup> See generally Vikas Kumar Jaiswal & Ashish Kant Chaudhari, *The Economic Implications Of Crypto Currency Adoption: A Comparative Analysis Of Traditional Financial Systems And Decentralized Alternatives*, 14 IOSR J. ECON & FIN. 56 (2023) (documenting differences between cryptocurrencies and traditional financial products through lenses of monetary policy, financial inclusion, market efficiency, regulatory frameworks, and investment opportunities).

<sup>29</sup> For example, as of October 6, 2025, CoinMarketCap lists the total market capitalization of all cryptocurrencies as \$4.9 trillion. CoinMarketCap Landing Page, COINMARKETCAP (last visited Oct. 6, 2025, 5:25 PM) <https://coinmarketcap.com> [<https://perma.cc/4R5M-7CBD>].

<sup>30</sup> See, e.g., Press Release, U.S. Att’y Off., S.D.N.Y., *Former Coinbase Insider Sentenced In First Ever Cryptocurrency Insider Trading Case* (May 9, 2023) <https://www.justice.gov/usao-sdny/pr/former-coinbase-insider-sentenced-first-ever-cryptocurrency-insider-trading-case> [<https://perma.cc/5QL9-E8C5>]

<sup>31</sup> *iFinex Inc. v. State of New York*, No. 158119, 2023 WL 1961155, at \*1–3 (N.Y. App. Div. 2023) (on misrepresentation in cryptocurrency trading platform); Anirudh Dhawan & Tălis J. Putniņš, *A New Wolf in Town? Pump-and-Dump Manipulation in Cryptocurrency Markets*, 27 REV. FIN. 935 (2023).

<sup>31</sup> See generally Heaton, *supra* note 3 (criticizing the factors as duplicative and unscientific); Allen Ferrell & Andrew Roper, *Price Impact, Materiality, and Halliburton II*, 93 WASH. U. L. REV. 553, 558 n.18 (2015) (“The finance literature does not support viewing the first four *Cammer* factors as formulated and applied as constituting a reliable test for establishing semi-strong form market efficiency as they are commonly invoked prior to class certification.”). *But see In re Teva Sec. Litig.*, No. 17-CV-00558, 2021 U.S. Dist. LEXIS 43316, at \*82–83, n.26 (D. Conn. Mar. 9, 2021) (comparing support for the factors offered by O. Miguel

analysis of the use of event studies in the cryptocurrency context to the underlying econometric rationales for these methodologies.<sup>32</sup> We conclude that although our recommended approach can be useful, courts should take care to scrutinize expert conclusions with respect to particular issues in 10b-5 class actions such as “price impact.”<sup>33</sup> Indeed, the application of our suggested methodology illuminates some of the weaknesses in the ongoing use of expert testimony in securities cases as well.<sup>34</sup>

Overall, we suggest that while it may be reasonable for courts to use “short-hand” equivalents of scientific tests in reaching conclusions based on expert submission, judges should be careful about mechanically applying existing tests.<sup>35</sup> The fact that a judicial test is widely cited does not necessarily mean it is reliable, particularly as applied in an individual case.<sup>36</sup> Indeed, many sophisticated judges have recognized that economic analysis is but one tool, and judges also should apply “common sense,” even (or maybe especially) with respect to the most complex econometric issues that arise in litigation.<sup>37</sup>

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Villanueva & Steven Feinstein, *Stock price reactivity to earnings announcements: the role of the Cammer/Krogman factors*, REV. QUANTITATIVE FIN. & ACCOUNTING (Working Paper, 2020) with criticism of the factors offered by Paul A. Ferrillo, Frederick C. Dunbar, & David Tabak, *The “Less Than” Efficient Capital Markets Hypothesis: Requiring More Proof from Plaintiffs in Fraud-on-the-Market Cases*, 78 ST. JOHN’S L. REV. 81, 119–22 (2004).

<sup>32</sup> See Jill E. Fisch & Jonah B. Gelbach, *Power and Statistical Significance in Securities Fraud Litigation*, 11 HARV. BUS. L. REV. 55, 57 (2021) (noting academic literature behind event study methodology allows one to infer a causal relationship at a 95% confidence level from finding a stock price movement exceeded the magnitude of 95% of movements occurring by chance). Courts have generally adopted the 95% confidence requirement into law; see also *Erica P. John Fund, Inc. v. Halliburton Co.*, 309 F.R.D. 251, 262 (N.D. Tex. 2015) (“[C]ourts generally require a party’s expert to testify based on an event study that meets the 95% confidence standard, which means ‘one can reject with 95% confidence the null hypothesis that the corrective disclosure had no impact on price.’”). But see *In re Chi. Bridge & Iron Co. Sec. Litig.*, No. 17-CV-01580, 2019 U.S. Dist. LEXIS 180895, at \*39–40 (S.D.N.Y. Oct. 18, 2019) (“[I]t makes little sense to treat a finding just above the 5% level as nearly irrebuttable evidence that the disclosure impacted the stock price, while not considering a finding below the 5% level at all.”).

<sup>33</sup> After plaintiffs successfully invoke the *Basic* presumption that they relied on a misrepresentation reflected in the market price at the time of the purchase, defendants can rebut the presumption by showing that alleged misstatements had no impact on the stock price. See *Basic*, 485 U.S. at 248. Following *Goldman Sachs*, the Second Circuit has used expert testimony in the price impact analysis to identify any “mismatch between the contents of the misrepresentation and the corrective disclosure.” *In re Goldman Sachs Grp., Inc., Sec. Litig.*, No. 10-CV-3461, 2021 U.S. Dist. LEXIS 235241, at \*25 (S.D.N.Y. Dec. 8, 2021).

<sup>34</sup> See *infra* Section I.B.5.

<sup>35</sup> See *Carpenters Pension*, 310 F.R.D. at 89 (citing testimony that “one should not apply a strict mechanical test in deciding on whether something is meaningful” to conclude that a failure to identify a certain percentage of statistically significant days does not demonstrate an improper methodology).

<sup>36</sup> Compare *Amorgianos v. Nat’l R.R. Passenger Corp.*, 303 F.3d 256, 266 (2d Cir. 2002) (noting that the *Daubert* test for evidence is “fluid” and “will necessarily vary from case to case”).

<sup>37</sup> See *Goldman Sachs*, 594 U.S. at 122 (“In assessing price impact at class certification, courts should be open to all probative evidence on that question—qualitative as well as quantitative—aided by a good dose of common sense.” (internal quotations committed)).

Accordingly, we view our methodology and approach as a flexible framework for courts to use in cryptocurrency litigation, and we hope judges will apply the methodology as a starting point in their analysis, with the understanding that individual cases might differ.

In Part I, we provide some background, particularly for the aspects of the cryptocurrency markets that are most relevant to our methodological approach. In Part II, we set forth our approach and empirical results, including the details of our event studies. In Part III, we assess the potential application of the *Cammer* factors in cryptocurrency litigation. Although we share some of the skepticism of other academics who have written about the use of these factors in securities litigation,<sup>38</sup> we also note that the framework overall can be a useful one.

## I. CRYPTOCURRENCY LITIGATION VS. SECURITIES LITIGATION

Regulators have debated extensively the common aspects of cryptocurrency assets and securities, with good reason.<sup>39</sup> Many cryptocurrency assets have characteristics that resemble those of securities, though many others obviously do not.<sup>40</sup>

Our aim here is not to revisit the regulatory questions about cryptocurrency assets. Instead, we inquire about the comparison between the two categories for litigation purposes. To some extent, the regulatory comparison is highly relevant to the litigation questions. Indeed, the notion that federal regulators seek to regulate markets using “regulation by enforcement” assumes that the question of whether a cryptocurrency asset is a security matters to litigation outcomes.<sup>41</sup>

We begin with two threshold background questions. First, what are the key characteristics of cryptocurrencies and cryptocurrency assets? Second, how do judges currently approach market efficiency issues in securities litigations? The answers to these questions inform our use of event studies in the crypto context.

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<sup>38</sup> See, e.g., Heaton, *supra* note 3; Brav & Heaton, *supra* note 12.

<sup>39</sup> See Declan Harty, *Scams, crashes and calamity: Departing Wall Street regulator warns of crypto risks*, POLITICO (Jan. 9, 2025, 12:00 PM), <https://www.politico.com/news/2025/01/09/wall-street-regulator-crypto-rules-00197188> [<https://perma.cc/Y26G-L7AH>].

<sup>40</sup> See Rueckert, *infra* note 44; see also Alqudah et al., *infra* note 44.

<sup>41</sup> See generally Jason Gottlieb, *Cryptocurrency Litigation and Regulatory Proceedings Tracker*, MORRISON COHEN (Jan. 21, 2025) <https://www.morrisoncohen.com/insights/the-morrison-cohen-cryptocurrency-litigation-tracker> [<https://perma.cc/3XND-7WX9>] (providing a comprehensive view of key cryptocurrency litigation and regulatory proceedings).

### A. Some Background on Cryptocurrencies

First, cryptocurrencies are broadly defined as “digital currencies that use cryptographic technologies to secure their operation.”<sup>42</sup> Some popular commentators suggest that, because there are no dividends or other underlying stream of operational cash flows associated with cryptocurrencies, that the “efficient market price” of such currencies is zero.<sup>43</sup> This is transparently incorrect. First, fiat currency also has no dividends or operational stream of cash flows. In this regard, many cryptocurrencies are best analogized to currencies rather than stocks and bonds—notwithstanding valid concerns about serving as a store of value or medium of exchange.<sup>44</sup> Second, research suggests beliefs about beliefs (or “higher order beliefs”) can sustain positive prices in equilibrium.<sup>45</sup> For example, the U.S. dollar has value because people believe it has value. As faith in currency declines, so too does its value.<sup>46</sup>

Cryptocurrency exchanges are platforms that facilitate the buying and selling of cryptocurrencies between users.<sup>47</sup> There are two main types of exchanges: centralized and decentralized. Centralized cryptocurrency exchanges—such as Coinbase, Binance, and Kraken—combine the functions of stock exchanges and brokerages; they both act as market makers by matching up interested buyers and sellers on the platform (like an exchange) while simultaneously accepting individual users’ orders and acting as a custodian of assets (like a brokerage firm).<sup>48</sup> Transactions on centralized exchanges are not

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<sup>42</sup> See *What Is a Cryptocurrency*, COINMARKETCAP, <https://coinmarketcap.com/academy/glossary/cryptocurrency> [<https://perma.cc/S5WU-HEPX>].

<sup>43</sup> Cf. Nouriel Roubini, *Nouriel Roubini: bitcoin is not a hedge against tail risk*, FINANCIAL TIMES (Feb. 10, 2021), <https://www.ft.com/content/9be5ad05-b17a-4449-807b-5dbcb5ef8170> [<https://perma.cc/3VYM-EYYV>] (arguing that the “fundamental value of bitcoin is zero and would be negative if a proper carbon tax was applied to its massive polluting energy-hogging production”).

<sup>44</sup> See generally Christian Rueckert, *Cryptocurrencies and fundamental rights*, 5 J. CYBERSECURITY 1 (2019) (comparing cryptocurrencies to traditional currencies and discussing their implications on fundamental rights). *But see* Alqudah et al., *The Sustainability of Investing in Cryptocurrencies: A Bibliometric Analysis of Research Trends*, 11 INT’L J. FIN. STUD. 93 (2023) (examining the financial behavior and performance of cryptocurrencies by comparing them to traditional investment assets like stocks and bonds).

<sup>45</sup> See, e.g., Jean Tirole, *Asset Bubbles and Overlapping Generations*, 53 ECONOMETRICA 1071, 1093 (1985 (describing the role of common beliefs)).

<sup>46</sup> See generally Janvi Kumar, *The Fragility of Trust: Exploring the Relationship between Currency Stability and Public Confidence*, 13 OPEN J. BUS. & MGMT. 15 (2025) (exploring how the value and stability of money are fundamentally rooted in trust and public confidence).

<sup>47</sup> Large cryptocurrency exchanges handle trillions of dollars of volume every year. For example, in 2021, the volume on Binance was over \$9 trillion. Amended Complaint, Sec. & Exch. Comm’n v. Binance Holdings Ltd., No. 23-CV-01599, 2024 U.S. Dist. LEXIS 114924, at \*28 (Oct. 26, 2024).

<sup>48</sup> Nathan Rieff, *What Are Centralized Cryptocurrency Exchanges*, INVESTOPEDIA (Aug. 30, 2024), <https://www.investopedia.com/tech/what-are-centralized-cryptocurrency-exchanges> [<https://perma.cc/BLR6-L6YL>].

reported on the blockchain.<sup>49</sup> Decentralized exchanges operate autonomously based on code written on the blockchain that matches interested buyers and sellers through liquidity pools.<sup>50</sup> Most decentralized exchanges do not take custody of assets but do report transactions on the blockchain.<sup>51</sup>

A key distinction between securities markets and crypto markets is that customers of centralized crypto exchanges often can only trade a subset of cryptocurrencies, and the criteria frequently permit only trading of assets listed at a particular exchange.<sup>52</sup> For example, as of September 2025, Coinbase allows customers to transact in approximately 250 cryptocurrencies and 3 fiat currencies.<sup>53</sup> As a result, to transact in some crypto assets, a user of a centralized exchange might need to use either a decentralized exchange (for example, Uniswap) or a different competing centralized exchange where that asset is listed (for example, Binance).<sup>54</sup>

Centralized exchanges also may initiate support for new cryptocurrency listings.<sup>55</sup> Centralized exchanges often determine which cryptocurrencies

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<sup>49</sup> While centralized exchanges are run by intermediaries, decentralized exchanges are often run by networks such as a blockchain, which acts as a self-regulating platform on which cryptocurrencies are traded. See Wijdan Khaliq, *Centralized And Decentralized Crypto Exchanges Compared*, COINBUREAU (Nov. 22, 2024), <https://coinbureau.com/education/centralized-vs-decentralized-crypto-exchanges> [https://perma.cc/PRY3-2HFC]; *Blockchain Technology and Data Protection*, COINBUREAU (Mar. 29, 2023), <https://coinbureau.com/analysis/blockchain-technology-data-protection> [https://perma.cc/9SZM-N5MR] (defining and describing blockchain). Centralized exchanges aggregate user holdings into wallets as opposed to recording every transaction separately on the blockchain. For example, Coinbase has twenty-five publicly identified wallets on the Ethereum blockchain that pool customer cryptocurrency token holdings.

<sup>50</sup> Nathan Crooks, *What are decentralized exchanges*, THE BLOCK (Aug. 29, 2023, 8:11 AM), <https://www.theblock.co/learn/245709/what-are-decentralized-exchanges> [https://perma.cc/3328-SPC3].

<sup>51</sup> Uniswap, one of the largest decentralized exchanges on the Ethereum blockchain, does not require that users hold assets in custody. It describes its protocol as follows: “the Uniswap Protocol operates on public blockchains where all transactions and smart contract interactions are recorded on a transparent and immutable ledger... Anyone can access and verify these transactions, ensuring transparency and accountability.” See *What is Decentralized Finance (DeFi)?*, UNISWAP LABS, (Feb. 2025) <https://support.uniswap.org/hc/en-us/articles/20571999964685-What-is-Decentralized-Finance-DeFi> [https://perma.cc/DX5R-7C95].

<sup>52</sup> See Cointree, *The Difference Between Cryptocurrency vs Stock Market*, COINTREE, <https://www.cointree.com/learn/cryptocurrency-exchange-vs-stock-exchange> [https://perma.cc/A3HF-B9XW] (noting most exchanges will only allow customers to trade digital assets for digital assets, with some allowing for an exchange of cryptocurrencies to fiat currencies like Australian or U.S. dollars).

<sup>53</sup> See *Coinbase Volume Chart in USD*, BITDEGREE, <https://www.bitdegree.org/top-crypto-exchanges/coinbase> [https://perma.cc/83RR-WWYC]; *Digital Asset Disclosures*, COINBASE, <https://www.coinbase.com/legal/digital-asset-disclosures> [https://perma.cc/MV37-WAJD] (describing the digital assets they support for trading).

<sup>54</sup> See *id.*

<sup>55</sup> See *What Is Cryptocurrency Listing In Simple Words*, WHITEBIT BLOG (May 7, 2024), <https://blog.whitebit.com/en/what-is-cryptocurrency-listing-in-simple-words> [https://perma.cc/J87Z-6MPA] (providing an overview of key steps for new token listing in a crypto exchange and how listing affects price).

to list based on strict criteria<sup>56</sup> and regularly announce new listings on their social media accounts (called “new listing announcements”). An analogy to securities markets would be if a broker permitted users to trade only certain U.S. stocks listed on its platform and occasionally added support for additional stocks.

### B. Existing Judicial Approaches to Market Efficiency Questions

In traditional securities litigation, showing that a market is efficient serves two key purposes. First, plaintiffs show that a security traded in an efficient market can benefit from the fraud-on-the-market theory, also referred to as the “*Basic* presumption.”<sup>57</sup> Under the fraud-on-the-market theory, the price of a security trading in an efficient market is assumed to reflect all available material information regarding the company.<sup>58</sup> Traders will rely on the price as an indicator of the value and, therefore, indirectly rely on any misleading statements that affect the price.<sup>59</sup> The fraud-on-the-market theory effectively extends fraud liability to all security traders whether or not they were aware of the misleading statements.<sup>60</sup>

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<sup>56</sup> Coinbase’s listing criteria can be found here: *Listing Prioritization Process & Standards*, COINBASE, (Nov. 2024), <https://coinbase.bynder.com/m/5af95a1d8290bb39/original/Coinbase-Exchange-Listing-Prioritization-Process-and-Listing-Standards.pdf> [<https://perma.cc/6SFE-XMDP>]. Binance’s listing criteria can be found here: *How to Get Your Coin Listed on Binance.com*, BINANCE (June 18, 2021, 3:12 AM) <https://www.binance.com/en/support/faq/how-to-get-your-coin-listed-on-binance-com-053e4bdc48364343b863d1833618d8ba> [<https://perma.cc/YE7H-5HEA>]. Kraken’s criteria can be found here: *5 simple steps: How to get listed on Kraken*, KRAKEN (Sep. 19, 2024), <https://blog.kraken.com/product/asset-listings/5-simple-steps-how-to-get-listed-on-kraken> [<https://perma.cc/J4VZ-727C>].

<sup>57</sup> *Goldman Sachs*, 594 U.S. at 119.

<sup>58</sup> *Basic*, 485 U.S. at 241.

<sup>59</sup> *Id.*; see also *Wal-Mart Stores, Inc. v. Dukes*, 564 U.S. 338, 351 n.6 (2011) (“[A]ll traders who purchase stock in an efficient market are presumed to have relied on the accuracy of a company’s public statements.”). As Professors Henry Hu and John Morley explain, the presumption is justified on the grounds that even if an investor is not aware of a piece of information, she can be said to rely on it because the information will influence the security’s price. See Henry T. C. Hu & John D. Morley, *A Regulatory Framework for Exchange-Traded Funds*, 91 S. CAL. L. REV. 839, 908 (2018). Others have criticized this view. See, e.g., Jonathan R. Macey et al., *Lessons from Financial Economics: Materiality, Reliance, and Extending the Reach of Basic v. Levinson*, 77 VA. L. REV. 1017, 1018 (1991) (“We suggest that the focus of the Supreme Court’s holding in *Basic* is misplaced: what determines whether investors were justified in relying on the integrity of the market price is not the efficiency of the relevant market but rather whether a misstatement distorted the price of the affected security.”).

<sup>60</sup> The fraud-on-the-market theory creates a rebuttable presumption that all parties who traded the stock relied on the fraudulent statements. *In re Advance Auto Parts, Inc., Sec. Litig.*, No. 18-212, 2020 U.S. Dist. LEXIS 208085, at \*3–4 (D. Del. Nov. 6, 2020). As a result, the fraud-on-the-market theory is key for class action lawsuits, as it allows class action plaintiffs to avoid problems that arise from determining individual reliance. Sylvia E. Simson & Keith Hammeran, *Rebutting the Presumption of Class-Wide Reliance at the Class Certification Stage: Analysis of and Key Takeaways From Arkansas Teacher Ret. Sys. V. Goldman Sachs Grp., Inc. and the Supreme Court’s Recent Grant of Certiorari*, Nat’l L. R. (Dec. 17, 2020),

Secondly, market reactions can be equated to a change in the underlying asset's value, allowing parties in litigation to value damages as new information makes its way into the market.<sup>61</sup>

There is no universal, mandatory test to determine if a market is efficient,<sup>62</sup> but as noted above, the court in *Cammer v. Bloom* established five factors to demonstrate market efficiency: trading volume, analyst coverage, exchange trading, market capitalization, and evidence of causality.<sup>63</sup> While these factors are commonly used, they are not a “mandatory analytic framework for market efficiency inquiries” as courts must consider the nature of a market in its totality in determining whether the market is efficient.<sup>64</sup> Courts often evaluate the first four factors collectively as indicia of market efficiency while viewing the fifth factor as direct evidence of market efficiency.<sup>65</sup> The Second Circuit in *In re Petrobras* expressly declined to answer the question of whether plaintiffs can demonstrate market efficiency solely using the first four factors.<sup>66</sup> We discuss each factor in turn.

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<https://natlawreview.com/article/rebutting-presumption-class-wide-reliance-class-certification-stage-analysis-and-key> [<https://perma.cc/G2QH-7BP4>].

<sup>61</sup> The efficiency of a market is important in damages calculation. The primary measure of damages in securities class actions is the difference between the security's actual value in an efficient market and the inflated price caused by the fraud. When the market is efficient, event studies can be used to establish price declines following corrective disclosures. See Kristin Feitzinger, Amir Rozen & Shaama Pandya, *Economic Analysis at the Class Certification Stage*, CORNERSTONE RESEARCH (Jan. 2022), <https://www.cornerstone.com/wp-content/uploads/2022/01/Economic-Analysis-at-the-Class-Certification-Stage.pdf>.

<sup>62</sup> To invoke the fraud-on-the-market presumption, the Supreme Court only requires that the plaintiff show the stock traded on a “generally efficient market” but does not elaborate on the method for determining so. See *Halliburton*, 573 U.S. at 279. To be clear, academic economists have long disagreed on how to test for market efficiency, before and after *Cammer* was decided. In 1981, Robert Shiller argued for testing market efficiency based on stock price volatility measures. Robert J. Shiller, *The Use of Volatility Measures in Assessing Market Efficiency*, 36 J. FIN. 291–92 (1981). Others have suggested testing a stock's efficiency in terms of (1) trading strategies based on earnings announcements and the predictive value of past returns and (2) price deviations from a random walk model. See John M. Griffin, Patrick J. Kelly & Federico Nardari, *Do Market Efficiency Measures Yield Correct Inferences? A Comparison of Developed and Emerging Markets*, 23 REV. FIN. STUD. 3225, 3226 (2010). Law Professors Jeffrey N. Gordon and Lewis A. Kornhauser provided a—fair—summary of the economics literature on the subject: “the ability to test for market efficiency is subject to question.” Jeffrey N. Gordon & Lewis A. Kornhauser, *Efficient Markets, Costly Information, and Securities Research*, 60 N.Y.U. L. REV. 761, 765 (1985).

<sup>63</sup> *Cammer*, 711 F. Supp. at 1286–87.

<sup>64</sup> *Bratya SPRL v. Bed Bath & Beyond Corp.*, No. 22-CV-02541, 2024 U.S. Dist. LEXIS 175313, at \*32–33 (D.D.C. Sep. 27, 2024) (quoting *Loc. 703, I.B. of T. Grocery & Food Emps. Welfare Fund v. Regions Fin. Corp.*, 762 F.3d 1248, 1255 (11th Cir. 2014)).

<sup>65</sup> See, e.g., *Waggoner*, 875 F.3d at 94.

<sup>66</sup> *Petrobras*, 862 F.3d at 276–77 (“We therefore decline to reach the Petrobras Defendants’ legal question—whether plaintiffs may satisfy the *Basic* presumption without any direct evidence of price impact—because the issue is not squarely presented for our review.”).

## 1. Volume

First, the *Cammer* court stated that “the existence of an actively traded market, as evidenced by a large weekly volume of stock trades, suggests there is an efficient market is because it implies significant investor interest in the company.”<sup>67</sup> In securities markets, it is common to evaluate this factor by considering the average weekly volume as a fraction of shares outstanding, and practitioners tend to focus on whether average weekly volume is at least 2% of shares outstanding.<sup>68</sup> Courts and academics have cautioned that this factor can be exaggerated through double-counting, sometimes by over 50% on some exchanges.<sup>69</sup> Alternatively, it may benefit defendants in smaller, off-exchange securities, as a low trading volume may indicate a lack of market efficiency.<sup>70</sup> If the security is dual-listed or traded in multiple international markets, a court may require that the trading volume of each market be analyzed separately.<sup>71</sup>

The volume factor is different from most other indicia factors in one key aspect. Unlike analyst coverage, the presence of market makers on an exchange, or the ability to file an SEC Form S-3, a security’s trading volume is not static—trading volume can, in fact, indicate whether a market is undergoing a period of inefficiency.<sup>72</sup> The D.C. District Court in *Bratya SPRL*

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<sup>67</sup> *Cammer*, 711 F. Supp. at 1286. Later research shows that the volume factor correlates more significantly than most of the other *Cammer* factors with market efficiency, as proxied for by price responses to large, unexpected earnings announcements. See Barber, *supra* note 3, 305–06 (noting that trading volume and number of analysts were the only statistically significant predictors of market efficiency out of the *Cammer-Krogman* factors).

<sup>68</sup> See, e.g., David Tabak, *Testing Securities Market Efficiency With Cammer Factors*, LAW360 (Feb. 5, 2019, 2:54 PM), [https://www.nera.com/content/dam/nera/publications/2019/PUB\\_Testing%20Securities%20Market%20Efficiency%20With%20Cammer%20Factors.pdf](https://www.nera.com/content/dam/nera/publications/2019/PUB_Testing%20Securities%20Market%20Efficiency%20With%20Cammer%20Factors.pdf) [<https://perma.cc/Q42X-QL64>]. The 2% threshold often used by practitioners is the same threshold employed by the *Cammer* court in 1989. *Cammer*, 711 F. Supp. at 1293. Since that time, the typical trading volume for a publicly traded security has tripled. Assen Koev & Tiago Duarte-Silva, *Capital Markets Professional Perspective: The Cammer Turnover Factor*, BLOOMBERG LAW, (Jul. 2019) <https://www.bloomberglaw.com/external/document/X1TB-PA5O000000/capital-markets-professional-perspective-the-Cammer-turnover-fac> [<https://perma.cc/2X5U-K6BV>]. As such, the 2% threshold that is applied to securities today may be less effective than what it would have been during the *Cammer* court.

<sup>69</sup> See, e.g., *Unger v. Amedisys Inc.*, 401 F.3d 316, 324 (5th Cir. 2005) (citing M. Barclay & F. Torchio, *A Comparison of Trading Models Used for Calculating Aggregate Damages in Securities Litigation*, 64 L. & CONTEMP. PROBS. 105, 106 (2001)).

<sup>70</sup> See Andrew Baker, Note, *Single-Firm Event Studies, Securities Fraud, and Financial Crisis: Problems of Inference*, 68 STAN. L. REV. 1207, 1231–32 (2016) (“For smaller, off-exchange securities, defense experts may be able to demonstrate low trading volume, a comparatively large bid-ask spread, or other objective bright-line standards in disputing efficiency.”).

<sup>71</sup> *Roofer’s Pension Fund v. Papa*, 333 F.R.D. 66, 81–82 (D.N.J. 2019) (rejecting an expert’s assertion that overall volume is appropriate because the security in a secondary market will move parallel to the primary market).

<sup>72</sup> *Bed Bath & Beyond*, 2024 U.S. Dist. LEXIS 175313, at \*38–39 (citing trial testimony from Professor Daniel R. Fischel). A frequent expert witness in securities cases, Professor Fischel first incorporated efficient markets theory into a conclusion about how Courts should resolve fraud-on-the-market cases in a 1982 law review article. See generally Daniel R. Fischel, *Use of Modern Finance Theory in Securities Fraud Cases Involving Actively Traded Securities*,

v. *Bed Bath & Beyond* qualified *Cammer* to conclude that when trading of a volume of a stock is “astronomical” during a class period, it is more likely “aberrational market behavior . . . demonstrating inefficiency.”<sup>73</sup> In that case, weekly trading volume of Bed Bath & Beyond (BBBY) stock during the class period that amounted to 1,346.6 percent of total shares outstanding, while daily trading volume averaged 269.3 percent.<sup>74</sup> The court noted that this daily volume placed BBBY above the 95th percentile of daily volume for stocks traded on the NYSE or Nasdaq.<sup>75</sup> However, this 95th percentile of daily share turnover rate was 2.95%.<sup>76</sup> Thus, the Court found that the market during the class period was nonetheless inefficient because the trading’s “astronomical” value was largely due to a Reddit-prompted “short squeeze” that one of the defendant investors allegedly encouraged.<sup>77</sup> Under short squeeze trading circumstances, volume may play an outsized role in a court’s *Cammer* analysis and may even provide evidence of market *inefficiency*.<sup>78</sup>

Courts may alter the volume threshold when applying the *Cammer* factors to different securities. For instance, when the volume factor is applied to debt, courts often require a lower threshold because bonds are not expected to be traded as often as equity securities.<sup>79</sup> Therefore, what would be a mediocre trading volume for equity securities could indicate substantial public interest when debt securities show the same volume.<sup>80</sup>

## 2. Analysts

Second, the *Cammer* Court stated, “existence of such [professional] analysts would imply [information is] closely reviewed by investment professionals, who would in turn make buy/sell recommendations to client investors.”<sup>81</sup> The *Cammer* court’s main rationale—that review and dissemination of information by third-parties leads to efficiency—also extends to crypto

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38 BUS. LAW. 1 (1982). He noted that “the rational course for investors is simply to accept the market price,” and that an efficient market protects even the naïve investors who don’t question the market price. *Id.* at 8. Thus, Professor Fischel laid the groundwork for centralizing the focus of fraud-on-the-market cases not on whether plaintiffs actually relied on a price, but whether the misrepresentation actually caused a price distortion. *Id.* at 13.

<sup>73</sup> *Bed Bath & Beyond*, 2024 U.S. Dist. LEXIS 175313, at \*41.

<sup>74</sup> *Id.* at \*39.

<sup>75</sup> *Id.* at \*40.

<sup>76</sup> *Id.*

<sup>77</sup> *See id.* at \*58 (concluding that “hyperactive trading volume seems less an indication that traders are responding to new value-relevant information than that they are reacting to (or participating in) market manipulation.”).

<sup>78</sup> *See id.* at \*39; *see also* *Juncadella v. Robinhood Fin. LLC*, 76 F4th 1335, 1343–44 (11th Cir. 2023) (noting how unprecedented levels of high trading volumes create unprecedented risks for market makers who sell the stock to those buying *en masse* as part of a short squeeze).

<sup>79</sup> *In re DVI, Inc. Sec. Litig.*, 249 F.R.D. 196, 214–15 (E.D. Pa. 2008).

<sup>80</sup> *Id.*

<sup>81</sup> *Cammer*, 711 F. Supp. at 1286.

markets.<sup>82</sup> In securities markets, this factor is measured using the number of analysts covering the firm, and practitioners tend to focus on whether there are at least five analysts providing earnings-per-share estimates, though courts may be satisfied with as few as one analyst for equity securities.<sup>83</sup>

In debt markets, courts may well count the number of credit rating agencies following the security because, analogous to equity analysts, such coverage promotes the dissemination of information by professionals.<sup>84</sup> Courts often focus on direct coverage of the specific security in question rather than general coverage over the company that issues it, especially for debt securities.<sup>85</sup> Some have raised the concern that this factor is biased against plaintiffs alleging fraud committed by smaller firms, who receive less analyst coverage than bigger firms traded on the same exchanges.<sup>86</sup> However, as with trading volume, the analyst coverage factor has been empirically shown to be a significant predictor of whether a market will be efficient.<sup>87</sup>

### 3. Exchanges

Third, the *Cammer* Court reasoned, “The existence of market makers and arbitrageurs would ensure completion of the market mechanism; these individuals would react swiftly to company news and reported financial results by

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<sup>82</sup> See Patel, *supra* note 16, at 216 n.232 (citing *Teva*, 2021 WL 872156, at \*8).

<sup>83</sup> See Tabak, *supra* note 69 (showing a *Cammer* Analyst Factor figure demonstrating that the fifth percentile of the S&P 500 analyst coverage is five analysts). *But see* David Tabak & Elaine Buckberg, *Do Courts Count Cammer Factors?*, HARV. L. SCH. F. CORP. GOVERNANCE (Aug. 23, 2012), <https://corpgov.law.harvard.edu/2012/08/23/do-courts-count-Cammer-factors> [<https://perma.cc/GTR7-7UHN>] (“The way that courts approached this was not always consistent. For example, one court found that the presence of a single analyst satisfied the analyst factor . . .”). However, this may be acceptable when a small number of analysts may have outsized influence via their recommendations. *See* Roger K. Loh & René M. Stulz, *When Are Analyst Recommendation Changes Influential?*, 24 REV. FIN. STUD. 593, 593 (2011) (“Recommendation changes are more likely to be influential if they are from leader, star, previously influential analysts, issued away from consensus, accompanied by earnings forecasts, and issued on growth, small, high institutional ownership, or high forecast dispersion firms.”); *see also* Villanueva & Feinstein, *supra* note 8 at 233 (suggesting that two analysts was a significant indicator of market efficiency).

<sup>84</sup> See *Teva*, 2021 U.S. Dist. LEXIS 43316, at \*59–60.

<sup>85</sup> See *In re Winstar Communs. Secs. Litig.*, 290 F.R.D. 437, 446 (S.D.N.Y. 2013) (recounting how many analysts reported directly on the health and value of the company’s bonds and stocks); *see also Teamsters*, 546 F.3d at 205–06 (finding a lack of analysts covering an asset-backed security, even when there was adequate coverage of the company that held the underlying assets).

<sup>86</sup> Heaton, *supra* note 3, at 461.

<sup>87</sup> Barber, *supra* note 3, at 306 (noting that trading volume and number of analysts were the only statistically significant predictors of market efficiency out of the *Cammer*-Krogman factors). Courts commonly look at how much analyst coverage a security has relative to its peers on an exchange, in addition to which firms have analysts providing coverage. *See, e.g.,* Loritz v. Exide Techs., No. 13-CV-02607, 2015 U.S. Dist. LEXIS 100471, at \*30–31 (C.D. Cal. July 21, 2015) (analyzing Exide’s percentile of coverage on the Nasdaq and noting its coverage by Deutsche Bank, Macquarie Research, and Piper Jaffray analysts among others).

buying or selling stock and driving it to a changed price level.”<sup>88</sup> The SEC’s definition of a market maker, which some courts choose to apply as well, is someone who “ready to buy or sell a stock at publicly quoted prices.”<sup>89</sup> Though the definition can be helpful, courts are not required to find that an institution meets the SEC’s definition to conclude that the institution amounts to a market maker.<sup>90</sup> In securities markets, this factor is established through a combination of the listing exchange, available market makers, and the presence of institutional investors.<sup>91</sup> Stocks traded on a national exchange are often “presumed to be traded on an efficient market.”<sup>92</sup> However, courts and academics are skeptical about considering only the mere *number* of market makers, as a high number of market makers does not necessarily mean that they are actively responding to company news.<sup>93</sup> Therefore, it is common for courts also to consider the characteristics and activity of these market makers.<sup>94</sup>

#### 4. Market Capitalization

Fourth, the *Cammer* Court stated, “it would be helpful to allege the Company was entitled to file an S-3 Registration Statement in connection with

<sup>88</sup> *Cammer*, 711 F. Supp. at 1287.

<sup>89</sup> *Market Centers: Buying and Selling Stock*, U.S. SEC. EXCH. COMM’N, (last modified Oct. 15, 2021) <https://www.sec.gov/answers/market.htm#:~:text=For%20a%20stock%20that%27s%20listed%20on%20an%20exchange%2C,or%20sell%20a%20stock%20at%20publicly%20quoted%20prices> [<https://perma.cc/E8C4-CRNL>]. While exchanges like the Nasdaq and NYSE have registered market makers, courts will apply this definition in other markets. *Teamsters*, 546 F.3d at 206 (quoting 17 C.F.R. § 240.15c3-1(c)(8) (2006)).

<sup>90</sup> *See, e.g., In re Dynex Cap. Sec. Litig.*, No. 05-CV-1897, 2011 U.S. Dist. LEXIS 22484, at \*15 (S.D.N.Y. Mar. 7, 2011) (finding some institutions were market makers for bonds utilizing “documentary and testimonial evidence,” despite finding an existence of thirteen market makers for bonds from documentary and testimonial evidence and on grounds that the SEC’s definition was developed for markets “other than the bond market relevant here.”).

<sup>91</sup> *See, e.g., O. Miguel Villanueva, At What Values Are Cammer-Krogman Factors Most Dispositive for Stock Price Reactivity?*, SSRN (Aug. 11, 2023) (unpublished manuscript) <https://ssrn.com/abstract=4534306> [<https://perma.cc/V4GZ-Q4WD>] (for market makers). *See also* Tabak, *supra* note 68 (for institutional ownership).

<sup>92</sup> *Loc. 703*, 762 F.3d at 1257 (quoting *Thompson v. RelationServe Media, Inc.*, 610 F.3d 628, 693–94 (11th Cir. 2010) (Tjoflat, J., concurring in part and dissenting in part)).

<sup>93</sup> *See, e.g., Unger*, 401 F.3d at 324 (finding a district court erred in failing to address a “growing concern that the mere number of market makers, without further analysis, has little to do with market efficiency.”). In *Unger*, the Fifth Circuit also concluded that the district court incorrectly based its finding of market efficiency on “a single Internet printout, coupled with affidavits by plaintiffs’ witnesses that were admitted without opportunity for cross-examination.” *Id.* *See also* Barber, *supra* note 3, at 307 (finding no empirical correlation between the mere number of market makers and the efficiency of a market); Heaton, *supra* note 3, at 462–63.

<sup>94</sup> *See* O’Neil v. Appel, 165 F.R.D. 479, 502 (W.D. Mich. 1996) (“[I]t is impossible to accord much significance to the number of market makers, until one knows the volume of shares that they committed to trade, the volume of shares they actually traded, and the prices at which they did so.”); *see also* *Supermarket of Homes, Inc. v. San Fernando Valley Bd. of Realtors*, No. 80-1888, 1983 U.S. Dist. LEXIS 14113, at \*18 (C.D. Cal. Sep. 1, 1983) (noting “the centralized dissemination of information contributes to the efficiency of geographically fragmented markets for housing and brokerage services”).

public offerings . . . it is the number of shares traded and *value of shares outstanding* that involve the facts which imply efficiency.”<sup>95</sup> Ineligibility to file an S-3 will generally not disqualify a finding of an efficient market, but it will weigh heavily against one.<sup>96</sup> In securities markets, the main criterion for S-3 registration is a market capitalization above \$75 million.<sup>97</sup> Some courts have also considered a company’s eligibility to file either a Form F-3 or a Form S-3.<sup>98</sup> Courts have evaluated market capitalization and S-3 eligibility as it existed during the class period.<sup>99</sup> Courts may separate their analysis of whether a company is eligible to file an S-3 form from their analysis of the company’s market capitalization as outlined in *Krogman*.<sup>100</sup> Commentators have argued that focusing purely on S-3 eligibility in the market efficiency analysis introduces a problem of confounding variables with another factor: the S-3 factor may overlap with the number of analysts covering a security or could merely be a “proxy for market capitalization.”<sup>101</sup> Thus, when analyzing this factor, some courts may skip a full eligibility assessment and only address the market capitalization requirement of the S-3 form.<sup>102</sup>

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<sup>95</sup> *Cammer*, 711 F. Supp. at 1287 (emphasis added). Subsequent courts have elaborated that S-3 eligibility is premised on the belief that the stock is already traded in an open and efficient market, and any additional disclosure that would come with an S-1 or S-2 form is therefore unnecessary. *See, e.g., O’Neil*, 165 F.R.D. at 502.

<sup>96</sup> *O’Neil*, 165 F.R.D. at 502. *See* Barbara Black, *Fraud on the Market: A Criticism of Dispensing With Reliance Requirements In Certain Open Market Transactions*, 62 N.C.L. REV. 435, 468 (1984) (“When the SEC has determined that information about a corporation is sufficiently widely disseminated that it need not be directly provided to the purchaser in the prospectus, the courts should likewise appropriately presume indirect reliance on the information by open market investors in fraud on the market cases”).

<sup>97</sup> *Form 3: Initial Statement of Beneficial Ownership of Securities*, U.S. SEC. EXCH. COMM’N, 5 <https://www.sec.gov/files/forms-3.pdf> [<https://perma.cc/V5HB-HHV6>]. *See also* Villanueva & Feinstein, *supra* note 8 at 203–34. Even though S-3 eligibility has become more lenient since the *Cammer* decision, the current requirements, including the market capitalization requirement of \$75 million, have been employed in recent decisions. *See, e.g., Krogman*, 202 F.R.D. at 477; *but see Wilson*, 2018 U.S. Dist. LEXIS 138832, at \*28 n.10 (suggesting the relaxed S-3 eligibility requirements employed post-*Cammer* might make this less probative).

<sup>98</sup> *See, e.g., Teva*, 2021 U.S. Dist. LEXIS 43316, at \*43 (noting the company in question filed forms F-3 until it became a domestic issuer and then began filing Forms S-3).

<sup>99</sup> *See, e.g., Junge v. Geron, Corp.*, No. 20-00547, 2022 U.S. Dist. LEXIS 61962, at \*11–13 (N.D. Cal. Apr. 2, 2022) (finding a “quintessentially efficient market” in part from a market capitalization in the 35th to 46th percentiles of NYSE and Nasdaq, a market capitalization amount that averaged \$731.69 million and reached peaks of over \$1 billion markets during the class period).

<sup>100</sup> *See, e.g., Rougier v. Applied Optoelectronics, Inc.*, No. 17-CV-02399, 2019 U.S. Dist. LEXIS 198919, at \*35–36 (S.D. Tex. Nov. 13, 2019).

<sup>101</sup> *Heaton, supra* note 3, at 464.

<sup>102</sup> *See, e.g., Norfolk Cnty. Ret. Sys. v. Cmty. Health Sys., Inc.*, 332 F.R.D. 556, 575 (M.D. Tenn. 2019) (considering only the market capitalization requirement for this factor). Other requirements that courts may not address include, for example, timely filing of all prior reports or payment of all dividends on preferred stock. *Form 3: Initial Statement of Beneficial Ownership of Securities, supra* note 97, at 3–4. Scholars have argued that the S3 eligibility factor is redundant because it serves as a proxy for market capitalization, and because it correlates with the number of securities analysts. *See, e.g., Heaton, supra* note 3, at 464.

## 5. Cause-and-Effect Relationship

Finally, the *Cammer* Court reasoned that “a cause and effect relationship between unexpected corporate events or financial releases and an immediate response in the stock price . . . is the essence of an efficient market and the foundation for the fraud on the market theory.”<sup>103</sup> In securities markets, this is often done in an ad-hoc manner where a selection of events and event studies are presented.<sup>104</sup> In some cases, examining the relationship between a misrepresentation and its effect on the security price alone can be sufficient to show its market was efficient.<sup>105</sup>

While it is possible for a plaintiff to establish that a market is efficient without satisfying the fifth factor,<sup>106</sup> failing to satisfy this factor leaves a plaintiff’s case vulnerable to challenges.<sup>107</sup> As Cornell and Haut point out, the event study is the only *Cammer* factor that speaks to “a direct assessment of efficiency that is amenable to scientific quantification—the speed with which security prices respond to information, in other words informational efficiency.”<sup>108</sup> Most notably, the fraud-on-the-market theory can be rebutted when direct evidence is shown that the alleged misrepresentations did not impact the security’s price.<sup>109</sup> For these reasons, establishing a cause-and-effect

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<sup>103</sup> *Cammer*, 711 F. Supp. at 1287. Courts may emphasize this factor because it may provide more direct evidence of whether a market is efficient. *Waggoner*, 875 F.3d at 89. Scholars have pointed out that this factor provides “a direct assessment of efficiency that is amenable to scientific quantification—the speed with which security prices respond to information, in other words informational efficiency.” Bradford Cornell & John Haut, *How Efficient Is Sufficient: Applying the Concept of Market Efficiency in Litigation*, 74 Bus. L. 417, 421 (2019).

<sup>104</sup> See Tabak, *supra* note 68 (“The standards and benchmarks regarding this factor have probably been the most discussed, and the most disputed.”).

<sup>105</sup> *In re 2TheMart.com, Inc. Sec. Litig.*, 114 F. Supp. 2d 955, 964–65 (C.D. Cal. 2000) (finding that a market was efficient based solely on the responsiveness of the share price to the release of misleading information). *But see In re MDC Holdings Sec. Litig.*, 754 F. Supp. 785, 805 (S.D. Cal. 1990) (requiring more than a price change to show that a company’s notes traded in an efficient market when a misstatement was corrected).

<sup>106</sup> *Di Donato v. Insys Therapeutics, Inc.*, 333 F.R.D. 427, 439–42 (D. Ariz. 2019); see also *Strougo v. Barclays PLC*, 312 F.R.D. 307, 322 (S.D.N.Y. 2016) (“[A] plaintiff attempting to demonstrate market efficiency through an event study will often face an onerous task, whether or not the market is efficient. However, indirect evidence of market efficiency—including that a stock trades in high volumes on a large national market and is followed by a large number of analysts—will typically be sufficient to satisfy the *Basic* presumption on class certification.”); *Loc. 703*, 762 F.3d at 1255.

<sup>107</sup> See, e.g., *In re Fed. Home Loan Mortg. Corp. (Freddie Mac) Secs. Litig.*, 281 F.R.D. 174, 180–81 (S.D.N.Y. 2012) (concluding plaintiffs failed to demonstrate market efficiency despite satisfaction of the other factors because the event studies failed to show a cause-and-effect relationship). *But see In re Computer Sci. Corp. Sec. Litig.*, 288 F.R.D. 112, 120 (E.D. Va. 2012) (distinguishing *Fed. Home Loan Mortg. Corp.* on grounds that it concerned the market for preferred shares of a security, not common stock).

<sup>108</sup> Cornell & Haut, *supra* note 103.

<sup>109</sup> See *Halliburton*, 573 U.S. at 264, 280–81 (showing that the misrepresentation did not impact the price of the security requires (i) that the original misrepresentation did not affect the security price, and (ii) any corrective disclosures also did not affect the security price); see also *Advance Auto Parts*, 2020 U.S. Dist. LEXIS 208085, at \*8–11.

relationship is an important element that may make or break a case, and the event study is a key analytical tool to address this factor.<sup>110</sup>

Event studies that show a cause-and-effect relationship don't require expert testimony to invoke the *Basic* presumption, but failure to admit such testimony to help courts understand why the event study suggests a cause-and-effect relationship exists can impact securities cases.<sup>111</sup> In typical event study cases, the plaintiff and defense attorneys will provide dueling experts who scrutinize an event study, usually proffered by the plaintiff.<sup>112</sup> These experts are typically accountants, economists, or investment bankers.<sup>113</sup> The event study purports to show a statistically-significant cause-and-effect relationship between a misstatement or event and a price impact.<sup>114</sup> These dueling expert testimony battles tend to be particularly contentious for securities class actions involving blue-chip stocks.<sup>115</sup> Expert witnesses in federal securities lawsuits tend to offer two types of statistical models to support their claims: (1) an ordinary least squares ("OLS") market model with a VIX standard error correction and (2) a feasible generalized least squares ("FGLS") market model.<sup>116</sup> Based on those models, they can opine on the probability that the movement in question was caused by the release of information or whether events unrelated to the disclosure caused the movement.<sup>117</sup>

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<sup>110</sup> See Villanueva, *supra* note 12. The proper manner in which these event studies should be performed is subject to debate in a growing literature. For instance, some have questioned the importance and desired levels of statistical significance in performing these event studies. See, e.g., Jonah B. Gelbach, *Estimation Evidence*, 168 U. PA. L. REV. 549, 552 (2020) (questioning whether courts' adherence to a specific significance level—usually 5%—is consistent with the preponderance of evidence standard to which plaintiffs are held). Others have argued that event studies used to assess price reactivity should use intraday trading data rather than daily data. See, e.g., Rajeev R. Bhattacharya, Joseph Bial, & Alex Evans., *It Is Imperative To Perform Event Studies Only With High-Frequency Intraday Data For Securities Litigations And Valuations*, 23 J. INT'L BUS. & L. 1, 21 (2014). See also Fisch, Gelbach & Klick, *supra* note 4, at 613 (citing Alex Rinaudo & Atanu Saha, *An Intraday Event Study Methodology for Determining Loss Causation*, 2 J. FIN. PERSP. 161, 163 (2014)) (noting that intraday studies may be used where confounding events occurred on the same day). Despite these debates about methodology, the event study remains a central feature of modern securities litigation.

<sup>111</sup> See, e.g., *In re Pfizer Inc. Sec. Litig.*, 819 F.3d 642, 666–67 (2d Cir. 2016) (finding a district court abused its discretion by excluding all Professor Fischel's testimony when he could not readily associate only a few parts of a cause-and-effect relationship).

<sup>112</sup> *Id.* at 651 (recounting how a defense expert questioned Professor Fischel's assumptions in challenging part of plaintiff's testimony).

<sup>113</sup> See Michael J. Kaufman, *Regressing: The Troubling Dispositive Role of Event Studies in Securities Fraud Litigation*, 15 STAN. J. L. BUS. & FIN. 183, 196 (2009) ("[T]hus an expert—usually an accountant, economist, or investment banker—may be used to track the movement of a stock's price in reaction to the disclosure of the allegedly material facts.").

<sup>114</sup> See Fisch & Gelbach, *supra* note 32 and accompanying text.

<sup>115</sup> See Baker, *supra* note 70, at 1232.

<sup>116</sup> *Id.* at 1245. Though these two are commonly used, other statistical models used in securities litigation include the standard OLS model and an SQ test. These two methodologies are notable because they are more capable of detecting abnormal performance of independent variables (that is, misstatements) impacting dependent variables (that is, stock prices) than the VIX-adjusted or FGLS models. See *id.* at 1257.

<sup>117</sup> MICHAEL J. KAUFMAN, *Materiality*, in EXPERT WITNESSES: SECURITIES CASES § 2:23 (Thomson 2008).

Event studies are not the only method of assessing the cause-and-effect relationship. Sometimes courts will heed experts' advice to rely on both event studies and other tools for assessing price impact. In a 2022 securities class action against Apple, a Northern District of California court relied in part on expert assertions that event studies were part of a "full array of generally accepted and widely used valuation tools" that could assess price impact.<sup>118</sup> Expert witnesses can currently opine on two categories of price impact: "front-end inflation," or the price impact from introducing an allegedly false statement, and "inflation maintenance," or the price impact measured by how much the stock price would have fallen without the false statement.<sup>119</sup> The latter often requires experts to conduct a counterfactual causation analysis to determine what likely would have happened to the stock price had the defendant not made a false statement.<sup>120</sup> This analysis usually involves experts affirmatively linking price movement to dates on which the disclosure of information occurred while facing questioning about instances of effect without cause or cause without effect.<sup>121</sup> One of our authors has previously proposed that courts allow experts to consider expected future cash flows and discount rates in this counterfactual inquiry.<sup>122</sup>

The Supreme Court in *Goldman Sachs* cautioned that causal inferences offered by experts are subject to a high standard of scrutiny.

[T]hat final inference—that the back-end price drop equals front-end inflation—starts to break down when there is a mismatch between the contents of the misrepresentation and the corrective disclosure. That may occur when the earlier misrepresentation is generic (e.g., "we have faith in our business model") and the later corrective disclosure is specific (e.g., "our fourth quarter earnings

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<sup>118</sup> *In re Apple Inc. Sec. Litig.*, No. 19-CV-2033, 2022 U.S. Dist. LEXIS 23771, at \*31 (N.D. Cal. Feb. 4, 2022).

<sup>119</sup> *Goldman Sachs*, 594 U.S. at 123. The "inflation maintenance" theory is sometimes referred to as the "price maintenance" theory. See *Sjunde AP-Fonden*, 2024 U.S. Dist. LEXIS 64060, at \*38–40.

<sup>120</sup> See, e.g., *In re Vivendi, S.A. Sec. Litig.*, 838 F.3d 223, 258 (2d Cir. 2016) ("the proper question for purposes of our inquiry into price impact is not what might have happened had a company remained silent, but what would have happened if it had spoken truthfully").

<sup>121</sup> Under this theory, plaintiffs typically "point to a negative disclosure about a company and an associated drop in its stock price, then allege that the disclosure corrected an earlier misrepresentation; and then claim that the price drop is equal to the amount of inflation maintained by the earlier misrepresentation." *Goldman Sachs*, 594 U.S. at 123 (citing *Glickenhau & Co. v. Household Int'l, Inc.*, 787 F.3d 408, 415 (7th Cir. 2020)); *In re Vivendi*, 838 F.3d at 233–37, 253–59).

<sup>122</sup> Frank Partnoy, *Market Prices vs. Fundamental Value: The Case for Using Discounted Cash Flow Analysis in Securities Class Actions*, 77 BUS. LAW. 1059, 1073–74 (2022); see also Andrew C. Baker, Jonah B. Gelbach & Eric Talley, *Validating Valuation: How Statistical Learning Can Cabin Expert Discretion in Valuation Disputes*, 51 J. CORP. L. (forthcoming 2025) <https://ssrn.com/abstract=4849281> [<https://perma.cc/G9EH-LHJY>] (finding expert valuation opinions produce highly variable swings of outcomes and proposing courts use stock price or market capitalization data in valuation decisions).

did not meet expectations”). Under those circumstances, it is less likely that the specific disclosure actually corrected the generic misrepresentation, which means that there is less reason to infer front-end price inflation—that is, price impact—from the back-end price drop.<sup>123</sup>

As the law has developed governing how courts use event studies, subsequent legal cases have reinforced the *Cammer* factors’ use, rendering them ubiquitous in modern securities litigation.<sup>124</sup> All regional circuits in the United States have utilized the *Cammer* factors to differing degrees. The Third, Sixth, and Ninth Circuits have effectively adopted the factors as the go-to test for market efficiency.<sup>125</sup> The First, Second, Fourth, Fifth, and Eleventh Circuits utilize the *Cammer* factors, but explicitly direct district courts to also consider any other evidence suggesting market efficiency.<sup>126</sup> Finally, the court of appeals in the Seventh, Eighth, and Tenth circuits have not yet addressed the *Cammer* factors, even though the factors are routinely applied by its district courts.<sup>127</sup> Recently, the *Cammer* factors have spread beyond the United States and are now used in Australian courts.<sup>128</sup>

Event studies are becoming more common for assessing price responsiveness in non-litigation contexts.<sup>129</sup> As cryptocurrency litigation becomes both increasingly common and subject to heightened appellate scrutiny,<sup>130</sup> courts will have to wrestle with how event studies in those cases should be designed,

<sup>123</sup> *Goldman Sachs*, 594 U.S. at 123.

<sup>124</sup> See, e.g., Tabak, *supra* note 68; Villanueva & Feinstein, *supra* note 8. The application and effects of the factors differ from court to court, however, including on how the factors influence the outcome of the case. See Geoffrey Christopher Rapp, *Proving Markets Inefficient: The Variability of Federal Court Decisions on Market Efficiency in Cammer v. Bloom and Its Progeny*, 10 U. MIAMI BUS. L. REV. 303, 316–17 (2002) (noting different outcomes in cases that applied the *Cammer* factors to similar situations). Proffered explanations for such variability include a judge’s lack of understanding of the test and reliance on experts. *Id.* at 317–20.

<sup>125</sup> See, e.g., *In re DVI, Inc. Sec. Litig.*, 639 F.3d 623, 634 n.16 (3d Cir. 2011); *Freeman v. Laventhol & Horwath*, 915 F.2d 193, 199 (6th Cir. 1990); *Binder v. Gillespie*, 184 F.3d 1059, 1065 (9th Cir. 1999).

<sup>126</sup> See, e.g., *Stuebler v. Xcelera.com*, 430 F.3d 503, 511–12 (1st Cir. 2005); *Petrobras*, 862 F.3d at 276–79; *Gariety v. Grant Thornton, LLP*, 368 F.3d 356, 368 (4th Cir. 2004); *Bell v. Ascendant Sols., Inc.*, 422 F.3d 307, 313 n.10 (5th Cir. 2005); *Loc. 703*, 762 F.3d at 1255.

<sup>127</sup> See, e.g., *In re Northfield Lab’ys, Inc. Sec. Litig.*, 267 F.R.D. 536, 545–46 (N.D. Ill. 2010); *Första AP-Fonden v. St. Jude Med., Inc.*, 312 F.R.D. 511, 517–19 (D. Minn. 2015); *Bennett v. Sprint Nextel Corp.*, 298 F.R.D. 498, 507–08 (D. Kan. 2014). No court in the D.C. Circuit has directly addressed the *Cammer* factors, although the district court has acknowledged its use by experts. See *Howard v. Liquidity Servs. Inc.*, 322 F.R.D. 103, 116 n.7 (D.D.C. 2017).

<sup>128</sup> See *TPT Patrol Pty Ltd. as trustee for Amies Superannuation Fund v Myer Holdings Ltd.* [2019] FCA 1747, ¶¶ 682–89 (Austl.).

<sup>129</sup> See, e.g., Jeroen Koenraadt & Edith Leung, *Investor Reactions to Crypto Token Regulation*, EUR. ACCT. REV. 367 (2022) (conducting an event study on 1,886 crypto assets to determine price responsiveness to news about crypto asset regulation); Jiahang Zhang & Chi Zhang, *Do Cryptocurrency Markets React to Issuer Sentiments? Evidence from Twitter*, 61 RSCH. INT’L BUS. & FIN. 2 (2022) (conducting an event study on 47 crypto assets to determine price responsiveness to posts on Twitter).

<sup>130</sup> See, e.g., *Rensel v. Centra Tech., Inc.*, 2 F.4th 1359 (11th Cir. 2021) (vacating district court’s order denying plaintiff’s motion for class certification and remanding for further proceedings); *Williams v. Binance*, 96 F.4th 129 (2d Cir. 2024) (reversing district court’s finding

and when it is appropriate to rely on an event study's finding. The remainder of this Article provides a framework for each.

## II. EMPIRICAL ANALYSIS

In this Section, we describe our empirical and econometric analysis. We begin with proposing our suggested crypto event study methodology. This can offer a framework for how event studies can be designed to test market efficiency for cryptocurrencies in securities fraud class actions. Then we apply the methodology to the event of new coin listings.

### A. Crypto Event Study Methodology

Event studies are designed to isolate how much of the price change in a particular security on a particular day is unique to the specific security and *not* attributable to movements in the broader market.<sup>131</sup> In securities markets, a valid event study isolates the portion of stock returns that is unique to the specific company. For example, if Apple's stock went up by 7% on a particular day, an event study assesses how much of that price increase was attributable to the fact that the broader market went up by 3% on the same day ("Expected Return") and how much of the 7% was not attributable to market movements that day ("Excess Return").

To accomplish this, the classic event study estimates the historical relation between the daily return on a specific stock, and the daily return on a broad market index (for example, the S&P 500).<sup>132</sup> In a classic event study, one estimates this relation over the 100 days<sup>133</sup> before the event in question, using the regression:

$$\text{Return}[t] = \alpha + \beta \text{Market}[t] + \varepsilon[t]$$

where  $\text{Return}[t]$  is the return on day  $t$ ;  $\text{Market}[t]$  is the return of the market index on day  $t$ ;  $\varepsilon[t]$  (*Epsilon*) is the error term of the model—the portion

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that federal and state securities laws were not impermissibly extraterritorial as applied to transactions on the Binance exchange).

<sup>131</sup> See Cornerstone Research, *Event Studies and "Bellwether" Effects*, NAT'L L. REV. (Nov. 30, 2020), <https://natlawreview.com/article/event-studies-and-bellwether-effects> [<https://perma.cc/8T7J-PB48>] ("As the first analytical step in the process of isolating the price effect of the event of interest—for example, the alleged fraud—an event study allows the financial economic expert to estimate the portion of company stock returns that is not attributable to market or industry effects.")

<sup>132</sup> See, e.g., *Glickenhau*, 787 F.3d at 416 (predicting what the return of a Household International stock would be if it followed on broader S&P 500 market and industry stock movements and comparing it to the actual return).

<sup>133</sup> Jonathan Klick and Robert Sitkoff use 100 days in their seminal example explaining how it is possible to assess empirically the effect of an unanticipated event on a company's stock price. Jonathan Klick & Robert H. Sitkoff, *Agency Costs, Charitable Trusts, and Corporate Control: Evidence from Hershey's Kiss-Off*, 108 COLUM. L. REV. 749, 797–98 (2008).

of the stock return on day  $t$  that cannot be explained by market movements;  $\alpha$  (*Alpha*) is the intercept of the return regression model which represents the Expected Return independent of market movements;<sup>134</sup>  $\beta$  (*Beta*) is the sensitivity of the stock return to the concurrent market return.<sup>135</sup> The Expected Return is then calculated using the  $\alpha$  and  $\beta$  estimated over the 100 days prior to the event.<sup>136</sup>

$$\text{Expected Return}[t] = \alpha + \beta \text{Market}[t]$$

The difference between the Expected Return and the actual return on day  $t$  is known as the Excess Return.<sup>137</sup>

$$\text{Excess Return}[t] = \text{Return}[t] - \text{Expected Return}[t]$$

Finally, the classic event study tests whether the Excess Return on the event date (that is, day 0) is statistically significantly using a z-test at the 5% significance level.<sup>138</sup>

We adapt the event study methodology to crypto markets by adjusting for several key differences between securities markets and crypto markets. In each case, the adjustments concern the computation of  $\text{Return}[t]$  and  $\text{Market}[t]$  but preserve the underlying statistical methodology.

- (1) Unlike securities markets which trade from 9:30 am to 4:00 pm from Monday to Friday, cryptocurrency markets trade 24/7.<sup>139</sup> Accordingly, we use the price at 11:59 pm UTC or last available price that day as the closing price and define the daily return as the percentage change in closing price from one day to the next.
- (2) Most securities trade on just a few large, reputable exchanges; yet, cryptocurrencies trade on a much greater number of smaller exchanges<sup>140</sup>—some of which have more or less credible pricing data. To address this, we rely on CoinMarketCap (CMC) which computes a volume-weighted price across all exchanges and

<sup>134</sup> For example, if the market return is 0%, the cryptocurrency token's Expected Return would be  $\alpha\%$  on that day.

<sup>135</sup> For example, if  $\beta = 1$ , then we expect a one-to-one relationship between market returns and cryptocurrency returns; if the market return is 5%, the cryptocurrency Expected Return is  $\alpha\% + 5\%$ .

<sup>136</sup> See Klick & Sitkoff, *supra* note 133 and accompanying text.

<sup>137</sup> See Fisch, Gelbach & Klick, *supra* note 4, at 572 (defining excess return as “the component of the actual return that cannot be explained by market movements on the event date”).

<sup>138</sup> See *id.* at 574 n.122 (citing *Halliburton* and academic literature to argue that courts and experts tend to use significance at the 5% level). Some question whether the 5% statistical significance level for securities fraud event studies is appropriate. See Brav & Heaton, *supra* note 12, at 596–99.

<sup>139</sup> *What makes crypto 24/7/365?*, KRAKEN, <https://www.kraken.com/learn/what-makes-crypto-24-7-365> [<https://perma.cc/4P5D-7TAX>].

<sup>140</sup> For example, Ethereum itself trades on hundreds of exchanges or more, according to the list of available exchanges on CMC's main website. *Ethereum*, COINMARKETCAP, <https://coinmarketcap.com/currencies/ethereum> [<https://perma.cc/FC8X-XK39>].

excludes exchanges that have disabled withdrawals or deposits due to financial illiquidity.<sup>141</sup>

- (3) Finally, as with securities markets, academic research has found that daily cryptocurrency returns are highly correlated with a cryptocurrency market factor.<sup>142</sup> We therefore construct a cryptocurrency market index as the value-weighted daily return of all cryptocurrencies available in CMC each day.

We next apply the above statistical methodology. We repeat the steps described above for each of several cryptocurrency assets and dates, using daily returns on each cryptocurrency and the cryptocurrency market index.

### B. Application: New Coin Listings

To apply our methodology, we collect data on new listing announcements from the official social media channels and websites of Kraken, Binance, and Coinbase. We restrict attention to first-time listing announcements on a particular exchange, to cryptocurrencies listed on the Ethereum blockchain, and to non-stablecoins.<sup>143</sup> Given a *token-exchange-announcement* triplet combination, we then collect data on closing prices and daily volume from CMC for the thirty days before and after each announcement. We require at least fifteen days of price and volume data prior to the announcement and exclude tokens that undergo a hard fork during the period.<sup>144</sup>

One difference between securities markets and crypto markets is that, by virtue of fragmentation of the latter, price and volume need to be computed from a variety of different exchanges. Our approach computes trading volume as total volume across all exchanges (from CMC) and closing price as the volume-weighted average price for a token across all exchanges (from CMC). Because cryptocurrency markets trade 24/7, we define the closing price as

<sup>141</sup> See *How are prices calculated on CoinMarketCap?*, COINMARKETCAP, <https://support.coinmarketcap.com/hc/en-us/articles/360015968632-How-are-prices-calculated-on-CoinMarketCap> [<https://perma.cc/VV94-QM86>].

<sup>142</sup> Yukun Liu, Aleh Tsyvinski & Xi Wu, *Common Risk Factors in Cryptocurrency*, 77 J. FIN. 1133, 1155 (2022) (“The results show that the cryptocurrency market factor is crucial in explaining the portfolio returns of the quintile portfolios.”).

<sup>143</sup> Stablecoins should have minimal changes in value. We exclude the top ten stablecoins by market capitalization according to CMC: USDT, USDC, BUSD, DAI, TUSD, USDP, USDD, GUSD, FEI, and USTC. We restrict attention to the Ethereum blockchain to facilitate integration with Etherscan, a web tool that allows one to search the Ethereum blockchain for transactions, addresses, tokens, and prices taking place on Ethereum. See *generally About Etherscan*, ETHERSCAN, <https://etherscan.io/aboutus> [<https://perma.cc/6773-QJYR>].

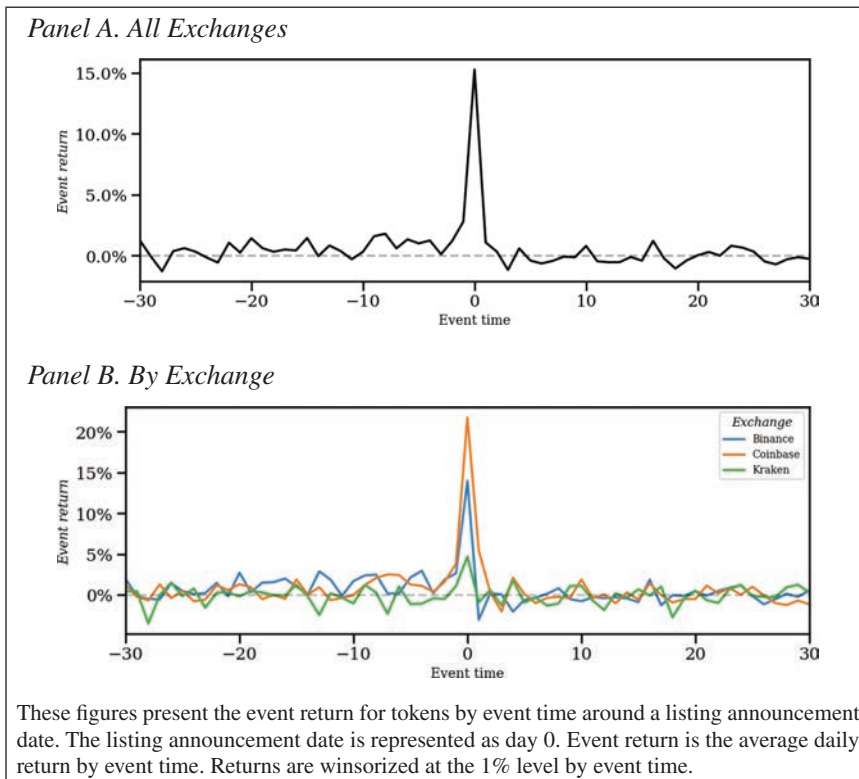
<sup>144</sup> A hard fork is a change or update to the protocol underlying the cryptocurrency. This can lead to a potentially confounding shock to return and volume. See *The Impact of Soft Fork and Hard Fork on Cryptocurrency*, TRANSFI (Aug. 21, 2024), <https://www.transfi.com/blog/understanding-soft-fork-and-hard-fork-in-cryptocurrency> [<https://perma.cc/2GK6-XUJ8>] (noting the disagreements on whether crypto traders will update their software or only use the original protocol can alter trading volumes and price stability).

the price as of 11:59 PM UTC and define the daily return as the percentage change in closing price from one day to the next.

The final sample consists of 452 token-exchange-announcements from August 2017 to May 2023. Of these, 155 are for listings on Binance (with an average market cap of \$1.2 billion), 196 for listings on Coinbase (with average market cap of \$1 billion), and 101 for listings on Kraken (with an average market cap of \$1.1 billion).<sup>145</sup>

As in securities litigation, one of the most important questions in applying our methodology is the use of the event study, and the presence of excess returns.<sup>146</sup> Accordingly, we apply the crypto event study methodology to each new token listing announcement. We estimate a separate event study for each new listing announcement we consider on Kraken, Binance, and Coinbase, for a total of 452 event studies. The results are set forth below in Figure 1.

FIGURE 1. EVENT RETURN AROUND LISTING ANNOUNCEMENT DATES



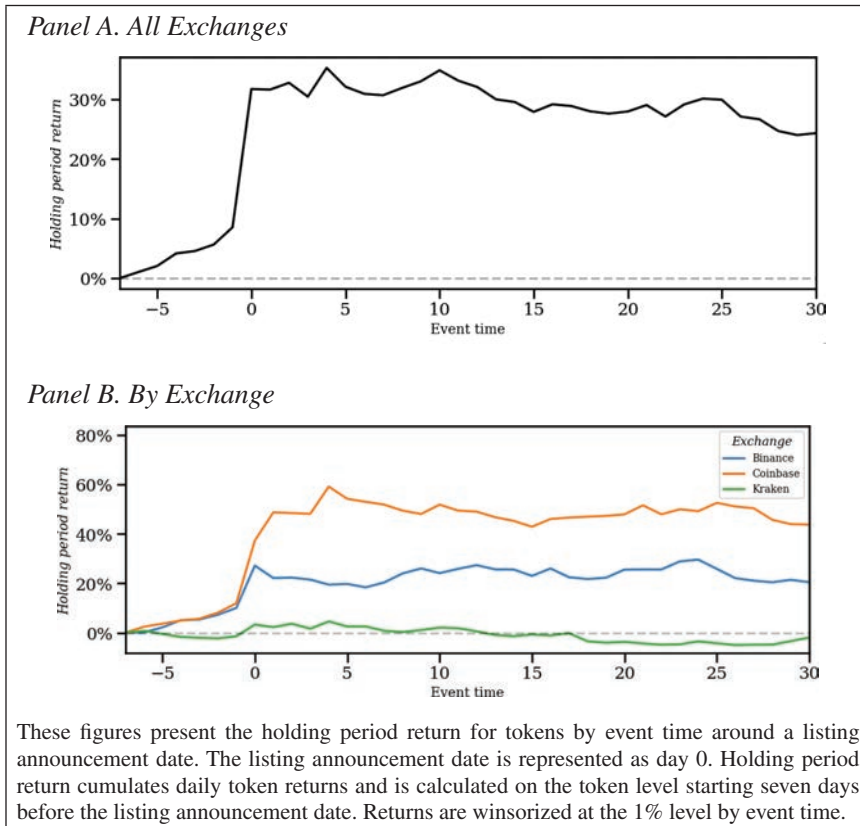
<sup>145</sup> Market cap is equal to price times circulating supply. See *Crypto Market Cap — What It Is and Why It Matters*, CRYPTO.COM (Mar. 22, 2024), <https://crypto.com/en/university/what-is-crypto-market-cap> [<https://perma.cc/4CFX-KNHM>].

<sup>146</sup> See Fisch, Gelbach & Klick, *supra* note 12 and accompanying text.

Figure 1 presents average daily price reactions around new listing announcements. Panel A shows that prices react swiftly to listing announcements, with prices increasing by 15.3% on the day of the announcement (“day 0”).

Figure 2 presents the average holding period return around new listing announcements. Holding period return is calculated as the cumulative return to having purchased the token 7 days prior to the listing (that is, day -7) and held through the indicated date.

FIGURE 2. HOLDING PERIOD RETURN AROUND LISTING ANNOUNCEMENT DATES



Note from Panel A that the holding period return of 31.7% on day 0 represents the return from purchasing the security on day -7 and holding through the end of day 0. We find relatively weak evidence of a price reaction to new listing announcements for the Kraken exchange (average day 0 return of 4.7%) but much stronger reactions for new listings on Binance (average day 0 return of 14.0%) and Coinbase (average day 0 return of 21.7%). Panel B also shows that the price increase on the announcement date generally reverts for

listings on Kraken, but not Binance or Coinbase. For example, the holding period return for new listings on Kraken is 3.3% from day -7 through day 0, but -1.93% from day -7 through day 30.

Table 1 presents the results of applying the event study methodology as described above to our sample of token listing announcements. We conduct a separate event study for each of the 452 new listing announcements. Panel A reports descriptive statistics of the event date Excess Returns across all new listing announcements and broken out by exchange. The cryptocurrency tokens in our sample on average have an average Excess Return of 15.3% on the announcement date (day 0). We find relatively lower Excess Returns for Kraken announcements (3.7%) compared to Binance (14.2%) and Coinbase (22.2%).

Panel B demonstrates that many more listings show statistically significant event date reactions than would be expected if there was truly no significant price reaction. For example, at the 5% significance level, we would expect 5% (23) of listings in our sample to have statistically significant price reactions purely through random chance. However, we observe 36% (162) listings with statistically significant price reactions. The average Excess Return for statistically significant listings is 41.7%. Broken out by exchange, all three exchanges have far greater than 5% of listings with event date Excess Returns significant at the 5% level. Though Kraken (12%) has relatively fewer statistically significant listing announcements than Binance (33%) or Coinbase (51%), we still observe more than twice as many significant listings as would be expected at the 5% significance level. The data suggests that the market reactions to listing events are highly statistically significant and unlikely to be attributable to random chance. A full list of listings with event date Excess Returns statistically significant at the 5% level can be found in Appendix Table 1, along with data on whether the respective token satisfies the crypto-equivalent of the *Cammer* factors offered in Section 3.

TABLE I. LISTING ANNOUNCEMENT EXCESS RETURNS

*Panel A. Descriptive statistics of Estimated Excess Return*

Exchange	n	Mean	St.Dev	25%	50%	75%
All	452	15.3%	28.5%	-0.7%	5.1%	21.1%
Binance	155	14.2%	29.0%	-3.2%	4.2%	23.8%
Coinbase	196	22.2%	32.2%	1.4%	12.5%	29.8%
Kraken	101	3.7%	10.8%	-0.9%	0.9%	5.0%

*Panel B. Statistically significant listings by exchange*

Exchange	% Listings	Average Excess Returns
All	36%	42%
Binance	33%	45%
Coinbase	51%	42%
Kraken	12%	27%

These tables give descriptive statistics of Excess Returns on the listing announcement event date (“Excess Return”) broken out by exchange. A single market factor regression is run for each listing token for the [-100,-5] pre-period given in event time where an event time of 0 corresponds to the day of the listing announcement. The market factor is the value-weighted CMC index as described in Section 4. Each regression is run on the listing token level to estimate Expected Returns. The Excess Returns in these tables are calculated as the daily returns on the event dates minus the same-day Expected Returns. An Excess Return z-score is calculated as the event date Excess Return divided by the standard deviation of Excess Returns in the [-100,-5] pre-period. Panel A provides descriptive statistics for the Excess Returns for all listings and broken out by exchange. Panel B provides the percent of total listings with Excess Returns on the announcement day that are significant at the 5% level via a two-tailed z-test, and the average Excess Returns for those listings.

### III. CAMMER-LIKE FACTORS FOR CRYPTOCURRENCY LITIGATION

The presence of an efficient market is crucial for the interpretation of an event study: in an efficient market, market reactions can be equated to a change in the value of the underlying asset. As discussed *supra*, the court in *Cammer v. Bloom* established five factors for courts to evaluate when plaintiffs attempt to demonstrate market efficiency.<sup>147</sup> Subsequent legal cases have reinforced the use of the *Cammer* factors, and their use is now ubiquitous in modern securities litigation.<sup>148</sup>

<sup>147</sup> See *Cammer*, 711 F. Supp. at 1286–87.

<sup>148</sup> See Tabak & Buckberg, *supra* note 83 (noting that dozens of courts have relied on the *Cammer* factors to evaluate market efficiency); Villanueva & Feinstein, *supra* note 8, at 205,

With the rise of cryptocurrency, it is inevitable that courts will and should consider how the *Cammer* factors should be adopted for their use in cryptocurrency litigation. Adopting the *Cammer* factors to a different kind of security is not a new endeavor. The *Cammer* factors were initially developed for *common stock* securities, yet courts have also been able to apply them to *debt* securities.<sup>149</sup> The different natures of equity and debt markets led courts to suggest that “the *Cammer* factors be adjusted in the context of [debt] markets.”<sup>150</sup>

Similarly, we suggest that the *Cammer* factors be adapted and adopted for cryptocurrency markets.<sup>151</sup> We offer the following five crypto equivalents to the *Cammer* factors that can be used to evaluate the appropriateness of an event study in crypto markets.

### 1. Volume

The analog to the *Cammer* volume factor in crypto markets is volume as a fraction of circulating supply. Given that the total volume of cryptocurrency trades has at times approximated the total volume of stock trades,<sup>152</sup> we suggest a crypto factor based on average weekly volume of 2% of circulating supply,<sup>153</sup> with the additional requirement of average daily volume of at least \$1 million. The factor could alternatively measure an average daily volume of 2% of circulating supply to be analogous to the 95<sup>th</sup> percentile scrutinized by the *Bed Bath & Beyond* Court.<sup>154</sup> The 2% of circulating supply and \$1 million thresholds are purely starting points for a court’s volume analysis. If courts envision treating cryptocurrencies in securities class actions as analogous to stocks, this amount should not be a hard-and-fast rule, but should fluctuate with market dynamics. Note that it is important to use circulating supply, not total supply, because the latter includes locked-up supply that is analogous to treasury stock.<sup>155</sup>

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233 (noting that numerous courts have followed *Cammer* and *Krogman* and concluding that the results support courts’ widespread use of those factors).

<sup>149</sup> See, e.g., *In re HealthSouth Corp. Sec. Litig.*, 261 F.R.D. 616, 633 (N.D. Ala. 2009) (addressing the application of *Cammer* factors to use in debt securities).

<sup>150</sup> *Dynex*, 2011 U.S. Dist. LEXIS 22484, at \*13.

<sup>151</sup> Others have argued along similar lines. See Patel, *supra* note 16, at 215.

<sup>152</sup> See, e.g., Oscar Williams-Grut, *The cryptocurrency market is now doing the same daily volume as the New York Stock Exchange*, BUS. INSIDER (Dec. 20, 2017, 7:17 AM), <https://www.businessinsider.com/daily-cryptocurrency-volumes-vs-stock-market-volumes-2017-12> [<https://perma.cc/TL8D-888R>].

<sup>153</sup> Circulating supply refers to the number of coins or tokens that have been mined or created and that are circulating in public hands. See *Supply (Circulating, Total, Max)*, COINMARKETCAP, <https://support.coinmarketcap.com/hc/en-us/articles/360043396252-Supply-Circulating-Total-Max> [<https://perma.cc/4UNJ-EH2Y>]; see also *StrongHands (SHND)*, COINLORE, <https://www.coinlore.com/coin/stronghands> [<https://perma.cc/6RMJ-2N6Q>] (defining circulating supply for a cryptocurrency called StrongHands at over seventeen billion coins/tokens).

<sup>154</sup> See *supra* notes 73–78 and accompanying text.

<sup>155</sup> See COINMARKETCAP, *supra* note 153.

## 2. Analysts

In crypto markets, the analyst coverage factor can be measured based on whether data on the cryptocurrency (for example, prices, volume, supply) and news on the cryptocurrency (for example, press releases and social media commentary) are publicly available from professional, third-party data vendors (for example, CMC). In crypto markets these third-party data vendors play a similar role as analysts in securities markets. To the extent that other sources arise, we recommend focusing on cryptocurrencies with data on prices, volume, circulating supply, and social media / news coverage on CMC.

We base our recommendation that courts look to CMC on the platform's authority in the financial services and cryptocurrency industry. CMC is frequently cited by both major news outlets such as CNBC and Bloomberg<sup>156</sup> and individual analysts, including government researchers. As of June 2022, it surpassed over 340 million page views per month.<sup>157</sup> The platform also has enabling technology that seamlessly integrates CMC data into cryptocurrency trader tools,<sup>158</sup> making it comparable to Bloomberg Terminal or other databases that support securities trading. Finally, reports from CMC are used by venture capital firms and analysts to track and predict funding trends in the crypto industry.<sup>159</sup> Because it monitors inflows into crypto assets, CMC provides authoritative data for decisionmakers on which cryptocurrencies are backed by the most liquidity and thus which crypto currency markets may be more or less efficient.

## 3. Exchanges

The analog in crypto markets is the presence of centralized exchanges that expose the token to a wide client base and act as custodians for institutional investors.<sup>160</sup> The more centralized exchanges that offer support for the token, the more efficient the crypto market because of the presence of

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<sup>156</sup> See *About CoinMarketCap*, COINMARKETCAP, <https://coinmarketcap.com/about/> [<https://perma.cc/ZPB4-UGWV>].

<sup>157</sup> *Id.*

<sup>158</sup> See *CMC Hot List: Top 10 Tools for Pros*, COINMARKETCAP, <https://coinmarketcap.com/academy/article/cmc-hot-list-top-10-tools-for-pros> [<https://perma.cc/V4G7-CFCV>] (noting the tools allow users to build decentralized applications that can integrate CMC data).

<sup>159</sup> See *Crypto Venture Capital Funding Predicted To Hit \$18 Billion in 2025 Following \$13.6 Billion Recovery in 2024*, COINMARKETCAP (Jan. 2025), <https://coinmarketcap.com/academy/article/crypto-venture-capital-funding-predicted-to-hit-dollar18-billion-in-2025-following-dollar136-billion-recovery-in-2024> [<https://perma.cc/9Z5U-YQJJ>].

<sup>160</sup> See, e.g., Jesse Pound, *BlackRock files for spot bitcoin ETF, with Coinbase as a crypto custodian*, CNBC (June 15, 2023, 5:16 PM), <https://www.cnbc.com/2023/06/15/blackrock-files-for-spot-bitcoin-etf-with-coinbase-as-a-crypto-custodian.html> [<https://perma.cc/WXC3-23GN>].

arbitrageurs and additional liquidity that the exchanges bring.<sup>161</sup> We suggest a crypto factor based on the number of top three exchanges—Kraken, Binance, or Coinbase—that list the token.

The analog we propose reflects research indicating centralized exchanges can provide evidence of market efficiency. We justify the analog in part because the centralized exchange factor need not only describe a narrow conception of a stock exchange like the NYSE. Platforms where securities and currencies are bought and sold make markets efficient by improving liquidity, a key component of any efficient market. The market for credit default swaps (“CDSs”)<sup>162</sup> depends on a Central Counterparty (“CCP”) acting as an exchange that can enhance CDS market efficiency by providing enhanced liquidity.<sup>163</sup> There, a client who wants CDS exposure buys a CDS from an institution, usually a bank, who in turn places an order from a dealer. The dealer, who seeks protection for the risk of the trade, then purchases a counter-vailing position with a CCP, who in turn requires the dealer to post a “margin” as collateral in the event the client’s bet fails. If the CDS looks less likely to default (in which case the client’s bet is failing), the CCP may demand more collateral from the broker dealer (who makes this demand from the bank or client). If the client cannot post the additional collateral, the CCP may seize it. Duffie et al.’s research shows that CCPs are vital to creating “netting efficiency” by lowering the amount of collateral that dealers are required to post, which can impact the market liquidity for CDS by offsetting obligations, improving cash flow management, enhancing pricing efficiency, and managing systemic risk.<sup>164</sup>

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<sup>161</sup> Cf. Patel, *supra* note 16, at 179 (noting “crypto asset arbitrage is costly”); see also Igor Makarov & Antoinette Schoar, *Trading and Arbitrage in Cryptocurrency Markets*, 135 J. FIN. ECON. 293, 293 (2020) (analyzing price differences across crypto exchanges).

<sup>162</sup> CDSs are financial derivatives that function like insurance on a bond or a loan, where the buyer pays a premium to the seller, and in return, the seller agrees to compensate the buyer on the insured amount of the defaulted bond or loan. Mark J. Flannery, Joel F. Houston & Frank Partnoy, *Credit Default Swap Spreads as Viable Substitutes for Credit Ratings*, 158 U. PENN. L. REV. 2085, 2087–89 (2010). They are probably best known for their role in the 2008 subprime mortgage financial crisis as a crucial way investors bet against the housing market. *Id.*

<sup>163</sup> Darrell Duffie, Martin Scheicher & Guillaume Vuilleme, *Central Clearing and Collateral Demand*, 116 J. FIN. ECON. 237, 237–39 (2015) (explaining how CCPs step into bilateral trades by means of novation, becoming the buyer to every seller and the seller to every buyer in a process that mitigates counterparty credit risk enhancing market efficiency by providing increased liquidity).

<sup>164</sup> See *id.* at 248, 251 (finding that while introducing dealer-to-dealer margins increases “system-wide” demand for collateral, requiring the market to have a central clearing exchange through a CCP reduces the amount of collateral demanded).

#### 4. Market Capitalization

Obviously, security registration requirements do not apply to cryptocurrency assets that are not registered.<sup>165</sup> Accordingly, in place of an S-3 Registration Statement factor, we suggest a factor based on a minimum circulating supply of \$30 million. The rationale for this threshold is the observation that—if the cryptocurrency were instead a publicly traded company—this threshold would meet criteria for inclusion in the Russell 3000 total market index.<sup>166</sup> For example, the various Russell indices as of their 2025 reconstitution report \$30.3 million as a minimum threshold.<sup>167</sup> Cryptocurrency market capitalizations at \$30 million can be analogous to securities that courts have found trade in an efficient market, as courts have accepted wide ranges of market capitalizations as supportive evidence of market efficiency.<sup>168</sup>

#### 5. Cause-and-Effect Relationship

Cryptocurrencies also have relevant events where the corresponding market reaction can be tested. One such event is a new listing announcement on an exchange. Such announcements can be used to test whether the market for a particular cryptocurrency is sufficiently efficient to draw meaningful inferences from the event study.

Event studies are well-suited for assessing the efficiency of a market for a given cryptocurrency. This is largely because event studies surrounding cryptocurrencies can leverage intraday trading data to test such efficiency in a way

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<sup>165</sup> The SEC has acknowledged that some cryptocurrency assets should not be considered securities, despite taking the position that some coins will be considered securities. Gary Gensler, *Prepared Remarks of Gary Gensler on Crypto Markets at Penn Law Capital Markets Association Annual Conference*, U.S. SEC. EXCH. COMM'N, (Apr. 4, 2022), <https://www.sec.gov/newsroom/speeches-statements/gensler-remarks-crypto-markets-040422> [<https://perma.cc/PXY6-83G2>].

<sup>166</sup> *Russell US Equity Indices: Construction and Methodology*, FTSE RUSSELL (August 2025), at 13 [https://www.lseg.com/content/dam/ftse-russell/en\\_us/documents/ground-rules/russell-us-indexes-construction-and-methodology.pdf](https://www.lseg.com/content/dam/ftse-russell/en_us/documents/ground-rules/russell-us-indexes-construction-and-methodology.pdf) [<https://perma.cc/66DT-5Q87>] (noting companies with a total market capitalization less than \$30 million are not eligible for inclusion in Russell U.S. indexes).

<sup>167</sup> Russell US Market Cap Completion Indices, at 2, [https://www.lseg.com/content/dam/ftse-russell/en\\_us/documents/other/russell-us-market-cap-completion-indexes-solution-overview.pdf](https://www.lseg.com/content/dam/ftse-russell/en_us/documents/other/russell-us-market-cap-completion-indexes-solution-overview.pdf)

<sup>168</sup> *See, e.g., Rougier*, 2019 U.S. Dist. LEXIS 198919, at \*38 (finding efficiency for a security with a market capitalization averaging over \$1 billion at or above the 45th percentile of the NASDAQ and NYSE throughout the class period); *In re Netbank, Inc. Sec. Litig.*, 259 F.R.D. 656, 672 (N.D. Ga. 2009) (finding efficiency where market capitalization ranged from approximately \$246 million to \$432 million); *DVI*, 249 F.R.D. at 212 (finding efficiency in between \$12 million and \$300 million); *Pa. Ave. Funds v. Inyx Inc.*, No. 08-CV-6857, 2011 U.S. Dist. LEXIS 72999, at \*27–28 (S.D.N.Y. 2011) (finding efficiency where market capitalization rates were above \$22.4 million).

securities markets cannot.<sup>169</sup> One of the authors has previously concluded that in securities markets, managers might successfully “bundle” disclosures of good news (“positive bundling”) with disclosures of bad news or might bundle disclosures of bad news with additional bad news (“noise bundling”) to reduce firms’ liability in litigation.<sup>170</sup> These bundling activities make event studies much more difficult to do for traditional stocks because it becomes harder to statistically determine which disclosure materially impacted the stock price.<sup>171</sup> With cryptocurrencies, because many traders rely on information from decentralized sources such as blockchain, managers are not controlling the information, and thus traders are not subject to the same kinds of incentives that drive how managers disclose good and bad information. However, in the cryptocurrency arena, information may be subject to delays between when a command for a purchase or sale is made and when it is executed in cryptocurrency platforms,<sup>172</sup> which may complicate how event studies determine whether a statement is causally linked to a price drop.

Courts can apply our event study factor for cryptocurrencies in a similar fashion as the current *Cammer* event study factor. Whether a token’s new listing announcement is a statistically significant predictor of a market reaction can similarly serve as a sufficient but not necessary indicator of market efficiency. For the 95 out of 162 newly listed tokens with statistically significant excess returns, the tokens were able to satisfy all other proposed crypto *Cammer* factors as well. These tokens contain a wide range of excess returns that are attributable to the token alone, rather than to swings in the cryptocurrency market.<sup>173</sup> The non-event study factors can likewise serve as supportive indicia of a finding of market efficiency, with the event study playing more of a lead role. Alternatively, the new listing event, rather than the non-event study factors, can play a supporting role in a court’s *Cammer* analysis. Thirty tokens with statistically significant new listing announcements lacked a weekly volume divided by circulating supply greater than 2%, a daily dollar volume greater than \$1 million, or a price times circulating supply greater

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<sup>169</sup> Cf. Patel, *supra* note 16, at 217 n.237 (citing Ben R. Marshall, Nick Nguyen & Nuttawat Visaltanachoti, *A Note on Intraday Event Studies*, 28 EUR. ACCT. REV. 605 (2019) to argue that event studies can be conducted for any time frequency that the data allow).

<sup>170</sup> See Barbara A. Bliss, Frank Partnoy & Michael Furchtgott, *Information Bundling and Securities Litigation*, 65 J. ACCT. & ECON. 61, 79 (2018) (finding “bundling significantly reduced the likelihood of being sued and enabled firms that were sued to settle those lawsuits for significantly lower sums.”).

<sup>171</sup> See Fisch, Gelbach, & Klick, *supra* note 4, at 614 (“If the presence of overlapping news makes it difficult or impossible for plaintiffs to marshal admissible and useful event study evidence, defendants may strategically structure their disclosures to impede plaintiffs’ ability to establish price effect.”)

<sup>172</sup> The term describing the gap between such times is known as latency. See Dirk G. Baur & Thomas Dimpfl, *Information Transmission across Cryptocurrency Markets and the Role of the Blockchain*, SSRN (Apr. 11, 2020) (unpublished manuscript) <https://ssrn.com/abstract=3573367> [<https://perma.cc/Pgz5-RZJ7>] (concluding price discovery across cryptocurrency platforms is slow because of long confirmation times and delays in processing contributing to latency).

<sup>173</sup> The minimum excess return for the 95 tokens satisfying all five of our criteria is 3.43%, while the maximum is 135.55%. See *infra* App.

than \$30 million. These tokens also contained a wide a range of statistically significant excess returns.<sup>174</sup> 10 tokens collectively failed the crypto analyst factor because they were not actively tracked with enough data by CMC. Like for securities, the non-event study crypto factors should be viewed holistically, rather than individually. Courts should also consider the type of exchange on which the new listing announcement occurred and whether this exchange is statistically associated with an increase in returns.

Table 2 provides a summary of our five *Cammer*-like crypto factors.

TABLE 2. *CAMMER*-LIKE FACTORS IN CRYPTOCURRENCY

<i>Cammer</i> Factor	<i>Cammer</i> Rationale	Securities Markets	Crypto Markets
Volume	“[T]he existence of an actively traded market, as evidenced by a large weekly volume of stock trades, suggests there is an efficient market is because it implies significant investor interest in the company.”	Weekly volume divided by shares outstanding greater than 2%.	(1) Weekly volume divided by circulating supply greater than 2%. (2) Daily dollar volume greater than \$1 million.
Analysts	“[E]xistence of such analysts would imply [information is] closely reviewed by investment professionals, who would in turn make buy/sell recommendations to client investors.”	Number of analysts covering the firm.	Actively tracked by CMC with relevant data all available.
Presence of market makers and arbitrageurs	“The existence of market makers and arbitrageurs would ensure completion of the market mechanism; these individuals would react swiftly to company news and reported financial results by buying or selling stock and driving it to a changed price level.”	(1) Number of market makers. (2) Institutional holdings divided by shares outstanding.	Listed by major, centralized exchange.
Eligibility to file a S-3 Registration Statement	“[I]t would be helpful to allege the Company was entitled to file an S-3 Registration Statement in connection with public offerings... it is the number of shares traded and <i>value of shares outstanding</i> that involve the facts which imply efficiency.”	Market capitalization greater than \$75 million.	Price times circulating supply greater than \$30 million.
A cause-and-effect relationship between unexpected, material events and price	“[A] cause and effect relationship between unexpected corporate events or financial releases and an immediate response in the stock price . . . is the essence of an efficient market and the foundation for the fraud on the market theory.”	Use event studies to link price movement to past events, for example, earnings reports.	Use event studies to link price movement to past events, for example, new listing announcements.

<sup>174</sup> The minimum excess return across the 30 tokens that fail the market capitalization and volume criteria is 9.51%, while the maximum is 152.32%. *See infra* App.

We recognize that other academics, practitioners, and judges might find that the threshold levels for different *Cammer* factors should be different from the factors we use here.<sup>175</sup> Our application is for illustrative purposes, and the suggested thresholds should not be taken as hard-and-fast rules. Nevertheless, they provide some information that is useful in assessing both market efficiency questions and questions about the use of event studies below. Additionally, we note that as in the securities markets, the answers to questions about volume, analyst coverage, exchanges, and market capitalization are not dispositive. Rather, they are additional data to help an adjudicator assess the extent to which it would be appropriate to reach certain conclusions with respect to material (or other factors). We provide all our *Cammer* factor data in the Appendix, for completeness.

To show how these factors would be applied in practice, we assess these *Cammer*-like factors for each of the 452 announcements of new listings of cryptocurrency tokens. The results are set forth in the Appendix. In each of the *Cammer* factor columns in the Appendix, we indicate whether the ticker satisfies our version of the *Cammer* test. In the Appendix, we also provide a list of 162 cryptocurrencies whose prices had statistically significant positive reactions to new listing announcements. We offer these cryptocurrencies as satisfying this fifth factor because their new listing announcements were associated with a statistically significant price reaction. The Appendix notes whether each example satisfies the other four crypto factors used to assess market efficiency.

#### IV. POLICY IMPLICATIONS

*Cammer* analysis is an example of “second-best” policy. Ideally, courts would implement sophisticated and rigorous tests that adapt over time in determining whether a market is efficient for litigation purposes. However, that approach can be prohibitively expensive and potentially inflexible. For better or worse, courts in securities cases follow *Cammer*.<sup>176</sup>

Although ideally judges would implement an optimal “first-best” policy with respect to determinations of market efficiency in the cryptocurrency context, the lessons from the use of *Cammer* factors in securities litigation suggest that it can be preferable instead for judges to follow a relatively low-cost and straightforward multi-factor test, even if imperfect.<sup>177</sup>

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<sup>175</sup> See, e.g., Gelbach, *supra* note 110; see also *infra* Section I.B (noting case law differing application of the factors).

<sup>176</sup> See *supra* note 7 and accompanying cases.

<sup>177</sup> See Tabak & Buckberg, *supra* note 83 (noting that courts’ ultimate conclusions on market efficiency tend to look the same as if they had simply counted the *Cammer* factors).

The approach we advocate here advances a novel normative strategy in that we embrace a multi-factor test that is admittedly flawed *ex ante*, but that we believe will be “second best” optimal *ex post*. Indeed, we expect that courts might gravitate in the direction of factors similar to those articulated above over time, even if they do not immediately adopt our multi-factor approach, given the inevitable grappling with the pros and cons of determinations of cryptocurrency market efficiency.

In the securities fraud context, there have been vexing questions about how judges should consider and weigh various empirical approaches and social science methods in making market efficiency determinations.<sup>178</sup> Likewise, how courts manage and adjudicate a potential wave of cryptocurrency class actions will depend on similar consideration and weighting, and on any lessons that judges can glean from the policy choices they make in traditional securities cases.

Our recommended approach is potentially subject to the same types of academic criticism as assessments of market efficiency in securities litigation. As Professor Langevoort noted in 2009, “[t]he downside to making the science so determinative is that judges and other non-expert policymakers may not notice when very important questions of law are assumed away in all the number crunching.”<sup>179</sup> Likewise, judges in cryptocurrency cases might not notice policy determinations that are embedded within the assumptions implicit in our proffered test.

Accordingly, one central aspect of our policy discussion recognizes that the lessons learned from event studies in securities class actions should guide how courts apply similar analyses in crypto setting. For example, as Professors Brav and Heaton point out, event studies conducted with data from single-firms often have low statistical power, leading courts to incorrectly require plaintiffs meet high statistical significance burdens even if the event studies have less “power” to detect a meaningful price impact.<sup>180</sup> We believe such risks also are present in the cryptocurrency context, given that so many disputes involve single issues.

The Supreme Court in *Daubert* cautioned that the mere fact that a scientific theory is widely accepted does not necessarily make it reliable,

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<sup>178</sup> See, e.g., Fisch & Gelbach, *supra* note 32, at 96; Baker, *supra* note 70, at 1260 (arguing “[c]ourts should be unwilling to cede their adjudicative role in these disputes to the results of an empirical analysis with unknown or unascertained rates of error”).

<sup>179</sup> Donald C. Langevoort, *Compared to What? Econometric Evidence and the Counterfactual Difficulty*, 35 J. CORP. L. 183, 187 (2009).

<sup>180</sup> See Brav & Heaton, *supra* note 12, at 586–87 (hypothesizing that there is “no evidence” Courts want to create a decision-making regime that is more likely to have a false negative and exonerate a guilty fraud-on-the-market defendant than it is to punish an innocent defendant); see also Michael I. Meyerson & William Meyerson, *Significant Statistics: The Unwitting Policy Making of Mathematically Ignorant Judges*, 37 PEPP. L. REV. 771, 840 (2010) (noting failure to consider statistical power creates policy incentives where “the probability of an incorrect exoneration far exceeds the probability of an incorrect condemnation”).

recommending courts evaluate scientific theories based on their whether the theory or technique has been tested, subjected to peer review, has a known error rate, and is generally accepted in the scientific community.<sup>181</sup> In applying this principle to securities fraud litigation, judges have been cautious about over-relying on statistical significance as the sole barometer of a causality.<sup>182</sup> These concerns also should be present in the cryptocurrency context.

Likewise, Professors Fisch and Gelbach suggest that the SEC, rather than the courts, may be better poised to make policy choices between risk allocation.<sup>183</sup> Courts' avoidance of such policy questions is not unique to securities class actions.<sup>184</sup> To the extent regulators have a comparative advantage enforcing prohibitions against fraud that involve cryptocurrencies, this skepticism might warrant higher judicial standards and thresholds in using the various factors of the tests we analyze here. Accordingly, we recognize that the courts likely would benefit from an evolutionary approach to the various thresholds under each factor.<sup>185</sup>

Overall, our suggestions with respect to applying the *Cammer* factors in cryptocurrency litigation give the courts have an opportunity to clarify their policy preferences in terms of who should bear risk: cryptocurrency investors, crypto managers, or third-party vendors and intermediaries. The early judicial adopters of our suggested multi-factor approach inevitably would assess each factor in a unique setting and might tailor each factor to nuances of the case. The first cases will be important, but unlike the early securities cases on market efficiency, cryptocurrency cases assessing market efficiency will have

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<sup>181</sup> *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 594–95 (1993).

<sup>182</sup> *See* *Matrixx Initiatives, Inc., v. Siracusano*, 563 U.S. 27, 29 (2011) (affirming the principle that statistical significance is relevant, but not dispositive on the question of materiality in securities fraud cases); *Pirmik v. Fiat Chrysler Autos., N.V.*, 327 F.R.D. 38, 46 (S.D.N.Y. 2018) (“A confidence level of 92.12% with a p-level of 7.88% indicates that the return under study is among the top 7.88% of ‘normal’ returns in terms of absolute magnitude or, in this case, among the bottom 3.94% of the most negative returns. That is obviously less comfort than a result that is statistically significant at a confidence level of 95%, but it does not prove the *absence* of price impact.” (emphasis in original)).

<sup>183</sup> *See* Fisch & Gelbach, *supra* note 32, at 96 (“Ultimately, decision-makers at the SEC make policy choices. It is appropriate for them to decide, for example, that they are willing to tolerate more fraud in order to reduce the extent of litigation costs, or vice-versa. Agency policy goals will more effectively achieve the decision-makers’ aims if the decision-makers are better informed with respect to technical questions.”).

<sup>184</sup> *See* Gelbach, *supra* note 110 (differentiating academic standards of statistical significance from litigation standards in court).

<sup>185</sup> This approach to letting thresholds evolve based on market conditions may require guidance from either Congress or the SEC. Both the Court of Chancery and federal courts have expressed skepticism towards using case law to set numerical thresholds on grounds that this is something best done by a legislature or agency. *See In re Zhongpin Inc., S’holder Litig.*, No. 7393-VCN, 2014 Del. Ch. LEXIS 252, at \*23–25 (Del. Ch. Nov. 26, 2014) (finding “latent and active” control of a company even where a shareholder only had 17% of a controlling interest); *see also* *Tabak v. Canadian Solar Inc.*, 549 Fed. App’x 24, 27 (2d Cir. 2013) (relying on the SEC’s presumption that 5% was an appropriate numerical threshold for judging whether a financial statement deviation was material).

two backdrops: securities cases and the empirics set forth above. We in turn discuss the policy ramifications of our proposed factors based on how they assign risk.

The \$1 million average daily volume and average weekly volume of 2% of circulating supply factor would shift the risk to the investors depending on the nature of the token they invest in. Investors whose cryptocurrency portfolios likely comprise blue-chip cryptocurrencies (for example, Bitcoin or Ethereum) will not have to bear the same risk as investors whose cryptocurrency holdings are largely focused on rare coins that aren't minable (for example, EYWA<sup>186</sup>). This may cause more sophisticated investors with the capacity to sue to focus their cryptocurrency holdings on those currencies that always clear this threshold.<sup>187</sup> Conversely, the average retail investor who lacks such resources may decide that the prospect of lucrative returns warrants a risk that they would assume even if a court would find the market efficient. Should courts adopt this factor even as merely a guidepost, they would signal a preference for establishing some cryptocurrencies as worthy of investor recovery while treating others almost as fads.

Relatedly, our analyst factor's reliance on the availability of CMC data is better described as shifting risk away from exchanges rather than towards the investors. This acknowledges the fact that rapid cryptocurrency trading has at times been weakened by informational delays.<sup>188</sup> Courts have at times sought to expand access to the data provided by exchanges in order to democratize information available to investors that cannot afford products.<sup>189</sup> However, the continued existence of tiered service offerings from third party vendors like CMC shows that this desire to expand access to data is remains subject to its own market dynamics. Furthermore, given that CMC offers both free and for-sale data on over 10,000 cryptocurrencies, it is consistent with jurisprudence that seeks to promote access and investor reliance on the existence of publicly available information.<sup>190</sup>

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<sup>186</sup> As of January 2025, EYWA's daily trading volume fluctuated between as low as \$658 thousand and as high as \$7 million. See *EYWA (EYWA) Price Stats*, COINLORE, <https://www.coinlore.com/coin/eywa> [<https://perma.cc/F94H-WQFC>]. Whether it would have satisfied our *Cammer* factor for market efficiency would depend on the class period during which an investor alleged fraud-on-the-market.

<sup>187</sup> For context, the average daily trading volume of Bitcoin in 2022 over a random thirty-day period was \$24.73 billion, higher than Apple's by 58.42%. See Ana Zirojevic, *Bitcoin's average daily trading volume is almost 60% higher than Apple's*, FINBOLD (Mar. 9, 2022), <https://finbold.com/bitcoins-average-daily-trading-volume-is-almost-60-higher-than-apples> [<https://perma.cc/TY26-ZVY2>].

<sup>188</sup> See Baur & Dimpfl, *supra* note 172.

<sup>189</sup> See, e.g., *Nasdaq Stock Mkt. v. Sec. Exch. Comm'n*, 34 F.4th 1105, 1106–08 (D.C. Cir. 2022) (upholding SEC changes to a Market Data Infrastructure Rule that sought to address an information asymmetry in the market for securities data between participants who relied on a core data feed compared with participants that could subscribe to Nasdaq proprietary products).

<sup>190</sup> See *id.*



This shifts risks to managers of cryptocurrency funds (like Pantera Capital<sup>196</sup>). Like in securities fraud actions, it may make little sense for non-institutional investors to bring suit unless as a class they can demonstrate causality. On one hand, simply requiring that an event have a statistically significant reaction to a price protects investors who relied on a cryptocurrency fund manager's statements. Additionally, as fund managers control both the infrastructure on which lesser-known tokens are traded and the tokens themselves, those who invest in solely the latter may not receive information about new listings as quickly as those who control the exchanges. Using a test of whether a cryptocurrency's new listing is statistically associated with a price reaction is a step towards bridging any potential information asymmetry that may arise between those who own exchanges getting ready to list the tokens and those who invest in currencies. Courts might assess market efficiency questions by tailoring event studies to suit characteristics of cryptocurrencies. For example, courts might balance intraday trading data with the "common sense" principles espoused in the recent *Goldman Sachs* ruling.<sup>197</sup>

Most fundamentally, our proposed *Cammer* factors are focused on valuation and information. One of us has previously argued that, as a matter of principle, judges should shift their focus from the market prices of firms' shares to the fundamental value of the firms themselves.<sup>198</sup> Federal courts have suggested as much in securities cases, and the Delaware Court of Chancery uses metrics of discounted cash flow ("DCF") analysis in conjunction with adjusted deal price to determine whether a transaction is fair.<sup>199</sup> Event studies for cryptocurrency fraud cases have the opportunity to continue this paradigm shift by using event studies to assess how misstatements cause changes in value, not only price.

## CONCLUSION

In this paper, we study how market efficiency tests may be applied to litigations involving cryptocurrencies and cryptocurrency assets. We modify

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<sup>196</sup> Pantera Capital exclusively invests in blockchain-related companies, including tokens themselves. See *Portfolio*, PANTERA CAPITAL, <https://panteracapital.com/portfolio/> [<https://perma.cc/C5A2-YR7Y>].

<sup>197</sup> See *Goldman Sachs*, 594 U.S. at 122 ("courts may consider expert testimony and use their common sense in assessing whether a generic misrepresentation had a price impact."). Professor Langevoort first espouses the idea of "common sense" price impacts. See Donald C. Langevoort, *Judgment Day for Fraud-on-the-Market: Reflections on Amgen and the Second Coming of Halliburton*, 57 ARIZ. L. REV. 37, 56 (2015) ("Event studies may help, but there is no reason in the class certification inquiry to limit evidence to those, especially in 'confirmatory lie' cases. Courts should be open to all probative evidence on that question—qualitative as well as quantitative—aided by a good dose of common sense.").

<sup>198</sup> See Partnoy, *supra* note 122.

<sup>199</sup> See, e.g., *SourceHOV Holdings, Inc. v. Manichaeen Cap. LLC*, 246 A.3d 139 (Del. 2021) (en banc) (affirming the Delaware Court of Chancery's use of the DCF analysis).

the traditional event study methodology so that it may be used to address the unique institutional concerns that arise in the crypto markets. Using 452 new listings of cryptocurrency tokens, we show that this modified methodology may be used to measure abnormal returns in the crypto markets. Drawing on the extensive securities litigation caselaw, we then discuss the *Cammer* factors that courts use to determine whether trading in a particular security at issue is efficient. We show how courts can analogize from the *Cammer* factors in the securities litigation context to create *Cammer*-like factors for crypto litigations.

To be clear, our *Cammer*-like factors—just as the *Cammer* factors do—test whether the market prices of cryptocurrencies and cryptocurrency assets are sufficiently responsive to new information. This type of informational efficiency—that prices quickly incorporate new information—may differ from a fundamental value efficiency, where prices reflect the true value of the asset.<sup>200</sup> We are confident that the debate over which markets are information-efficient or fundamental-value-efficient will continue to rage,<sup>201</sup> and those debates may be particularly sharp when it comes to crypto. Regardless of that academic debate, judges must make timely decisions on the real-world cases in front of them. We offer a framework—to be taken with a grain (or mountain) of salt—that allows them to do so in the cryptocurrency context.

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<sup>200</sup> Recently, Courts have acknowledged these different characterizations of efficiency, but they do not seem to impact whether a plaintiff can show the security traded in an efficient market. See *In re Bed Bath & Beyond Corp. Sec. Litig.*, 687 F.Supp. 3d 1, 27–28 (D.D.C. 2023) (affirming that whether a stock was undervalued or overvalued does not impact whether the false statements impact price and cause loss).

<sup>201</sup> Professor Fisch summed up the current state of this debate as such: “Few scholars believe that the public capital markets are fundamental value efficient. Information efficiency, in contrast, means that securities prices rapidly incorporate publicly available information. Most scholars believe that the markets are information efficient to some degree.” Jill E. Fisch, *The Trouble with Basic: Price Distortion after Halliburton*, 90 WASH. U. L. REV. 895, 909 (2013).

## APPENDIX

## Statistically Significant Listing Announcement Returns

## Panel A. Coinbase

Ticker	Name	Excess Return (Day 0)	Commer Factors				
			Vol.	Analysts	Exchanges	Market Cap.	Event Study
COVAL	CircuitsOfValue	152.32%***	Fail	Pass	Pass	Fail	Pass
NCT	Nectar	152.01%***	Fail	Pass	Pass	Pass	Pass
NMR	Numeraire	151.89%***	Fail	Pass	Pass	Pass	Pass
SHPING	Shping Coin	140.0%***	Fail	Pass	Pass	Fail	Pass
FX	Function X	135.55%***	Pass	Pass	Pass	Pass	Pass
ACH	Alchemy	127.79%***	Pass	Pass	Pass	Fail	Pass
ASM	ASSEMBLE	119.71%***	Pass	Pass	Pass	Fail	Pass
STORJ	StorjToken	94.77%***	Pass	Pass	Pass	Pass	Pass
NU	NuCypher	93.67%***	Pass	Pass	Pass	Fail	Pass
PLU	Pluton	88.44%***	Fail	Pass	Pass	Fail	Pass
REQ	Request Token	85.94%***	Pass	Pass	Pass	Pass	Pass
JASMY	JasmyCoin	79.31%***	N/A	Fail	Pass	N/A	Pass
IOTX	IoTeX Network	77.63%***	Pass	Pass	Pass	Pass	Pass
MCO2	Moss Carbon	76.85%***	N/A	Fail	Pass	N/A	Pass
PAPER	Paper	76.84%***	N/A	Fail	Pass	N/A	Pass
KRL	Kryll	73.37%***	Fail	Pass	Pass	Fail	Pass
MUSE	Muse	72.01%***	Fail	Pass	Pass	Fail	Pass
DDX	DerivaDAO	70.67%***	Fail	Pass	Pass	Pass	Pass
MONA	Monavale	69.53%***	Fail	Pass	Pass	Fail	Pass
PRO	Propy	62.18%***	Pass	Pass	Pass	Pass	Pass
DYP	DeFiYieldProtocol	61.96%***	Pass	Pass	Pass	Fail	Pass
POWR	PowerLedger	60.96%***	Pass	Pass	Pass	Pass	Pass
NKN	NKN	58.35%***	Pass	Pass	Pass	Pass	Pass
UPI	Pawtocol Network	58.31%***	Pass	Pass	Pass	Fail	Pass
SKL	SKALE	56.65%***	Pass	Pass	Pass	Pass	Pass
CRPT	CRPT	53.86%***	Fail	Pass	Pass	Fail	Pass
MDT	Measurable Data	50.5%***	Pass	Pass	Pass	Pass	Pass

Ticker	Name	Excess Return (Day 0)	Cammr Factors				
			Vol.	Analysts	Exchanges	Market Cap.	Event Study
PLA	PlayDapp Token	49.66%***	N/A	Fail	Pass	N/A	Pass
AST	AirSwap Token	46.67%***	Fail	Pass	Pass	Fail	Pass
INV	Inverse DAO	44.9%***	N/A	Fail	Pass	N/A	Pass
ANKR	Ankr Network	44.37%***	Pass	Pass	Pass	Pass	Pass
NDX	Indexed	44.33%***	Fail	Pass	Pass	Fail	Pass
VGX	Voyager Token	44.01%***	Pass	Pass	Pass	Pass	Pass
TIME	ChronoTech	41.87%***	Fail	Pass	Pass	Fail	Pass
AGLD	Adventure Gold	40.55%***	Pass	Pass	Pass	Pass	Pass
TRU	TrueFi	39.96%***	Pass	Pass	Pass	Pass	Pass
CTSI	Cartesi Token	39.47%***	Pass	Pass	Pass	Pass	Pass
KROM	Kromatika	38.61%***	Fail	Pass	Pass	Fail	Pass
BAND	BandToken	38.5%***	Pass	Pass	Pass	Pass	Pass
RLC	iEx.ec Network	38.43%***	Pass	Pass	Pass	Pass	Pass
SPELL	Spell Token	37.25%***	N/A	Fail	Pass	N/A	Pass
POND	Marlin POND	34.42%***	Pass	Pass	Pass	Pass	Pass
DIMO	Dimo	33.11%***	Fail	Pass	Pass	Fail	Pass
MATIC	Matic Token	32.79%***	Pass	Pass	Pass	Pass	Pass
BLZ	Bluzelle Token	30.71%***	Pass	Pass	Pass	Pass	Pass
TRB	Tellor Tributes	30.62%***	Pass	Pass	Pass	Pass	Pass
DIA	DIAToken	30.26%***	Pass	Pass	Pass	Pass	Pass
QUICK	Quickswap	30.19%***	Pass	Pass	Pass	Pass	Pass
TRAC	Trace Token	30.14%***	Pass	Pass	Pass	Pass	Pass
BIFI	BiFi	29.62%***	Fail	Pass	Pass	Fail	Pass
RADAR	DappRadar	29.49%***	N/A	Fail	Pass	N/A	Pass
GODS	Gods Unchained	29.08%***	Pass	Pass	Pass	Pass	Pass
SWFTC	SwftCoin	29.0%***	Pass	Pass	Pass	Fail	Pass
AXL	Axelar	28.82%***	Pass	Pass	Pass	Pass	Pass
CTX	Cryptex	28.52%***	N/A	Fail	Pass	N/A	Pass
OGN	OriginToken	25.76%**	Pass	Pass	Pass	Pass	Pass
SUPER	SuperFarm	25.35%***	Pass	Pass	Pass	Pass	Pass
IDEX	IDEX Token	24.74%**	Pass	Pass	Pass	Pass	Pass

Ticker	Name	Excess Return (Day 0)	Cammr Factors				
			Vol.	Analysts	Exchanges	Market Cap.	Event Study
API3	API3	24.6%***	Pass	Pass	Pass	Pass	Pass
ARPA	ARPA Token	24.18%***	Pass	Pass	Pass	Pass	Pass
BAT	Basic Attention	23.46%***	Pass	Pass	Pass	Pass	Pass
YFII	YFII.finance	22.28%***	Pass	Pass	Pass	Pass	Pass
TRIBE	Tribe	22.0%***	Pass	Pass	Pass	Pass	Pass
LQTY	LQTY	21.87%**	Fail	Pass	Pass	Pass	Pass
ENJ	Enjin Coin	21.35%**	Pass	Pass	Pass	Pass	Pass
CRV	Curve DAO	20.99%**	Pass	Pass	Pass	Pass	Pass
REN	Republic Token	20.53%**	Pass	Pass	Pass	Pass	Pass
AIOZ	AIOZ Network	20.14%***	Fail	Pass	Pass	Pass	Pass
OMG	OMGToken	20.12%***	Pass	Pass	Pass	Pass	Pass
BNT	Bancor Network	19.88%***	Pass	Pass	Pass	Pass	Pass
UNFI	UNFI	19.69%***	Pass	Pass	Pass	Pass	Pass
METIS	Metis Token	19.12%***	Pass	Pass	Pass	Pass	Pass
AMP	Amp	18.33%***	Pass	Pass	Pass	Pass	Pass
MATH	MATH Token	18.25%***	Fail	Pass	Pass	Fail	Pass
DEXT	DEXTools	18.0%***	Fail	Pass	Pass	Fail	Pass
AUCTION	Bounce Token	17.56%**	Pass	Pass	Pass	Pass	Pass
SYLO	Sylo	17.53%***	Fail	Pass	Pass	Fail	Pass
LRC	LoopringCoin V2	17.4%**	Pass	Pass	Pass	Pass	Pass
GYEN	GMO JPY	16.94%***	Fail	Pass	Pass	Fail	Pass
DAR	Dalarnia	16.66%**	Pass	Pass	Pass	Pass	Pass
ATA	Automata	16.42%***	Pass	Pass	Pass	Fail	Pass
ALCX	Alchemix	16.34%***	Pass	Pass	Pass	Pass	Pass
CRO	CRO	15.9%***	Pass	Pass	Pass	Pass	Pass
ZRX	0x Protocol Token	15.01%***	Pass	Pass	Pass	Pass	Pass
LOOM	Loom Token	15.0%**	Pass	Pass	Pass	Pass	Pass
PRQ	Parsiq Token	14.5%**	Pass	Pass	Pass	Fail	Pass
FIS	StaFi	13.71%**	Pass	Pass	Pass	Fail	Pass
QSP	Quantstamp	12.76%**	Pass	Pass	Pass	Fail	Pass
POLS	Polkastarter	12.64%**	Pass	Pass	Pass	Pass	Pass

Ticker	Name	Excess Return (Day 0)	Cammer Factors				
			Vol.	Analysts	Exchanges	Market Cap.	Event Study
AERGO	Aergo	12.43%**	Pass	Pass	Pass	Pass	Pass
HOPR	HOPR Token	11.94%***	Fail	Pass	Pass	Fail	Pass
PUNDIX	Pundi X Token	11.81%**	Pass	Pass	Pass	Pass	Pass
TVK	Terra Virtua	10.86%**	Pass	Pass	Pass	Pass	Pass
OCEAN	Ocean Token	8.98%**	Pass	Pass	Pass	Pass	Pass
ERN	EthernityChain	8.84%**	Pass	Pass	Pass	Pass	Pass
ELA	ELA	8.18%**	Fail	Pass	Pass	Pass	Pass
SNT	Status Network	7.85%**	Pass	Pass	Pass	Pass	Pass
TBTC	tBTC	5.66%***	N/A	Fail	Pass	N/A	Pass
OSMO	Osmosis	3.43%**	Pass	Pass	Pass	Pass	Pass

## Panel B. Binance

Ticker	Name	Excess Return (Day 0)	Cammr Factors				
			Vol.	Analyst	Exchanges	Market Cap.	Event Study
VIBE	Vibe Coin	151.75%***	Fail	Pass	Pass	Pass	Pass
DENT	DENT	130.59%***	Pass	Pass	Pass	Pass	Pass
YFII	YFII.finance	128.29%***	Pass	Pass	Pass	Fail	Pass
FOR	The Force Token	96.77%***	Pass	Pass	Pass	Fail	Pass
RAD	Radicle	88.43%***	Pass	Pass	Pass	Pass	Pass
TNB	Time New Bank	86.19%***	Pass	Pass	Pass	Pass	Pass
RLC	iEx.ec Network Token	82.3%***	Pass	Pass	Pass	Pass	Pass
RARE	SuperRare	80.73%***	Pass	Pass	Pass	Pass	Pass
CHZ	chiliZ	79.42%***	Pass	Pass	Pass	Fail	Pass
JASMY	JasmyCoin	63.22%***	Pass	Pass	Pass	Pass	Pass
OAX	openANX Token	62.43%***	Fail	Pass	Pass	Fail	Pass
EVX	Everex	60.45%***	Fail	Pass	Pass	Fail	Pass
FTM	Fantom Token	57.53%***	Pass	Pass	Pass	Fail	Pass
FLUX	Flux	52.17%***	Pass	Pass	Pass	Pass	Pass
DF	dForce	50.34%***	Pass	Pass	Pass	Fail	Pass
LUN	Lunyr Token	47.96%***	Fail	Pass	Pass	Fail	Pass
YFI	yearn.finance	46.37%***	Pass	Pass	Pass	Pass	Pass
HOT	HoloToken	46.31%***	Pass	Pass	Pass	Pass	Pass
KP3R	Keep3rV1	42.84%***	Pass	Pass	Pass	Pass	Pass
VGX	Voyager Token	41.54%***	Pass	Pass	Pass	Pass	Pass
NU	NuCypher	40.28%***	Pass	Pass	Pass	Pass	Pass
BCPT	BLOCKMASON CREDIT PROTOCOL TOKEN	37.19%***	Fail	Pass	Pass	Fail	Pass
IDEX	IDEX Token	36.58%***	Fail	Pass	Pass	Pass	Pass
OXT	Orchid	36.26%***	Pass	Pass	Pass	Pass	Pass
LTO	LTO Network Token	35.65%***	Pass	Pass	Pass	Pass	Pass
ANY	Anyswap	33.99%***	Pass	Pass	Pass	Pass	Pass

Ticker	Name	Excess Return (Day 0)	Cammer Factors				
			Vol.	Analyst	Exchanges	Market Cap.	Event Study
QNT	Quant	33.5%***	Pass	Pass	Pass	Pass	Pass
REN	Republic Token	32.99%***	Fail	Pass	Pass	Fail	Pass
FUEL	Fuel Token	32.85%**	Fail	Pass	Pass	Fail	Pass
TRIBE	Tribe	30.94%***	Pass	Pass	Pass	Pass	Pass
GTC	Gitcoin	30.74%**	Pass	Pass	Pass	Fail	Pass
ACH	Alchemy	28.6%***	Pass	Pass	Pass	Pass	Pass
STX	Stox	27.55%***	Fail	Pass	Pass	Fail	Pass
WINGS	WINGS	26.29%***	Pass	Pass	Pass	Pass	Pass
MLN	Melon Token	25.25%**	Pass	Pass	Pass	Pass	Pass
UTK	Utrust Token	24.96%**	Pass	Pass	Pass	Pass	Pass
BZRX	bZx Protocol Token	24.28%**	Pass	Pass	Pass	Pass	Pass
API3	API3	24.15%***	Pass	Pass	Pass	Pass	Pass
YGG	Yield Guild Games Token	23.39%**	Pass	Pass	Pass	Pass	Pass
BAL	Balancer	22.81%***	N/A	Fail	Pass	N/A	Pass
POE	Po.et	22.67%**	Fail	Pass	Pass	Fail	Pass
KEEP	KEEP Token	21.4%***	Pass	Pass	Pass	Pass	Pass
SSV	SSV Token	19.55%***	Pass	Pass	Pass	Pass	Pass
ARPA	ARPA Token	18.32%**	Pass	Pass	Pass	Fail	Pass
RNDR	Render Token	17.99%**	Pass	Pass	Pass	Pass	Pass
ILV	Illuvium	15.55%**	Pass	Pass	Pass	Pass	Pass
KEY	SelfKey	15.52%***	Fail	Pass	Pass	Fail	Pass
EGLD	Elrond Gold	11.87%**	Pass	Pass	Pass	Pass	Pass
GHST	Aavegotchi GHST Token	10.53%**	Pass	Pass	Pass	Pass	Pass
BNB	BNB	9.51%***	Fail	Pass	Pass	Fail	Pass
NEXO	Nexo	9.09%***	Pass	Pass	Pass	Pass	Pass

*Panel C. Kraken*

Ticker	Name	Excess Return (Day 0)	Cammer Factors				
			Vol.	Analyst	Exchanges	Market Cap.	Event Study
KEEP	KEEP Token	57.86%***	Fail	Pass	Pass	Pass	Pass
RBC	Rubic	53.59%***	Fail	Pass	Pass	Fail	Pass
RARI	Rarible	40.55%***	Pass	Pass	Pass	Pass	Pass
PLA	PlayDapp Token	35.21%***	Pass	Pass	Pass	Pass	Pass
MATIC	Matic Token	32.43%***	Pass	Pass	Pass	Pass	Pass
EGLD	Elrond Gold	18.92%***	Pass	Pass	Pass	Pass	Pass
KIN	Kin	17.58%**	Pass	Pass	Pass	Pass	Pass
OCEAN	Ocean Token	16.21%**	Pass	Pass	Pass	Pass	Pass
XRT	Robonomics	15.8%***	Fail	Pass	Pass	Fail	Pass
LCX	LCX	15.74%**	Fail	Pass	Pass	Pass	Pass
COTI	COTI Token	11.03%***	Pass	Pass	Pass	Pass	Pass
OMG	OMGToken	9.1%***	Pass	Pass	Pass	Pass	Pass

These tables give the full list of listing announcements with Excess Returns on the token listing announcement date (day 0) that are positive and statistically significant at the two-tailed 5% level.

