To ICO or not to ICO – Empirical analysis of Initial Coin Offerings and Token Sales*

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Abstract

The current paper is the holistic study on ICOs and token sales and presenting key stages of the industry evolution from 2013 to date. We argue that blockchain technology has created a new viable vehicle for early stage capital raising. We trace the evolution of ICOs and token sales using a hand-constructed complete database from small contribution campaigns from a project's backers and the community in 2013, to the multibillion-dollar industry as it is at the beginning of 2018. We show that successful ICOs tend to be more self-compliant with the forthcoming potential regulation and spend more effort on signalling their quality and reducing the asymmetric information problem. We also look into various proxies for ICOs' success and show these are only weakly correlated with projects' tokens long-run performance that is instead mostly influenced by the Ether cryptocurrency performance.

Keywords: Crowdfunding, ICOs, token sales, cryptocurrencies, token offering, fintech.
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Introduction

With the global recession that followed the 2007-08 crash, due to the subprime lending crisis, the issues with systemic risk became (and continue to be) a key matter of scientific query for finance professionals. One of the outcomes of the financial crisis is creation of a new cryptocurrency called bitcoin, that provides a trusted peer-to-peer payments network to move value around that doesn't rely on the current financial system but is maintained by the users of the network or the 'nodes'. Back in 2008, blockchain (the technology underlying bitcoin) seemed to be an IT-confined short-lived phenomenon. Ten years later, it has radically changed the financial industry landscape and its outlook. The most significant and disruptive breakthrough so far has been the way start-ups and SMEs attract financial resources with Initial Coin Offerings (ICOs) or token sales. The amount of capital raised by ICOs and token sales bypassed the traditional Venture Capital (VC) in 2017 (Catalini et al. 2018) becoming a direct threat to the VC and angel investor model.

For entrepreneurial ventures (EVs) and small and medium enterprises (SMEs), it is rarely the case that internal funds are sufficient to finance their investment projects and scalability requirements. Since business profits are highly procyclical, this is especially true during economic downturns. Indeed, up until recently, these finance-hungry entities had only two possibilities – to borrow from local banks or to sell part of their companies to outside investors. Looking at the various funding mechanisms preceding blockchain financing, be it IPOs, bonds, VC or bank loans, we observe that they are localized to a particular geographical area, be it national or some union boundaries, defined by common legislation, cultural and linguistic similarities or common past[1].

With the state of the art in blockchain, not only has it has revolutionized and truly internationalized the funding process for SMEs, but, for the first time, it also allowed for considerable disintermediation of the post-issue market trading of new distributed financial instruments called tokens[2]. ICOs have abruptly shaken the whole system of borrowing and investing, by allowing anybody anywhere in the world to invest in a startup formed by the team members residing in several countries, with an office rented, say, in Singapore, with legal entity being registered in Switzerland, and ICO process run under the Virgin Islands jurisdiction.

[1] See, for example French and Poterba (1991) for equity home-bias puzzle.
[2] Tokens or coins are a medium of exchange granting rights to use future services of realized project and as such represent claims whose value is connected to the ultimate success of the issuing start-up.

Using social media, blogs, web-based communications and other internet channels, companies have suddenly realized the possibility to attract financing from abroad, free from the limitations of the local financial system, without the need to sell a larger part of its business to a venture capitalist. Nor do they need to spend substantial resources on marketing and promotion of the capital issuance and on extortionate fees to intermediaries without whom the process would be doomed as compared to the aggregate cost associated with raising funds via an IPO. Not anymore. Internet, blockchain and distributed ledgers have removed the need for financial intermediaries, leading to a genuine revolution in the way SMEs obtain early stage financing.

We use the data from a proprietary hand-constructed database on all traced token sales that took place from 2013 to September 2017[3] to study various new mechanisms and features that characterize and differentiate blockchain financing from other funding methods. We provide detailed statistics on many aspects of blockchain financing and study its evolution from the early stages when the annual number of ICOs were below a dozen (2013-2015) up to the recent times when the total funds attracted internationally reached tens of US$ billion.

We contribute to the scant existing literature on ICOs in the following way. First, we provide a comparative study of token sales vs. crowdfunding and conventional financing methods such as IPOs and VC. Next, we provide a detailed overview of the complete ICO activity since the inception, free from selection bias and with much richer set of variables compared to the existing studies on ICOs. Our multi-dimensional dataset allows us to analyze a host of measures of ICO success and we find that various proxies for ICOs' success are only weakly correlated with projects' tokens performance in the next six months. We provide statistical evidence that successful ICOs tend to be more self-compliant with the forthcoming regulation and spend more effort on signalling their quality and reducing the asymmetric information problem. We also illustrate the fallacy of focusing on one single measure of ICO success, often being the focus of the empirical studies. We show that various measures of success are only weakly correlated between each other and, worryingly, are not correlated with the post-ICO long-run token performance, which depends more on the Ether cryptocurrency return, on which blockchain the majority of the tokens are being issued nowadays.

[3] We use a detailed dataset up to September 2017, as well as limited-data dataset extended to 31 March 2018, although with very few variables of interest collected.

The first section looks at the history of the innovative financing methods for SMEs following the 2007-08 global financial crisis, introduces the concept of blockchain-based capital raising methods, and compare various aspects of ICO financing against conventional methods and crowdfunding. Here we also discuss the existing ICO literature. Section two provides an overview of the evolution of token sales. Data mining methods and summary statistics are given in the third section. The penultimate section looks at the host of existing success measures of ICOs and their correlation. The last section concludes.

1. Novel financing methods for start-ups and SMEs

During the recent financial crisis, the international financial system (banks and other lending institutions who take deposits from lenders and make loans to borrowers) was badly damaged from taking excessive risks originating in subprime mortgages. This has led to frictions that have prevented banks from supplying a sufficient volume of loans to the market participants, thus aggravating the crisis and leading to a much higher fall in output. Conveniently termed as credit crunch, the reduction of the supply of loans coming not from reduced demand but from inability or unwillingness of financial institutions to issue loans to enterprises, especially to SMEs, is currently of the highest importance to policy makers, economic agents and the public alike. Moreover, higher compliance costs have resulted in lower funds available for SME and start-up financing in the form of bank loans.

As an alternative to bank loans, venture capital represents the main, and sometimes the only source of financial capital for high-growth start-ups and SMEs. It is a form of equity financing where the outside investor provides external financing, expertise, guidance and support in exchange for a stake ownership. Given more widespread use of equity funding by young high-growth-potential companies from 1980s, VC has grown into established and truly international source of financing, with venture funds raised capital in 2016 totaling $41.6 billion in US and $77 billion worldwide (National Venture Capital Association 2017). Still, VC funds are estimated to finance less than 0.25% of all new ventures (Kaplan and Lerner 2017).

Although VC-backed firms have traditionally been quite active in the Initial public offerings (IPOs) market, this option of capital raising was either available to rather large or successful firms or used as an exit option at the last stages of VC-financing. Many European stock exchanges have been experimenting with creating special segments, or second-tier markets

dedicated to firms that were unable or unwilling to fulfil the requirements to be admitted to the main markets. As noticed by Vismara et al. (2012) there were eleven second-tier markets launched in Germany, France, Italy and the UK with only five existing by 2012. Most of the time these markets were designed to meet the needs of younger and smaller companies that would tap into the public market during IPOs and follow-up issues for needed finance. Still, this way to obtain financing is costly and virtually closed for smaller SMEs and start-ups.

The last five years have witnessed the proliferation of the actors that to some extent took the role of a financial intermediary between borrowers and financial markets. From the crowdfunding and peer-to-peer (P2P) platforms that connect lenders with borrowers through online platforms to the initial coin offerings that completely bypass financial intermediaries, these new advances have led to the creation and explosive growth of what is called an Alternative Finance (AF) sector. Measured in size to be over €5b in Europe in 2016 and $35b in the US, it represents a viable alternative to traditional sources of financing.

With the advent of the internet, the geographical boundaries between financing counterparties have been removed, and many financial institutions established purely online subsidiaries for private and corporate customers. Burned in the recent financial crisis, mired in the red tape of supervisory regulation, apprehensive of excessive risk-taking, and overloaded with high running costs, they were no longer ready to provide finance to riskier borrowers. As a result, in the last decade this role was, to some extent, overtaken by private actors who organized online platforms matching borrowers and lenders and administering provision of credit at a lower cost. Be it private lenders or small businesses, this activity has become, by far, the biggest AF sector by volume in Europe, following the new EU regulation on e-money institutions (EU Directive 2009/110/EC).

The P2P online lending platforms have implicitly taken the functions of the financial lending institutions, from matching assets to liabilities to performing credit checks and monitoring of the borrowers. A much more radical step forward was introduced with the development of so-called crowdfunding – an online platform that allows entrepreneurs and firms to attract funds from individual investors by publishing and advertising their projects. Having started from the donation-based and reward-based crowdfunding (Hemer 2011), it turned out to be an alternative venue to attract the needed seed capital for entrepreneurs or small firms that have limited access to more traditional financing sources described above (Ordanini et al. 2011). As a result, at an

earlier development stage, the role of the financial intermediary was overtaken by the online platform, reducing transaction and search costs and vastly expanding the investor base at the expense of lower monitoring effort and greater need for stronger signalling to overcome the potential underinvestment due to the asymmetric information (Rossi and Vismara 2018).

Several unrelated factors contributed to the explosive growth of investment-based crowdfunding that is rapidly becoming a viable alternative to more traditional ways of external equity financing [4]. As outlined by Block et al. (2018), both supply-side factors such as rapid growth of the Fintech sector, internet and social media usage along with the persisting impact of the 2007-08 financial crisis, manifested in reduced bank lending and a low interest rate environment, increased government attention to entrepreneurial financing as well as demand-factors (higher importance of market externalities and knowledge economy, disruptive effects on incumbents from start-ups) played an important role in ongoing development of crowdfunding and AF in general. In other words, a technology-enabled market for new financial services is rapidly emerging around the world.

The development of a new asset class of digital assets (bitcoin, altcoins, cryptocurrencies, crypto assets, tokens, etc.) and associated blockchains in 2009-2013 allowed for their secure exchange or trading over the Internet. With the ability to record virtually everything of value, the "Blockchain Revolution" is challenging and disrupting current *centralized* business models and the financial services sector – a fact that is already being acknowledged by global financial players who are tacitly or openly studying blockchain adoption[5].

[Insert Table 1 about here]

Table 1 briefly outlines the main features of blockchain financing versus other methods. The most remarkable of all are the ease of investing and no dilution of ownership of the founders along with high liquidity of the bought coins/tokens in secondary markets. It is important to note however, that these come at the cost of extreme information asymmetry, absence of quality certification and regulation. All these result in a lack of investor protection. The true international nature of the industry, absence of any prior regulation or standards and the decentralized nature of the blockchain backend have led to a rich set of techniques developed

[4] See Bottiglia and Pichler (2016) for a review of the European experience.
[5] Taking for example Enterprise Ethereum Alliance that includes not only the Fintech start-ups but also giants like J.P. Morgan, Mastercard and other global financial players.

and tried by various startups in order to reduce information asymmetries, raise sufficient funds for development and keep investors content in the process. In the next section, we closely examine various stages and methods of blockchain-based funding originating in 2013 and continuing to grow and evolve up to the present.

Several papers study various crowdfunding campaign characteristics (Ahlers et al. 2015; Vismara, 2016a; Vismara 2016b and others), signals from the entrepreneurs, and various means of reducing the asymmetric information problem as the key factors to the campaign's success. Similar analysis may be applied to blockchain crowdfunding. Several studies up to date looked at the issue. Adhami et al. (2018) collected very basic data on the sample of ICOs run mostly in 2017 up to end of August. Fisch (2018), Amsden & Schweizer (2018), and Blaseg (2018) have used more recent samples and attempted to identify the success factors behind ICOs looking at the funds raised and tokens' listing status. Howell, Niessner and Yermack (2018) and Momtaz (2018) instead looked at the post-ICO performance as measures of success, such as trading volume or liquidity and first-day underpricing.

2. The evolution of ICOs

With a considerable degree of subjectivity, ICO activity may be split into several stages that we list in Table 2 and provide selected summary statistics in Table 3.

[Insert Table 2 about here]

Below we briefly outline the key distinct features of each stage.

[Insert Table 3 about here]

2.1. Prototype phase

The first documented and confirmed attempt to use blockchain for funding a start-up venture is traced back to 2013 when J.R. Willet, a bitcoin enthusiast during the San Jose Bitcoin conference suggested to the audience the idea of joint financing for building a new and more versatile protocol layer on top of bitcoin. In exchange for bitcoins, the contributors would receive new coins which represented de facto an ownership stake of the new technology. With a simple bitcointalk.org forum thread announcement, no advertisement, legal or financial intermediation, or social media campaigns, the developer managed to attract 4740 bitcoins from

551 anonymous contributors from crypto community, to whom he later distributed the new Mastercoins. The funds were used to develop the original idea into a viable software and issued tokens could be instantly traded first on the dedicated exchange organized by the developers (buymastercoin.com) and later on other exchanges, providing liquidity, exit strategy or speculation chances to investors. Such lightning speed, anonymity, low transaction costs and after-issue liquidity were not reachable in conventional crowdfunding and therefore, the Mastercoin ICO paved the way for many more to come. Blockchain-funding activity slowly gathered pace, with relatively few ICOs taking place in 2013 (with 2 ICOs that raised US$630k), 2014 (with 11 ICOs that raised US$33m), and 2015 (with 14 ICOs that raised US$11m), collecting from investors variable amounts of funds from few hundreds to fifteen million US dollars equivalents. Initial fund-raising campaigns disclosed only the virtual identities of the founders (although well-known by the community long before) but the subsequent ICOs emphasized the teams' compositions to lend credibility to the funded projects. The majority of the ICOs in that period focused on the infrastructure and platform projects aimed to upgrade and expand the bitcoin ecosystem, but already in 2014, the US singer Tatiana, inspired by the first conventional crowdfunding campaign run by British rock band Marillion in 1997, attempted to finance the production of her new album by fundraising bitcoin in exchange for newly issued Tatiana coins[6].

At that time, virtually all fundraising campaigns called themselves all but ICOs (donations, crowdfunding, crowd sale, presale or even software sales) and half of them were conducted without providing a detailed description of the project, state of the art and future plans of the developers given the collected funds (a document that was subsequently called a "whitepaper"). Those projects relied on already established communities composed of blockchain zealots and first investors who sensed an opportunity to invest money, receive tokens and become a part of the rapidly growing ecosystems within the blockchain industry. Given the anonymity of the investors and the absence of regulation regarding cryptocurrencies trade and usage, little did they care about anti-money-laundering (AML) and know-your-customer (KYC) compliance rules and as a result, those first ICOs were not accompanied by legal support, nor have they thought about compliance with securities regulation in developers' or investors' jurisdictions. With one notable exception – the Ethereum donation campaign that run for forty days in the summer of 2014, with a well-thought strategy and development plan that was later for the first

[6] Following the failure of the campaign to collect the required minimum of US$25,000 (only 40% pledged), these coins did not end up on any active exchange. What is interesting, the funds were not returned to investors as was planned in case of under-investment – a quite frequent practice in the forthcoming ICOs.

time called the "Roadmap". This ICO had the funds collected by the foundation set-up in Switzerland, mandatory but rather formal registration of the investors, and unique contribution addresses for each investors for greater security. A special escrow account under control of the third parties was used for better transparency throughout the process and hence, the reduction of moral hazard ex post. Moreover, carefully drafted by lawyers, the legal "Terms of Sale" document had to be accepted in order to receive new Ethereum coins.

It was the Ethereum project that aimed at and succeeded in developing a toolkit that allowed for implementation of the world's first programmable blockchain, the concept of automated protocols that execute predetermined actions when certain preconditions are met or better known as 'smart contracts', resulting in an openly available software to create proprietary tokens on the Ethereum blockchain requiring little effort.[7] The possibility to execute token sales on the Ethereum blockchain, ushered in a new stage of blockchain financing. Apart from Ethereum, several other projects from that time (Antshares/NEO, NXT, Bitshares) used blockchain financing to push forward their implementation.

2.2. Initial start-up phase

It took a full year for the first fundraising campaign to be run on the Ethereum blockchain (Augur in September 2015, raising over US$5m both in Bitcoin and Ether) and by June 2016, only 3 ICOs followed suit. The majority of ICOs continued to accept funding in Bitcoin only with one quarter allowing investment with other altcoins. Unlike the first-stage ICOs, the majority of these required some formal registration of the users prior to be allowed to invest and many (46% of all cases) have taken legal advice and drafted the purchase agreements outlining the risks and stressing the new nature of the tokens distinctly different from conventional securities. All fundraising campaigns have not warned or excluded US investors from participating and one third of all ICOs originated in the USA, which either chose the Anglo-Saxon jurisdiction to run token sales or did not formally comply with existing US regulations. It was, in fact, a US-based gaming start-up called "Breakout" that called the funding campaign "an ICO event" for the first time[8] in November 2014, but the rest (except 4 cases in total) of the subsequent fundraising campaigns were run as crowdfunding, crowdsales or software sales, with one calling the fundraiser an IPO.

[7] It might take less than 20 minutes to issue one's own tokens on the Ethereum blockchain (https://medium.com/bitfwd/how-to-issue-your-own-token-on-ethereum-in-less-than-20-minutes-ac1f8f022793).
[8] Interestingly, this ICO raised only half of the declared minimum needed to proceed with the project but never returned money to investors and continued the development nevertheless.

In this phase, 4 out of 27 start-ups had used some sort of VC seed funding before the ICO and 10 ICOs pioneered the presale arrangements selling the tokens to early backers, individual private investors or business angels at large discounts. One quarter of all ICOs in this period successfully ran funding campaigns raising millions of dollars equivalents without publishing a whitepaper (that later went on to become the de facto issuing prospectus, much like conventional IPOs). The majority of ICOs offered deep discounts (up to 50%) to early buyers to create an impression of high investor interest and maximize the campaign's chances of success. Various distribution model types where tried to allocate the tokens to investors – even Dutch auction in one case – but the majority of these envisage either a token or monetary cap on the accepted funds. The tokens were offered either at fixed price (or at fixed price plus early investment or referral bonus) or running proportional sales with the price to be determined at the end of the campaign, given the total contributed amount.

Four start-ups chose the uncapped model where the firms were ready to accept unlimited funding from investors (issuing an uncapped number of tokens to investors) limited only by the demand. One of them was "The DAO", an uncapped ICO that eventually met a tragic end. It marked the biggest crowdfunding project up to that time with investors contributing over US$150m in Ether. Due to a bug in the smart contract, hackers managed to steal approximately one third of the funds shortly after the fundraising campaign. Nevertheless, the hack did not stop ICO activity worldwide.

2.3. Late start-up phase

The subsequent year was characterized by rapid internationalization of the phenomenon – 112 ICOs from 23 countries raised close to US$300m. The increased regulatory attention and legal uncertainties surrounding blockchain financing called for more thought on the right procedures and possible consequences after funding for companies. More than one third of these ICOs have explicitly chosen the governing jurisdiction for token sales, with twenty percent choosing Swiss law, another twenty percent choosing an Anglo-Saxon jurisdiction and the rest predominantly the countries of their teams' origin[9]. Moreover, starting from August 2016, some ICOs either warned or discouraged US residents from investing (e.g. Lykke, under Swiss jurisdiction), while others allowed only accredited US investors to participate (QTUM and Blockchain capital, both US), excluded particular US states (Cosmos) or prohibited participation of all US

[9] As disclosed in the token sales purchased agreements that usually accompany ICO campaigns.

residents altogether (Elastic, Flashcoin, Dfinity, Melonport, Edgeless, Aeternity, TaaS, E4Row)[10].

In this phase, half of the ICOs chose to accept only bitcoin, eighteen percent opted for bitcoin or ether contributions and more than one fifth, accepted only ether. Companies have started to target potential investors through PR articles and press-releases, participating in hackathons or other blockchain events, social media campaigns along with online channels and have started to allocate tokens to active private promoters through so-called "bounty campaigns". Although around ten percent of all fundraisers eventually turned out to be frauds (authors' own estimates from the constructed database), the term "ICO" did not have a negative connotation during this phase and the majority of these startups ran their campaigns as an ICO or a token sale.

2.4. Early growth phase

Spectacular appreciation in the price of bitcoin and other cryptocurrencies during 2017 brought increased media attention and rising investment interest from outside of the "crypto community". Having sensed an opportunity to raise funds quickly and cheaply, many startups (deploying blockchain or not) rushed in to announce and run their token sales. Almost US$2.5b were raised by 169 ICOs during this period. A median ICO size grew around seven-fold to an average of above US$4m, with several ICOs raising more than US$100m. Fifteen percent of these reached their funding hard caps but one third of all ICOs raised less than their requested minimum and refunded investors, re-ran the campaigns or continued development at a slower pace.

In this period the ICO phenomenon started to take the form as we know it today. First, small advertisement and bounty campaigns through social media to attract the attention of the crowd running small-scale fundraising campaigns called pre-sales targeted to big investors (whales) or business angels or venture capitalists who obtained the tokens at huge discounts. These to be followed by more intensive advertisement using collected funds from the pre-sale and then the main public sale, offering deep discount for early participants. It has become a standard to provide investors with a startup's pitch, presented in the whitepaper, establish active communication channels with the community through dedicated Slack, Discord, Telegram or

[10] We hypothesize that at that time it was becoming increasingly clear that under US regulations securities laws, such a token sale or ICO would be considered a securities offering, which requires explicit registeration with the SEC.

other blockchain forums, and to release detailed information about the fundraising and business development through blogs or specialized blockchain news websites. The sold tokens were often distributed automatically by smart contracts, during the crowd sale or immediately after , with the issuers arranging for listing of the tokens on various online crypto-exchanges. In fact, in all the first 4 phases of ICO's evolution, three quarters of issued tokens were eventually freely traded on crypto exchanges[11].

Faced by the regulators' scrutiny worldwide, the SEC decision to treat The DAO's token as securities with all the consequences [12], Chinese ban on all national ICO activity and several cases of large security breaches during the funding processes, many ICOs allocated considerable funds to legal compliance, choosing Switzerland or Singapore as governing jurisdictions for token sales. Sixty percent have prohibited US residents from participating[13]. In August of 2017, the US-based startup for blockchain-based data storage network called Filecoin not only managed to raise US$284m from institutional and private investors, but also tried to be compliant with any future forthcoming regulation on ICOs. The campaign featured running KYC checks on all investors, allowing only accredited investors from selected jurisdictions to participate (USA and UK), warning investors from other jurisdictions (China and Canada), and selling a new product, called a "Simple Agreement for Future Tokens" (SAFT)[14], restricted from sale and to be converted into tokens only after the network's launch.

2.5. Late growth phase

What followed after the Filecoin ICO was a flood of new token sales all over the world, with blockchain and even non-fintech-related startups[15] trying to raise capital before the activity was restricted or regulated, with the assumption that the regulation would not apply retroactively to past fundraising campaigns. Over 1,200 ICOs were conducted by the end of March 2018, collectively raising close to US$4b[16] but according to anecdotal evidence with half of them failing to raise the required announced minimum to proceed[17]. The ICO activity shows no sign of slowing, already surpassing the aggregate VC funding in the fintech industry, and whether

[11] Data is taken from coinmarketcap.com.
[12] https://www.sec.gov/news/press-release/2017-131
[13] Data comes from our database of ICOs.
[14] Modelled from the similar instruments for equity investment, SAFE, pioneered in the late 2013 (http://www.ycombinator.com/documents/).
[15] Here we refer to the start-ups that plan to use tokens only as a means of obtaining financing for projects that have nothing to do with blockchain or fintech in general (Sandcoin, Sosnovkino, Rasputin Online to name a few).
[16] As reported by Icobench database.
[17] https://news.bitcoin.com/46-last-years-icos-failed-already/

this turns out to be the maturity or the decline phase depends entirely on the regulatory decisions that will follow in the near future.

3. Data and summary statistics

The first task is to give an objective definition to the ICO funding process. Since we treat the phenomenon as startups' funding mechanism, an operational definition is adopted that treats an ICO as a crowdfunded fundraising campaign that sells the new proprietary tokens to investors in exchange for existing cryptocurrencies and fiat money as an option[18]. Given the absence of a coherent and reliable database, the task of constructing a complete list of true ICOs is not easy. We proceed in the following way. The lists from seven of the largest ICO tracking websites were taken and merged, eliminating the double entries with ICO end dates until October 1, 2017[19]. The mediocre quality of sourced data is obvious with some websites even showing incorrect listing dates. The initial list was manually checked and missing data filled in using various sources such as:

- Textual search for words "ICO", "crowdfunding", "token sales" in Bitcointalk forums.
- Websites of the ICO companies - looking for statistics and terms of ICOs. Quite often, these were not operational anymore, so we looked through their archived versions.
- Companies' blogs – private ones or hosted on major blogging servers such as Medium.com, Steemit or Dusil.
- Blockchain forums - Bitcointalk, Bitcoingarden, Reddit, Thewiring and Forebits.
- Social media communication channels - Twitter, Facebook, Linkedin, Tumblr.
- Github - as a source of information for open projects that placed their depositories there.
- Chat channels as places where developers provided information to the interested parties in a relatively safe and confidential manner– Telegram, Slack, Discord.
- Press releases, news and wire articles.

This paper marks the first such holistic analysis of ICOs using such a rich dataset. While some of the current studies (Catalini et al. 2018; Fisch 2018; Amsden and Schweizer 2018, Momtaz 2018) look at some specific aspects of ICOs, this is the first such exhaustive study tracing the trends and evolution of ICOs. The original sample up to October 1, 2017 was merged with the later deals up to March 3, 2018 taken from the ICObench database through API calls, the latter

[18] We exclude the cases were only fiat money are accepted as most of these are usually variations of elaborate frauds or Ponzi schemes not leading to creation of the new cryptocurrency that is traded afterwards.
[19] Smith & Crown, Tokenmarket, Icobazaar, Coinschedule, Hubcoin, Icodata, and Icoprojectrank.

database though being much poorer in available details. We also investigated all references to potential ICOs found during the data-cleaning phase in the sources listed above. As a result, the constructed database is a unique source of ICO activity from 2013 that is the most comprehensive and rich in detail as at the moment of writing.

To study the measures taken by the founders to signal their better quality and to reduce asymmetric information we propose to classify all ICOs in the following way. First, we exclude all pure fraud campaigns identified by the users before or during the fundraising campaign, postponed or cancelled ICOs, and ICOs that were run as jokes or by dilettante developers without raising any amount of money (we have counted 47 cases up to September 2017). Second, we identified as *Top ICOs* those that have had their funding limits (called hard caps) reached before the end of the campaign. For the ICOs run with no hard cap (unlimited upper limit) - 19 in total in the sample - we have marked as Top ICOs those that have raised funds above the third quartile of all capped ICOs (6 ICOs in total) giving us the final count of 86 campaigns in this category. Third, we identified as *Failed ICOs* those that raised less than the self-imposed minimum caps aka "soft caps" (42 in total). Of these, 19 refunded the funds to the investors straight away, 4 offered optional refunds, 8 ended up cutting all communication channels and disappeared without refunding users, and the rest continued with limited funding. All other ICOs were grouped together as *Average ICOs* category, 189 campaigns in total. Table 4 shows summary statistics for all ICOs altogether and for these three groups of the token sales separately.

[Insert Table 4 about here]

Table 4 clearly illustrates the main features of successful token sales. The preliminary univariate analysis shows that these are the ones that managed to attract higher investor interest *through* massive marketing campaigns in all media, signalling their quality with prior VC-participation, selling a bigger proportion of tokens to the public and allocating a smaller percentage to the developers, vesting those for longer time-periods. Moreover, self-compliance seems to lead to higher chances of success, as well as offering less time- or contribution-size bonuses to ensure fairer treatment to investors. Last, but not the least, is listing in the ICO aggregation websites for greater publicity and quality certification.

5. What determines ICO success

The majority of the empirical studies on ICOs tried to identify the factors behind the fundraising campaign success. Interestingly, one can put forward a range of proxies that might measure ICO success. The literature so far has focused on such measures as total funds raised or a certain threshold reached, issued tokens listed on popular crypto-exchange, or first-day underpricing and tokens' liquidity. Given the rich dataset, we test if these measures are correlated as should be the case if they all correctly identify the successful ICOs. We also look at the correlation of the media coverage on listing websites and their individual ratings assigned to various ICOs as the predictors of the subsequent ICO campaign success (more detailed study of the phenomenon is undertaken by Boreiko and Vidusso 2018).

[Insert Table 5 about here]

Surprisingly, the data proves otherwise. Although we do observe some consistent significant correlation coefficient of some proxies among each other, none of them are correlated with tokens' long-run performance as measured by the return in five months following the first month of trading. Instead, the only factor related to the post-ICO performance seem to be the contemporaneous return on Ether cryptocurrency. This probably stems from the fact that majority of the tokens in the sample (forty-eight per cent) are issued on Ethereum blockchain.

Conclusion

The 2007-08 recession or "credit crunch" led to reduced availability of credit to companies, particularly to start-ups. At the same time, it drew the attention of governments and regulators to the needs of businesses, spurred competition and innovation process and brought to the fore the deficiencies of the traditional financial model as inept to the needs of the "connected global economy". Governmental and regulatory actions aimed at easing the credit-provision process in general or making it more attractive to borrow or sell equity in the public markets for SMEs seemed not to address the needs of start-ups and small businesses, with VCs often being too risk-averse or unwilling to finance new, innovative ventures. The phenomena of crowdfunding and P2P lending, where individuals become angel investors and co-finance new ventures and projects, from purely social-impact and/or reward-oriented activities now represents a large share of business financing across the developed world (Cambridge Centre for Alternative Finance 2017). Regulating bodies reacted ex-post with favorable laws and rules, with the AF sector already large and rapidly growing even further.

Similarly, blockchain financing with ICOs and token sales is now a well-established practice worldwide with start-ups raising a collective of above US$1b monthly in 2018. In this paper, we have analyzed the initial phases of the industry's development from 2013 to September 2017, collecting detailed information on all campaigns or ICO attempts in this period, providing a thorough quantitative analysis of the phenomenon and laying the foundation for future research in this area. Among the directions to be taken are the studies of: a) ICO funds collection and long-run token performance, b) effects of various signals and means to reduce asymmetric information in a multivariate context, c) role of auction mechanisms and bonus schemes, and d) investor behavior during ICO campaigns. On top of that, similar to equity crowdfunding, studies on the role of the platforms, the importance of rating websites and online exchanges, merits special attention. Self-compliance and effects of legal tools chosen to ensure smooth token sales also represent very interesting topics to look at. Last but not least, are the analysis of token sales, investment dynamics and alternative methods of raising capital versus more traditional means such as VC and private equity.

The Fintech revolution and blockchain technology seem to have the potential to completely disrupt traditional financial and banking industries in a rapid, unpredictable manner; therefore, viewed by many national regulators with suspicion and apprehension, especially with the underlying anonymity and disintermediation principles. Some countries have prohibited national ICO activity (China), some are in the process of implementing or have already implemented favorable regulation (Switzerland, Singapore, Russia), others are looking at the matter and preparing to take action (USA, EU countries). Whether they will take a prohibitive stance or a favorable one remains to be seen. However, much like the evolution of the crowdfunding[20] and the alternative finance space, it may already be that the cat is out of the bag i.e. it may already be too late to prohibit the activity, given the sheer pace and reach of technology enabled innovations in the current day and the demand for alternatives within the wider economy. After all, economies constantly reinvent themselves.

[20] Interesting, the Italian authorities did try to shut down the crowdfunding activity in the country, only to later become the first country in the world to adopt a national crowdfunding regulation in 2012.

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Table 1. Blockchain funding vs. earlier alternatives

Characteristics	IPOs	Venture capital	Reward- and equity-crowdfunding	ICOs / ITOs
Marketing channels	underwriters	private negotiations	online platforms	social media
Investor base	exclusive, local	Partners	exclusive, local	inclusive, global
Intermediation	syndicates	VCs	online platforms	no
Asymmetric information	average	Low	above average	highest
Funding currency	fiat	Fiat	fiat	crypto/fiat
Investor Protection	courts	Automatic	courts	no
Regulation	"standardized"	"standardized"	country-specific	no
Acquisition of	ownership stake	ownership stake	product/ownership	future service
Monitoring ex-post	governance mechanisms	VCs	absent	absent
Lock-ups	owners	No	unclear	developers
Market-making	lead underwriter	N/A	No	decentralized
Liquidity	low	N/A	No	high

The table lists the main characteristics of ICO fundraising mechanism as compared to VC, Crowdfunding and IPO alternatives.

Table 2. Stages of ICO evolution in 2013-2018

Stage	Period	N of ICOs	Leading ICO	Prominent ICOs	Stage Features
1. Prototypes	Aug 2013 – Aug 2014	10	Ethereum	Maidsafe NEM	Marketing through bitcointalk.org forum mostly. Crypto-enthusiasts and projects' community as investors. No legal entity or compliance thought except for Ethereum ICO.
2. Early start-up	Sep 2014 – May 2016	27	The DAO	Augur Antshares Lisk	More frequent usage of social media and novel marketing campaigns. Experiments with various token sales types and starting adoption of smart contracts. The term "ICO" is used for the first time. Few VC-backed start-ups conducting crowd sales.
3. Late start-up	Jun 2016 – May 2017	128	MobileGo	Aragon Iconomi Gnosis	Fast growth of ICOs number, total and average funds raised. Higher investment in marketing campaigns. Tokens issued mostly on Ethereum blockchain with funds accepted in Bitcoin or Ether. Selection of benevolent jurisdiction and attempts for self-compliance using legal advice.
4. Early growth	Jun 2017 – Sep 2017	212	Filecoin	Tezos EOS Coindash	Exclusion or limitations for investors from selected jurisdictions. Large investors (whales) participation. Many tokens sales raise unseen before funds in very short time. Pioneering of SAFT sales.
5. Late growth *	Sep 2017 – Mar 2018	1,209	Na	PolkaDot HDAC Sirin Labs	Legal uncertainty about sold token's nature. Increased regulators' attention and comments. Increased participation of private and venture capital in private sales before / instead of public small pre-sale followed by several rounds of main token sales. Stable number of new ICOs per month from January 2018.

* Estimates are taken from icobench.com database and not confirmed.

Table 3. Stages of ICO evolution in 2013-2018

Stage	Period	N.	Scams	Mean funds raised, US$k	Median funds raised, US$k	Total raised, US$m	Net funds raised, US$m	% of HC reached	% of MC not reached	% of tokens offered	% of tokens sold
1	08/13 – 08/14	10	0	3,023	704	30.4	28.7	10	30	80	81
2	09/14 – 05/16	24	3	6,622	557	178.8	28.7	4	17	55	55
3	06/16 – 05/17	114	14	2,240	623	286.7	283.6	13	18	66	50
4	06/17 – 09/17	167	18	11,330	4,396	2,401.8	2,335.9	15	34	56	45
5*	09/17 – 03/18	1,209	Na	16,341	7,400	3,938.1	Na	Na	Na	Na	Na

The table shows the selected data for 1524 ICOs run from 2013 to 31 March 2018. Legitimate ICOs are all completed ICOs that were not identified as scams during the fundraising campaign. ICOs size was calculated by converting all contributed cryptocurrencies into US dollars using the exchange rates as at the last date of the campaign. Total Funds raised are all funds contributed by the investors. Net funds raised refer to the funds that were collected by the start-ups, net of refunds, thefts or losses due to security breaches. % of overfunded ICOs/% of underfunded ICOs are the percentages of ICOs that raised the amounts equal /smaller the predefined limits (hard cap and min cap correspondingly). % of token offered is the percentage of tokens planned to be distributed to the investors. % of token sold is the actual percentage of the distributed tokens.
* Estimates are taken from icobench.com database. Only 241 ICOs there have fundraising data available.

Table 4. Summary ICOs statistics

	Total sample (N=316)	MC not reached (N=43)	Funded (N=184)	HC reached (N=89)	Diff. in means (HC-MC)*
Panel A. General fundraising statistics					
Total funds raised, $US m	2,922.0	7.4	607.5	2,307.0	na
Net funds raised, $US m	2,682.7	5.1	592.4	2,085.0	na
Average net funds raised, $US k	8,489.6	118.7	3,220	23,429	***
Average N. of Investors	3,582	519	3,223	4,677	***
Average investment, $US	4,922	877	2,025	10,812	***
% with fiat contributions	12.7	4.7	12.5	16.9	**
% of total tokens sold	48.8	17.5	52.3	54.8	***
ICO campaign planned, days	34	33	37	28	-
ICO campaign actual, days	29	31	38	9	***
Panel B. ICO mechanics					
% with proportional distribution	21.5	27.9	25.5	10.1	***
% of uncapped	6.3	0.0	7.6	6.7	*
% with bonus offered	69.6	69.0	75.5	57.5	-
% with pre-sale stage	29.8	9.3	25.0	50.0	***
% with defined MC	43.0	88.4	34.2	39.4	***
% with defined HC	82.6	72.1	82.6	87.6	**
Panel C. Signalling mechanisms					
% with WP	84.5	76.7	82.1	93.3	**
% with prior VC-backing	14.9	0.0	9.7	33.0	***
% with Ethereum token	48.1	32.5	42.9	66.3	***
% of tokens for sale	59.9	55.5	63.9	53.8	-
N of twitter posts	771	571	926	547	-
N of twitter followers	14,835	2,956	12,330	25,820	***
Days in Twitter before ICO	302	288	255	403	-
Days in Bitcointalk before ICO	42	25	44	47	**
Listing coverage (0-6)	3.5	2.5	3.4	4.3	***
Icobazaar rating (0-5)	3.3	3.2	3.3	3.3	-
Icobench rating (0-5)	2.8	2.2	2.8	3.0	***
Icoholder rating (0-5)	3.0	2.6	2.9	3.3	***
Panel D. Self- compliance and security					
% with Purchase agreement	55.2	32.6	51.7	74.1	***
% with investors exclusion	26.5	21.4	21.2	40.2	**
% ICO-friendly jurisdiction	14.5	4.8	10.4	28.1	***
% with compulsory registration	63.0	50.0	60.1	75.3	***
% with Escrow arrangement	35.7	28.6	39.4	31.5	-
% with unique addresses	41.3	41.0	45.2	32.9	-
Panel E. Moral hazard reduction mechanisms					
% of tokens retained by founders	15.7	24.4	14.8	13.5	**
Average vesting period, months	4.5	0.5	3.4	8.5	***
% with multi-sig wallet	4.5	0.0	5.6	4.5	-

% exchanges-run ICOs	8.4	7.1	6.1	13.5	-
% collected more $US 100k	78.1	30.2	79.9	97.8	***
% tokens listed on exchanges	74.1	25.5	76.6	92.1	***
Average rank on Coinmarketcap	373	651	402	284	***
% tokens delisted	2.5	0.0	2.7	3.4	-
Mean token LR return, %	296.4	324.1	250.4	374.2	-
Median token LR return, %	51.3	305.8	35.5	60.1	-

The table shows the selected data for total sample of 315 ICOs and for subsamples of campaigns that were underfunded (minimum cap (MC) not reached), fully funded (hard cap (HC) reached) and the rest. The last column shows the significance of t-test statistics for difference in means between HC and MC subsamples. The data is aggregated into panels containing fundraising, mechanics, signalling, self-compliance, and moral-hazard reduction indicators. *Net funds raised* are *Total funds raised* less losses due to hacks and security breaches. *% with proportional distribution* are ICOs that sold their tokens without a fixed price per token. *% of uncapped* show a proportion of campaigns run without HC limit. *% with bonus offered* show ICOs that featured price discounts for earlier/larger investment. *% with WP* are ICOs that published a White Paper before the campaign's start. *Listing coverage* measures the number of listing websites (out of 6 selected) that covered a particular ICO. *% with Purchase agreement* are ICOs that prior to tokens' acquisition made available a document regarding the token sale conditions and risks. % with investors exclusion show ICOs that restricted USA residents participation. *% ICO-friendly jurisdiction* includes ICOs that have chosen Swiss or Singapore jurisdiction for running token sales. *% with Escrow arrangement* stands for campaigns with contribution address controlled by external parties. *% with unique addresses* are those ICOs that created individual unique addresses for investment instead of single contribution address. % with multi-sig wallet refer to ICOs with contribution address controlled by multiple parties. *% exchanges-run ICOs* are ICOs that sold part of the offering through affiliated online exchanges. *Average rank on Coinmarketcap* stands for the relative rank of the ICO token in the list of all cryptocurrencies as at 31/12/17. *Mean/median token LR return* measures the token associated return in 5-month period that starts 30 calendar days after listing day.
***/**/* - refer to the significance levels of 1% / 5% / 10%.

Table 5. Pairwise correlations of proxies for ICO success

Proxy/Proxy	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Token LR return	-	-0.17	0.03	0.01	-0.01	0.07	-0.02	0.06	-0.05	0.01	-0.02	0.06	0.05	**0.24**
2. Token Listed on Exchange		-	**0.18**	**0.46**	**0.44**	**0.26**	0.16	**0.25**	**0.30**	0.02	**0.23**	**0.32**	-	-
3. Token Coinmarketcap ranking			0.01	**-0.27**	**-0.19**	**-0.19**	-0.08	**-0.34**	**-0.16**	0.09	**-0.41**	**-0.30**	-0.04	0.05
4. Total funds raised				**0.17**	**0.12**	**0.37**	**0.48**	**0.27**	**0.20**	0.06	0.13	**0.25**	0.11	**-0.14**
5. Raised more $US 100k					**0.46**	**0.30**	**0.21**	**0.17**	**0.41**	-0.05	**0.31**	**0.34**	0.11	**-0.14**
6. Raised more than min cap						**0.25**	0.13	**0.15**	**0.22**	0.08	**0.20**	**0.22**	**-0.17**	-0.03
7. Reached hard cap							0.15	**0.22**	**0.28**	-0.04	**0.16**	**0.33**	**0.18**	**-0.19**
8. N. investors								**0.17**	**0.20**	0.10	0.01	**0.19**	0.04	-0.04
9. N. Twitter followers									**0.11**	0.01	**0.35**	**0.30**	-0.08	-0.07
10.Listing coverage										0.11	**0.46**	**0.51**	**0.29**	-0.08
11.Icobaazar rating											0.06	-0.04	0.00	**-0.17**
12.Icobench rating												**0.80**	-0.08	**-0.17**
13.Icoholder rating													0.04	-0.12
14.Bitcoin LR return														-0.04
15.Ether LR return														1.00

The table shows pairwise Pearson correlation coefficients of various proxies for ICO success. Values significant at 5% or lower are in bold. Token/Bitcoin/Ether LR returns stand for corresponding returns of the ICO tokens and two cryptocurrencies in the five month period after thirty days of each token's listing. The proxies are defined in Table 4.