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# Initial coin offerings: an emergent research area

## Abstract

**Purpose** – The purpose of this paper is to identify the main insights current literature offers regarding initial coin offerings (ICOs) and the avenues for future research.

**Design/methodology/approach** – The approach consists of a systematic literature review of 130 papers from the SCOPUS database published in English between January 2018 and December 2020, with supplemental semantic analysis of the abstracts to obtain key themes and concepts.

**Findings** – Regulation and the determinants of ICO success are the main themes for current research and represent fruitful areas of continued scholarship. The research agenda in ICOs is just beginning and several topics and questions merit future inquiry: the behaviour of issuers and investors, the importance of human capital, the role of intermediaries and infomediaries and the use of signalling.

**Originality/value** – To the knowledge, this is one of the first systematic studies of current literature in ICOs. It provides a roadmap for future work on a phenomenon that will only grow in significance.

**Keywords** Systematic literature review, Semantic analysis, Initial coin offerings, Initial capital offerings

**Paper type** Literature review

## 1. Introduction

Initial coin offerings (ICOs), a.k.a. “token offerings” and “token sales”, along with other fintech developments, are disrupting global capital markets. ICOs are an alternative form of financing that raises money for projects with a business model based on blockchain technology (Fisch, 2019; Boreiko et al., 2019), corresponding to the concept of crypto-startups. Because of the decentralized nature of blockchain, which allows the exchange of value without the need for a trusted central authority or intermediary, ICOs join team developers, investors, customers, advisors and other stakeholders from different locations. ICOs integrate the financial globalization phenomenon and decentralized governance mechanisms (Hacker and Thomale, 2019).

ICOs offer entrepreneurs the opportunity of quickly raising capital by selling digital tokens to investors from all over the world (Debler, 2018), contributing to the democratization of entrepreneurship (Chuen and Lee, 2017) and direct access to the capital market (Rohr and Wright, 2019) thought decentralization. ICOs offer developers a return for open source decentralized networks, which traditionally rely on volunteer work (e.g. Wikipedia), balancing the interests of promoters and users (Popper, 2016; Momtaz, 2020a, 2020b, 2020c, 2020d). ICOs favour the creation of an ecosystem enabling the development of a new product with a ready customer base (Deloitte 2018).

The increase in the number of users of the platform is expected to increase its value; nevertheless, ICOs may present some disadvantages for entrepreneurs. Token sales may be inefficient from the fiscal point of view, given that the amount obtained is treated as deferred revenue, compared to traditional financing (Cook and Heath, 2017). ICOs may represent a cost of opportunity to entrepreneurs, as they sell a considerable part of the tokens of the project in an initial phase, when the valuation of the project is low. Although the demand for ICOs remains high, there is an increase in difficulty in several projects reaching the amount of funding sought (PwC, 2017).

The main advantages for investors of ICOs are the democratization of access to investments on a global scale; the possibility of diversification; the possibility of participation in investments in the initial phase (Chen, 2018); and investment in a net asset that is

transacted in the main crypto exchanges (Momtaz, 2020b). According to Boreiko et al. (2019), online crypto exchanges are trusted intermediaries and the crypto market is a segment of the capital market.

Notwithstanding the advantages, ICO also presents risks to investors. ICOs often occur in the design phase of a project, based on the white paper, i.e. before the existence of an innovation, product or service or even customers (EY, 2017). In the secondary market, the value of tokens is subject to high volatility, speculation and is not related to fundamentals (Cappa and Pinelli, 2020). This exposes investors to a high risk of loss (EY, 2017, 2018). Given the information asymmetry (Chen, 2019), it is difficult for investors to evaluate the project. Although ICOs can be used as diversifiers, they cannot perform the role of a hedge or safe-haven asset in a portfolio (Adhami and Guedan, 2020).

There is also the risk of investment in fraudulent tokens (Tiwari et al., 2020) and tokens that have a reduced likelihood of success, i.e. "Zombie ICOs". The safety of wallets and crypto

exchanges and possible attacks are equally relevant (Autonomous Next 2018). With the growth of the ICO market, cyber-attacks have occurred frequently, with an estimated 10% of funds being lost or stolen (EY, 2018). Fintech and ICOs also raise concerns about financial crime and money laundering (Essaghoolian, 2019). At the same time, ICOs are an important source of finance for sustainable projects and social enterprises (Chiu and Greene, 2019).

The literature has compared ICOs with IPOs and crowdfunding (Momtaz, 2018; Kranz et al., 2019; Block et al., 2020). ICOs differ from IPOs for several reasons (Momtaz, 2019b). While in IPOs, companies sell shares in stock exchanges, ICO projects sell digital tokens in crypto

exchanges that might not confer property rights. Compared to IPOs, ICOs decrease transaction costs and contribute to the democratization of access to finance through disintermediation. While IPOs involve the public offer of the company in a growing or maturing stage of the company life cycle, ICOs offer a fraction of the digital project/idea in its early stage. All jurisdictions regulate IPOs, whereas ICOs are unregulated. This is changing as regulators are paying more attention to ICOs. The spirit of the white paper (ICO) can be equated to the prospectus (IPO). Unlike the latter, which regulations standardize regarding the contents and format, the structure of the white papers and the information disclosed are variable and heterogeneous.

Utility tokens reward crowdfunding; in particular, conferring the possibility of using a product/service upon its launch. ICOs occur in a decentralized way, usually without recourse to a platform such as crowdfunding (Fisch, 2019). Another similarity between ICOs and crowdfunding is investing in companies and projects in their initial phase (Chen, 2018).

One of the main differences of ICOs compared to crowdfunding is its liquidity, with the possibility of a secondary market transaction in a crypto exchange (Chen, 2018). Block et al. (2020) maintained that ICO campaigns attracted more technology-interested investors than crowdfunding ones.

The ICO market is extremely complex and volatile (Ibba et al., 2018). ICOs have received increasing interest from project developers and entrepreneurs, retail and institutional investors, regulators and media (Bellavitis et al., 2021). In addition, academics are paying attention. The Journal of Alternative Investments (Kazemi, 2019) dedicated the first special issue to ICOs. Since then, Small Business Economics, the Journal of Risk and Financial Management and others have followed suit; the marquee journal Management Science plans a special issue in 2022. That such an outlet is highlighting ICOs with a special issue demonstrates its significance as a field of research independent of practical considerations.

Over the past two years, ICOs have moved from "too small to care" to "too big to ignore" (OECD, 2019). Although ICOs are one of the main topics studied in the field of blockchain technology, the research in ICOs is still in its infancy (Xu et al., 2019). This paper performs a systematic literature of the current ICO research. The main research questions are:

*RQ1.* What insights does the current literature offer regarding ICO?

*RQ2.* What lessons could be learned from the published literature?

*RQ3.* What needs to be investigated now?

Kher et al. (2020) performed a systematic literature review about blockchain and its applications, including ICOs,

smart contracts and cryptocurrencies. This paper adds to previous systematic literature reviews a descriptive analysis of the published papers and offers a semantic representation of previous studies.

The next section presents a snapshot of the size of the ICO market and the main characteristics of the projects. After this, the methodology section details the main steps of the systematic literature review (i.e. descriptive, narrative and semantic). Results of the methods follow, including a synopsis of what the current literature offers about ICOs. The conclusion provides insights for future research.

## 2. Snapshot of initial coin offerings

ICOs “consist of the creation of digital tokens by small companies to investors, in exchange for fiat currency or first-generation dominant cryptocurrencies” (OECD, 2019, 7). They have raised the attention of internet users, as measured by the Google Trends Research Index, with the apex observed in December 2020 (Graph 1).

Since Mastercoin, the first ICO launched in 2013, almost \$31bn has been raised through ICOs as of June 2019 (Graph 2).

The 10 top countries account for 64% of the total number of successful token sales and 74% of the amount raised, i.e. tokens that managed to raise at least the minimum (soft cap) that they set out to raise. The USA remains a leading ICO destination. Within Europe, the UK has gained terrain in terms of volume and numbers, followed by Switzerland. Across Asia, Singapore is the main ICO hub, followed by Hong Kong. The Cayman Islands and the British Virgin Islands also rank among the top 10 ICO countries by volume.

The lack of sustained business operations seems not to impact fundraising success. In the first quarter of 2019, the number of projects that attracted funds at the idea stage is around 67.37%. In the same period, the distribution of projects in the other milestones of the development process is as follows: minimum viable product, 17.82%, beta, 6.65%, fully ready product, 3.63%, code, 2.72% and alpha, 1.81% (Icorating, 2019). Although ICOs mainly involve innovative blockchain projects at an early stage of development, well-established companies are increasingly engaged in ICOs (ESMA, 2019). At the same time, the investor base is expanding from the “blockchain community” to a broader group of investors, including institutional investors.

Proceeds raised in an ICO can reach up to \$4.2bn, as the one-year record EOS token sale shows. EOS conducted a two-step ICO for the development of a blockchain infrastructure for decentralized apps in the Cayman Islands. In the first phase, which took place in 2017 and lasted five days, \$185.1m was raised. In the second phase, which lasted 350 days,

\$4bn was raised. The second-largest ICO was Telegram (\$1.7bn), a social media application to enhance messenger ecosystems (British Virgin Islands). Tatatu (\$575m), a social media application for Entertainment (Cayman Islands) and Dragon (\$320m), a decentralized currency for Casinos/Gambling (British Virgin Islands), are third and fourth, respectively. Out of 7,934 ICOs, 43% of the projects were listed, 24% were executed and 4% are trading in exchanges (CoinSchedule.com).

The share of projects offering utility tokens (tokens of the protocol itself), represents around 50.3% of the market (Icorating, 2019). Service tokens (token as an internal currency, used to pay for project services) are 25%, while hybrid tokens (payment for services + bonuses for work performed) are 16.15% (ibid). Security tokens (tokens secured by an obligation, such as promises of dividend payment, receipt of company shares or credit tokens) are 6.4% and reward tokens (used to reward contributions of participants to the network) are 1.22% (ibid). Cryptocurrency (new cryptocurrency without additional exceptional properties) constitutes 0.61% and vote tokens (conferring the right to vote and the ability to influence project development) are 0.3%.

## 3. Methodology

A research on “ICO” as search terms on the abstract, title or keywords in the database SCOPUS allowed us to record 130 relevant studies published in English. The search code used was (TITLE-ABS-KEY (“ICO”) OR TITLE-ABS-KEY (“token sale”) OR TITLE-ABS-KEY (“token offering”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (SRCTYPE, “J”)).

The review covers papers published from January 2018 to December 2020, and includes advance online versions of articles. The information for each paper was recoded into an Excel spreadsheet, comprising the following columns, namely, title of the paper, year, abstract, keywords, authors, authors’ affiliations and journal. Furthermore, the authors also added a column with the classification of the journal and the type of method used.

This study adopted a hybrid design comprising the systematic qualitative review of methods and narrative, supplemented by semantic network analysis. Using a systematic method, we document the geographical spread of the papers by author, year, research methods and primary topical areas, thus providing a reproducible and reliable assessment of current progress in the research field.

The narrative discussion indicates the research production within each of the topical areas, explores emerging themes and methods and identifies knowledge gaps for future research directions. Semantic network analysis further explores connections among key topical areas.

We also content-analysed the papers' abstracts through Leximancer, a software programme that automatically extracts semantic networks from qualitative data. Leximancer identified the connections among topics. Leximancer has been successfully used for literature review (Crofts and Bisman, 2010; Jin and Wang, 2016). Leximancer generates conceptual maps based on co-occurrences of words in keyword lists (Brochado *et al.*, 2017). The analysis's reliability is secured by its stability (i.e. intercoder reliability) and reproducibility (i.e. high consistency in the way data are coded).

## 4. Results and discussion

### 4.1. Descriptive analysis

#### 4.1.1. *Number of publications by journals, authors and institutions.*

Research about ICO is recent. Of the 130 papers, 21 were published in 2018, 38 in 2019, 68 in 2020 and 3 in 2021.

The 130 papers were published in 90 SCOPUS indexed journals. Around 72% of the papers appear in the first two quartiles of SCOPUS (50% to Q1 and 22% to Q2). A breakdown of the number of articles by journal appears in Table 2. Small Business Economics published eight papers, followed by the European Business Organization Law and *Journal of Alternative Investments* at four apiece.

Table 1 ICO geographical breakdown: Top 10 countries (Jan 2016–Dec 2019)

<i>Country</i>	<i>Amount raised</i>	<i>(%) of total</i>	<i>Rank</i>	<i>N° tokens</i>	<i>(%) of total</i>	<i>Rank</i>
USA	\$10,335,481,677	34.30	1	258	15.51	1
Singapore	\$2,756,427,823	9.15	2	212	12.75	2
UK	\$1,901,042,555	6.31	3	174	10.46	3
Virgin Islands, British	\$1,638,959,377	5.44	4			
Switzerland	\$1,488,555,102	4.94	5	82	4.93	6
Cayman Islands	\$1,365,878,859	4.53	6	40	2.41	8
Estonia	\$963,202,334	3.20	7	87	5.23	5
Venezuela	\$735,000,000	2.44	8			
Hong Kong	\$572,296,566	1.90	9	47	2.83	7
Russian Federation	\$555,728,041	1.84	10	89	5.35	4
Australia				37	2.22	9
Germany				35	2.10	10

Source: CoinSchedule

Table 2 Number of articles by journal

<i>Journal</i>	<i>No. of papers</i>
<i>Small Business Economics</i>	8
<i>European Business Organization Law Review</i>	5
<i>Journal of Alternative Investments</i>	5
<i>Electronic Commerce Research and Applications</i>	3
<i>Electronic Markets</i>	3
<i>Journal of Industrial and Business Economics</i>	3
<i>Venture Capital</i>	3
<i>Accounting Perspectives</i>	2
<i>Applied Economics Letters</i>	2
<i>Business and Information Systems Engineering</i>	2
<i>European Company and Financial Law Review</i>	2
<i>European Journal of Comparative Law and Governance</i>	2
<i>European Journal of Finance</i>	2
<i>European Journal of Risk Regulation</i>	2
<i>Finance Research Letters</i>	2
<i>IEEE Transactions on Engineering Management</i>	2
<i>Journal of Business Venturing</i>	2
<i>Journal of Economics and Business</i>	2
<i>Journal of Private Equity</i>	2
<i>Managerial Finance</i>	2
<i>Sustainability</i>	2
<i>Technological Forecasting and Social Change</i>	2
<i>Technology Innovation Management Review</i>	2
<i>Tilburg Law Review</i>	2
Other (66)	1

In total, 160 authors contributed to the 130 publications under analysis (Table 3). The leading author in ICO research is Momtaz (2019a), with seven papers indexed in SCOPUS. Fisch, C. accounted for five papers Vismara, S. for four papers and Adhami, S. and Giudici, G. three papers each.

Table 4 exhibits national-level statistics for the number of papers. The USA, as the leading hub for ICOs, has the most papers with 34; Germany, Italy and the UK is second with 19, 18 and 7, respectively. The 130 papers in our study span 40 separate countries. The total sums to more than 130 because papers have multiple authors from different countries. Taking into account that a journal might be indexed in more than one scientific area, 66 papers are indexed in economics, econometrics and finance, 63 papers are indexed in business,

**Table 3** Leading authors

<i>Author</i>	<i>No. of papers</i>
Momtaz, P.P.	7
Fisch, C.	5
Vismara, S.	4
Giudici, G.	3
Adhami, S.	3
Hou, W.	2
Chen, K.	2
Zhang, S.	2
Martinazzi, S.	2
An, J.	2
Block, J.H.	2
Boreiko, D.	2
Kim, S.K.	2
Masiak, C.	2
Meoli, M.	2
Bellavitis, C.	2
Vanacker, T.	2
Chiu, I.H.Y.	2
Gregoriou, A.	2
Other (141)	1

**Table 4** Leading countries for papers

<i>Country</i>	<i>No. of documents</i>
USA	34
Germany	19
UK	18
Italy	17
The Netherlands	13
Belgium	11
China	11
Australia	6
France	5
Switzerland	5
Canada	4
Russian Federation	4
Austria	3
Hong Kong	3
Spain	3

management and accounting, 37 in social sciences, 23 in computer science, 11 in engineering, 6 in decision sciences and 5 in environmental science.

Table 5 shows the leading affiliations. Erasmus Rotterdam is first with seven, followed by the University of California system that are not UCLA (Berkeley and Santa Cruz) and UCLA itself with six apiece. Ghent has five, followed by Bergamo and Erasmus School of Economics at four each.





Table 6 Research methods in publications reviewed

<i>Type of methods</i>	<i>No. of papers</i>	<i>Notable details</i>
Qualitative	63 (48.5%)	Nearly 60% off the articles discuss some aspect of ICOs and law
Quantitative	54 (41.5%)	Empirical testing of hypotheses constitutes 35% of these papers
Conceptual	13 (10%)	69% are mathematical model

Legal articles dominate the qualitative category. Nearly 60% of these manuscripts are legal articles investigating myriad topics involving ICOs, namely, securities law, bankruptcy regulations, EU regulations and ways of streamlining law to lower regulatory burden to attract investment. There are several papers involving case studies and several more that describe what the future in ICOs may be or introduce a special issue involving ICOs.

There is considerable variety among the quantitative papers, but the most popular type is the traditional testing of hypotheses; this category represents around 35% of the total number of quantitative papers. Almost all of these papers feature some form of linear regression (OLS, 2SLS or GLS), but several have probability models such as logit and probit to test dependent variables such as “invest/not invest”. Another 26% are empirical but do not test explicit hypotheses; most of these are event studies testing a regulation, e.g. prohibition of ICOs in China in September 2017. The remainder are a potpourri of factor

analysis, textual analysis and simple statistical tests such as *T*-test of means.

Of the conceptual papers, 69% are mathematical models offering theorems and lemmas for proofs. The remaining 31% propose frameworks for the application of

#### 4.2. Semantic analysis

The analyses led to a visual network of research interests over domains that offers an overall conceptual mapping of how key concepts are related.

The content analysis of the 130 abstracts revealed the existence of the following themes, namely, “ICOs” (100%), “investors” (71%), “blockchain” (56%), “tokens” (56%), “regulation” (29%), “success” (15%), “securities” (24%) and “model” (11%).

The theme “ICO” includes the concepts “ICO”, “raise”, “investment”, “capital”, “finance”, “companies”, “social” and “crowdfunding”. The theme “ICO” is the most important one. This theme describes ICOs as a new wave of innovation of tokenization that will revolutionize the landscape of entrepreneurship and innovation (Chen, 2018). Innovative firms over a range of industrial sectors will use ICOs to raise capital.

The theme “investors” includes the concepts “investors”, “market”, “funding”, “information”, “risks” and “future”. This theme is related to the information asymmetries and decision-making under uncertainty that potential investors face due to the relatively unregulated ICO space (Chen, 2019; Felix and von Eije, 2019), and how to mitigate these uncertainties

(Albrecht *et al.*, 2019; Chen and Chen, 2020). For example, Momtaz (2020c) studied the evidence of moral hazard in ICOs signalling and before and after the listing date. In a separate study, he tackled the agency costs due to asymmetric information as CEO loyalty to investors declines (Momtaz, 2020d).

The theme “blockchain” includes the concepts “blockchain”, “technology”, “used”, “cryptocurrency”, “development” and “value”. This theme links ICOs with blockchain technology (Chen, 2018) and blockchain ventures (Huang *et al.*, 2019).

The theme “tokens” encompasses the concepts “tokens”, “provide”, “based”, “digital”, “exchange” and “legal”. Blockchain project developers can raise capital by selling tokens

to a crowd of investors that expect financial value creation (Adhami *et al.*, 2018). Tokens can offer investors different classes of financial and non-financial rights and rewards (Chiu and Greene 2019) and are a component of a well-diversified portfolio (Adhami and Guegan, 2020). Tokenization also allows the marriage of technologies, markets and sustainable finance (Chiu and Greene, 2019).

The theme “market” encompasses the concepts “market” (56%), “capital” (46%), “finance” (34%), “companies” (27%), “challenges” (22%) and “equity” (17%). “Market” is linked both to the primary market, used by companies to raise capital and to the secondary market, where tokens are exchanged in a crypto exchange (Rohr and Wright, 2019).

The theme “regulation” joins the concepts “regulation”, “financial”, “regulatory”, “governance” and “rights”. Due to the uncertainty of the applicable regulatory framework for ICOs, the literature recognizes that ICOs convey risks for the issuers of the tokens, the exchanges (Tiwari, 2018), and for the investors that participate in the token offering (Gikay, 2019). This theme also includes papers that discuss the need for an efficient regulatory environment to protect the participants in financial investments (Stănescu 2019) and to

promote financial inclusion by promoting additional funding sources for small and medium enterprises (Tjio and Hu, 2020). The paper by Bellavitis *et al.* (2020) studied the regulatory spillovers of the ban of ICOs. Additionally, this theme is mainly linked with the papers

published in journals classified in the field of computer science and is related to the

development of decentralized blockchain applications and software programming (Ibba, 2018; Cai *et al.*, 2018) and the key factors for the successful development of a cryptocurrency from the perspective of their users (Kar *et al.*, 2019). Therefore,

“development” is located close to “blockchain” in the concept map.

The theme “success” joins the concepts “success”, “important”, “factors”, “analysis” and “time”. The theme “securities” includes the concepts “securities”, “process” and “money”. Researchers have discussed whether tokens are securities according to the US laws (Rohr and Wright, 2019). Studies and under the EU regulation (Hacker and Thomale, 2018; Vandezande, 2020; Veerpalu *et al.*, 2020).

“Information” is a theme with a single concept. As ICOs are not regulated, potential investors face information asymmetries and decision-making under uncertainty. Albrecht

*et al.* (2019) investigate whether blockchain ventures can effectively reduce these information asymmetries by using signalling mechanisms on Twitter and how the resulting effects differ (Figure 2).

## 5. Conclusion and future research

ICOs have proven to be one of the most relevant applications of blockchain technology for finance, offering micro, small and medium-sized companies a novel way of raising capital and solving the SME financing gap. ICOs are both a financial innovation and a technological innovation. This article has identified current patterns and future trends in ICO research that have received increasing attention since 2017. We recapitulate here the three main research questions and our insights.

### 5.1. What insights does current literature offer regarding initial coin offerings?

ICOs is a research topic of an increasing concern to the literature. The analysis reveals that ICOs are a multi-disciplinary phenomenon attracting attention from various disciplines such as finance, business, law, computer science and engineering. We have summarized the most important findings for each article in their respective fields, but a key one that encompasses most if not all of them is the need to understand more deeply how regulation and policy may influence the future development of this space. There are so many complexities regarding the policy and regulation of ICOs that this should be a fertile topic of research for years to come.

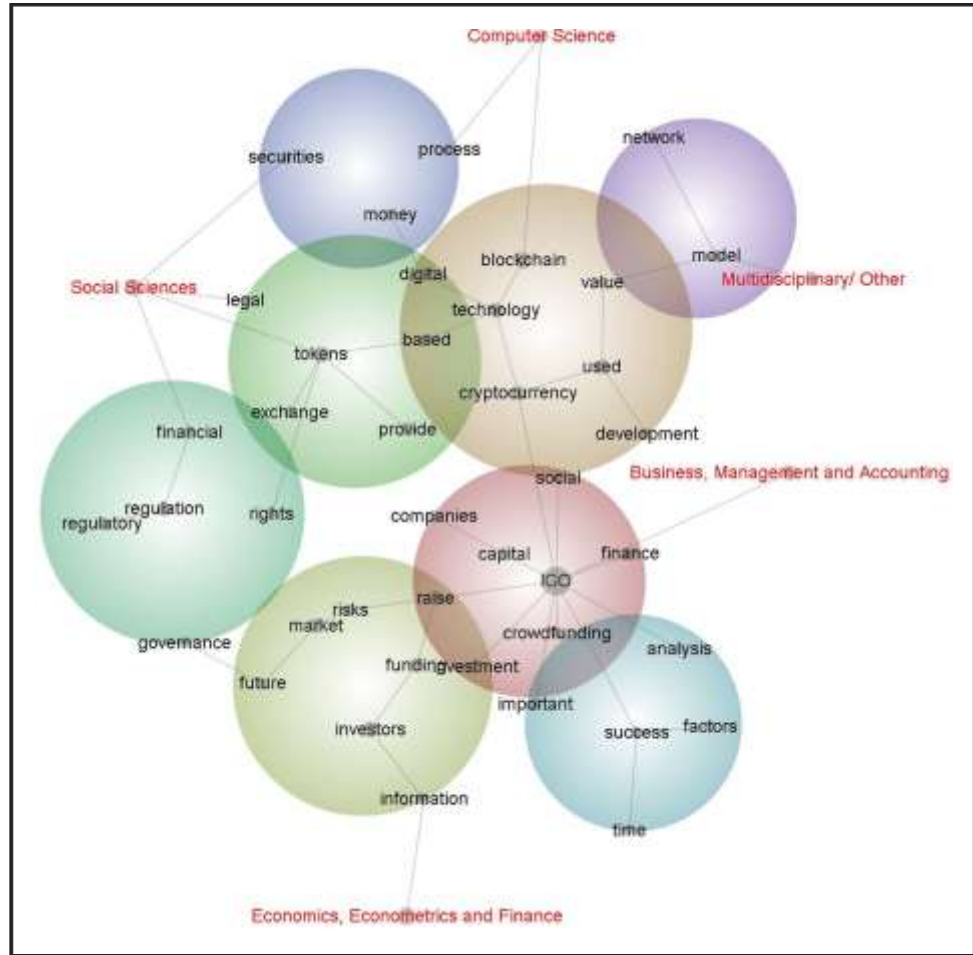
### 5.2. What lessons can we learn from these publications?

A few studies target ICO investor and entrepreneur’s behaviour and attitudes. Regarding

ICO investors, studies reveal they are heterogeneous; a variety of technological, financial and ideological motives influence them (Fisch *et al.*, 2019). Arias-Oliva *et al.* (2019) conclude that performance expectancy and the facilitating conditions explain the intention

to buy an ICO. The study by Ayarci and Birkan (2020) reveals that the most important factors that influence the decision to invest in an ICO are the white paper, website news,

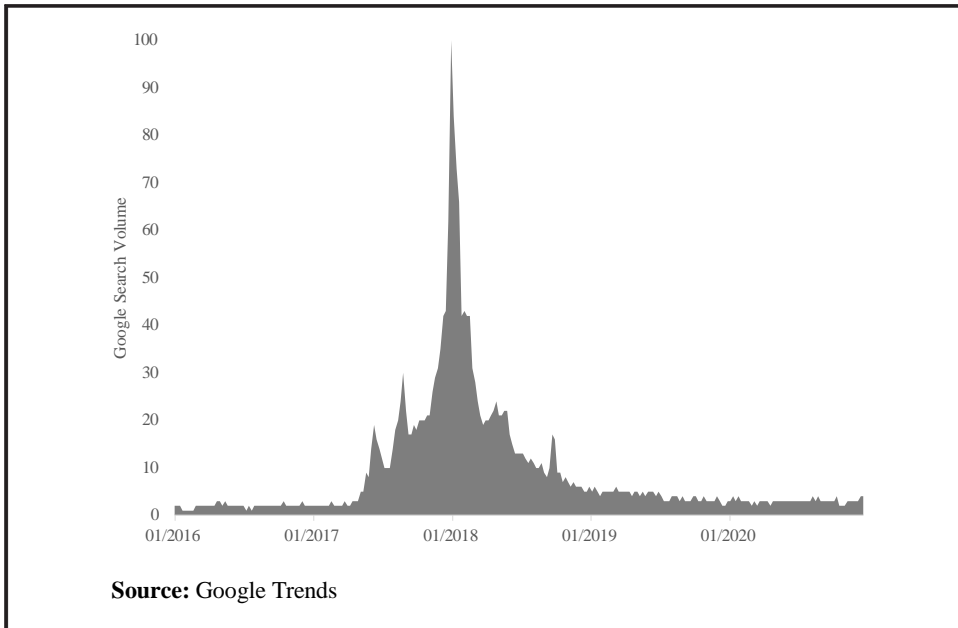
Figure 2 Initial coin offerings concept map



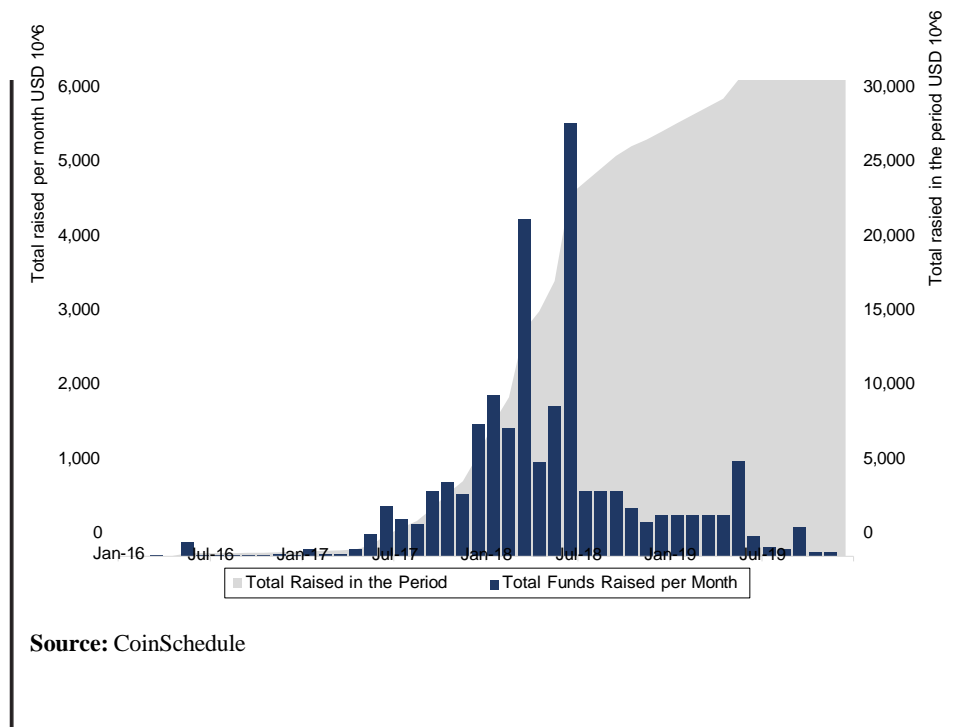
sector, founder, team and social media. Boreiko and Risteski (2020) maintain that only large serial investors invest more in successful campaigns that distribute tokens, which are later listed in the secondary market (crypto exchange).

Schuckes and Gutmann (2020) conclude that four dimensions influence entrepreneurs of ICO-funded startups, namely, personal and ideological drivers, tokenomics, community building and funding. Fisch *et al.* (2020) report an ICO financing gap for female entrepreneurs. Previous literature offers implications for investors. To assess the legitimacy of an ICO (Tiwari *et al.*, 2020), investors should consider the determinants of ICO success. They should also evaluate the ICO white paper, as lack of clarity in the white paper correlates with an increased likelihood of fraud. Additional factors associated with ICO legitimacy include the utility of the offer (a strong value added), management due diligence (social media profiles and past job history) and ICO ratings and reviews (cryptocurrency websites). The analysis of papers in law highlights the importance of a regulatory framework to promote financial innovation, protect investors and enhance financial stability simultaneously. To address concerns about regulatory uncertainty (Gikay, 2019), studies mainly address the legal classification of a variety of tokens (equity and utility) according to the existing regulations in the US and Europe (Vandezande, 2020; Tiwari, 2018; Debler, 2018;

**Figure 3** Attention to initial coin offerings



**Figure 4** ICO



Essaghooan, 2019; Verpalu et al., 2020). Other researchers (Thomale, 2018; Gikay, 2019; Boreiko et al., 2019) provide an overview of how countries regulate ICOs, including the 2017 ban in China, soft law in some European countries and the Sandbox in the UK (Mangano, 2018; Truby, 2020). The “wait and see” approach is a popular one. A better understanding of the buyer side should guide future regulatory requirements (Cohney et al., 2018). Although promoters use the computer code rather than the traditional contract to make their promises to investors, Cohney et al. (2018) identifies mismatches between the disclosures and the codes. Therefore, smart contract audit is an important issue for regulators.

Law papers assist regulators by comparing different regulatory solutions and by offering an overview of the main risks. For developers, clarifying the legal background for ICOs specifies the requirements that an issuance should meet. Regulation for protecting investors from fraudulent issuers (Tjio and Hu, 2020) becomes clearer via these comparative studies. Regulators’ warnings about fraud decreased investors’ interest in ICOs, yet more global regulations of ICOs reduced the number of fraudulent and more speculative ICOs (Bellavitis et al., 2021).

Most papers in the related fields of economics, finance and business management fit into two groups. The first group addresses issues related with the primary market, including the ICO determinants of the token sale funding success (Fisch, 2019; Giudici and Adhami, 2019; Samieifar and Baur, 2020; Roosenboom, van der Kolk and Jong, 2020); unsuccessful case studies (Rrustemi and Tuchschnid, 2020); the geographical location of ICOs (Huang et al., 2020); and corporate governance issues (Goergen and Rondi, 2019). Additionally, researchers examined the impact of social media/Twitter activity and engagement (Albrecht, et al., 2020; Grover et al., 2019) and advisor’s centrality (Giudici et al., 2020). Ga”chter and Ga”chter (2020) argue that the public “hype” surrounding an ICO, based on Google search activity explains the amount raised. Masiak et al. (2020) identify market cycles on ICOs fundraising.

A second group of articles targets the secondary market (post-ICO performance), and addresses specific themes of asset pricing. These include:

- The existence of bubbles (Stolbov, 2019); fintech portfolios’ rates of return (Vroomen and Desa, 2018).
- ICO market indices and diversified portfolios (Adhami and Guegan, 2020).
- The impact of institutional investors on post-ICO performance (Fisch and Momtaz, 2020).
- ICO returns (Domingo *et al.*, 2020; Momtaz, 2020b; Capa and Pinelli, 2020).
- The underpricing hypothesis test (Felix and von Eije, 2019; Hsieh and Oppermann, 2020).

This group also includes the impact of CEO emotions on underpricing in ICOs (Momtaz, 2020a); the sensitivity to environmental shocks (e.g. China’s ban of ICOs and the marketing ban on FaceBook), and digital social capital on ICO market capitalization (Perez *et al.*, 2020).

Papers in the field of computer science focus on communication and security. Major lessons state that ICO developers should use plain language, strengthen public disclosure of information, provide a helpdesk, seek regulatory guidance (Tiwari *et al.*, 2020) and ensure blockchain network security strategies (Kim, 2019).

### 5.3. What needs to be investigated now?

In this section, we provide some recommendations for future research.

The majority of the ICO research addresses the perspective of ICO promoters and regulators. Only a few studies study the behaviour of investors (exceptions are the articles by and Arias-Oliva et al., 2019; Fisch et al., 2019 and by Ayarci and Birkan, 2020). Future studies should test whether ICO token motivations vary according to the token type (e.g.

security vs utility). In the field of behavioural finance, another area that merits future research is to study behavioural biases in ICO investors and the relationship between financial literacy and ICO investments.

Among the articles, a recurring theme we find for future investigation is the role of human capital and corporate governance with regard to ICOs. Both Huang et al. (2020) and Fisch (2019) mention this possibility. For Huang et al. (2020), the focus is the level

of mathematical training/STEM ability of a given nation, as their research involved the geography of where ICOs occurred. In contrast, Fisch (2019) concerns himself with the signalling that surrounds ICOs. He is interested in the signals that various forms of human and social capital can generate. As he admits in the conclusion of his paper, he uses some variables to capture these effects but not in a nuanced way. He specifies, “operationalizing human capital with founder biographies, education and professional experience” (p. 20). He also suggests examining the importance/types of human capital with regard to different financing mechanisms such as ICOs, crowdfunding and venture capital.

Chen (2019) research studies signalling in channels and information asymmetry. He saves for future work the different signals that entrepreneurs and investors can send. Signalling is also an important theme for Giudici and Adhami (2019), but their focus is the signal that governance sends. They maintain that governance will remain a key variable for ICOs for

the near future, and therefore, deserving of additional study. Felix (2018) also sees governance as an avenue for future work, but he has the specific objective of discovering the conditions that lead to fraudulent activity in ICOs, with an eye towards regulators proactively preventing such conditions. Anson (2018) notes that there is no corporate governance for token holders at the conclusion of his piece, but does not offer specific direction for additional research. In contrast, Ivashchenko *et al.* (2018) study the relationship between ICOs and SMEs to identify the best practices of Europe with regard to regulation and policy. A natural addendum would be to expand this research globally, i.e. to discern best practices worldwide at the nexus of ICOs and SMEs.

Another major theme is the role of intermediaries, particularly “infomediaries”. O’Dair and Owen (2019) examine regulation and policy of ICOs in the realm of the creative industries, but they specifically identify intermediaries and infomediaries as an interesting topic for future work. De George *et al.* (2018) treat infomediaries in their research as trust-builders in the ICO market with their role as independent appraisers of ICO quality. They postpone the study of social media as intermediaries/infomediaries for another article.

As ICO regulations are evolving and some countries are adopting a “wait and see” approach, regulatory benchmarks and the impact of regulation on various ICOs stakeholders merit future research. While many articles call for increased regulation, few if any study what the intended and unintended consequences of new regulation may be (i.e. regulatory impact).

From a computer science perspective, potential areas of research include security issues and privacy rights. The latter in particular is fertile ground given how ubiquitous technology is. Moreover, the role of social media and networking tools to decrease information asymmetry and to allow community engagement also merits future research.

We can summarize the major themes for future research from finance and business in four major categories: human capital, signalling, regulation and intermediaries. The specific topics are as follows:

- Human capital and its relationship to the geographic location of ICOs.
- Refining human capital variables.
- Human capital and its importance/signal to different forms of funding, namely, ICOs, crowdfunding and venture capital.
- Signalling in channels and the different signals of entrepreneurs and investors.
- Signalling and governance.
- Governance, regulation and policy.
- Policy and the role of intermediaries/infomediaries.
- The use of social media as an intermediary/infomediary.
- The ICO ecosystem.
- Regulatory benchmark and regulation impact assessment.
- The relation between financial literacy and ICO financial inclusion.

We expect this paper to offer a roadmap for the most important future areas of research regarding ICOs. This is the primary contribution of our work. We recognize there are limitations. Our data collection only targeted studies published in the Scopus database. As there is relevant ongoing research on working papers and conference communications that will be published, the results of this study might be updated with a certain lag.

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