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Adam Smith Business School

WORKING PAPER SERIES

Financial Literacy and Attitudes to Cryptocurrencies

Georgios A. Panos, Tatja Karkkainen and Adele Atkinson

Paper no. 2020-26
November 2020

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Georgios A. Panos† Tatja Karkkainen Adele Atkinson

11th November 2020

Abstract

We examine the relationship between financial literacy and attitudes to cryptocurrencies, using microdata from 15 countries. Our financial literacy proxy exerts a large negative effect on the probability of currently owning cryptocurrencies. The financially literate are also more likely to be aware of cryptocurrencies, and more likely to report that they do not intend to own them. We confirm the external validity of our financial literacy proxy and findings using data from a second novel survey of retail investors in 3 Asian countries. More financially literate retail investors are more likely not to have held any cryptocurrencies. We show that the relationship between financial literacy and attitudes to cryptocurrencies is moderated by a different perception of the financial risk involved in cryptocurrencies versus alternative instruments by the more financially literate. Our findings shed light on the demand for cryptocurrencies among the general population and suggest that it is largely driven by unsophisticated users.

JEL Classification: B26; D18; E41; G11; G53;

Keywords: Financial Literacy; Cryptocurrencies; Attitudes; Bitcoin; Financial Risk.

† Corresponding author, Adam Smith Business School, University of Glasgow, Georgios.Panos@gla.ac.uk
Karkkainen: Adam Smith Business School, University of Glasgow, Tatja.Karkkainen@glasgow.ac.uk
Atkinson: adelea@hotmail.co.uk

We thank seminar participants for valuable comments at the ADBI-WSBI G20 Conference, the Athens Stock Exchange, the Universities of Glasgow, Stirling, the Leeds, Derby, Southampton, the Aristotle University of Thessaloniki, the University of Macedonia, the 3rd International Workshop on the Internet for Financial Collective Awareness & Intelligence (IFIN 2018), and the Shifting Paradigms Conference at the University of Aberdeen.

The authors gratefully acknowledge funding from the Think Forward Initiative. This paper's findings, interpretations and conclusions are entirely those of the authors and do not necessarily represent the views or policies of the Think Forward Initiative, the ING, the OECD, the S&P, their Executive Directors, or the countries they represent. Any remaining errors are our own.

1. Introduction

The emergence of cryptocurrencies using both cryptography and blockchain technology in 2009 signaled a major turning point for the financial world. As of end October 2020, there are more than 5,000 cryptocurrencies in circulation, with an estimated market capitalization close to 400 billion USD. Both the number of cryptocurrencies and their market capitalization have more than doubled in one year.

The supply of cryptocurrencies is inherently complex and typically limited. In the case of bitcoin, currency is only released into circulation when miners are rewarded for processing and verifying transactions and finding solutions to cryptographic puzzles of increasing difficulty. While the number of units circulating and maximum supply of cryptocurrencies such as bitcoin has been the subject of academic discussion, until recently the demand side of the market was much less well understood, and considered to be largely unpredictable (Baur, et al., 2015). The ability of cryptocurrencies to facilitate anonymous peer-to-peer transactions without the need to involve third parties has been flagged as a potential driver of demand. Intuitively, users interested in these characteristics are unlikely to reveal their motivation and preferences or provide information about the specifics of their engagement with cryptocurrencies. Nevertheless, in their recent seminal study, Foley, et al. (2019) estimate that around $76 billion of illegal activity per year involves bitcoin transactions – accounting for some 46% of all bitcoin transactions.

Bitcoin prices famously rose to over 18,000 USD at the end of 2017, before plummeting again and continuing to fall throughout 2018 to a low of under 4,000 USD. Prices increased again to just under 13,000 USD in 2019 and have continued to fluctuate in 2020 with a large decline in March once again followed by a rally. This fluctuation in market price has led to demand from retail investors seeking super-normal returns, rather than an alternative currency. In an early study, Glaser, et al. (2014) reports '*strong indications that especially uninformed users approaching digital currencies are not*

primarily interested in an alternative transaction system but seek to participate in an alternative investment vehicle'[1].

Rooney and Levy (2018) point out to the emergence of some 300 cryptofunds, or funds that engage only in cryptocurrencies. These are actively managing some $10 billion in assets. PwC (2020) reports that in the 1st quarter of 2020 there are around 150 active crypto hedge funds, two thirds of which (63%) were launched in 2018 or 2019. The remaining cryptofunds are likely to be index funds, or 'trackers' that are invested in a basket of cryptocurrencies.

This study sheds further light on the demand for cryptocurrencies by examining the determinants of attitudes to cryptocurrencies using data from a new consumer survey covering 15 countries. We attempt to identify the characteristics of cryptocurrency users and prospective users, focusing particularly on their financial literacy in terms of their understanding of fundamental financial concepts. Since cryptocurrency users who are engaged in illegal activity and the managers of cryptofunds are less likely to respond to surveys, we aim to examine the characteristics of the general population of ordinary users. This population is understudied but widely served by FinTech providers through cryptocurrency exchanges, dedicated platforms, digital wallets and related Apps. We aim to assess whether financial literacy is a key determinant for the demand for cryptocurrencies. Are the more financially literate more or less likely to be aware of cryptocurrencies? Is financial literacy positively or negatively related to current cryptocurrency ownership? Does it affect the positive or negative disposition towards cryptocurrencies among prospective owners? Are factors such as digital literacy skills, age, preference for informal practices, and financial advice interacting with financial literacy in determining the demand for cryptocurrencies? Evidently, the investigation of the relationship between financial literacy and attitudes to cryptocurrencies is important for several reasons.

[1] The authors examine trading data from a bitcoin exchange, transaction data from bitcoin blockchain, visitor statistics for the bitcoin Wikipedia article and dates of important bitcoin events.

First, the FinTech era has introduced investors to a range of new financial markets and instruments, many of which are accessible via digital channels, without intermediation, advice and/or monitoring by an authorized body. Yet financial markets and instruments were already considered complex by most non-expert users (e.g. Remund, 2010; Van Rooij, *et al.*, 2011). In the novel territories of the FinTech era, the ability of even inexperienced investors to engage in informed financial decision making becomes paramount.

Second, cryptocurrencies have been characterized by extremely high volatility. One of the key tenets of the global financial literacy enhancement agenda involves increasing consumers' ability to understand and assess the financial risk involved in different choice options. IOSCO and OECD's (2019) *Core Competencies Framework on Financial Literacy for Investors* entails 7 key elements, all of which are highly relevant to cryptocurrency investors. Examples include: '*Explain the difference between investing and speculation*'; '*Identify and compare the features and risks of different asset classes';* '*Identify the cyber security risks of using online platforms for investing*'; '*Differentiate between an unrealized and realized gain/loss*'; '*Be aware that investors may not always make rational decisions due to biases*', and' '*Describe the main features of common investment scams and frauds*', *inter alia* (OECD, 2018: 4-5). One would expect the more financially literate to be less likely to engage in a highly volatile new instrument and in transactions driven by unrealistically high promised rewards or by sentiment and imitation.

Third, cryptocurrencies have spurred considerable debate among industry experts, academics, policymakers and regulators, and acquired 'sworn' enemies and 'zealot' followers. They have received rapturous appraisals by certain technology and investment gurus. They have attracted a large volume of new investors and speculators, and they are frequently the subject of discussion in the media. One could expect the financially literate to be affected more by networks, advisor and peers that encourage the transfer of knowledge rather than mere imitation (Haliassos, *et al.*, 2020).

Fourth, the design and range of cryptocurrencies is relatively new and evolving. For example, new ideas entailing notions of 'stablecoins', which possess features of both crypto and fiat money, have been put forward as the future of the market for cryptocurrencies. The

proposal is for these to be pegged or linked to a major currency such as the dollar or the euro. One such instance is the inception of Libra by Facebook, which was aspired to go in circulation in 2020, but has also recently seen criticism by investors and regulators, including the US Congress, the Federal Reserve Board, and the Financial Stability Board. In particular, Randal K. Quarles, the chairman of the Financial Stability Board, warned the finance ministers and central-bank governors of the G20 in writing that stablecoins are likely to become a source of threat to global financial markets (FSB, 2019). Regulators are concerned because of the limited insight and monitoring capacity on cryptocurrencies and the several likely, but poorly anticipated, risks entailed in such new instruments (Foley, et al., 2019).

Several central banks have also expressed interest in the potential establishment of a central bank digital currency (CBDC). Although not necessarily founded upon the same underlying technologies as cryptocurrencies, CBDCs are seen a likely key ingredient of future international monetary systems. A speech by Christine Lagarde, President of the European Central Bank (ECB), at the Deutche Bundesbank in 10th September 2020 is a prominent example, highlighting the potential of a digital Euro in facilitating international payment systems, strengthening monetary sovereignty and trust, along with the position in the dominance of global payments. However, President Lagarde also emphasized the risks that the establishment of a digital Euro would entail and suggested that people might not be aware of these risks.

If the current cryptocurrency market is dominated by illegitimate users, a few sophisticated 'cryptofund' managers, many speculators, and many more unsophisticated and potentially less financially literate investors, then concerns about consumer detriment and sources of risk are entirely justified. For any financial market to function efficiently, there needs to be a combination of informed investors and speculators. This is particularly the case for newly established markets involving novel alternative instruments available to the wider population. If a market is dominated by users interested in illegal affairs and by unsophisticated investors, then the future of that market is likely to be opaque. It can even endanger financial stability if cryptocurrencies attract increasing numbers of unsophisticated investors who finance their demand via borrowing. It can be a source of

risk to the financial resilience of households if the related demand occurs as part of a non-diversified portfolio of investments, substituting limited savings or rainy-day funds.

Our main empirical question is whether the more financially literate are more likely to engage in the market for cryptocurrencies, in terms of owning and/or intending to own cryptocurrencies. We are also interested in the moderators underlying any such relationship, i.e. if any effect of financial literacy can be explained by digital literacy, age, inclination to informal practices, financial advice, or the enhanced understanding of the financial risk involved in cryptocurrencies. With all the media attention and the likely peer pressure from acclaimed cryptocurrency investors, it is likely that more present-biased individuals and those with limited risk awareness or erroneous risk perceptions are prone to indulge in sentiment-driven decision making and peer pressure. It is of interest to examine whether those who are financially literate and present biased are more or less likely to consider investing in in cryptocurrencies.

Our study utilizes data from the ING 2018 International Survey on Mobile Banking. The online survey questioned a representative sample of the general population aged 15+ in each of the 15 participant countries. Countries include the USA, Australia, the United Kingdom, several members of the European Union, along with countries in Eastern Europe and Central Asia (hereafter *ECA*). Apart from the usual demographics and use of mobile banking, the survey covered awareness of, and attitudes to cryptocurrencies, in terms of having heard of cryptocurrencies, current holdings, and future plans to own cryptocurrencies (ING, 2018). Our empirical approach matches the data from this survey with data from the S&P 2014 Global Financial Literacy Survey (Klapper, Lusardi and von Oudheusden, 2015), based on country, gender, age and income groups. This exercise enables the generation of a financial literacy proxy, capturing the probability of knowing at least 3 of the 4 main financial literacy concepts, i.e. inflation, simple interest/numeracy, compound interest, and financial risk. Our measure approximates this probability based on a score calculated as the average percentage of 3-out-of-4 correct answers for respondents of a given gender, age group (15-34, 35-54, ≥55) and income band (top 60%, bottom 40%) in each country. We also experiment with additional financial literacy proxies that standardize any country-level differences in financial literacy.

Cryptocurrencies are held by 9.3% of the respondents aged 18-65 in the 15 countries surveyed, and a further 14.1% intend to become cryptocurrency owners in the future. Some 42.4% of the sample neither own nor intend to own cryptocurrencies, whilst the remaining 34.1% have never heard of cryptocurrencies before. Our figures for cryptocurrency ownership among 18-65 year-olds are 8.9% in the USA, 7.1% in Australia, 7.2% in the United Kingdom, and 9% in Germany. Similar proportions of ownership in these countries have been found in other studies. A survey by YouGov in the USA found that some 9% of respondents who had heard about cryptocurrencies had bought bitcoin whilst 5% had mined them (Yougov, 2018b; 2019). Jakubauskas (2018) reports rates of cryptocurrency ownership of 9% in the United Kingdom and 6% in Germany. The figures are also in line with the cryptocurrency benchmarking study by Rauchs, et al. (2018) and the reports by Yougov, (2018a) and the FCA (2019). Our figures for ownership and intention to own are notably high among the ECA countries, i.e. Turkey, Romania, the Czech Republic, and Poland. A striking 17.7% of the sample in Turkey own some cryptocurrency, with an additional 24.4% not owning but intending to own in the future. Spain also exhibits high figures of current and prospective ownership, i.e. 10.5% and 18.9%, respectively. Our results also show that males, younger adults, and the more educated are more likely to engage in the cryptocurrency market.

We estimate weighted multinomial probit models of attitudes to cryptocurrencies, in terms of four categories capturing current ownership, the intention to own in the future, no intention to own in the future, and having heard of cryptocurrencies. Our financial literacy proxy is the independent variable of primary interest, but we also include a rich set of control variables for demographic characteristics, and PPP-deflated monthly income per capita. We also generate proxies for digital literacy, preference for cash as an indication of inclination to informal practices, and intertemporal preferences captured by the future-time reference of the respondent's language. Chen (2013) describes language as a powerful marker of intertemporal preferences, via a linguistically induced bias in time perception or a deeper driver of precision of beliefs about time. Strong inflectional FTR languages, like English, have been associated less future-oriented behaviour. Present-biased beliefs have been associated with engagement in more risky behaviours, e.g. lower saving rates and less healthy lifestyles, inter alia.

To our knowledge, our study is one of the first to examine the relationship between financial literacy and attitudes to cryptocurrencies on a global scale. Recently, in a contemporaneous study to ours, Fujiki (2020) finds a positive impact from financial literacy on cryptocurrency ownership in Japan. However, the author finds a larger negative impact from financial education, and controls for several other financial literacy proxies in the same specification. Hence, this contemporaneous finding seems unlikely to be robust and could be due to multicollinearity. Moreover, there are recent inquiries in different aspects of the demand for cryptocurrencies. Hasso, *et al.* (2019) examine brokerage accounts and show that men are more likely than women to engage in cryptocurrency trading, trade more frequently, and be more speculative. As a result, men realize lower returns. Bannier, et al. (2019) find that women know less about the characteristics of bitcoin than men. They suggest that actual and perceived financial literacy explains approximately 40 percent of the gender gap in bitcoin literacy. Lammer, et al. (2019) use data from an online German bank and examine the investment behavior of individuals who invest in cryptocurrencies with structured retail products. They report that cryptocurrency investors are active traders, prone to investment biases, and hold risky portfolios.

Our estimates reveal that people who are more financially literate are less likely to own cryptocurrencies and more likely not to intend to own them in the future. As expected, they are more likely to have heard of cryptocurrencies before. The results are economically and statistically significant. An increase in the financial literacy score of one standard deviation (0.1470) from the average of 0.5133 decreases the predicted probability of cryptocurrency ownership by 39.6%, i.e. by 3.71 percentage points − from 9.41% to 5.7%. The same increase in the financial literacy score increases the probability of having no intention of holding cryptocurrencies in the future by 22.7% and it decreases the probability of claiming to never have heard of cryptocurrencies by 18.8%. The results are robust in models with interaction terms between financial literacy and country[2], as well as models with interaction terms between financial literacy, education, and income. The results are also robust in models using bootstrapping, unweighted models, and models using alternative financial literacy proxies which standardize any country-level differences in

[2] These models also indicate some country heterogeneity in cryptocurrency ownership, in terms of positive effects of the interaction terms between financial literacy and Germany, Luxembourg, the Netherlands, Australia, and the Czech Republic.

financial literacy. In addition, they are robust to the use of a multinomial probit model with selection, in which awareness of cryptocurrencies is the dependent variable in the first stage. Finally, they are robust to an instrumental variable model that caters to concerns regarding omitted variable bias.

We examine the external validity of our findings using data from the OECD 2019 Consumer Insights Survey on Cryptoassets which reports findings from a survey of 3,428 consumers and retail investors in Malaysia, the Philippines, and Vietnam (OECD, 2019). The online survey explored retail investors to collect data on consumers' attitudes, behaviors and experiences in relation to cryptocurrencies and initial coin offerings. Importantly, the questionnaire also included financial literacy questions. The level of cryptocurrency holding was higher than found in other markets: 36.8% of the investors currently own some cryptocurrency, 14.6% previously owned, 31.1% never held any cryptocurrency, and 17.5% have never heard of cryptocurrencies. Our estimates suggest the more financially literate respondents in these three markets are 10.8% more likely to have never held cryptocurrencies. Instrumental-variable estimates also confirm financial literacy's large negative impact on the probability of current ownership and a large positive impact on the probability of not having held cryptocurrencies.

Using the ING International Survey, we investigate the specifics of the negative relationship between financial literacy and cryptocurrency ownership, in terms of the candidate variables that can moderate this relationship. We show that digital literacy[3] exerts a large, positive impact on current cryptocurrency ownership and on the intention to become an owner in the future. However, in models with interaction terms between financial literacy and digital literacy, the effect of financial literacy remains significant and is of similar magnitude to our baseline estimates. Moreover, we examine whether preference for cash can conceptually serve as a proxy for favorable attitudes to informal

[3] The importance of digital competence was recognised by the European Commission (2006; 2014) in its recommendation on key competences for lifelong learning when it identified digital competence as one of eight key competences essential for all individuals in a knowledge-based society. The American Library Association (2016) offers this definition: "*Digital literacy is the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills*". Our digital literacy is computed as the number of items owned among the following: (1) Smartphone; (2) Tablet; (3) Smart TV; (4) Mobile phone (but not a smartphone); (5) Wearable device (such as an Apple Watch).

practices and whether it might moderate the effect of financial literacy on cryptocurrency ownership. We find that a higher preference for cash is significantly positively related to cryptocurrency ownership and awareness, and negatively related to the intention not to own in the future. Although there is a positive effect of the interaction term between financial literacy and preference for cash on the probability of intending to own cryptocurrency in the future, the main effects of financial literacy remain robust in economic and statistical terms. We also find that cryptocurrencies are more popular among individuals under the age of 45, but age is not the primary moderator of the established relationships between financial literacy and attitudes to cryptocurrencies. This is also the case for the likely moderating role of financial advice regarding cryptocurrencies[4]. The effect of financial literacy is robust in models with interaction terms between financial literacy and financial advice. There is a negative effect on cryptocurrency ownership by the interaction term between financial literacy and advice from the internet and specialist websites, signaling that the more financially literate might be better able to seek financial information online.

The perception of the relative risk of cryptocurrencies and alternative assets is employed to explain the established relationship between financial literacy and attitudes to cryptocurrencies. We estimate models with interaction terms between financial literacy and such risk perceptions and we find significant effects of these interaction terms. Moreover, the effect of the financial literacy variable diminishes in terms of both magnitude and significance in these models. The robustness of our proposed moderator is confirmed by the greater negative impact on cryptocurrency ownership and the intention to own in the future by the financial risk constituent of the financial literacy measure. Finally, we estimate models including an interaction term between financial literacy and intertemporal preferences, i.e. the future-time reference of the respondent's language (hereafter inflectional FTR). We find a large negative effect of this interaction terms and interpret this as signaling that greater financial literacy skills, namely a more informed perception

[4] Cryptocurrency owners and prospective owners are more likely to have a source of financial advice. Starting from the effect of the highest magnitude. The following sources of advice exert positive significant impacts on cryptocurrency ownership: online programmes or algorithms for tailored advice, the internet and specialist websites, friends and relatives, and lastly, by an independent financial or bank advisor.

of financial risk, might be conducive to more prudent financial decision making by the present biased.

Our study presents evidence suggesting that individuals with higher financial literacy are less likely to hold cryptocurrencies in their portfolio, despite displaying higher awareness about them. This is consistent with the observation that cryptocurrencies have their own intrinsic complexities, any reflects a more informed perception of financial risk. Our results have implications for the efficiency of the cryptocurrency market. If the cryptocurrency market is dominated by users engaging in illegal transactions and unsophisticated users, as the less financially literate in our study, then the policy makers in central banks are right to be concerned about potential threats to global financial stability from the cryptocurrency markets. They should also be concerned about the financial well-being of the users of cryptocurrencies. Considering Facebook's proposal to develop stablecoins, pegged to a major currency and made available to its 2.4 billion users, there should be concerns regarding the financial well-being and overall welfare of this major global audience. In addition, our results highlight several implications specific to the ways in which cryptocurrency investments are financed. Baur, et al. (2015) posit that if bitcoin investments are leveraged, a significant fall in its value could lead to margin calls and then also affect other assets. Liu and Tsyvinski (2018) find that certain industries have significant exposures to bitcoin returns, both positive (Consumer Goods and Healthcare) and negative (Fabricated Products and Metal Mining). Although the authors find no exposure of the Finance, Retail and Wholesale industries, a radical proposal such as Facebook's stablecoin in a universe of unsophisticated traders and debt-financed usage might indeed entail severe implications for macroeconomic and international financial stability.

Our study supports the view that more financially literate consumers may also help to contribute to better functioning financial markets (Hilgert et al., 2003). Liu and Tsyvinski (2018) also find that high investor attention predicts high future returns over short horizons for bitcoin and Ripple and medium-term horizons for Ethereum. The authors document herding effects by showing that high negative investor attention negatively predicts future bitcoin returns. Any future cryptocurrency proposal could therefore benefit from parallel programmes that can increase both financial literacy and transparency in the

cryptocurrency market. This is in line with a similar suggestion by Georgarakos and Pasini (2011) for promoting higher national equity ownership. Indeed, the presentation format of financial information has been shown to affect more individuals with low skills in financial literacy (Hastings and Tejeda-Ashton, 2008; Hastings and Mitchell, 2018). In view of the evidence by Haliassos, et al. (2019) regarding exogenous peer effects and a social-multiplier effect on financial knowledge, a network dominated by largely unsophisticated users is more likely to overreact or underreact to different types of information, in the absence of fundamentals.

The remainder of this study is organised as follows. *Section 2* reviews the market for cryptocurrencies and makes the conceptual link between financial literacy and the demand for cryptocurrencies. *Section 3* presents the data, the summary statistics of the key variables and our empirical strategy. Then, *Section 4* presents the results of the estimates for the role of financial literacy on attitudes to cryptocurrencies, along with the relevant robustness and external validity exercises. *Section 5* presents our inquiry regarding the main moderators that are likely to explain the effect of financial literacy on the demand for cryptocurrencies. Finally, *Section 6* concludes and discusses the relevant implications of our findings.

2. Background and literature

2.1 *The market for cryptocurrencies*

Figure 1 presents the eighteen cryptocurrencies with the highest market capitalization for the period 2016-2019, namely Bitcoin, Bitcoin Cash, Bitcoin SV, ChainLink, Dai, Dash, EOS, Ethereum, Ethereum Classic, IOTA, Litecoin, Monero, NEM, NEO, Ripple, Stellar, Tether and Tezos. Their market capitalization at the end of 2019 is around $300 billion. Bitcoin alone represents around half of this market capitalization, as can be seen at the top panel of Figure 1. Overall market capitalization picked in late 2017, with that of bitcoin exceeding $300 billion. However, the following years saw significant fluctuations. Following the sharp drop in its price in early 2018 and continuing decline throughout most of the year, bitcoin's market capitalization fell to $60 billion in February 2019 and increased once more to $210 billion by July 2019. At much lower volumes, the other

cryptocurrencies, and most notably Ethereum, displayed similar patterns in terms of the timing of changes in their market capitalization up to December 2019. The bottom panel of Figure 1 contrasts the top figure with figures on the market capitalization of the largest twelve S&P100 companies. The current market capitalization of the entire cryptocurrency market is just close to that of each of the equities in the lower half of the top 12. Hence, the size of the cryptocurrency market is objectively small, but not negligible and with likely future growth potential.

[Insert Figure 1 about here]

Whilst the universe of cryptocurrencies is not homogenous, they share common features in terms of the use of both cryptography and blockchain technology, their facilitation by technology over the internet and the likely decentralization within a network of users. Some cryptocurrencies, such as Ripple and NEO, function more as payment systems than others due to their more effective operation structure in confirming transactions (European Parliament, 2018).

Focusing on one of the first cryptocurrencies, bitcoin, can help us to better understand the market. Bitcoin was designed for irreversible online transactions (Nakamoto, 2008). The cryptocurrency's integrated payment transfer mechanism can be thought to function as a self-standing network that does not require intermediaries. However, in reality it is not widely used as a payment transfer mechanism. A very limited amount of goods and services are denominated in bitcoin and its fractions, i.e. '*Satoshis'*, and those services include the transaction fees on the bitcoin blockchain. Bjerg (2016) posits that bitcoin is like '*commodity money without gold, fiat money without a state, and credit money without debt*', and Yermack (2015) suggests that bitcoin serves more as a speculative investment than as a currency. The prevalence of massive speculative investing was also made evident during the rapid increase in cryptocurrency prices, especially in the price of bitcoin in late 2017 followed by an equally rapid decline in early 2018.

The supply of bitcoin is predetermined to be restricted to 21 million bitcoin units (Nakamoto, 2008). Bitcoin miners today typically use heavy duty computers requiring significant amounts of electricity to mine, process or verify transactions which are then

incorporated into new blocks on the bitcoin blockchain. A new 1-megabyte block containing on average two thousand transactions is mined every 10 minutes, for which the successful miner receives 6.25 bitcoins per block (decreasing by design from 12.5 bitcoins prior to May 2020). In total, up to 1,800 new bitcoins are produced each day. Due to the increase of specialist mining rigs on the bitcoin network, and the increased complexity of the puzzle to be solved, the chances of a normal user being able to mine blocks has been reduced in the recent past. As a result, the average cryptocurrency user is more likely to purchase cryptocurrencies through an exchange or invest in an initial coin offering (ICO)[5] than acquire them from mining.

By design, the bitcoin blockchain system does not incorporate future cashflows or interest, apart from the compensation to miners for verifying transactions. The lack of attention to fundamentals can motivate investors to contribute to speculative price increases, such as that witnessed in the Californian real estate market in the late 1880s (Shiller, 1990). Exacerbated by the limited supply feature and the related scarcity element, limited knowledge and/or attention may have contributed to the sudden increase in the price of bitcoin during the period between the late 2017 and early 2018.

Figure 2 presents the price development of bitcoin for the period between 2016-2019, compared to certain asset classes, namely gold, real estate, sovereign bonds, equities, and cash. The price of bitcoin reached that of gold in March 2017 for the first time and then the rally began, with the price of bitcoin reaching $19,000 in December 2017, with that of gold remaining close to $1,250 per ounce. The bottom panel of Figure 2 shows that the remaining asset classes exhibit far more stable prices than that of bitcoin. The sole exception are equities, with the proxy of the S&P Global 1200 total return index increasing from $1,800 in January 2016 to $2,500 in February 2018, then decreasing to $2,000 by January 2019, and risking again to $2,600 by December 2019.

[Insert Figure 2 about here]

[5] Initial coin offerings (ICOs) are a new method of raising capital for early-stage ventures. In an ICO, a blockchain-based issuer sells cryptographically secured digital assets, usually called tokens. The ICO market raised over $31 billion between January 2016 and August 2019, and at least 20 individual ICOs to date have taken in more than $100 million (Howell, et al., 2019).

In standard financial instruments, scalability can make the services cheaper. In contrast, it seems that the greater popularity of bitcoin made the transactions more expensive. This has largely been seen as a difficulty of bitcoin network's ability to scale up and function as a payment system. However, its scarcity and limited scalability have meant that it is perceived more as a store of value, which can serve as a substitute to fiat money in situations of crisis or in regions of low financial inclusion, high currency volatility and/or low trust in financial institutions[6]. Nevertheless, when cryptocurrencies were compared to the currencies of the least developed countries between 2014 and 2017, the former were shown to exhibit more volatility (Kasper, 2017). Polasik, et al. (2015) discuss how the demand for bitcoin is higher in low income countries, with large informal sectors and imprudent monetary policies (Polasik, et al., 2015). Bitcoin volatility was also found to be related to global economic and financial events (Conrad, et al., 2018). The top panel of *Figure 3* presents daily one-month running annualized volatilities for bitcoin and selected asset classes, namely gold, real estate, sovereign bonds, equities, and cash. It is evident that the volatility of bitcoin is several times that of stocks, gold, real estate, and bonds[7]. The bottom panel of the figure presents the corresponding volatilities in comparison to some international currencies, i.e. those of the countries in our study, namely the Polish Zloty, the Romanian Leu, the Turkish Lira, the Euro, the Australian dollar, the British pound, the US dollar, the Czech Koruna, the Philippines Peso, the Malaysian Ringgit and the Vietnamese Dong. It is only the Turkish Lira that has exhibited comparable volatility to bitcoin in the period after August 2018. Other countries exhibiting high volatility involve the Polish Zloty, the Romanian Leu, the Philippines Peso, and the Euro

[6] The demand for bitcoin seems to have surged during events such as the banking crisis of Cyprus in 2013 (Forbes, 2013) and the political unrest in Zimbabwe in 2017 (Telegraph, 2013). Moreover, following 2014, hyperinflation in Venezuela and the initiation of their own Petro cryptocurrency also increased the demand of bitcoin (Time, 2018). Furthermore, anecdotal evidence suggests cryptocurrency usage among refugees is high, providing transport security and facilitating remittances. The public dialogue has seen arguments emphasizing on the future potential of the blockchain technology facilitating functions among refugee communities, including financial inclusion and remittances (Flore, 2018; Forbes, 2019).

[7] The *Appendix Table A1* calculates the standard investment risk and return characteristics of bitcoin, in terms of the Sharpe and Sortino ratios. Bitcoin's volatility nearing 90% is compensated by higher returns during the 3-year period 2016-2019. However, in 2018, this high volatility corresponds to very large negative returns, which are much higher compared to the remaining asset classes. Bitcoin entails the largest negative Sortino ratio for the year 2018, compared to real estate and the remaining asset categories.

after February 2019. However, the volatility of bitcoin is many times higher than that of all currencies.

[Insert Figure 3 about here]

While the complex information on the supply side of cryptocurrencies is available to current and prospective users, e.g. the production, mining, technology, circulating and maximum supply, much less is known regarding the composition of the demand side. Such information is essential for price determination (Ciaian et al., 2016)[8].

In addition to the procurement of cryptocurrencies by miners, there appear to be three other dominant groups that seek to acquire them: illegal traders, ordinary consumers and large 'cryptofunds'. Foley, et al. (2019), for example, estimate that some 46% of bitcoin transactions are related to illegal activity. Glaser, et al. (2014) assert that uninformed users are attracted to digital currencies as an alternative investment vehicle, rather than as an alternative transaction system, and the consensus seems to be that cryptocurrencies are perceived by the general public as assets rather than currencies (e.g. European Union, 2018)[9]. Finally, Rooney and Levy (2018) point to the emergence of some 300 'cryptofunds', which manage some $10 billion in assets. At least 150 of these are active crypto hedge funds (PwC, 2020).

Traditionally, assets are valued for their future revenue stream or the intrinsic utility that commodities entail. Financial instruments are considered to hold no intrinsic utility value and are essentially a claim on borrower's future income or assets. Cryptocurrencies may be thought to hold a utility through their own decentralized and self-governing systems that can provide a medium of exchange and a store of value, but their lack of traditional

[8] Böhme et al. (2015), Dwyer (2015) and Yermack (2015) present early introductions to the economics of bitcoin.

[9] Analyzing the functions of money, Jevons (1875) concluded that money allows utilities such as a medium of exchange, a measure of value, a store of value and a standard of deferred payment. Intuitively, money facilitates the exchange of goods and services through its sought characteristics for 'portability', 'indestructibility', 'homogeneity', 'divisibility', 'stability of value' and 'cognizability'. Shiller (2018) discusses the difficulty of applying technological advancements to substitute money citing the proposal to the Econometric Society during the years of the Great Depression (i.e. in 1932), by John Pease Norton, a former student of Irvin Fisher, for a dollar backed not by gold but by electricity. Despite the attention the proposal received in the years of deflation and lack of liquidity, it lacked a good reasoning for choosing electricity over other commodities to back the dollar.

financial fundamentals makes their value complex to calculate[10]. To complicate things further, whilst cryptocurrencies are largely designed to be decentralized, exchanges may have a certain influence on the volume of transactions and the resulting price, which is indicative of a certain tendency for centralization of market power (e.g. Brandvold, et al., 2015).

As the demand for cryptocurrencies is unpredictable, it is difficult to forecast their future value and usage (Baur, et al., 2015). For instance, Garcia, et al. (2014), suggested a low bound to a fundamental price for bitcoin by considering the cost of electricity, user sentiment, social interaction, and adoption reinforcement. Indeed, Kristoufek (2013) posited that a crucial driver of bitcoin's price is mere sentiment-driven speculation, as sentiment is a key driver of most retail-investor phenomena (Barber and Odean, 2008). Liu and Tsyvinski (2018) find that there is a strong time-series momentum effect in cryptocurrency markets, with returns being predicted by factors that are specific to cryptocurrency markets. Importantly, proxies for investor attention strongly forecast cryptocurrency returns. Bianchi and Dickerson (2019) point out that the relation between volume, current and future returns depends on the relative significance of hedging versus speculative trade, as well as on the aggregate balance of informed vs. uninformed traders. The authors also highlight the presence of highly heterogeneous market participants, e.g. miners, individual traders, and large-scale investors.

2.2 *Could financial literacy be relevant to the demand for cryptocurrencies?*

Individuals' asset allocations are often characterized by certain common errors: low stock market participation, under-diversification, poor trading performance, and investment in actively managed and costly mutual funds (Beshears, et al., 2018). It is obvious that investment in the cryptocurrency market can be linked to the latter three errors, and it is not yet clear if the figures for cryptocurrency-market participation are similar to these for

[10] For instance, Brainard et al. (1990) view fundamental-based returns of equities as the firm's cash flow after tax minus depreciation, divided by the net replacement cost of assets. During the early 2000's, the newly-founded technological companies had limited cashflows and faced several valuation challenges. The observed increases in their equity prices were largely fueled by sentiment-driven investing by retail investors (Baker and Wurgler, 2007).

stock market participation[11]. However, there are potential inferences that can be made for the market for cryptocurrencies from the literature on stock market participation. For instance, individuals expecting higher stock market returns are more likely to participate in stock markets (Hurd, et al., 2011; Kezdi and Willis, 2011), while those who believe that other market participants might cheat them out of their investment will perceive lower expected returns and be less willing to participate (Guiso, et al. 2008). Greenwood and Nagel (2009) conclude that less experienced and younger investors are more likely to invest in over-priced assets due to lack of previous investing experience. Mistakes in investing are likely to take place when a new financial instrument is introduced (Campbell, 2006)[12].

Recent literature has linked financial literacy with avoiding financial mistakes and engaging in prudent financial behavior, e.g. formal vs. informal financial market participation (Klapper, et al., 2013), stock market participation (van Rooij et al., 2011; Almenberg et al., 2011)[13] and the frequency of stock trading (Graham, et al., 2009), negotiation of debt terms and repayment patterns (Moore, 2003; Campbell, 2006; Lusardi and Tufano, 2009a; b), levels of debt and default (Stango and Zinman, 2009; Gerardi et al. 2010), retirement planning (Klapper and Panos, 2011; Lusardi and Mitchell, 2011a; b; c), and banking of the unbanked population in developing countries (Cole, et al., 2011). The analysis in Lusardi, et al. (2017) indicates that financial literacy acquired early in life and shaping financial decisions around the lifecycle, can explain some 35-40% of retirement wealth inequality in the USA. Part of this could possibly be attributed to the improved ability by individuals to hold and trade stocks and effectively manage portfolios involving risky assets through diversification (e.g Calvet et al., 2007; Christiansen, et al., 2008; von Gaudecker, 2015, Bianchi, 2018)[14]. The ability of individuals to assess financial risk and

[11] Guiso and Sodini (2013) find that only half of US households participate in the stock market. In several European countries, e.g. Greece, Italy, Spain, and Austria, the participation rates are below 10%.

[12] For instance, during the dot.com bubble in the late 1990s, higher participation rates were seen among the inexperienced younger investors (Greenwood and Nagel, 2009). These newly IPO'ed technology stocks were difficult to be valued, due to non-existent revenues and opaque growth characteristics. Due to the lack of fundamentals, the prices were seen as driven by sentiment-induced trading by the majority of the retail investors.

[13] van Rooij et al. (2011) report a certain lack of understand among retail investors about the differences between equities and bond investments, and a greater propensity to invest in the stock market. Christelis et al. (2010) also propose that higher cognitive abilities are positively related to direct stock ownership.

[14] Indeed, greater financial illiteracy has been linked to portfolio under-diversification. In von Gaudecker (2015), nearly all households that score high on financial literacy or rely on professionals or private

make optimal financial decisions has significant implications for portfolio allocation, wealth accumulation (Behrman, et al., 2012), and – ultimately – financial well-being.

Could the market for cryptocurrencies attract individuals with low financial literacy? Should we expect the financially literate to be in favor or against ownership and prospective ownership of cryptocurrencies, such as bitcoin? The literature has already pointed out that the market largely attracts 'illegal traders' and 'cryptofunds'. Wang (1994) and Llorente et al. (2002) show that trades based on private information are mimicked by uninformed investors, resulting in return continuations following high volume periods, and price reversals following low-volume periods. If the more financially literate are more likely to participate in stock markets, have a more diversified asset portfolio and obtain higher asset returns, it is likely that they will also be more likely to engage in the cryptocurrency market. On the other hand, if the more financially literate are better positioned to assess financial risk, minimize financial decisions based on imitation and sentiment, and/or overcome or avoid the formation of mistaken beliefs and expectation of constantly high returns, then they might be less likely to engage in the market for cryptocurrencies. Indeed, low financial literacy has been associated with mistaken perceptions and beliefs about financial products and less willingness to accept financial advice (Anderson, et al., 2017)[15].

Hence, our primary research question is whether the more financially literate are more or less likely to own and/or to intend to own cryptocurrencies, than those with low levels of financial literacy. Our secondary set of research questions involves the moderating factors in any relationship between financial literacy and cryptocurrency ownership. As we previously highlighted, these may include digital literacy, age, preference for cash and informal practices, and financial advice. Intuitively, they could involve a more

contacts for advice achieve reasonable investment outcomes, and these group differences stem from the top of the loss distribution. Bianchi (2018) finds that more financially literate households hold riskier positions when expected returns are higher. They are more likely to actively rebalance their portfolios and to do so in a way that holds their risk exposure relatively constant over time, and they are more likely to buy assets that provide higher returns than the assets that they sell. In addition, Choi, et al. (2010) and Duarte and Hastings (2012) relate financial literacy with choosing a low-fee investment portfolio.

[15] Collins (2012) shows that financial literacy and financial advice are complementary rather than substitute. For instance, if the more financially literate have access to better financial information and financial advisors (Calcagno and Monticone, 2015; Stolper, 2018), then it could be the case that optimal financial advice drives the relationship between financial literacy and attitudes to cryptocurrencies, rather than knowledge per se.

'enlightened' understanding of the risk and reward prospects of cryptocurrencies. Indeed, evidence from financial literacy surveys around the world indicates that questions relating to financial risk are the most difficult for respondents to contextualize and respond correctly to (Lusardi and Mitchell, 2014; Montagnoli, et al., 2020).

3. Data and Empirical Strategy

3.1 *The ING 2018 International Survey on Mobile Banking*

We utilize the ING 2018 International Survey on Mobile Banking[16]. The survey was conducted between 26th March and 6th April 2018 by Ipsos International[17]. The data collection took place in 15 countries, namely the United States, Australia, the United Kingdom, Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Spain, the Czech Republic, Poland, Romania, and Turkey. Around 1,000 people were surveyed in each country, with the sole exception of Luxembourg, in which 500 individuals were interviewed. The sampling is representative of gender ratios and the age distribution, selecting from pools of possible respondents furnished by panel providers in each country. In addition, sampling weights are provided by the data collectors to render the data representative of the population by country. The final sample comprises of 14,828 adult respondents who were interviewed online. In our analysis, we drop the very few respondents with no educational qualification, i.e. 90 observations, and another 1,471 respondents who were aged more than 65 at the time of the interview. Our resulting sample comprises of 13,267 individuals, aged 18-65. 48.6% are male, with an average age of 42 years. 49.7% are married, 48% are employed full-time, 12.3% are employed part-time, and 6.4% are self-employed. 22.2% have a university degree, and 14.2% have a postgraduate university degree. The average household income per capita (PPP-divided) is €1,078.3 per month and there are missing income observations for 10.6% of the sample.

[16] The data and documentation are available upon request to ING.

[17] The survey took place shortly after a period of rapid increase and then a sharp decrease in the prices of several cryptocurrencies, most notably bitcoin, during late 2017 and early 2018.

The ING International Survey inquired about how cryptocurrencies, such as bitcoin, are perceived across the European Union, ECA, the UK, the USA and Australia. The surveyors defined cryptocurrency as '*a type of digital currency not created or secured by the government but by a network of individuals*'. The question that enables the depiction of attitudes to cryptocurrencies was the following: "*Have you ever heard of cryptocurrency? If so, do you own any?*". The response categories involved: (a) I have heard of cryptocurrency; (b) I own some cryptocurrency; (c) I expect to own cryptocurrency in the future. The grid options for each of the three items involved: (I) Yes, and (II) No. As a result, the wording of the question enables the generation of a categorical variable for attitudes to cryptocurrencies entailing four categories, namely: (1) Own cryptocurrencies at present; (2) Don't own and expect to own in the future; (3) Don't own and don't expect to own in the future, and; (4) Have not heard of cryptocurrencies before.

3.2 *Attitudes to cryptocurrencies*

Figure 4 presents the frequencies of responses to the main question regarding attitudes to cryptocurrencies, overall and for each of the 15 countries in the sample from the ING Mobile Banking Survey. Weighted averages are shown for the four categories of responses, i.e. owning cryptocurrencies, not owning but intending to own, not owning and not intending to own, and not having heard of cryptocurrencies. The bars indicate that 9.3% of individuals in the sample own some cryptocurrency. 14.1% do not own but intend to own in the future. Some 42.5% of the sample do not own and do not intend to own cryptocurrency. The remaining 34.1% have never heard of cryptocurrency before. The figure of ownership is 8.9% in the USA and 7.1% in Australia. In the USA 12.1% of the sample intends to own cryptocurrencies and 37% does not intend to own in the future. The corresponding figures for Australia are 10.1% and 53.4%, respectively. 42% of the US sample has never heard of cryptocurrencies, with the figure for Australia being lower, i.e. 29.4%.

[Insert Figure 4 about here]

The figures for ownership and intention to own are notably high among the *ECA* countries in our sample, i.e. Turkey, Romania, the Czech Republic, and Poland. The latter

three countries are among the newest member countries in the European Union. A striking 17.7% if the sample in Turkey own some cryptocurrency, with an additional 24.4% not owning but intending to own. The figures for not intending to own and not having heard of cryptocurrency in Turkey are 28.3% and 29.6%, respectively. The high figures of ownership and intention to own cryptocurrency can be related to uncertainty stemming from the recent high volatility in the Turkish lira, which is also evident in the second panel of Figure 3. In Romania, some 12.7% of respondents own cryptocurrencies, with another 24.8% intending to own in the future. 37.9% do not intend to own and a remaining 24.7% have never heard of cryptocurrencies. In the Czech Republic, the figures for the four categories are 9.6%, 11%, 49.4%, and 30.1%, respectively. In Poland, 11.8% of the sample own some cryptocurrency, with an additional 18.5% intending to own in the future. Some 47.1% do not intend to own, and a rather small figure of 22.6% have never heard of cryptocurrencies.

In the United Kingdom, 7.2% of the sample owns cryptocurrencies, with an additional 9.8% intending to own in the future. The corresponding Australian figures are similar, i.e. 7.1% and 10.1%). 46.1% of the UK sample does not intend to own cryptocurrencies in the future, and some 36.9% have never heard about them. Among the old member countries of the European Union, the figures for ownership (and intention to own) are: a rather high 10.5% (18.8%) in Spain, 8.3% (7.3%) in the Netherlands, 4.3% (9.8%) in Luxembourg, 8.4% (18%) in Italy, 9% (14.5% in Germany), 6.7% (11.2%) in France, 5% (5.6%) in Belgium, and 9% (11.8%) in Austria. 38.1% of the Spanish respondents have heard of cryptocurrencies but do not intend to own them in the future. The figures for negative inclination towards future ownership of cryptocurrencies in the remaining old EU countries are: 40% in the Netherlands, 53.8% in Luxembourg, 44.5% in Italy, 48% in Germany, 34.6% in France, 27.9% in Belgium, and 58.4% in Austria. Finally, the fraction of individuals who have never heard of cryptocurrencies are 32.6% in Spain, 44.4% in the Netherlands, 32% in Luxembourg, 28.7% in Italy, 28.6% in Germany, a high 47.5% in France, a striking 61.5% in Belgium, and some 20.9% in Austria[18].

[18] The *Appendix Figures A1 and A2* present the demographic composition of our attitudes to cryptocurrencies. Each bar of the Appendix Figure A1 presents a decomposition of all four attitudinal variables by gender, overall and, then, for each of the 15 countries in our sample. Evidently, males are more likely to own cryptocurrencies and less likely not to have heard about them. This pattern exists in

Consequently, the figures from the ING survey on cryptocurrency ownership corroborate online surveys conducted by YouGov in the UK[19] and USA, and by Dalia Research in the US, UK, and Germany (Yougov, 2018a; b; 2019; Rauchs, et al., 2018; Jakubauskas, 2018). The latter also report figures for Brazil, Japan, South Korea, China and India.

3.3 *Empirical Strategy*

Starting with the notable variation in the descriptive statistics on attitudes to cryptocurrencies across countries, we then examine the relationship between financial literacy and attitudes to cryptocurrencies using regression analysis. Then, we also examine the specifics of this relationship, in terms of the moderating factors. The ING 2018 International Survey on Mobile Banking did not include specific questions regarding financial knowledge. Hence, we generate an external proxy for financial literacy for the individuals in our sample, based on their individual demographic and country profile[20]. We merge the observations on individuals in our sample with disaggregated financial literacy figures from the Standard & Poor's Ratings Services Global Financial Literacy Survey[21].

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all countries in our sample. Lower participation rates by females have also been seen in equity investment (e.g. van Rooij at al., 2011) and other risky-asset investments (Almberg and Dreber, 2015). In the *Appendix Figure A2*, it is shown that the young are more likely to own cryptocurrencies and to intend to own in the future. The old are more likely not to intend to own in the future. Higher participation rates among the younger investors were also seen during the dot.com stock investing boom in the late 1990s (Greenwood and Nagel, 2008). The highly educated are more likely to own cryptocurrencies and less likely not to have heard about them. The self-employed and the employed are more likely to own cryptocurrencies. The inactive and the unemployed are the groups more likely not to have heard about them. Respondents in higher income groups are more likely to own cryptocurrencies, and they are less likely not to have heard about them. However, they are also the groups that are more likely not to intend to own cryptocurrencies in the future.

[19] It is worth noting that the Financial Conduct Authority (2019) reports a lower figure for ownership of some 3% in the UK and a higher figure of 70% for unawareness of cryptocurrencies, based on a face-to-face survey conducted in mid-December 2018.

[20] The advantage of using an external financial literacy proxy is that the variable is an exogenous approximation of financial knowledge. The obvious limitation is that it is an approximation of individual-level financial literacy.

[21] The Standard & Poor's Ratings Services Global Financial Literacy Survey conducted the world's largest and most comprehensive global measurement of financial literacy. It probed knowledge of four basic financial concepts: numeracy, interest compounding, inflation, and risk diversification. The survey is based on interviews with more than 150,000 adults in over 140 countries. The survey was implemented in 2014, as a collaboration between McGraw Hill Financial, Gallup, Inc., the World Bank Development Research Group, and the Global Financial Literacy Excellence Centre at the George Washington University.

The merging is conducted at the individual level based on the score by gender, age group (15-34, 35-54, ≥55), and income group (top 60%/bottom 40%) for each country[22].

The survey included five financial literacy questions covering the four fundamental financial concepts, i.e. interest (numeracy), interest compounding, inflation (money illusion), and the understanding of financial risk (Klapper et al., 2015). The disaggregated financial literacy figures we utilize approximate the probability of an individual in a given country of a specific gender, age and income group knowing at least 3 out of 4 concepts, by answering correctly to the related questions[23]. Our primary financial literacy proxy is the average score by gender, age, and income in each country. We get 180 distinctive financial-literacy profiles, i.e. 15*2*3*2, for the individuals in the ING 2018 International Survey.

Figure 5 presents scatterplots for the four response categories in the attitudes to cryptocurrencies, with financial literacy at the country level on the horizontal axis. The four scatterplots indicate a modest negative relationship between financial literacy and ownership of cryptocurrencies, and a stronger negative relationship between financial literacy and the intention to own cryptocurrencies in the future. On the bottom two scatterplots there is a stronger positive association between financial literacy and the

[22] The disaggregated statistics for each of the 4 constituent concepts of financial literacy by gender, age and income group for of the 15 countries in our sample are shown in the *Appendix Table A3*. Data for all countries in the S&P Global Financial Literacy Survey are publicly available at: https://www.cssf.lu/fileadmin/files/Protection_consommateurs/Education_financiere/SP_Ratings_Global_FinLit-Summary_Statistics_as_of_12152015.xls

[23] The exact wording of the questions was: (1) Risk diversification: "*Suppose you have some money. Is it safer to put your money into one business or investment, or to put your money into multiple businesses or investments?*". The response categories were: (i) *one business or investment*; (ii) *multiple businesses or investments*; (iii) *I don't know*; (iv) *refused to answer*. (2) Inflation: "*Suppose over the next 10 years the prices of the things you buy double. If your income also doubles, will you be able to buy less than you can buy today, the same as you can buy today, or more than you can buy today*"? The response categories were: (i) *less*; (ii) *the same*; (iii) *more*; (iv) *I don't know*; (v) *refused to answer*. (3) Numeracy (interest): "*Suppose you need to borrow 100 US dollars. Which is the lower amount to pay back 105 US dollars or 100 US dollars plus three percent*"? The response categories were: (i) *105 US dollars*; (ii) *100 US dollars plus three percent*; (iii) *I don't know*; (iv) *refused to answer*. (4a) Compound interest I: "*Suppose you put money in the bank for two years and the bank agrees to add 15 percent per year to your account. Will the bank add more money to your account the second year than it did the first year, or will it add the same amount of money both years*"? The response categories were: (i) *more*; (ii) *the same*; (iii) *I don't know*; (iv) *refused to answer*. (4b) Compound interest II: "*Suppose you had 100 US dollars in a savings account and the bank adds 10 percent per year to the account. How much money would you have in the account after five years if you did not remove any money from the account*"? The response categories were: (i) *more than 150 dollars*; (ii) *exactly 150 dollars*; (iii) *less than 150 dollars*; (iv) *I don't know*; (v) *refused to answer*.

negative inclination towards ownership of cryptocurrencies in the future. There is also a positive association between financial literacy country scores and the likelihood of not having heard of cryptocurrencies. On the left-hand side of all four scatterplots are Romania and Turkey, with low financial literacy country scores and higher rates for cryptocurrency ownership and the inclination to own. At the very right of all scatterplots are Australia, Germany, the United Kingdom, and the Netherlands, with high financial literacy country scores and low ownership and inclination-to-own rates.

Insert Figure 5 about here]

Following the indicative figures based on country-level scores of financial literacy, we then examine the relationship between financial literacy and attitudes to cryptocurrencies at the individual level. We estimate weighted multinomial probit regressions (McFadden, 1989) for attitudes to cryptocurrencies, using a proxy for financial literacy at the individual level as our main explanatory variable. We also utilize a rich set of control variables for individual characteristics in our specifications. We estimate specifications of the following form for attitudes to cryptocurrencies:

$$AC_i = \beta_1 (FL_i) + \beta_2 X_i + \theta_r + \varepsilon_i, \quad (1)$$

where: AC_i is a 4-category variable capturing attitudes to cryptocurrencies for individual i, FL_i is a variable capturing financial literacy, X_i is a vector of individual characteristics, θ_r is a fixed effect for country of residence and ε_i is the usual error term.

The list of control variables in the vector X_j includes demographic characteristics, namely gender, a 3rd order polynomial in PPP-divided household income per capita, 6 age-group dummy variables, 4 dummy variables for marital status, a household size variable, 5 dummy variables for the level of education, and 7 dummy variables for occupational status. These variables are described in detail in *Table 1*. In addition, we generate three additional variables capturing digital literacy, preference for cash, and the inflectional FTR of the respondent's language. A strong inflectional FTR indicates an inclination for present-biased beliefs. Moreover, we generate variables for the sources of financial advice on cryptocurrencies, and the perceptions of the reward and risk involved in cryptocurrencies. These variables, which entail proxies for the factors that could moderate the effect of

financial literacy on attitudes to cryptocurrencies, are described in detail in the following sub-section.

In additional specifications, we examine the explanatory power of specific moderating factors, M_i, which are likely to moderate the impact of financial literacy on attitudes to cryptocurrencies, i.e.:

$$AC_i = \beta_1(FL_i) + \beta_2 M_i + \beta_3(FL_i)M_i + \beta_4 X_i + \theta_r + \varepsilon_i, \qquad (2)$$

We are interested in whether the effect of FL_i retains significance and magnitude after the inclusion of the interaction term with the moderating variable or not. These moderating variables are discussed in detail in sub-section 3.6.

3.4 *Main control variables and related summary statistics*

Table 1 presents our primary list of explanatory variables from the ING Mobile Banking Survey and their weighted summary statistics. The figures are presented overall (Column 1), for individuals who own cryptocurrencies (Column 2), for individuals who do not own cryptocurrencies but intend to in the future (Column 3), for respondents who do not intend to own cryptocurrencies in the future (Column 4), and for individuals who have never heard of cryptocurrencies (Column 5). Column 6 presents the difference in the figures between individuals who own or intend to own cryptocurrencies and those who do not intend to own or have never heard of cryptocurrencies, along with a weighted t-test for differences in averages[24]. The table shows that our financial-literacy proxy, which captures the probability of knowing at least 3 out of 4 financial literacy concepts, entails lower figures along individuals owning and intending to own cryptocurrencies, compared to individuals who do not intend to own or have never heard of cryptocurrencies. The mean difference between the two groups is negative and statistically significant at the 1% level. This observation matches well with the scatterplots for attitudes and financial literacy scores at the country level shown in Figure 5.

[24] The weighted t-test is computed via the parmby and metaparm commands in Stata (Newson, 2008).

[Insert Table 1 about here]

In terms of demographic characteristics, the average PPP-divided monthly household income per capita in the sample is €1,078.3, with owners and prospective owners of cryptocurrencies being poorer by some €84 per month on average. Individuals intending to own cryptocurrencies in the future have approximately €200 per month less income than individuals who have heard of cryptocurrencies but do not intend to own them. 48.6% of the sample are males, with 68.1% of owners and 60.5% of prospective owners being males. 31.1% of those who have never heard of cryptocurrencies are males. The average age in the sample is 42 years, with the sample of owners and prospective owners being significantly younger. The average age among owners is 37.5 years, and the figure for prospective owners is 38.1 years. The average age for those not intending to own is 43.9 years, and it is 42.7 years for those who have never heard of cryptocurrencies. 49.7% of the sample are married, 22.9% are single, 17.5% are in a relationship, and 9.9% are widowed or divorced/separated.

3.5 *Proxies for moderating factors and related summary statistics*

First, we compute a variable capturing digital literacy, as the number of items owned among the following: (1) Smartphone; (2) Tablet; (3) Smart TV; (4) Mobile phone (but not a smartphone); (5) Wearable device (such as an Apple Watch). This is converted into an index via dividing by 5. The figures in Table 1 indicate that individuals owning and intending to own score higher in terms of digital literacy, compared to individuals who do not intend to own or have never heard of cryptocurrencies before. Individuals who are more familiar with technology can be thought of as more likely to be aware of cryptocurrencies and the underlying technology that supports them. For instance, Giudici, *et al.* (2018) study the success rates of Initial Coin Offerings (ICOs) and find that the availability of their source code is positively and significantly associated with reports of successful asset raising.

Second, we also generate a variable capturing preference for cash by counting the number of different types of payment usually made in cash, among the following: (1) Rent/mortgage; (2) Utilities (e.g. electricity, gas); (3) Lunch/coffee/snack; (4) Regular

(weekly) grocery/food shopping; (5) Restaurant; (6) Public transport (subway, bus); (7) Taxis; (8) Gifts; (9) Pocket money; (10) Lending money to a friend or family member. The count is converted into an index by dividing by 10. We consider the preference for cash as indicative of a certain tendency towards informal practices and payments in countries with well-developed financial markets and relatively high levels of financial inclusion. Rogoff (2016) points out that cash is also largely anonymous, i.e. it can only be traced through large serial numbers, and it has traditionally played an important role in facilitating crime and illegal trade. Hence, a higher preference for cash might be thought of as a proxy for inclination to informal practices and payments. In Table 1, owners and prospective owners of cryptocurrencies score higher in the preference for cash, compared to those who are negatively inclined or have not heard of cryptocurrencies. While this significant mean difference could be driven by the younger or the more digitally literate, the lower figure for preference for cash among those who have heard but do not intend to own cryptocurrencies could be indicating a positive correlation between cryptocurrency and inclination to informality.

Third, we generate a variable for intertemporal preferences or present-biased beliefs, captured via the future time-reference of the respondent's language or *inflectional FTR*. The inflectional FTR data for the languages in our sample is provided in Chen (2013)[25]. He finds that the languages that grammatically associate the future and the present foster future-oriented behavior and shows that speakers of such languages exhibit less risky behavior, i.e. save more, retire with more wealth, smoke less, practice safer sex, and are less obese. The inflectional FTR is a dummy variable taking the value 1 for 4 out of 11 languages in the ING 2018 International Survey, namely French, Italian, Spanish, and Turkish. The remaining 7 languages, namely German, English, Luxembourgish, Dutch, Polish, Romanian, and Czech, take the value 0. The figures in Table 1 indicate a significantly higher inflectional FTR among owners and prospective owners of cryptocurrencies, compared to the remaining sample, i.e. the future time-reference of

[25] Languages where verbs have distinct future forms are said to have an "inflectional" future. The original source data on inflectional futures is from Dahl (1985) and Dahl and Velupillai (2011).

respondents' language is higher among those owning and intending to own cryptocurrencies.

Fourth, we generate a set of proxies for the sources of financial advice on investment and cryptocurrencies. These questions were asked to the sub-sample of the 8,734 individuals who had heard of cryptocurrencies before. Individuals who had heard of cryptocurrencies before were presented with the following question: '*If you had money available (about 1 month's take-home/net pay) and you wanted some more information on cryptocurrency as a possible investment, where would you most likely get advice*'*?* The response options involved the following categories: (1) An independent financial advisor or bank advisor; (2) My friends/My family; (3) The internet and specialist websites; (4) An online computer program or algorithm that provides tailored advice; (5) I (would) never invest money in cryptocurrency; (6) I don't know. Intuitively, individuals with higher financial literacy are more capable to assess the quality of financial advice. Hence, it could be the case that financial advice on cryptocurrencies could be moderating any effect of financial literacy on the demand for cryptocurrencies.

Advice from friends and family has been described as an informal source of investment information (Stolper and Walter, 2017). Evidence suggests that individuals are more likely to initiate stock market investment if their neighbors have recently experienced good returns[26]. On the other hand, Chaliassos, et al. (2019) find that exogenous exposure to more financially literate neighbors promotes saving in private retirement accounts and stockholding, primarily for educated households and via substantial interaction and knowledge transfer possibilities. Previous literature has shown that the more financially literate are better able to seek for appropriate financial advice on financial matters (e.g. Calcagno and Monticone, 2015; Stolper, 2018). Hilgert, et al. (2003) find that households with higher financial practice index scores hold a preference on sourcing information on financial service over the internet than other media outlets.

[26] In a field experiment, Bursztyn, et al. (2014) show that apart from the learning effect, such peer effects can arise because one's utility of owning an asset is directly affected by whether a peer owns the asset, due to relative wealth considerations or the pleasure of being able to talk about a commonly held investment.

In terms of access to financial advice, 19.8% of the sample would receive financial advice for investment in cryptocurrencies from an independent financial advisor or bank advisor, 8.1% would seek such advice from friends and family, 27.8% would look for advice on cryptocurrencies from the internet and specialist websites, and 6.7% would utilise an online computer program or algorithm for tailored advice on investment in cryptocurrencies. A remaining 37.6% of the sample would not look for financial advice or would not know where to look for financial advice on cryptocurrencies. There are notable differences between owners/prospective owners of cryptocurrencies and the rest, in terms of the likelihood of using the internet and specialist websites for financial advice. Moreover, owners and prospective owners are significantly less likely than non-owners and those who have never heard of cryptocurrencies to report that they have not used any financial advice and that they do not know where to seek for financial advice.

Fifth, we generate proxies for the perceptions of reward and risk of investment in cryptocurrencies. There were two specific questions in the 2018 ING Mobile Banking survey that enable the examination of these moderators. These questions were asked to the sub-sample of the 8,734 individuals who had heard of cryptocurrencies before. Our reward proxy originates in the following question: "*Crypto-money or cryptocurrency is a kind of digital currency. This currency is not created nor secured by the government, but by a network of individuals. Bitcoin is the best-known example. Please indicate how much you agree or disagree with the following statements*":

- "Digital currencies – such as bitcoins – are the future of spending online".
- "Digital currencies – such as bitcoins – are the future of investment as storage of value".
- "I think the value of digital currencies – such as bitcoins – will increase in the next 12 months".

We reverse the order of the six grid options offered for each item in the original survey, so that responses signify: (1) Strongly disagree; (2) Disagree; (3) Neither agree or disagree/I don't have an opinion; (4) Agree; (5) Strongly agree[27]. In Table 1, the perceptions of reward

[27] The *Appendix Figure A3* presents in bars the frequencies of responses for each of the three statements. Panel A presents the frequencies of each of the five categories. Panel B presents the percentage of individuals who strongly agree or agree with each of the three statements. Weighted frequencies are presented overall and by country. Overall, less than a third of the sample agree or strongly agree with the view that digital currencies are the future of spending, the future of investment as storage of value, and with the view that their value will increase in the next 12 months. It is also the case that about one third of the overall sample strongly disagrees or disagrees with each of the statements. About 40% of the sample neither agrees or disagrees or has no view on the prospects of cryptocurrencies. In Panel B, it is worth

are notably higher among owners and prospective owners of cryptocurrencies, compared to the rest. Owners and prospective owners of cryptocurrencies are significantly more likely to believe that digital currencies, such as bitcoin, are the future of spending online, the future of investment as storage of value. Moreover, noting that the survey took place in mid-2018, the former are more likely to believe that the value of digital currencies, such as bitcoin, will increase in the next 12 months, compared to individuals who do not intend to own or have never heard of cryptocurrencies[28].

Finally, our proxy for the perception of the risk of cryptocurrencies stems from the following question: "*Cryptocurrencies are a type of asset. How would you compare the risk of owning cryptocurrency compared to the following alternative assets*"?

- Cash
- Government bonds
- Stock market investment
- Real estate / property funds
- Gold
- Investing in your own business

We reverse the order of the five grid options offered for each item, so that responses signify the following: (1) Holding cryptocurrency entails much lower risk compared to holding … [the alternative asset]; (2) Holding cryptocurrency entails lower risk compared to holding …; (3) Holding cryptocurrency entails about the same risk as holding …; (4) Holding cryptocurrency entails higher risk compared to holding …; (5) Holding cryptocurrency entails much higher risk compared to holding … [the alternative asset].[29] In Table 1, it is

noting that individuals in Australia, the Netherlands, Luxembourg, Austria and Belgium appear more skeptical regarding the prospects of cryptocurrencies in all three aspects. The figures on reward prospects in the 3 aspects are relatively low in Turkey too, despite the high rates of ownership of cryptocurrency in the country. This might indicate that the respondents in Turkey value highly other attributes in cryptocurrency usage, e.g. they might see it as a hedging instrument in view of the large devaluations of the Turkish Lira.

[28] In the *Appendix Table A4*, we present the average of the key variables from the ING sample, distinguishing between individuals of high and low financial literacy within each country, i.e. those for which the percentile of the financial literacy score is greater than the 50th percentile within each country or lower/equal to the 50th percentile in that country. It is shown that the highly literate group within each country has lower scores on all 3 reward perceptions of cryptocurrencies. These associations are also confirmed in the weighted pairwise correlation matrix in the *Appendix Table A5*.

[29] The *Appendix Figure A4* presents the weighted frequencies of responses for our risk proxy question. Panel A presents the response figures in each of the five categories for the risk comparison with each of the six alternative assets. Panel B presents the percentage of individuals who find that cryptocurrency is much riskier or riskier than each of the alternative assets. Overall, 71% find that cryptocurrency is much riskier or riskier than cash, 64.1% find it is much riskier or riskier than bonds, 47.3% find it is much riskier or

shown that, compared to the rest of respondents, owners and prospective owners of cryptocurrency are significantly less likely to believe that cryptocurrencies, such as bitcoin are riskier than cash, bonds, stocks, real estate/funds, gold, and investment in one's own business[30].

3.6 *The OECD 2019 Consumer Insights Survey on Cryptoassets*

We utilize a second novel survey, in order to establish the external validity of our results, particularly with respect to the financial literacy proxy used in our analysis. We use microdata from 3 countries from the OECD 2019 Consumer Insights Survey on Cryptoassets (OECD, 2019). The survey is based on a custom-built questionnaire, which was designed to survey retail investors/consumers, in order to collect data on their attitudes, behaviors and experiences towards digital financial assets, specifically digital (or crypto) currencies and initial coin offerings. In 2019, the survey was conducted in three Asia-Pacific jurisdictions with funding support from the Japanese Government. A research analytics provider was commissioned to translate the questionnaire into local languages and administer it via online channels among retail investors across Malaysia, the Philippines and Vietnam. This survey, which was conducted in February and March 2019, lasted between 15 and 20 minutes per respondent. It was self-administered.

A two-stage sampling approach was used in the research design. The core survey was based on an online sample of 3,006 respondents aged 18 and over, living in Malaysia, the Philippines and Vietnam (over 1,000 per country). Hard quotas were set on age and gender, and soft quotas on income, in order to ensure that the sample was representative of the online adult population in each country. This was supplemented by a booster sample of individuals who had ever invested in cryptoassets. The booster sample was used to increase the robustness of the sample for analysis and provide valuable information on the purchase process and behavior concerning cryptoassets. The respondents included a diversified range of consumers across age, gender, income and education. The final sample comprises

riskier than stocks, 66.5% find it is much riskier or riskier than real estate, 71.8% find it is much riskier or riskier than gold, and 59.3% find it is much riskier or riskier than investing in one's own business.

[30] In the *Appendix Table A4*, it is also shown that the individuals in the high literacy group within each country give higher scores on all six risk perceptions of cryptocurrencies. These associations are also confirmed in the weighted pairwise correlation matrix in the *Appendix Table A5*.

of 3,428 individuals, 2,979 of which are from the main sample and 449 from the booster sample. 1,138 of the respondents are from Malaysia, 1,144 are from the Philippines, and 1,146 are from Vietnam. 49.8% of the pooled sample are male and the average age is 36.1 years. 58.2% are homeowners, 63.9% are employed full-time, 5.5% are employed part-time, and 12.4% are self-employed. 57.9% have a University degree, and another 11.7% have a postgraduate qualification. The average monthly household income is 4,318 international dollars or 1,510 US dollars[31].

As the OECD 2019 Consumer Insights Survey on Cryptoassets comprises retail investors who are more likely to engage with cryptoassets, there we have 36.8% of investors currently owning cryptocurrencies, with the figures being 27.2% in Malaysia, 35.5% in the Philippines, and 37.3% in Vietnam (shown in the *Appendix Table A2*). 14.6% of the sample previously held cryptocurrencies but do not hold them anymore. The figures for previous owners are 13.9% in Malaysia, 12.8% in the Philippines, and 17.1% in Vietnam. 31.1% of the OECD sample have never held cryptocurrencies, with the figures being 41.9% in Malaysia, 25.4% in the Philippines, and 26% in Vietnam. Finally, 17.5% of the retail investor sample have never heard of cryptocurrencies, with the figures being 14.1% in Malaysia, 22.6% in the Philippines, and 15.9% in Vietnam.

4. Financial literacy and attitudes to cryptocurrencies

4.1 Does financial literacy affect the demand for cryptocurrencies?

Table 2 presents our baseline estimates of the relationship between financial literacy and attitudes to cryptocurrencies. Marginal effects and robust standard errors are shown in brackets for the four response categories of our dependent variable, namely owning cryptocurrencies (Column 1), not owning but intending to own in the future (Column 2), not owning and not intending to own in the future (Column 3), and not having heard of

[31] The Appendix Table A2 presents the respective summary statistics for variables used in the analysis of the OECD 2019 Consumer Insights Survey on Cryptoassets. There, the summary statistics are presented for the pooled sample of 3 countries, and for each of the different 4 categories of the dependent variable for attitudes to cryptocurrencies, i.e. for current owners, previous owners, those who never held, and those whose who never heard of cryptocurrencies.

cryptocurrencies before (4). The estimation method is a weighted multinomial probit regression. The error terms are assumed to be independent, standard normal, random variables. The multinomial probit model is the most suitable model to estimate attitudes to cryptocurrencies, as, unlike the multinomial logit, it does not suffer from the Independence of Irrelevant Alternatives (IIA) assumption. For financial choice models, omitting that assumption is of realistic benefit[32]. A further advantage of using the multinomial probit model to study the relationship between financial literacy and attitudes to cryptocurrencies lies with the ability to use all the information available, including answers from those respondents who do not identify with cryptocurrencies, because they have not heard of them before.

[Insert Table 2 about here]

Our estimates confirm a negative relationship between financial literacy and ownership of cryptocurrencies. The relationship is economically and statistically significant at the 1% level. A one standard-deviation increase in the financial-literacy score of 0.1470 from the average of 0.5133 decreases the predicted probability of cryptocurrency ownership by 39.5%, i.e. by 3.71 percentage points − from 9.41% to 5.7%[33]. The more financially literate are more likely to have heard of cryptocurrencies, but do not intend to own them in the future. A one standard deviation increase in financial literacy increases the probability of having no intention of owning cryptocurrencies in the future by 22.7%. The more financially literate are less likely to report that they have not heard of cryptocurrencies before. A one standard deviation increase in financial literacy decreases the probability of not having heard of cryptocurrencies by 18.8% respectively.

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[32] For instance, the assumption would signify that omitting the category for those who have not heard of cryptocurrencies before would induce the proportionate allocation of responses from the omitted category to the remaining categories, based on their observed frequencies.

[33] It is worth noting that the marginal effects of financial literacy reported in the tables implement a change by 1 unit, in a variable that ranges between 0.1833 and 0.7548. They are calculated over the entire distribution, not at the mean of other independent variables. Alternatively, one could multiply the financial-literacy variable by 10 and that would render the marginal effects of financial literacy closer to the calculated magnitudes.

The estimates of the remaining control variables show that digital literacy is positively and significantly associated with ownership and prospective ownership. It is negatively and significantly associated with negative inclination regarding future ownership and with ignorance regarding cryptocurrencies. A strong inflectional FTR is positively associated with the intention to own in the future and negatively associated with ignorance regarding cryptocurrencies. A higher preference for cash is positively associated with current ownership. It is negatively associated with negative inclination towards future ownership of cryptocurrencies. It is also positively associated with ignorance regarding cryptocurrencies. The first two patterns are likely to signify a positive association between informality and cryptocurrency ownership.

Males are less likely than females to report not having heard about cryptocurrencies, and they are both more likely to own and intend to own in the future, but they are also more likely than females to be negatively disposed towards them. The effects are of larger magnitudes for ownership and prospective future ownership. There is a negative non-linear (concave) relationship between income and negative inclination towards future cryptocurrency ownership. In contrast there is a positive convex relationship between income and ignorance about cryptocurrencies. In addition, younger groups are more likely to own and to intend to own cryptocurrencies, compared to their older counterparts.

The more highly educated are less likely to report not having heard about cryptocurrencies. They are more likely to own cryptocurrency at present. However, they are also more likely to have no intention to own in the future. The self-employed are much more likely to own and intend to own cryptocurrencies compared to students and all remaining labor market groups. Employed individuals are more likely to own and less likely not to intend to own cryptocurrencies, compared to students. They are also more likely to have heard about them. The unemployed, the inactive, and retirees are less likely not to intend to own cryptocurrencies in the future. They are also more likely to not have heard about them, compared to students.

Table 2 shows that more financially literate individuals are significantly less likely to own and more likely to have no intention of owning cryptocurrencies, despite the fact that they are more likely to be aware of them. This confirms the pattern observed in Figure

5, which illustrates that countries with lower financial literacy scores exhibit lower rates of ownership and prospective ownership of cryptocurrencies. In *Table 3*, we examine country variations in the relationship between financial literacy and our four response categories for attitudes to cryptocurrencies. We introduce a set of 15 interaction terms between countries and financial literacy.

[Insert Table 3 about here]

The estimates confirm the robustness of our findings in Table 2, as the effect of financial literacy on cryptocurrency ownership remains negative and statistically significant at the 5% level. Moreover, it remains positive and statistically significant at the 1% level, with respect to the negative inclination to own in the future. It also remains negative and statistically significant at the 1% level when it comes to the probability of having heard of cryptocurrencies before. However, the country interactions also indicate heterogeneity in the effect of financial literacy on cryptocurrency ownership by country. There are positive effects on ownership from the interaction terms between financial literacy and residents of Austria, Germany, Luxembourg, the Netherlands, the UK, the Czech Republic, and Australia. The reference category in this comparative assessment is the interaction term with Belgium, i.e. the country with the lowest ownership rates[34].

4.2 Robustness exercises

In this sub-section, we conduct a number of robustness exercises to confirm the validity of our primary findings, i.e. the negative relationship between financial literacy and cryptocurrency ownership, the positive relationship between financial literacy and the

[34] For completeness, we also present an additional robustness check in the *Appendix Table A6*. Using the multinomial probit specification of Table 2, we replace the 5 education categories with a continuous variable capturing years of education. The continuous years of education variable is computed as follows: Individuals with 'Pre-sixteen education' get assigned with 9 years of education. Individuals with 'A-levels, GNVQ or college' get assigned with 12 years of education. Respondents with 'Higher vocational education or HND' get assigned with 14 years. Then, respondents with 'University (Bachelor)' get assigned with 16 years, and individuals with 'Higher university degree' get assigned with 19 years. Then, we estimate, including a triple interaction term between financial literacy, years of education, and the logarithm of monthly PPP-divided household income per capita. We omit the 3rd order polynomial in income in this specification. The estimates of the Appendix Table A6 confirm the robustness of our findings. This is also the case in models with separate interaction terms between financial literacy and the years of education, and financial literacy and income. These results are also available upon request. Hence, our findings are not driven primarily by education or income.

intention not to own cryptocurrencies in the future, and the negative relationship with lack of awareness of cryptocurrencies.

Our first robustness exercise in *Panel A* of *Table 4* replicates our primary estimation of Table 2, removing the individual weights used to make the sample estimates representative at the country level. In the unweighted estimation, financial literacy decreases the probability of cryptocurrency ownership by 44.9% and the effect is significant at the 5% level. The magnitudes of the effects of financial literacy are very similar to those of Table 2. The financial literate are more likely to have no intention of owning cryptocurrency in the future and the magnitude of the effect is 25.4%. In *Panel B*, we present estimates from unweighted multinomial probit regressions with bootstrapped standard errors, based on 1,000 replications. The exercise stems from the consideration that our financial literacy proxy is derived from an external database, i.e. the S&P 2014 Global Financial Literacy Survey and is matched to the ING Mobile Banking Survey based on gender, age and income categories. Any resulting 'match bias' could affect the standard errors of the multinomial probit regressions. The estimates with bootstrapped standard errors confirm the robustness of our findings. There is a negative effect of financial literacy on cryptocurrency ownership, significant at the 5% level. There is a positive effect of financial literacy on the negative predisposition to own cryptocurrency in the future, significant at the 1% level. Moreover, financial literacy is positively related to awareness, there is a negative effect of financial literacy on not having heard about cryptocurrencies, significant at the 1% level.

[Insert Table 4 about here]

In *Panel C* of Table 4, we present marginal effects and standard errors from bootstrapped multinomial probit regressions, based on 1,000 replications and using sampling weights. The rationale of the exercise is to confirm that our previous estimates are not due to any 'match bias' or inconsistent weighting. The bootstrapped estimates confirm our previous findings, and the effects are very similar, both in terms of significance and magnitude.

In *Panel D* of Table 4, we conduct an additional exercise, aiming to cater to any concerns regarding the large differences in financial literacy that exist between countries. We employ a binary 'High financial literacy' (*hereafter* FLH) indicator, which stems from the computation of percentiles of financial literacy for each country separately. Individuals are in the FLH group if their financial-literacy percentile within their country is greater than 50. If their proxy score belongs to a within-country percentile that is less than or equal to 50, they are in the low financial literacy group (hereafter FLL). Hence, any concerns regarding the results being driven by the higher financial literacy scores in particular countries should be mitigated via this exercise. Indeed, the weighted multinomial probit estimates of Panel D confirm that the 'high financial literacy' group within each country is 15.9% less likely to own cryptocurrencies, i.e. 1.5 percentage points less likely with the predicted probability of ownership being 9.3%. The effect is significant at the 5% level. Moreover, individuals in the 'high financial literacy' group in each country are 9.9% more likely not to intend to own cryptocurrencies in the future, and they are 8.4% less likely not to have heard about them.

In *Panel E* of Table 4, we use a logarithmic financial literacy measure and estimate weighted multinomial probit regressions. The estimates confirm the robustness of the negative effect of financial literacy on cryptocurrency ownership, and the effect becomes significant at the 1% level. Moreover, the positive effect of financial literacy on the negative disposition to own cryptocurrencies in the future remains and is significant at the 1% level. The magnitudes of both effects are similar to our baseline estimates in Table 2. Finally, the negative effect of financial literacy on lack of awareness about cryptocurrencies remains but becomes marginally insignificant at conventional levels.

In *Panels F and G*, we experiment with two alternative financial literacy measures in our weighted multinomial probit regressions. Our alternative measure I is computed as $\mathrm{FL}_{\mathrm{i}}^{1} = \prod \frac{\mathrm{FL}_{\mathrm{gender}}\mathrm{FL}_{\mathrm{age}}\mathrm{FL}_{\mathrm{income}}}{\mathrm{FL}_{\mathrm{country}}^{2}}$, i.e. as a multiplication of the three financial literacy scores by gender, age and income in each country, and divided with the squared country-level financial literacy score. Then, our alternative measure II removes any country level differences in financial literacy by dividing the multiplicative product of the three scores by the cubed country-level score, i.e. $\mathrm{FL}_{\mathrm{i}}^{2} = \prod \frac{\mathrm{FL}_{\mathrm{gender}}\mathrm{FL}_{\mathrm{age}}\mathrm{FL}_{\mathrm{income}}}{\mathrm{FL}_{\mathrm{country}}^{3}}$. Hence, once more,

country-level differences are omitted, and our alternative measure II becomes a ranking of the probability for an individual in each country to know at least 3 out of 4 financial-literacy concepts. The effect of an increase of standard deviation in FL^1 (from 0.5304 to 0.7084) on the probability of cryptocurrency ownership is -15.7% and significant at the 5% level. It is 9.87% on having no intention to own cryptocurrencies in the future, and significant at the 1% level. In addition, the effect is in the magnitude of -8.39% on the probability of not having heard about cryptocurrencies. Then, the effect of an increase of one standard deviation in FL^2 (from 1.0527 to 1.2624) on the probability of cryptocurrency ownership is -11.1% and significant at the 1% level. It is 4.99% on the intention not to own cryptocurrencies in the future, and significant at the 1% level. In addition, the effect is in the magnitude of -2.5% on the probability of not having heard about cryptocurrencies, and marginally insignificant.

Finally, *Panels H and I* present weighted multinomial probit estimates for the sub-samples of males and females. The results are robust for the male sub-sample and mostly robust for the female sub-sample. The effect of an increase of one standard deviation (0.1495) in financial literacy on the probability of cryptocurrency ownership is in the magnitude of -46.9% for males. The effect is of a similar magnitude for females, but the marginal effect becomes insignificant at conventional levels for the female sub-sample. This is likely to be due to the fact that both financial literacy and cryptocurrency ownership are lower amongst the female sub-sample. The remaining effects are robust and of higher magnitudes for the male sub-sample, compared to the female sub-sample. Higher financial literacy is positively related to not intending to own cryptocurrencies in the future. The effect is in the magnitude of 30.6% for males and 22.5% for females. Finally, it is confirmed that higher financial literacy is negatively related to lack of awareness about cryptocurrencies. The effect is in the magnitude of -16% for females and marginally insignificant – but of high magnitude – for males.

In the bottom two panels of Table 4, we also estimate regressions catering to two additional considerations that are worth a robustness exercise. In *Panel J*, we drop Turkey and Romania from our sample, as these are the countries with particularly high rates of cryptocurrency ownership, and it is worth examining if these are the primary drivers of our main result so far. It is likely that respondents in these countries are more likely to hold

cryptocurrencies as assets rather than currencies. The estimates there show that the negative effect of financial literacy on cryptocurrency ownership is significant at the 10% level and of a magnitude of -21.25%. Hence, although the magnitude of the effect is lower, the negative effect is still robust. The positive effect of financial literacy on the intension not to own cryptocurrency in the future remains significant at the 1% level and is of a 15.1% magnitude. The financially literate in the remaining sample are -16.2% less likely not to have heard of cryptocurrencies. Finally, in *Panel I*, we include those aged 66-75, who were dropped in our main sample, for reasons of comparability with the OECD survey and in order to keep the working age population. All effects previously estimated are robust and of high magnitudes, although somewhat smaller than those of Table 2.

4.3 Selection bias

Another major concern regarding the robustness of our primary findings could stem from the structure of the categorical responses in our variable for attitudes to cryptocurrencies. These also include the individuals who have never heard of cryptocurrencies before, as the fourth response category. In *Table 5*, we implement a two-stage methodology, presenting marginal effects from a multinomial probit model with three categories and a 1st stage selection equation[35]. The estimates are weighted, and robust standard errors are shown in brackets. At the first stage, we estimate the probability of having heard about cryptocurrencies, and then, at our 2nd stage, we distinguish between owning, expecting to own in the future, and not expecting to own in the future. As an exclusion restriction in our 1st stage selection equation, we include an additional variable capturing ignorance regarding online payment methods. The wording of the original question was: "*Would you be willing to use any of these providers to pay for goods and services 6 months from now, either in store or online? Please select all the payment methods you would use*" Multiple responses were allowed, involving (i) 'In store'; (ii) 'Online'; (iii) 'I would never use this', and; (iv) 'I don't know this service'. The exclusion restriction captures the lack of awareness of the following main providers, as options to pay for goods and services in the near future, either in store or online: ApplePay,

[35] The multinomial probit model with a selection equation is estimated using the cmp routine in Stata. The Geweke-Hajivassiliou-Keane algorithm is used for simulating the cumulative multivariate normal distribution (Cappellari and Jenkins 2003; 2005; Gates 2006).

Google/AndroidPay, PayPal, Facebook, AmazonPay (Amazon account), own bank's app. It is a continuous index, ranging from 0 to 1 and stemming from the division of the summation of the 6 dummy variables on unawareness regarding each of the 6 providers – i.e. responses stating that 'I don't know this service' – divided by 6. The additional summary statistics in the *Appendix Table A4* indicate the average score on lack of awareness of online payment providers is 0.282, and that score is higher among individuals with low financial literacy.

[Insert Table 5 about here]

In Table 5, we present our estimates from the multinomial probit model with selection. The estimates confirm the robustness of the findings in our baseline model, which did not account for selection. Greater familiarity with online payment methods is positively related to having heard of cryptocurrencies. So is financial literacy in our selection equation, but the effect is of a smaller magnitude, compared to our model in Table 2. An increase in financial literacy by one standard deviation increases the probability of having heard of cryptocurrencies by 10.17% and the effect is significant at the 1% level. At the 2nd stage estimates, an increase in financial literacy by one standard deviation (i.e. by 0.1470 from the average of 0.5133) reduces the probability of cryptocurrency ownership by 23.23%. The effect is significant at the 1% level. The one standard deviation increase in financial literacy increases the probability of not intending to own in the future by 7.8%. That effect is significant at the 5% level. Hence, the estimates from the weighted multinomial probit model with selection confirm and further reinforce the robustness of our baseline findings from Table 2.

4.4 Endogeneity

Another major concern regarding the validity of our estimates could stem from considerations regarding omitted variables confounding our estimates. For instance, one might think that the more financially literate are better able to access conventional assets such as stocks and shares or dollar-denominated bank accounts. Lower levels of financial literacy may be correlated with a lack of access to financial services (Cole, *et al.*, 2011), making cryptocurrencies more attractive. An alternative source of endogeneity could

involve any measurement error arising from the fact that our financial literacy variable is a proxy from an external data source. If actual financial literacy is higher than the proxy, our estimates would be biased downwards and that would be less of a concern. However, if actual financial literacy is lower, then our estimates could be biased upwards. In order to cater to these concerns, we estimate instrumental-variable (IV) multinomial probit regressions. Our first stage regression estimates financial literacy using an instrument from an additional question in the ING survey. Respondents are asked about their motivation for using mobile banking. One of the response options involved using mobile banking for efficient personal financial management. Intuitively, individuals who give this response can be thought of as more financially literate, and the variable can be thought to be unrelated to the unobserved determinants of attitudes to cryptocurrencies. In the bottom of *Table 6*, the tests of our instrumental variable – which stem from a linear probability model of cryptocurrency ownership (available upon request) – confirm the statistical validity of the instrument chosen.

[Insert Table 6 about here]

The IV multinomial probit regressions confirm the robustness of our findings. The effect of financial literacy on the probability of owning cryptocurrencies is -41.27% and significant at the 1% level. The effect of the probability of not having heard of cryptocurrencies is -37.1% and significant at the 1% level. The one finding that is different is that there is a positive and significant effect of financial literacy on both the positive and the negative inclination to own cryptocurrencies in the future. The effect on the positive inclination is 17.86% and that on the negative inclination is 29.3%. Noting that the effect on the negative inclination is higher, the IV estimates in Table 6 confirm the robustness of our previous estimates to endogeneity concerns.

4.5 External validity

The biggest concern that might remain, despite the battery of previous robustness exercises, stems from the fact that our financial literacy proxy is derived from an external data source, i.e. from the merging of the S&P financial literacy statistics to the ING database. We have already shown bootstrapped estimates and IV regressions catering to

relevant considerations. In this sub-section, we examine the external validity of our results using a completely different sample. Ideally, such a sample incorporates micro-data on financial literacy questions and attitudes towards cryptocurrencies. The OECD 2019 Consumer Insights Survey on Cryptoassets inquired about both, including 2 questions on similar concepts to the S&P survey, capturing the understanding of respondents on financial risk and inflation. Hence, in the new sample, our financial literacy variable is calculated as the number of correct response in the following two questions: "*An investment with a high return is likely to be high risk*", and "*High inflation means that the cost of living is increasing rapidly*". The response categories involved "True", "False", and "I don't know". Noting that this is a sample of retail investors and consumers in 3 countries, who we expect to be more financially literate, 69.9% of respondents answered correctly to both questions, with the figures being 82% on the risk question and 80.3% on the inflation question.

In *Table 7*, we present our multinomial probit estimates for attitudes to cryptocurrencies among retail investors in the OECD survey. It is worth noting that the 4 response categories have two different categories, compared to the ING survey, due to the different formatting of the questions. Specifically, the four response categories here are: (i) Currently owning; (ii) Previously held; (iii) Never held; and, (iv) Never heard of. Marginal effects and robust standard errors are presented in brackets. The specification includes a very rich set of control variables, similar to the specifications using the ING survey. Notably, there are questions on digital literacy, risk tolerance, and present orientation, which are used. These variables come from the following questions: "To what extent do the following statements describe you?". "*I am prepared to risk some of my own money when saving or making an investment*" (risk tolerance); "*I tend to live for today and let tomorrow take care of itself*" (present orientation); "*I enjoy learning about new ways of using technology such as smart phones*" (digital literacy). The response categories are: 1 (*Does not describe me very well*); 2 (*Describes me somewhat*); 3 (*Describes me very well*). Apart from these controls, we include control variables for gender (male). Age (5 categories), a 3rd order polynomial in PPP-divided household income, home ownership, education (5 categories), occupation (8 categories), and 3 country dummy variables.

[Insert Table 7 about here]

The results in Table 7 show a positive effect of financial literacy on the probability of having never held cryptocurrencies. The effect is in the magnitude of 10.83% and significant at the 1% level. The financially literate are also found to be 19.7% less likely to have never heard about cryptocurrencies. These results seem to largely confirm the external validity of our inferences from the ING sample when using the OECD sample. However, it is important to note that since the financial literacy variable in the OECD dataset stems from questions asked of respondents, the potential concern regarding endogeneity from omitted variables might still hold for this sample. Measurement error in the financial literacy variable should be less of a concern in this instance.

Hence, in *Table 8*, we present estimates from IV multinomial probit regressions for the OECD sample. Our instrument stems from reactions to the following statement: "*I prefer to use financial companies that have a strong ethical stance*". Again, the response categories ranges involved the following 3 categories: 1 (*Does not describe very well*); 2 (*Describes me somewhat*); 3 (*Describes me very well*). Intuitively, one can think of investors interested in ethical finance to be more sophisticated and/or informed. That variable seems unlikely to be correlated with the unobserved determinants of attitudes to cryptocurrencies. The statistics based on a linear probability model for cryptocurrency ownership (available upon request), shown at the bottom of Table 8, confirm the validity of our instrument. Moreover, the estimates of Table 8 show that financially literate investors are 40.6% less likely to currently hold cryptocurrencies. The magnitude of the effect is very similar to that in our previous ING sample. Moreover, they are 70.5% more likely not to have held cryptocurrencies before, and much less likely never to have heard about cryptocurrencies. Thus, in Tables 7 and 8 the external validity of our results from the ING sample with the financial literacy proxy are confirmed in the OECD sample, which involved own questions on financial literacy to the respondents.

[Insert Table 8 about here]

5. Moderating factors

In our estimates, we have established that financial literacy is positively related to awareness of cryptocurrencies, negatively related to current ownership of any cryptocurrencies, and positively related to a negative inclination towards future ownership. In this section, we try to identify the mechanics of these relationships in the ING sample, by presenting multinomial probit models, in the context of equation 2. We use the same specification as in Table 2 and add interaction terms between financial literacy and some of the key candidate explanations of the relationships we have identified.

5.1 Digital literacy, preference for cash, age, and financial advice

In columns A_1-A_4 of *Table 9*, we present estimates in which we interact financial literacy with the digital literacy variable. The effects of the interaction terms between financial literacy and digital literacy are small and insignificant at any conventional levels. Moreover, the sign, the magnitude, and the significance of the marginal effects of financial literacy on our 4 categories for attitudes to cryptocurrencies remain largely unaffected, and similar to those presented in Table 2.

[Insert Table 9 about here]

In columns B_1-B_4 of Table 9, we present estimates in which we interact financial literacy with the preference for cash variable. The results confirm that that a higher preference for cash, and potentially informal conduct, does not explain the negative relationship between financial literacy and cryptocurrency ownership. There is a positive effect of the interaction term between financial literacy and preference for cash on the intention to own in the future. Moreover, there is a negative effect of the interaction term on no intention to own in the future. There is also an insignificant marginal effect of the interaction term on the probability of current ownership. These might suggest that our preference for cash variable could be depicting favorable attitudes towards informal practices, and those favoring such practices might be both more financially literate and in favor of cryptocurrency ownership. However, both the magnitudes and the significance of the effects of financial literacy remain. Hence, neither higher financial literacy among the more digitally literate nor lower financial literacy among those favoring informal

practices[36] explain why financial literacy is negatively related to cryptocurrency ownership and positively related to the intention not to own cryptocurrency in the future.

In *Table 10*, we present marginal effects from multinomial probit estimates, in which we interact financial literacy with age categories. In the specification of columns A_1-A_4, we replace our age dummies with a single dichotomous variable, taking the value one for individuals younger than 45. We also include an interaction term between financial literacy and younger age. Alternatively, the effect could be driven by a non-linear relationship between financial literacy and age, and by older adults being less willing to engage with cryptocurrencies. The correlation matrix of the *Appendix Table A5* confirms a positive weighted pairwise correlation between financial literacy and the continuous age variable. Hence, in the specification of columns B_1-B_4, we replace age with dummy variables for each of our five age groups, namely individuals aged 18-25, 26-35, 36-45, 46-55, and 56-65 (reference category). Moreover, we include five interaction terms between financial literacy and the age dummies. Both sets of estimates confirm the robustness of our findings. Financially literate young adults are more likely to own and intend to own cryptocurrencies, and less likely not to intend to own and not to have heard about cryptocurrencies. However, financial literacy remains negatively related to current ownership and the effect is significant at the 5% level. It remains positively related to no intention to own in the future and negatively related to unawareness about cryptocurrencies. Hence, the higher cryptocurrency ownership and positive disposition towards cryptocurrencies among the more financially literate younger sub-sample is not the primary driver of the effect of financial literacy.

[Insert Table 10 about here]

In *Table 11*, we test one additional explanation for the established relationship between financial literacy and attitudes to cryptocurrencies, for the sub-sample of the 8.734 individuals who have heard of cryptocurrencies before. In the estimates of columns A_1-A_3, we depart from the baseline specification and adhere five dummy variables for the sources

[36] The higher digital literacy and the lower preference for cash by the more financial literate is indicated in the weighted summary statistics by high and low financial literacy group, presented in the *Appendix Table A5*. The is also the case for the higher financial literacy among the younger sub-sample, i.e. those younger than 45.

of financial advice. Then, in columns B_1-B_3, we also adhere the respective interaction terms between financial literacy and different sources of financial advice on investment and cryptocurrencies[37].

[Insert Table 11 about here]

The estimates in columns A_1-A_3 of Table 11 indicate that more sophisticated types of financial advice about cryptocurrencies exert a higher impact on the probability of ownership. Hence, individuals seeking tailored advice via computer programs and algorithms (i.e. robo-advice), as well as advice from the internet and specialist websites are more likely to own cryptocurrencies, compared to those not seeking any advice on cryptocurrencies. This is also the case for individuals seeking advice from friends and family, and from an independent financial or bank advisor. The effect on cryptocurrency ownership of advice from an independent financial or bank advisor is of a smaller magnitude, compared to the effects of the remaining sources of advice. The effects of financial literacy on attitudes to cryptocurrencies remain unaffected by the inclusion of the related financial advice variables in columns A_1-A_3, in all terms of sign, significance and magnitude. The effects of financial literacy become even larger in size, and the negative effect of financial literacy on current ownership becomes significant at the 1% level.

In columns B_1-B_3, we also include interaction terms between financial literacy and the sources of financial advice on cryptocurrencies. Some interesting patterns prevail with respect to the effects of the interaction terms. Financially literate individuals seeking advice from the internet and specialist websites are less likely to own cryptocurrencies. Moreover, financially literate individuals seeking financial advice from friends and family are more likely to intend to own and less likely to have no intention to own in the future. This could be indicative of either a selection of distinctive information sources by the more financially literate or of peer effects stemming from imitation of friends and family. However, once

[37] We merge the two final categories in one variable − namely (5) I (would) never invest money in cryptocurrency and (6) I don't know − into one category depicting not seeking specific financial advice regarding cryptocurrencies. It is worth noting that our estimates remain unaffected by the merging and that, when used separately, the two variables (and their interaction terms with financial literacy) have almost identical effects on attitudes to cryptocurrencies. These results are available upon request.

more, the effects of the financial literacy variable remain robust and of similar magnitudes to those of Table 2.

5.2 The role of perceptions of reward and risk

In the previous sub-section, we established that none of the current proposed moderators so far − namely digital literacy, preference for cash/informality, young age, and financial advice – can fully explain the established relationships between financial literacy and attitudes to cryptocurrencies. In this sub-section, we aim to test a fifth moderator, which is compatible with our expectation regarding the role of financial literacy on financial decision making. One would expect the financially literate to be in a better position to evaluate financial risk, and the related relationship between risk and reward. In order to examine this prediction, we interact financial literacy with proxies for the likely reward and risk from engagement with the cryptocurrency market.

In *Table 12*, we introduce a set of three cardinal variables capturing the reward prospects of holding cryptocurrencies. We estimate our multinomial probit specification for individuals who have heard of cryptocurrencies before and introduce the three variables, ranging from 1 to 5 (columns A_1-A_3). For each of the three variables, higher values indicate that respondents are more likely to agree that cryptocurrencies are the future of spending online (*consumption motive*), the future of investment as a store of value (*investment motive*), and that the value of cryptocurrencies will increase in the next 12 months (*speculation motive*), respectively. In columns B_1-B_3, we also introduce interaction terms between financial literacy and each of the three reward perception variables. The estimates in columns A_1-A_3 indicate that all three reward perceptions regarding the prospects of cryptocurrencies are positively related to ownership and prospective future ownership. They are also negatively related to not intending to own cryptocurrencies in the future. The inspection of the coefficients suggests that the investment motive has a smaller marginal effect on current ownership, compared to the consumption or speculation motive. Moreover, the speculation motive has a smaller marginal effect on the positive disposition to future ownership, compared to the consumption and investment motive. Finally, the consumption motive exerts a higher negative impact than the investment motive. Then, the

investment motive exerts a higher impact than the speculation motive on the negative disposition to future ownership.

[Insert Table 12 about here]

The estimates in columns B_1-B_3 indicate that the interaction terms between financial literacy and the three reward perceptions on cryptocurrencies exert insignificant impacts on all three attitudes to cryptocurrencies. The effect of financial literacy becomes significant at the 5% level and has a similar magnitude to our baseline model in Table 2. The positive effect on having no intention to own cryptocurrencies in the future is significant at the 5% level. Hence, different perceptions regarding the prospective rewards of engagement in cryptocurrencies by the financially literate are not the main moderating factor for the effects of financial literacy on attitudes to cryptocurrencies.

In *Table 13*, we introduce a set of six cardinal variables capturing the perceptions of the risk involved in investment in cryptocurrencies compared to six alternative assets, namely cash, bonds, stocks, real estate/property funds, gold, and investment in one's own business. We estimate our multinomial probit specification for individuals who have heard of cryptocurrencies before and introduce the six variables, which range between 1 and 5 (columns A_1-A_3). For each of the six variables, higher values indicate that respondents believe that holding cryptocurrencies entails more risk than holding each of the six alternative assets, respectively. In columns B_1-B_3, we also introduce interaction terms between financial literacy and each of the six risk perception variables. The estimates in columns A_1-A_3 indicate that respondents who believe that cryptocurrencies are riskier than cash, bonds, stocks, and investment in own business are less likely to own cryptocurrencies. Believing that cryptocurrencies are riskier than cash, bonds, stocks and entrepreneurship exerts negative impacts on current ownership. Moreover, believing that cryptocurrencies are riskier than cash, stocks and entrepreneurship exerts negative impacts on and the intention to own in the future. These same variables of comparative assessment of risk exert positive impacts on the intention not to own in the future. Believing that cryptocurrencies are riskier than gold exerts a positive impact on the intension to own in the future.

[Insert Table 13 about here]

The estimates in columns B_1-B_3, in which interaction terms between financial literacy and the six risk perceptions are introduced in the specification, reveal some interesting patterns. Firstly, there are significant negative interaction effects on the probability of owning cryptocurrency. These are the effects of the interaction terms between financial literacy and the perception that cryptocurrencies are riskier than real estate/property funds, and between financial literacy and the perception that they are riskier than gold. There is a positive effect on the probability of owning cryptocurrencies by the interaction term between financial literacy and the perception that cryptocurrencies are riskier than an investment in one's own business and in stocks. Hence, the financially literate individuals who believe that cryptocurrencies are riskier than real estate and gold are less likely to own cryptocurrencies at present. This is likely to indicate a greater ability by the more financially literate to assess the objective risk of cryptocurrencies, in comparison to these alternative assets which entail the highest risk among the options offered. Financially literate respondents who believe that cryptocurrencies entail more risk than stocks and entrepreneurship, are more likely to own cryptocurrencies. The latter is a rather odd finding, which could be driven by the highest cryptocurrency ownership among the self-employed or by the fact that entrepreneurship might entail an innate ability (Baumol, 1990) and is not really seen as an alternative asset by the non-entrepreneurial population. Secondly, in the specification with the interaction terms of columns B_1-B_3, the effect of financial literacy on attitudes to cryptocurrencies becomes lower in terms of magnitude and it becomes insignificant in all columns. Hence, it appears that the negative effect of financial literacy on cryptocurrency ownership and the positive effect on the intention not to own cryptocurrency in the future are likely to be driven by the different assessments of the risk of cryptocurrencies, compared to alternative assets, by the more financially literate. This is in accordance with our prior expectation that the ability to assess financial risk is a key financial literacy skill.

In *Table 14*, we introduce both sets of reward and risk perceptions regarding cryptocurrencies (columns A_1-A_3), and then, the interaction terms between financial literacy and the 3 reward variables and the 6 risk variables (columns B_1-B_3). The estimation results in columns A_1-A_3 are identical to those of the respective columns of Table 12 and 13. The effects of financial literacy on attitudes to cryptocurrencies remains significant and

similar to those of our baseline specification in Table 2. In the models with the nine interaction terms in columns B_1-B_3, the magnitude of the effect of financial literacy diminishes to less than half and becomes insignificant at conventional levels. This confirms and further reinforces the findings of the previous Table 13. After all, the ability to understand financial risk should correlate with understanding financial reward, as well as an understanding of the relationship between financial risk and reward.

[Insert Table 14 about here]

In *Table 15*, we introduce a set of variables for perceptions of reward and risk, which are continuous transformations of the respective sets of variables used in the previous tables. Specifically, in columns A_1-A_3, we introduce a reward perception variable, which stems from the summation of the 3 reward variables, divided by 15, i.e. $Reward\ perception = \sum_{i=1}^{3} \frac{Reward_i}{15}$. The risk perception variable is the summation of the 6 risk variables, divided by 30, i.e. $Risk\ perception = \sum_{i=1}^{6} \frac{Risk_i}{30}$. Then, in columns B_1-B_3, we also introduce two interaction terms, one between financial literacy and the continuous reward variable, and another between financial literacy and the continuous risk variable. The results in columns A_1-A_3 confirm that the reward perception exerts a large positive impact on cryptocurrency ownership and prospective ownership in the future. It exerts a large negative impact on the intention not to own cryptocurrency in the future. The risk perception variable exerts a smaller negative impact on the probability of cryptocurrency ownership. It is significant at the 10% level. The effects of financial literacy remain significant and of magnitudes similar to those of our baseline specification in Table 2.

[Insert Table 15 about here]

The estimates in columns B_1-B_3 produce a negative interaction term between financial literacy and the cryptocurrency risk perception on the probability of owning cryptocurrencies. The effect of the interaction term is large in magnitude and the effect of financial literacy diminishes both in size and significance. Hence, it is confirmed that the negative effect of financial literacy on cryptocurrency ownership is driven by a different perception of risk regarding cryptocurrencies by the more financially literate, compared to

less financially literate individuals[38]. All main financial literacy effects on attitudes to cryptocurrencies diminish, both in terms of magnitude and significance, in the specification with the interaction terms between financial literacy, reward and risk.

5.3 Validation: Financial-literacy constituents and intertemporal preferences

The inquiry into the mechanics of the relationship between financial literacy and attitudes to cryptocurrencies suggests that the financially literate have an enhanced ability to evaluate the relative risk of owning cryptocurrencies over alternative assets and other types of investment activity. In this section, we conduct two sets of exercises, aiming to validate this conjecture.

In *Table 16*, we estimate a multinomial probit regression for the full sample, introducing four new variables which correspond to the four distinct financial-literacy constituent concepts, namely the understanding of financial risk, the score on understanding inflation, the score on understanding simple interest (numeracy), and the score on understanding interest compounding. In this specification, we omit the country fixed effects, to avoid multicollinearity with our four country-level scores. The individual financial-literacy constituent variables are computed as $FL_{constituent}^{individual} = \prod \frac{FL_{constituent}^{country} FL_{gender}^{matched} FL_{matcehd}^{matched} FL_{income}^{matched}}{\mathrm{FL}_{\mathrm{country}}^{4}}$, where $FL_{constituent}^{country}$ refers to the country scores in each of the four distinctive financial-literacy concepts in the S&P 2014 Global Financial Literacy Survey and $\mathrm{FL}_{\mathrm{country}}^{4}$ refers to the overall country-level score on financial literacy, raised to the power of four. This exercise creates four individual level variables in the merged dataset, which remove country level differences in overall financial literacy.

[Insert Table 16 about here]

[38] The weighted pairwise correlation matrix in the Appendix Table A5 has already indicated a positive correlation between financial literacy and the perception about the risk of cryptocurrencies, and a bigger negative correlation with the perception about the reward from cryptocurrencies. This is also confirmed in the mean differences between the FLH and the FLL groups in the Appendix Table A4.

The estimates in Table 16 show that understanding financial risk is negatively associated with cryptocurrency ownership. It is also negatively associated with the intention to own in the future and positively associated with not having heard of cryptocurrencies. Among the basic four financial-literacy components, understanding financial risk is the one variable that exerts a significant negative impact on any favorable attitudes to cryptocurrencies. In contract, understanding interest compounding seems to be positively associated with cryptocurrency ownership. Understanding compounding exerts negative effects on both the positive and the negative inclination towards future ownership. Overall, the results of this exercise are in accordance with the interpretation that understanding financial risk, i.e. a key financial literacy skill, is negatively related to cryptocurrency ownership and the inclination in favor of future ownership. Finally, there is a negative effect from understanding inflation and a positive effect from understanding interest rates on not intending to own cryptocurrencies in the future.

In *Table 17*, we conduct one final exercise aiming to test the validity of our proposed moderator in a broader context. If the financially literate are negatively disposed towards cryptocurrencies due to being in a better position to evaluate the financial risk entailed in their ownership compared to other investment alternatives, does this mean that the more financially-literate present-biased individuals will be in a better position to avoid any innate inclination towards high-risk investment, such as that in cryptocurrencies? To evaluate this question, we use a risk tolerance proxy enabled by the inflectional FTR variable and present multinomial probit estimates, in which we introduce an interaction term between financial literacy and the inflectional FTR. The results of Table 17 show that inflectional FTR exerts a large positive impact on cryptocurrency ownership. The interaction term between financial literacy and inflectional FTR exerts an even larger negative impact on the probability of owning cryptocurrencies. Moreover, the effect of financial literacy on cryptocurrency ownership in column A_1 diminishes in magnitude and significance at conventional levels. In a similar spirit, although the more present biased are less likely to report that they do not intend to own cryptocurrencies in the future, those who are both financially literate and live in countries with predispositions towards present bias are more likely than others to have no intention to own. Evidently, greater financial literacy skills

among individuals who may be more prone to risky behaviour due to present bias might help prevent some of the innate urges to rush into riskier investment decisions.

[Insert Table 17 about here]

6. Concluding remarks

This study examines the significant role of financial literacy in the formation of attitudes to cryptocurrency ownership globally. We show that financial literacy exerts a statitically significant negative impact on the probability of owning cryptocurrency. Financially literate individuals are also more likely to have no intention of owning cryptocurrencies in the future. Overall, they are more likely to have heard about cryptocurrencies and be aware of them. Our analysis also shows that the size of these effects is economically important and robust in different specifications, when using different financial literacy definitions, and when including a rich set of control variables. We also show our results are robust when using a sample selection model, with awareness about cryptocurrencies at the first stage. They are robust to an IV model, for endogeneity due to measurement error or omitted variable, which may confound the estimates of financial literacy. Moreover, we document the external validity of our financial literacy proxy and the robustness of our findings when using a different sample of retail investors from 3 Asian countries.

Examining the moderators of the established relationships, we find that the effect of financial literacy remains unaltered in models with interaction terms between financial literacy and digital literacy, preference for cash/informality, age, and financial advice, *inter alia*. The one moderator that explains the relationship between financial literacy and attitudes to cryptocurrencies is perception of the risk that cryptocurrencies entail, in comparison to alternative assets. In models with interaction terms between financial literacy and risk perception, significant interaction effects are found, and the effect of the financial literacy variable diminishes in size and significance. This conjecture is confirmed by the greater negative impact of the financial-risk constituent of the financial literacy measure on ownership and on the intention to own cryptocurrencies in the future. It is also confirmed by a large negative effect on ownership by the interaction term between financial

literacy and intertemporal preferences towards a present bias, as approximated by the inflectional FTR of the individual's language. We interpret our results as indicative that greater financial literacy skills among individuals whose linguistic background is associated with present-biased beliefs might mitigate some of the temptation to engage in high-risk investment decisions.

The importance of financial literacy in modern economies cannot be overemphasized. Financial literacy has a clear public good element to it, as it has been conceptually linked to macroeconomic financial stability. Lusardi et al. (2017) assess that differences in financial knowledge formed early in life can explain some 35-40% of retirement wealth inequality in the United States. We find our findings are complementary to this recent insight, by suggesting that financial literacy is negatively associated with investment decisions towards highly volatile assets such as cryptocurrencies. More recently, Foley et al. (2019) present evidence suggesting that some 46% of bitcoin transactions are related to illegal activity, and some $10 billion in assets are managed by dedicated 'cryptofunds' (Rooney and Levy, 2018). Such activity is less likely to be captured in surveys. Our survey inquiry comes is a timely complement to that recent evidence. It is conducive to shedding light on the demand side of cryptocurrencies and suggests that apart from illegal and exclusive activity, a large part of the cryptocurrency market comprises of unsophisticated investors with lower financial literacy skills. These investors are likely to overestimate the reward prospects in cryptocurrencies and underestimate the risk involved in such investments. For any new financial instrument or alternative asset to become established, less volatile and less likely to be subject to manipulation, the market needs to be dominated by sophisticated investors and formal/legitimate uses. Our findings and the recent evidence regarding the uses of bitcoin suggest that the current state of the market for cryptocurrencies is far from that. Hence, it is entirely appropriate that policy makers in central banks and other regulatory bodies should be concerned. Efforts are needed to increase the public understanding of the supply side and enable an inquiry into the motivations and incentives of market participants in the demand side of cryptocurrencies. This will increase awareness and transparency, and might ultimately make this market less volatile, more predictable and less subject to any manipulation.

We contribute to the financial economics literature by presenting novel evidence suggesting that the financially literate are less likely to invest in the cryptocurrency market, due to a more informed perception regarding the risks involved compared to alternative assets. With most economic models relying on the premise of rational agents, any cognitive skills that are likely to induce such behavior, such as financial literacy in our setting, are likely to be conducive to the validity and predictive power of these economic models. Such models and predictions are essential for the highly volatile and largely unpredictable cryptocurrency market. We contribute to the literature on financial education and education economics. Our findings may potentially be considered when designing financial education related to FinTech and investor participation, by including elements on digital finance with the objective of providing a broader view on the subject. They are also relevant to regulators and supervisors with responsibility for financial consumer protection and market stability.

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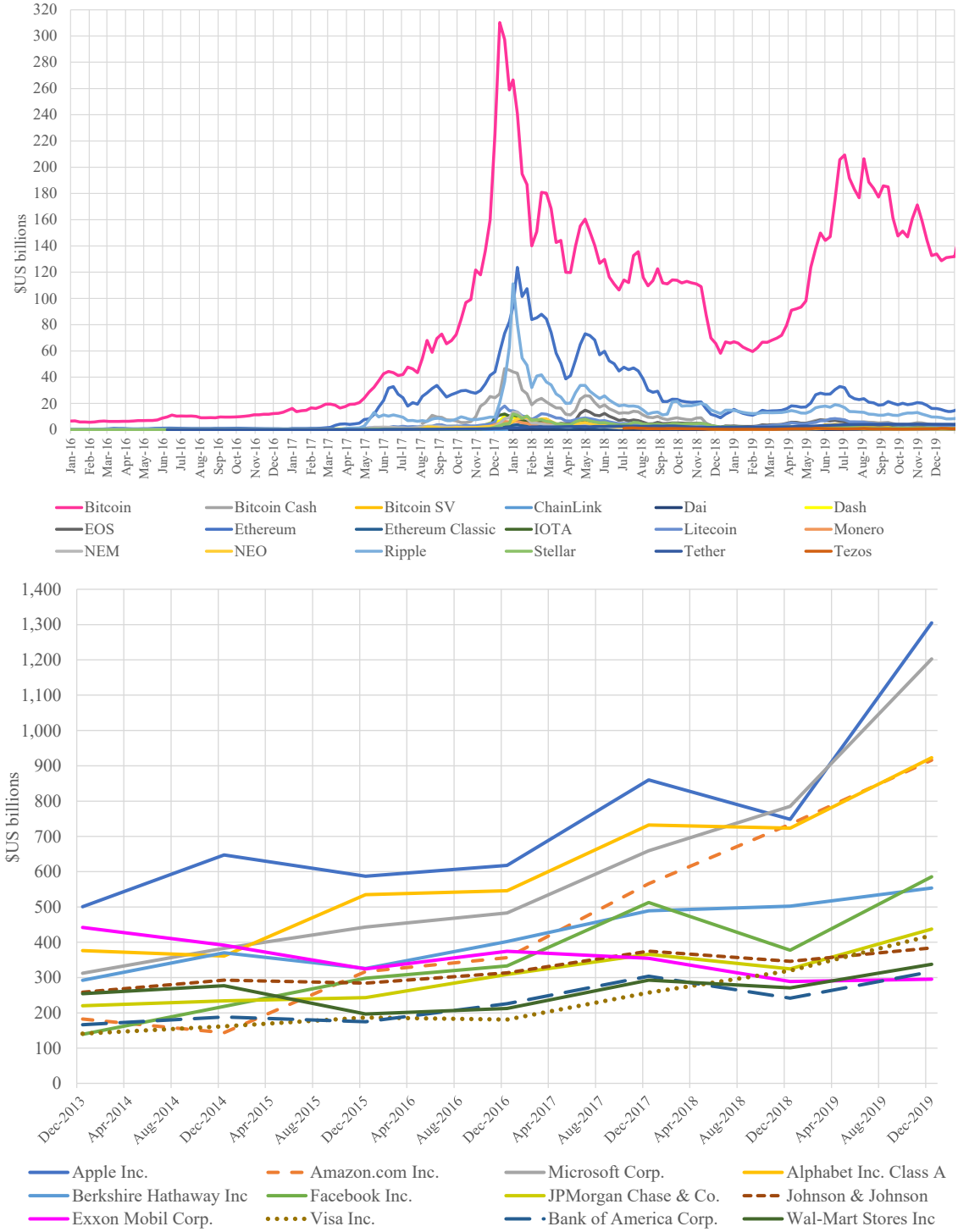


Figure 1

Market capitalisation among cryptocurrencies and the largest S&P companies

This figure presents the ten cryptocurrencies with the highest market capitalization for the period 2016-2019, namely Bitcoin, Bitcoin Cash, Bitcoin SV, ChainLink, Dai, Dash, EOS, Ethereum, Ethereum Classic, IOTA, Litecoin, Monero, NEM, NEO, Ripple, Stellar, Tether and Tezos. The data on market capitalization among cryptocurrencies is from: https://www.cryptocurrencychart.com/top/25. The data on the largest 12 S&P100 companies is from Bloomberg and http://siblisresearch.com/data/market-caps-sp-100-us/

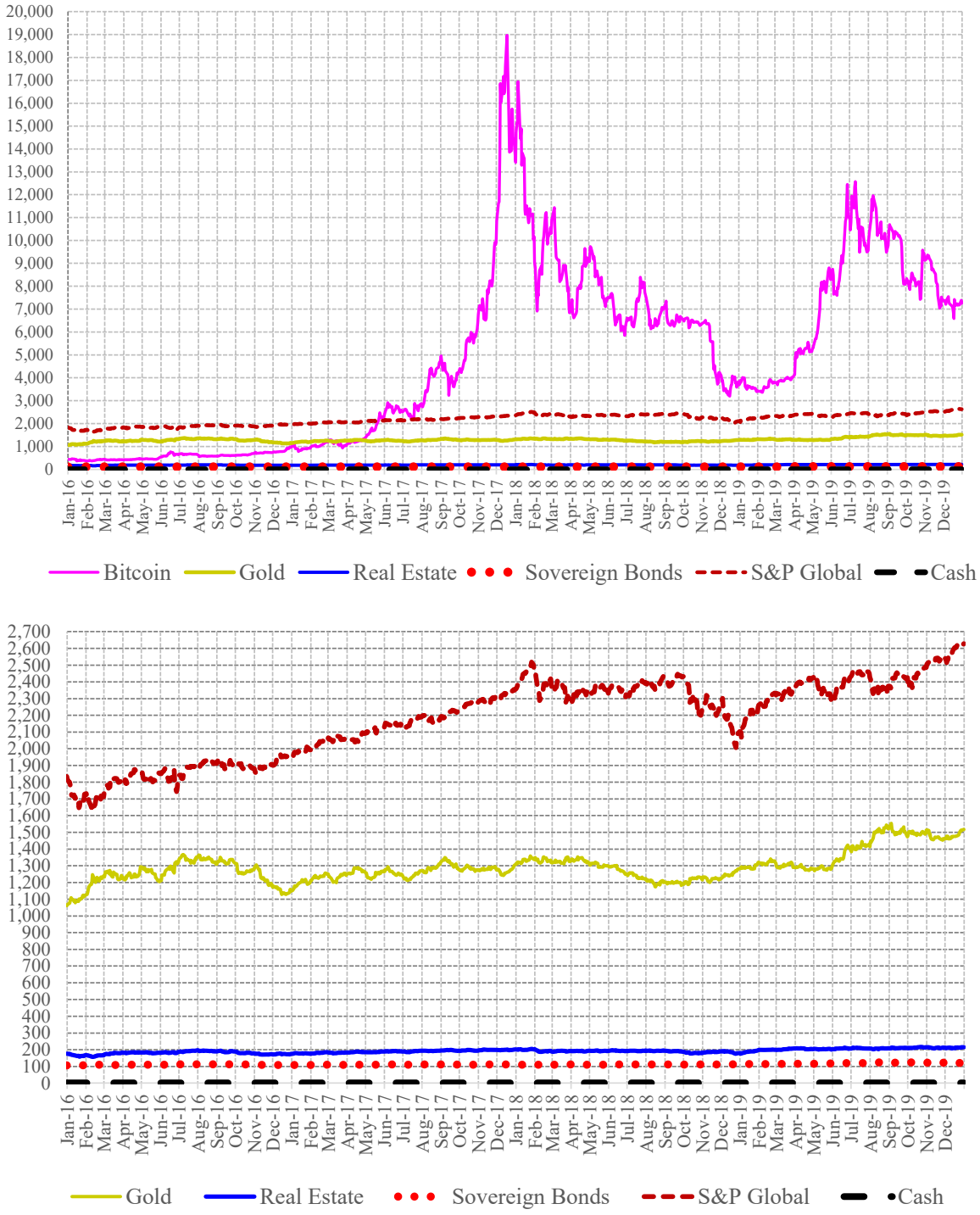


Figure 2

The price development of bitcoin and other asset classes between 2016-2019 ($US)

This figure presents the daily price development of bitcoin for the period between 2016-2019, compared to other asset classes, namely gold, real estate, sovereign bonds, equities, and cash. The data is from Bloomberg for the period 1.1.2016 – 31.12.2019. The price of the US T-Bill is used as a cash proxy. The Bloomberg Barclays GDP Core Developed Govt AA- or Above TR Hedged USD is used for sovereign bonds. The MSCI ACWI REAL ESTATE USD price index is used for real estate. The SP GLOBAL 1200 total return index is used for equities. The GOLD SPOT XAU in USD is used for gold. Bitcoin's daily price in USD stems from Coindesk.

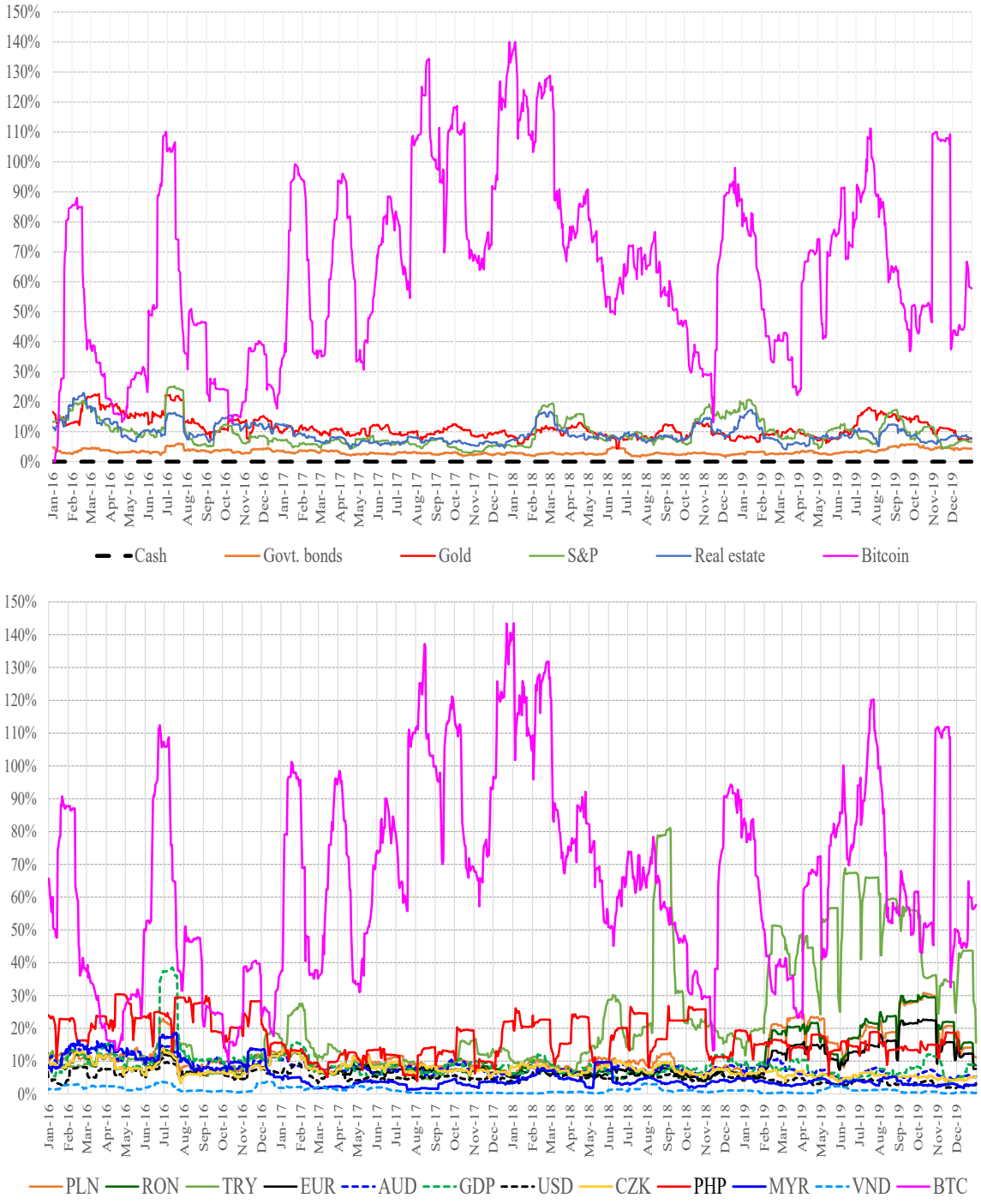


Figure 3

Daily one-month running annualised volatilities of bitcoin and international currencies

The top panel of this figure presents daily one-month running annualized volatilities for bitcoin and selected asset classes, namely gold, real estate, sovereign bonds, equities, and cash. The data is from Bloomberg for the period 1.1.2016 – 31.12.2019, and the proxies used are identical to those in Figure 2. The bottom part of the figure presents daily one-month running annualized volatilities for bitcoin and currencies of the countries in the ING International Survey on Mobile Banking and the OECD Consumer Insights Survey on Cryptoassets, namely the Polish Zloty, the Romanian Leu, the Turkish Lira, the Euro, the Australian dollar, the British pound, the US dollar, the Czech Koruna, the Philippines Peso, the Malaysian Ringgit and the Vietnamese Dong.

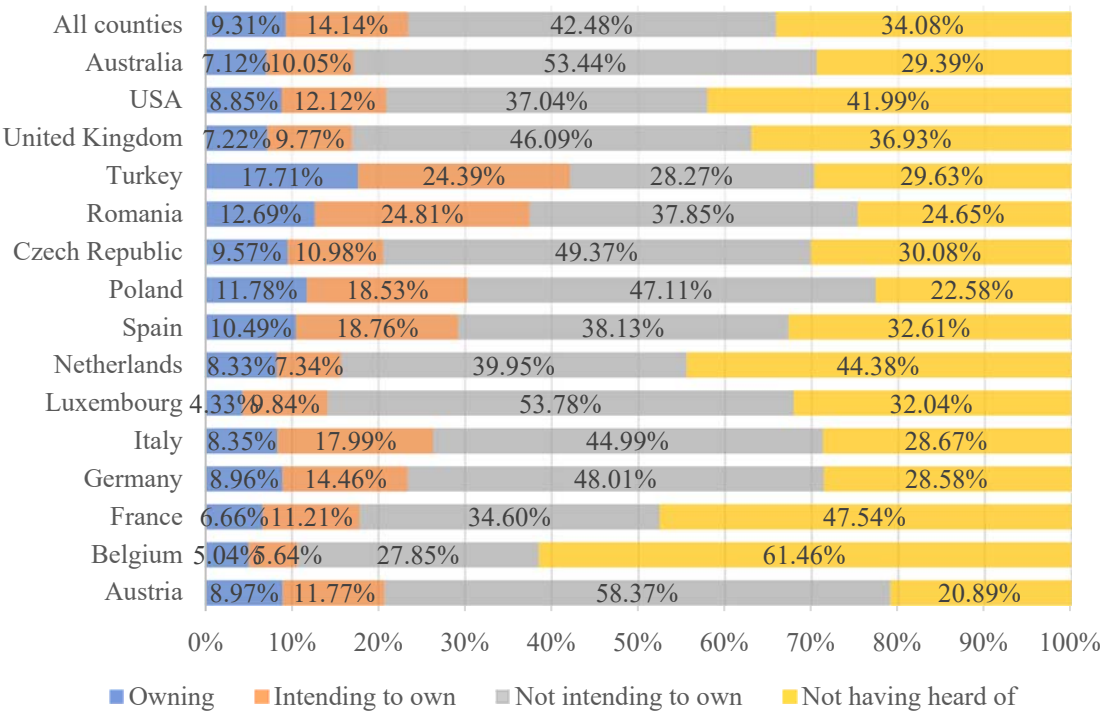


Figure 4

Attitudes to Cryptocurrencies (ING International Survey on Mobile Banking, 2018)

This figure presents the frequencies of responses to our main question regarding attitudes to cryptocurrencies, overall and by country. Weighted frequencies are shown for the four categories of responses, i.e. owning cryptocurrencies, not owning but intending to own, not owning and not intending to own, and not having heard of cryptocurrencies.

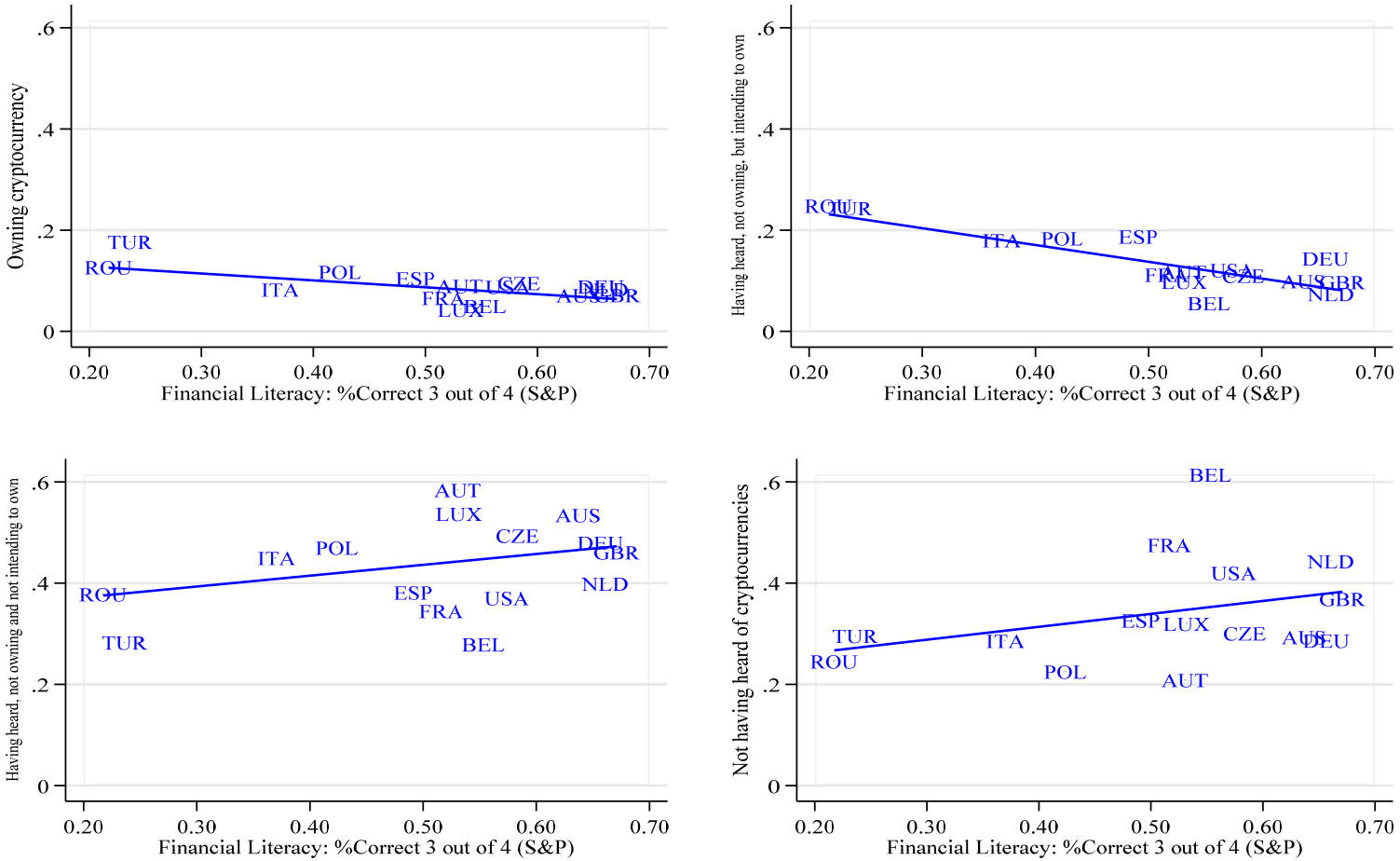


Figure 5

Attitudes to cryptocurrencies and financial literacy at the country level

This figure presents twoway scatterplots between the four response categories in the question regarding attitudes to cryptocurrencies, and financial literacy scores at the country level. Figures are weighted by GDP per capita (PPP current international $) from the World Bank's World Development Indicators. Financial literacy figures are from the S&P 2014 Global Financial Literacy Survey, and represent the percentage of individuals who responded correctly to at least 3 out of 4 concepts in each of the 15 countries in our sample.

Table 1

Weighted summary statistics

This table reports weighted averages for all individuals in the ING 2018 International Survey on Mobile Banking (Column 1). It reports weighted averages for individuals owning cryptocurrency (Column 2), for individuals intending to own cryptocurrency in the future (Column 3), for those not intending to own (Column 4), and for individuals who have not heard of cryptocurrencies before (Column 5). Column 6 reports mean differences and asterisks for the levels of significance from weighted t-tests between individuals currently owning or expecting to own cryptocurrencies in the future and those not intending to own or who have not heard of cryptocurrencies before. Weighted t-tests and levels of significance are computed using the parmby and metaparm commands in Stata. The asterisks denote the following levels of significance: *** p<0.01, ** p<0.05, * p<0.1. The financial literacy variable is calculated as a individual average of the country financial literacy scores by gender, age group (15-34, 35-54, >55) and income (top 60%, bottom 40%) from the S&P 2014Global Financial Literacy Survey.

	(1)	(2)	(3)	(4)	(5)	(6)	
	All	**Owning**	**Intend to own**	**Not intend to own**	**Not having heard of**	**Difference: 1/2 – 3/4**	
	[100.0%]	*[9.22%]*	*[13.96%]*	*[42.65%]*	*[34.17%]*		
Panel A: Full sample							
Number of observations	*13,267*	*1,223*	*1,852*	*5,659*	*4,533*		
Financial literacy	0.514	0.486	0.469	0.529	0.521	-0.050	***
Digital literacy	0.478	0.578	0.543	0.469	0.436	0.103	***
Preference for cash	0.835	0.897	0.905	0.818	0.811	0.087	***
Inflectional FTR	0.334	0.362	0.409	0.287	0.353	0.074	***
Household income per capita	1,078.3	1,047.8	970.9	1,171.7	1,015.2	-84.1	***
Missing income	10.6%	4.5%	6.5%	10.7%	13.8%	-0.064	***
Male	48.6%	68.1%	60.5%	54.3%	31.1%	0.195	***
Age	42.05	37.53	38.08	43.86	42.67	-5.467	***
Young (<45)	54.5%	70.6%	66.7%	48.8%	52.3%	0.179	***
Married	49.7%	52.4%	48.7%	49.8%	49.2%	0.007	
Single	22.9%	21.5%	26.1%	23.2%	21.6%	0.018	**
In a relationship	17.5%	19.3%	17.9%	16.9%	17.6%	0.012	
Widowed/Divorced/Separated	9.9%	6.8%	7.4%	10.1%	11.6%	-0.036	***
Household size	2.70	2.89	2.88	2.59	2.70	0.242	***
Panel B: Sub-sample of individuals who have heard of cryptocurrencies before							
Number of observations	*8,734*	*1,223*	*1,852*	*5,659*	–		
Fin. advice: An independent financial advisor	19.8%	18.3%	28.6%	17.2%	17.2%	0.073	***
–"– My friends/family	8.1%	12.4%	11.5%	6.1%	6.1%	0.058	***
–"– The internet and specialist websites	27.8%	45.1%	39.5%	20.1%	20.1%	0.216	***
–"– An online computer program or algorithm for tailored advice	6.7%	15.4%	10.6%	3.6%	3.6%	0.090	***
–"– No financial advice	37.6%	8.9%	9.8%	53.1%	53.1%	-0.437	***
Reward perception	0.602	0.784	0.744	0.515	0.515	0.245	***
Risk perception	0.732	0.659	0.686	0.764	0.764	-0.089	***
Digital currencies – e.g. bitcoin – are the future of spending online	3.003	3.939	3.757	2.547	2.547	1.282	***
–"– of investment as storage of value	2.953	3.876	3.710	2.498	2.498	1.278	***
I think the value of digital currencies – e.g. bitcoin – will increase in the next 12 months	3.072	3.939	3.687	2.677	2.677	1.110	***
Cryptocurrency riskier than cash	3.870	3.496	3.642	4.027	4.027	-0.443	***
- " - bonds	3.682	3.287	3.462	3.842	3.842	-0.449	***
- " - stocks	3.259	2.905	2.937	3.444	3.444	-0.519	***
- " - real estate/funds	3.747	3.390	3.527	3.898	3.898	-0.425	***
- " - gold	3.907	3.537	3.749	4.041	4.041	-0.376	***
- " - investing in own business	3.509	3.159	3.261	3.668	3.668	-0.448	***

Table 2

Attitudes to cryptocurrencies and financial literacy

This table reports estimates of the determinants of attitudes to cryptocurrencies from a weighted multinomial probit regression. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies and robust standard errors are presented in brackets. The specification also includes a constant term. The % Fin. Literacy effect is calculated as the change in the predicted probability by an increase in the financial literacy score from 0.5177 to 0.61.77. The %Interquartile-change effect is calculated as the change in the predicted probability by an increase in financial literacy from 0.442 to 0.6233. The asterisks denote the following levels of significance: *** p<0.01, ** p<0.05, * p<0.1.

	Own	***Intend to own***	***Not intend to own***	***Not having heard of***
	(1)	(2)	(3)	(4)
Financial literacy	-0.300***	0.084	0.668***	-0.452***
	[0.116]	[0.135]	[0.190]	[0.175]
Digital literacy	0.120***	0.133***	-0.078***	-0.175***
	[0.012]	[0.014]	[0.021]	[0.019]
Inflectional FTR	-0.008	0.130***	-0.042	-0.080***
	[0.019]	[0.025]	[0.028]	[0.024]
Preference for cash	0.012**	0.002	-0.042***	0.029***
	[0.006]	[0.006]	[0.009]	[0.009]
Male	0.067***	0.049***	0.075***	-0.192***
	[0.006]	[0.007]	[0.010]	[0.009]
Log(Household income per capita)	-0.015	-0.010	-0.078***	0.102***
	[0.018]	[0.020]	[0.030]	[0.026]
Log(Household income per capita)^2	0.004	0.004	0.023***	-0.031***
	[0.005]	[0.006]	[0.008]	[0.007]
Log(Household income per capita)^3	-0.001	-0.001	-0.002***	0.002***
	[0.000]	[0.000]	[0.001]	[0.001]
Missing household income per capita	-0.039*	-0.02	0.033	0.026
	[0.021]	[0.023]	[0.032]	[0.027]
Age: 18-25	0.071***	0.073***	-0.160***	0.016
	[0.012]	[0.014]	[0.019]	[0.017]
–"– 26-35	0.073***	0.051***	-0.156***	0.032**
	[0.010]	[0.011]	[0.015]	[0.014]
–"– 36-45	0.041***	0.026**	-0.099***	0.032**
	[0.010]	[0.011]	[0.015]	[0.014]
–"– 46-55	0.027***	0.009	-0.056***	0.02
	[0.010]	[0.011]	[0.014]	[0.013]
–"– 56-65	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
Married/Cohabiting/Civil partnership	0.005	-0.022**	-0.025*	0.041***
	[0.008]	[0.009]	[0.013]	[0.012]
In a relationship	0.008	-0.019**	-0.011	0.023*
	[0.008]	[0.009]	[0.014]	[0.013]
Widowed/Divorced/Separated	0.024**	0.004	-0.052***	0.024
	[0.012]	[0.013]	[0.017]	[0.016]
Single	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
Household size	0.006*	0.009***	-0.015***	-0.001
	[0.003]	[0.004]	[0.005]	[0.005]
Pre-sixteen education	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
A-levels, GNVQ or college	0.021**	-0.008	0.055***	-0.068***
	[0.010]	[0.011]	[0.015]	[0.013]
Higher vocational education or HND	0.028**	0.011	0.066***	-0.104***
	[0.011]	[0.012]	[0.017]	[0.015]

Table 2 continued in next page

Table 2 continued from last page

	(1)	(2)	(3)	(4)
University (Bachelors)	0.032***	0.020*	0.120***	-0.172***
	[0.011]	[0.012]	[0.017]	[0.015]
Higher university degree	0.055***	0.016	0.141***	-0.212***
	[0.011]	[0.013]	[0.018]	[0.016]
Occupation: Self-Employed	0.051***	0.044**	-0.061**	-0.034
	[0.015]	[0.017]	[0.026]	[0.025]
–"– Full-time employee	0.024*	0.007	-0.073***	0.041**
	[0.012]	[0.014]	[0.021]	[0.019]
–"– Part-time employee	0.025*	0.006	-0.079***	0.047**
	[0.014]	[0.015]	[0.023]	[0.021]
–"– Student	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
–"– Unemployed	0.008	-0.007	-0.059**	0.058**
	[0.016]	[0.018]	[0.026]	[0.023]
–"– Inactive	0.009	-0.013	-0.055**	0.059***
	[0.015]	[0.017]	[0.024]	[0.022]
–"– Retired	0.022	-0.017	-0.068***	0.063***
	[0.017]	[0.019]	[0.026]	[0.024]
Country: Austria	0.006	0.145***	0.290***	-0.440***
	[0.017]	[0.026]	[0.028]	[0.024]
–"– Belgium	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
–"– France	-0.014	0.010	0.087***	-0.082***
	[0.020]	[0.022]	[0.030]	[0.025]
–"– Germany	0.041*	0.151***	0.094***	-0.286***
	[0.022]	[0.031]	[0.035]	[0.031]
–"– Italy	-0.042	0.067**	0.311***	-0.336***
	[0.028]	[0.031]	[0.044]	[0.040]
–"– Luxembourg	-0.054***	0.041	0.248***	-0.235***
	[0.021]	[0.025]	[0.030]	[0.027]
–"– Netherlands	0.053**	0.073**	0.026	-0.152***
	[0.022]	[0.031]	[0.035]	[0.030]
–"– Spain	-0.001	0.058***	0.160***	-0.217***
	[0.021]	[0.022]	[0.031]	[0.026]
–"– United Kingdom	0.015	0.092***	0.083**	-0.191***
	[0.021]	[0.031]	[0.035]	[0.031]
–"– Poland	0.001	0.206***	0.278***	-0.485***
	[0.021]	[0.030]	[0.036]	[0.032]
–"– Romania	-0.064	0.256***	0.334***	-0.525***
	[0.041]	[0.050]	[0.067]	[0.061]
–"– Czech Republic	0.049**	0.141***	0.263***	-0.454***
	[0.022]	[0.031]	[0.036]	[0.031]
–"– Turkey	-0.018	0.117**	0.276***	-0.374***
	[0.040]	[0.046]	[0.065]	[0.059]
–"– Australia	0.029	0.110***	0.160***	-0.299***
	[0.021]	[0.030]	[0.033]	[0.029]
–"– USA	0.014	0.129***	0.057**	-0.200***
	[0.017]	[0.026]	[0.028]	[0.023]
Predicted probability	*0.0931*	*0.1412*	*0.4247*	*0.3410*
%Fin. literacy effect	*-39.46%*	*4.76%*	*22.70%*	*-18.83%*
#Observations	13,267			
Log-likelihood	-14,574.9			
Wald χ^2	2,935.9***			

Table 3

The interaction between financial-literacy and countries

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a weighted multinomial probit regression. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies and robust standard errors are presented in brackets. The remaining specification is identical to that of Table 2, and it also incorporates 15 interaction terms between financial literacy and country.

	Own	***Intend to own***	***Not intend to own***	***Not having heard of***
	(1)	(2)	(3)	(4)
Financial literacy	-1.264**	0.599	3.242***	-2.577***
	[0.607]	[0.855]	[0.952]	[0.782]
Austria	-1.160***	0.273	1.871***	-0.983*
	[0.393]	[0.548]	[0.633]	[0.552]
Belgium	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
France	-0.541	0.432	1.697***	-1.588***
	[0.392]	[0.532]	[0.619]	[0.506]
Germany	-0.599	0.458	1.677***	-1.536***
	[0.371]	[0.512]	[0.582]	[0.489]
Italy	-0.470	0.312	1.858***	-1.700***
	[0.352]	[0.494]	[0.551]	[0.454]
Luxembourg	-1.002*	0.571	1.370**	-0.939
	[0.544]	[0.583]	[0.679]	[0.597]
The Netherlands	-0.734*	0.04	1.586**	-0.892*
	[0.404]	[0.566]	[0.619]	[0.512]
Spain	-0.469	0.151	1.159*	-0.841
	[0.390]	[0.530]	[0.633]	[0.533]
United Kingdom	-1.111	1.514*	0.259	-0.662
	[0.713]	[0.848]	[1.058]	[0.922]
Poland	-0.479	0.479	1.554***	-1.554***
	[0.366]	[0.509]	[0.577]	[0.489]
Romania	-0.438	0.778	1.635***	-1.975***
	[0.360]	[0.505]	[0.573]	[0.478]
Czech Republic	-0.741*	0.479	0.453	-0.191
	[0.418]	[0.572]	[0.668]	[0.578]
Turkey	-0.422	0.649	1.525***	-1.752***
	[0.352]	[0.500]	[0.568]	[0.469]
Australia	-0.573	0.372	1.901***	-1.701***
	[0.365]	[0.515]	[0.575]	[0.479]
USA	-0.49	0.256	2.050***	-1.816***
	[0.369]	[0.519]	[0.589]	[0.484]
Fin. literacy*Austria	2.106***	-0.204	-2.790**	0.888
	[0.700]	[0.969]	[1.133]	[0.998]
Fin. literacy*Belgium	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
Fin. literacy*France	0.916	-0.762	-2.870***	2.715***
	[0.702]	[0.946]	[1.113]	[0.914]
Fin. literacy*Germany	1.096*	-0.535	-2.753***	2.192***
	[0.637]	[0.880]	[0.999]	[0.837]
Fin. literacy*Italy	0.643	-0.392	-2.819***	2.568***
	[0.639]	[0.883]	[1.003]	[0.840]
Fin. literacy*Luxembourg	1.696*	-0.949	-1.939	1.192
	[0.975]	[1.041]	[1.219]	[1.086]
Fin. literacy*Netherlands	1.310*	-0.038	-2.711***	1.439*
	[0.675]	[0.946]	[1.043]	[0.863]
Fin. literacy*Spain	0.796	-0.108	-1.654	0.965
	[0.708]	[0.951]	[1.158]	[0.987]

Table 3 continued in next page

Table 3 continued from last page

	(1)	(2)	(3)	(4)
Fin. literacy*United Kingdom	1.817*	-2.185	-0.675	1.044
	[1.101]	[1.332]	[1.643]	[1.425]
Fin. literacy*Poland	0.804	-0.465	-2.144**	1.806*
	[0.674]	[0.917]	[1.072]	[0.931]
Fin. literacy*Romania	0.191	-1.519	-1.882	3.210***
	[0.774]	[1.014]	[1.295]	[1.135]
Fin. literacy*Czech Republic	1.381*	-0.577	-0.406	-0.398
	[0.725]	[0.989]	[1.160]	[1.006]
Fin. literacy*Turkey	0.344	-1.515	-1.722	2.893***
	[0.699]	[0.987]	[1.239]	[1.062]
Fin. literacy*Australia	1.042*	-0.469	-3.006***	2.434***
	[0.632]	[0.887]	[0.994]	[0.828]
Fin. literacy*USA	0.885	-0.232	-3.487***	2.833***
	[0.646]	[0.902]	[1.030]	[0.849]
Predicted probability	*0.0931*	*0.1413*	*0.4247*	*0.3409*
%Fin. literacy effect	*-73.97%*	*12.88%*	*83.58%*	*-59.98%*
#Observations		13,267		
Log-likelihood		-14,531.1		
Wald χ^2		2,966.7***		

Table 4

Robustness exercises

This table reports estimates of the effect of financial literacy on attitudes to cryptocurrencies from 9 distinctive weighted multinomial probit regressions. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies and robust standard errors are presented in brackets. The remaining specification of all models is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Not having heard of***
Panel A: Unweighted estimation	(A_1)	(A_2)	(A_3)	(A_4)
Financial literacy	-0.279**	0.084	0.643***	-0.448***
	[0.114]	[0.132]	[0.188]	[0.173]
%Fin. literacy effect	*-44.92%*	*4.96%*	*25.40%*	*-22.95%*
Panel B: Unweighted estimation–Bootstrapped S.E.	(B_1)	(B_2)	(B_3)	(B_4)
Financial literacy	-0.279**	0.084	0.643***	-0.448**
	[0.112]	[0.132]	[0.197]	[0.175]
%Fin. literacy effect	*-44.92%*	*4.96%*	*25.40%*	*-22.95%*
Panel C: Bootstrapped estimation	(C_1)	(C_2)	(C_3)	(C_4)
Financial literacy	-0.280**	0.084	0.643***	-0.447**
	[0.112]	[0.133]	[0.197]	[0.175]
%Fin. literacy effect	*-44.80%*	*5.01%*	*25.41%*	*-22.94%*
Panel D: High financial-literacy by country indicator	(D_1)	(D_2)	(D_3)	(D_4)
High financial literacy by country	-0.015**	0.001	0.042***	-0.029***
	[0.006]	[0.007]	[0.011]	[0.010]
%Fin. literacy effect	*-15.86%*	*1.03%*	*9.87%*	*-8.39%*
Panel E: Logarithmic financial literacy	(E_1)	(E_2)	(E_3)	(E_4)
Log(Financial literacy)	-0.183***	-0.034	0.321***	-0.104
	[0.053]	[0.062]	[0.089]	[0.082]
%Fin. literacy effect	*-40.67%*	*-9.20%*	*17.81%*	*-8.71%*
Panel F: Alternative financial-literacy measure I	(F_1)	(F_2)	(F_3)	(F_4)
$FL_i^1 = \prod \frac{FL_{gender} FL_{age} FL_{income}}{FL_{country}^2}$	-0.086**	0.021	0.220***	-0.155***
	[0.036]	[0.042]	[0.060]	[0.057]
%Fin. literacy effect	*-15.72%*	*2.17%*	*9.29%*	*-8.13%*
Panel G: Alternative financial-literacy measure II	(G_1)	(G_2)	(G_3)	(G_4)
$FL_i^2 = \prod\prod \frac{FL_{gender} FL_{age} FL_{income}}{FL_{country}^3}$	-0.052***	-0.009	0.100***	-0.039
	[0.016]	[0.019]	[0.027]	[0.026]
%Fin. literacy effect	*-11.07%*	*-1.41%*	*4.98%*	*-2.51%*
Panel H: Male sub-sample	(H_1)	(H_2)	(H_3)	(H_4)
Financial literacy	-0.517**	-0.212	1.024***	-0.295
	[0.215]	[0.241]	[0.315]	[0.256]
%Fin. Literacy effect	*-46.86%*	*-21.28%*	*30.55%*	*-20.26%*
Panel I: Female sub-sample	(I_1)	(I_2)	(I_3)	(I_4)
Financial literacy	-0.208	0.123	0.606**	-0.521*
	[0.143]	[0.181]	[0.285]	[0.292]
%Fin. literacy effect	*-42.86%*	*11.68%*	*22.46%*	*-16.00%*
Panel J: Excluding Turkey and Romania	(J_1)	(J_2)	(J_3)	(J_4)
Financial literacy	-0.195*	0.108	0.689***	-0.601***
	[0.116]	[0.133]	[0.202]	[0.186]
%Fin. literacy effect	*-21.25%*	*7.25%*	*15.08%*	*-16.17%*
Panel I: Including 66-75 year-old	(J_1)	(J_2)	(J_3)	(J_4)
Financial literacy	-0.230**	0.033	0.696***	-0.500***
	[0.107]	[0.124]	[0.181]	[0.167]
%Fin. literacy effect	*-33.90%*	*0.02%*	*23.11%*	*-20.13%*

Table 5

Weighted multinomial probit model with selection

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a weighted multinomial probit regression with a first stage selection equation modelling the probability of having heard of cryptocurrencies before. Marginal effects for the three categories of the variable on attitudes to cryptocurrencies (Owning; Intending to own in the future, and; Not intending to own in the future) are presented, along with robust standard errors in brackets. The specification is identical to Table 2 and includes a constant term. The selection equation is identified via an exclusion restriction capturing ignorance of online payments, in terms of knowledge of the following providers, as options to pay for goods and services in the near future, either in store or online: ApplePay, Google/AndroidPay, PayPal, Facebook, AmazonPay (Amazon account), and own bank's app. It is a continuous index, ranging between 0 and 1, and stemming from the summation of unawareness of the six providers, divided by 6.

	Own	***Intend to own***	***Not intend to own***	**Selection equation: Having heard of**
	(A_1)	(A_2)	(A_3)	(S_1)
Financial literacy	-0.404***	-0.101	0.253**	0.487***
	[0.099]	[0.104]	[0.105]	[0.173]
Digital literacy	0.026**	0.024**	-0.123***	0.151***
	[0.010]	[0.011]	[0.011]	[0.019]
Inflectional FTR	-0.038**	0.069***	-0.063***	0.059**
	[0.016]	[0.019]	[0.019]	[0.024]
Preference for cash	0.020***	0.013**	-0.017***	-0.031***
	[0.005]	[0.005]	[0.005]	[0.008]
Male	-0.023***	-0.044***	-0.026***	0.185***
	[0.005]	[0.006]	[0.006]	[0.009]
Log(Household income per capita)	0.025	0.033**	-0.014	-0.091***
	[0.015]	[0.016]	[0.017]	[0.026]
Log(Household income per capita)^2	-0.008**	-0.009**	0.004	0.028***
	[0.004]	[0.004]	[0.005]	[0.007]
Log(Household income per capita)^3	0.001**	0.001*	-0.001	-0.002***
	[0.000]	[0.000]	[0.000]	[0.001]
Missing household income per capita	-0.021	-0.004	0.035*	-0.022
	[0.018]	[0.018]	[0.019]	[0.027]
Lack of awareness regarding online payment providers	–	–	–	-0.173***
				[0.013]
Predicted probability	0.2258	0.2602	0.4515	0.6590
%Fin. literacy effect	*-23.23%*	*-7.34%*	*7.82%*	*10.17%*
#Observations			13,267	
Log-likelihood			-14,460.6	
Wald χ^2			2,695.8***	

Table 6

Weighted instrumental-variables multinomial probit model

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a weighted multinomial probit regression with a first stage equation modelling endogenous financial literacy. Marginal effects for the for categories of the variable on attitudes to cryptocurrencies (Owning; Intending to own in the future, Not intending to own in the future, and Not having heard of) are presented, along with robust standard errors in brackets. The specification is identical to Table 2 and includes a constant term. The first-stage equation is identified via an instrumental variable capturing individuals who responded that they use mobile banking for effective personal financial management in a related question.

	Own	***Intend to own***	***Not intend to own***	***Not having heard of***	**First-stage equation:** ***Financial literacy***
	(A_1)	(A_2)	(A_3)	(A_4)	(F_1)
Financial literacy	-0.508***	0.297***	1.004***	-1.058***	–
	[0.009]	[0.006]	[0.008]	[0.008]	
Digital literacy	0.133***	0.178***	-0.031	-0.170***	0.002*
	[0.017]	[0.015]	[0.021]	[0.020]	[0.001]
Inflectional FTR	-0.030	0.138***	-0.049*	-0.043*	-0.003***
	[0.027]	[0.026]	[0.029]	[0.025]	[0.001]
Preference for cash	0.023***	0.005	-0.039***	0.026***	0.001
	[0.008]	[0.007]	[0.009]	[0.009]	[0.000]
Male	0.054***	0.063***	0.097***	-0.181***	0.030***
	[0.007]	[0.007]	[0.009]	[0.008]	[0.000]
Log(Household income)	0.003	-0.011	-0.085***	0.098***	-0.007***
	[0.025]	[0.022]	[0.030]	[0.028]	[0.001]
Log(Household income)^2	-0.002	0.005	0.026***	-0.030***	0.001*
	[0.007]	[0.006]	[0.008]	[0.008]	[0.000]
Log(Household income)^3	0.001	-0.001	-0.002***	0.002***	0.000***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]
Missing household income	-0.048	-0.04	0.006	0.045	0.028***
	[0.029]	[0.024]	[0.031]	[0.028]	[0.001]
Mobile banking usage for efficient personal financial management	–	–	–	–	0.001*** [0.000]
Predicted probability	0.1464	0.1663	0.4651	0.3541	0.5137
%Fin. literacy effect	*-41.27%*	*17.86%*	*29.30%*	*-37.05%*	–

Additional statistics based on a linear probability IV model for cryptocurrency ownership (available upon request)

Test of excluded instruments $F_{(1, 13,225)}$	7.88***	(c) Anderson-Rubin Wald test: $F_{(2,1050)}$	0.42
(a) Kleibergen-Paap rk LM statistic $\chi^2_{(2)}$	7.90***	(c) Anderson-Rubin Wald test: $\chi^2_{(2)}$	0.42
(a) Kleibergen-Paap rk Wald statistic $\chi^2_{(2)}$	7.91***	(c) Stock-Wright LM S-statistic: $\chi^2_{(2)}$	0.42
(b) Kleibergen-Paap Wald rk F-statistic	7.88	(d) Hansen J statistic $\chi2(1)$	0.000

#Observations	13,267
Log-likelihood	17,307.0
Wald χ^2	2,695.8***

Table 7

External validity: Estimates from the OECD Consumer Insights Survey on Cryptoassets (2019)

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a multinomial probit regression. Marginal effects for the for categories of the variable on attitudes to cryptocurrencies (Currently owning; Previously owning; Never held; and, Never heard of) are presented, along with robust standard errors in brackets. The specification includes control variables for labor market status (8 dummies) and a constant term.

	Currently hold	**Previously held**	**Never held**	**Never heard of**
	(1)	(2)	(3)	(4)
Financial literacy	0.002	-0.001	0.034***	-0.034***
	[0.013]	[0.010]	[0.013]	[0.009]
Digital literacy	0.014	-0.011	0.023*	-0.026***
	[0.014]	[0.011]	[0.014]	[0.010]
Risk tolerance	0.112***	-0.013	-0.090***	-0.008
	[0.011]	[0.009]	[0.011]	[0.009]
Present orientation	0.043***	-0.003	-0.078***	0.038***
	[0.010]	[0.008]	[0.010]	[0.008]
Male	0.018	0.015	-0.015	-0.017
	[0.015]	[0.012]	[0.015]	[0.012]
Age: 18-25	0.201***	-0.043	-0.190***	0.033
	[0.048]	[0.036]	[0.043]	[0.036]
–"–: 26-35	0.208***	-0.018	-0.211***	0.021
	[0.045]	[0.033]	[0.040]	[0.034]
–"–: 36-45	0.160***	-0.039	-0.133***	0.012
	[0.045]	[0.033]	[0.040]	[0.034]
–"–: 46-55	0.148***	-0.064*	-0.094**	0.01
	[0.046]	[0.034]	[0.040]	[0.035]
–"–: 56-65	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
Log(Household income-PPP)	-0.228***	0.006	0.058	0.164***
	[0.065]	[0.050]	[0.064]	[0.042]
Log(Household income-PPP)^2	0.057***	-0.001	-0.013	-0.045***
	[0.016]	[0.012]	[0.016]	[0.010]
Log(Household income-PPP)^3	-0.003***	0.001	0.001	0.003***
	[0.001]	[0.001]	[0.001]	[0.001]
Home owner	0.142***	0.029**	-0.108***	-0.063***
	[0.017]	[0.014]	[0.017]	[0.013]
Education: No qualifications	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
–"–: Pre-sixteen	-0.133**	-0.042	0.198***	-0.023
	[0.062]	[0.046]	[0.064]	[0.035]
–"–: A-levels, GNVQ or college	-0.132**	-0.101**	0.289***	-0.055
	[0.066]	[0.050]	[0.066]	[0.037]
–"–: University (Bachelor)	-0.051	-0.046	0.234***	-0.137***
	[0.061]	[0.046]	[0.064]	[0.035]
–"–: Higher university degree	-0.014	-0.069	0.200***	-0.117***
	[0.064]	[0.049]	[0.067]	[0.040]
Philippines	0.186***	-0.002	-0.163***	-0.02
	[0.021]	[0.017]	[0.021]	[0.017]
Vietnam	0.043**	0.025*	-0.098***	0.030**
	[0.019]	[0.015]	[0.018]	[0.015]
Predicted probability	0.3688	0.1457	0.3109	0.1746
%Fin. literacy effect	*0.56%*	*-0.90%*	*10.83%*	*-19.73%*
#Observations		3,428		
Log-likelihood		-3,815.6		
Wald χ^2		1,093.7***		

Table 8

External validity: IV estimates from the OECD Consumer Insights Survey on Cryptoassets (2019)

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a instrumental-variable multinomial probit regression. Marginal effects for the for categories of the variable on attitudes to cryptocurrencies (Currently owning; Previously owning; Never held; and, Never heard of) are presented, along with robust standard errors in brackets. The specification includes control variables for age group (5 dummies), labor market status (8 dummies), country (Malaysia, Philippines, and Vietnam) and a constant term.

	Currently hold	**Previously held**	**Never held**	**Never heard of**	**First-stage equation: *Financial literacy***
	(A_1)	(A_2)	(A_3)	(A_4)	(F_1)
Financial literacy	-0.165**	0.034	0.325***	-0.140***	–
	[0.067]	[0.083]	[0.070]	[0.025]	
Preference for ethical finance	–	–	–	–	0.091***
					[0.017]
Digital literacy	0.039*	-0.018	-0.029	-0.001	0.164***
	[0.020]	[0.024]	[0.022]	[0.007]	[0.021]
Risk tolerance	0.116***	0.025**	-0.045***	-0.023***	0.012
	[0.012]	[0.011]	[0.012]	[0.005]	[0.016]
Present orientation	0.049***	0.016	-0.044***	0.004	-0.030**
	[0.012]	[0.012]	[0.014]	[0.005]	[0.013]
Male	0.012	0.024*	-0.01	-0.009	-0.004
	[0.016]	[0.014]	[0.015]	[0.006]	[0.021]
Log(Household income-PPP)	-0.206***	-0.079	-0.010	0.104***	-0.016
	[0.065]	[0.059]	[0.061]	[0.024]	[0.087]
Log(Household income-PPP)^2	0.054***	0.022	-0.002	-0.027***	0.019
	[0.016]	[0.015]	[0.015]	[0.006]	[0.021]
Log(Household income-PPP)^3	-0.003***	-0.001	0.001	0.002***	-0.001
	[0.001]	[0.001]	[0.001]	[0.000]	[0.001]
Home owner	0.139***	0.087***	-0.075***	-0.047***	0.060**
	[0.017]	[0.017]	[0.017]	[0.007]	[0.024]
Education: No qualifications	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
–"–: Pre-sixteen	-0.117*	-0.102*	0.105	0.019	0.119
	[0.066]	[0.056]	[0.064]	[0.021]	[0.099]
–"–: A-levels, GNVQ or college	-0.113	-0.177***	0.184**	0.009	0.147
	[0.071]	[0.063]	[0.074]	[0.023]	[0.102]
–"–: University (Bachelor)	-0.032	-0.083	0.117	-0.031	0.254***
	[0.070]	[0.066]	[0.075]	[0.023]	[0.098]
–"–: Higher university degree	-0.009	-0.093	0.140*	-0.036	0.122
	[0.069]	[0.062]	[0.072]	[0.023]	[0.102]
Marginal effect	*-40.58%*	*16.28%*	*70.49%*	*-105.88%*	
Predicted probability	0.4060	0.2104	0.4604	0.1324	1.6237

Statistics based on a linear probability IV model for cryptocurrency ownership (available upon request)			
Test of excluded instruments $F_{(1, 13,225)}$	28.88***	(c) Anderson-Rubin Wald test: $F_{(1, 3,401)}$	0.01
(a) Kleibergen-Paap rk LM statistic $\chi^2_{(2)}$	28.38***	(c) Anderson-Rubin Wald test: $\chi^2_{(2)}$	0.01
(a) Kleibergen-Paap rk Wald statistic $\chi^2_{(2)}$	29.11***	(c) Stock-Wright LM S-statistic: $\chi^2_{(2)}$	0.01
(b) Kleibergen-Paap Wald rk F-statistic	28.88***	(d) Hansen J statistic $\chi2(1)$	0.000
#Observations		3,428	
Log-likelihood		-6,800.0	
Wald χ^2		4,233.7***	

Table 9

Interactions between financial literacy and (i) digital literacy; (ii) preference for cash

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from two weighted multinomial probit regressions. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies are presented in Columns A_1 - A_4 and Columns B_1 - B_4, respectively, along with robust standard errors in brackets. The first model (A_1 - A_4) incorporates an interaction term between financial literacy and digital literacy. The second model (B_1 - B_4) incorporates an interaction term between financial literacy and preference for cash. The remaining specification is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Not having heard of***	***Own***	***Intend to own***	***Not intend to own***	***Not having heard of***
	(A_1)	(A_2)	(A_3)	(A_4)	(B_1)	(B_2)	(B_3)	(B_4)
Financial literacy	-0.289**	0.063	0.736***	-0.510***	-0.334***	0.021	0.750***	-0.437**
	[0.127]	[0.143]	[0.202]	[0.187]	[0.119]	[0.139]	[0.196]	[0.181]
Digital literacy	0.130***	0.116***	-0.008	-0.237***	0.120***	0.132***	-0.077***	-0.175***
	[0.037]	[0.044]	[0.073]	[0.069]	[0.012]	[0.014]	[0.021]	[0.019]
Financial literacy*Digital literacy	-0.020	0.035	-0.135	0.120	–	–	–	–
	[0.072]	[0.085]	[0.134]	[0.128]				
Preference for cash	0.012**	0.002	-0.042***	0.029***	-0.010	-0.039*	0.012	0.038
	[0.006]	[0.006]	[0.009]	[0.009]	[0.018]	[0.022]	[0.033]	[0.031]
Fin. literacy*Preference for cash	–	–	–	–	0.044	0.083**	-0.107*	-0.019
					[0.035]	[0.042]	[0.061]	[0.058]
Inflectional FTR	-0.008	0.130***	-0.042	-0.080***	-0.008	0.129***	-0.042	-0.079***
	[0.019]	[0.025]	[0.028]	[0.024]	[0.019]	[0.025]	[0.028]	[0.024]
Male	0.067***	0.049***	0.075***	-0.192***	0.067***	0.049***	0.076***	-0.192***
	[0.006]	[0.007]	[0.010]	[0.009]	[0.006]	[0.007]	[0.010]	[0.009]
Log(Household income p.c.)	-0.015	-0.01	-0.076**	0.101***	-0.014	-0.008	-0.080***	0.101***
	[0.018]	[0.020]	[0.030]	[0.026]	[0.018]	[0.020]	[0.030]	[0.026]
Log(Household income p.c.)^2	0.004	0.004	0.023***	-0.030***	0.003	0.003	0.024***	-0.030***
	[0.005]	[0.006]	[0.008]	[0.007]	[0.005]	[0.006]	[0.008]	[0.007]
Log(Household income p.c.)^3	-0.001	-0.001	-0.002***	0.002***	-0.001	-0.001	-0.002***	0.002***
	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]
Missing household income	-0.039*	-0.019	0.032	0.026	-0.039*	-0.02	0.033	0.026
	[0.021]	[0.023]	[0.032]	[0.027]	[0.021]	[0.023]	[0.032]	[0.027]
%Fin. literacy effect	*-38.50%*	*2.25%*	*25.06%*	*-20.92%*	*-42.68%*	*-2.16%*	*25.51%*	*-18.50%*
#Observations		13,267				13,267		
Log-likelihood		-14,574.2				-14,574.2		
Wald χ^2		2,935.4***				2,935.4***		

Table 10

Interactions between financial literacy and age

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from two weighted multinomial probit regressions. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies are presented in Columns A_1 - A_4 and Columns B_1 - B_4, respectively, along with robust standard errors in brackets. The first model (A_1 - A_4) incorporates an interaction term between financial literacy and young age (<45). The second model (B_1 - B_4) incorporates five interaction term between financial literacy and six age categories. namely 18-25, 26-35, 36-45, 46-55. 56-65 (reference group). The remaining specification is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Not having heard of***	***Own***	***Intend to own***	***Not intend to own***	***Not having heard of***
	(A_1)	(A_2)	(A_3)	(A_4)	(B_1)	(B_2)	(B_3)	(B_4)
Financial literacy	-0.266**	0.108	0.584***	-0.426**	-0.274**	0.147	0.700***	-0.573***
	[0.116]	[0.134]	[0.188]	[0.174]	[0.123]	[0.144]	[0.200]	[0.184]
Young age (<45)	-0.022	-0.045**	-0.054	0.120***	–	–	–	–
	[0.018]	[0.022]	[0.033]	[0.031]				
Fin. Literacy*Young age	0.128***	0.163***	-0.089	-0.202***	–	–	–	–
	[0.033]	[0.041]	[0.060]	[0.055]				
Age: 18-25	–	–	–	–	-0.074**	-0.037	-0.054	0.164***
					[0.030]	[0.036]	[0.055]	[0.050]
–"– 26-35	–	–	–	–	-0.012	-0.067**	-0.039	0.118**
					[0.027]	[0.033]	[0.050]	[0.047]
–"– 36-45	–	–	–	–	-0.025	-0.032	-0.029	0.086*
					[0.026]	[0.033]	[0.049]	[0.046]
–"– 46-55	–	–	–	–	-0.004	-0.004	0.033	-0.025
					[0.028]	[0.034]	[0.049]	[0.047]
–"– 56-65	–	–	–	–	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
Fin. literacy*Age: 18-25	–	–	–	–	0.283***	0.218***	-0.211**	-0.290***
					[0.056]	[0.067]	[0.099]	[0.092]
Fin. literacy*Age: 26-35	–	–	–	–	0.166***	0.233***	-0.233**	-0.166*
					[0.051]	[0.063]	[0.092]	[0.086]
Fin. literacy*Age: 36-45	–	–	–	–	0.129***	0.113*	-0.139	-0.103
					[0.050]	[0.061]	[0.088]	[0.082]
Fin. literacy*Age: 46-55	–	–	–	–	0.061	0.022	-0.171*	0.088
					[0.053]	[0.065]	[0.090]	[0.085]
Fin. literacy*Age: 56-65	–	–	–	–	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
Digital literacy	0.123***	0.134***	-0.085***	-0.173***	0.118***	0.131***	-0.077***	-0.172***
	[0.012]	[0.014]	[0.021]	[0.019]	[0.012]	[0.014]	[0.021]	[0.019]
Inflectional FTR	-0.007	0.130***	-0.042	-0.080***	-0.007	0.132***	-0.044	-0.081***
	[0.019]	[0.025]	[0.028]	[0.024]	[0.019]	[0.025]	[0.028]	[0.024]
Preference for cash	0.012**	0.003	-0.043***	0.028***	0.012**	0.003	-0.043***	0.028***
	[0.006]	[0.006]	[0.009]	[0.009]	[0.006]	[0.006]	[0.009]	[0.009]
Male	0.064***	0.046***	0.080***	-0.190***	0.063***	0.044***	0.079***	-0.186***
	[0.006]	[0.007]	[0.010]	[0.009]	[0.006]	[0.007]	[0.010]	[0.009]
%Fin. literacy effect	*-35.87%*	*7.92%*	*19.83%*	*-17.77%*	*-36.85%*	*10.78%*	*23.52%*	*-22.99%*
#Observations		13,267				13,267		
Log-likelihood		-14,586.4				-14,538.4		
Wald χ^2		2,910.6***				2,969.1***		

Table 11

The interactions between financial literacy and sources of financial advice for investment

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from two weighted multinomial probit regressions for the sub-sample of individuals who have heard of cryptocurrencies before. Marginal effects for the remaining three categories of the variable on attitudes to cryptocurrencies are presented in Columns A_1 - A_3 and Columns B_1 - B_3, respectively, along with robust standard errors in brackets. The first model (A_1 - A_3) incorporates five variables capturing distinctive sources of financial advice on cryptocurrencies among individuals who have heard of them. The second model (B_1 - B_3) also incorporates five interaction terms between financial literacy and the sources of financial advice on cryptocurrencies. The remaining specification is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Own***	***Intend to own***	***Not intend to own***
	($\underline{A_1}$)	($\underline{A_2}$)	($\underline{A_3}$)	($\underline{B_1}$)	($\underline{B_2}$)	($\underline{B_3}$)
Financial literacy	-0.546***	-0.040	0.586***	-0.515***	-0.104	0.619***
	[0.165]	[0.189]	[0.202]	[0.174]	[0.198]	[0.210]
Fin. advice: Independent financial or bank advisor	0.080***	0.224***	-0.305***	0.068	0.182***	-0.250***
	[0.012]	[0.012]	[0.012]	[0.044]	[0.045]	[0.046]
–"– My friends/family	0.138***	0.225***	-0.363***	0.118**	0.124**	-0.243***
	[0.014]	[0.016]	[0.016]	[0.050]	[0.061]	[0.063]
–"– The internet and specialist websites	0.154***	0.221***	-0.374***	0.211***	0.174***	-0.385***
	[0.010]	[0.011]	[0.010]	[0.038]	[0.041]	[0.042]
–"– An online computer program or algorithm for tailored advice	0.205***	0.245***	-0.450***	0.167***	0.249***	-0.416***
	[0.014]	[0.017]	[0.017]	[0.048]	[0.056]	[0.061]
–"– No financial advice	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}	{*Ref.*}
Fin. literacy*Fin. advice: An independent financial or bank advisor	–	–	–	0.027	0.084	-0.111
				[0.083]	[0.087]	[0.089]
Fin. literacy*Fin. advice: My friends/family	–	–	–	0.035	0.197*	-0.232**
				[0.093]	[0.113]	[0.117]
Fin. literacy*Fin. advice: The internet and specialist websites	–	–	–	-0.118*	0.096	0.022
				[0.072]	[0.080]	[0.080]
Fin. literacy*Fin. advice: An online computer program or algorithm for tailored advice	–	–	–	0.076	-0.01	-0.066
				[0.091]	[0.110]	[0.118]
Fin. literacy* No financial advice	–	–	–	{*Ref.*}	{*Ref.*}	{*Ref.*}
Digital literacy	0.112***	0.080***	-0.192***	0.111***	0.081***	-0.192***
	[0.017]	[0.020]	[0.022]	[0.017]	[0.020]	[0.022]
Inflectional FTR	-0.038	0.190***	-0.152***	-0.04	0.192***	-0.152***
	[0.030]	[0.037]	[0.037]	[0.030]	[0.037]	[0.037]
Preference for cash	0.016**	0.003	-0.020**	0.015*	0.003	-0.019*
	[0.008]	[0.009]	[0.010]	[0.008]	[0.009]	[0.010]
Male	0.058***	0.006	-0.064***	0.057***	0.006	-0.063***
	[0.009]	[0.010]	[0.011]	[0.009]	[0.010]	[0.011]
Log(Household income per capita)	-0.012	0.014	-0.002	-0.013	0.015	-0.002
	[0.026]	[0.030]	[0.033]	[0.026]	[0.030]	[0.033]
Log(Household income per capita)^2	0.001	-0.005	0.004	0.001	-0.005	0.004
	[0.007]	[0.008]	[0.009]	[0.007]	[0.008]	[0.009]
Log(Household income per capita)^3	-0.001	0.001	-0.001	-0.001	0.001	-0.001
	[0.000]	[0.001]	[0.001]	[0.000]	[0.001]	[0.001]
Missing household income per capita	-0.053*	-0.012	0.065*	-0.054*	-0.013	0.067*
	[0.031]	[0.034]	[0.037]	[0.031]	[0.034]	[0.037]
%Fin. literacy effect	*-44.90%*	*-6.60%*	*12.43%*	*-43.35%*	*-10.46%*	*13.23%*
#Observations		8,734			8,734	
Log-likelihood		-6,457.1			-6,448.7	
Wald χ^2		2,079.6***			2,080.0***	

Table 12

The interactions between financial literacy and the perception of rewards from cryptocurrencies

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from two weighted multinomial probit regressions for the sub-sample of individuals who have heard of cryptocurrencies before. Marginal effects for the remaining three categories of the variable on attitudes to cryptocurrencies are presented in Columns A_1 - A_3 and Columns B_1 - B_3, respectively, along with robust standard errors in brackets. The first model (A_1 - A_3) incorporates three variables capturing reward perceptions on cryptocurrencies among the individuals who have heard of them. The second model (B_1 - B_3) also incorporates three interaction terms between financial literacy and the reward perceptions on cryptocurrencies. The remaining specification is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Own***	***Intend to own***	***Not intend to own***
	(A_1)	(A_2)	(A_3)	(B_1)	(B_2)	(B_3)
Financial literacy	-0.498***	0.141	0.357*	-0.456**	0.006	0.450**
	[0.163]	[0.183]	[0.185]	[0.191]	[0.207]	[0.217]
Digital currencies – e.g. bitcoin – are the future of spending online	0.037***	0.053***	-0.091***	0.046***	0.023	-0.069***
	[0.005]	[0.006]	[0.006]	[0.017]	[0.021]	[0.021]
–"– are the future of investment as storage of value	0.024***	0.053***	-0.078***	0.050***	0.057**	-0.106***
	[0.006]	[0.007]	[0.006]	[0.018]	[0.022]	[0.022]
I think the value of digital currencies – e.g. bitcoin – will increase in the next 12 months	0.038***	0.014***	-0.053***	0.011	0.022	-0.033*
	[0.005]	[0.005]	[0.005]	[0.016]	[0.018]	[0.019]
Fin. literacy*Future of spending online	–	–	–	-0.018	0.062	-0.043
				[0.034]	[0.041]	[0.040]
Fin. literacy*Future of investment or storage of value	–	–	–	-0.049	-0.007	0.056
				[0.035]	[0.043]	[0.042]
Fin. literacy*The value will increase in next 12 months	–	–	–	0.054*	-0.014	-0.04
				[0.031]	[0.035]	[0.036]
Digital literacy	0.082***	0.063***	-0.145***	0.082***	0.062***	-0.144***
	[0.017]	[0.019]	[0.020]	[0.017]	[0.020]	[0.020]
Inflectional FTR	-0.071**	0.167***	-0.097***	-0.072**	0.168***	-0.096***
	[0.030]	[0.038]	[0.035]	[0.030]	[0.038]	[0.035]
Preference for cash	0.002	-0.006	0.005	0.002	-0.006	0.004
	[0.008]	[0.009]	[0.009]	[0.008]	[0.009]	[0.009]
Male	0.071***	0.019*	-0.091***	0.071***	0.019*	-0.090***
	[0.009]	[0.010]	[0.010]	[0.009]	[0.010]	[0.010]
Log(Household income per capita)	0.001	0.019	-0.019	-0.001	0.020	-0.019
	[0.025]	[0.029]	[0.030]	[0.025]	[0.029]	[0.030]
Log(Household income per capita)^2	-0.002	-0.006	0.008	-0.001	-0.006	0.008
	[0.007]	[0.008]	[0.008]	[0.007]	[0.008]	[0.008]
Log(Household income per capita)^3	0.001	0.001	-0.001	0.001	0.001	-0.001
	[0.000]	[0.001]	[0.001]	[0.000]	[0.001]	[0.001]
Missing household income per capita	-0.021	-0.015	0.037	-0.021	-0.015	0.036
	[0.030]	[0.033]	[0.034]	[0.030]	[0.033]	[0.034]
%Fin. literacy effect	*-41.72%*	*5.96%*	*7.39%*	*-39.28%*	*-2.59%*	*9.66%*
#Observations		8,734			8,734	
Log-likelihood		-5841.4			-5837.1	
Wald χ^2		2,143.0***			2,139.1***	

Table 13

The interaction between financial literacy and risk perception

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from two weighted multinomial probit regressions for the sub-sample of individuals who have heard of cryptocurrencies before. Marginal effects for the remaining three categories of the variable on attitudes to cryptocurrencies are presented in Columns A_1 - A_3 and Columns B_1 - B_3, respectively, along with robust standard errors in brackets. The first model (A_1 - A_3) incorporates six variables capturing risk perceptions on cryptocurrencies among the individuals who have heard of them. The second model (B_1 - B_3) also incorporates six interaction terms between financial literacy and risk perception of cryptocurrencies. The remaining specification is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Own***	***Intend to own***	***Not intend to own***
	(A_1)	(A_2)	(A_3)	(B_1)	(B_2)	(B_3)
Financial literacy	-0.473***	0.076	0.397*	-0.307*	0.156	0.151
	[0.168]	[0.193]	[0.214]	[0.185]	[0.218]	[0.245]
Cryptocurrency riskier than cash	-0.007*	-0.013***	0.020***	-0.008	0.002	0.006
	[0.004]	[0.004]	[0.005]	[0.012]	[0.015]	[0.017]
- " - bonds	-0.010**	0.001	0.008	-0.007	-0.001	0.008
	[0.004]	[0.005]	[0.005]	[0.013]	[0.015]	[0.017]
- " - stocks	-0.012***	-0.033***	0.045***	-0.030***	-0.022	0.052***
	[0.004]	[0.004]	[0.005]	[0.012]	[0.014]	[0.016]
- " - real estate/property funds	-0.002	0.001	0.001	0.034***	-0.011	-0.023
	[0.004]	[0.005]	[0.005]	[0.013]	[0.016]	[0.018]
- " - gold	-0.006	0.009*	-0.003	0.02	0.006	-0.026
	[0.004]	[0.005]	[0.005]	[0.013]	[0.016]	[0.018]
- " - investing in own business	-0.008**	-0.013***	0.021***	-0.035***	-0.009	0.044***
	[0.004]	[0.004]	[0.005]	[0.012]	[0.014]	[0.016]
Fin. literacy* Crypto. riskier than cash	–	–	–	0.004	-0.031	0.027
				[0.023]	[0.029]	[0.032]
- " - bonds	–	–	–	-0.005	0.005	-0.001
				[0.025]	[0.030]	[0.034]
- " - stocks	–	–	–	0.038*	-0.023	-0.015
				[0.023]	[0.028]	[0.031]
- " - real estate/property funds	–	–	–	-0.073***	0.027	0.046
				[0.025]	[0.031]	[0.034]
- " - gold	–	–	–	-0.051**	0.006	0.045
				[0.025]	[0.031]	[0.035]
- " - investing in own business	–	–	–	0.054**	-0.009	-0.045
				[0.023]	[0.028]	[0.031]
Digital literacy	0.134***	0.134***	-0.268***	0.134***	0.134***	-0.268***
	[0.017]	[0.020]	[0.023]	[0.017]	[0.020]	[0.023]
Inflectional FTR	-0.047	0.191***	-0.144***	-0.048	0.191***	-0.144***
	[0.030]	[0.039]	[0.039]	[0.030]	[0.039]	[0.039]
Preference for cash	0.016*	0.007	-0.023**	0.014*	0.008	-0.022**
	[0.008]	[0.009]	[0.011]	[0.008]	[0.009]	[0.011]
Male	0.070***	0.017	-0.087***	0.070***	0.017	-0.086***
	[0.009]	[0.011]	[0.012]	[0.009]	[0.011]	[0.012]
%Fin. literacy effect	*-40.34%*	*2.47%*	*8.25%*	*-28.46%*	*9.42%*	*2.96%*
#Observations		8,734			8,734	
Log-likelihood		-6,955.7			-6,941.1	
Wald χ^2		1,411.0***			1,460.4***	

Table 14

The interaction between financial literacy and perceptions of reward and risk

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from two weighted multinomial probit regressions for the sub-sample of individuals who have heard of cryptocurrencies before. Marginal effects and robust standard errors are presented in brackets. The first model (A_1 - A_3) incorporates nice variables capturing reward and risk perceptions on cryptocurrencies among the individuals who have heard of them. The second model (B_1 - B_3) also incorporates nine interaction terms between financial literacy and risk perception of cryptocurrencies. The remaining specification is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Own***	***Intend to own***	***Not intend to own***
	(A_1)	(A_2)	(A_3)	(B_1)	(B_2)	(B_3)
Financial literacy	-0.489***	0.133	0.356*	-0.202	0.011	0.191
	[0.162]	[0.183]	[0.184]	[0.232]	[0.252]	[0.269]
Digital currencies – e.g. bitcoin – are the future of spending online	0.036***	0.053***	-0.089***	0.048***	0.019	-0.067***
	[0.005]	[0.006]	[0.006]	[0.018]	[0.021]	[0.022]
–"– are the future of investment as storage of value	0.023***	0.053***	-0.076***	0.052***	0.061***	-0.113***
	[0.006]	[0.007]	[0.006]	[0.019]	[0.022]	[0.022]
I think the value of digital currencies – e.g. bitcoin – will increase in the next 12 months	0.038***	0.014***	-0.052***	0.013	0.021	-0.034*
	[0.005]	[0.005]	[0.005]	[0.016]	[0.018]	[0.019]
Fin. literacy*Future of spending online	–	–	–	-0.026	0.069*	-0.044
				[0.034]	[0.041]	[0.041]
Fin. literacy*Future of investment or storage of value	–	–	–	-0.057	-0.015	0.071*
				[0.035]	[0.043]	[0.042]
Fin. literacy*The value will increase in next 12 months	–	–	–	0.049	-0.014	-0.035
				[0.031]	[0.035]	[0.035]
Fin. literacy* Cryptocurrency riskier than cash	0.001	-0.004	0.004	-0.003	0.006	-0.003
	[0.003]	[0.004]	[0.004]	[0.011]	[0.013]	[0.014]
- " - bonds	-0.004	0.007	-0.003	0.001	0.01	-0.011
	[0.004]	[0.004]	[0.005]	[0.012]	[0.014]	[0.015]
- " - stocks	0.001	-0.017***	0.016***	-0.017	-0.011	0.029**
	[0.003]	[0.004]	[0.004]	[0.011]	[0.013]	[0.014]
- " - real estate/property funds	0.002	0.005	-0.007	0.032***	-0.015	-0.017
	[0.004]	[0.004]	[0.005]	[0.012]	[0.015]	[0.016]
- " - gold	-0.003	0.012***	-0.008*	0.022*	0.011	-0.033**
	[0.004]	[0.004]	[0.005]	[0.012]	[0.015]	[0.016]
- " - investing in own business	-0.002	-0.004	0.006	-0.022*	0.002	0.02
	[0.004]	[0.004]	[0.004]	[0.011]	[0.013]	[0.014]
Fin. literacy* Cryptocurrency riskier than cash	–	–	–	0.006	-0.02	0.014
				[0.022]	[0.026]	[0.028]
- " - bonds	–	–	–	-0.011	-0.006	0.017
				[0.023]	[0.028]	[0.029]
- " - stocks	–	–	–	0.036	-0.011	-0.024
				[0.022]	[0.026]	[0.027]
- " - real estate/funds	–	–	–	-0.061***	0.043	0.017
				[0.023]	[0.029]	[0.030]
- " - gold	–	–	–	-0.050**	0.002	0.048
				[0.023]	[0.029]	[0.030]
- " - investing in own business	–	–	–	0.041*	-0.013	-0.028
				[0.022]	[0.025]	[0.027]
%Fin. literacy effect	*-41.15%*	*5.53%*	*7.39%*	*-19.67%*	*0.07%*	*4.24%*
#Observations		8,734			8,734	
Log-likelihood		-5,821.9			-5,804.1	
Wald χ^2		2,159.7***			2,189.1***	

Table 15

The interaction between financial literacy and continuous reward/risk variables

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from two weighted multinomial probit regressions for the sub-sample of individuals who have heard of cryptocurrencies before. Marginal effects for the three categories of the variable on attitudes to cryptocurrencies are presented in Columns A_1 - A_3 and Columns B_1 - B_3, respectively, along with robust standard errors in brackets. The first model (A_1 - A_3) incorporates two continuous indices capturing the reward perceptions and risk perception of cryptocurrencies among the individuals who have heard of them. The second model (B_1 - B_3) also incorporates two interaction terms between financial literacy and the reward and risk perceptions on cryptocurrencies. The remaining specification is identical to that of Table 2.

	Own	***Intend to own***	***Not intend to own***	***Own***	***Intend to own***	***Not intend to own***
	(A_1)	(A_2)	(A_3)	(B_1)	(B_2)	(B_3)
Financial literacy	-0.485***	0.138	0.348*	-0.194	-0.029	0.223
	[0.162]	[0.183]	[0.185]	[0.234]	[0.253]	[0.269]
Reward perception	0.485***	0.616***	-1.101***	0.572***	0.502***	-1.074***
	[0.021]	[0.022]	[0.020]	[0.081]	[0.083]	[0.097]
Fin. Literacy*Reward perception	–	–	–	-0.178	0.235	-0.057
				[0.158]	[0.166]	[0.191]
Risk perception	-0.036*	0.010	0.026	0.085	-0.002	-0.083
	[0.019]	[0.023]	[0.024]	[0.063]	[0.072]	[0.081]
Fin. Literacy*Risk perception	–	–	–	-0.244**	0.027	0.217
				[0.121]	[0.140]	[0.152]
Digital literacy	0.081***	0.066***	-0.148***	0.082***	0.066***	-0.148***
	[0.017]	[0.019]	[0.020]	[0.017]	[0.019]	[0.020]
Inflectional FTR	-0.070**	0.158***	-0.089**	-0.070**	0.158***	-0.089**
	[0.030]	[0.038]	[0.035]	[0.030]	[0.038]	[0.035]
Preference for cash	0.001	-0.006	0.005	0.001	-0.006	0.005
	[0.008]	[0.009]	[0.009]	[0.008]	[0.009]	[0.009]
Male	0.072***	0.019*	-0.091***	0.072***	0.019*	-0.091***
	[0.009]	[0.010]	[0.010]	[0.009]	[0.010]	[0.010]
Log(Household income per capita)	-0.001	0.021	-0.020	-0.001	0.022	-0.022
	[0.025]	[0.029]	[0.030]	[0.025]	[0.029]	[0.030]
Log(Household income per capita)^2	-0.001	-0.007	0.008	-0.001	-0.007	0.008
	[0.007]	[0.008]	[0.008]	[0.007]	[0.008]	[0.008]
Log(Household income per capita)^3	0.001	0.001	-0.001	0.001	0.001	-0.001
	[0.000]	[0.001]	[0.001]	[0.000]	[0.001]	[0.001]
Missing household income p.c.	-0.021	-0.015	0.036	-0.021	-0.016	0.036
	[0.030]	[0.033]	[0.034]	[0.030]	[0.033]	[0.034]
%Fin. literacy effect	*-40.95%*	*5.88%*	*7.21%*	*-18.97%*	*-2.61%*	*4.97%*
#Observations		8,734			8,734	
Log-likelihood		-5,855.7			-5,852.3	
Wald χ^2		2,134.6***			2,133.6***	

Table 16

The effect of the constituent concepts of financial literacy

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a weighted multinomial probit regression. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies and robust standard errors are presented in brackets. Instead of a single financial literacy proxy, the specification includes the four financial literacy constituents, i.e. measures that approximate financial knowledge related to financial risk, inflation, interest/numeracy, and compound interest. Except for country dummy variables, which are excluded, the remaining specification is identical to that of Table 2, and it also incorporates 15 interaction terms between financial literacy and country.

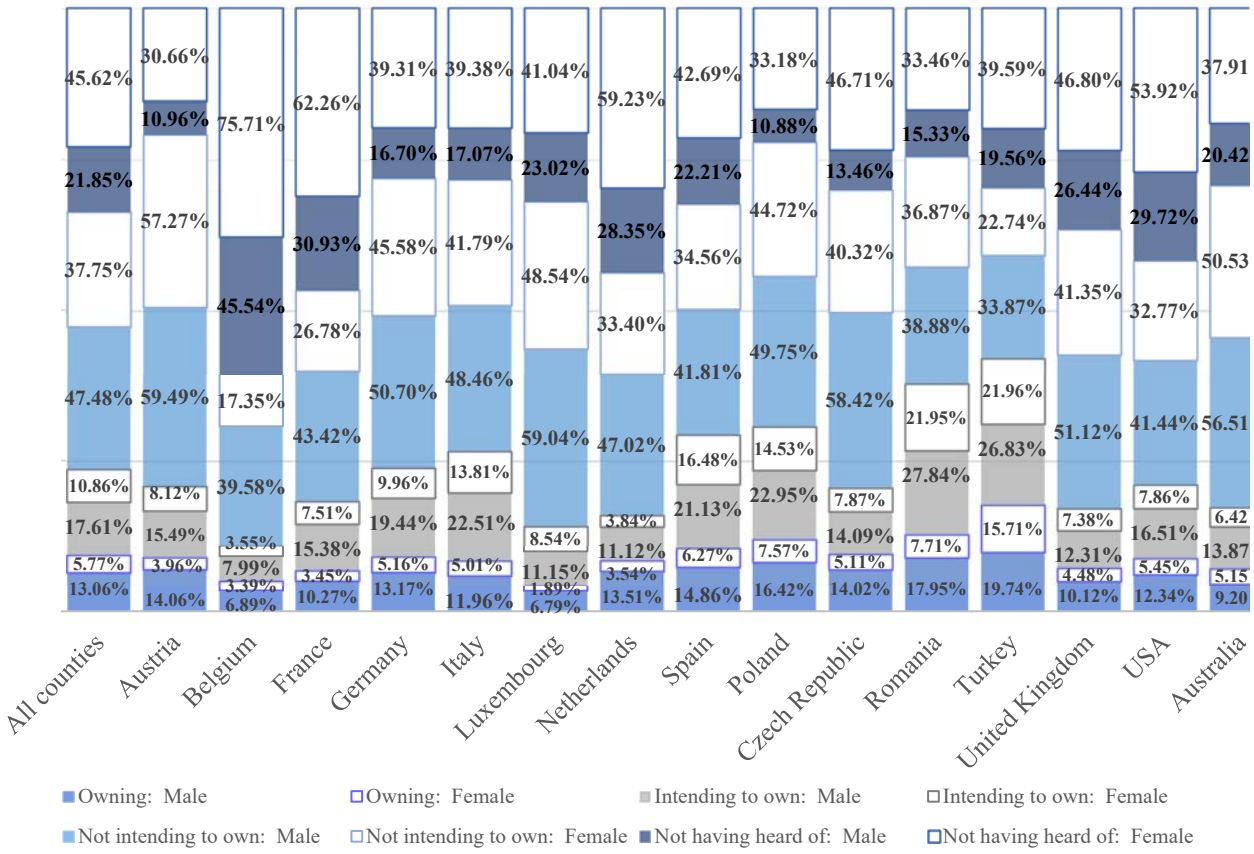
	Own	***Intend to own***	***Not intend to own***	***Not having heard of***
	(1)	(2)	(3)	(4)
Fin. Literacy I: Financial risk	-0.066***	-0.058***	0.042	0.082***
	[0.017]	[0.020]	[0.029]	[0.027]
Fin. Literacy II: Inflation	-0.005	0.021	-0.247***	0.232***
	[0.015]	[0.019]	[0.028]	[0.027]
Fin. Literacy III: Interest/numeracy	0.012	0.074**	0.446***	-0.532***
	[0.025]	[0.031]	[0.043]	[0.041]
Fin. Literacy IV: Compound interest	0.035**	-0.051***	-0.225***	0.241***
	[0.016]	[0.020]	[0.029]	[0.028]
Digital literacy	0.126***	0.142***	-0.078***	-0.190***
	[0.012]	[0.014]	[0.021]	[0.019]
Inflectional FTR	-0.002	0.019**	-0.127***	0.110***
	[0.006]	[0.008]	[0.011]	[0.010]
Preference for cash	0.017***	0.015**	-0.032***	0.001
	[0.005]	[0.006]	[0.009]	[0.008]
Male	0.063***	0.049***	0.090***	-0.202***
	[0.006]	[0.007]	[0.010]	[0.009]
Log(Household income per capita)	0.070***	0.071***	-0.161***	0.021
	[0.012]	[0.014]	[0.019]	[0.018]
Log(Household income per capita)^2	0.001	-0.005	-0.046*	0.051**
	[0.015]	[0.018]	[0.025]	[0.022]
Log(Household income per capita)^3	-0.001	0.004	0.012*	-0.016***
	[0.004]	[0.005]	[0.007]	[0.006]
Missing household income p.c.	0.001	-0.001	-0.001	0.001**
	[0.000]	[0.000]	[0.000]	[0.000]
%Financial risk effect	*-15.88%*	*-9.56%*	*2.23%*	*5.63%*
#Observations		13,267		
Log-likelihood		-14,848.4		
Wald χ^2		2,527.4***		

Table 17

Interaction between financial literacy and inflectional FTR/risk tolerance

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a weighted multinomial probit regression. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies and robust standard errors are presented in brackets. The specification includes an interaction term between financial literacy and inflectional FTR, i.e. our risk tolerance proxy. The remaining specification is identical to that of Table 2.

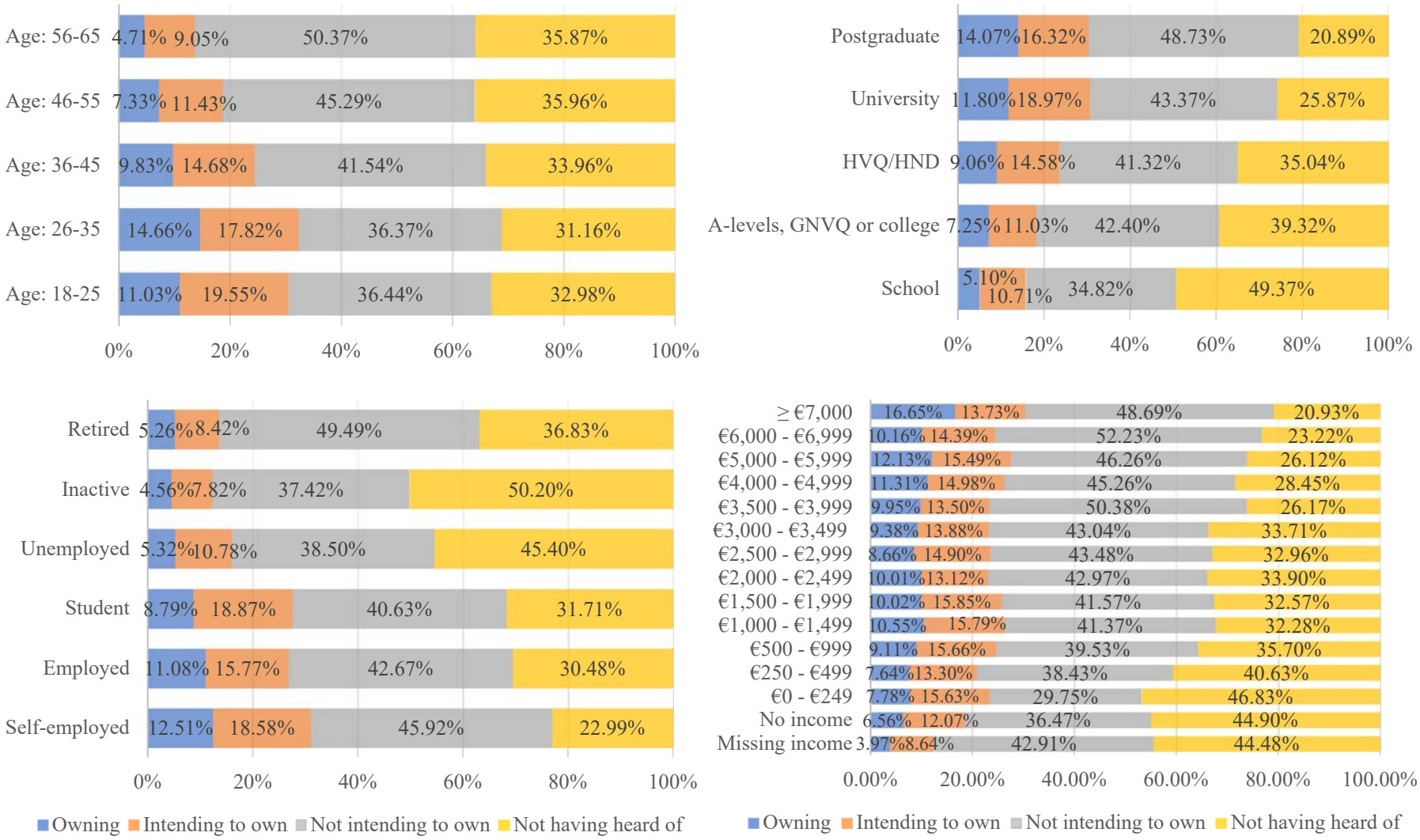
	Own	***Intend to own***	***Not intend to own***	***Not having heard of***
	(1)	(2)	(3)	(4)
Financial literacy	-0.170	0.151	0.476**	-0.457**
	[0.126]	[0.148]	[0.206]	[0.190]
Inflectional FTR	0.226**	0.243**	-0.403**	-0.065
	[0.104]	[0.118]	[0.170]	[0.156]
Fin. Literacy*Inflectional FTR	-0.416**	-0.204	0.648**	-0.029
	[0.182]	[0.208]	[0.303]	[0.279]
Digital literacy	0.120***	0.133***	-0.078***	-0.175***
	[0.012]	[0.014]	[0.021]	[0.019]
Preference for cash	0.012**	0.002	-0.042***	0.029***
	[0.006]	[0.006]	[0.009]	[0.009]
Male	0.068***	0.050***	0.075***	-0.192***
	[0.006]	[0.007]	[0.010]	[0.009]
Log(Household income per capita)	-0.014	-0.009	-0.079***	0.102***
	[0.018]	[0.020]	[0.030]	[0.026]
Log(Household income per capita)^2	0.003	0.004	0.024***	-0.031***
	[0.005]	[0.006]	[0.008]	[0.007]
Log(Household income per capita)^3	-0.001	-0.001	-0.002***	0.002***
	[0.000]	[0.000]	[0.001]	[0.001]
Missing household income per capita	-0.039*	-0.020	0.034	0.026
	[0.021]	[0.023]	[0.032]	[0.027]
%Fin. literacy effect	*-25.06%*	*13.49%*	*16.12%*	*-18.63%*
#Observations		13,267		
Log-likelihood		-14,570.4		
Wald χ^2		2,942.7***		



Appendix Figure A1

Attitudes to cryptocurrencies and gender (ING International Survey on Mobile Banking, 2018)

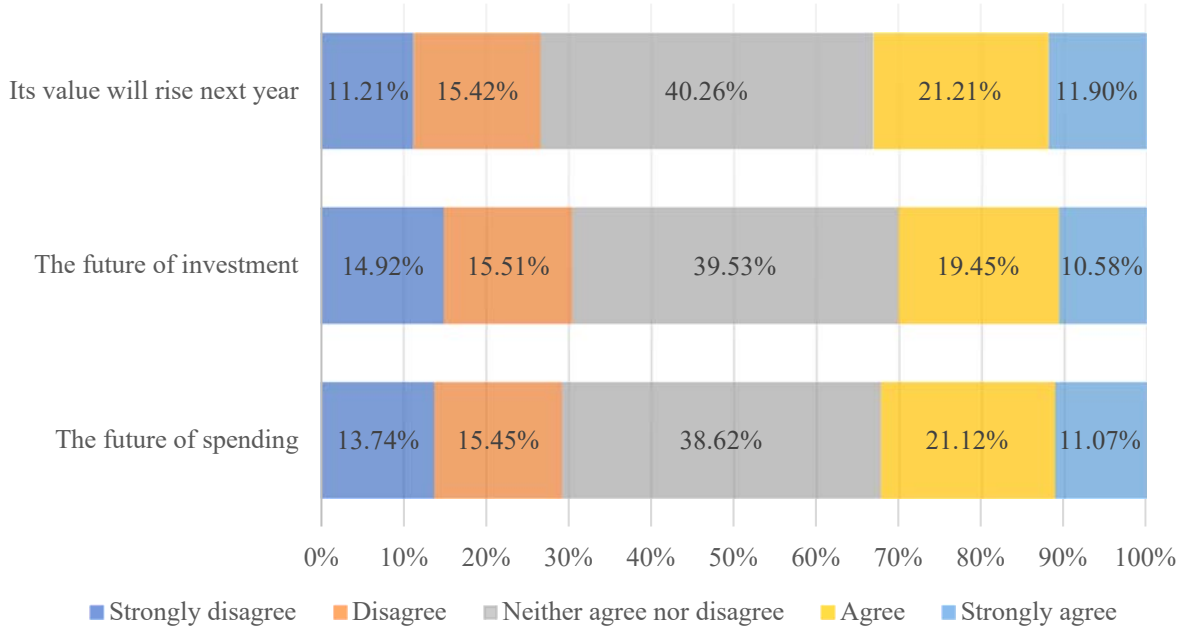
This figure presents the demographic composition of attitudes to cryptocurrencies by gender. Each bar of the figure presents the weighted frequencies of the four categories for each gender, i.e. (i) owning cryptocurrency; (ii) not owning but intending to own; (iii) not owning and not intending to own, and (iv) not having heard of cryptocurrencies before. The first bar shows the frequencies for the sample overall, by gender, and then, the remaining bars present the frequencies by gender for each of the countries in our sample. Females are presented in white boxes in each bar.

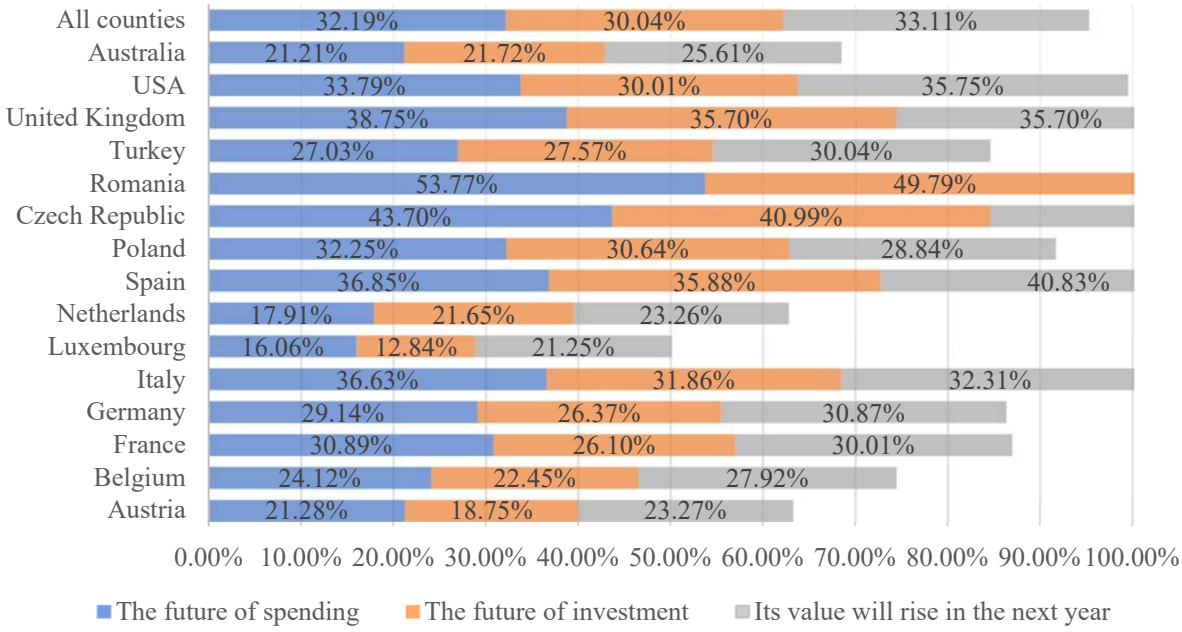


Appendix Figure A2

Attitudes to cryptocurrencies by demographic group (ING International Survey on Mobile Banking 2018)

This figure presents the demographic composition of attitudes to cryptocurrencies by age group, education category, labor market status, and income bracket. All figures are weighted.

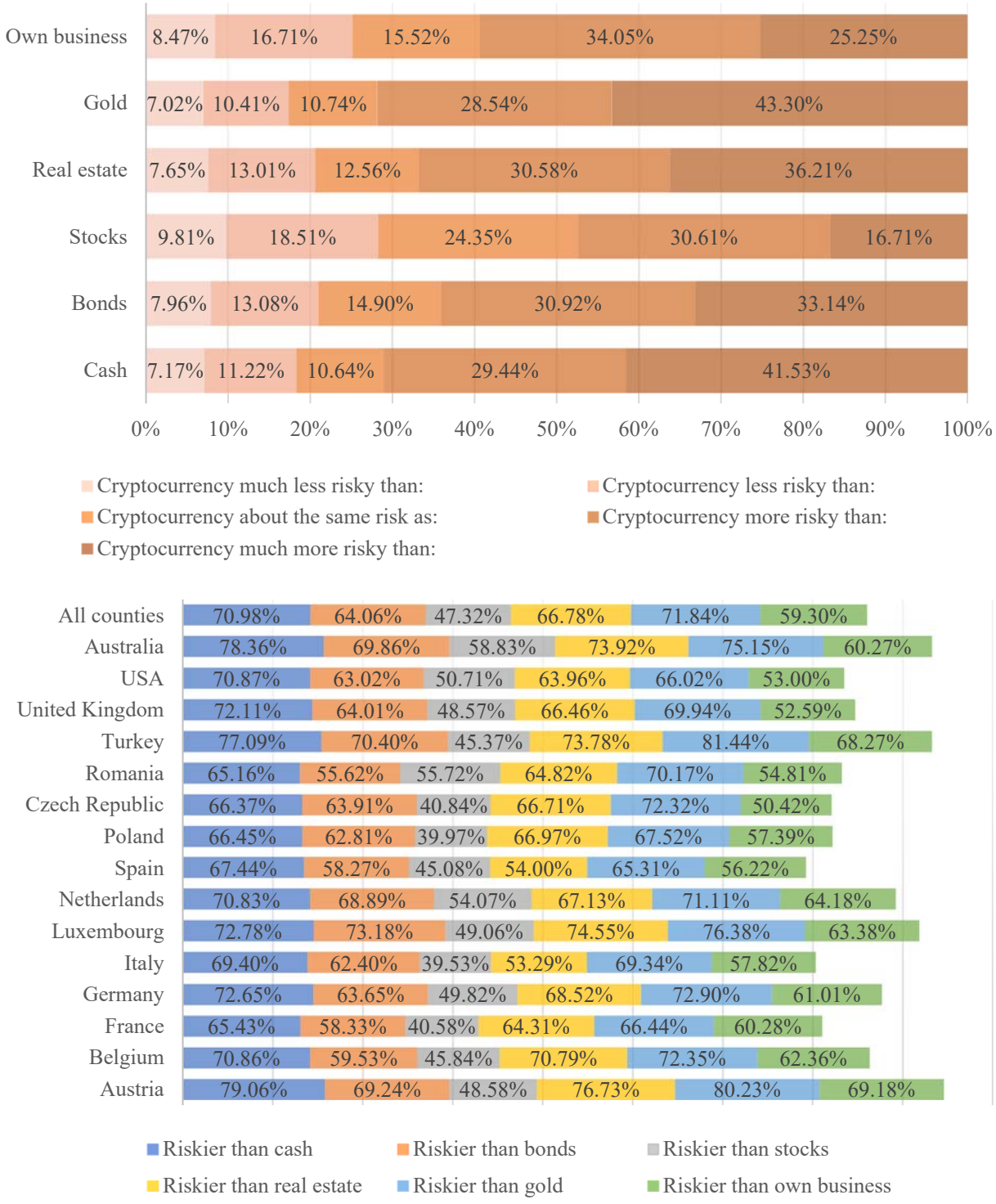




Appendix Figure A3

Reward perceptions of cryptocurrencies

This figure presents the response frequencies in each of the 3 cryptocurrency reward perception questions. The top figure presents the percentages of individuals who strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree with each of the three statements regarding the prospects of cryptocurrencies, such as bitcoin. The bottom picture presents the fraction of individuals who agree or strongly agree with each of the three statements in the overall sample, and then for each country in the sample. All figures are weighted.



Appendix Figure A4

Risk perceptions of cryptocurrencies

This figure presents the response frequencies in each of the 6 cryptocurrency risk perception questions. The top figure presents the percentages of individuals who find that cryptocurrency entails much lower risk, lower risk, about the same risk, higher risk, and much higher risk than each of the 6 alternatives, i.e. cash, bonds, stocks, gold, real estate/property funds, investment in own business. The bottom picture presents the fraction of individuals who find that holding cryptocurrency entails higher risk or much higher risk, compared to holding each of the 6 alternatives in the overall sample, and then for each country in the sample. All figures are weighted.

Appendix Table A1

Risk and return characteristics of bitcoin and other instruments

This table presents calculations of the standard investment risk and return characteristics of bitcoin, and other financial instruments, namely cash, bonds, equities, gold, and real estate. The left panel entails calculations for the 3-year period between 1.1.2016 - 1.1.2019, and the right panel presents calculations for the 1-year period between 1.1.2018 – 1.1.2019. Columns 1 and 5 present the annualized return and Columns 2 and 6 present the standard deviation. Columns 3 and 7 present the Sharpe ratio. Columns 4 and 8 present the Sortino ratio. The analysis employs 0.5% as the risk-free rate ($\bar{R}$) for the calculation of the Sharpe and Sortino ratios. The Sharpe ratio is calculated as the excess reward of each asset (j) over the risk-free rate divided by the standard deviation, i.e. $Sharpe_j = \frac{R_j - \bar{R}}{SD_j}$. The Sortino ratios is calculated as the excess reward over the risk-free rate divided by the standard deviation of the downside, i.e. $Sortino_j = \frac{R_j - \bar{R}}{SD_j^D}$.The data stems from Thomson Reuters and Bloomberg. The US T-Bill is used as a cash proxy. The Bloomberg Barclays GDP Core Developed Govt AA- or Above TR Hedged USD are used to display sovereign bonds. The SP GLOBAL 1200 total return index is used for equities. The Gold Bullion LBM $/t, US T-Bill for gold; The MSCI ACWI REAL ESTATE USD price index is used for real estate. Bitcoin's daily price is from Coindesk.

	3-year period (2016-2019)				1-year period (2018)			
	Return % (ann.)	SD % (ann.)	Sharpe	Sortino	Return % (ann.)	SD % (ann.)	Sharpe	Sortino
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bitcoin	70.76	73.35	0.72	1.40	-73.42	79.63	-1.02	-2.08
Cash	1.39	0.05	-	-	2.06	0.02	-	-
Bonds	3.42	3.39	0.59	0.87	2.04	2.77	-0.03	-0.02
Equities	9.01	10.89	0.67	0.95	-10.47	12.91	-1.01	-1.28
Gold	8.96	11.99	0.59	0.94	-1.56	9.83	-0.41	-0.52
Real Estate	5.02	10.24	0.31	0.48	-10.40	10.67	-1.19	-1.51

Appendix Table A2

Summary statistics – OECD Consumer Insights Survey on Cryptoassets (2019)

This table reports averages for all individuals in the OECD 2019 Consumer Insights Survey on Cryptoassets (Column 1) in three countries, namely Malaysia, Philippines, and Vietnam. It reports averages for individuals currently owning cryptocurrency (Column 2), for individuals previously owning cryptocurrency (Column 3), for those who never held any cryptocurrency (Column 4), and for individuals who have not heard of cryptocurrencies before (Column 5). Column 6 reports mean differences and asterisks for the levels of significance from t-tests between individuals currently owning and those who never held any cryptocurrencies before. The asterisks denote the following levels of significance: *** p<0.01, ** p<0.05, * p<0.1. The financial literacy variable is calculated as the number of correct response in the following two questions: "*An investment with a high return is likely to be high risk*", and "*High inflation means that the cost of living is increasing rapidly*". The response categories involved "True", "False", and "I don't know".

	(1)	(2)	(3)	(4)	(5)	(6)	
	All	**Currently hold**	**Previously held**	**Never held**	**Never heard of**	**Difference (2)-(4)**	**[Sig.]**
	[3,428]	*[1,261]*	*[500]*	*[1,066]*	*[601]*		
Panel A: Sample composition							
All countries	–	36.8%	14.6%	31.1%	17.5%	–	
Malaysia *[1,138]*	–	30.1%	13.9%	41.9%	14.1%	–	
Philippines *[1,144]*	–	39.2%	12.8%	25.4%	22.6%	–	
Vietnam *[1,146]*	–	41.0%	17.1%	26.0%	15.9%	–	
Panel B: Individual characteristics and mean differences							
Financial literacy	1.624	1.697	1.644	1.675	1.361	0.053	
Digital literacy	2.602	2.679	2.580	2.567	2.521	0.099	***
Risk tolerance	2.164	2.388	2.140	1.956	2.083	0.248	***
Present orientation	1.983	2.108	1.960	1.765	2.128	0.148	***
Male	49.8%	50.8%	52.2%	49.1%	46.9%	-0.015	
Age	36.07	36.29	36.16	37.72	32.63	0.134	***
Household income-PPP	4,318.0	5,198.1	4,402.1	3,966.8	2,606.3	796.0	***
Home owner	58.2%	74.7%	65.0%	50.4%	32.0%	0.097	***
Occupation: Self-Employed	12.4%	10.7%	11.0%	13.8%	14.6%	-0.003	**
–"–: Full-time employee	63.9%	75.9%	71.6%	58.2%	42.8%	0.043	***
–"–: Part-time employee	5.8%	5.4%	5.2%	6.0%	7.0%	0.002	
–"–: Unemployed	5.5%	2.2%	3.4%	7.3%	11.0%	-0.012	***
–"–: Inactive	5.5%	2.6%	4.8%	5.8%	11.8%	-0.022	***
–"–: Retired	1.4%	0.6%	0.4%	1.5%	3.7%	0.002	**
–"–: Homemaker	1.8%	0.5%	1.0%	3.6%	1.8%	-0.005	***
–"–: Student	3.6%	2.1%	2.6%	3.9%	7.3%	-0.005	**
Education: No qualifications	2.0%	1.2%	2.0%	0.8%	5.7%	-0.008	
–"–: Pre-sixteen	19.0%	10.2%	17.4%	18.5%	39.8%	-0.073	***
–"–: A-levels, GNVQ or college	9.4%	5.0%	5.6%	13.5%	14.6%	-0.006	***
–"–: University (Bachelor)	57.9%	66.4%	64.6%	58.3%	33.9%	0.018	***
–"–: Higher university degree	11.7%	17.3%	10.4%	8.9%	6.0%	0.069	***
Malaysia [1,138 obs.]	33.2%	27.2%	31.6%	44.8%	26.6%	-0.044	***
Philippines [1,144 obs.]	33.4%	35.5%	29.2%	27.3%	43.1%	0.063	***
Vietnam [1,146 obs.]	33.4%	37.3%	39.2%	28.0%	30.3%	-0.019	***

Appendix Table A3

Country-level financial literacy scores

This table reports the representative country-level scores in financial literacy, its 4 constituent concepts, and the figures by gender, age group and income group for the selected sample of 15 countries from the S&P 2014 Global Financial Literacy Survey. The figures are publicly available at: https://www.cssf.lu/fileadmin/files/Protection_consommateurs/Education_financiere/SP_Ratings_Global_FinLit-Summary_Statistics_as_of_12152015.xls

Country	Country score	Constituent concepts			Gender		Age group			Income group	
		Financial risk	Inflation	Interest/ numeracy	Compound interest	Males	Females	15-34	35-54	>55	Top 60%	Bottom 40%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
United States	57%	69%	63%	52%	61%	62%	52%	57%	65%	57%	64%	47%
Australia	64%	69%	63%	61%	68%	72%	56%	64%	67%	72%	73%	50%
Austria	53%	59%	64%	61%	52%	55%	51%	56%	54%	54%	59%	44%
Belgium	55%	65%	62%	58%	53%	59%	52%	63%	58%	56%	59%	50%
France	52%	50%	67%	60%	54%	56%	48%	46%	58%	53%	55%	47%
Germany	66%	74%	62%	66%	64%	72%	60%	72%	82%	61%	73%	55%
Italy	37%	40%	55%	55%	38%	45%	30%	47%	39%	35%	44%	27%
Luxembourg	53%	53%	67%	57%	51%	61%	46%	58%	49%	57%	56%	50%
Netherlands	66%	73%	67%	59%	69%	75%	58%	71%	71%	68%	71%	60%
Spain	49%	56%	65%	59%	43%	50%	48%	47%	51%	56%	54%	43%
United Kingdom	67%	69%	66%	71%	68%	66%	68%	67%	71%	68%	70%	63%
Czech Republic	58%	56%	64%	71%	54%	65%	53%	59%	60%	61%	61%	55%
Poland	42%	39%	63%	60%	45%	49%	36%	50%	44%	39%	44%	40%
Romania	22%	22%	49%	37%	25%	22%	22%	30%	23%	19%	25%	17%
Turkey	24%	23%	47%	49%	45%	28%	19%	28%	23%	16%	26%	20%

Table A4

Weighted summary statistics by financial literacy group

This table reports weighted averages for all individuals (Column 1). It reports weighted averages for individuals in the high financial literacy group in Column 2 (FLH), and for individuals in the low financial literacy group in Column 3 (FLL). We employ a binary 'High financial literacy' indicator, which stems from the computation of percentiles of financial literacy for each country separately. Individuals are considered to be of 'high financial literacy' (FLH) if the percentile of their financial-literacy score within their country is greater than 50. If it is lower than or equal to fifty within country, they are considered to be of 'low financial literacy' (FLL). Column 4 reports mean differences and asterisks for the levels of significance from weighted t-tests between individuals in the high and the low financial literacy group. The asterisks denote the following levels of significance: *** p<0.01, ** p<0.05, * p<0.1.

	All	FLH	FLL	Difference	[Sig]
	(1)	(2)	(3)	(4)	
Financial literacy	0.514	0.539	0.493	0.046	***
Digital literacy	0.478	0.505	0.456	0.049	***
Inflectional FTR	0.334	0.326	0.340	-0.014	
Preference for cash	0.835	0.824	0.845	-0.021	***
Household income per capita	1,078.3	1,355.2	851.9	503.3	***
Missing income	10.6%	11.0%	10.2%	0.008	
Male	48.6%	78.2%	24.1%	0.541	***
Age	42.0471	40.9386	42.9616	-2.023	***
Young (<45)	54.5%	58.6%	51.2%	0.074	***
Married	49.7%	50.2%	49.2%	0.010	
Single	22.9%	25.2%	21.1%	0.042	***
In a relationship	17.5%	17.7%	17.3%	0.004	
Widowed/Divorced/Separated	9.9%	6.9%	12.4%	-0.055	***
Household size	2.6978	2.6155	2.7656	-0.150	***
Pre-sixteen education	11.2%	9.1%	12.9%	-0.039	***
A-levels, GNVQ or college	34.7%	32.2%	36.8%	-0.046	***
Higher vocational education or HND	17.8%	16.7%	18.6%	-0.019	***
University (Bachelors)	22.2%	24.6%	20.2%	0.044	***
Higher university degree	14.2%	17.5%	11.5%	0.060	***
Occupation: Self-Employed	6.4%	7.1%	5.8%	0.013	***
–"– Full-time employee	48.0%	61.3%	37.0%	0.243	***
–"– Part-time employee	12.0%	8.2%	15.2%	-0.070	***
–"– Student	7.1%	7.1%	7.1%	0.000	
–"– Unemployed	6.4%	3.5%	8.8%	-0.053	***
–"– Inactive	9.6%	4.5%	13.7%	-0.092	***
–"– Retired	10.5%	8.3%	12.4%	-0.041	***
Fin. advice: An independent financial advisor or bank advisor	19.8%	19.4%	20.2%	-0.008	
–"– My friends/family	8.1%	8.2%	8.1%	0.001	
–"– The internet and specialist websites	27.8%	30.6%	24.7%	0.059	***
–"– An online computer program or algorithm for tailored advice	6.7%	7.0%	6.4%	0.006	
–"– No financial advice	37.6%	34.8%	40.6%	-0.058	***
Reward perception	0.602	0.597	0.607	-0.011	**
Risk perception	0.732	0.745	0.719	0.026	***
Digital currencies – e.g. bitcoin – are the future of spending online	3.003	2.982	3.025	-0.043	*
- " - investment as storage of value	2.953	2.917	2.991	-0.074	***
I think the value of digital currencies – e.g. bitcoin – will increase in the next 12 months	3.072	3.050	3.095	-0.046	*
Cryptocurrency riskier than cash	3.870	3.915	3.820	0.095	***
- " - bonds	3.682	3.770	3.588	0.182	***
- " - stocks	3.259	3.328	3.185	0.143	***
- " - real estate/funds	3.747	3.813	3.676	0.137	***
- " - gold	3.907	3.957	3.853	0.105	***
- " - investing in own business	3.509	3.571	3.442	0.130	***
Lack of awareness regarding online payment providers	0.282	0.255	0.304	-0.049	***
Mobile banking usage for efficient personal financial management	37.1%	40.2%	34.4%	0.058	***

Appendix Table A5

Weighted pairwise correlation matrix

This table reports the weighted pairwise correlation matrix for all individuals in the ING 2018 International Survey on Mobile Banking. The asterisk denotes the following level of significance: * p<0.05. The financial literacy variable is calculated as the individual average of the country financial literacy scores by gender, age group (15-34, 35-54, >55) and income (top 60%, bottom 40%) from the S&P 2014 Global Financial Literacy Survey.

		(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		Owning crypto	Intending to own	Financial literacy	Male	Age	University	Household income	Inflectional FTR	Digital literacy	Preference for cash	Risk perception	Reward perception	Future of spending online	”– investment/stor. value	Value ↑in 12 months	Bitcoin riskier than cash	”– bonds	”– equities	”– real estate	”– gold	”– own firm
(1)	Owning crypto	1.00																				
(2)	Intending to own	-0.13*	1.00																			
(3)	Financial literacy	-0.06*	-0.12*	1.00																		
(4)	Male	0.07*	0.06*	0.15*	1.00																	
(6)	Age	0.12*	0.09*	0.11*	0.53*	1.00																
(7)	University	-0.10*	-0.11*	0.05*	-0.07*	-0.04*	1.00															
(8)	Household income	0.04*	0.07*	-0.22*	0.05*	0.00	-0.05*	1.00														
(9)	Inflectional FTR	0.00	-0.04*	0.38*	0.23*	0.08*	0.16*	0.00	1.00													
(10)	Digital literacy	0.01	0.06*	-0.41*	-0.01	0.00	-0.01	0.16*	0.02	1.00												
(11)	Preference for cash	0.14*	0.12*	-0.02	0.11*	0.09*	-0.12*	0.10*	0.07*	0.01	1.00											
(12)	Risk perception	0.03*	0.05*	-0.22*	-0.02	0.02*	-0.06*	0.00	-0.18*	-0.02*	-0.01	1.00										
(13)	Reward perception	-0.15*	-0.12*	0.03*	0.06*	0.04*	0.17*	0.03*	0.09*	-0.03*	-0.05*	-0.06*	1.00									
(14)	Future of spending online	0.35*	0.35*	-0.20*	-0.02	-0.02*	-0.22*	0.05*	-0.16*	0.09*	0.14*	0.11*	-0.36*	1.00								
(15)	”– investment/stor. value	0.32*	0.33*	-0.20*	-0.01	-0.01	-0.20*	0.05*	-0.16*	0.09*	0.14*	0.11*	-0.33*	0.92*	1.00							
(16)	Value ↑in 12 months	0.32*	0.33*	-0.18*	-0.03*	-0.03*	-0.22*	0.04*	-0.16*	0.08*	0.14*	0.10*	-0.35*	0.92*	0.81*	1.00						
(17)	Bitcoin riskier than cash	0.31*	0.28*	-0.16*	-0.02	-0.02	-0.17*	0.05*	-0.10*	0.09*	0.11*	0.09*	-0.30*	0.87*	0.68*	0.70*	1.00					
(18)	”– bonds	-0.11*	-0.09*	0.03*	0.03*	0.01	0.09*	0.01	0.06*	-0.01	-0.05*	-0.02	0.77*	-0.27*	-0.25*	-0.27*	-0.22*	1.00				
(19)	”– equities	-0.12*	-0.09*	0.05*	0.07*	0.06*	0.16*	0.03*	0.07*	-0.02*	-0.03*	-0.07*	0.80*	-0.29*	-0.26*	-0.28*	-0.25*	0.54*	1.00			
(20)	”– real estate	-0.11*	-0.13*	0.04*	0.05*	0.03*	0.13*	0.01	0.08*	-0.07*	-0.02	-0.05*	0.71*	-0.31*	-0.28*	-0.29*	-0.26*	0.42*	0.50*	1.00		
(21)	”– gold	-0.11*	-0.08*	0.03*	0.05*	0.03*	0.13*	0.03*	0.06*	-0.07*	-0.04*	-0.06*	0.81*	-0.28*	-0.26*	-0.27*	-0.23*	0.55*	0.59*	0.50*	1.00	
(22)	”– own firm	-0.11*	-0.06*	-0.01	0.04*	0.02	0.13*	0.02	0.05*	0.00	-0.05*	-0.03*	0.79*	-0.26*	-0.23*	-0.25*	-0.22*	0.59*	0.58*	0.43*	0.61*	1.00

Appendix Table A6

The interaction between financial literacy, years of education and income

This table reports selected estimates of the determinants of attitudes to cryptocurrencies from a weighted multinomial probit regression. Marginal effects for the four categories of the variable on attitudes to cryptocurrencies and robust standard errors are presented in brackets. The remaining specification is identical to that of Table 2, with the exception of the 3rd order polynomial in household income and the replacement of the 5 education categories with a continuous variable capturing years of education. The continuous years of education variable is computed as follows: Individuals with 'Pre-sixteen education' get assigned with 9 years of education. Individuals with 'A-levels, GNVQ or college' get assigned with 12 years of education. Respondents with 'Higher vocational education or HND' get assigned with 14 years. Then, respondents with 'University (Bachelor)' get assigned with 16 years, and individuals with 'Higher university degree' get assigned with 19 years. Finally, the specification also incorporates a triple interaction term between financial literacy, years of education, and the logarithm of monthly PPP-divided household income per capita.

	Own	***Intend to own***	***Not intend to own***	***Not having heard of***
	(A1)	(A2)	(A3)	(A4)
Financial literacy	-0.245**	0.044	0.915***	-0.715***
	[0.112]	[0.129]	[0.180]	[0.165]
Years of Education	0.007***	0.003	0.017***	-0.027***
	[0.002]	[0.002]	[0.003]	[0.002]
Log(Household income per capita)	0.011***	0.005	0.008	-0.023***
	[0.003]	[0.004]	[0.005]	[0.005]
Fin. literacy*Years of education*Log(Household income p.c.)	-0.001	0.001	-0.001	0.001**
	[0.000]	[0.000]	[0.001]	[0.001]
Digital literacy	0.120***	0.133***	-0.074***	-0.180***
	[0.012]	[0.014]	[0.021]	[0.019]
Inflectional FTR	-0.008	0.131***	-0.042	-0.081***
	[0.019]	[0.025]	[0.028]	[0.024]
Preference for cash	0.012**	0.001	-0.044***	0.031***
	[0.006]	[0.006]	[0.009]	[0.009]
Male	0.068***	0.051***	0.069***	-0.188***
	[0.006]	[0.007]	[0.010]	[0.009]
%Fin. literacy effect	*-34.39%*	*-0.94%*	*30.97%*	*-27.72%*
#Observations		13,267		
Log-likelihood		-14,591.7		
Wald χ^2		2,915.0***		