DOI: 10.1111/fima.12336

ORIGINAL ARTICLE

Financial Management | WILEY

Blockchain speculation or value creation? Evidence from corporate investments

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Abstract

Many corporate executives believe blockchain technology is broadly scalable and will achieve mainstream adoption, yet there is little evidence of significant shareholder value creation associated with corporate adoption of blockchain technology. We collect a broad sample of firms that invest in blockchain technology and examine the stock price reaction to the "first" public revelation of this news. Initial reactions average close to +13% and are followed by reversals over the next 3 months. However, we report a striking difference based on the credibility of the investment. Blockchain investments that are at an advanced stage or are confirmed in subsequent financial statements are associated with higher initial reactions and little or no reversal. The results suggest that credible corporate strategies involving blockchain technology are viewed favorably by investors.

KEYWORDS
bitcoin, blockchain investment, cryptocurrency, investment credibility

"While you usually hear about blockchain technologies that are implemented for cryptocurrencies like Bitcoin, the truth is that enterprise-level blockchain networks are starting to emerge that have a wide range of use cases in the private and public sectors. For example, financial institutions are evaluating blockchain to improve the tracking and tracing of real currencies; transportation and logistics

industries can use it to improve tracking of containers or packages; and regulatory agencies can use it to improve import control efficiency. Blockchain also can free up capital flows, improve efficiencies, reduce costs, and build trust across a broad range of stakeholders and ecosystems."

Frank Yiannas, Vice President of Food Safety for Walmart

1 | INTRODUCTION

A blockchain[1] is a shared ledger of records that is cryptographically secured. The records are grouped into sequential blocks that are each linked to the prior and subsequent block. Blockchains eliminate the need for separate record keeping and can operate without a third party or trust authority. Perhaps the most well-known blockchain is the Bitcoin blockchain, which was introduced in 2008 (see Nakamoto, 2008) to enable secure peer-to-peer financial transactions without using an intermediary. The potential applications of blockchain technology are widespread and include, for example, tracking items through supply chains,[2] maintaining digital records, and streamlining the clearing and settlement process for financial transactions.[3]

Despite the technology's vast potential, to date there is little evidence that corporate blockchain adoption creates lasting shareholder value. In a recent study, Cheng, De Franco, Jiang, and Lin (2019) examine 82 firms that mention "blockchain," "bitcoin," or "cryptocurrency(ies)" in their 8-K disclosures. For 56 firms that lack a significant commitment or meaningful track record in blockchain technology, 8-K disclosures are associated with an initial reaction averaging about +8%, which mostly reverses over the next month. For the remaining 26 firms that make a significant commitment, there is no significant stock price reaction. The authors conclude that investors overreact to speculative blockchain investments due to the Bitcoin price bubble.[4]

Nevertheless, firms are investing significant amounts of capital in blockchain technology. In Deloitte's (2018) global blockchain survey of 1,053 senior corporate executives, 84% of respondents believe that blockchain technology is broadly scalable and will eventually achieve mainstream adoption, and 39% plan to invest $5 million or more in blockchain technology in the coming year.[5] Corporate executives' favorable view of blockchain technology seems inconsistent with the academic literature that shows little evidence of value creation associated with corporate blockchain investments.

We present new evidence that aligns the seemingly conflicting views of investors versus corporate executives. The two key distinctions of our study are that we identify a sample of "initial" news releases that a firm is investing in blockchain technology and we classify these announcements based on their credibility. As we elaborate below, we find significant and sustained increases in shareholder value for credible blockchain investments.

Specifically, we study the stock price reaction in response to the first public announcement that a firm is already using blockchain technology or is considering its potential use. We collect our sample by manually searching Factiva for all articles that mention the term "blockchain," and after several data screens that we elaborate on in Section 2, we identify a final sample of 249 news announcements that reveal an investment in blockchain technology by NYSE- and Nasdaq-listed firms.[6]

[1] See Yiannas (2018).

[2] For instance, in 2018 UPS and Walmart filed blockchain-related patents to track package deliveries, and since 2016 Walmart has been collaborating with IBM (and several other companies) to identify blockchain-based solutions related to food recalls.

[3] For instance, by the end of 2015 Bank of America had filed over 30 blockchain-related patents.

[4] Only 29 of our 249 sample firms have an 8-K that mentions the term "blockchain," "bitcoin," or "cryptocurrency(ies)," and in most of these cases the 8-K is filed after our announcement date, often by several months. Section 3.5 provides a brief discussion of the relation between our analysis and that of Cheng, De Franco, Jiang, and Lin (2019).

[5] The survey is available here: https://www2.deloitte.com/content/dam/Deloitte/cz/Documents/financial-services/cz-2018-deloitte-global-blockchain-survey.pdf.

[6] In Section 3.6, we find similar results using an expanded sample that includes 235 announcements of blockchain investments by over-the-counter (OTC) firms.

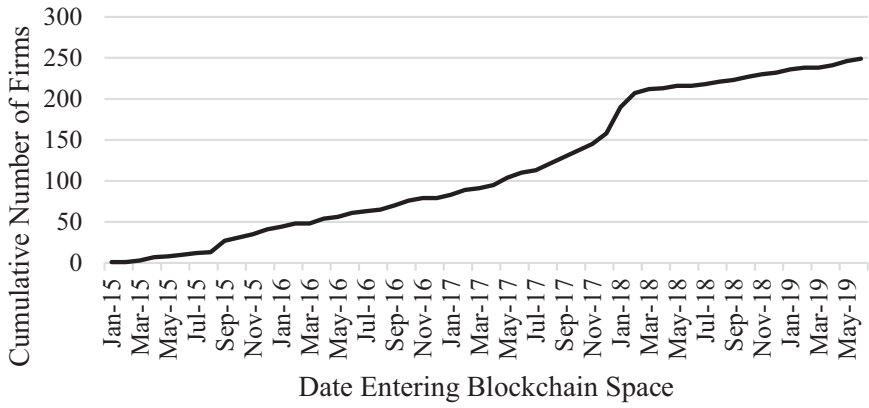

FIGURE 1 This figure presents the cumulative number of exchange-listed firms with initial news coverage of their blockchain investment

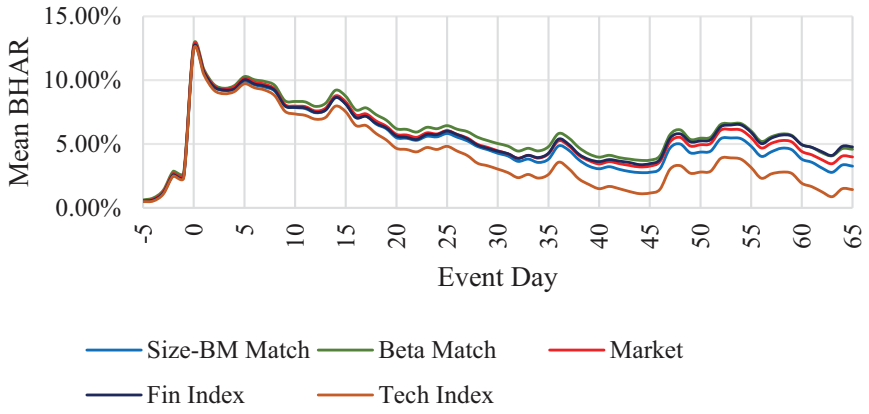

FIGURE 2 This figure presents average buy-and-hold abnormal returns (BHARs) around initial news coverage of corporate blockchain investments based on five benchmarks [Color figure can be viewed at wileyonlinelibrary.com]

In our sample, corporate blockchain investments first appeared during 2015 in the financial sector before spreading across the economy. By the middle of 2019, investing firms are comprised roughly one-third in the financial sector, one-third in the technology sector, and the remainder spread across other sectors. Figure 1 illustrates the rapid growth in the number of exchange-listed firms investing in blockchains.

At the first public announcement of blockchain investments, we observe a favorable stock price reaction of close to +13%, on average, and a substantial return reversal over the next 3 months (see Figure 2). These average effects, however, obscure large differences across announcements based on the credibility of the firm's blockchain investment. We use two proxies for credibility.

First, credible investments are those at an advanced stage in which the firm is currently using or will imminently use an existing or new blockchain for a commercial purpose (i.e., blockchain is or will imminently be integrated into the firm's business operations), as opposed to firms at a preliminary stage such as those currently studying potential applications, involved in initial joint collaborations with other firms, or joining research consortiums to study the technology's potential uses.

Second, credible investments are those in which the firm specifically mentions the term blockchain in its quarterly or annual financial statements (10-Q or 10-K) at the end of the announcement quarter or in the next three quarters.

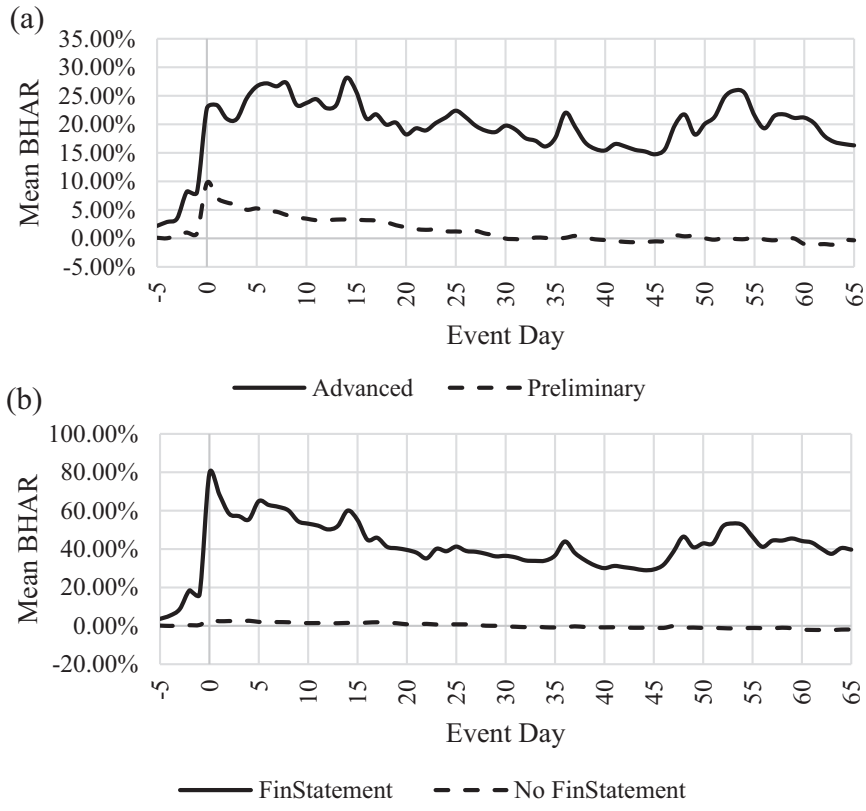

FIGURE 3 **(a)** This figure presents average buy-and-hold abnormal returns (BHARs) around initial news coverage of corporate blockchain investments (based on a Size–BM benchmark) sorted by the stage of the investment. **(b)** This figure presents average buy-and-hold abnormal returns (BHARs) around initial news coverage of corporate blockchain investments (based on a Size–BM benchmark) sorted by whether the firm mentions blockchain in its subsequent 10-Q or 10-K financial statements

This second measure is ex post, as these reports become public on average 4 months after the initial blockchain announcement and therefore do not directly influence the announcement reaction. These measures of credibility reasonably reflect the firm's level of commitment to its blockchain investment.

Figures 3a and 3b illustrate that firms with credible announcements are associated with higher initial stock price reactions and only small return reversals over the next 3 months. Multivariate estimations indicate that credible blockchain investments are associated with significantly higher initial reactions and no significant reversal, after controlling for quarter-fixed effects, firm size, turnover, prior stock performance, lottery-like features including idiosyncratic volatility and skewness, and Bitcoin-related sentiment proxied by the recent price appreciation in Bitcoin. The results imply that investors hold a favorable view of credible investments in blockchain technology, consistent with the optimistic outlook of corporate executives.

Our study adds to the literature on how investors view firms' adoption of new and innovative technologies. For example, Cooper, Dimitrov, and Rau (2001) find that dot com name changes generate striking announcement returns and no subsequent reversal regardless of the firm's level of involvement with the internet. In contrast, Cheng et al. (2019) report that corporate 8-K filings that discuss a firm's blockchain activities are associated with stock price overreactions. Our results occupy an important middle ground, as we demonstrate that the firm's level of commitment matters for long-run value additivity.

Our work also contributes to a rapidly emerging literature on blockchain technology, cryptocurrencies, and initial coin offerings. Several recent studies provide detailed theory and discussion on how blockchains work and the technology's economic and governance-related implications (e.g., Abadi & Brunnermeier, 2019; Bohme, Christin, Edelman, & Moore, 2015; Catalini and Gans, 2019a; Cong & He, 2018; Harvey, 2016; Iansiti & Lakhani, 2017; Malinova and Park, 2017; Raskin & Yermack, 2018; Yermack, 2017; Tapscott and Tapscott, 2018; Cong, He, & Li, 2019; Khapko and Zoican, 2019; Saleh, 2020).

Some other studies examine the asset pricing properties of cryptocurrencies (e.g., Bianchi, 2019; Hu, Parlour, & Rajan, 2018; Liu and Tsyvinsky, 2018; Makarov & Schoar, 2019), initial coin offerings (e.g., Catalini and Gans, 2019b; Cong, Li, and Wang, 2018; Li and Mann, 2020; Sockin and Xiong, 2020), and cryptocurrency mining activities (Cong et al., 2019; Easley, O'Hara, & Basu, 2019; Huberman, Leshno, and Moallemi, 2019). Related to our study, Chen, Wu, and Yang (2019) find that FinTech innovation creates value based on patent filings of seven types of FinTech technology, though blockchain patent filings represent less than 3% of their total sample of filings by U.S. public firms (60 blockchain patent filings from 2,429 total filings across the seven groups).

2 | SAMPLE, VARIABLES, AND DESCRIPTIVE STATISTICS

2.1 | Identifying firms that invest in blockchain technology

We manually assemble a sample of the first announcement of a firm's investment in blockchain technology. We start by identifying all exchange-listed firms that are linked to blockchain technology via news articles. We search the Dow Jones Factiva global news database, which provides access to newspapers, journals, newswires, and company reports from over 36,000 sources. During our search period from October 2008 (the publication month of the original whitepaper for Bitcoin) through June 2019, we find over 74,000 news articles that contain the term "blockchain."

These articles mention a total of 743 NYSE- and Nasdaq-listed stocks (after excluding mutual funds and exchange-traded funds).[7] For each of these firms, we identify the earliest news article that includes the company's name and the term blockchain. We then read each of these articles to determine whether it specifically mentions that the firm is investing in blockchain technology. Of the 743 initial firms, 481 are not associated with a blockchain investment. Common reasons why noninvesting firms are mentioned in articles with the term blockchain include: Blockchain startups hiring former executives of nonblockchain firms; articles containing multiple stories, one of which is about blockchain; articles comparing blockchain to previous technological advances, such as the internet; and articles detailing businesses that could be affected by blockchain technology.[8] Appendix B provides some examples of these articles.

For each of the 262 firms (743 minus 481) that we can link to a blockchain investment, we identify the first article as the announcement/event date. To be included in the final sample, firms must have data available on market capitalization, volume, and prior return, and must have stock return data so we can calculate abnormal returns over several event windows (details are provided below). After imposing these restrictions, the final sample consists of 249 firms. In Section 3.5, we provide supplemental analyses that includes an additional 235 over-the-counter (OTC)-listed firms that invest in blockchain technology.

In an online appendix, we provide the complete list of sample firms and their announcement dates. This list includes our final sample of 249 firms and also contains 453 firms that are mentioned in articles with the term "blockchain" but that are noninvesting firms (28 of the 481 noninvesting firms are excluded after imposing our data restrictions).

[7] Merging on firm name produces a match for 390 companies, and we manually match an additional 353 companies. Our manual search adds observations in which the firm name appears differently on Factiva versus the CRSP database. For example, the name for insurance company Aegon N.V., a member of the final sample, is listed as "Aegon N.V." on Factiva and "AEGON N V" on CRSP.

[8] As one of our placebo tests in Section 3.4, we show that stock price reactions for these noninvesting firms are small and insignificant, as expected.

2.2 | Measures of credibility

We use two measures of the credibility of a blockchain investment. The first is the stage of investment. Based on the content of the news articles, we categorize each firm's blockchain investment as "Advanced" or "Preliminary." *Advanced* ($N = 54$) reflects an advanced investment stage in which the announcement explicitly states the firm is currently using or will imminently use an existing or new blockchain for a commercial purpose (i.e., blockchain is or will imminently be integrated into the firm's business operations). *Preliminary* ($N = 195$) indicates an announcement that is not classified as *Advanced* and therefore reflects a preliminary investment stage in the research and development of blockchain technology. Thus, there is a clear demarcation between groups, as firms in the advanced category are actually using the technology, whereas those in the preliminary category may use the technology in the future, as many preliminary investments involve studying potential applications or joining research consortiums to study the technology's potential uses. Appendix C provides examples of sample firm classifications into *Advanced* or *Preliminary* stage.

The second measure of credibility is a binary indicator based on whether the investing firm mentions the term "blockchain" in its 10-Q or 10-K (*FinStatement*) during the quarter of or the three quarters following the announcement quarter. We manually search 10-Qs and 10-Ks of sample firms and identify 31 firms that mention blockchain in a subsequent financial statement. This classification reasonably signals greater credibility as there is a better likelihood that the company already has or will eventually adopt blockchain technology as part of its business. This measure of credibility is ex post, as the average time between the initial blockchain announcement and the subsequent mention in a 10-Q or 10-K equals 146 calendar days. Thus, these financial statements do not have a direct influence on the announcement reaction. Slightly fewer than half of the observations in the *FinStatement* group (13 of 31) are also classified as *Advanced*, which suggests the two measures of credibility capture different information.

2.3 | Control variables

Our multivariate estimations include several controls. Market capitalization (*MktCap*) equals the stock price multiplied by the number of shares outstanding, measured 6 days prior to the event date. Share turnover (*Turnover*) is the average daily trading volume over the 125 trading days ending 22 days before the event date, scaled by shares outstanding. Prior stock performance (*PriorRet*) equals the market-adjusted stock performance over the 125 trading days ending 22 days before the event date. Book-to-market (*BM*) is the ratio of book equity to market equity measured as of the fiscal quarter ending prior to the event date.

We also control for potentially larger reactions in stocks associated with lottery-type features. Following Kumar (2009), we use idiosyncratic volatility (*Ivol*) and idiosyncratic skewness (*Iskew*) to capture lottery-type features. *Ivol* is the standard deviation of residuals from a market model estimated over the 125 trading days ending 22 days prior to the event day. We use the CRSP value-weighted index as a benchmark and include lead and lag returns to account for nonsynchronous trading (Dimson, 1979). Idiosyncratic skewness (*Iskew*) is the skewness of residuals from these regressions.

Prior studies show that investor sentiment can influence stock trading behavior (e.g., Baker & Wurgler, 2006). Following this lead, we argue that Bitcoin-related sentiment can affect the stock trading behavior related to blockchain-linked stocks. We approximate the degree of Bitcoin-related sentiment with the 1-month return on Bitcoin (*BitcoinReturn*) defined as the percentage change in the price of Bitcoin over the one calendar month ending 6 days prior to the announcement date. We collect closing Bitcoin prices from Bloomberg and restrict the data to U.S. trading days.[9]

The sample contains 79 financial firms defined as those involved in banking, insurance, investing, and financial consulting, and 87 technology firms defined as those involved in technology, communications, and data services. We include binary indicators *Fin* and *Tech* to control for the industry effects related to these announcements.

[9] Our results are qualitatively similar if we use Bitcoin prices collected from coinmetrics.io.

2.4 | Descriptive statistics

Figure 1 illustrates the cumulative number of sample firms by month. The first news article linking a firm to a blockchain investment occurs in January 2015.

In Table 1, Panel A provides descriptive statistics of firm characteristics for the full sample. The average market capitalization of firms associated with blockchain announcements equals about $33 billion, daily share turnover equals 1.56%, market-adjusted stock returns over the prior 125 days average 1.66%, and the BM ratio equals .62. Panels B and C provide statistics partitioned by our two measures of credibility. Firms at an advanced stage of implementing blockchain technology and firms that mention blockchain in their subsequent 10-Q or 10-K are smaller and have higher idiosyncratic volatility in comparison to other firms.

3 | REACTIONS TO CORPORATE BLOCKCHAIN ANNOUNCEMENTS

We estimate the stock price reaction to corporate blockchain announcements using buy-and-hold abnormal returns (BHARs) over windows that capture initial reactions, (−1, +1) and (−5, +5), postannouncement reactions over 1 and 3 months, (+6, +22) and (+6, +65), and combined windows, (−5, +22) and (−5, +65), where day 0 is the event date defined as the date on which the first news article linking the firm to a blockchain investment is published.

BHAR is the firm's return over a specific window minus a benchmark's return over the same window. We use five benchmarks: (a) portfolios matched on size and BM; (b) portfolios matched on beta; (c) the CRSP value-weighted index as a proxy for the overall market; (d) a global financial ETF (iShares IXG); and (e) a global technology ETF (iShares IXN). We choose global financial and technology ETFs because blockchain is a financial technology with global implications.

For size and BM matching, if a firm has both market capitalization and BM data available, we match it to one of the Fama and French's (1992) 25 size and BM portfolios based on the breakpoints used to create the portfolio.[10] If the firm does not have BM data available, we match it to one of the Fama and French's (1992) 10 size portfolios, again based on the breakpoints used to create the portfolios.

To match firms to beta portfolios, for each sample firm we first estimate market betas over a 125 trading-day window ending 22 days prior to the event date using the CRSP value-weighted index as the market return. To account for nonsynchronous trading, we include the market's lead and lag returns (Dimson, 1979). We also estimate market betas over the same period for the entire universe of CRSP firms with at least 22 days of observable returns during the estimation window. We then sort firms into 10 equal-sized and equal-weighted portfolios based on these beta estimations. Similar to the size and BM matching, the beta-matched portfolio is the portfolio to which the sample firm belongs.

3.1 | Full sample

Figure 2 plots the full sample mean BHARs for all benchmarks. The figure shows that the initial reaction to news that firms have invested in blockchain technology is approximately +13% through the event day ($t = 0$). This favorable initial reaction largely reverses over the next 3 months to about +5%.

Table 2 reports BHARs within each event window and tests whether mean and median BHARs are statistically different from zero based on t-tests and sign tests, respectively. Across benchmarks, mean BHARs are about +7% in the 3-day window and about +10% in the 11-day window centered on the announcement date (p-values $< .01$). These favorable reactions partially reverse in the following 1 and 3 months. Compared to means, median BHARs are smaller

[10] We obtain all size and BM portfolio returns and breakpoints from Kenneth French's online data library, which is available at: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

TABLE 1 Summary statistics

Panel A: Full sample								
Group	***N***	***MktCap* (mil $)**	***Turnover* (%)**	***PriorRet* (%)**	***Ivol* (%)**	***Iskew***	***BitcoinReturn* (%)**	***BM***
All	249	33,307	1.561	1.657	2.433	0.359	20.326	0.620
Panel B: Sorted by stage of investment								
Advanced	54	15,439	1.347	7.249	3.125	0.542	24.626	0.428
Preliminary	195	38,256	1.620	0.108	2.242	0.309	19.135	0.676
Adv – Prelim		**−22,817**	−0.273	7.141	**0.883**	0.234	5.491	−0.249
p-value (*Adv – Prelim*)		**(.002)**	(.456)	(.422)	**(.059)**	(.432)	(.373)	(.154)
Panel C: Sorted by *FinStatement*								
FinStatement	31	25,009	3.479	6.052	5.185	1.880	58.580	1.230
No FinStatement	218	34,488	1.288	1.032	2.042	0.143	14.886	0.528
Fin – No Fin		−9,479	2.189	5.020	**3.143**	**1.737**	**43.695**	0.702
p-value (*Fin – No Fin*)		(.536)	(.108)	(.735)	**(.000)**	**(.000)**	**(.000)**	(.236)

Note. This table presents statistics for exchange-listed firms that invest in blockchain technology. The event date is the first public news announcement that a firm has made an investment in blockchain technology. Panel A presents average firm characteristics for the entire sample: Market capitalization (*MktCap*), turnover, Prior return (*PriorRet*), idiosyncratic volatility (*Ivol*), idiosyncratic skewness (*Iskew*), Bitcoin return (*BitcoinReturn*), and book-to-market (*BM*). Panels B and C present average firm characteristics for subsamples partitioned on variables that proxy for credibility: Stage of investment (Stage) and whether there is a mention of blockchain in subsequent 10-Q/10-K financial statements (*FinStatement*), respectively. All variables are defined in Appendix A.

TABLE 2 Reactions to corporate blockchain announcements

		Initial reaction windows				Postreaction windows				Full reaction windows			
		1		2		3		4		5		6	
		(−1 to +1)		(−5 to +5)		(+6 to +22)		(+6 to +65)		(−5 to +22)		(−5 to +65)	
Benchmark	*N*	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Size–BM match	249	**7.381**	**0.302**	**9.887**	−0.083	−0.494	−0.454	−2.776	−2.517	**5.303**	0.241	3.268	−1.931
		(.004)	**(.011)**	**(.002)**	(.612)	(.719)	(.163)	(.104)	(.128)	**(.005)**	(.704)	(.247)	(.205)
Beta match	249	**7.310**	**0.324**	**10.253**	0.528	−0.214	−0.065	−1.856	−1.544	**5.950**	0.346	4.589	−0.225
		(.004)	**(.042)**	**(.002)**	(.375)	(.876)	(.899)	(.275)	(.205)	**(.002)**	(.526)	(.105)	(.899)
CRSP VW index	249	**7.371**	**0.268**	**10.111**	0.405	−0.478	**−0.422**	−2.305	**−2.286**	**5.540**	**−0.163**	3.988	−1.387
		(.004)	**(.076)**	**(.002)**	(.311)	(.730)	**(.076)**	(.175)	**(.031)**	**(.003)**	(.899)	(.160)	(.254)
Global Fin ETF	249	**7.370**	**0.279**	**10.001**	0.332	**−0.519**	**−0.208**	**−1.424**	**−1.339**	**5.398**	0.006	**4.772**	−0.409
		(.004)	**(.008)**	**(.002)**	(.163)	(.711)	(1.000)	(.401)	(.205)	**(.004)**	(1.000)	**(.092)**	(.526)
Global Tech ETF	249	**7.275**	0.298	**9.693**	**−0.147**	**−1.184**	**−1.281**	**−4.416**	**−4.475**	**4.410**	**−1.504**	1.430	**−3.543**
		(.004)	(.375)	**(.003)**	(.612)	(.401)	**(.001)**	**(.010)**	**(.000)**	**(.019)**	**(.042)**	(.613)	**(.000)**

Note. This table reports stock price reactions when firms publicly announce their investment in blockchain technology measured by buy-and-hold abnormal returns (BHARs) using five separate benchmarks. The five benchmarks are as follows: (a) a size- and BM-matched portfolio; (b) a beta-matched portfolio; (c) the CRSP value-weighted index; (d) a global financial ETF (iShares IXG); and (e) a global technology ETF (iShares IXN). For size and BM portfolios, sample firms are matched to either one of the 25 Fama and French's (1992) size–BM portfolios, or one of the 10 Fama and French's (1992) size portfolios if BM is unavailable. All portfolio returns and breakpoints data are obtained from Kenneth French's online data library. For beta-matched portfolios, for each sample firm we estimate market betas over a 125 trading-day window ending 22 days prior to the event date. To account for nonsynchronous trading, we include the market's lead and lag returns (Dimson, 1979). Market betas are also estimated over the same period for the entire universe of CRSP firms with at least 22 days of observable returns during the estimation window. We then sort firms into deciles based on these beta estimations, and the beta-matched portfolio is the decile portfolio to which the sample firm belongs. We require that firms have observable returns for at least half of the trading days in each window. All mean and median BHAR estimates are in percent; *p*-values based on *t*-tests and sign tests are in parentheses below the means and medians, respectively. Bolded estimates are significant at the 10% level or better.

TABLE 3 Mean buy-and-hold abnormal returns partitioned by measures of credibility

Panel A: Sorted by stage of investment				
		Event window		
Group	*N*	(−5 to +5)	(+6 to +65)	(−5 to +65)
Advanced	54	**26.642**	−1.650	16.302
		(.011)	(.745)	(.107)
Preliminary	195	**5.247**	**−3.088**	−0.341
		(.077)	**(.066)**	(.881)
Adv − Prelim		**21.395**	1.438	16.643
		(.047)	(.787)	(.108)
Panel B: Sorted by *FinStatement*				
		Event window		
Group	*N*	(−5 to +5)	(+6 to +65)	(−5 to +65)
FinStatement	31	**64.978**	−2.938	**39.694**
		(.004)	(.789)	**(.051)**
No FinStatement	218	2.053	**−2.753**	−1.911
		(.209)	**(.023)**	(.158)
Fin − No Fin		**62.924**	−0.185	**41.606**
		(.001)	(.987)	**(.042)**

Note. This table reports buy-and-hold abnormal returns (BHARs) within groups sorted by proxies for credibility (*Stage* and *FinStatement*) based on size- and BM-matched portfolios. For size and BM portfolios, sample firms are matched to either one of the 25 Fama and French's (1992) size–BM portfolios, or one of the 10 Fama and French's (1992) size portfolios when BM is unavailable. All mean BHAR estimates are in percent. All sorting variables are defined in Appendix A; *p*-values based on *t*-tests are in parentheses below the means. Bolded estimates are significant at the 10% level or better.

in magnitude implying that BHARs across event firms exhibit positive skewness. For the remainder of the analysis, we use the size–BM-matched portfolios as the benchmark.

3.2 | Partitioned by measures of credibility

Table 3 reports that more credible announcements of blockchain investments are associated with significantly higher immediate reactions and significantly higher reactions over the entire 3-month window. In particular, Panel A shows that firms at an advanced stage of blockchain implementation exhibit a mean BHAR of about 26% (*p*-value = .011) over the 11-day event window, whereas those in a preliminary stage are associated with a BHAR of 5% (*p*-value = .077). Over the entire window (−5, +65), the BHAR for advanced stage investments (16.30%) is greater than that for preliminary investments (−0.34%) by over 16 percentage points, although the difference is not significant at conventional levels (*p*-value = .108).

Similarly, in Panel B firms that mention blockchain in their subsequent financial statements have an average BHAR of 64.98% (*p*-value = .004) compared to an insignificant 2.05% (*p*-value = .209) for those that do not. In the extended window (−5, +65), the difference in BHARs equals roughly 41% (*p*-value = .042). In sum, the univariate evidence is supportive of long-lasting value creation associated with credible corporate investments in blockchain technology.

3.3 | Multivariate analysis

This section presents multivariate OLS estimations that examine the stock price reaction to announcements of corporate investments in blockchain technology, after controlling for various firm attributes and Bitcoin-related sentiment. We model BHARs over three event windows: *BHAR (−5, +5)* to capture the immediate reaction to the news; *BHAR (+6, +65)* to examine the postevent window; and *BHAR (−5, +65)* to assess the net effect of the immediate reaction and subsequent 3 months. Because BHARs exhibit positive skewness, the dependent variable equals 1 plus the natural logarithm of the BHAR over the given window. We include calendar quarter fixed effects and provide *p*-values based on standard errors that are robust to heteroscedasticity.

The key explanatory variables are our two measures of credibility (*Advanced* and *FinStatement*). The control variables include *Log(MktCap)* to account for firm size, *Turnover* to account for stock liquidity, *PriorRet* to capture the firm's prior stock performance, *Log(Ivol)* and *Iskew* to account for lottery-type features, and the recent Bitcoin return (*BitcoinReturn*) to account for Bitcoin-related sentiment. We also include binary indicators for firms in the financial sector (*Fin*) and technology sector (*Tech*) as well as the quarter fixed effects.[11] All variables are defined in Appendix A.

In Models (1) and (2) of Table 4, which present estimations of the initial reaction in the window (−5, +5), *Advanced* and *FinStatement* enter with a significant and positive coefficient, all else equal. This indicates that the immediate reaction is higher for announcements that more credibly signal a blockchain investment. In terms of economic significance, investments that are at an advanced stage and announcements that are followed by a firm's specific mention of blockchain in its subsequent financial statements are associated with initial reactions that are 11.3 percentage points higher and 25.4 percentage points higher, respectively.[12]

Among the controls, the significant predictors of initial reactions are the firm's prior stock performance, idiosyncratic skewness, and the recent return on Bitcoin. The variable *PriorRet* enters with a negative coefficient, indicating that prior stock returns are inversely related to the announcement reaction. This negative relation could reflect the market's anticipation that the firm will invest in blockchain technology. For example, suppose the first news article we find is an announcement by the company that it has already been researching blockchain or previously began implementing the technology into its operations. In this case, the market would partially incorporate the information into prices prior to our specified announcement date. Thus, higher prior returns would be associated with a lower announcement effect. The positive coefficient of *Iskew* is consistent with the idea that lottery-type stocks are associated with higher reactions. Moreover, the positive effect of *BitcoinReturn* implies that reactions are higher for announcements that occur after larger Bitcoin price run-ups.

Models (3) and (4) present estimates for the postevent window, *BHAR (+6, +65)*. The key result is that the coefficient estimates of *Advanced* and *FinStatement* are small and insignificant, showing that despite the larger initial reactions, there is a lack of a more pronounced reversal for more credible announcements. Moreover, the coefficient of *Log(1+BitcoinReturn)* changes sign and has a slightly larger magnitude than in the initial window, indicating that the effect of higher initial reactions due to high Bitcoin returns completely reverses over the next 3 months.

Finally, Models (5) and (6) present estimates for the entire window, *BHAR (−5, +65)*. The coefficients of *Advanced* and *FinStatement* are significantly positive and similar in economic magnitude compared to the initial window. Thus, after controlling for other factors, the more favorable initial stock price effect for credible blockchain announcements is long lasting. The coefficient of *Advanced* is slightly below that in the initial window and the coefficient of *FinStatement* is larger than in the initial window.

[11] We note that including the variable book-to-market as an explanatory variable reduces the sample size from 249 to 196. In unreported specifications that make this restriction, we find no significant effect of book-to-market over any event window.

[12] The percent change in the pre-log-transformed dependent variable is measured as $e^{\beta(X_2 - X_1)} - 1$, where $X_2 - X_1$ refers to the change in the observed value of the explanatory variable. In Model 1 of Table 4, the percent change in 1+ *BHAR (−5, +5)* for moving from a nonadvanced announcement to an advanced announcement is $e^{0.098(1-0)} - 1$, which equals 10.3%. Thus, for the average announcer that has a *BHAR (−5, +5)* of +10%, an increase of 10.3% in the pre-logged dependent variable, 1+ *BHAR (−5, +5)*, equals an economic effect of 11.3 percentage points.

TABLE 4 Multivariate regressions

	Log BHAR (−5, +5)		*Log BHAR (+6, +65)*		*Log BHAR (−5, +65)*	
Variable	**1**	**2**	**3**	**4**	**5**	**6**
Advanced	**0.098**		0.001		**0.106**	
	(.027)		(.977)		**(.037)**	
FinStatement		**0.208**		0.088		**0.310**
		(.015)		(.408)		**(.012)**
Log MktCap	−0.008	−0.007	0.006	0.007	−0.002	0.000
	(.282)	(.292)	(.530)	(.436)	(.868)	(.970)
Turnover	−0.003	−0.005	0.000	−0.001	−0.004	−0.006
	(.635)	(.449)	(.957)	(.950)	(.645)	(.468)
PriorRet	**−0.002**	**−0.001**	0.000	0.000	−0.001	−0.001
	(.002)	**(.001)**	(.715)	(.670)	(.137)	(.196)
Log Ivol	0.052	0.046	**−0.082**	**−0.086**	−0.030	−0.041
	(.138)	(.213)	**(.076)**	**(.071)**	(.539)	(.431)
Iskew	**0.020**	**0.013**	0.000	−0.003	**0.020**	0.010
	(.012)	**(.070)**	(.991)	(.738)	**(.075)**	(.389)
Log BitcoinReturn	**0.218**	**0.171**	**−0.240**	**−0.256**	−0.037	−0.104
	(.006)	**(.015)**	**(.001)**	**(.002)**	(.696)	(.298)
Fin	0.060	0.053	−0.034	−0.031	0.031	0.026
	(.110)	(.153)	(.454)	(.490)	(.528)	(.608)
Tech	0.026	0.028	**−0.095**	**−0.094**	−0.071	−0.067
	(.518)	(.466)	**(.055)**	**(.056)**	(.176)	(.173)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
N	249	249	249	249	249	249
Adj. R^2	.2818	.3143	.155	.1617	.0624	.1212
F-statistic	**3.04**	**3.08**	**2.43**	**2.46**	**1.83**	**1.79**
p-value	**(.002)**	**(.002)**	**(.012)**	**(.012)**	**(.064)**	**(.071)**

Note. This table reports estimates from OLS regressions that explain buy-and-hold abnormal returns (BHARs) around corporate blockchain announcements. The dependent variables are logarithmic one plus BHAR (−5, +5), BHAR (+6, +65), or BHAR (−5, +65), calculated using size and/or BM portfolios as the benchmark. The explanatory variables include proxies for credibility (*Advanced* and *FinStatement*) and several controls. *Log MktCap* is logarithmic *MktCap*, *Log Ivol* is logarithmic *Ivol*, and *Log BitcoinReturn* is logarithmic one plus *BitcoinReturn*. All variables are defined in Appendix A. All regressions include calendar quarter fixed effects, and standard errors are robust to heteroscedasticity; *p*-values are in parentheses below coefficient estimates. Bolded estimates are significant at the 10% level or better.

3.4 | Placebo tests

We conduct four placebo tests to alleviate the concern that the large stock price reactions we report are driven by something other than the announcement of a specific firm's blockchain investment. The first placebo test includes a combined sample consisting of our final sample of 249 blockchain investing firms and an additional 453 firms that are mentioned in a Factiva article with the term "blockchain" but are not associated with an investment in the technology (see Section 2.1 for a discussion of these firms). Our expectation is that the average stock price reaction for this combined sample will weaken substantially due to the inclusion of noninvesting firms. The second placebo test uses

TABLE 5 Placebo tests

Group	*N*	Event window (−5, +5)	Event window (+6, +65)	Event window (−5, +65)
(1) Sample firms and nonblockchain investment firms	702	**4.329%**	−0.842%	2.134%
		(.001)	(.343)	(.120)
(2) Nonblockchain investment firms	453	1.273%	0.224%	1.511%
		(.171)	(.833)	(.302)
(3) Sample firms with randomized event dates	249	0.964%	−1.218%	−0.902%
		(.333)	(.463)	(.641)
(4) Sample firms with event dates 12 months prior to actual dates	249	−0.296%	−1.554%	−1.947%
		(.491)	(.264)	(.167)

Note. This table reports mean buy-and-hold abnormal returns (BHARs) using four placebo groups. BHARs are based on size- and BM-matched portfolios. For size and BM portfolios, sample firms are matched to either one of the 25 Fama and French's (1992) size–BM portfolios, or one of the 10 Fama and French's (1992) size portfolios when BM is unavailable. Group (1) includes the main sample of 249 investing firms and also includes 453 firms that are mentioned in a Factiva article with the term "blockchain" but are not included in our sample of blockchain investing firms because they are not directly connected to a blockchain investment. The additional 453 firms meet the same sample criteria as our final sample of 249 firms. Group (2) includes only the 453 firms that are mentioned in a Factiva article with the term "blockchain" but are not included in our sample of blockchain investing firms because they are not directly connected to a blockchain investment. Group (3) contains the main sample of 249 firms but uses randomized sample-firm and sample-date matches (i.e., each event firm is randomly matched to another firm's event date). Group (4) also includes our main sample of 249 firms but assigns a new event date exactly 12 months earlier than the actual event date; *p*-values based on *t*-tests are in parentheses below the means. Bolded estimates are significant at the 10% level or better.

only the 453 noninvesting firms described above. Our expectation is that these noninvesting firms do not experience a significant price reaction because they are not making a blockchain investment.

The third placebo test contains our main sample of 249 firms but uses randomized sample-firm and sample-date matches (i.e., each event firm is randomly matched to another firm's event date). The goal of this test is to rule out that firms with a potential link to blockchain exhibit a large stock price reaction in response to a news article with the term blockchain. An insignificant reaction would help to rule out this concern.

The final placebo test uses our main sample but assigns a new event date to each firm exactly 12 months earlier than the firm's actual event date to address any potential seasonality effect associated with a firm. The goal of this test is to rule out that our event firms experience extreme daily returns as a norm on a specific day of the year. In unreported tests, we find similar results if we assign a new event date to each announcement firm exactly 6 months prior to the actual announcement date.

Table 5 presents the results. In the combined sample of investing and noninvesting firms (Group 1), the average 11-day reaction, BHAR (−5, +5), equals 4.33% and is statistically significant at the 1% level. This reaction is substantially smaller in magnitude than that reported in Table 2 for our main sample (9.89%), suggesting that noninvesting firms do not generate large price changes. In the next three placebo tests, average values of BHAR (−5, +5) are 1.27%, 0.96%, and −0.30%, respectively, all of which are statistically insignificant with *p*-values of .17, .33, and .49. Further, average BHARs over the extended windows are similarly small and insignificant. This evidence suggests that the large reactions we report in our main tests are due to the unique pairing of our sample firms with their blockchain investment dates. The key takeaway from these placebo tests is that our main results likely arise from a specific firm's blockchain investment as opposed to some spurious effect.

TABLE 6 Expanded analysis with over-the-counter (OTC) firms

Panel A: Summary statistics for OTC firms							
Group	*N*	*MktCap* (mil $)	*Turnover* (%)	*PriorRet* (%)	*Ivol* (%)	*Iskew*	*BitcoinReturn* (%)
All	235	14,564	0.092	5.073	5.795	0.599	22.833
Sorted by stage of investment							
Advanced	73	3,687	0.087	22.628	7.664	0.975	28.285
Preliminary	162	19,465	0.095	−2.838	4.952	0.430	20.377
Adv − Prelim		**−15,778**	−0.008	25.467	**2.711**	**0.545**	7.908
p-value (*Adv − Prelim*)		**(.000)**	(.804)	(.153)	**(.006)**	**(.071)**	(.259)
Sorted by *FinStatement*							
FinStatement	25	24.004	0.308	22.485	11.041	1.657	52.245
No FinStatement	210	16,295	0.066	3.000	5.170	0.473	19.332
Fin − No Fin		**−16,271**	**0.241**	19.485	**5.871**	**1.184**	**32.913**
p-value (*Fin − No Fin*)		**(.000)**	**(.057)**	(.611)	**(.001)**	**(.027)**	**(.006)**

Panel B: Stock price reactions for OTC firms				
		Event window		
Group	*N*	(−5 to +5)	(+6 to +65)	(−5 to +65)
All	235	**35.038**	−5.210	**12.134**
		(.001)	(.133)	**(.021)**
By stage				
Advanced	73	**64.935**	−5.551	**19.290**
		(.031)	(.469)	**(.071)**
Preliminary	162	**21.566**	−5.056	8.909
		(.000)	(.171)	(.136)
Adv − Prelim		43.369	−0.495	10.381
		(.154)	(.954)	(.392)
By *FinStatement*				
FinStatement	25	**73.997**	−9.374	29.820
		(.010)	(.513)	(.156)
No FinStatement	210	**30.401**	−4.714	**10.028**
		(.001)	(.180)	**(.062)**
Fin − No Fin		43.596	−4.661	19.792
		(.135)	(.751)	(.356)

Panel C: Stock price reactions for a combined sample of exchange-listed and OTC firms				
		Event window		
Group	*N*	(−5 to +5)	(+6 to +65)	(−5 to +65)
All	484	**22.099**	**−3.958**	**7.573**
		(.000)	**(.037)**	**(.010)**

(Continues)

TABLE 6 (Continued)

Panel C: Stock price reactions for a combined sample of exchange-listed and OTC firms				
		Event window		
Group	*N*	(−5 to +5)	(+6 to +65)	(−5 to +65)
By stage				
Advanced	127	**48.653**	−3.892	**18.019**
		(.006)	(.425)	**(.016)**
Preliminary	357	**12.653**	**−3.981**	3.592
		(.000)	**(.037)**	(.196)
Adv – Prelim		**36.001**	0.089	**14.427**
		(.045)	(.987)	**(.076)**
By *FinStatement*				
FinStatement	56	**69.004**	−5.812	**35.286**
		(.000)	(.504)	**(.015)**
No FinStatement	428	**15.962**	**−3.715**	3.947
		(.003)	**(.042)**	(.148)
Fin — No Fin		**53.042**	−2.096	**31.339**
		(.003)	(.813)	**(.032)**

Note. This table reports summary statistics and buy-and-hold abnormal returns (BHARs) including over-the-counter (OTC) firms based on size- and BM-matched portfolios. For size and BM portfolios, sample firms are matched to either one of the 25 Fama and French's (1992) size–BM portfolios, or one of the 10 Fama and French's (1992) size portfolios when BM is unavailable. Panel A presents summary statistics; Panels B and C present BHARs for the sample of OTC firms and for the combined sample of exchange-listed and OTC firms, respectively. All mean BHAR estimates are in percent. All sorting variables are defined in Appendix A; *p*-values based on *t*-tests are in parentheses below the means. Bolded estimates are significant at the 10% level or better.

3.5 | Discussion

Our finding that credible blockchain announcements have a lasting stock price effect appears to differ from the result of Cheng et al. (2019). They find that 8-K filings that mention "blockchain," "bitcoin," or "cryptocurrency(ies)" are associated with no significant value creation over an extended window from 3 days prior to the filing through 30 days after the filing. We hypothesize that the different results are caused at least in part by the news announcements of blockchain investments that precede the 8-K filings and therefore diminish the information content of the actual 8-K filing. To test this hypothesis, we identify 29 firms among our sample of 249 blockchain announcements that have also filed an 8-K disclosure that contains the term "blockchain," "bitcoin," or "cryptocurrency(ies)." We find that our news announcement date occurs an average of 93 calendar days before the 8-K filing date.

For these 29 firms, using our news announcement date the average BHAR (−5, +5) equals 69.3% (*p*-value = .004) and the average BHAR (−5, +65) equals 42.1% (*p*-value = .05). In contrast, on the 8-K filing date, the average BHAR (−5, +5) equals 24.2% (*p*-value = .06) and the average BHAR (−5, +65) equals 36.1% (*p*-value = .15). Thus, for the sample with both a news announcement and an 8-K filing, the average reaction to the 8-K filing is substantially lower than the reaction to the often earlier blockchain news announcement despite some overlap in the windows surrounding the 8-K filings and our announcement dates.

The evidence supports our conjecture that the first public news announcements of blockchain investments tend to occur earlier than the 8-K filings and thus are associated with more positive stock price reactions. However, we are

hesitant to generalize this result as it is based on 12% of our sample firms (29 of 249) that overlap with the sample of Cheng et al. (2019).

3.6 | Including OTC-listed firms

As an out-of-sample test, we construct a sample of blockchain investments by OTC firms using the same data collection process as for the main sample. During October 2008 through June 2019, we identify 701 unique OTC firms that are mentioned in an article on Factiva that also contains the term blockchain. After reading through these articles, we identify 440 firms that are linked to a blockchain investment. We require that the stock has a price of at least $0.01 and market capitalization of at least $1 million, resulting in a final OTC sample of 235 firms. In Table 6, Panel A presents summary statistics for the OTC firms. The average OTC firm is substantially smaller (*MktCap* = $14,564 million), less liquid (*Volume* = 0.09%), and more volatile (*Ivol* = 5.79%) than the average exchange-listed firm.[13]

We calculate BHARs using daily returns as the percent change in the bid–ask midpoint to account for nonsynchronous trading. Table 6 presents BHARs for the OTC sample (Panel B) and the combined sample of 484 firms (Panel C). The results are generally consistent with those reported for the main sample. In the combined sample, more credible blockchain announcements have more favorable initial reactions and no significant reversals.

The key findings for OTC firms and the combined sample of exchange-listed and OTC firms are consistent with the main results in the paper. Across samples, blockchain investments are viewed more favorably by investors when the announcements are credible.

4 | CONCLUSION

Many corporate executives believe blockchain technology offers enormous potential for value creation, and they are spending significant capital on blockchain investments. Thus, it is important to understand whether investors agree about the potential value of this technology. Chen et al. (2019) show that broad fintech adoptions tend to be accompanied with positive value creations in stock markets. In a recent paper, however, Cheng et al. (2019) find no evidence of lasting value creation in firms that mention their blockchain plans in their 8-K filings.

Our analysis of stock price reactions to corporate blockchain investments differs from Cheng et al. (2019) in two key ways. First, we collect a comprehensive sample of the initial public announcement of corporate blockchain investments. To the extent that investors believe a firm's use of blockchain technology will create value, they should capitalize the news when it first becomes known. Second, we identify credible investments defined as those at an advanced stage and/or mentioned in the firm's subsequent 10-Q or 10-K financial statements.

Our multivariate estimations show that announcements of credible blockchain investments are associated with significantly higher announcement reactions and no subsequent reversal. These estimations control for firm size, liquidity, prior returns, idiosyncratic volatility and skewness, and the recent performance of Bitcoin. Overall, the findings suggest that investors view this disruptive new technology as value enhancing when the firm's blockchain plans are credible.

ACKNOWLEDGMENTS

We thank seminar participants at Florida State University, Hofstra University, Stony Brook University, Southwest Jiaotong University, the Dilip Shome Memorial Conference at Virginia Tech, the 2019 Block Summit Series 2, and the 2019 FMA meeting for helpful comments. Danling Jiang acknowledges financial support from the National Science Foundation of China (NSFC) (Grant #91746109).

[13] The characteristics for firms listed on OTC Markets are consistent with prior literature (Ang, Shtauber, & Tetlock, 2013; Bruggemann, Kaul, Leuz, & Werner, 2018).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Autore DM, Clarke N, Jiang D. Blockchain speculation or value creation? Evidence from corporate investments. *Financial Management*. 2021;50:727–746. https://doi.org/10.1111/fima.12336

APPENDIX A: VARIABLE DEFINITIONS

Our data sources include CRSP, Compustat, and OTC Markets datasets from WRDS, as well as Factiva, Bloomberg, and Kenneth French's online data library.

A1. | Measures of abnormal stock returns

BHAR (−n, +m): The buy-and-hold abnormal stock return over days *−n* through *+m*, calculated as the buy-and-hold return on the stock minus the buy-and-hold return on a portfolio matched on size and book-to-market. Specifically, if a firm has both market capitalization and book-to-market data available, it is matched to one of the Fama and French's (1992) 25 size and book-to-market portfolios based on the same breakpoints used to create the portfolios. If a firm has only market capitalization data available, it is matched to one of the Fama and French's (1992) 10 size portfolios based on the same breakpoints used to create the portfolios.

A2. | Measures of credibility

Advanced: An announcement that explicitly states the firm is currently using or will imminently use an existing or new blockchain for a commercial purpose (i.e., blockchain is or will imminently be integrated into the firm's business operations).

Preliminary: An announcement that is not classified as *Advanced* and therefore reflects a preliminary investment stage in the research and development of blockchain technology.

FinStatement: An announcement in which the subject firm includes the word blockchain in a subsequent quarterly or annual financial statement (10-Q or 10-K) filed at the end of the announcement quarter or in the next three quarters.

A.3. | Control variables

BitcoinReturn: The percentage change in the price of Bitcoin over the one calendar month ending 6 days prior to the event date.

BM: The ratio of book equity to market equity measured as of the fiscal quarter ending prior to the event date.

Fin: An indicator variable that is set to 1 if the firm is involved in banking, insurance, investing, and financial consulting.

Iskew: Idiosyncratic skewness, measured as the skewness of residuals from a market model estimated over the 125 trading days ending on 22 days prior to the event date; the benchmark is the CRSP value-weighted index and lead and lag returns are included to account for nonsynchronous trading (Dimson, 1979).

Ivol: Idiosyncratic volatility, measured as the standard deviation of residuals from a market model estimated over the 125 trading days ending 22 days prior to the event date; the benchmark is the CRSP value-weighted index and lead and lag returns are included to account for nonsynchronous trading (Dimson, 1979).

MktCap: Market capitalization, measured as the stock price multiplied by the number of shares outstanding, measured 6 days prior to the event date.

PriorRet: Prior return, measured as the percentage return net of the corresponding return on the CRSP value-weighted index measured over the 125 trading days ending 22 days prior to the event date.

Tech: An indicator variable that is set to 1 if the firm is involved in technology, communications, and data services.

Turnover: The average daily trading volume measured over the 125 trading days ending 22 days prior to the event date, as a percentage of shares outstanding measured 22 days prior to the event date; if daily volume is missing, we set it equal to 0.

APPENDIX B: EXAMPLES OF FIRMS MENTIONED IN BLOCKCHAIN INVESTMENT ARTICLES BUT NOT INCLUDED IN OUR SAMPLE

This appendix presents three examples of Factiva articles in which firms are mentioned with the key phrase "blockchain" but are not included in our sample of blockchain technology investments because they are not directly connected to a blockchain investment.

Example 1:

Companies: Costco Wholesale Corporation (NASDAQ: COST); Walmart Inc. (NYSE: WMT)

Article date: September 10, 2015

Source: American Banker ("Morning Scan" article)

Excerpt 1: "Citigroup's Citi Ventures, Capital One Financial, Visa and Fiserv are among the financial services companies that have invested in the Bitcoin startup Chain Inc.…they view the *blockchain* technology as a possible way to replace the inefficient methods they now use to verify transactions."

Excerpt 2: "American Express lost Costco, but won Sam's Club. The warehouse retailer, the biggest rival to Costco, has said it will start accepting Amex cards on Oct. 1. Unlike Amex's deal with *Costco*, the Sam's Club agreement is not exclusive. But it's a welcome shot of good news for Amex, as Sam's Club, owned by *Walmart*, is a major retailer, with about 650 stores. That's just a little bit less than Costco's 680 stores."

Example 2:

Companies: PayPal Holdings, Inc. (NASDAQ: PYPL); eBay Inc. (NASDAQ: EBAY); Amazon.com, Inc. (NASDAQ: AMZN); Groupon, Inc. (NASDAQ: GRPN)

Article date: February 3, 2016

Source: Institutional Asset Manager

Excerpt: "Elliptic, a *blockchain* intelligence company, has announced its Board of Advisors—David Harris, Martine Niejadlik, Richard Brown, and Nadav Rosenberg…Prior to her time at Coinbase, Martine ran risk management teams at *PayPal*, *eBay*, and *Amazon*, and was a lead developer of the FICO score…Rosenberg's success as Managing Director of Europe Operations at Taboola.com, and as a senior executive and Regional Director *Groupon* UK & IR translates to invaluable experience in corporate and business development strategy; especially in fast-growing technology companies."

Example 3:

Companies: Palo Alto Networks, Inc. (NYSE: PANW); Fortinet, Inc. (NASDAQ: FTNT); Okta, Inc. (NASDAQ: OKTA); CyberArk Software Ltd. (NASDAQ: CYBR)

Article date: February 3, 2016

Source: Investor's Business Daily

Excerpt: "*Palo Alto Networks* (PANW), *Fortinet* (FTNT), *Okta* (OKTA), and *CyberArk Software* (CYBR) are among the network security firms that could prosper from utilizing blockchain technology, an analyst said Friday."

APPENDIX C: ANNOUNCEMENT CLASSIFICATION EXAMPLES

This appendix presents examples of initial news coverage of corporate investments in blockchain technology and our classification of sample investment announcements into *Advanced* (current and imminent use) and *Preliminary* stages of investment.

C1. | Examples of *Advanced* stage

C.1.1. | Current use of blockchain

Company: Xinyuan Real Estate Co., Ltd. (NYSE: XIN)

Article date: July 18, 2016

Source: PR Newswire

Excerpt: "Xinyuan Real Estate Co., Ltd…today announced that its new blockchain-powered real estate technology platform was released at the 1st China Financial Technology Conference held in Beijing in the second week of July….the company expects that the platform will be able to support various types of applications, including consumer finance, investment, and financing as well as industrial finance, by connecting investment and financing institutions, credit bureaus, and merchants."

C.1.2. | Imminent use of blockchain

Company: Chanticleer Holdings (NASDAQ: BURG)

Article date: January 2, 2018

Source: CNN

Excerpt: "Chanticleer Holdings, the owner of a number of burger restaurants including some Hooters restaurants, said on Tuesday it will begin offering its customer rewards program on blockchain technology. Customers can generate rewards by eating at any of the company's restaurants and use the rewards for future burger purchases, or trade with other people."

C.2. | Examples of *Preliminary* stage

Example 1:

Company: International Business Machines (NYSE: IBM)

Article date: March 13, 2015

Source: Benzinga

Excerpt: "An unidentified source told Reuters on Thursday that [International Business Machines] was working together with the Federal Reserve to explore the use of blockchain to facilitate cross-border cash payments…If realized, the system would cut down on transaction costs and make international payments easier and more streamlined."

Example 2:

Companies: McCormick & Co., Inc. (NYSE: MKC); The Kroger Co. (NYSE: KR); Tyson Foods, Inc. (NYSE: TSN); Unilever (NYSE: UN)

Article date: August 22, 2017

Source: PR Newswire

Excerpt: "A group of leading companies across the global food supply chain today announced a major blockchain collaboration with IBM intended to further strengthen consumer confidence in the global food system. The consortium, which includes…Kroger, McCormick and Company, Tyson Foods, Unilever…will work with IBM to identify new areas where the global supply chain can benefit from blockchain."