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The success of Initial Coin Offerings: Third-party affiliation with specialized Venture Capitalists through the lens of Signalling Theory

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Dissertation

Master in Finance

Supervised by

Fábio Dias Duarte

2023

Acknowledgments

I would like to start by expressing my sincere gratitude to my professor and supervisor, Fábio Dias Duarte, for his guidance, expertise, and, most importantly, patience shown throughout all phases of writing this dissertation. I appreciate your never-ending effort, inspirational words, and availability.

I also want to thank my friends in Braga, Coimbra, and Porto for their unwavering support, for being understanding of my disappearance through these challenging times, and for helping me grow and providing me with lifelong memories. I'm grateful to have each and every one of you in my life.

Finally, I would like to extend my appreciation to my family, to my dad, for always giving me the best advice, and especially my mother, who has been incredible patient and supportive. Thank you for doing everything for me, for doing the impossible to allow me to have the best education possible, to teach me the best values and make me the woman I am today.

Abstract

In the last decade, initial coin offerings (ICOs) have emerged as a new form of digital and decentralized finance (DeFi), with the potential to disrupt conventional finance sources and enlarge the pool of raising capital alternatives. However, its decentralized nature, the lack of regulation, the opacity and complexity of this market, and fraud events, led to a crisis of trust on ICO which may jeopardize the ability of firms, especially in early stages, to succeed in their fundraising campaigns. This study examines the role played by firm's affiliation with third-party specialized ventures capitalists (VCs) to overcome the lack of regulation and transparency and restore the trust on the market and on ICOs' issuers. Based on data from 191 ICOs, our results reveal that VC-backed firms have higher ICO success. However, this association depends on the VC's specialization. We found evidence indicating that the ICO success is higher for firms affiliated with VC specialized on blockchain-based technologies and businesses, particularly if they are opaquer and riskier. The affiliation with one specialist VC leads investors to buy more tokens. This effect is as greater as the incremental number of third-party affiliations with other specialized VCs. However, if early-stage firms possess a product/service to signal investors quality and marketability, the affiliation with a generalist VC also plays a certification role translated into a higher probability of ICO's success. Our findings offer several contributions for theory-building, entrepreneurs, and practitioners.

Keywords: Initial Coin Offerings, Early-stage firms, Venture Capitalists, Specialization, Signalling Theory.

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1. Introduction

In their lifespan, firms seek unceasingly innumerous ways to get capital to implement their innovative ideas, develop new products or services, and increase their productivity and long-term growth. However, early-stage firms face several constraints limiting their ability to raise debt capital (Coleman et al., 2016; Oranburg, 2020), leading literature on entrepreneurial finance to largely address the role played by founder's own capital (e.g., Wasserman, 2008), angel investors (e.g., Dibrova, 2015; Lerner et al., 2018) and venture capitalists (e.g., Davila et al., 2003; Keuschnigg et al., 2004; Cavallo et al., 2019) in financing firms' seed and early growth stages (hereafter briefly mentioned as *early-stage*). More recently, the increasing use of internet-based technologies and the development of blockchain applications have been viewed as promoters of a new wave of digital and decentralized finance (DeFi) with the promise to enlarge the pool of raising capital alternatives for early-stage firms (Block et al., 2021). Initial Coin Offerings (ICOs) and crypto assets emerged in this new wave of finance.

In the last decade, the ICO crowdsourcing market has gained significant momentum, attracting attention from investors, speculators, media, and entrepreneurs. At the same time, its rapid growth challenged practitioners, scholars, and regulators (Giudici et al., 2020; Sharma et al., 2020). ICOs are a new method of raising capital for early-stage firms using blockchain technology. ICOs allow entrepreneurs to get funds in exchange for a token—i.e., a unit of value intended to provide utility or to act as securities. Securities and Exchange Commission (SEC) distinguishes three main token categories: (1) the currency tokens, used only as a means of exchange, by providing the same functions as fiat currency, (2) the security tokens, which can represent assets of the venture and the entitlement to receive dividends, and (3) utility tokens, that concedes the investor consumptive rights to access a product or a service when launched in the market. These tokens can be traded on a secondary market (Fisch, 2019; Benedetti and Kostovetsky, 2021) after the conclusion of the ICO or used to obtain products and, in some cases, profits (Adhami et al., 2018; Sharma et al., 2020; Ahmad, Kowalewski and Pisany, 2021). The great majority of tokens issued are not useable at the time of the ICO; instead, they provide the tokens' holder a promise of future rewards (Fisch, 2019; Fisch and Momtaz, 2020; Bellavitis et al., 2021).

Amidst the first efforts to regulate this new instrument, ICOs are seen as the most recent player in the risk capital market due to the high volatility and speculation of issued tokens (Harrison and Mason, 2019). This market has been growing on account of the reduction of the cost of capital, the open-source product development in P2P platforms, and

the creation of secondary markets. The disintermediated nature of blockchain technology enables the elimination of some investment and geographic barriers that firms face in traditional financial markets, allowing new ventures to cut financial intermediaries from the process and hence raising money at lower costs, without necessarily giving equity in exchange for funding (Adhami et al., 2018; Chen and Bellavitis, 2020; Fisch et al., 2021).

The innovative technology involved has made ICOs a flexible and convenient funding mechanism, facilitating innovation and new business models (Chen and Bellavitis, 2020; Ahmad et al, 2021). From the demand point of view, the increased interest and use of crypto assets by a wider public made possible for entrepreneurs to have access to investors all around the globe, allowing financial investment democratization. From the supply side perspective, ICOs offer investors an alternative strategy to diversify their portfolios, due to the innumerous projects available worldwide in these platforms, and an any-time exit alternative (Adhami and Guegan, 2020).

The promise of DeFi for financial investment democratization, ease of execution, and low transaction costs in this crowdsourcing mechanism have attracted many financially constrained entrepreneurs to raise capital via the ICO market (Preston, 2017). However, although offering innovative and faster ways of raising capital, some policymakers (e.g., European Commission, 2018) and researchers (e.g., Bellavitis et al., 2021) call attention to opportunistic behaviour and potential frauds on this market, due the lack of regulation and DeFi literacy surrounding ICOs and crypto assets market in general, coupled with the highly technical environment of ICOs and high information asymmetries between early-stage firms and (informal) investors. These challenges represent an increased investment risk for investors, especially for non-professional and small investors who may lack the necessary experience to effectively evaluate investment opportunities (Courtney et al., 2017; Howell et al., 2020; Momtaz, 2019). For constrained firms, the perceptions of these investment risks coupled with a strong price's volatility may undermine the success of early-stage projects.

In a nutshell, ICO market faces a huge challenge to promote investors' trust and confidence to boost the success of ICOs and enable further growth. In this context, third-party affiliation and quality and credibility certification may play a crucial role to restore the trust on the market and on ICOs' issuers. The affiliation with third-party professional investors, such as Venture Capitalists (VCs), may reduce investors and market uncertainties. Research on equity finance broadly documented that the success of further funding rounds is greater for firms informing that they have received prior investment rounds from VCs

(e.g., Ahlstrom and Bruton, 2006; Schwienbacher, 2007). VC ex-ante investments may offer a signal of the firms' quality and future returns for uninformed investors whose ability to screen firm projects' quality is limited. VC' backed firms also benefit from the VCs' network and experience, offering them the access to external resources and competencies that otherwise would be out of their reach (Colombo et al., 2006; Hsu, 2006; Lindsey, 2008).

In ICO context there is some empirical evidence aligned with those arguments showing that the ability to raise funds is higher for VC' backed ventures (Hackober and Bock, 2021; Belitski and Boreiko, 2022; Alshater et al., 2023). The advantage of new ventures affiliated with VCs arises from screening, monitoring, and advisory roles they play. But this effect is not consensual (e.g., Sharma et al., 2020). Moreover, the understanding of how relevant the VC's knowledge of DeFi-related topics is on ICO success is at least scant. This topic is of particular interest to the development of this market as some research advances suggest that the specialized knowledge in the blockchain can be decisive in this industry (e.g., Hackober and Bock, 2021) more than the professional experience or other human quality signals that does not measure expertise (e.g., Campino et al., 2021). The mixed evidence on the role played by VCs along with the scarce literature about ICOs phenomenon enhanced the enthusiasm of our research.

We contribute to expand the debate on third-party affiliation by examining the certification role played by VCs' specialization. Grounded on Signalling Theory (Spence, 1973), this study starts by examining to what extent investment decisions are driven by third-party quality signals, especially in contexts with higher market and investors uncertainties. Then, inspired by crowdfunding (e.g., Kleinert et al., 2020) and IPO (e.g., Megginson and Weiss, 1991; Lee and Wahal, 2004) literature on the certification hypothesis, we assess whether VCs expertise linked to DeFi knowledge influence the success of ICOs. The ICO market is extremely volatile and complex (Ibba et al, 2018). VC's specialization on blockchain allows them to better understand DeFi mechanisms and crypto assets opportunities. Hence, we argue that, in absence of a centralized financial mechanism, the affiliation with a VC, signalling an expertise on blockchain-based technologies, may offer third-party credible signals that certifies not only the signals emitted by the ICO' issuer but also legitimize the market and the ICO itself.

Based on data from 191 ICOs, our results confirm that early-stage firms affiliated with a third-party VC have higher ICO success, particularly in context of higher market and investors uncertainty. However, this association is driven by VC's specialization. Among

more opaque and riskier ones, firms backed by a single generalist VC does not have superior advantages in terms of ICO success compared to non-VC-backed firms. To produce effects on ICO success, more opaque firms need to affiliate with more than one generalist VC, thus triggering a signalling channel sustained by the complementary of signals. In this regard, we found that the effect of third-party affiliation with specialized VCs is more powerful than that reported by firms affiliated with generalist VCs. We found evidence indicating that the ICO success is higher for firms affiliated with VC specialized on DeFI, namely on blockchain-based technologies and businesses, particularly if they are opaquer and riskier. The simple association with one specialist VC seems to lead investors to buy more tokens, and this effect is as greater as the incremental number of third-party affiliations with other specialized VCs.

These results offer three main contributions. First, for the theory-building, we show that in this new wave of alternative finance, the certification effect of third-party affiliation depends on VCs' knowledge and expertise on blockchain. The specialization effect is particularly remarkable in contexts of higher uncertainties faced by investors in seed stage investment rounds. Hence, in ICO market, we found that the certification effect of third-party comes from the knowledge of the third-party signaller. This result aligns with Hackober and Bock (2021)' arguments on the role of specialized knowledge in blockchain. This finding seems to suggest that investors, usually retailors and informal ones, are aware of the challenges coming from the low knowledge they might have on DeFi mechanisms which leads them to find entities that offers a sense of knowledge and mastery of blockchain and crypto assets. Second, from entrepreneurial point of view, this evidence may lead early-stage entrepreneurs to affiliate with specialized VCs in order to maximize the changes of investors' engagement and finance their projects. Finally, for researchers and practitioners, this study contributes to the open debate around blockchain-based decentralization opportunities, particularly about the potential growth that ICOs will have in the future as a financial alternative for early-stage firms to raise significant amounts of capital. Given the limited information available, accurately assessing the likelihood of ICO success is a crucial task for researchers (Xu et al, 2021).

This study is organized as follows. Section 2 describes the theoretical framework and stablishes the research hypotheses. Section 3 describes the data, variables, and our methodological approach. Section 4 presents the empirical results. Section 5 extends our

analysis to alternative measures of VC's third-party affiliation. Section 6 discusses the main findings and implications. Section 7 concludes.

2. Theoretical Framework

2.1 Initial Coin Offerings

With the advent of digital and decentralized finance (DeFi), the Initial Coin Offerings (ICO) and crypto assets opened a new dynamic of the entrepreneurial finance, challenging traditional perspectives about the efficiency of economic system (Fisch et al., 2021; Campino et al., 2021). The ICO's low threshold and fast early-stage financing method provide a new development opportunity for small firms in early stages. ICOs also perform the function of platform development, attracting media attention and marketing among potential customers (Sharma et al., 2020), which in turn helps the early-stage firms to understand if the offered product or service will be successful in the long run. Therefore, digital finance has the potential to bring forth more efficient markets, by democratizing entrepreneurship and creating new ways to raise funds and engage stakeholders, by foreclosing traditional financing intermediaries from the process, such as banks (Alshater et al., 2023), thus reducing funding costs while increasing financing and market flexibility.

ICOs resemble Peer-to-Peer (P2P) crowdfunding in their approach in the sense that both provide early investment opportunities in the primary markets from a crowd of investors (Chen, 2019), not necessarily formal and professional ones, via an open call on the internet. During an ICO, investors can buy tokens directly from the early-stage firm (i.e., the issuer) at a predefined price which, in turn, provides the venture with early-stage financing that is available both directly and immediately, similarly to P2P crowdfunding mechanisms. After the ICO, tokens can be traded on a secondary market, providing the investor with a security function not available through crowdfunding (Fisch et al., 2021; Xu et al., 2021).

Tokens also resemble traditional securities as some of them allow investors to receive dividends and hold other financial benefits (Sameeh, 2018; Fisch, 2019). This explains why some researchers often go back to traditional financial literature of Initial Public Offerings (IPOs) when analysing the phenomenon of ICOs (e.g., Adhami et al., 2018; Amsden and Schweizer, 2018). From the investors point of view, ICOs and IPOs enable a private firm to offer its shares to the public for the first time through a new stock issuance, and provide secondary market liquidity (Chen, 2019). From the demand side, in both markets, the issuer needs to choose target proceeds, the fraction of issuance to be sold, the distribution method,

lockups, and exchange listing (Howell et al., 2020; Sharma et al., 2020; Belitski and Boreiko, 2022). But ICO and IPO differ in terms of regulatory requirements and investor protections (Aslan et al., 2023; Alshater et al., 2023; Belitski and Boreiko, 2022). They also differ from the innovation point of view as the former relies on digital and decentralized market alternatively to what occurs in traditional capital markets. Indeed, ICOs operations are grounded on crypto assets, which allows issuers and investors to avoid the ordinary regulatory framework and disclosure obligations commonly associated with IPOs (Ahmad et al., 2021; Aslan et al., 2023). The lower regulation and smaller transaction costs of ICOs have been leading early-stage firms to seek this type of financial mechanism, whereas IPOs are usually pursued by already established businesses (Adhami et al., 2018; Howell et al., 2020; Momtaz, 2019).

Literature on both IPOs and ICOs highlights the importance of transparency for successful fundraising (Loughran and Ritter, 2002; Howell et al., 2020). However, early-stage firms that engage in the ICO market often struggle to provide sufficient transparency due to a lack of data and noisy information about their products, technologies, and market relationships (Vohora et al., 2004; Amsden and Schweizer, 2018). This leads to high levels of uncertainty and ambiguity among stakeholders, making it challenging for these firms to gain investor's confidence (Zott and Huy, 2007).

2.2 Information asymmetries and Signalling Theory

As occurs in crowdfunding (Ahlers et al., 2015), ICO market is complex, unregulated, and operates in a high-noisy context. New ventures may struggle to capture the attention and trust of the crowd of investors to engage on new entrepreneurial projects, particularly in early stages when firms' fate is still uncertain. Unlike traditional entrepreneurial environments, that are subject to a host of regulations, crowdsourcing platforms make investors more vulnerable to potential exploitation by entrepreneurs (Gama et al., 2023).

Previous evidence shows a great number of firms misleading investors by implementing exit scams (Fisch, 2019; Giudici and Adhami, 2019; Howell et al., 2020; Bellavitis et al., 2021). In ICOs, opportunistic behaviour and frauds are exacerbated (Bellavitis et al., 2021) due to a low legal enforcement (Davydiuk et al., 2023), an absence of disclosure obligations and low screening ability (Giudici et al., 2020), investors' lack of fundamental knowledge, particularly on crypto assets and blockchain technology, and the early stage of ICO projects (Ofir and Sadeh, 2020; Ahmad et al., 2021).

Under a such high-risk investment environment, reducing uncertainty is crucial to rebuild investor's trust and willingness to invest their funds and, consequently, to ensure the success and sustainable growth of the ICO industry and their operators. In that journey, the quality of information released by entrepreneurs about their project and fundraising campaign may play a crucial role on the success of ICOs. However, ICO' issuers may find it difficult to produce documentation or information that some non-professional investors are able to evaluate. Entrepreneurs face the challenge of drawing attention to substantive information to inform the crowd of investors and reduce their risk exposure, whereas multiple other information is competing for the target audience's attention. The theory of signalling and information transfer in markets (Spence, 1973, 2002) offer optimal options for reducing information asymmetries and attract new investors based on observable signals.

Typically, this signalling channel involves two parties: (1) the informed sender (i.e., the issuer) with a privileged perspective on the underlying quality of the campaign who must decide whether and how to signal information, and (2) the less informed receiver who must decide how to interpret the signal and act accordingly (Connelly et al., 2011). To be effective in reducing information asymmetry, the signal must be observable for the investor, and costly for high-quality issuers making it difficult to imitate by low-quality competitors (Connelly et al., 2011; Ahmad et al., 2021, Fisch et al., 2019). Those costly project's quality and credibility signals may increase the ability of high-quality entrepreneurs to attract higher amounts of funding (Connelly et al., 2011), thus increasing the success of ICOs (Fisch et al., 2019; Courtney et al., 2017).

In ICO's setting, the communication is prepared in the pre-ICO phase. Usually, in the preparation of the campaigns' phase, the issuer publishes a *whitepaper* and launches a website to inform potential investors about the ICO campaign (Fisch, 2019; Masiak et al., 2020). The *whitepaper* is an electronic public document similar to a business plan, detailing information about the issuer' project and disclosing the token for the monetary investment required (Adhami et al., 2018). The voluntarily disclosure of information through whitepapers plays a role in mitigating the lack of transparency in this market, thus reducing the failure rate of ICOs (e.g., Howell et al., 2020). However, presenting a *whitepaper* can be challenging for founders, especially when the project is still in its start-up and seed phase. Because performance measures may be missing, founders intentionally provide investors with information regarding their capabilities and the quality of their business as alternative indicators of future performance hoping this approach helps investors to guide investment

decisions (Chitsazan et al., 2022). Typically, whitepapers concentrate on financing aspects, the core business, key milestones, and team members (Florysiak and Schandlbauer, 2022; Sharma et al., 2020; Adhami et al., 2018; Xu et al, 2021), but can also provide an in-depth analysis of the technology (Masiak et al., 2020). Some whitepapers include a single page of information only, while others share dozens of pages with information. So, information provided by the whitepaper can be either too limited or too noisy.

Accurate communication of information in this context is particularly challenging, since signals originating from the early-stage firms may also reduce each other's effect (Drover et al., 2017). Hence, arguably, signals about the quality of the issuer and the project arising from whitepapers may be difficult to interpret in ICO' campaigns. Hence, literature has been exploring several other ICO's success drivers– see Table 1–, namely bounty programs and pre-sale discounts (Sharma et al., 2020), design choices (Howell et al., 2020), marketing on social media (Courtney et al., 2017, Howell et al., 2020; Sharma et al., 2020; Ayarci and Birkan, 2020), and founders' equity retention and their experience in business (Vismara, 2018; Campino et al., 2021; Chitsazan et al., 2022). We explore the role of information cascades on ICO's success, putting our lenses on the effect of issuers' affiliation with third-party reputable actors.

Table 1. Literature review about ICO success

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Ayarci and Birkan (2020)	International Journal of Financial Research	66 responses (attendees who have invested in an ICO at least once)	Online survey	Decision to invest in an ICO	ICO whitepaper, Websites for finance news and ICO listings, ICO project sector and founder and ICO project team and social media.	Signalling Theory	Whitepaper, reputable and specialized websites and the quality of the project founder and team are considered the most relevant factors of an investment decision. The social circle has a significantly lower impact than initially expected.	The most important signals among all possible signals are the whitepaper, project industry, founder, and team. A creative project in the right industry, a strong whitepaper, and a trustworthy project team typically persuades investors to invest in an ICO. When it comes to financial decisions, people do not trust their close friends, co-workers, and relatives. However, they are influenced by specialized news websites as well as the views of largely anonymous users they encounter on social media sites and online messaging services.
Busenitz et al. (2005)	Entrepreneurship theory and practice	183 VC-backed ventures	Transaction data /Survey	Out of business, still private, merged or acquired and IPOs	NVT equity(percentage), founding experience (percentage), NVT experience (dummy), NVT industry experience (number), NVT wealth invested (%)	Signalling Theory	The proportion of NVT equity at the time of first round VC funding and the percentage of personal net worth invested in the firm prior to first round VC funding have no significant effect on the long-term venture outcomes.	Members of the team can send signals through their investing choices. Early funding process signals to venture capitalists don't seem to have a meaningful correlation with long-term venture outcomes. The percentage of individual wealth invested in a venture, as well as the number of shares owned by NVT, should convey the company's commitment, as well as send an important signal.
Gompers et al. (2009)	Journal of Economics and Management Strategy	9 industries (24331 observations)	Transaction data	Yearly Success (dummy)	Firm Herfindahl (%), Avg. Herfindahl of people at firm (%), Firm x Avg. Person Herfindahl (%), Firm general experience avg. (log) Experience of people at firm (number)	Signalling Theory	Success of a company and the level of specialization of each VC have a strong relationship. The generalists' worse performance appears to be the result of both ineffective funding distribution across industries and bad investment decision-making inside industries. Organizations in the VC industry with more expertise typically perform better. In cases where the individual partners are highly specialized, the marginal benefit of increased VC firm concentration appears to be very limited.	Investment specialists seem to be the most responsive to signals of investment opportunity, but this is mitigated when the average specialization level of their partners is high.

Table 2. Literature review about ICO success

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Bertoni et al. (2011)	Research Policy	538 NTBFs (new technology-based firms)	Transaction data	Probability of obtaining VC finance (%)	Firm size, (log), Technology incubator (dummy), Academic origin (dummy), Patent (dummy)	Treatment and Selection effect	VC investments have a significant favourable impact on the expansion of a company's employment and NTBF sales. VC investments help portfolio companies' employment development.	High-tech start-ups benefit greatly from VC in terms of growth performance. Coaching and other forms of non-financial support that VC investors provide to portfolio companies also play a role in the contribution of VC to business performance. The sample shows no evidence of a favourable selection effect.
Vismara (2018)	Small Business Economics	271 crowdfunding projects	Transaction data	Funding Amount (%), No Investors (number)	Equity offered to investors (%), Social Capital (number)	Information Asymmetries and Signalling Theory	Entrepreneurs who sell a smaller portion of their companies upon listing and have more social capital are more likely to start successful campaigns. Investors are less likely to be interested in founders who sell a larger percentage of their businesses at listing. Thus, to raise the likelihood that their initiatives will succeed, founders' behaviour during listing is crucial. Larger social networks provide supporters more success opportunities.	Retention of equity is seen as a hallmark of excellence. Entrepreneurs' social networks have been shown to affect venture funding decisions and aid investors reduce knowledge asymmetries.
Courtney et al. (2017)	Entrepreneurship Theory and practice	170248 crowdfunding projects (2009-2015)	Transaction data	Success (dummy)	Media (dummy), Past Success (log), Backer Sentiment (number)	Signalling Theory	Third-party endorsements lessen worries about information asymmetry harming the project's quality and founder's credibility. Supporters may find that information supplied via media usage is just as valuable as information shared via patents.	Start-up signals that are endorsed by a third party are more reliable and complete, but start-up signals that are initiated by a start-up cancel each other out. The founder's crowdfunding experience and the start-up's use of the media both convey the same information about the project's quality and founder legitimacy, cancelling out each other's signalling advantages. The information supplied through media use and founder crowdfunding experiences is enhanced and verified by the positive backer feedback, boosting the signalling advantages of both. When the project creators have no prior crowdfunding experience, the usage of media is more advantageous.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Adhami et al (2018)	Journal of Economics and Business	253 ICOs (2014-2017)	Transaction data	Success (binary)	White paper, Code availability, Presale, Bonuses and Type of token (dummy).	Information Asymmetries	The probability of an ICO's success is higher when the code source is available, when a token presale is organized and when tokens allow contributors to access a specific service. Even though the probability of an ICO success is unaffected by the availability of a whitepaper, it is strongly and positively affected by the presence of a set of codes for the blockchain project.	Although the quality of information provided is typically poor and the offering details on governance and the use of proceeds are opaque, the ICO success rate is remarkably high.
Amsden and Schwiezer (2018)	2nd Emerging trends in Entrepreneurial Finance Conference	1009 ICOs (2015-2018)	Transaction data	Total amount raised (number), Trading (binary) and CMC trading (binary)	ETH platform (binary), GitHub (binary), Patent (binary), Restricted areas (binary), Tax Haven (binary), Telegram (binary), Whitelist (binary) and WP pages (number)	Signalling Theory	Higher venture uncertainty (lack of a presence on GitHub or Telegram, shorter WP, higher percentage of tokens distributed) is negatively related with the amount raised in the ICO. Differently from equity crowdfunding, higher venture quality (better connected CEO and larger team size) is positively related with the amount raised. During periods of higher primary cryptocurrency prices (higher prices for Ethereum), ICOs are less appealing to investors and, thus, are less likely to be successful.	Distributing a higher percentage of tokens in the ICO reduces the alignment between entrepreneurs and investors and is a signal to investors that the ICO team is less confident about the venture's quality and future success. ICOs that are not on GitHub and Telegram signal less transparency.
Chen (2019)	Electronic Commerce Research and Applications	626 ICOs (2015-2018)	Transaction data	Total amount raised (log), underpricing (%)	Signals from Official announcements, Open-source code and social media	Signalling Theory and Information Asymmetry	Investor comments play the role of information surveillance for ventures' voluntary disclosures on social media, which is a multiple-way communication channel. Investor's feedback is a potential trust builder on the internet to reflect company-investor relationships and the quality of the company's disclosed information	In crowd sale stage, high credible and easy interpretable signals have significant effects on token trading. High credible and hard-interpretable signals, which deliver project fundamental information, lose their functions in crowd and listing stages, causing information asymmetry in ICOs. Investors tend to choose and trust credible signals sources, official announcements, rather than social media. Technical-ability signals from different channels have different impacts, due to investors' various backgrounds and interpretation abilities.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Fisch (2019)	Journal of Business Venturing	423 ICOs (2016-2018)	Transaction data	The amount of funding raised in the ICO (log)	Patent (Dummy), White paper (dummy), high quality source code (dummy)	Signalling Theory	While a whitepaper and high-quality source code lead to higher amounts of funding, patents do not seem to have an effect on the amount raised. This is because, although whitepapers and patents can be similar in terms of general content, a whitepaper is less restrictive with respect to legal necessities. Patents require that an invention is previously undisclosed, while a venture can publish a whitepaper to demonstrate its technological capabilities even if it has already revealed its code. Therefore, whitepapers may constitute a substitute for patents in the context of ICOs.	Traditional indicators of venture quality may not be as useful in the ICO context, as well as human capital variables, which are highly noisy and as not as readily available. The results show that investors consider a different set of indicators that are highly specific to the ICO, such as the usage of the Ethereum-standard or token supply. In contrast to the technical signals, these determinants may not have any direct association with a venture's underlying capabilities, but nevertheless seem to influence investors' decision-making.
Giudici et al (2019)	Journal of Industrial and Business Economics	935 ICOs (2014-2017)	Transaction data	Success and Listed (binary) and Amount raised (number)	Jurisdiction (binary), % Distributed (%)	Signalling Theory	The size of both the project team and the advisory committee is positively and significantly related to the three measures of success. When a larger fraction of the tokens is retained by insiders, the probability of success is larger, an effect that is attenuated if the token gives access to a service. Leadership by individuals with stronger educational background or longer tenures is not significantly related with fundraising success.	Specific provisions about the incorporation and future jurisdiction of the project are not considered a credible governance signal. The more people involved in the team or advisory committee, the larger the reputational capital at stake by venture insiders, which provides a good screening signal. Retaining tokens is also another effective governance signal, especially when these tokens resemble more traditional securities. However, this signal is weaker when the token is not an investment or a cryptocurrency, but just a means to access a service.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Fisch and Momtaz (2020)	Journal of Corporate Finance	566 ICOs (2015-2018)	Transaction data	Buy-and-hold abnormal returns (number)	Institutional investor backing (dummy)	Information Asymmetries	In the developing blockchain industry, venture capitalists are a crucial, value-enhancing intermediary. Higher post-ICO performance is correlated with institutional investor backing. Institutional investors can profit from ICOs at rates above the market. The post-ICO performance of BTBFs with VC backing is statistically and economically much better.	Institutional investors' superior screening and coaching abilities enable them to partly overcome information asymmetries.
Howell et al (2020)	The Review of Financial Studies	1520 ICOs	Transaction data	Employment (number), Employment growth (log), Issuer failed (dummy)	Utility value (dummy), White paper (dummy), Incentive (dummy), Budget for use of proceeds (dummy), Founder token vesting schedule (dummy), VC backed (dummy), stated goal to raise (dummy), Male CEO (dummy), Crypto experience (dummy), Finance experience (dummy), Computer science experience (dummy), Entrepreneurship experience (dummy)	Information Asymmetries	ICO token exchange listing causes higher future employment. When an ICO issuer has raised VC funding in the past, has a lockup period for its team, reserves some tokens in an incentive pool, makes voluntary disclosures via a white paper, provides a budget for the use of ICO proceeds, has a founder with experience as an entrepreneur or in computer science, and more, these factors are associated with lower failure rates and/or higher future employment. Success is linked to token sales that employ dynamic pricing methods, encourage transparency, crowdsource development by making source code available to the public on GitHub, and have sizable Telegram user bases. The most effective tokens in terms of helping the issuer in avoiding failure and achieving higher levels of future employment are those created with a utility feature giving access to future goods and services.	It is important to reduce information asymmetry and the use of bonding and certification strategies to reduce agency costs and improve ICO success. The results suggests that ICO issuers are mindful of the importance of transparency.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Masiak et al (2020)	Small Business Economics	104 weekly observations (01/01/17-30/12/18) of ICOs	Transaction data	Growth rate of ICO volumes, (log), Bitcoin returns and Ether returns (log)	Growth rate of ICO volumes, (log), Bitcoin returns and Ether returns (log)	Herding Behaviour	First study to analyse how the returns from one ICO influence the returns of subsequent ICOs and how these returns are driven by the overall cryptocurrency climate. For ventures conducting an ICO, it is important to consider the market timing. Entrepreneurs need to be aware of spill over and hype effects and carefully decide when to start their ICO campaign. While a hype surrounding one ICO positively influences subsequent ICO, when facing lower Bitcoin and Ether prices, entrepreneurial firms that have not yet started the ICO campaign should postpone.	The crypto and ICO market may be driven by irrational herding behaviour. Since ICOs are considerably publicized in media channels, this may lead to social contagion processes. Investors may simply follow others without considering all the facts or their own experience.
Roosenboom et al (2020)	Venture Capital	630 ICOs (2015-2017)	Transaction data	Soft cap hit (dummy), Funding percentage (%), Funding raised (number) and Token tradability (dummy)	Expert rating (1-5), Profile rating (0-5), GitHub_preICO (dummy), Insider token retention (%), Presale (dummy), Bonus scheme (dummy), Duration and Team members (number)	Information Asymmetries	A higher profile and expert ratings are more successful in raising funds and perform better ex-post. Having a pre-ICO GitHub repository, organising a presale for early investors, a shorter planned token sale duration, not having a bonus scheme, and having a larger project team is positively associated to fundraising success.	For entrepreneurs it is important to make the ICO as transparent as possible and for investors, expert ratings are a useful way in which to overcome the information asymmetry problems associated with token sales.
Sharma et al (2020)	Pacific-Bossin Finance Journal	2700 ICOs	Transaction data	Failed and Undersubscribed (dummy). Token Sale Price (number)	ICO size (log), Start bonus, VC backing (dummy) and Use of the social network (number)	Adverse Selection	Bigger sized ICOs and the provision of start bonuses are more likely to fail and/or to achieve lower token sale prices. VC backing has a positive impact on the token sale price and on returns, leading to a positive ICO performance; it is also positively associated with ICO failure and liquidity. The use of social network reduces the likelihood of failure and has a negative effect on the token sale price.	Start bonuses have a positive effect on the probability of an ICO failure, indicating that adverse selection plays a big role in the success of ICO. Using start bonuses implies platform weakness and a lack of confidence in the issuance process. VC backing has also a positive effect on the probability of ICO failure, that may be driven by the inexperience of the VC in a relatively new sector where the technology has not been tested yet or adverse selection effect where VC backed platforms are more aggressive in ICO offer price. VC' backing and token sale price have a positive relationship, confirming the presence of an adverse selection effect.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Ahmad et al (2021)	Economics of Innovation and New Technology	503 ICOS worldwide (2015-2018)	Transaction data	Soft cap (binary) and Hard cap (binary)	Bonus (binary), Presale (binary), Fin. Dev (index), Legal friendly (binary) and ETH (number);	Information Asymmetries and Signalling Theory	The probability of an ICO 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. However, bonuses and presale programs have a negative impact on the success of the ICO. Positive tendencies on the ETH market are also positively associated with the ICO success. Besides this, ICOs are more likely to be successful in economically developed countries with good financial and informational technology structure.	Signals need to be chosen carefully with a deep understanding of the specific ICO market features. Implementing excessive presale and bonus programmes may be counterproductive in the case of the ICO market, as such activities produce a negative signal of an aggressive and, consequently, unreliable marketing.
Boreiko and Risteski (2021)	Small Business Economics	472 ICOs (2013~2017)	Transaction data	Timing of investment (number), total funds raised (log)	Type of investor (dummy), Investors participation (%)	Information Asymmetries	Serial and large investors groups invest earlier, which can be explained by private information about ICO projects, obtained through learnings or higher effort. Although serial investors invest earlier, they do not possess the skills to select better ICOs.	Serial investors have more experience and are better informed than occasional contributors about the quality of the projects offering tokens for sale. However, in extreme information asymmetry scenarios, even experienced ICO investors fail in selecting better projects.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Campino et al (2021)	Journal of Business Economics	340 ICOs	Transaction data	Soft cap achieved (binary), Capital raised above the soft cap (log), Total capital raised (log)	Person location, Projects per person, LinkedIn connections, Education and Team elements (number). Previous managerial experience, Previous technology experience, Business degree, Technology degree (binary). Team rating and vision rating (%).	Human Capital Theory	Several team variables contribute to the success of a project, namely, the promoters' location, their networks, the size of the team and the ratings attributed to external parties concerning teams' aspects. However, characteristics related with promoters' education or professional experience do not play a relevant role defining the success of a project.	Human capital characteristics are important contributors for ICO success. Nevertheless, characteristics such as professional experience might not be the best signallers of human capital quality and might not be good predictors of successful projects since they do not necessarily mean expertise. Human capital theory should consider the role of larger and diversified teams' contribution to the successful outcome of ICO projects.
Fahlenbrach and Frattaroli (2021)	Financial Markets and Portfolio Management	306 ICOs (2016-2018)	Transaction data	Number of contributors (number)	Presale (dummy), Is a security (dummy), KYC/AML procedure (dummy), Hard cap size (log)	Behaviour of individual investors and Irrational investors behaviour	In ICOs with a high presale and/or a large presale discount, holding period returns for crowd sale investors are significantly lower. If there is a presale and the presale discount is substantial, large investors sell their shares earlier. Presale ICOs draw in more investors. KYC regulations boost investor numbers. Since a large founder share raises the danger of dilution for investors if the founders decide to sell the tokens in the secondary market, an increase in the fraction of tokens retained by the founders is connected with a drop in the number of investors.	As they sell the tokens before the product is produced, it appears that the purpose of participating in the ICO is not to prepurchase a product that they intend to utilize but rather to engage in speculation. Most of these tokens are not moved to another wallet belonging to the same investors, but rather sold on an exchange.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Hackober and Bock (2021)	Journal of Business Economics	649 ICOs	Transaction data	The amount of funding raised during the ICO (log), Survived (binary)	VC investor (binary), Reputation (binary), 1nsDays1stVCinvtoICO (number - days between the first funding event and the ICO), HHI (dummy), CVC investors (dummy)	Signalling Theory	Venture capital investors have a significantly positive effect on ICOs. The reputation, the time of treatment as well as the specialization of these type of investors has a positive influence on the ICO. Longer treatment periods have a significantly positive impact on the success of BTBFs (blockchain technology-based firms). Blockchain-specialized investors can provide better support and guidance to their BTBF portfolio companies. Hence, superior, and specialized industry knowledge seems to be decisive in blockchain.	VC investors send a signal to other ICO investors regarding the quality of the respective BTBF. Also, the signal that is generated when a VC investor conducts an investment into a BTBF is received by other stakeholders, helping to attract new highly skilled employees and to broaden the customer base as the VC investment represents a certification. Moreover, this certification gains additional importance due to a lack of signals which emerge from regulatory obligations such as audited accounts which exist in other funding contexts.
Xu et al. (2021)	Decision Support Systems	4286 ICOs	Transaction data	Amount of funds raised compared to the soft cap, Success (dummy)	Team Knowledge (work experience, innovation ability and social connection) and Expert Evaluation	Information Asymmetries	ICO success is predicted by team expertise and expert evaluations. A team with diverse team knowledge may have a higher chance of success with an initial coin offering. A team with diverse skills may be able to generate more money, which is an important tip for beginning businesses when putting up a strong team.	This study has substantial management implications because ICO markets are still in the early stages of growth and have high information asymmetry. Potential investors can prejudge the success likelihood of ICO ventures to safeguard themselves from investment failures. Potential investors can predict failure risk using the suggested approach, and they can then invest in reputable cryptocurrency ventures in ICOs.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Belitski and Boreiko (2022)	Journal of Technology Transfer	166 ICOs (2013-2017)	Transaction data	Total funds raised (log)	Whitepaper (binary), presence on GitHub (binary) and VC backing (binary)	Information Asymmetries and signalling theory	ICOs that obtained VC or business angel financing, before the campaign or during presale, have raised more funding. The publication of a whitepaper increases the number of investors, while it does not affect the amount raised and other ICO performance indicators. ICO founders who publish their project in the GitHub repository raise more funds, have more investors, are more likely to reach the hard cap and have higher ranking.	Describing how the token sale is organized sends a signal to investors and, consequently, induces higher participation. The ICO characteristics that serve as positive signals for ICO investors and enable to increase the size of fundraising are the following: the number of investors, funds contributed to the maximum target set by founders, ICO listing on Coinmarketcap, and token ranking.
Chitsazan et al. (2022)	Technological Forecasting and Social Change	78 empirical studies (2017-2022)	Transaction data	Amount of raised funds, Reaching the hard cap, reaching a percentage of the hard cap, Reaching the soft cap	Founders-related factors, ICO characteristics, Venture characteristics, market factors, Investor, and contextual factors	Signalling Theory	The founder's educational background, professional expertise in business, technology, academia, and other company boards all have a positive impact on the success of their ICO. The quantity of specialists involved in rating, the ICO's profile rating, and KYC requirements all appear to also have a substantial impact on ICO success. ICO structure, financial information, the structure of the whitepaper, governance considerations and geographical location are ICO-related elements that affect ICO success.	A company's human capital, measured by the number of advisers, team members, and place of origin of the team members, sends out encouraging signals that encourage investors to fund a particular ICO project. A presale, bonuses, length of launch, and ICO success are all substantially impacted by these elements. It has been noted that the type of token and the function of the token are important indicators of a' ICO's success.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Alshater et al. (2023)	Small Business Economics	80 empirical studies related to ICOs (2018-2022)	Transaction data	Successful Campaign, Funds raised, Post-ICOs trading activity and Investors' return	Whitepaper, Profiles of entrepreneurs and ventures, Social media, Role of advisors and Independent ratings	Information Asymmetries and Signalling Theory	A successful offer and more money raised are the results of voluntary disclosures concerning token rights, the project team, the size of the advisory committee, and technical information. A key factor in the success of an ICO is the use of positive language in tweets, the selection of advisors with extensive networks, and social media. In addition, the size, pricing, prior performance of ICOs, pre-sale, source code quality, shareholder rights, bonus, volatility of cryptocurrencies, and timing of ICOs are also crucial elements. The company also achieves success through registering ICOs, disclosing project source code, securing pre-ICO venture capital or business angel funding, and publishing white papers. Finally, the likelihood of success is higher in nations with developed financial markets, crowdfunding platforms, and ICO-friendly policies.	The success of ICOs is largely due to the information and signals provided in their white papers, which are crucial in minimizing information asymmetry. Additionally, unique content, readability, length, tone, complexity, and high-quality source code all transmit significant signals. Images of the team's confidence are a strong signal that influences the amount of money raised.
Aslan et al (2023)	Borsa Istanbul Review	2318 ICOs (2015-2020)	Transaction data	Success/Failure (Binary), Underpricing (number), Gross Proceeds (log) and post-ICO performance (number)	Soft cap and hard cap (number), Duration of offering (days)	Underpricing	Higher expert rating, lower fraction of distributed tokens, shorter token sale duration and not having a bonus scheme increase the chances of success for ICOs. Setting higher hard cap levels has a negative impact on the success of an ICO campaign.	Average underpricing in ICOs is considerable higher in comparison to IPOs because companies issuing ICOs are usually in the early stages of development and face uncertain future demand for their non-existent products. ICO offer price, market sentiment measured by the CCI30 cryptocurrency market index, and duration of an ICO campaign are significant drivers of underpricing.

Table 1. Literature review about ICO success *(Cont.)*

Study	Journal	Sample	Data	Dependent variable(s)	Key explanatory variables	Theoretical Framework	Key Findings	Contributions and Implications for the Theoretical Framework
Davydiuk et al (2023)	Management Science	5644 ICOs (2016-2018)	Transaction data	Amount of funds raised (log), Fundraising success (%), Tokens listed on an exchange (dummy), Working website (dummy), Product developed (dummy), Application available to download (dummy)	Fraction of tokens retained (%)	Information Asymmetries and Signalling Theory	ICO issuers that retain a larger fraction of their tokens are more successful in their funding efforts and are more likely to develop a working product. There is a positive relationship between the fraction of tokens retained by entrepreneurs and the quality of the ICO.	Retention is a stronger signal when markets are crowded, and investors do not have as much time to conduct due diligence and when the quality of public information about entrepreneurs decreases. In a market with more ICOs or more content available per ICO, investors cannot undertake as much due diligence per–ICO - they have less time to study each ICO. As a result, investors will rely more on signals of quality such as retention.
Our study	n.a.	191 ICOs	Transaction data	% Hard cap raised (log)	VC backing (binary), VC specialization, Stage of development (Product)	Signalling Theory and Third-party affiliation	We found evidence indicating that the ICO success is higher for firms affiliated with VC specialized on blockchain-based technologies and businesses, particularly if they are opaquer and riskier. The affiliation with one specialist VC led investors to buy more tokens. This effect is as greater as the incremental number of third-party affiliations with other specialized VCs. However, if early-stage firms possess a product/service to signal investors quality and marketability, the affiliation with a generalist VC play a certification role translated into higher the ICO's success.	Aligned with Hackober and Bock (2021), our findings suggest that specialized industry knowledge seems to be decisive in the area of blockchain. The affiliation with specialized VC reduces investors and market uncertainties. The specialization of VC backers in blockchain-based technologies offers a third-party certification of issuer's prospects (which is not observed for firms backed by generalists VC) and legitimize the market and the ICO itself. This certification gains crucial importance when the potential investors face higher adverse selection problems in seed stages, in a market extremely volatile and complex.

2.3 Third-party affiliation in ICOs and Research Hypotheses

Previous research points to the role played by information cascades among investors in crowdfunding (e.g., Vismara, 2018) and in IPOs (e.g., Aggarwal et al., 2002; Amihud et al., 2003). Information cascades occur when external information obtained from prior participants of an event supersede' one's individual private signal (Welch, 1992). Among individual investors, information cascades lead late investors to drive their investment decisions based on the behaviour of early investors (Masiak et al., 2020). In crowdfunding markets, uninformed investors are the most active promoters of cascades with positive effects on the functioning of these markets (Parker, 2014).

Early institutional investors, as VCs, may enhance the prestige of early-stage firms by providing a third-party endorsement signal about firm's quality to uninformed external investors. This third-party affiliation may play a crucial role to interpret noisy information conveyed by signals (Courtney et al., 2017), thus influencing the decision of further investors. In fact, Chemmanur et al. (2006) state that prior VC investment is the strongest signal of future growth rate, since the greater the backing the more optimistic will be retail investors about the firm.

Literature supports the extension of the role fulfilled by VCs beyond the traditional financial intermediation due to two factors. First, the selection effect. VCs invest in firms with a higher potential growth and, consequently, they are linked to companies with a higher future performance (Fisch et al., 2019). Prestigious institutional investors value their reputation highly and will consider carefully before investing, which creates a perception in the market that the firm must be of good quality (Ahlstrom and Bruton, 2006; Schwienbacher, 2007; Ahmad et al., 2021). Second, the treatment effect. VCs perform value-adding services, namely professional coaching, and provide access to their networks (Fisch et al., 2019). Networks and business linkages serve as critical channels for firms to access potential suppliers and customers, as well as other financial resources (Courtney et al., 2017). Together, these characteristics give the VCs a signalling (certification), and monitoring power that potential external investors can benefit from, by enhancing a venture's legitimacy and reputation.

The signalling and certification roles performed by VCs in helping entrepreneurs to raise capital has been largely studied. In IPO settings, extant literature shows that VCs play a certification role by increasing the value of companies going public and mitigating underpricing events (e.g., Megginson and Weiss, 1991; Baker and Gompers, 2003). This

evidence aligns with literature from entrepreneurial finance (e.g., Ahlstrom and Bruton, 2006; Schwienbacher, 2007). In crowdfunding, the affiliation with reputable third-party microfinance institutions, that pre-disburses the loan, is also proven to increase the campaigns success (e.g., Gama et al., 2023). Hence, it is not surprising that VCs have been also playing an increasing intermediary role in the emergence of new blockchain-based financial opportunities (Fisch and Momtaz, 2019).

In the ICO context, VC's backing benefits have been shown to be associated with higher amount raised, higher ranking and a higher likelihood to reach the hard cap (Belitski and Boreiko, 2022). These effects tend to be higher for younger firms (Fisch et al., 2019; Fisch et al., 2020; Bertoni et al., 2011; Busenitz et al., 2005). But these effects are not consensual. For example, Sharma et al. (2020) found that VC backing has a positive relationship with both the token sale price and returns, due to a significantly higher price observed in the public sale compared to the pre-sale one, but a negative relationship with ICO success. As there is still no consensus in the role played by VCs in this new digital finance method, we start our empirical research from the following standard hypothesis:

Hypothesis 1 (H1): *VC's backed firms have higher success on ICO than non-backed firms.*

In this study, we posit that the affiliation effect is not independent of the level of market and investor's uncertainty. Investor uncertainty and information asymmetry are closely related, as it occurs when investors lack confidence in their ability to predict the future market development and the potential performance of their investments (Fisch et al., 2022). Such common factors in the ICO may lead investors to be uncertain about the value and risks associated with their investments, which can result in higher reluctance to invest in the ICO. Market uncertainty relates to uncertainty in the demand for a firm's offering and is mainly determined by exogenous factors such as customer preferences and competition (Fisch et al., 2022). In the ICO, many early-stage firms lack a prototype or product/service to demonstrate to potential investors (Fahlenbrach and Frattaroli, 2021). For potential investors it is difficult to assess how the market will react to an unexperienced product. In such cases, potential investors are essentially investing in the promise of a future return that may or may not materialize. In this scenario adverse selection problems might occur. Hence, we argue that the role of VCs in certifying the quality of an early-stage project is particularly important. Besides the potential to mitigate information asymmetry between firms and

investors, VCs mitigate market uncertainties about future returns by leveraging their reputation to assure the quality of the firm. Therefore, formally we hypothesize that:

> Hypothesis 2 (H2): *The advantage of VC-backing is higher for ICO' issuers not possessing a product or service to demonstrate.*

The ICO market is extremely volatile and complex (Ibba et al, 2018). Market' actors still struggling to have a comprehensive knowledge on blockchain-based opportunities, crypto assets, and technological risks (Hackober et al., 2021; Fisch, 2019). Negative investor sentiment can undermine the ability of early-stage firms to attract the capital they need from this new digital financing market (Alshater et al., 2023).

Literature shows that higher team profile (Roosenboom, 2020; Alshater et al., 2023), and experience (Gompers et al., 2009; Gu et al., 2018) and third-party expert evaluation (Xu et al., 2021) plays an important role in the success of ICO. ICO success may also depend on the expertise of VC, namely their knowledge on the complex technologies in which ICO operates. In markets characterized by significant technological uncertainty and complexity, establishing partnerships with reputable players can enhance a firm's legitimacy and credibility, which, consequently, can have a significant impact on a firm's prospects for success (Chang, 2004). However, merely being backed by a VC has been proven to be insufficient for the success of an early-stage firm. In a new sector where the product has not yet been tested in the market, having an inexperienced VC as a supporter of the platform can increase the likelihood of ICO's failure (Sharma et al., 2020).

One can argue that third-party endorsements can influence potential investors, but only if those parties are experts in a particular field and can accurately assess quality in uncertain circumstances. Otherwise, they could wrongly screen the better ICOs or, even, lead the early-stage firms to failure, due to flawed advice. Vanacker and Forbes (2016) show that campaigns supported by VCs with industry-specific experience have a greater impact on financial resource providers than does media exposure. When potential investors recognize that a VC possesses a significant expertise in a particular industry, they are more likely to positively perceive the VC's reputation, since the accumulation of such knowledge is considered valuable information about the VC's ability to choose and guide a company effectively. Therefore, we posit that the effects of VC's specialization on blockchain technologies may also influence the effect of third-party affiliation under the certification hypothesis. Formally, we hypothesize the following hypotheses:

Hypothesis 3 (H3): *Firms backed by specialized VC have higher success on ICO than the counterparts.*

Hypothesis 4 (H4): *The effect of specialized VC-banking on ICO success is particularly higher for issuers not possessing a product or service to demonstrate.*

3. Data, variables, and method

3.1 Data

We use primary and secondary market data, publicly available, collected by Fahlenbrach and Frattaroli (2021) on 306 completed ICOs, between March 2016 and March 2018. As data from smaller ICOs is usually scarce or unavailable, to construct the sample, Fahlenbrach and Frattaroli (2021) have retained only records of ICOs, from which the total amount of funding exceeded $1 million and that share similarities between each other in terms of industry composition, variation in state of incorporation, fraction with KYC[1] policies and similar number of employees. For the characteristics of those ICOs, they have exclusively relied on primary sources such as whitepapers or other documents published by issuers. To ensure the quality of the data, the authors have hand collected information on token sales from primary sources and collected information on the exact split of funds raised from presale and crowdsale investors, the pricing schedules for both, founder token vesting schedules and whether a VC has invested into the issuer prior to the ICO. Due to missing values, our final sample includes 191 ICOs. Data on Ethereum's market prices were collected from coinmarketcap.com, a website that aggregates traded prices from all cryptocurrency exchanges. Data on Financial Development Index were collected from the International Monetary Fund database.

3.2 Variables

Table 2 contains detailed definitions and sources of the dependent and independent variables used in the empirical analysis.

[1]Financial institutions use Know-Your-Costumer (KYC) guidelines for the identity verification of a costumer and to determine whether a costumer is eligible for a given transaction. Blockchain technology is proposed in the literature as an infrastructure for decentralized KYC that is able to improve costumer experience, minimize future costs and associated risks (Malhotra et al., 2022; Ostern et al., 2021).

Table 3. Variables definition

Variables	Type	Definition	Data Source
Dependent variable			
Hardcap_raised	Percentage	Fraction of the maximum amount the company manages to raise during its ICO.	Fahlenbrach and Frattaroli (2021)
Independent variables			
Main covariates			
VC	Binary	Binary variable: =1 if the issuers is backed by a venture capitalist, =0 otherwise.	Fahlenbrach and Frattaroli (2021)
VC_G	Binary	Binary variable: =1 if the issuers is backed by venture capitalists (only) generalist in blockchain support, =0 otherwise	Fahlenbrach and Frattaroli (2021)
VC_S	Binary	Binary variable: =1 if the issuers is backed by at least one venture capitalist's specialist in blockchain support, =0 otherwise	Fahlenbrach and Frattaroli (2021)
Product	Binary	Binary variable: =1 if the product/service for which funding is being raised or an early "alpha" or "beta" version of it has been developed; =0 otherwise (i.e., seed stage)	Fahlenbrach and Frattaroli (2021)
Controls			
Campaigns			
Roadmap	Binary	Binary variable: =1 if there is a whitepaper containing a roadmap with dates and milestones for the development and commercialization of the product; =0 otherwise.	Fahlenbrach and Frattaroli (2021)
Whitepaper	Discrete	Number of pages in the whitepaper document.	Fahlenbrach and Frattaroli (2021)
Investors ID	Binary	Binary variable: =1 if the ICO's promoter required participants to identify themselves by submitting personal documents such as a passport copy, utility bills, etc.; =0 otherwise	Fahlenbrach and Frattaroli (2021)
Maturity	Discrete	Number of days between ICO start date and planned end date	Fahlenbrach and Frattaroli (2021)
Issuer			
Age	Discrete	Years since the founding team started working on the project for which the ICO is being conducted, rounded to the nearest integer (where unavailable, the date of incorporation from the commercial register is used).	Fahlenbrach and Frattaroli (2021)
Market			
ETH yield	Continuous	90-day yield of Ethereum	Coin market
Country			
Financial Development	Index (Ranging from 0=low to 1=high)	Ranking of countries on the depth, access and efficiency of the financial institutions and financial markets.	IFM

3.2.2 Dependent Variable

Following Davydiuk et al. (2023) and Roosenboom et al. (2020) we examine the percentage of the hard cap raised as measure of ICO success, which includes funds raised whilst the crowdsale and presale stages. *Hardcap_Raised* is the ratio (in %) between the amount raised in the ICO and the cap target amount (i.e., the hard cap). To improve the fit of our model we use this variable in the logarithm form as it allows us to reduce the skewness of the variable distribution, thus transforming the distribution of our measure of success to a more normally (shaped bell) curve.

3.2.2 Independent Variables

Main Covariates

To test the hypothesis H1, we use the variable *VC*, a binary variable that takes the value 1 if the issuers is backed by a Venture Capitalist, and 0 otherwise. To test the hypothesis H2 we rely on the binary variable *Product* that takes the value 1 if firm has a product/service in an early "alpha" or "beta" version, and 0 if the firm does have a product/service to demonstrate. To test hypothesis H3 we use a set of two binary variables: *VC_G* that takes the value 1 if the firm is backed only by VC non-specialized in blockchain, and 0 if the firms is not backed by a VC at all; *VC_S* that takes the value 1 if the firm is backed by at least one VC specialized in blockchain-based technologies and businesses, and 0 if the firms is not backed by a VC at all. To test hypothesis H4 we rely on the interaction term *VC_S* x *Product* (and *VC_G* x *Product*).

Control Variables

Following literature on ICO' signalling instruments, we divide our independent variables into 3 main control groups: campaigns, issuer, market and country characteristics. Regarding the ICOs' campaigns characteristics, we control for: the existence of a project *Roadmap* (a binary variable that takes the value 1 if there is a whitepaper containing a roadmap with dates and milestones for the development and commercialization of the product) (e.g. Adhmad et al., 2021); the number of pages in the *whitepaper* document (e.g. Davydiuk et al., 2023; Amsden et al., 2018); the *investors ID* (a binary variable if the ICO's promoter required participants to identify themselves by submitting personal documents such as a passport copy or utility bills) (e.g.Davydiuk et al., 2023; Fisch and Momtaz, 2019; Burns and Moro; 2018; Aslan et al.,

2023); and lastly, the ICO' *Maturity* as the number of days between ICO start date and planned end date (e.g. Roosenboom et al., 2020; Xu et al., 2021).

We also control the issuers' *Age* as the number of years since the founding team started working on the project for which the ICO is being conducted, rounded to the nearest integer, and when it is not feasible, the date of incorporation from the commercial register is used (e.g., Fisch et al., 2022; Lin et al., 2022). Market and Country characteristics are captured by the *ETH yield*, that studies the 90-day return of Ethereum close prices (e.g. Ahmad et al., 2021), and the *Financial Development* that ranks the country in which the ICO was launched, in terms of depth, access and efficiency of the financial institutions and financial markets, in the range of 0 to 1 (e.g. Huang et al., 2020; Ahmad et al., 2021).

3.3 Descriptive statistics

Table 3 reports the descriptive statistics. Table 4 displays the correlation matrix of the different covariates used. The correlation coefficients reported does not indicate that multicollinearity is a problem.

Table 4. Descriptive Statistics

Variables	Measure	# Obs.	Mean	Std. dev.	Min	Max
Dependent variable						
Hardcap_raised	%	191	71.162	39.046	2	181
Independent variables						
VC	Binary (1=VC backed; 0=otherwise)	191	0.251	0.435	0	1
VC_G	Binary (1=VC backed by a specialist; 0=otherwise)	191	0.068	0.253	0	1
VC_S	Binary (1=VC backed by a generalist only; 0=otherwise)	191	0.183	0.388	0	1
Product	Binary (1=yes; 0=no)	191	0.534	0.500	0	1
Controls						
Campaigns						
Roadmap	Binary (1=yes; 0=no)	191	0.812	0.392	0	1
Whitepaper	Discrete (#pages)	191	30.529	17.064	0	89
Investors ID	Binary (1=yes; 0=no)	191	0.550	0.499	0	1
Maturity	Discrete (#days)	191	31.859	22.342	1	148
Issuer						
Age	Discrete (#years)	191	1.644	1.892	0	9
Market & Country						
ETH yield	Continuous (g)	191	2.003	2.677	-0.436	12.351
Financial Development	Index (ranging 0(low)-1(high))	191	0.707	0.220	0.101	0.967

On average, the ICOs in our dataset raises 71% of the amount defined for the hard cap (standard deviation=39 pp). We use log of this variable as the key measure of ICO success in our multivariate analysis in order to lessen the skewness of the sample due to a high standard deviation in relation to the variable's average. Regarding the independent variables, 25.1% of the ICOs are backed by a venture capitalist, 6.8% by generalist VCs and 18.3% backed by at least one VC specialist in blockchain-based solutions. Only 53.4% of early-stage firms already has a product or prototype developed when the ICO is launched. 81% of ICO' issuers provides a roadmap with dates and milestones for the development and commercialization of the product/service. Significant discrepancies are found in the whitepaper's length. While some did not contain any pages with information, because the whitepaper did not exist or was not reported, other whitepapers contain 89 pages maximum. The mean value of the whitepaper length is 31 pages. We also observe that 55% of the ICOs has implemented KYC procedures. On average, ICO's are opened for 32 days since the moment it was launched until the planned end date. Relatively to the issuer, on average, it takes 1.6 years to issue tokens in an ICO since the moment they start working on the project. Finally, when examining market and country characteristics, we find that, on average, Ethereum has a positive 90-day return, with the price in the moment of the ICO launch being two times greater than de price 90 days before. The majority of the ICOs included in our dataset are well developed in terms of the breadth, accessibility, and effectiveness of the financial institutions and financial markets, according to the average of the Financial Development (i.e., 0.7, ranking from 0 to 1).

3.4 Model

To test our research hypothesis H1 and H2 we employ an Ordinary Least Squares (OLS) regression model, as follows:

$$\ln(Hardcap\_raised)^{OLS} = \beta_{0i} + \beta_{1i} VC + \beta_{2i} Product + \beta_{3i}(VC \times Product) + \sum_{k=1}^{7} \gamma_{ki} Z_k + \varepsilon_i \quad \text{eq (1)}$$

Hypotheses H3 and H4 are tested by estimation the following OLS model:

$$\ln(Hardcap\_raised)^{OLS} = \beta_{0i} + \beta_{1i} VC\_G + \beta_{2i} VC\_S + \beta_{3i} Product + \beta_{4i}(VC\_GxProduct) + \beta_{5i}(VC\_SxProduct) + \sum_{k=1}^{7} \gamma_{ki} Z_k + \varepsilon_i \quad \text{eq (2)}$$

where Z is the vector of k control variables, and ε the error term.

Table 5. Correlation Matrix (Covariates)

		1	2	3	4	5	6	7	8	9	10	11
Independent variables												
VC	**1**	1.0000										
VC_G	**2**	0.4665*	1.0000									
VC_S	**3**	0.8176*	-0.1280	1.0000								
Product	**4**	0.1057	0.0857	0.0626	1.0000							
Controls												
Campaigns												
Roadmap	**5**	-0.1529*	0.0239	-0.1870*	0.1134	1.0000						
Whitepaper	**6**	-0.0776	-0.0035	-0.0847	0.1709*	0.1904*	1.0000					
Investors ID	**7**	0.1119	0.0357	0.1023	0.1672*	0.1289	0.2618*	1.0000				
Maturity	**8**	-0.0700	-0.0571	-0.0413	0.0289	-0.0031	-0.0660	-0.0596	1.0000			
Issuer												
Age	**9**	0.2501*	0.0620	0.2400*	0.0908	0.0723	0.2278*	0.1527*	0.0289	1.0000		
Market & Country												
ETH yield	**10**	0.1520*	-0.0778	0.2211*	-0.0840	-0.1441*	0.0552	0.0090	-0.1736*	0.1115	1.0000	
Financial	**11**	0.0535	0.0555	0.0239	0.0275	0.0398	0.0299	0.0887	0.0601	-0.0322	0.0687	1.0000

* p-value<0.05

4. Main Findings

In this section, we examine the estimations obtained from eq.1 (Table 5) and eq.2 (Table 6). Column I.1 displays the model with the *VC* dummy variable(s). In Column I.2 we add the dummy variable *Product*. Column II includes control variables. Column(s) III display the full model with the cross effects between *VC* (and VC type) and *Product*. All *p-values* are based on robust standard errors (reported in parenthesis).

Table 5 reports a positive and statistically significant coefficient for the variable *VC* (Columns I.1-II, $p<0.01$). This result reveals that early-stage firms backed by venture capitalists prior the ICO have higher success than non-backed firms as the ability of the formers to achieve their hard cap is statistically higher than the latter ones. This evidence is in line with hypothesis H1. As anticipated, our estimates also report a positive and statistically significant coefficient for *Product* (Column I.2-II, $p<0.05$). Having a product/service developed at the time of the crowdsale increases the ability to raise more capital. The magnitude of the coefficients of our main dependent variables suggest that, even though both aspects help the ICO succeed, it seems that being backed by a VC has a greater influence on the success than the ability to have a product or a prototype to show prior to the ICO ($\beta_{VC} > \beta_{Product}$).

Of particular relevance for our study is the effect of *VC*'affiliation on the association between the *Product* and the ICO's success. As many of early-stage firms do not have any product or prototype to demonstrate and mitigate investors and market uncertainties (in our sample 46,4%), it is critical to examine the role played by VCs, as third-party quality signaller, for those firms. Column III report a negative and statistically significant coefficient for the interaction term *VC x Product* ($p<0.05$), whilst the coefficients of the constitute terms *VC* and *Product* remain positive and statistically significant (Column III, $p<0.01$). The negative coefficient of the interaction terms suggests that the positive effect we found of the VC affiliation on ICO's success is lower for firms that have a product to demonstrate. Linear combinations reported in Column III illustrate this main finding. Early-stage firms backed by a VC without a product (VC=1 & Product=0, Lincom=0.646, $p<0.01$) raise more e^64.6 percentage points(ppts), at mean, in terms of ICO's hard cap than non-VC's backed firms without a product (i.e., the base outcome group), whereas firms backed by a VC with a product (VC=1 & Product=1, Lincom=0.587, $p<0.01$) raise e^58.7 ppts more than the base outcome. In practice, VC-backing has a higher impact on the success of the ICO when the

issuer lacks a finished product or a working prototype, and, consequently, when the information asymmetry is greater. These results are consistent with Hypothesis H2.

Table 6. VC' backed issuer effect (binary). Dependent Variable: ln (Hardcap_raised). Method: OLS

	Column I		**Column II**	**Column III**
	Main Variables		[+ Controls]	[+ Cross effects]
Variables	**I.1**	**I.2**	**II**	**III**
Dependent variable				
VC	0.418***	0.384***	0.361***	0.646***
	(0.108)	(0.108)	(0.112)	(0.189)
Product		0.278**	0.289**	0.406***
		(0.125)	(0.120)	(0.154)
Interactions				
VC x Product				-0.465**
				(0.230)
Linear combinations				
VC=0 & Product=1				0.406***
				(0.154)
VC=1 & Product=0				0.646***
				(0.189)
VC=1 & Product=1				0.587***
				(0.152)
Controls				
Campaigns				
Roadmap			0.380**	0.366**
			(0.174)	(0.172)
Whitepaper			-0.008**	-0.008**
			(0.004)	(0.004)
Investors ID			0.194	0.201
			(0.133)	(0.133)
Maturity			-0.002	-0.002
			(0.002)	(0.002)
Issuer				
Age			-0.034	-0.048
			(0.034)	(0.035)
Market & Country				
ETH yield			0.041**	0.044**
			(0.020)	(0.020)
Financial Development			0.547*	0.565*
			(0.318)	(0.317)
Intercept	3.898***	3.758***	3.250***	3.211***
	(0.079)	(0.109)	(0.313)	(0.316)
Observations	191	191	191	191
R-squared	0.043	0.068	0.162	0.174

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Regarding our controls, the estimates report a positive and statistically significant coefficient for the variables *Roadmap* ($p<0.05$), *Financial Development* ($p<0.1$) and *ETH yield* ($p<0.1$). This suggests that having a roadmap with dates and milestones for the development and commercialization of the product, the financial development of the country to which the early-stage firm belongs, and positive changes in the price of Ethereum, used as a proxy for the overall market for crypto-assets, all positively impact the ICO success. Contrary to our expectations, the results report a negative and statistically significant coefficient for *Whitepaper* ($p<0.05$). Contrary to the findings of Samieifar and Baur (2021), we conclude that having a higher number of pages in the whitepaper document has a negative impact on the amount raised. This may suggest that longer whitepapers may provide noisy signals, perhaps some of them contradictory, discouraging some investors to engage in the ICO (Goldstein and Yang, 2019; Courtney et al., 2017). The number of years the founding team had been working on the company before the launch, KYC requirements, and the length of the ICO have no appreciable effects on our model.

Table 6 displays our estimates regarding the role played by VC's historical association with businesses using blockchain technology on the success of the ICO (eq.2). The variable *VC_S* reports a positive and statistically significant coefficient (Column I.1–II, $p<0.01$), whereas the variable *VC_G* has no impact on the success of ICOs across the model (Column I.1–II, $p>0.10$). This evidence suggests that early-stage companies backed by specialized VC prior to the ICO are better equipped to succeed in ICO' campaigns than those backed by generalist VCs, who seem to have similar ability to be well-succeeded than non-VCs-backed firms. This leads us to conclude that VC backing itself cannot forecast the success of an ICO, which recommend some cautions when concluding about not rejecting our hypothesis H1. In turn, the value of VC affiliation to mitigate uncertainties depends on their industry-specific-specialization. This particularly aligns with our Hypothesis H3, namely with the theoretical arguments pointing to a positive effect of specialized third-party affiliation and to the certification hypothesis on the investors' engagement and ICO's success.

The effect of the product development on the hard cap amount raised is consistent with that reported in the previous model (Table 5). Our estimates show a positive and statistically significant coefficient for *Product* (Column I.2-II, $p<0.05$). Column III reports the effect played by third party affiliation with a specialized VC on the association between *Product* and ICO success. The coefficient of the interaction term *VC_G x Product* is not statistically significant (Column III.1, $p>0.10$). This aligns with evidence reported in Column

I-II.2, thus suggesting that the association with a VC not specialized in blockchain-based technologies does not impact the ability of firms to fulfil the ICO's target funding goal. Linear combinations reported in Column III.1 provide a more detailed analysis of this effect. The success of ICO's issued by firms without a product is not statistically different between backed by a generalist VC and those firms not backed at all (VC_G=1 & Product=0, Lincom=-0.024, p>0.10). Nevertheless, linear combinations also show that among firms with a product, those backed by a generalist VC (VC_G=1 & Product=1, Lincom=0.536, p<0.01) raise higher amount of funds (in % of the hard cap) than those without a VC' affiliation (VC_G=0 & Product=1, Lincom=0.273, p<0.05). In a nutshell, this mixed evidence suggest that the affiliation with generalist VC does not play a role to mitigate uncertainties in higher information asymmetry contexts; but, if early-stage firms possess a product/service to signal investors quality and marketability, the affiliation with a generalist VC play a certification role translated into higher the ICO's success.

The coefficient for the interaction term *VC_S x Product* is negative and statistically significant (Column III.2, p<0.01), whereas the constitute terms of the interaction, i.e., *VC specialist* and *Product,* remain positive and statistically significant (Column III.2, p<0.01). This suggests that the positive effect of VC specialization decreases when businesses have a product to show to potential investors. In other words, the role that a VC specialist has on early stages without a product (VC_S=1 & Product=0, Lincom=0.822, p<0.01) is higher than on firms with a product (VC_S=1 & Product=1, Lincom=0.6, p<0.01). In line with Hypothesis H4, this suggests that the value of third-party affiliation with a specialist VC is crucial to mitigate the lower ICO's attractiveness faced by issuers lacking a product/service or a functional prototype. The effects of the control variables remain consistent to those reported in Table 5.

Table 7. VC type effect (binary). Dependent Variable: ln (Hardcap_raised). Method: OLS

	Column I		Column II	Column III	
	Main Variables		[+ Controls]	[+ Cross effects]	
Variables	**I.1**	**I.2**	**II**	**III.1**	**III.2**
Dependent variable					
VC_G	0.249	0.195	0.171	-0.024	0.160
	(0.202)	(0.189)	(0.152)	(0.363)	(0.148)
VC_S	0.480***	0.453***	0.443***	0.445***	0.822***
	(0.107)	(0.110)	(0.124)	(0.124)	(0.171)
Product		0.283**	0.291**	0.273**	0.412***
		(0.126)	(0.119)	(0.126)	(0.143)
Interactions					
VC_G x Product				0.287	
				(0.394)	
VC_S x Product					-0.633***
					(0.218)
Linear combinations					
VC_G=0 & Product=1				0.273**	
				(0.126)	
VC_G=1 & Product=0				-0.024	
				(0.363)	
VC_G=1 & Product=1				0.536***	
				(0.154)	
VC_S=0 & Product=1					0.412***
					(0.143)
VC_S=1 & Product=0					0.822***
					(0.171)
VC_S=1 & Product=1					0.600***
					(0.169)
Controls					
Campaigns					
Roadmap			0.394**	0.403**	0.392**
			(0.175)	(0.177)	(0.171)
Whitepaper			-0.008**	-0.008**	-0.008**
			(0.004)	(0.004)	(0.004)
Investors ID			0.188	0.180	0.182
			(0.132)	(0.133)	(0.132)
Maturity			-0.002	-0.002	-0.002
			(0.002)	(0.002)	(0.002)
Issuer					
Age			-0.036	-0.033	-0.048
			(0.034)	(0.034)	(0.034)
Market & Country					
ETH yield			0.037*	0.037*	0.040**
			(0.020)	(0.020)	(0.020)
Financial Development			0.559*	0.547*	0.555*
			(0.317)	(0.321)	(0.315)
Intercept	3.898***	3.755***	3.241***	3.247***	3.202***
	(0.079)	(0.109)	(0.313)	(0.316)	(0.315)
Observations	191	191	191	191	191
R-squared	0.047	0.072	0.166	0.168	0.185

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Additional Analysis

In this section we extend our analysis on the relevance of VCs to ICO success by looking at the number of VCs (and VC specialists). In other words, we replace VC's binary variables by discrete variables measuring the number of VC (generalists and specialists) that support ICOs' issuers. This additional analysis is relevant as the same firm may have a mix of generalist and specialist VCs which is ignored by our previous estimates. The descriptive statistics of these variables are reported in Table 7. The results are reported in Tables 8 and 9.

Table 8. Descriptive Statistics (additional analysis) - number of VCs

Variable	Definition	Sample	# Obs.	Mean	Std. Dev.	Min	Max
#VC	Total number of VCs that backed the ICO.	Full Sample	191	0.681	1.663	0	11
		VC-backed firms	48	2.708	2.361	1	11
#VC_G	Total number of generalist VCs that backed the ICO.	Full Sample	191	0,330	1.081	0	8
		VC-backed firms	48	1,313	1.847	0	8
#VC_S	Total number of specialist VCs that backed the ICO.	Full Sample	191	0.351	0.945	0	8
		VC-backed firms	48	1.396	1.455	0	8

Table 8 reports a positive and statistically significant coefficient for the variable *#VC* (Column I.1-II, $p < 0.01$) and for the variable *Product* (Colum I.2, $p < 0.05$). These results are consistent of those reported in Table 5. However, the interaction effect between *#VC Product* on the ICO success are statistically insignificant (Column III, $p>0.10$), indicating that the number of VCs supporting the early-stage firm does not affect the amount of hard cap raised when a product/services or a prototype is available at the time of the ICO. Hence, the number of VCs backing the ICO's issuer is not relevant in this signaling channel among safer firms (Column III, #VC & Product=1, Lincom=0.045, $p>0.10$). But, among firms without a product to show to the crowd of investors, an increase of the number of VCs backing the issuer increases the percentage of hard cap raised, as shown by linear combinations (#VC & Product=0, Lincom=0.115, $p<0.01$). This suggest that for more opaque and risky firms, the signaling effect of the affiliation with VCs is as higher as the number of affiliations.

Table 9. Effect of the number of VCs backing the issuer. Dependent Variable: ln (Hardcap_raised+1). Method: OLS

	Column I		Column II	Column III
	Main Variables		[+ Controls]	[+ Cross effects]
Variables	**I.1**	**I.2**	**II**	**III**
Dependent variable				
#VC	0.109***	0.106***	0.361***	0.361***
	(0.022)	(0.021)	(0.135)	(0.135)
Product		0.301**	0.313***	0.362***
		(0.124)	(0.119)	(0.136)
Interactions				
#VC x Product				-0.070
				(0.051)
Linear combinations				
#VC & Product=0				0.115***
				(0.033)
#VC & Product=1				0.045
				(0.039)
Controls				
Campaigns				
Roadmap			0.326*	0.318*
			(0.170)	(0.170)
Whitepaper			-0.008**	-0.009**
			(0.004)	(0.004)
Investors ID			0.202	0.219
			(0.132)	(0.135)
Maturity			-0.002	-0.002
			(0.002)	(0.002)
Issuer				
Age			-0.029	-0.031
			(0.032)	(0.032)
Market & Country				
ETH yield			0.039*	0.038*
			(0.020)	(0.020)
Financial Development			0.555*	0.569*
			(0.318)	(0.320)
Intercept	3.929***	3.770***	3.304***	3.294***
	(0.071)	(0.107)	(0.308)	(0.309)
Observations	191	191	191	191
R-squared	0.043	0.073	0.158	0.162

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 reports the estimates for the number of generalist and specialist VC. The results reveal a non-statistically significant effect of the number generalist VCs when we include the variable *Product* in the model (i.e., Column II, p>0.1) and a positive and statistically significant coefficient for *#VC_S* (Column I.1-II, p < 0.01), in line with evidence reported in Table 6. However, when we include the interaction term *#VC_G x Product*, which is non-statistically significant (Column III.1, p>0.10), the coefficient of the constitutive term *#VC_G* turns to positive and statistically significant (Column III.1, p<0.05). As the linear

combinations reveal, this evidence suggest that the number of generalist VCs is relevant for issuers without a product to show (Column III.1, #VC_G & Product=0, Lincom=0.097, $p<0.05$) but not for those with a product (#VC_G & Product=1, Lincom=0.010, $p>0.10$). This result does not align with that reported in Table 6-Column II.1. Similar effects are reported for specialist VCs. For generalist VCs, the results from Table 6 and Table 9 suggest that, while being or not affiliated with a generalist VC is relevant for companies with a product– i.e., less opaque, and less riskier ones–, the number of generalist VCs is not relevant for the success of the ICOs issued by early-stage firms with a product/service (Table 9). In turn, the success of ICOs issued by more opaque and risky firms depends on the number of generalist VCs associated with them (Table 9). Regarding the VC specialization effect, the results show that an increase of the number of specialized VCs affiliated with the ICO' issuer produces an incremental positive effect on ICOs success only for more opaque firms. We discuss these results in section 6.

Table 10. Effect of the number of VCs backing the issuer by type. Dependent Variable: ln(Hardcap_raised+1). Method: OLS

	Column I		Column II	Column III	
	Main Variables		[+ Controls]	[+ Cross effects]	
Variables	**I.1**	**I.2**	**II**	**III.1**	**III.2**
Dependent variables					
#VC_G	0.076**	0.075***	0.051	0.097**	0.046
	(0.031)	(0.028)	(0.033)	(0.048)	(0.034)
#VC_S	0.149***	0.144***	0.130**	0.121**	0.174*
	(0.043)	(0.036)	(0.052)	(0.052)	(0.097)
Product		0.300**	0.307**	0.337***	0.340**
		(0.125)	(0.119)	(0.129)	(0.133)
Interactions					
#VC_G x Product				-0.087	
				(0.069)	
#VC_S x Product					-0.091
					(0.114)
Linear combinations					
#VC_G & Product=0				0.097**	
				(0.048)	
#VC_G & Product=1				0.010	
				(0.050)	
#VC_S & Product=0					0.174*
					(0.097)
#VC_S & Product=1					0.083
					(0.069)
Controls					
Campaigns					
Roadmap			0.339*	0.335*	0.332*
			(0.172)	(0.172)	(0.173)
Whitepaper			-0.008**	-0.008**	-0.008**
			(0.004)	(0.004)	(0.004)
Investors ID			0.203	0.215	0.212
			(0.132)	(0.134)	(0.134)
Maturity			-0.002	-0.003	-0.002
			(0.002)	(0.002)	(0.002)
Issuer					
Age			-0.029	-0.030	-0.032
			(0.032)	(0.032)	(0.032)
Market & Country					
ETH yield			0.034	0.035	0.033
			(0.022)	(0.022)	(0.022)
Financial Development			0.573*	0.589*	0.572*
			(0.319)	(0.321)	(0.320)
Intercept	3.925***	3.767***	3.288***	3.278***	3.289***
	(0.072)	(0.107)	(0.309)	(0.310)	(0.311)
Observations	191	191	191	191	191
R-squared	0.045	0.075	0.160	0.163	0.162

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6. Discussion

The signalling and certification effects of the affiliation with Venture Capitalists (VCs) has been extensively examined in initial public offerings (IPO) and on crowdfunding platforms. We extend the knowledge on this topic to the Initial Coin Offering (ICO) context, which has not been sufficiently explored in the literature. Due to novelty of this market, its complexity, lack of regulation, and greater information asymmetry faced by investors, early-stage firm's affiliation with VC, particularly with VC specialized in blockchain-based technologies, might play a key role to overcome these problems. We establish the importance of third-party signalling in the performance of ICOs and contrast the causal influence of VCs' investment (and its specialization) in campaigns with higher opaqueness, in an effort to expand and encourage developing research in new financing instruments.

Overall, the results show that ex-ante VC funding has a favourable impact on the ability of early-stage firms to be well-succeeded in an ICO (see Table 5). To a better understanding of the influence that third-party affiliation with VCs might have on ICOs, we expanded our research to the signalling entrepreneurial finance literature by shedding light on how different signals operate in certain signalling environments. For this purpose, we confront third-party signals with the presence/absence of a product or prototype developed ex-ante the ICO, as a measure of low/high investors and market uncertainties associated with high/low firm's development stage. While the presence of a product or a service to demonstrate to the crowd of investors (ex-ante the ICO) is an indicator of the firm's quality and lower uncertainties, thus acting as a positive signal for investors as confirmed by our models, VCs come out to be the most relevant signal to investors, as the magnitude of the coefficients of the variable *VC* are consistently higher than those of the *Product* across our models. Among firms not possessing a finished product or prototype to show to potential investors, the impact of VC affiliation is amplified (Table 5). This evidence aligns with theoretical arguments in which we ground our Hypothesis H2, i.e., third-party affiliation is more important for firms and investors facing greater information asymmetries and uncertainties (Chang, 2004; Jeong et al., 2020).

We also show that retail investors tend to rely on the reputation of VCs, coming from their specialization on blockchain-based technologies and businesses, to screen better quality and risk of the ICO and its issuer and to take the investment decision. Overall, ICOs issued

by firms affiliated with specialized VC perform better than those issued by firms affiliated with generalist VCs or by firms not affiliated with a VC at all (see Table 6).

Due to the novelty and complexity of ICO market, VCs with less industry experience occasionally struggle to identify the most promising companies and inadvertently direct investors to incorrect decisions (Bertoni et al., 2011). By being backed by a specialized VC, early-stage firms can increase the proportion of hard cap raised, as it reassures other possible resource providers and serves as a trustworthy and favourable indication about the quality of the issuer, as opposed to a VC without experience in blockchain technology-based businesses. Regardless of their level of industry expertise, our findings also demonstrate that early-stage firms perform better when the number of VCs supporting the ICO increases (see Table 8). Nevertheless, this result is not linear. The signalling and certification effects of the affiliation with a specialized VC, particularly (but not exclusively) for investors in ICO issued by more opaque firms, are recognized by the simple association with at least one specialized VCs (see in Table 6-Column III.2). However, investors demand complementary signals from more than one specialized VCs to certify the quality of the issuer if the firm does not have any product or service at least as a showcase (Table 9-Column III.2). This means that the affiliation with a specialized VC' backing itself is a signal of credibility and quality among firms with low uncertainties, but for more opaque and risky firms, the signalling effect of the affiliation increases with complementary specialized affiliations, which translates in incremental quality signal.

More interestingly are the mixed evidence we found about the cross effects between the affiliation with generalist VC and the firm's opaqueness. Our results suggest that being affiliated with a generalist VC is relevant (irrelevant) for less (more) opaque issuers (Table 6); but the number of generalist VCs backing the ICO' issuer is not relevant for its success among less opaque early-stage firms (Table 9). Moreover, we found that the success of ICOs issued by more opaque and risky firms depends on the number of generalist VCs associated with them (Table 9). Overall, these results seem to suggest that the signalling effect of generalist VCs among opaquer early-stage firms is translated into ICO' success only if the issuers are backed by more than one generalist VC, which makes sense from a theoretical perspective as the certification effect of generalist VCs tend to be lower than that attributed to specialized VCs. We encourage further research to examine this result in more detail.

Our results also offer practical implications. Understanding the role that signals play in drawing investors to campaigns gives issuers an opportunity to assess which signals might

have the biggest influence on their ICOs and attempt to control those that are broadcast to the public in order to increase the likelihood of a successful ICO. Our findings suggest that VC signalling has a higher impact on the hard cap raised than presenting a product to potential investors. This suggests that more important than trying to have a product or prototype developed at the time of the ICO, early-stage firms must put extra efforts to attract VCs to affiliate with. We also find that VCs' specialization is a key driver of investors' decision making. In line with the certification hypothesis, the evidence points that third-party affiliation with specialized VC plays a certification effect translated in higher ICO success for opaquer early-stage firms.

This study also offers controversial evidence that may inspire future research, by concluding that having more VC specialists or generalists becomes insignificant when an early-stage firm has a product to present to potential investors, which is contrary to the findings on the earlier models.

7. Concluding remarks

The market for Initial Coin Offerings (ICOs) is experiencing a considerable momentum. The rapid expansion of this market has presented challenges for practitioners, scholars, and regulators. ICOs represent a novel approach to raising capital for early-stage companies by leveraging blockchain technology. This fundraising method enables early-stage entrepreneurs to raise low-cost funds from a crowd of investors promising to facilitate innovation and new business models (Chen and Bellavitis, 2020; Ahmad et al, 2021). For investors, ICOs offer alternative strategy to diversify their portfolios (Adhami and Guegan, 2020). However, its decentralized nature and the lack of regulation in the market have drawn the attention of policymakers, regulators, and academics, concerned about the opacity of the market. In fact, the crisis of trust that these markets have been experiencing, partly due to fraud events, their complex operation, and lack of regulation, may jeopardize the ability of firms, especially in early stages, to succeed in their ICO campaigns. In this context, this study examines the role played by firm's affiliation with third-party specialized Ventures Capitalists (VCs) to overcome the lack of regulation and transparency and restore the trust on the market and on ICOs' issuers. To do so, we ground our research on Signalling Theory (Spence, 1973) and on the role of information cascades.

Overall, our results show that VC funding prior to an ICO has a favourable impact on the early-stage firm's success, which is consistent with the findings of Fisch and Momtaz (2020), Hackober and Bock (2021), and Belitski and Boreiko (2022). This effect is amplified when there is a greater information asymmetry between issuers and investors. We illustrate this by looking at the influence VCs have when an early-stage firm doesn't have a finished product or prototype to show to potential investors, which is particularly prevalent in the case of ICOs. As expected, our findings enable us to draw the conclusion that VCs function as a signal of the quality of the early-stage firm, especially when there is less information available. Although investors often rely on the VC's affiliation to select ICO's issuers, the newness of ICOs phenomenon not only affects retail investors. VCs may not always be able to choose the most promising businesses due to a lack of experience (Bertoni et al., 2011). Hence, we extend our research into the value played by VC knowledge to predict ICO's success. We find that the affiliation with a specialist VC is particularly relevant in context of higher investors and market uncertainties. Specialist VCs can positively influence the percentage of the hard cap raised by an early-stage firm by being able to offer better support and guidance. Riskier firms may engage with VCs with specialized knowledge because the

value of generalist VC contributions is limited. This is in line with Arthurs and Busenitz (2006) arguments. Being a specialized VC has advantages, including increased access to the most promising businesses in their industry, which offers them an edge when choosing or managing enterprises.

In a nutshell, we found that among more opaque and riskier firms, firms backed by generalist VCs do not have superior advantages in terms of ICO success compared to non-VC-backed firms. Among early-stage firms not able to signal their quality and marketability, the positive association between ICO success and VCs backing is if the VCs is typed as specialist on DeFI, namely on blockchain projects.

These findings offer several contributions. For the theory-building, we show that the certification effect of third-party depends on their knowledge and expertise on blockchain. From entrepreneurial point of view, our evidence may lead early-stage entrepreneurs to affiliate with specialized VCs in order to maximize the changes of investors' engagement and finance their projects. For practitioners, this research makes a valuable contribution to the ongoing debate concerning the opportunities presented by blockchain-based decentralization, specifically focusing on the potential expansion that ICOs may witness in the future as a viable financial option for early-stage companies seeking substantial capital to innovate and growth.

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