Initial Coin Offerings, Blockchain Technology, and White Paper Disclosures♠

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Abstract

We examine voluntary disclosures made by issuers of initial coin offerings (ICOs) in their "white papers" and use them to rate the blockchain technology being developed by the ICO issuers. First, we find that most ICOs receive a low rating. In fact, over 80% of the ICOs do not need to use a blockchain. Second, ICO projects with a higher rating raised more funds than their counterparts, after controlling for other project-, issuer-, and token-related features. Third, ICOs with a high rating are more likely to have their digital coins/tokens listed on a cryptocurrency exchange within 180 days after their ICO end dates. Finally, results indicate that providing technical details in the white paper can be an effective way to signal the quality of an ICO project. Overall, these results are consistent with ICO token buyers/investors taking into consideration the underlying blockchain technology of the ICO projects when making their purchasing/investing decisions. Since the white paper is the main source of ICO information, our findings imply that the credibility of this information is important to protect the interests of ICO buyers/investors and to ensure the long-term viability of the ICO as a capital-raising tool for blockchain-based ventures.

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1. Introduction

In this study, we examine disclosures voluntarily provided by issuers of initial coin offerings (ICOs), especially information about the ventures' blockchain technology. In a typical ICO, the issuer uses blockchain technology to create a new cryptocurrency, which may or may not be associated with the product or service provided on the blockchain, and sells the new digital tokens (or coins) to the backers of the ICO project. We focus on blockchain technology, because it is a unique feature of all ICOs. We develop a rating scheme based on two factors that we believe are important in assessing the blockchain technology behind an ICO project: whether the project needs to use a blockchain, and whether the issuer provides technical details on its blockchain technology. We then use our self-constructed ratings to investigate whether ICO issuers use "blockchain" to hype their projects and to shed light on the functioning of the unregulated ICO market, as captured by the total amount of funds raised and the post-ICO listing of the coins/tokens in a cryptocurrency exchange.

ICOs have provided an innovative means for entrepreneurs to raise capital for their blockchain-based ventures, for consumers to acquire rights to products or services that are still under development, and for investors to get access to a new class of investment assets. The surge in the popularity of ICOs can be attributed to the astronomical rise in the price of Bitcoin in 2017, which has attracted investors to the cryptocurrency market, as well as to the ease of creating new crypto tokens using an existing blockchain platform (e.g., Ethereum or Waves). Since ICOs are a relatively new phenomenon, regulators around the world are debating the appropriate legal framework for them. This is because the tokens sold at ICOs only give the buyers the right to the products or services being developed by the ventures, not an equity stake in the ICO issuers. Therefore, the tokens may not be considered securities under the law in many

jurisdictions. While China and South Korea banned trading of cryptocurrencies in September 2017, several jurisdictions have embraced blockchain as an innovation and heavily promoted themselves as the ideal venues for blockchain-based ventures.[1]

On the one hand, ICOs are not regulated in most jurisdictions and, therefore, misconduct is a major concern.[2] Indeed, the U.S. Securities and Exchange Commission (SEC) has pursued enforcement actions against ICO-related fraud and even created a fake ICO to educate investors on ICO scams.[3] On the other hand, ICO issuers face a severe information asymmetry problem, because they are pre-revenue startups and some are still in the idea stage. As a result, it is difficult for ICO issuers to credibly communicate their potentials to prospective investors. If the issuers do nothing to mitigate this information gap, it will impede their ability to raise the funds required to launch the projects beyond the idea stage.

To mitigate this information gap, most ICO issuers voluntarily use a "white paper" to provide information about their ventures (such as their business plan, blockchain platform design, founding team background, token distribution, anticipated use of funds, milestones, etc.). Since white papers are not subject to regulatory scrutiny, their content varies by issuer, and some issuers may use them to hype their ICOs. If investors do not trust the information disclosed in the white papers, they will price-protect themselves or stay away from ICOs altogether. If ICO token buyers/investors rely on white paper information in making their decisions, the reliability of the information is important for protecting their interests. Hence, the effective functioning of the

[1] Malta passed a regulatory framework to attract foreign investment in blockchain technologies, while Switzerland designated one canton as a "Crypto Valley" (https://money.cnn.com/2018/07/18/technology/startups/malta-blockchain/index.html). The Monetary Authority of Singapore has issued a guide to ICOs (http://www.mas.gov.sg/News-and-Publications/Monographs-and-Information-Papers/2017/Guidance-on-Digital-Token-Offerings.aspx).
[2] See https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11.
[3] See https://www.sec.gov/spotlight/cybersecurity-enforcement-actions and https://www.sec.gov/news/press-release/2018-88.

ICO market relies on the credibility of white paper disclosures. In the absence of regulatory oversight, there is no assurance that the information disclosed in ICO white papers are reliable. Hence, it is an empirical question whether prospective token buyers/investors use the white paper information in making purchase/investment decisions.

In this study, we shed light on this question by investigating whether the information disclosed in ICO white papers helps investors distinguish ICOs that actually leverage blockchain technology from those that do not actually need to use a blockchain. To the extent that token buyers/investors value blockchain-based ventures and use white paper information to assess the underlying blockchain technology, ICOs with higher ratings will raise more funds and be listed on virtual exchanges faster than those with lower ratings. We note that we assign the rating for each ICO using the information from the white paper, and the rating is not intended to capture the reliability of the white paper disclosures. Hence, if we find that the rating has insignificant explanatory power for the amount of funds raised during the ICO period, it will be consistent with either investors not finding the blockchain information relevant, or investors ignoring the information due to lack of credibility. On the other hand, a significant finding will be consistent with investors finding the information relevant regardless of its reliability, or with investors being fixated on the information.

We focus on white paper disclosures in this study, because they are the most common means for ICO issuers to communicate with prospective buyers/investors. While some ICO issuers post their source codes on GitHub, most have not launched their platforms and, hence, their source codes are either not available or still very preliminary.[4] As a result, prospective

[4] Several prior studies have used the availability of source codes on GitHub as a proxy for the transparency of the ICOs (e.g., Adhami et al. 2018, Amsden and Schweizer 2018, Howell et al. 2018, Boureau et al. 2018). For the reasons stated in the text, we do not use it as a transparency proxy because it also reflects how far along the blockchain-based project is in the development stage.

investors cannot use the source codes to verify the credibility of the white paper disclosures. Indeed, Cohney, Hoffman, Sklaroff and Wishnick (2018) find that the source codes of many of the top-50 ICOs did not include three specific governance attributes (i.e., token supply, vesting, and modifiability) discussed in the white papers and other marketing materials.

To examine our research questions, we select a stratified random sample of 355 ICOs from 1,583 ICOs with available white papers during the period January 2016 through June 2018. First, we test the explanatory power of our blockchain rating and other white paper disclosures on the amount of funds raised during the ICO period, using both a Tobit model and a Heckman two-stage procedure to account for the fact that many ICOs failed to raise the minimum funding target and, hence, we set the missing amount raised to zero. Second, we use the Cox proportional hazards model to examine whether our ICO rating and other white paper information increase an ICO's hazard rate for listing success, which is defined as the success of the ICO issuer to have the new tokens listed in a cryptocurrency exchange within 180 days after the ICO end date. We also investigate listing success using a Probit model to test whether or not an issuer had its tokens listed on a cryptocurrency exchange within 180 days after the ICO end date.

We document the following four key results. First, we find that over 80% of the ICOs do not actually need to use a blockchain. In fact, only 55 out of the 355 ICOs in our sample have their digital tokens as an integral part of their products/services provided by their blockchain platforms. Of the remaining ICOs, 200 provide products/services not directly tied to their blockchains, and 100 do not disclose enough information on what their digital tokens can buy or the tokens are sold just to raise money. This result lends support to the suspicion that many ICOs

are using "blockchain" as a hype to attract investors.[5] Univariate statistics show that ICOs that do not need a blockchain raised less money than other ICOs, indicating that token investors/buyers take into consideration the blockchain technology being used by the ICOs. Notwithstanding, 49% of these ICOs were successful in raising an average of $6.1 million. To the extent that these ICOs used "blockchain" as a hype, their token buyers/investors could suffer potential losses.

Second, the Tobit regressions show that our self-constructed ICO rating is positively associated with the likelihood of having a non-zero amount raised, as well as the amount raised for the ICOs with non-zero amount raised. The Heckman two-stage procedure produces similar results. These findings are consistent with ICO token buyers/investors considering the extent to which the blockchain technology is incorporated into ICO projects when making their purchasing/investing decisions. Third, the duration analysis finds no evidence that the ICO rating or other white paper information disclosures is related to the probability of ICO listing success. However, the Probit regression results show that our ICO rating exhibits significant explanatory power for whether or not an issuer had its tokens listed on a cryptocurrency exchange within 180 days. Taken together, these results suggest that token buyers/investors (cryptocurrency exchanges) use white paper information or information correlated with that in the white papers to make buying/investing (listing) decisions.

Finally, we find that the amount of technical details provided in the white paper significantly impacts the effect our blockchain rating has on the amount of funds raised at ICOs. In particular, for ICOs with a high blockchain rating, having technical discussion in the white paper is positively associated with the amount of funds raised. However, the same is not true for

[5] Cheng, De Franco, Jiang, and Lin (2019) document that investors overreact to public firms' speculative disclosures of a potential involvement in blockchain technology, which is also consistent with these firms using "blockchain" as a hype.

ICOs with the lowest blockchain rating. These findings suggest that providing technical details can be an effective way for high quality ICO projects to credibly signal their quality. This is probably the case because ICO token buyers/investors assume that it requires founding teams with the appropriate technical knowledge to prepare the information, or because ICO projects with technical details are likely to be better developed.

This study contributes to two strands of literature. First, we add to the emerging ICO literature that examines various project-, issuer-, and token-related characteristics as ways to shed light on ICO success, for example, as captured by first-day raw and abnormal returns, post-ICO token performance, total amount raised, exchange listing, liquidity, volatility, and crash risk (Adhami et al. 2018, Momtaz 2018, Benedetti and Kostovetsky 2018, Amsden and Schweizer 2018, Howell et al. 2018, and Bourveau et al. 2018). Unlike these studies, we put emphasis on the blockchain technology employed by the ICO ventures and develop a rating scheme for it, while controlling for the disclosures of other ICO characteristics. Our rating scheme allows us to distinguish ICOs that need to use a blockchain from those that do not, and the extent to which blockchain technology is incorporated into the ICO projects. To the best of our knowledge, this is the first study to rate blockchain technology used by ICO issuers in a large sample analysis. Our rating scheme is partly based on the analysis of Wust and Gervais (2018), which provides several cases as examples. While both ICOBench.com and ICOData.com provide ICO ratings, they do not focus on blockchain technology and they continue to update their ratings even after the end of the ICO period, making their ratings unsuitable for our purposes.[6]

[6] ICOBench's expert ratings and ICO analyzer bot (Benchy) ratings are updated continuously even after the ICOs are completed. First, we find that many of the ICOBench expert assessments are dated after the ICO end dates. Second, ICOBench staff indicated to us in email exchanges that their ICO profiles and social media activity statistics, which are also included in the calculation of the Benchy rating, are updated every five to six hours. Hence, the use of ICOBench's expert and/or Benchy ratings could induce spurious results if they are generated after the dependent variables are computed. For example, an expert may provide an optimistic rating or social media activities may pick up after an ICO has successfully raised more funds than expected. If we include the ICOBench

This study is also different from these prior studies in that we do not restrict our sample to ICOs with the amount of funds raised non-missing. In general, it is in the interest of the ICO teams to announce successful fund-raising campaigns. Hence, if we cannot find the amount raised for an ICO after an extensive search, we set it to zero. That is, the fact that ICOs have missing information on amount raised is indicative of their failure to raise sufficient funds. Excluding these ICOs would substantially bias the estimation, especially given the fact that many ICOs have amount raised data missing. To account for the censoring of the dependent variable, we use both a Tobit model and the Heckman two-step procedure for this analysis. Similarly, we examine listing on cryptocurrency exchanges using both a Cox proportional harzards and a Probit models, assuming that an ICO failed if it took its issuer more than 180 days to have the tokens listed on a cryptocurrency exchange due to its failure to meet listing requirements.[7]

Second, we contribute to the voluntary disclosure literature on capital-raising activities and shed light on the regulatory debate over ICOs. Prior research shows that companies have incentives to provide information voluntarily to reduce information asymmetry, both in general (Healy and Palepu 2001; Botosan and Plumlee 2002; Lamber, Leuz, and Verrecchia 2007; Leuz and Wysocki 2016) and during equity offerings (Frankel, McNichols and Wilson 1995; Lang and Lundholm 2000; Leone, Rock, and Willenborg 2007). The ICO setting is similar to peer-to-peer lending (Michels 2012) and crowdfunding (Cascino, Correia and Tamayo 2018; Madsen and McMullin 2018) in that they are not subject to securities regulations.[8] Our finding that information collected from ICO white papers, especially that on blockchain technology, is associated with the amount raised is consistent with investors being able to distinguish ICOs that

expert and/or Benchy ratings into our regressions, they will be highly significant, as documented by Momtaz (2018) and Bourveau et al. (2018) in some of their empirical tests.

[7] We note that Benedetti and Kostovetsky (2018) also consider sample selection issue using the Heckman procedure.

[8] Reward crowdfunding is potentially subject to consumer protection regulation.

need a blockchain versus those that do not. Given that ICO issuers voluntarily provide the white papers, they use white papers as a medium to reduce the information gap between them and their potential investors. The finding that token buyers/investors rely on the information disclosed or the information correlated with that disclosed in the white papers indicates that the reliability of the information is important for protecting the interests of ICO buyers/investors and for ensuring well-functioning ICO and cryptocurrency markets (Leuz and Wysocki 2016). It implies that securities regulators should consider regulating ICO white papers and/or the ICO community should self-regulate by providing guidelines for white paper disclosures.[9]

Section 2 provides institutional background on blockchains and ICOs. Section 3 describes the data and sample, while section 4 presents the ICO rating methodology. Section 5 reports the empirical findings. Section 6 concludes.

2. Background

2.1. Blockchain and Cryptocurrencies

A blockchain is a digital distributed ledger, which is used to store transaction records or self-executing codes in blocks that are shared across a network of computers (or "nodes") running an open-source software (Narayanan et al. 2016). Each block is cryptographically secured and linked to the previous block by containing the hash value of the previous block. To add a new block to the chain, a node must solve computationally intensive cryptographical problems (the "proof-of-work" or "mining" system).[10] If the node successfully adds the block to

[9] There are examples of these initiatives. The Canadian Securities Exchange, an alternative stock exchange, launched a blockchain-based platform for companies to issue security token offerings (STOs). While similar to ICOs, STOs are subject to all applicable securities regulations. Harbor.com and iComplyICO.com offer one-stop service to help ICO issuers comply with all securities regulations and monitor ongoing compliance.
[10] "Proof-of-stake" is an alternative system that relies on the "wealth" rather than the computing power of the node.

the chain, it will receive coins or tokens native to the blockchain. If the content of a block is altered (intentionally by the node owner or by hackers) in one of the nodes on the network, the hash value associated with the block will change and so do the hashes of all the subsequent blocks on the chain. Any discrepancies in the copies of the blockchain across the nodes in the network will be reconciled using a consensus mechanism. Hence, it is very difficult to alter or delete the content of the blockchain, making it "immutable." Since blockchain uses cryptographic techniques to verify data and a consensus mechanism to produce new blocks and reconcile discrepancies across the computer network, it does not require a central control or trusted third party (i.e., it is "decentralized"). This decentralized feature means that the blockchain platforms are not controlled by any party, including the founders/creators.[11] Any computer can join the platforms without permission (i.e., "permissionless") and help verify new data and generate new blocks in return for tokens native to the blockchain. For these reasons, Catalini and Gans (2017) predict that blockchain technology will change the nature of intermediation and benefit the majority of platform contributors rather than a few centralized third parties.

The most well-known application of such a decentralized, public blockchain architecture is Bitcoin (Nakamoto 2008). Other blockchain platforms, such as Ethereum and Waves, have since been created with more functionality, making it easier to create new cryptocurrencies and run self-executing codes called "smart contracts." These smart contracts can increase contractibility and enforceability (Cong and He 2018). In principle, ICO issuers can use smart contracts to make their white paper disclosures credible, by encoding the terms and conditions of the token sales, as well as the rights and obligations of insiders and other token owners in the

[11] The tokens native to the blockchain are used as a means to reward the founders, their teams, and other helpers for creating and maintaining the open-source platforms.

blockchain. For example, the maximum number of tokens for sale in the ICO, future issuance of additional tokens, and voting rights per token can be encoded into smart contracts. Similarly, the vesting and lock-up requirements of insider tokens can be written into smart contracts, such that insiders cannot sell their tokens until the tokens are fully vested or the lock-up period has expired. As another example, tokens reserved to fund research and development, or other expenditures could be released for sales or transferred directly to the service providers only when specific milestones are met.

2.2. Initial Coin Offerings (ICOs) and Post-ICO Exchange Listing

ICOs or token sales provide a means for early-stage startups to raise funding for their projects. The majority of ICO-issuers use blockchain technology to various degrees and their goals often include reducing operational cost as well as providing transparency, immutability, and removal of trusted third parties. In an ICO campaign, the startups adopt an existing blockchain-based platform (e.g., Ethereum or Waves) or create a new blockchain platform to issue digital tokens/coins, and sell a percentage of them to early backers of the projects. In most cases, only tokens native to the platform can be used to obtain the products or services in the future. Hence, these backers hope to obtain the products or services when the projects are completed, or to sell the tokens for a profit to other investors/customers. A total of 873 ICOs raised $6.2 billion in 2017, while 1,119 ICOs raised $7.4 billion in the first 11 months of 2018.[12]

One of the first steps for entrepreneurs to raise capital using an ICO is to write a white paper, which describes the project, the underlying blockchain technology, the background of the founder and team members, token distribution, use of funds, etc. While some white papers are technically oriented, others are more businesslike. The founding team promotes its ICO on

[12] https://www.icodata.io/stats/2018.

various social media platforms with links to its white paper and website. There are also many ICO-specific platforms that list and promote ICOs. For example, ICOBench lists more than 2,000 ICOs by the end of 2018 and provides different tiers of services to issuers that would like to list their ICOs on the site. There are other platforms such as ICODrops, Smith & Crown, Token Data, CryptoCompare, etc. An ICO can be listed on multiple platforms. In addition to issuer-initiated listings on these platforms, some platforms add selected ICOs themselves to augment their ICO databases.

During an ICO, prospective investors need to first register on the project's website and then transfer funds to the ICO's address (or "digital wallet"). ICOs accept fiat money and various cryptocurrencies, such as Bitcoin, Ethereum, Litecoin, etc. Some ICOs require Know Your Customer (KYC) or Whitelist to meet anti-money laundering (AML) regulations, which might create a barrier for some investors to participate in the ICOs. Some ICOs also put restrictions on the country of domicile of the potential buyers, so that the issuers can avoid meeting the regulations of certain jurisdictions.

Unlike stocks in initial public offerings, coins/tokens do not list on a cryptocurrency exchange immediately after the ICO. It usually takes about one week to six months for a token to be listed on an exchange, if it gets listed at all.[13] Of the 355 ICOs in our sample, 219 were not listed within six months. Exchange listing is the only way for digital coins/tokens to obtain liquidity. According to CoinMarketCap, there are more than 1,855 tokens listed in cryptocurrency exchanges by the end of 2018. While more than 400 cryptocurrency exchanges trading Bitcoin, there are fewer exchanges trading other digital tokens. For example, the well-known "Tezos" token is only traded on three exchanges in 2018.[14] Some cryptocurrency

[13] https://www.quora.com/How-long-does-it-usually-take-to-get-listed-on-the-exchange-table-after-ICO
[14] https://tezosnews.us/exchanges-tezos-trading/

exchanges charge between $500,000 and $1,000,000 for a listing (*Business Insider*, 2018). Some big exchanges, such as Bittrex, are free to list on, but the bar for listing is high. Specifically, Bittrex requires the token to pass a compliance review to confirm that: (1) a candidate token is not a security under applicable laws, and (2) the trading of the candidate token would not be subject to laws applicable to the trading of commodities. Moreover, Bittrex takes into consideration the innovativeness of the project, new blockchain features, significant uses over existing blockchains, interesting innovative or unique applications, market interest, etc. Apart from listing fees, most exchanges also profit from transaction fees. According to *Bloomberg*, the top ten exchanges are generating as much as $3 million per day in fees, or around $1 billion per year (Bloomberg 2018).

Founders and team members can trade their tokens on any participating cryptocurrency exchange, but there is currently no requirement for insiders to disclose their trades.

2.3. ICO Regulations

There are limited regulatory oversight on ICOs. Most of the regulatory effort is to protect investors against unregistered and fraudulent ICOs. Among the 24 enforcement actions against ICOs listed on the SEC website from 2016 to 2018, twelve are settled cease-and-desist orders against unregistered ICOs, and eight are against fraudulent ICOs. Following the investigation of the DAO token scandal, the SEC issued a report in July 2017 to provide guidance on how to determine whether or not digital coins/tokens issued in ICOs should be considered securities under U.S. securities law. In April 2018, North America Securities Administers Association (NASAA) organized a task force to investigate ICOs and cryptocurrencies related products. More than 40 jurisdictions in North America participated in the "Operation Cryptosweep"

operation, which resulted in over 200 inquiries and over 50 enforcement actions against ICO issuers.

A major regulatory concern is fraudulent ICOs. Some ICO issuers posted false or misleading information in their marketing materials or white papers, leaving little recourse for investors after the fact.[15] Currently, there is no disclosure regulation or guideline on the information disclosed in the whitepaper. Regulators, such as the Monetary Authority of Singapore, the Malta Financial Services Authority, and the U.S. SEC have all issued warnings against specific ICOs. The SEC even created a fake ICO as a means to educate investors about ICO scams.[16]

3. Data and Sample

We extract information on ICOs completed between January 2016 and June 2018 from six websites: ICOBench.com, TokenData.io, TokenMarket.net, ICOMarks.com, CryptoCompare.com, and ICODrops.com. We use ICOBench.com as the main data source, because it provides fundraising information for the largest number of ICOs. If the ICO start date, end date, amount of funds raised, or white paper is missing on ICOBench.com, we use data from the other websites in the following order: TokenData.io, TokenMarket.net, ICOMarks.com, CryptoCompare.com, and ICODrops.com. Furthermore, we download token prices from CoinMarketCap.com.

[15] For example, the founders of Centra Tech claimed to raise funds to offer a debit card backed by Visa and MasterCard that would allow users to instantly convert hard-to-spend cryptocurrencies into U.S. dollars and other legal tenders. In reality, Centra faked partnerships with Visa, Mastercard, The Bancorp, and an insurance company in their promotional materials. They also created a fictitious executive as its co-founder, including a photo randomly downloaded from the Internet. Centra raised about $32 million between July 2017 and October 2017 from ICO investors. The SEC filed criminal charges against Centra and its founders, alleging the violations of anti-fraud and registration provisions under the federal securities laws.

[16] Hilary (2018) discusses law enforcement and regulatory issues related to the rapid adoption of the blockchain technology.

Table 1, panel A summarizes the sample construction process. We collect a total of 5,866 ICOs across the six websites. After removing duplicate ICOs, we end up with 3,597 unique ICOs, completed between January 2016 and June 2018. Among these, 1,583 provide a downloadable white paper, 1,220 provide the amount of funds raised, 1,285 have post-ICO trading data, 937 provide both a white paper and the amount of funds raised, and 441 have all three pieces of information.

To make the subsequent data collection and rating analysis manageable, we use proportional stratified sampling to obtain our final sample. Since we need an ICO's white paper, we start with the 1,583 ICOs with a white paper available and divide them into five subgroups (strata), based on the amount of funds raised. If we cannot find the amount raised after an extensive search process, we set the amount to $0, assuming that those ICOs failed. We divide the sample into five strata: $0, more than zero but less than $1 million, $1 million to less than $10 million, $10 million to less than 100 million, and $100 million or more. From each subgroup, we randomly draw a subsample proportional to the size of the subgroup. This process results in a total of 355 ICOs in our final sample. Table 1, panel B shows the number of observations drawn from each subgroup.

We collect data from the white papers of these 355 ICOs. In particular, we get the necessary details for rating the blockchain technology and assessing the technicality of the discussion (to be discussed in section 4). We also read the white papers to construct variables on voluntary business disclosures. Specifically, we check whether the white paper provides information on token distribution, use of funds raised, insider token lockup period, insider token vesting period, governance, project risks, founding team members, and advisors.

Table 2, panels A and B report the number of ICOs by year and month, respectively. Panel A indicates that seven of the ICOs were completed in 2016, 159 in 2017, and 150 in the first half of 2018 (39 ICOs have no information on their ICO start and end dates). Statistics not tabulated show that the total amount of capital raised by all ICOs increased from $31 million in 2016 to $1.6 billion in 2017, and $1.2 billion in the first half of 2018. For the 210 ICOs with non-zero amount raised, the mean amount raised is $13.9 million and the median is $5.7 million. The months between September 2017 and March 2018 had the highest number of ICOs (over 5% in each of those months).

4. ICO Rating Methodology

One unique feature of all ICOs is that they all use blockchain technology, setting them apart from other early-stage ventures, including those funded by crowdfunding. Hence, the blockchain technology being adopted by an ICO project is a critical element of a successful blockchain-based venture. Our ICO rating scheme focuses on two factors that we believe are important in evaluating the blockchain technology used in an ICO project. These two factors are (1) the types of products or services the digital coin/token can be used for (i.e., does the project need to use a blockchain?) and (2) the depth of the technical discussion of the blockchain technology.[17]

We assign a score of 0, 1, or 2 to each of these two factors, based on our analysis of the information from the white papers. We choose a 3-point rating scale to maximize the different among the three groups of ICOs and to make the rating method less subjective. A more refined

[17] In the previous two versions of this study (dated August 20 and September 25, 2018), we use three factors: Blockchain Platform Originality, Token Utility, and Technical Writing. In this version, we combine the first two factors into one and label it "Blockchain Rating."

rating scheme will require the raters to make more subjective judgements. A coauthor is in charge of conducting the ratings. Specifically, he assigns each ICO to two research assistants, who are graduate students specialized in computer sciences. The two RAs review the white paper and rate the ICO independently. The RAs present their analyses to the coauthor in regular meetings, in which the RAs will justify their ratings and discuss the cases further if there are disagreements between the two RAs. At the end of each discussion, the coauthor assigns the final ratings to each ICO.

4.1. Factor 1 - Blockchain Rating

The first factor evaluates the usefulness of a digital token from the blockchain technology by first identifying the product or service associated with the token, and then determining whether the product or service can be provided without the blockchain. We assign a score of 0, 1, or 2 to this factor according to the following criteria:

Score	Criterion
0	if it is unclear what product/service a token can buy (e.g., the tokens are sold in order to raise money that could be achieved by conventional crowdfunding platforms)
1	if a token is associated with some product/service provided by the ICO project, but such product/service does not need a blockchain per Wust and Gervais (2018)
2	if a token is associated with some product/service provided by the ICO project and such product/service needs a blockchain per Wust and Gervais (2018)

We will illustrate the rating of this factor using various examples. First, one might wonder why it could be unclear what a token can be used for. Below are specific examples of ICO projects that have not provided a clear description of the token utility and, therefore, received a score of 0:

- The Sand Coin project doesn't mention any particular use of its tokens. Instead, its white paper simply states that "the goal of the project is to raise funds via a blockchain system and

an ICO to develop a sand quarry in the Moscow Region." In other words, Sand Coins are sold merely to raise money and do not provide specific utility to token holders.

- The BoatPilot project aims to provide a free marine navigation service for private and commercial yachting markets. It allows yachtsmen to track marine routes and access the most relevant information on coastal objects, using an augmented reality function. Despite its ambitious goal of "being Google Maps and TripAdvisor in one program," it is unclear what type of product/service a user can buy with the token. Instead, its white paper simply mentions that tokens are "used to reward people who send their geo-data to this platform."
- The SwissBorg project aims to create a Cyber Wealth Management Platform to help its clients manage their portfolio of crypto assets. Although its tokens can be used "to give holders the ability to choose the direction in which the network will be developed," its white paper doesn't define any specific product/service for its tokens.

Second, if a token is indeed associated with some product/service provided by the venture, we need to determine whether such product/service needs to be offered on a blockchain or not. To make that determination, we apply the methodology developed by Wust and Gervais (2018). The underlying motivation for their methodology can be summarized as follows: a blockchain can be viewed as a database shared among a network of computers that have read and write privilege. Compared to a conventional database, a blockchain does not require the participating computers to trust each other. This distinguishing feature is due to the use of cryptography techniques and consensus algorithms. Therefore, to claim that a project needs a blockchain, one needs to explain why a blockchain is a better choice than a conventional database. To this end, we consider the following cases as discussed in Wust and Gervais (2018):

- Case 1: If only one writer exists in the system, there is no need to build the trust among participating computers. In this case, a conventional database is a better choice because it is more cost effective (or at least more mature technology) than a blockchain.
- Case 2: If a trusted third party (TTP) is already available for a specific application and this TTP can serve as an effective delegate for all the writers in the system, this case reduces to the previous case and again a conventional database is a better choice.
- Case 3: If all the writers mutually trust each other, a database with shared read-write access is the best solution, because there is no need to build the trust.
- Case 4: If all the writers do not trust each other and there is not an effective TTP, a blockchain solution makes sense.

According to the rating criteria stated above, Cases 1 to 3 will receive a score of 1, while Case 4 will receive a score of 2. Figure 1 summarizes these four cases using a flow chart. In order to apply decision rule given in the flow chart, we need to identify three pieces of information: (i) whether the blockchain platform has a single writer or multiple writers, (ii) whether these writers trust each other, and (iii) whether there is an effective TTP. The first two pieces can often be found based on the description of the platform, whereas the last piece can be sometimes hard to find. When the white paper does not provide enough information on the existence of a TTP, we make an educated guess. A similar flow chart can be found in a recent "Blockchain Technology Review" published by the National Institute of Standards and Technology (Yaga et al. 2018). The review encourage organizations to take a critical view on blockchain technology and examine whether existing technologies can better solve their problems, which is in the same spirit as Wust and Gervais (2018).

To demonstrate how to use this rating scheme, we look at two well-known examples—the Dragon Coin project and the Filecoin project. In the Dragon Coin project, tokens can be "exchanged for non-negotiable physical gaming chips at the Dragon Junket or any Dragon affiliated gaming venue." In other words, the tokens can be used to buy physical gaming chips. Such service is quite common in gambling industry where customers use fiat currency (or credit cards) to buy physical gaming chips. As such, it is unclear why blockchain is a suitable technical solution. To advocate the use of blockchain, its white paper claims that the "use of the Dragon Digital Platform will incur costs much closer to 1% than the usual 5%." However, it doesn't provide any evidence to support this claim. In particular, it doesn't explain why a blockchain is a better choice than a conventional database. In fact, a conventional database is better for at least three reasons. First, a conventional database offers better performance than current blockchain systems in terms of transaction volumes and transaction speed. For example, Bitcoin can currently support around only seven transactions per second, while a conventional database system used by Visa International can handle a peak of more than 50,000 transactions per second. Second, a conventional database is cost-effective. In fact, there are a wide range of database products available in the market, such as Oracle Database, Microsoft SQL, and SAP. Third, the Dragon Coin project requires licenses from the Macau Gaming Inspection and Coordination Bureau. With these licenses, the Dragan platform can already serve as a TTP. In sum, Dragon Coin resembles case (2) above and, hence, we assign it a score of 1 for this factor.

In the Filecoin project, the ICO issuer aims to develop a new blockchain protocol and platform on which a token can be used to store digital files (in an encrypted form). More specifically, "clients spend tokens for storing and retrieving data and miners earn tokens by storing and serving data." In other words, a token indeed has a clear usage: storing and retrieving

data. Such service is based on its own blockchain platform, a decentralized storage network where miners (an essential component of the platform) are storing data in exchange for tokens as well as maintaining the network. These miners are mutually distrusting writers. Moreover, there is no effective TTP in the system, because creating and maintaining a TTP is costly in this application scenario. This corresponds to case (4) above and, hence, the Filecoin project receives a score of 2 for this factor. See Howell et al. (2018) for a more detailed discussion of Filecoin.

4.2. Factor 2 – Technicality Rating

The second factor captures the quality of the technical presentation in the white paper. We consider a white paper with a technical description of the underlying blockchain technology to be more credible, because it will require the founding team members with the appropriate technical knowledge to prepare it. Furthermore, for the founding teams to provide that level of details, the ICO projects are likely to be further along in the development stage. Roughly speaking, blockchain technology consists of the following components: cryptography techniques, peer-to-peer networks, consensus algorithms, and smart contracts. We say a white paper contains sufficient technical details if it provides non-trivial discussion on one or more components. We assign a score from 0 to 2 to this factor as follows:

Score	Criterion
0	if the white paper contains essentially no technical discussion
1	if the white paper contains limited technical discussion
2	if the white paper contains technical discussion in the style of an academic paper focusing on one or more components of blockchain technology

We illustrate this factor through the following three examples:

- The Bankera white paper contains essentially no technical discussion. Its section called "Technology" states, "Most of the technology required for successful operations for Bankera is already developed and will be ready for testing as a minimum viable product prior to the

ICO. The core elements of Bankera's current technology include modules for SWIFT messaging, SEPA payments, payment cards integration, bank's ledger, Bitcoin, Ethereum, DASH, NEW modules, fraud analytics and more." In other words, it simply mentions a few established cryptocurrencies and blockchain technology. Hence, we assign it a rating of 0.

- The white paper of Dragon Coin contains a system diagram and some discussions on Ethereum and smart contracts. Those discussions are, however, based on existing information sources. For instance, it credits the Ethereum Foundation for its discussion of "Ethereum"[18] and CoinDesk for its discussion of "smart contracts"[19]. Hence, it only contains limited technical discussions and we assign it a rating of 1.
- The Filecoin white paper is written in the style of an academic paper. It contains precise definitions, system diagrams of its new protocol, descriptions of data structures and algorithms, as well as references (most of them are academic papers). More importantly, it proposes new consensus algorithms called Proof-of-Replication and Proof-of-Spacetime. Hence, we assign it the highest rating of 2.

There are other information sources available beyond that in the white papers, such as the quality of source code posted on GitHub and the frequency of source code updates. In this paper, we confine our attention to white papers for two reasons. First, very few ICO issuers have launched their blockchain platforms by the time of their ICO. Therefore, white papers are the main disclosure documents that enable us to evaluate the envisioned blockchain platforms.

[18] "Ethereum is a decentralized platform that runs smart contracts: applications that run exactly as programmed without any possibility of downtime, censorship, fraud or third party interference. These apps run on a custom built blockchain, … This enables developers to create markets, store registries of debts or promises, move funds in accordance with instructions given long in the past…, all without a middle man or counterparty risk."
[19] "Smart contracts are usually written in Solidity, … It is then compiled into byte code, which is submitted to the Ethereum blockchain. Here it will remain active in readiness to be triggered by a specified event… The Ethereum virtual machine (EVM) will execute the code and… will create an immutable ledger containing transactional data."

Second, most of the source code provided by ICO issuers (often posted on GitHub) is still at the development stage, showing only a few functionalities of the envisioned platforms. Hence, the source code may not contain as much technical information as the white papers (Cohney et al. 2018).

5. Empirical Findings

5.1. ICO Blockchain and Technicality Ratings

Table 3 reports statistics on the two factors used in our ICO rating scheme. Our main blockchain technology rating is *BCRating*, which assesses the need for and usefulness of the underlying blockchain technology to provide the intended product or service. Panel A indicates that the tokens of 55 ICO projects are associated with some product or service provided by the blockchain platform and, hence, they receive the highest score of 2. Another 200 projects use their tokens for products or services unrelated to their blockchain platforms and, hence, they actually do not need to use a blockchain and receive a score of 1. The remaining 100 ICO projects do not specify clearly how their tokens can be used and why they need to use a blockchain at all, so their *BCRating* is 0. About 80% of the ICOs with a *BCRating* of 2 raised a positive amount of funds, while less than 50% of those with a *BCRating* of 0 did so. ICOs with a high *BCRating* score also raised more funds on average than those with a 0 *BCRating* score ($24,900,000 versus $12,400,000). Finally, 65% of the ICOs with a score of 2 are listed on a cryptocurrency exchange, compared with only 31% for those with a *BCRating* score of 0.

As for technical disclosure style and quality (*Technicality*), panel B shows that there are 24 ICO projects with a white paper that reads like an academic paper (including theory, formulas, proofs, applications, citations, etc.) and, hence, receive the highest score of 2. Another

92 ICOs have white papers with some technical discussion (scoring 1), and 239 ICOs' white papers have little or no technical detail (scoring 0). ICO projects with a *Technicality* score of 2 raised average funding of $26,800,000 per project, compared with a mean of $17,800,000 for projects with scores of 1 and $9,794,080 for projects with scores of 0.

In sum, the univariate statistics summarized in table 3 suggest that most ICOs do not need a blockchain and their white papers provide little technical description of their blockchain platforms. Furthermore, those ICOs that actually need a blockchain and that disclose technical details of their blockchain platform raised more funds during the ICO period and are more likely to be listed on a cryptocurrency exchange than those that do not.

5.2. Blockchain Rating: Effect on Total Amount Raised and Post-ICO Listing

Table 4 panel A provides summary statistics of the dependent and explanatory variables in our multivariate analysis. The main dependent variables are *AmountRaised*, *Listing*, and *Days*. *AmountRaised* is the dollar amount raised during the ICO. The mean *AmoutRaised* is $8,237,766, while the mean amount of non-zero amount raised, *AmoutRaised(>0)*, is $13.9 million. In the regression analysis, we use the logarithm of *AmountRaised* (*LogAmount*) to account for its right-skewed distribution. *Listing* is an indicator variable equal to 1 if an ICO issuer had its digital coin listed on a cryptocurrency exchange within 180 days after the ICO end date, while *Days* is the number of days it took an ICO to be listed on a cryptocurrency exchange (*Days* is capped at 180). Mean *Listing* is 0.35, indicating that 35% of the ICOs had their coins listed on a digital exchange within 180 days, and the average *Days* is about 130.

The key independent variable is *BCRating*, generated from our rating methodology. *BCRating* ranges from 0 to 2, with a mean of 0.87 and median of 1. Median *Technicality* is 0, suggesting that over half of the white papers had little to no technical writing. The other

explanatory variables are *TokenDis*, *Lockup*, VestPer, *Gov*, *UseFunds, Risk, TeamBio*, *TeamTech*, *TeamMkt*, *TeamSize*, *AdviSize*, and *AdviTech.* These are all indicator variables and are based on whether relevant information is disclosed in a white paper. In particular, *TokenDis* equals one if an ICO company discusses token distribution in its white paper, and zero otherwise. Appendix A defines the other variables. Apart from getting information about the founding team and advisor team, we also construct composite measures on these two teams. *Team* is the sum of the four founding team related variables and *Advi* is the sum of the two variables related to the advisor team. Average *Team* and *Advi* are 2.09 and 0.53, respectively. These indicate that more than half of the ICOs disclose at least two aspects of their founding teams in the white papers, but most of them do not discuss their advisor teams. Finally, we include monthly Bitcoin return (*BitRet*), Bitcoin trading volume (*BitVol*), and Bitcoin volatility (*BitStd*) in the month before the end of the ICO period. We include these three Bitcoin-related measures in the regression model to control for any time-series variations in the condition of the cryptocurrency market.

Table 4, panel B presents the Pearson and Spearman correlation matrix for these variables. The upper diagonal reports Spearman correlation coefficients and the lower diagonal reports Pearson correlation coefficients. *LogAmount*, the logarithm of amount raised, is positively correlated with our two self-constructed rating factors: *BCRating* and *Technicality*. While several control variables are significantly correlated, most of the correlation coefficients are small, except that *BitVol* and *BitStd* have a Pearson correlation coefficient of 0.94 and *Team* and *Advi* have a Spearman correlation coefficient of 0.58. Hence, it may be difficult to disentangle the effects of these variables in the regression analysis.

5.2.1. Amount Raised during the ICO period

We first examine the amount of funds raised at the ICOs. Since 41% of the ICOs in our sample do not provide amount raised information, we consider them failed and set the amount raised to zero. To take into account this censoring of the dependent variable (at zero), we analyze the data using both a Tobit model and the Heckman two-step procedure. Table 5 presents the results of regressing the logarithm of *AmountRaised* (*LogAmount*) on *BCRating* and the other explanatory variables. Columns (1) to (4) present the results from using the Tobit model. Specifically, *LogAmount* is positively associated with *BCRating* across four different model specifications. These results indicate that ICOs that integrate blockchain technology into their products/services raised more funds on average than those ICOs that do not need a blockchain. Moreover, we find that ICOs that disclosed the lockup period for insiders' tokens (*Lockup*) and information on their founding advisor teams in their white papers (*Advi*) also raised a higher amount during their ICO campaigns. These findings suggest that the lockup requirement serves as a signal of interest alignment between investors and insiders, and that more information on the founding advisors helps reduce information asymmetry. Surprisingly, the disclosure of how the issuers plan to use the funds raised (*UseFunds*) is actually negatively associated with *LogAmount*. In addition, both monthly Bitcoin returns (*BitRet*) and Bitcoin trading volume (*BitVol*) exhibit significant explanatory power for the amount raised at ICOs (columns 2 to 4). Finally, the disclosure of founding team member with a marketing background (*TeamMkt*) is associated with a higher amount raised (column 4).

Next, we use the Heckman two-step procedure to separately examine the determinants of the ICOs that raised a positive amount of funds using a Probit model, and the determinants of the amount raised on the subsample of ICOs with a positive amount raised using an OLS method.

Table 5, columns (5) to (12) summarize the results of these estimations. Consistent with the Tobit regression results reported in columns (1) to (4), *BCRating* is positively associated with both the likelihood of having a non-zero amount raised (columns 5-8) and the amount of funds raised for ICOs with non-zero amount raised (columns 9-12). Moreover, *Lockup*, *UseFunds*, *Advi*, and *TeamMkt* also exhibit significant explanatory power in the Probit regressions, but not the OLS regressions. In other words, these variables only affect the probability of an ICO raising a positive amount, but not the amount raised once it is positive.

Overall, the results summarized in table 5 suggest that the quality of ICOs, especially regarding the underlying blockchain technology, matters to token buyers/investors, and that the disclosures of information about the founding and advisor teams help mitigate the information asymmetry problem between ICO issuers and prospective buyers/investors. These results, as a whole, are consistent with token buyers/investors making use of information disclosed in white papers to help them distinguish ICOs that levered the blockchain technology from those that do not actually need to use a blockchain.

5.2.2. Post-ICO Listing

Next, we examine the post-ICO listing of the tokens on a virtual exchange. For the founders and buyers/investors of ICOs, the liquidity of the digital tokens is important if they want to sell the tokens to make a profit or diversify their investment portfolios subsequent to the ICOs. Hence, another measure of ICO success is the post-ICO listing of the digital tokens/coins on at least one cryptocurrency exchange. In this section, we investigate the number of days an ICO took to get listed on a virtual exchange after the ICO end date (*Days*). If it takes an issuer more than 180 days after the ICO period to have the new tokens listed on a crypto exchange, we consider it a listing failure (i.e., *Days* is capped at 180). We use a Cox proportional hazards

model to conduct this duration analysis. We include as additional explanatory variables the 3-month Bitcoin return, trading volume, and volatility, all computed before the ICO listing day. We supplement the duration analysis with a Probit analysis, where the dependent variable, *Listing*, is an indicator variable that takes a value of 1 if an ICO is listed in a virtual exchange within 180 days after the end of the ICO period, and 0 otherwise.

Table 6 summarizes the estimation of the Hazards and Probit regressions. Results reported under columns (1) to (4) show no evidence that *BCRating* affects the post-ICO listing outcome in the Cox hazards model, where the dependent variable is *Days*. In contrast, the estimation results of the Probit model (columns 5-8) suggest that *BCRating* is positively correlated with the listing outcome in three of the model specifications. The Probit model examines the probability that an ICO issuer listed its token within 180 days. Taken together, the results presented in table 6 are consistent with *BCRating* exhibiting significant power to explain whether or not a newly issued token will be listed on a cryptocurrency exchange within 180 days (*Listing*). In passing, we note that the estimated coefficients on the three Bitcoin-related variables (*BitRetList, BitVolList, and BitStdList*) are all statistically significant. This result suggests that the condition of the cryptocurrency market, as captured by the Bitcoin-related variables, is an important factor determining whether a new digital coin or token will be listed on a virtual exchange or not.

5.3. Technicality Rating: Interaction Effect on Total Amount Raised and Post-ICO Listing

White papers are the main information source about ICO projects. Many of the successful ICOs, such as Filecoin, signal their quality by providing considerable technical information about their blockchain platforms, technology, and products. Other ICOs, such as Bankera, simply mention “Bitcoin” and related terms in their white papers without disclosing any technical

information about their ICO projects. In this section, we investigate whether the quality of technical discussion has an interactive effect on the amount of funds raised during ICOs and the post-ICO listing outcomes.

To examine the interactive effect of technical disclosure, we add to our main regression equations the variable *Technicality* and its interaction with *BCRating (BC*Tech).* The estimation results presented in Table 7 suggest that there is little evidence that the level of technical information disclosed in the white paper has an interactive effect on the amount of funds raised. In particular, the interaction term, *BC*Tech*, exhibits significant explanatory power only in column (5). Regarding the main effects, the estimated coefficients on *BCRating* are qualitatively similar to those reported in table 5, while those on *Technicality* are indistinguishable from zero. In Table 8, we examine the interactive effect of *Technicality* on listing outcomes. Again, we find no support in either the Cox Hazards model or Probit model that disclosing more technical information in the white paper is associated with a higher likelihood of getting listed on a virtual cryptocurrency exchange.

Using the interaction term *BC*Tech* to test for an interactive effect of *Technicality* assumes that *Technicality* is linearly related to the effect of *BCRating* on *LogAmount* or *Listing*. We relax this linearity assumption by partitioning the sample by *BCRating* and then testing the effect of *Technicality* on *LogAmount* or *Listing*. Table 9 reports the Tobit estimation of the amount raised by subsamples of *BCRating*. Consistent with our suspicion that the effect of *Technicality* is nonlinear, we find that for ICOs with *BCRating* that equals 1 or 2, *Technicality* is positively associated with the amount of funds raised. However, when *BCRating* is 0, more technical disclosure does not help to attract more investment. These results indicate that providing technical details in the white paper can be an effective way to signal the quality of an

ICO project, if and only if the project discuss how the digital tokens can be used. Results not tabulated indicate that the Heckman's two-step procedure produces results qualitatively similar to those based on the Tobit model.

Finally, we examine the effect of *Technicality* on the post-ICO listing in the three *BCRating* subsamples. Results (not tabulated) of a duration analysis show that *Technicality* has insignificant explanatory power for the number of days it took an ICO to be listed (*Days*), holding *BCRating* constant. We repeat the test using a Probit model, examining whether or not *Technicality* has explanatory power for the likelihood of an ICO listed within 180 days, holding *BCRating* constant. Table 10 reports weak results, with the estimated coefficients on *Technicality* being statistically different from zero only under columns (2), (5), and (9). The weak results may be due to the fact that ICO issuers can provide technical information about their projects to cryptocurrency exchanges when applying for listing subsequent to the end of the ICO period.

6. Conclusion

Initial coin offerings (ICOs) have emerged as a major financing tool for blockchain-based entrepreneurial ventures. We evaluate whether or not an ICO project needs a blockchain, and develop an ICO rating system based on technical information disclosed voluntarily in a white paper by the ICO issuers. Our empirical results are consistent with ICO token buyers/investors taking into consideration the blockchain technology being used by ICO projects when making their purchasing/investing decisions. Since the ICO white paper is the token buyers' main source of information, our finding that buyers rely on this information suggests that ensuring the credibility of the information is important to protect the interests of ICO buyers/investors.

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Appendix A: Variable Definitions

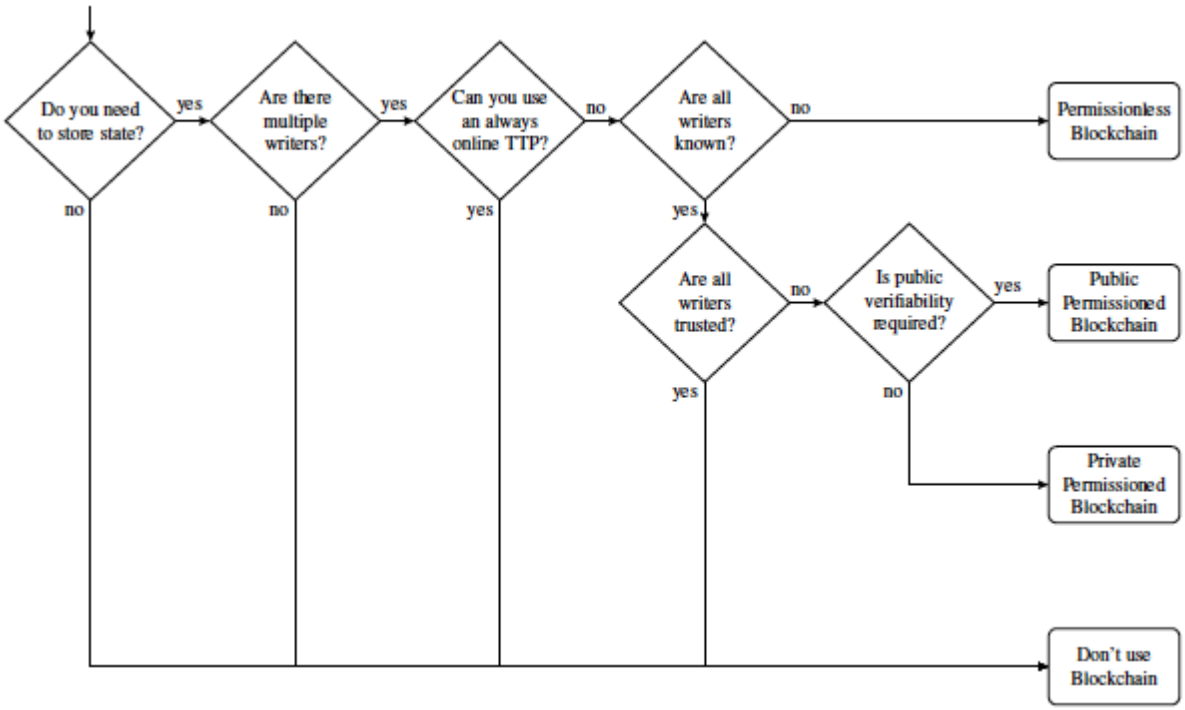
Variable	Definition
AmountRaised	Total amount of funds raised druing ICO.
LogAmount	The logarithm of *AmountRaised*.
Days	Number of days until an ICO is listed in a cryptocurrency exchange in the first 180 days after the ICO end date.
Listing	An indicator variable equals to 1 if an ICO is listed on a cryptocurrency exchange within the first 180 days after the ICO end date; 0 otherwise.
Rating	Sum of the scores from *Platform*, *Token utility*, and *Technical writing*.
BCRating	A score that equals 0 if it is not clear what a token can do; 1 if a token is associated with some service which is unrelated to the project's blockchain platform based on the criterion in Wust and Gervais (2018); 2 if a token is associated with some service which is provided by the project's blockchain platform based on the criterion in Wust and Gervais (2018)
Technicality	A score that equals 0 if essentially no technical writing in the ICO white paper; 1 if limited technical writing; 2 if professional technical writing (with sufficient technical details).
Decentralized	Number of times "decentralized" was mentioned in the whitepaper.
TokenDis	Indicator variable that takes a value of 1 if token distribution is disclosed; 0 otherwise.
Lockup	Indicator variable that takes a value of 1 if insider token lockup period is disclosed; 0 otherwise.
VestPer	Indicator variable that takes a value of 1 if insider token vesting period is disclosed; 0 otherwise.

(continued)

Appendix A: Variable Definitions (continued)

Variable	Definition
Gov	Indicator variable that takes a value of 1 if governance is disclosed; 0 otherwise.
UseFunds	Indicator variable that takes a value of 1 if use of funds is disclosed; 0 otherwise.
Risk	Indicator variable that takes a value of 1 if project risk is disclosed; 0 otherwise.
BitRet	Bitcoin return over the month before ICO ends.
BitVol	Bitcoin trading volume over the month before ICO ends.
BitStd	Bitcoin volatility over the month before ICO ends.
BitRetList	Three-month Bitcoin return before an ICO is listed.
BitVolList	Three-month Bitcoin trading volume before an ICO is listed.
BitStdList	Three-month Bitcoin volatility before an ICO is listed.
Words	Logarithm of the number of words in the white paper.
TeamBio	Indicator variable that takes a value of 1 if team biography is disclosed; 0 otherwise.
TeamTech	Indicator variable that takes a value of 1 if founding team tech background is disclosed; 0 otherwise.
TeamMkt	Indicator variable that takes a value of 1 if founding team marketing background is disclosed; 0 otherwise.
TeamSize	Indicator variable that takes a value of 1 if founding team size is disclosed; 0 otherwise.
AdviSize	Indicator variable that takes a value of 1 if advisor team size is disclosed; 0 otherwise.
AdviTech	Indicator variable that takes a value of 1 if advisor technology background is disclosed; 0 otherwise.
Team	Sum of team variable.
Advi	Sum of advisor variable.

Figure 1. Do You Need a Blockchain?
Wust and Gervais (2017) provide the following flow chart and explanations to help determine whether a blockchain is the appropriate technical solution to solve a problem.



Explanations:
1. Writers refer to entities with write access to the blockchain.
2. If a trusted third party (TTP) is available that is not always online, this can be used to establish a known group of writers, i.e. the TTP can function as a certificate authority in such a setting.
3. Public and private permissioned blockchains differ in that a public blockchain allows anyone to read the contents of the chain and thus verify the validity of the stored data, while a private blockchain only allows a limited number of participants to read the chain.
4. For any blockchain based solution, it is possible to make use of cryptographic primitives in order to hide privacy-relevant content.

Source: Wust and Gervais (2017), figure 1.

Table 1. Sample Construction
This table describes the sample construction process and the number ICOs available at each step of the process. The sample period is from January 2016 to June 2018.

Panel A: Sample Construction

Data source	Number of ICOs	
ICOBench.com	1,813	
Tokendata.io	1,314	
ICOMarks	1,129	
CryptoCompare.com	655	
ICODrops.com	370	
TokenMarket.net	585	
Total ICOs		5,866
Duplicated ICOs		(2,269)
Unique ICOs		3,597
Unique ICOs with:		
a white paper		1,583
the amount of funds raised		1,220
post-ICO trading data from CoinMarketCap.com (i.e., listed in a crypto exchange)		1,285
a white paper and the amount of funds raised		937
a white paper, the amount of funds raised, and post-ICO trading data		441

Panel B: Proportional stratified sampling by amount raised

Amount raised subgroup (stratum)	Number of ICOs selected
$100 million or more	3
$10 million to less than $100 million	84
$1 million to less than $10 million	81
More than $0 but but less than $1 million	42
No amount raised information	145
All	355

Panel C: Availability of key variables

ICOs	Number of ICOs	Total number
With Amount Raised	210	355
Without Amount Raised	145	
With Token Price data (i.e., listed in a crypto exchange)	136	355
Without Token Price data	219	

Table 2. Numbers of ICOs by Year and Month

This table provides summary statistics on the ICO sample used in this study. Panel A and B reports number of ICOs over our sample period by month from January 2016 to June 2018. Panel C presents ICO description based on different types. Panel D reports sample description based on main variables.

Panel A: Number of ICOs in each year over sample period

Year	Number of ICOs	Percent
2016	7	2%
2017	159	45%
2018	150	42%
No End date	39	11%
Total	355	100%

Panel B: Number of ICOs in each month over sample period

Month	Number of ICOs	Percentage
201601	1	0.28%
201603	2	0.56%
201609	1	0.28%
201610	1	0.28%
201611	1	0.28%
201612	1	0.28%
201701	1	0.28%
201702	2	0.56%
201703	2	0.56%
201704	7	1.97%
201705	5	1.41%
201706	3	0.85%
201707	11	3.10%
201708	9	2.54%
201709	22	6.20%
201710	22	6.20%
201711	31	8.73%
201712	44	12.39%
201801	41	11.55%
201802	34	9.58%
201803	47	13.24%
201804	12	3.38%
201805	12	3.38%
201806	4	1.13%
No End date	39	10.99%
Total	355	100.00%

Table 3. Summary Statistics on ICO Rating
This table provides summary statistics on the two factors (*BCRating* and *Technicality*) we used to rate the blockchain technology of an ICO. See section 4 and appendix A for the definitions of these two factors.

Panel A: BCRating

Token Utility	2	1	0
N	55	200	100
% with amount raised (non-zero)	80%	59%	49%
Mean amount raised (non-zero)	24,900,000	10,400,000	12,400,000
Mean amount raised (all)	19,900,000	6,101,428	6,072,394
% with token trading data	65%	35%	31%

Panel B: Technicality

Technicality	2	1	0
N	24	92	239
% with amount raised (non-zero)	75%	76%	51%
Mean amount raised (non-zero)	26,800,000	17,800,000	9,794,080
Mean amount raised (all)	20,100,000	13,500,000	4,999,489
% with token trading data	42%	52%	33%

Table 4. Descriptive Statistics on Dependent and Explanatory Variables
Panel A of this table reports summary statistics of the dependent and independent variables. Panel B shows the correlation coefficients of the regression variables. The definition for the variables is given in Appendix A. The sample covers the period from January 2016 through June 2018.

Panel A: Summary statistics

Variable	N	Mean	SD	Min	P25	P50	P75	Max
AmountRaised	355	8,237,766	18,000,000	0	0	616,064	8,530,867	158,000,000
AmountRaised(>0)	210	13,900,000	21,700,000	15	1,512,108	5,720,400	18,400,000	158,000,000
LogAmount	355	8.95	7.66	0.00	0.00	13.33	15.96	18.88
Listing	314	0.35	0.48	0.00	0.00	0.00	1.00	1.00
Days	314	129.88	73.32	0.00	39.00	180.00	180.00	180.00
BCRating	355	0.87	0.65	0.00	0.00	1.00	1.00	2.00
Technicality	355	0.39	0.61	0.00	0.00	0.00	1.00	2.00
TokenDis	355	0.70	0.46	0.00	0.00	1.00	1.00	1.00
Lockup	355	0.16	0.37	0.00	0.00	0.00	0.00	1.00
VestPer	355	0.17	0.38	0.00	0.00	0.00	0.00	1.00
Gov	355	0.14	0.35	0.00	0.00	0.00	0.00	1.00
UseFunds	355	0.52	0.50	0.00	0.00	1.00	1.00	1.00
Team	355	2.09	1.59	0.00	0.00	2.00	4.00	4.00
Advi	355	0.53	0.80	0.00	0.00	0.00	1.00	2.00
Risk	355	0.41	0.49	0.00	0.00	0.00	1.00	1.00
BitRet	316	0.21	0.32	-0.33	-0.08	0.26	0.48	0.70
BitVol	316	22.07	1.20	17.99	21.35	22.27	22.83	23.32
BitStd	316	1126.61	739.67	10.49	596.65	1136.08	1302.35	2394.54
Words	340	8.65	0.76	3.26	8.33	8.72	9.07	10.87
TeamBio	355	0.74	0.44	0.00	0.00	1.00	1.00	1.00
TeamTech	355	0.44	0.50	0.00	0.00	0.00	1.00	1.00
TeamMkt	355	0.33	0.47	0.00	0.00	0.00	1.00	1.00
TeamSize	355	0.58	0.49	0.00	0.00	1.00	1.00	1.00
AdviSize	355	0.33	0.47	0.00	0.00	0.00	1.00	1.00
AdviTech	355	0.20	0.40	0.00	0.00	0.00	0.00	1.00

Table 4 (continued)
Panel B: Pearson (reported in lower diagonal) and Spearman (upper diagonal) correlation coefficients

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
1.LogAmount		0.33*	0.28*	-0.13	0.08	0.12	0.21*	-0.12	0.04	0.16*	0.15*	0.29*	0.27*	0.08	0.25*
2.BCRating	0.23*		0.26*	-0.01	0.03	0.05	0.13	-0.06	-0.08	-0.03	-0.02	0.12	0.05	0.03	0.13
3.Technicality	0.25*	0.23*		0.22*	-0.03	-0.13	0.04	0.16*	-0.05	-0.05	-0.04	-0.03	0.01	0.02	0.20*
4.TokenDis	-0.05	0.01	0.19*		0.22*	0.20*	-0.04	0.44*	-0.11	0.18*	0.20*	0.22*	0.15	0.21*	0.10
5.Lockup	0.13	0.04	-0.01	0.21*		0.24*	0.01	0.17*	0.16*	0.07	0.04	0.11	0.10	0.09	0.17*
6.VestPer	0.12	0.04	-0.11	0.18*	0.27*		0.13	0.24*	0.03	-0.03	-0.02	0.29*	0.24*	0.16*	0.19*
7.Gov	0.18*	0.12	0.09	-0.03	0.09	0.15*		0.04	0.01	-0.13	-0.10	0.14	0.09	0.22*	0.10
8.UseFunds	-0.08	-0.05	-0.13	0.45*	0.19*	0.24*	0.04		-0.05	0.10	0.07	0.19*	0.09	0.25*	0.14*
9.BitRet	0.10	-0.09	-0.03	-0.10	-0.14	0.02	0.02	-0.04		0.27*	0.19*	0.09	-0.03	-0.02	-0.00
10.BitVol	0.26*	-0.08	-0.13	0.21*	0.06	0.01	-0.14	0.09	0.14*		0.94*	0.04	0.12	0.07	0.10
11.BitStd	0.18*	0.01	-0.03	0.15*	-0.01	-0.04	-0.10	0.06	-0.12	0.85*		0.08	0.13	0.09	0.14
12.Team	0.23*	0.13*	-0.03	0.24*	0.14*	0.28*	0.14*	0.22*	0.10	0.08	0.05		0.59*	0.22*	0.33*
13.Advi	0.23*	0.08	-0.01	0.14*	0.12	0.24*	0.11	0.11	-0.03	0.12	0.10	0.58*		0.15*	0.24*
14.Risk	0.11	0.05	0.04	0.23*	0.15*	0.17*	0.24*	0.27*	-0.01	0.09	0.08	0.24*	0.20*		0.23*
15.Words	0.15*	0.08	0.18*	0.14	0.12	0.20*	0.05	0.16*	0.03	0.15*	0.15*	0.32*	0.23*	0.20*	

Table 5 Effect of Blockchain Rating on the Amount of Funds Raised during the ICO Period

This table reports the results of regressing the total amount of funds raised during the ICO period on Blockchain Rating, *BCRating*. Columns (1) to (4) summarize results using a Tobit model, while column (5) to (12) show the results of the Heckman two-step procedure. The definition for the variables is given in Appendix A. The sample period is from January 2016 through June 2018. *t*- or *z*-statistics are reported in parentheses under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
					Heckman two-step procedure							
	Tobit				Probit				OLS (Amount raised>0)			
BCRating	3.36***	3.61***	3.77***	3.71***	0.31***	0.48***	0.50***	0.52***	0.77	0.84***	0.92***	1.00***
	(3.43)	(4.02)	(4.22)	(4.20)	(2.80)	(3.54)	(3.61)	(3.60)	(1.11)	(2.79)	(3.01)	(3.26)
TokenDis	-2.14	-0.88	-1.04	-1.20	-0.21	-0.12	-0.17	-0.18	-0.45	-0.76*	-0.72*	-0.77*
	(-1.36)	(-0.60)	(-0.72)	(-0.84)	(-1.17)	(-0.54)	(-0.78)	(-0.81)	(-0.76)	(-1.96)	(-1.86)	(-1.96)
Lockup	3.43*	3.48**	2.90*	2.60	0.37*	0.59**	0.49**	0.49*	0.37	0.67	0.64	0.63
	(1.92)	(2.15)	(1.79)	(1.63)	(1.78)	(2.39)	(1.99)	(1.90)	(0.45)	(1.45)	(1.42)	(1.37)
VestPer	1.05	0.64	0.41	0.75	0.04	-0.08	-0.07	0.01	0.29	0.44	0.23	0.26
	(0.58)	(0.41)	(0.26)	(0.48)	(0.21)	(-0.33)	(-0.29)	(0.04)	(0.65)	(1.05)	(0.56)	(0.61)
Gov	3.59**	1.35	0.91	0.77	0.44*	0.14	0.04	0.01	0.29	0.60	0.65	0.65
	(1.98)	(0.82)	(0.56)	(0.48)	(1.94)	(0.53)	(0.16)	(0.03)	(0.32)	(1.45)	(1.58)	(1.56)
UseFunds	-3.03**	-3.08**	-2.95**	-2.61**	-0.36**	-0.43**	-0.41**	-0.39*	0.25	-0.04	-0.00	-0.01
	(-2.05)	(-2.31)	(-2.23)	(-2.00)	(-2.16)	(-2.23)	(-2.14)	(-1.96)	(0.30)	(-0.09)	(-0.01)	(-0.03)
Risk	0.97	0.37	0.28	0.11	0.10	0.15	0.15	0.11	0.11	0.10	0.03	0.06
	(0.70)	(0.30)	(0.22)	(0.09)	(0.64)	(0.83)	(0.81)	(0.59)	(0.28)	(0.29)	(0.09)	(0.17)
Team	0.97*	0.66	0.67		0.09	0.06	0.07		0.19	0.28**	0.24*	
	(1.91)	(1.42)	(1.42)		(1.63)	(0.85)	(0.99)		(0.80)	(2.21)	(1.86)	
Advi	1.79*	2.67***	2.53***		0.20*	0.43***	0.42***		0.24	0.29	0.28	
	(1.88)	(3.11)	(2.95)		(1.74)	(3.22)	(3.08)		(0.55)	(1.02)	(1.00)	
BitRet		3.82**	3.61*	3.43*		0.26	0.24	0.19		-0.58	-0.42	-0.43
		(2.03)	(1.94)	(1.86)		(0.92)	(0.84)	(0.64)		(-1.03)	(-0.78)	(-0.77)
BitVol		-2.93***	-2.64***	-2.45***		-0.95***	-0.90***	-0.91***		-0.29	-0.29	-0.31
		(-3.14)	(-2.85)	(-2.69)		(-3.75)	(-3.50)	(-3.44)		(-0.93)	(-1.00)	(-1.07)
BitStd		0.00	0.00	0.00		0.00**	0.00*	0.00*		0.00**	0.00**	0.00**
		(0.75)	(0.39)	(0.36)		(2.09)	(1.78)	(1.83)		(2.33)	(2.08)	(1.99)
Words			0.73	0.83			0.01	0.01			0.47**	0.48**
			(0.89)	(1.02)			(0.08)	(0.09)			(2.23)	(2.24)
TeamBio				-2.89				-0.38				-0.11
				(-1.54)				(-1.39)				(-0.20)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
					Heckman two-step procedure							
	Tobit				Probit				OLS (Amount raised>0)			
TeamTech				-0.35				-0.08				0.53
				(-0.18)				(-0.28)				(0.92)
TeamMkt				4.75***				0.63**				0.81
				(2.83)				(2.45)				(1.44)
TeamSize				1.05				0.16				-0.30
				(0.49)				(0.53)				(-0.47)
AdviSize				1.78				0.23				0.54
				(0.93)				(0.85)				(0.95)
AdviTech				2.53				0.50				0.03
				(1.22)				(1.54)				(0.04)
IMR									-0.89	0.47	0.62	0.93
									(-0.23)	(0.44)	(0.57)	(0.84)
Constant	1.33	65.23***	53.52***	50.38**	-0.15	20.17***	19.03***	19.41***	14.26***	18.84***	15.00**	15.27***
	(0.84)	(3.39)	(2.65)	(2.54)	(-0.88)	(3.78)	(3.45)	(3.41)	(4.08)	(3.19)	(2.56)	(2.64)
N	355	316	304	304	355	316	304	304	210	203	198	198
R-squared									0.19	0.24	0.27	0.28

Table 6 Effect of Blockchain Rating on Post-ICO Listing

This table reports the effect of Blockchain Rating on the likelihood of listing on a cryptocurrency exchange within 180 days after the ICO end date. Columns (1) to (4) show results of using a Hazards model, while columns (5) to (8) present results of using a Probit model. The definition of the variables is given in Appendix A. The sample period is from January 2016 through June 2018. z-statistics are reported in parentheses under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Hazards (Dependent variable = Days)				Probit (Dependent variable = Listing)			
BCRating	0.12	0.04	0.02	0.02	0.20	0.26*	0.26*	0.26*
	(1.27)	(0.39)	(0.23)	(0.15)	(1.58)	(1.78)	(1.72)	(1.69)
FundRank	0.42***	0.30**	0.26*	0.29**	0.95***	0.68***	0.61***	0.63***
	(3.39)	(2.27)	(1.87)	(2.07)	(5.28)	(3.28)	(2.81)	(2.85)
TokenDis	-0.24	-0.20	-0.23	-0.22	-0.49**	-0.25	-0.26	-0.23
	(-1.60)	(-1.27)	(-1.42)	(-1.32)	(-2.46)	(-1.02)	(-1.08)	(-0.94)
Lockup	0.15	0.23	0.23	0.26	0.37*	0.57**	0.60**	0.58**
	(0.93)	(1.36)	(1.36)	(1.47)	(1.71)	(2.39)	(2.47)	(2.35)
VestPer	0.02	-0.04	-0.05	-0.09	-0.03	-0.12	-0.17	-0.18
	(0.16)	(-0.22)	(-0.33)	(-0.56)	(-0.14)	(-0.48)	(-0.69)	(-0.72)
Gov	-0.16	-0.31*	-0.31*	-0.31*	-0.23	-0.42*	-0.42	-0.42
	(-0.91)	(-1.78)	(-1.74)	(-1.73)	(-1.05)	(-1.66)	(-1.61)	(-1.59)
UseFunds	0.03	0.01	0.01	-0.00	0.03	-0.02	-0.01	-0.02
	(0.24)	(0.06)	(0.04)	(-0.02)	(0.15)	(-0.08)	(-0.07)	(-0.11)
Risk	0.05	0.13	0.13	0.14	0.02	0.16	0.13	0.13
	(0.42)	(1.04)	(0.97)	(1.11)	(0.12)	(0.83)	(0.63)	(0.64)
Team	-0.02	0.02	0.01		-0.04	-0.02	-0.06	
	(-0.36)	(0.44)	(0.19)		(-0.70)	(-0.28)	(-0.83)	
Advi	0.06	0.12	0.13		0.13	0.26*	0.29**	
	(0.65)	(1.36)	(1.45)		(1.10)	(1.91)	(2.04)	
BitRetList		0.66**	0.69***	0.68**		0.67*	0.69*	0.66*
		(2.56)	(2.60)	(2.54)		(1.95)	(1.96)	(1.88)
BitVolList		0.54***	0.55***	0.57***		-0.78***	0.80***	0.80***
		(-4.56)	(-4.56)	(-4.62)		(-3.43)	(-3.45)	(-3.43)
BitStdList		0.00***	0.00***	0.00***		0.00***	0.00***	0.00***
		(3.24)	(3.22)	(3.34)		(4.00)	(4.06)	(4.04)
Words			0.13	0.12			0.32**	0.30**
			(1.42)	(1.34)			(2.20)	(2.06)
TeamBio				0.13				0.12
				(0.63)				(0.40)
TeamTech				0.05				0.04
				(0.24)				(0.13)
TeamMkt				-0.18				-0.09
				(-1.00)				(-0.30)
TeamSize				0.04				-0.29
				(0.17)				(-0.80)
AdviSize				0.04				0.24
				(0.20)				(0.74)
AdviTech				0.28				0.37
				(1.22)				(1.09)
Constant					1.78***	14.76***	12.63**	12.55**
					(-5.81)	(3.00)	(2.52)	(2.51)
N	303	303	292	292	314	314	302	302

Table 7 Interaction Effect of Blockchain Rating and Technicality on the Amount of Funds Raised at ICOs

This table reports the results of regressing the total amount of funds raised during the ICO period on the interaction term between *BCRating* and *Technicality*. Columns (1) to (4) summarize results using a Tobit model, while column (5) to (12) show the results of the Heckman two-step procedure. The definition for the variables is given in Appendix A. The sample period is from January 2016 through June 2018. *t*- or *z*-statistics are reported in parentheses under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
					Heckman two-step procedure							
	Tobit				Probit				OLS (Amount raised>0)			
*BC*Tech*	1.95	0.58	0.34	0.35	0.36*	0.24	0.22	0.21	-0.14	0.10	-0.00	0.00
	(1.36)	(0.44)	(0.26)	(0.28)	(1.89)	(1.10)	(1.00)	(0.91)	(-0.30)	(0.28)	(-0.00)	(0.01)
BCRating	1.41	2.80**	3.13***	3.12***	0.09	0.32*	0.35**	0.37**	0.61	0.63*	0.82**	0.88**
	(1.13)	(2.40)	(2.66)	(2.67)	(0.64)	(1.93)	(2.04)	(2.07)	(1.64)	(1.74)	(2.21)	(2.32)
Technicality	1.69	1.36	1.41	1.13	0.09	0.07	0.08	0.07	0.46	0.54	0.57	0.51
	(0.92)	(0.82)	(0.85)	(0.68)	(0.42)	(0.28)	(0.33)	(0.26)	(0.88)	(1.14)	(1.18)	(1.05)
TokenDis	-1.19	-0.39	-0.59	-0.83	-0.10	-0.03	-0.08	-0.10	-0.35	-0.64*	-0.62	-0.67*
	(-0.77)	(-0.26)	(-0.41)	(-0.58)	(-0.56)	(-0.13)	(-0.36)	(-0.44)	(-0.85)	(-1.67)	(-1.62)	(-1.72)
Lockup	3.30*	3.36**	2.79*	2.54	0.39*	0.61**	0.53**	0.53**	0.19	0.62	0.61	0.59
	(1.89)	(2.09)	(1.73)	(1.59)	(1.83)	(2.47)	(2.10)	(2.02)	(0.30)	(1.37)	(1.36)	(1.30)
VestPer	1.76	0.99	0.81	1.09	0.11	-0.04	-0.03	0.04	0.34	0.56	0.38	0.39
	(1.00)	(0.63)	(0.51)	(0.69)	(0.51)	(-0.18)	(-0.12)	(0.17)	(0.74)	(1.35)	(0.88)	(0.90)
Gov	3.04*	1.23	0.83	0.70	0.38	0.09	-0.00	-0.03	0.23	0.61	0.65	0.64
	(1.71)	(0.75)	(0.51)	(0.43)	(1.63)	(0.33)	(-0.00)	(-0.10)	(0.40)	(1.48)	(1.58)	(1.55)
UseFunds	-2.93**	-3.03**	-2.87**	-2.55*	-0.36**	-0.44**	-0.42**	-0.39**	0.38	-0.04	-0.02	-0.01
	(-2.03)	(-2.28)	(-2.19)	(-1.96)	(-2.18)	(-2.26)	(-2.16)	(-1.99)	(0.65)	(-0.09)	(-0.06)	(-0.02)
Risk	0.67	0.17	0.11	-0.02	0.08	0.15	0.16	0.12	0.02	0.00	-0.05	-0.03
	(0.49)	(0.14)	(0.09)	(-0.02)	(0.53)	(0.80)	(0.84)	(0.63)	(0.05)	(0.01)	(-0.15)	(-0.09)
Team	0.97*	0.69	0.74		0.09	0.06	0.08		0.18	0.30**	0.28**	
	(1.96)	(1.49)	(1.57)		(1.61)	(0.96)	(1.14)		(1.04)	(2.37)	(2.14)	
Advi	1.79*	2.60***	2.46***		0.19*	0.40***	0.40***		0.18	0.30	0.30	
	(1.93)	(3.05)	(2.89)		(1.67)	(3.02)	(2.92)		(0.56)	(1.12)	(1.14)	
BitRet		3.94**	3.73**	3.54*		0.26	0.24	0.18		-0.46	-0.30	-0.32
		(2.11)	(2.01)	(1.93)		(0.91)	(0.83)	(0.62)		(-0.83)	(-0.55)	(-0.59)
BitVol		-2.65***	2.41***	-2.27**		-0.94***	-0.89***	-0.91***		-0.23	-0.28	-0.28
		(-2.84)	(-2.60)	(-2.48)		(-3.68)	(-3.43)	(-3.41)		(-0.79)	(-0.98)	(-0.99)
BitStd		0.00	0.00	0.00		0.00*	0.00*	0.00*		0.00**	0.00*	0.00*
		(0.53)	(0.24)	(0.24)		(1.95)	(1.68)	(1.76)		(2.09)	(1.94)	(1.88)
Words			0.38	0.54			-0.03	-0.03			0.36*	0.38*
			(0.46)	(0.65)			(-0.24)	(-0.19)			(1.68)	(1.74)
TeamBio				-2.67				-0.36				-0.04
				(-1.42)				(-1.32)				(-0.06)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
					Heckman two-step procedure							
	Tobit				Probit				OLS (Amount raised>0)			
TeamTech				-0.50				-0.08				0.43
				(-0.26)				(-0.28)				(0.76)
TeamMkt				4.64***				0.60**				0.83
				(2.77)				(2.31)				(1.53)
TeamSize				1.34				0.22				-0.16
				(0.62)				(0.70)				(-0.26)
AdviSize				1.56				0.19				0.45
				(0.82)				(0.70)				(0.80)
AdviTech				2.71				0.51				0.14
				(1.30)				(1.56)				(0.23)
IMR									-1.46	0.60	0.89	1.06
									(-0.56)	(0.59)	(0.86)	(1.00)
Constant	0.95	58.97***	51.02**	48.41**	-0.19	20.02***	19.33***	19.78***	14.57***	17.40***	15.17***	15.14***
	(0.56)	(3.06)	(2.54)	(2.45)	(-1.00)	(3.70)	(3.45)	(3.43)	(6.13)	(3.10)	(2.67)	(2.68)
N	355	316	304	304	355	316	304	304	210	203	198	198
R-squared									0.22	0.27	0.28	0.29

Table 8 Interaction Effect of Blockchain Rating and Technicality on Post-ICO Listing

This table reports the interactive effect of *Technicality* over Blockchain Rating on the likelihood of listing on a cryptocurrency exchange. Columns (1) to (4) show results of using a Hazards model, while columns (5) to (8) present results of using a Probit model. The definition of the variables is given in Appendix A. The sample period is from January 2016 through June 2018. z-statistics are reported in parentheses under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Hazards (Dependent variable = Days)				Probit (Dependent variable = Listing)			
*BC*Tech*	0.04	-0.05	-0.02	-0.01	0.06	-0.05	-0.04	-0.04
	(0.32)	(-0.38)	(-0.13)	(-0.07)	(0.33)	(-0.23)	(-0.17)	(-0.17)
FundRank	0.42***	0.29**	0.25*	0.28**	0.95***	0.65***	0.60***	0.62***
	(3.30)	(2.18)	(1.82)	(2.03)	(5.21)	(3.07)	(2.71)	(2.75)
BCRating	0.10	0.04	0.02	0.00	0.16	0.26	0.27	0.26
	(0.83)	(0.36)	(0.16)	(0.03)	(0.98)	(1.36)	(1.35)	(1.32)
Technicality	-0.01	0.13	0.07	0.08	-0.04	0.18	0.10	0.10
	(-0.07)	(0.81)	(0.43)	(0.50)	(-0.18)	(0.67)	(0.36)	(0.37)
TokenDis	-0.24	-0.18	-0.21	-0.20	-0.48**	-0.21	-0.24	-0.21
	(-1.53)	(-1.10)	(-1.28)	(-1.18)	(-2.41)	(-0.86)	(-0.97)	(-0.84)
Lockup	0.15	0.22	0.23	0.25	0.38*	0.57**	0.59**	0.57**
	(0.93)	(1.30)	(1.33)	(1.45)	(1.72)	(2.36)	(2.44)	(2.31)
VestPer	0.03	-0.02	-0.04	-0.08	-0.02	-0.09	-0.16	-0.17
	(0.20)	(-0.15)	(-0.27)	(-0.49)	(-0.11)	(-0.35)	(-0.61)	(-0.64)
Gov	-0.17	-0.31*	-0.31*	-0.32*	-0.24	-0.43*	-0.42	-0.41
	(-0.96)	(-1.78)	(-1.75)	(-1.75)	(-1.08)	(-1.65)	(-1.59)	(-1.56)
UseFunds	0.04	0.01	0.01	0.00	0.02	-0.02	-0.01	-0.02
	(0.27)	(0.09)	(0.06)	(0.00)	(0.13)	(-0.08)	(-0.06)	(-0.10)
Risk	0.05	0.11	0.12	0.13	0.02	0.15	0.12	0.12
	(0.37)	(0.90)	(0.89)	(1.01)	(0.14)	(0.74)	(0.59)	(0.60)
Team	-0.02	0.02	0.01		-0.05	-0.02	-0.06	
	(-0.36)	(0.46)	(0.21)		(-0.71)	(-0.24)	(-0.79)	
Advi	0.06	0.12	0.13		0.13	0.26*	0.29**	
	(0.66)	(1.34)	(1.44)		(1.12)	(1.91)	(2.03)	
BitRetList		0.66**	0.69***	0.69**		0.65*	0.68*	0.66*
		(2.57)	(2.61)	(2.55)		(1.90)	(1.93)	(1.86)
BitVolList		0.55***	0.55***	0.57***		-0.80***	0.81***	0.80***
		(-4.60)	(-4.57)	(-4.64)		(-3.43)	(-3.45)	(-3.43)
BitStdList		0.00***	0.00***	0.00***		0.00***	0.00***	0.00***
		(3.29)	(3.23)	(3.35)		(4.04)	(4.06)	(4.04)
Words			0.12	0.11			0.31**	0.29*
			(1.28)	(1.17)			(2.09)	(1.94)
TeamBio				0.14				0.13
				(0.69)				(0.43)
TeamTech				0.04				0.04
				(0.18)				(0.11)
TeamMkt				-0.19				-0.09
				(-1.05)				(-0.30)
TeamSize				0.05				-0.29
				(0.23)				(-0.78)
AdviSize				0.03				0.24
				(0.17)				(0.73)
AdviTech				0.29				0.37
				(1.26)				(1.09)
Constant					1.75***	14.98***	12.79**	12.70**
					(-5.52)	(3.00)	(2.53)	(2.52)
N	303	303	292	292	314	314	302	302

Table 9 Effect of Technicality on the Amount of Funds Raised during the ICO period, by subsamples of Blockchain Rating

This table reports the Tobit estimation of the effect of *Technicality* on the amount raised at ICOs by *BCRating* subsamples. The definition for the variables is given in Appendix A. The sample period is from January 2016 through June 2018. z-statistics are reported in parentheses under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	BCRating=0				*BCRating*=1				*BCRating*=2			
Technicality	2.63	1.98	2.25	1.82	3.65**	2.51*	2.62*	2.47*	5.07***	2.49**	2.13*	2.25*
	(1.09)	(0.89)	(0.95)	(0.77)	(2.37)	(1.75)	(1.84)	(1.72)	(3.57)	(2.06)	(1.83)	(1.99)
TokenDis	1.85	3.37	2.66	1.46	-2.83	-2.07	-1.67	-1.81	-1.74	-0.05	-1.15	-1.66
	(0.57)	(1.07)	(0.81)	(0.45)	(-1.23)	(-0.93)	(-0.76)	(-0.83)	(-0.75)	(-0.03)	(-0.61)	(-0.88)
Lockup	12.21***	10.15***	9.89***	8.98**	1.07	1.76	0.69	0.40	0.87	-1.09	-1.10	-0.10
	(2.98)	(2.81)	(2.68)	(2.48)	(0.47)	(0.83)	(0.32)	(0.19)	(0.26)	(-0.36)	(-0.40)	(-0.03)
VestPer	-7.44	-9.29**	-9.82**	-10.73**	4.06*	3.37*	3.42*	3.93**	-1.01	-1.08	-0.39	-1.10
	(-1.42)	(-2.02)	(-2.11)	(-2.34)	(1.88)	(1.77)	(1.79)	(2.05)	(-0.30)	(-0.38)	(-0.15)	(-0.41)
Gov	6.43	5.46	4.07	4.41	4.06	2.70	2.31	2.03	0.47	-0.88	-0.99	-0.68
	(1.40)	(1.25)	(0.88)	(0.96)	(1.60)	(1.18)	(1.03)	(0.91)	(0.20)	(-0.45)	(-0.55)	(-0.38)
UseFunds	-4.49	-4.23	-4.66	-3.93	-1.42	-1.85	-1.57	-1.37	-3.87	-4.57**	-4.14**	-3.57*
	(-1.39)	(-1.46)	(-1.62)	(-1.36)	(-0.72)	(-1.04)	(-0.89)	(-0.77)	(-1.50)	(-2.09)	(-2.06)	(-1.72)
Risk	-3.31	-2.56	-1.31	-1.76	1.84	0.50	-0.13	0.02	0.94	1.12	0.37	0.01
	(-1.03)	(-0.89)	(-0.44)	(-0.57)	(1.02)	(0.31)	(-0.08)	(0.01)	(0.39)	(0.58)	(0.20)	(0.00)
Team	-0.07	-0.90	-0.45		1.70**	1.83***	1.83***		0.36	0.69	0.59	
	(-0.06)	(-0.91)	(-0.45)		(2.37)	(2.64)	(2.61)		(0.52)	(1.16)	(1.06)	
Advi	7.12***	9.00***	8.50***		1.26	1.82	1.54		-0.18	0.09	0.03	
	(2.75)	(3.88)	(3.68)		(1.04)	(1.65)	(1.38)		(-0.13)	(0.08)	(0.03)	
BitRet		8.51*	10.00**	10.36**		1.30	0.63	0.55		2.29	1.93	2.10
		(1.99)	(2.30)	(2.44)		(0.51)	(0.25)	(0.22)		(0.82)	(0.75)	(0.84)
BitVol		-4.22*	-4.59**	-4.81**		-4.27***	3.88***	3.83***		-0.81	-0.25	0.30
		(-1.98)	(-2.14)	(-2.31)		(-3.00)	(-2.77)	(-2.76)		(-0.78)	(-0.26)	(0.31)
BitStd		-0.00	0.00	0.00		0.00	0.00	0.00		0.00	-0.00	-0.00
		(-0.18)	(0.09)	(0.28)		(1.21)	(0.76)	(0.80)		(0.39)	(-0.03)	(-0.54)
Words			-1.24	-0.54			1.41	1.15			-0.41	0.03
			(-0.58)	(-0.25)			(0.90)	(0.72)			(-0.56)	(0.05)
TeamBio				-5.32				0.67				-3.74
				(-1.49)				(0.23)				(-1.52)
TeamTech				-2.20				-0.97				-1.02
				(-0.47)				(-0.39)				(-0.32)
TeamMkt				6.32*				5.88**				1.48
				(1.72)				(2.43)				(0.63)
TeamSize				0.19				2.06				4.57

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		BCRating=0				*BCRating*=1				*BCRating*=2		
				(0.04)				(0.72)				(1.20)
AdviSize				8.50**				-0.35				-0.43
				(2.03)				(-0.14)				(-0.10)
AdviTech				7.95*				2.88				0.30
				(1.71)				(1.05)				(0.07)
Constant	-0.47	92.33**	109.46**	110.31**	0.19	93.11***	73.84**	75.96**	9.47***	28.49	22.47	8.88
	(-0.17)	(2.09)	(2.27)	(2.34)	(0.08)	(3.19)	(2.41)	(2.50)	(4.28)	(1.38)	(1.11)	(0.42)
N	100	92	88	88	200	175	168	168	55	49	48	48

Table 10 Effect of Technicality on Post-ICO Listing, by subsamples of Blockchain Rating

This table reports the Probit estimation of the effect of *Technicality* on the likelihood of an ICO listed its token on a cryptocurrency exchange within 180 days after the ICO end date (i.e., dependent variable is *Listing*), by *BCRating* subsamples. The definition for the variables is given in Appendix A. The sample period is from January 2016 through June 2018. z-statistics are reported in parentheses under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	BCRating=0				BCRating=1				BCRating=2			
Technicality	0.42	0.76*	0.89	1.13	-0.38*	-0.10	-0.19	-0.18	0.64*	0.79	0.76	0.46
	(1.63)	(1.68)	(1.62)	(1.58)	(-1.83)	(-0.43)	(-0.74)	(-0.66)	(1.91)	(1.60)	(1.48)	(0.34)
FundRank					1.12***	0.77***	0.62*	0.66**	0.91*	1.72**	1.63**	10.62
					(4.40)	(2.58)	(1.92)	(2.00)	(1.70)	(2.20)	(2.06)	(1.34)
TokenDis	-0.80**	0.46	0.62	0.46	-0.38	-0.22	-0.19	-0.15	-0.37	-0.05	-0.14	-4.23
	(-2.03)	(0.67)	(0.83)	(0.52)	(-1.25)	(-0.57)	(-0.48)	(-0.37)	(-0.73)	(-0.07)	(-0.18)	(-0.96)
Lockup	0.07	1.05	1.42	2.40*	0.59**	0.97***	1.05***	1.02***	1.62*	1.41	1.38	5.52
	(0.14)	(1.15)	(1.39)	(1.70)	(2.10)	(3.07)	(3.10)	(2.98)	(1.88)	(1.28)	(1.26)	(1.04)
VestPer	-0.49	-0.12	0.06	0.60	-0.22	-0.35	-0.53	-0.61	1.46	1.43	1.43	14.17
	(-0.88)	(-0.14)	(0.07)	(0.38)	(-0.80)	(-1.07)	(-1.43)	(-1.58)	(1.62)	(1.39)	(1.34)	(1.10)
Gov	0.90*	1.98**	2.18**	2.83**	-0.60*	-0.88**	-0.96**	-0.94**	-1.02*	-1.36*	-1.36*	-4.51
	(1.74)	(2.25)	(2.24)	(2.30)	(-1.71)	(-2.08)	(-2.14)	(-2.08)	(-1.78)	(-1.69)	(-1.73)	(-1.23)
UseFunds	0.40	0.47	0.61	1.10	-0.14	0.01	-0.06	-0.08	0.56	0.84	0.82	8.40
	(1.04)	(0.85)	(1.04)	(1.46)	(-0.54)	(0.02)	(-0.18)	(-0.23)	(0.88)	(0.95)	(0.95)	(1.20)
Risk	-0.37	-0.61	-0.66	-0.74	0.22	0.29	0.10	0.11	-0.31	-0.54	-0.55	-5.38
	(-0.99)	(-0.99)	(-1.06)	(-0.91)	(0.91)	(1.05)	(0.32)	(0.37)	(-0.60)	(-0.73)	(-0.75)	(-0.99)
Team	0.03	0.01	-0.14		-0.10	-0.01	-0.02		-0.32*	-0.68**	-0.67**	
	(0.27)	(0.06)	(-0.57)		(-1.04)	(-0.05)	(-0.15)		(-1.72)	(-2.24)	(-2.20)	
Advi	0.21	-0.10	0.06		0.22	0.36*	0.31		0.27	1.30**	1.24**	
	(0.74)	(-0.23)	(0.13)		(1.42)	(1.93)	(1.52)		(0.77)	(2.26)	(2.13)	
BitRetList		4.88**	5.08**	7.50**		-0.80	-0.92	-0.90		1.08	1.14	10.96
		(2.39)	(2.40)	(2.48)		(-1.43)	(-1.55)	(-1.50)		(0.99)	(1.05)	(1.21)
BitVolList		-0.23	-0.18	0.03		-2.44***	-2.87***	-2.91***		-0.53	-0.48	-0.24
		(-0.39)	(-0.34)	(0.04)		(-3.50)	(-3.75)	(-3.70)		(-1.02)	(-0.92)	(-0.22)
BitStdList		-0.00	-0.00	-0.00		0.00***	0.00***	0.00***		0.00	0.00	-0.00
		(-0.43)	(-0.43)	(-1.10)		(4.38)	(4.60)	(4.57)		(1.56)	(1.42)	(-0.23)
Words			0.14	0.32			0.77***	0.75**			-0.00	-1.18
			(0.40)	(0.79)			(2.68)	(2.56)			(-0.01)	(-0.62)
TeamBio				-1.99*				0.39				1.04
				(-1.66)				(0.76)				(0.64)
TeamTech				-0.99				0.22				-12.39
				(-0.58)				(0.48)				(-1.22)
TeamMkt				1.49				-0.41				7.93

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	BCRating=0				BCRating=1				BCRating=2			
				(1.50)				(-0.86)				(1.23)
TeamSize				0.96				-0.16				-4.44
				(0.67)				(-0.32)				(-1.19)
AdviSize				-1.07				0.09				21.64
				(-0.63)				(0.19)				(0.03)
AdviTech				0.92				0.65				-19.68
				(0.58)				(1.39)				(-0.02)
Constant	-0.57*	3.51	0.98	-4.64	1.76***	50.35***	53.33***	54.10***	-1.08	8.22	7.45	2.27
	(-1.94)	(0.27)	(0.08)	(-0.30)	(-3.98)	(3.34)	(3.30)	(3.26)	(-1.22)	(0.75)	(0.68)	(0.11)
N	92	92	88	88	173	173	166	166	49	49	48	48