Why do businesses go crypto? An empirical analysis of Initial Coin Offerings

Saman Adhami*, Giancarlo Giudici[,a], Stefano Martinazzi****

* Bocconi University, Milan-ITALY

saman.adhami@unibocconi.it

** Politecnico di Milano, School of Management, Milan-ITALY

giancarlo.giudici@polimi.it stefano.martinazzi@mail.polimi.it

[a] Corresponding author:

Politecnico di Milano – School of Management

Via Lambruschini 4 – 20156 Milano ITALY

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Abstract

In this work, we provide the first comprehensive description of the Initial Coin Offering (ICO) phenomenon, which by the end of 2017 allowed startups around the world to raise more than $5.3 billion, according to market observers. We analyze the determinants of the success of these token offerings by considering a sample of 253 campaigns. We find that the probability of an ICO's success is higher if the code source is available, when a token presale is organized, and when tokens allow contributors to access a specific service (or to share profits). Our results provide valuable insights into this new source of capital for businesses and into the key determinants of fundraising success.

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1. Introduction

Initial Coin Offerings (ICOs) can be defined as open calls for funding promoted by organizations, companies, and entrepreneurs to raise money through cryptocurrencies, in exchange for a "token" that can be sold on the Internet or used in the future to obtain products or services and, at times, profits.[1] An example of an ICO—the MobileGo project—is described in the Appendix.

Building on the notices released by the portal Tokendata.io, we estimate that until 2017 ICOs raised as much as $5.3 billion around the world. For comparison, in 2016, venture capital invested $71.8 billion in the United States and $4.3 billion in Europe (preliminary figures for 2017 are comparable; sources: National Venture Capital Association and Invest Europe). Well-known crowdfunding portals, such as Kickstarter and Crowdcube, raised a total of $3.4 billion and $483 million, respectively, from their establishment up to December 2017 (source: platform web sites). Therefore, the ICO phenomenon cannot be neglected or hastily marked as a scam.

The importance of the topic to business activity is relevant for at least three reasons. First, adopting innovative technologies based on 'blockchains', that we introduce in Section 2, it is possible to reduce the costs of capital raising, avoiding intermediaries (crowdfunding platforms) and payment agents (banks, credit card circuits). Second, ICOs favor open-source project development and decentralized business, generating a built-in customer base and positive network effects (Giudici and Rossi-Lamastra, 2018). Third, the token mechanism allows funders to create a secondary market for their investments, while conventional equity-based, lending-based or reward-based contracts are essentially illiquid.

The increase and funding success of Initial Coin Offerings (ICOs) around the world is challenging finance researchers, investors, and entrepreneurs, as well as market authorities. Bypassing any regulation that

[1] Note that the definition is very similar to the notion of a crowdfunding campaign, where fiat currency is collected (Belleflamme, Lambert, & Schwienbacher, 2014). Similarities and differences are discussed by Adhami & Giudici (2018).

normally applies to businesses placing securities to retail investors, dozens of developer teams and entrepreneurs collect money in absence of official prospectuses, with no particular protection for contributors and disclosing only a very limited set of information. Provided that whether the tokens offered in ICOs in exchange for money represent financial security is unclear (and the answer is likely different in different countries), the fact is that ICOs represent a new and unexplored source of financing for innovative projects.

This work is the first to address the specific characteristics of ICOs in the finance literature[2] and to explore the determinants of fundraising success. We analyze a sample of 253 ICOs that occurred from 2014 to August 2017. We find that the success rate is quite high (81.0%), and projects originate primarily in the United States, Russia, the United Kingdom, and Canada. The project objective is predominantly related to the development of a blockchain, the issuance of new cryptocurrencies, or other fintech services. ICO tokens grant contributors the right to access platform services in 68.0% of the cases, governance powers in 24.9% of the cases, and profit rights in 26.1% of the cases. The secondary market for ICO tokens is quite liquid on the first day of trading, and the initial return is large (mean value +919.9% compared to the offer price, median value +24.7%). We validate the hypothesis that the probability of an ICO success is higher if the programming code source is available (but no correlation is detected with the availability of an unofficial prospectus, the so called "white paper"), if a token presale is organized, and if the ICO tokens give contributors access to project services (and share future profits).

The remainder of this work is organized as follows. Section 2 introduces the blockchain technology — which is the building block of any cryptocurrency — the nature of cryptocurrencies, and the institutional framework of ICOs. Section 3 introduces our hypotheses on the determinants of ICO success. Section 4

[2] Before our work, only three papers were listed on the SSRN website that cited "initial coin offerings" (Enyi & Le, 2017; Venegas, 2017; Yadav, 2017), but none of them conducted a quantitative analysis of the deals. ResearchGate hosted the paper by Conley (2017), which does not analyze empirical data as well. On Scopus at the moment, only three short articles from the Economist are listed.

describes the sample and outlines the main characteristics of the nascent ICO market. Section 5 presents the econometric analysis of the determinants of the success of ICO campaigns and comments on the findings. Finally, Section 6 concludes with a preliminary discussion and a future research agenda. Given the newness of the ICO phenomenon, a brief description of a sample ICO is presented in the Appendix.

2. Cryptocurrencies and Initial Coin Offerings

2.1 Blockchain technology

Cryptocurrencies rely on "blockchain" technologies to create a distributed system of certification and integrity on the Internet whenever payment transactions occur. In the case of fiat money, a central trusted party (namely, the central bank) guarantees the value of banknotes and national currencies. On stock exchanges, central securities depositories transcribe all transactions and trading, and provide evidence of the legitimate owners of each security. In contrast, the blockchain is a digital, decentralized, distributed ledger (Pilkington, 2016; Vaizeyv & Hancock, 2016), a file recording transactions in which all network nodes have a copy of the ledger and no one has the sole authority to update it. Blockchains rely on hashing, a cryptographic system to transform any text of any arbitrary length into a theoretically irreversible fixed-length string of numbers and letters (the "hash") to provide security, accuracy, and immutability of the registrations.

When a cryptocurrency transaction is recorded, a new "block" that upgrades the account positions of the involved parties on the shared ledger is generated, with no need to obtain certification from a third entity (e.g., a bank or a payment agent). The settlement is obtained through a "consensus protocol" applied by other network participants; the protocol may be enforced by anyone in the network or just by a selection of nodes.

The interest of the economic world in blockchain and 'distributed ledger' technology arose because of the possibilities that this technology is expected to deliver (Yuan & Wang, 2016) through its ability to decentralize information storage and management across thousands of different memories spread throughout the world and without a trusted party as the central and only keeper of the system's validity.[3] The advantages of the blockchain technology are related to fault tolerance (the system relies on many separate components and the risk that all of them will fail is extremely low), attack resistance (attacking and manipulating the entire network is expensive), and collusion resistance (a third party could be corrupted, but its presence is not necessary with blockchains). In contrast, distributed systems are slower and more redundant than centralized ones, and scalability is difficult because a limited number of transactions can be managed every second.

2.2 Cryptocurrencies

In 2008, Satoshi Nakamoto, a pseudonym for probably a team of developers, released its Bitcoin paper (Nakamoto, 2008) and the source code on the Internet, allowing the birth of the first "cryptocurrency" after the early proposal for B-money ideated by Dai (1988). In January 2009, New Liberty Standard opened the first Bitcoin trading platform (the initial exchange rate was 1,309.03 Bitcoin for one U.S. dollar) and in February 2010, the first payment in Bitcoin was processed to buy two pizzas at a price of 10,000 (more than $140 million at today's exchange rate). In the 2010s, Bitcoin started gaining attention. The first large company to accept Bitcoin was the WordPress online publishing platform;

[3] An example is a paper from Goldman Sachs (Boroujerdi & Wolf, 2015) that envisaged that blockchains would have been able to "make central banks retire." The nascent literature on blockchains depicts a range of applicability nearly as broad as the Internet itself (van der Veer & Gielen, 2016). Applications other than cryptocurrencies include financial markets (Biella & Zinetti, 2016), custodian services, supply chain management, and trade finance (Ream, Chu, & Schatsky, 2016), Internet-of-Things (Dorri, Kanhere, & Jurdak, 2016), and policy making (Condos, Sorrell, & Donegan, 2016). See also Morgan (2016). Banks such as BNP Paribas are experimenting with blockchains to settle payments among companies (see https://group.bnpparibas/en/press-release/bnp-paribas-completes-real-time-blockchain-payments).

Overstock.com, Zynga, and TigerDirect followed swiftly. Today, hundreds of large companies worldwide accept Bitcoin for their services, including Amazon, Bloomberg, Microsoft, PayPal, Subway, Target, and Tesla.[4] In 2017, the proposal for a Bitcoin ETF investment vehicle that would be easily accessible to retail investors was rejected by the U.S. Securities and Exchange Commission (SEC). Yet, other financial products, such as ETNs (listed in countries such as Sweden that, in contrast to the United States, allowed such issuances) and CFDs (derivative products) that replicate Bitcoin's price performance, are available on the markets by brokers.

Bitcoins can be generated by a "mining process" that solves a computational puzzle: the first miner that solves the puzzle earns the right to add his block to the blockchain (Decker & Wattenhofer, 2013). Bitcoin's protocol intentionally makes mining increasingly difficult, meaning that gaining control of a majority of the network is prohibitively expensive in term of computational efforts (Eyal & Sirer, 2014). The increasing scarcity of the primary issue of new Bitcoins and the strong demand by wealthy people willing to "hide" cross-border money flows (Moser, Bohme, & Breuker, 2013) sustained Bitcoin's value on the market and nourished a speculative bubble (Baek & Elbek, 2015; Cheah & Fry, 2015). As of the end of December 2017, the price of one Bitcoin on the Internet was quoted at approximately $14,000 (the price was virtually zero when it first started to trade in July 2010) and its performance in the previous 12 months was +1,360%.

After Bitcoin, a plethora of digital currencies have been created: Ethereum (established in 2015), Fabric, Corda, Ripple, and many others. Dedicated platforms have been established to exchange fiat money into cryptocurrencies and vice versa. As of December 2017, an estimated 900 digital currencies are active

[4] A comprehensive list of companies accepting payment in Bitcoin is published at http://www.ebay.com/gds/100-Companies-That-Accept-Bitcoins-As-Payment-/10000000206483242/g.html

around the world and their entire capitalization is exploding, with a total market value of more than $567 billion.[5]

A number of studies attempted to analyze the political economy of the phenomenon (Ametrano, 2016; Bjerg, 2015; Böhme, Christin, Edelman, & Moore, 2015; Dwyer, 2015; Ennis, 2016; Karlstrøm, 2014; Lo & Wang, 2014) and explore its impact on traditional market failures stemming from information asymmetry and moral hazard (Davidson, De Filippi, & Potts, 2016; Ducas & Wilner, 2017; Johnson, Laszka, Grossklags, Vasek, & Moore, 2014; Schrijvers, Bonneau, Boneh, & Roughgarden, 2016; Teo, 2015; Tschorsch & Scheuermann, 2016). Cryptocurrencies have also attracted the attention of policymakers, with a number of public institutions issuing statements and creating task forces to study the topic (Condos, et al., 2016; European Securities and Markets Authority, 2017; Vaizeyv & Hancock, 2016). Despite the claim that blockchains allow secure transactions, hackers have been able to act malevolently by exploiting flaws in the system or in ancillary services linked to blockchains (Faggart, 2017). For example, several millions in Bitcoin from the Japanese platform Mt. Gox in 2014 and $50 million in Ether during the Decentralized Autonomous Organization (DAO) attack in 2016 were stolen.

2.3 Initial Coin Offerings

As soon as cryptocurrencies were discovered as a new means to clear payments, the opportunity immediately arose to use them to raise money through ICOs.

One of the first ICOs was organized by the DAO project and raised $150 million. The DAO was conceived as a decentralized venture capital vehicle through which funds would have been allocated on the basis of votes, where the weight of each shareholder was determined by the quantity pledged during the ICO. According to its creator, Christoph Jentzsch, the DAO should have been able to allow contributors to maintain real-time control over their funds and to completely automatize the enforcement of

[5] Source: Coinmarketcap.com. See also Anderson, Holz, Ponomarev, and Weber (2016).

governance rules through software. The DAO was developed on the Ethereum infrastructure, and the rights and obligations of the firm toward the pledgers, and vice versa, were written in the code. Unfortunately, because of a major fault in the code, the DAO was reportedly hacked, resulting in a $60 million theft.[6]

Typically, ICOs require the disclosure of a document ("white paper" or "token sale term") that contains a number of pieces of information on IT protocols, adopted public blockchain, token supply, pricing and distribution mechanism, and details on the project to be developed (eventually a business plan, including a team description). Fundraising begins at a given time and pledgers can then bid on the project. Usually, campaigns accept Bitcoins and Ethers, but do not disdain also receiving commitments in fiat money through the backup of a financial institution: a notable example is the Tezos ICO that was supported by Bitcoin Suisse AG through fiat money contributions. Theoretically, distributed ledger technologies allow the design of complex claim structures ("smart contracts," see Kosba, Miller, Shi, Wen, & Papamanthou, 2016) that are then offered to pledgers. For example, money could be released only on occurrence of certain events, such as for an escrow agreement. Alternatively, particular rights could be attributed to early contributors, such as the ownership of a token that can be spent to obtain a service or be traded, or polls might be organized among pledgers.

ICOs raise a number of issues that the literature is starting to address. The first issue is the optimal technical design of an ICO to prevent any type of fallacy in the code or to simply attract contributors (Conley, 2017; Yadav, 2017). The second issue is the relationship between ICO activity and regulations (Enyi & Le, 2017). Normally, companies and entrepreneurs must issue public prospectuses that are approved by market authorities whenever they want to tap public retail investors for funds in exchange for securities. Therefore, the main question is: Are ICO pledgers subscribing to equity securities? In the

[6] See http://www.businessinsider.com/dao-hacked-ethereum-crashing-in-value-tens-of-millions-allegedly-stolen-2016-6

United States, the "Howey test" is commonly adopted to assess what is or is not a security (Bramanathan, 2017).[7] In the European Union, the MiFID regulation is intended to define "transferable securities"; other countries are characterized by similar regulations.

In July 2017, the SEC warned investors[8] about the risks of joining an ICO, stating that DAO tokens were securities and, thus, subject to federal laws. In September 2017, the SEC charged two ICOs that allegedly placed unregistered securities. Previously, the Ontario Securities Commission advised promoters that ICOs could trigger securities law requirements.[9] On March 2018 the European Commission published a document entitled "FinTech Action plan: For a more competitive and innovative European financial sector"[10] outlining that ICOs "may offer firms new and innovative ways of raising capital", but "also present clear risks to investors". Other countries, such as Switzerland and Singapore, seem to adopt a friendlier approach to ICOs to attract fintech startups. The Australian market authority issued a document[11] stating that "ICOs have the potential to make an important contribution to the options available to businesses to raise funds and to investment options available to investors," however specifying that "an ICO must be conducted in a manner that promotes investor trust and confidence, and complies with the relevant laws."

At the opposite end of the spectrum, in September 2017, China and South Korea declared ICOs illegal, asking that all related fundraising activities be halted immediately and that money be refunded to contributors of past offerings.

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[7] Under the Howey Test, a transaction is an investment contract if: (i) it is an investment of money (or other assets, as subsequent cases also included), (ii) profits are expected from the investment, (iii) the investment of money is in a common enterprise, and (iv) any profit comes from the efforts of a promoter or a third party.

[8] See https://www.sec.gov/oiea/investor-alerts-and-bulletins/ib_coinofferings

[9] Interestingly, the market authority also stated that "Many uses of distributed ledger technologies have the potential to increase transparency and efficiencies in our capital markets, and we are keen to support this type of innovation." See http://www.osc.gov.on.ca/en/NewsEvents_nr_20170308_osc-highlights-potential-securities-law-requirements.htm

[10] See https://ec.europa.eu/info/sites/info/files/180308-action-plan-fintech_en.pdf

[11] See http://asic.gov.au/regulatory-resources/digital-transformation/initial-coin-offerings/

3. Research hypotheses

Understanding the determinants of the success of an ICO campaign plays a decisive role in guiding proponents through the structuring of future token sales because doing so sheds light on the main signals and drivers of project success that potential contributors seek.

Different from established businesses, ICO projects are characterized by strong information asymmetry and opaqueness. Contributors rely on a very limited set of information, the main element being the "white paper," a document compiled by project promoters. Although some ICO documents are more technical than others, many also include the full specification of the token sale terms. In addition, many ICO projects provide partial or complete sets of programming codes, usually through GitHub repositories[12], which are tangible pieces of information on the viability of the project for potential contributors who are able to pre-assess the technical value of the idea and learn about previous efforts of the project team. On the other hand, it may be argued that making the source code available could lead to a higher chance of hacking. Yet the literature posits that open-source strategies offer the potential for a more flexible technology and quicker innovation (von Hippel & von Krogh, 2003; West & Gallagher, 2006); open-source code is more reliable since it typically has thousands of independent programmers testing and fixing bugs (Stamelos, Angelis, Oiokonomou, & Bleris, 2002); mobilizing developers through open source coding creates empowerment, sense of ownership and democratization (Söderberg, 2015). Such benefits should be particularly welcome by ICO contributors, since cryptocurrencies rely on self-governed decentralized organizations.

We introduce Hypothesis H1:

[12] GitHub is a web-based hosting service used for computer coding and cooperation in open source projects.

H1: The availability and quality of the information regarding prospective ICO projects matters to potential contributors and positively affects the probability of a project's success.

This hypothesis, in turn, transforms into the following:

H1A: The availability of a "white paper" positively affects the probability of success.

H1B: The availability, even partial, of a project's code positively affects the probability of success.

Furthermore, the structure of the token sale should also affect the likelihood of the ICO reaching its minimum funding goal. In this regard, the existence of a presale event to specific subgroups of contributors and the presence of a bonus scheme for the sale can increase the probability that the ICO will close successfully. Presales can generate initial market interest and price discovery for a larger pool of web-based contributors, whereas bonus schemes can entice interested people and attract enough early funding to generate momentum for the ICO. Therefore:

H2: The structure of an ICO matters to contributors and can have substantial effects on the campaign's ultimate success.

Again, this hypothesis can be subdivided into:

H2A: ICOs that are preceded by a presale are more likely to succeed.

H2B: ICOs that include a bonus scheme for the sale are more likely to succeed.

Finally, because the token is the asset whose ownership is sought by contributors, its features determine its attractiveness and, thus, the success of the ICO. Tokens can grant contributors access to the service proposed by the startup or be used as internal currency within their marketplaces. Moreover, tokens can provide governance rights to holders, such as the right to vote in future corporate decisions or profit rights such as those granted by a dividend-bearing share. Furthermore, tokens can

enable donors to receive the ability to contribute to the project's development, which might be particularly useful for developers who intend to build on the technology or platform of the startup initiating the ICO. Lastly, if the project relies on its own blockchain, the token can serve as proper cryptocurrency and store of value, potentially comparable to Bitcoin or Ethereum. Our final hypothesis is:

H3: Token characteristics matter to contributors and can have different and significant effects on an ICO's probability of success.

4. Sample and Monovariate Statistics

Following Adhami and Giudici (2018), our working definition of an ICO is "an open call, through the Internet, for the provision of cryptocurrencies in exchange for tokens generated through smart contracts and relying on the blockchain technology, allowing the pledger to enjoy an exclusive right or reward or financial claim."

We singled out the candidate deals that occurred from 2014 to August 2017 through the lists published by the main ICO information providers on the web, namely, TokenData.io, CoinMarketCap.com, CoinSchedule.com, CoinDesk.com, IcoAlert.com, ICOBazaar.com, TokenMarket.net, and SmithAndCrown.com. The lists were cross-checked for the collection of information from secondary sources on the Internet (and through systematic data extraction through API consoles from major social media platforms and blockchain forums) on the proponents and the deal structures, allowing us to minimize the probability of missing observations. The data were complemented by a thorough analyses of available "white papers" issued by the proponents.

Our sample consists of 253 ICOs, of which 205 (81.0%) successfully closed their offering. ICOs can be labelled as "failed" for a number of reasons, the main reason being not having reached the minimum

funding goal, in which case the general practice is to refund contributors—but this has not always been the case. A failed ICO may also be the result of a security flaw (i.e., a successful hacker attack) and the consecutive retirement of sold tokens, or the suspension of a planned distribution. Moreover, an ICO may reveal itself to be a scam or at least perceived as a scam by the online community, resulting in a very low or zero amount of funding. Finally, cases exist in which low demand for the token being offered results in the project promoters halting the crowd sale.

Figure 1 shows the time flow of the ICOs. In 2014 and 2015, ICOs were virtually non-existent, whereas the phenomenon clearly exploded in 2017, with 216 offerings from January to August.

Figure 1 about here

Table 1 reports basic statistics on the sample, obtained from information available on the Web and official "white papers" (available in 213 cases, or 84.2% of the sample). The ICO geographical distribution (according to the predominant nationality of the team or the project) shows the United States at the frontline (47 projects), followed by the Russian Federation (17 projects), Switzerland (16), the United Kingdom (14), and Canada (11). Interestingly, a relevant number of projects have been proposed from Singapore and Switzerland—countries that issued specific actions for fintech companies. Many projects cannot be attributed to a dominant country of origin, whereas 31 projects (12.2% of the sample) adopt a "decentralized governance" mechanism; in other words, project promoters cooperate online from multiple locations throughout the world with no incorporation of the business, thus fully adopting the decentralization philosophy that is the basis of the distributed ledger technologies. In a limited number of cases (21), the white papers specify the jurisdiction that regulates the token sale. In these instances, we often find Singapore, Gibraltar, Cayman Islands, Virgin Islands, Delaware, and Estonia as choices of jurisdiction. For instance, Starta, a startup incubator project with a Russian team,

incorporated in the friendly jurisdiction of Singapore. There is also the case of a crowdfunding platform project (Starbase) that specified in its white paper the ongoing effort to search for the "right jurisdiction" by contacting lawyers from Luxembourg, Singapore, and Switzerland. The fact that the majority of the ICOs were successful despite the absence of a regulatory authority of reference for the token sale suggests that contributors have been quite insensitive to regulatory issues and the lack of protective measures. Furthermore, most ICO promoters delegate the assessment of investment eligibility to the investors themselves. In other words, the responsibility of checking the eligibility of investing in the token offering according to their country of residence regulations relies solely on the potential investor.

In contrast, potential contributors have been sensitive to the technological aspects of the projects presented. Indeed, projects with full or partial code transparency accounted for only 20.8% of the failed offerings, whereas those without any code made publicly available accounted for 70.8% of the failures. The discrepancy is accounted for by failed ICOs for which information on code availability at the time of the offering was not retrievable.

The sample ICOs succeeded in raising $1.939 billion, but the real amount is certainly larger because the value was not available for 34 completed deals. The largest ICO belongs to the Swiss project Tezos, which raised approximately $232 million in July 2017. The project aimed to provide an alternative to Ethereum with a stronger distributed governance system through a different protocol and with a different approach within the language used to build smart contracts. In the sample, 50 projects raised $10 million or more.[13]

The most popular blockchain-based network chosen as the underlying technology for the projects is not Bitcoin (only 13 projects adopted it) but, instead, Ethereum (143 projects, or more than 50% of the sample). This choice may be explained by the fact that the latter was developed from the beginning with

[13] Yet, given delays in the project schedule and disputes among the founders, the press reports that the Tezos project could implode just three months after the ICO, thus enhancing doubts about the ICO frenzy. See http://www.zerohedge.com/news/2017-10-19/worlds-largest-ico-imploding-after-just-3-months

the purpose of managing "smart contracts," unlike Bitcoin.[14] In 16 cases, Waves was adopted (an alternative open-source blockchain), whereas in 56 cases the promoters aimed at developing their own blockchain.

In most cases (223), ICO projects were collecting money for the first time, whereas eight cases represent follow-up offerings. The remaining 22 offerings were in the presale phase, and were supposed to be followed by a more diffused ICO. Given the dominant presence of projects in the startup phase, it is impossible to define the size of the business. Therefore, in Table 1, we also report statistics on the size of the core team, which on average is 4.7 fellows.

Table 1 about here

Similar to crowdfunding campaigns, ICOs frequently reserve bonuses for early bird contributors, which occurred in 127 sample offerings. In eight cases, the early bird discount included a "major contributor" premium, or a bonus for contributors pledging larger amounts. Then, 37.2% of the offerings present no bonus scheme, whereas no specific information about the topic existed for the remaining.

As discussed in Section 3, the disclosure of the programming source code might be an important variable because such disclosure allows the community to pre-assess the technical validity of the offer and the actual state of the project. In its absence, savvy individuals could imagine that there is nothing behind the ICO. For developers, creating other applications that may rely on it could be difficult, which may potentially increase the overall value of the project. In our sample, the code was made available in 100 cases, whereas in 153 cases it was not disclosed.

[14] "Smart contracts" are self-executing contracts that are directly written into lines of code across a distributed, decentralized blockchain. Smart contracts permit trusted transactions and agreements to be carried out without the need for a central authority, legal system, or external enforcement mechanism (Ream, Chu & Schatsky, 2016).

The funding target is difficult to compute because most of the time the ICO price is defined in a cryptocurrency[15] (in 42 cases Bitcoin, in 89 cases Ethereum), but in our sample, we have projects that raised CHF (4), EUR (only one case), and USD (84 cases). Given the significant volatility of cryptocurrencies, the exchange rate in USD can change significantly in a few days. Therefore, we measure the funding target using the average exchange rate computed during the ICO period (on average, ICOs are open for 27 days, but the duration is heterogeneous—some ICOs close in a few days, whereas other are open for some months). Usually a minimum and a maximum funding target are defined: the average values equal $635,617 and $579 million, respectively. This range is quite wide and, indeed, we observe that the funding target in many cases is rather uncertain, indicating that project promoters do not typically exhibit a detailed budget for future investments. Moreover, some projects did not intentionally disclose minimum and maximum funding caps for either the project or the single contributor to supposedly prevent large market participants from manipulating the market or controlling the supply. [16]

Similar to IPOs (in which both institutional investors and small retail investors are reserved tranches of securities), ICOs are often segmented into different offerings targeted to specific audiences: community users, project managers, bounties (i.e., rewards for contributors that supported promoters in solving a project's technical problems or increasing its value), and—obviously—the Internet crowd. The intended specific use of proceeds is detailed in only 78 cases (30.8%) and divided among software development, marketing activities, and business development/operations. In 85 cases (33.6% of the sample), a presale phase was organized and reserved for selected partners before the launch of the ICO.

[15] Note that the ICO price currency may be different from the blockchain adopted, which is described in Table 1.

[16] For the same reason, it is difficult to define a measure of "oversubscription" by comparing the demand for tokens with the ICO supply. Tokens are primarily allocated on a first-come first served basis, with a maximum lot for each contributor.

Table 2 about here

The sample ICOs aimed to collect money for very heterogeneous types of projects (see Table 2). Not surprisingly, the majority of them refer to the creation of innovative financial services (39 cases), the development of new (or existing) blockchains and evolved smart contracts (32), the provision of high tech services on the blockchain (e.g., cloud computing or telecom services) (24), and the inauguration and operation of decentralized marketplaces and digital asset exchanges (24). We also find activities that are usually considered unethical (gambling/betting and adult services/entertainment, with 16 and six projects, respectively). In 18 cases, the ICOs aimed to raise money to be invested in financial securities and funds (comprising venture capital), or to develop startup incubators—some exclusively directed at crypto-investments or green investing. We also find curious cases, such as cannabis marketplaces and the "Star Wars" coin (the digital currency of the decentralized Star Wars community).

Table 3 about here

The rights attached to the token offered in the ICO are a key variable because they contribute to whether or not the issuance qualifies as a security offering. Table 3 shows that often (68.0% of the cases) ICO contributors are rewarded through exclusive access to the services offered by the platform project. Tokens may be used as currency in commercial transactions in 20.9% of the cases (assessment based primarily on the project's intention to create a new blockchain instead of relying on an existing one). Governance rights (such as voting in decision polls) are granted in 24.9% of the ICOs, whereas profit rights are offered in 26.1% of the cases. Contribution rights (i.e., the opportunity to determine the characteristics of the product/service to be offered) are provided in only 16.2% of the projects, and are a stronger, more formal mechanism to allow for community-based innovation and product tailoring than

what has occurred during the past years with reward-based crowdfunding. It is important to notice that each token may assume multiple roles and grant different rights to the holders, which adds to the difficulty in pinpointing the type of financial security that may be used for comparison.

Focusing on the 205 successful projects, Table 4 highlights that the average number of contributors (available for 56 projects only) is 4,121, whereas the median is 2,394.

ICO tokens may be sold on a secondary market where sellers can deposit their tokens and decree some parameters, such as minimum prices, accepted currencies, and so on. Then exchange platforms are automatically searched for the best matches and trades are executed. We collected information on trading volume on the first day (available for 140 projects) and found that the average value is 792,034 tokens or approximately $1.23 million (median value 22,105 tokens or $4,279). This data show that, in many cases, the secondary market for ICO tokens is relatively liquid considering the absence of a fully regulated listing process. Taking stock of the IPO literature, we also computed the first-day underpricing, i.e. the percentage difference between the first-day closing price of the token on cryptocurrency exchanges and the ICO price. The value is available for 140 observations and is negative for 34.7% of the ICOs; the mean value is +929.9% and the median value is +24.7%.

Table 4 about here

5. Determinants of ICO success

We estimated a logit model, where the dependent variable is *Success*, a binary variable that takes the value of one if the ICO campaign has been successful and zero in all cases previously specified within the causes of failure. Pertaining to Hypothesis 1 (H1), we introduce two dummy variables that ascertain the availability, for an observed ICO, of the “white paper” and the programming code, namely, *White_paper* and *Code_availability*. In reference to Hypothesis 2 (H2), two other dummy variables have been created

to capture the terms of the ICO, specifically *Presale* and *Bonuses*, which take the value of one if the sampled ICO presented a presale offering or any type of sale incentive, respectively. Furthermore, five dummy variables were developed to represent the token role effects explained along with Hypothesis 3 (H3): *Token_currency* (which takes the value of one if the token can be used as currency), *Token_service* (which takes the value of one if the token can be used to access or pay for services), *Token_governance* (which takes the value of one if the token grants governance rights to its holder), *Token_profit* (which takes the value of one if the token grants profit rights to its holder), and *Token_contribution* (which takes the value of one if the token grants developer or contribution rights to its holder).

Among the control variables, *Jurisdiction* assumes the value of one when the project promoters have specified a jurisdiction of reference for the ICO token sale, thus offering minimum legal protection to potential contributors in the case of fraud, and zero otherwise. Moreover, *Fintech* and *Smart_contract* are dummy variables capturing any industry effect. Therefore, *Fintech* takes the value of one when the ICO refers to an innovative financial service startup, and *Smart_contract* takes the value of one when the ICO refers to smart contract or blockchain service development.

Moreover, for a subsample of token offerings that adopted either the Bitcoin or the Ethereum platform, we control for both the return and the volatility of the cryptocurrencies themselves at 30 days and seven days before the ICO start date (*30D_return, 30D_volatility, 7D_return, 7D_volatility*). Doing so captures any relationship between the market momentum of the cryptocurrencies and the probability of raising financing.

Tables 5 and 6 present the monovariate statistics and the correlation matrix, respectively, for the main variables of the analysis. We find no relevant issue of multicollinearity among the covariates.

Tables 5 and 6 about here

Table 7 presents the results of the estimations of the Logit models with robust standard errors. Given the unavailability of some data, the first model in the set relies on 208 observations, which declines to 145 for Models 2 and 3 and returns to 208 observations for the final model specification.

Table 7 about here

Through Model 1, we find that although the coefficient for the *White_paper* variable is not statistically different from zero, the coefficient of *Code_availability* is positive and highly significant (p-value < 1%), confirming hypothesis H1B but not Hypothesis H1A. At the same time, we find a very significant and positive effect for the *Presale* variable, which corroborates H2A. Although the likelihood of success seems unaffected by bonus schemes or currency, governance, and contribution roles of the token, the right of access to services and the right to receive a share of company profits appear positively related to ICO success, with the coefficients of *Token_services* and *Token_profit* being statistically significant at 99% and 95%, respectively. Still, H3 is only partly confirmed because not all of the possible roles played by tokens are significantly correlated with success and because the token right with the strongest effect is the right to access the services of the startup project rather than the profit-sharing right. The control variable *Jurisdiction* is significant at a 95% confidence level and positive, with an effect that is even stronger than that of *Code_availability*. This result leads us to rectify the statements about the insensitivity of the contributors to the legal issues surrounding the ICO that we made in Section 4 when commenting on the monovariate statistics. When controlling for other variables, the choice of a jurisdiction of reference for the token sale by project promoters is appreciated and adds to the probability of the campaign's success.

In Models 2 and 3, the 30-day (and seven-day, respectively) returns and volatilities of the underlying cryptocurrency are introduced for the subsample for which the Bitcoin and the Ethereum blockchains

are adopted (145 observations)[17]: we experience an increase in the pseudo-R2 but find no significant correlations. Thus, it appears that neither the return nor the volatility of the currency associated with the underlying blockchain affects ICO success probability when such statistics refer to both the month and the week prior to the ICO start date. The significance of the coefficients remains unaltered relative to Model 1.

Model 4 refers to the entire ICO sample and controls for the project objective with the variables *Fintech* and *Smart_contract*. The significance and explanatory power of the model is practically unchanged relative to Model 1, and the previous set of coefficients still appears very significant despite the fact that the business controls are not statistically different from zero.

As a robustness check, Probit estimations[18] were run for the four models and all confirmed the results in Table 7. Finally, further tests were conducted with the inclusion of a binary variable that captures ICOs during the period after May 2017, the date when Google Trends indicated a surge for the terms ICO and "initial coin offering." However, no systematic change was detected regarding the probability of ICO success.

6. Conclusions

Our analysis uncovers the characteristics of the nascent market for ICOs, where tokens are offered to Internet users in exchange for new project and business financing.

Although the quality of information provided by proponents is typically poor and offering details on governance and the use of proceeds are opaque (Adhami & Giudici, 2018), the ICO success rate is remarkably high (81%). Project heterogeneity is quite significant and only a minority of the campaigns could be considered a security offering.

[17] Note that the variable *Token_currency* is omitted because in the subsample of 145 ICOs adopting Bitcoin or Ethereum, there are obviously no cases in which a new cryptocurrency is created.

[18] Probit model estimates are available on request.

Our econometric analysis reveals that the probability of success of an ICO is unaffected by the availability of a “white paper” but is strongly and positively affected by the presence of a set of codes for the blockchain project. “White papers” have different lengths and information quality, and the mere presence of one such document as an attachment to the ICO announcement is not particularly valued by potential contributors, especially because these documents have no certification or audited features. However, the informative power of coding strings is very strong for ICO projects, and the availability of sets of codes (even partial ones) is a tangible proof-of-concept that is appreciated by prospective funders, which also reveal themselves to be quite tech savvy.

Regarding the ICO terms and the marketing of tokens, bonus schemes were found to be only marginally significant for the probability of success of the campaign. In this regard, further study of different bonus schemes is deemed necessary to understand their attractiveness to contributors. In contrast, presale initiatives (preceding the ICO) appear to be strongly significant and positively related to ICO success, revealing that testing the market with a targeted, smaller token sale is a valuable strategy to entice ICO funders.

Furthermore, the conditions of the cryptocurrency markets underlying the ICOs that do not create ex-novo blockchains of their own, as measured by average return and volatility, are not taken into account by investors and, thus, do not affect the probability of success of the ICO.

Our research provides unprecedented elements for businessmen, pledgers, and policymakers interested in ICOs and in estimating the probability of funding success.

Despite the existence of various web portals that portray themselves as ICO data providers, all have very limited and partial data. Further studies should scan the Internet to extract whatever data are available from a variety of sources, including crowdsale announcement posts, the news pre- and post-campaigns, and the growing number of social media discussions on ICOs in which contributors and project promoters contribute to shedding light on the processes being undertaken.

The market for ICOs shares several features of the crowdfunding realm, including low contributor protection, a limited set of available information, no supervision by public authorities, and no relevant track record for proponents. ICO contributors are likely driven by intrinsic motivations, similar to crowdfunding (Giudici, Guerini, & Rossi-Lamastra, 2018). The difference is that, typically, crowdfunding portals collect fiat money through traditional payment channels (banks, credit cards), whereas ICOs offer tokens and rely on cryptocurrency blockchains. Thus, ICOs are out of any centralized control and do not need to rely on a platform (that usually carries out a selection process to protect its own reputation). Not by chance, ICO promoters are starting to implement contractual provisions to protect investors, such as escrow accounts.

The literature on crowdfunding analyzes both single campaign characteristics and platform characteristics, whereas studies on the likelihood of ICO success can only rely on project and project promoter-related factors because no platforms exist that manage ICO campaigns. Indeed, each entrepreneurial team can easily reach and manage tech-savvy token sale participants through the blockchain, and no evidence exists that suggests that a specific platform for ICOs could increase or rationalize fundraising volumes.

The research agenda on ICOs is just beginning. A number of questions remain. What are the benefits and threats of collecting money through cryptocurrency blockchains instead of fiat money? Should investors be better protected against the risk of fraud in both primary and secondary markets? More generally, should ICOs be regulated? Why do online contributors seem eager to provide such a significant amount of funds to ICOs? What are the reasons behind the huge token underpricing experienced to date? Do ICOs have the potential to increase the efficiency of new business financing or do they just represent a new Ponzi scheme?

Hopefully, this empirical investigation will also be useful to the growing number of online contributors that are actively seeking ICOs in which to invest, considering that, on average, an enticing secondary

market has existed for the tokens and a remarkable amount of money has been left on the table by project promoters, as the current underpricing levels demonstrate.

We believe that ICOs have significant potential in funding "decentralized" cross-country teams of developers, favoring open innovation. Although some countries have banned ICOs, others are clearly signaling the "borders" that should not be trespassed, and will probably move toward regulating token offerings to avoid fraud.

Appendix: An ICO example

The MobileGo project[19] raised $53.07 million during a 30-day ICO, one of the largest ever. The ICO started on April 25, 2017, to fund decentralized smart contract technology solutions for the gaming industry, supporting marketing and branding investments and the development of smart contract technology. The proposal was to create an alternative mobile gaming store, in a market worth more than $30 billion each year and that is dominated by Apple and Google Play, by charging a lower fee on developers' revenues relative to that of these leaders and reducing the time to obtain payments.

According to the project's "white paper," the proponent team was headed by Sergey Sholom,[20] who holds a Ph.D. in mathematical modeling and is founder of Datcroft Games Ltd., a gaming development company established in 2004 and headquartered in London that claims more than 13 million gamers and 100 employees. Sholom is also CEO of GameCredits Inc., founded in Belgrade (Serbia) in 2016 to deliver blockchain-based products to the gaming industry. In 2014, GameCredits created its own cryptocurrency (GAME) to securely purchase existing in-game items out of conventional payment facilities. According to proponents' claims, the GameCredits store had more than 300 games from 150 developers scheduled for its initial launch.

[19] www.mobilego.io
[20] https://www.linkedin.com/in/sergeysholom

Notably, the white paper mentioned that “The MobileGo token crowdsale fund is not owned by GameCredits Inc. This fund is primary owned by the MobileGo Foundation to be furtherly transferred to a special company incorporated in Singapore as a separate entity and solely independent ownership structure.” The ICO document also outlined a number of milestones to be achieved by the project before the first quarter of 2018.

The project offered 100 million “MGO tokens” in the ICO against four cryptocurrencies: Bitcoin, Waves, Ethereum, and GAME (in this latter case, a bonus was offered to pledgers). Out of this, 70 million was placed in the ICO, and 30 million was reserved for partnerships, marketing, and development for the coming five years. In addition, early bird pledgers also received discounts based on predefined percentages and criteria. The tokens were issued simultaneously on the Wave and Ethereum blockchains.

Owners of MGO tokens would have been eligible for the following rights: (i) coupon reward discounts when using Gamecredits to purchase content in the store, (ii) free entrance into VIP gaming tournaments with real cash prizes, and (iii) private beta testing of newly released games in the store.

The collected funds would have been invested to promote the Gamecredits store, increase gamers, and monetize. Moreover, the proponents committed to using a percentage of the profits from the Gamecredits mobile store to buy back MobileGo tokens to increase their value.

The price was not disclosed in the “white paper,” but monitoring the market activity during the ICO window reveals an average ICO price of $0.758 per token.

The MGO tokens began trading on the Bittrex Exchange on June 13, 2017 and the initial underpricing equaled 162% (considering the first closing price of $1.99 per token). The last price on December 31, 2017, was $1.30, yielding a return of approximately 54% to the average ICO pledger. Moreover, around the ICO, the company cryptocurrency GAME experienced a significant increase in market value: in January 2017, the cryptocurrency was exchanged at about $0.20 and reached $4.86 on June 23.

In December 2017, Gamecredits announced the public beta release of the game store.

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Figure 1. Time flows of Initial Coin Offerings

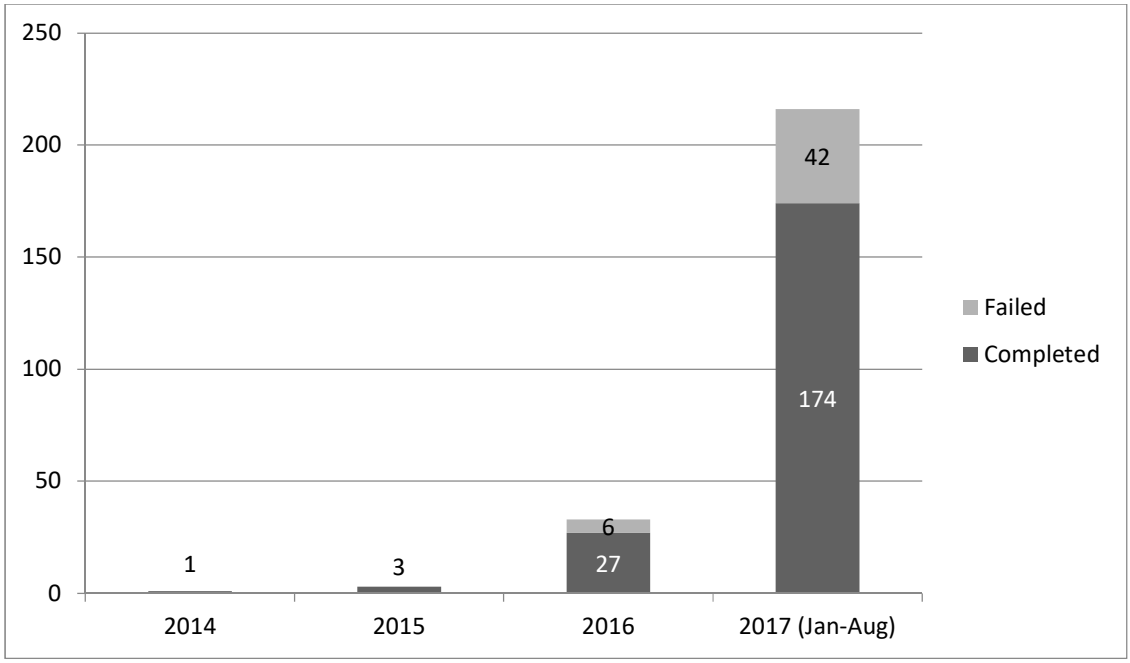

Table 1. Initial Coin Offerings' characteristics. Sample: 253 ICOs occurred from 2014 to August 2017

Country of origin	Number	%	Core team size (average)
United States	47	18.6%	4.3
Decentralized/mixed	31	12.2%	3.6
Russian Federation	17	6.7%	4.0
Switzerland	16	6.3%	11.8
United Kingdom	14	5.5%	5.1
Canada	11	4.3%	2.3
China	10	4.0%	3.3
Singapore	9	3.6%	5.1
Others/NA	98	38.7%	NA
Blockchain adopted			
Ethereum	143	56.5%	4.9
Own blockchain	56	22.1%	4.7
Waves	16	6.3%	3.0
Bitcoin	13	5.1%	5.5
Others/NA	25	9.9%	6.8
ICO stage			
Initial	223	88.1%	4.5
Follow-up	8	3.2%	8.9
Presale	22	8.7%	5.0
Bonuses			
Early bird	127	50.2%	4.5
Early bird + major contributor	8	3.2%	8.6
Others	3	1.2%	4.7
None/NA	115	45.4%	5.0
Code availability			
Yes	100	39.5%	5.4
No	153	60.5%	4.3

Table 2. Typology of ICO projects. Sample: 253 ICOs occurred from 2014 to August 2017

Project	Number	%
Financial services/fintech	39	15.4%
Smart contracts	32	12.6%
High tech services	24	9.5%
Marketplaces and exchanges	24	9.5%
Investments/VCs/Incubators	18	7.1%
Gambling platforms	16	6.3%
Gaming	14	5.5%
Media and entertainment	14	5.5%
Payment solutions	13	5.1%
Advertising	7	2.8%
Adult entertainment and services	6	2.4%
Others/miscellaneous	46	18.2%

Table 3. Rights attached to ICO tokens. Sample: 253 ICOs occurred from 2014 to August 2017

Right	Yes	No	N/A
Currency	53 (20.9%)	180 (71.1%)	20 (7.9%)
Access to platform services	172 (68.0%)	61 (24.1%)	20 (7.9%)
Governance decisions	63 (24.9%)	170 (67.2%)	20 (7.9%)
Profit rights	66 (26.1%)	167 (66.0%)	20 (7.9%)
Contribution rights	41 (16.2%)	193 (76.3%)	19 (7.5%)

Table 4. ICO outcome. Sample: 205 successful ICOs occurred from 2014 to 2017

	Mean	Median	Observations
Number of contributors	4,121	2,394	56
First day trading volume (tokens)	792,034	22,034	140
First day trading volume ($)	1,232,809	4,279	140
Underpricing	+919.9%	+24.7%	140

Table 5. Regression variables: Monovariate statistics

Variable	Observations	Median	Mean	Std. dev.	Minimum	Maximum
Success	253	1	0.81	0.39	0	1
White_paper	253	1	0.84	0.37	0	1
Code_availability	253	0	0.40	0.49	0	1
Jurisdiction	253	0	0.19	0.40	0	1
Presale	224	0	0.38	0.49	0	1
Bonuses	232	1	0.59	0.49	0	1
Token_currency	233	0	0.23	0.42	0	1
Token_service	233	1	0.74	0.44	0	1
Token_governance	233	0	0.27	0.45	0	1
Token_profit	233	0	0.28	0.45	0	1
Token_contribution	234	0	0.18	0.38	0	1
Fintech	253	0	0.15	0.36	0	1
Smart_contract	253	0	0.13	0.33	0	1
30D_return (%)	174	0.31	0.43	2.00	–3.28	5.68
30D_volatility (%)	174	7.43	7.15	2.64	1.16	13.35
7D_return (%)	174	–0.24	0.14	3.40	–9.38	11.64
7D_volatility (%)	174	6.27	7.09	3.96	1.02	17.68

Table 6. Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Success (1)	1												
White_paper (2)	0.03	1											
Code_availability (3)	0.19	0.09	1										
Jurisdiction (4)	0.06	0.07	–0.09	1									
Presale (5)	0.24	0.06	–0.11	–0.01	1								
Bonuses (6)	0.07	0.04	–0.11	0.02	0.15	1							
Token_currency (7)	0.03	0.03	0.10	–0.04	–0.06	–0.09	1						
Token_service (8)	0.18	0.16	0.04	–0.23	0.11	–0.01	0.05	1					
Token_governance (9)	–0.14	0.07	–0.09	0.03	0.03	–0.01	–0.05	–0.28	1				
Token_profit (10)	–0.13	–0.12	–0.12	0.14	–0.09	0.04	–0.06	–0.76	0.23	1			
Token_contribution (11)	0.09	0.12	–0.06	–0.01	0.19	0.14	–0.03	0.05	0.19	–0.13	1		
Fintech (12)	–0.06	–0.08	0.02	0.02	–0.02	0.14	–0.04	–0.09	0.05	0.04	–0.05	1	
Smart_contract (13)	–0.09	0.07	–0.03	–0.03	–0.18	–0.02	–0.02	0.08	–0.01	–0.10	0.00	–0.10	1

Table 7. Logit regression results. Standard errors in parentheses. *, **, and *** = significantly different from zero at the 90%, 95%, and 99% levels

Variable	(1)	(2)	(3)	(4)
White_paper	–0.1019	–0.3628	–0.5543	–0.2118
	(0.6438)	(1.1323)	(0.9973)	(0.6481)
Code_availability	1.4187 ***	1.8190 **	2.0135 ***	1.3983 **
	(0.5480)	(0.8037)	(0.7657)	(0.5730)
Jurisdiction	1.8072 **	1.1725 *	1.3171 *	1.8372 **
	(0.7215)	(0.6829)	(0.6773)	(0.7499)
Presale	2.4027 ***	2.7104 **	2.5035 **	2.4802 ***
	(0.8469)	(0.9449)	(1.0285)	(0.8161)
Bonuses	0.7727	0.3408	0.3168	0.8202
	(0.4793)	(0.5923)	(0.6200)	(0.5123)
Token_currency	–0.5872	–	–	–0.8945
	(0.5422)			(0.6147)
Token_services	2.0582 ***	2.2929 ***	2.1042 ***	1.9531 ***
	(0.6503)	(0.8863)	(0.8179)	(0.6670)
Token_governance	–0.3535	–1.0016	–0.8440	–0.4255
	(0.5054)	(0.6126)	(0.6208)	(0.4970)
Token_profit	1.3534 **	1.7050 *	1.5459 *	1.4106 **
	(0.6839)	(0.8810)	(0.8620)	(0.6693)
Token_contribution	0.5622	1.3329	0.9469	0.5045
	(0.9110)	(1.5237)	(1.5132)	(0.9014)
30D_return	–	0.1023	–	–
		(0.1233)		
30D_volatility	–	–0.1358	–	–
		(0.1223)		
7D_return	–	–	–0.0984	–
			(0.0740)	
7D_volatility	–	–	–0.4653	–
			(1.2580)	
Fintech	–	–	–	–0.2330
				(0.6317)
Smart_contract	–	–	–	1.1807
				(0.9308)
Constant	–1.3664	–0.0670	–0.4653	–1.2552
	(0.8765)	(1.5364)	(1.2580)	(0.8809)
Pseudo R2	23.44%	25.16%	25.03%	24.95%
Wald Chi2	24.24 ***	34.08 ***	26.74 ***	29.83 ***
Sample Size	208	145	145	208

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