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Initial Coin Offerings: Financing Growth with Cryptocurrency Token Sales

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Initial coin offerings (ICOs) have emerged as a new mechanism for entrepreneurial finance, with parallels to initial public offerings, venture capital, and presale crowdfunding. In a sample of more than 1,500 ICOs that collectively raise $12.9 billion, we examine which issuer and ICO characteristics predict successful real outcomes (increasing issuer employment and avoiding enterprise failure). Success is associated with disclosure, credible commitment to the project, and quality signals. An instrumental variables analysis finds that ICO token exchange listing causes higher future employment, indicating that access to token liquidity has important real consequences for the enterprise. (*JEL* G12, G31)

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Initial coin offerings (ICOs) are a new method of raising capital for early-stage ventures, an alternative to more traditional sources of start-up funding, such as venture capital (VC) and angel finance. In an ICO, a blockchain-based issuer

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sells cryptographically secured digital assets, usually called tokens. The ICO market grew explosively in 2017 and early 2018; according to one estimate, between January 2016 and August 2019 ICOs raised over \$31 billion, and at least 20 individual ICOs to date have taken in more than \$100 million.[1] At the same time, the market has become notorious for scams, jokes, and frauds. Its growth and novel characteristics have attracted interest from entrepreneurs, investors, and regulators. This paper asks which venture and ICO process characteristics predict operating success for ICO issuers, focusing on whether the market exhibits dynamics consistent with existing theoretical literature about entrepreneurial finance and, more recently, about ICOs.

When well designed, ICOs can provide more security, liquidity and transparency than conventional financing instruments. These features potentially mitigate costs of asymmetric information and agency problems that have long deterred arms-length retail investment in early-stage private ventures (Hall and Lerner 2010). These frictions have made fundraising difficult for those entrepreneurs who are located outside VC hubs or lack elite professional networks (Chen et al. 2010). While these frictions may represent unavoidable risks of start-up ventures, they might also arise due to inefficient aspects of market design or overly burdensome regulation, problems that many ICOs have openly tried to address.

We 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 that is recorded and exchanged on a blockchain to reduce transaction costs and create a record of ownership; the underlying assets may range from commodities to currencies to real estate or even corporate equity. The third is a utility token, which gives its holder consumptive rights to access a product or service.[2] Utility tokens comprise the largest and most well-regarded ICOs and are the primary focus of our paper, although our data include numerous tokens in all categories. Utility token ICOs somewhat resemble crowdfunding presales of products on platforms such as Kickstarter. Perhaps a closer analogy is selling tradable ownership rights to stadium seats before a sports or entertainment venue is built, a practice that goes back to the 19th century.[3] While utility tokens can be simple "corporate coupons" that give the holder the right to

[1] See https://www.coinschedule.com/stats.

[2] 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 widespread circulation has led it to become also a store of value. An emerging class of so-called "stablecoins," such as Tether, arguably belong to both the first and second categories. Other papers have developed taxonomies of ICOs that can be elaborate. See, for example, Zetzsche et al. (2017) and Lo and Medda (2019).

[3] The practice of raising capital from prospective customers by selling ownership rights for future seats in an unbuilt arena dates back at least to Royal Albert Hall in London in the 1860s (we thank Bruce Grundy for this reference). Others trace the practice to the time of the Reformation or even earlier, when European church construction began to be financed by the advance sales of pews that were owned in perpetuity by their sponsors and could be resold for profit. See Fowler (1844). For utility tokens to have value, the issuer must commit to a

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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 unbuilt stadium's games were to be played (or at least watched) by people in the grandstands.

Why should a platform have its own token instead of accepting payment using conventional fiat currency? This foundational question casts a long shadow over current political debates about how to regulate token markets, and it plays a central role in motivating the models in most of the ICO theory papers that we cite below. ICO proponents argue that blockchains with native tokens permit disintermediation of Internet marketplaces with centralized control, such as Amazon or Facebook. In these firms with traditional equity-debt capital structures, the managers' control over the platform enables them to extract a large share of its economic surplus on behalf of the equity holders, who are often also the managers. These platforms' centralized control and opacity also raise concerns over their use of transacting party data, a privilege that has become controversial and triggered high-profile political hearings and legislative reforms.[4]

In the blockchain utility token model, platform management is decentralized, and value accrues to the token holders, who may include the platform developers but are mostly its customers, workers and other contributors. The token's value is often expected to increase with the value of the decentralized network. This correspondence enables three features, though not every ICO makes use of all three. First, the token can reward the network creators without giving them operational control after the network has launched. Second, token buyers who may be prospective customers can fund the platform's development, speculating on the future value of the service it will provide. Third, like concert tickets, food stamps, or stock certificates, the token's value arises by providing access to a future good or service, creating customer commitment.

We study a sample of 1,520 geographically dispersed ICOs, for which we gather data on a wide range of characteristics, such as whether the token has utility value, previous VC financing, and founder professional backgrounds. The amount raised in the ICO is public information for 580 ICOs, which collectively raise the equivalent of $12.9 billion. We analyze ICO process characteristics for a subsample of 451 successful offerings that subsequently trade on secondary market exchanges for at least 90 days. Our descriptive statistics document design tradeoffs faced by ICO issuers, who

cap on the total supply, and this is easily done in a sports arena or church, where adding new seats is physically difficult. Smart contracts can impose these limits for ICO tokens.

4 The 2018 enactment of the European General Data Protection Regulation reform in the European Union and days of United States Congressional hearings in 2019 have been among the most prominent manifestations of the political backlash against large, centrally controlled Internet platforms. Among other issues, these platforms have been accused of earning large profits by enabling invasions of privacy and online bullying, suppressing consumer retail competition, permitting the dissemination of supremacist "hate speech," and facilitating the manipulation of democratic elections via precisely targeted "fake news" disinformation promulgated by unmonitored rogue platform users.

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must balance objectives not unlike those for initial public offerings (IPOs) of equity securities: target proceeds, fraction of total token supply sold, pricing mechanism, distribution method, lockups and set-asides, token rights, and choice of secondary market exchange. Our detailed benchmarks of data in these areas, nearly all hand-collected from original sources, represent one contribution of our study.

We study the operational progress of ICO issuers by tracking the failure rate of the companies in our sample through November 2018 and, for those firms still operating at that time, by analyzing their employment as reported by individuals on LinkedIn in both November 2018 and July 2019. As most of the ICO issuers in our sample raised funds in 2017 or early 2018, an issuer's headcount through mid-2019 provides an important indicator of progress toward commercializing its product or service.

A significant predictor of survival and employment is whether a token has apparent utility value, which is relevant to current policy debates over whether ICO tokens are investment securities in disguise, or whether they represent an innovation that enables a new venture to raise funds in a way that promotes future product adoption and loyalty, while also offering liquidity. Additional factors associated with ICO success reflect long-standing theories in corporate finance about the importance of reducing information asymmetry and the use of bonding and certification strategies to reduce agency costs. We find that ICO issuers have lower failure rates and/or higher future employment when the issuer makes voluntary disclosures via a white paper, when the white paper provides a budget for the use of ICO proceeds, when the issuer's executive team has a lockup (vesting) period for sale of its ICO tokens, when some tokens are reserved in an incentive pool, when the issuer has successfully raised VC funding in the past, and when the CEO or founder has professional experience as an entrepreneur or in computer science.

In related analysis, we study which tokens become listed on an exchange, which represents an important step toward wider circulation that would facilitate an issuer's progress toward operational goals. We conduct two exercises. First, we examine factors that predict listing. These largely parallel the factors that predict survival and employment. Second, noting that listing is itself an interesting characteristic, with a strong connection to token liquidity, we instrument for listing to assess its effect on employment.[5] Specifically, we use price changes in the Ethereum Classic (ETC) token around the time of an ICO, focusing on periods when Bitcoin prices are high (see Section 4.1.2 for details). The IV estimate indicates that successful token listing increases the issuer's future employment substantially.

Further analysis shows that many aspects of ICO design choices and social media promotion have significant associations with measures of ICO issuers'

[5] We could not identify suitable instruments for the other issuer and ICO process characteristics.

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operating success. For example, success is associated with token sales that use dynamic pricing mechanisms, that promote transparency and crowdsource development by publicly posting source code on GitHub, and that have large Telegram user groups. We categorize the issuers into 12 sectors and find that success along both real and financial dimensions is associated with business models related to advertising and rewards, tokenizing real assets (e.g., putting real estate or art on a blockchain), and new blockchain protocols (creating a new blockchain rather than attaching the token to the Ethereum or another existing blockchain). These results shed light on where the market has perceived opportunities for value creation.

One reason that ICOs have proliferated so quickly is that in their most basic form they impose almost no costs on the issuer. This contrasts with IPOs, where explicit underwriting and legal costs compose a significant fraction of the funds raised (Ellis, Michaely, and O'Hara 2000). IPOs also have less quantifiable costs, importantly the cost of disclosure, the ongoing regulatory burden, and the possibility that a high stock price will attract product market competition (Maksimovic and Pichler 2001). In our discussion and analysis below, we draw parallels and highlight differences between ICOs and three forms of more conventional finance: equity crowdfunding, venture capital, and IPOs. The literature in financial economics about these instruments illuminates mechanisms that may be important for ICOs. These comparisons highlight connections between our 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).

This paper also contributes to a nascent literature describing the economics of digital assets. The subset of this literature focused on ICOs now includes more than 100 working papers. We relate our findings to recent ICO theory papers, including Li and Mann (2018), Sockin and Xiong (2018), and Cong, Li, and Wang (2018). For example, the importance of utility value to success and the prevalence of token presales are consistent with the ways that ICOs resolve cross-side and same-side coordination failures in Li and Mann (2018).[6]

Our detailed investigation of token issuers' real outcomes complements a number of other recent empirical studies. Deng, Lee, and Zhong (2018) study the post-ICO GitHub-based technological development of token issuers, making it the only paper to date besides ours that examines tangible operational outcomes for ICO issuers. Additional related work investigates ICO financial market success measured as an indicator for obtaining an exchange listing for the token. These papers include Amsden and Schweizer (2018), De Jong, Roosenboom, and van der Kolk (2018), Lyandres, Palazzo, and Rabetti (2019),

[6] Additional recent theory contributions include papers by Bakos and Halaburda (2019), Gan, Tsoukalas, and Netessine (2019), and Kassibrakis and Malamud (2019). Blémus and Guegan (2019) study the implications of tokens for corporate governance.

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and Boreiko and Vidusso (2018). Other papers study topics that resemble the empirical literature on IPOs, focusing on variables such as token underpricing, investor returns, the amount raised in the ICO, and post-offering liquidity, topics that we do not consider in our study.[7] Some papers, including Boreiko and Risteski (2019) and Fahlenbrach and Frattaroli (2019), use the transparency of blockchain addresses to study the behavior of individual ICO investors. Li and Mann (2019) and Ofir and Sadeh (2019) provide literature reviews of this fast-growing subject area.

1. The ICO Market

ICOs are a phenomenon of the worldwide networks of open blockchains and distributed ledgers that began with the 2009 launch of Bitcoin and now include thousands of digital assets.[8] These novel databases provide decentralized record-keeping that cannot be retroactively edited and use cryptographic functions that link records, enable rapid verification of data, and prevent hacking. Early blockchains, such as Bitcoin and Litecoin, were designed as simple payment systems, and they also provide an archival function because text can be appended to ordinary transactions. The advent of more sophisticated blockchains, such as Ethereum and EOS, has enabled a much wider range of applications, including insurance contracts, voting schemes, and contingent investment products. ICOs are a fundraising mechanism in which a new token is sold to investors and prospective users. Most tokens sold in ICOs are smart contracts within the Ethereum blockchain, though some are the units of account in new blockchain protocols.

To explore what predicts ICO success – the primary aim of this paper – one must first understand the features of this new market. This section begins by discussing the legal status of ICO tokens. The subsequent sections describe the data that we use in this paper and explain the economic content and institutional practice behind the variables we collect.

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[7] On token underpricing, see: Benedetti and Kostovetsky (2018), Chanson, Risius, and Wortmann (2018), Dittmar and Wu (2018), Drobetz, Momtaz, and Schröder (2018), Felix (2018), Stastny (2018), Chen (2019), and Momtaz (2019). On investor returns, see Benedetti and Kostovetsky (2018), Chanson, Risius, and Wortmann (2018), Dittmar and Wu (2018), Drobetz, Momtaz, and Schröder (2018), Hu, Parlour, and Rajan (2018), Lu (2018), Momtaz (2018a), Stastny (2018), Yuryev (2018), and Stanley (2019). On the amount raised, including failure to meet a set target, see Adhami, Giudici, and Martinazzi (2018), An et al. (2019), Ante, Sandner, and Fiedler (2018), Blaseg (2018), Burns and Moro (2018), Davydiuk, Gupta, and Rosen (2018), Feng et al. (2018), Fenu et al. (2018), Fisch (2018), Lee, Li, and Shin (2018), Momtaz (2018b), Momtaz (2018c), Rhue (2018b), Albrecht, Lutz, and Neumann (2019), Ante and Fiedler (2019), Cai and Gomaa (2019), Cerchiello, Tasca, and Toma (2019), Chen (2019), Johnson and Yi (2019), Masiak et al. (2019), Philippi, Schuhmacher, and Bastian (2019), and Wu et al. (2019). On liquidity, see Bourveau et al. (2018), Lyandres, Palazzo, and Rabetti (2019), and Fisch and Momtaz (2019). On trading volume, see Florysiak and Schandlbauer (2018). Fisch et al. (2019) use survey data to study the motivations of ICO investors. Li and Yi (2019) study the factor structure of tokens' post-ICO expected returns.

[8] See Flood and Robb (2017) for an account of the historical antecedents that led to the launch of cryptographic tokens by Nakamoto and others.

1.1 Legal status of ICO tokens

Because of their novel design, cryptographic assets have given rise to a large number of legal uncertainties in the United States and elsewhere. Regulatory questions begin with basic problems, such as how to account for cryptographic assets as part of a company audit. For ICO tokens, another important and still unresolved issue is whether the sale of tokens in an ICO creates income tax liability for the promoter and potential capital gains liability for investors. Some tokens may have the legal status of commodities, which would implicate a federal regulatory regime, and some token issuers may be construed as money transmitters, a status which in the United States requires cumbersome state-by-state registration and broad know-your-customer compliance obligations.[9]

The most important legal question surrounding ICO tokens is whether they have the status of securities. Should they, this would trigger various compliance requirements that could create cost, risk, and delay for issuers. In the United States, the four-part *Howey* test, which originated in a 1946 Supreme Court case, governs whether an investment scheme qualifies as a security.[10] How United States courts interpret the 73-year-old *Ho*wey precedent in the context of modern technology will have worldwide implications, because United States securities laws are often followed at least informally by many other countries.[11] Two parts of the *Howey* test seem to be satisfied by most token sales: whether an investment of money is made by the ICO purchaser, and whether the ICO investment is part of a common enterprise among numerous purchasers. Uncertainties arise from the other two branches of the test: whether the success of the enterprise depends on the efforts of a third-party promoter, and whether a purchaser has an expectation of a financial return, such as capital gains. Virtually all tokens are issued by promoters, but after launch many tokens are governed not by a management team but instead by a computer algorithm on a decentralized public network. This was recognized by the U.S. Securities and Exchange Commission's (SEC's) Director of the Division of Corporate

[9] See a 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 be variously covered by the United States securities, commodities, and/or money transmission laws, which may have overlapping effects and are not mutually exclusive.

[10] *SEC* v. *W.J. Howey Co.*, 328 United States 293 (1946). Rohr and Wright (2017) provide a detailed analysis of the relevant statutes and caselaw and their potential applications to blockchain-based tokens. More broadly, a significant body of legal scholarship has begun to emerge around these issues, including many papers that propose the optimal regulation of ICOs. See Baker (2017), Enyi and Le (2017), Preston (2017), Robinson (2017), Burilov (2018), Chiu (2018), Chiu and Greene (2018), Dambre (2018), Dell'Erba (2018), Gurrea-Martínez and Remolina (2018), Holoweiko (2018), Sherman (2018), Zhang et al. (2018), Annunziata (2019), Brummer, Kiviat, and Massari (2019), De Andrés et al. (2019), Essaghoolian (2019), Hughes and Wang (2019), Lausen (2019), Mendelson (2019), Smith (2019), Travis (2019), Waxenbaum (2019), Rodrigues (Forthcoming), and Verstein (Forthcoming).

[11] International regulation of ICOs is studied by Barsan (2017), Kaal and Dell'Erba (2017), Shroff and Venkataraman (2017), Blemus (2017), Collomb, De Filippi, and Sok (2018), Gürcan (2018), Gutfleisch (2018), Hacker and Thomale (2018), Kaal (2018), Klöhn, Parhofer, and Resas (2018), Koeppl and Kronick (2018), Pilkington (2018), Bellavitis, Cumming, and Vanacker (2019), Burilov (2019), Caponera and Gola (2019), Chohan (2019), Flood and McCullagh (2019), Frick (2019), Maas (2019), Vandezande (2019), Maume (Forthcoming), and McCullagh and Flood (Forthcoming).

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Finance in a June 2018 address, in which he opined that the Ether token on the Ethereum blockchain, viewed as one of the first-ever ICOs, no longer met the criteria to qualify as a security due to its lack of centralized control.[12] If a token buyer intends to use a token as a customer, he may not be motivated by an expectation of financial profit. However, many ICOs have no apparent utility purpose (47% of our sample), and nonutility tokens are almost certainly securities under *Howey*.

The commission has brought a handful of high-profile enforcement actions against select token issuers, such as the Airfox and Paragon settlements announced in November 2018, and these cases have tended to have extreme fact patterns that leave little ambiguity about whether the underlying tokens qualified as securities (Rhue 2018a). Further test cases of these principles seem inevitable in the near future, given the intensity of the SEC's scrutiny of ICOs. SEC Chairman Walter J. Clayton took an extreme position in a February 2018 United States 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 supersede *Howey* and clarify the future regulation of ICOs through legislation.

Some issuers have responded to the threat of United States securities regulations by selling rights to tokens as explicit securities to accredited investors under established registration exemptions, which requires extensive know-your-customer due diligence. 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 (see the appendix). SAFT issuers enter into an investment contract for the future delivery of tokens – essentially a forward contract – once a platform is developed and becomes functional. The tokens delivered in the future are meant to be products that are subject not to securities laws, but instead to the ordinary consumer protection and tax laws of the United States and various states. Whether federal agencies and courts will adopt the regulatory stances anticipated by the SAFT framework is a question for the future.

Seeking to bring regulatory clarity to the United States ICO market, the SEC created a Strategic Hub for Innovation in Financial Technology in October 2018 to "serve as a resource for public engagement on the SEC's FinTech-related issues," and in April 2019 that group published a memorandum that enumerated criteria for "whether offers and sales of a digital asset are securities transactions" under *Howey*.[13] On the same day, the group issued a No-Action letter opining that the tokens of one issuer, Turn-Key Jet, were not subject to the securities laws. A milestone occurred in August 2019 when INX Limited filed for an

[12] See Hinman (2018).

[13] See SEC (2019).

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IPO (rather than an ICO) of its utility tokens via the SEC's usual securities registration process, making it potentially the first fully registered token sale in the United States capital markets. These developments appear to be part of a gradual trend toward regulatory compliance by the larger and more reputable token issuers, matched partly by a willingness of the United States regulator to limit its reach into the ICO market by acknowledging that not every token qualifies as an investment security.

Other countries have adopted a wide variety of regulatory stances toward ICOs. These range from blanket prohibitions (China, South Korea) to relatively accommodating safe harbors (Singapore, Switzerland). Whether a country can enforce its tax and securities laws against an ICO issuer is not always obvious, because public blockchains, including Ethereum, operate everywhere and are not anchored physically in any particular jurisdiction. An issuer that markets tokens to United States investors has United States compliance obligations even if the issuer is located abroad, leading some issuers to declare their ICOs off-limits to United States residents (this is the case for 19% of our sample). However, bringing a foreign issuer into a United States court might be impossible. Also, the pseudo-anonymous nature of public blockchain addresses makes excluding United States buyers difficult. The geographic distribution of ICOs appears to reflect emerging international regulatory competition between countries seeking to attract a portion of the fast-growing market (see Figure 1). For example, Singapore is the primary location of 81 ICOs in our sample.

1.2 Market overview

We create a large, unique data set of ICOs and their characteristics. Data are hand-collected from issuer Web sites and white papers, as well as news articles, ICO aggregator and tracker Web sites, LinkedIn, GitHub, Twitter, and Telegram.[14] We will use our data in Section 4 to investigate of ICO success factors. As shown in Table 1, panel A, we begin with a sample of all 1,520 unique ICOs listed on the TokenData Web site as of April 2018. At the start of our data collection in the summer of 2017, TokenData was recognized as the most prominent and respected Web site among several that tracked the growing roster of ICOs.[15] We merge the ICOs from TokenData with daily trading data from CoinMarketCap, which is the most comprehensive and credible source of trading data for digital assets, with indices featured in the data feeds

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[14] The data were collected by a team of more than a dozen research assistants and then spot-checked.

[15] Some ICO listing Web sites have biased samples, because the sites charge payments for including the tokens in their rosters. Deng, Lee, and Zhong (2018, footnote 7) discuss the benefits and limitations of many ICO aggregators. They note that TokenData is 1 of 3 Web sites "that have the most comprehensive coverage and provide the most thorough list of deal characteristics" and that TokenData covers the largest number of ICOs. Amsden and Schweizer (2018, footnote 32) similarly observe the comprehensiveness of TokenData's coverage. In a recent analysis of ICO white papers, Shifflet and Jones (2018) used TokenData as one of its three sources of a sample of 3,291 documents. See https://www.wsj.com/graphics/whitepapers/. One of the other sites used by *The Journal*, ICOBench, had only just launched and had limited coverage at the time of our data collection.

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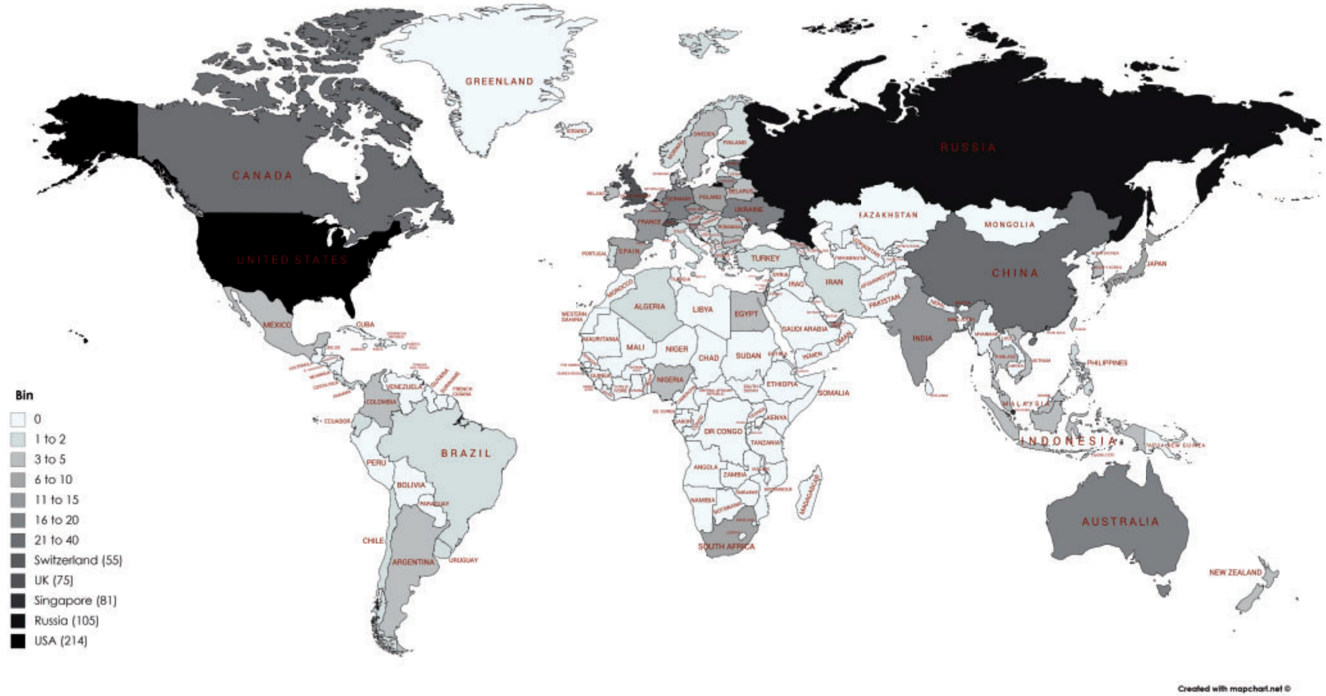

Figure 1
Number of ICOs by country
This figure shows the location of ICO issuers in our sample, which includes all ICOs in TokenData from 2014 to 2018. We observe location for 1,055 of the ICOs, based on issuer Web sites and other public material. Of these, 73 are dispersed across at lease five countries and are not shown. The remaining 982 are included in the figure, except for the Cayman Islands (3 ICOs), Curacao (1), Cyprus (1), Gibraltar (1), Marshall Islands (1), and Saint Kitts (1). Countries are grouped by bins of their number of ICOs. The top-five countries are shown separately.

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provided by NASDAQ, Bloomberg Terminal, Thomson Reuters, and others. CoinMarketCap aggregates daily data from those public exchanges that charge trading fees. Exchanges without fees permit issuers or other stakeholders to generate false volume, where a trader (or its bots) trades back and forth with itself. Two examples illustrate CoinMarketCap's coverage as of August 2019. Price and volume data for the token Blocktix, which has a $0.28 million market cap, comes from a single exchange, HitBTC. Data for EOS, one of the top-five tokens with a market cap of $3.4 billion, comes from 117 exchanges.

Table 1
ICO issuer characteristics

A. Sample summary

	N
Total sample	1,520
Completed ICO	1,266
Listed on exchange	672

B. ICO success measures

	N	Mean	SD	Min	Median	Max
Employment (as of November 2018)	1,520	12.56	35.22	0.00	3.00	716.00
Employment (as of July 2019)	1,520	14.27	42.15	0	4	1,096.00
Employment growth = $\log\left(\frac{\text{EmpNov2018}}{\text{EmpJuly2019}}\right)$	1,520	0.009	1.17	−3.97	0	5.6
Issuer failed (as of Nov 2018)	1,520	0.30				

C. Issuer characteristics

	N	Mean	SD	Min	Median	Max
Amount raised (USD millions)	580	22.17	176.87	0.00	7.42	4,234.28
Days from ICO start to first trading date	596	67.15	82.07	0.00	44.00	1,071
Token has apparent utility value	1,520	0.53				
Had a presale	1,520	0.43				
Had a white paper	1,520	0.86				
Incentive set aside	1,520	0.43				
Founder token vesting schedule	1,520	0.22				
Had a budget for use of proceeds	1,520	0.42				
Venture capital backed	1,520	0.09				
Stated goal to raise	1,520	0.51				

D. Issuer founder/CEO characteristics

	N	Mean
Male	1,017	0.96
Professional background in crypto	964	0.28
Professional background in financial services	964	0.33
Professional background in computer science	964	0.48
Professional background in entrepreneurship	964	0.57

This table shows overview statistics about our sample of 1,520 initial coin offerings. Panel A enumerates our whole sample, the number that were completed (i.e., ICO was not canceled midsale), and the number that listed on a cryptocurrency exchange. Subsequently, where the sample is smaller than 1,520, data were not available for the remaining ICOs. Panel B summarizes the proxies for ICO success. Employment is the number of people who identify themselves as employees on LinkedIn or the number of people listed as employees on the Web site where no LinkedIn profile was available. Employment growth is the difference in logs, specifically: $\log\left(\frac{\text{EmpNov2018}}{\text{EmpJuly2019}}\right)$. We use this measure both because it linearized the raw difference and because we use log employment in the analysis. We classify an ICO as failed if the issuer does not have an active Web site, the token is not listed on CoinMarketCap, and Internet searches yield no other indication that it still exists. Panel C describes key characteristics we collected about issuers. For all panels, data were gathered from issuer Web sites, technical white papers, news articles, and LinkedIn.

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Table 1
(Continued)

E. Issuer GitHub and social media characteristics

	N	Mean	SD	Min	Median	Max
Has GitHub source code repository	1,520	0.52				
Number of repositories	812	17.00	36.86	0.00	5	610
Main repository: Number of commits (000s)	783	2.18	7.65	0.00	0.092	140.31
Main repository: Number of branches	783	11.94	51.32	1	2	946
Main repository: Number of releases	783	80.83	1410.97	0	0	39,214
Main repository: Number of contributors	783	44.93	138.15	0	3	2,224
Main repository: Months between last commit and July 10, 2019	783	15.73	14.07	0.03	15.87	122.93
Has Telegram group	451	0.83				
Number of Telegram group members (000s)	357	5.09	9.30	0.01	2.03	88.34
Has Twitter page	451	0.97				
Number of Twitter followers (000s)	451	22.21	53.40	0.01	6.76	741.00

Panel D contains characteristics of the CEO or lead founder of issuers, based on data from LinkedIn and issuer Web sites. Panel E contains data about the issuer's GitHub presence and about the issuer's social media presence, gathered from GitHub, Telegram, and Twitter. GitHub is 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. The remaining rows include only those ICOs with a GitHub source code repository. 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 on social media (Telegram, Twitter) were gathered for a subset of 451 ICOs that listed on an exchange and traded for at least 90 days as of April 2018.

Table 1, panel A shows that of the 1,520 ICOs, 1,266 were completed.[16] Figure 2 shows the number of ICOs and the United States dollar value equivalent of amount raised by quarter. It indicates that our sample ends before the overall market bubble concluded in the first half of 2018. We observe the amount raised for 580 ICOs and convert it when necessary to United States dollars (Table 1, panel B). This variable has a mean of \$22 million, a median of \$7.4 million, and a maximum value of \$4.2 billion for the EOS token sale (the next highest is Tezos, at \$230 million). We do not use amount raised as a success metric, because raising more money than needed for development has potential downsides, such as unwanted publicity and the agency problems that arise when founders have a large cash cushion. The VC literature recognizes these issues (Gompers 1995).

Roughly half of the completed ICOs ultimately became listed on an exchange as of November 2018, the point at which we tabulate the data for Table 1. Some crypto exchanges are centralized, such as Poloniex and Binance, and

[16] Completed means that the ICO was not canceled and that the tokens were actually sold (or given away in the case of airdrops). TokenData categorizes all ICOs as completed, active, or failed. We use their failure indicator and spot check for accuracy.

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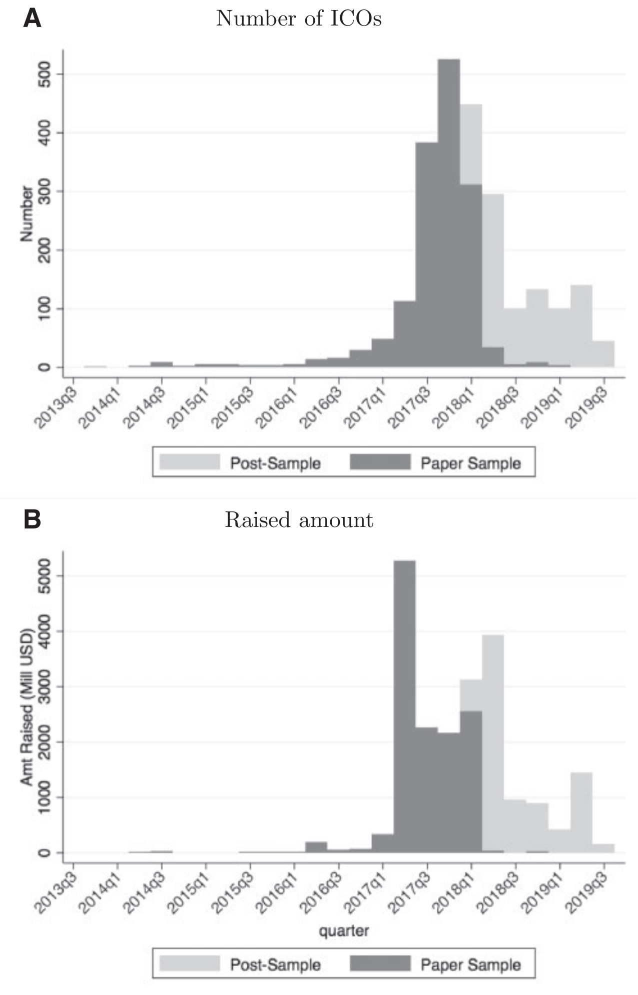

Figure 2
Number of ICOs and amount raised by quarter
This figure shows the total quarterly amount raised and number of ICOs. Dark bars represent our sample, while light bars represent other unique ICOs appearing in either TokenData (our baseline source for the ICOs) or ICOBench after our sample ends. The light bars help to illustrate the market development. Panel A shows a bar chart of the number of ICOs that begin in each quarter. The dark bars include all 1,520 ICOs in our sample, whereas the light bars include 899 ICOs outside our sample. The amount raised is only available for 580 of the ICOs in our sample, and these are included in the dark bars of panel B. The light bars in panel B represent 485 ICOs outside our sample for which amount raised is observed.

others are decentralized (peer-to-peer), such as ShapeShift and EtherDelta. They vary in approaches to approving tokens for listing. For example, Circle, which runs the Poloniex exchange, considers dozens of factors including: “Does the project encourage rational participation by investors?” and “Is the team

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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] By comparison, listing a registered equity security on a traditional exchange, such as NASDAQ, costs $125,000 to $300,000. Some exchanges charge token-specific listing fees depending on factors such as expected daily volume.

We aim to establish predictors of success in the ICO market so we tabulate information about the operational progress of each token's parent organization. The first real outcome success measure is employment, defined as individuals who identify as employees of the issuer on LinkedIn. We collect employment data at two points in time, November 2018 and July 2019. Table 1, panel B shows that at the first measurement date the mean of this variable is 12.6, and the median is 3. Eight months later at the second measurement date, these values increase to 14.3 and 4, respectively. The growth rate of employment (in log form) has a mean of 0.9% and a median of 0% between these two dates. Second, we use an indicator for whether the ICO issuer has failed by November 2018, which is the case for 30% of the sample.[19]

Panel C of Table 1 indicates that 9% of ICO issuers have previously received VC equity financing. Anticipating that portfolio companies may raise additional funding through ICOs, some VCs now include rights to future tokens as a standard term sheet clause.[20] As the relationship between the VC and ICO markets matures, they function as complements in some circumstances and substitutes in others. Instances where issuers previously raise equity VC or include VCs as token buyers include Kik, Blockstack, and Filecoin. In contrast, the founder of Pillar explicitly described its ICO as a substitute for VC.[21]

1.3 Prevalence of utility tokens

Utility tokens confer consumptive rights, unlike equity. Using issuer white papers and other public information, we assess whether each token's issuer intended the token to have utility value. Table 1, panel C indicates that 53% of ICOs in our sample sell tokens with intended utility value. Utility tokens 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.

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

18 See Russo (2018).

19 We classify an ICO as failed if the issuer does not have an active Web site, the token is not listed on CoinMarketCap, and Internet searches yield no other indication that it still exists (if it ever did).

20 Based on author conversation with a Union Square Ventures founding general partner and https://www.coindesk.com/ico-investors-seek-veto-power-future-token-sales. 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. See Actualize (2018).

21 Digital identity company Pillar's founder unsuccessfully sought VC before raising $25 million in an ICO. See Volpicelli (2017).

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There are exceptions; for example, ICONOMI tokens come with the rights to a portion of fees paid to the network. The most common right for utility token holders is the right to use the token to access services. For example, the Basic Attention Token (BAT), which was sold in an ICO that raised $35 million in 24 seconds, is the only means for users, advertisers and publishers, to transact for attention on the Brave Internet browser.

Token holders sometimes have platform governance rights, like equity shareholders. At one extreme, token holders set the overall business strategy (Johnson and Yi 2019). An example is TheDAO (a "decentralized autonomous organization"), which became famous for incurring an attack that precipitated a hard fork of the Ethereum blockchain in 2016. 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. The smart contracts that create ICO tokens can include state-contingent privileges similar to those in VC contracts, which typically give an entrepreneur more control in good states of the future, and the investor more control in bad states.

1.4 Presales

Our data show that for 43% of ICOs, the issuer segments the market by conducting a presale before the public ICO. This resembles how IPO issuers have often sold private equity to VCs and other stakeholders prior to going public. ICO presales 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 IPO process (Sherman and Titman 2002; Derrien and Womack 2003).

Presale 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). Li and Mann (2018) rationalize the presale as one mechanism to resolve the coordination failure that emerges in the case of what they call a "same-side network effect during the ICO." This is a traditional network effect, in that the value of being a user depends on there being a sufficient number of other users on the platform. Preselling discounted tokens can help the issuer approach the needed critical mass of participants.

1.5 White papers and other bonding devices

The failure rates of ICOs have attracted scrutiny from regulators, and a number of empirical studies document evidence of fraud (Cohney et al. 2018; Hamrick et al. 2018; Li, Shin, and Wang 2018; Liebau and Schueffel 2019). Even if an ICO occurs without market manipulation, such as a "pump and dump" scheme, issuers may modify the rights of token holders or even abscond with

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the proceeds, and there is no accountability via audits or oversight through corporate governance of promoters' use of proceeds. More generally, ICO token buyers do not have legally enforceable residual claims due to the absence of regulation.

We therefore expect that certification, disclosure, and bonding mechanisms are important for ICO success. Table 1, panel C, lists variables relevant to these mechanisms. Eighty-six percent of issuers publish a white paper, a voluntary disclosure document similar in spirit to an IPO prospectus. However, in the absence of regulation their contents vary dramatically. Most describe how the token will be used, including its benefits to holders and how its blockchain architecture will operate. Beyond the white paper, issuers typically conduct public relations campaigns to promote tokens.

Table 1, panel C shows that 43% of issuers set tokens aside to incentivize platform development through a foundation, bounty, or endowment. There is a vesting schedule for tokens assigned to insiders in 22% of ICOs, and a budget for use of the proceeds in 42%. Vesting periods for founders 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 shares that exist in the IPO market. A few ICO issuers, including Golem, have tied token lockups to specific development milestones. Other lockups 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 prespecified period.

1.6 Founder backgrounds

ICO issuers are sometimes firms and sometimes simply a group of developers. We are able to identify a lead individual in the form of a founder or CEO for 1,017 of the ICOs, summarized in Table 1, panel D. Of these, 96% of founders are male, a distribution that is even more skewed than the share of VC-backed entrepreneurs who are male, which Gompers and Wang (2017) find to be about 90% post-2010. LinkedIn information about previous jobs is available for 964 ICOs. Among these, 28% 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 48% in computer science. If the founder/CEO claims on LinkedIn to have previously founded a company, we assign him an entrepreneurship background, which applies to 57% of the sample (these classifications are not mutually exclusive).

1.7 Location

We identify the issuer's headquarters office location for 1,296 tokens, and the map in Figure 1 illustrates that issuers are located or partially located in 60 countries. The top-five countries are identified individually; the United States and Russia lead, with 214 and 105 ICOs, respectively. The dollar amounts raised

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by country roughly correlate with the number of ICOs. The United States leads, with Switzerland, Singapore, Russia, China, and Israel following (in order).

ICOs may facilitate entrepreneurial finance in countries with less mature regulatory systems, such as Russia and China. ICOs often employ self-enforcing, state-contingent contracts that enable arms-length investors to have some degree of trust without relying on enforcement by weak government institutions.[22] Lerner and Schoar (2005) examine private equity contracts across countries and find that in low-enforcement countries with socialist backgrounds or civil law traditions, it is most common for private equity investors to purchase majority equity ownership. The cost of this may inhibit optimal development of vibrant entrepreneurial ecosystems in these markets.

Location also raises the issue of jurisdiction for legal purposes. An ICO issuer that successfully removes its tokens from the jurisdiction of the securities laws may create income tax or value-added tax liability. To reduce potential income tax liability, some token issuers have routed their ICOs through nonprofit 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." However, Huang, Meoli, and Vismara (2018) find that tax considerations are less important than lenient securities regulation in attracting ICOs to individual countries.

1.8 GitHub and social media characteristics

Publishing source code provides a powerful form of transparency, which also leverages the wisdom of the crowd to identify bugs and improve quality. GitHub is the dominant Web-based repository hosting service for computer code. We collect GitHub data as of July 2019. A main repository holds the token contract for 812 ICOs, or 53% of the sample of 1,520. As shown in Table 1, panel E, the average main GitHub repository has more than 2,100 commits (revisions), 11 branches (pointers to specific versions), 80 releases (official new versions of the software), and 44 contributors (people who are not organization members but contribute to the project). We use the number of months from the last commit as a proxy for ongoing engagement with the software; a higher number of months implies less user engagement.[23]

Token issuers use social media to communicate with stakeholders primarily on two platforms, Telegram and Twitter. Telegram is a cloud-based messaging application with a focus on security and speed. Accounts are tied only to phone numbers. 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 the crypto community. Eighty-three percent of the ICOs in our detailed sample have a

[22] For an alternative (yet skeptical) view, see the analysis in Venegas (2017) and Cohney et al. (2018).

[23] Specifically, this is the number of months between July 10, 2019, and the last commit prior to that date.

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Table 2
Token and ICO process characteristics

	N	Mean	SD	Min	Median	Max
Token on Ethereum blockchain	451	0.73				
Token on Waves blockchain	451	0.05				
Airdrop (token price was $0)	451	0.14				
Capped (limit on number tokens sold)	451	0.76				
U.S. investors barred	451	0.19				
Future token creation	451	0.14				
Dynamic pricing (price changes during ICO)	451	0.34				
Sensitive pricing (price changes during ICO reflect demand)	451	0.09				
Auction pricing	451	0.05				
Accepted USD as payment	451	0.10				
Accepted Euros as payment	451	0.03				
Accepted Bitcoin as payment	451	0.41				
Accepted Ether as payment	451	0.66				
Accepted XRP as payment	451	0.02				
Accepted Litecoin as payment	451	0.09				
Accepted Waves as payment	451	0.04				
Met goal if had stated goal	419	0.52				
Amount raised less stated goal, if any (USD mill)	419	−8.45	36	−279	0	160
Fraction total token supply sold in ICO	283	0.53	0.32	0.00	0.54	1.00
Duration of ICO in days	367	40.0	89.5	0.00	28.0	948
Number of currencies accepted	359	2.07	1.76	1.00	1.00	15.0

This table contains summary statistics about the token and ICO process. Data were gathered from issuer Web sites, technical white papers, news articles, and LinkedIn.

Telegram group, and among this subset, the average group has more than 5,000 members. Ninety-seven percent of the detailed sample has an official Twitter account, which has on average 22,200 followers. Data on social media are as of November 2018.

1.9 ICO processes

When launching an ICO, the issuer typically makes tradeoffs among a set of economic variables with parallels to IPO decision points: target proceeds, fraction of total token supply sold, pricing mechanism, and distribution method, among others. To study the ICO process in depth, we hand-collect data on the 451 exchange-listed tokens that had traded on an exchange for at least 90 days as of April 2018. Table 2 lists the summary statistics for these variables from the ICO processes. They represent an important contribution of our study.

In most ICOs, a prospective buyer sends payment to the blockchain address of the issuer. Payment usually occurs in cryptocurrency, most commonly Ether, because the majority of ICOs occur on the Ethereum blockchain. Table 2 shows that 66% of ICOs in our data accept Ether. Orders are filled through automated, preestablished smart contracts. These dictate, for example, how to ration tokens when the offer is oversubscribed. The issuer has no control over the ICO process once the smart contract launches. As offers are accepted, the contract sends tokens to the blockchain addresses of successful buyers, while refunds are conveyed to addresses of unsuccessful buyers.

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Data in Table 2 indicate that the Ethereum blockchain dominates the token market, with 73% of tokens using the ERC20 smart contract template. ERC20 refers to an off-the-shelf Ethereum protocol that standardizes issuance, distribution, and control functionality of tokens. Knowing that a token is ERC20 compliant provides information about its reliability and interoperability with other systems. 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.

The Waves blockchain is a distant second, hosting 5% of the ICOs in our sample. Fifty-one percent of ICOs disclose a fundraising goal. We are able to ascertain whether this goal is achieved for 419 token offerings, and of these, 52% meet their goal. Fourteen percent of ICOs give tokens away for free, a strategy for building interest known as an airdrop.

More than three quarters of ICOs place a cap on the number of tokens sold (the number sold is akin to the public float in an IPO). Some capped sales have been grossly oversubscribed, creating an incentive to buy just as the sale starts, which can lead to blockchain congestion and high transaction fees. In an uncapped ICO, buyers do not know what share of total supply a token represents. Fourteen percent of issuers have the right to issue more tokens after the ICO, expanding the total supply (this parallels IPOs, where issuers can conduct seasoned equity offerings). On average, 53% of total token supply is sold in an ICO, including both capped and uncapped deals. ICOs sometimes occur essentially instantaneously, while at the other extreme some have lasted for multiple years. The average duration is 40 days.

Most ICOs in our data sell tokens on a fixed price and first-come, first-served basis. Thirty-three percent of ICOs use dynamic pricing, where the price changes during the ICO in a predetermined way. Nine percent have a price that is sensitive to demand (i.e., changes during the ICO in a way that reflects demand), and 5% use an auction mechanism. For example, Gnosis and Viva used auctions in which the number of tokens sold was unknown and depended on the lowest successful bid. The infrequency of auction mechanisms may seem puzzling to economists, as auctions are an efficient way to allocate a scarce resource. Auctions are also rare among IPOs (Kutsuna and Smith 2003). Their paucity among ICOs suggests that rather than regulatory institutions, other features of the complex IPO process or even inertia may explain their rarity. This appears to be a fruitful avenue for future research.[24]

1.10 ICO industry sectors

We assign each issuer to one of 12 industry sectors, shown in the left column of Table 3.[25] The largest category is NonCrypto Marketplaces and Services,

[24] 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 blockchain technology, there is abundant opportunity for scams. See Morris (2017).

[25] We developed sector categories via a detailed analysis of a subset of 60 ICOs. Research assistants then applied these categories to the whole sample.

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Table 3
Exchange-traded ICO issuer sectors and VC-backed blockchain start-up sectors

	ICO issuers				VC-backed blockchain start-ups				*p*-values	
	Total #		Amount raised		Total #		Amount raised			
	N	Share	N	Ave $	N	Share	N	Ave $	Shares	Amt raised
Ads, rewards	51	0.05	31	18.6	20	0.03	16	4.45	0.07	0.01
Asset management & other crypto financial services	174	0.15	92	20.2	132	0.19	109	4.04	0.05	0.00
Data storage/computing	67	0.06	42	18.0	38	0.05	30	4.53	0.65	0.04
Enterprise, health, identity	73	0.06	26	12.3	112	0.16	83	3.52	0.00	0.00
Gaming, entertainment, messaging	153	0.14	66	9.12	31	0.04	23	15.2	0.00	0.42
New blockchain protocol	67	0.06	41	123	17	0.02	15	20.7	0.00	0.55
Noncrypto marketplace/service	206	0.18	103	11.7	41	0.06	27	6.69	0.00	0.10
Payments, wallets	106	0.09	50	18.6	194	0.28	165	4.85	0.00	0.00
Prediction markets and gambling	23	0.02	16	7.92	5	0.01	3	6.23	0.03	0.77
Smart contract creation	56	0.05	28	18.4	11	0.02	7	1.18	0.00	0.23
Tokenizing real assets	46	0.04	13	11.3	9	0.01	7	2.32	0.00	0.22
Trading and crypto exchanges	106	0.09	42	15.0	89	0.13	67	3.86	0.03	0.00
Unknown/Other	392	0.25	30	4.9	72	0.09	58	7.06	0.00	0.58
All	1520		580	22.2	771		610	5.40		0.02

The left columns of this table describe sectors of ICO issuers. The sector categories were determined after researching a subset of sixty ICOs in detail. Data for the issuers is gathered from white papers and Web sites. The right part of the panel, "VC-backed blockchain start-ups", includes the 771 blockchain start-ups that received seed or VC investment as of April 2018. They have been assigned, where possible to 1 of the 12 sectors. No sector applied for 72 ("Other"). "$ amt raised" indicates the amount of financing in nominal United States dollars. Data for the VC-backed start-ups is from CB Insights. "N with amt raised" is the number of issuers where we observe the amount raised.

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with 18% of issuers. One example in this category is Paragon, which raised $70 million to build "a community dedicated to the worldwide legalization and systematization of cannabis" and later became a high-profile target of SEC enforcement in November 2018. The second largest sector is Asset Management / Other Crypto Financial Services, with 15% of issuers. One example in this category is Bloom, a platform for identity attestation, risk assessment and credit scoring that raised $41 million. An interesting category is Smart Contract Creation, with 5% of issuers. 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).

To explore what types of ventures use ICOs instead of traditional financing, we collect data from the CB Insights database on start-ups using blockchain technology that receive seed or VC investment. We are able to assign most of the VC-backed start-ups into one of the 12 ICO sectors, and data reflecting these assignments appear on the right side of Table 3. Two sectors are much better represented among VC-backed blockchain start-ups than among ICO issuers: Payments and Wallets, and Enterprise, Health and Identity. This may reflect VC-backed blockchain start-up being more oriented towards centralized, business-oriented, or easily monetized blockchain business models than ICO issuers.

To pursue the possibility that they are more business-oriented, we categorize the VC-backed blockchain start-ups as either having a business-to-business model or a business-to-consumer model. We find that 43% have a business-to-business model, while essentially all ICO issuers in our sample target atomized consumers and are usually building two-sided marketplaces (see the theory in Garratt and van Oordt 2019). These differences indicate selection by start-ups into different types of financing. Enterprise-focused blockchain start-ups, such as Digital Asset Holdings, are more likely to fund themselves with VC, while decentralized, consumer-focused platforms are more likely to issue tokens, as they may not be well suited to conventional equity and debt instruments.

2. Advantages of ICOs

As a new financing instrument, what do ICOs offer that other entrepreneurial finance methods do not? That is, why would a venture use an ICO rather than a traditional instrument? This section discusses six advantages of ICOs: (1) financing the development of decentralized networks; (2) securing commitment from future customers and gauging their demand; (3) establishing immutable, nonnegotiable governance terms; (4) providing rapid liquidity; (5) hastening network effects; and (6) reducing transaction costs. These advantages provide context for understanding "success," which we consider empirically in Section 4.

2.1 Financing development of decentralized networks

Instead of value accruing to network sponsors or intermediaries, as is the case with equity-funded start-ups such as Facebook and Google, it is possible for

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a blockchain network's value to accrue to its token holders, who are diffuse future contributors and users of the blockchain. Popper (2016) points out that this can remunerate creators of content for open source applications, which have traditionally relied on volunteer work (e.g. Wikipedia and Unix). That is, an ICO compensates initial developers without giving them more control of the network than any other token holders (Canidio 2018). After the network launches, a native token can also incentivize platform helpers, such as validators.

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 increase 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 token whose value is tied to work that maintains the network. As an illustration, consider Augur, a decentralized prediction market that has been functional since 2016. Betting and payouts are conducted using Ether. Augur's token, REP, is used to identify the true outcome for any market in a decentralized manner. Suppose a market exists to guess whether the Patriots will win the 2020 Super Bowl. After the game ends, Augur's oracle process will come to consensus about whether the Patriots 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 5 times the value of open interest in markets. If her report deviates from the crowd's, she loses her tokens, which elicits honest reporting. 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.

It is possible for a token to both be used to compensate "work" for the network while also being used by customers. The appendix describes the example of the Filecoin network. There, customers are not expected to hold tokens for long. Instead, the service providers hold tokens and are therefore more likely to participate in platform governance. This is similar to producer-owned cooperatives, such as the farmer-owned agricultural co-ops discussed in Hansmann (1996). The result is that, in theory, the value of the token will scale neither too quickly nor too slowly with the network's value.

2.2 Securing commitment from future customers

A second advantage of ICOs is that they permit a venture to raise financing from future users, similar to the presale of goods via crowdfunding. This contrasts with conventional equity, where investors have claims on future cash flows and are generally distinct from intended customers. Raising capital from customers could potentially redistribute network growth gains from financial

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intermediaries, such as VCs, to developers and consumers. It also helps to promote the brand among consumers and provide the issuer with an early signal about demand (Demers and Lewellen 2003; Catalini and Gans 2018). Some have therefore heralded ICOs as a means to "democratize" access to investment opportunities in new ventures.[26] However, conventional institutional investors, such as hedge funds and VCs, have purchased significant shares of tokens, especially in the most sought-after ICOs, raising concerns that utility tokens are held mostly by speculators rather than future customers.

In Li and Mann's (2018) model, users purchase tokens to make a credible commitment to use the platform. It is precisely because the token is worthless outside of the platform that its purchase offers a credible commitment to spend the token later on the platform. Their theory also suggests the presence of speculators does not detract from the ability of utility tokens to resolve coordination problems; speculators would only purchase tokens if they believed that the tokens would ultimately be held and spent by platform users. An alternative theoretical justification for speculation appears in Cong, Li, and Wang (2018). They argue that an important aspect of ICOs is expected price appreciation, which helps to accelerate adoption and network effects by making token ownership attractive to potential early users.

2.3 Establishing immutable governance terms

A third advantage of ICOs arises from the credible commitments that an issuer makes to token scarcity and governance through the immutable token creation contract. Once the token contract and platform are launched, the platform can exist independently of the issuer. Catalini and Gans (2018) consider utility tokens that will serve as the medium of exchange on a platform and have no governance or future cash flow rights. However, their model raises several concerns about ICOs as a fundraising mechanism. Similar to the theory in Canidio (2018), they argue that the ability to issue tokens in the future (i.e., earn seigniorage revenue) creates commitment problems.

2.4 Providing rapid liquidity

ICOs provide start-up investors with early liquidity because the tokens are easily transferable. Liquidity increases dramatically if the token is listed on a cryptocurrency exchange, where it is tradable for other cryptocurrencies or for fiat currency. The liquidity feature of tokens differs sharply from the preferred equity used in VC or the presale contracts used in crowdfunding. Instead, this benefit is a key parallel between IPOs and ICOs (Zingales 1995). Liquidity is not guaranteed, however; as shown in our data, 47% of the ICO tokens had not

[26] For example, Sam Altman, the president of Y Combinator, a well-regarded start-up 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 O'Leary (2017).

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become exchange-traded by November 2018, and even for those tokens that become listed, liquidity may prove low or nonexistent.

2.5 Hastening network effects

Tokens hasten network effects because token holders are motivated to help the platform succeed either by using tokens directly or contributing (e.g., finding bugs or adding features). This advantage highlights the dynamic aspect of token value, emphasized in the model in Cong, Li, and Wang (2018), where expected token price appreciation leads more users to join the platform. Bakos and Halaburda (2018) model the sale of platform-specific utility tokens in an ICO as useful if preselling tokens can help solve a coordination problem among prospective users, that is, to jump-start one-sided network effects. The incentive to prejoin in order to benefit from token appreciation is an important differentiating feature of ICO models relative to conventional network effects.

Establishing network effects quickly is particularly important in this setting, because decentralized applications are often easily imitated. Of course, token holders may hoard their tokens if they expect their value to appreciate. Platforms therefore often have mechanisms for issuing tokens in the future or releasing existing supply from a reserve inventory.

2.6 Reducing transaction and regulatory costs

A final benefit of using a token on the platform instead of fiat currency is lower transaction costs, especially when agents exist 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 seigniorage, could be accomplished without a native token. Indeed, low transaction costs alone do not motivate a native token, as the platform could alternatively use Bitcoin or Ether.

Relatedly, thus far a benefit of conducting an ICO is that the transaction and regulatory costs have been essentially zero, in striking contrast with IPOs, which impose large underwriting and legal costs. Disclosure also has been entirely voluntary, in contrast to the large amount of disclosure required for listed, public companies. However, the increasing regulatory scrutiny of the sector appears to have made the low regulatory burden a fleeting phenomenon, and ICO issuers now frequently use token sale strategies that explicitly acknowledge the instrument is sold as a security and aim to comply with existing securities laws (see Section 2.1).

3. Analysis of ICO Success Factors

We study the factors associated with ICO success using variants of Equation (1):

$$Success_{i,t} = \alpha + \beta' \mathbf{X_i} + \gamma \, BTC\,Price_t + \tau_t + Sector_i + Country_i + \varepsilon_{i,t}. \quad (1)$$

We regress success measures on a vector of characteristics $\mathbf{X}_i$, which are generally not time-varying. All except the GitHub and social media variables

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are observed before the ICO or any exchange listing. We include the price of Bitcoin and fixed effects for the calendar quarter that the ICO started (τ_t), both of which help to control for market sentiment (in some specifications we use fixed effects tied to other time intervals). Finally, our main models also include indicator variables for industry sectors and for the top-nine countries by number of ICOs, as well as an indicator for being dispersed across at least five countries. For some ICOs we are unable to identify a country or sector, so models with these fixed effects have slightly smaller samples. Standard errors for the regression estimates are clustered by the quarter in which each token begins trading.

3.1 ICO characteristics and issuer real outcomes

We begin our analysis of ICO success factors by studying how the future employment at token issuers, the failure rates of these issuers, and their success in obtaining token exchange listings are associated with important characteristics of the parent organizations and their top managers.

3.1.1 Issuer and founder/CEO characteristics. Our analysis of future employment at token issuers appears in Table 4, in which the dependent variable is projected on proxies for issuer quality, transparency, and credibility. Most of the token sales in our sample were concluded in the spring of 2018 or earlier, and we obtain future employment data from LinkedIn at two subsequent points: November 2018 and July 2019. The dependent variable in the first three columns of Table 4 equals the log of 1 plus employment at each issuer as of July 2019. In Column 4, the earlier November 2018 measure is used instead. The last two columns use the growth rate of employment at each issuer between these two dates. In most of our regression models, we include fixed effects for calendar quarters in which each ICO starts to control for time-series shocks that affect ICOs. Standard errors are clustered by calendar quarters as well. In a few models, such as Column 2 of this table, we substitute weekly fixed effects and weekly clustering in place of quarterly to show that the main results are not driven by time variation within a specific quarter, and we add fixed effects for countries and industry sectors in Columns 3 and 6. As shown by the patterns of estimates in Table 4 and in other tables, varying the inclusion of these fixed effects has little meaningful effect on the other estimates.

The first row of Table 4 shows a positive and significant association between token utility value and future employment. For example, the coefficient of 0.308 in Column 1 implies that utility tokens are associated with a 36% increase in employees by July 2019 relative to other types of tokens (mainly security tokens),[27] whereas the coefficient of 0.184 in Column 4 implies that

[27] When the dependent variable is logged, and coefficients are greater than 0.1, the correct percentage interpretation is $100*(e^{\beta}-1)$.

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Table 4
Relationship between issuer characteristics and employment

Dependent variable:	Employment (1)	(2)	(3)	Old employment (4)	Employment growth (5)	(6)
Utility value	0.308***	0.341***	0.343***	0.184**	0.125*	0.146**
	(0.102)	(0.106)	(0.106)	(0.078)	(0.068)	(0.060)
White paper	0.185	0.200	0.210	0.341**	−0.156	−0.123
	(0.190)	(0.170)	(0.167)	(0.154)	(0.113)	(0.117)
Incentive pool	0.177*	0.148	0.192*	0.251***	−0.074	−0.050
	(0.088)	(0.094)	(0.093)	(0.077)	(0.094)	(0.095)
Insider vesting	0.230**	0.228**	0.230**	0.265***	−0.034	−0.062
	(0.105)	(0.104)	(0.096)	(0.081)	(0.056)	(0.060)
Budget	0.212*	0.219**	0.217***	0.198	0.014	0.024
	(0.102)	(0.092)	(0.072)	(0.117)	(0.058)	(0.084)
VC equity	0.854***	0.838***	0.809***	0.603***	0.251***	0.289***
	(0.125)	(0.134)	(0.130)	(0.129)	(0.080)	(0.085)
Male	−0.507**	−0.388	−0.440*	−0.051	−0.456	−0.448*
	(0.205)	(0.249)	(0.221)	(0.299)	(0.305)	(0.228)
Crypto experience	0.083	0.079	0.024	−0.109	0.192*	0.180**
	(0.111)	(0.122)	(0.106)	(0.118)	(0.092)	(0.082)
Finance experience	0.195**	0.183**	0.115	0.109	0.086	0.061
	(0.077)	(0.091)	(0.078)	(0.124)	(0.132)	(0.117)
Comp. sci. experience	0.252***	0.239***	0.238***	0.206***	0.046	0.071
	(0.031)	(0.082)	(0.040)	(0.047)	(0.055)	(0.068)
Entrep. experience	0.397***	0.387***	0.412***	0.281***	0.116	0.145
	(0.107)	(0.098)	(0.085)	(0.078)	(0.100)	(0.106)
Observations	961	961	940	961	961	940
R^2	.168	.244	.204	.185	.058	.089
Quarter start FE	Y		Y	Y	Y	Y
Sector & country FE			Y			Y
Week start FE		Y				

This table contains regression estimates of the relationship between issuer characteristics and real outcomes. The dependent variable in Columns 1-3 is the log of one plus number of employees, which is the number of individuals that identify as being employed by the issuer on LinkedIn as of July 2019. The dependent variable in Column 4 is the same but collected as of November 2018. The dependent variable in Columns 5 and 6 is the difference in log employment between November 2018 and July 2019. Utility value indicates that the token is intended to have consumptive value. The following five variables are issuer and token contract characteristics. Incentive pool means that a fraction of tokens are set aside to compensate future external developers or contributors to the network. The final five variables refer to the issuer's main founder or CEO, if it has one. Quarter/week start fixed effects control for the calendar quarter or week in which the ICO began. Sector fixed effects control for each of 12 mutually exclusive sectors. Country fixed effects control for the nine most common countries as well as a dummy for the issuer being dispersed across at least five countries. Standard errors clustered by quarter (for models with quarter FE) or by week (for models with week FE) appear in parentheses.

employment is 20% higher by November 2018. The growth rate of employment between these two dates is also higher for utility token issuers. These results are consistent with theory. First, Li and Mann (2018) argue that ICOs can create economic value if the issuers sell utility tokens that promote network effects on a new platform. Second, Cong, Li, and Wang (2018) focus on how network effects interact with token price dynamics. They argue that tokens can help accelerate network adoption when the value of the network increases in its number of users. While they do not explicitly discuss utility tokens, the dependence of token value on the size of the user base suggests that the token is used as a medium of exchange or to purchase a product/service. Third, Lee and Parlour (2018) model, in which an ICO is essentially a means of crowdfunding,

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requires the token to have utility value. The positive correlation between utility value and real outcomes is relevant to the regulatory debate about ICOs (see Section 2.1), as some observers argue that utility tokens should not be regulated as securities.

Voluntary disclosure is also associated with future employment, although the positive coefficient estimates for the relevant variables are not always statistically significant. Publishing a white paper and a budget for use of proceeds predicts higher future employment as of November 2018, and including a budget for the use of ICO proceeds in the white paper is associated with higher employment by July 2019. The importance of these disclosures that are not required by law speaks to the long-standing academic debate about the effectiveness of voluntary versus mandatory disclosure. For public securities offerings in the United States, disclosure has been required since the 1933 and 1934 securities acts, but critics view these rules as costly and inflexible (e.g., Easterbrook and Fischel 1984). If disclosure were voluntary, according to this critique, companies would still choose to release information to the market, but each issuer would tailor its releases to its own needs and circumstances, potentially increasing the volume and variety of information reaching investors. The diverse and extremely frequent white paper disclosures by the ICO issuers in our sample seem to reflect this type of outcome. Our results suggest that ICO issuers are mindful of the importance of transparency, 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).

We find strong evidence that bonding to reduce agency costs is relevant to future employment. Indicators for setting aside an incentive pool of tokens and using insider vesting schedules always have the expected signs and are significant in models for the levels of future employment. Relatedly, prior VC investment in the issuer is among the strongest and most significant predictors of future employment and its growth rate. These estimates parallel papers in the IPO literature that have found a positive relation between VC backing and post-IPO success, such as Baker and Gompers (2003) and Hochberg (2011). Catalini and Gans (2018) note that a challenge for the ICO model is that the issuer may raise insufficient capital to cover its costs of development. They suggest this latent funding need helps explain why ICO issuers sometimes raise VC before the ICO. Our finding that previous VC consistently predicts higher employee headcount supports their hypothesis, though of course it is also consistent with a variety of other mechanisms, including simply being a proxy for quality.

Finally, the background of the issuer's founder/CEO also has significant associations with future employment. While founders' backgrounds in finance and computer science appear to be important, the strongest result is that entrepreneurial experience is associated with 49% more employees (Table 4, Column 2). Evidence in other studies shows that the quality of a start-up's founding team is the most important factor in attracting early-stage angel and

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Table 5
Relationship between issuer characteristics and issuer failure

	Failure			
Dependent variable:	(1)	(2)	(3)	(4)
Utility value	−0.070***	−0.755***	−0.049**	−0.097***
	(0.019)	(0.258)	(0.018)	(0.028)
White paper	−0.073**	−0.438	−0.091***	−0.081
	(0.029)	(0.277)	(0.027)	(0.053)
Incentive pool	−0.080***	−1.017***	−0.076***	−0.078***
	(0.017)	(0.350)	(0.018)	(0.023)
Insider vesting	−0.032**	−0.978**	−0.029**	−0.032**
	(0.015)	(0.423)	(0.012)	(0.013)
Budget	−0.058***	−0.770***	−0.050**	−0.062***
	(0.019)	(0.289)	(0.020)	(0.018)
VC equity	−0.079***		−0.063***	−0.067***
	(0.013)		(0.013)	(0.013)
Male	0.059*	0.661	0.036	0.051
	(0.030)	(0.617)	(0.036)	(0.041)
Crypto experience	−0.025*	−0.360	−0.029**	−0.024
	(0.014)	(0.245)	(0.013)	(0.017)
Finance experience	−0.019	−0.294	−0.002	−0.032*
	(0.014)	(0.233)	(0.014)	(0.018)
Comp. sci. experience	−0.046***	−0.770***	−0.049***	−0.050***
	(0.013)	(0.192)	(0.013)	(0.018)
Entrep. experience	−0.029	−0.397	−0.028	−0.042**
	(0.026)	(0.357)	(0.025)	(0.020)
Observations	961	954	940	961
R^2	.152		.179	.242
Pseudo R^2		.215		
Quarter start FE	Y	Y	Y	
Sector & country FE			Y	
Week start FE				Y

This table contains regression estimates of the relationship between issuer characteristics and failure. The dependent variable is an indicator for whether the issuer failed, which means that the issuer does not have an active Web site, the token is not listed on CoinMarketCap, and Internet searches yield no other indication that it still exists as of November 2018. Column 2 uses a logit model. Utility value indicates that the token is intended to have consumptive value. The following five variables are issuer and token contract characteristics. Incentive pool means that a fraction of tokens are set aside to compensate future external developers or contributors to the network. The final five variables refer to the issuer's main founder or CEO, if it has one. Quarter/week start fixed effects control for the calendar quarter or week in which the ICO began. Sector fixed effects control for each of 12 mutually exclusive sectors. Country fixed effects control for the nine most common countries as well as a dummy for the issuer being dispersed across at least five countries. Standard errors clustered by quarter (for models with quarter FE) or by week (for models with week FE) appear in parentheses.

VC investment capital (Gompers et al. 2016; Bernstein, Korteweg, and Laws 2017; Howell 2019), and our results show that founder quality affects ICO capital raising as well.

Table 5 shows regression estimates in which the indicator for token failure (as of November 2018) is projected on the same proxies for issuer quality, transparency, and credibility as used in Table 4. All columns report linear probability estimates except Column 2, which uses a logit model and drops fixed effect groups without successes, so its sample size is somewhat smaller. Column 3 includes sector fixed effects. Columns 1-3 use quarterly fixed effects, whereas Column 4 uses weekly fixed effects.

Estimates in Table 5 indicate that utility token issuers are significantly less likely to experience failure than issuers of other types of tokens, a strong result

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across all four models. Other estimates in Table 5 for the determinants of failure are similar to those in Table 4 for the future employment, suggesting a heavy emphasis on bonding and transparency. Failure is less likely when issuers publish a white paper, disclose a budget for the use of proceeds, provide an incentive pool of tokens for employees, and establish vesting schedules for top managers' token holdings. Issuers whose top managers have computer science backgrounds experience significantly less failure. Prior VC equity reduces the probability of failure on the order of 5% to 10 %, depending upon the model (the estimate is not identified in the logit model). While statistically significant, these estimates for the VC variable have much less economic significance than those in Table 4's models of future employment and employment growth. The asymmetry between the importance of VC equity for success (employment, Table 4) and failure (Table 5) is consistent with VCs investing in a highly skewed portfolio, in which there are (hopefully) a few home runs, and many failures (Ewens, Nanda, and Rhodes-Kropf 2018).

3.1.2 Exchange listing and future employment. Regression estimates in Tables 4 and 5 illuminate relationships between ICO issuer characteristics and the real outcomes of employment and failure. A further outcome, whether the token becomes listed on a cryptocurrency exchange, has particular importance for investors because of its strong connection to token liquidity, a primary benefit of ICOs relative to conventional instruments in entrepreneurial finance. Beyond its significance for investors, listing may help ICO issuers achieve real outcomes, a conjecture we explore in this section. In a two-stage regression model, we instrument for listing and demonstrate that listing causally affects the token issuer's future employment. (We found no instruments for the other issuer and ICO process characteristics.)

Because only a subset of relatively more successful ICOs achieve exchange listings, we first attempt to identify which variables are associated with selection into listing. Table 6 presents a regression analysis using models very similar to those in Tables 4 and 5, in which we study future employment and operational failure. In general, results in Table 6 are fairly similar to those in Tables 4 and 5; explanatory variables, such as the use of an incentive pool, insider vesting, VC backing, and computer science founder experience, have statistically significant associations with successful exchange listing. Interestingly, founder financial experience also exhibits a positive and significant association with listing, which is a more financial outcome, while it has no robust relation with future employment or operational failure.[28]

Next, we estimate a two-stage least squares model, with estimates shown in Table 7. The instrumental variable for token listing is price changes in the

[28] In related work, Amsden and Schweizer (2018), De Jong, Roosenboom, and van der Kolk (2018), Boreiko and Vidusso (2018) and Deng, Lee, and Zhong (2018) study listing predictors and also find that disclosure and VC backing are associated with listing.

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Table 6
Relationship between issuer characteristics and listing on an exchange

Dependent variable:	Listing on an exchange			
	(1)	(2)	(3)	(4)
Utility value	0.052	0.307	0.059**	0.050
	(0.034)	(0.193)	(0.024)	(0.037)
White paper	0.028	0.278	0.057	0.026
	(0.050)	(0.262)	(0.054)	(0.062)
Incentive pool	0.095**	0.460**	0.090*	0.130***
	(0.042)	(0.218)	(0.045)	(0.024)
Insider vesting	0.180***	0.925***	0.177***	0.160***
	(0.025)	(0.144)	(0.022)	(0.038)
Budget	0.030	0.149	0.030*	0.036
	(0.021)	(0.121)	(0.015)	(0.041)
VC equity	0.096**	0.541**	0.094*	0.113**
	(0.042)	(0.233)	(0.050)	(0.045)
Male	−0.020	−0.112	−0.039	0.008
	(0.093)	(0.476)	(0.090)	(0.078)
Crypto experience	0.079**	0.429***	0.066**	0.059
	(0.031)	(0.158)	(0.030)	(0.036)
Finance experience	0.056**	0.281***	0.057***	0.038
	(0.020)	(0.105)	(0.019)	(0.045)
Comp. sci. experience	0.090***	0.488***	0.083***	0.068**
	(0.018)	(0.043)	(0.018)	(0.033)
Entrep. experience	0.049	0.279*	0.045	0.033
	(0.033)	(0.166)	(0.032)	(0.027)
Observations	961	900	940	961
R^2	0.224		0.247	0.304
Pseudo R^2		0.163		
Quarter start FE	Y	Y	Y	
Sector & country FE			Y	
Week start FE				Y

This table contains regression estimates of the relationship between issuer characteristics and listing on an exchange. The dependent variable is an indicator for whether or not the issuer listed on a cryptocurrency exchange as of November 2018. Column 2 uses a logit model. Utility value indicates that the token is intended to have consumptive value. The following five variables are issuer and token contract characteristics. Incentive pool means that a fraction of tokens are set aside to compensate future external developers or contributors to the network. The final five variables refer to the issuer's main founder or CEO, if it has one. Quarter/week start fixed effects control for the calendar quarter or week in which the ICO began. Sector fixed effects control for each of 12 mutually exclusive sectors. Country fixed effects control for the nine most common countries as well as a dummy for the issuer being dispersed across at least five countries. Standard errors clustered by quarter (for models with quarter FE) or by week (for models with week FE) appear in parentheses.

Ethereum Classic (ETC) token around the time of an ICO. As noted above, the large majority of ICOs occur on the Ethereum blockchain and accept Ether (ETH) as payment. One barrier to being listed on an exchange is the high fee that exchanges charge for the opportunity. These have been reported to range from \$1 million to \$3 million, and they appear to correlate with market sentiment. Because issuer wealth is tightly tied to ETH, high ETH prices may predict the ability or willingness to pay to list on an exchange.

We do not use price changes of ETH itself as an instrument for changes in issuer wealth, because ETH raises a concern about the exclusion restriction, which would require that ETH price movements cannot independently affect employment. To understand this, suppose that ETH price changes comprise two types of variation. The first type (call this "Type 1") is driven by overall

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Table 7
Effect of listing status on future employment (IV using ETC)

	Period: No bubble			Period: Shoulders of bubble			Period: Bubble		
	OLS	2SLS		OLS	2SLS		OLS	2SLS	
Dependent variable:	Employment	1st stage Listed	2nd stage Employment	Employment	1st stage Listed	2nd stage Employment	Employment	1st stage Listed	2nd stage Employment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Listed on exchange	1.046***		0.566	1.161***		0.971***	1.324***		1.716**
	(0.116)		(0.523)	(0.111)		(0.360)	(0.204)		(0.750)
Δ ETC price		0.095***			0.251***			0.223***	
		(0.017)			(0.033)			(0.053)	
Observations	628	628	628	548	548	548	228	228	228
R^2	.119	.080	.095	.176	.097	.172	.181	.203	.167
F-stat		33.14			57.58			17.94	
Year start FE	Y	Y	Y	Y	Y	Y	Y	Y	Y

This table contains OLS and 2SLS regression estimates of the effect of an ICO becoming listed on an exchange upon labor market outcomes. The dependent variable in Columns 1, 3, 4, 6, 7 and 9 is the log of one plus number of employees, which is the number of individuals that identify as being employed by the issuer on LinkedIn as of July 2019. The dependent variable in Columns 2, 5, and 8 is an indicator for listing on a cryptocurrency exchange. ETC Price is defined as the 90th percentile of ETC between 23 and 43 days after an ICO is started, divided by the average ETC price in the 30 days before the ICO start date. Days 23 and 43 cutoffs are the 25th and the 50th percentile differences between the ICO start date and the first trading date for those ICOs that have become listed on an exchange. No Bubble is defined as days in which Bitcoin prices are below 6,000 USD, which is is almost all days before October 29, 2017 and after November 13, 2018 (while the price has since recovered, it did so after the end of our data). Shoulders Bubble is defined as days in which Bitcoin prices are between 6,000 and 11,000 USD, which is is almost all days between October 29, 2017 and November 13, 2018, as well as between January 30, 2018 and November 13, 2018. Bubble is defined as days in which Bitcoin prices are above 11,000 USD, which is almost all days between November 30, 2017 and January 29, 2018. Standard errors are in parentheses.

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ICO activity. ICO activity likely affects ETH prices, because most ICO tokens are smart contracts hosted on Ethereum, requiring small ETH expenditures for each of their transactions (as explained above in Section 2.9). If many successful ICOs are on the ETH blockchain, they may cause higher short-term ETH prices, which would violate the exclusion restriction. The second type of variation (call this "Type 2") reflects broader Ethereum value and cryptocurrency market conditions beyond the ICO market. We seek an instrument that is correlated with Type 2 but not with Type 1 variation.

Price changes in Ethereum Classic (ETC) appear to provide a suitable instrument for changes in issuer wealth. ETC was created in 2016 as a controversial hard fork from ETH. It is strongly correlated with Type 2 variation because ETC and ETH have a common design and shared heritage, but we believe ETC is uncorrelated with Part 1 variation because ICO token contracts do not occur on the ETC blockchain, and ETC is rarely if ever used as a means of payment in token sales. As Type 2 variation over a longer term likely affects employment, we consider price movements of ETC over a short window (20 days), making it unlikely that the price changes affect employment measured at least 1 year later.[29] In sum, ETC price changes likely satisfy the IV requirements of the relevance condition and the exclusion restriction, because they are uncorrelated with Type 1 variation but correlated with Type 2 variation.

Our IV estimation makes use of a market mechanism in which exchange listing fees for ICOs are costly. Conversely, when listing fees are low, it should matter less how much money founders raise in their ICOs. Exchange fees tend to be higher when overall cryptocurrency market sentiment is frothier, which can be proxied with the price of Bitcoin (BTC). Some exchanges post listing fees in BTC, creating a direct connection, but even when the fees are posted in fiat, they tend to increase when sentiment is high. We therefore divide the sample into three time periods: No Bubble, Shoulders of Bubble, and Bubble. No Bubble is defined as days in which BTC prices are below \$6,000, which is almost all days before Octobe 29, 2017 and after November 13, 2018 (while the price has since recovered, it did so after the end of our data). Shoulders of Bubble is defined as days in which BTC prices are between \$6,000 and \$11,000, which is almost all days between October 29, 2017 and November 29, 2017, as well as between January 30, 2018 and November 13, 2018. Bubble is defined as days in which BTC prices are above \$11,000, which is almost all days between November 30, 2017 and January 29, 2018. Our research indicates that exchange fees are higher during the Bubble period.

29 We measure the change in ETC prices as the 90th percentile of ETC prices between 23 and 43 days after the start of an ICO, relative to the average ETC price 30 days before the start of the ICO. In this case, 23- and 43-day cutoffs are the 25th and 50th percentiles for how long it takes for tokens in our data set to list on an exchange. The results are not very sensitive to selecting other thresholds. The analysis includes 1,404 ICOs for which we can calculate the ETC price change. This is smaller than the 1,520 in the overall sample, because there are 50 tokens issued before ETC was available and 65 without a start date. Of the 1,404, 570 eventually became listed on an exchange, and 834 did not. For the post-ICO price, we use the 90th percentile to capture the spikes in prices. Our results are similar if we use the 75th or the 95th percentiles, for example.

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Table 7 shows two-stage least squares estimates for a model in which future employment (specifically, the log of one plus future employment) measured in July 2019 is the dependent variable, and token listing is the independent variable of interest. Columns 1-3 show estimates for the No Bubble period, Columns 4-6 for the Shoulders of Bubble period, and Columns 7-9 for the Bubble period. In each case, the first column shows the naive ordinary least squares (OLS) relationship between listing and employment. The second and third columns contain the first and second stages of the IV estimation, respectively. We do not include other controls in the regression because all of the variables we observe about issuers are choices, such as where to locate or whether to raise VC. As these are endogenously determined, including them in the IV analysis as controls could lead to a "bad control" problem which we wish to avoid experience.

Estimates in Table 7 indicate that when listing fees are high during the Bubble period, ICO listing exhibits a strongly positive association with future employment. In the No Bubble period, the second stage estimate of the effect of listing on future employment is statistically insignificant (Column 3). The first stage is economically small. In the Shoulders of Bubble period, the second stage estimate is larger, at 0.97, and is statistically significant (Column 6). Finally, in the Bubble period, the significant second stage coefficient of 1.72 indicates that listing causes a more than 500% increase in the number of employees (Column 9). The first-stage estimate is large and robust in the Shoulders and Bubble periods, with Cragg-Donald F-statistics of 58 and 18, respectively, which satisfy the rule of thumb of 10 for weak instruments.

We conduct a placebo test to validate our use of ETC price changes around the ICO date as the instrumental variable (results are not reported to save space). In this test we reestimate the IV regressions using ETC price changes 2 months before the ICO start. This earlier price change should not affect the amount of money the founders obtain from the ICO proceeds. Consistent with this intuition, we find marginally significant first stages, with very low F-statistics, and completely insignificant second stages in this placebo test.

In Table 7, the OLS estimates (Columns 1, 4, and 7) increase across the three time periods and are strong and significant throughout, indicating the importance of an IV approach in this context. The estimated IV effect is larger than the OLS effect in the Bubble period, indicating that the subset of listings sensitive to the ETC price lead to higher employment than the average ETC price increase captured by the OLS regression. This could reflect endogeneity that biases the OLS result downward. Alternatively, the local average treatment effect for compliers with the instrument may be larger than the population average treatment effect. As Jiang (2015) explains, this can lead to a larger IV effect even if the exclusion restriction is satisfied. In our context, it seems possible that some issuers are very strong or very weak and will have good or bad outcomes regardless of whether their token lists or not. The IV captures the marginal issuers, whose listing status is sensitive to the ETC price-change

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instrument. Their future success depends more on the liquidity enabled by exchange listing.

In sum, this section shows that when a token sold in an ICO succeeds in becoming listed on a cryptocurrency exchange, the liquidity and reputation benefits of listing causally increase issuer employment. Therefore, ICO capital raising and listing help to issuers to achieve real economic progress in the crypto sector.

3.2 Operating sectors

The remaining analyses examine the relationship between additional issuer or ICO characteristics and real outcomes. While the independent variables considered subsequently do not have the same obvious connections with entrepreneurial finance theory as those in Tables 4-6, they help to illuminate the ICO market and constitute an important contribution of this study.

We begin by addressing ICO business models, or "sectors." The left three columns of Table 7 present regression estimates of associations between our real ICO outcomes and the indicator variables for the 12 sectors introduced in Table 3 above. Based upon these estimates, three of the less popular sectors stand out as the ones most significantly associated with successful ICOs: the advertising and loyalty rewards tokens, tokens issued by organizations developing new blockchain protocols, and tokens connected to smart contract creation platforms. We also find that tokenizing real assets has a strong positive relationship with employment, and a negative relationship with failure. This likely is linked to the increasing apparent viability of what is often called the "security token" business model (Kharif 2019). Further estimates in the left half of Table 8 indicate that tokens issued by asset management firms as well as those associated with enterprise blockchains, healthcare, and identity management have stronger associations with future employment growth.

The predictive power of new blockchain protocols supports the model in Chod and Lyandres (2018), which focuses on the tradeoff between diversification and monitoring from the perspective of a potential investor. The authors compare the ICO model to the conventional VC model; while VC investors are poorly diversified, they can monitor the venture closely and thus reduce underinvestment induced by agency conflicts (because the entrepreneur chooses the investment level after raising money). Their model predicts that an ICO will dominate VC when the issuer's payoffs are highly right-skewed. We do not have a direct measure of issuer uncertainty, but it seems likely that issuers building new blockchain protocols (rather than issuing an ERC20 token that is part of the Ethereum blockchain) have more right-skewed payoffs.

This is because new blockchain protocols usually intend to be the infrastructure for diverse applications. They may be riskier investments than tokens tied to a narrow product or service, but their potential for value creation seems much larger because they can become the infrastructure for potentially widespread and diverse applications. Whereas value has not accrued to the

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Table 8
Relationship between issuer sector/ICO characteristics and real outcomes

Dependent variable:	Employment	Employment growth	Failure	Employment		Failure
	(1)	(2)	(3)	(4)	(5)	(6)
Ads, rewards	0.694***	0.201	−0.169***			
	(0.225)	(0.206)	(0.047)			
Data storage/computing	−0.138	−0.056	−0.120*			
	(0.219)	(0.186)	(0.068)			
Enterprise, health, identity	0.222	0.336**	−0.012			
	(0.161)	(0.118)	(0.038)			
Gaming, entert., messag.	−0.077	0.070	−0.099*			
	(0.149)	(0.160)	(0.052)			
New blockchain protocol	0.922***	0.107	−0.182***			
	(0.113)	(0.174)	(0.028)			
Payments, wallets	0.152	0.142	−0.061			
	(0.162)	(0.174)	(0.060)			
Prediction mkts and gambl.	−0.238	−0.155	−0.117*			
	(0.403)	(0.150)	(0.067)			
Smart contract creation	0.381**	0.305*	−0.132**			
	(0.180)	(0.148)	(0.058)			
Tokenizing real assets	0.608***	0.269*	−0.214***			
	(0.186)	(0.153)	(0.039)			
Trading, Crypto exchs.	0.120	0.065	−0.092**			
	(0.102)	(0.140)	(0.042)			
Asset mgmnt, crypto fin servi.	0.117	0.290**	−0.079			
	(0.169)	(0.125)	(0.051)			
Barred to U.S.				0.533***	0.435***	−0.010
				(0.142)	(0.138)	(0.015)
Dynamic pricing				0.307**	0.189	−0.031
				(0.145)	(0.135)	(0.047)
Presale				−0.043	−0.050	−0.042
				(0.116)	(0.110)	(0.031)
Stated goal to raise				0.083	0.090	−0.029
				(0.111)	(0.162)	(0.052)
Airdrop (free)				0.138	−0.083	0.017
				(0.179)	(0.206)	(0.033)
Accept BTC				0.132	0.220	−0.054
				(0.229)	(0.272)	(0.069)
Accept ETH				0.507*	0.470**	−0.028
				(0.245)	(0.196)	(0.050)
Accept USD				0.120	0.354***	−0.030
				(0.156)	(0.093)	(0.046)
Future token creation				0.183	0.269	−0.015
				(0.251)	(0.225)	(0.038)
Raised USD (bill)					0.872***	−0.053***
					(0.080)	(0.015)
Observations	1,125	1,125	1,125	451	361	361
R^2	.117	.048	.106	.209	.188	.125
Quarter start FE	Y	Y	Y	Y	Y	Y
Country FE	Y	Y	Y	Y	Y	Y

This table contains regression estimates of the relationship between sector and ICO characteristics and outcomes. The dependent variable in Columns 1 and 4-5 is the log of one plus number of employees, which is the number of individuals that identify as being employed by the issuer on LinkedIn as of July 2019. The dependent variable in Column 2 is the difference in log employment between November 2018 and July 2019. The dependent variable in Columns 3 and 6 is an indicator for whether the issuer failed, which means that the issuer does not have an active Web site, the token is not listed on CoinMarketCap, and Internet searches yield no other indication that it still exists as of November 2018. The independent variables in Columns 1-3 are sector fixed effects representing 12 mutually exclusive sectors. The independent variables in Columns 4-6 are key characteristics of the ICO. Barred to the United States means that buyers from the United States were excluded. Dynamic pricing means that the price changed over the course of the ICO. Future token creation means that the issuer has the ability per the token smart contract to generate new tokens in the future. Raised USD is the ultimate amount raised in the ICO in millions of nominal United States dollars, which is not available for all ICOs. Country fixed effects control for the nine most common countries as well as a dummy for the issuer being dispersed across at least five countries. Quarter start fixed effects control for the calendar quarter in which the ICO began. Standard errors clustered by quarter appear in parentheses.

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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 developed for Facebook. Consistent with the hypothesis that new blockchain protocols are likely to be better suited to ICOs than to VC, Table 3 shows that they compose 6% of ICOs compared to 2% of VC-backed blockchain start-ups, a difference that is highly significant.

3.3 ICO design choices

We study the importance of ICO design features in the right three columns of Table 8. We use only the dependent variable for future employment, as we obtain no significant results for associations of ICO design features with employment growth or ICO failure. Our independent variables are from the subsample of 451 tokens that trade for at least 90 days, as of April, 2018, after achieving an exchange listing. Because of the costs and time required for data collection, most of these variables have not appeared in other ICO empirical papers except for the presale indicator, which is used as a control variable by many authors. Column 4 shows estimates for a model with quarterly and country fixed effects. In Columns 5 and 6, we use the amount raised in the token sale as a control variable, and this model has a smaller sample size because this variable is not available for all observations. Among all ICO characteristics, amount raised is the strongest positive predictor of employment, and negative predictor of failure. Indeed, none of the ICO characteristics predict failure significantly besides amount raised.

One of the most consistent and also unsurprising results in the analysis of ICO design features is that those ICOs which accept ETH tokens as payment – about two-thirds of the sample – are associated with higher future employment. The large majority of this subgroup would use the ERC20 token template, a design choice that many potential investors are likely to find reassuring due to its wide adoption in the marketplace. ICOs with dynamic pricing, in which the sale price escalates during the transaction, also are associated with higher future employment at the issuer. Somewhat surprisingly, tokens that attempt to bar United States investors seem to be more successful as well. For other ICO design characteristics, the full range of which appear in Table 2, we do not obtain significant estimates, and we exclude these variables from the model in order to keep it reasonably parsimonious.

3.4 GitHub and social media

In Table 9 we analyze the importance of GitHub and social media as factors in ICO success. Publishing code on GitHub has strong associations with future employment, employment growth, and avoidance of failure. For example, posting code on GitHub is associated with a 100% employment increase, and a decrease in the probability of failure by 12 percentage points. We find little

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Table 9
Relationship between issuer GitHub, social media characteristics and outcomes

Dependent variable:	Employment	Employment growth	Employment			Failure			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Code on GitHub (GH)	1.098***	0.307***	0.937***			−0.114***	−0.085**		
	(0.165)	(0.056)	(0.229)			(0.039)	(0.031)		
Twitter account	0.156	−0.359	0.108			0.041	0.106		
	(0.323)	(0.369)	(0.322)			(0.104)	(0.091)		
Telegram group	0.729***	0.085	0.736***			−0.202***	−0.191***		
	(0.183)	(0.101)	(0.186)			(0.063)	(0.057)		
GH repositories (000s)				7.854***				−0.515**	
				(1.649)				(0.193)	
GH commits (000s)				0.018**				−0.001	
				(0.007)				(0.001)	
GH main rep branches (000s)				0.724				−0.350***	
				(1.709)				(0.102)	
GH main rep releases (000s)				−0.063***				−0.002	
				(0.005)				(0.004)	
GH main rep contrib. (000s)				0.103				−0.100*	
				(0.404)				(0.057)	
GH months from last commit				−0.024***	−0.031***			0.004**	0.004
				(0.004)	(0.005)			(0.001)	(0.003)
Telegram members (000s)					0.009				0.001
					(0.010)				(0.002)
Twitter followers (000s)					0.007***				−0.000
					(0.002)				(0.000)
Observations	451	451	433	780	274	451	433	780	274
R^2	.224	.074	.270	.173	.333	.210	.266	.081	.269
Quarter start FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sector & Country FE			Y				Y		

This table contains regression estimates of the relationship between issuer GitHub and social media variables and outcomes. The dependent variable in Columns 1, 3, 4 and 5 is the log of one plus number of employees, which is the number of individuals that identify as being employed by the issuer on LinkedIn as of November 2018. The dependent variable in Column 2 is the difference in log employment between November 2018 and July 2019. The dependent variable in Column 6-9 is an indicator for whether the issuer failed, which means that the issuer does not have an active Web site, the token is not listed on CoinMarketCap, and Internet searches yield no other indication that it still exists. The independent variables are collected from Twitter, Telegram, and GitHub. GitHub is 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. The remaining rows include only those ICOs with a GitHub source code repository. Telegram is a cloud-based mobile and desktop messaging application with a focus on security and speed. We collect these characteristics for a subset of 451 ICOs that had traded on an exchange for at least 90 days as of April 2018. Quarter start fixed effects control for the calendar quarter in which the ICO began. Sector fixed effects control for each of 12 mutually exclusive sectors. Country fixed effects control for the nine most common countries as well as a dummy for the issuer being dispersed across at least five countries. Standard errors clustered by quarter appear in parentheses.

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evidence in support of the importance of Twitter, although the number of Twitter followers of the issuer is positively associated with its future employment. Having a Telegram group is positively associated with employment.

We gather detailed data about GitHub for the subsample of 780 tokens for which the ICO's source code is posted on GitHub. As shown in Columns 4 and 8, many of the GitHub variables exhibit significant associations with future employment and with failure avoidance in this subsample, in the directions that we would expect. For instance, future employment is higher when there are more GitHub repositories and commits, and when less time has elapsed since the last commit, or code revision. 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. We obtain symmetric estimates with opposite signs when failure is the dependent variable, but not all of these results are statistically significant.

3.5 Issuer countries

In Table 10, we study whether an ICO issuer's real outcomes are more closely associated with some host countries than others. For each ICO, we read white papers and other publicity material to identify up to four countries in which the issuer maintains an office or the management team resides. The table uses indicator variables for the top-nine countries, as well as an indicator for dispersed ICOs whose issuers are domiciled in more than four countries. All regressions include quarterly fixed effects and clustered standard errors. Columns 2 and 5 also include fixed effects for industry sectors, and columns 3 and 6 include the full range of issuer and manager control variables used earlier in Tables 4, 5, and 6 (estimates for those variables are not reported to save space).

The table contains a striking pattern of estimates, with Switzerland-based issuers having the strongest and most robust relationship with success. Switzerland is home to the so-called "crypto valley" and is known for lenient regulation of ICOs. The indicator for Singapore, which has a reputation as the most welcoming ICO nation-state in the Eastern hemisphere, behaves similarly, although the estimates are smaller. ICOs based in Canada, Hong Kong, and, to an extent, Russia and the United States are also more likely to achieve significant operational outcomes in the desired direction. We make no claims about causation, and it is entirely possible that higher quality ICO issuers gravitate toward those countries with reputations for thoughtful regulation and well-developed investor markets. However, the data clearly show that like most investment markets, outcomes from the sales and trading of ICOs are closely associated with geography, and the location of an ICO provides a transparent signal about the issuer's prospects for success.

A final note about all of the regression results in this paper is that the main findings are robust to inclusion of alternative independent variables. For example, we continue to find very strong positive effects of being in

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Table 10
Relationship between issuer country and outcomes

	Employment			Failure		
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
USA	0.550***	0.303***	0.094*	−0.179***	−0.058	−0.028
	(0.064)	(0.061)	(0.051)	(0.030)	(0.036)	(0.018)
China	0.474**	0.287	0.116	−0.103*	0.048	0.053
	(0.167)	(0.172)	(0.093)	(0.058)	(0.057)	(0.050)
Canada	0.758***	0.416***	0.553***	−0.186**	−0.058	0.029
	(0.199)	(0.116)	(0.142)	(0.065)	(0.055)	(0.040)
Russia	0.195**	−0.055	−0.221**	−0.202***	−0.074	−0.039
	(0.082)	(0.077)	(0.077)	(0.049)	(0.048)	(0.044)
Singapore	0.759***	0.516***	0.159	−0.212***	−0.069***	−0.021
	(0.142)	(0.141)	(0.109)	(0.025)	(0.018)	(0.018)
Switzerland	1.200***	0.905***	0.605***	−0.258***	−0.131***	−0.054***
	(0.129)	(0.127)	(0.104)	(0.020)	(0.014)	(0.014)
Israel	0.087	−0.053	−0.299	−0.096	−0.019	0.078
	(0.271)	(0.218)	(0.364)	(0.118)	(0.098)	(0.104)
UK	0.369***	0.179	−0.219	−0.213***	−0.109**	−0.048***
	(0.122)	(0.158)	(0.188)	(0.055)	(0.039)	(0.012)
HK	0.843***	0.533***	0.685***	−0.160**	−0.014	0.009
	(0.052)	(0.120)	(0.225)	(0.063)	(0.048)	(0.030)
> 4 countries	−0.136	−0.378**	0.320	−0.050	0.102	−0.097
	(0.145)	(0.158)	(0.238)	(0.058)	(0.067)	(0.057)
Observations	1,292	1,125	961	1,292	1,125	961
R^2	.100	.117	.193	.094	.106	.164
Quarter start FE	Y	Y	Y	Y	Y	Y
Sector FE		Y			Y	
Issuer controls			Y			Y

This table contains regression estimates of the relationship between issuer countries and real outcomes. The dependent variable in Columns 1-3 is the log of one plus number of employees, which is the number of individuals that identify as being employed by the issuer on LinkedIn as of July 2019. The dependent variable in Columns 4-6 is an indicator for whether the issuer failed, which means that the issuer does not have an active Web site, the token is not listed on CoinMarketCap, and Internet searches yield no other indication that it still exists. The independent variables consist of indicators for the nine most common countries. We also create an indicator for the issuer being dispersed across at least five countries. The omitted group is all other countries besides the nine most common. Issuer controls include all independent variables reported in Tables 4, 5, and 6. Quarter start fixed effects control for the calendar quarter in which the ICO began. Sector fixed effects control for each of 12 mutually exclusive sectors. Standard errors clustered by quarter appear in parentheses.

Switzerland, of VC investment, and of having an incentive pool on employment when all the covariates at our disposal are included (i.e., ICO characteristics, GitHub measures, the covariates in Tables 4-6). While omitted variable biases can never be completely eliminated in our empirical approach, robustness of certain findings to comprehensively including known variables is quite striking given the relatively small sample and represents an important initial step for research on digital assets.

4. Conclusion

This paper studies the market for ICOs, which grew rapidly from mid-2017 through mid-2018 and emerged as a vibrant alternative channel for start-up financing. We study a sample of more than 1,500 ICOs that collectively raise the equivalent of $12.9 billion. Our data set, which includes hand collected data about ICO design features and offering mechanisms, provides new insights into how the market operates and the design tradeoffs faced by ICO issuers.

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We examine ICO success in two dimensions of operational progress, as measured by future employment (and its growth rate) as well as an indicator for failure of the venture. Tokens designed with a utility feature enabling the access of future products and services appear to be the most successful in helping the issuer avoid failure and achieve higher levels of future employment. Other variables that predict future ICO operational success are related to voluntary disclosure, bonding, certification, promotion through social media platforms, and code development on GitHub. Finally, an instrumental variables analysis shows that successful ICO listing helps cause higher levels of future employment.

Our paper contributes to a rapidly growing literature about ICOs. While some ICO success factors reflect classical corporate finance predictions about the importance of reducing information asymmetry and engaging in bonding, others tend to support new theoretical models that illuminate ICOs' unique potential to promote customer adoption and loyalty while raising capital from a new class of investors.

Appendix A

Filecoin Case Study

Filecoin, which raised more than $200 million in its 2017 ICO, is a project of Protocol Labs, Inc., a Delaware corporation headquartered in San Francisco. The company kindly shared with us confidential transaction-level data on an anonymized basis, permitting us to study the prices paid by different types of investors, as well order sizes, means of payment, vesting schedules and related information. To our knowledge, these are the first such data made available for academic research.

Protocol Labs is building a new blockchain (the Filecoin protocol) to host a peer-to-peer decentralized storage market. The storage infrastructure is called InterPlanetary File Storage (IPFS), another project of Protocol Labs. Decentralized storage represents an alternative to incumbent cloud storage providers, such as Dropbox, Amazon, and Google. Filecoin's advocates perceive market power, vulnerability to cyber attacks, and centralization of control over others' data as drawbacks to these centralized services. The Filecoin protocol will be completely automated, so that once the network goes live, Protocol Labs will have no direct control, although the company will own a large amount of FIL tokens that will allow it indirectly to influence the Filecoin storage market.

Filecoin's token, which uses the symbol FIL, is a utility token that will provide access to this marketplace as the only means of customer payment for storage services. Storage providers (known as storage miners) will earn FIL by storing digital files for clients. FIL is also a work token, because storage miners must post FIL as collateral in order to pledge their storage power and be eligible to match with clients. A second type of producer, a retrieval miner, responds to requests for files by rapidly retrieving and reassembling them. Filecoin has a number of competitors, 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% of the ultimate supply of 2 billion tokens. Of the remaining tokens, 15% are retained by Protocol Labs for research, engineering, business development, marketing, and other purposes, 5% are held by the Filecoin Foundation for long-term network governance and public use data preservation (e.g., storing government climate data), and 70% 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

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with SEC regulations (see Section 2.1).[30] CoinList, a new platform for SEC-compliant token sales, managed the ICO. CoinList is an AngelList spin-off that emerged from collaboration with Protocol Labs for the Filecoin sale. Its participation likely helps reduce information asymmetry, just as reputable underwriters do in IPO markets (Loughran and Ritter 2002).

Filecoin conducted a presale to offer discounts to select investors, which ended on August 1, 2017.[31] Participants in Filecoin's presale included investors who 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 Protocol Labs employees. The public sale followed soon after the presale and lasted from August 10 to September 7. Only accredited investors could participate, allowing Filecoin's ICO to be exempt from United States securities laws. The presale and registrations for the public sale helped gauge demand for the public sale, which the issuer had underestimated.

In the presale, Filecoin raised approximately $52 million from 150 investors. Presale FIL tokens were offered at $0.75, but investors could obtain discounts for agreeing to vesting (lockup) periods, leading to an average price paid of $0.57. In the public sale, the price charged for each token was determined by a dynamic formula, whereby the price would equal the total dollar amount raised up to that point divided by $40 million. Therefore, the public token sale began at a price of $1.30 ($52 million divided by $40 million), and the FIL subscription prices 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. 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 start-up, a practice that can lead to overvaluation (Gornall and Strebulaev 2019).

Filecoin's public sale raised $153.8 million from more than 2,100 investors in over 50 countries, of which $135 million came in the first hour. Under the terms of the public sale, all buyers in the first hour were ultimately charged an identical price equal to the weighted average first-hour sale price. Equalization of first-hour prices was done to avoid a rush in the first minutes of the sale, because Protocol Labs feared investors would not read the documentation accompanying the purchase process in an effort to benefit from the lowest prices. After adjustments for individual investors' choices of vesting discounts, the first-hour investors paid an average of $2.43 per token. 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 A.1, panel A summarizes this information. It shows that the presale 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 United States dollars, Bitcoin, Ether, or Zcash.[32] Figure A.1 shows the amount raised in each currency for the three offer periods. Presale investors paid mostly in United States dollars, while 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 A.1, panel C, we show information about the purchases made by members of the Protocol Labs core team, advisors, and venture capital investors. Six members of the Protocol Labs core team and nine angel and VC investors who had

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

31 Although we use the term "ICO" throughout this paper for simplicity, and the Filecoin project appears in all rankings of top ICOs, Protocol Labs did not use the ICO term to describe its token sale. Protocol Labs termed its presale the "Advisor Sale,"and what we call its ICO, the company referred to as a "Public Sale." We use the terms "presale" and "ICO" to be consistent with the language elsewhere in the paper.

32 Estimates of the amount raised depend on the exchange rates used. We use the daily United States dollar closing price of each cryptocurrency on CoinMarketCap. Many media reports valued the proceeds of Filecoin's ICO at $257 million rather than $206 million, and the difference represented the appreciation of Ether, Bitcoin, and Zcash obtained by the company during the ICO period.

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Table A.1
Filecoin

A. Summary statistics

	Number of transactions	Average FIL per transaction	Average USD per transaction	Median USD per transaction	Average USD/FIL
Presale	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

B. Vesting discounts in advisor sale (presale) and public sale

Vesting period:	6 months		12 months		24 months		36 months	
Portion of ICO:	Presale	Public	Presale	Public	Presale	Public	Presale	Public
Vesting discount:	N/A	0	7.5%	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

C. Number of investors during ICO by investor type

	Core team	Previous PL investors	Others
Presale	6	9	128
1st hour of public sale	0	1	1,358
Rest of public sale	1	0	815

D. Advisor sale (presale)

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

Panel A shows summary statistics about the three periods of Filecoin's ICO, which are the presale (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 B shows the discounts offered by vesting horizon; the minimum was 6 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 C 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 D shows the average number invested per investor (converted to USD) across the three groups during the advisor sale.

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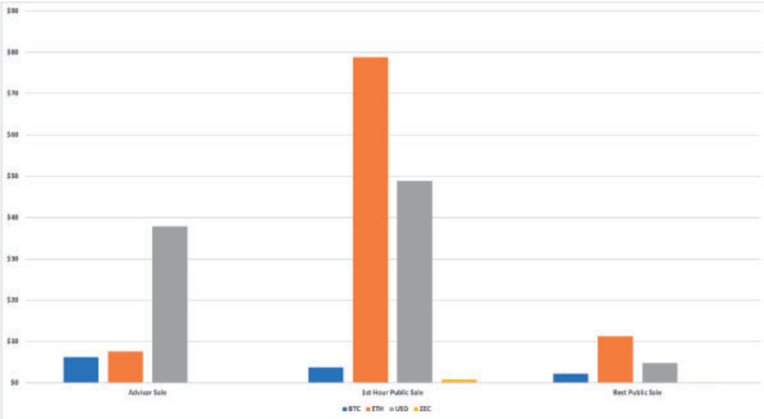

Figure A.1
Filecoin ICO investments by currency (millions of USD)
This figure shows the USD equivalent amount invested during the Filecoin ICO. We separately show the advisor sale, the 1st hour of public sale, and the rest of the public sale. The exchange rates for the 1st hour of the advisor sale are observed on August 10, 2017, at 4 pm EST (the end of the 1st hour of the public sale). For the advisor sale and the public sale, exchange rates are the closing price of the currency on August 1, 2017 and September 7, 2017, respectively.

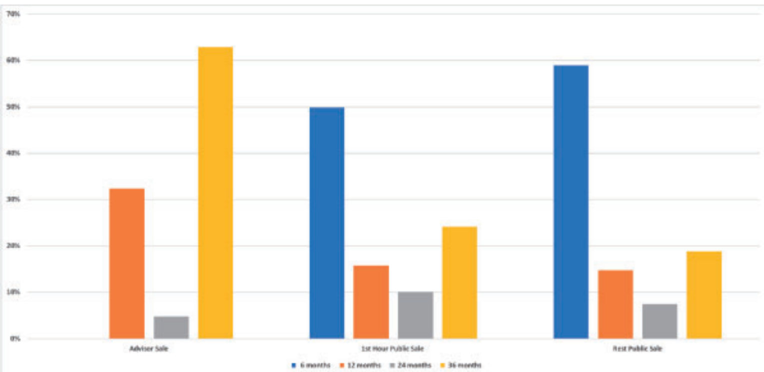

Figure A.2
Filecoin ICO investor vesting length (months)
This figure shows what percentage of transactions during the three different time periods of the ICO: advisor sale, first hour of public sale, and the rest of the public sale, chose the 6-, the 12-, the 24-, and the 36-month vesting horizon. Note that investors during the advisor sale didn't have the 6-month vesting option.

previously invested in Protocol Labs equity also invested during the presale. One core team member and one VC participated in the public sale. Core team members invested an average of $40,800 each, whereas 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 A.1, panel B. The vesting periods will begin after the network launches. All FIL tokens sold in the ICO are locked up for at least 6 months after network launch. Presale investors were not given

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the 6-month option; their tokens could be locked up for 12, 24, or 36 months, providing discounts of 7.5%, 15%, and 30%, respectively. Figure A.2 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 presale, and the preference for the shortest possible vesting periods in the public sale.

At the time of this writing, more than 2 years after the start of the Filecoin ICO, the FIL tokens have not yet been delivered to investors. Filecoin futures have traded on Gate.io and Lbank since December 13, 2017, and the futures prices provide an estimate of the value of the underlying FIL tokens. While the FIL futures traded as high as $27.66 each in the crypto bull market of late 2017, prices have retreated to a recent level around $6.00. Even with the sharp decline in prices, mirroring that of the overall crypto market since late 2017, the recent prices of Filecoin imply that its 200 million outstanding tokens have a fair market value of approximately $1.2 billion, substantially more than the $206 million that they sold for in 2017. Consistent with the results of this study, Filecoin's parent company Protocol Labs saw its headcount increase approximately fivefold, from about 20 employees at the time of its ICO in July-September 2017 to about 100 by November 2018, according to conversations with the company's general counsel.

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