The long-run performance of Initial Coin Offerings

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Abstract

This study investigates the follow-on funding scenario of token-backed companies (e.g., companies that issued ICOs and STOs). Our sample comprises 523 successfully funded STOs and ICOs issued in the USA and Europe from 2015 to 2021 and combines data from token portals, CrunchBase, CryptoFund Research, and Orbis. 12% of the ventures failed after the token offerings while 31% went after at least one follow-on round, an IPO, or an M&A. Adopting competing risk proportional hazards models we investigate the determinants of follow-on rounds. Our results show that previous investment rounds, the presence of crypto funds during the token offerings, and the type of token issued affect the probability of raising additional money. In particular, utility token-backed companies are more attractive to subsequent investors than security-token-backed companies. Our results suggest different roles of token offering over the firm financing life cycle.

Keywords: follow-up funding, firm survival, security token, token offerings, token-backed firms.

1. Introduction

Distributed ledger technologies (DLTs) have enabled a set of new financial channels to supply credit to small and medium enterprises directly and created new ways for individuals to invest (Bertoni et al., 2021; Block et al., 2021; Kher et al., 2020). Initial coin offerings (ICOs) and security token offerings (STOs) leverage blockchain technologies (a type of DLTs) to collect financing without intermediaries: they are a direct peer-to-peer financing mechanism that allows companies to raise funds in exchange for cryptographic tokens that can be publicly traded (Bongini et al., 2022; Fish et al., 2020; Momtaz, 2021). ICOs and STOs are based on tokens sold to investors as a unit of value. The difference lies in the token nature: ICOs refer to utility tokens and STOs to security tokens. The former offers the right to use company products or services, whereas the latter makes the buyer an investor, providing him with interests or preferred dividends. Entrepreneurs issuing ICOs raise capital to create an online platform or ecosystem where all transactions require using that native token. In contrast, in the case of STOs, the token resembles pure traditional financial investments. Both are investment assets that investors may acquire and trade.

The token offerings market has a brief history: it started in 2013, but official activity has been documented since the end of 2016, with a peak from 2017 to 2019 with a total of over 31 billion USD raised (Bellavitis et al., 2021; 2022; Howell et al., 2019). However, after the market's steep decline from the highs, traditional financial actors have shown a great interest in Digital Assets in recent years. Major players such as State Street, NASDAQ, and BNY Mellon have started offering digital asset services, and regulatory authorities have developed ad-hoc regulations to answer investors' and issuers' needs. For example, in Europe, the MiCA Regulation disciplines ICOs while the DLT Pilot Regime is focused on market infrastructures for the trading and post-trading of tokenized securities on DLT platforms.

Until now, most research in ICOs and STOs domain focused on the offering success determinants (Ante and Fiedler, 2019; Adhami et al., 2018; Beinke et al., 2021; Bongini et al., 2022; Campino et al., 2022; Chitsazan et al., 2022; Fish and Momtaz 2020; Howell et al., 2020; Lambert et al., 2021; Momtaz, 2019; Zhao et al., 2020). However, successful token offerings may be only a starting point in the start-up financing cycle. The common expectation, as well as in all newborn ventures, is that only a small number of token offerings will survive (Bellavitis et al., 2021), and depending on how well the project does, those token issuing may or may not represent a signal for other subsequent financing rounds. Due to the topic's novelty and data availability, works that deal with the post-offering scenarios of token-backed companies (e.g., companies that issued ICOs and STOs) are at the beginning.

The majority explores the financial performance of the instrument, investigating the trading volume, retention, and the average return for investors generated after the campaign (Aslan et al., 2023; Benedetti and Kostovetsky, 2021; Cumming et al., 2023; Fish and Momtaz, 2020; Florysiak and Schandlbauer; 2022; Lyandres et al., 2022; Momtaz, 2020; Yen et al., 2021). Only a few works (Dombrowski et al., 2023; Howell et al., 2019) adopt a corporate perspective, looking at the token-backed ventures' operational and economic performance (measured by product development or company failure rates).

As for crowded-backed companies, token-backed businesses are block-chain-based and innovative companies that may attract other external finance provided by institutional investors such as venture capitalists (VCs) and private equities (PEs) or may fail soon after the offering because of the risky nature of the financed technological project or the overconfidence of their proponents. (Bellavitis et al., 2021; Huang et al., 2020). Moreover, as for crowdfunding, ICOs and STOs' role in the venture financing life-cycle needs to be pinned down. On the one hand, they could be adopted by newly born high-tech companies to overcome the initial equity gap at the beginning of their life cycle. On the other, since these instruments could be immediately traded, ICOs and STOs could be used by mature companies as alternatives to IPOs. Assessing the financing profiles of token-backed companies is critical for the future of these markets, their token issuers, and investors' interests. Thus, specific analyses have yet to be done on the role of ICOs and STOs in the start-up financing cycle and their role in subsequent financing rounds.

Against this background, this study focuses on token-backed companies and analyses their post-offering scenario while investigating the determinants of kicking and tapping other sources of finance. Grounding on signaling and certification theory, we test our hypotheses using a comprehensive sample of 523 successful STOs and ICOs issued in the US and Europe area from 2015 to 2021. Data from token portals are combined with CrunchBase information about the company's financial history, with CryptoFund Research to identify crypto funds that participate in the token offering, and with Orbis to collect information about the company's profile.

Results show that even if the amount raised in token offering does not affect the likelihood of obtaining additional funds, the type of the token issued differently does: utility token-backed companies have a more positive effect in attracting additional rounds than security token-backed. This means that, at the moment, only utility tokens may be one of the steps of the venture financing cycle. Moreover, the likelihood of follow-on funds significantly decreases for high-tech token-backed companies that have already obtained previous investments before the token offering by institutional or non-institutional investors and for token-backed companies that present crypto-fund investors, along

with individuals during the offering. These findings support the view that a dispersed ownership structure could reduce the likelihood of issuing further equity.

Our study first contributes to the literature on token offerings (e.g., Bongini et al., 2022; Fish and Momtaz, 2020; Howell et al., 2020; Lambert et al., 2021) and more in general on Decentralised Finance (DeFi) instruments as new sources of alternative entrepreneurial finance (Bertoni et al., 2022; Block et al., 2021; Manigart and Khosravi, 2023) focusing on the post-offering scenario of token-backed companies and their abilities to attract new sources of funds. This perspective has been recently investigated only by a few works (Dombrowski et al., 2023; Howell et al., 2020) when most of the literature is focused on token market evaluation and the determinants of campaign success. Moreover, looking at the venture financing cycle in terms of the likelihood of obtaining other equity financing rounds, the study provides insights into the use of utility versus security tokens along with it. As crowdfunding positively impacts subsequent investments, also token offerings have a reputational effect on the start-up valuation conducted by subsequent investors, but it depends on the type of token issued. Utility tokens could be considered a signal to attract other sources of finance, while companies may issue security tokens later. Secondly, the study contributes to previous literature in the entrepreneurial finance domain about the determinants of follow-on funds and the relationships between new digital financing instruments and traditional start-up financing subjects (PEs, VCs, business angel investors - BAs) (e.g., Butticè et al., 2020; Colombo and Shafi, 2021; Drover et al., 2017; Eldrige et al., 2021; Hornuf et al., 2018; Signori and Vismara, 2018) with a focus on pre-seed and seed ventures research field which is larger underexplored (Cumming and Johan, 2017).

The paper is structured as follows: Section 2 summarizes existing studies and introduces our theories, background and hypotheses. Sections 3 and 4 present our sample, method, and empirical findings. Section 5 discusses and concludes the paper.

2. Literature background and hypotheses

ICOs and STOs are, by definition, alternative decentralized finance channels arising from the disintermediation of traditional private capital subjects. As in crowdfunding, i.e., the first form of digitalized disintermediating investment for start-ups, token offerings publish information about the issuers, and investors evaluate the quality of the offering and decide whether to invest without a professional advisor or financial intermediary. Indeed, one of the main expectations of these blockchain-based financing instruments is to bypass traditional intermediaries such as banks, VCs, and PE, reduce marketing, distribution, and transaction costs (Huang et al., 2020), and enlarge both the

supply side (i.e., the number of investors in digital finance markets) as well as the demand side with more financing opportunities to entrepreneurs (Fish et al., 2020). The funding raised in ICOs already surpasses the volume raised in crowdfunding (Bellavitis et al., 2021) and since the mean funding per ICO ranges between $10 and $20 m (Bellavitis et al., 2021; Howell et al., 2020), ICOs may compete with VCs and PEs rounds or directly with initial public offerings (IPOs).

Though the names sound similar, ICOs and STOs are unlike IPOs. In particular, two key elements distinguish token offerings and IPOs: token firms are much younger and smaller, typically in the earliest stage of a firm's life cycle, and they do not use an underwriter to determine the token's value and attract buyers (Benedetti and Kostovetsky, 2021). In general, for startups, token offerings are more accessible and less troublesome than IPOs and allow companies to collect more considerable capital in less time than crowdfunding campaigns (Ackermann et al., 2020; Kaal and Dell'Erba, 2018). Moreover, thanks to the blockchain, tokens can easily connect entrepreneurs with a wide range of investors or potential new users for their products or services, who will be particularly likely to engage with the project (Adhami et al. 2018). Finally, tokens can be immediately publicly traded, overcoming the liquidity problem due to the absence of a secondary market that characterizes equity crowdfunding (Block et al., 2020). This aspect particularly benefits investors since tokens are fungible and fractionalized, i.e investors can trade them at arbitrarily low prices per fractionalized unit, exchange them among investors, or convert them into other cryptocurrencies or fiat currencies on an exchange (Dombrowski et al., 2023).

Over the last decade, ICOs and STOs have emerged as novel market that allows small and institutional investors to directly engage in financing entrepreneurial ventures democratizing access to the online investment market (Ackermann et al., 2020; Fisch and Momtaz, 2020). Extant studies have primarily investigated the factors that lead to token offering success (e.g., Adhami et al., 2018; Ante and Fiedler, 2019; Beinke et al., 2021; Bongini et al., 2022; Campino et al., 2022; Roosenboom et al. 2020). Within this debate, the literature has identified among others fundraising success factors, the institutional environment, and the market sentiment (Aslan et al., 2023; Bellavitis et al., 2021; 2022; Drobetz et al., 2019); founder and human capital characteristics (An et al. 2019; Colombo et al., 2022; Momtaz, 2021a, b); token offering information such as the ones in the white paper (Adhami et al., 2018; Bongini et al., 2022; Florysiak and Schandlbauer, 2018; Samieifar and Baur, 2021) or comments on the social network (Moro et al., 2023). Surprisingly, compared with the pre-campaign success factor, we know less about what happens after successful token offerings. Some works explore ventures' financial post-ICO performance by looking at the market trading dynamics in the short and long run (e.g., Aslan et al., 2023; Benedetti and Kostovetsky, 2021; Drobetz et al., 2019; Fisch and

Momtaz, 2020; Lyandres et al., 2019 Roosenboom et al., 2020). Findings mainly evidence a higher average underpricing in token offerings than IPOs and higher liquidity and trading volume of exchange-traded tokens when issuers disclose more information during the campaign. Also, Cumming et al. (2023) study post offerings evidencing a positive effect of crypto funds that co-invest with the crowd on post-ICO evaluation and risk-adjust token price performance. Only a few works explore post-ICO performance by adopting an operational perspective. The first work of Howell et al. (2018) provide evidence that the ICO characteristics also predict the issuers' operating success evidencing an impact on the future employment rate (identified as the number of employees on LinkedIn or the company website). Afterward, Dombrowsky et al. (2023) investigated the difference between crowdfunded and crypto-fund-backed token issuers in terms of operational and financial performance. Institutional investor-backed ventures have a lower likelihood of survival and poorer operating performance compared with crowdfunded ventures. In terms of financial performance, their presence higher firm evaluation and abnormal return only in the short term.

However, the factors that explain post-campaign outcomes for start-ups that experienced successful online fundraising cannot be simply generalized. This implies that token offerings may represent, for the company, an instrument of seed financing or/and the ultimate status of business growth. As financing is crucial for start-ups in the seed and later stages for supporting their survival, growth, and expansion, current research has made significant progress in understanding the subsequent evolution of ventures that adopt digital online financing channels. In particular, the effects of successful or unsuccessful equity crowdfunding on follow-on fundraising (Colombo and Shafi, 2021; Drover et al., 2017; Eldrige et al., 2021; Signori and Vismara, 2018; WalthoffBorm, Vanacker et al., 2018; Rossi et al., 2022) or on start-up performance and survival (Butticè et al., 2020; Coakley et al., 2021, 2022; Cumming et al., 2019; Eldrige et al., 2021; Hornuf et al., 2018; Sorenson et al., 2016). Since crowdfunding and token offering have many aspects in common (Ackermann et al., 2020), our hypotheses are grounded on the literature in the crowdfunding domain that has explored which factors affect the likelihood of obtaining post-campaign funds by crowded-backed companies.

2.1 Theory and Hypotheses Development

Popular issuers in token offerings are high-tech start-ups or blockchain-based start-ups. These companies offer investors potentially high returns but also high risk as they struggle with highly complex technological problems (Chen, 2019; Yen and Wang, 2021) associated with legal and environmental challenges (Bongini et al., 2022). Blockchain technology is still novel and constantly

updated. Ventures often conduct token offerings at a very early development stage when the market and technological risks are at their highest peaks. After an initially successful token offering, high-tech ventures are expected to be more likely to persist in their search for new equity capital and attract the necessary resources to pursue their projects. Token offerings and, in general, all disintermediated financing channels present severe information asymmetries and possible adverse selection problems that could compromise the efficiency of the project selection (Ahlers et al., 2015; Colombo, 2021). To overcome information asymmetries typical of the seed and start-up stage, token-backed firms seeking capital often use high-quality signals to communicate their value to the market (Ahlers et al., 2018). Also, institutional investors face information asymmetries in distinguishing high-quality from low-quality start-ups. Newborn ventures usually have a limited track record, high intangible assets, and a lack of internal funds, making their evaluation challenging. Previous literature demonstrated that adopting online channels, such as crowdfunding campaigns in the start-up financial cycle, works as a signal for other subsequent investors. Drover et al. (2017) and Butticè et al. (2020) find that crowdfunding performance influences VCs' screening decisions. A successful crowdfunding campaign demonstrates that an entrepreneur can reach the first investment milestone and indicates the business's market appeal (Butticè et al., 2020). Moreover, the high technological features that characterized blockchain instruments and, thus, the business could signal the entrepreneurs' digital and technological competencies. In the case of token-backed companies the amount collected positively affects the operational performance of the venture in terms of product development and venture profitability (Dombrowsky et al., 2023). Thus we hypothesize:

HP1: The amount raised in a token offering affects the probability of follow-on funds for token-backed companies

ICOs and STOs could also assume different meanings for other entrepreneurial finance subjects. Since ICOs and STOs are entirely different in nature (Lambert et al., 2021; Momtaz, 2021) they could be adopted by companies with different businesses and presenting different stages of financing cycles. Moreover, scams have affected the ICO market due to the novelty of the phenomenon and the limited regulatory oversight that exacerbates uncertainty (Huang et al., 2020). Indeed, one disadvantage of ICOs is the uncertainty of regulation and subsequent regulatory arbitrage (Bellavitis et al., 2022; Cumming et al., 2019; Kher et al., 2021). Thus ICOs face the challenge of establishing regulatory legitimacy, defined as the judgments rendered by media, regulators, and other industry actors based on the degree to which organizations comply with rules and policies issued by

governments (Aldrich and Fiol, 1994). There is much regulatory uncertainty surrounding utility tokens while security tokens fall within the jurisdiction of a securities commission (HOWEY test in the US or MiFID in Europe). Since STOs are subject to security law, they appeal to institutional investors and are perceived as less uncertain than ICOs (Bellavitis et al., 2021; Momtaz, 2021). Even if Fisch (2019) finds no significant difference between the different types of tokens and the amount raised in the campaign, these aspects could affect the perception of other traditional entrepreneurial finance subjects in the post-offering scenario, which could prefer security token backed-companies over utility token-backed companies. Thus we hypothesize:

HP2: Security tokens and utility tokens differently affect the probability of follow-on funds for token-backed companies

Prior financing from institutional investors is associated with a certification mechanism that conveys firm quality to other investors and reduces information asymmetries (Colombo et al., 2022) thanks to implied screening activity that is assumed to take place to support the financing decision. This is the case for crowded-backed companies, where the number of venture capital investors supporting the firm before the crowdfunding campaign positively impacts the likelihood of obtaining post-campaign financing (Hornuf et al., 2018). Utility token issuers that received a previous VC round experience lower failure rates and/or higher future employment (Howell et al., 2020).

However, firms with more dispersed ownership are found to be less likely to issue further equity (Eldrige et al., 2021; Signori and Vismara, 2018), and other studies evidence potential conflicts among investors in the case of dispersed capital structure (Dimov and De Clercq Citation, 2006; Falconieri et al., 2019). A dispersed capital structure can lead to a divergence of interests between investors and this divergence can result in less growth opportunities for the ventures. In particular, in light of new actors that enter the entrepreneurial finance ecosystem (Bertoni et al., 2022; Manigart and Khosravi, 2023), recent studies have investigated financing schemes involving heterogeneous co-investors (Bonnet et al., 2022; Capizzi et al., 2019; Domborwsky et al., 2023). Among them, Dombrowsky et al. (2023) provide evidence of a co-investment strategy between the crowd and crypto funds during the token offering with different effects in terms of the operational and financial performance of the company. The presence of multiple institutional investors could affect the likelihood of raising additional money: the amount collected is sufficient for the company's development or different investment strategies could dampen the likelihood of new investors' entrance. Whether founders choose investors

strategically and what type of investors they choose can significantly impact a venture's subsequent ability to raise additional money. Based on the existing literature, the following hypothesis is generated.

HP3: Prior financing decreases the probability of follow-on funds for token-backed companies

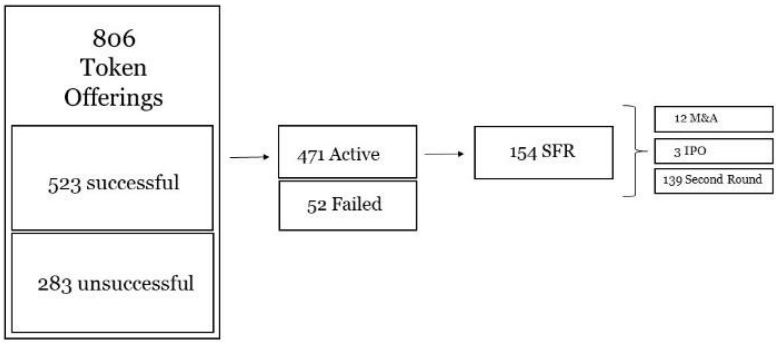
3. Data and empirical methodology

3.1 Data

We refer to Momtaz (2021)'s ICOs and STOs data from the Token Offerings Research Database (TORD; available at: https://www.paulmomtaz.com/data/tord). We select token offerings issued in US and Europe from 2015 and update the list until December 2021 across multiple well-known aggregators: Coinitelligence.com, Tokenmarket.net, Blockdata, STOscope.com, STOrating.com, STOwise.com, STOcheck.com, STOAnalytics, and ICObench.com. The United States and Europe are the two leading areas of the token offering market, where the USA had a large share of the market, comprising 30% of token offerings, at the onset of this industry, while Europe has increased its relevance steadily over time (Bellavitis et al., 2021;2022). Moreover, in both areas, regulators extend existing securities laws to cryptocurrency exchanges and token offerings requiring KYC and CFT as mandatory, which are relevant for our study since they contribute to reducing non-comparability issues. In total, we start from 3,052 token offerings. As in Lambert et al. (2021) and Bongini et al. (2022) we do not consider stablecoins (279 in total) and companies for whom the white paper is not available (388). Since there are differences between the project and the company name, we cross-checked our sample of token offerings among multiple online sources (token platforms, Google, and specialized websites on blockchain news, such as coindesk.com, cointelegraph.com, ledgerinsights.com) to identify the company's name on two data sources: Crunchbase and Orbis. We monitor these companies from the closing date of the token offerings until the end of 2022 in CrunchBase to retrieve information relative to the funders (round number and the date). Crunchbase covers worldwide equity rounds and is a popular and validated data source used in entrepreneurial finance studies (e.g., Cumming et al., 2019; Signori and Vismara, 2018; Rossi et al., 2022). In Orbis, we collected information about the venture status (the company foundation year, status, and sector description). Due to a range of missing values, a common problem in ICO/STO research (Bongini et al., 2022; Fish, 2019; Momtaz, 2020), our final sample comprises 806 uniquely identified companies that issued a token offering from December 2016 to December 2021, 99 STOs and 707 ICOs, respectively. Among them, 65% (523) of

the sample closed successfully the offering, i.e., collected the target amount. Following Signori and Vismara (2018), we categorize our sample of successful token offerings into different post-offering scenarios: active companies (471, 90% of the sample), those that are categorized in Orbis as "active" until the end of 2022; failed companies, those that are categorized as "dissolved" or "in liquidation" (52, 10% of the sample), and SFR companies those that raised a Subsequent Funding Round, or have been subjected of an M&A transaction, or developed an IPO (in total 154, 33% of active companies).

Figure 1: Sample post-offering scenarios



3.2 Variables

To explore post-offering determinants, we rely on variables describing the issuers, the offering, and the company's funding history. Table 1 presents the descriptive statistics of our sample of successful token offerings, and Appendix 1 and 2 display the variable description and correlation matrix.

A company's *Age* is the length of time the company has been active (from the founding until the campaign time). On average, companies are start-ups (2.59 years) founded by 2 entrepreneurs (*N_founders*). Both information is available on CrunchBase. *Sector* refers to the company's SIC (Standard Industrial Classification) code and the business category assigned by Orbis. We group projects into nine sectors. Most companies refer to the IT sector (48% of the sample). The second most highly represented sector is finance and real estate (35%), followed by services (11%). Following

Signori and Vismara (2018) and Colombo and Shafi (2021), we retrieve information from the white paper about the company's innovation level through the dummy variable *Patent*s that takes the value 1 if the company holds a patent. Only 8% of cases held at least one patent.

Regarding the offering characteristics, we rely on previous studies about the success of token offerings to identify a list of independent variables (Beike et al., 2021; Bongini et al., 2022; Campino et al., 2022; Dombrowski et al., 2023). We collected information at the time of the offering about to token type issued, security or utility token (on average, 33% of the company issued a security token - *STO*), and the publication of a *Pre-sale* offering before the campaign (on average, 35% of the issuers). Since token offerings vary in size, ranging from micro-cap ($0.1 million or less) to mega-cap (several billion), following Bellavitis et al. (2021) and Momtaz (2020), we control for the logarithm of the amount collected at the end of the token offering (*Ln_Amount_raised).* The sample presents, on average, 19 million euros raised. This volume is in line with the mean funding between $10 and $20 m, evidenced by previous studies on the ICO market (Bellavitis et al., 2021; Howell et al., 2020; Momtaz, 2020b). We also control the campaign *year* and timing. Most token offerings occurred in 2017 and 2018 (71% of our sample). About the timing, token offering, on average, lasts around 30 days to 90 days (PWC, 2019). We control for those campaigns for whom the timing is lower than 45 days (*Short_campaign*, 76% of the sample).

Finally, we collected information regarding funding rounds' characteristics before and during the token offering. In our sample, 46% of firms had a *Round before* the token offering, and 29% had a *Round after*. On average, token-backed companies experience one previous investment (with a maximum of 13) and one follow-on round (with a maximum of 12). Regarding the type of investors that inject money before the token offerings, following Kleinert et al. (2020), we distinguish between institutional investors (VCs and PE) and non-institutional investors (BAs and accelerators). In detail, 19% of the sample received support from at least one BA or accelerator before the token offerings, while 29% were from a VC or PE. As Cumming et al. (2022) and Dombrowski et al. (2023), we map token-backed companies on the CryptoFund Research database to identify whether during the token offerings, the start-up has received investment from *Crypto Fund* alongside individuals, 22% of token offerings in the sample see the presence of crypto funds, where on average there is one crypto funds and a maximum of 15 operators. Even among crypto funds, two investment strategies are defined: *Venture-style capital* and *Hedge Fund-style*, where the latter actively trades in tokens.

Table 1 – Sample descriptive statistics.

Variable	Obs.	Mean	Std. dev.	Min	Max
Age	523	2.59	5.48	0.09	11.68
N_Founders	523	1.84	1.23	0.00	8.00
Sector					
Agricolture, foresty and fishing (d)	523	0.01	0.08		
Energy (d)	523	0.01	0.12		
Finance and Real Estate (d)	523	0.35	0.48		
IT (d)	523	0.48	0.50		
Industrial (d)	523	0.02	0.14		
Services (d)	523	0.11	0.32		
Media and Communication (d)	523	0.01	0.12		
Healthcare (d)	523	0.00	0.04		
Country					
USA(d)	523	0.36	0.48		
EU (d)	523	0.36	0.48		
UK (d)	523	0.16	0.37		
Swiss (d)	523	0.13	0.33		
Patent (d)	523	0.08	0.27		
Token's characteristics					
STO (d)	523	0.33	0.12		
Pre-sale (d)	523	0.36	0.48		
ln_amount_raised	523	15.41	2.58	0.00	20.17
Year 2015 (d)	523	0.01	0.08		
Year 2016 (d)	523	0.01	0.12		
Year 2017 (d)	523	0.31	0.46		
Year 2018 (d)	523	0.42	0.49		
Year 2019 (d)	523	0.13	0.34		
Year 2020 (d)	523	0.04	0.19		
Year 2021 (d)	523	0.08	0.27		
Short_campaign (d)	523	0.76	0.43		
Financing round characteristics					
Round_before (d)	523	0.46	0.50		
Round_after (d)	523	0.29	0.46		
Nrounds_before	523	0.94	1.61	0.00	13.00
Nrounds_after	523	0.60	1.34	0.00	12.00
Status (d 1=active)	523	0.90	0.30		
BAAC_before (d)	523	0.19	0.39		

PEVC_before (d)	523	0.29	0.45		
Crypto Fund (d)	523	0.22	0.41		
Crypto Fund_n	523	0.68	1.97	0.00	15
Venture-style capital_n	523	0.50	1.45	0.00	10
Hedge fund-style_n	523	0.18	0.67	0.00	6

Table 2 shows the differences between token-backed companies based on token types (STO or ICO) and follow-on rounds. Regarding the differences between token types, security token-backed companies are older (4 years) than utility token-backed companies (2.4 years) (in line with Momtaz, 2021) and with an offering longer than 45 days (48% vs 75%). Also, significant differences among sectors are detected. ICOs are more frequently concentrated in IT industries than STOs (52% vs 12%), whereas the latter is more frequently in Energy, Finance, Agriculture, and Healthcare sectors than ICOs. On average, companies that issued an STO have a higher number of previous financing rounds than ICO (1.3 vs 0.9).

The analysis of the t-test shows that the characteristics of the token-backed firms that were able to obtain new rounds of investments after the offering (SFR=1) are: a higher number of funders (2.2) and the presence of at least one patent. Regarding the token‘s characteristics, the companies able to obtain subsequent rounds launched shorter campaigns than companies that did not obtain subsequent rounds (84% vs 73%). They are also characterized by the presence of crypto funds (36% vs 16%) both with venture-style capital and hedge fund-style. Regarding financial characteristics, token-backed firms that got subsequent financing rounds have received more investments before the offering either from business angels and accelerators (48% vs 7%) and private equity and venture capitalist (40% vs 24%) than companies without subsequent funding rounds.

Table 2 Differences between token type and post-offering scenarios

	Token Type			**Subsequent Funding Round**		
	ICO	**STO**	Diff. of means	**SFR=1**	**SFR=0**	Diff. of means
	(461 obs)	(62 obs)		(154 obs)	(369 obs)	
Age	2.40	3.99	**	2.22	2.73	
N_Founders	1.83	1.87		2.24	1.66	***
Patent (d)	0.08	0.09		0.16	0.04	***

STO (d)				0.13	0.11	
Pre-sale (d)	0.36	0.34		0.31	0.38	
Status (d)	0.89	0.97				
Short_campaign	0.75	0.48	***	0.84	0.73	***
ln_amount_raised	15.59	14.24		15.59	15.33	
Nrounds_before	0.89	1.33	**	0.58	0.69	***
PEVC_before (d)	0.27	0.37		0.40	0.24	***
BAAC_before (d)	0.20	0.09		0.48	0.07	***
Crypto Fund (d)	0.22	0.16		0.36	0.16	***
Crypto Fund_n	0.73	0.30		1.42	0.37	***
Venture-style capital_n	0.54	0.24		0.98	0.30	***
Hedge fund-style_n	0.19	0.06		0.44	0.07	***
Nrounds_after	0.58	0.70				
Agricolture (d)	0.00	0.06	***	0	0.01	
Energy (d)	0.00	0.09	***	0.02	0.01	
Finance and Real Estate (d)	0.30	0.52	***	0.34	0.35	
IT (d)	0.52	0.12	***	0.49	0.48	
Industrial (d)	0.07	0.05	**	0.01	0.01	
Services (d)	0.11	0.09		0.11	0.12	
Media and Communication (d)	0.00	0.02		0.01	0.01	
Healthcare (d)	0.00	0.05	**	0	0	

d): dummy variable. The table reports the average values and the significant results of the univariate tests for the differences between ventures that issued an ICO or STO and ventures that received or did not a subsequent funding round. ***, ** , * indicate significance at the 1%, 5%, and 10% levels respectively of the t-test for the difference in means.

3.3 Method

Our study investigates the determinants of post-offering financing rounds for successful token-backed companies. We adopt a competing risks proportional hazard duration model (Fine and Gray, 1999). In this competing risk setting, companies are observed from study entry to the occurrence of the event of interest, a competing event, or censoring. In our setting, we consider a new equity round as the event of interest, with failure as the competing event. Active companies correspond to the right-censored observations. This approach allowed us to determine the hazard rate for the post-campaign

outcome scenario of interest in the presence of other possible competing scenarios. The time to the occurrence of the event is measured in days from the closing date of the token offering. For failed companies, the event date is the failure date reported on the Orbis database. For the subsequent funding round, we use the date of the first round after the campaign as reported on Crunchbase. We consider the first successful round if a company obtains multiple financing rounds.

The Competing-risks regression is expressed by the hazard function, denoted by h(t). The model is semiparametric in that the baseline sub hazard $h_{1,0}(t)$ (that for covariates set to zero) is left unspecified, while the effect of covariates x is assumed to be proportional:

$$h_1(t|\mathbf{x})=h_{1,0}(t)\times\exp(\delta_i+\sum_{k=1}^{K}\alpha_k X_{kij-1}+\sum_{k=1}^{K}\alpha_k S_{ki}+\sum_{k=1}^{K}\alpha_k Z_{kj}+J_i+W_i+\varepsilon_i) \quad (1)$$

where t represents the time to the first financing round; h(t) is the hazard function determined by a set of k covariates (included in vectors X_k, S_k, Z_k), and the coefficients (α_k) that measure the impact of covariates on time of the event of interest; i represents each firm; and j is the time variable. In our analysis, the covariates can be divided into three main groups of variables: a) the vector that includes the firms' characteristics (X_k): number of funders, presence of patents, and age b) the vector that includes the token's characteristics (S_k): the type of token (security or utility), the presence of a pre-sale, the logarithm of the amount raised and c) the vector that considers the previous round financing characteristics (Z_k,): the presence of business angels and accelerators or private equity and venture capitalist before the offerings and the presence and the type of crypto funds investment styles during the token offering. Then we add industry (J_i) and country (W_i) controls.

The analysis is conducted on companies that have completed a successful token offering (Signori and Vismara, 2018). This raises endogeneity issues about the possibility that latent unobserved characteristics that determine the success of a company's initial offering may also be correlated with the likelihood of going through a given post-offering scenario. Accounting for unobserved factors is, therefore, essential. We address this issue by adopting the two-step Heckman procedure. In the first step, we consider the overall sample of 806 token offerings and develop a probit regression with the success dummy as the dependent variable. We refer to both company and offering characteristics that

could influence the success, such as the log of company age, patent dummies, number of funders, type of the token issued, and industry dummies as the independent variables. As an instrumental variable, we identify the campaign timing. During the launch phase of the token offering, the project team announces the number of days the campaign will accept funding, so the campaign time is set in advance. Campaigns with a longer duration are less likely to reach their funding goals because it signals a lack of confidence in the project for potential investors. Thus, this variable is presumably correlated with project success and uncorrelated with a company's likelihood of going through a given post-offering scenario. We adopt the short variable campaign to identify campaigns shorter than 45 days[1]. Therefore, in the second step, we run competing risk models while correcting for selection bias thanks to the inclusion of the inverse Mills ratio, estimated in the first step, among the independent variables.

4. Results

Table 3 shows the results of the models used to test our hypotheses. Model 1 reports the results of the first step of the Heckman model; the sample refers to successful and unsuccessful campaigns (obs. 740). The likelihood of successfully closing the campaign increases for larger founders' startups ($p < 0.10$, 8%), when the company presents a patent ($p < 0.10$, 38%), in the case of a security token issued ($p < 0.05$, 48%), and if the company received previous financing rounds before the token offering ($p < 0.10$, 21%). The campaign timing, in particular campaigns that are shorter than 45 days was used as the instrumental variable since it affects the success of token offering ($p < 0.05$) but not the likelihood of subsequent funding rounds. The inverse Mills ratio is not significant in all models suggesting that selection bias is not a major concern in our analysis.

Then we investigate the determinants of subsequent funding rounds moving to the second step of the Heckman model, which is a competing risk regression on the post-offering scenarios where we consider a new equity round (Subsequent Funding Round) as the event of interest with "failure" as the competing event (Model 2, 4, 6, 8, 10, 12) or new equity round as the event of interest with "active" as competing event (Model 3, 5, 7, 9, 11, 13). Models 2 and 3 introduce explanatory variables about offering - the amount raised in the campaign – and the presence of the previous round. From Model 4

[1] Another possible instrumental variable adopted in the literature of crowded-backed companies is the number of competing offerings open at the time of the campaign. We test also this variable as instrumental but it is not significant. Also the Dombrowski et al., (2023) study found no effect of competing offerings in the context of token offerings. This is probably due to the different scenarios in which crowdfunding campaigns and token offerings are developed: in the crowdfunding domain investors look to a single platform during the investment decision while in token offerings multiple token portals collect information from the web but the campaign is directly managed on the company website.

to 7, we add variables referring to the type of previous investors, business angels and accelerators (BAAC) or private equity and venture capital (PEVC) separately. Finally, from Model 8 to Model 13, information about crypto funds and different investment styles (venture *vs.* hedge) is introduced. We report coefficients instead of sub-hazard ratios in the results.

Our results in Model 2 show that the chances of obtaining a follow-on round after the token offerings are enhanced for younger ventures ($p < 0.10$), that conducted a pre-sale ($p < 0.001$), while decreasing in the presence of a patent ($p < 0.001$). These results show a different effect regarding the signaling function of ventures characteristic during the firm life cycle, particularly before and after the token offering, when the competing event is the failure or company activity. The company team members and patents positively increase token offering success but their significance changes when the likelihood of subsequent funding rounds is considered. Also, the age of the company has no effect in terms of the likelihood to close successfully the token offering and a positive or negative effect when the chance of obtaining a follow-on round is considered. These results are consistent with the literature that evidences how signal meaning changes based on the life stage considered (Svetek, 2022). In particular, human capital is considered a strong signal in the seed stage but not during the growth stage, as well as patents (Colombo, 2020; Hsu and Ziedonis, 2007; Yang et al., 2023).

Regarding token offering characteristics, in all Models (2-13) the amount raised in the offering does not increase the likelihood of a follow-on round thus our *HP1* is not supported. About the token types, even if a security token increases the likelihood of closing the campaign successfully (Model 1) it reduces the follow-up fund probability when the competing event is a company failure ($p < 0.05$) while it has no effect when the competing event is an active company. This result evidences a different signal function based on the token type issued confirming our *HP2* and a positive effect of a utility token in the survivorship of the start-up.

From Model 4 to 7 we test the probability of subsequent rounds based on the previous investors types that invested in the company. To have received investment from both business angels and accelerators (Models 4 and 5) and private equity and venture capital (Models 6 and 7) negatively affects the likelihood of follow-up funds. The magnitude of BAs' previous rounds (-15.54) is higher than VCs (-0.68). This effect could be due to two different investment styles that characterized these kinds of investors. In particular, BAs' hands-on investment style and the inclination to establish a trust-based relationship with the entrepreneur may result in higher agency costs and thus generate friction and conflicts with subsequent investors compared with venture-backed companies (Mason et al., 2016; Sørheim, 2005). Even if previous investors' participation positively increases the probability to successfully close the token offering, this signal is not a significant predictor of subsequent financing

rounds. Different effects on the basis of crypto funds as co-investors during the token offering are also revealed in Models 10 to 13. Hedge-fund-style investment strategy reduces the probability to raise additional money both in the case of failure and active company as competing events (Models 12 and 13), with a higher magnitude for the former case. The venture investment style only negatively impacts the likelihood of obtaining additional money when the active scenario suggests that their presence fulfills the start-up's equity financing gap (Model 11). These results indicate a different effect on the company in terms of the investment style adopted by crypto funds supporting Dombrosky et al. (2023) findings. Hedge funds that co-invest in the token offerings tend to adopt a shorter-term strategy with the aim to increase the token price compared with the venture style, hence generating a positive effect on the company's financial performance but a negative one on its long-term operating performance. Our results support these findings since hedge funds are strongly negatively associated with company survivorship ($p < 0.01$, Model 12) and the likelihood to obtain additional rounds (Model 13). These results confirm our *HP3* and are consistent with previous literature about the possible reluctance of entrepreneurs to further dilute their control stake after multiple financing rounds, both in the case of investment round before the token offerings and co-investments during the offering.

Table 3 – Main results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
VARIABLES	Heckman	Failure	Active	Failure	Active	Failure	Active	Failure	Active	Failure	Active	Failure	Active
Age	-0.007	-0.436*	0.006***	-0.380*	0.007***	-0.405*	0.007***	-0.424*	0.006***	-0.416*	0.006***	-0.433*	0.006***
	(0.010)	(0.245)	(0.002)	(0.229)	(0.002)	(0.240)	(0.002)	(0.227)	(0.002)	(0.228)	(0.002)	(0.236)	(0.002)
N_Founders	0.083*	-0.032	-0.104***	0.006	-0.078**	0.002	-0.100***	0.016	-0.096***	0.003	-0.102***	-0.001	-0.092***
	(0.044)	(0.155)	(0.033)	(0.157)	(0.032)	(0.149)	(0.033)	(0.153)	(0.032)	(0.150)	(0.032)	(0.151)	(0.032)
STO (d)	0.479**	-1.441**	0.090	-1.482**	0.044	-1.457**	0.079	-1.573**	0.081	-1.570**	0.071	-1.451**	0.073
	(0.193)	(0.692)	(0.109)	(0.719)	(0.106)	(0.669)	(0.108)	(0.672)	(0.107)	(0.655)	(0.107)	(0.707)	(0.107)
Patent (d)	0.387*	-13.575***	-0.564**	-16.648***	-0.494**	-13.626***	-0.550**	-13.850***	-0.535**	-14.081***	-0.540**	-16.691***	-0.552**
	(0.230)	(0.494)	(0.223)	(0.509)	(0.216)	(0.477)	(0.224)	(0.542)	(0.225)	(0.537)	(0.224)	(0.517)	(0.225)
Pre-sale (d)	0.027	1.251***	0.009	1.194**	-0.006	1.188**	0.000	1.230***	-0.010	1.224***	-0.011	1.245***	-0.015
	(0.111)	(0.467)	(0.066)	(0.479)	(0.065)	(0.464)	(0.066)	(0.452)	(0.066)	(0.459)	(0.065)	(0.460)	(0.065)
Short_offering	0.247**												
	(0.116)												
ln_raise_sto		-0.093	-0.010	-0.075	-0.006	-0.102	-0.009	-0.076	-0.005	-0.084	-0.004	-0.072	-0.002
		(0.088)	(0.012)	(0.085)	(0.012)	(0.112)	(0.012)	(0.113)	(0.012)	(0.115)	(0.012)	(0.099)	(0.012)
round_before	0.215*	-0.443	-0.077					-0.479	-0.064	-0.463	-0.053	-0.448	-0.070
	(0.113)	(0.478)	(0.071)					(0.506)	(0.070)	(0.490)	(0.070)	(0.499)	(0.070)
Crypto Fund (d)								-1.781	-0.243**				
								(1.144)	(0.108)				
BAAC_before				-15.541***	-0.434**								
				(0.476)	(0.193)								
PEVC_before						-0.686*	-0.058						
						(0.414)	(0.049)						
Venture-style capital_n										-1.150	-0.096**		
										(0.782)	(0.046)		
Hedge fund-style_n												-16.527***	-0.332***
												(0.493)	(0.102)
Mills ratio		-0.741	0.025	-0.459	0.025	-0.490	0.065	-0.808	-0.001	-0.833	0.011	-0.803	0.015
		(1.190)	(0.182)	(1.105)	(0.169)	(1.101)	(0.174)	(1.165)	(0.180)	(1.166)	(0.181)	(1.193)	(0.180)

Constant	3.405												
	(2,037.946)												
Geo FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes												
Obs.	740	523	467	523	467	523	467	523	467	523	467	523	467
Pseudo R2	0.0882												

Determinants of subsequent funding round events. Two-step Heckman selection model on the determinants of subsequent funding round scenarios. The first step is a probit regression with the success dummy as the dependent variable. Short offering (<45 days) is the instrumental variable. The second step is a competing risks regression where in Failure models, the hazard rate of completing a Subsequent Funding Round is the latent dependent variable, while failure is the competing event; in Active models, the hazard rate of a Subsequent Funding Round is the latent dependent variable, while being active is the competing events. Geographical and industry-fixed effects are included. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively. Coefficients are reported and standard errors are in parentheses.

4.1 Additional Analysis and Robustness

We develop additional analysis with the aim to check the robustness of our evidence. Firstly, as Signori and Vismara (2018) we do not consider the last year of offerings (2021, 40 token offering) to reduce potential censoring concerns (Models 14 and 15), and our results are robust. Secondly, we consider the joint effect of token types and the presence of crypto-funds (Model 16), and different investment styles in the company (Model 18 and 20). Model 16 pinpoints that issuing security tokens and the presence of crypto-funds dampen the likelihood of going through subsequent funding rounds ($p < 0.01$), confirming previous results about the reluctance of entrepreneurs to issue further equity. This effect is confirmed both in the case of venture-style investment ($p < 0.01$; Model 18) and hedge-fund style ($p < 0.01$; Model 20) with a higher magnitude for the latter one. Results are robust also when we perform the variables venture-style investment (Model 17) and hedge-fund style (Model 19) with a dummy. Thirdly, we add in the models a control for the market characteristics. Following Cumming et al. (2022) and Dombronsky et al. (2023) we distinguish between periods of bull and bear market. The bull market spans between 2015 and January 2018 while the bear market is between February 2018 and January 2019. The bear market is a favorable market assessment in the initial offering and it is considered a positive signal for the future success of the firm in terms of additional rounds ($p < 0.01$; Models 22 and 24) while the bull market negatively affects the probability to raise additional money for active companies ($p < 0.01$; Model 23).

Table 4 – Robustness

	Model 14	Model 15	Model 16	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24
VARIABLES	Failure	Active	Failure	Failure	Failure	Failure	Failure	Failure	Failure	Active	Active
Age	-0.436*	0.006***	-0.418*	-0.419*	-0.416*	-0.433*	-0.433*	-0.434*	-0.395*	0.006**	0.007***
	(0.245)	(0.002)	(0.225)	(0.229)	(0.228)	(0.228)	(0.236)	(0.244)	(0.239)	(0.002)	(0.002)
N_Founders	-0.032	-0.104***	0.019	0.002	-0.003	-0.001	-0.001	-0.025	-0.085	-0.112***	-0.108***
	(0.155)	(0.033)	(0.151)	(0.152)	(0.150)	(0.151)	(0.151)	(0.155)	(0.149)	(0.032)	(0.032)
STO (d)	-1.441**	0.090	-1.571**	-1.553**	-1.561**	-1.451**	-1.451**	-1.359*	-1.811***	0.010	0.064
	(0.692)	-0.109	(0.663)	(0.670)	(0.658)	(0.707)	(0.707)	(0.695)	(0.647)	(0.109)	(0.111)
Patent (d)	-13.575***	-0.564**	-14.108***	-13.083***	-14.089***	-15.694***	-16.689***	-15.111***	-14.747***	-0.594***	-0.631***
	(0.494)	(0.223)	(0.560)	(0.518)	(0.537)	(0.561)	(0.624)	(0.484)	(0.538)	(0.221)	(0.224)
Pre-sale (d)	1.251***	0.009	1.227***	1.219***	1.223***	1.242***	1.245***	1.260***	1.032**	-0.009	-0.044
	(0.467)	(0.066)	(0.453)	(0.458)	(0.459)	(0.450)	(0.460)	(0.468)	(0.489)	(0.066)	(0.067)
ln_raise_sto	-0.093	-0.010	-0.077	-0.083	-0.084	-0.070	-0.072	-0.097	-0.098	-0.006	-0.014
	(0.088)	(0.012)	(0.119)	(0.108)	(0.114)	(0.094)	(0.099)	(0.088)	(0.079)	(0.012)	(0.012)
round_before	-0.443	-0.077	-0.474	-0.459	-0.463	-0.448	-0.448	-0.402	-0.720	-0.124*	-0.098
	(0.478)	(0.071)	(0.506)	(0.486)	(0.490)	(0.449)	(0.499)	(0.477)	(0.499)	(0.071)	(0.070)
Crypto Fund_n			-1.260								
			(0.889)								
Crypto Fund*STO			-9.765***								
			(1.363)								
Venture-style capital_d				-1.580							
				(-1.106)							
Venture-style capital_n					-1.144						
					(0.781)						
Venture-style capital_n*STO					-10.100***						
					(1.364)						
Hedge fund-style_d						-16.213***					
						(-0.424)					
Hedge fund-style_n							-16.603***				

							(0.497)				
Hedge fund-style_n*STO							1.796				
							(1.106)				
Market_bull								0.200		-0.243***	
								(0.362)		(0.079)	
Market_bear									1.240***		0.249***
									(0.450)		(0.072)
Mills ratio	-0.741	0.025	-0.825	-0.808	-0.834	-0.803	-0.801	-0.437	-3.003**	-0.282	-0.258
	(1.190)	(0.182)	(1.175)	(1.155)	(1.166)	(1.193)	(1.192)	(0.923)	(1.186)	(0.188)	(0.216)
Geo FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	483	453	523	523	523	523	523	523	523	467	467

Competing risks regression where in Failure models, the hazard rate of completing a Subsequent Funding Round is the latent dependent variable, while failure is the competing event; in Active models, the hazard rate of a Subsequent Funding Round is the latent dependent variable, while being active is the competing events. In Models 14 and 15, token offerings completed in 2021 are excluded. In Models 17 and 19, the number of venture-style capital and hedge-fund style are replaced by a dummy. In Models 16, 18, and 20 the presence of crypto-funds and different investment styles are interacted with the type of token issued. From Model 21 to 24, variables market bull and market bear are added. Geographical and industry-fixed effects are included. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively. Coefficients are reported and standard errors are in parentheses.

5. Discussion and conclusion

This study analyzed the determinants of post-offering financing rounds for token-backed companies investigating the role of the amount raised during the token offerings (*HP1*), the type of the token issued (*HP2*), and previous investment rounds (*HP3*) as signals that could facilitate or inibite follow-on rounds. The analysis is developed on 523 successful token offerings issued in Europe and the USA from 2015 to 2021. Our analysis reveals that the token type issued affects the probability of raising additional funds, and this is independent of the amount raised in the offering. We interpret this result as not supportive of *HP1* while a confirmation of *HP2*. The amount raised during the token offering positively affects the operational performance of the venture, providing the necessary financial support to develop a product/service for a broader market and the first profit (Dombrowski et al., 2023; Howell et al., 2018); yet it is not considered a signal for subsequent investment. Only utility tokens positively affect the likelihood of follow-on funds, while the presence of previous investors before and during the token offering, both institutional and non-institutional, reduces it. This means that our *H3* is supported.

Our results contribute to the literature about token offerings (e.g., Bongini et al., 2022; Fish and Momtaz, 2020; Howell et al., 2020) and, in particular, to those studies that investigate the post-funding phase (e.g., Dombrowski et al., 2023; Howell et al., 2020). The investigation into the types of tokens issued shows that even if STOs are more successful than ICOs in raising money during the campaign, the differences in the underlying token affect the probability of obtaining a follow-on round and thus, the venture financing cycle stage in which they are employed. Security tokens are subject to higher investor protection and regulation compared to ICOs. This aspect positively impacts investor participation during the campaign but after the token offering, ventures that issued utility tokens increase the probability of raising additional funds compared to security token issuers. This result also contributes to the literature on signals in the entrepreneurial finance domain (e.g., Butticè et al., 2020; Hornuf et al., 2018; Signori and Vismara, 2018) evidencing that only utility tokens are a signal to attract follow-on funds. Comparing our evidence with the previous empirical literature on crowded-backed companies, where a successful crowdfunding campaign provides a certification effect on the ventures and positively influences the decision of a follow-on fund by a VC (Butticè et al., 2020; Drover et al., 2017), we provide evidence that the type of the token issued affects subsequent investment decisions. As for crowded-backed companies, the adoption of rewards and equity models could bring different benefits to the companies with different consequences in terms of growth opportunities, innovations, and financing rounds. The differences between utility and security tokens

lie in the asset's nature and its adoption during the company life-cycle. Security tokens may be better issued later in the company life-cycle, while utility tokens are best in the seed stage when ventures may need additional financing rounds. Providing empirical evidence of utility tokens' signaling effect, our results contrast those by Catalini and Gans (2018), who theorize that startups that rely on ICOs to raise funds will face constraints in raising follow-on capital. The practical consequences of this empirical grounding are that utility token offerings appear to be a complementary financial channel in the start-up financing cycle with a reputational effect on the other investors that operate in the seed and start-up stages

Other signals, such as previous rounds, are valuable and expensive means to increase the probability of reaching the target amount during the token offering, but they reduce the likelihood to obtain follow-on funds. During the token offerings, the previous round assumes a certification meaning. As supported by the literature (Beatty and Ritter, 1986; Gompers 1996), previous rounds are related to better firm performance and increased resources, knowledge, and networks of the company, thus, the chances of obtaining follow-on finance. They represent a "stamp of approval" and a quality signal that is difficult to imitate (Lerner, 2002). In this regard, the certification effect is most relevant for companies in the seed stage where uncertainty is high since prior financing decreases the uncertainty about the company's potential success (Kleinert et al., 2020; Hornuf et al., 2018). The signaling effect loses its meaning after the token offerings. Since token offering is an integrated market where crypto funds, co-invest alongside individuals during the campaign (Cumming et al., 2023), the chance to raise additional rounds after the token offerings is negatively affected by the presence of crypto-funds who entered during the campaign and also by the ones before the token offering (BAs and VCs). A more dispersed capital structure could reduce the growth opportunities for the company and increase agency problems (Dimov and De Clercq Citation, 2006; Falconieri et al., 2019). Also, Dombrowski et al. (2023) have evidenced that the certification of institutional investors during the campaign can harm the operating performance of the token-backed ventures, and we add to this result a negative consequence also in terms of additional funding opportunities.

Other elements emerge from our analysis that contribute to the literature on the use of signals in new venture financing, particularly how the signal meaning changes during the financing rounds (Colombo, 2021; Yang et al., 2023), demonstrating a substitution effect. Patents significantly influence the likelihood of a successful token offering. Since the technological components are a strategic asset for blockchain-based start-ups (Bourveau et al., 2022; Chen, 2019; Roosenboom et al., 2020), the presence of a patent is considered a credible, costly, and non-imitable signal of technological and innovative capabilities of the venture during the token offering. The patent's signaling effect is only

valuable during the token offering, while its effect is absent or negative on follow-up rounds. Hsu and Ziedonis (2008) provide evidence that the signaling value of patents is greater in earlier financing rounds than the later ones and, thus, is especially useful in the extremely early stage of a venture's development. Also, the number of founders is a signal that increases the token success but is ineffective in attracting additional funds. Scholars demonstrate that the number of founders is a proxy of venture human or social capital, and this kind of signal has the greatest effects on acquiring first-round financing (e.g., Ko and McKelvie, 2018).

Given the absence of research on this topic, this study inevitably remains novel and exploratory in its intent. Identifying the signaling function of token offerings on follow-up funding has important implications for token-backed businesses and investors. Future research may enlarge the analyzed sample in the observed period and its dimension, integrating information about accounting and financial information. Moreover, other outcomes of token offering could be explored in the long run, for example, company level of innovation and economic performance.

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Appendix 1 - Variable description

Variable	
Age	The company's age at the time of the token offering
N_founders	The number of company's founders
Agricolture, foresty and fishing (d)	Dummy equals 1 if the company's sector is agriculture, forestry, and fishing
Energy (d)	Dummy equals 1 if the company's sector is energy
Finance (d)	Dummy equals 1 if the company's sector is finance, insurance, and real estate
IT (d)	Dummy equals 1 if the company's sector is IT
Industrial (d)	Dummy equals 1 if the company's sector is industrial
Real Estate (d)	Dummy equals 1 if the company's sector is real estate
Services (d)	Dummy equals 1 if the company's sector is services
Media and Communication (d)	Dummy equals 1 if the company's sector is media and communication
Healthcare (d)	Dummy equals 1 if the company's sector is the healthcare
USA(d)	Dummy equals 1 if the company is based in the USA
EU (d)	Dummy equals 1 if the company is based in the EU
UK (d)	Dummy equals 1 if the company is based in the UK
Swiss (d)	Dummy equals 1 if the company is based in the Swiss
Patents (d)	Dummy equals 1 if the company holds a patent
STO (d)	Dummy equals 1 for security token offerings
Pre-sale (d)	Dummy equals 1 if the offering provides for a pre-sale
Ln_Amount_raised (€)	The logarithm of the amount raised in the token offerings
Year 2015 (d)	Dummy equals 1 if the offering started in 2015
Year 2016 (d)	Dummy equals 1 if the offering started in 2016
Year 2017 (d)	Dummy equals 1 if the offering started in 2017
Year 2018 (d)	Dummy equals 1 if the offering started in 2018
Year 2019 (d)	Dummy equals 1 if the offering started in 2019
Year 2020 (d)	Dummy equals 1 if the offering started in 2020
Year 2021 (d)	Dummy equals 1 if the offering started in 2021
Market Bull (d)	Dummy equals 1 if the offering takes place between 2015 and January 2018
Market Bear (d)	Dummy equals 1 if the offering takes place between February 2018 and January 2019
Short_campaign	Dummy equals 1 if the campaign timing is lower than 45 days
STO (d)	Dummy equals 1 for security token offerings
N_Rounds before	Number of investments before the token offering
Round_before (d)	Dummy equals 1 if the company obtains investments before the token offering
N_Round after	Number of follow-on investments after the token offering
Rounds after (d)	Dummy equals 1 if the company obtains a follow-on investment after the token offering

BAAC (d)	Dummy equals 1 if the company obtains previous investment from at least one business angel or accelerator
PEVC (d)	Dummy equals 1 if the company obtains previous investment from at least one private equity or venture capital
Crypto Fund (d)	Dummy equals 1 if the company has secured crypto fund backing during the token offerings
Crypto Fund_n	The number of crypto funds that backed the company during the token offerings
Venture-style capital_n	The number of crypto funds with venture-style capital investment strategies that backed the company during the token offerings
Hedge fund-style_n	The number of crypto funds with hedge fund-style investment strategies that backed the company during the token offerings

Appendix 2 – Pairwise Correlations Matrix

Variables	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15
(1) Crypto fund (d)	1														
(2) Crypto Fund_n	0.65	1													
(3) Venture-style capital_n	0.65	0.96	1												
(4) Hedge fund-style_n	0.50	0.84	0.67	1											
(5) Age	0.01	-0.00	0.00	-0.03	1										
(6) STO (d)	-0.04	-0.06	-0.06	-0.06	0.09	1									
(7) Pre-sale (d)	-0.15	-0.14	-0.14	-0.12	-0.03	-0.01	1								
(8) ln_amount_raised	0.14	0.22	0.24	0.13	-0.01	0.03	-0.09	1							
(9) N_founders	0.15	0.09	0.07	0.11	-0.04	0.01	-0.05	-0.00	1						
(10) Patent (d)	0.12	0.09	0.11	0.05	0.06	0.02	-0.00	0.03	0.04	1					
(11) Short_campaign (d)	0.17	0.13	0.13	0.10	0.02	-0.22	-0.13	-0.02	0.12	0.06	1				
(12) Round_before	0.17	0.15	0.17	0.08	0.06	0.06	-0.07	-0.01	0.23	0.13	0.13	1			
(13) Round_after	0.22	0.24	0.21	0.24	-0.04	0.02	-0.06	0.02	0.21	0.21	0.11	0.16	1		
(14) PEVC_before (d)	0.24	0.22	0.25	0.10	0.09	0.06	-0.1	0.03	0.19	0.14	0.09	0.68	0.16	1	
(15) BAAC_before (d)	0.17	0.21	0.2	0.19	0.01	-0.08	-0.05	0.00	0.24	0.16	0.14	0.29	0.47	0.20	1