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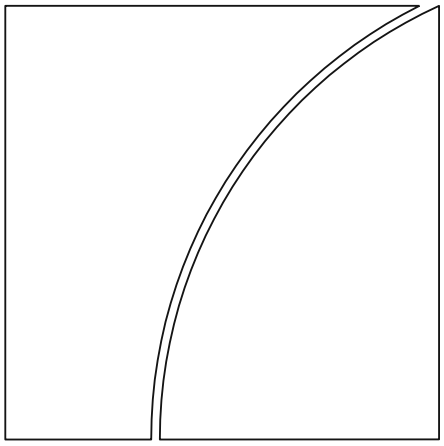

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by Raphael Auer and David Tercero-Lucas

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Distrust or Speculation? The Socioeconomic Drivers of U.S. Cryptocurrency Investments*

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Abstract

Employing representative data from the U.S. Survey of Consumer Payment Choice, we disprove the hypothesis that cryptocurrency investors are motivated by distrust in fiat currencies or regulated finance. Compared with the general population, investors show no differences in their level of security concerns with either cash or commercial banking services. We find that cryptocurrency investors tend to be educated, young and digital natives. In recent years, a gap in ownership of cryptocurrencies across genders has emerged. We examine how investor characteristics vary across cryptocurrencies and show that owners of cryptocurrencies increasingly tend to hold their investment for longer periods.

JEL Classification: D14 D91 E42 G11 G12 G28 O33

Keywords: digital currencies, cryptocurrencies, distributed ledger technology, blockchain, payments, digitalisation, banking, household finance, money, bitcoin, ether, xrp, bitcoin cash, litecoin, stellar, eos

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1 Introduction

The rise and fall of bitcoin, ether, and related cryptocurrencies – with market capitalisations (see Figure 1a) at times rivalling that of silver, the world's major financial companies, and even the stock markets of large advanced economies[1] – warrants a close examination of investor motivations and levels of sophistication.

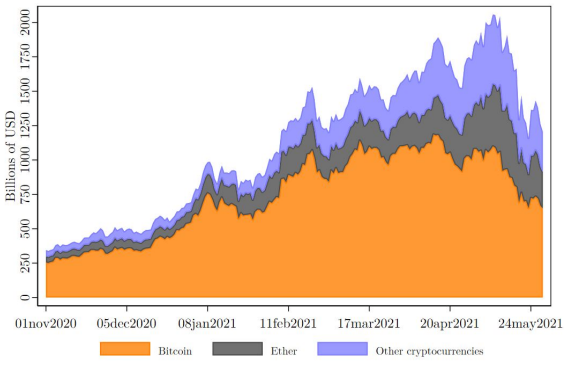
One aspect of particular relevance is that the purported motivation for the creation of these cryptocurrencies has been to design an alternative to fiat money and commercial banking, with the goal of creating a new form of exchange that is resistant to debasement and censorship by governments and financial institutions. As put by Nakamoto (2008, p.1):[2]

"What is needed is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party".

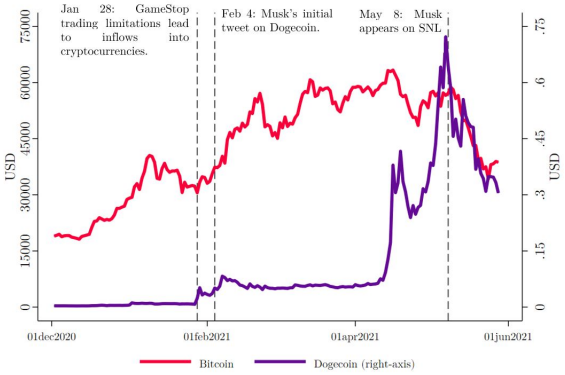
This narrative is also relied upon frequently by the proponents of this asset class. One noteworthy episode is the trading suspension of GameStop shares on the app Robinhood that occurred in early 2021. The suspension was – incorrectly – interpreted as censorship and market manipulation in favour of large hedge funds (see Ossinger and Hunter (2021) and Appendix A). Due to ensuing media coverage, a substantial inflow of funds into cryptocurrencies resulted.

Figure 1: Market valuations have reached new records.

(a) Market capitalisations*



(b) Bitcoin and dogecoin prices



Source: CoinMarketCap (Panel (a)) and Coindesk.com (Panel (b)). **Other cryptocurrencies* include the sum of the market capitalization of the biggest cryptocurrencies (excluding stablecoins) after bitcoin and ether.

[1] As of 26 May 2021, silver had a market capitalization of around $1.51 trillion, gold's market capitalization was $12.04, JPMorgan Chase was $497.38 billion and Bank of America was $365.75 billion (CompaniesMarketCap, 2021). In comparison, at that day, total market capitalisation of cryptocurrencies was $1.72 trillion. As of 8 May 2021, total market capitalisation of cryptocurrencies (including stablecoins) reached its peak at $2.42 trillion, doubling the combined market capitalisation of all companies included in the German DAX 30 index (CoinMarketCap, 2021).

[2] For example, Vitalik Buterin, considered "non-discrimination and non-censorship" one of the key principles behind the design of Ethereum (Buterin, 2013)

In the subsequent hype, the price of bitcoin continued surging, exceeding $50,000 soon after the trading suspension, and peaking at over $63,000 several weeks later (see Figure 1b). Brought to the attention of many via widely read tweets by Elon Musk, the cryptocurrency Dogecoin saw an almost ten-fold price increase during this episode (Ossinger and Hunter, 2021). However, cryptocurrency prices collapsed during mid-May 2021, after renewed statements by Mr Musk and the announcement of a ban for financial institutions and payment companies from providing cryptocurrency services in China.[3]

As the end of the GameStop episode exemplifies, the narrative of cryptocurrencies as a censorship-resistant asset class does not always square with reality.[4] Cryptocurrencies are rife with fraud and theft (Auer and Claessens, 2019; Foley et al., 2019; Twomey and Mann, 2020),[5] mostly due to the fact that coins are held in the custody of unregulated middlemen (Kharif, 2020). Cryptocurrencies such as bitcoin that are sustained by costly computing ("proof-of-work") tend to be centralised (Huang, 2020) and their basic security model might not be sustainable (Auer, 2019a).[6] There is ample debate on the censorship-resistance, decentralisation, and legal nature of other cryptocurrencies, as well (Fröwis and Böhme, 2017; Walch, 2019; SEC, 2020).[7]

Amidst a discrepancy between sociological narrative and factual evidence, it is important to understand who the retail investors in cryptocurrencies are, what their level of trust and knowledge is, and how they interact with the mainstream financial system. The objective of this paper is hence threefold. We start by examining the hypothesis that cryptocurrencies are sought out of distrust in fiat currencies or regulated finance. Second, we study the broader socioeconomic characteristics of U.S. retail consumers and disentangle the role of knowledge acquisition and investment decisions conditional on knowledge. Third, we examine the evolution of patterns of cryptocurrency investments across time and cryptocurrencies.

[3]See BBC (2021). Dogecoin has been subject to even higher volatility during May. Its price dropped by around 30% on May 9, the day of the appearance of Elon Musk on the TV show "Saturday Night Live".

[4]The emergence of cryptocurrencies has also led to the development of stablecoins, such as the Facebook's Diem project. For an analysis of this and other global stablecoins, see Arner et al. (2020), Frost et al. (2020), Melachrinos and Pfister (2020) and Tercero-Lucas (2020).

[5]There have been many cases of fraud in the industry. One example is the project PlusToken, which turned out to be a cryptocurrency Ponzi scheme that attracted millions of people with promises of high returns on investment. The operators were taken to court and found guilty of defrauding investors of almost $2.3 billion (Akhtar, 2021). Investors are also subject to cyber attacks that have affected both open source distributed ledgers (e.g., in February, 2020, the IOTA Foundation had to temporarily shut down the IOTA network after suffering an attack on its wallet app (Pan, 2020)) and cryptocurrencies exchange markets (e.g., in the first quarter of 2020, Altsbit, an Italian cryptocurrency exchange, had to close because the majority of user funds were stolen in a cyber attack (Partz, 2020)).

[6]Also, the environmental impact must not be forgotten. Bitcoin's energy consumption is exceeding that of entire countries (see Carstens (2018a) and De Vries (2018)).

[7]They are further used for illegal activities, including money laundering and the financing of terrorism. See e.g., Fanusie and Robinson (2018). Foley et al. (2019) estimate that around one quarter of bitcoin users were involved in illegal activity in the pre-2018 period, which translated to $76 billion per year.

We employ the Survey of Consumer Payment Choice (SCPC), a representative micro-level dataset provided by the Federal Reserve Bank of Atlanta. The survey covers the 2014-19 period and is representative of the US population. Using a variety of econometric specifications, we first disprove the hypothesis that cryptocurrencies are sought as an alternative to fiat currencies or regulated finance in the US. Compared with the general population, cryptocurrency investors show no differences in their level of security concerns with either cash or commercial banking services. We do, however, find that those who are concerned with the security of cash or bank accounts tend to acquire information about cryptocurrencies.[8]

Our second set of results regards the broader sociodemographics of cryptocurrency investors. Higher educational attainment is associated with more knowledge about and likelihood of owning a cryptocurrency. Male gender is associated with a 2 to 2.2 percentage points higher likelihood of owning at least one cryptocurrency. The probability of knowing at least one cryptocurrency is higher for men and for those individuals with higher levels of both income and an education.

We provide some evidence that the impact of gender and age on cryptocurrency investment is unrelated to differences in knowledge about the underlying technology. Despite converging knowledge levels about cryptocurrencies, a gender gap in terms of ownership has emerged.[9] In the same vein, although age has no effect on knowledge about cryptocurrencies, it does have a strong effect on investment decisions.

Our last set of results regards the evolution of these patterns of cryptocurrency investments across time and cryptocurrencies. Owners of ether and xrp are the most educated in our sample, followed by bitcoin cash and bitcoin users. Conversely, those owning litecoin are the least educated. We document trends in knowledge and ownership, and develop an empirical test for so called "hodling"- a term in the cryptocurrency community that refers to buying and holding a cryptocurrency over the long-term.[10] Specifically, we estimate that owning a cryptocurrency in one year increases the probability, on average, of owning a cryptocurrency in the following year by 50%.

Overall, our paper contributes to several literatures spanning the fields of sociology, economics, financial stability, and computer science. Our focus on the sophistication of retail cryptocurrency investors and on whether the demand for cryptocurrencies is driven by distrust in fiat money and/or the commercial financial industry contributes to the literature of the sociology of financial markets (Pixley, 2004; Knorr Cetina and Preda, 2005; Preda, 2007; Knorr Cetina and Preda, 2012). Lack of trust has been shown to be a main driver of investment decisions and limited stock market participation (see Guiso et al. (2008); Georgarakos and Pasini (2011); Balloch et al. (2015)).[11] Given the paramount importance of trust for the monetary and

[8]Our findings also suggest that experience with digital finance, captured through having a debit card, and using a mobile payment app, increases the probability of investing in cryptocurrencies.

[9]This is in contrast to the finding of a survey discussed in Baker (2019), which found that "67 percent of women felt their lack of familiarity with bitcoin stopped them from investing in it, compared to 48 percent of men".

[10]For a further explanation of the origin of the term, see StormGain (2020).

[11]Employing data from all Bitnodes operating worldwide between 2014 and 2018, (Saiedi

financial system (see Carstens (2018b, 2019); Borio (2019)), the persistent rise of cryptocurrencies could potentially evidence rising distrust in today's arrangements.[12] In that light, our key finding alleviates these concerns: cryptocurrency investors do not present differences in their level of security concerns with mainstream payment options, i.e., trust in cash or the banking deposits.

From a policy angle, one of the main takeaways is that as the goals of investors are the same as those for other asset classes, so should be the regulation. A clarifying regulatory and supervisory framework for cryptocurrency markets may be useful for the industry. In fact, regulatory announcements have had a strong impact on cryptocurrency prices and transaction volumes (Auer and Claessens, 2019, 2020), and those pointing to the establishment of specific regulations tailored to cryptocurrencies and initial coin offerings are strongly correlated with relevant market gains. Here, one important consideration regards how one could apply technology-neutral regulation, while at the same time harnessing the potential of the technology itself in the supervision process. One option for such a framework is "embedded supervision", developed in Auer (2019b). This means implementing a supervisory framework for cryptocurrencies that allows for compliance to be automatically monitored by reading the market's ledger. The goal is low-cost supervision of decentralised markets, which may be particularly relevant amidst recent deliberations of the need for adequate prudential oversight of the cryptocurrency industry (Basel Committee, 2019, 2021).

We are also interested in the prevention of consumer fraud in the cryptocurrency industry, and in particular, whether cryptocurrencies in general, or specific projects, target poor and uneducated or rather the sophisticated and wealthy investor class who can afford to experiment. Several consumer agencies have warned against cryptocurrency scams. Policymakers have also shown their concern about the increasing adoption of cryptocurrencies.[13] Our results – which show that cryptocurrency investors tend to be educated – to some extent imply that a majority of cryptocurrency investors are aware of the inherent risks. Our findings also suggest that being young increases the likelihood of owning cryptocurrencies. Since older people are at greater risk of both consumer and financial fraud (Temple, 2007; DeLiema et al., 2020), young people stand a better chance of avoiding them. This part of the analysis is closely related to recent literature analysing the profile and behaviour of cryptocurrency users.[14]

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et al., 2020) argue that low trust in the financial system has contributed to the spread of Bitcoin infrastructure. In addition, they show that Bitcoin's support is higher in cities with well-developed banking services. Beyond trust, (De Bondt, 2005) finds that self-confidence and financial sophistication are important determinants of the perceived attractiveness of different asset classes and investment strategies. Analysing a survey of more than 3,100 European investors, he also documents differences in values and beliefs by age, health status, religious affiliation, and gender. As he highlights, people's values and beliefs are highly correlated with investment behaviour.

[12] The level of trust is also determined by other factors such as differences in educational attainment (Guiso et al., 2004) or in religious upbringing (Guiso et al., 2003).

[13] For instance, a member of the US Federal Reserve Board, Lael Brainard, stated that "cryptocurrencies may raise important investor and consumer protection issues. The lack of strong governance and questions about the applicable legal framework for some cryptocurrencies may make consumers vulnerable to mistakes, thefts, and security breaches without much, or any, recourse" (Brainard, 2018).

[14] Almost all previous studies focus solely on Bitcoin and do not tackle the security and convenience

Our analysis is also related to the literature examining gender gaps in finance.[15] Women tend to be more risk-averse than men when it comes to holding risky assets (Jianakoplos and Bernasek, 1998; Borghans et al., 2009; Arano et al., 2010), and there are significant differences across genders in the use of FinTech (Chen et al., 2021).

Further, understanding the concerns and sociodemographic characteristics of cryptocurrency owners is crucial to those wanting to gauge the potential of cryptocurrency markets and estimate how large this asset class could eventually become. We find that cryptocurrencies, at least at current, remain niche markets dominated by young male investors, while other parts of the population acquire information about this asset class, but ultimately do not invest in it. However, a feature pertinent to analysing the potential of the cryptocurrency market is the phenomenon of *hodling*. Our results suggest that it is a persistent trait among cryptocurrency investors.

In addition, our findings may be informative for the likely user sophistication of future digital currencies,[16] including stablecoins or central bank digital currencies. Understanding the socioeconomic characteristics of cryptocurrency investors can be a first step in forecasting who the initial adopters of such future digital currencies may be.[17]

The remainder of this paper is structured as follows. Section 2 describes the data used. Section 3 outlines the empirical strategy used to identify the effects of interest. Section 4 provides an overview of the main results and presents some robustness checks. Section 5 documents some trends. Section 6 concludes.

aspects of cryptocurrencies. In this respect, Bohr and Bashir (2014) show that age, mining status, time of initial use, engaging in online discourse, geographical location, and political orientation are relevant factors to use bitcoin. Henry et al. (2018) estimate that being a man and having a higher level of education increases the probability of knowing bitcoin in Canada. Moreover, bitcoin awareness is more common among unemployed individuals. Using a survey among Austrian households, Stix (2019) argues that potential adopters of cryptocurrencies are younger and are more willing to accept financial risk. Fujiki (2020) finds that Japanese crypto-asset owners are more likely to be men, young, have a high pre-tax income, hold graduate degrees, and have a high level of financial literacy.

[15] Employing U.S. data, Bannier et al. (2019) find that men have greater knowledge regarding the features of bitcoin than women.

[16] Voskobojnikov et al. (2020) find that the type of cryptocurrency and its area of application are critical to determining which risks and mitigation strategies the user employs.

[17] In particular, the degree of user sophistication may be key to the adoption of a token-based CBDC that requires the handling of digital signatures and allows for anonymity. Auer and Böhme (2020) analyse the technical design choices for retail CBDCs and their trade-offs, while Auer et al. (2020) take stock of approaches around the world.

2 Data

In this paper, we use data from the Survey of Consumer Payment Choice (SCPC). The SCPC is a representative micro-level data set provided by the Federal Reserve Bank of Atlanta since 2009. It provides an overview of the payment behaviour of US consumers. The SCPC[18] comprises information from the Diary of Consumer Payment Choice (DCPC). In the DCPC, consumers record details of specific payment transactions and choices (Foster et al., 2009). The SCPC does not have a perfect longitudinal design, meaning that if a person is selected in a given wave, that person does not always continue as a sample member in the subsequent editions.[19]

Each annual wave contains information about US consumers' payment behaviour regarding the use of cash, electronic payments and cryptocurrencies, as well as the number of transactions made via these means of payment. A crucial feature of the SCPC for this analysis is that it makes information for every respondent on whether that person is aware of one or more cryptocurrencies and whether that person owns any cryptocurrencies. In addition, the data include such socioeconomic characteristics as age, gender, race, region, education level, marital status, household income level and the number of people living in the same household.

2.1 The Estimation sample

The main analysis uses the 2019 wave, completed by a total of 3,372 individuals.[20] As an additional analysis, we use the 2014-19 waves. In Figure 2a, it is shown that the 2014, 2015, 2016, 2017 and 2018 samples contain 1,238, 1,429, 3,404, 3,099 and 3,153 individuals respectively. From the data, 1,264 individuals participated in just one wave and 3,876 participated in more than one wave. From them, 470 participated in the six waves of the survey (Figure 2b).

2.2 Descriptive statistics

Table 1 presents the main descriptive statistics for the 2019 wave.[21] We use four main outcome variables: ownership; ownership number; knowledge; and knowledge number. Ownership (knowledge) captures whether an individual owns (recognises or knows of) at least one of the following cryptocurrencies: bitcoin, xrp, litecoin, ether, bitcoin cash, stellar, eos, or any other cryptocurrency. Ownership number (knowledge number) stands for the number of different cryptocurrencies that a person owns (recognises or knows of). Of the people who responded to the survey, 73% knew of at least one cryptocurrency. However, only 1.4% owned a cryptocurrency in 2019.[22]

[18] For detailed analysis on each version of the SCPC, see Foster et al. (2009, 2011, 2013), Schuh and Stavins (2014, 2015), Greene et al. (2017), Greene and Schuh (2017), and Foster et al. (2020).

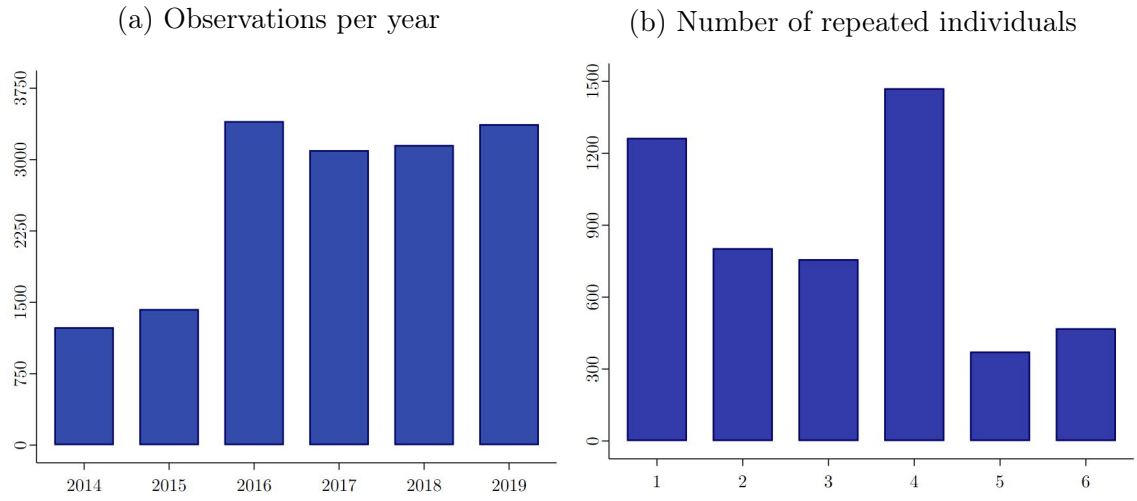
[19] For instance, since 2014 (N=1238), only 470 individuals have remained in the sample in the subsequent editions until 2019 (Figure 2b).

[20] In the 2019 survey, respondents participate in September (SCPC) and October (DCPC) (Foster et al., 2020).

[21] Table B1, in the Appendix, presents the main descriptive statistics with weights.

[22] There are no cryptocurrency owners who state that they do not know about cryptocurrencies.

Figure 2: Observations and repeated individuals.



Source: 2014-19 SCPC.

It is likely that those individuals with a higher level of digital skills know and own more cryptocurrencies rather than those with a lower level. The level of digitalisation is captured through three different variables: i) whether a person has a debit card, ii) whether a person has used a mobile app to pay in the past 12 months, iii) and whether a person has used PayPal to make a purchase or pay another person.[23] In 2019, more than 81% of the survey respondents have a debit card, 25.4% have used a mobile app to pay and almost 40% have used at least once PayPal to make an online purchase in the past 12 months.

Digitalisation has led to a proliferation of cashless or contactless payment methods driven by consumers and companies, both of whom want to be able to make payments quickly and safely and transfer funds around the world at no cost. Hence, the decision to invest in cryptocurrencies may be driven by consumer perception of other means of payments. These variables allow us to test whether the demand for cryptocurrencies is indeed driven by distrust in cash or the financial industry. In the SCPC, respondents classify the security and convenience of cash, bank account number payments and online banking bill payments into five categories: 1 – very inconvenient/risky, 2 – inconvenient/risky, 3 – neither inconvenient nor convenient/risky nor secure, 4 – convenient/secure, 5 – very convenient/secure. In all cases, the average ranges from around 2.7 to 4.

Regarding the socioeconomic indicators included in the analysis, the average income category is 11.3. Household income is divided into sixteen categories (see Table C1 in the Appendix). Category 11 corresponds to a level of household income between $40,000 and $49,999. The average educational attainment of the 2019 sample is 3.4. Educational attainment was divided into 16 categories in the 2018 and 2019 survey waves. However, since it was divided into just five categories in the 2014–17 waves, we transform the 16 categories into five (see Table C2). The variable "married"

[23]PayPal launched its own cryptocurrency service, allowing people to buy, hold and sell cryptocurrencies on its site and applications (BBC, 2020).

Table 1: Descriptive statistics (2019 wave)

Variable	Mean	Std. Dev.	Min.	Max.
Main outcome variables				
Ownership	0.014	0.118	0	1
Ownership-number	0.031	0.315	0	7
Knowledge	0.730	0.444	0	1
Knowledge-number	1.281	1.250	0	8
Digitalisation variables				
Having a debit card	0.815	0.388	0	1
Mobile app for payments	0.254	0.435	0	1
Usage of PayPal	0.391	0.488	0	1
Secur. and conv. variables				
Convenience of cash	3.994	1.140	1	5
Security of cash	2.685	1.551	1	5
Conv. of bank acc. number paym.	3.234	1.183	1	5
Sec. of bank acc. number paym.	2.828	1.283	1	5
Conv. of on. bank. bill payments	3.926	1.074	1	5
Security of on. bank. bill paym.	3.260	1.211	1	5
Sociodemographic variables				
Income	11.320	3.929	1	16
Education	3.407	1.119	1	5
Married	0.695	0.461	0	1
Age	52.981	15.298	18	109
Retired	0.255	0.436	0	1
Male	0.436	0.496	0	1
White	0.839	0.368	0	1

The final sample includes 3235 observations. Descriptive statistics are computed without using weights. Ownership (knowledge) captures whether an individual owns (recognises or knows) at least one of the following cryptocurrencies: Bitcoin, xrp, litecoin, ether, bitcoin cash, stellar, eos, or any other different cryptocurrency. Ownership-number (knowledge-number) stands for the number of different cryptocurrencies that a person owns (recognises or knows).

represents current marital status. It takes a value of 1 if the respondent is married and a value of 0 if the respondent is separated, divorced or widowed or never married. In the sample, 43.6% of individuals are men; the average age is close to 53; 25.6% are retired; and 83.8% are white.

3 Methodology

In order to corroborate or disprove the hypothesis that cryptocurrencies are sought after as an alternative to fiat currencies or regulated finance, as well as to study the socioeconomic characteristics of US retail cryptocurrency investors, we employ the standard linear probability model (LPM):

$$Y_{i,t} = \beta_0 + \beta_1 D_{i,t} + \beta_2 S_{i,t} + \beta_3 X_{i,t} + \epsilon_{i,t} \tag{1}$$

where $Y_{i,t}$ is a categorical variable that takes the value 1 if individual i owns (recognises) at least one cryptocurrency in the year t, and 0 otherwise. $D_{i,t}$ is a vector of digitalisation variables at individual level in year t. $S_{i,t}$ is a vector of security and convenience variables at individual level in year t. $X_{i,t}$ is a vector of socioeconomic variables at the individual level that includes gender, age, level of education, income, race and marital status in year t. Finally, standard errors are clustered by individual.

In the cases in which the outcome of interest is a count variable that takes nonnegative integer values 0, 1, 2, 3, ..., i.e., the number of known or owned cryptocurrencies, a standard count model is applied.

Since the outcome of interest is nonnegative, we need to specify our object of interest, $E(Y_{i,t}|W_{i,t})$, by means of a function that guarantees nonnegative values.[24] The simplest model in this context is the Poisson model, which models the conditional mean through the exponential function. However, once the goodness-of-fit chi-squared test is performed[25], we conclude that the data do not fit the model well. Therefore, a negative binomial model is performed. The main difference between both models is that the negative binomial model relaxes the assumption of the equality of the conditional mean and the conditional variance. Let us consider the following specification for the conditional mean:

$$E(Y_{i,t}|W_{i,t}) = exp(\beta_0 + \beta_1 D_{i,t} + \beta_2 S_{i,t} + \beta_3 X_{i,t}) = exp(W_i'\beta) \tag{2}$$

The conditional variance is modelled as follows:

$$V(Y_{i,t}|W_{i,t}) = exp(W_i'\beta) * (1 + \alpha \cdot exp(W_i'\beta)) \tag{3}$$

where α is the overdispersion parameter. The negative binomial model is estimated by maximum likelihood (ML) and average marginal effects are computed.

4 Empirical results

The main purpose of this paper is to analyse whether the demand for cryptocurrencies is indeed driven by distrust in cash or the financial industry, and to develop a socioeconomic profile of US retail cryptocurrency investors. The next sections aim at answering these research questions

[24] Assume for simplicity that $W_{i,t} = \beta_0 + \beta_1 D_{i,t} + \beta_2 S_{i,t} + \beta_3 X_{i,t}$.

[25] The results of this test are available upon request.

4.1 LPM results

4.1.1 Initial results

Tables 2 and 3 show the econometric results of estimating Equation (1). In each column, we estimate the relationship between each independent variable and the main outcome variable (i.e., owning or recognising at least one cryptocurrency). Weights are included in all regressions.[26]

The first set of initial results (Table 2, upper rows) show that all the digitalisation variables have a positive impact on the likelihood of owning at least one cryptocurrency. Having a debit card, using a mobile app for payments and using PayPal increase the probability of investing into cryptocurrencies by 1.9, 3.5 and 2 percentage points, respectively. The findings also show that the demand for cryptocurrencies is not driven by distrust in cash or the financial industry, given that there are no differences in the perceived security of cash and offline and online banking. We can thus preliminarily disprove the hypothesis that cryptocurrencies are sought as an alternative to fiat currencies or regulated finance. However, compared with non-owners, cryptocurrency owners tend to find both cash and traditional banking services less convenient, although this is not the case for online banking.[27]

We also show the correlation between payment experience and level of knowledge about cryptocurrencies. We find that the level of digitalisation increases knowledge about cryptocurrencies by around 16–17 percentage points. Those who recognise at least one cryptocurrency find cash less secure. In other words, ceteris paribus, if a consumer considers cash to be one step lower in terms of the security scale, the probability of that consumer knowing about at least one cryptocurrency is 3.5 percentage points lower. That same consumer is also likely to consider paying bills via online banking more secure and paying bills via online banking more convenient.[28] These patterns are consistent with those observed among people who have security concerns around fiat money and so acquire information about cryptocurrencies, but ultimately decide not to invest in them.

Of course, broader socioeconomic characteristics matter as well when it comes to knowledge acquisition and investment decisions around cryptocurrencies. From Table 3, it can be derived that education, income, being a man and being married positively influence both knowing about and owning a cryptocurrency. However, being one year older (or being retired) has a negative significant effect only on owning a cryptocurrency. Race is uncorrelated with cryptocurrency ownership.

[26] Survey weights are provided by the SCPC to generate population estimates.

[27] In order to purchase cryptocurrencies, investors need a mean of payment such as a debit or a credit card. In Appendix D, we restrict the sample to those individuals who are: (i) debit card adopters, and (ii) credit card adopters. Replicating columns 4-9 of Table 3, results are completely robust.

[28] Krombholz et al. (2017) present one of the first studies analysing how bitcoin users assess the bitcoin ecosystem in terms of privacy, anonymity and security.

Table 2: Payment behaviour, cryptocurrency ownership and knowledge

	Debit	Mobile	PayPal	Cash		Trad. Bank.		Online Bank.	
				Conv.	Sec.	Conv.	Sec.	Conv.	Sec.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Owner.	0.019***	0.035***	0.019**	-0.007*	-0.001	-0.008***	-0.002	-0.001	-0.001
	(0.005)	(0.011)	(0.009)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
R^2	0.003	0.015	0.005	0.004	0.000	0.006	0.000	0.000	0.000
Know.	0.158***	0.171***	0.171***	-0.007	-0.035***	-0.042***	-0.010	0.035***	0.024**
	(0.033)	(0.023)	(0.022)	(0.010)	(0.007)	(0.009)	(0.009)	(0.011)	(0.010)
R^2	0.017	0.030	0.034	0.000	0.014	0.012	0.001	0.007	0.004
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Owner. (know.) captures whether an individual owns (knows or recognises) at least one cryptocurrency. Debit stands for having a debit card; Mobile: Using of mobile app for payments. Trad. Bank.: bank account number payments; Online Bank.: online banking bill payments. Conv. and Sec. stand for convenience and security respectively.

Table 3: Sociodemographics and cryptocurrency ownership and knowledge

	Education	Income	Age	Retired	Married	Male	White
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Owner.	0.009***	0.002**	-0.001***	-0.020***	0.017***	0.023***	0.002
	(0.003)	(0.001)	(0.000)	(0.005)	(0.007)	(0.008)	(0.009)
R^2	0.007	0.004	0.010	0.004	0.004	0.008	0.000
Know.	0.110***	0.031***	-0.001	0.007	0.056**	0.114***	0.086**
	(0.010)	(0.003)	(0.001)	(0.027)	(0.025)	(0.023)	(0.029)
R^2	0.086	0.080	0.001	0.000	0.003	0.016	0.007
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Owner. (know.) captures whether an individual owns (knows or recognises) at least one cryptocurrency.

4.1.2 Payment behaviour and sociodemographics: joint regressions

Table 4 presents a new set of regressions that examine the partial effect of payment behaviour and broader sociodemographics. It shows the econometric results of

estimating Equation (1) when the main outcome variable is owning at least one cryptocurrency. Since education and income are jointly influenced by an unmeasured third variable (latent variable), they are included separately in each regression. This is a way of dealing with the possible endogeneity problem.[29] In addition, weights are included. Columns 1 and 2 present the main results excluding the payment behaviour indicators. Columns 3-4 and 5-6 present the outcomes including the digitalisation variables (i.e., having a debit card, usage of mobile app payments, and usage of PayPal) and the convenience and security variables respectively. Finally, columns 7 and 8 present the results with all variables included at the same time.[30]

Security concerns have no impact on cryptocurrency investments also conditioned on sociodemographic indicators. This highlights that the demand for cryptocurrencies is not driven by distrust in cash, traditional banking payments or online banking payments. Both having a debit card and having used a mobile app to make a payment in the last 12 months increase the probability of owning a cryptocurrency by 0.9 and 2.4-2.7 percentage points, respectively. Compared with non-owners, cryptocurrency investors tend to find traditional banking services less convenient. There are no differences with respect to cash and online banking payments.

Income level does not affect the main outcome variable of this specification. Each additional year of age reduces, on average, the probability of owning a cryptocurrency by 0.1 percentage points. In order to corroborate this result, Table F1, in Appendix F, reproduces Table 4, but instead of using the variable "age" it uses the variable "retired". "Retired" captures whether a person has withdrawn from active working life or not. Results show that being retired reduces the probability of owning a cryptocurrency, on average, by between 1 and 1.7 percentage points. Albert and Duffy (2012) show that older adults are more risk-averse than younger adults, having a lower expected utility from future income. The study of Stix (2019) also supports this finding. He argues that potential adopters of cryptocurrencies are younger and are more willing to accept financial risks. Analysing mortality beliefs, Heimer et al. (2019) estimate that older individuals place more weight on natural ageing, overestimating long-run survival rates. This reduces consumption and investment during retirement, in line with our results.

Being a man in the US increases, on average, the likelihood of owning at least one cryptocurrency by 2 to 2.2 percentage points.[31] As Jianakoplos and Bernasek (1998) document, there are gender differences in financial risk-taking. When it comes to holding risky assets, women tend to be more risk-averse than men and therefore are unlikely to trust digital currencies that are volatile. Related research by Borghans et al. (2009) and Arano et al. (2010) also support this finding. Gender differences also extend to a sector closely related to the cryptocurrency industry: the FinTech industry. Chen et al. (2021) find that men are more likely to use Fintech products and services than women. Being married seems to increase the likelihood of investing

[29] Table E1 presents the results of estimating Equation (1) with both income and education included at the same time. Results do not differ from those presented in Table 4.

[30] In order to test multicollinearity, we compute the Variable Inflation Factor (VIF) for the regressors in columns 7 and 8. The values of all variables lie in the (1, 2) interval.

[31] This can be interpreted as the difference between 0.7% of female respondents and 2.9% of male respondents in the survey (Figure 8a).

in cryptocurrencies as well. On the contrary, race does not affect the probability of owning a cryptocurrency.

In contrast, the higher the educational attainment achieved by the individual, the more likely it is that that individual owns a cryptocurrency. This result is consistent with the findings of Black et al. (2018). They show that an extra year of education increases participation in financial markets, and therefore risk-taking, by 2 percentage points.

4.1.3 Drivers of knowledge acquisition: joint regressions

For the purpose of this study, it is essential to understand the impact of payment behaviour variables and socioeconomic characteristics on information and knowledge about cryptocurrencies. Table 5 shows the results of estimating Equation (1) when the main outcome variable is knowing about at least one cryptocurrency.

In this case, we find that all the digitalisation indicators are statistically significant, i.e. the digitalisation level increases the knowledge about cryptocurrencies. Those who recognise at least one cryptocurrency also find traditional banking payments less convenient and online banking bill payments more convenient than those who do not. While they also find cash less secure, there is no discernible effect found regarding their opinion of the safety of either traditional or online banking.

Moving from a lower category of education to a higher one increases the probability, on average, of recognising at least one cryptocurrency by around 8.7 to 11.1 percentage points.[32] Similarly, the higher the income level, the higher is the probability (from 2.3 percentage points to 3.1) of knowing about at least one cryptocurrency. On the other hand, current marital status (being married, separated, divorced or widowed or never having married) is not statistically significantly related to the dependent variable. Being a man in the US increases, on average, the probability of knowing about at least one cryptocurrency by between 9.6 and 12.1 percentage points. This result is in line with the study of Bannier et al. (2019). They highlight that men have a higher degree of knowledge regarding bitcoin than women. Age, however, is not a relevant factor in terms of knowing about at least one cryptocurrency. If "retired" is incorporated into the model instead of age, results coincide with the ones in the main regression (Table F2 in Appendix F).

[32]The magnitude of the coefficients is generally larger in this section because of the percentage of individuals who know about cryptocurrencies is much larger than the percentage of owners.

Table 4: Ownership – payment behavior and sociodemographics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			0.009***	0.009**			0.010**	0.009**
card			(0.003)	(0.004)			(0.004)	(0.004)
Mobile			0.029***	0.026**			0.027***	0.024**
app			(0.010)	(0.010)			(0.010)	(0.010)
PayPal			0.007	0.009			0.007	0.008
			(0.008)	(0.008)			(0.008)	(0.008)
Convenience variables								
Cash					-0.006	-0.006	-0.005	-0.005
					(0.004)	(0.004)	(0.004)	(0.004)
Trad.					-	-0.006*	-0.006*	-0.006*
Banking					0.007**			
					(0.004)	(0.004)	(0.004)	(0.004)
Online					0.002	0.002	0.000	0.001
Banking					(0.004)	(0.004)	(0.004)	(0.004)
Security variables								
Cash					-0.000	0.000	0.000	0.000
					(0.003)	(0.003)	(0.003)	(0.003)
Trad.					0.001	0.000	0.001	0.001
banking					(0.005)	(0.005)	(0.005)	(0.005)
Online					-0.002	-0.000	-0.002	-0.001
Banking					(0.005)	(0.005)	(0.005)	(0.005)
Sociodemographic variables								
Educ.	0.009***		0.006*		0.008**		0.005*	
	(0.004)		(0.003)		(0.004)		(0.003)	
Income		0.002*		0.000		0.001		0.001
		(0.001)		(0.001)		(0.001)		(0.001)
Age		-		-		-		-
		0.001***		0.001***		0.001***		0.001**
		(0.000)		(0.000)		(0.000)		(0.000)
Married	0.014**	0.011	0.013**	0.012*	0.013**	0.010	0.012**	0.011*
	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
Male	0.022***	0.020***	0.022***	0.021***	0.022***	0.020***	0.022***	0.021***
	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)
White	-0.000	-0.002	-0.001	-0.001	-0.001	-0.002	-0.001	-0.002
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.018	0.022	0.031	0.032	0.025	0.028	0.036	0.037
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Table 5: Knowledge – payment behavior and sociodemographics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			0.079**	0.058*			0.075**	0.056*
card			(0.032)	(0.032)			(0.031)	(0.032)
Mobile			0.086***	0.095***			0.078***	0.087***
app			(0.023)	(0.025)			(0.023)	(0.024)
PayPal			0.085***	0.098***			0.074***	0.084***
			(0.021)	(0.022)			(0.021)	(0.021)
Convenience variables								
Cash					0.010	0.003	0.016*	0.008
					(0.009)	(0.009)	(0.009)	(0.009)
Trad.					-	-	-	-
banking					0.044***	0.052***	0.040***	0.049***
					(0.009)	(0.009)	(0.009)	(0.009)
Online					0.040***	0.041***	0.032***	0.034***
Banking					(0.011)	(0.011)	(0.011)	(0.011)
Security variables								
Cash					-	-	-	-
					0.026***	0.024***	0.023***	0.022***
					(0.007)	(0.007)	(0.007)	(0.007)
Trad.					-0.008	-0.015	-0.006	-0.011
banking					(0.010)	(0.010)	(0.010)	(0.010)
Online					0.017	0.019*	0.013	0.014
Banking					(0.011)	(0.011)	(0.011)	(0.011)
Sociodemographic variables								
Educ.	0.111***		0.092***		0.101***		0.087***	
	(0.009)		(0.010)		(0.009)		(0.010)	
Income		0.031***		0.025***		0.028***		0.023***
		(0.003)		(0.003)		(0.003)		(0.003)
Age		-0.001		0.000		-0.000		0.001
		(0.001)		(0.001)		(0.001)		(0.001)
Married	0.022	-0.041	0.013	-0.036	0.016	-0.044*	0.009	-0.039*
	(0.024)	(0.025)	(0.023)	(0.024)	(0.023)	(0.024)	(0.023)	(0.023)
Male	0.117***	0.096***	0.121***	0.104***	0.118***	0.099***	0.120***	0.105***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.022)
White	0.080***	0.038	0.074***	0.039	0.074***	0.034	0.068**	0.034
	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)	(0.027)	(0.026)	(0.026)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.111	0.094	0.136	0.120	0.136	0.124	0.156	0.143
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

4.1.4 Ownership conditioned on knowing about cryptocurrencies

Table 6 presents the results when we restrict the sample to those individuals that know about at least one cryptocurrency. The hypothesis that the demand for cryptocurrencies is driven by distrust in cash or the financial sector is rejected. Security concerns have no impact on cryptocurrency investment conditioned on knowing about cryptocurrencies. Education increases the likelihood of owning a cryptocurrency conditioned on knowing about at least one cryptocurrency. Nonetheless, becoming one year older decreases, on average, the likelihood of owning a cryptocurrency by 0.1 percentage points. These results are consistent with those presented in Table 4.

4.2 Negative binomial model results

Tables 7 and 8 show the results of estimating Equation (2), when the main outcome variable is the number of cryptocurrencies owned and the number of cryptocurrencies known.

Table 7 reveals that, compared with non-owners, cryptocurrency investors show no differences in their level of security concerns with either cash or commercial banking services. These investors do find traditional banking services less convenient, results that are consistent through the whole study. Nevertheless, educational attainment does not play a role here and income level is not statistically significant when the digitalisation variables are included in the model. With each increasing year of age, the difference in the logs of expected counts would be expected to decrease by 0.002–0.003 units, while holding the other variables in the model constant. This result is in line with the estimates of Stix (2019). The difference in the logs of expected counts is expected to be 0.068–0.106 units higher for males compared with females, while holding the other variables constant in the model. Gender differences in financial risk-taking (Jianakoplos and Bernasek, 1998; Borghans et al., 2009; Arano et al., 2010; Chen et al., 2021) are also present in this case. Being married compared with being single, divorced or widowed also positively affects the main variable of interest.

Table 8 exhibits results in line with the outcomes presented in Table 5. Its interpretation is as follows: if an individual had achieved one extra level of education, the difference in the logs of expected counts would be expected to increase by around 0.22–0.29 units, while holding the other variables in the model constant. Moreover, being in a higher category of income increases the difference in the logs of expected counts by 0.05–0.07 units. The relationship between the number of known cryptocurrencies and age is negative. The difference in the logs of expected counts is expected to be 0.49–0.56 units higher for males compared with females, while holding the other variables constant in the model. Marital status and race are not relevant factors.

Table 6: Ownership conditional on knowing at least one cryptocurrency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			0.015***	0.011**			0.015***	0.011**
card			(0.005)	(0.005)			(0.006)	(0.005)
Mobile			0.034***	0.029**			0.032***	0.027**
app			(0.013)	(0.013)			(0.012)	(0.012)
PayPal			0.010	0.012			0.010	0.011
			(0.010)	(0.010)			(0.010)	(0.010)
Convenience variables								
Cash					-0.008	-0.008	-0.006	-0.006
					(0.006)	(0.006)	(0.005)	(0.005)
Trad.					-0.009*	-0.008*	-0.008*	-0.007
Banking					(0.005)	(0.005)	(0.005)	(0.005)
Online					0.002	0.002	0.000	0.001
Banking					(0.005)	(0.005)	(0.005)	(0.005)
Security variables								
Cash					0.000	0.000	0.000	0.000
					(0.003)	(0.003)	(0.003)	(0.003)
Trad.					0.002	0.001	0.002	0.001
banking					(0.007)	(0.007)	(0.007)	(0.007)
Online					-0.003	-0.001	-0.003	-0.002
Banking					(0.006)	(0.006)	(0.007)	(0.006)
Sociodemographic variables								
Educ.	0.011**		0.007*		0.010*		0.006	
	(0.005)		(0.004)		(0.005)		(0.005)	
Income		0.001		0.000		0.001		0.000
		(0.002)		(0.002)		(0.002)		(0.002)
Age		-		-		-		-
		0.001***		0.001***		0.001***		0.001**
		(0.000)		(0.000)		(0.000)		(0.000)
Married	0.020**	0.020*	0.020**	0.022**	0.019**	0.019*	0.019**	0.020**
	(0.009)	(0.011)	(0.009)	(0.011)	(0.008)	(0.010)	(0.008)	(0.010)
Male	0.028***	0.025***	0.029***	0.028***	0.028***	0.026***	0.029***	0.027***
	(0.011)	(0.010)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
White	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.000	-0.000
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.018	0.022	0.031	0.032	0.025	0.028	0.036	0.037
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Table 7: Number of owned cryptocurrencies (negative binomial model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			0.106*	0.078			0.100	0.070
card			(0.057)	(0.051)			(0.062)	(0.057)
Mobile			0.066**	0.050*			0.065**	0.052**
app			(0.029)	(0.028)			(0.028)	(0.023)
PayPal			0.054	0.050*			0.057	0.047*
			(0.035)	(0.028)			(0.038)	(0.028)
Convenience variables								
Cash					- 0.017**	-0.017*	-0.012	-0.013
					(0.008)	(0.008)	(0.008)	(0.008)
Trad.					-	-	-	-
banking					0.021***	0.016**	0.022**	0.017**
					(0.008)	(0.008)	(0.010)	(0.009)
Online					0.006	0.007	0.003	0.005
Banking					(0.012)	(0.010)	(0.012)	(0.011)
Security variables								
Cash					0.010	0.010	0.011	0.011
					(0.008)	(0.009)	(0.010)	(0.010)
Trad.					0.010	0.012	0.008	0.010
banking					(0.010)	(0.010)	(0.010)	(0.010)
Online					-0.004	-0.006	-0.008	-0.008
Banking					(0.008)	(0.009)	(0.011)	(0.010)
Sociodemographic variables								
Educ.	0.021*		0.005		0.027**		0.013*	
	(0.011)		(0.012)		(0.013)		(0.009)	
Income		0.007**		0.002		0.009*		0.005
		(0.003)		(0.003)		(0.005)		(0.004)
Age		- 0.003***		- 0.002**		- 0.003***		- 0.002**
		(0.001)		(0.001)		(0.001)		(0.001)
Married	0.058**	0.067**	0.066**	0.072**	0.052***	0.060**	0.062**	0.066**
	(0.023)	(0.027)	(0.030)	(0.031)	(0.020)	(0.024)	(0.028)	(0.027)
Male	0.068**	0.072**	0.098**	0.090**	0.079**	0.085***	0.106**	0.100***
	(0.031)	(0.031)	(0.041)	(0.035)	(0.038)	(0.033)	(0.043)	(0.038)
White	0.007	0.009	0.022	0.025	0.003	0.001	0.018	0.016
	(0.018)	(0.020)	(0.022)	(0.023)	(0.020)	(0.021)	(0.022)	(0.021)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2	0.053	0.086	0.101	0.116	0.077	0.106	0.117	0.131
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Table 8: Number of known cryptocurrencies (negative binomial model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			0.245**	0.191*			0.243**	0.189*
card			(0.116)	(0.111)			(0.112)	(0.108)
Mobile			0.388***	0.352***			0.374***	0.341***
app			(0.077)	(0.079)			(0.077)	(0.079)
PayPal			0.229***	0.260***			0.205***	0.233***
			(0.070)	(0.071)			(0.071)	(0.073)
Convenience variables								
Cash					-0.007	-0.015	0.018	0.005
					(0.029)	(0.029)	(0.028)	(0.029)
Trad.					-	-	-	-
banking					0.113***	0.114***	0.097***	0.104***
					(0.031)	(0.031)	(0.032)	(0.032)
Online					0.075**	0.077**	0.051	0.057*
Banking					(0.034)	(0.034)	(0.034)	(0.034)
Security variables								
Cash					-	-	-	-
					0.083***	0.075***	0.077***	0.073***
					(0.021)	(0.022)	(0.021)	(0.021)
Trad.					0.005	-0.020	0.011	-0.011
banking					(0.037)	(0.036)	(0.036)	(0.036)
Online					0.020	0.038	0.010	0.023
Banking					(0.040)	(0.039)	(0.040)	(0.040)
Sociodemographic variables								
Educ.	0.293***		0.225***		0.271***		0.215***	
	(0.031)		(0.030)		(0.033)		(0.031)	
Income		0.073***		0.051***		0.067***		0.049***
		(0.014)		(0.013)		(0.014)		(0.013)
Age		-		-		-		-
		0.012***		0.008***		0.011***		0.006***
		(0.002)		(0.002)		(0.002)		(0.002)
Married	-0.004	-0.119	-0.022	-0.101	-0.024	-0.136	-0.033	-0.115
	(0.077)	(0.088)	(0.074)	(0.086)	(0.075)	(0.087)	(0.073)	(0.085)
Male	0.555***	0.494***	0.556***	0.513***	0.559***	0.503***	0.557***	0.518***
	(0.076)	(0.073)	(0.073)	(0.071)	(0.075)	(0.072)	(0.072)	(0.071)
White	0.066	-0.016	0.056	-0.008	0.053	-0.024	0.042	-0.020
	(0.088)	(0.087)	(0.086)	(0.086)	(0.087)	(0.086)	(0.086)	(0.086)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2	0.038	0.035	0.052	0.047	0.045	0.042	0.058	0.053
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments; Online Banking: online banking bill payments.

4.3 Robustness checks

In the baseline specification (Equation (1)), a LPM was employed. One limitation of the LPM is that it does not impose any restriction on the probability. The inability to impose restrictions on the values of the regressors or the parameters means we could obtain estimated probabilities outside the unit interval. The logit model overcomes this limitation by modelling the probability as a cumulative distribution function that always lies in the [0,1] interval. Tables 9 and 10 reports the estimations using a logit model. As marginal effects are not constant, the average marginal effects are computed.

The main results are completely robust to the use of a logit model.[33] Overall, the findings in Table 9 suggest that we can disprove the hypothesis that cryptocurrencies are sought as an alternative to fiat currencies or regulated banking. Cryptocurrency investors show no differences in their level of security concerns with either cash or commercial banking services. They also consider traditional banking services less convenient. Results highlight that being a digital native boosts the usage of cryptocurrencies. Education and being a man increase, on average, the probability of owning at least one cryptocurrency by 0.5 and 1 percentage points, respectively. On the contrary, becoming one year older decreases, on average, the likelihood of owning at least one cryptocurrency by 0.1 percentage points. Results in Table 10 are in line with those in Table 5.

4.4 Differences across cryptocurrencies

Are there differences in investor characteristics across groups of cryptocurrencies? This section starts by introducing the best-known cryptocurrencies. As Figure 3a shows, the most widely known cryptocurrency is bitcoin, followed by bitcoin cash and ether. Figure 3b depicts the percentage of owners classified by each kind of cryptocurrency in 2019. Bitcoin is the most widely owned cryptocurrency, with twice as many investors as is the case for ether. After ether, litecoin is the third most owned cryptocurrency.

So far, we have treated the owners of cryptocurrencies as if they were a uniform and homogeneous group of investors who share the same sociodemographic profile. Investor characteristics may, however, vary across groups of cryptocurrencies. Figure 3c shows that cryptocurrency owners are generally more educated than the average. Among the various cryptocurrencies, owners of xrp and ether are the most educated, while those owning litecoin are the least educated, with bitcoin owners ranking in the middle. Cryptocurrency owners have a household income level higher than the average, with owners of xrp, ether and stellar being the wealthiest (Figure 3d).

[33] In Appendix G, we control for potential rare event bias in the logit model. The sign and significance of the main variables of the logistic rare event regression à la King and Zeng (2001) are completely robust.

Table 9: Ownership - payment behaviour and sociodemographics (logit model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			0.031**	0.026*			0.031**	0.026*
card			(0.015)	(0.015)			(0.015)	(0.015)
Mobile			0.023***	0.019**			0.021**	0.017**
app			(0.009)	(0.008)			(0.008)	(0.007)
PayPal			0.008	0.009			0.009	0.009
			(0.007)	(0.007)			(0.008)	(0.007)
Convenience variables								
Cash					-0.005*	-0.005	-0.004	-0.003
					(0.003)	(0.003)	(0.003)	(0.003)
Trad.					-	-0.006*	-	-0.006*
banking					0.007**		0.006**	
					(0.003)	(0.003)	(0.003)	(0.004)
Online					0.002	0.002	0.000	0.000
Banking					(0.003)	(0.003)	(0.003)	(0.003)
Security variables								
Cash					-0.001	-0.000	-0.001	-0.001
					(0.003)	(0.002)	(0.002)	(0.002)
Trad.					0.001	0.001	0.001	0.001
banking					(0.004)	(0.004)	(0.004)	(0.004)
Online					-0.002	-0.002	-0.002	-0.001
Banking					(0.004)	(0.004)	(0.004)	(0.004)
Sociodemographic variables								
Educ.	0.010**		0.006*		0.009**		0.005*	
	(0.004)		(0.004)		(0.004)		(0.004)	
Income		0.002		0.001		0.002		0.002
		(0.002)		(0.002)		(0.002)		(0.001)
Age		-		-		-		-
		0.001***		0.001**		0.001**		0.001**
		(0.000)		(0.000)		(0.000)		(0.000)
Married	0.020*	0.024*	0.020*	0.024**	0.020*	0.023*	0.020*	0.023**
	(0.012)	(0.013)	(0.011)	(0.012)	(0.012)	(0.013)	(0.011)	(0.012)
Male	0.025**	0.025**	0.025**	0.025**	0.025**	0.024**	0.024***	0.024***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)
White	-0.000	-0.003	0.001	-0.003	-0.000	-0.003	0.001	-0.002
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2	0.110	0.168	0.184	0.217	0.151	0.197	0.213	0.238
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

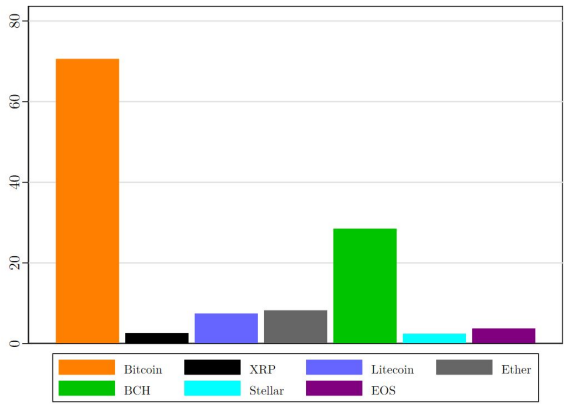
Table 10: Knowledge - payment behaviour and sociodemographics (logit model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			0.066**	0.050*			0.064**	0.048*
card			(0.027)	(0.028)			(0.026)	(0.027)
Mobile			0.098***	0.107***			0.086***	0.094***
app			(0.026)	(0.028)			(0.025)	(0.027)
PayPal			0.089***	0.102***			0.076***	0.087***
			(0.023)	(0.023)			(0.023)	(0.023)
Convenience variables								
Cash					0.010	0.002	0.015	0.007
					(0.009)	(0.009)	(0.009)	(0.009)
Trad.					-	-	-	-
banking					0.045***	0.053***	0.041***	0.049***
					(0.010)	(0.010)	(0.009)	(0.010)
Online					0.039***	0.040***	0.028***	0.032***
Banking					(0.011)	(0.011)	(0.011)	(0.011)
Security variables								
Cash					-	-	-	-
					0.024***	0.024***	0.022***	0.021***
					(0.007)	(0.007)	(0.007)	(0.007)
Trad.					-0.011	-0.017	-0.008	-0.013
banking					(0.011)	(0.010)	(0.011)	(0.010)
Online					0.020*	0.022*	0.015	0.016
Banking					(0.011)	(0.012)	(0.011)	(0.011)
Sociodemographic variables								
Educ.	0.110***		0.090***		0.098***		0.084***	
	(0.009)		(0.009)		(0.009)		(0.009)	
Income		0.028***		0.021***		0.025***		0.020***
		(0.002)		(0.003)		(0.002)		(0.003)
Age		-0.001		0.000		-0.000		0.001
		(0.001)		(0.001)		(0.001)		(0.001)
Married	0.023	-0.037	0.011	-0.035	0.016	-0.040*	0.006	-0.038*
	(0.023)	(0.024)	(0.022)	(0.023)	(0.022)	(0.023)	(0.022)	(0.023)
Male	0.118***	0.095***	0.122***	0.104***	0.118***	0.100***	0.120***	0.105***
	(0.022)	(0.022)	(0.021)	(0.022)	(0.021)	(0.022)	(0.021)	(0.021)
White	0.076***	0.035	0.066***	0.034	0.069***	0.030	0.060**	0.029
	(0.026)	(0.026)	(0.025)	(0.026)	(0.025)	(0.025)	(0.025)	(0.025)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2	0.097	0.077	0.121	0.102	0.121	0.104	0.139	0.124
Obs.	3,235	3,235	3,235	3,235	3,235	3,235	3,235	3,235

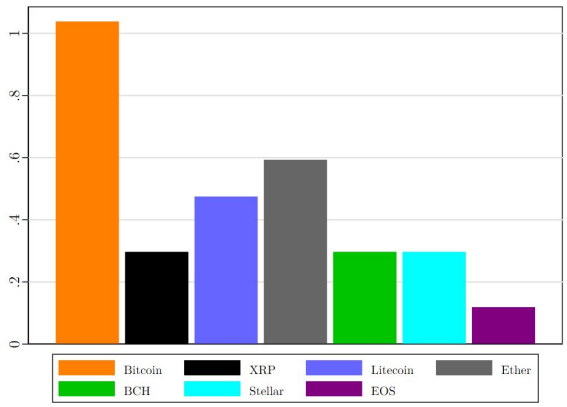
Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Figure 3: Knowledge and owners by group of crypto (2019).

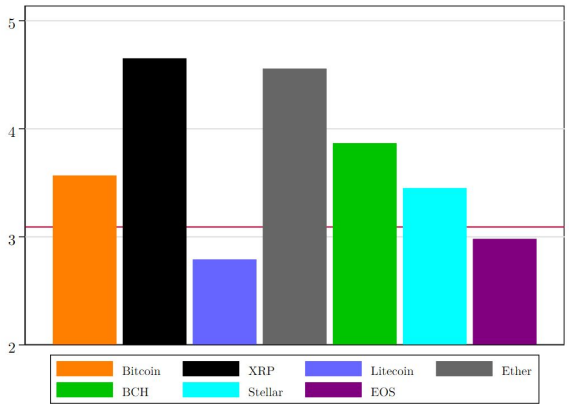
(a) Recognising crypto (in %).



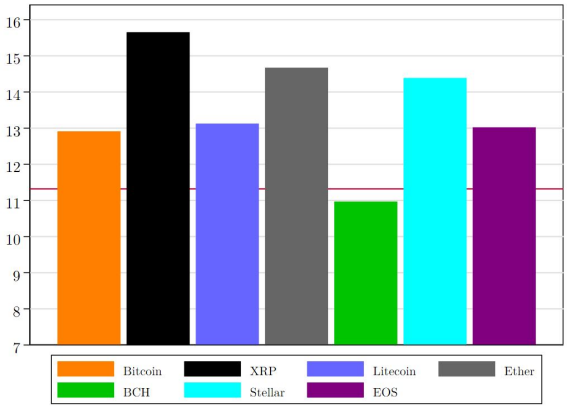
(b) Cryptocurrency owners (in %).



(c) Education average by crypto owner.



(d) Income average by crypto owner.



Source: 2019 SCPC.
Note. In panels (c) and (d), the brown line represents the average income and education for all individuals (see Appendix C, Tables C1 and C2 for the household income and educational attainment classifications respectively). Survey weights are included.

5 Trends in and outlook for the cryptocurrency industry

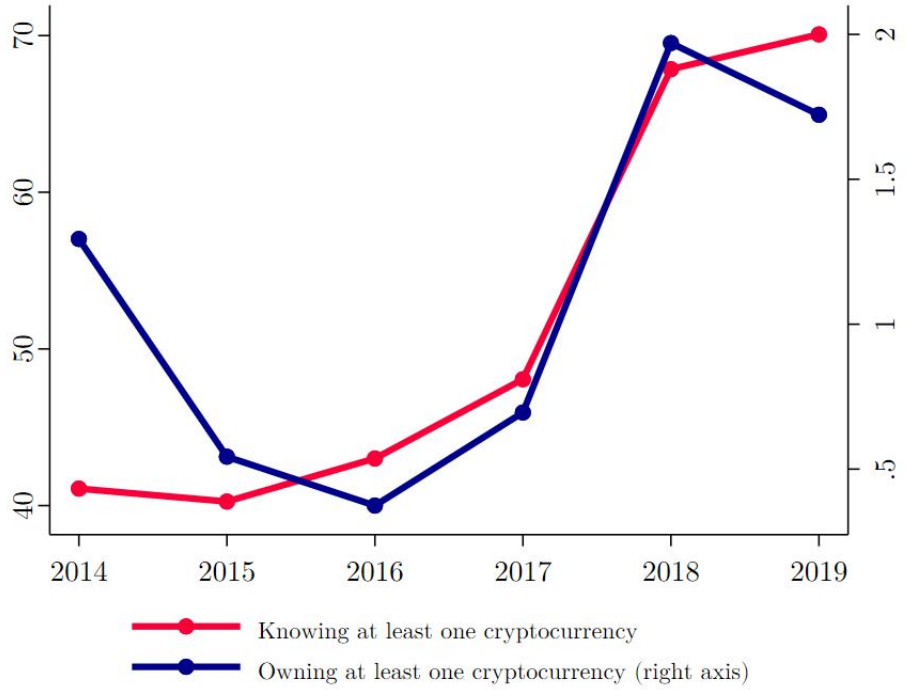
What do the findings of this study imply for the future of the cryptocurrency industry? We discuss whether cryptocurrencies are likely to attract new investors in the future and whether they may retain their existing ones. We also discuss trends in the socioeconomic characteristics of cryptocurrency investors.

5.1 Attracting new investors

While knowledge about cryptocurrencies is becoming pervasive, ownership remains limited to a niche population. In 2014 only some 40% of US citizens were aware of at least one cryptocurrency (mainly bitcoin). This percentage increased to almost 70% in 2019 (see Figure 4). If the trend continues, in one or two years the entire US population will recognise at least one cryptocurrency. The acceptance and usage of cryptocurrencies are nonetheless not high. Only 1.4% of the US population owned

at least one cryptocurrency in 2019.[34] The fraction of crypto-owners experienced a positive trend since 2016 with a slight decline in 2019.

Figure 4: Cryptocurrency facts



Source: SCPC.
Note. Survey weights are included.

Since knowledge about cryptocurrencies is already pervasive, it is not likely that significant numbers of new investors will be won over to the asset class via the route of new people learning about the topic. Figure 5 shows the amount of new weekly Twitter followers of some of the major cryptocurrency exchanges, such as Binance or Coinbase. There was a significant increase of Twitter followers at the end of the first bitcoin rush.[35] By the end of 2020, cryptocurrency exchanges were gaining some new followers, but not as much as during the last quarter of 2017 or the first quarter of 2018. It is likely that once a person follows one of these accounts, she is much more likely to show interest in a cryptocurrency and to invest in the future. Shen et al. (2019) show that the number of tweets concerning bitcoin can predict the next day's trading volume and volatility.

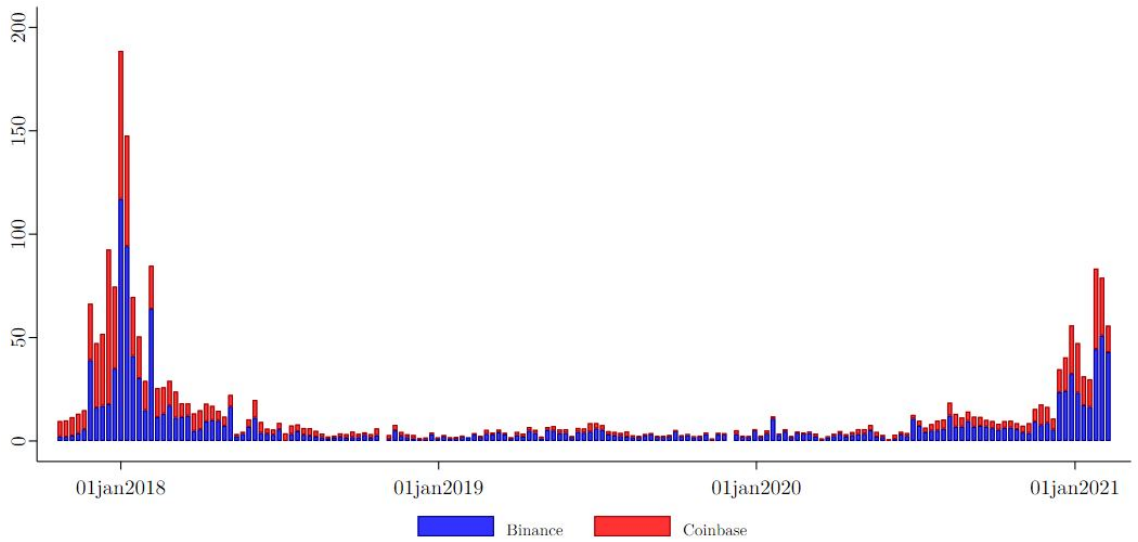
At the end of 2017, LendEDU launched two surveys[36] asking about bitcoin as an investment option. At the time, over 80% of respondents believed that bitcoin would be the largest cryptocurrency in terms of market capitalisation in five years (Figure 6a). Asked whether they would like to own bitcoin through futures contracts if that were possible, more than 40% of the respondents answered affirmatively, while

[34]This percentage is in line with that of other countries. For instance, Stix (2019) shows that about 1.5% of Austrians own crypto-assets.

[35]Note that it is possible to game this statistic by buying Twitter followers.

[36]Both surveys were answered by the same people, i.e., 564 Americans. See Gitlen (2017) for further details about the methodology of the survey.

Figure 5: New Weekly Twitter Followers of Cryptocurrency Exchanges

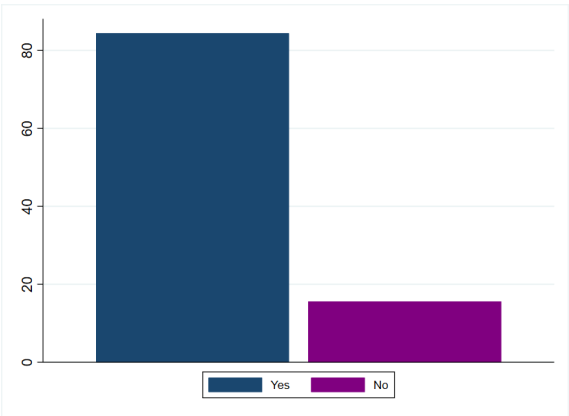


Source: Socialblade (retrieved from The Block).

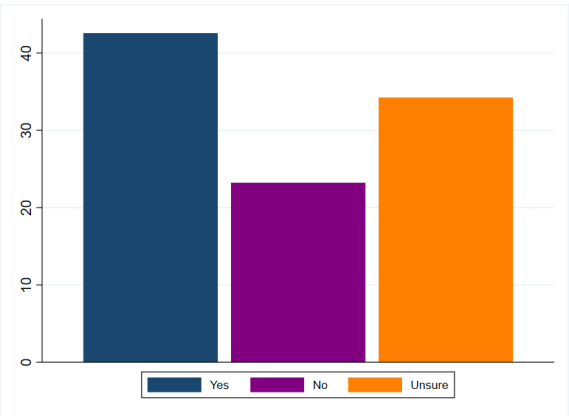
around 34% were not sure (Figure 6b). As a result of the high volatility of bitcoin and other cryptocurrencies, the market for cryptocurrency futures contracts grew during 2020 as cryptocurrency investors started to make agreements to buy or sell a cryptocurrency at a later date for a fixed price. Concurrently, some regulatory agencies banned the sale of cryptocurrency derivatives and exchange-traded notes, arguing that these products pose harm and so are ill-suited for the average investor. The UK Financial Conduct Authority (FCA), for example, was the first agency to take such a step, banning the sale of cryptocurrency derivatives and exchange-traded notes.[37]

Figure 6: Bitcoin's prospects

(a) In 5 years, will Bitcoin be the largest crypto in terms of market capitalization? (in %).



(b) If possible, would you rather own Bitcoin through futures contracts? (in %).



Source: Gitlen (2017).
Note: These questions belong to Part #2 of the survey conducted in November 2017, and correspond to questions 4 and 3, respectively.

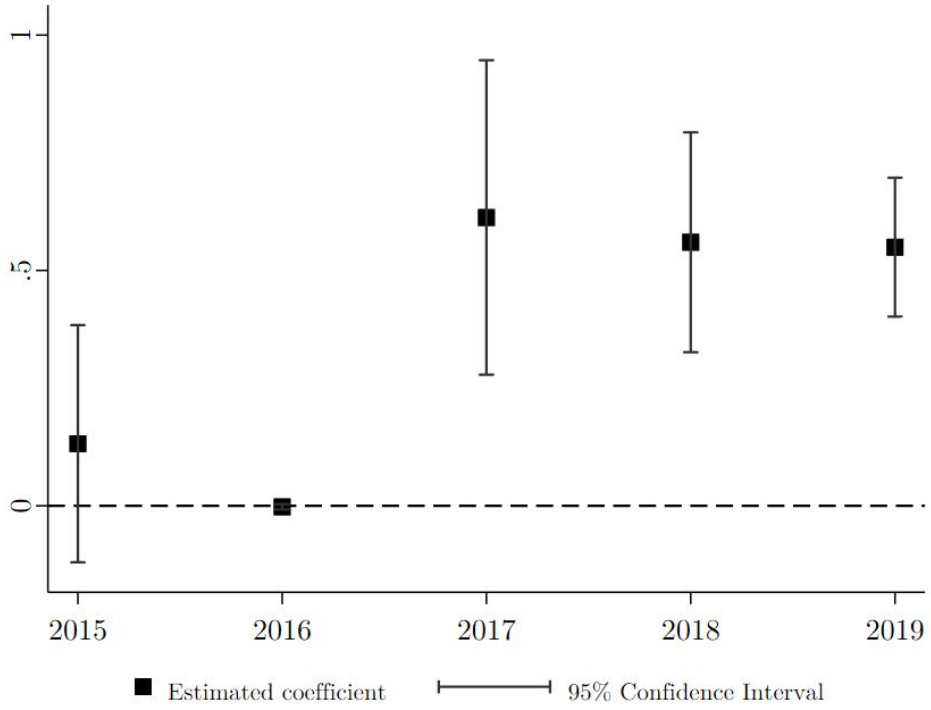
[37]For further information, see FCA (2020).

5.2 Retaining existing investors

One of the main features of the cryptocurrency market is its volatility. The price of cryptocurrencies can rise and fall dramatically in the course of a single day. Recognising that the market is prone to such swings, as well as manipulation, the "holding strategy" has evolved. Hodling means to buy a cryptocurrency and hold onto it for a prolonged time without any selling or trading activity. But what is the probability of hodling in the population we examine? To answer this question, we compute the likelihood that an individual that has a cryptocurrency one year continues being an owner the following year.[38] To do so, we estimate Equation (1) maintaining just those individuals that are repeated each two years in the SCPC.[39]

Figure 7 presents the estimated coefficients for the variable of owning at least one cryptocurrency in the previous year.[40] Five regressions are performed. Results are as follows. The likelihood of owning a cryptocurrency in 2015 and 2016 is not affected by owning a cryptocurrency in 2014 and 2015 respectively.

Figure 7: Estimated coefficients (LPM)



Source: Authors' elaboration.
Note: The regression of the 2014-2015 waves contains 900 repeated individuals. The 2015-2016, 2016-2017, 2017-2018 and 2018-2019 waves have 1013, 2575, 2526, 2652 repeated individuals respectively.

Notwithstanding, owning a cryptocurrency in 2016, 2017 and 2018 increases the probability, on average, of owning a cryptocurrency in 2017, 2018 and 2019 by 61,

[38] This measure only captures one dimension of *hodling*. Investors might also increase or reduce the size of their position.

[39] For instance, if an individual responded to the 2014 survey but did not answer the 2015 wave, this observation is deleted.

[40] Figure H1 in the Appendix H shows the estimated coefficients and standard errors presented in Figure 7.

56 and 55 percentage points, respectively. In other words, those who invested in cryptocurrencies in the past are likely to remain invested.

If this finding – that *hodling* has become more pervasive, remains constant in years to come, it may indicate a certain stabilisation in cryptocurrency markets since investors may be using this asset as a store of value rather than a speculative asset. This confirms concurrent work in the field of computer science Abramova et al. (2021), which identifies that the population of cryptocurrency users has grown out of the original group of tech-savvy "cypherpunks" into a heterogeneous community of individuals, including both professional and amateur investors (called "hodlers" and "rookies", respectively).

5.3 Trends in the gender and age gap

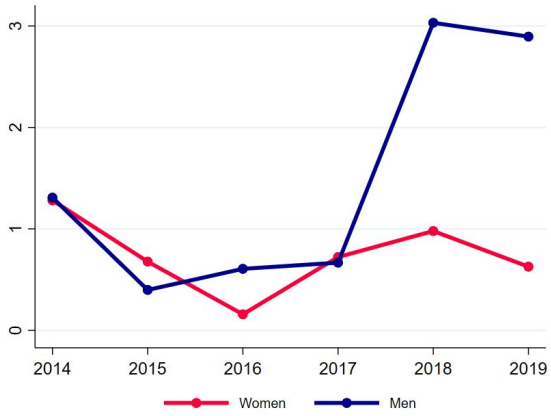
The impact of characteristics such as gender and age on cryptocurrency investments may be driven by preferences rather than differences in knowledge about the underlying technology. In terms of gender, the knowledge gap has decreased over time. In 2014 only 30% of women had knowledge of at least one cryptocurrency (the percentage was 50% for men), while in 2019 almost 65% of women (and 75% of men) recognised at least one cryptocurrency (Figure 8b). However, during that time, an ownership gap actually emerged, evidencing that preferences matter. As Figure 8a shows, whilst the percentage of male and female owners was pretty similar from 2014 to 2017, in 2018 a gender gap emerged.[41]

At the same time, Figure 8c presents the age profile of cryptocurrency users. Owners are younger, on average, than non-owners of cryptocurrencies. This has a strong effect on investment decisions. On the other hand, the age profile of those who recognise at least one cryptocurrency is similar to those who have not (Figure 8d). This evidences that differences in ownership across age are not driven by knowledge, but rather by preferences

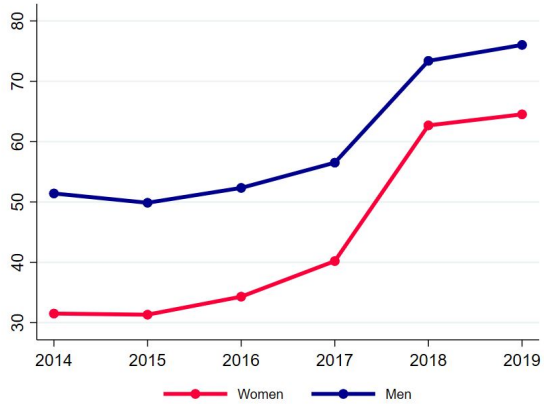
[41] The gender gap is present not only in the cryptocurrency industry but also in the FinTech industry. Chen et al. (2021) find that only 21% of women use fintech products and services while 29% of men do.

Figure 8: Cryptocurrency trends (2014-19).

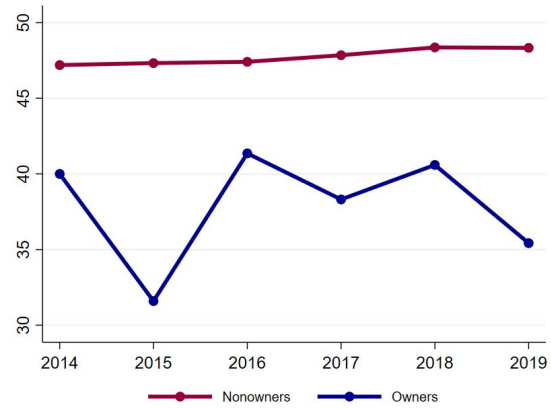
(a) % who own cryptocurrency



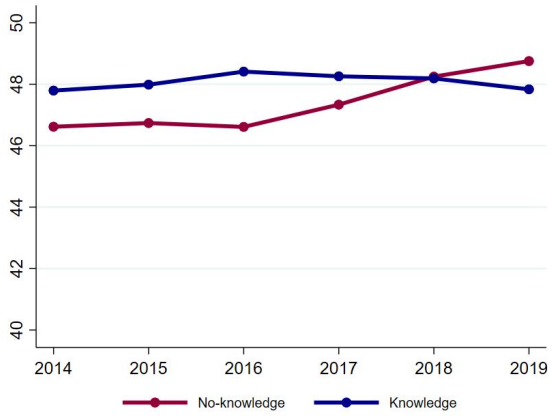
(b) % with knowledge about cryptocurrencies



(c) Age of owners vs age of non-owners



(d) Age of people with knowledge about crypto vs. age of people without it



Source: 2019 SCPC.
Note. Survey weights are included.

6 Conclusion and policy implications

Providing an in-depth exploration of representative data on cryptocurrency owners, we disprove the hypothesis that cryptocurrencies are sought as an alternative to fiat currencies or regulated finance: compared with the general population, US cryptocurrency investors show no differences in their level of security concerns with either cash or commercial banking services.

We also examine the underlying socioeconomic correlates of cryptocurrency investing. We find that men tend to invest more in cryptocurrencies than women. Furthermore, higher levels of income and education, and having digital financial experience (captured through having a debit card and using a mobile app to pay for products and/or services) increase the likelihood of recognising at least one cryptocurrency.

We show that these patterns are driven by the impact of socioeconomic features on knowledge about cryptocurrencies, but also on investment decisions conditional on knowledge about this asset class. Among the various cryptocurrencies, owners of ether and xrp have the highest income and educational levels, while those owning litecoin are the least educated. Last, we document that owning a cryptocurrency increases the probability, on average, of owning a cryptocurrency in one's portfolio the following year by more than 50%.

Finally, we provide some evidence that the impact of gender and age on cryptocurrency investment is unrelated to differences in knowledge about the underlying technology. For example, while knowledge levels have converged over the sample we observe, a gender gap in terms of ownership has emerged.

From a policy perspective, the overall takeaway of our analysis is that as the objectives of investors are the same as those for other asset classes, so should be the regulation.[42] Cryptocurrencies are not sought as an alternative to fiat currencies or regulated finance, but instead are a niche digital speculation object. A clarifying regulatory and supervisory framework for cryptocurrency markets may be beneficial for the industry. In fact, regulatory announcements have had a strong impact on cryptocurrency prices and transaction volumes (Auer and Claessens, 2019, 2020), and those pointing to the establishment of specific regulations tailored to cryptocurrencies and initial coin offerings are strongly correlated with relevant market gains.

Better regulation may also be beneficial – quintessential in fact – for the industry when it comes to the basic security model of many cryptocurrencies. This is so as the long-term viability of cryptocurrencies based on proof-of-work is questionable. Auer (2019a) shows that proof-of-work can only achieve payment security (i.e., finality) if the income of miners is high,[43] and it is questionable whether transaction fees will always be high enough to generate an adequate level of income to guarantee save transactions and rule out majority attacks. In the particular for the case of Bitcoin, the security of payments will decrease each time the "block subsidy" declines (Auer, 2020). Potential solutions[44] often involve some degree of institutionalisation, which in the long-run may require regulation or supervision.[45]

In the light of these considerations, an important point regards how one could

[42] Bouri et al. (2017) stress that although bitcoin was a poor hedge in the 2011-2015 period, it may be suitable for diversification purposes. In the same spirit, Corbet et al. (2018) find that cryptocurrencies may serve as diversification assets for investors in the short-term. Bonaparte (2021) argues that cryptocurrency investors consider cryptocurrencies as a portfolio diversification vehicle.

[43] See also Chiu and Koeppl (2017) and Budish (2018) for related arguments of the cost of decentralised trust, and Leshno and Strack (2020) for a generalization.

[44] Hasu et al. (2019) and Moroz et al. (2020) propose protocol-level changes, among others by increasing miner income or implementing double-spend counter-attacks. Other important platforms in the crypto sphere have already moved or are planning to move to proof-of-stake (Kim, 2021). One of the drawbacks of proof-of-stake is however that so called "long-run" attacks may occur.

[45] Also the enforcement of anti-money laundering and countering the financing of terrorism regulations are paramount for the industry (FATF, 2014, 2020).Coelho et al. (2021) map out regulatory approaches followed around the world in this respect.

apply technology-neutral regulation to this asset class, while at the same time harnessing the potential of the technology itself in the supervision process. In this regard, one promising option that supervisory and regulatory agencies could pursue is "embedded supervision" (Auer, 2019b). By this, we understand implementing a supervisory framework for cryptocurrencies that allows for compliance to be automatically monitored by reading the market's ledger. The main aim is low-cost supervision of decentralised markets, which may be particularly relevant amidst recent deliberations of the need for adequate prudential oversight of the cryptocurrency industry (Basel Committee, 2019, 2021).

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Appendix

This Appendix provides additional explanations, tables and figures that are also discussed in the paper.

Appendix A. Social networks move markets

A rumour that professional money managers and some hedge funds were shorting GameStop's shares spread on the forum Reddit in the mid of January 2021. Boosted by comments on WallStreetBets, a subreddit page where users discuss stock trading, a large number of online traders – and some hedge funds[46] – started to buy shares and stock options, increasing the price of GameStop's shares. GameStop's market capitalisation increased to over $22.6 billion from $5 billion, with the stock opening on 27 January at $354.83 a share. Many retail investors were using the American financial services firm Robinhood, which is used to trade stocks and exchange-traded funds through a mobile app. Robinhood, however, had to cease trading of GameStop's shares, as it was facing a $3 billion security demand by its clearing house NSCC amid a massive spike of trading activity and heightened price volatility (Kelly et al., 2021).[47]

[46] Some hedge funds have made profits of more than $700 million. See Chung (2021).

[47] See Jasinski (2021) for further details about all of the factors that led to Robinhood having to cease trading GameStop shares.

Appendix B. Descriptive statistics

Table B1 presents the main descriptive statistics with weights. In the SCPC, respondents were assigned post-stratified survey weights designed to align as much as possible the composition of the SCPC sample with that of the Current Population Study (CPS) (Foster et al., 2020).

Table B1: Weighted Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.
Main outcome variables				
Ownership	0.017	0.131	0	1
Ownership-number	0.04	0.356	0	7
Knowledge	0.709	0.454	0	1
Knowledge-number	1.327	1.382	0	8
Digitalisation variables				
Having a debit card	0.826	0.379	0	1
Mobile app for payments	0.301	0.459	0	1
Usage of PayPal	0.379	0.485	0	1
Secur. and conv. variables				
Convenience of cash	3.945	1.172	1	5
Security of cash	2.733	1.554	1	5
Conv. of bank acc. number paym.	3.213	1.198	1	5
Sec. of bank acc. number paym.	2.836	1.304	1	5
Conv. of on. bank. bill payments	3.909	1.084	1	5
Security of on. bank. bill paym.	3.244	1.214	1	5
Sociodemographic variables				
Income	11.386	4.083	1	16
Education	3.111	1.209	1	5
Married	0.666	0.472	0	1
Age	48.218	16.824	18	109
Retired	0.195	0.396	0	1
Male	0.482	0.5	0	1
White	0.732	0.443	0	1

The final sample includes 3235 observations. Ownership (knowledge) captures whether an individual owns (recognises or knows) at least one of the following cryptocurrencies: Bitcoin, xrp, litecoin, ether, bitcoin cash, stellar, eos, or any other different cryptocurrency. Ownership-number (knowledge-number) stands for the number of different cryptocurrencies that a person owns (recognises or knows).

Appendix C. Income and education

Table C1 shows the household income classification. Table C2 depicts the educational attainment classification. Education was divided into 16 categories in the 2018 and 2019 waves. However, since it was divided into just five categories in the 2014–17 waves, we reduced it to five.

Table C1: Household income classification

Category	**Interval**	**Category**	**Interval**
1	Less than 5,000.	9	30,000 to 34,999.
2	5,000 to 7,499.	10	35,000 to 39,999.
3	7,500 to 9,999.	11	40,000 to 49,999.
4	10,000 to 12,499.	12	50,000 to 59,999.
5	12,500 to 14,999.	13	60,000 to 74,999.
6	15,000 to 19,999.	14	75,000 to 99,999.
7	20,000 to 24,999.	15	100,000 to 149,999.
8	25,000 to 29,999.	16	150,000 or more.

Source: 2014-19 SCPC.

Table C2: Educational attainment classification

Category	**Education level**
1	12th grade (no diploma) or less.
2	High school graduate - high school diploma or the equivalent.
3	Some college but no degree.
4	Associate degree in college (occupational/vocational program or) academic program or bachelors degree.
5	Master's degree, professional school degree or Doctorate degree.

Source: 2014-19 SCPC.

Appendix D. Ownership conditioned on having a debit - credit card

The most common and accepted payment methods to buy cryptocurrencies include debit cards, credit cards and bank transfers. As the SCPC allows us to restrict the sample to those individuals that are (i) debit card adopters and (ii) credit card adopters, we replicate columns 4–9 of Table 3 to assess whether our results are robust.

As Table D1 shows, compared with the general public, cryptocurrency owners show no differences in their level of security concerns with either cash or commercial banking services. Cryptocurrency investors find cash and traditional banking services less convenient. These results are consistent with those presented in Table 3 although the coefficients of cash convenience and traditional banking payments convenience are higher in magnitude.

Table D1: Ownership conditional on being a debit/credit card adopter

	Cash		Trad. Banking		Online Banking	
	Conv.	Sec.	Conv.	Sec.	Conv.	Sec.
	(1)	(2)	(3)	(4)	(5)	(6)
Debit card adopter						
Owner.	-0.008*	-0.001	-0.010***	-0.003	-0.003	-0.001
	(0.005)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)
R^2	0.005	0.000	0.007	0.001	0.000	0.000
Credit card adopter						
Owner.	-0.009*	-0.002	-0.011***	-0.002	-0.004	-0.001
	(0.005)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
R^2	0.005	0.001	0.008	0.000	0.001	0.000
Weights	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	2,636	2,636	2,636	2,636	2,636	2,636

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Owner. captures whether an individual owns at least one cryptocurrency. Trad. Banking: bank account number payments; Online Banking: online banking bill payments. Conv. and Sec. stand for convenience and security respectively.

Appendix E. LPM with income and education

Table E1 and E2 present the results of the LPM with both income and education included at the same time. If these results are compared with those in Tables 4 and 5, they do not differ.

Table E1: LPM (ownership) with income and education

	(1)	(2)	(3)	(4)
Digitalisation variables				
Debit card		0.009**		0.009**
		(0.004)		(0.004)
Mobile app		0.024**		0.023**
		(0.010)		(0.009)
PayPal		0.007		0.006
		(0.008)		(0.008)
Convenience variables				
Cash			-0.005	-0.004
			(0.004)	(0.004)
Trad. Banking			-0.006*	-0.005*
			(0.004)	(0.004)
Online Banking			0.001	0.000
			(0.004)	(0.004)
Security variables				
Cash			0.000	0.000
			(0.003)	(0.003)
Trad. banking			0.001	0.001
			(0.005)	(0.005)
Online Banking			-0.001	-0.002
			(0.005)	(0.005)
Sociodemographic variables				
Education	0.008***	0.007**	0.007**	0.006*
	(0.003)	(0.003)	(0.003)	(0.003)
Income	0.000	-0.001	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.001***	-0.001***	-0.001***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.014*	0.014**	0.012*	0.013*
	(0.007)	(0.007)	(0.007)	(0.007)
Male	0.021***	0.022***	0.021***	0.021***
	(0.008)	(0.008)	(0.008)	(0.008)
White	-0.000	0.000	-0.000	-0.000
	(0.009)	(0.008)	(0.009)	(0.008)
Weights	Yes	Yes	Yes	Yes
R^2	0.015	0.029	0.023	0.034
Observations	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Table E2: LPM (knowledge) with income and education

	(1)	(2)	(3)	(4)
Digitalisation variables				
Debit card		0.054*		0.053*
		(0.032)		(0.031)
Mobile app		0.080***		0.075***
		(0.025)		(0.024)
PayPal		0.077***		0.068***
		(0.022)		(0.021)
Convenience variables				
Cash			0.010	0.014
			(0.009)	(0.009)
Trad. Banking			-0.046***	-0.044***
			(0.009)	(0.009)
Online Banking			0.035***	0.029***
			(0.011)	(0.011)
Security variables				
Cash			-0.023***	-0.021***
			(0.007)	(0.007)
Trad. banking			-0.008	-0.005
			(0.010)	(0.010)
Online Banking			0.014	0.010
			(0.011)	(0.011)
Sociodemographic variables				
Education	0.082***	0.073***	0.075***	0.068***
	(0.011)	(0.011)	(0.011)	(0.011)
Income	0.019***	0.015***	0.018***	0.014***
	(0.003)	(0.003)	(0.003)	(0.003)
Age	-0.001	0.000	-0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Married	-0.019	-0.018	-0.023	-0.021
	(0.024)	(0.024)	(0.024)	(0.023)
Male	0.107***	0.113***	0.108***	0.112***
	(0.022)	(0.022)	(0.022)	(0.021)
White	0.056**	0.055**	0.050*	0.049*
	(0.027)	(0.027)	(0.027)	(0.027)
Weights	Yes	Yes	Yes	Yes
R^2	0.130	0.147	0.153	0.167
Observations	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Appendix F. Retired population

Table F1 estimates Equation (1). It reproduces Table 4 but instead of using the variable "age", it uses the variable "retired". "Retired" captures whether a person has withdrawn from active working life or not.

Results show that being retired reduces the likelihood of owning at least one cryptocurrency, on average, between 1 and 1.7 percentage points. The rest of the results are completely in line with those in Section 4.1.2.

Table F2 estimates Equation (1). As in the previous case, it reproduces Table 5 but instead of using the variable "age", it uses the variable "retired".

Results show that being retired does not affect the probability of recognising at least one cryptocurrency. The rest of the results are consistent with those presented in Section 4.1.3.

Appendix G. Logistic rare event regression.

Table G1 presents the outcomes of the logistic regression controlling for rare events à la King and Zeng (2001). The sign and significance of the main variables are completely consistent with those of the logistic regressions without applying the rare events correction.

Table F1: Owning at least one cryptocurrency

	(1)	(2)	(3)	(4)
Digitalisation variables				
Debit card		0.010**		0.010**
		(0.004)		(0.004)
Mobile app		0.029***		0.027***
		(0.011)		(0.010)
PayPal		0.009		0.008
		(0.008)		(0.008)
Convenience variables				
Cash			-0.006	-0.005
			(0.004)	(0.004)
Trad. Banking			-0.008**	-0.006*
			(0.004)	(0.003)
Online Banking			0.002	0.001
			(0.004)	(0.004)
Security variables				
Cash			-0.000	0.000
			(0.003)	(0.003)
Trad. banking			0.000	0.001
			(0.005)	(0.005)
Online Banking			-0.001	-0.002
			(0.005)	(0.005)
Sociodemographic variables				
Income	0.001	0.000	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Being retired	-0.018***	-0.010***	-0.015***	-0.008***
	(0.004)	(0.003)	(0.004)	(0.003)
Married	0.011	0.012*	0.010	0.011
	(0.007)	(0.007)	(0.007)	(0.007)
Male	0.020***	0.022***	0.020***	0.021***
	(0.007)	(0.007)	(0.008)	(0.008)
White	-0.002	-0.001	-0.002	-0.001
	(0.009)	(0.009)	(0.009)	(0.009)
Weights	Yes	Yes	Yes	Yes
R^2	0.015	0.029	0.023	0.034
Observations	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Table F2: Knowing at least one cryptocurrency

	(1)	(2)	(3)	(4)
Digitalisation variables				
Debit card		0.060*		0.058*
		(0.032)		(0.031)
Mobile app		0.100***		0.089***
		(0.024)		(0.023)
PayPal		0.099***		0.085***
		(0.022)		(0.021)
Convenience variables				
Cash			0.002	0.009
			(0.009)	(0.009)
Trad. Banking			-0.054***	-0.049***
			(0.009)	(0.009)
Online Banking			0.041***	0.033***
			(0.011)	(0.011)
Security variables				
Cash			-0.024***	-0.023***
			(0.007)	(0.007)
Trad. banking			-0.015	-0.011
			(0.010)	(0.010)
Online Banking			0.018	0.013
			(0.011)	(0.011)
Sociodemographic variables				
Income	0.031***	0.025***	0.028***	0.023***
	(0.003)	(0.003)	(0.003)	(0.003)
Being retired	0.009	0.045*	0.024	0.055**
	(0.026)	(0.026)	(0.025)	(0.026)
Married	-0.041	-0.035	-0.043*	-0.038
	(0.025)	(0.024)	(0.024)	(0.023)
Male	0.097***	0.105***	0.100***	0.106***
	(0.022)	(0.022)	(0.022)	(0.022)
White	0.037	0.037	0.032	0.031
	(0.028)	(0.027)	(0.027)	(0.026)
Weights	Yes	Yes	Yes	Yes
R^2	0.093	0.121	0.124	0.145
Observations	3,235	3,235	3,235	3,235

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Table G1: Ownership - Logistic rare events regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digitalisation variables								
Debit			1.361*	1.079			1.376*	1.110
card			(0.761)	(0.828)			(0.779)	(0.824)
Mobile			1.409***	1.167***			1.262***	1.031**
app			(0.424)	(0.439)			(0.401)	(0.402)
PayPal			0.489	0.549			0.524	0.567
			(0.444)	(0.427)			(0.471)	(0.460)
Convenience variables								
Cash					-0.319*	-0.284	-0.220	-0.198
					(0.178)	(0.187)	(0.170)	(0.173)
Trad.					-	-	-	-0.351
Banking					0.449**	0.396**	0.401**	
					(0.188)	(0.201)	(0.194)	(0.217)
Online					0.089	0.099	0.008	0.009
Banking					(0.192)	(0.189)	(0.189)	(0.193)
Security variables								
Cash					-0.049	-0.024	-0.040	-0.034
					(0.153)	(0.154)	(0.146)	(0.146)
Trad.					0.081	0.055	0.082	0.063
banking					(0.260)	(0.239)	(0.236)	(0.226)
Online					-0.139	-0.111	-0.129	-0.092
Banking					(0.266)	(0.256)	(0.251)	(0.239)
Sociodemographic variables								
Educ.	0.584***		0.375*		0.516**		0.330*	
	(0.195)		(0.202)		(0.204)		(0.208)	
Income		0.134		0.068		0.144*		0.087
		(0.093)		(0.095)		(0.087)		(0.085)
Age		-		-		-		-
		0.079***		0.064***		0.070***		0.056***
		(0.020)		(0.021)		(0.020)		(0.021)
Married	1.106*	1.397*	1.153*	1.438**	1.149	1.316*	1.182*	1.366**
	(0.669)	(0.736)	(0.658)	(0.698)	(0.707)	(0.732)	(0.684)	(0.686)
Male	1.455***	1.486***	1.491***	1.531***	1.493***	1.459***	1.478***	1.466***
	(0.539)	(0.549)	(0.523)	(0.537)	(0.503)	(0.520)	(0.481)	(0.495)
White	-0.047	-0.221	0.028	-0.180	-0.028	-0.188	0.018	-0.148
	(0.553)	(0.561)	(0.552)	(0.554)	(0.535)	(0.536)	(0.534)	(0.547)
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual. Constant included but not reported. Trad. Banking: bank account number payments. Online Banking: online banking bill payments.

Appendix H. Owners over time

Table H1 shows the estimated coefficients and standard errors presented in Figure 7.

Table H1: Owners over time

	2015	2016	2017	2018	2019
Estimated coefficient	0.132	-0.002	0.612***	0.556***	0.549***
	(0.128)	(0.003)	(0.170)	(0.119)	(0.075)
R^2	0.039	0.014	0.169	0.142	0.418
Observations	900	1,013	2,575	2,526	2,652

Notes: ***, ** and * indicate 1%, 5% and 10% significance levels respectively. In parentheses are presented robust standard errors clustered by individual.

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