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Ownership, uses and perceptions of cryptocurrency: Results from a population survey

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ABSTRACT

A decade after the launch of Bitcoin, cryptocurrencies are maturing from a niche phenomenon and appealing to a broader audience. However, the actual prevalence of cryptocurrency ownership and usage, the users' socio-demographics, the motives to buy, and the popularity of and knowledge about cryptocurrencies have not been sufficiently researched. Based on a representative online survey among 3864 Germans, we find that 83% of the respondents are aware of the phenomenon, yet the respondents' self-assessed knowledge about cryptocurrencies and the underlying blockchain technology is limited. 9.2% of the respondents owned cryptocurrencies at the time of the survey; another 9.1% have owned cryptocurrencies in the past. Cryptocurrency users tend to be young, male, well-educated and well-off. Ownership is often associated with long-term investments, and 62% of the respondents state that their ownership is ideologically motivated. The empirical analysis discloses that a major driver of ownership is knowledge about cryptocurrencies, mediated by trust. There is some discrepancy between the actual and perceived usage domains of cryptocurrencies, which reflects the polarization of the phenomenon. The findings have implications for regulators and businesses which are potentially affected by the increasing societal relevance of cryptocurrency.

1. Introduction

Cryptocurrencies are native digital assets of open access public blockchain systems with various purposes, e.g. to align the participants' incentives in economic coordination mechanisms (Rauchs et al., 2018). From a legal perspective, they serve as a store of value, as a medium of exchange, and they sometimes even have characteristics of securities. From a socioeconomic perspective, cryptocurrencies constitute a multifaceted phenomenon because, on the one hand, they facilitate illegitimate activities like money laundering, terrorist financing and tax evasion (Houben and Snyers, 2018; Bloomberg, 2017; Strehle and Ante, 2020), while on the other hand, the underlying technology has the potential to radically change social and financial interaction positively, e.g. through its transparent and comprehensive processes (Chang et al., 2020; Steinmetz et al., 2020).

Cryptocurrencies vary significantly in their technical design, architecture, governance and overall purpose (García-Monleón et al., 2021). While Bitcoin was invented to create a non-censorable and resilient internet currency (Nakamoto, 2008), other cryptocurrencies provide features such as anonymity-enhancing cryptographic means (e.g., Ben-Sasson et al., 2014), increased computational functionality (e.g., Buterin, 2014) or superior transaction throughput capacities (e.g., Popov, 2018). All variations of cryptocurrencies share a framework consisting of a protocol layer, a network layer and a data layer (Rauchs et al., 2018), which jointly constitute a distributed ledger technology (DLT) system. In most cases, cryptocurrencies are based on blockchains, a subcategory of DLT which is characterized by an open access for contribution, e.g. dedicating computational effort for the maintenance of the system, and unrestricted (public) transparency, which refers to the accessibility of the transaction database itself. Similar technical systems can be differentiated along the two dimensions of accessibility to transaction processing and accessibility to transaction data. For example, systems of federated (selected entities for system maintenance & transaction processing) or consortium character (selected participants; restricted access to maintenance, transaction processing and transaction database) are often also referred to as blockchains. These types of blockchain form the base layer for blockchain applications beyond cryptocurrencies, e.g. in supply chain management and finance

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(Choi, 2020), or on-demand service platforms (Choi et al., 2020).

Besides native assets based on a dedicated blockchain such as the above mentioned, so-called tokens are also considered a type of cryptocurrency. Tokens are technically tied to a blockchain and co-exist with its native currency but do not serve any fundamental function in the maintenance of the DLT system itself. Instead, they can easily be created and implemented to serve specific purposes in dedicated software systems, making them valuable in a wide range of use cases. 2017 and 2018 saw a considerable number of new cryptocurrency projects issuing such tokens in exchange for funding, with the tokens consequently becoming speculative assets (García-Monleón et al., 2021). This phenomenon is referred to as initial coin offerings (ICO), which has meanwhile received considerable attention from academic research (e.g. Ante and Meyer, 2021; Chod and Lyandres, 2021; Bogusz et al., 2020; Choi, 2020; Gan et al., 2021). As of today, the variety of cryptocurrencies has reached noticeable dimensions – the cryptocurrency market data provider Coingecko listed over 6600 cryptocurrencies in April 2021. For the purpose of regulation, the tokens are categorized according to their intended use and functionality, e.g., utility tokens, payment tokens and security tokens (Finma, 2018). However, these legal categories often include both tokens and cryptocurrencies, so these asset classes are not very well differentiated. Moreover, it is noteworthy that most jurisdictions have not regulated cryptocurrencies at all (White et al., 2020).

Triggered by the exponential growth of the cryptocurrency market in late 2017 and early 2018, the topic of cryptocurrencies was increasingly covered by the mainstream media, which has raised public attention and awareness. Still, the actual prevalence of cryptocurrency ownership and knowledge among the general public has received little research attention. Systematic research into the users' motives to buy and use cryptocurrencies likewise remains scarce, as does reliable data on the users' socioeconomic characteristics. The growing relevance of cryptocurrencies is not reflected in social science research (Baur et al., 2015), which obstructs effective measures by regulators to balance consumer protection with facilitating innovation. Understanding where and why cryptocurrencies are used, and by whom, helps regulators to assess the field of tension between the protection of investors and the facilitation of innovation, and allows businesses to assess how cryptocurrencies might affect them.

This study first sums up the existing literature about cryptocurrency usage (Section 2) and derives research questions for subsequent analyses (Section 3). Based on a representative sample of German internet users and sophisticated statistical methods, it extends the literature by investigating cryptocurrency awareness, prevalence and motives for ownership (Section 4). Moreover, we investigate the socioeconomic and demographic determinants of cryptocurrency knowledge, blockchain knowledge, current and former ownership, and the level of trust in cryptocurrencies. The results are discussed in Section 5. Limitations and recommendations for future research are formulated in Section 6. Section 7 concludes the paper.

2. Literature review

Most of the academic literature on cryptocurrencies focuses on technical aspects. Yli-Huumo et al. (2016) find that 80.5% of the research concerns Bitcoin, while only 19.5% investigates other blockchain technology applications. Publications on Bitcoin have increased significantly over the past years. Holub and Johnson (2018) find that research from 2011 to 2016 mostly focuses on technology, including mining pool behavior, use cases of Bitcoin and blockchain, privacy issues, system security and stability, and the development of cryptocurrencies. Baur et al. (2015) identify four major streams of research on Bitcoin: Technical, Economic, Regulatory and Social Science, with the latter being the least developed research stream.

The relevance of Bitcoin and cryptocurrencies in society is closely related to their state of adoption. A few studies have investigated the state of cryptocurrency adoption, often only of Bitcoin, sometimes using the Technology Acceptance Model (TAM) (Davis, 1989) or variants thereof. These studies mostly focus on the determinants of the intention to use the technology, to which we refer in Section 2.5 on the motivational aspects of cryptocurrency ownership. Besides the academic literature, several surveys provide results on cryptocurrency knowledge, awareness and ownership, although rarely based on representative samples. To a lesser extent, both these surveys and the academic literature investigate the users' sociodemographic characteristics and usage behavior. The next section reviews the available literature, most of which is of a descriptive nature. To the best of our knowledge, no study exists that is based on a representative sample and uses multivariate statistics.

2.1. Awareness and knowledge

In an online survey of 2500 adult German internet users, Frenzel et al. (2019) find that 66% of the respondents have at least a rough idea of what cryptocurrencies are. 90% of the respondents have heard of Bitcoin. Deutsche Postbank (2018) surveyed 3100 respondents, representative of the German population, about their knowledge on cryptocurrencies. Only 4% of the respondents consider their knowledge to be 'very good', 16% selected 'good', 39% chose 'less good', and 41% indicated 'not good'. Among the digital natives (aged 18–34 years), 29% consider their knowledge to be either 'very good' or 'good'. Bearingpoint (2019) conducted a survey among 2020 internet users, representative of the German population, finding that 6% are highly knowledgeable about the topic, while 43% have heard about cryptocurrencies but have limited knowledge, and 20% are utterly ignorant about cryptocurrencies.

In another representative study of about 1000 German internet users, Bearingpoint (2018) report an increasing trend regarding the awareness of cryptocurrencies, from 72% in 2016 to 71% in 2017 and 88% of the respondents in 2018. According to the author, men tend to have more interest in cryptocurrencies and are more likely to own them. Interest and usage are highest among young respondents (22%; 18–29 years), followed by the age groups 30–49 (17%) and 50–69 (13%). The overall ownership rate is estimated at 5% (8.2% male, 1.9% female). For the UK, the FCA (2019a) reports that 58% of the respondents have never heard of cryptocurrencies, while English et al. (2020) find that the share of unaware respondents dropped to 27%. However, the authors explain that the drop might be due to applying different methodologies. Crowder (2019) reports on a survey among 1000 retirees, representative of the American population aged 55 and above. 32.9% of the respondents have never heard of Bitcoin, while 56.7% are aware of Bitcoin but do not consider it as an investment.

In a representative telephone survey among 1004 Germans over 16 years of age, Bitkom (2019) find that 68% have heard or read about cryptocurrencies. 56% of the respondents recognize that cryptocurrencies can speed up payment processes online and 51% are aware of the potential of cryptocurrencies to make transfers of money cheaper. Another telephone survey by Wciom (2019) among 1600 adult Russians find that 74% of them know the term 'Bitcoin'. Of those who know Bitcoin, only 9% state to have detailed knowledge. Among 18–24-year-olds, the level of awareness is higher (67%).

Exton and Doidge (2018) conducted a survey among 14,828 adult respondents, asking about cryptocurrency awareness and ownership in 15 countries, including several European countries, as well as Turkey, the USA and Australia. Across the European countries, 66% of the respondents have heard of cryptocurrencies (77% male; 55% female). Awareness ranges from 38% in Belgium to 79% in Austria. In 11 of the 12 European countries, the majority of respondents have heard of cryptocurrencies. In the USA, the awareness rate is lower than in Europe for both men (69%) and women (45%). The study finds cryptocurrency ownership to be more prevalent in countries with lower per capita income. Ante et al. (2020) analyzed a representative sample of 3,846 German citizens, extracting the determinants of positive cryptocurrency

Table 1
Studies on the awareness and knowledge of cryptocurrencies.

Study	Sample	Findings
Frenzel et al. (2019)	2500 adult German internet users	• 66% of respondents know cryptocurrencies • 90% have heard of Bitcoin
Deutsche Postbank (2018)	3100 Germans (representative)	• 4% have very good knowledge of cryptocurrencies, 16% good, 39% less good, 41% not good • 29% of digital natives (18–34 years) have very good or good knowledge
Bearingpoint (2019)	2200 German internet users (representative)	• 6% actively use cryptocurrencies and know a lot about the topic • 43% have heard about cryptocurrencies and have some knowledge • 20% know nothing about cryptocurrencies
Bearingpoint (2018)	1000 German internet users (representative)	• Awareness of cryptocurrencies rose from 72% in 2016 to 71% in 2017 and 88% of the respondents in 2018 • Interest and usage (22%) are highest among 18–29-year-olds • Ownership is estimated at 5% (8.2% male and 1.9% female)
FCA (2019a)	2,132 Brits aged 16+	• 58% never heard of cryptocurrencies • 27% picked the correct definition of cryptocurrencies from a list • 15% were unable to define them correctly
English et al. (2020)	3,085 Brits	• 27% have never heard of cryptocurrencies • 92% of cryptocurrency owners can define the term correctly • 77% recognized at least three different cryptocurrencies • 90% conducted some research before purchasing • 89% understood that their investment had no regulatory protection
Crowder (2019)	1,000 American retirees (representative of age 55 and above)	• 56.7% are aware of Bitcoin but do not consider it an investment
Bitkom (2019)	1,004 Germans over 16 years of age	• 68% have heard or read about cryptocurrencies • 56% recognize that cryptocurrencies can speed up online payment processes • 51% are aware that cryptocurrencies can make transfers of money cheaper
Wciom (2019)	1600 adult Russians	• 74% know the term 'Bitcoin' • 9% say they have detailed knowledge about Bitcoin • 67% of 18–24-year-olds are aware of Bitcoin
Exton and Doidge (2018)	14,828 adults from 15 countries (representative)	• Across European countries, 66% of the respondents have heard of cryptocurrencies (77% male, 55% female) • Awareness varies across Europe: from 38% in Belgium to 79% in Austria • Ownership rates are lower in richer countries
Ante et al. (2020)	3,846 German internet users (representative)	• Successful crypto-investors tend to know more about the assets and own more of them than un-successful ones

Table 2
Studies on cryptocurrency ownership.

Study	Sample	Findings
Blandin et al. (2020)	Service provider data on accounts until September 2020	• 101 million unique cryptocurrency users worldwide by September 2020 • User activity varies significantly
Brandt (2019)	1000 adult internet users for each country	Ownership by region: • Germany: 4% • France 4% • Italy: 6% • Denmark: 8% • Spain: 10% • Turkey: 20%
Deutsche Postbank (2018)	3100 Germans (representative)	• Ownership in Germany: 3% • 4% among German 'digital natives' (18–34 years)
Global Web Index (2018)	111,899 internet users	• Ownership by region: • Latin America: 6.5% • Middle East: 6% • Asia-Pacific: 5.6% • Europe: 3.8%
Wciom (2019)	1600 adult Russians	• Ownership in Russia: 2%
Laboure and Reid (2020)	3600 Deutsche Bank customers from Italy, France, USA, UK, Germany and China	Respondents who held cryptocurrency in the past 12 months: • China: 26% • Italy: 7% • Germany: 7% • USA: 7% • France: 6% • UK: 4%
FCA (2019a)	2132 Brits aged 16+	• 3% of the sample have bought cryptocurrency in the past • 7% of non-buyers consider buying in the future • 8% of cryptocurrency owners did extensive research before investing, 16% did none • 40% of owners expect to hold their cryptocurrency for at least three years • 50% of cryptocurrency owners have sold some or all of their holdings
English et al. (2020)	3085 Brits	• 3.86% of the population own cryptocurrency • 50% of these have holdings under 260 GBP
Exton and Doidge (2018)	14,828 adults from 15 countries (representative)	• Ownership: Europeans: 9%; Luxembourg: 4%; Germany: 8%; Romania: 12%; USA: 8%; Turkey: 18%; Australia: 7% • Intention to buy in the future: Europeans: 25%; Australia: 15%; Romania: 38%; Turkey: 45%
Crowder (2019)	1000 American retirees (representative of age 55 and above)	• 2.7% own Bitcoin

investment returns. The authors find that successful crypto-investors have significantly greater industry knowledge, as proxied by the self-assessed knowledge about cryptocurrencies and the number of cryptocurrencies a respondent knows.

Many studies focus on assessing the awareness of the phenomenon of cryptocurrencies, asking respondents if the term 'cryptocurrencies' or 'Bitcoin' is known. Only few studies present information about the actual or self-proclaimed knowledge levels of the respondents about cryptocurrencies or the underlying technology, which would allow for more thorough investigations of those that are attracted to crypto-currencies or especially knowledgeable on the topic. Table 1 summarizes the results of the reviewed studies.

2.2. Ownership

Based on service provider data, Blandin et al. (2020) estimate the global number of unique cryptocurrency users at 101 million in September 2020 – an increase by 189% compared to 2019. This figure does not include self-hosted wallets. For North America and Europe, 40% of these users are considered active. The authors note, however, that user activity varies significantly across and within regions, and the service providers use different definitions of activity.

Brandt (2019) reports the share of cryptocurrency owners in Germany and France at 4% each, in Italy at 6%, in Denmark at 8%, in Spain at 10% and in Turkey at 20%, based on responses by about 1000 adult internet users in each country. According to Exton and Doidge (2018), the share of respondents owning cryptocurrencies ranges from 5% in Belgium to 12% in Romania and 18% in Turkey. Deutsche Postbank (2018) estimates the share of German citizens owning cryptocurrency at 3%, and at 4% among digital natives. Global Web Index (2018) conducted a worldwide survey among 111,899 internet users to determine the rate of cryptocurrency ownership. They find the highest rate in Latin America (6.5%), followed by the Middle East (6%), Asia-Pacific (5.6%) and Europe (3.8%). Wciom (2019) find that only 2% of Russians actually own cryptocurrencies. Laboure and Reid (2020) conducted a survey among 3600 Deutsche Bank customers from the USA, the UK, Germany, France, Italy and China. The share of respondents who bought or sold cryptocurrencies in the last 12 months are highest in China (26%), followed by Italy, Germany and the USA (7% each). The lowest shares are reported for France (6%) and the UK (4%). For the latter, the FCA (2019a) finds that 3% have bought cryptocurrencies in the past, while 7% of the non-owners consider buying some in the future. A follow-up study by English et al. (2020) estimated an ownership rate of 3.86% for the UK. 75% of the owners hold less than 1000 British Pounds (GBP). When including previous owners of cryptocurrency, the share among the population is 5.35%.

According to Exton and Doidge (2018), 9% of Europeans owned cryptocurrencies in 2018, while 25% say they will probably buy some in the future. Across 12 European countries, the prevalence of ownership ranges from 4% in Luxembourg to 8% in Germany and 12% in Romania. The ownership rate is estimated at 8% in the USA, 18% in Turkey, and 7% in Australia. In the latter, 15% expect to own cryptocurrencies in the future, while the corresponding share is 21% in the USA. The highest share is again reported for Romania (38%) and Turkey (45%). Regarding the latter two states, however, the authors indicate a potential sampling bias in favor of young professionals with high exposure to media and technology, which might explain higher rates of (expected) ownership. Table 2 summarizes the results of these studies.

2.3. Trustworthiness

A major driver of the purchase decision is the perceived trust towards cryptocurrency. However, assessing the level of trust that a respondent has in a cryptocurrency is not trivial. It can either relate to the asset's technological robustness against manipulation, reflect the investor's ideological mindset, or relate to the asset's price stability or the capabilities of the project that issued the cryptocurrency. Accordingly, the reviewed studies have proxied trust perceptions of Bitcoin and cryptocurrencies differently and examine different aspects of trust. This sections thus presents the current state of the scarce literature relating to trust perceptions of cryptocurrencies.

Bearingpoint (2018) assess the trustworthiness of cryptocurrencies in terms of price stability. Only 23% of the respondents trust the price stability of cryptocurrencies, in contrast to gold (82%) and fiat currencies (72%). 31% of the respondents believe that cryptocurrencies can exceed the established fiat currencies in terms of usage in the future. The next year, Bearingpoint (2019) report that only 17% of the respondents trust the price stability of cryptocurrencies, and the share of those who think it is very likely that cryptocurrencies surpass fiat currencies as a medium of exchange has dropped to 3%. Regarding the question whether cryptocurrencies can replace cash / debit cards in the future, Laboure and Reid (2020) find that among respondents from the US, the UK, France, Italy and Germany, 27% / 25% think so, whereas 44% / 46% disagree. In contrast, 44% / 44 % of Chinese respondents agree to these statements, while only 27% / 26% disagree. The differences between Chinese and Western respondents are also present among other

Table 3
Studies on the trustworthiness of cryptocurrencies.

Study	Sample	Findings
Bearingpoint (2019)	2200 German internet users (representative)	• 17% of the respondents trust in the price stability of cryptocurrencies • 3% believe it is very likely that cryptocurrency use will surpass fiat currencies in the future
Bearingpoint (2018)	1000 German internet users (representative)	• 23% of the respondents trust in the price stability of cryptocurrencies • 31% believe that cryptocurrency use can surpass fiat currencies in the future
Laboure and Reid (2020)	3600 Deutsche Bank customers from Italy, France, USA, UK, Germany and China	Respondents from the Western countries (Italy, France, USA, UK, Germany) and China: • 27% / 44% agree that cryptocurrencies will replace cash in the future (44% / 27% disagree) • 25% / 44% expect that cryptocurrencies will replace debit cards in the future (46% / 26% disagree) • 48% / 48% say that cryptocurrencies are creating a financial bubble • 56% / 39% will never invest in them • 54% / 48% think they facilitate fraud • 55% / 44% think they are volatile
Wciom (2019)	1600 adult Russians	• 28% believe Bitcoin is harder to steal than ordinary money • 29% think Bitcoin is easier to steal than ordinary money
Exton and Doidge (2018)	14,828 adults from 15 countries (representative)	• Cryptocurrencies are considered riskier for investment purposes than stock markets (46%), government bonds (63%), real estate (65%), gold (70%) and cash (70%)
Zarifis et al. (2014)	focus groups and interviews	• Knowledge about blockchain technology promotes trust • For those with less knowledge, the acceptance of cryptocurrencies by merchants is an indicator of its trustworthiness
Mahomed (2018)	280 South Africans	• The intention to adopt cryptocurrencies is promoted by hedonic motives and trust • Trust positively affects performance expectancy for cryptocurrencies, i.e. trust increases the perceived benefit a respondent would expect from using cryptocurrencies
Krombholz et al. (2017)	990 Bitcoin users	• The greatest perceived risks of handling and owning cryptocurrencies are value fluctuation, vulnerabilities and theft through malware

trust-related perceptions: 54% / 48% of the respondents agree that cryptocurrencies facilitate fraud, 48% / 48% think that they are creating a financial bubble, 56% / 39% state they will never invest in them, and 55% / 44% agree they are volatile. Although the survey is not based on a representative sample, major regional differences in the perceptions about cryptocurrencies are disclosed.

Exton and Doidge (2018) asked respondents who have heard of Bitcoin as well as current and potential future owners about the (unspecified) relative risk of Bitcoin compared to other assets. Cryptocurrencies are considered riskier for investment purposes than the stock market (46%), government bonds (63%), real estate (65%), gold (70%) and cash (70%).

Zarifis et al., (2014) investigate if trust in business-to-consumer transactions is higher when they are carried out through cryptocurrencies, as opposed to traditional payment methods. Based on focus groups and interviews, they find that more knowledge about cryptocurrency technology raises the respondents' level of trust, while for those with less knowledge, the acceptance of cryptocurrencies by merchants is an indicator for its trustworthiness. Among South African respondents, Mahomed (2018) finds that trust promotes consumers' intention to adopt cryptocurrencies. Furthermore, trust is a mediator of consumers' performance expectancy. In other words, trust positively influences individuals' estimations about the benefits that cryptocurrencies can bring them.

In a survey of 990 Bitcoin users, Krombholz et al. (2017) conclude that despite their increased popularity, cryptocurrencies are not yet a mass phenomenon, and the risk of human error continues to be perceived as a threat. 22% of the respondents reported losses due to security breaches, and 43.2% of those acknowledged that the loss was due to their personal failure to implement adequate security measures. Among the perceived risks of handling and owning cryptocurrencies, the respondents ranked value fluctuation the highest, followed by wallet vulnerabilities and theft through malware. The least serious risks are associated with cryptographic flaws, double spending and Denial-of-service attacks. Many respondents find the ease of use impeded by handling keys produced by public key cryptography. Users tend to trust not in third-party providers (e.g. wallet providers) but rather in the robustness of the underlying blockchain technology. In the realm of security vulnerability, Wciom (2019) find that 28% of Russians believe that Bitcoin is harder to steal than ordinary money; 29% of the respondents think it is easier.

The trustworthiness of cryptocurrencies also suffers from the fact that a considerable amount of Bitcoin has been involved in exchanges involving illicit goods (Martin, 2014). Christin (2013) estimates that 4.5% to 9% of Bitcoin have been involved in trades associated with Silkroad, a marketplace similar to eBay but for illicit goods. Table 3 summarizes the results of these studies.

Most surveys fail to adequately specify the terms 'risk' and 'trust' for the respondents – likely because not all respondents are able to make this distinction. The terms are used interchangeably, or risk perceptions serve as proxies for trustworthiness. None of the reviewed studies examines a high-level trust perception, which would allow for assessing a general sentiment towards cryptocurrencies among respondents. Moreover, none of the studies differentiates levels of trust by the respondents, which would allow for more detailed examinations, e.g. which parts of the population are especially enthusiastic and potential users of cryptocurrencies.

2.4. Socioeconomic characteristics of users

Research about the sociodemographic characteristics of cryptocurrency owners and users is scarce. Most of the literature we have reviewed lacks comprehensive descriptive statistics about the users and owners of cryptocurrencies.

Knowledge about and ownership of cryptocurrencies is mostly associated with male gender and young age. Wciom (2019) present additional determinants of awareness about Bitcoin: higher education (71%), living in major cities (75%), male gender (66%) and active internet usage (69%). Exton and Doidge (2018) find that Europeans' awareness of cryptocurrencies is not significantly higher among younger age groups (18–24: 64%; 25–34: 69%; 35–44: 69%) than for older age groups (45–54: 66%; 55–64: 65%; 65+: 60%). In Australia, awareness is much higher among respondents aged 18–24 (82%). European respondents who use mobile banking applications are more likely to be aware of cryptocurrencies (69%) than those who do not (59%). In Europe, the probability of owning cryptocurrency is higher for males (13%) than for females (6%), and it is greatest for 25–34-year-olds (16%). Laboure and Reid (2020) report that the shares of respondents who have bought or sold cryptocurrency in the last 12 months are highest among the age group of 18–34-year-olds, as opposed to the age groups 35 -54 and 55+. In France (14%), Italy (14%), Germany (12%) and the UK (8%), the rate of ownership among the youngest age group is at least twice as high as for 35–54-year-olds. In China, 29% of the youngest age group have recently bought or sold cryptocurrencies. For the UK, the FCA (2019a) finds that respondents who can define cryptocurrencies (27%), i.e. have a certain knowledge about them, are mostly male, aged 20-44 years and of higher socioeconomic status, based on education, income and profession. English et al. (2020) in a follow-up study add that 79% of cryptocurrency owners are male, 69% are over 35 years old and 27% are classified as C2DE social grade (middle and working class).

Bohr and Bashir (2014) investigate Bitcoin usage among 1193

Table 4
Studies on the sociodemographics of cryptocurrency users.

Study	Sample	Findings
Wciom (2019)	1600 adult Russians	Determinants of high awareness: • Higher education (71%) • Living in major cities (75%) • Male (66%) • Active internet usage (69%)
Exton and Doidge (2018)	14,828 adults from 15 countries (representative)	• In Europe, men (13%) are more likely to own cryptocurrency than women (6%) • Highest ownership rate among 25–34-year-olds (16%)
Laboure and Reid (2020)	3600 Deutsche Bank customers from Italy, France, USA, UK, Germany and China	Share of respondents who have bought or sold cryptocurrencies in the last 12 months (18–34; 35–54; 55+ years): • China: 29%; 26%; 8% • Italy: 14%; 6%; 1% • France: 14%; 5%; 1% • Germany: 12%; 6%; 4% • USA: 11%; 8%; 0% • UK: 8%; 4%; 1%
Bohr and Bashir (2014)	1193 respondents from bitcointalk.org, Reddit, Twitter and Googleplus	Political ideologies among users: • Libertarian: 47% • Progressive: 17% • Socialist: 9% • Centrist: 8% • Anarchist: 7% • Green: 7% • Conservative: 5%
Wilson and Yelowitz (2015)	Google trends data from 01/2011 to 07/2013 for all US states and DC	• Computer-programming and internet searches for illegal activity keywords correlate with interest in Bitcoin
FCA (2019a)	2132 Brits aged 16+	• Of those who define cryptocurrency correctly (27%), most were male, aged 20–44 years and AB social grade[11]
English et al. (2020)	3085 Brits	• Cryptocurrency owners are mostly male (79%), over the age of 35 (69%) and classified as C2DE social grade (middle and working class) (27%).

Table 5
Studies on the motives of cryptocurrency users.

Study	Sample	Findings
Deutsche Postbank (2018)	3100 Germans (representative)	Motives not to invest in cryptocurrencies: • Excessive risk: 56% • Insufficient knowledge: 50% • The purely virtual character of the currency: 36% • Fear of hacks and theft: 31% • Lack of deposit insurance: 30% • Lack of state control: 29% Motives to invest in cryptocurrencies: • Investment opportunity: 29% (46% among digital natives) • Independence from monetary policy: 56% (51% men; 60% women) • High yields: 45% (56% men; 36% women) • Anonymity: 32% (39% men; 26% women)
Bearingpoint (2019)	2200 German internet users (representative)	• Cryptocurrencies are interesting investment opportunities: 25% • Cryptocurrencies will outperform traditional securities in times of recession: 4%
Bitkom (2019)	1004 Germans over 16 years of age	• Cryptocurrencies are useful only for speculation due to their volatility: 62% • The handling of cryptocurrencies too complex: 61% • Using cryptocurrencies in messenger apps for small payments among peers is a desirable feature: 15%
Wciom (2019)	1600 adult Russians	• Bitcoin is a good investment: 10% • Bitcoin is not a good investment: 65%
Exton and Doidge (2018)	14,828 adults from 15 countries (representative)	• Cryptocurrencies are the future of online spending: 35% • The price will rise over the next 12 months: 35% • Cryptocurrency investments are riskier than real estate: 65% • Cryptocurrency investments are riskier than shares: 46%
FCA (2019a)	2132 Brits aged 16+	Reasons to buy cryptocurrencies • Gamble (31%) • Diversify the portfolio (30%) • Make money quickly (18%) • Other reasons (17%) • Instead of buying other financial instruments (11%) • As part of a long-run savings plan (8%) • Avoid 'missing out' (4%) Reasons not to buy cryptocurrency: • Too risky to buy (e.g. price volatility) (29%) • Do not know how they work (23%) • Do not know how to buy them (20%) • Too risky to use (e.g. in exchange for goods/services) (19%) • Not enough money (16%) • They are not regulated (12%) • Too difficult or complex to buy (8%) • Negative image (6%)
FCA (2019b)	31 past, current, and potential cryptocurrency owners	• Most cryptocurrency buyers are looking to make substantial financial gains and/or experience 'fear of missing out' • Most bought cryptocurrency after talking to friends, family or co-workers who made a profit
Arias-Oliva et al. (2019)	402 Spaniards aged above 20 with a university degree	The intention to use cryptocurrencies is mainly driven by • Performance expectancy • Facilitating conditions • Effort expectancy Less important factors: • Social influence • Perceived risk • Financial literacy
Schaupp and Festa (2018)	117 US business students	Intention to use cryptocurrency is driven by: • Attitude • Subjective norms • Perceived behavioral control
Mendoza-Tello et al. (2018)	115 Spaniards	• Social commerce usage (E-commerce carried out through social networks) raises perceived trustworthiness and the intention to use cryptocurrencies • Perceived trustworthiness promotes the intention to use cryptocurrencies and the perceived usefulness of them • Perceived usefulness raises the intention to use
Shahzad et al. (2018)	376 respondents from China	• Awareness and trustworthiness drive the intention to use Bitcoin • Perceived usefulness partially mediates the relationship between perceived ease of use and intention to use
Walton and Johnston (2018)	237 South Africans	• The expected benefits, general attitudes towards Bitcoin and subjective norms directly determine the intent to use Bitcoin • Usefulness, ease of use and risk perceptions influence the intention to use Bitcoin only indirectly
Baur et al. (2015)	13 individuals	• Consumers attribute the usefulness of Bitcoin to anonymity and security
Knauer and Mann (2019)	157 Germans	Acceptance of blockchain technology stimulated by: • Improved transaction conditions • Privacy protection • Independence from institutions • Fraud protection
Alzahrani and Daim (2019a)	Literature review	Four main categories of influencing factors for the cryptocurrency adoption decision are identified:

(*continued on next page*)

Table 5 (*continued*)

Study	Sample	Findings
Alzahrani and Daim (2019b)	Literature review and expert input	• Technical (esp. anonymity, fast transfers) • Economic (esp. investment opportunity, low transaction cost, acceptance by businesses for payments) • Social • Personal (esp. technological curiosity) The most influential factors for consumer's cryptocurrency adoption decision: • Investment opportunity • Subjective norms • Recognition by businesses • Privacy

respondents from the community forum bitcointalk.org, as well as from Reddit, Twitter and Googleplus. The authors find that age and not being a US citizen predict Bitcoin ownership. Younger users are more optimistic regarding the value of Bitcoin. Further predictors of optimism regarding Bitcoin's long-term success are engagement in community forums and the respondent considering herself an investor. The authors argue that while not much information is available, age, time of initial use, geographic location, mining status, engaging in online discourse, and political orientation are relevant factors to describe the target audience. 47% of Bitcoin users are libertarian, while 17% subscribe to progressive, 9% to socialist, 8% to centrist, and 7% to anarchist political ideology. 7% consider themselves greens, and 5% are conservative. While libertarians tend to regard Bitcoin as an alternative currency that is free from governmental influence, politically left-minded respondents are attracted by Bitcoin's potential to disrupt the financial system. Wilson and Yelowitz (2015) find that writing computer code and searching for illegal activity keywords online are associated with greater interest in Bitcoin, while investment-related search terms are not. Table 4 summarizes these results.

The review shows that detailed descriptive statistics of cryptocurrency users from a representative sample is not existing as of today - especially in terms of income, educational and relationship statuses. This is especially surprising against the backdrop of the medial attention that cryptocurrencies have experienced in the past and considerable awareness levels , e.g. among Western populations.

2.5. Motives

Deutsche Postbank (2018) conducted a survey of the motives not to invest in cryptocurrency. 56% of the respondents state that it entails excessive risks, while half of the respondents cite insufficient knowledge. Other answers refer to the purely virtual character of the currency (36%), fear of hacks and theft (31%), the lack of deposit insurance (30%), and a lack of state control (29%). The respondents thus indirectly appreciate the security services offered by financial institutions and state-control – features which e.g. Bitcoin explicitly circumvents. In the same study, 29% of the respondents consider cryptocurrencies interesting for investment purposes, whereas for digital natives, the share is 46%. Of those who are interested in investing, 56% value the independence from the monetary policy of central banks (51% men; 60% women). Other important factors of attraction are the high potential yields (45% overall; 56% men; 36% women) and anonymity (32% overall; 39% men; 26% women). According to Bearingpoint (2019), 25% of the German respondents consider cryptocurrencies a suitable investment opportunity. However, cryptocurrencies are perceived as complementary to the respondents' portfolios as only 4% believe cryptocurrencies will outperform traditional securities during a recession. Bitkom (2019) report that 62% of German respondents agree that because of their volatility, cryptocurrencies are only useful for speculation. Moreover, 61% of the respondents find the handling of cryptocurrencies too complex. Wciom (2019) find that buying Bitcoin is considered a good investment by 10% of the responding Russians, while 65% negate this.

The study by Exton and Doidge (2018) indirectly discloses Europeans' motives to buy and not to buy cryptocurrencies: 35% of the respondents agree that cryptocurrencies are the future of online spending and 35% predict the price will rise within the next 12 months. Motives not to buy are indicated by 65% who perceive cryptocurrency investments as riskier than real estate, and by 46% who perceive them as riskier than shares. Similarly, the FCA (2019a) reports that most British respondents look for a financial advantage from buying cryptocurrencies. The most common reasons to buy refer to the investment as a gamble (31%), portfolio diversification (30%), and the expectation of quick gains (18%). The most important reasons not to buy cryptocurrencies concern risk perceptions (e.g. volatility, 29%) and a lack of knowledge about how cryptocurrencies function (23%) and how to buy them (20%). The FCA (2019b) asked 31 British consumers who at some point held cryptocurrency or intended to buy it about the factors driving their decisions. The hope to get rich quick was mentioned by most respondents, as was the 'fear of missing out' on a lucrative investment opportunity. Most of those who had bought cryptocurrencies did so after speaking to friends, family members or co-workers who had invested successfully. King and Koutmos (2021) empirically find that herding behavior, or 'trend chasing', is present in some cryptocurrency markets and driving price developments. The authors' findings are indicative of the primarily financial motives of consumers to buy cryptocurrencies and social influence of buying decisions.

A handful of studies empirically investigate the drivers for the intention to use cryptocurrencies (Arias-Oliva et al., 2019; Schaupp and Festa, 2018; Alzahrani and Daim, 2019a,2019b), as a payment method in particular (Mendoza-Tello et al., 2018), the intention use Bitcoin in particular (Shahzad et al., 2018; Walton and Johnston, 2018; Baur et al., 2015), and the intention to use blockchain-based applications (Knauer and Mann, 2019). In these studies, various methodologies are applied to model and explain the behavioral intention to use the technology. The results are similar across the reviewed studies: Variables with high explanatory power are found to be performance expectancy, facilitating conditions and effort expectancy. In other words, the different studies empirically validate that consumers' motives of using cryptocurrencies are influenced by their individual cost-benefit evaluation, whereby the potential benefit of using cryptocurrencies for a specific activity, e.g. cross-border payments, is more important than the potential effort to learn how to use them. Constructs reflecting social influence, perceived risk and financial literacy are found to be less important, e.g. according to Aria-Oliva et al. (2019). Table 5 summarizes the results of the reviewed studies.

Within none of the reviewed studies, the strength of motivation is investigated, although it would be interesting to find out which role

[1] AB social grade is a socioeconomic status classification originally developed by the National Readership Survey, which is widely used for market research purposes in the UK. AB refers to the top quintile of the population in terms of education, income and occupation.

Table 6
Studies on cryptocurrency usage.

Study	Sample	Findings
Civey (2017)	10,033 German internet users (representative)	• 1.7% conduct payments using cryptocurrencies • 11.4% can imagine paying with Bitcoin in the future • 6.4% are undecided • 28% 'rather cannot' imagine paying with cryptocurrencies • 47.6% 'certainly cannot' imagine paying with cryptocurrencies
DCI Institute (2018)	496 adult internet users	• 3.6% use cryptocurrency for online payment purposes
Exton and Doidge (2018)	14,828 adults from 15 countries (representative)	• 16–17% of Europeans consider Bitcoin only as an investment • 15–30% would use cryptocurrencies for other purposes
English et al. (2020)	3085 Brits (658 owners)	• 47% of cryptocurrency owners have never used them other than as an investment • 27% have used cryptocurrency for payments • 25% have exchanged cryptocurrencies for other cryptocurrencies • 12% have used cryptocurrency to buy other financial products

ideologic motives play in consumers' decision-making processes of buying or using cryptocurrencies. This is especially intriguing with regards to the impression, e.g. by the results by Deutsche Postbank (2018), that the topic of cryptocurrency is somehow polarizing.

2.6. Usage

Cryptocurrency usage domains are mostly condensed to usage as a means of payment or as an investment. The review of the previous section on the intentions to use cryptocurrencies reveals that its usage is mostly predefined as a means of payment, while surveys also asked for respondents' motivations for using cryptocurrency as a speculative asset. In the following, the results of these surveys are presented to give an overview of the state of knowledge about how cryptocurrencies are used.

Civey (2017) find that most respondents of a representative survey among 10,033 internet users cannot imagine making payments with cryptocurrencies. While only 1.7% of the respondents had made cryptocurrency payments by the time of interview, 11.4% can imagine doing so in the future. 75.6% of the respondents 'rather cannot' (28%) or 'certainly cannot' (47.6%) imagine using cryptocurrencies for payments; 6.4% are undecided, and 4.9% are unfamiliar with the term 'cryptocurrency'. In a survey among 496 adult internet users, the DCI Institute (2018) finds that Bitcoin is rarely used for online payment purposes (3.6%), compared to more established solutions such as PayPal (67%) and credit cards (30%). Exton and Doidge (2018) asked the respondents if they would use cryptocurrencies for payments in specific settings. Approximately 16% of the Europeans consider Bitcoin only as an investment, while 15–30% would use cryptocurrencies for other purposes, such as receiving their income (15%), paying taxes (21%) or making international payments (30%). Across all proposed applications, however, most respondents do not want to change the way they pay. Interestingly, current owners of cryptocurrency are less inclined to use it for payments than non-owners. Thus, cryptocurrencies, especially Bitcoin, are currently used primarily as a speculative asset, as confirmed by English et al. (2020), who report that 47% of cryptocurrency owners have never used them for any purpose other than speculating. According to the authors, the second most prominent application is to buy goods or services (27%) or to exchange them for other cryptocurrencies (25%).

It can be concluded that cryptocurrencies are currently not widely used as a means of payment. This is in line with data provided by specialist websites monitoring the acceptance of cryptocurrencies by merchants and the existence of Bitcoin-ATMs, which indicate a generally low state of adoption by the public. As of January 11, 2021, Coinmap (2021) lists 18,726 venues around the world (except China) that accept Bitcoin. Coin ATM Radar (2021) counts the number of Bitcoin-ATMs that will exchange fiat currency for Bitcoin or other cryptocurrencies at 13,958. The USA take the lead (11,374), followed by Canada (1042), the UK (226), and Austria (142). To put these numbers into perspective, there were 12,835 standard ATMs in Austria at the end of 2018 (European Central Bank, 2020). Yet Bitcoin ATMs are likely not the most popular source of cryptocurrency. As of January 11, 2021, Coinmarketcap (2021) listed 299 online exchanges, some of which accept fiat currency in exchange for cryptocurrency, with varying levels of sophistication and regulatory compliance. Table 6 summarizes these results.

From the previous section it can be seen that most of the reviewed academic literature predefines cryptocurrency as an alternative means of payment and thus only analyzes the intentions of respondents to use cryptocurrencies as such. Similarly, the reviewed surveys in this section assess the usage intentions of cryptocurrencies in the realm of payments, financial transactions or investment. Although cryptocurrencies have different functionalities and can have attributes of non-financial character, e.g. facilitating voting mechanisms, they can be speculative assets simultaneously. However, the existing research does not adequately address and sufficiently differentiate the variety of potential uses of cryptocurrency. Moreover, it has not been investigated which uses are believed to be most prominent as opposed to the actual use of cryptocurrencies.

3. Research questions, dataset and methodology

In the following, the study's research questions are formulated based on the research gaps and open issues identified in the existing literature. We address the research question based on an online survey of 3864 German respondents, who are representative of the German adult internet population. The survey data and the process of sampling is described in Section 3.2. The closing section of this chapter entails a description of our explorative research approach and the variables used.

3.1. Research questions

In line with the structure of the preceding literature review, our first set of research questions aims to verify prior results regarding the awareness, knowledge, ownership, trustworthiness, sociodemographics, motives and usage of cryptocurrencies. By drawing a clear picture of the perceptions and knowledge regarding cryptocurrency in Germany, these insights can provide a comprehensive view on cryptocurrency users from a single panel. This can help businesses that are affected by cryptocurrency to define user groups of special interest and help regulators to analyze the relevance of cryptocurrency in general or to protect retail investors from risky or fraudulent investment opportunities. We formulate the following research questions:

R1: What is the level of awareness of cryptocurrencies in the population?

R2: How much does the population know about cryptocurrencies?

R3: What is the share of ownership among the population?

R4: How does the population perceive the trustworthiness of cryptocurrencies?

R5: What are the sociodemographic characteristics of cryptocurrency users?

R6: What is the extent of ideological motivation driving cryptocurrency ownership?

In addition to these verifying research questions, we derive a second set of questions from the research gaps indicated in the literature review. These explorative research questions aim to deepen the understanding

Table 7
Variables in the descriptive and multivariate analyses.

Domain	Variable name	Type	Categories / scale	Description
Knowledge and awareness	*Crypto knowledge*	ordinal	[0;10]	Respondents were asked to rank their knowledge about cryptocurrency and their knowledge about blockchain technology on a scale from zero to ten. *Crypto knowledge* served as a selection variable: Respondents who stated the value of zero directed to the sociodemographic questions of the survey.
	Blockchain knowledge	ordinal	[0;10]	
	No. coins known	integer	[0;15]	All respondents who stated a knowledge level other than zero were shown a list of the 15 largest cryptocurrencies in terms of market capitalization according to coinmarketcap.com and asked to tick the ones they have heard of. We thus learned which and how many of these cryptocurrencies the respondents are familiar with.
Ownership	*Current owner*	binary	[0,1]	To assess the prevalence of cryptocurrency ownership, we use the dummy variables *current owner* and *former owner*, which indicate if a person holds or held any cryptocurrencies. For the descriptive analysis, the variable *non-owner* captures the rest of the sample.
	Former owner	binary	[0,1]	
	Non-owner	binary	[0,1]	
	No. coins owned	integer	[0;15]	Current owners of cryptocurrency were asked which of the 15 pre-selected currencies they own, which yields the variable *no. coins owned*.
Trust	*Trust*	ordinal	[0;10]	The variable *trust* represents the subjective value that the respondents assigned to the trustworthiness of cryptocurrencies.
Motives	*Ideological motivation*	ordinal	[0;10]	The subjective estimation as to which extent the decision to buy cryptocurrency was ideologically driven, is represented by the variable *ideological motivation*.
Usage	*Payments*	ordinal	[0;10]	To investigate the usage domains of cryptocurrency, the respondents were asked to state which use cases they think cryptocurrencies are mostly used in – independently of their own usage, if any. The respondents ranked each of the pre-defined items on a scale from zero (no usage) to ten (high usage). Then the cryptocurrency owners among the respondents were asked to indicate how many days per month they actually engage in each of these eight activities.
	Speculation	ordinal	[0;10]	
	Investment	ordinal	[0;10]	
	Criminal acts	ordinal	[0;10]	
	Concealment of activities	ordinal	[0;10]	
	Utility & services	ordinal	[0;10]	
	Financing	ordinal	[0;10]	
	Voting	ordinal	[0;10]	
Socio-economics	*Age*	continuous	[18;99]	The variable *age* is a respondent's age in years.
	Male	binary	[0,1]	*Male* is a dummy variable with evident meaning.
	Income	ordinal	[0.45,0.75,1.25,1.75,2.5,4,6.5]	*Income* is monthly net household income in thousands of Euros. The variable is calculated from the ordinal scale of eight income categories: less than 500 Euros (0.45), 500-999 Euros (0.75), 1,000-1,499 Euros (1.25), 1,500-1,999 Euros (1.75), 2,000-2,999 Euros (2.5), 3,000-4,999 Euros (4) and 5,000 Euros or more (6.5).
	No graduation	binary	[0,1]	Each respondent's highest educational attainment is recorded using the dummy variables *no graduation, middle school, A-levels, craftsman apprenticeship, merchant apprenticeship, university degree*, and *PhD*.
	Middle school	binary	[0,1]	
	A-levels	binary	[0,1]	
	Craftsman apprenticeship	binary	[0,1]	
	Merchant apprenticeship	binary	[0,1]	
	University degree	binary	[0,1]	
	PhD	binary	[0,1]	
	Single	binary	[0,1]	Similar to the educational attainments, we captured the respondents' relationship statuses by means of five dummy variables: *Single, married, relationship, widowed*, and separated or *divorced*.
	Married	binary	[0,1]	
	Relationship	binary	[0,1]	
	Widowed	binary	[0,1]	
	Divorced	binary	[0,1]	

Table 8
Summary statistics on knowledge, trust and sociodemographics.

	(1) Full sample Mean	SD	(2) Current owners	(3) Former owners	(4) (2) & (3)	(5) Non-owners	Δ(4) vs. (5)
Knowledge							
Crypto knowledge	3.76	2.78	7.31	6.03	6.68	3.10	3.57***
Blockchain knowledge	2.56	2.85	6.40	4.99	5.70	1.85	3.85***
Trust							
Trust	3.62	2.68	6.73	5.10	5.92	3.01	2.91***
Demographics							
Age	46.72	16.03	38.27	39.78	39.02	48.45	9.43***
Male	0.51	-	0.74	0.63	0.68	0.47	0.21***
Income	2.26	1.45	2.85	2.62	2.74	2.15	0.59***
Education							
No graduation	0.01	-	0.01	0.01	0.01	0.01	0.00
Middle school	0.21	-	0.11	0.20	0.16	0.22	0.06***
A-levels	0.16	-	0.17	0.23	0.20	0.15	0.06***
Craftsman	0.14	-	0.11	0.09	0.10	0.15	0.05***
Merchant	0.22	-	0.22	0.14	0.18	0.23	0.05***
University	0.25	-	0.35	0.32	0.33	0.23	0.10***
PhD	0.02	-	0.03	0.01	0.02	0.02	0.00
Relationship status							
Single	0.24	-	0.29	0.26	0.28	0.24	0.04**
Married	0.43	-	0.48	0.39	0.43	0.43	0.01
Relationship	0.20	-	0.17	0.29	0.23	0.19	0.04**
Widowed	0.03	-	0.01	0.01	0.01	0.03	0.02***
Divorced	0.10	-	0.05	0.04	0.05	0.11	0.07***
N	3,864	357	351	708	3,156		
Share	100%	9.2%	9.1%	18.3%	81.7%		

, * indicates significance at the 5% and 1% level respectively (t-test)

of the phenomenon of cryptocurrency usage, e.g. concerning the predictors of ownership, knowledge and trustworthiness. The results can help regulators understand why cryptocurrency matters to whom, and businesses in the ecosystem may learn which forces drive the use of cryptocurrency, so they can work to increase engagement and trust in the technology.

As indicated in Section 2.6, a research gap consists in comparing the most relevant usage domains for cryptocurrencies to those domains that the respondents *think* are the more relevant ones. The results should provide a perspective on cryptocurrency usage beyond investment and speculation. Such a comparison can be a starting point for analyzing the public image of cryptocurrencies, which can be of value to ecosystem stakeholders aiming to resolve prejudices and devise adequate responses. We thus formulate the following second set of research questions:

R7: What are cryptocurrencies actually used for?

R8: Is there a discrepancy between the perceived and the actual usage of cryptocurrencies?

R9: Which factors influence the knowledge, ownership and perceived trustworthiness of cryptocurrencies?

3.2. Survey data

The survey data is based on a sample of 3,864 adult German internet users - individuals who were online at least once a quarter during the previous year. The sample is representative of the German internet population with regard to age and sex and was conducted online between February and March 2019. 34,440 panelists were contacted, 12.6% of whom (4326) responded. 276 respondents were rejected because of their IP address, browser cookies or browser fingerprints in order to prevent multiple participation. Another 184 participants who sped through the survey, i.e. answered suspiciously quickly, were dropped manually. The manual exclusion of responses was performed by the panel provider based on past experiences with online surveys and excluded responses were replaced to assure the representative character of the sample. Finally, two more participants were removed manually because their response behavior was deemed inconsistent. The term 'inconsistent' refers to inexplicable answers by respondents, for example, stating a high knowledge level about cryptocurrency while in the following item stating to not know any of the presented and most well-established cryptocurrencies such as Bitcoin.

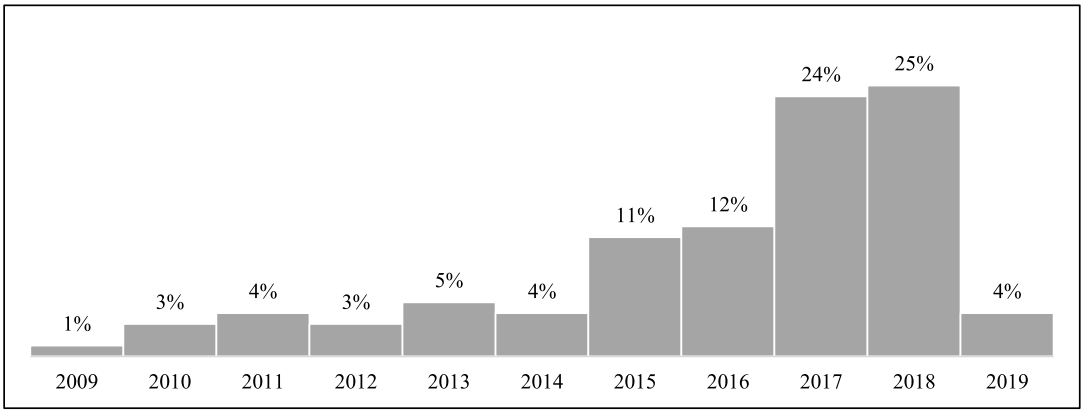

Fig. 1. Year of the current owners' first cryptocurrency acquisition.

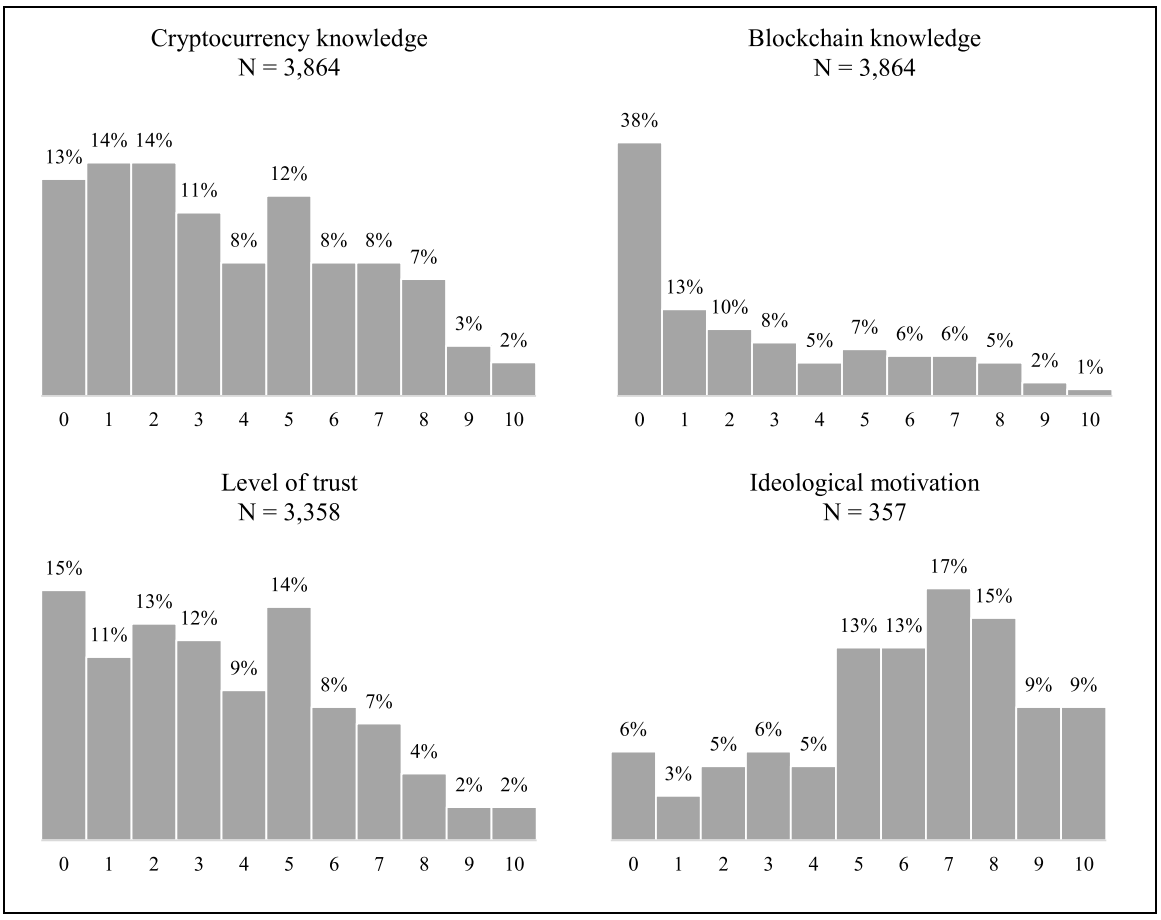

Fig. 2. Distribution of knowledge, trust and ideological motivation.

The panelists were invited by e-mail, and initially no indication was given as to the topic of the survey to prevent any bias from self-selection. Personalized monetary rewards for participation were offered. The questionnaire itself filtered the participants twice: once according to their familiarity with the topic of 'cryptocurrencies' and, at a later stage, according to whether they possess(ed) cryptocurrencies. Participants who met neither criterion were forwarded to provide only sociodemographic information.

3.3. Statistical analyses and variables

The research questions outlined in Section 3.1 are addressed through descriptive and multivariate statistical analyses. Research question R1 – R6 aim at verifying the findings retrieved from the literature and are addressed using descriptive statistics. Research questions R7 – R8 are addressed by comparing descriptive analyses results about perceived and actual usage statistics. Student's *t*-test was used for assessing the significance of differences of the means of selected subsamples. Correlations were calculated based on Pearson correlation. Against the background of the scarce literature, the subsequent research question R9 is of explorative character. For identifying predictors for cryptocurrency and blockchain knowledge, current and former ownership of cryptocurrency as well as for trust, we use logistic regressions given the explorative nature of the present study.

Alongside the structure of the literature review, the variables used include the domains of knowledge and awareness, ownership, trust, ideology, usage as well as socioeconomics and are described in Table 7.

4. Results

In this section, the analyses' results are presented. These include descriptive results in the first section, followed by correlation analysis and lastly, multivariate results of predicting cryptocurrency and blockchain knowledge, current and former ownership as well as trustworthiness.

4.1. Descriptive results

The descriptive results presented in the following, are structured similar to the literature section. These include the awareness, knowledge, ownership statistics, as well as statistics on trustworthiness, socioeconomic characteristics, motives and usage of cryptocurrencies by the respondents of the survey.

4.1.1. Awareness, knowledge, and ownership

Table 8 summarizes the basic descriptive statistics of the dataset across the 3,864 respondents. Columns (1–5) present different samples: (1) the full sample, (2) current cryptocurrency owners, (3) former cryptocurrency owners, (4) the sum of current and former cryptocurrency owners (henceforth: 'owners'), and (5) respondents who have never owned cryptocurrencies ('non-owners'). The far-right column presents the results of a *t*-test of the divergence between owners and non-owners.

83% of the respondents are aware of cryptocurrencies. Across the full sample, the average self-assessed knowledge about cryptocurrency is 3.76 [0;10]. The standard deviation of 2.78 indicates that most responses are close to the average and thus concentrated at a low level. More than half of the responses (51.8%) are between 0 and 3. The

Table 9
Assumed and actual use of cryptocurrencies

	Assumed use [0;10]						Actual use(days per month)
	(1) Fullsample	(2) Former owners	(3) Current owners	(4) (2) & (3)	(5) Non-owners	Δ(4) vs. (5)	(6) Current owners
Payments	4.74	5.44	6.29	5.87	4.44	1.43***	2.74
Speculation	6.56	6.74	7.19	6.97	6.45	0.52***	2.50
Investment	4.76	5.13	6.41	5.78	4.49	1.29***	3.52
Criminal acts	6.49	6.50	6.10	6.30	6.54	0.24*	1.61
Concealment	6.35	6.44	6.15	6.30	6.36	0.07	2.50
Utility & services	5.06	5.57	6.22	5.90	4.84	1.05***	2.76
Financing	4.28	5.16	5.28	5.22	4.03	1.19***	2.26
Voting	3.69	4.40	4.68	4.55	3.46	1.08***	1.92
N	3,358	351	357	708	2,650		365

*,**, *** indicates significance at the 10%, 5% and 1% level, respectively (*t*-test)

difference between owners and non-owners is significant: While owners report a knowledge level of 6.68, the average for the non-owners is 3.1. Current owners report the highest knowledge levels (7.31); however, their involvement may bias their perception. Regarding the self-assessed knowledge about blockchain technology, the average across the sample is only 2.56 (standard deviation of 2.85). Non-owners (1.85) are significantly less knowledgeable than owners (5.70). Overall, the distribution of knowledge about blockchain technology across the subsamples is similar to that of knowledge about cryptocurrencies, but on a lower level.

Across the full sample, the rate of current ownership is 9.2%. Another 9.1% of the respondents have previously owned cryptocurrency, whereas the vast majority of 81.7% have never owned any. The probability of a current owner of cryptocurrency holding Bitcoin is 80.7%, 25.8% for Ethereum and 16% for Litecoin. On average, the respondents have heard about 2.2 different cryptocurrencies. Current owners hold 1.9 cryptocurrencies on average and know about 5.5 (see Table A.1). In sum, while Bitcoin is well known among the population, only 7.4% actually own it. As indicated in Section 2, the analysis confirms that Bitcoin is by far the most relevant cryptocurrency.

In accordance with the fact that Bitcoin was but an obscure experiment back in 2009, only 1% of the current owners bought or mined cryptocurrency that year (Fig. 1). As Bitcoin was initially difficult to buy, it can be assumed that most of the early owners mined their Bitcoin in those days. 4% of the respondents explicitly state that they never bought cryptocurrency, which indicates that they mined them. The share of current owners who bought cryptocurrency in the subsequent years remained low, ranging from 3% in 2010 to 5% in 2013. Only after 2014 did the figure rise, from 11% in 2015 up to 25% in 2018. Most current owners (53%) acquired their cryptocurrency between 2017 and 2019, where the last year only refers to the period January to March.

4.1.2. *Trustworthiness*

The 'perceived trustworthiness' reflects the respondents' individual opinions about the integrity of cryptocurrency in general. The survey purposely did not specify how trustworthiness was to be assessed, e.g. whether it refers to the robustness of the technology, a cryptocurrency's price stability or the integrity of a project team. That is because trust is a

Table 10
Pearson correlation heatmap

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Ownership																			
(1) Current owner																			
(2) Former owner	**-0.10**																		
Assessment																			
(3) Crypto knowledge	**0.41**	**0.26**																	
(4) Blockchain knowledge	**0.43**	**0.27**	**0.80**																
Trust																			
(5) Trust	**0.40**	**0.19**	**0.57**	**0.55**															
Demographics																			
(6) Age	**-0.17**	**-0.14**	**-0.24**	**-0.25**	**-0.27**														
(7) Male	**0.15**	**0.07**	**0.23**	**0.26**	**0.06**	0.00													
(8) Income	**0.13**	**0.08**	**0.28**	**0.30**	**0.08**	**0.05**	**0.15**												
Education																			
(9) No graduation	-0.01	-0.01	**-0.04**	**-0.03**	0.00	**-0.06**	0.01	**-0.06**											
(10) Middle school	**-0.07**	-0.01	**-0.13**	**-0.10**	0.01	**0.05**	**-0.03**	**-0.16**	**-0.04**										
(11) A-levels	0.02	**0.07**	**0.06**	**0.05**	**0.07**	**-0.22**	**-0.05**	**-0.07**	**-0.04**	**-0.22**									
(12) Craftsman	-0.03	**-0.04**	**-0.06**	**-0.06**	-0.03	**0.10**	**0.16**	**-0.07**	**-0.03**	**-0.21**	**-0.17**								
(13) Merchant	0.00	**-0.06**	**-0.05**	**-0.09**	**-0.06**	**0.08**	**-0.14**	-0.02	**-0.05**	**-0.27**	**-0.23**	**-0.21**							
(14) University	**0.07**	**0.05**	**0.17**	**0.18**	0.01	-0.01	**0.07**	**0.26**	**-0.05**	**-0.30**	**-0.25**	**-0.23**	**-0.31**						
(15) PhD	0.03	-0.01	**0.04**	**0.04**	0.00	**0.04**	0.03	**0.13**	-0.01	**-0.07**	**-0.06**	**-0.05**	**-0.07**	**-0.08**					
Relationship status																			
(16) Single	**0.04**	0.02	**0.03**	0.03	**0.05**	**-0.27**	**0.08**	**-0.24**	**0.05**	0.03	**0.12**	**-0.05**	**-0.06**	-0.03	**-0.05**				
(17) Married	**0.03**	-0.02	**0.05**	**0.06**	0.00	**0.22**	**0.04**	**0.35**	-0.03	-0.02	**-0.10**	**0.03**	0.00	**0.08**	**0.05**	**-0.49**			
(18) Relationship	-0.02	**0.07**	0.02	0.01	0.03	**-0.21**	**-0.08**	-0.01	0.01	**-0.03**	**0.07**	-0.03	0.02	-0.03	-0.02	**-0.28**	**-0.43**		
(19) Widowed	**-0.04**	-0.03	**-0.07**	**-0.06**	**-0.07**	**0.17**	**-0.06**	**-0.07**	-0.01	-0.01	**-0.04**	0.03	**0.06**	**-0.04**	0.03	**-0.10**	**-0.15**	**-0.08**	
(20) Divorced	**-0.05**	**-0.06**	**-0.12**	**-0.11**	**-0.08**	**0.22**	**-0.05**	**-0.16**	-0.03	**0.06**	**-0.08**	**0.04**	0.02	**-0.03**	0.00	**-0.19**	**-0.29**	**-0.17**	**-0.06**

1.00 0.80 0.60 0.40 0.20 0.00 -0.20 -0.40 -0.60 -0.80 -1.00

Significance at the 5%-level is highlighted in bold

Table 11
Logistic regressions to predict cryptocurrency and blockchain knowledge

Model	(1) Coef. (SE)	(2) Coef. (SE)
Demographics		
Age	-0.018 (0.004)***	-0.027 (0.003)***
Male	0.768 (0.114)***	0.867 (0.078)***
Income	0.273 (0.056)***	0.275 (0.033)***
Education		
No graduation	-2.540 (0.856)***	-1.388 (0.675)**
Middle school	-1.298 (0.624)**	-0.719 (0.345)**
A-levels	-0.591 (0.636)*	-0.289 (0.351)
Craftsman	-1.113 (0.629)	-0.897 (0.347)
Merchant	-0.685 (0.623)	-0.747 (0.343)***
University	0.150 (0.630)	-0.051 (0.344)**
PhD	-	-
Relationship status		
Single	0.238 (0.188)	0.235 (0.141)*
Married	-0.027 (0.166)	0.222 (0.130)*
Relationship	0.349 (0.197)*	0.216 (0.146)
Widowed	-0.197 (0.281)	0.368 (0.249)
Divorced	-	-
N	3,646	3,646
Dependent variable	Crypto knowledge	Blockchain knowledge
Pseudo R^2	0.10	0.11

*, **, *** indicates significance at the 10%, 5% and 1% level, respectively. Constant terms included but not shown.

complex social construct. Presenting the respondents with predefined options would bias the reporting of their general attitudes. The overall average score of the perceived trustworthiness of cryptocurrencies is 3.62 [0;10]. While current cryptocurrency owners report the highest level of trust (6.73), the scores are considerably lower for former owners (5.10) and non-owners (3.01). The difference between owners and non-owners is significant (see Table 8). Respondents who assign themselves greater knowledge have more trust in cryptocurrencies. Among the knowledgeable respondents [8;10], trustworthiness is as high as 6.38 (n = 466), while the average for the less knowledgeable respondents [1;3] is only 2.24 (n = 2,001).

4.1.3. Socioeconomic characteristics of users

The respondents' socioeconomic characteristics are expressed in terms of their demographics, educational attainment and relationship status (see Table 8). The average age of current and previous owners of cryptocurrency is 39.02, which is significantly lower than for non-owners (48.45). While the share of males is 47% in the latter group, it is significantly higher among current and former owners (68%). Current owners in particular are predominantly male (74%), which shows that either women sold their cryptocurrency earlier than men, or the majority of new owners is male. The deviations in the gender-structure of current and previous owners could be explained gender-specific risk affinity, which led women to sell earlier, led men to hold longer onto their investments, led men to buy into cryptocurrency later on, or a combination of the aforementioned interpretations. Owners and non-owners also differ significantly in terms of income: Current and former ownership is associated with higher monthly net household income. Current owners report the highest income across all subgroups (2850 Euros), former owners report 2620 Euros, and non-owners report 2150 Euros. Relative to non-owners, a greater share of owners have a university degree (33% vs. 23%). Current owners are more likely to have a PhD (3%) than former owners (1%) and non-owners (2%). Regarding the respondents' relationship status, owners and non-owners differ in several respects: The share of current and former owners who are single (28%) and in a relationship (23%) is 4% higher than among non-owners. Owners of cryptocurrencies are significantly less likely to be widowed or divorced, most likely because they are younger.

The analysis shows that past and present owners of cryptocurrency are likely to be young, male, well-educated and relatively well-off. While 43% of owners are married, they are significantly more likely to be single or in a relationship than non-owners. Seeing that we have identified significant divergences between owners and non-owners in every socioeconomic category, people involved in cryptocurrency have clear specific socioeconomic characteristics.

4.1.4. Motives

The literature review has shown that the motives to own and use cryptocurrencies are multi-faceted. The current owners (n = 357) were

Table 12
Logistic regressions to predict current and former cryptocurrency ownership

Model	(1) Coef. (SE)	(2) Coef. (SE)	(3) Coef. (SE)	(4) Coef. (SE)
Demographics				
Age	-0.046 (0.005)***	-0.020 (0.006)***	-0.025 (0.004)***	-0.011 (0.005)**
Male	0.948 (0.134)***	0.571 (0.158)***	0.496 (0.128)***	0.131 (0.139)
Income	0.226 (0.041)***	0.018 (0.053)***	0.178 (0.041)***	0.044 (0.045)
Education				
No graduation	-0.184 (0.862)	-0.190 (1.936)	1.149 (0.994)	1.701 (1.218)
Middle school	-0.872 (0.412)**	-0.871 (0.488)*	0.963 (0.625)	1.207 (0.642)*
A-levels	-0.431 (0.403)	-0.471 (0.475)	1.153 (0.622)*	1.221 (0.639)
Craftsman	-0.702 (0.413)	-0.637 (0.481)	0.348 (0.646)	0.533 (0.663)
Merchant	-0.106 (0.388)*	0.083 (0.458)	0.464 (0.628)	0.566 (0.646)
University	-0.265 (0.378)	-0.242 (0.444)	1.005 (0.612)	1.016 (0.626)
PhD	-	-	-	-
Relationship status				
Single	0.042 (0.289)	-0.143 (0.315)	0.458 (0.307)	0.409 (0.315)
Married	0.071 (0.277)	-0.259 (0.301)	0.337 (0.294)	0.236 (0.300)
Relationship	-0.345 (0.298)	-0.473 (0.328)	0.784 (0.302)	0.798 (0.309)**
Widowed	-0.707 (0.758)	-0.918 (0.790)	0.575 (0.522)**	0.601 (0.534)
Divorced	-	-	-	-
Knowledge				
Crypto knowledge		0.267 (0.052)***		0.103 (0.046)**
Blockchain knowledge		0.113 (0.039)***		0.138 (0.039)***
Trust				
Trust		0.336 (0.031)***		0.050 (0.029)*
N	3,646	3,188	3,646	3,188
Dependent variable	Current ownership	Current ownership	Former ownership	Former ownership
Pseudo R^2	0.12	0.35	0.07	0.12

*, **, *** indicates significance at the 10%, 5% and 1% level, respectively. Constant terms included but not shown.

Table 13
Logistic regressions to predict trust in cryptocurrencies

Model	(1) Coef. (SE)	(2) Coef. (SE)	(3) Coef. (SE)
Demographics			
Age	-0.022 (0.003)***	-0.008 (0.004)**	-0.015 (0.004)***
Male	0.011 (0.108)	-0.324 (0.112)***	-0.128 (0.110)
Income	-0.001 (0.042)	-0.152 (0.044)***	-0.045 (0.042)
Education			
No graduation	-1.286 (0.874)	-1.488 (0.998)	-1.653 (0.917)*
Middle school	-0.438 (0.428)	-0.354 (0.430)	-0.437 (0.429)
A-levels	-0.294 (0.436)	-0.312 (0.438)	-0.346 (0.438)
Craftsman	-0.520 (0.431)	-0.369 (0.435)	-0.464 (0.433)
Merchant	-0.407 (0.424)	-0.315 (0.425)	-0.427 (0.424)
University	-0.547 (0.422)	-0.657 (0.422)	-0.601 (0.421)
PhD	-	-	-
Relationship status			
Single	0.138 (0.191)	0.165 (0.197)	0.144 (0.194)
Married	0.109 (0.172)	0.092 (0.182)	0.119 (0.172)
Relationship	0.174 (0.196)	0.238 (0.202)	0.190 (0.197)
Widowed	-0.622 (0.284) **	-0.751 (0.300)***	-0.663 (0.285)**
Divorced	-	-	-
Knowledge			
Crypto knowledge		0.180 (0.035)***	
Blockchain knowledge		0.249 (0.039)***	
Ownership			
Current owner			3.588 (0.716)***
Former owner			1.511 (0.273)***
Non-owner			-
N	3,188	3,188	3,188
Dependent variable	Trust	Trust	Trust
Pseudo R^2	0.03	0.12	0.08

*, **, *** indicates significance at the 10%, 5% and 1% level, respectively. Constant terms included but not shown.

asked to state their level of ideological motivation to own or use cryptocurrencies on a scale of 0 to 10. Fig. 2 shows that 62% report an ideological motivation to own cryptocurrency in the upper range [6;10]. Lower levels of ideological motivation were reported less often: only 6% report no ideological motivation for their ownership, and only 19% report low levels [1;4]. The results disclose that for the majority of German cryptocurrency owners, their ownership is associated with an emotional component, which is confirmed by the modal level of 7 (17%).

4.1.5. Usage

The usage behavior of cryptocurrencies has rarely been investigated thoroughly. Most existing surveys distinguish only two modes of using cryptocurrencies: for investment purposes and as a means of payment. By contrast, we embrace further associated uses. The current owners were asked to indicate how many days per month they use their cryptocurrency for each of eight predefined options. The results are presented in column (6) of Table 9. We find that cryptocurrency is mostly used for financial gain: Investment attracts 3.52 days of usage per month on average. Speculation (2.5 days) and financing (2.26 days) are also popular uses, as is using cryptocurrencies for project-specific utility and to gain access to services (2.76 days). Using cryptocurrency for voting (1.92 days) and in relation to criminal acts (1.61 days) is reported to a lesser extent. The latter figure, however, is likely to be subject to some degree of underreporting.

Besides the actual usage, we also asked all respondents who indicated a knowledge level greater than zero about the extent – to be indicated on the familiar [0;10] scale – to which they think cryptocurrencies are used for each of the eight purposes. Columns (1–5) of Table 9 present the results of the assumed usage intensity across the domains and subsamples. The respondents held the most important usage domains for cryptocurrencies to be speculation (6.56), criminal acts (6.49), and the concealment of activities (6.35) – evidence of the negative image of cryptocurrency. Except for concealment, the assumed uses differ significantly between owners and non-owners. Discrepancies also exist between the perceived and the actual uses of cryptocurrency. While the assumed usage domains for cryptocurrencies are connotated negatively, the most important actual uses are investments, accessing utility and services, and payments, which bear no negative connotation.

4.2. Correlations

Table 10 shows correlations among the various sociodemographic aspects. We find strong correlations between crypto knowledge and blockchain knowledge, and between ownership and knowledge about cryptocurrency and blockchain technology. Furthermore, there are strong correlations between the level of trust in cryptocurrencies and each of the three variables ownership, crypto knowledge and blockchain knowledge. These correlations reveal a triangular relationship between ownership, knowledge and trust, in which each variable influences the others. The correlations between current ownership, and both trust and knowledge are stronger compared to previous ownership, which indicates that owning cryptocurrency by the time of the survey led respondents to state higher levels of knowledge and trust. Because the respondents' actual knowledge levels have not been verified within the survey, the results need to be interpreted with care.

Taking into account the respondents' sociodemographic characteristics, strong correlations are found between knowledge about both cryptocurrency and blockchain technology, and university degree, higher incomes and male gender. Likewise, university degree, income and male gender are strongly correlating with current and previous ownership of cryptocurrencies. Referring to trust, university degree is the only correlating variable in this set.

4.3. Multivariate results

For the multivariate analysis, we use logistic regressions, as the dependent variables are ordered factorial responses (Tables 11 and 13) and dummy variables (Table 12). The analysis addresses research question R9 regarding the determinants of knowledge about cryptocurrency and blockchain technology, as well as the determinants of cryptocurrency ownership and trust.

4.3.1. The determinants of knowledge about cryptocurrencies and blockchain technology

Table 11 presents the results of logistic regressions predicting cryptocurrency knowledge and blockchain knowledge. Both dependent variables are negatively affected by age, and positively affected by male gender and income. Low educational achievement significantly reduces the probability of being knowledgeable in both realms. For cryptocurrency knowledge, a university degree is the only educational status with a positive effect, whereas for blockchain knowledge, all educational statuses have a negative impact compared to the baseline category, PhD. Respondents who are in a relationship are more likely to have detailed (self-assessed) knowledge on cryptocurrencies, while for blockchain knowledge, the effects of being single and being married are significant.

4.3.2. The determinants of cryptocurrency ownership

Table 12 shows the results of the logistic regressions predicting current and former ownership of cryptocurrency. As with knowledge, the likelihood of ownership is negatively affected by higher age and positively affected by male gender and higher income. Also similarly to the regressions on knowledge, current ownership is negatively affected by all educational achievements short of a PhD. By contrast, previous cryptocurrency ownership is made more likely by all educational categories, and significantly so by A-levels in model (3) and middle school in model (4). The respondents' relationship status does not seem to have a meaningful impact on ownership in general, except that being widowed (model 3) and being in a relationship (model 4) affect former ownership. Models (2) and (4) additionally include the variables of cryptocurrency knowledge, blockchain knowledge and trust. In both models, these variables have a significant positive impact on current and former ownership of cryptocurrency. However, the effects of knowledge about cryptocurrencies and trust are greater on current ownership than on previous ownership. Thus, alongside demographics and income, self-assessed knowledge and trust significantly shape a person's likelihood of buying cryptocurrency.

4.3.3. The determinants of the trustworthiness of cryptocurrencies

The determinants of trust in cryptocurrencies are assessed using three different models (Table 13). Model (1) includes only sociodemographic and socioeconomic independent variables. We find only two significant effects. As with the models on knowledge and ownership, younger respondents find cryptocurrencies more trustworthy. Also, being widowed tends to reduce trust. Model (2) additionally includes cryptocurrency and blockchain knowledge, for which we find large and significant positive effects. Interestingly, trust is more strongly affected by knowledge about blockchain than by knowledge about cryptocurrencies. But as both variables are positively correlated, this observation needs to be interpreted carefully. Investigating the different strengths of these effects present an interesting future research opportunity. Model (3) includes the ownership variables, for which we also find large and significant positive effects. The effect of current ownership is more than twice as large as that of past ownership, which may be due to the current owners having 'skin in the game'. Across models (1) to (3), all educational categories negatively affect trust, which means that the omitted category, PhD, has a large positive effect.

5. Discussion

Having examined the existing research and surveys about cryptocurrency awareness, knowledge, ownership and adoption in general, our findings complement the literature by adding results about the German population and about the socioeconomic characteristics of a representative sample of cryptocurrency users. Furthermore, we have investigated the determinants of knowledge, ownership and trustworthiness of cryptocurrencies.

The literature review reveals the ambiguity regarding the state of cryptocurrency adoption. Integrating our results on awareness, ownership and knowledge with the literature is furthermore challenging because of the different survey designs and methods. According to our results, the awareness and rate of ownership among the population are higher than indicated by most previous surveys. The awareness level of 83% that we find among Germans exceeds the figures indicated by most other surveys, reporting on Germany (Frenzel et al., 2019, 66%; Bitkom, 2019, 68%; Bearingpoint, 2019, 43%; Exton and Doidge, 2018, 71%), except for Bearing Point (2018; 88%). The finding that current owners of cryptocurrency are significantly younger than those who have never owned any refines the figures reported by Bearingpoint (2018) and Deutsche Postbank (2018). Contrary to the only deviating finding by Exton and Doidge (2018) that awareness (among Europeans) is similar among all age groups, we find that for German respondents, the cryptocurrency phenomenon is more present among younger age groups. This is further supported by the regression results which reveal that higher age is associated with less knowledge.

We find that 9% of German internet users currently own cryptocurrency, which is surprisingly high compared to previous surveys reporting figures for the German population (Laboure and Reid, 2020, 7%; Brandt, 2019, 4%, Bearingpoint, 2018, 5%; Deutsche Postbank, 2018, 3%). Exton and Doidge (2018), however, report a similar figure of 8%. The deviations across the studies may result from different survey methods and panels. Additionally, some surveys asked specifically about Bitcoin, while others referred to cryptocurrencies in general. As these surveys were carried out at different times, media reporting on the topic, which affects both awareness and ownership, varied. Nevertheless, if 9% of the German internet population own cryptocurrency, the phenomenon has much more societal relevance than expected. In comparison, the rate of stock ownership (including funds) among the German population stood at 15.2% in 2019 (Deutsches Aktieninstitut, 2020). Since cryptocurrencies are often associated with high volatility and risk (e.g. Deutsche Postbank, 2018), and in light of the high ownership rate, it may be worthwhile to reconsider protective measures for investors against fraudulent offers or high-risk investments.

Referring to knowledge about cryptocurrencies, Deutsche Postbank (2018) used a scale from 'very good' to 'not good', which limits the comparability with our results. We can, however, map their categories to ours, so that their 'very good' corresponds to our [9;10], 'good' to [6;8], 'less good' to [3;5] and 'not good' to [0;2]. Then the frequency distributions regarding cryptocurrency knowledge among the German population are quite similar (5% vs. 4%; 23% vs. 16%; 31% vs. 39%; 41% vs. 41%). With an average self-assessed level of knowledge of 3.67 [0;10], the understanding of the functioning and characteristics of cryptocurrencies appears generally low. This is in line with findings by Bearingpoint (2019), who report that only 6% of German respondents consider themselves well-educated on the topic, and in an international context, Wciom (2019), who report that only 9% of Russians have detailed knowledge about cryptocurrencies. Having asked the respondents about their knowledge regarding the underlying blockchain technology, we are able to complement the existing findings by an additional knowledge category. Since the respondents know less about blockchain technology than about cryptocurrencies, it seems that knowledge about cryptocurrencies extends beyond its technological features. This implies that the topics of cryptocurrency and blockchain technology need to be separated when assessing the respondents' knowledge in more detail.

In contrast to Arias-Oliva et al. (2019), our findings indicate that knowledge on the topic is a key driver of ownership. Note, however, that Arias-Oliva et al. (2019) refer to knowledge in terms of financial literacy, whereas we elicited the respondents' self-assigned knowledge on cryptocurrencies and blockchain technology. The authors point out that financial literacy may improve the capacity for good financial decisions (e.g. Stolper and Walter, 2017), i.e. investment decisions, but not on the technological level (Arias-Oliva et al., 2019). In this regard, our results further contribute to the literature by confirming the positive influence

of technological knowledge on the decision to embrace cryptocurrencies. Furthermore, knowledge about both blockchain and cryptocurrency correlates with trustworthiness, and trust correlates with ownership, which confirms that despite the respondents' low average level of knowledge, knowledge is a key driver of cryptocurrency ownership. This finding lends empirical support to Zarifis et al., (2014). However, differentiating knowledge in terms of financial literacy from knowledge in terms of technological capability is complex in the realm of cryptocurrencies because these two categories are not distinct - both reasons can simultaneously motivate the ownership of cryptocurrencies. This is in line with Deutsche Postbank (2018), according to whom independence from governmental influence is the most important motive, followed by high yields from speculation.

Our finding about the importance of knowledge for cryptocurrency usage is in line with the currently observable industry practice. Educating potential users, investors or developers about the advantageous features of blockchain technology and the purposes of their cryptocurrencies is a major part of the marketing activities of different stakeholders in the ecosystem, including cryptocurrency projects, exchanges and related service providers. Through such initiatives, different user groups such as developers (e.g. Tezos, 2021), traders (e.g. Binance Academy, 2021) and users (Stellar, 2021) are targeted.

Besides knowledge, the subjective trustworthiness of cryptocurrencies may be another mediator for ownership. The triangular relationship between knowledge, trust, and ownership is characterized by high correlations. The intuitive causation is that knowledge raises the trustworthiness of cryptocurrencies (Zarifis et al., 2014), which in turn makes ownership more likely. The exact direction of cause and effect – e.g. if trust raises the probability of ownership or if ownership influences trust indirectly through individual investment risk exposure –remains an open question for future research. Also, it is likely that ownership positively influences the respondents' *perceived* (as opposed to actual) level of knowledge.

Having asked cryptocurrency owners to what extent ideological motives influenced their purchase decision, we find an average score of 5.97 [0;10]. This result extends prior findings by Deutsche Postbank (2018), who asked for explicit motives. Apart from investment and speculation, the motives to own cryptocurrency relate to reducing the dependence on traditional currencies, whereas the motives not to own cryptocurrency are associated with the lack of government control and security. Also, Baur et al. (2015) highlight that anonymity is an important motive, which currency with regulatory oversight cannot provide. Evidently, cryptocurrency is a divisive topic where ideology is an important factor. This finding matters to companies trying to define target groups for their services, products or investments, and to regulators pondering the reasons why users are attracted to currency schemes that are free of government influence.

The socioeconomic profile of cryptocurrency users is characterized by young age and male gender, which confirms results by Deutsche Postbank (2018), Exton and Doidge (2018), the FCA (2019a) and Wciom (2019), all of whom report higher interest among digital natives and greater knowledge among men. The regression results also reveal that younger age and male gender have a positive influence on knowledge and ownership of cryptocurrencies, and that younger age promotes trust in cryptocurrencies. With respect to the influence of being on the knowledge levels about cryptocurrency and blockchain technology, it needs to be taken into account the tendencies of men to overestimate their individual technological knowledge levels. It is thus likely that being male is less of a reliable predictor for knowledge in this realm. Nevertheless, technological affinity – which is most prevalent among young men – is clearly associated with an interest in blockchain technology. From an investment perspective, cryptocurrencies are perceived as high-risk but high-yield speculative assets (Deutsche Postbank, 2018). Thus, beside tech affinity, greater risk affinity is also part to the socio-economic profile of cryptocurrency owners.

Cryptocurrency owners are considerably better educated than the average internet user, and by implication the general population. This finding supports Aria-Oliva et al. (2019), who find that financial literacy, which is more prevalent among respondents with a university degree, is associated with greater knowledge about cryptocurrency. Yet causation between education and cryptocurrency ownership is unclear. Better education correlates with high income, which facilitates investing in cryptocurrency. At the same time, education helps people understand the complexity of cryptocurrencies, recognize their potential and then invest in them. Whichever direction of influence prevails, the good education of cryptocurrency owners has implications for both companies and governments. Companies in the ecosystem ought to tailor their communication to this specific target group of consumers or investors. Governments should consider the skepticism towards cryptocurrency by less-educated parts of the population when developing central bank digital currencies. While current cryptocurrency users are already familiar with the technology, state-initiated digital currency would have to be accepted by the whole population, including many individuals who are much less educated (regarding this topic) than current owners.

By comparing the respondents' actual and assumed usage domains, we have been able to confirm an unfounded negative bias in the public image of cryptocurrencies, as already indicated in Bearingpoint (2019) and Laboure and Reid (2020). Those who know the least about cryptocurrencies and those who have never owned them are most likely to suspect that cryptocurrency is mostly used for criminal activities. This divergence in the perception regarding what cryptocurrencies are used for and their actual usage reflects the low perceived trustworthiness of cryptocurrencies. Knowledgeable respondents are often also owners and perceive cryptocurrencies as trustworthy, while less knowledgeable respondents are sceptic about non-criminal usage and the trustworthiness. Similarly to findings by Shahzad et al. (2018), a deeper understanding of the technology is identified as the dividing line between the two streams. For the ecosystem of cryptocurrency companies and organizations, as well as for governments seeking to introduce their own digital currencies, improving the knowledge among potential users and the public is critical to cryptocurrency adoption.

6. Limitations & future research

Data from online surveys is inherently biased because participation in an online panel necessitates a certain level of technical knowledge. Someone who has a limited understanding and experience of using the internet is considered part of the internet population but unlikely to be part of an online panel. Therefore, as with any online survey, the representativeness of our work may be impaired by the underrepresentation of inexperienced internet users in the online panel we employed. Conversely, tech savvy internet users, who are more likely to be exposed to the topic of cryptocurrency, may be overrepresented.

Apart from the composition of the panel, additional limitations arise from the survey design. Our results show that various ideological motives shape the ambiguous perceptions regarding cryptocurrencies. Future research may focus on investigating and categorizing these motives, their strength and their relation to trustworthiness. Moreover, we only asked the current owners of cryptocurrency to state the extent to which their acquisition was ideologically motivated. It would have been intriguing to compare the extent of ideology across current and former owners, and to assess why previous owners sold and why non-owners refuse to buy cryptocurrency, and to what extent the latter decision is ideologically motivated.

Like the ideological influence on engagement, assessing the trustworthiness of cryptocurrencies is complex because it addresses several domains. For example, cryptocurrency is often associated with initial coin offerings, a sizable number of which were initiated with criminal intentions. A respondent's level of trust may reflect this image-focused aspect, but it may also relate to the robustness of the underlying technology. It would be interesting to assess the strengths of the individual dimensions of trust by users and non-users to obtain a clearer picture of

the multi-faceted concept of trust in cryptocurrencies. In the same vein, it is also of interest to see whether ownership of cryptocurrencies influences perceptions of trust, or vice versa.

Our results on cryptocurrency and blockchain knowledge rely on the respondents' self-assessment, which we did not verify. Nor did we specify what exactly the questionnaire meant by 'knowledge'. Our assessment lacks a clear differentiation of knowledge beyond cryptocurrencies and blockchain technology. This makes it difficult to compare the results to those of existing surveys — which may have similar limitations of their own.

Our comparison of the assumed and the actual use cases of cryptocurrencies suffers from the limitation that the two variables are measured differently. Additionally, the use cases overlap, which makes interpretation difficult. For example, a user may own a cryptocurrency with a specific utility for an in-development software system, but purely for the purpose of financial speculation. Nevertheless, our method of comparing the actual and assumed usage domains can serve to indicate the public image of cryptocurrencies and as a basis for subsequent surveys assessing the image and usage of cryptocurrencies.

An enhanced framework to assess the adoption of cryptocurrencies and blockchain technology could build upon our findings but would have to be extended by certain technical parameters, such as the number of active addresses on cryptocurrency networks, the transferred value or the number of new applications that rely on cryptocurrency systems, as well as statistics on their usage. Also relevant are the availability of online and offline purchase opportunities, the number of merchants who accept cryptocurrency, and the number of payments to these addresses. Although the transparency of blockchains makes assessing technical indicators as proxies for adoption easier than with other technologies, any conclusions from blockchain-level data must recognize that a user can have multiple addresses and transactions can be initiated automatically by programmed bots. Despite the increasing complexity due to the accessibility and pseudo-anonymous usage of (public) blockchains, analyzing usage parameters on the blockchain level certainly presents an interesting field for further research to complement the existing findings on the state of cryptocurrency adoption.

7. Conclusion

A representative sample has allowed us to confirm the high awareness of cryptocurrencies among the German population of 83% and to estimate an ownership rate of 9%. While the general knowledge about cryptocurrency and blockchain technology as well as the level of trust in cryptocurrencies are quite low, a deep understanding of the phenomenon, was identified as a major driver of ownership. Our correlation and regression analysis disclosed a triangular relationship between ownership, trust and knowledge, in which each variable can explain the others. Cryptocurrency owners have a distinct socioeconomic profile characterized by young age, male gender, higher educational achievement and higher income than non-owners.

Cryptocurrencies are perceived to be associated with illegal activities, mostly by less knowledgeable respondents. However, we find a significant discrepancy between the assumed and the actual usage of cryptocurrencies. People who know about cryptocurrencies and especially blockchain have more trust in these phenomena and are more likely to be owners and users. This finding indicates that knowledge is the key for a wider adoption of cryptocurrencies. Knowing that cryptocurrency enthusiasts tend to be younger, male, well-educated and well-off can help to identify the groups who need to be protected against unregulated investment offers. Yet to foster the general acceptance of cryptocurrencies and similar concepts, e.g. central bank digital currency, it is necessary to educate also those parts of the population who are skeptic and have false perceptions about the primary uses of cryptocurrencies.

Our study's results contribute to the public, scientific and managerial knowledge on the topic of cryptocurrency. The results can serve as orientation for regulators and businesses, or as a starting point for academic research on the topic of cryptocurrency adoption. For regulators, the assessment of cryptocurrency awareness, ownership and knowledge can provide orientation to judge the relevance of the phenomenon, e.g. regarding regulatory measures to protect retail investors. Moreover, governments can use insights on the trustworthiness and acceptance of cryptocurrencies in the development of central bank digital currencies. The socioeconomic profiles of users can help businesses to identify specific target groups as potential customers or as trend indicators. More specific, managers planning to integrate with cryptocurrency, or

Table A.1
Awareness and ownership of 15 well-known cryptocurrencies

	Awareness				Ownership	
	Full sample	Non-owners	Former owners	Current owners	Full sample	Current owners
Bitcoin (BTC)	82.71%	80.70%	88.03%	95.24%	7.45%	80.67%
Ethereum (ETH)	19.49%	13.12%	32.19%	63.31%	2.38%	25.77%
Ripple (XRP)	9.83%	4.72%	18.80%	46.22%	1.42%	15.41%
Bitcoin Cash (BCH)	26.63%	19.55%	50.71%	65.55%	1.29%	14.01%
EOS (EOS)	7.79%	5.23%	15.10%	23.25%	0.34%	3.64%
Stellar Lumens (XLM)	4.76%	2.50%	12.25%	17.37%	0.34%	3.64%
Litecoin (LTC)	14.18%	7.79%	28.49%	56.58%	1.48%	15.97%
Tether (USDT)	5.43%	3.26%	10.54%	19.61%	0.31%	3.36%
Bitcoin SV (BSV)	8.70%	5.77%	20.23%	23.25%	0.36%	3.92%
TRON (TRX)	5.75%	3.74%	10.83%	18.49%	0.47%	5.04%
Cardano (ADA)	2.48%	0.73%	5.98%	14.57%	0.21%	2.24%
Iota (IOT)	5.49%	2.34%	10.83%	28.01%	0.62%	6.72%
Monero (XMR)	6.63%	3.17%	16.24%	27.73%	0.54%	5.88%
Binance Coin (BNB)	5.41%	3.14%	14.53%	16.53%	0.16%	1.68%
Dash (DSH)	10.71%	6.91%	20.80%	34.45%	0.67%	7.28%
No. coins known	2.16	1.62	3.56	5.50	2.16	5.50
No. coins owned	0.18	-	-	1.95	0.18	1.95
Ideological motivation	-	-	-	-	-	5.97
N	3,864	3,156	351	357	3,864	357

The cryptocurrencies are ordered by their market capitalization at the time of the survey.

themselves become an issuer, can use the results to grasp a clearer picture of their customers, supporters and investors, and improve product development, communication efforts and strategies to present and potential customers as well as for ecosystem development. On the contrary, a managerial implication might be that cryptocurrency users' socio-economic profiles differ substantially from businesses' existing customers. In this case, businesses would need to refuse to integrate cryptocurrency or focus on educating them about the potentials and advantages the technology holds, in general, and in regard to improving the existing product or service itself. Researchers can build upon the results for surveys in additional countries or to address open research questions, e.g. regarding the relationships between ownership, knowledge and trustworthiness, and the motives for cryptocurrency users—potentially even in a longitudinal setting. Ideally, such surveys are complemented by analyses of on-chain transaction data and technical parameters from popular blockchain systems. Those endeavors promise to paint an even more accurate picture of the perception and adoption of cryptocurrency in the general population. Such knowledge is needed as a sound basis for businesses to build products and services around blockchain technology and cryptocurrencies that actually add value for consumers and investors.

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CRediT authorship contribution statement

Fred Steinmetz: Conceptualization, Methodology, Data curation, Investigation, Formal analysis, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Marc von Meduna:** Conceptualization, Methodology, Writing – review & editing. **Lennart Ante:** Formal analysis, Writing – review & editing. **Ingo Fiedler:** Methodology, Writing – review & editing.

Declaration of Competing Interest

None.

Appendix

Table A.1. Awareness and ownership of 15 well-known cryptocurrencies

References

Alzahrani, S., Daim, T.U., 2019a. Analysis of the cryptocurrency adoption decision: literature review. In: Proceedings of the 2019 Portland International Conference on Management of Engineering and Technology (PICMET), pp. 1–11. https://doi.org/10.23919/PICMET.2019.8893819. IEEE.

Alzahrani, S., Daim, T.U., 2019b. Evaluation of the cryptocurrency adoption decision using hierarchical decision modeling (HDM). In: Proceedings of the 2019 Portland International Conference on Management of Engineering and Technology (PICMET), pp. 1–7. https://doi.org/10.23919/PICMET.2019.8893897. IEEE.

Ante, L., Fiedler, I., Meduna, M., Steinmetz, F., 2020. Returns from investing in cryptocurrency: evidence from German individual investors. BRL Work. Pap. Ser. No 6. https://doi.org/10.2139/ssrn.3540876.

Ante, L., Meyer, A., 2021. Cross-listings of blockchain-based tokens issued through initial coin offerings: do liquidity and specific cryptocurrency exchanges matter? Decis. Econ. Finance 1–24. https://doi.org/10.1007/s10203-021-00323-0.

Arias-Oliva, M., Pelegrín-Borondo, J., Matías-Clavero, G., 2019. Variables influencing cryptocurrency use: a technology acceptance model in Spain. Front. Psychol. 10, 475. https://doi.org/10.3389/fpsyg.2019.00475.

Baur, A.W., Bühler, J., Bick, M., Bonorden, C.S., et al., 2015. Cryptocurrencies as a disruption? Empirical findings on user adoption and future potential of Bitcoin and co. In: Janssen, M., et al. (Eds.), Open and Big Data Management and Innovation. I3E 2015. Lecture Notes in Computer Science. Springer, vol 9373Cham. https://doi.org/10.1007/978-3-319-25013-7_6.

Zarifis, A., Efthymiou, L., Cheng, X., Demetriou, S., 2014. Consumer trust in digital currency enabled transactions. In: *International Conference on Business Information Systems*. Springer, Cham, pp. 241–254. https://doi.org/10.1007/978-3-319-11460-6_21.

Bearingpoint. (2019). Gold statt facebook-geld: deutsche zeigen kaum interesse an virtuellen währungen. Press release from June 27. Available at: https://www.bearingpoint.com/de-de/ueber-uns/pressemitteilungen-und-medienberichte/pressemitteilungen/umfrage-kryptowaehrungen. Last accessed: January 11, 2021.

Bearingpoint. (2018). Kryptowährungen – vertrauen in preisstabilität und anlagepotential gesunken. Press release from May 9. Available at: https://www.bearingpoint.com/de-de/ueber-uns/pressemitteilungen-und-medienberichte/pressemitteilungen/kryptowaehrungen-kaum-genutzt. Last accessed: January 11, 2021.

Ben-Sasson, E., Chiesa, A., Garman, C., Green, M., Miers, I., Tromer, E., Virza, M., 2014. Zerocash: decentralized anonymous payments from Bitcoin. In: Proceedings of the IEEE Symposium on Security & Privacy (Oakland) 2014, pp. 459–474. https://doi.org/10.1109/SP.2014.36. IEEE, 2014.

Binance Academy. (2021). Learn all about blockchain & crypto. Available at: https://academy.binance.com/en. Last accessed: April 25, 2021.

Bitkom. (2019). Digital finance 2019: die transformation der finanzindustrie in Zahlen. Available at: https://www.bitkom.org/Bitkom/Publikationen/Digital-Finance-2019-Die-Transformation-der-Finanzindustrie-in-Zahlen. Last accessed: January 11, 2021.

Blandin, A., Pieters, G.C., Wu, Y., Dek, A., Eisermann, T., Njoki, D., & Taylor, S. (2020). 3rd global cryptoasset benchmarking study. Available at: 10.2139/ssrn.3700822.

Bloomberg, J. (2017). Using Bitcoin or other cryptocurrency to commit crimes? Law enforcement is onto you. Forbes.com. Available at: https://www.forbes.com/sites/jasonbloomberg/2017/12/28/using-bitcoin-or-other-cryptocurrency-to-commit-crimes-law-enforcement-is-onto-you/#1006bdfc3bdc. Last accessed: January 11, 2021.

Bogusz, C.I., Laurell, C., Sandström, C., 2020. Tracking the digital evolution of entrepreneurial finance: the interplay between crowdfunding, blockchain technologies, cryptocurrencies, and initial coin offerings. IEEE Trans. Eng. Manag. 67 (4), 1099–1108. https://doi.org/10.1109/TEM.2020.2984032.

Bohr, J., Bashir, M., 2014. Who uses Bitcoin? An exploration of the Bitcoin Community. In: Miri, A., Hengartner, U., Huang, N.F., Jøsang, A., Garcia-Alfaro, J. (Eds.), 2014. 12th Annual Conference on Privacy. Security and Trust, (eds), pp. 94–101. https://doi.org/10.1109/PST.2014.6890928.

Brandt, M. (2019). So verbreitet sind Kryptowährungen. Statista.com. Available at: https://de.statista.com/infografik/18102/nutzung-von-kryptowaehrungen. Last accessed: January 11, 2021.

Buterin, V. (2014). Ethereum: a next-generation smart contract and decentralized application platform. Available at: https://github.com/ethereum/wiki/wiki/White-Paper. Last accessed: January 11, 2021.

Chang, V., Baudier, P., Zhang, H., Xu, Q., Zhang, J., Arami, M., 2020. How blockchain can impact financial services – the overview, challenges and recommendations from expert interviewees. Technol. Forecast. Soc. Change 158, 120166. https://doi.org/10.1016/j.techfore.2020.120166.

Chod, J., Lyandres, E., 2021. A theory of ICOs: diversification, agency, and information asymmetry. Manag. Sci. https://doi.org/10.1287/mnsc.2020.3754.

Choi, T.M., 2020. Financing product development projects in the blockchain era: initial coin offerings versus traditional bank loans. IEEE Trans. Eng. Manag. https://doi.org/10.1109/TEM.2020.3032426.

Choi, T.M., 2020. Creating all-win by blockchain technology in supply chains: Impacts of agents' risk attitudes towards cryptocurrency. J. Oper. Res. Soc. 1–16. https://doi.org/10.1080/01605682.2020.1800419.

Choi, T.M., Guo, S., Liu, N., Shi, X., 2020. Optimal pricing in on-demand-service-platform-operations with hired agents and risk-sensitive customers in the blockchain era. Eur. J. Oper. Res. 284 (3), 1031–1042. https://doi.org/10.1016/j.ejor.2020.01.049.

Christin, N., 2013. Traveling the Silk Road: a measurement analysis of a large anonymous online marketplace. In: Proceedings of the 22nd international conference on World Wide Web, pp. 213–224. https://doi.org/10.1145/2488388.2488408. ACM.

Civey. (2017). Könnten Sie sich vorstellen, in Kryptowährungen (z.B. „BitCoin") zu bezahlen? Statista.com. Available at: https://de.statista.com/statistik/daten/studie/742385/umfrage/umfrage-in-deutschland-zur-zahlungsbereitschaft-mit-kryptowaehrungen-bitcoin. Last accessed: January 11, 2021.

Coinmarketcap. (2021). Top 100 cryptocurrency exchanges by trade volume. Available at: https://coinmarketcap.com/rankings/exchanges. Last accessed: January 11, 2021.

Coinmap. (2021). Cryptocurrency merchants and ATMs in the world in one map. Available at: https://coinmap.org/view/#/world/24.68695241/-29.97070312/3. Last accessed: January 11, 2021.

Coin ATM Radar. (2021). Bitcoin ATMs by country. Available at: https://coinatmradar.com/countries. Last accessed: January 11, 2021.

Crowder, D. (2019). New survey reveals American retirees currently have a negative outlook on Bitcoin. Gold IRA Guide. Available at: https://goldiraguide.org/new-sur

vey-reveals-american-retirees-currently-have-a-negative-outlook-on-bitcoin. Last accessed: January 11, 2021.
Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. 13 (3), 319–334. https://doi.org/10.2307/249008.
DCI Institute. (2018). Welche Zahlungsmethoden haben Sie bereits genutzt? Statista. com. Available at: https://de.statista.com/statistik/daten/studie/514832/umfrage/genutzte-zahlungsmethoden-fuer-digitale-inhalte-und-services-in-deutschland. Last accessed: January 11, 2021.
Deutsche Postbank, 2018. Postbank Studie: Der digitale Deutsche 2018. Deutsche Postbank AG. Unpublished study.
Deutsches Aktieninstitut. (2020). Aktionärszahlen des Deutschen Aktieninstituts 2019. Deutsches Aktieninstitut e.V. Available at: https://www.dai.de/files/dai_usercontent/dokumente/Statistiken/Deutsches%20Aktieninstitut_Aktionaerszahlen%202019.pdf. Last accessed: January 11, 2021.
Exton, J., & Doidge, F. (2018). Cracking the code on cryptocurrency – Bitcoin buy-in across Europe, the USA and Australia. ING international survey Mobile Banking – Cryptocurrency. Available at: https://think.ing.com/reports/cracking-the-code-on-cryptocurrency. Last accessed: January 11, 2021.
European Central Bank. (2020). Anzahl der Bankautomaten in Österreich von 2000 bis 2017. Statista.com. Available at: https://de.statista.com/statistik/daten/studie/476078/umfrage/anzahl-der-bankautomaten-in-oesterreich. Last accessed: January 11, 2021.
English, R., Tomova, G., Levene, J., 2020. Cryptoasset Consumer Research 2020. Financial Conduct Authority. Research note. Available at. https://www.fca.org.uk/publication/research/research-note-cryptoasset-consumer-research-2020.pdf. Last accessed: January 11, 2021.
FCA, 2019a. Cryptoassets: Ownership and attitudes in the UK – Consumer Survey Research Report. Financial Conduct Authority. Pub ref: 005940 Available at. https://www.fca.org.uk/publication/research/cryptoassets-ownership-attitudes-uk-consumer-survey-research-report.pdf. Last accessed: January 11, 2021.
FCA, 2019b. How and why Consumers Buy Cryptoassets – a Report for the FCA. Financial Conduct Authority Research Report. Available at: https://www.fca.org.uk/publication/research/how-and-why-consumers-buy-cryptoassets.pdf. Last accessed: January 11, 2021.
Finma. (2018). Annual Report 2018 – developments in FinTech. Swiss Financial Market Supervisory Authority. Available at: https://www.finma.ch/en/documentation/dossier/dossier-fintech/entwicklungen-im-bereich-fintech/#:~:text=As%20set%20out%20in%20its,of%20money%20or%20value%20transfer . Last accessed: January 11, 2021.
Frenzel, A., Albrecht, S., Argac, D., Daum, S., & Kolesky, K. (2019). SCHUFA Kredit-Kompass 2019. Schufa Holding AG. Available at: https://www.schufa.de/media/editorial/ueber_uns/bilder/studien_und_publikationen/kredit_kompass/skk_2019/SCHUFA_Kredit-Kompass-2019_ES_web.pdf. Last accessed: January 11, 2021.
Gan, J., Tsoukalas, G., Netessine, S., 2021. Initial coin offerings, speculation, and asset tokenization. Manag. Sci. 67 (2), 914–931. https://doi.org/10.1287/mnsc.2020.3796.
García-Monleón, F., Danvila-del-Valle, I., Lara, F.J., 2021. Intrinsic value in crypto currencies. Technol. Forecast. Soc. Change 162, 120393. https://doi.org/10.1016/j.techfore.2020.120393.
Global Web Index. (2018). GlobalWebIndex Q2 2018. Trendstream Ltd. Available at: https://blog.globalwebindex.com/chart-of-the-week/cryptocurrency. Last accessed: January 11, 2021.
Holub, M., & Johnson, J. (2018). Bitcoin research across disciplines. The information society, 34(2), 114-126, 10.1080/01972243.2017.1414094.
King, T., Koutmos, D., 2021. Herding and feedback trading in cryptocurrency markets. Ann. Oper. Res. 300 (1), 79–96. https://doi.org/10.1007/s10479-020-03874-4.
Knauer, F., Mann, A., 2019. What is in it for me? Identifying drivers of blockchain acceptance among German Consumers. J. Br. Blockchain Assoc. 10484 https://doi.org/10.31585/jbba-3-1-(1)2020.
Krombholz, K., Judmayer, A., Gusenbauer, M., Weippl, E., 2017. The other side of the coin: user experiences with Bitcoin security and privacy. Financ. Cryptogr. Data Secur. 9603, 555–580. https://doi.org/10.1007/978-3-662-54970-4_33.
Laboure, M., & Reid, J. (2020). The future of payments – part III. Digital currencies: the ultimate hard power tool. Deutsche Bank Research. Available at: https://www.dbresearch.com/PROD/RPS_EN-PROD/PROD0000000000504589/The_Future_of_Payments_-_Part_III__Digital_Currenc.pdf?undefined&realload=EynPUixFLCEp9NehoKIpyp763uuAr5RlinRnGrfRKfziJGDibpyxYFnbWPkrAMWUg3NbAk/~hsr7im~CpeqLBA==. Last accessed: January 11, 2021.
Mahomed, N. (2018). Understanding consumer adoption of cryptocurrencies (Doctoral dissertation, University of Pretoria). Available at: https://repository.up.ac.za/bitstream/handle/2263/64874/Mahomed_Understanding_2018.pdf?sequence=1. Last accessed: January 11, 2021.
Martin, J., 2014. Lost on the Silk Road: online drug distribution and the 'cryptomarket. Criminol. Crim. Justice 14 (3), 351–367. https://doi.org/10.1177/1748895813505234.
Mendoza-Tello, J.C., Mora, H., Pujol-López, F.A., Lytras, M.D., 2018. Social commerce as a driver to enhance trust and intention to use cryptocurrencies for electronic payments. IEEE Access 6, 50737–50751. https://doi.org/10.1109/ACCESS.2018.2869359.
Nakamoto, S. (2008). Bitcoin: a peer-to-peer electronic cash system. Available at: https://bitcoin.org/bitcoin.pdf. Last accessed: January 11, 2021.
Popov, S. (2018). The tangle. Available at: https://whitepaper.io/document/3/iota-whitepaper. Last accessed: January 11, 2021.
Schaupp, L.C., Festa, M., 2018. Cryptocurrency adoption and the road to regulation. In: Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age, pp. 1–9. https://doi.org/10.1145/3209281.3209336.
Shahzad, F., Xiu, G., Wang, J., Shahbaz, M., 2018. An empirical investigation on the adoption of cryptocurrencies among the people of mainland China. Technol. Soc. 55, 33–44. https://doi.org/10.1016/j.techsoc.2018.05.006.
Steinmetz, F., Ante, L., Fiedler, I., 2020. Blockchain and the Digital Economy – the Socio-Economic Impact of Blockchain Technology. Agenda Publishing, Ltd, Newcastle, UK.
Stellar. (2021). Learn blockchain basics. Available at: https://www.stellar.org/learn/blockchain-basics. Last accessed: April 25, 2021.
Stolper, O.A., Walter, A., 2017. Financial literacy, financial advice, and financial behavior. J. Bus. Econ. 87 (5), 564–581. https://doi.org/10.1007/s11573-017-0853-9.
Strehle, E., Ante, L., 2020. Exclusive mining of blockchain transactions. In: Scientific Reports 2020 - Conference Proceedings of the Scientific Track of the Blockchain Autumn School 2020, pp. 87–95. https://doi.org/10.2139/ssrn.3686529.
Tezos. (2021). Developer portal. Available at: https://tezos.com/developer-portal. Last accessed: April 25, 2021.
Wciom. (2019). Cryptocurrencies: after the hype. Available at: https://wciom.ru/index.php?id=236&uid=9646. Last accessed: January 11, 2021.
Walton, A., Johnston, K., 2018. Exploring perceptions of Bitcoin adoption: the South African virtual community perspective. Interdiscip. J. Inf. Knowl. Manag. 13, 165–182. https://doi.org/10.28945/4080.
White, R., Marinakis, Y., Islam, N., Walsh, S., 2020. Is Bitcoin a currency, a technology-based product, or something else? Technol. Forecast. Soc. Change 151, 119877. https://doi.org/10.1016/j.techfore.2019.119877.
Yelowitz, A., Wilson, M., 2015. Characteristics of Bitcoin users: an analysis of Google search data. Appl. Econ. Lett. 22 (13), 1030. https://doi.org/10.1080/13504851.2014.995359.
Yli-Huumo, J., Ko, D., Choi, S., Park, S., Smolander, K., 2016. Where is current research on blockchain technology? -A systematic review. PLoS ONE 11 (10), e0163477. https://doi.org/10.1371/journal.pone.0163477.
Houben, R., & Snyers, A. (2018). Cryptocurrencies and blockchain. *Legal context and implications for financial crime, money laundering and tax evasion*. Available at: https://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU(2018)619024. Last accessed: August 02, 2021.
Rauchs, M., Glidden, A., Gordon, B., Pieters, G. C., Recanatini, M., Rostand, F., Vagneur, K., Zhang, B. Z. (2018). Distributed ledger technology systems: A conceptual framework. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3230013. Last accessed: August 02, 2021.

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