Initial Coin Offerings, Blockchain Technology, and Voluntary Disclosures[1]

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Abstract

Initial coin offering (ICO) has emerged as a major financing tool for blockchain-based entrepreneurial ventures. We evaluate whether an ICO project needs a blockchain platform or not and develop an ICO rating system, based on information disclosed voluntarily by the ICO issuers in the so-called "white paper." We find that ICO projects with a higher rating raised more funding at ICOs, are more likely to exceed the minimum funding target, and are closer to the maximum funding target. However, the rating is not associated with the likelihood of the ICOs being listed in a cryptocurrency exchange within the first 180 days after the end of the ICO period.

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1. Introduction

Initial coin offerings (ICOs) have provided an innovative way for entrepreneurs to raise capital for their early-stage ventures, for consumers to acquire right to products or services that are still being under development, and for investors to access a new asset class. In an ICO, an issuer uses blockchain or distributed ledger technology to create a new cryptocurrency and sell the new digit coins or tokens to backers of their projects. The ease of creating new crypto tokens using an existing blockchain platform (e.g., Ethereum or Waves) has led to a surge in the number of ICOs in recent years. On the other hand, the astronomical rise in Bitcoin price in 2017 has attracted investors to the cryptocurrency market. However, the tokens sold in the ICOs may or may not be considered securities under current securities laws. This is because the tokens give the buyers the right to get access to the products or services provided by the platforms being built by the ventures, but not an equity stake on the projects or issuers. The ICO surge has ignited debates among regulators, legal scholars, academics, and other stakeholders on the legitimacy of ICOs and the need for regulations. On one extreme, China and South Korea have banned ICOs since September 2017. On another extreme, jurisdictions such as Singapore, Switzerland, and Malta have embraced it as an innovation and heavily promoted themselves as the ideal designations for blockchain-based ventures, including FinTech companies. Most countries are still developing applicable regulations, while some are following the wait-and-see approach. Since most ICOs are not regulated, misconducts and scams are a major concern (SEC 2018). Moreover, issuers may use blockchain as a marketing stunt to take advantage of the hype in the cryptocurrency market, even though their ventures actually do not need a blockchain (Wust and Gervais 2017).

ICO issuers face a severe information asymmetry problem, because they are pre-revenue businesses and some are still in the idea stage. If the issuers do nothing to mitigate this information gap, it will impede their chance of raising the funds required to launch the projects beyond the idea stage. Indeed, the voluntary disclosure literature has shown that companies have incentives to provide information voluntarily to reduce information asymmetry in general (Healy and Palepu 2001, Leuz and Wysocki 2016), during seasoned equity offerings (Frankel, McNichols and Wilson 1995, Lang and Lundholm 2000), and even in unregulated peer-to-peer lending (Michels 2012). To that end, most ICO issuers use a "white paper" to provide information about their ventures (such as business plan, blockchain platform design, founding team background, token distribution, use of funds, milestones, etc). Hence, white papers are similar to prospectus used for equity issuances in terms of the information provided by the issuers. However, white papers are neither regulated nor audited. While issuers can use white papers to fill the information gap between them and prospective buyers, some have used them to hype their ICOs (see section 2.3).

The ICO setting differs from other capital raising settings in the sense that their underlying blockchain architecture can make the disclosures in white papers credible, even in the absence of regulation or enforcement. A blockchain is a distributed digit ledger, which is used to store transaction records or self-executing codes into blocks and saved across a network of computers. It uses cryptographic techniques and a consensus mechanism to verify data to be included into a new block and reconcile discrepancies across the computer network, thereby eliminating the need for a central control or trusted third party. This decentralized feature means that the blockchain platforms are not controlled by any party, including the founders/creators. The tokens are used as a mean to reward the founders, their teams, and other helpers for creating

and maintaining the open-source platforms. Any computer can join the platforms without permission (i.e., "permissionless") and help verify new data in return for tokens. Bitcoin is a well-known application of such a public, decentralized blockchain architecture; so is Ethereum. In contrast, some ICOs are similar to crowdfunding campaigns because they use a private "permissioned" blockchain architecture. As a result, the founders still control the ventures and decide what records can be appended to the blockchain. Hence, whether the blockchain platform is decentralized or not is potentially an important signal for investors.

Second, the terms and conditions of the token sales, as well as the rights and obligations of insiders and other token owners can be encoded into self-executing "smart contracts." For example, the maximum number of tokens for sales in an ICO, the schedule of future token issuances, and token voting right can be encoded into the blockchain platform. 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 will be released for sales or transferred directly to the service providers only when specific milestones are met. Hence, ICO issuers can make credible commitments using their blockchain platforms. However, Cohney, Hoffman, Sklaroff and Wishnick (2018) examine the top-50 ICOs in 2017 by amount raised and find that the source codes of many ICO issuers failed to reflect three specific governance attributes (i.e., token supply, vesting, and modifiability) given in their white papers and other marketing materials.

In this study, we investigate whether the information voluntarily disclosed in ICO white papers helps investors distinguish ICOs that have a legitimate use of the blockchain technology from ones that mainly use blockchain as a marketing gimmick. Specifically, we develop a rating

scheme to evaluate whether a venture needs a blockchain, using detailed information on the blockchain architecture provided in the ICO white papers. We also count the number of times the issuers mentioned the decentralization feature of their blockchain platforms in their white papers. Finally, we keep track of whether the issuers disclose information on token distribution, lockup period, vesting period, governance, use of funds raised, team biography, team technical background, team marketing background, team size, advisor team size, advisor's background, and project risk.

We test whether these factors are associated with ICO success during the ICO period and during the 180 days subsequent to the ICO period. We capture ICO success during the ICO period using the amount raised, the percentage of amount raised above the minimum funding target (soft cap) if positive, and whether the amount raised exceeds 80% of the maximum target (hard cap) or not. If we cannot find the amount raised for an ICO after extensive search, we set it to zero, assuming that the ICO failed. We use a Tobit model for this analysis. Since not all ICOs provide their soft caps or hard caps, the related analysis is done on a small subsample. We capture ICO success in the 180 days after the ICO period using the number of days it took to be listed on a cryptocurrency exchange. If it took an ICO more than 180 days to be listed, we assume that the ICO failed. We use a hazards model to conduct this analysis.

Our sample consists of 369 ICOs that are randomly-selected from 1,581 ICOs with white papers available for the period January 2016 through June 2018. Unlike other studies, we do not restrict our sample to ICOs with non-missing amount of funds raised or token trading data. The fact that ICOs have missing amount raised or token trading prices (i.e., not listed on an exchange) is indicative of their failure to raise sufficient funds and meet listing requirement.

Excluding these ICOs will bias the estimation, especially given the fact that many ICOs have missing amount raised or token trading price data.

First, we document that over half of the ICOs do not need a blockchain, according to the criteria in Wust and Gervais (2017). In fact, only 59 ICOs receive a rating of three or higher (out of five), while 160 ICOs have a rating of one and 75 have a rating of zero. Second, the Tobit model regressions show that ICO rating is positively associated with the likelihood of having a non-zero amount raised and the amount raised. ICO rating also has a positive effect on the likelihood of raising an amount above the soft cap or within 80% of the hard cap, as well as the amount raised above the soft cap or above 80% of the hard cap. Finally, the hazards model finds no evidence that ICO rating has power explaining the number of days it took for an ICO to be listed on a cryptocurrency exchange. Taken together, these empirical results are consistent with ICO token buyers considering the blockchain technology being used by the ICO projects when making their purchasing decision. Since ICO white paper is the token buyers' main source of information, our finding that buyers rely on this information suggests that the credibility of the information is important to protect the interests of ICO buyers/investors.

This study contributes to two strands of literatures. First, we add to the emerging ICO literature that has examined various project, issuer and token characteristics to shed light on ICO success, as captured by first-day raw and abnormal returns, post-ICO token performance, total amount raised, liquidity, volatility, and crash risk (see section 3 for a summary). Similar to these studies, we also examine these characteristics collected from ICO white papers. However, we put additional emphasis on the blockchain architecture employed by the ventures. The documented results are consistent with investors being able to distinguish ICOs that need a blockchain versus

those that do not. We also use a Tobit model and a hazards model to avoid sample selection biases.

Second, we contribute to the voluntary disclosure literature, especially related to capital raising activities. We find that information collected from ICO white papers, especially on the blockchain architecture used by the ventures, are associated with the amount raised in ICOs. Given that ICO white papers are unregulated and unaudited, our results suggest that startup ventures use white papers as a medium to voluntarily provide valuable information to reduce the information gap between them and their potential investors. The fact that the blockchain technology allows ICO issuers to encode the rights and obligations of the insiders and other token owners into self-executing "smart contracts," the disclosure of the blockchain architecture is a costly signal that make it credible.

The rest of the paper is organized as follows. Section 2 discusses institutional background on blockchain and ICOs. Section 3 summarizes the related research on ICOs. Section 4 describes the data and sample, while section 5 presents the empirical findings. Section 6 concludes.

2. Background

2.1 Blockchain and Cryptocurrencies

A blockchain is a distributed digit ledger, which is used to store records into blocks and shared across a network of computers, called "nodes." 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 problems (the so-called "proof-of-work" or "mining" system)[2]. If the node earns the right to add the block to the chain, it will receive coins or tokens native to the blockchain. If the content of a block is altered

[2] Solving a math problem is unnecessary in some other type of systems, such as in "proof-of-stake" systems.

(intentionally by the node owner or hackers) in one of the nodes on the network, the hash value associated with the block will change and so are 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 reconciliated using a consensus mechanism. Hence, it is very difficult to alter or delete the content of the blockchain, making it "immutable." Since the blockchain is shared by a network of computers based on a consensus mechanism, it does not require a central control or trusted third party (i.e., "decentralized").

The most well-known application of the blockchain technology is Bitcoin (Satoshi, 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." Over half of the initial coin offerings are based on the Ethereum platform. The terms and conditions of the token sales, as well as the rights and obligations of insiders and other token owners can be written into "smart contracts," as part of the source code. For example, the maximum number of tokens for sales in the ICO, future issuance of additional tokens, and voting right 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 will be released for sales or transferred directly to the service providers only when specific milestones are met.

2.2 Initial Coin Offerings (ICOs)

ICOs, token sales, or crowd sales provide a mean for early-stage startups to raise funding for their projects. The majority of ICO-issuers use blockchain technology in various degree 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 use an existing blockchain-based platform (e.g., Ethereum or Waves) or create a new blockchain to issue virtual tokens/coins and sell a percentage of them to early backers of the projects. The backers purchase the coins/tokens either hoping to use the products or services created by the platforms when the projects are completed or to sell the tokens for a profit. ICO was first held by Mastercoin in July 2013. Ethereum used ICO as a funding tool in August 2014 and raised 3,700 Bitcoins in the first 12 hours, worthy approximately $2.3 million at that thime. ICOs became increasingly popular with early-stage ventures in 2017. According to icodata.io, 1,001 ICOs raised almost $6.3 billion in the first seven months of 2018, compared with 873 ICOs and $6.2 billion in 2017.[3]

Section 2.2.1 describes the ICO process. Section 2.2.2 explains post-ICO listing and trading of the coins/tokens sold in the ICOs. Section 2.2.3 discusses current regulations and ICO scams.

2.2.1 The ICO Process

One of the first steps for entrepreneurs to use ICO to fund their early-stage projects is to write a white paper. Similar to an IPO prospectus to certain extent, the white paper usually describes the project, the blockchain architecture that will be used, the background of the founder and team members, token distribution, use of funds, etc. While some white papers are technically-oriented and heavy on mathematical formulas and academic models, others are more business-oriented and focus on the global trend and landscape of the business opportunity.

For example, Sirin Labs initiated an ICO to fund the development of FINNEY, an open-source blockchain smartphone and all-in-one PC. The white paper has nine sections and is 33-

[3] See https://www.icodata.io/stats/2018 and https://www.icodata.io/stats/2017.

page long. In sections one and two, it describes the background of the Sirin labs and their mission to develop the world's first securest phone. In section three, it discusses the security challenges embedded in smartphone operating systems and apps. Section four introduces the features and specifications of the new cryptography-based operating system of the product Finney, including a distributed ledger consensus module and a decentralized app-store (D-AAP). In section five, the white paper provides details on its blockchain technology, architecture and hardware designs, system service and core libraries and Blockshield. Section 6 describes its marketing plan, including creating pre-sale buzz to generate awareness and presales. In section 7, the paper talks about its token distribution and crowdsale details. In particular, 40% will be allocated to the crowdsale, 35% to the SIRIN Labs, 10% to the team with a 12-month vesting period, 10% to the operating system, and the remaining 5% to professional fees and bounties. The fund allocated will be used for COGS (54%), R&D (21%), operations (9%), marketing (8%) and others. In section 8, it outlines the project's roadmap and milestones. Lastly, the white paper provides a half-page-long risk disclosure statement and concludes.

A founding team is usually composed of technical members (developers), marketing members, and advisors. Some teams have prior blockchain-related experience, while others are new to the field. Some of the advisors are brought in through the founders' network, while others recruited online via ICO-specific platforms. Some ICO teams also hire legal advisors to make sure that their ICOs are in compliance with all relevant regulations. Advisors are usually paid a percentage of the tokens sold.

The founding team will promote its ICO on various social media platforms with links to its white paper and website. For example, Tezos, an ICO that raised $232 million dollars, created its Twitter, Facebook, and Telegram accounts to post ICO-related information to its

followers. There are also many ICO-specific platforms that list and promote ICOs. For example, ICOBench.com lists more than 2,000 ICOs and provides different tiers of services to issuers that would like to list their ICO on the site. The regular listing is free and it offers two premium listings. For the price of one Bitcoin, a team can have its ICO listed on top of the browse section for three days, featured in competitors' ICO profiles, and have competitors removed from its own profile. For the price of 41 Bitcoins, an ICO will be posted on the top of the list for 30 days, featured in a weekly newsletter, and be provided with a full analytical review by the ICOBench expert team. There are other platforms such as ICODrops, Smith & Crown, Token Data, CryptoCompare, etc. Some are free, while others follow a similar business model as ICOBench. They differ in terms of their ICO coverage and analytics they offer. For example, ICOBench features an ICO-rating system combining the ratings determined by its ICO analytical robot (Benchy) and ICO advisors on its platform. TrackICO features statistics such as the ICO's twitter statistics and Alexa statistics. An ICO can be listed on multiple platforms. In addition to team-initiated listing on these platforms, some platforms add ICOs themselves to complete their databases.

During an ICO, prospective investors will first need to register on the project's website to buy tokens, 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. Usually the process is very simple and almost anyone can participate in an ICO (except those from jurisdictions that are restricted by the issuers). For example, in the sale of AVINOC, buyers can register simply by signing in with any of their social media accounts (e.g., Twitter, LinkedIn, Gmail, Microsoft, etc), and then they can deposit cryptocurrency to the address designated by the AVINOC team. There will a private presale and a public crowdsale. The presale takes place

between June 20, 2018 and July 15, 2018, and the crowdsale follows immediately between July 15, 2018 and July 31, 2018. In the pre-sales, the buyers get a discount of 7.5% but have to invest a minimum of $50,000. In the crowdsale, only a minimum of $10 is required to participate. To receive the AVINOC tokens, buyers need to have a personal ETH wallet address. The wallet supports ERC20 tokens and the buyers will own the private key to their digital wallets. After the crowdsale, the issuers sent AVINOC tokens to the addresses of the ETH-wallet registered by the buyers in the AVINOC system. The buyers can keep the tokens in their digit wallets or, if available, trade the tokens on an online exchange. Some ICOs require Know Your Customer (KYC) or Whitelist to meet anti-money laundering (AML) regulation, which might set a barrier for some investors to participate in the ICOs. Some ICOs also put restrictions on the country of domicile of the potential buyers, such that the issuers can avoid meeting the regulations of certain jurisdictions.

2.2.2 Post-ICO Exchange Listing

After the completion of an ICO, some tokens will be listed on virtual coin/token exchanges. According to CoinMarketCap.com, there are more than 1,855 tokens listed in a cryptocurrency exchange and more than 400 cryptocurrency exchanges trading Bitcoin. However, there are less exchanges trading a specific digit token. The well-known token "Tezos" is only traded on three exchanges: GateCoin, Gate.io, and HitBTC.[4] Unlike IPOs, tokens do not list on a cryptocurrency exchange immediately after the ICOs. It usually takes about one week to six months for a token to be listed on an exchange, if it gets listed at all.[5] As listing on exchange is a major way for coins/tokens to obtain liquidity, it is competitive to be listed on an exchange. *Business Insider* indicates that some cryptocurrency exchanges charge between $500,000 and

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

$1,000,000 for listing (Business Insider, 2018). Some big exchanges, such as Bittrex, are free to list, but the bar for listing is high. Specifically, the token must successfully complete a compliance review, which requires a legal memorandum to conclude 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. In addition to passing such a legal requirement, Bittrex takes into consideration the innovation of the project, new blockchain features, significant uses over existing blockchains, interesting innovative or unique applications, and market interest, etc. In addition to listing fees, most exchanges profit from transaction fees. According to *Bloomberg*, the top 10 exchanges are generating as much as $3 million in fees a day, or around $1 billion per year (Bloomberg 2018). Binance, the largest exchange by trading volume, only started its operation in July 2017. It claims to process up to 1.4 million orders per second, which makes it the fastest cryptocurrency exchange. Its rapid growth is also attributable to its loose requirement on customer registration. It does not require a "Know Your Customer (KYC)" process, which takes hours to complete. On the contrary, it can take as little as 20 minutes to open and fund a new Binance account. Among the top five cryptocurrency exchanges, four are based in Asia (Binance, Upbit, Huobi, and Bithumb), and one (Bittrex) in the United States. The identity of the traders on these exchanges are unknown, but U.S.-based exchanges are generally subject to more regulations. Founder and team members can trade their tokens on any cryptocurrency exchanges, but there is no requirement for insiders to disclose their trades at this time.

ICOs are speculative investments, because they are based on early-stage ventures. While some ICOs generate stunning returns, many ICOs have seen their token prices dropped dramatically after listing. For example, Tezos' ICO price was $0.47 USD and it is traded

between $1 to $ 5 dollars between 2017 and 2018, which is about two to ten times its ICO price. On the other hand, Sirin Labs' ICO price was $1.548 USD, it spiked for a short period of time after being launched on an exchange, and now trading around 10% to 20% of its ICO price since June 2018. There are also numerous ICOs that did not even make to any virtual exchange. Specifically, 188 out of the 220 ICOs in our sample are not listed within six months.

2.2.3 ICO Regulations and Frauds

As ICO is a relatively new field, regulators around the world are debating about the right legal rules for ICOs. While ICOs are banned in China and South Korea since September 2017, they are encouraged in crypto-friendly countries such as Singapore, Switzerland, Estonia, and Malta. The Monetary Authority of Singapore issues a guide to ICOs in November 2017.[6] Malta has established a regulatory framework to attract foreign investment in blockchain technologies, while Switzerland has designated a canton as a "Crypto Valley."[7] The U.S. Securities and Exchange Commission (SEC) and the Ontario Securities Commission in Canada have issued a series of warnings against ICOs.[8]

The SEC has maintained a website to educate retail investors on ICO scams.[9] It has also pursued enforcement actions against ICO-related frauds.[10] For example, the SEC files a complaint against Centra Tech for false representations.[11] Centra raised about $32 million between July 2017 and October 2017 from investors. As stated in the court filing, the co-founder Sohrab "Sam" Sharma was involved in every aspects of preparing the white paper, including text editing, graphics design, and formatting. According to the white paper, the purpose of Centra

[6] http://www.mas.gov.sg/News-and-Publications/Monographs-and-Information-Papers/2017/Guidance-on-Digital-Token-Offerings.aspx
[7] https://money.cnn.com/2018/07/18/technology/startups/malta-blockchain/index.html
[8] https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11
[9] https://www.sec.gov/news/press-release/2018-88
[10] https://www.sec.gov/spotlight/cybersecurity-enforcement-actions
[11] https://www.sec.gov/litigation/complaints/2018/comp-pr2018-70.pdf

was to raise capital to enable Centra to complete and operate the "world's first Multi-Blockchain Debit Card and Smart and Insured Wallet," a financial system that would allow holders of various hard-to-spend cryptocurrencies to easily convert their crypto assets into legal tender, such as the U.S. dollars, and spend these cryptocurrencies in real time using a Visa or MasterCard backed "Centra Card." All assets stored on Centra would be "fully insured" and the platform would be "the world's first Amazon style superstore designed to make crypto currency acceptable." The white paper suggests that the purchase of the Centra Token is a chance for investors to "join our success and mission while generating a profit." Centra began publicly releasing various versions of the white paper to generate investor interests.

The SEC alleges that Centra claimed false partnerships with Visa, Mastercard, The Bancorp, and an insurance company in their promotional materials. Centra created a fictional experienced businessman named "Michael Edwards" as its co-founder, including a photo randomly downloaded from the Internet, and stated that this fictitious co-founder has invested a lot of money in the project. In addition, Centra promised in its white paper that the "Centra Token Rewards Program" would entitle investors to 0.8% of total revenue that Centra will earn from all "Centra Card" transactions.

3. Research on ICOs

Three studies have analyzed the economic benefit of ICOs to entrepreneurs, as well as the potential welfare effects. Chod and Lyandres (2018) show that ICOs will be more optimal than traditional venture capital financing for ventures with highly uncertain payoffs, a larger proportion of idiosyncratic risk, low information asymmetry, and high risk of failure and right-skewed payoff distributions. Li and Mann (2018) illustrate that in the presence of network effect

(i.e., the value of a platform increases with the number of users), the ICO structure helps coordinate platform adoption and spread information about platform quality to late adopters who are less informed. Catalini and Gans (2018) find that an ICO helps reveal consumer demand for the venture's platform by generating buyer competition for the token, leading to higher returns to the issuer than traditional equity financing. However, the ICO will fail if the issuer cannot commit to a future token sale schedule and to only accept the tokens for accessing the platform.

Several empirical studies examine ICO success, as captured by a variety of measures. Adhami, Guidici and Martinazzi (2018) examine 253 ICOs, of which 81% were considered successful, from 2014 to August 2017. Using a Logit model, they find that the available of a project's source code, Pre-ICO sale and token characteristics, but not the available of a white paper or discount for early buyers, are associated with a higher likelihood of success. For 140 ICOs with trading data, they also find that the mean (median) first-day return was 929.9% (24.7%), with over 65% of them exhibited a positive first-day return (i.e., underpriced).

Momtaz (2018) studies ICO underpricing in more details for a sample of 302 tokens with trading data on coinmarketcap.com between August 2015 and April 2018. He documents that average first-day raw and abnormal returns range from 6.8% to 8.2%, but 39.5%-45.7% of the ICOs experienced negative first-day returns.[12] Using ICOBench.com expert ratings (on management team quality, project vision, and ICO profile), he finds that management team and project vision exhibit robust explanatory power for first-day returns, the probability of positive first-day returns, total amount raised, and delisting from one or all cryptocurrency exchanges.

Benedetti and Kostovetsky (2018) investigate both ICO underpricing and post-ICO performance using coinmarketcap.com trading data for ICOs completed up to the end of April

[12] He computes first-day raw returns as the first closing price minus first opening price scaled by first opening price and first-day abnormal returns as first-day raw returns minus either the equal-weighted or value-weighted returns on all cryptocurrencies available on coinmarketcap.com.

2018. In 416 ICOs that are listed within 60 days after the ICO end dates, they document a value-weighted average return of 173% over an average 31-day holding period between the end of the ICO and the opening of the first trading day.[13] Finally, the post-ICO buy-and-hold token market-adjusted returns from investing at the first-day opening price are significantly positive for four holding horizons, ranging from 1 day to 30 days..

Amsden and Schweizer (2018) examine the tradability of 1,009 ICOs from 2015 to March 2018. They find that the probability of an ICO being traded on an exchange or not is negatively related to the uncertainty of the venture (no source code available, not on Telegram, and low percentage of tokens retained), but positively related to the quality of the venture (well-connected founders). Supplementary analysis on total amount raised shows similar findings, except that code availability is no longer a significant factor but the size of the founding team is.

Howell, Niessner and Yermack (2018) study 453 ICOs that have at least 90 days of trading data as of April 11, 2018 on coinmarketcap.com. They find that liquidity and trading volume of the tokens, their measures of ICO success, are higher for issuers that signal their quality (Prior VC investment), transparency (Posting a white paper, Telegram group members, Twitter followers), and credibility (Insider token vesting, founder having entrepreneurial experience). Amount raised in the ICO are associated with having a vesting requirement for insiders, prior VC equity investment, founder having entrepreneurial experience, and source code on Github; but adversely affected by issuers' ability to create future tokens.

Bourveau, De George, Ellahie, and Macciocchi (2018) investigate a sample of 776 utility-based ICOs from April 2014 through February 2018. They find that the disclosure of source code, but not a white paper, increases the likelihood of ICO completion. Furthermore, the

[13] Including another 471 ICOs that were not listed within 60 days and assigned a return of -100% to them would reduce the value-weighted average return to 90%.

disclosure of platform information and having high ICOBench.com ratings (on white paper quality, social media activity, and overall) increase the ICO success probability, while having a minimum funding target requirement or a high proportion of founding members with a LinkedIn profile reduces the probability of success. Finally, an issuer's overall rating from ICOBench.com and/or ICOrating.com exhibits explanatory power for the total amount raised, first-day trading return, illiquidity, volatility, and crash risk. However, neither the disclosure of a white paper nor the quality of the white paper has power explaining these outcome variables.

Similar to Amsden and Schweizer (2018), Howell et al. (2018), and Bourveau et al. (2018), we also extract information from ICO white papers. Unlike these studies, we focus more on the blockchain architecture used by the ICO ventures. As discussed in more details in section 4.2, we create an ICO rating scheme and assign a rating to each ICO issuer based on the blockchain architecture information provided in their white papers. This rating allows us to distinguish ICOs that are levering the power of the blockchain technology from those that are taking advantage of the hype surrounding blockchain and cryptocurrencies.

4. Data and Sample

4.1 ICO Sample and data sources

We extract ICO information from seven websites: ICOBench.com, TokenData.io, TokenMarket.net, ICOMarkss.com, CryptoCompare.com, ICODrops.com, and CoinMarketCap.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, ICOMarkss.com, CryptoCompare.com,

and ICODrops.com. Furthermore, we download token prices from CoinMarketCap.com, as well as minimum funding target (soft cap) and maximum target (hard cap) data from ICOBench.com.

Table 1, panel A summarizes the sample construction process. We collect 7,462 ICOs across the seven websites. After removing duplicated ICOs, we end up with a total of 3,597 unique ICOs, completed between January 2016 and June 2018. Among these 3,597 ICOs, 1,518 of them have a downloadable white paper, 1,219 have the amount of funds raised, 1,545 have post-ICO trading data, 935 have both a white paper and amount of funds raised, and 393 have all information available.

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 1,518 ICOs with a white paper available and divide them into five subgroups (strata), based on the amount of funds raised ($0, $0-1 million, $1-10 million, $10-100 million, and over $100 million). If we cannot find the amount raised after an extensive search process, we set the amount to $0, assuming that those ICOs failed to raise the minimum funding target. From each subgroup, we randomly draw a subsample in proportional to the size of the subgroup. This process results in a total of 369 ICOs in our final sample. Table 1, panel B shows the number of observations drew from each subgroup.

We collect the required information and data items from the white papers of the 369 ICOs. In particular, we get the details of the blockchain architecture for the rating scheme to be discussed in the next subsection. We count the number of times the word "decentralized" and its derivatives are mentioned in the white paper, as another measure to capture the need for the blockchain technology. Finally, 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.

4.2 ICO Rating Methodology

We focus on three factors that we believe are important in evaluating the technical level of an ICO project. All these factors are determined solely based on white papers—the typical, but unregulated, disclosure documents which often have a discussion on how the blockchain platform will operate and what type of service the token will provide. In particular, we will assign a score to each factor based on the following rating guideline:

Factor 1: Blockchain platform

Score	Description
0	if the project uses an existing blockchain platform or doesn't mention any details about the platform it is going to use
1	if the project builds its own blockchain platform with new protocols/algorithms

Factor 2: Token utility

Score	Description
0	if the project doesn't need a blockchain based on the criterion in (Wust and Gervais 2017), as Figure 1 details
1	if the project needs a blockchain and uses its tokens for accessing products/services unrelated to its blockchain platform[14]
2	if the project needs a blockchain and uses its tokens for accessing products/services provided by its blockchain platform[15]

Factor 3: Technical writing

Score	Description
0	if essentially no technical writing
1	if limited technical writing
2	if professional technical writing (with sufficient technical details)

[14] Asset tokenization is a particular example of ICO projects receiving score 1 in terms of token utility for which a token is associated with some physical asset, such as agricultural lands in the case of Smartlands and gaming chips in the case of Dragon Coins. Such tokenization facilitates ownerships and trading, creating a more liquid world for certain physical assets.

[15] Filecoin project is a particular example that a token can be used to store digital files on its blockchain platform.

To illustrate the above rating guideline, we briefly provide two case studies here, namely Filecoin and HoweyCoin. Filecoin is a project of the Protocol Labs that raised more than $200 million through its ICO. The company developed a new blockchain protocol to build its own platform on which a token can be used to store digital files on some participant's local storage (in an encrypted form). The company published two versions of its white paper on July 15, 2014 and July 19, 2017, respectively, before the public sale of its tokens lasted from August 10 to September 7, 2017. Both versions are written in the form of a technical paper with sufficient details. As such, the Filecoin project receives the highest scores for every factors according to our rating guideline.

On the other hand, HoweyCoin is a fake ICO project launched by the U.S. Securities and Exchange Commission in May 2018 in order to educate investors how to identify ICO scams. It also has a white paper on its website, which, as expected, receives the lowest scores for every factors for the following reasons. *First*, it doesn't provide any details about its blockchain platform. *Second*, it doesn't need a blockchain according to (Wust and Gervais 2017), because there is indeed some online trusted third party, such as Booking.com, to match airfare and hotel deals with potential customers. *Third*, its white paper has essentially no technical details with respect to blockchain technology.

Next, we would like to have a single score indicating the technical level based on the above three factors. We choose to sum up individual scores of these three factors. For example, Filecoin receives an overall score of 5 and HoweyCoin receives an overall score of 0. Again, this overall score is solely based on white papers. There are some important factors beyond 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 the following reasons.

First, very few ICO issuers have launched their blockchain platforms at the time of writing. As such, white papers are the main disclosure documents of ICOs that enable us to evaluate the technical level of the envisioned platforms. Second, most of the source code provided by ICO issuers (often posted on GitHub) is still at the development stage, showing only certain functionality of the envisioned platforms. Hence, the source code may not contain as much technical information as white papers.

4.3 Descriptive Statistics on the ICO data

Table 2 provides descriptive statistics on the 369 ICOs in our sample over the sample period from January 2016 through June 2018. Panels A and B reports the numbers of ICOs by year and month, respectively. Panel A indicates that seven of the ICOs were completed in 2016, 167 in 2017, and 155 in the first half of 2018 (40 ICOs have no information on their ICO start and end dates). Statistics not tabulated show that the amount raised increased from $31 million in 2016 to $2.6 billion in 2017 and $1.6 billion in the first half of 2018. For the 244 ICOs with non-zero amount raised, the mean amount is $19.7 million and the median is $5.9 million. Only 62 ICOs provide soft cap information and 47 have at least one day of trading data on Coinmarketcap.com.

Table 3 reports statistics on the three factors used in our ICO rating scheme. For factor 1 (Blockchain platform), panel A reports that 51 projects built their own platforms, while the remaining 318 projects used an existing platform (mainly Ethereum, Waves, or Bitcoin). On average, these 51 projects raised more funds than the other projects ($28,742,952 versus $9,260,348). Moreover, 73% of the 51 projects have token price data (i.e., listed on an exchange), compared with only 3% for the projects that used an existing platform.

Regarding Factor 2 (Token utility), panel B indicates that 52 projects use their tokens for accessing services provided by their blockchain platform and hence receive the highest score of 2, another 211 projects use their tokens for services unrelated to their platforms and receive a score of 1, and 106 projects actually do not need a blockchain. The mean amount raised for projects with a score of 2 is $27,733,468, compared with $11,409,048 for projects with a score of 1, and $5,294,640 for projects that do not need a blockchain.

As for Factor 3 (Technical writing), panel C shows that there are 27 projects with a white paper read like an academic paper (including theory, formula, proof, application, citation, etc.) and hence receive the maximum score of 2. Moreover, 94 ICOs have white papers with some technical writing and 248 white papers have little technical details. Projects with technically written white paper raised a mean funding of $25,020,202 per project, compared with a mean of $24,614,092 for projects some technical writing, and $5,731,497 for projects without technical writing.

Finally, we calculate our rating as the sum of the scores of these three factors. Statistics not tabulated indicate that there are 6 ICO projects received the maximum rating of five, 15 with a rating of four, 38 with a rating of three, 75 with a rating of two, 160 with a rating of one, and 75 with a rating of zero. This result suggests that most ICOs do not need a blockchain or fail to describe the technical aspect of their blockchain platforms in writing.

5. Empirical Findings

5.1 Summary Statistics on Regression Variables

Table 4 panel A provides summary statistics of the dependent and explanatory variables. Our main dependent variables are three measures of ICO success: *AmountRaised*, *OverSoftCap*,

and *NearHardCap*. *AmountRaised* is dollar amount raised during ICO. *OverSoftCap* measures percentage of funds exceeds its soft cap, conditional on the availability of soft cap information. *NearHardCap* is calculated as (-1)*((Hard Cap*0.8 – AmountRaised)/(Hard Cap*0.8)), representing how close amount raised is to 80% of the hard cap, given hard cap information is available.

The mean (median) amount of funds raised, *AmoutRaised*, is $12 million ($708,413). In comparison, the mean (median) amount of non-zero funds raised, *AmoutRaised(raw)*, is approximately $19.7 millions ($5.9 million). In the regression analysis, we use the logarithm of *AmountRaised* (*LogAmount*) to account for its right-skewed distribution. There are 62 ICOs with soft cap information and 61 of them have valid *OverSoftCap* information. If amount raised during ICO is below soft cap, we set *OverSoftCap* to zero. On average, ICOs with soft cap information available raise 6% more funds than the minimum funding target. The median percentage of funds raised over soft cap is zero, indicating that more than half of these 61 ICOs did not raise enough funds as planned. We have 89 ICOs with hard cap information available. If an ICO raise more funds than 80% of its hard cap, we set *NearHardCap* to zero. These 89 ICOs, on average, raise 62% less funds than 80% of their hard caps. Only 19 ICOs raised more than 80% of their hard caps.

The key independent variables are *Rating*, generated from our rating methodology, and *Decentralized*. *Rating* ranges from 0 to 5, with a mean and median of 1. This provides an early evidence that more than half of our ICO sample do not need a blockchain to build their products or services. The word “decentralized” was mentioned on average six times per white paper (median of 2 times), with a maximum of 138 times. This result confirms that of our rating

scheme that the majority of the ICO issuers does not need to use the blockchain technology in their underlying products or services.

The other explanatory variables are *TokenDis*, *Lockup*, VestPer, *Gov*, *UseFunds*, *Risk*, *TeamBio*, *TeamTech*, *TeamMkt*, *TeamSize*, *AdviSize*, and *AdviTech.* As discussed earlier, these indicator variables are based on whether relevant information is disclosed in a white paper. For example, *TokenDis* equals one if an ICO company discusses token distribution in its white paper, and zero otherwise. 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 *Adi* is the sum of the two advisor team related variables. 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 the words count of the white paper, monthly Bitcoin return, Bitcoin trading volume, and Bitcoin volatility in the regressions. We include these three Bitcoin measures in the regression model to control for any time-series variations in the popularity 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* is positively correlated with our ICO *Rating*, according to the Pearson correlation coefficient. Based on the Spearman correlation coefficients, *LogAmount* is positively correlated with the disclosure of risk relevant information (*Risk*), number of words (*Words*), percentage of amount raised over soft cap (*OverSoftCap*), and the distance of amount raised to 80% of hard cap (*NearHardCap*). In addition, the disclosure of vesting period is positively correlated with the disclosure of the use of funds, suggesting ICO issuers tend to disclose these two types of information at the same time.

5.2 Amount Raised during the ICO period

We examine three measures of amount raised at ICOs: Total amount raised (*AmountRaised*), percentage of amount raised over the soft cap (OverSoftCap), and the closeness of amount raised to 80% of the hard cap (NearHardCap).

Table 5, panel A presents the results of regressing the logarithm of *AmountRaised* on *Rating*, *Decentralized*, and other explanatory variables using a Tobit model. Since 39% of ICOs in our sample do not have amount raised information available (i.e., failed ICOs), the distribution is left-censored at 0. The Tobit model accounts for the censoring of the dependent variable. *AmountRaised* is positively associated with *Rating* and *Decentralized* across four different regression specifications. These results indicate that ICOs with a legitimate use of the blockchain technology, on average, raised more funds than those ICOs that may be taking advantage of the hype surrounding blockchain and cryptocurrencies. We also find that ICOs that disclosed their insider's lockup period on their tokens, founding team, and advisor team in their white papers raised a higher amount during their ICO campaigns. These findings are consistent with the notion that lockup period serves as a signal of interest alignment between investors and insiders in the short period, and more disclosure about the founding teams and advisors reduce information asymmetry. In addition, both monthly Bitcoin returns and Bitcoin trading volume exhibit significant explanatory power for the amount raised at ICOs. Finally, the disclosure of founding team member with a marketing background is associated with a higher amount raised. These results, as a whole, demonstrate that token buyers/investors value and make use of information disclosed in white papers to make purchasing/investment decision, and they can distinguish ICOs that need blockchain technology versus those that do not.

Table 5, panel B summaries the results of using *OverSoftCap* as the dependent variable in the Tobit model. This set of tests consider ICO success based on whether the amount raised in the ICO exceeds the minimum funding target and, if affirmative, the extent it exceeds the target. Consistent with the findings in panel A, the ICO Rating variable is positively associated with *OverSoftCap*. Similarly, ICOs taken place after the months with high Bitcoin returns are associated with a higher amount raised over the stated soft cap. In contrast to the results in panel A, the number of words in the white paper exhibits a negative effect, while disclosing advisors' technical background has a positive effect on *OverSoftCap*.

Given the limited number of ICOs with soft cap information, we next consider an ICO a success if the amount raised exceed 80% of the stated hard cap. Table 5, panel C presents the results of the Tobit analysis using *NearHardCap* as the dependent variable. The estimated coefficients on Rating are significantly positive under columns (1) and (4), but indistinguishable from zero under columns (2) and (3).

Overall, the results summarized in table 5 suggest that the quality of ICOs, especially regarding the underlying blockchain technology, matters for token buyers/investors and 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 are consistent with investors using information in ICO white papers to help them distinguish ICOs that levered the blockchain technology from those that use blockchain as a marketing stunt.

5.3 Post-ICO Exchange Listing

For the founders and buyers/investors of ICOs, the liquidity of the digit tokens is important if they want to sell the tokens to make a profit or diversify their investment portfolio subsequent to the ICOs. Hence, another measure of ICO success is the post-ICO listing of the

digit tokens/coins in at least one cryptocurrency exchange. In this section, we investigate how many days an ICO took to get listed on an exchange. To account for listing outcome and days until listing, we use a Cox proportional hazards model to conduct this analysis. In particular, we consider an ICO a success if it is traded on an exchange within 180 days after the end date of the ICO. Because of the 180-day cutoff, this analysis is restricted to ICOs completed by the end of 2017. We include 3-month Bitcoin return, volume, and volatility before listing day. If an ICO is not listed, we use 180 days after the end date of the ICO as the reference date. Table 6 presents the results of the hazards model analysis. We find no support that *Rating* affects post-ICO listing outcome. Indeed, only Bitcoin returns exhibit power explaining listing outcome. There are two possible explanations for the null findings. First, cryptocurrency exchanges may have access to additional private information post-ICO to assess the quality of ICO projects. Second, ICO issuers may have disclosed additional information to token buyers/investors post-ICO.

6. Conclusion

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

References

Adhami, S., G. Guidici, and S. Martinazzi. 2018. Why do businesses go crypto? An empirical analysis of Initial Coin Offerings. *Journal of Economics and Business,* Forthcoming.

Amsden, R. and D. Schweizer. 2018. Are Blockchain Crowdsales the New 'Gold Rush'? Success Determinants of Initial Coin Offerings. Working Paper.

Benedetti, H. and L. Kostovetsky. 2018. Digital Tulips? Returns to Investors in Initial Coin Offerings. Working Paper.

Bian, S., Z. Deng, F. Li, W. Monroe, P. Shi, Z. Sun, W. Wu, S. Wang, W. Wang, A. Yuan, T. Zhang, and J. Li. 2018. IcoRating: A Deep-Learning System for Scam ICO Identification. Available at arXiv, 8 March 2018.

Bourveau, T., E. De George, A. Ellahie, and D. Macciocchi. 2018. Initial Coin Offerings: Early Evidence on the Role of Disclosure in the Unregulated Crypto Market. Working Paper.

Cascino, S., M. Correia, and A. Tamayo. 2018. Does Consumer Protection Enhance Disclosure Credibility in Reward Crowdfunding? Working Paper, London School of Economics.

Catalini, C. and J. Gans. 2017. Some Simple Economics of the Blockchain. Working Paper, MIT and University of Toronto.

Catalini, C. and J. Gans. 2018. Initial Coin Offerings and the Value of Crypto Tokens. Working Paper, MIT and University of Toronto.

Chod, J. and E. Lyandres. 2018. A Theory of ICOs: Diversification, Agency, and Information Asymmetry. Working Paper.

Cohney, S., D. Hoffman, J. Sklaroff, and D. Wishnick. 2018. Coin-Operated Capitalism. Working Paper, University of Pennsylvania.

Frankel, R., M. McNichols, and G.P. Wilson. 1995. Discretionary Disclosure and External Financing. *The Accounting Review* 70(1), 135-150.

Healy, P.M. and K.G. Palepu. 2001. Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. *Journal of Accounting and Economics* 31, 405-440.

Howell, S., M. Niessner and D. Yermack. 2018. Initial Coin Offerings: Financing Growth with Cryptocurrency Token Sales. Working Papers.

Lang, M. and R. Lundholm. 2000. Voluntary Disclosure and Equity Offerings: Reducing Information Asymmetry or Hyping the Stock. *Contemporary Accounting Research* 17 (4), 623-662.

Leone, A., S. Rock, and M. Willenborg. 2007. Disclosure of Intended Use of Proceeds and Underpricing in Initial Public Offerings. *Journal of Accounting Research* 45 (1), 111-153.

Leuz, C., and P. Wysocki. 2016. The Economics of Disclosure and Financial Reporting Regulation: U.S. and International Evidence and Suggestions for Future Research. *Journal of Accounting Research* 54 (2), 525-622.

Li, J. and W. Mann. 2018. Initial Coin Offering and Platform Building. Working Paper.

Madsen, J. and J. McMullin. 2018. Economic Consequences of Risk and Ability Disclosures: Evidence from Crowdfunding. Working Paper.

Michels, J. 2012. Do Unverifiable Disclosures Matter? Evidence from Peer-to-Peer Lending. T*he Accounting Review* 87 (July), 1385-1413.

Momtaz, P. 2018. Initial Coin Offerings. Working Paper.

Securities and Exchange Commission. 2017. SEC Issues Investigative Report Concluding DAO Tokens, a Digital Asset, were Securities. Press Release (https://www.sec.gov/news/press-release/2017-131).

Wust, K. and A. Gervais. 2017. Do You Need a Blockchain? IACR Crypotology ePrint Archive.

Yermack, D. 2017. Corporate Governance and Blockchains. *Review of Finance* 21 (1), 7-31.

Appendix A: Variable Definitions

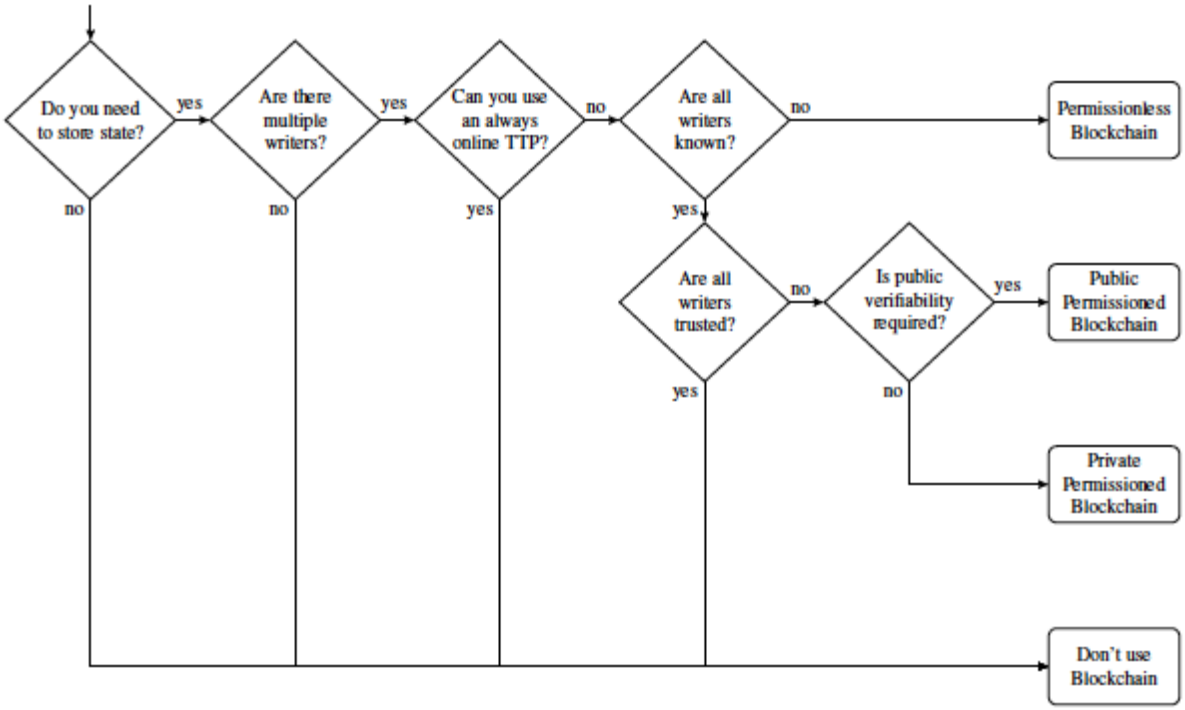
Variable	Definition
AmountRaised	Total amount of funds raised druing ICO.
LogAmount	The logarithm of *AmountRaised*.
OverSoftCap	Percentage over soft cap, measured using the average exchange rate between the start and end dates of an ICO
NearHardCap	The closeness of amount raised to 80% of the hard cap, calculated as (Hard Cap*0.8 – AmountRaised) / (Hard Cap*0.8).
Days180	Number of days until an ICO is listed in a cryptocurrency exchange in the first 180 days after the ICO end date.
Listing180	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 *Technicality*.
Platform	A score that equals 0 if the ICO project uses an existing blockchain platform or doesn't mention any details about the platform it is going to use; 1 if the project builds its own blockchain platform with new protocols/algorithms.
Token utility	A score that equals 0 if the product provided by the ICO project doesn't need a blockchain based on the criterion in (Wust and Gervais 2017); 1 if a token is associated with some service which is unrelated to the project's blockchain platform; 2 if a token is associated with some service which is provided by the project's blockchain platform.
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

(continued)

Appendix A: Variable Definitions (continued)

Variable	Definition
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.
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.
Team	Sum of team variable
Advi	Sum of advisor variable
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
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.

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.

Figure 2
This figure shows amount of funds raised by month over the sample period from January 2016 through June 2018.

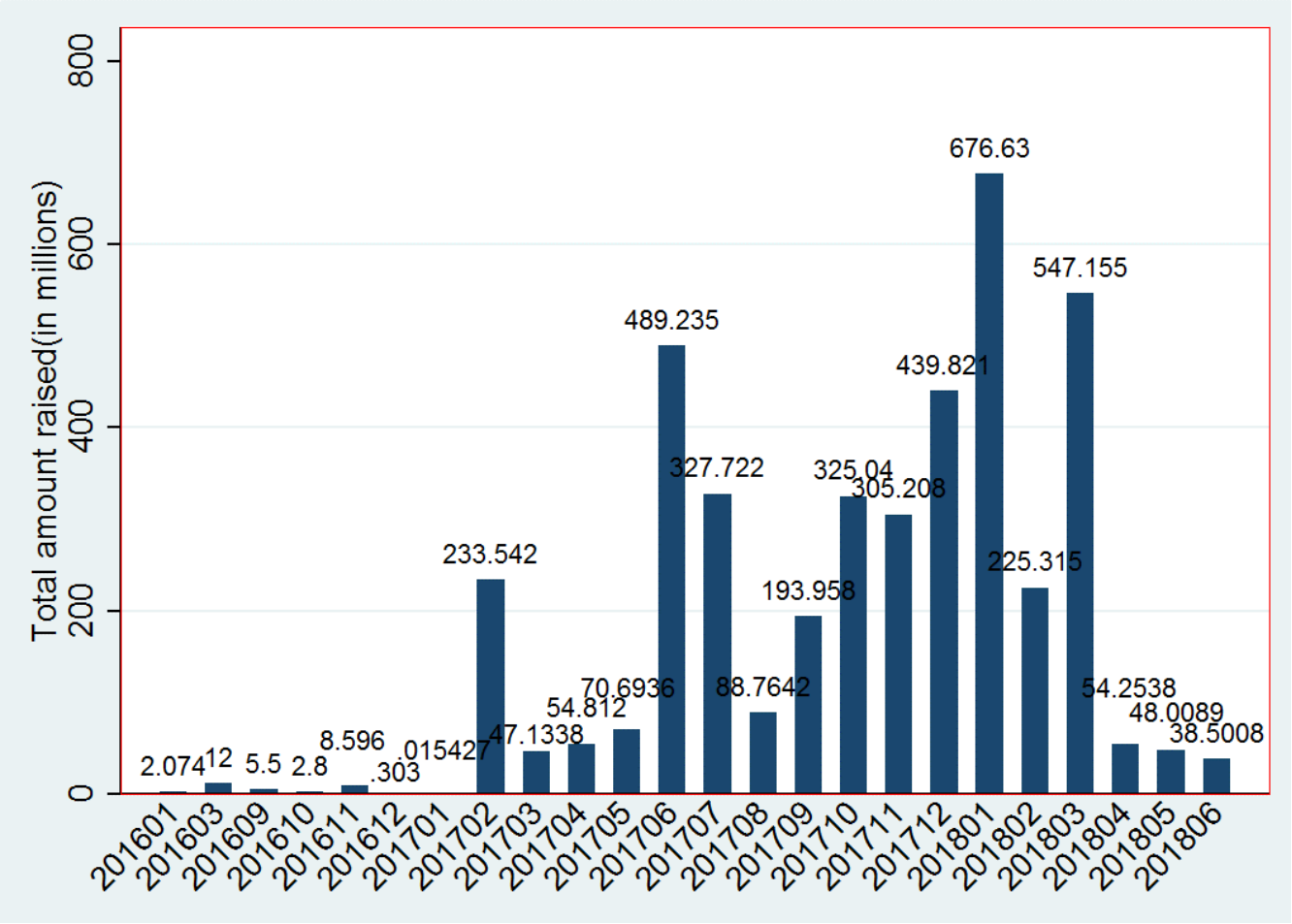


Table 1. Sample Construction

This table describes the sample construction process and the number ICOs available at each step of the process. The sample period is from January 2014 to June 2018.

Panel A: Sample Construction

Data source	**Number of ICOs**	
ICOBench.com	1,813	
CoinMarketCap.com	1,596	
Tokendata.io	1,314	
ICOMarks	1,129	
CryptoCompare.com	655	
ICODrops.com	370	
TokenMarket.net	585	
Total ICOs		7,462
Duplicated ICOs		(3,865)
Unique ICOs		3,597
Unique ICOs with a white paper		1,545

Panel B: Proportional stratified sampling by amount raised

Amount raised subgroup (stratum)	**Number of observations selected**
>100 million	12
10 million to 100 million	84
1 million to 10 million	82
less than 1 million	48
No amount raised information	143
All	369

Panel C: Availability of key variables

ICOs	Number of ICOs	Total number
With Amount Raised	244	369
Without Amount Raised	125	
With Soft Cap data	62	369
Without Soft Cap data	307	
With Token Price data	47	369
Without Token Price data	322	

Table 2. Summary Statistics on ICOs

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 2014 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	167	45%
2018	155	42%
No End date	40	11%
Total	369	100%

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

Month	Number of ICOs	Percentage
201601	1	0.27%
201603	2	0.54%
201609	1	0.27%
201610	1	0.27%
201611	1	0.27%
201612	1	0.27%
201701	1	0.27%
201702	3	0.81%
201703	2	0.54%
201704	7	1.90%
201705	5	1.36%
201706	6	1.63%
201707	12	3.25%
201708	9	2.44%
201709	23	6.23%
201710	23	6.23%
201711	32	8.67%
201712	44	11.92%
201801	42	11.38%
201802	34	9.21%
201803	49	13.28%
201804	12	3.25%
201805	14	3.79%
201806	4	1.08%
No End date	40	10.84%

Table 3. Summary Statistics on ICO Rating

This table provides summary statistics on the three factors used in constructing the ICO rating. See Appendix A for the definitions of these three factors.

Panel A: ICO description based on Blockchain platform (factor 1)

Platform	1	0
N	51	318
Mean amount (all)	28,742,952	9,260,348
Median amount (all)	2,800,000	561,532
% with amount raised (non-zero)	63%	60%
Mean amount raised (non-zero)	45,809,080	15,337,452
Median amount raised (non-zero)	14,919,087	5,272,002
% with token trading data	73%	3%

Panel B: ICO description based on Token Utility (factor 2)

Token Utility	2 (Blockchain)	1 (Crowdfunding)	0 (Others)
N	52	211	106
Mean amount (all)	27,733,468	11,409,048	5,294,640
Median amount (all)	10,467,769	1,000,000	668
% with amount raised (non-zero)	79%	62%	50%
Mean amount raised (non-zero)	35,174,152	18,517,764	10,589,279
Median amount raised (non-zero)	12,158,963	5,836,495	1,453,740
% with token trading data	31%	8%	13%

Panel C: ICO description based on Technical writing (factor 3)

Technical writing	2	1	0
N	27	94	248
Mean amount (all)	25,020,202	24,614,092	5,731,497
Median amount (all)	6,500,000	6,024,811	15,419
% with amount raised (non-zero)	78%	77%	53%
Mean amount raised (non-zero)	32,168,832	32,135,064	10,850,467
Median amount raised (non-zero)	11,000,000	11,637,823	3,502,044
% with token trading data	33%	14%	10%

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 2014 through June 2018.

Panel A: Summary statistics

Variable	N	Mean	SD	P25	P50	P75	Min	Max
AmountRaised	369	12,000,000	31,900,000	0	708,413	10,500,000	0	320,000,000
AmountRaised(raw)	224	19,700,000	39,000,000	1,476,870	5,899,069	21,200,000	15	320,000,000
LogAmount	369	9	8	0	13	16	0	20
OverSoftCap	61	6	28	0	0	2	0	211
NearHardCap	89	-0.62	0.40	-1	-0.85	-0.17	-1	0
Listing180	220	0	0	0	0	0	0	1
Days180	220	157	57	180	180	180	0	180
Rating	369	1	1	1	1	2	0	5
Decentralized	366	6	11	1	2	8	0	138
TokenDis	369	1	0	0	1	1	0	1
Lockup	369	0	0	0	0	0	0	1
VestPer	369	0	0	0	0	0	0	1
Gov	369	0	0	0	0	0	0	1
UseFunds	369	1	1	0	1	1	0	1
Team	369	2	2	0	2	4	0	4
Advi	369	1	1	0	0	1	0	2
Risk	369	0	0	0	0	1	0	1
BitRet	329	0	0	0	0	0	0	1
BitVol	329	22	1	21	22	23	18	23
BitStd	329	1,111	739	597	1,136	1,302	10	2,395
Words	354	9	1	8	9	9	3	11
TeamBio	369	1	0	0	1	1	0	1
TeamTech	369	0	0	0	0	1	0	1
TeamMkt	369	0	0	0	0	1	0	1
TeamSize	369	1	0	0	1	1	0	1
AdviSize	369	0	0	0	0	1	0	1
AdviTech	369	0	0	0	0	0	0	1

Table 4 (continued)

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

	LogAmount	*Rating*	*TokenDis*	*Lockup*	*VestPer*	*Gov*	*UseFunds*	*BitRet*	*BitVol*	*BitStd*	*Team*	*Advi*	*Risk*	*Words*	*OverSoftCap*	*NearHardCap*
LogAmount		0.29	-0.22	0.10	0.16	0.29	-0.03	-0.02	0.17	0.22	0.19	0.37	0.41*	0.51*	0.52*	0.77*
Rating	0.36*		-0.14	-0.17	0.30	0.08	-0.06	-0.02	0.17	0.18	0.09	0.18	0.22	0.13	0.34	0.28
TokenDis	-0.06	-0.18*		0.24	0.13	-0.36	0.30	-0.36	0.20	0.22	0.06	0.05	-0.16	-0.08	-0.39	-0.04
Lockup	0.11	-0.02	0.22*		-0.06	-0.05	0.18	0.01	0.19	0.03	0.10	0.15	-0.10	-0.04	0.07	0.25
VestPer	0.14	-0.03	0.19*	0.28*		0.06	0.48*	-0.17	-0.02	-0.02	0.33	0.32	0.34	0.29	0.12	0.02
Gov	0.18*	0.18*	-0.01	0.09	0.16*		-0.23	-0.13	0.14	0.09	0.15	0.02	-0.03	0.04	0.10	0.18
UseFunds	0.02	-0.14*	0.46*	0.18*	0.25*	0.06		-0.10	-0.08	-0.29	0.18	-0.04	0.16	0.05	-0.08	0.09
BitRet	-0.09	-0.07	-0.10	-0.12	0.03	0.03	-0.04		-0.21	-0.20	-0.14	-0.32	0.28	0.08	0.27	0.02
BitVol	0.12	-0.22*	0.21*	0.06	0.00	-0.14	0.10	-0.15*		0.82*	0.20	0.27	0.19	0.20	0.10	0.23
BitStd	0.20*	-0.11	0.16*	-0.00	-0.04	-0.10	0.06	-0.13	0.86*		0.32	0.38	0.28	0.31	0.04	0.22
Team	0.24*	0.02	0.26*	0.14*	0.28*	0.15*	0.23*	0.09	0.08	0.06		0.64*	0.29	0.35	0.03	0.23
Advi	0.20*	0.03	0.16*	0.11	0.25*	0.13	0.12	-0.03	0.13	0.11	0.58*		0.26	0.48*	0.10	0.32
Risk	0.12	0.05	0.23*	0.15*	0.17*	0.23*	0.26*	-0.02	0.11	0.10	0.25*	0.20*		0.62*	0.31	0.29
Words	0.27*	0.16*	0.13	0.12	0.19*	0.05	0.16*	0.04	0.15*	0.15*	0.32*	0.23*	0.22*		-0.02	0.30
OverSoftCap	-0.23	0.16	-0.37*	-0.09	-0.09	-0.04	-0.21	0.20	-0.16	-0.13	-0.03	-0.05	-0.09	-0.23		0.50*
NearHardCap	0.72*	0.28*	-0.06	-0.01	0.05	0.07	-0.05	0.02	0.19	0.26	0.31*	0.37*	0.18	0.26	-0.08	

* indicating significance at the 1% significance levels.

Table 5
Panel A reports the results of regressing Amount Raised on explanatory variables using Tobit model. Panel B (C) presents the results of regressing OverSoftCap (NearHardCap) on explanatory variables. The definition for the variables is given in Appendix A. The sample period is from January 2014 through June 2018. T-statistics are reported in brackets under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

Panel A: Amount of funds raised during ICOs

	(1)	(2)	(3)	(4)
Rating	2.14***	1.68***	1.78***	1.62***
	(3.93)	(3.31)	(3.49)	(3.23)
Decentralized	0.11**	0.13*	0.13*	0.13*
	(2.03)	(1.84)	(1.76)	(1.72)
TokenDis	-1.26	-0.24	-0.28	-0.41
	(-0.84)	(-0.17)	(-0.20)	(-0.30)
Lockup	3.52**	3.45**	3.09**	2.93*
	(2.11)	(2.26)	(2.02)	(1.93)
VestPer	0.53	-0.08	0.04	0.28
	(0.31)	(-0.05)	(0.02)	(0.19)
Gov	2.87*	1.06	0.85	0.81
	(1.68)	(0.67)	(0.55)	(0.52)
UseFunds	-3.08**	-3.27**	-3.09**	-2.77**
	(-2.24)	(-2.59)	(-2.47)	(-2.22)
Risk	0.15	-0.14	-0.12	-0.27
	(0.12)	(-0.12)	(-0.10)	(-0.23)
Team	1.29***	1.03**	1.02**	
	(2.73)	(2.36)	(2.31)	
Advi	1.39	2.20***	2.15***	
	(1.58)	(2.74)	(2.66)	
BitRet		3.77**	3.60**	3.42*
		(2.11)	(2.03)	(1.95)
BitVol		-2.58***	-2.26**	-2.11**
		(-2.88)	(-2.54)	(-2.40)
BitStd		0.00	0.00	0.00
		(0.61)	(0.30)	(0.27)
Words			0.12	0.26
			(0.15)	(0.32)
TeamBio				-2.42
				(-1.33)
TeamTech				0.17
				(0.09)

	(1)	(2)	(3)	(4)
TeamMkt				4.11**
				(2.59)
TeamSize				1.96
				(0.95)
AdviSize				0.83
				(0.45)
AdviTech				3.02
				(1.53)
Constant	0.66	57.62***	50.20***	47.56**
	(0.42)	(3.11)	(2.62)	(2.51)
Observations	366	327	317	317
Pseudo R-squared	0.0343	0.0499	0.0503	0.0549

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(Continued)

Table 5 (continued)
Panel B: Percentage of amount over soft cap

	(1)	(2)	(3)	(4)
Rating	8.69	12.15**	11.50**	13.24**
	(1.51)	(2.05)	(2.02)	(2.28)
Decentralized	-0.13	-0.13	0.27	0.27
	(-0.22)	(-0.21)	(0.46)	(0.45)
TokenDis	-39.97***	-22.30	-21.10	-12.49
	(-2.99)	(-1.48)	(-1.45)	(-0.80)
Lockup	-4.37	-4.58	-6.52	-11.75
	(-0.39)	(-0.40)	(-0.59)	(-1.02)
VestPer	-0.72	-1.60	0.85	-5.74
	(-0.05)	(-0.12)	(0.06)	(-0.40)
Gov	-16.06	-10.93	-12.79	-10.59
	(-1.13)	(-0.76)	(-0.94)	(-0.77)
UseFunds	1.93	-4.18	-5.62	-2.92
	(0.17)	(-0.37)	(-0.50)	(-0.26)
Risk	-6.77	-9.36	-2.99	-2.08
	(-0.69)	(-0.89)	(-0.28)	(-0.18)
Team	-1.35	-0.75	0.93	
	(-0.33)	(-0.19)	(0.24)	
Advi	7.59	10.22	11.82*	
	(1.16)	(1.52)	(1.68)	
BitRet		36.86*	43.44**	48.64**
		(1.88)	(2.27)	(2.41)
BitVol		-1.65	2.17	4.89
		(-0.14)	(0.19)	(0.42)
BitStd		-0.01	-0.01	-0.02
		(-0.60)	(-0.75)	(-1.12)
Words			-21.03*	-22.32**
			(-2.00)	(-2.10)
TeamBio				-2.80
				(-0.14)
TeamTech				-15.86
				(-1.14)
TeamMkt				8.17
				(0.63)
TeamSize				21.90
				(1.27)
AdviSize				-17.08
				(-1.04)
AdviTech				39.27**
				(2.23)

	(1)	(2)	(3)	(4)
Constant	23.28	44.45	137.62	82.95
	(1.35)	(0.17)	(0.54)	(0.33)
Observations	59	59	57	57
Pseudo R-squared	0.0332	0.046	0.0573	0.0699

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(Continued)

Table 5 (continued)
Panel C: Percentage near hard cap

	(1)	(2)	(3)	(4)
Rating	0.13**	0.09	0.09	0.10*
	(2.41)	(1.50)	(1.62)	(1.78)
Decentralized	0.00	0.01	0.01	0.01
	(0.78)	(1.43)	(1.26)	(1.00)
TokenDis	-0.05	-0.03	-0.02	-0.03
	(-0.38)	(-0.21)	(-0.16)	(-0.19)
Lockup	-0.03	0.02	0.01	-0.03
	(-0.27)	(0.15)	(0.13)	(-0.24)
VestPer	-0.24*	-0.19	-0.18	-0.18
	(-1.71)	(-1.37)	(-1.26)	(-1.24)
Gov	0.15	0.20	0.20	0.20
	(0.94)	(1.27)	(1.25)	(1.24)
UseFunds	0.07	0.09	0.08	0.06
	(0.58)	(0.78)	(0.68)	(0.45)
Risk	0.09	0.05	0.03	0.03
	(0.87)	(0.53)	(0.31)	(0.27)
Team	0.05	0.04	0.05	
	(1.15)	(0.96)	(1.18)	
Advi	0.15**	0.18**	0.15*	
	(2.06)	(2.40)	(1.98)	
BitRet		0.17	0.18	0.17
		(1.01)	(1.07)	(0.99)
BitVol		-0.15	-0.13	-0.09
		(-1.09)	(-0.96)	(-0.65)
BitStd		0.00**	0.00*	0.00
		(2.23)	(1.97)	(1.48)
Words			0.01	0.00
			(0.09)	(0.03)
TeamBio				0.03
				(0.19)
TeamTech				0.01
				(0.09)
TeamMkt				0.28*
				(1.96)
TeamSize				-0.09
				(-0.53)
AdviSize				0.05
				(0.30)
AdviTech				0.24
				(1.53)

	(1)	(2)	(3)	(4)
Constant	-1.01***	1.88	1.47	0.73
	(-6.37)	(0.64)	(0.49)	(0.25)
Observations	88	88	86	86
Pseudo R-squared	0.162	0.224	0.2118	0.2378

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6

This table reports the results of hazards model considering days until an ICO firm is listed on a cryptocurrency exchange in a 180 days window after ICO fundraising ends. The definition for the variables is given in Appendix A. The sample period is from January 2014 through June 2018. Z-statistics are reported in brackets under the estimated coefficients, with *, **, and *** indicating statistical significance at the 10%, 5% and 1% levels.

	(1)	(2)	(3)	(4)
FundRank	0.10	0.01	-0.00	-0.00
	(0.62)	(0.03)	(-0.02)	(-0.01)
Rating	0.04	0.01	0.01	0.02
	(0.59)	(0.19)	(0.19)	(0.28)
Decentralized	0.01	0.01	0.01	0.01
	(0.92)	(0.96)	(0.74)	(0.82)
TokenDis	0.01	0.00	-0.01	-0.00
	(0.04)	(0.01)	(-0.06)	(-0.00)
Lockup	0.13	0.09	0.08	0.06
	(0.55)	(0.34)	(0.30)	(0.21)
VestPer	0.03	0.06	0.06	0.07
	(0.14)	(0.28)	(0.28)	(0.28)
Gov	0.09	0.01	0.01	0.02
	(0.46)	(0.06)	(0.04)	(0.07)
UseFunds	0.02	-0.02	-0.01	-0.03
	(0.13)	(-0.09)	(-0.08)	(-0.13)
Risk	-0.15	-0.17	-0.18	-0.19
	(-0.98)	(-0.97)	(-0.96)	(-1.04)
Team	-0.01	0.01	0.00	
	(-0.15)	(0.12)	(0.02)	
Advi	0.03	0.07	0.07	
	(0.32)	(0.56)	(0.61)	
BitRet		0.49*	0.50*	0.51*
		(1.77)	(1.78)	(1.84)
BitVol		-0.14	-0.15	-0.15
		(-1.04)	(-1.06)	(-1.06)
BitStd		-0.00	-0.00	-0.00
		(-0.18)	(-0.14)	(-0.22)
Words			0.06	0.05
			(0.48)	(0.42)
TeamBio				0.16
				(0.57)
TeamTech				-0.01
				(-0.05)
TeamMkt				-0.03
				(-0.11)

	(1)	(2)	(3)	(4)
TeamSize				-0.10
				(-0.31)
AdviSize				0.16
				(0.48)
AdviTech				-0.00
				(-0.01)
Observations	214	173	167	167

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1