Initial Coin Offerings:

Financing Growth with Cryptocurrency Token Sales

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June 21, 2018

Abstract

Initial coin offerings (ICOs) are sales of blockchain-based digital tokens associated with specific platforms or assets. Since 2014 ICOs have emerged as a new financing instrument, with some parallels to IPOs, venture capital, and pre-sale crowdfunding. We examine the relationship between issuer characteristics and measures of success, with a focus on liquidity, using 453 ICOs that collectively raise $5.7 billion. We also employ propriety transaction data in a case study of Filecoin, one of the most successful ICOs. We find that liquidity and trading volume are higher when issuers offer voluntary disclosure, credibly commit to the project, and signal quality.

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1 Introduction

Initial coin offerings (ICOs) may be a significant innovation in entrepreneurial finance. In an ICO, a blockchain-based venture raises capital by selling cryptographically secured digital assets, usually called "tokens." These ventures often resemble the startups that conventionally finance themselves with angel or venture capital (VC) investment, though there are many scams, jokes, and tokens that have nothing to do with a new product or business. Explosive fundraising has attracted interest from entrepreneurs, investors, and regulators. Between January 2014 and June 2018, ICOs raised over $18 billion (see Figure 1). At least 15 individual ICOs have raised more than $100 million. ICO token buyers include prospective customers, but appear to primarily consist of speculators. Tokens are natural targets for speculation because they are usually exchangeable for fiat and cryptocurrency. This liquidity is an attractive feature compared to conventional VC securities (Metrick and Yasuda 2011). However, it may have a dark side if issuers' ability to cash out quickly undercuts their incentives to build successful businesses.

It is important at the outset to define three types of digital assets. The first is a general-purpose medium of exchange and store-of-value cryptocurrency, such as Bitcoin (these are often termed "coins"). The second is a security token, which represents a conventional security on a blockchain to reduce transaction costs and create a record of ownership. The third is a "utility" token, which represents the right to access a service that the issuer will provide through a new network. Utility tokens comprise the largest and most well-regarded ICOs and are the primary focus of this paper.[1]

Utility token ICOs bear some resemblance to crowdfunding pre-sales on platforms like Kickstarter. A perhaps closer analogy is buying the rights to a stadium seat before the venue is built, if those rights could be easily traded. While utility tokens can be simple "corporate coupons" that give the holder the right to an issuer's product or service, the most well-known ICOs employ them as the means of payment in a new marketplace. In this case, we can extend the analogy to suppose that the stadium's games were to be played by people in the

[1] These are our definitions, not an industry standard, and we do not view the categories as mutually exclusive. For example, ether (the token of the Ethereum blockchain) is a utility token, but its broad use has led it to serve as a store of value.

grandstands. Proponents argue that blockchains with native tokens permit disintermediation of Internet-based marketplaces, such as Uber or Facebook, where the platform developer currently controls the platform and extracts surplus. In the blockchain-token model, platform management is decentralized, and value accrues to token holders.

Why would a platform need its own token? The value proposition for many utility token ICOs requires the token's value to increase with the value of the network, enabling a decentralized new platform to have several important features. First, the token can reward the network creators without giving them control after the network has launched. Second, token buyers may be willing to fund the platform's development, speculating on its long-term success. Third, like concert tickets, food stamps, or stock certificates, the token's value is tied to access to a specific good or service with limited use elsewhere, creating a degree of customer commitment.

We show how a successful ICO may work in a detailed case study of Filecoin, which is a project of Protocol Labs, Inc. We employ proprietary transaction-level data from its ICO in mid-2017, which raised over $200 million.[2] When its network launches, Filecoin will be a *decentralized* cloud storage marketplace that connects people who wish to store digital files with others who have excess storage capacity. Its token will be the sole form of payment accepted on its platform. As in many other ICOs, a private "pre-sale" preceded the main public sale to provide token discounts to insiders, previous equity investors in Protocol Labs, and other strategic investors. Pre-sale investors, including prestigious VC firms such as Sequoia Capital and Andreessen Horowitz, paid an average of $0.57 per token and agreed to long vesting periods. In the main public sale, investors paid an average of $2.57. Pre-sale discounts are akin to the lower prices that early investors receive for conventional startup equity, in exchange for taking on more risk, providing services, and signaling quality to the market (Hellmann and Puri 2002).

The empirical portion of this paper closely studies a sample of 453 tokens that completed ICOs and were subsequently traded on a secondary market exchange for at least 90 days. This subset of relatively successful ICOs raised the equivalent of $5.7 billion. We study

[2] We use the term "ICO" throughout this paper for simplicity, but Filecoin does not use this term to describe its sale.

which issuer and token characteristics are associated with success. Our primary criteria for success are measures of liquidity, which we observe at horizons up to six months from the first trading date. We focus on liquidity for two reasons. First, from the perspective of an early stage investor, liquidity is a central benefit of ICOs relative to conventional financing instruments. Second, liquidity captures market depth and interest in the token, in the absence of commercial success measures (few issuers have launched their networks as of this writing). Also, in their theory of token-based platforms, Sockin and Xiong (2018) show that token trading enables information aggregation from potential customers about demand for a platform's service, and conclude that an individual's decision to join a token-based platform depends positively on volume.

We find that liquidity and trading volume are higher for tokens that (i) offer voluntary disclosure; (ii) credibly commit to the project; and (iii) signal quality or potential to create substantial value. The results indicate that in this nascent sector, information asymmetry leads to economic mechanisms that parallel other entrepreneurial financing settings. Disclosure measures associated with success include making source code public on Github, publishing a white paper, and publishing an intended budget for use of proceeds. Community engagement, measured by the number of Telegram group members (and to a lesser degree Twitter followers) is also associated with success. So is an insider vesting schedule, which is hard-coded into the token contract and is a measure of bonding (commitment). An entrepreneurial professional background for the lead founder or CEO is strongly associated with success. Experience in the crypto community, finance, or computer science are not. Signals of quality associated with success include prior VC equity investment in the issuer, holding a pre-sale before the public ICO, raising more money in the ICO, having clear utility value to the token, and planning to create a new blockchain protocol. New blockchain protocols usually intend to be the infrastructure for diverse applications, so while they may be riskier investments, their potential for value creation can dwarf that of applications built on other blockchains.

We examine other outcomes of interest, including the amount raised in the ICO, outright failure (delisting or disappearance), abnormal returns, and volatility.[3] Variables

[3]We are not concerned with predicting return anomalies (i.e., observable factors at the start of trading

with predictive power differ across these outcomes, highlighting the importance of choosing a valid proxy for "success." For example, entrepreneurial experience and VC backing also strongly predict the amount raised but are uncorrelated with failure. Tokenized real assets, which are tokens tied to real-world assets such as the price of gold or the U.S. dollar, tend to have higher failure rates. These are essentially the opposite of utility tokens and more often appear to be scams.

Beyond this empirical exercise, we offer a detailed explanation of how ICOs work. We discuss the central design tradeoffs an issuer faces when launching an ICO, which are not unlike those for an IPO of equity securities: target proceeds, fraction of total token supply sold, pricing mechanism, distribution method, lock-ups and set-asides, token rights, and choice of exchange. We also present new descriptive statistics; for example, we document how the sub-sectors in which ICOs occur have shifted over time as the industry matures. We compare the sectors in which ICOs concentrate to those in which VC-backed blockchain- and digital asset-related startups concentrate to understand which sectors are well-suited to ICOs. Notably, about half of the VC-backed startups have an enterprise focus (business-to-business), while ICO ventures typically target atomized consumers or developers (business-to-consumer).

We also discuss the regulatory landscape. Foremost among a number of uncertainties is whether ICO tokens have the legal status of securities and thus costly disclosure, liability, and compliance requirements. Three parts of the *Howey* test, which governs whether an investment scheme represents a security in the U.S., seem to apply to token sales.[4] The uncertain branch of the test concerns whether the investor has an expectation of a financial return. Utility tokens – which comprise 68 percent of our sample – may not qualify if the investor intends to gain access as a customer to a platform. Avoidance of onerous regulatory jurisdictions may help explain the location of some ICOs (see Figure 2).

ICOs often employ complex, self-enforcing, and state-contingent contracts that enable

that predict returns). Further, in light of the sector's immaturity and speculative frenzy, returns appear more divorced from the goal of serious utility token issuers to use the ICO to (a) raise financing; and (b) promote customer adoption of their networks.

[4]These are whether an investment of money is made by the purchaser, whether the investment is part of a common enterprise among numerous investors, and whether the success of the enterprise depends on the efforts of a third-party promoter.

arms-length investors to have some degree of trust without relying on enforcement by government institutions. Lerner and Schoar (2005) examine private equity contracts across countries. In high-enforcement, common law countries such as the U.S., investors mostly use convertible preferred stock with covenants. Conversely, in low-enforcement countries with socialist backgrounds or civil law traditions, it is most common for private equity investors to purchase majority equity ownership that comes with explicit board control rights. Lerner and Schoar (2005) conclude that complex, state-contingent contracts such as convertible preferred stock rely on strong legal institutions. ICO issuers are concentrated in a set of countries that seem more related to technical expertise than to legal systems, with the highest number of ICOs in Russia, China, the U.S., and Switzerland. ICOs may permit early stage, risky investment to circumvent reliance on well-functioning property rights and contract enforcement.

This paper contributes to a nascent literature describing the economics of digital assets. Some of this work is theoretical or descriptive, such as Harvey (2016), Catalini and Gans (2016), Yermack (2017), Cong, He and Zheng (2017), Biais, Bisiere, Bouvard and Casamatta (2018), Cong, Li and Wang (2018), and Sockin and Xiong (2018). Our study complements a number of recent empirical papers examining token sales, including Amsden and Schweizer (2018), Fisch (2018), Momtaz (2018), and Adhami, Giudici and Martinazzi (2018). To our knowledge, ours is the only one that focuses on an exchange-traded sample and employs liquidity as a success measure. It is also unique in its use of proprietary transaction data from a specific ICO. Further, we have a larger sample and a broader range of variables than other work. Further related empirical papers include Catalini and Tucker (2017) and Athey, Catalini and Tucker (2017).

We draw parallels between ICOs and equity crowdfunding, venture capital, and IPOs, where abundant literature in financial economics sheds light on the mechanisms that may be important for this new market going forward. This highlights the connection between this paper and the broader entrepreneurial finance literature, especially work on new vehicles for financing and alternative contracting structures, including Kaplan, Sensoy and Strömberg (2009), Hochberg (2011), Mollick (2014), and Bernstein, Korteweg and Laws (2017).

2 Characteristics of initial coin offerings

2.1 Blockchains and the Internet

ICOs are derivatives of the larger blockchain phenomenon that began with Bitcoin's launch in 2009 and has spawned thousands of digital assets. Blockchains are often described as enabling the direct, secure transfer of value over the Internet between parties that do not trust each other. Transacting value over the Internet (e.g. sending money or identifying friends) has required intermediaries such as Visa or Facebook. Public or "permissionless" blockchains such as Bitcoin and Ethereum make these intermediaries unnecessary. Blockchains are distributed ledgers, providing decentralized record-keeping that cannot be retroactively edited. Cryptography enables rapid verification and prevents hacking. Otherwise, the technology has much in common with distributed databases, which large companies use to harmonize information and logistics.[5]

A blockchain consists of a sequential list of transactions in a unit of value (called a digital asset, cryptocurrency, coin, or token) that is native to the blockchain; the Bitcoin blockchain uses bitcoins, the Ethereum blockchain uses ether, and the bank-oriented Ripple's XRP blockchain uses XRP. Additional text, such as the contingent terms of insurance contracts, can be appended to a transaction. Bitcoin permits simple and limited additional text, but other blockchains, such as Ethereum and EOS, permit essentially any code to be executed as part of a transaction. Decentralized nodes monitor and update public blockchains using freely available software, or "protocol," that verifies transactions and ensures that no coin is spent twice. These nodes are helper agents that together with a consensus mechanism allow public blockchains to run without any centralized authority. The blockchain creator outsources intermediation to the crowd.[6]

The Bitcoin and Ethereum blockchains have been resilient to hacking. Third party entities such as online exchanges have been compromised. An ongoing challenge for public blockchains is limited capacity. Bitcoin and Ethereum can add a maximum of seven and 20 transactions per second to their respective ledgers, while the credit card company Visa can

[5] https://docs.oracle.com/cd/B10501_01/server.920/a96521/ds_concepts.htm

[6] For further details on how blockchains work, see Narayanan et al. (2016).

process 56,000 transactions per second.[7] Blockchain capacity constraints play a role in the ICO distribution process; in the first minutes of many token sales, far more would-be buyers submit purchase orders than the network can handle.

2.2 Advantages of ICOs

This section discusses six potential advantages of ICOs: (i) to finance decentralized networks, (ii) to raise financing from future customers and gauge their demand, (iii) to establish immutable, non-negotiable governance terms, (iv) to provide rapid liquidity; (v) to hasten network effects; and (vi) to reduce transaction costs.

First, ICOs can fund development of new decentralized networks. Instead of value accruing to intermediaries, in theory a blockchain network's value accrues to its cryptocurrency holders, who may be diffuse contributors and users of the blockchain. Popper (2016) points out that this can remunerate creators of open source applications, which have traditionally relied on volunteer work (e.g. Wikipedia and Unix). That is, an ICO can compensate initial developers without giving them more control of the network than any other token holders. Aligning incentives between the platform's creators and token holders may depend on the token's value being tied to the value of the network. After the network launches, a native token can also incentivize platform "helpers," such as validators.

The second advantage of ICOs is that they permit the venture to raise financing from future users, similar to the pre-sale of goods via crowdfunding. When tokens represent consumptive goods (i.e, right to access a service), they are often called "utility" tokens. Their use can range widely; examples might include serving as a means of payment, stake for gambling, or loan collateral. Relatedly, the ICO provides the issuer with an early signal about consumer demand, which enables better informed investments in building the platform (Catalini and Gans 2018). Similarly, one motivation for going public in an IPO is to learn the firm's market value (Subrahmanyam and Titman 1999). Also like IPOs, the ICO can help create brand hype among consumers (Demers and Lewellen 2003). Utility tokens combine the customer payment mechanism and the investment mechanism in one instrument. This

[7] https://usa.visa.com/dam/VCOM/download/corporate/media/visa-fact-sheet-Jun2015.pdf

contrasts with conventional companies, where equity-holders who have claims on future cash flows are distinct from customers. This advantage could potentially redistribute network growth gains from financial intermediaries such as VCs to developers and consumers. Some have heralded ICOs as a means to "democratize" access to investment opportunities in new ventures.[8] However, conventional institutional investors such as hedge funds and VCs seem to be purchasing an increasing share of tokens, especially in the most sought-after ICOs.

The third advantage is the credible commitment that the issuer makes to token scarcity and governance. Features such as token vesting for insiders and how tokens may be used to pay for services on the platform are usually immutably determined when the token contract is written, before the ICO. An exception is when rights to future tokens, rather than actual tokens, are sold in the ICO (see Section 2.6). Once the token contract and platform are launched, the platform can exist independently of the issuer.

The fourth advantage is liquidity, which occurs when a cryptocurrency exchange permits trading in the new token. In many cases, the token is tradable for cryptocurrency or fiat currency within a few days of the ICO. This liquidity feature differs sharply from venture capital and equity crowdfunding but is also an important reason why companies IPO (Zingales 1995). However, there are two caveats. First, some ICOs offer or require lock-up periods, during which ICO participants may not sell their tokens. Second, liquidity is not guaranteed; many ICO tokens are never exchange-traded, and even if the token is listed, a holder may not be able to find a counterparty. Related to liquidity is the ability to take advantage of temporary overvaluation, a phenomenon that also exists in IPO markets (Pagano, Panetta and Zingales 1998).

The fifth advantage is that tokens can hasten network effects, which are often central to the marketplaces that ICO issuers seek to build. This advantage highlights the dynamic aspect of token value. This is emphasized in the model in Cong et al. (2018), where expected token price appreciation leads more users to join the platform. The incentive to pre-join to benefit from token appreciation is an important differentiating feature of ICO models relative to conventional network effects. Establishing network effects quickly is particularly

[8] For example, Sam Altman, the president of Y Combinator, a well-regarded startup accelerator in Silicon Valley, said in 2017 that "We are interested in how companies like Y Combinator can use the blockchain to democratize access to investing." See https://www.coindesk.com/y-combinator-sam-altman-icos-bubble/.

important because decentralized applications are often easily imitated.[9] Token holders are motivated to help the platform succeed either by using tokens directly or contributing (e.g. finding bugs or adding features). Of course, token holders may not spend the token if they expect its value to appreciate. Platforms therefore often have mechanisms for issuing tokens in the future or releasing existing supply from a non-traded reserve inventory. If a token's value derives from people using it, there is a delicate balance between allowing investors to purchase it for speculation – which might raise the most money – and distributing it broadly to potential users. A minority of ICOs give tokens away for free, termed an "airdrop."

A final benefit of using a token on the platform instead of, say fiat currency or bitcoin, is lower transaction costs, especially when agents are in multiple countries. Other conventional currency services, such as the need for a common unit of account or the desire of the issuer to collect seignorage, could be accomplished without a native token.

2.3 How ICOs Work

Most ICOs are conducted as follows. A prospective buyer submits a purchase order for a token by sending a payment to the issuer. Payment is usually in cryptocurrency, and most commonly in ether (the Ethereum blockchain's coin), which prospective buyers can purchase for fiat on cryptocurrency exchanges. At the sale's conclusion, the token contract automatically sends the purchased tokens to the blockchain addresses of successful buyers. One reason that ICOs have proliferated so quickly is that in their most basic form they impose essentially zero costs on the issuer. This contrasts with IPOs, where underwriting and disclosure costs comprise a significant fraction of the funds raised (Ellis, Michaely and O'hara 2000). IPOs also have less quantifiable costs, such as the regulatory burden, information revelation, and the possibility of attracting product market competitors with a high stock price (Maksimovic and Pichler 2001).

ICOs are typically preceded by the release of "white paper" disclosure documents that are similar in spirit to IPO prospectuses. White papers vary dramatically, but the most common element is a description of how the token will be used, including its benefits to holders, and how its blockchain architecture will operate. White papers sometimes provide

[9] E.g., https://blog.gdax.com/the-perfect-token-sale-structure-63c169789491

a simple budget for use of ICO proceeds and a description of incentives for insiders. What is often missing is basic information about the issuer; many white papers do not provide a contact address (or any information about location), much less information about the legal entity or individuals behind the ICO. Beyond the white paper, issuers typically conduct public relations campaigns to promote tokens, including Internet advertising and "influencer" retention.

Most ICOs use ERC20 tokens, which are smart contracts (automated software) hosted by the Ethereum blockchain. Anyone can create such a contract for free. After launch, the issuer has no control over the tokens beyond what was specified ex-ante in the contract. All transactions in the new token are inscribed in and secured by the Ethereum blockchain. The ERC20 token protocol standardizes issuance, distribution, and control functionality, so that knowing a token is ERC20 provides some information about its reliability and interoperability with other systems.[10] ERC20 tokens can be specialized to a platform's needs. For example, the issuer may want to bar some class of agents from spending its token.

There is often no mechanism to prevent the issuer from absconding with the ICO proceeds, nor is there accountability or oversight of promoters' use of proceeds. Scams have plagued ICOs.[11] More generally, ICO token buyers appear to have no enforceable claims, reflecting the current absence of regulation relative to conventional financing. We therefore expect that certification, disclosure, and bonding mechanisms will be especially important to ICO success.

2.4 ICO Design Choices

When launching an ICO, the issuer typically makes tradeoffs among a set of economic variables with parallels to IPO decision points: (i) target proceeds; (ii) fraction of total token supply sold; (iii) pricing mechanism; (iv) distribution method; (v) lock-ups and set-asides; (vi) token rights; and (vii) exchange listing. We discuss each in turn.

Large proceeds are a striking feature of many ICOs. For example, in early 2018 Telegram

[10] https://theethereum.wiki/w/index.php/ERC20_Token_Standard

[11] For example, during messaging app Kik's ICO, which raised $100 million, a fake address was circulated on social media, drawing meaningful amounts of funds intended for Kik.

and EOS raised \$1.7 and \$4.2 billion, respectively (the latter is larger than all but two global IPOs in the first half of 2018).[12] Raising too much money has potential downsides, such as unwanted publicity and the agency problems that arise when the founders have a large cash cushion, issues that are recognized in VC (Gompers 1995). Some ICOs seek to finance a specific development objective, and aim to raise a fixed, budgeted amount. Others set a goal to raise and may exceed it. There is usually a ceiling or "cap" on the number of tokens sold, though this does not always translate to a cap on the amount raised. Some ICOs have been uncapped, with an unlimited number of tokens sold during the sale (defined as a period of time, and usually expressed in a number of Ethereum blocks). The obvious risk in an uncapped ICO is that buyers do not know what share of total supply a token represents. Some capped sales have experienced massive oversubscription, which creates an incentive to buy just as the sale starts and leads to blockchain congestion and high transaction fees.[13]

The fraction of tokens sold is akin to the "public float" in an IPO. The issuer typically reserves tokens for founders and employees, as well as to reward future platform participants for building applications or acting as market makers. Some ICOs have allocated this platform development reserve to a nonprofit foundation legally separate from the issuer company. For example, the Tezos ICO assigned all proceeds (ultimately \$232 million) to the Switzerland-based Tezos Foundation, which was independent of the for-profit company Tezos. In our sample, on average 54 percent of total token supply is sold in the ICO.

The simplest and most common ICO pricing mechanism sells a certain number of tokens on a first-come, first-served basis at a fixed price. A slightly different approach is to sell shares of the total token supply in proportion to the bid amount with an ex-ante fixed token price.[14] Some issuers have established pricing tiers that increase predictably over time. To the extent that breathless coverage and pricing mechanisms that benefit early buyers create a "fear of missing out" and attract investors who lack knowledge about the intricacies of

[12] See https://www.ft.com/content/69abdb66-666c-11e8-b6eb-4acfcfb08c11.

[13] Since the Ethereum blockchain uses proof-of-work mining like Bitcoin, a buyer's purchase order is fulfilled only if a miner includes the order as a transaction in a published block. Prospective token subscribers can include voluntary transaction fees in their order transactions, providing miners with an incentive to include that customer's order in their next block.

[14] That is, bidder i in the set of N total bidders submits a desired $spend_i$, and is allocated a number of tokens T_i such that $\frac{spend_i}{\sum_i^N spend_i} = \frac{T_i}{\sum_i^N T_i}$. In oversubscribed sales, the buyer is refunded $spend_i - TXprice$.

blockchain technology, there is abundant opportunity for scams.[15] Other issuers have sought price discovery through their sale. For example, Gnosis and Viva used auctions in which the number of tokens sold was unknown and depended on the lowest successful bid.

Token distribution, the fourth decision area, faces several tensions. An issuer may wish to jump-start network effects by distributing tokens widely, but this is difficult without know-your-customer diligence because a single buyer can use many addresses and masquerade as many small buyers. Distribution is also complicated by the fact that most ICOs precede network launch. The most common approach is to create a pre-functional token that is useful only for being issued and traded on secondary market exchanges. The token may develop utility value when the network is functional, or it may be exchanged for a new token that is native to the network. An alternative is to record sales and promise to deliver tokens once the network is functional.

An additional distribution decision is whether to hold a pre-sale. Pre-sales are used by 45 percent of our sample, and their prevalence means that the ICO is often not the "initial" token offering. Similarly, IPO issuers have usually already sold equity to VCs and other stakeholders. ICO pre-sales serve multiple functions. One is to fund the costs of promoting the ICO itself. A second is to certify the issuer, particularly if well-known experts or institutions participate. A third is to determine demand and the appropriate price, which is analogous to the book-building part of the conventional IPO process (Sherman and Titman 2002, Derrien and Womack 2003). Pre-sale buyers usually receive discounts. These are akin to the lower prices that conventional early stage equity investors receive in exchange for taking on more risk, providing value-added services, and signaling quality to the market (Hellmann and Puri 2002). The best analogy is to a convertible note, the standard financing instrument used by angel investors in seed deals; these notes convert to equity at a discount to the next funding round's price, which is usually about 20 percent.

The fifth question is how much, if any, of the token supply to lock up ex-ante. Many token contracts include vesting periods for founders, which may help align developer incentives with those of token buyers. Brav and Gompers (2003) find that this commitment device to alleviate moral hazard problems is the best explanation for the 180-day lockups of insider

[15] https://www.theatlantic.com/technology/archive/2017/05/cryptocurrency-ponzi-schemes/528624/

shares that exist in the IPO market. A few issuers, including Golem, have tied token lock-ups to specific development milestones. Other lock-ups are hard-coded set-asides to incentivize future network contributors. For example, Bancor set funds aside for a market maker that is charged with maintaining price stability, and from which funds cannot be removed for a pre-specified period.

Sixth, the issuer must determine what rights to assign to the token. Utility tokens notably differ from equity in that they confer consumptive rights. They also typically do not carry rights to the future cash flows of the issuer or platform, except to the degree the token's value is intrinsically tied to the network's value. There are exceptions; for example, ICONOMI tokens come with the rights to a portion of fees paid to the network. The most common right is to pay for services. For example, the Basic Attention Token (BAT) will be the only means for users, advertisers, and publishers to transact for attention on the Brave internet browser.[16] Token holders sometimes have platform governance rights, like equity shareholders. At one extreme, token holders may set the overall business strategy. An example is TheDAO (a "decentralized autonomous organization"), which became famous for having been hacked. More commonly, token holders have limited governance roles, such as adjudicating disputes. Token holders may also have the right to play a role in creating and securing blocks through a "proof-of-stake" system where, as with company stock, voting power is determined by token holdings. VC securities involve shifting control rights across states of the world; in particular, giving the entrepreneur more control in good states, and the investor more control in bad states. VC securities also tend to separate cash flow from control rights. In principle, the smart contracts that create tokens can replicate these sorts of state-contingent contracts.

Finally, after the ICO the issuer must decide whether to apply to list on an online exchange, and if so, which one(s). Common exchanges for ICOs include Poloniex, Binance, OKEX, and Bittrex. Some are decentralized (peer-to-peer), such as Shapeshift and EtherDelta. The exchanges have different approaches to selecting projects for listing. For example, Circle, which runs the Poloniex exchange, considers dozens of factors including:

[16] Brave, founded by the former CEO of Mozilla, held its BAT ICO in June 2017; it raised $35 million in 24 seconds.

"Does the project encourage rational participation by investors?" and "Is the team transparent with company developments, operations, and hiring?"[17] In 2017 it was reported that many exchanges charged listing fees ranging as high as $1 to $3 million.[18] Listing a registered equity security on a traditional exchange such as NASDAQ costs just $125,000 to $300,000. Some exchanges charge token-specific listing fees depending on factors such as expected daily volume.

2.5 Tokens and Network Value

The appropriate valuation model for a token depends on how it is classified. Is the token a currency, commodity, security, or coupon? For example, currencies can be valued based on their velocity and the prices and quantities of goods and services. An equity claim on a business might be valued in terms of the net present value of future cash flows. A utility token's value lies in its ability to fulfill the transaction needs of platform users. Such tokens may or may not be securities, but they are probably best valued using approaches for equity-like claims, such as a DCF model.

Regardless of how it is valued, a utility token faces a tension between two adverse outcomes. On one hand, the ability of an ICO to jump-start network effects may be undermined if token holders perceive more value from holding rather than using the tokens. On the other hand, if a utility token's value does not rise with the network's value, there is no reason to hold it at all, and extremely high velocity will put downward price pressure on the token. While the technology is still evolving, one approach to resolving this tension is a "work" token (a token can be both a work and utility token). A work token's value is derived from the right to compensated contribution to a network, which will become more valuable as demand for the platform's services increases.

To illustrate, consider Augur, a decentralized prediction market platform that has been functional since 2016 and competes with betting websites such as Betfair.[19] Betting and payouts are conducted using ether. Augur's token, REP, is used to identify the true outcome

[17] https://www.circle.com/marketing/pdfs/en/circle-asset-framework.pdf

[18] https://www.bloomberg.com/news/articles/2018-04-03/crypto-exchanges-charge-millions-to-list-tokens-autonomous-says

[19] See http://www.augur.net/whitepaper.pdf.

for any market in a decentralized manner. Suppose there is a market to guess whether the Patriots will win the 2019 Super Bowl. After the game ends, Augur's oracle process will come to consensus about which team won. Anyone can stake REP to report on the outcome. The reporter receives her REP back plus a portion of the reporting fee if her report is the same as the majority. The fee is a function of how much has been staked and is also set such that the overall market capitalization of REP is at least five times the value of open interest in markets. If her report deviates from the crowd's, she loses her tokens. REP is a work token because the reporters "work" for the network. With higher demand, more revenue accrues to reporters, who then are willing to stake more for the right to report. A significant fraction of tokens is locked up at any given time through these stakes, preventing excess velocity. In other work token models, such as Filecoin described below, the token is also used by customers, who are not expected to hold tokens for long. Instead, it is service providers who hold tokens and are therefore more likely to participate in platform governance. This is similar to producer-owned cooperatives, such as the farmer-owned cooperatives that market agricultural products discussed in Hansmann (1996). The result is that, in theory, the value of the token will scale neither too fast nor too slow with the network value.

2.6 Regulation

Regulators in the U.S. and other countries have grappled with a number of questions regarding ICOs. The most important is whether or not ICO tokens have the legal status of securities, which would trigger various disclosure, liability, and compliance requirements.[20] A second question is whether the sale of tokens creates income tax liability for the promoter or for the investors who buy and later re-sell them. A third is whether some tokens are commodities, which implies further compliance obligations (via the CFTC in the U.S.). Finally, some token issuers may be construed as money transmitters, which in the U.S. requires state-level registration and compliance.[21]

[20] Among other potential problems, an ICO issuer might incur delays in coming to market, see its customer base narrowed, and face future class action liability for securities fraud if the ICO has the legal status of a security.

[21] See the memo published by a leading law firm at https://www.clearygottlieb.com/-/media/files/alert-memos-2018/us-regulators-continue-scrutiny-of-virtual-currencies-and-icos.pdf, which details how token issuers could variously be covered by the U.S. securities, commodities, and/or money transmission laws,

The four-part *Howey* test, which originated in a 1946 Supreme Court case, currently governs whether an investment scheme qualifies as a security in the U.S.[22] U.S. securities laws are often followed at least informally by many other countries. Three parts of the 72-year-old test seem to clearly apply to most if not all token sales: whether an investment of money is made by the purchaser, whether the investment is part of a common enterprise among numerous investors, and whether the success of the enterprise depends on the efforts of a third-party promoter. The uncertain branch of the test concerns whether the investor has an expectation of a financial return, such as capital gains. If the token buyer intends to use the token as a customer, this branch may not be satisfied, and the token might not be deemed a security. Many ICOs have no utility value (32 percent of our sample) and almost certainly would be deemed securities under current law. However, it is unclear how utility tokens would be treated in court if issuers resist efforts by the SEC to deem them securities.[23] Rohr and Wright (2017) provide a detailed analysis of the relevant caselaw and its potential applications to blockchain-based tokens.

An ICO issuer that successfully removes its tokens from the jurisdiction of the securities laws may create income or value-added tax liability. The problem is apparent from language in the white paper published by Ethereum at the time of its ether token sale in early 2014, which asserted that "Ether is a product, NOT a security or investment offering." Any sale of a "product" typically generates taxable income for the seller, whereas the raising of capital through the sale of securities does not.[24] To reduce potential income tax liability, some token issuers have routed their ICOs through non-profit foundations, while others have located in tax havens such as the Cayman Islands or Zug, Switzerland, which has come to be known as the "Crypto Valley."

Countries have adopted a wide range of regulatory stances toward ICOs. These range from blanket prohibitions (China, South Korea) to relatively accommodating "sandbox" safe harbors (Singapore). Whether a country can apply its tax and securities laws to an

which may have overlapping effects and are not mutually exclusive.

[22] *SEC* v. *W.J. Howey Co.*, 328 U.S. 293 (1946).

[23] Current SEC Chairman Walter J. Clayton took an extreme position in a February 2018 U.S. Senate hearing, stating that "I believe every ICO I've seen is a security," but the decision for any individual ICO ultimately belongs to the federal courts and not to the SEC. Congress also has the opportunity to clarify the definition of a security through future legislation.

[24] https://hackernoon.com/icos-trade-offs-between-securities-and-tax-law-ee7090421c3b

ICO in practice is not always obvious because public blockchains, including Ethereum, do not physically reside in any particular jurisdiction. An issuer that markets tokens to U.S. investors may have compliance obligations even if the issuer is located outside the country. Fear of U.S. regulation has led some issuers to declare their ICOs off-limits to U.S. residents. Avoidance of jurisdictions with more onerous regulations may help explain the location of some ICOs (see Figure 2). For example, 31 ICOs in our sample are located in Singapore. However, the pseudo-anonymous nature of public blockchain addresses make excluding U.S. buyers difficult in practice.

Some issuers have responded to the threat of security regulations by conducting extensive know-your-customer due diligence or selling rights to tokens as explicit securities to accredited investors under established registration exemptions. Since late 2017, some ICOs have taken place under the Simple Agreement for Future Tokens (SAFT) framework, which was introduced by Cooley (a law firm) and Protocol Labs, the company responsible for Filecoin.[25] SAFT issuers voluntary stipulate that they are entering into an investment contract for the future delivery of tokens – essentially a forward contract – once a platform is developed and becomes functional. The initial investment is a securities contract, but the tokens delivered in the future are meant to be a product that is subject not to securities laws, but instead to the ordinary consumer protection and tax laws of the U.S. and various states. Whether federal agencies and courts will assume the regulatory stances anticipated by the SAFT framework is a question for the future.

3 Filecoin Case Study

This section studies the Filecoin ICO, which raised more than $200 million. Filecoin is a project of the Protocol Labs, a Delaware corporation.[26] It is important to note that while we use the term "ICO" throughout this paper for simplicity, Protocol Labs does not use this term to describe the sale. Proprietary transaction-level data permit us to explore the prices paid by different types of investors, order sizes, and vesting schedules. To our knowledge,

[25]https://saftproject.com/static/SAFT-Project-Whitepaper.pdf

[26]Protocol Labs kindly shared with us anonymized transaction-level data about the ICO on the condition that it would remain confidential.

this is the first such data made available for research. Filecoin is a useful case study because it has a clear and compelling business model. It also permits straightforward parallels to the three conventional financing instruments for growth companies. First, the ICO enabled diffuse arms-length investors to buy the rights to access a future product, which did not exist at the time of the ICO. This is reminiscent of pre-sale crowdfunding. Second, Filecoin is a risky, early stage venture, and investors in its tokens are essentially purchasing a call option on a small probability of high growth; these features are analogous to the VC model. Third, the large size of Filecoin's ICO (more than $200 million) is similar to standard IPO proceeds.[27]

Filecoin's token, which uses the symbol FIL, is a utility token because it will provide access to a decentralized cloud storage marketplace. It will be the exchange currency for a service in that marketplace, required to participate and transact. The Filecoin protocol will be a completely automated, or self-enforcing, peer-to-peer exchange that accepts asks and bids to arrange storage transactions. Protocol Labs is building a new blockchain (the Filecoin protocol) to host this marketplace. Once the network is live, Protocol Labs will have no control over the network other than through the tokens that they own. The underlying storage infrastructure is called InterPlanetary File Storage (IPFS), another project of Protocol Labs. Decentralized storage is an alternative to incumbent cloud storage providers such as Amazon and Google. Filecoin's advocates perceive market power, vulnerability to cyber-attacks, and centralization of control over others' data as drawbacks to these incumbent providers.

On the Filecoin platform, distributed storage providers ("storage miners") will earn FIL by storing digital files for clients, who must use FIL to pay for storage. FIL is a work token as well as a utility token because storage miners must stake FIL (i.e., post it as collateral) in order to pledge their storage power and be eligible to match with clients.[28] Storage miners create new blocks through an innovative "Proof-of-Spacetime" system in which they prove that they are providing storage (contrasting with proof-of-work on the Bitcoin or Ethereum blockchains). A second type of producer, the "retrieval miner," responds to requests for files

[27]For example, software company Cloudera and e-commerce platform Carvana each raised about $225 million in their 2017 IPOs.

[28]Utility tokens are introduced in Section 2.2, and work tokens in Section 2.5.

by rapidly retrieving them. Retrieval miners do not stake FIL or create new blocks. By default, files will be encrypted, so that no one but the client can read the content of the stored files. The client must use a content identifier to retrieve files, and a private key (a highly secure password) to decrypt them. There are a number of competitors to Filecoin, including Golem, Storj, Sia, Elastic, and SONM. One way that Filecoin distinguishes its business model is that its prices are based on a competitive bidding process among storage miners. Filecoin contends that its model is the only one to offer incentive compatible storage with cryptographic guarantees for users.

The Filecoin ICO was capped at 200 million FIL tokens, representing 10 percent of the ultimate supply limit of 2 billion tokens. Of the remaining tokens, 15 percent are held by Protocol Labs for research, engineering, business development, marketing, and other purposes, five percent are held by the Filecoin Foundation for long-term network governance and public use data preservation (e.g., storing government climate data), and 70 percent are reserved for miner rewards. The ICO did not sell FIL, but rather rights to future FIL through a SAFT, an investment vehicle that attempts to comply with SEC regulations (see Section 2.6).[29] Only accredited investors could participate. CoinList, a new platform for SEC-compliant token sales, managed the ICO. CoinList is an AngelList spinoff that emerged from collaboration with Protocol Labs for the Filecoin sale. It likely helps reduce information asymmetry, just as reputable underwriters do in IPO markets (Loughran and Ritter 2002).

Filecoin conducted a pre-sale to offer discounts to select investors, which ended on August 1, 2017.[30] Participants in Filecoin's pre-sale included investors that had previously purchased equity in Protocol Labs, including Union Square Ventures. Other participants were VCs such as Sequoia Capital and Andreessen Horowitz, accredited advisors and individual investors, and accredited Protocol Labs employees. The public sale followed soon after the pre-sale and lasted from August 10 to September 7.

In the pre-sale, Filecoin raised approximately $52 million from 150 investors. The pre-sale FIL tokens were priced at $0.75. After accounting for discounts to investors who agreed

[29]See the Filecoin Private Placement Memorandum: https://coinlist.co/assets/index/filecoin_index/Protocol%20Labs%20-%20SAFT%20-%20Private%20Placement%20Memorandum-bbd65da01fdc4a15219c49ad20fb9e28681adec9fae744c41cccd124545c4c73.pdf.

[30]Filecoin terms its pre-sale the "Advisor Sale", and what we term its ICO the "Public Sale." We use the terms "pre-sale" and "ICO" to be consistent with the language elsewhere in the paper.

to vesting (lock-up) periods, the average price was $0.57. In the public sale, the price for each token was the total dollar amount raised so far divided by $40 million. It began at $1.30 ($52 million divided by $40 million), and increased continuously thereafter. Again, discounts were offered to buyers who agreed to vesting periods. The escalating price over time during the public sale maximized the final price at the sale's conclusion, creating a high-water reference point for the market, which could be helpful when the network and its token launch. This is similar to the common practice of using the price per share in the most recent equity financing round (e.g., a VC Series D) to value a startup. Among startups, this practice can lead to overvaluation (Gornall and Strebulaev 2017).

The public sale raised $153.8 million from more than 2,100 investors in over 50 countries, of which $135 million was raised in the first hour. Buyers in the first hour were ultimately charged $2.43 per token, which is a weighted average price after adjusting for vesting discounts. Protocol Labs decided after the pre-sale to change its pricing policy slightly for the first hour: it would use the pricing rule to identify the average price for the first hour, and then charge all first-hour buyers the average price. Protocol Labs wished to avoid a rush in the first minutes of the sale, because they feared investors would not read the documentation accompanying the purchase process in an effort to benefit from the lowest prices. The pre-sale and registrations for the public sale helped gauge demand for the public sale, which they had underestimated. After the first hour, the price increased gradually over the remaining four weeks of the public sale. Buyers after the first hour paid a vesting-adjusted weighted-average price of $4.61 per token. Table 1, Panel 1 summarizes this information. It shows that the pre-sale buyers paid much lower prices than the buyers in the public sale, especially those who bought in the later stages.

Token buyers could pay in U.S. dollars, bitcoin, ether, or Zcash.[31] Figure 3 shows the amount raised in each currency for the three offer periods. The pre-sale investors paid mostly in U.S. dollars, while the public investors paid mostly in ether. Very few paid in bitcoin or Zcash. The majority of funds were raised in the first hour of the public sale. In Table 1, Panel 3, we show information about the purchases made by members of the Protocol Labs

[31] Estimates of the amount raised depend on the exchange rates used. We use the daily U.S. dollar closing price of each cryptocurrency on CoinMarketCap.

core team, advisors, and venture capital investors. Six members of the Protocol Labs core team and nine angel and VC investors that had previously invested in Protocol Labs equity invested during the pre-sale. Just one core team member and one VC participated in the public sale. Core team members invested an average of $40,800 each, while the VCs on average purchased more than $1.7 million worth of tokens each.

Price discounts for investors who agreed to different vesting periods are listed in Table 1, Panel 2. The vesting periods will begin after the network launches. All FIL tokens sold in the ICO are locked up for at least six months after network launch. Pre-sale investors were not given the six month option; their tokens could be locked up for 12, 24, or 36 months, providing discounts of 7.5, 15, and 30 percent, respectively. Figure 4 shows the distribution of vesting choices for each of the three periods of the ICO. A dramatic difference is apparent between the long vesting schedules agreed to by most of the strategic investors in the pre-sale, and the preference for the shortest possible vesting periods in the public sale.

At the time of this writing, more than nine months after the start of the Filecoin ICO, investors at all stages of the ICO appear to have gotten a bargain price. Although the FIL tokens have not yet been delivered to investors, six-month Filecoin futures have been trading on Gate.io and Lbank since December 13, 2017, and the futures prices provide an estimate of the value of the underlying tokens. (It is unclear whether the futures are tied to legitimate SAFT holdings.) Figure 5 shows the prices and the dollar trading volume of the futures contracts, from that date through June 15, 2018. The price has fluctuated between $6.90 and $27.66 per FIL.

4 Data and Summary Statistics

4.1 Data Sources and Collection

We combine data from several widely accessed websites, as there is currently no industry-standard data source. We begin with a comprehensive list of almost 2,000 token ICOs from TokenData.[32] We then identify a subset of 453 tokens, including subsequently delisted ones,

[32]https://www.tokendata.io/

that have at least three months of trading data as of April 11, 2018 on CoinMarketCap, which is the most comprehensive and credible source of trading data on digital assets.[33] The first ICO in our sample occurred in 2013, and the last in January 2018. Figure 6 shows the distribution of the sample across time, highlighting the surge of ICOs in 2017. By construction, membership in our dataset conditions on success. Many announced ICOs fail before or during the ICO itself, and many completed ICOs are not subsequently listed on an exchange.

CoinMarketCap aggregates daily data from public exchanges with application programming interfaces that charge trading fees.[34] For example, data for the token Blocktix, which has a $25 million market cap, is drawn from four exchanges: Upbit, Cryptopia, Bittrex, and HitBTC. Data for EOS, one of the largest tokens with a $12 billion market cap, is drawn from over 50 exchanges. Volume is 24-hour trading volume in U.S. dollars. Price is the volume-weighted average of all prices. Circulating supply approximates the number of tokens that are circulating in the market and is analogous to a public company's float.

4.2 Summary Statistics

We collect detailed issuer data for the exchange-traded tokens, focusing on variables potentially relevant to transparency, bonding, certification, and quality. We also collect data on token characteristics and the ICO process. The data come from issuer websites, white papers, news articles, ICO aggregator and tracker websites, LinkedIn, Github, Twitter, and Telegram. Data were gathered manually by a team of research assistants and spot-checked.

4.2.1 Issuers

We begin with indicator variables describing issuers in Table 2, Panel 1. Data about the lead founder or CEO is available for 387 ICOs.[35] Of these, 97 percent are male. This is higher

[33] All data available on https://coinmarketcap.com/.

[34] Exchanges without fees permit issuers or other stakeholders to generate false volume, where a trader (or its bots) trades back and forth with itself.

[35] Where there is no CEO and founders appeared co-equal, one was chosen at random.

than the share of VC-backed entrepreneurs who are male, which Gompers and Wang (2017) find to be about 90 percent post-2010. Forty percent of founders/CEOs have backgrounds in the "crypto" community, which includes having worked at a blockchain-based company. Thirty-three percent have backgrounds in financial services, and 60 percent in computer science. If the founder claims on LinkedIn to have previously founded a company, we assign him an entrepreneurship background, which applies to 58 percent of the sample.

Eleven percent of issuers previously received VC equity financing. As the relationship between the VC and ICO markets matures, it appears they are complements in some circumstances and substitutes in others. Instances where issuers previously raise equity VC or include VCs as token buyers (e.g. Kik, Blockstack, and Filecoin) are paralleled by other instances where the ICO substitutes for VC. For example, digital identity company Pillar's founder unsuccessfully sought VC before raising $25 million in an ICO.[36] Anticipating that their portfolio companies may try to raise funding through ICOs, some VCs now include rights to future tokens as a standard term sheet clause.[37] The National Venture Capital Association has added a protective provision to its model term sheet that gives investors a veto over token, cryptocurrency and blockchain related offerings.[38]

Just under 10 percent appear to have failed (no ongoing online presence). Eighty-one percent of issuers published a white paper prior to the ICO. The white paper typically contains information about tokens set aside to incentivize platform development through a foundation, bounty, or endowment (67 percent of issuers have something of this kind), the vesting schedule for tokens assigned to insiders (36 percent have some vesting), and a budget for use of the proceeds (57 percent have one). There appears to be utility value for 68 percent of of the tokens. The Ethereum blockchain is dominant, with 74 percent of tokens using the ERC20 smart contract.

Issuers are located or partially located in 60 countries. Figure 2 contains a map with countries color-coded by their number of issuers. In analysis, we employ indicator variables for the top nine countries by number of ICOs, as well as for those issuers dispersed across at

[36] http://www.wired.co.uk/article/what-is-initial-coin-offering-ico-token-sale

[37] Author conversation with Union Square Ventures partner, and https://www.coindesk.com/ico-investors-seek-veto-power-future-token-sales/

[38] https://nvca.org/pressreleases/nvca-unveils-updated-model-legal-documents/

least five countries. Eighteen percent of issuers are located in the U.S., while six percent are dispersed. The dollar amounts raised by country roughly correlate with the number of ICOs. The U.S. leads, with over $900 million. Next is Switzerland, with $652 million. Singapore, Russia, China, and Israel follow (in order).

Publishing source code is a powerful form of transparency, and also leverages the wisdom of the crowd to to identify bugs quickly and improve quality. Github is the dominant web-based repository hosting service for computer code. It enables open source development, version control, and broad-based collaboration. An issuer may create multiple repositories, or directories for specific projects. Typically, there is a main repository containing the token contract. We identify this repository for 67 percent of ICOs and summarize it in Table 2, Panel 2. The average main repository has over 2,000 commits (revisions), 11 branches (pointers to specific versions), 30 releases (official new versions of the software), and 49 contributors (people who are not organization members but contribute to the project). The days between the last commit and April 11, 2018 proxies for ongoing engagement with the software.

Social media is a central means for issuers to communicate with stakeholders. The two primary platforms are Telegram and Twitter. Telegram is a cloud-based mobile and desktop messaging application with a focus on security and speed. Accounts are tied only to phone numbers. Its "group" chats permit 100,000 members and enable simple message broadcasting. Telegram's own source code is publicly available and, to some degree, open-source. As a result of this and perceived independence from large companies and governments, it has become a preferred platform for many in the crypto community. Eighty-three percent of our sample has a Telegram group, and among this subset, the average group has over 5,000 members. Ninety-seven percent of the sample has an official Twitter account, which has on average 22,200 followers.

We assign each issuer to one of 12 sectors, shown in the left columns of Table 3.[39] The largest is asset management/other crypto financial services, with 19 percent of issuers. One example in this category is Bloom, a platform for identity attestation, risk assessment and credit scoring that raised $41 million. The second largest category is non-crypto marketplaces

[39]Sector categories are based on detailed research of a subset of 60 ICOs.

and services. One example is Paragon, which raised $70 million and is building "a community dedicated to the worldwide legalization and systematization of cannabis." They plan to record and store product information, verify patient identification, and assure payments. The types of issuers conducting ICOs have changed as the industry has matured. Figure 7 shows each sector's quarterly share of total ICO fundraising. The early period was dominated by data storage/computing, new blockchain protocols, and prediction markets/gambling. More recently, the market has shifted to more specific business applications, including payments and wallets; enterprise, health and identity; and smart contracts. An example of a smart contract ICO is Agrella, which raised $29 million and plans to enable users to create and manage legal agreements that automate obligation fulfillment (e.g. payment).

4.2.2 ICO Characteristics

ICO processes and outcomes, based on the decision variables discussed in Section 2.4, are described in Table 4. Sixty-one percent of ICOs disclose a fundraising goal. Of these, 53 percent do not meet the goal. The amount raised is available for 364 ICOs. It averages $15.8 million nominal U.S. dollars, or $16.3 million if airdrops (which comprise 14 percent of ICOs) are excluded. We observe the fraction of total token supply sold for 416 ICOs; for this subset, the average is 54 percent, though there is wide variation. Three quarters of ICOs have a cap on the number of tokens sold. Most ICOs in our data have a fixed price. Only 34 percent use dynamic pricing, where the price changes during the ICO in a pre-determined way. Nine percent have a price that is sensitive to demand, and five percent use an auction mechanism. To avoid regulatory scrutiny, 19 percent of the ICOs claim to bar U.S. investors. Eight percent limit the number of tokens any single buyer can purchase in order to distribute tokens widely. On average, issuers accept just over two types of currencies. Ether is dominant, with 66 percent of issuers accepting it. Only 10 percent accept U.S. dollars.

4.2.3 Liquidity

Liquidity is our primary measure of success. From the perspective of an early stage investor, liquidity is a central benefit of ICOs relative to conventional financing instruments. Also, liquidity captures market depth and interest in the token, in the absence of measures of commercial success. Sockin and Xiong (2018) point out that token trading enables information aggregation from potential customers about demand for the platform's service. In traditional asset market models with imperfect information, agents have nothing to learn from trading volume. Conversely, the decision to join a token-based platform depends positively on token trading volume. Sockin and Xiong (2018) conclude that "any fundamental analysis of the cryptocurrency should look beyond prices and to volumes as an anchor."

We consider three liquidity measures. The first is price impact, based on a standard illiquidity measure for low-frequency trading data (see Amihud 2002 and Amihud, Mendelson and Pedersen 2006). This statistic, shown in Equation 1, gives the volume needed to move the price by 1 percent. We take the average over the last five days.

$$Illiquidity_t = \frac{1}{5} \sum_{t=t-5}^{t} \frac{\left|\log\left(\frac{p_t}{p_{t-1}}\right)\right|}{p_t volume_t} \tag{1}$$

This measure has been shown to perform well at measuring price impact with daily data (Goyenko et al. 2009, Hasbrouck 2009). For ease of interpretation, we negate the log of this measure and term it "Liquidity." Table 4, Panel 2 shows summary statistics seven, 28, 140, and 168 days after the start of trading (the latter three correspond to one, five, and six months). The left graph in Figure 8 contains a scatterplot of the primary measure we use in analysis, liquidity at five months. Liquidity has increased over time albeit with wide dispersion.

To examine whether ICO tokens are relatively liquid, we compare them to NASDAQ stocks over the same period. NASDAQ stocks are a natural benchmark because relative to other large exchanges, they are weighted towards Internet and technology stocks, as well as towards smaller companies. Table 5, Panel 1 shows that the NASDAQ stocks have much higher average liquidity and lower standard deviation. To test whether this reflects basic characteristics of the assets, we use the Fama-Macbeth regression in Equation 2, where t denotes a week and i an asset.

$$Liquidity_{i,t} = \alpha + \beta ICO_i + \gamma_1 Volatility_{i,t-1} + \gamma_2 Volume_{i,t-1} + \gamma_3 log(Price_{i,t-1}) + \varepsilon_{i,t} \tag{2}$$

After controlling for volatility, volume, and price, the coefficient on the indicator for being an ICO is -1.2, implying that ICO tokens are 7 percent less liquid than a conventional benchmark.

We also employ two alternative measures of liquidity. The first is dollar volume ($p_t volume_t$). We use the 24-hour U.S. dollar volume measure provided by CoinMarketCap, averaged over the prior five days (shown in the right graph in Figure 8). The second is turnover, which is volume normalized by circulating supply, also averaged over the past five days. This is a proxy for trading activity (see Datar et al. 1998). It is summarized in Appendix Table A1. We use the turnover variable only for robustness tests, because it is available for a smaller sample.

4.2.4 Returns

Price data permit us to calculate cumulative returns from the first day of trading. Raw returns five months after the start of trading are shown in Figure 9 (the whole sample in the left graph, and a sample excluding tokens with returns greater than 30 in the right graph). We calculate abnormal returns using the bitcoin price as a benchmark.[40] Abnormal returns over time are plotted in Figure 10. There has been no secular change over time in raw or abnormal returns, unlike liquidity, which has increased. The log raw and abnormal return measures exhibit high variance and skewness across tokens, shown in Table 4, Panel 2. The average abnormal return (not logged) is 1.49. This implies that the relative to the bitcoin benchmark, the average token price increases by 149 percent between the first day of trading and five months later. However, the median token falls in value by almost 50 percent. This is similar to the skewness in VC portfolio company returns (Kerr, Nanda and Rhodes-Kropf 2014). Finally, volatility, a proxy for uncertainty, is calculated as the rolling standard deviation of prices over the past five days (summarized in Appendix Table A1).

We do not attempt to calculate underpricing, which in an IPO context is when the offer price is lower than the closing price on the first day of trading. This is because the "offer price" in the ICO setting should be the price that token buyers pay in the ICO (including

[40]Bitcoin is much larger than any other cryptocurrency and arguably serves as a proxy for the market index. In robustness tests, we also use ether and joint ether/bitcoin indices. Summary statistics using an ether benchmark are in Appendix Table A1.

the pre-sale, when applicable). However, this price is rarely publicly available.

4.3 Which Sectors are Suited to ICOs?

To explore what types of ventures use ICOs instead of traditional financing, we collect data on startups using blockchain technology that received seed or venture capital investment in the CB Insights database. Figure 1 shows total funding to these 638 startups in red bars and highlights how much more money has been raised in ICOs, using our estimation sample (dark blue bars) and a larger dataset of completed ICOs (light blue bars).

Essentially all issuers in our sample target atomized consumers and are usually building two-sided marketplaces. Like Bitcoin, they are often decentralized, with no intellectual property or revenue model. These ventures are not well suited to conventional equity and debt instruments. We hypothesize that startups exploiting blockchain technology and receiving VC will be more likely to be business-facing. Of the VC-backed startups we can categorize, 43 percent have a business-to-business model while the remainder have a business-to-consumer model. This indicates selection into financing instruments. Enterprise-focused blockchain startups such as Digital Asset Holdings, which has created a blockchain-based repo market for banks, among other services, are more likely to fund themselves with VC.

We are able to assign most of the VC-backed startups into one of the 12 ICO sectors, which are on the right side of Table 3. While there is substantial overlap, three sectors are much better represented among VC-backed startups than among ICO issuers: payments and wallets; enterprise, health and identity; and trading and crypto exchanges. By comparing Table 3 with Figure 7, it seems that the most prominent sectors among the VC-backed blockchain startups are those towards which the ICO space has shifted focus over time.

5 Relationship between Characteristics and Success

We study the factors associated with ICO success using variants of Equation 3:

$$Liquidity_{i,t} = \alpha + \beta' \mathbf{X_i} + \gamma BTCPrice_t + QuarterStartFE_i + \varepsilon_{i,t} \qquad (3)$$

We regress liquidity and volume (as well as other outcomes in supplementary analysis) on a vector of characteristics $\mathbf{X}_i$, which are generally not time-varying. All except the social media variables are observed before the start of trading. We also control for the current price of Bitcoin, which is a proxy for "market sentiment" in the industry. Finally, we include fixed effects for the quarter that the ICO token started trading. In our primary models, the dependent variables are observed after 140 trading days (five months). Standard errors for the regression estimates are clustered by the quarter in which each token begins trading.

Table 6 considers proxies for issuer quality, transparency, and credibility. Nearly all the coefficients are positive and significant, indicating that forms of issuer bonding translate into more liquidity and volume. Prior VC equity investment in the issuer, for example, is one measure of quality and credibility; this is among the strongest predictors of success among all the variables used in this paper both in terms of magnitude and robustness. Prior VC is associated with a more than 800 percent increase in liquidity. Similarly, Baker and Gompers (2003) and Hochberg (2011) find that prior VC is associated with success after IPO. Token vesting schedules for insiders are a measure of credibility, as insiders with mandatory long-term investments are likely to contribute to project success. This is also strongly associated with liquidity and volume. Proxies for transparency include publishing a white paper, a budget for the use of proceeds, and source code on Github; all of these have large, positive coefficients. Having a Telegram messaging group is also associated with success, but a Twitter account has no predictive power.

In the right two columns of Table 6, we examine Github, Twitter, and Telegram variables for the 234 tokens with available data. When a token has more followers on Twitter or more members in its Telegram group, its token tends to be more liquid. With respect to Github, we find no significant relationship between commits (the number of revisions to the repository) and liquidity. However, more releases (official new versions of the code) are negatively associated with liquidity. This may reflect significant changes to the issuer's business model, leading to market uncertainty about its future. More easily interpretable is the negative relationship between days from last commit and liquidity. A longer time since the last revision indicates that the code is not being actively worked on, and this may signal that the issuer is abandoning or not prioritizing the project.

The results in Table 6 speak to the longstanding debate about the effectiveness of mandatory disclosure. For equity IPOs in the U.S., disclosure has been mandatory since the passage of the securities acts in the 1930s, but critics view these rules as costly and inflexible (e.g. Easterbrook and Fischel 1984). Our results suggest that ICO issuers are mindful of the importance of transparency and actively tailor their disclosures of the source code, the operating budget, and their business plans in order to raise investor confidence. This behavior is consistent with literature on IPOs showing that attempts to reduce information asymmetry or agency costs make fundraising more successful (Healy and Palepu 2001, Loughran and Ritter 2002).

In Table 7, we examine issuer background and location. Entrepreneurship is the only founder background with a significantly positive association with both liquidity and volume, suggesting that experience in building a business is more relevant to success (columns 1-2). The coefficient associates entrepreneurial experience with a 100 percent increase in liquidity. There is evidence that the quality of a startup's founding team is the most important factor governing early stage angel and VC investment decisions (Gompers et al. 2016, Bernstein et al. 2017, Howell 2018). Our results show that founder quality is relevant for blockchain-based businesses as well. Locating in China, Switzerland, Singapore, and the U.S. are all associated with success (Table 7 columns 3-4). It seems likely that the first three reflect permissive regulatory environments; the Chinese ICOs all took place before the ban in September, 2017. The U.S. may be home to so many top issuers because of its deep capital markets, cutting edge blockchain technologists, and active fintech startup ecosystem.

We study the importance of ICO design features in Table 8. When an ICO has a pre-sale, it achieves higher liquidity and volume in the secondary market, a pattern that may reflect the signaling value of early expert investors. Liquidity and volume are also positively correlated with the amount raised, stating a funding target, and reaching that goal. Accepting ether as payment has a strong positive association with success; this reflects the token following industry standards. There is a smaller positive association with accepting bitcoin, and negative associations with other currencies. Pricing mechanisms that seek to reflect demand, such as auctions, do not have a significant association with liquidity and volume. Barring U.S. investors also has no relation with success.

Issuer variables are in Table 9. Tokens with a purported utility function are significantly more successful (columns 1 and 2). This result is relevant to the regulatory debate discussed in Section 2.6. We also find that tokens on the Ethereum blockchain are more successful. These ERC20 tokens have well-established properties and the contract code is straightforward to read, which may reassure investors (see Section 2.3). All but two sectors have no relationship to success (Table 9 columns 3-4). Payment or wallet services are associated with success. Among the strongest predictors of liquidity among all variables we consider is intending to build a new blockchain protocol (e.g. Filecoin). While perhaps riskier than other business models, a new blockchain's value creation potential may dwarf that of applications built on other blockchains, because it can be the infrastructure for potentially widespread and diverse applications. Whereas value does not accrue to the infrastructure layer of the Internet, the tie between the token and the network in a blockchain ensures that the two have correlated value, at least in theory. The potential of a new blockchain is like the value that Facebook created as the underlying network, relative to the value of applications such as games that developers build for use on Facebook.

We combine the variables with predictive power to examine, despite a loss of power, which have the strongest independent correlation with liquidity. Complete specifications with just 160 observations are in columns 1 and 3 of Table 10, and a version without variables where we have considerably less data is shown in columns 2 and 4. The most robust predictors of success are previous VC, social media followers, having a funding goal and meeting it, creating a new blockchain protocol, and the founder having entrepreneurial experience. Most of the other variables behave consistently with the prior tables in columns 2 and 4, but many lose significance in columns 1 and 3.

Amount raised in the ICO (in log millions of US dollars) is an additional dependent variable in Table 10 column 5. Factors with strong positive associations are insider vesting, previous VC, accepting bitcoin as payment, entrepreneurial experience, and posting source code on Github. Being located in more than four countries (i.e., dispersed founding team with no clear headquarters) leads to less money raised. Catalini and Gans (2018) theorize that limited token supply will be associated with higher amounts raised in the ICO. Consistent with their model, in our data the ability to create future tokens is negatively associated with amount raised.

We predict failure in Tables 11 and 12. Failure is an indicator for the token having delisted, or the issuer having no website or obvious web presence.[41] Many predictors of liquidity are also negatively associated with failure, such as having an incentive pool, insider vesting, white paper, utility value, and a fundraising goal. However, there are some notable differences. Founder computer science experience is associated with lower failure rates, but neither entrepreneurial experience nor VC backing have any correlation. VCs may back riskier startups, which are more likely to achieve success but also not less likely to fail than the average token. Tokenized real assets, which are tokens tied to real-world assets such as the price of gold or the U.S. dollar, tend to have higher failure rates. These are essentially the opposite of utility tokens and more often appear to be scams.

Three supplementary analyses are in the Appendix. Appendix Table A2 predicts cumulative abnormal returns at one month (columns 1 and 2) and five months (columns 3 and 4). Almost all variables are observed at the start of trading, so we do not expect returns to reflect them. The number of Twitter followers is positively associated with returns and is observed after the start of trading. Also, having a new blockchain protocol appears to predict returns. Russia is negatively associated with returns (columns 2 and 4). We find similar results using a combined ether-bitcoin benchmark. We predict volatility in Appendix Table A3. Last, Appendix Table A4 contains robustness tests. Columns 1 and 2 show that our liquidity results are similar at alternative horizons from the start of trading, one month and six months. Column 3 shows that the results are robust to turnover, an alternative liquidity measure.

6 Conclusion

This study introduces the ICO market and examines factors that predict success. We focus on determinants of liquidity for 453 ICOs, and also conduct a detailed case study of the

[41]For parsimony, in Appendix Table A4 columns 2 and 3 we include only variables with predictive power in the respective categories. For example, no other sectors have predictive power in column 3 besides those included. Also, we find no effect of amount raised in the ICO. This variable reduces the sample size considerably.

Filecoin ICO, employing proprietary transaction data. We find that liquidity is higher when token issuers take steps to reduce information asymmetry and bond their promises to create viable business platforms. We also find that tokens are more successful when they have an underlying utility function, a result with implications for the current regulatory debate over whether tokens are investment securities. Our results indicate that tokens have the greatest liquidity when they follow the utility model and the promoters take credible steps to commit to the construction of a bona fide blockchain business.

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Table 1: Filecoin

Panel 1: Summary Statistics

	Num Transactions	Avg. num FIL per transaction	Avg. USD per transaction	Median USD per transaction	Avg. USD/FIL
Pre-sale	210	430,554	$246,217	$49,356	$0.57
1st Hour of Public Sale	1,690	33,005	$80,255	$10,000	$2.43
Rest of Public Sale	1,167	3,474	$16,000	$3,480	$4.61

Panel 2: Vesting Discounts in Advisor Sale (Pre-sale) and Public Sale

Vesting period:	6 months		12 months		24 months		36 months	
Portion of ICO:	Pre-sale	Public	Pre-sale	Public	Pre-sale	Public	Pre-sale	Public
Vesting Discount:	N/A	0	0	7.5%	15%	15%	30%	20%
Avg. USD/transaction:	N/A	$58,414	$184,743	$35,970	$277,478	$26,175	$275,841	$61,575

Panel 3: Number of Investors During ICO by Investor Type

	Core team	Previous PL investors	Others
Pre-sale	6	9	128
1st Hour of Public Sale	0	1	1,358
Rest of Public Sale	1	0	815

Panel 4: Advisor Sale (Pre-sale)

	Avg. Investment in USD
Core team	$40,835
Previous PL investors	$1,786,440
Others	$276,760

Note: Panel 1 shows summary statistics about the three periods of Filecoin's ICO, which are the pre-sale (Filecoin terms this the "advisor sale"), the first hour of the public sale, and the rest of the public sale. We show the number of transactions (individual purchases), the average number of FIL tokens issued per transaction, the average and median USD paid per transaction, and the average price in USD of a FIL token. Panel 2 shows the discounts offered by vesting horizon; the minimum was six months. For some vesting horizons the discounts also depended on whether the investment was made during the advisor sale or during the public sale. Panel 3 shows the number of investors from two specific groups across the three time periods: Protocol Lab's "core team", which includes founders and critical employees, and previous Protocol Labs investors (including angel and VC investors). Panel 4 shows the average number invested per investor (converted to USD) across the three groups during the advisor sale.

Table 2: Exchange-traded ICO issuer summary statistics

Panel 1: Issuer characteristics (indicator variables)

	N	Mean
Founder/CEO Male	387	0.97
Founder/CEO professional background in crypto	387	0.40
Founder/CEO professional background in financial services	387	0.33
Founder/CEO professional background in computer science	387	0.60
Founder/CEO professional background in entrepreneurship	387	0.57
VC-backed	453	0.11
Failed	453	0.09
Has no website	453	0.08
Had a white paper	453	0.81
Incentive set aside	453	0.67
Founder token vesting schedule	453	0.36
Had a budget for use of proceeds	453	0.57
Token has apparent utility value	453	0.68
Created or plans to create a new blockchain protocol	453	0.09
Token on Ethereum blockchain	453	0.74
Token on Waves blockchain	453	0.06
Token on BitShares blockchain	453	0.04
Can create more tokens in future	453	0.14
Located (or partially located) in USA	453	0.18
Located (or partially located) in China	453	0.05
Located (or partially located) in Canada	453	0.02
Located (or partially located) in Russia	453	0.07
Located (or partially located) in Singapore	453	0.07
Located (or partially located) in Switzerland	453	0.07
Located (or partially located) in Israel	453	0.02
Located (or partially located) in the United Kingdom	453	0.05
Located (or partially located) in Hong Kong	453	0.02
Dispersed (>4 countries)	453	0.06

Note: This panel contains indicator variables about the issuer company and token. Data is gathered from issuer websites, technical white papers, news articles, and LinkedIn. The panel includes all 453 exchange-traded ICOs in our estimation sample; sample sizes vary depending on the number of tokens for which the variable was identified

Panel 2: Github

	N	Mean	S.d.	Min	Median	Max
Has Github source code repository	453	0.66				
Number of repositories	302	15.51	33.60	0.00	6.00	399.00
Main repository: Number of commits (000s)	302	2.01	6.37	0.00	0.18	92.73
Main repository: Number of branches	302	10.92	30.86	0.00	3.00	361.00
Main repository: Number of releases	302	29.53	95.90	0.00	0.00	1291.00
Main repository: Number of contributors	302	49.33	144.49	0.00	5.00	2041.00
Main repository: Days between last commit and April 11, 2018	289	262.57	447.42	0.00	111.00	3233.00

Note: This panel contains continuous variables about the issuer's Github presence. Github a web-based repository hosting service for, primarily, computer code. Repositories contain public source code about a project. The main repository contains the token/ICO contract. The platform enables open source development, version control, and broad-based collaboration. Data is gathered from the Github website. The remaining rows include only those ICOs with a Github source code repository. The panel includes all 453 exchange-traded ICOs in our estimation sample; sample sizes vary depending on the number of tokens for which the variable was identified

Panel 3: Social media

	N	Mean	S.d.	Min	Median	Max
Has Telegram group	453	0.83				
Number of Telegram group members (000s)	358	5.09	9.28	0.01	2.03	88.34
Has Twitter page	453	0.97	0.18	0.00	1.00	1.00
Number of Twitter followers (000s)	432	22.20	53.34	0.01	6.76	741.00

Note: This panel contains continuous variables about the issuer's social media presence. Telegram is a cloud-based mobile and desktop messaging application with a focus on security and speed. Accounts are tied only to phone numbers. Its "group" chats permit 100,000 members, and enable simple message broadcasting. Telegram's own source code is publicly available and, to some degree, open-source. As a result of this and perceived independence from large companies and governments, it has become a preferred platform for many in the crypto community. Data is gathered from the Telegram and Twitter websites. The table includes all 453 exchange-traded ICOs in our estimation sample; sample sizes vary depending on the number of tokens for which the variable was identified.

Table 3: Exchange-traded ICO issuer sectors and VC-backed blockchain startup sectors

	ICO issuers		VC-backed blockchain startups	
	N	Share of total	N	Share of total
Ads, rewards	21	0.05	20	0.03
Asset mgmnt & other crypto fin services	86	0.19	132	0.17
Data storage/computing	28	0.06	38	0.05
Enterprise, health, identity	18	0.04	112	0.15
Gaming, entertainment, messaging	51	0.11	31	0.04
New blockchain protocol	38	0.08	17	0.02
Non-crypto marketplace/service	80	0.18	41	0.05
Payments, wallets	36	0.08	194	0.25
Prediction markets and gambling	14	0.03	5	0.01
Smart contract creation	17	0.04	11	0.01
Tokenizing real assets	19	0.04	9	0.01
Trading and crypto exchanges	27	0.06	89	0.12
Other			69	0.09
Unknown	18	0.04	3	0.00

Note: This left part of this panel contains the share of issuers in each of 12 sectors, including all 453 exchange-traded ICOs in our estimation sample. The sector categories were determined after researching a subset of sixty ICOs in detail. Data for the issuers is gathered from white papers and websites. The right part of the panel, "VC-backed blockchain startups", includes the 771 blockchain startups that received seed or VC investment as of April, 2018. They have been assigned where possible to one of the 12 sectors. No sector applied for 69 ("Other"). Data for the VC-backed startups is from CB Insights.

Table 4: Exchange-traded ICO Processes and Outcomes Summary Statistics

Panel 1: Indicator variables

	N	Mean
Stated goal to raise	453	0.61
Raised less than goal, if had goal to raise	268	0.53
Airdrop (token price was $0)	453	0.14
Capped (limit on number tokens sold)	453	0.76
Dynamic pricing (price changed during ICO)	453	0.34
Sensitive pricing (price changed during ICO to reflect demand)	453	0.09
Auction pricing	453	0.05
US investors barred	453	0.19
Had a presale	453	0.45
Limited number of tokens each buyer could purchase	453	0.08
Accepted USD as payment	453	0.10
Accepted Euros as payment	453	0.03
Accepted bitcoin as payment	453	0.41
Accepted ether as payment	453	0.66
Accepted XRP as payment	453	0.02
Accepted Litecoin as payment	453	0.09
Accepted Waves as payment	453	0.04

Panel 2: Continuous data

	N	Mean	S.d.	Min	Median	Max
Amount raised (USD millions)	364	15.8	35.8	0.00	6.62	503
Amount raised (no airdrops, USD millions)	353	16.4	36.2	0.00	6.98	503
Amount raised less stated goal, if any	268	-8.19	25.5	-121	-0.03	160
Fraction total token supply sold in ICO	416	0.54	0.33	0.00	0.54	1.00
Duration of ICO in days	369	39.9	89.2	0.00	28.0	948
Days from ICO start to first trading date	389	52.9	84.9	0.00	34.0	1071
Number of currencies accepted	361	2.07	1.76	1.00	1.00	15.0
Log liquidity at 7 days	453	12.30	3.65	1.29	12.47	20.81
Log liquidity at 28 days	453	12.49	3.92	-0.32	12.79	20.63
Log liquidity at 140 days	443	13.08	4.25	1.93	13.79	22.45
Log liquidity at 168 days	429	13.01	4.48	0.07	13.43	22.41
Log volume at 7 days (mill USD)	453	10.74	3.11	0.15	10.72	19.10
Log volume at 28 days (mill USD)	453	10.52	3.31	-0.41	10.38	18.39
Log volume at 140 days (mill USD)	444	10.87	3.56	-0.69	11.10	19.47
Log volume at 168 days (mill USD)	430	10.89	3.67	-1.79	11.01	19.99
Log returns at 7 days	453	-0.09	0.80	-6.55	-0.05	3.89
Log returns at 28 days	453	-0.21	1.23	-8.62	-0.20	4.75
Log returns at 140 days	444	0.08	1.78	-16.64	0.15	4.50
Log returns at 168 days	430	0.05	1.81	-15.25	-0.01	5.63
Log abnormal (BTC) returns at 7 days	453	-0.14	0.80	-6.47	-0.08	3.75
Log abnormal (BTC) returns at 28 days	453	-0.39	1.24	-8.88	-0.31	4.26
Log abnormal (BTC) returns at 140 days	379	-0.52	1.87	-17.73	-0.45	4.34
Log abnormal (BTC) returns at 168 days	334	-0.70	1.87	-16.40	-0.62	4.91

Note: This table contains continuous variables summarizing the ICO process and outcomes. Liquidity is the negative of the Amihud price impact (illiquidity) measure averaged over the past five days. Volume is the total 24-hour US dollar trading volume averaged over the past five days. Returns are cumulative, and calculated using daily prices. Abnormal returns are the raw return less a benchmark (bitcoin, or BTC). Data for the top group of variables are from issuer websites, technical white papers, ICO aggregator and tracker websites, and news articles. Remaining data are from CoinMarketCap. The table includes all 453 exchange-traded ICOs in our estimation sample; sample sizes vary depending on the number of tokens for which the variable was identified or the number of tokens that have been trading for the specified number of days.

Table 5: Comparison of ICO and NASDAQ Liquidity

Panel 1: Summary statistics

	N	Mean	S.d.	Min	Median	Max
Log liquidity NASDAQ	1,610,609	18.16	3.00	4.81	18.31	28.85
Log liquidity ICOs	158,686	12.59	4.51	-1.11	13.02	31.39
Difference of means		5.57***				

Panel 2: Fama-MacBeth Regression

	(1)
	Liquidity
ICO_i	-1.2***
	(.058)
$Volatility_{i,t-1}$	-.15***
	(.009)
$Volume_{i,t-1}$	4.0e-09***
	(1.1e-10)
Log $Price_{i,t-1}$	1.3***
	(.024)
Observations	362321
R^2	.49

Note: This table compares the liquidity of NASDAQ stocks and exchange-traded ICOs. Liquidity is the negative of the Amihud price impact (illiquidity) measure averaged over the past five days. We use daily data for all NASDAQ stocks from Jan 2015 - Dec 2017, and daily data from our sample of 453 exchange-traded ICOs. Panel 2 shows results from the weekly Fama-MacBeth regression in Equation 2, where "ICO" is an indicator for the asset being an ICO token rather than a NASDAQ stock. *** indicates that the p-value for the difference of means is less than .01.

Table 6: Measures of issuer quality, transparency and credibility

	(1) Liquidity	(2) Volume	(3) Liquidity	(4) Volume
White paper	2.3***	1.7***		
	(.49)	(.37)		
Incentive pool	.13	.1		
	(.75)	(.48)		
Insider vesting	.86*	.81**		
	(.48)	(.36)		
Budget	.73*	.58**		
	(.35)	(.24)		
VC equity	2.4***	1.8***		
	(.45)	(.47)		
Code on Github (GH)	1***	1***		
	(.31)	(.21)		
Twitter account	-.35	-.47		
	(.62)	(.75)		
Telegram group	1.6**	1.4**		
	(.58)	(.54)		
Telegram members (000s)			.05*	.048*
			(.027)	(.026)
Twitter followers (000s)			.035***	.029***
			(.0043)	(.005)
GH repositories			.0024	-.0023
			(.0053)	(.0022)
GH commits (000s)			.02	.0095
			(.028)	(.037)
GH main rep branches			-.0011	-.00082
			(.0043)	(.0041)
GH main rep releases			-.0032***	-.0024***
			(.00054)	(.00032)
GH main rep contrib.			.0014	.0015
			(.0014)	(.0017)
GH days from last commit			-.0012*	-.00088**
			(.00057)	(.00039)
Observations	443	444	234	234
R^2	.35	.35	.42	.42
Quarter Start FE	Y	Y	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and two measures of market depth. Liquidity is the negative of the log Amihud price impact (illiquidity) measure averaged over the past five days. Volume is the log total 24-hour US dollar trading volume averaged over the past five days. Both are observed at 140 days (5 months) after the start of trading. BTC price is also included as a control (unreported). Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Founder background and issuer location

	(1) Liquidity	(2) Volume	(3) Liquidity	(4) Volume
Male	-.18	-.22		
	(1.4)	(.9)		
Crypto exper.	-.41	-.52**		
	(.34)	(.21)		
Finance exper.	.28	.00091		
	(.51)	(.41)		
Comp. sci. exper.	.71	.42		
	(.42)	(.32)		
Entrep. exper.	1.3***	1.2***		
	(.31)	(.23)		
USA			1.1**	1***
			(.4)	(.34)
China			2.9***	2.7***
			(.63)	(.47)
Canada			-.88	-.71
			(1.8)	(1.6)
Russia			.12	-.0083
			(.53)	(.51)
Singapore			2***	1.7***
			(.67)	(.56)
Switzerland			2.3***	1.8***
			(.67)	(.44)
Israel			.24	.012
			(.77)	(.67)
UK			-.74	-.34
			(.9)	(.69)
HK			1.5*	1.6
			(.81)	(.98)
>4 countries			-.61	-.64
			(.6)	(.54)
Observations	381	382	443	444
R^2	.19	.18	.22	.24
Quarter Start FE	Y	Y	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and two measures of market depth. Liquidity is the negative of the log Amihud price impact (illiquidity) measure averaged over the past five days. Volume is the log total 24-hour US dollar trading volume averaged over the past five days. Both are observed at 140 days (5 months) after the start of trading. BTC price is also included as a control (unreported). Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: ICO rules, process and outcomes

	(1) Liquidity	(2) Volume	(3) Liquidity	(4) Volume
Capped	.45	.38		
	(.6)	(.51)		
Barred to US	.22	.3		
	(.24)	(.19)		
Presale	.46***	.44**		
	(.14)	(.19)		
Had goal to raise	.53**	.48***		
	(.24)	(.15)		
Airdrop (free)	.18	.17		
	(.64)	(.61)		
Dynamic pricing	.7	.56		
	(.52)	(.39)		
Demand-sensitive pricing	-1.2	-.88		
	(1.2)	(.94)		
Auction pricing	.69	.61		
	(.81)	(.74)		
Future token creation	.64	.52		
	(.65)	(.58)		
Accept USD	.097	.29		
	(.43)	(.33)		
Accept EUR	-.84	-1.3		
	(.71)	(.76)		
Accept BTC	1.1***	.89***		
	(.32)	(.18)		
Accept ETH	2**	1.6**		
	(.84)	(.61)		
Accept XRP	-.38	.22		
	(.99)	(.81)		
Accept LTC	-.85*	-.74**		
	(.42)	(.31)		
Accept WAVES	-2.7**	-2.1**		
	(1)	(.74)		
Amt Raised (USD Mill)			.061**	.05***
			(.02)	(.015)
Raised less than goal			-1.1***	-1.1***
			(.31)	(.24)
Fraction tokens sold			.23	.063
			(.95)	(.86)
Duration (days)			-.0033	-.0039
			(.0064)	(.0052)
Days ICO start to list			-.0071*	-.0037
			(.0035)	(.0021)
Observations	443	444	256	256
R^2	.28	.29	.25	.26
Quarter Start FE	Y	Y	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and two measures of market depth. Liquidity is the negative of the log Amihud price impact (illiquidity) measure averaged over the past five days. Volume is the log total 24-hour US dollar trading volume averaged over the past five days. Both are observed at 140 days (5 months) after the start of trading. BTC price is also included as a control (unreported). Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Issuer sector, token utility value and blockchain used

	(1) Liquidity	(2) Volume	(3) Liquidity	(4) Volume
Utility value	1.5***	1.4***		
	(.31)	(.31)		
ETH blockchain	1.4**	1.2**		
	(.56)	(.44)		
WAVES blockchain	-1	-.61		
	(.96)	(.65)		
Ads, rewards			1.2	-.63
			(.71)	(1)
Asset mgmnt, crypto fin Services			-.024	.42
			(.38)	(.57)
Data storage/computing			1.6*	.046
			(.89)	(.44)
Enterprise, health, identity			1	-.33
			(1.1)	(.76)
Gaming, entertainment, messaging			.034	-.95
			(.46)	(.57)
New blockchain protocol			3.1**	1.7**
			(1.1)	(.7)
Non-crypto marketplace/service			0	0
			(.)	(.)
Payments, wallets			1.7**	.87*
			(.63)	(.42)
Prediction markets and gambling			2.1	.74
			(1.3)	(.67)
Smart contract creation			.13	1.8
			(.78)	(1.4)
Tokenizing real assets			.17	.76
			(1)	(.98)
Trading, Crypto exchanges			.54	.96
			(.61)	(.56)
Observations	443	444	427	386
R^2	.22	.23	.22	.14
Quarter Start FE	Y	Y	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and two measures of market depth. Liquidity is the negative of the log Amihud price impact (illiquidity) measure averaged over the past five days. Volume is the log total 24-hour US dollar trading volume averaged over the past five days. Both are observed at 140 days (5 months) after the start of trading. BTC price is also included as a control (unreported). Sample sizes vary based on data availability.. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Key variables combined

	(1) Liquidity	(2) Liquidity	(3) Volume	(4) Volume	(5) Amt Raised
White paper	.075	1.3**	-.87	.83***	.36
	(1.5)	(.48)	(.66)	(.24)	(.48)
Incentive pool	.88	.083	.84	-.082	.099
	(.85)	(.48)	(.57)	(.33)	(.35)
Insider vesting	-.17	.5**	-.03	.56***	.49**
	(.49)	(.23)	(.47)	(.17)	(.18)
Budget	-.26	.44	-.29	.27	.086
	(.43)	(.44)	(.28)	(.31)	(.16)
VC equity	.86**	1.9***	.7**	1.4***	.53***
	(.27)	(.31)	(.24)	(.28)	(.15)
Telegram members (000s)	.095***		.079***		
	(.019)		(.012)		
Twitter followers (000s)	.016***		.013**		
	(.0045)		(.004)		
GH repositories	.0097***		-.0036		
	(.002)		(.0033)		
GH commits (000s)	.099		.073		
	(.12)		(.12)		
GH main rep branches	.0076		.0039		
	(.0093)		(.0069)		
GH main rep releases	.0015		.0015		
	(.0039)		(.0025)		
GH main rep contrib.	-.0038		-.0022		
	(.0052)		(.0055)		
GH days from last commit	-.00093		-.00031		
	(.00099)		(.0006)		
Future token creation	.81**	.29	.61**	.15	-.36**
	(.32)	(.48)	(.23)	(.42)	(.13)
Amt Raised (USD Mill)	.022***		.017***		
	(.0057)		(.0042)		
Capped	-.85	-.66	-.56	-.48	.22
	(1.1)	(.52)	(.91)	(.41)	(.26)
Barred to US	-.59	-.24	-.086	-.071	.15
	(.38)	(.35)	(.36)	(.34)	(.14)
Presale	-.36	-.092	-.059	-.043	-.029
	(.52)	(.18)	(.46)	(.17)	(.17)
Had goal to raise	2.7**	.4	2*	.4**	.24
	(.94)	(.29)	(1)	(.14)	(.48)
Accept BTC	-.079	.42*	.19	.4*	.53***
	(.41)	(.23)	(.37)	(.23)	(.11)
Accept ETH	1.6*	1.2	1.3**	.9	.68
	(.87)	(.96)	(.53)	(.7)	(.51)
Accept WAVES	-.18	-2.3*	-1.3	-2.1**	-.44
	(1.2)	(1.2)	(.82)	(.83)	(1.1)
Raised less than goal	-1.8**		-1.5**		
	(.64)		(.5)		
Utility value	-.9	.017	-.66	.19	-.31
	(.66)	(.24)	(.55)	(.22)	(.2)
ETH blockchain	1.1		1.3		
	(1.4)		(1.3)		

Data storage/computing	1.2*	.17	1.8***	.25	.19
	(.53)	(.58)	(.24)	(.61)	(.55)
New blockchain protocol	1.5*	2.7**	1.7**	2.3***	.24
	(.8)	(.95)	(.54)	(.76)	(.42)
Payments, wallets	-.12	.73**	-.49	.56**	-.62***
	(1.2)	(.32)	(1.3)	(.26)	(.2)
Tokenizing real assets	.047	.94	-.12	.8	.027
	(.82)	(1.4)	(.78)	(1.1)	(.29)
Crypto exper.	-.22	-.54*	-.56**	-.64***	.074
	(.33)	(.27)	(.22)	(.19)	(.18)
Finance exper.	.34	-.079	.023	-.26	.21
	(.25)	(.42)	(.19)	(.39)	(.18)
Comp. sci. exper.	-.63	.34*	-.7*	.12	.18
	(.59)	(.17)	(.37)	(.15)	(.23)
Entrep. exper.	.83**	1.1***	.96**	1***	.41*
	(.34)	(.32)	(.36)	(.3)	(.21)
USA	-.34	.2	-.1	.21	.087
	(.58)	(.46)	(.3)	(.38)	(.18)
China	.32	2.1**	.99	2.1**	-.27
	(3.1)	(.92)	(2.1)	(.77)	(.36)
Canada	-2.2	-2.3*	-1.8	-2*	.85
	(1.4)	(1.1)	(1)	(1.1)	(.5)
Russia	-.76	-1.1**	-.55	-1.1***	-.27
	(.51)	(.43)	(.46)	(.3)	(.22)
Singapore	-.31	.48	-.062	.43	.099
	(.79)	(.75)	(.69)	(.62)	(.42)
Switzerland	1.4*	.95*	1.4**	.72**	.42
	(.7)	(.49)	(.56)	(.34)	(.25)
Israel	-.34	-1.3***	-.43	-1.3***	-.34
	(.41)	(.37)	(.26)	(.39)	(.45)
UK	-1.7	-2***	-1.4	-1.5***	-.08
	(2)	(.46)	(1.7)	(.35)	(.25)
HK	-4.1*	.41	-2.7	.73	-.25
	(2.1)	(.73)	(2)	(.82)	(.28)
>4 countries	.96	.45	.79	.31	-1.1***
	(1.9)	(.62)	(1.7)	(.43)	(.33)
Code on Github (GH)		.43		.62***	.54***
		(.3)		(.19)	(.16)
Telegram group		1.3**		1*	.12
		(.6)		(.55)	(.17)
WAVES blockchain		.031		.49	-.13
		(1.3)		(1.2)	(1)
Observations	160	381	160	382	325
R^2	.65	.39	.65	.38	.34
Quarter Start FE	Y	Y	Y	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics that had predictive power in prior regressions, and two outcomes, which follow definitions from previous tables. BTC price is also included as a control (unreported). Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Characteristics and Failure (Part 1)

	(1)	(2)
White paper	-.3***	
	(.061)	
Incentive pool	-.13***	
	(.038)	
Insider vesting	-.044*	
	(.025)	
Budget	-.078***	
	(.02)	
VC equity	-.021	
	(.044)	
Code on Github (GH)	-.052	
	(.031)	
Twitter account	.16	
	(.1)	
Telegram group	-.16***	
	(.035)	
Telegram members (000s)		.0054*
		(.0029)
Twitter followers (000s)		-.0014**
		(.00048)
GH repositories		.00079
		(.001)
GH commits (000s)		-.011***
		(.0037)
GH main rep branches		-.00022
		(.00035)
GH main rep releases		.00063***
		(.000094)
GH main rep contrib.		.0004**
		(.00016)
GH days from last commit		.00016
		(.00011)
Observations	453	237
R^2	.32	.25
Quarter Start FE	Y	Y

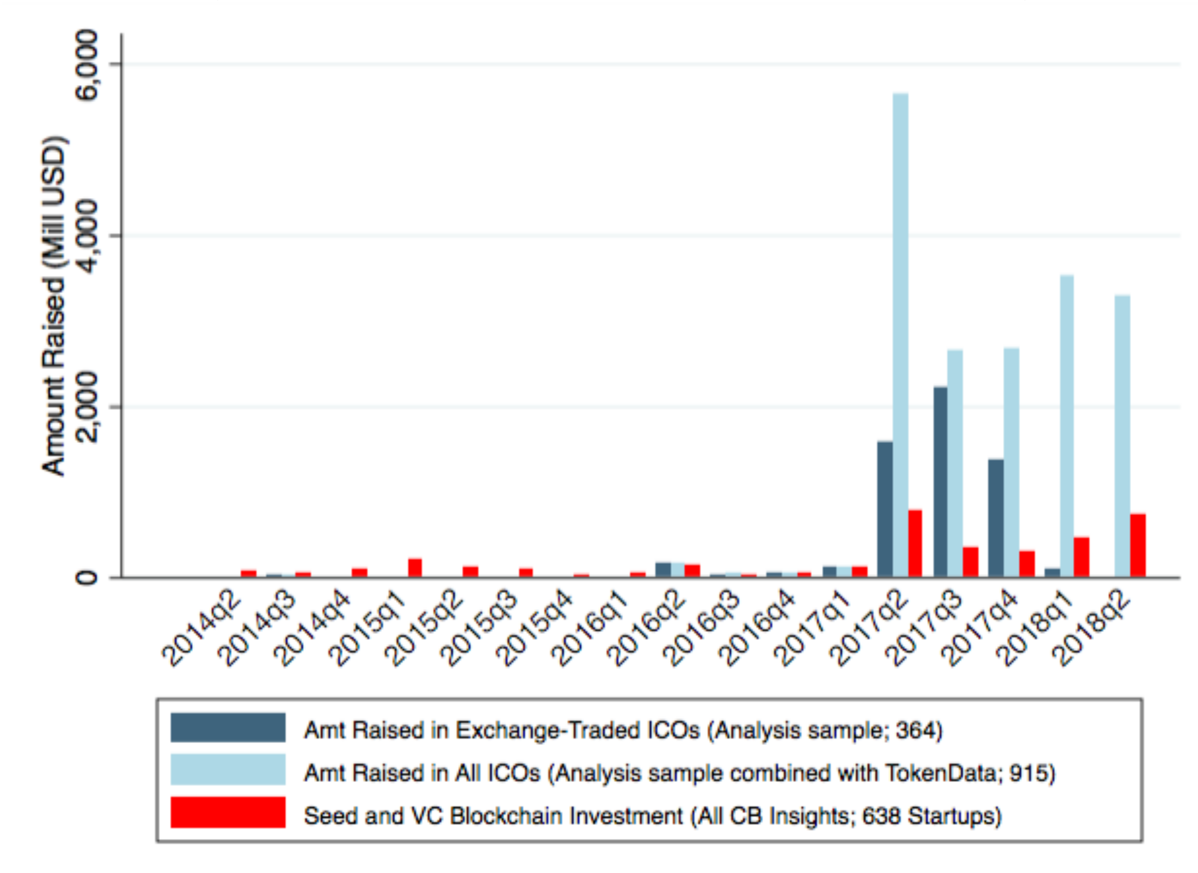
Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and failure, which is an indicator for the token having delisted, or the issuer having no website or obvious web presence. Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Characteristics and Failure (Part 2)

	(1)	(2)	(3)
Male	-.026		
	(.079)		
Crypto exper.	-.025		
	(.024)		
Finance exper.	.028*		
	(.014)		
Comp. sci. exper.	-.086**		
	(.031)		
Entrep. exper.	-.027		
	(.037)		
Switzerland		-.13***	
		(.036)	
UK		-.12***	
		(.036)	
Utility value		-.2***	
		(.052)	
Had goal to raise		-.23***	
		(.052)	
Ads, rewards			-.16***
			(.038)
Data storage/computing			-.15**
			(.061)
Enterprise, health, identity			-.19***
			(.033)
New blockchain protocol			-.16***
			(.054)
Tokenizing real assets			.22*
			(.11)
Observations	387	453	453
R^2	.07	.25	.099
Quarter Start FE	Y	Y	Y

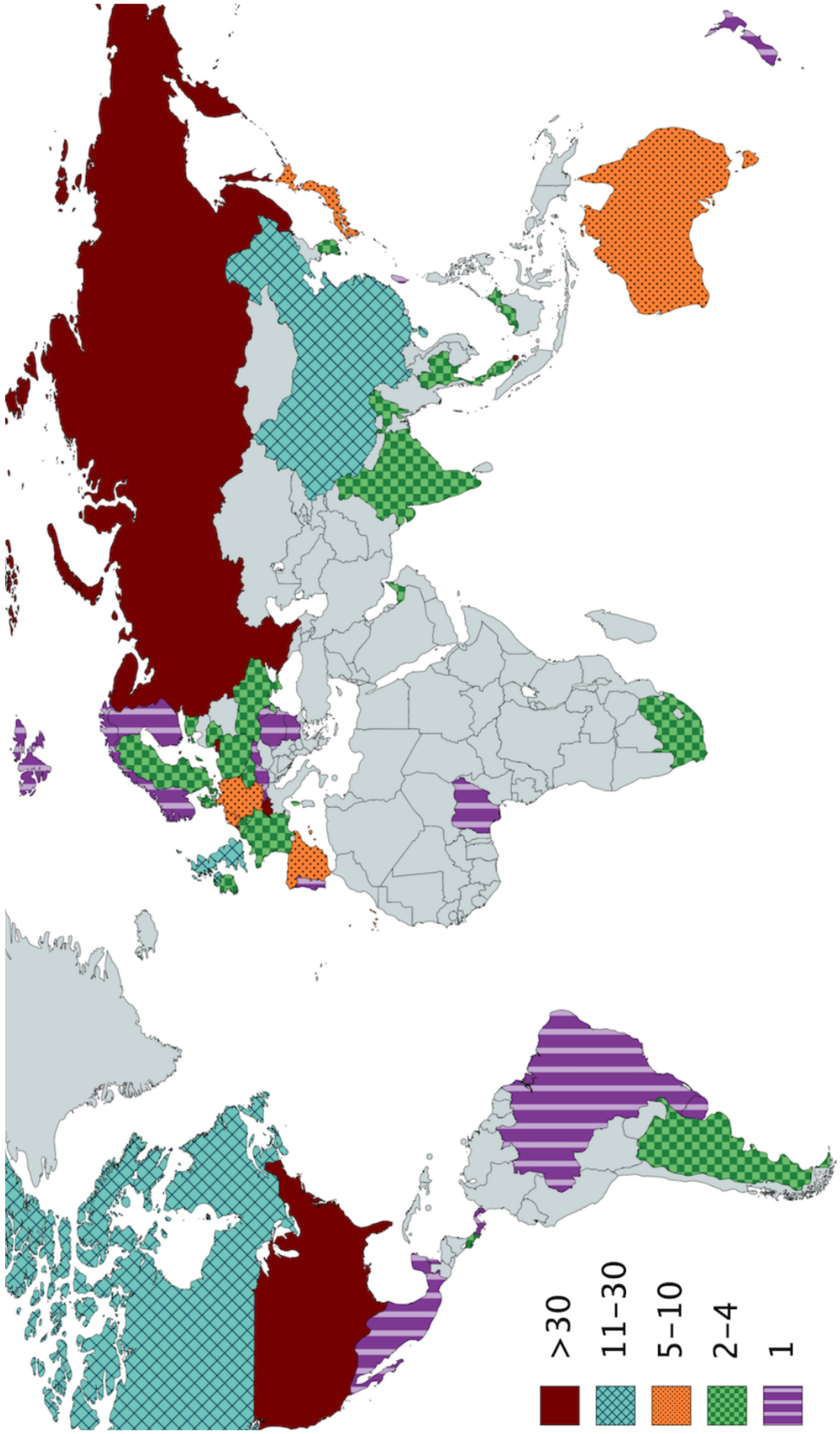
Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and failure, which is an indicator for the token having delisted, or the issuer having no website or obvious web presence. Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: ICO and VC-backed blockchain Startup Fundraising



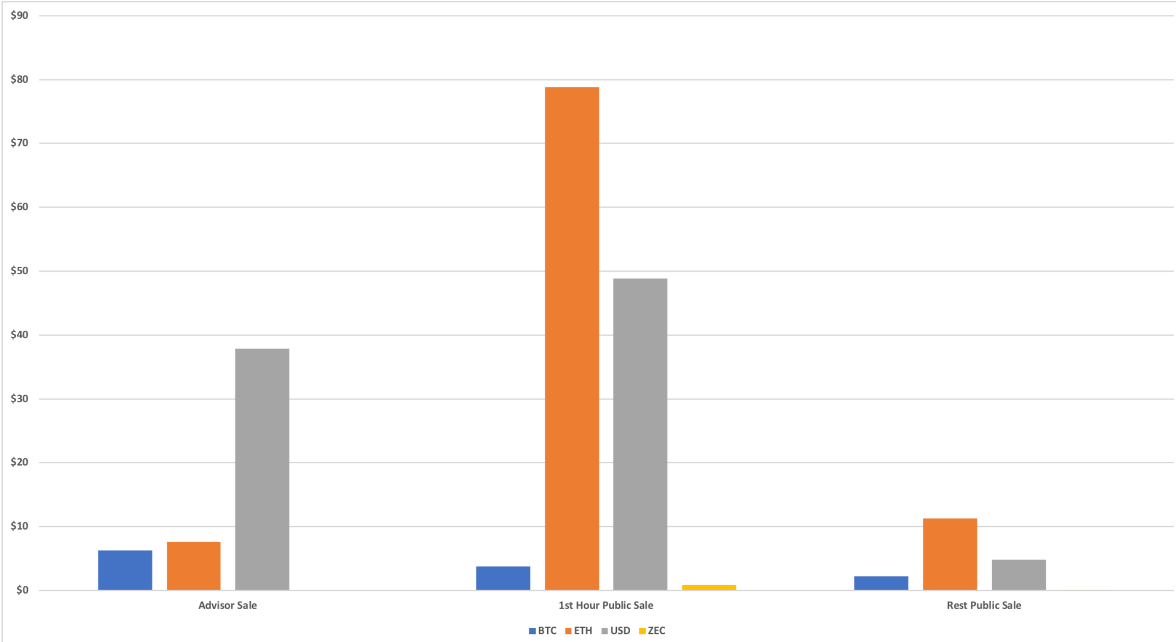
Note: This figure compares the amount raised through ICOs with the amount raised by blockchain-related startups. Data is quarterly from 2013 through the second quarter of 2018. The dark blue bars show total funding in our estimation sample of 453 exchange-traded ICOs (of which amount raised is non-missing for 364). The light blue bars combine our estimation sample with all remaining tokens that had completed ICOs and available amount raised from the TokenData database.

Figure 2: Number of ICOs by Country



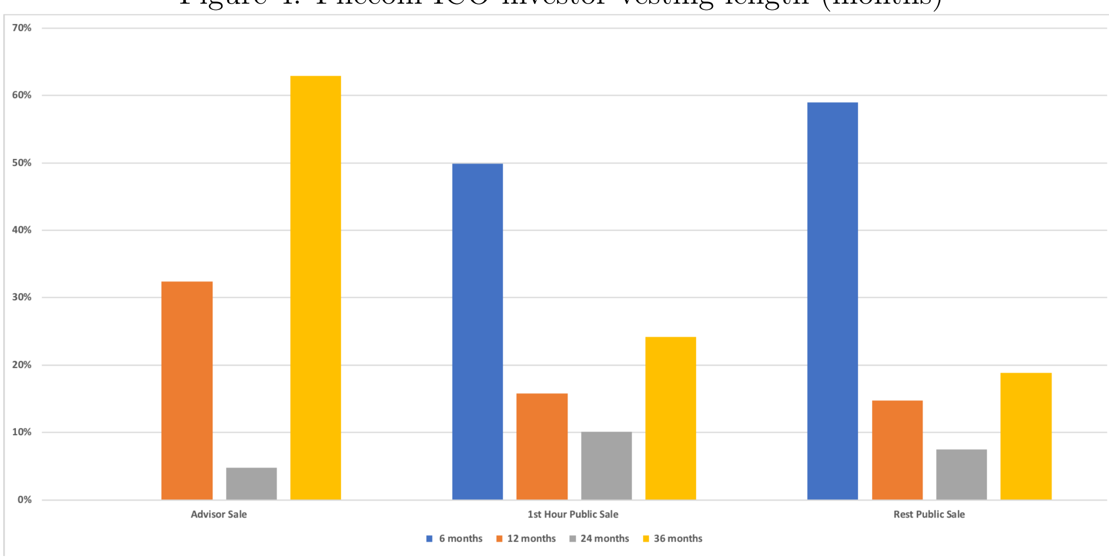
Note: This figure shows the location of ICO issuers in our sample. Not shown are the Cayman Islands (3 ICOs), Curacao (1), Cyprus (1), Gibraltar (1), Marshall Islands (1), Saint Kitts (1), and ICOs whose teams are dispersed across >4 countries (28). There are additionally 87 ICOs whose issuer locations are unknown.

Figure 3: Filecoin ICO investments by currency (millions of USD)



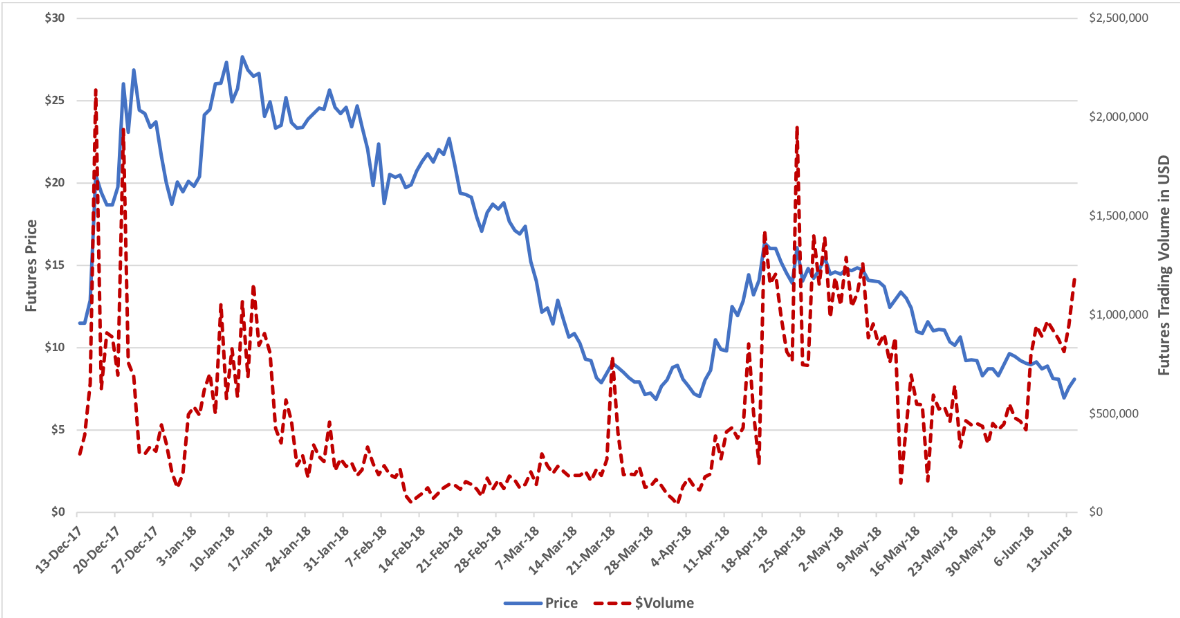
Note: This figure shows the USD equivalent amount invested during the Filecoin ICO. We separately show the advisor sale, the 1st hour of public sale, and the rest of the public sale. The exchange rates for the 1st hour of the advisor sale are observed on 8/10/2017 at 4 pm EST (the end of the first hour of the public sale). For advisor sale and for public sale, exchange rates are the closing price of the currency on 8/1/2017 and 9/7/2017, respectively.

Figure 4: Filecoin ICO investor vesting length (months)



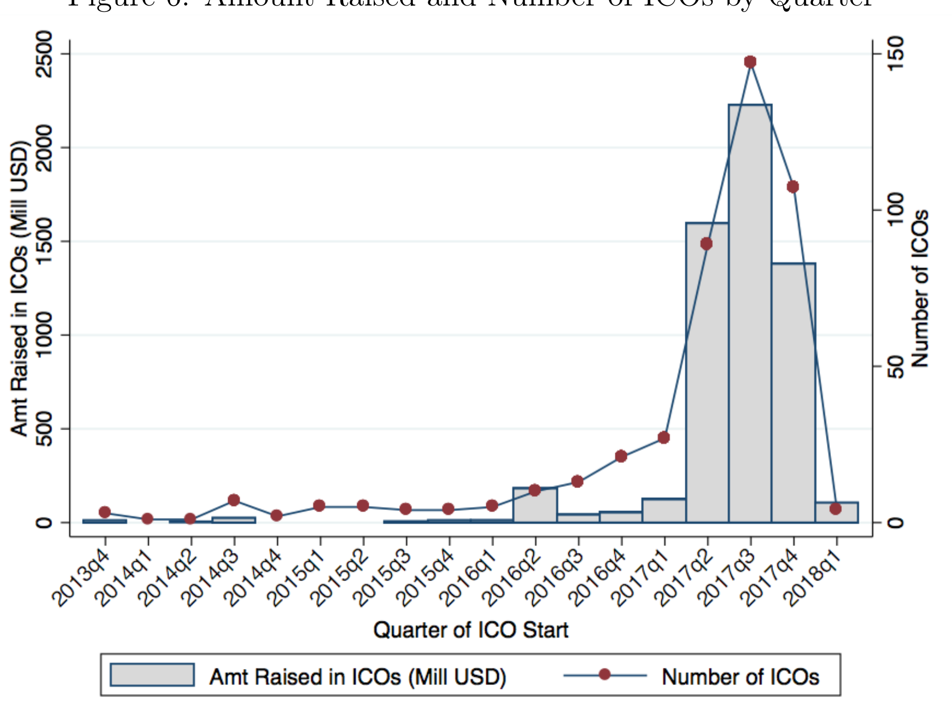
Note: This figure shows what percentage of transactions during the three different time periods of the ICO: advisor sale, first hour of public sale, and the rest of the public sale, chose the 6-month, the 12-month, the 24-month, and the 36-month vesting horizon. Note that investors during the advisor sale didn't have the 6-month vesting option.

Figure 5: Filecoin futures price and USD volume



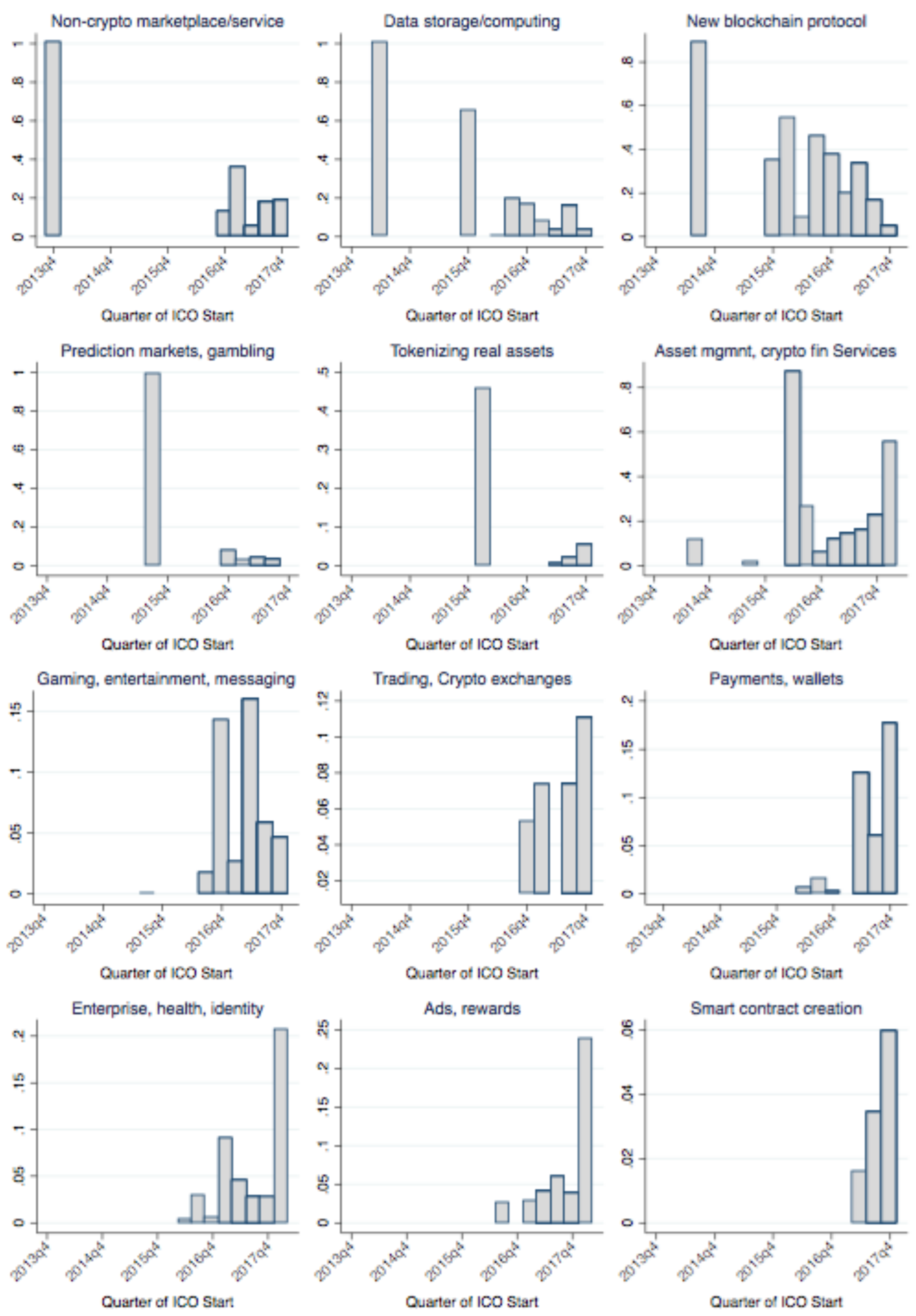
Note: This figure shows prices and dollar trading volume of Filecoin (FIL) futures contracts from 12/2017 (when futures trading began) to 06/2018. The left axis shows the price in USD and the right axis shows the dollar volume. Data from Gate.io and Lbank.

Figure 6: Amount Raised and Number of ICOs by Quarter



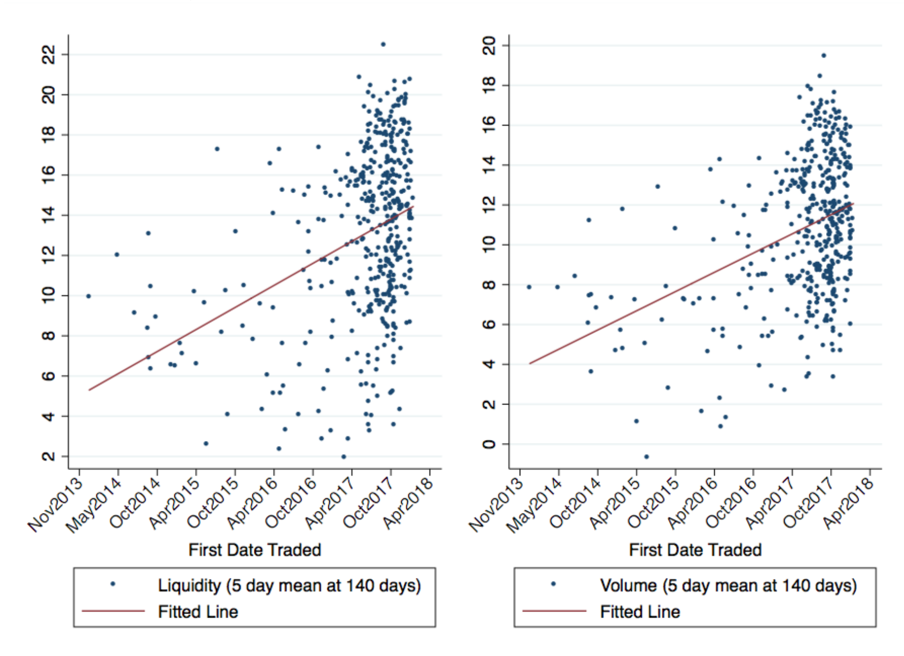
Note: This figure shows the total quarterly amount raised and number of ICOs in our sample. The overall number of ICOs is 453, while amount raised is available for 364.

Figure 7: Sector Share of Total Amount Raised in Quarter



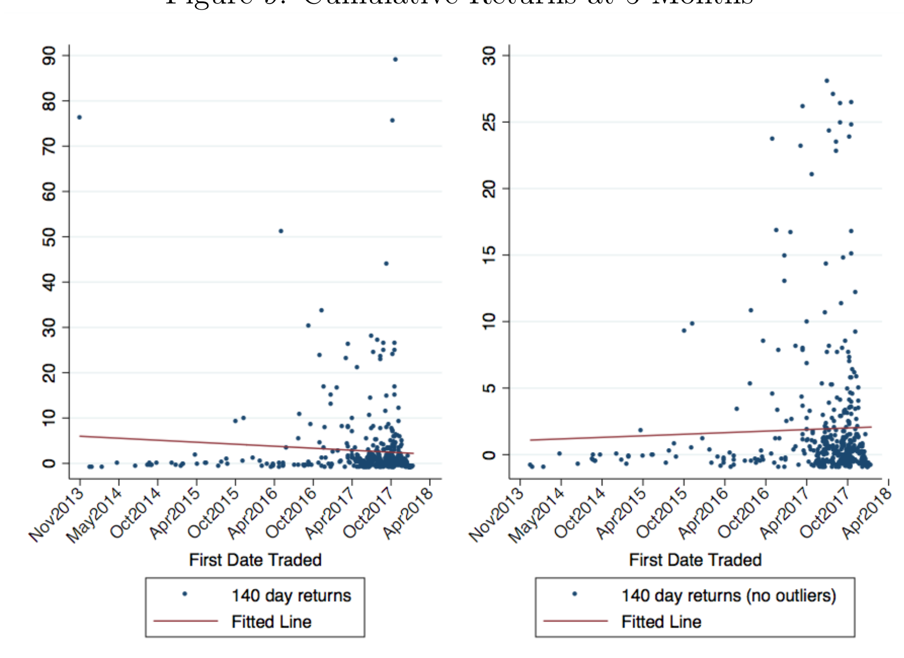
Note: This figure shows how different sectors have played larger roles in the ICO market over time. Each graph plots, for one of the 12 sectors, the quarterly amount raised in that sector as a share of the total quarterly amount raised. The sample includes the 453 exchange-traded ICOs in our estimation sample.

Figure 8: Liquidity and Volume at 5 Months



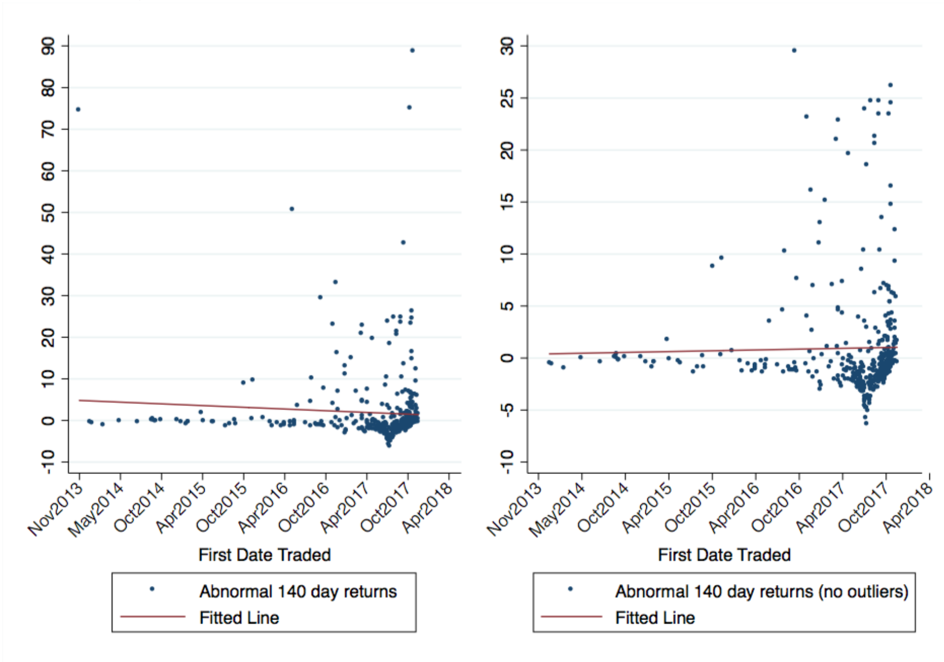
Note: This figure shows the liquidity measures 140 days (5 months) after the start of trading. Liquidity (left figure) is the negative of the log Amihud price impact (illiquidity) measure averaged over the past five days. Volume (right figure) is the log total 24-hour US dollar trading volume averaged over the past five days.

Figure 9: Cumulative Returns at 5 Months



Note: This figure shows raw cumulative returns between the start of trading and 140 days (5 months) subsequently. The right panel excludes observations with returns above 30.

Figure 10: Cumulative Abnormal Returns at 5 Months



Note: This figure shows abnormal cumulative returns between the start of trading and 140 days (5 months) subsequently. Abnormal returns are raw returns less bitcoin returns over the same period. The right panel excludes observations with abnormal returns above 30.

Initial Coin Offerings: Financing Growth with Cryptocurrency Token Sales

Appendix for Online Publication

Table A.1: Additional exchange-traded ICO summary statistics

	N	Mean	S.d.	Min	Median	Max
Turnover at 7 days	397	21.85	430.83	0.00	0.00	8584.33
Turnover at 140 days	395	9.99	173.37	0.00	0.00	3415.50
Volatility	452	71.13	1438.02	0.00	0.03	30548.28
Volatility	444	151.13	3104.04	0.00	0.02	65395.14
Log abnormal (ETH) returns at 7 days	434	-0.11	0.77	-6.40	-0.09	3.56
Log abnormal (ETH) returns at 28 days	434	-0.36	1.19	-8.77	-0.28	3.43
Log abnormal (ETH) returns at 140 days	361	-0.61	1.90	-19.75	-0.54	4.03
Log abnormal (ETH) returns at 168 days	316	-0.77	1.89	-18.67	-0.67	3.46

Note: This panel contains data on turnover and volatility. Turnover is 24-hr volume normalized by circulating token supply. Volatility is the 5-day rolling standard deviation of daily prices. Returns are cumulative, and calculated using daily prices. Abnormal returns are the raw return less the ether (ETH) benchmark. The table includes all 453 exchange-traded ICOs in our estimation sample; sample sizes vary depending on the number of tokens that have been trading for the specified number of days. Based on data gathered from CoinMarketCap.

Table A.2: Key variables and abnormal returns

	(1) Abn Returns at 1 month	(2) Abn Returns at 1 month	(3) Abn Returns at 5 months	(4) Abn Returns at 5 months
White paper	-.12	-.21	-.65	.21
	(.24)	(.17)	(.4)	(.29)
Incentive pool	.14	.0045	.29	-.096
	(.11)	(.086)	(.25)	(.19)
Insider vesting	.14	.12	-.41	-.19
	(.24)	(.1)	(.3)	(.22)
Budget	-.22***	-.011	.18	.2
	(.065)	(.16)	(.17)	(.14)
VC equity	-.051	.3***	.12	.21
	(.2)	(.076)	(.31)	(.3)
Telegram members (000s)	-.00041		-.0045	
	(.0073)		(.0059)	
Twitter followers (000s)	.0021***		.0098***	
	(.00053)		(.0029)	
GH repositories	-.0015		-.0044**	
	(.00098)		(.0015)	
GH commits (000s)	-.059		.033	
	(.047)		(.044)	
GH main rep branches	-.0044		-.0096**	
	(.0027)		(.0033)	
GH main rep releases	-.0031**		-.00044	
	(.0012)		(.0013)	
GH main rep contrib.	.0033		-.00099	
	(.0023)		(.0021)	
GH days from last commit	.00035		.00044	
	(.00027)		(.00052)	
Future token creation	-.0092	-.0033	.27	.086
	(.15)	(.1)	(.32)	(.14)
Amt Raised (USD Mill)	-.0052		-.0066	
	(.0062)		(.0047)	
Capped	-.38	-.12	.6	.45**
	(.25)	(.11)	(.6)	(.17)
Barred to US	-.022	-.012	-.13	-.32*
	(.3)	(.23)	(.21)	(.17)
Presale	.13	.013	.55***	.052
	(.14)	(.13)	(.096)	(.15)
Had goal to raise	-.17	-.089	-1.1***	-.42*
	(.44)	(.13)	(.29)	(.21)
Accept BTC	.084	.082	.27	.051
	(.27)	(.19)	(.26)	(.12)
Accept ETH	-.43***	-.48**	.14	-.02
	(.11)	(.2)	(.25)	(.15)
Accept WAVES	.69	-.6	-.41	-.32
	(.52)	(.39)	(.61)	(.49)
Raised less than goal	-.16		.075	
	(.13)		(.063)	
Utility value	.46***	.32**	.26	.23**
	(.13)	(.12)	(.23)	(.1)
ETH blockchain	.49**		1.1*	

	(.21)		(.59)	
Data storage/computing	.092	-.26**	1.1***	.15
	(.1)	(.12)	(.28)	(.27)
New blockchain protocol	.61***	-.099	1.5***	.53*
	(.14)	(.15)	(.41)	(.28)
Payments, wallets	-.39	.2	-.32	.048
	(.25)	(.25)	(.43)	(.27)
Tokenizing real assets	-.6	.24	-.63	-.015
	(.46)	(.21)	(.66)	(.48)
Crypto exper.	-.076	-.2**	.17	-.058
	(.29)	(.083)	(.18)	(.18)
Finance exper.	.11	.08	-.081	.023
	(.15)	(.094)	(.18)	(.16)
Comp. sci. exper.	.27***	.027	-.17	.081
	(.075)	(.1)	(.21)	(.085)
Entrep. exper.	-.21	.032	-.17	.16
	(.23)	(.051)	(.14)	(.16)
USA	.17	-.037	.17	-.024
	(.14)	(.078)	(.25)	(.075)
China	.12	.29	1.3**	.38
	(.17)	(.18)	(.44)	(.4)
Canada	-.32	.16	.74*	-.01
	(.29)	(.13)	(.34)	(.21)
Russia	-.56	-.78***	.72	-.45**
	(.38)	(.17)	(.43)	(.17)
Singapore	-.14	-.23	-.073	-.19
	(.35)	(.14)	(.26)	(.2)
Switzerland	.4*	.27	.51**	.07
	(.18)	(.2)	(.18)	(.11)
Israel	-1.3***	-.68*	.36	-.27
	(.36)	(.37)	(.38)	(.4)
UK	-.17	-.52	-.45	-.23
	(.15)	(.32)	(.63)	(.29)
HK	.089	.13	.53	.34
	(.58)	(.19)	(.57)	(.32)
>4 countries	-.12	.11	-.34	.32
	(.71)	(.2)	(.51)	(.28)
Code on Github (GH)		.054		.038
		(.19)		(.11)
Telegram group		.2		.44
		(.16)		(.32)
WAVES blockchain		.55		.17
		(.38)		(.34)
Observations	161	386	160	382
R^2	.46	.21	.51	.21
Quarter Start FE	Y	Y	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and abnormal returns. Abnormal returns are the raw cumulative return less the bitcoin (benchmark return) over the same period. They are observed at 28 days (1 month) and 140 days (5 months) after the start of trading. BTC price is also included as a control (unreported). Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Key variables and volatility

	(1) Volatility	(2) Volatility
White paper	-.67**	.094
	(.28)	(.56)
Incentive pool	-1.1	-.43**
	(.75)	(.16)
Insider vesting	-.33	-.15
	(.42)	(.26)
Budget	.74*	.54*
	(.33)	(.27)
VC equity	-.088	.11
	(.76)	(.23)
Telegram members (000s)	-.0032	
	(.028)	
Twitter followers (000s)	-.0077	
	(.005)	
GH repositories	-.0095	
	(.0069)	
GH commits (000s)	.059	
	(.048)	
GH main rep branches	.0058	
	(.0042)	
GH main rep releases	.0025	
	(.0019)	
GH main rep contrib.	-.0022	
	(.0017)	
GH days from last commit	-.00052*	
	(.00026)	
Future token creation	.69**	.32
	(.29)	(.33)
Amt Raised (USD Mill)	.015	
	(.011)	
Capped	.093	-.25
	(.57)	(.27)
Barred to US	-.84***	-.49*
	(.25)	(.28)
Presale	-.32	-.057
	(.2)	(.17)
Had goal to raise	.45	-.08
	(.65)	(.37)
Accept BTC	.066	.14
	(.13)	(.14)
Accept ETH	-.86	-.046
	(.94)	(.26)
Accept WAVES	1.5	-.47
	(1.2)	(.74)
Raised less than goal	.21	
	(.36)	
Utility value	-.19	.045
	(.43)	(.21)
ETH blockchain	1.4*	
	(.76)	

Data storage/computing	.94*	-.37
	(.46)	(.43)
New blockchain protocol	1.5***	1
	(.2)	(.76)
Payments, wallets	-1*	-.042
	(.54)	(.27)
Tokenizing real assets	-2.7***	1.6
	(.28)	(1.2)
Crypto exper.	-.55*	-.066
	(.27)	(.31)
Finance exper.	-.52	-.28
	(.42)	(.36)
Comp. sci. exper.	-1**	-.43*
	(.32)	(.24)
Entrep. exper.	.84	1***
	(.67)	(.28)
USA	-.13	.36
	(.34)	(.22)
China	.35	.44
	(1)	(.61)
Canada	-1.4**	-.89
	(.59)	(.88)
Russia	.38	.18
	(.8)	(.49)
Singapore	.85***	.7
	(.25)	(.4)
Switzerland	1.2	.78**
	(.81)	(.3)
Israel	1.8*	.78
	(.93)	(.59)
UK	-.57	-.09
	(1)	(.61)
HK	.9	.27
	(.78)	(.78)
>4 countries	.59	1.4
	(.34)	(1)
Code on Github (GH)		.46*
		(.25)
Telegram group		-.55*
		(.29)
WAVES blockchain		.51
		(.54)
Observations	160	381
R^2	.45	.2
Quarter Start FE	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and volatility. Volatility is the 5-day rolling standard deviation of daily prices, observed at 140 days (5 months) after the start of trading. BTC price is also included as a control (unreported). Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.4: Key variables and liquidity at 1 month and 6 months, and turnover

	(1) Liquidity 28 days	(2) Liquidity 168 days	(3) Turnover
White paper	.86*	.86*	.13
	(.42)	(.42)	(.58)
Code on Github (GH)	.04	.04	.11
	(.31)	(.31)	(.22)
Incentive pool	.1	.1	-.37
	(.15)	(.15)	(.35)
Insider vesting	1.3***	1.3***	-.1
	(.32)	(.32)	(.2)
Budget	.32	.32	.52**
	(.27)	(.27)	(.22)
VC equity	1.5***	1.5***	1.1***
	(.23)	(.23)	(.29)
Telegram group	1.1	1.1	.0019
	(.69)	(.69)	(.68)
Future token creation	.24	.24	.47
	(.45)	(.45)	(.38)
Capped	-1.1*	-1.1*	-1*
	(.6)	(.6)	(.48)
Barred to US	.32	.32	-.53*
	(.32)	(.32)	(.26)
Presale	-.099	-.099	-.24
	(.22)	(.22)	(.15)
Had goal to raise	.23	.23	.75**
	(.29)	(.29)	(.27)
Accept BTC	.54***	.54***	.36
	(.16)	(.16)	(.24)
Accept ETH	.3	.3	.79
	(.54)	(.54)	(.73)
Accept WAVES	-2.9***	-2.9***	-1.7**
	(.66)	(.66)	(.58)
Utility value	.3	.3	-.24
	(.3)	(.3)	(.25)
WAVES blockchain	.48	.48	.8
	(.93)	(.93)	(.95)
Data storage/computing	-.076	-.076	-.61
	(.31)	(.31)	(.64)
New blockchain protocol	1.8*	1.8*	1.7
	(.87)	(.87)	(.98)
Payments, wallets	.67	.67	.35
	(.49)	(.49)	(.42)
Tokenizing real assets	2.2	2.2	1.5
	(1.6)	(1.6)	(.91)
Crypto exper.	-1***	-1***	-.41*
	(.21)	(.21)	(.24)
Finance exper.	-.34*	-.34*	-.098
	(.18)	(.18)	(.47)
Comp. sci. exper.	.066	.066	-.4**
	(.3)	(.3)	(.18)

Entrep. exper.	1***	1***	1.2***
	(.29)	(.29)	(.37)
USA	.19	.19	.44
	(.44)	(.44)	(.48)
China	.7	.7	1.8***
	(.91)	(.91)	(.61)
Canada	-1.1	-1.1	-2.3
	(1.3)	(1.3)	(1.5)
Russia	-.98*	-.98*	-.17
	(.47)	(.47)	(.3)
Singapore	.043	.043	.96**
	(.69)	(.69)	(.39)
Switzerland	1.6***	1.6***	1.2***
	(.36)	(.36)	(.38)
Israel	-1.9***	-1.9***	.48
	(.62)	(.62)	(.54)
UK	-1.4***	-1.4***	-.42
	(.47)	(.47)	(.92)
HK	.81	.81	1
	(.84)	(.84)	(.89)
>4 countries	.77	.77	2.1
	(.87)	(.87)	(1.6)
Observations	385	385	350
R^2	.47	.47	.23
Quarter Start FE	Y	Y	Y

Note: This table contains regression (OLS) estimates of the relationship between ICO characteristics and liquidity at alternative horizons, as well as turnover (volume divided by circulating supply). Liquidity is observed at 28 days (1 month) and 168 days (6 months) after the start of trading. Turnover is volume normalized by circulating supply. It is averaged over the past five days and observed at 140 days (5 months) after the start of trading. BTC price is also included as a control (unreported). Sample sizes vary based on data availability. Standard errors (in parenthesis) clustered by the quarter the token started trading. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$