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Initial coin offerings and the cryptocurrency hype - the moderating role of exogenous and endogenous signals

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Abstract

Initial coin offerings (ICOs) have recently emerged as a new financing instrument for entrepreneurial ventures, spurring economic and academic interest. Nevertheless, the impact of exogenous and endogenous signals on the performance of ICOs as well as the effects of the cryptocurrency hype and subsequent downfall of Bitcoin between 2016 and 2019 remain underexplored. We applied ordinary least squares (OLS) regressions based on a dataset containing 1597 ICOs that covers almost 2.5 years. The results show that exogenous and endogenous signals have a significant effect on the funds raised in ICOs. We also find that the Bitcoin price heavily drives the performance of ICOs. However, this hype effect is moderated, as high-quality ICOs are not pegged to these price developments. Revealing the interplay between hypes and signals in the ICO's asset class should broaden the discussion of this emerging digital phenomenon.

Keywords Initial coin offering · Cryptocurrencies · Signaling theory · Fundraising

JEL classification G41 · D81 · L15 · L86 · M13

Introduction

The ongoing digitalization is creating numerous innovations and digital trends. One of those innovations is Bitcoin (BTC),

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a so-called cryptocurrency, which has its origin in the year 2008 (Mai et al. 2018; Ostern 2020). Bitcoin is based on blockchain technology, which is believed to have the potential to revolutionize the area of existing payment methods and shake up the financial industry (Alt 2020; Böhme et al. 2015; Bons et al. 2020). In less than a decade, the market capitalization of all bitcoins in the world exceeded 100 billion US dollars (USD) (Sun Yin et al. 2019; Wallbach et al. 2020). Today, there are more than 2000 different digital coins or tokens, all of them offering different functions (CoinMarketCap 2018). The development of new coins and new fields of application of cryptocurrencies is predominantly carried out by start-ups (Park and Yang 2018; Tönnissen et al. 2020). In order to fund these developments, a financing instrument that combines characteristics of an initial public offering (IPO) and crowdfunding, a so-called initial coin offering (ICO), has emerged (Chanson et al. 2018; Tönnissen et al. 2020).

In the case of an ICO, blockchain companies emit coins or tokens, which can be bought and traded by investors. These coins or tokens can be classified as securities, which represent a share of the emitting company, and are therefore comparable with shares bought during an IPO (Fisch and Momtaz 2020). However, an IPO is mostly used by larger and mature companies to raise additional capital (Mollick 2014). Instead, smaller

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or emerging companies rely on new ways of funding, such as crowdfunding. In contrast to ordinary crowdfunding instruments, the issued coins can be traded on different crypto-exchanges and thus attain a similar standing as an investment such as a normal stock bought on an exchange regarding its liquidity (Chen 2018). IPOs constitute a traditional and well-established fundraising vehicle (Braun et al. 2003), which have experienced an incredible hype during the dot-com bubble in the early 2000s. Companies from the technology sector going public during this time were highly underpriced and experienced substantial first day returns (Ljungqvist and Wilhelm 2003). A similar hype could be noticed for cryptocurrencies starting in 2016, where the market capitalization of all coins and tokens reached over 600 billion USD (CoinMarketCap 2018). These characteristics indicate that IPOs and ICOs have several similarities, but also significant differences.

The existing body of knowledge about IPOs and their influencing factors are very mature, which enables organizations to carry out financing or investment projects independently of cyclical fluctuations in the financial market. In contrast, due to the novelty of ICOs, the body of knowledge in this area is still embryonic and thus organizations lack the comprehensive knowledge to manage an ICO in different market situations. However, the need for research is recognized so that scholars revealed first factors influencing ICO success. For instance, Fisch (2019) exposed that venture characteristics are less relevant for the amount of funding in an ICO, but the underlying technology plays an essential role. Adhami et al. (2018) discovered an impact of code availability, presales and specific services, such as profit-sharing, on the probability of a successful ICO and Albrecht et al. (2020) examined the power of social media on the market capitalization of an ICO.

Nevertheless, the effects of exogenous signals (i.e., signals that cannot be directly influenced by the emitter such as expert ratings) or endogenous signals (i.e., signals that can be influenced directly such as the choice of social media channels) (Maier et al. 2020) on the performance of ICOs as well as their interactions with hype-driven market prices have not yet been considered. Against this background, the following questions arise:

- 1) How do exogenous and endogenous signals affect the fundraising of ICOs?
- 2) How do these signals moderate the influence of hype effects around the fundraising of ICOs?

To answer our questions, we have formulated five hypotheses. Hypotheses one and two postulate an influence of an exogenous and an endogenous signal on the amounts of funds raised in ICO campaigns. In hypotheses three to five, we consider the hype effect of the BTC price as well as the moderating effects of quality signals. To test our hypothesis, we

applied ordinary least squares (OLS) regressions built on a sample of 1597 ICO data records from ICOBench, the largest provider of ICO ratings, between November 2016 and March 2019. We complemented this record with a comprehensive and complete set of historical Bitcoin price information from CoinMarketCap, one of the most popular price makers in the digital currency industry.

By answering our research questions, we contribute to the nascent research area on ICOs, digital assets, and cryptocurrencies in several ways. First, we revealed the impact of hypes on the asset class of ICO. Second, we uncovered a strong herding driven by the lead assets of the market. Third, we illustrate the interconnection between hypes, expert ratings, and social media presence. In doing so, we broaden the existing theoretical lenses and add to the discussion concerning the impact of ICOs on the area of financial research as well as open up various new connection points for future research.

The remainder of this paper is structured as follows. In the next section, we introduce the theoretical background regarding ICOs and signaling theory as well as develop our hypotheses. Afterwards we outline our research methodology and present our results. Finally, we discuss the results, draw theoretical and practical implications and present avenues for future research.

Theory and hypotheses development

Initial coin offerings

ICOs represent a new fundraising method for blockchain start-ups based on the issuance of coins or tokens (Albrecht et al. 2020). The inflationary use of the term "cryptocurrency" may confuse because all cryptology-based units, such as coins or tokens, are often summarized under this term. However, only units that are by their nature Bitcoin-like and based on Bitcoin's technology (with an own blockchain, node, and miner) are coins. In contrast, tokens can be used for various tasks, e.g., from asset tokens, a cryptographic representation of traditional assets such as gold, stocks or paper currencies, up to utility tokens to enable access to digital services or digital right management (Hyvärinen et al. 2017; Siegfried et al. 2020). Tokens use an existing blockchain, such as the working infrastructure of Ethereum. The fact, however, that tokens could not exist without the underlying coins does not mean that they have a lower value. Most tokens only use platforms such as Ethereum to establish their project with an existing and established infrastructure cost-effectively. The long-term goal of the developing companies is often to detach their token from the platform and convert it into an own and independent coin. The distribution of tokens can be facilitated in a variety of ways. Nowadays, ICOs represent an attractive distribution

channel for developing companies, as in the case of a successful ICO campaign, all financial resources required for the project can be raised in the course of the ICO.

For the fundraising process, the emitting start-up usually publishes a whitepaper explaining the business model, the coin's technical approach, token creation, the type of blockchain used, and other information about features or functional details. In order to raise capital to finance its operations and product development, the tokens or coins created are issued via a platform in exchange for fiat or cryptocurrencies such as Ether or Bitcoin (Albrecht et al. 2020; Alt 2020). Usually, the emitting start-up defines two financing targets: Firstly, the soft cap, a minimum target, which must be reached at least for the realization of the project. Secondly, a hard cap, which immediately stops the ICO as soon as this amount is reached (Fridgen et al. 2018). The purchased coins or token typically offers its owner several specific rights, including access to the start-up application, the right to create or develop functions for an ecosystem, or the right to vote on governance issues (Chen 2018).

The components of an ICO exhibit typical characteristics of crowdfunding and an IPO (Albrecht et al. 2020; Tönnissen et al. 2020). Crowdfunding is an open call for financial support for projects, particularly via the Internet, in which a large group of people, the so-called crowd, evaluates, financially supports, or even designs the project (Mollick 2014). The objectives of crowdfunding are in line with the goals of ICO emitters who acquire financial resources by issuing coins or tokens and, in return, offer, among other things, the right to use or design the application (Tönnissen et al. 2020). Besides, both financial thresholds, soft and hard cap, have their origin in crowdfunding. Like crowdfunding campaigns, ICOs cause low transaction costs,¹ have almost no documentation requirements but enable start-ups to raise substantial funds comparable to expensive and highly regulated venture capital transactions or IPOs (Chen 2018; Howell et al. 2019). Moreover, ICOs, as well as crowdfunding campaigns, can overcome geographical barriers to funding and promote global dissemination at an early stage of the project as communication via the Internet is fast and cost-effective (Danmayr 2013; Lee Chang 2019). However, both crowdfunding campaigns and ICOs suffer from strong information asymmetry between emitters

and investors (Albrecht et al. 2020). For example, investors can only track project progress using the online information provided by the emitter (Gleasure et al. 2019). Emitters could, therefore, withhold information, which could jeopardize the success of the project (Bae 2018). In case of an IPO, the information asymmetry is reduced by a due diligence audit carried out by an external auditor before the IPO starts (Howell et al. 2019). Furthermore, the issue price of the share is determined based on this evaluation. In contrast, in case of ICOs, the emitter determines the issue price of the coin or token. However, ICOs and IPOs also have several similarities. Both financing vehicles, IPOs and ICOs, serve to raise capital for companies. In both cases, the investor acquires shares in the company and thus has a certain right of co-determination. In case of an ICO, coins or tokens are classified as securities, representing a share of the emitting company, which is why these are comparable with shares bought during an IPO (Fisch and Momtaz 2020; Howell et al. 2019).

Furthermore, the motives of emitters and investors of IPOs and ICOs are comparable. In the existing literature, two main clusters comprise the motives for an IPO: firstly, research of motives for going public, secondly research on the first-day returns, which encompasses the motivations of investors. Motives for going public can be divided into company and owner related motivations. Owner related motives cover reasons such as the diversification of the ownership (Bodnaruk et al. 2007) or the facilitation of acquisitions and increasing valuation (Brau and Fawcett 2006). Company related motives encompass general investment needs (W. Kim and Weisbach 2008) or monitoring and certification requirements by analysts, by the securities and exchange commission or markets (Holmström and Tirole 1993). In particular, company-related motives such as the investment needs coincide with the motives for an ICO. Table 1 summarizes the characteristics of ICOs and IPOs.

In contrast to the body of knowledge of IPOs and crowdfunding, research on ICOs is still in its infancy. However, the media hype around ICOs aroused the interest of scholars, so that first determinants of ICOs were revealed. For instance, Fisch (2019), Amsden and Schweizer (2018) and Jin et al. (2017) examined characteristics of whitepapers on the success of ICOs and showed that a stronger technical orientation (Fisch 2019), the writing style (Jin et al. 2017), and the length of the white paper (Amsden and Schweizer 2018) affect the success of the ICO campaign. Adhami et al. (2018) also examined determinants of an ICO success and found that the pre-sale of tokens, the sale of premium tokens with privileges, and the public availability of the source code have a positive effect on the success of an ICO. In contrast, Boreiko and Sahdev (2018) were able to show that issuing tokens to developers reduces the chances of success of the ICO campaign. Huang et al. (2020) shed light on technical and regulatory aspects by demonstrating that a mature

¹ The transaction costs for crowdfunding campaigns, for instance on [kickstarter.com](https://www.kickstarter.com), usually depend on the volume. Kickstarter receives a 5% fee and the payment service provider receives an additional 3–5% fee as well as a fixed fee of \$ 0.20 per transaction. The transaction costs for coins (e.g., the purchase / transaction of ether) are independent of the volume and are determined by the current gas price and transaction speed. According to Fahlenbrach and Frattaroli (2020) the average fee for sending ether from one address to another was \$0.13 in the period from March 2016 and March 2018. Still, in order for a coin to be listed and tradeable on an exchange a fee is paid and the emitter can purchase additional services from the exchange, such as a premium listing place. The prices for these additional services can be individually negotiated and can cost up to several million dollars, but being listed on an exchange is not a prerequisite for an ICO (Howell et al. 2019).

Table 1 Comparison between ICOs and IPOs

	ICO	IPO
Owner related motivations	Diversification of the ownership, facilitation of acquisitions and increasing valuation	
Company related motivations	General investment needs (currency for acquisitions, stock liquidity), monitoring and certification requirements by analysts, marketing, image and public relations	
		Monitoring and certification requirements by the securities and exchange commission markets (SEC)
Degree of regulation	Low	High
Disclosure of information for the campaign	Entirely voluntary	Large amount of disclosure required for listed, public companies
Information asymmetry between emitters and investors	Rather high	Rather low
External auditor	Unregulated, audit by self-proclaimed experts	Strongly regulated, audit by certified auditors
Transaction cost	Rather low, strongly self-determined by the emitter	Very high, strongly determined by regulations and mandatory processes
Issue price	Self-determined	Set by investment banks
Investors securities	Coins or tokens are classified as securities and represent a share of the emitting company	Companies must meet requirements by exchanges and the Securities and Exchange Commission (SEC)
Investment decision	Based on very high uncertainties (ICO whitepaper)	Based on lower uncertainties (IPO prospectus)
Type of emitters	Smaller and younger companies	Often rather larger and mature companies
Rights of co-determination	Co-determination possible, depending on number of shares	
Role of social media	Important (emitter communicates exclusively through these channels with its investors)	Additional (Use of social media can increase awareness before the launch of IPOs)
State of research	Initial stage	Very mature stage

technological basis or a sophisticated payment system in the issuing ICO country, as well as ICO-friendly regulatory conditions, lead to higher ICO ratings. Also, many scholars investigate the effects of social media on ICO campaigns. For instance, a positive sentiment of tweets (Albrecht et al. 2019) or a high twitter activity (Benedetti and Kostovetsky 2018) leads to a higher market capitalization of an ICO and Fiedler and Sandner (2017) pointed out that premium ICOs show an above-average activity on Twitter, Facebook and LinkedIn. However, existing research cannot provide a sufficient explanation of whether different quality signals influence the amount of funds raised in ICO campaigns or their moderating influence on hype-driven market prices. We therefore try to contribute to a better understanding of the influence of different quality signals on ICOs and illustrate strategies to strengthen or mitigate their impact on hype-driven ICO market. We hereby focus on exogenous (e.g., expert ratings) and endogenous (e.g., social media presence) signals that can be easily observed by potential investors and might influence their funding decision.

Signaling theory

The signaling theory provides a well-established explanation of how people judge quality in several situations, especially in situations where the quality is difficult or impossible to observe directly (Benlian and Hess 2011; Spence 1974, 1978).

The theory is rooted in information economics and contract theory and advocates that different parties involved in a particular transaction have different amounts of information about the transaction. This information asymmetry has an impact on the conditions of the transaction as well as on the relationship between the parties (Bauer et al. 2020; Kirmani and Rao 2000). The application of the signal theory in consumer research has revealed that consumers faced with difficult quality decisions or with situations where information asymmetries exist search for information references which provide actions or artifacts of companies that provide consumers credible information about unobservable product quality (Rao et al. 1999). Moreover, researchers indicate that the less buyers know about the seller and the more difficult it is for buyers to assess the product quality, the more likely it is that buyers will use signals to build their own quality expectation. To overcome information asymmetry situations, sellers can use social information cues to send pre-purchase signals about their quality through brand name, advertising, price (Kirmani and Rao 2000; Zavolokina et al. 2019), or collective signals of reputation, such as the electronic word of mouth (Amblee and Bui 2011) or expert opinions (Cheung et al. 2014). The same principle applies to the relationship of investors and investees in financing decisions. Here, signaling theory illustrates the effort undertaken by the capital-seeking party in order to reduce information asymmetries and signal the quality and viability of their product or firm. Two essential characteristics of

signals are usually required for it to be valuable. First, it has to be costly to produce, and secondly, it needs to be observable by others. A warranty can for example serve as a reliable signal. First, it is more costly for a low quality producer compared to a high quality producer to offer a warranty, and it is easily observable (Spence 1973, 2002).

Several empirical studies already assessed the value of quality signals in the context of financial investments in start-ups (e.g., Petty and Gruber 2011; Zacharakis and Meyer 2000). Investments in early-stage ventures are particularly difficult to assess, as information asymmetries are far greater compared to late-stage firms (Kirsch et al. 2009). Therefore investors are often confronted with unreliable, less regulated and often handpicked information about new firms, creating a difficult assessment of the underlying true quality (Plummer et al. 2016).

Hypotheses development

Considering ICOs through the lenses of signaling theory, there are many indications that signals can influence investors' investment decisions. In general, investment decisions are decisions made under information uncertainty. In order to reduce these uncertainties and to mitigate existing information asymmetries, IPO emitters provide audited IPO prospectuses and promote comprehensive analyst coverage. In the case of an ICO, these instruments are not available, resulting in comparatively higher information uncertainty among investors (Albrecht et al. 2020). Although ICO investors have access to a whitepaper, which like an IPO prospectus, contains information for assessing the quality of the offer, there are decisive differences between an ICO whitepaper and an IPO prospectus: Firstly, the whitepaper is reviewed by individual experts and thus represents an important contribution for investors (Fisch and Momtaz 2020). However, it does not guarantee that these experts are independent and certified, as in the case of an IPO prospectus (Howell et al. 2019). Secondly, the scope and level of detail of a whitepaper are often significantly lower than that of an IPO prospectus, and thirdly, the IPO prospectus contains significantly more mandatory elements than a whitepaper. Fourth, in the realm of ICOs, the reliability of the assessments from self-proclaimed experts are often difficult to judge. These reasons indicate that the quality assessment of an ICO's investment decision, based on the information provided by the emitter, comes with very high uncertainties. Therefore, it is quite obvious, and also consistent with the signaling theory, that investors seek further signals which provide credible information about unobservable characteristics of the ICO.

ICO accompanying platforms, such as ICOBench, offer investors this information in the form of social information cues, to be precise, as expert ratings. This expert rating includes an algorithmic evaluation by the platform as well as

subjective assessments by individual experts and represents an exogenous quality signal (Flanagin and Metzger 2013). Although the subjective assessment of experts is based on identical information that is also available to the investor, research has demonstrated that the mere nomination of the alleged expert as an "expert" already has a signaling effect on the quality and credibility of the property assessed by the expert (Bae 2018; Flanagin and Metzger 2013; Huang Lei 2018). Effects of the signals on investment decisions are also known from IPOs. Research on IPOs suggested that investors seek tangible and intangible information about the characteristics of organizations in which they might invest, since this information can be used to dispel concerns about risk and uncertainty (Bruton et al. 2009; Moss et al. 2015; Payne et al. 2009). The reputation of experts or underwriters signals the underlying risks of the offering (Carter et al. 1998). Furthermore, particularly young firms in IPOs stack their board with a diverse group of prestigious directors or experts to send a message to potential investors about the firm's legitimacy (Certo 2003; Connelly et al. 2011; Filatotchev and Bishop 2002). Consequently, we assume that if supposed expert rates an ICO highly, this rating will influence the investor, who will potentially invest higher amounts in the ICO or be more willing to invest in the ICO in the first place. Therefore, we postulate that positive ratings and evaluations by experts and analysts increase not only the recognition of the project but also the value seen in it.

Hypothesis 1. The higher the expert rating of an ICO, the higher the funds raised.

Social media encompasses a group of Internet-based applications that are based on the technology of web 2.0 and allows them to create and share user-generated content (Mihaylov 2018; Yingjie 2019). The term social media covers discussion forums such as Reddit, microblogging sites such as Twitter, social or professional networking sites such as Facebook and LinkedIn as well as social messengers such as WhatsApp. All of these social media applications (also called platforms) differ in their approach and have slightly different unique selling points (Kim 2018). However, they all have in common that each of them enables companies to easily communicate and interact on digital channels with many users, customers, or private investors (Wallbach et al. 2019). The content of the communication can thematically be very different. Companies can use these communication channels, for example, for marketing purposes or to announce economic events and thus strengthen their cognitive legitimacy (Chanson et al. 2018; Liu 2019; Madrazo-Lemarroy 2019). Lundmark et al. (2017), for example, examined the influence of the strategic use of Twitter on a company's organizational legitimacy and used IPO underpricing as a proxy measure. Their results indicate that the use of social media (i.e., Twitter) can increase

awareness before the launch of IPOs. This illustrates that social media enables companies to send signals to customers whose intensity depends on the type of information (e.g., content) and/or the coverage (e.g., number of information channels) which can be freely defined by the company.

ICOs can be considered as a digitalized copy of IPOs, where the usage of social media platforms is even more intense. Besides having a website, Twitter constitutes one of the most important communication channels (Fiedler and Sandner 2017). The emitter uses social media channels for important announcements such as the announcement of the issue price, to inform the community about the development of the project or for marketing purposes. The important role of social media is underlined by the fact that the emitter communicates exclusively through these channels with its investors.

The ICO environment also has strong parallels to the crowdfunding environment, which is strongly community-driven (Belleflamme et al. 2014). For example, both ICOs and crowdfunding campaigns frequently have a large number of investors who become customers or users after a successful campaign (Belleflamme et al. 2014). Unlike conventional investors or venture capitalists, community members are willing to share the project on their social media channels in order to promote the project and increase its chances of success (Lu et al. 2014). Furthermore, the way in which start-ups, emitters or even established companies interact with their consumers and investors has changed significantly with the advent of social media channels, especially communication channels based on connections between consumers, such as word-of-mouth or recommendations are fostered by the use of social media (Claussen et al. 2013). Existing research has shown that word-of-mouth in social media has a positive effect on the box office revenues of movies (Liu 2006) and positive customer product reviews lead to increases in book sales on Amazon (Chevalier and Mayzlin 2006). Customer product reviews allow consumers to express their opinions in respect to a product or service in a vivid description and thus contain considerably more information than a one-dimensional scale such as a product rating (Wessel et al. 2016). The power of digital word-of-mouth through social media is not limited to customer product reviews of existing products. Scholars have also shown that social media can be successfully used for pre-sales or marketing activities, so it is only natural that start-ups and mature companies increasingly rely on social media-based "network" and "viral" marketing strategies (Aral and Walker 2011). Empirical evidence for the successful use of social media activities on pre-sales in crowdfunding campaigns provides e.g., Beier and Wagner (2015), Lu et al. (2014), Thies et al. (2016). Beier and Wagner (2015), as well as Lu et al. (2014) revealed an impact on the success of the crowdfunding campaign caused by social media activities in a community-based environment. Thies et al. (2016) show that social media interactions are perceived as quality indicators on

crowdfunding platforms and can help customers in reducing risks associated with their investments. Based on the existing knowledge and the close parallels between these funding vehicles, we posit that social media presence, which represents an endogenous signal, positively influence the success of ICOs.

Hypothesis 2. The higher the social media presence of the ICO, the higher the funds raised.

Previous research has shown that, particularly in an online context, action-based or behavior-based social interactions can impact others' expected utility for a product or service (e.g., Cheung et al. 2014; Tucker and Zhang 2011). Action-based or behavior-based social interactions are often facilitated through popularity information (PI) (Thies et al. 2016). PI are used to present the decision of previous customers to future customers. These cues can be represented, for instance, in the form of aggregated statistics displaying the number of downloads, as an extensive media coverage of a trend or by an almost empty shelf space of an article in the supermarket. Many ICO platforms use PI cues as an indicator of the choices earlier adopters made by displaying the sum of the raised funding in order to influence consumers' choices and behavior. Such observable cues can help consumers to evaluate what the most appropriate behavior is in a given situation, because sometimes people, "determine what is correct by finding out what other people think is correct" (Cialdini 2009, p. 152). A possible result that can be produced by the stimulation of PI is that many individuals begin to behave identically (Liu 2018). Finally, this behavior can cause informational cascades, which represents an information-based description of herd behavior (Huck and Oechssler 2000). Informational cascades occur when individuals who face identical decisions under uncertainty, can observe the actions of other individuals who faced the same decisions earlier on, but not the motivation behind their actions (Bikhchandani et al. 1992). In these situations, individuals will consider their private information as well as the inferences drawn from observing predecessors' decisions. As soon as individuals consider the decisions of other individuals as more informative than their own information, it is likely that they will ignore their information and imitate the actions of other individuals in order to overcome current uncertainty (Sun 2013). This cascade is increasing, and a possible immediate successor will perceive even more reasons to ignore the own information (Yin 2019). Previous IS research showed that, due to large amounts of information available about the purchase decisions of consumers online, the Internet is the ideal environment for this type of herd behavior. Informational cascades have, for example, been found to arise on online microloan markets (Zhang and Liu 2012), when adopting software (Duan et al. 2009), during online auctions (Simonsohn

and Ariely 2008), but also on investment decisions in financial markets (Welch 2000).

Considering informational cascades in the light of ICOs, they can be a central driving mechanism to explain the behavior of investors on ICO platforms: First, in 2017, the blockchain was promoted as game-changing new technology in all media (Weking et al. 2020) and investors seemed to be very bullish, which also influenced the funds raised in other ICOs. According to Welch (2000) bullish financial markets lead to stronger information cascades. In times of bullish markets, investors tend towards overpricing assets (Chan 2014), and the number of IPOs, as well as the average returns, is unusually high (Lowry and Schwert 2002). These lead to a rising share price, which leads to a further increase in profits and thus attracts more investors. In both, during the dot-com bubble and the ICO hype, media has reported about incredible share price increases and first-day returns, which attracts new and, above all, less-informed investors. The lower level of knowledge about the specific investment vehicle leads to the fact that these investors tend to follow the choice of other investors. Second, investors on these platforms are faced with uncertainties when deciding to fund a project. The uniqueness of the project on these platforms highlights this point, as investors rarely have to choose between two similar projects running simultaneously (Kuppuswamy and Bayus 2017). Third, the value of the promised application or service remains relatively vague at the time of the investment decision, so that investors can only determine its real value after the application or service has been completed and launched (Shi and Whinston 2013). Fourth, ICO platforms are designed in such a way that it is very easy for potential investors to monitor the level of funding from other investors at any time during the project. Fifth, even if the outcome of the action of a predecessor is apparent, the actual motives for these actions are not revealed. For these reasons, we posit:

Hypothesis 3. The higher the BTC price, the higher the amount of funds raised in an ICO.

In accordance with the insights into the research of IPOs, it is also evident that there is the probability of different market behavior of investors depending on the quality of an ICO. In general, the quality of an IPO or an ICO is expressed by analyst coverage, ratings, or reputation systems, which reduce the possibilities of fraud and help investors make the right decisions. Previous research indicates that the quality of an IPO has a significant impact on the success of the IPO (DeGeorge et al. 2007). In the context of ICOs, Lee et al. (2019) pointed out that the quality of analyst ratings has a positive impact on the success of a campaign. While doing so, they pointed out that successful ICO has a rating of 3.4 on average (on a scale between 0 and 5), with failed token sales having an average rating of 2.9. In detail, they consider an

ICO as successful as soon as it has reached the soft-cap. However, by using this binary view (successful vs. failed campaign), they are not able to provide detailed information about the effects of the rating on the amount of funds raised by the campaign. Moreover, Lee et al. (2019) did not consider any interaction effects between factors promoting campaign success. Thus, they neglected a possible interaction effect between the BTC price and the success of the campaign. However, we assume that the BTC price, which is being cheered on by the hype surrounding the financing vehicle, moderates the influence of the ratings.² In the case of a high BTC price, a herding behavior occurs as postulated in hypothesis 3, which leads to a lower relevance of the reviews for the investor. Thus, low quality ICOs can be driven by the BTC price. In contrast, high quality ICOs will be perceived as individual profitable investments, without being pegged to a superordinate currency like BTC. Therefore, a high quality ICO will be less influenced by hype factors explained which leads to the following hypothesis:

Hypothesis 4. The effect of BTC price on funds raised is moderated by ICO ratings, so that higher rated ICOs are less driven by the BTC price.

Finally, we assume the influence of an ICO's social media presence on users' herding behavior. Social media enables companies to communicate information to investors and investors to share this information with other people. This leads to an increase in the range of information so that potential investors, who did not deal so intensively with ICO campaigns, will be better informed. Moreover, social media enables companies to be more sensitive to customer's needs (Du Helen 2019). Thus, potential investors, which feel more comprehensively informed, make their own self-confident decisions more independently of popular information cues. This means that the importance of popularity of information cues and the associated herd behavior decreases with a stronger social media presence. Therefore, we assume that if ICO campaigns use more information channels, investors will be more informed, and therefore these campaigns will not be so strongly driven by the hyped BTC price.

² Even though most ICOs are offering via a blockchain platform with smart-contract features such as Ethereum, we believe that Bitcoin (instead of Ether) constitutes the more appropriate and representative operationalization. In our investigation period Bitcoin and the underlying blockchain technology were represented clearly more strongly in the media than Ethereum (approx. Factor 10 more, compare e.g., Google Trends (2020), see Figure 4 in the Appendix). Therefore, we expect that Bitcoin has significantly fueled the media hype more than other currencies. Nevertheless, for control purposes and as an additional robustness check, we have calculated all models and analyses with the Ether price. All analyses showed comparable results. To emphasize this fact, we added the correlating exchange rates between Bitcoin and Ether Figure 5 (in the Appendix). Thus, we assume that the hype effect has an impact on the general technology and that all coins and tokens based on it are affected in the same way by the hype effect.

Hypothesis 5. The effect of BTC price on funds raised is moderated by social media presence, so that ICOs with a higher social media presence are less driven by the BTC price.

We summarize our hypotheses in a conceptual framework including all independent (ICO Rating, Social Media Presence and BTC Price), dependent (Funds Raised) and control variables (Time, Token Type, Ethereum and know your customer (KYC)) in Fig. 1.

Methodology

Dataset and model specification

For our data collection, we use the ICO rating platform ICOBench, the biggest provider of ICO ratings with over 5000 rated ICOs, as the source of data. ICOBench serves as a platform to present new ICO projects to investors, but also to keep track of closed ICOs. The ICOs listed on ICOBench collected a total of 24 billion dollars for projects from more than 25 industries. Besides the necessary metadata for an ICO, such as the issuing price, the start and end date, or the white paper, the platform also provides additional information in the form of an expert rating. Our data set encompassed a sample of 1597 ICOs between November 2016 and March 2019 with complete information about the projects raised funds, used token types, start and end dates, ICO ratings, base layer technology, know your customer compliance, and the used social media channels.

We additionally collected the market prices of BTC from CoinMarketCap, one of the most popular price providers in the industry of digital currencies. CoinMarketCap aggregates the real-time prices of multiple exchanges and provides an overview of over 2000 tokens or digital assets. Using the API of the platform, we have gathered a substantial and gapless set of historical price data for the whole observational period of nearly 900 days.

In order to operationalize our model, we have used the *Funds Raised* by an ICO in US dollars at the end of its funding

period as a dependent variable, because the higher the funds raised, the more resources are available for further development and operation, which provides a higher chance of success. Since the distribution of *Funds Raised* is positively skewed, we have log-transformed this variable (*ln Funds Raised*). We use *ICO Rating*, *Social Media Presence*, and *BTC Price* as independent and as moderating variables. *ICO Rating* was measured on a scale from 0 (lowest rating) to 5 (highest rating). *Social Media Presence* was measured on a scale from 1 to 13 and represents the number of different social media channels that are operated by the companies and *BTC Price* covers the development of historical prices of the BTC in 1000 USD. To unveil latent influences on the funds raised in an ICO, we control for four factors: Firstly, *Time*, measured in months for the period from November 2016 till March 2019 and shows if the timing itself also influences the funds raised in an ICO. Secondly, *Token Type*, a nominal variable labeled as 1 for payment token, 2 for security token, and 3 for utility token (base category). We have included this variable to ensure that specific tokens do not have a signaling effect themselves (such as security tokens). Furthermore, the majority of ICO emitters offer tokens of the type "utility tokens". Thirdly, *Ethereum*, a dummy variable is set to 1 if the project is based on Ethereum, otherwise, it is set to 0. Ethereum constitutes the most popular Blockchain infrastructure. By adding this control variable, we can control for the prominence of the Ethereum, as its wide distribution and its stage of development might have an influence on our results. Fourth, a dummy variable *KYC* is set to 1 if the project conducted a know your customer process, otherwise 0. *KYC* can help investors to assess the regulatory compliance of the project. In order to ensure that these voluntary regulatory requirements do not influence the amount of funding, we have included this variable as a control variable. Therefore, the model specification is as follows:

$$y_i = \alpha_i + \beta x_i + \gamma x_i$$

In this model, y_i constitutes the dependent variable describing the amount of funds raised for each ICO i . The set of independent variables is represented by βx_i , with γx_i as the error term.

Fig. 1 Conceptual framework of research for hypotheses

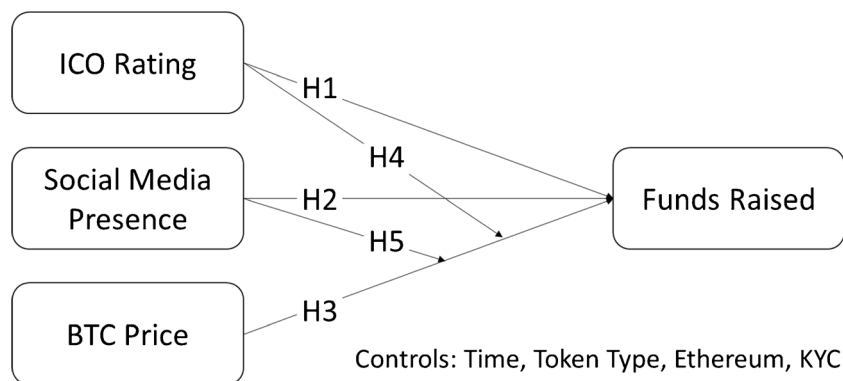


Table 2 Descriptive statistics

Variable	Mean	SD	Min	Max
<i>Funds Raised in USD</i>	1.55e7	1.16e8	279	4.2e9
<i>LN (Funds Raised in USD)</i>	15.1	18.9	5.63	22.2
<i>ICO Rating</i>	3.27	0.724	0.80	4.80
<i>BTC Price (1000\$)</i>	7.50	3.36	0.702	19.8
<i>Social Media Presence</i>	6.77	1.96	1	13
<i>Token Type</i>	2.94	0.277	1	3
<i>Ethereum</i>	0.775	0.418	0	1
<i>KYC</i>	0.416	0.493	0	1

$N = 1597$

Results

Descriptive statistics

Table 2 summarizes the descriptive statistics of our sample. The variable *Funds Raised* indicates a wide range, with a minimum of USD 279 up to USD 4.2 billion. The mean of USD 15.5 million indicates that a substantial amount of money is invested in early-stage projects. The average rating is 3.27 out of 5, while the highest rating is 4.8 and the lowest 0.8. To check the robustness of hypothesis 4, we split our sample into two groups by using a median split: firstly, high rated ICOs with a value ≥ 4.0 and secondly, low rated ICOs with a value < 4.0 .

Table 3 provides the Pearson correlations of all numerical variables used in the regression, excluding categorical variables.

Testing the hypotheses

To explain the development of the research model, we have stepwise added our independent variables in each regression model, shown in Table 4. Also, we need three sub-models of model 5, since we have included split sample robustness checks for hypothesis 4.

Our analysis clearly shows that the rating of an ICO substantially influences its funds raised by increasing them by 81.1% ($p \leq 0.001$) in model 2 if the rating is increased by one unit, and as a result of this, we confirm our first hypothesis. Our second hypothesis postulates a positive effect of Social Media Presence

on ICOs fundraising. Surprisingly the results of the regression show the opposite effect. With an increasing number of social media channels, the amount of funds raised tends to decrease -0.109 ($p \leq 0.001$). Thus, we find not support for our second hypothesis. For our third hypothesis, we included the BTC price in model 4. We can confirm our hypothesis since, with a rise in the BTC price by USD 1000, fundraising is increased by 5.0% ($p \leq 0.001$). To analyze our hypothesis 4, the moderating effect of the ICO Rating on the effect of hypothesis 3, we calculated an interaction term of the ICO Rating and the BTC Price and added it in model 5. Our results indicate that a higher rating weakens the effect of the BTC Price on Funds Raised (-0.051 , $p \leq 0.05$, confidence band (see Fig. 2). By using our split sample, we further examine this moderating effect on low-quality ICOs (rating < 4.00) in model 5a and on high-quality ICOs in model 5b. In the case of low-quality ICOs, a rise in the BTC Price of USD 1000 increases Funds Raised by 5.0% ($p \leq 0.001$), which is identical to the effect of the overall sample (model 4). In contrast, in the case of high-quality ICOs (model 5b), no significant effect was found. Thus, we confirm our hypothesis 4, the higher the rating of an ICO, the less is the ICO driven by BTC prices.

The moderation analysis of hypothesis 5 also confirms the interaction between the hype effect and the Social Media Presence. As shown in model 6 and Fig. 3, if an ICO serves ten or more social media channels, the hype-driven influence of the BTC price on the amount of raised funds does not exist anymore.

Discussion and conclusion

Summary and discussion of findings

In this study, we addressed the questions "How do exogenous and endogenous signals affect the fundraising of ICOs?" and "How do these signals moderate the influence of hype effects around the fundraising of ICOs?". To answer these questions, we have formulated five hypotheses, which we have largely confirmed in the analysis of 1597 ICOs.

Despite a large amount of information provided (e.g., the whitepaper), ICO investment decisions are information decisions with a high degree of uncertainty. It is well known from

Table 3 Pearson correlation

	(1)	(2)	(3)	(4)	(5)	(6)
(1) <i>LN (Funds Raised in USD)</i>	1					
(2) <i>ICO Rating</i>	0.235***	1				
(3) <i>BTC Price (1000\$)</i>	0.0996***	0.132***	1			
(4) <i>Social Media Presence</i>	0.0704**	0.671***	0.119***	1		
(5) <i>Ethereum</i>	-0.0177	0.200***	0.143***	0.182***	1	
(6) <i>KYC</i>	-0.000619	0.382***	0.0415	0.322***	0.203***	1

$N = 1597$; ** $p < 0.01$, *** $p < 0.001$

Table 4 Regression results

LN (Funds Raised in USD)	Model 1 Baseline	Model 2 ICO Rating	Model 3 Social Media Presence	Model 4 BTC Price	Model 5 Rating X BTC Price	Model 5a Low-Quality ICO	Model 5b High-Quality ICO	Model 6 Social Media Presence X BTC Price
Controls								
Time	-0.054*** [-4.379]	-0.077*** [-6.497]	-0.072*** [-6025]	-0.074*** [-6189]	-0.083*** [-6519]	-0.074*** [-5132]	-0.083*** [-3501]	-0.082*** [-6602]
Token Type Payment	1.204* [2.267]	0.951* [2.106]	0.935* [2124]	0.935* [2116]	0.883* [2023]	0.602 [1318]	1.933* [2.141]	0.900* [2077]
Token Type Security	-0.237 [-0.832]	-0.161 [-0.594]	-0.151 [-0.550]	-0.088 [-0.317]	-0.088 [-0.320]	-0.189 [-0.555]	0.151 [0.342]	-0.093 [-0.337]
Ethereum	0.109 [0.862]	-0.011 [-0.096]	-0.005 [-0.046]	-0.049 [-0.418]	-0.053 [-0.457]	-0.033 [-0.255]	-0.194 [-0.850]	-0.058 [-0.497]
Main Effects								
KYC	0.333*** [2.812]	0.031 [0.263]	0.035 [0.293]	0.054 [0.457]	0.086 [0.713]	0.145 [1012]	-0.108 [-0.618]	0.081 [0.676]
ICO Rating		0.811*** [11.124]	0.993*** [11,040]	0.974*** [10,900]	1.335*** [4640]	1.116*** [9321]	1.236*** [3166]	0.967*** [10,867]
Social Media Presence			-0.109*** [-3381]	-0.112*** [-3495]	-0.114*** [-3550]	-0.136*** [-3793]	-0.005 [-0.073]	0.021 [0.368]
Moderator								
BTC Price				0.050*** [3943]	0.211** [3028]	0.050*** [3497]	0.025 [0.768]	0.185*** [3462]
BTC Price X					-0.051* [-2506]			
ICO Rating								
BTC Price X								
Social Media Presence								
constant	52.508*** [6.150]	66.240*** [8.083]	62.752*** [7638]	64.084*** [7.775]	69.098*** [8.027]	63.665*** [6407]	68.278*** [4188]	-0.019** [-2741]
R ²	0.02	0.099	0.106	0.113	0.117	0.104	0.161	0.117
Observations	1597	1597	1597	1597	1597	1287	310	1597

Standard errors are in parentheses; Log-transformed variables: *Funds Raised*; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

previous e-commerce research that social information cues, in particular expert ratings, are an exogenous signal for buyers and thus also contribute to reducing the existing information uncertainty. With our first hypothesis, we have demonstrated that the signaling effect of social information cues also influences ICO investment decisions and leads to higher fundraising.

The analysis of our second hypothesis showed a surprising result. Contrary to our expectations, the number of social media channels has a negative impact on ICOs' fundraising. Previous research suggests that the presence of social media has a positive effect on the fundraising of projects, e.g., Lu et al. (2014), which we could not confirm. Thus, we assume that in the case of ICOs, the mere existence of several social media accounts on different platforms is not a credible quality signal and therefore does not automatically contribute to the success of the project. Also, empty social media channels can be associated with inattentiveness or negligence of the project teams, or even creates the impression that it could be a scam project. Therefore, we assume, a good social media presence is not determined by the number of different channels, but by the frequency and quality of information exchange on these platforms. The negative effect could, therefore, be explained by a higher number of neglected channels that imply a lack of content and no progress.

Information cascades or herd behavior are often observed in situations where a high level of information uncertainty exists. This behavior occurs when people who are faced with similar decisions under uncertainty can observe the actions of others who have previously been faced with the same decisions but do not see the motivation for their actions. It is well known that information cascades are increasingly occurring in bullish financial markets Welch (2000) and that these cascades are reinforced by media coverage of share price increases and massive investor gains. A combination of popularity information, the intensive and price-driven media coverage of the Bitcoin hype as well as the strong information uncertainty at ICO investment decisions have led to the hypothesis that herding behavior is prevalent among ICO investors, which we were able to confirm with our model.

Even more interesting, are our fourth and fifth hypotheses, in which we postulate moderating effects of ICO Ratings (H4) and Social Media Presence (H5) on hype-driven BTC prices. Firstly, by separating our sample into two groups, high-quality and low-quality ICOs, we were able to demonstrate that in case of low-quality ICOs a rising BTC price leads to increasing ICO fundraising whereas high-quality ICOs are not affected by the BTC price. This moderating effect highlights the assumption that there are fundamental differences between ICO projects that can be identified as high or low-quality by ratings. This implies that serious projects tend to be decoupled from hypes or external factors, which supports the assertion, that high-quality projects conducting an ICO to raise funds,

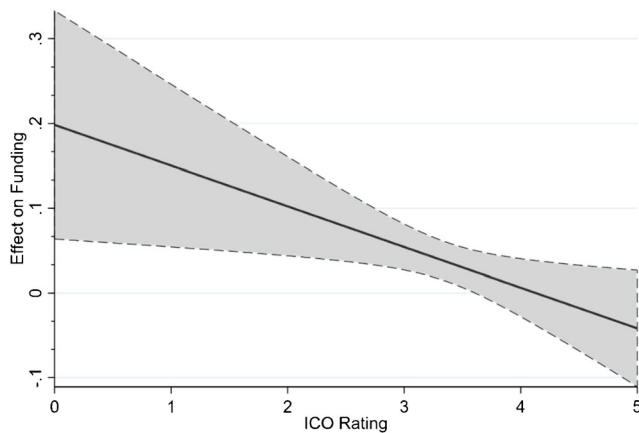


Fig. 2 Confidence band of the hype effect moderation by ICO Rating

can still be seen as valid stand-alone investment cases, even with a lot of low-quality ICOs flooding the market. Secondly, we were able to demonstrate an interaction between the social media presence and the effect of the hype-driven BTC price on the amount of funds raised in an ICO (H5). Our analysis showed that when companies serve ten or more social media channels, the effects of the hype-driven BTC price become insignificant. This could mean that potential investors will feel comprehensively informed when companies provide their information through multiple channels. Investors might thus be able to better assess the true potential of the investment and, in this case, ignore the effect of the BTC price.

Theoretical contributions

We shed light on the new class of digital assets and contribute to the existing body of knowledge in several ways. In doing so, we heed calls for research from Alt et al. (2018) and Tönnissen et al. (2020), which demand a stronger consideration of the interface between blockchain technology and financing vehicles and especially of potential success factors for token-based ecosystems

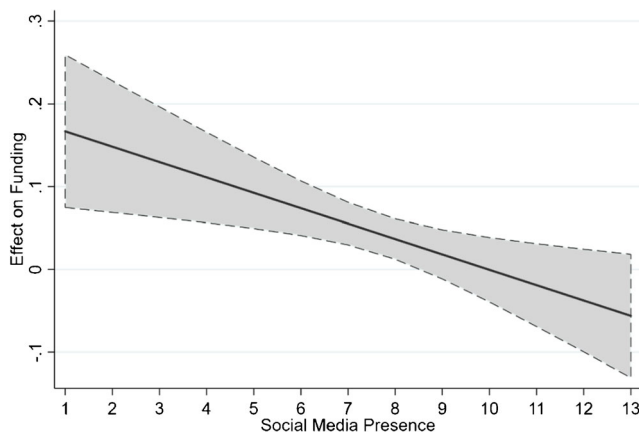


Fig. 3 Confidence band of the hype effect moderation by Social Media Presence

based on the blockchain. We were able to demonstrate that the signaling effect of social information cues, which was mainly investigated in the area of e-commerce, also has a signaling effect on investors of novel financing vehicles and thus reduces the information uncertainty of investors. First, this illustrates that mechanisms from the traditional e-commerce sector are suitable for promoting investment in new financing vehicles such as ICOs.

Second, considered in the light of investment research, the signal effect of social information cues in an ICO is almost as important as analyst reporting in a traditional IPO. Both mechanisms reduce information uncertainty among investors. For analyst coverage, companies have a high willingness to pay, which is not yet monetized for new types of financing vehicles such as ICOs. Thirdly, it is conceivable that the signaling effect of social information cues can be transferred to traditional financing vehicles, thus opening up a broad field of research.

Third, we reveal the impact of exogenous and endogenous signals and hypes on this asset class. We have shown that novel investment vehicles are susceptible to the herd behavior of the investors. In bullish markets, in particular, there is strong herding driven by the lead assets of the market, e.g., Bitcoin and Ether. This herding behavior varies for low-quality and high-quality ICOs. This indicates that high-quality ICOs can also be financed in bear markets and are independent of the market situation. In addition, this finding stimulates further fields of research, from financial to behavioral research. The question arises, for example, as to whether the herd behavior in IPOs or in restaurant selection also varies depending on quality or price.

Finally, our results on ICOs and their relation to hypes, exogenous and endogenous signals broadens the discussion concerning the impact of ICOs on the area of financial research and opens up various new connection points for future research.

Practical implications

For practitioners and investors, the knowledge that the hype surrounding cryptocurrencies is massively driving the funds raised in ICOs, regardless of their quality, can have an enormous impact on their decision-making processes.

For sustainable and long-term investments, investors should therefore be aware of potential herding mechanisms and pay particular attention to the quality of ICOs. Furthermore, investors can use ratings to gain a better understanding and insight into individual ICO projects, as they know that high ratings also influence the short-term performance of assets.

For ICO emitters, our results also provide important insights. Emitters should design their ICO in such a way that they can credibly convince investors of their quality. In particular, emitters should seek ways to minimize the existing information asymmetries between emitters and their investors. By confirming of our first hypothesis, we have been able to show that exogenous signals, such as expert ratings,

constitutes one of the main drivers of the campaign's success. Thus, these exogenous signals are an effective tool to mitigate the prevalent information asymmetries by investment decisions.

Limitations and future research

Firstly, contrary to our expectations, we could not find an overall positive effect of Social Media Presence on the ICOs fundraising. By taking a closer look into the effect of the individual social media channels, the effects might vary, as Social Media Presence is not only determined by the number of used channels but also by additional factors, such as activity, content, and interaction. Therefore, we propose a more detailed consideration of the effects of Social Media Presence on ICO fundraising in the future.

Secondly, we considered the hype effects by using the development of the lead currency. It is conceivable that additional aspects could enforce the hype generation besides the success of lead currencies. We also investigated the number of ICOs as an alternative operationalization of the hype effect and were able to show comparable results. Nevertheless, we cannot rule out that psychological or general economic factors may also influence the hype effects.

Finally, the existing body of knowledge about ICOs, their success factors, or their long-term performance is still embryonic. Thus, this field of research still offers much potential for further investigations. For example, the question arises as to whether the influence of ICO ratings on the funds raised also affects the long-term price performance of ICO projects. Moreover, the influence of the overall sentiment of investors across multiple markets and assets are also exciting research questions.

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Appendix

In order to support the argument on the usage of Bitcoin rather than Ether or Ethereum as hype indicator, we compared data from Google Trends (2020) during our observational period for all three keyword as shown in Fig. 4. Even though the pattern has some similarity, Bitcoin clearly stands out as the more relevant term with regard to the cryptocurrency hype and therefore is more adequate way to operationalize the surrounding hype of cryptocurrencies.

Adding to the decision to use Bitcoin value rather than ether, we also looked at their respective dollar value during our observational period by using the exchange rate data from Coin market cap (Coinmarketcap 2020a, b). Figure 5 clearly shows a very close development over the course of time of both currencies.

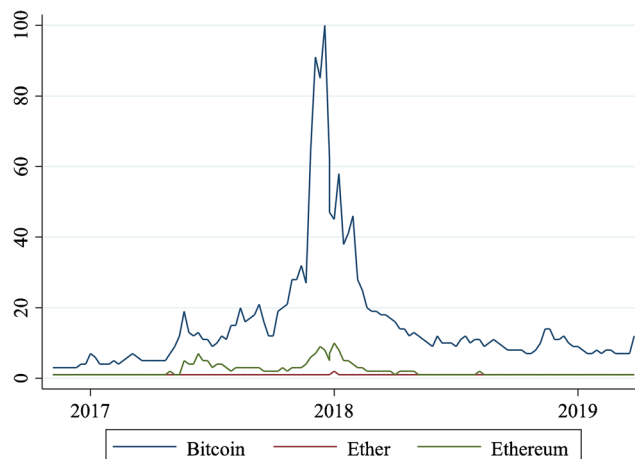
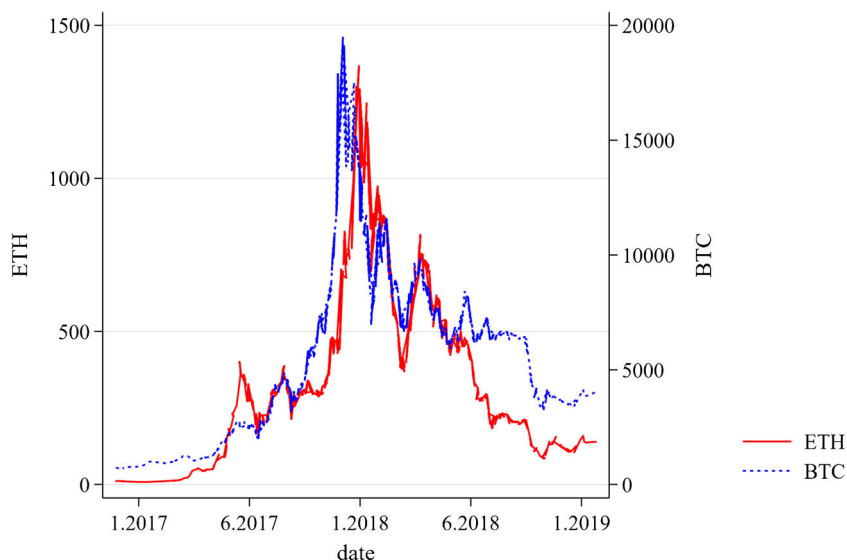


Fig. 4 Number of search queries for keywords based on Data from Google Trends (2020)

Fig. 5 Correlating exchange rates between Bitcoin and Ether



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