



Who adopts crypto assets in Japan? Evidence from the 2019 financial literacy survey

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ABSTRACT

The adoption of crypto assets has been of great concern to policymakers ever since Facebook announced its proposed cryptocurrency, Libra, in mid-2019. Behind this concern lies the possibility of widespread Libra adoption for day-to-day transactions, bringing with it a set of serious risks related to money laundering, illicit financing, and consumer and investor protection. This study first investigates the variables that distinguish Japanese crypto-asset owners from nonowners, then investigates the variables that distinguish the owners belonging to each group from the rest of the owners. The second investigation focuses on four groups: owners' level of understanding of crypto assets, the profitability of their investment in crypto assets, their holdings of conventional risky financial assets, and their adoption of noncash payment methods. In addition to the usual demographic variables, financial literacy, financial behavior, conventional risky financial asset holdings, and use of noncash payment methods are also investigated. Both probit models and multinomial logit models are estimated and two results are obtained. First, 35 variables distinguish average Japanese crypto-asset owners from nonowners. Owners are more likely to be male, aged below 30 years, have higher pretax income, work in private or public companies, or be self-employed, and be graduate-school graduates compared with nonowners. Owners tend to have higher financial literacy from two perspectives: a measure of objective financial literacy and the experience of financial education at school, and lower financial literacy from three perspectives: the experience of financial education about money management by parents at home, experience of financial troubles, and knowledge about credit cards, than average nonowners. Regarding financial behavior, owners tend to be overconfident about their financial literacy, impatient, judge based on reputation in selecting financial products, lack self-control, and less risk-averse than nonowners. Owners tend to have experience investing in conventional risky financial assets and to use noncash payment methods. Second, 40–60% of variables that statistically significantly distinguish between the average owners and nonowners also differentiate the owners belonging to three of the four groups (excluded is the group that uses noncash payment methods) from the owners not belonging to the groups. These results suggest that policies for crypto-asset owners, if ever implemented, should not only consider the average owner's characteristics, but also owners' heterogeneity.

1. Introduction

The adoption of crypto assets has been a great concern for policymakers ever since Facebook announced its cryptocurrency, Libra, in June 2019. Behind this concern lies the possibility of widespread adoption of Libra for day-to-day transactions in emerging market economies—as a result of the anticipated stability of Libra's value, which is linked to a basket of major sovereign currencies (such as USD, EUR, or GBP). The immediate reaction of G20 leaders to Libra being announced was a highly negative one and they pointed out a set of serious risks related to money laundering, illicit financing, and consumer and investor protection. Meanwhile, many central

banks—including those linked with advanced economies, such as China, Canada, the UK, Japan, the EU, Sweden, and Switzerland—have begun to research the possible introduction of central bank digital currencies.

Before Libra was announced, both academic researchers and investors tended to view crypto assets as being primarily used for storing value rather than as a medium of exchange for day-to-day transactions. Previous academic studies on crypto assets, as surveyed in Halaburda et al. (2020) or Smith and Kumar (2018), have established the volatile price formation of crypto assets—especially Bitcoin. Along with Bitcoin's volatile price, its slow settlement time, and high real costs of operating the system—especially the energy consumption required to

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power it—do not make it useful for day-to-day transactions, as noted by [Mester \(2020\)](#). Even when crypto assets are viewed as a store of value, investors have experienced recurring asset losses as a result of hacking attacks on crypto-asset-exchange companies. Japanese examples include the hacking attacks on Bitpoint in 2019 and on Tech Bureau in 2018. When viewed as a means of day-to-day transactions, crypto assets can also lead to losses. In one Japanese example, the 2014 failure of a Bitcoin exchange—called Mt. Gox—prevented the use of crypto assets for day-to-day transactions.

However, after Libra was announced—and given the possibility of widespread adoption of this cryptocurrency for day-to-day transactions—the use of crypto assets should not only be examined for value-storing purposes but also as everyday payment tools. To study the value-storing function of crypto assets, we should consider the effects of financial literacy on asset accumulation (see [Lusardi and Mitchell, 2014](#), and [Gomes et al., 2020](#), for surveys). For example, positive associations between stock market participation and level of financial knowledge, observed by [van Rooij et al. \(2011\)](#), have also been reported in Japan (for a recent example, see [Gan et al., 2019](#) and [Fujiki, 2020](#)). Would we obtain the same positive associations between crypto-asset ownership and financial literacy? To study the demand for crypto assets for day-to-day transactions, we should also consider the relationship between the choice of payment methods and demographic characteristics, such as age, gender, and educational attainments. For example, [Fujiki \(2019\)](#) showed that credit card users who make day-to-day payments of over 10,000 yen (about 90 US dollars) tend to be young and female, as well as have higher educational attainment, in comparison to cash-only users (see [Stavins \(2017\)](#) for a survey outside Japan, and [Fujiki \(2019\)](#) for evidence in Japan). [Huynh et al. \(2020\)](#) showed that improvements in welfare, resulting from the adoption of a central bank digital currency, vary depending on users' age and the differing degrees of users' education and income. Would we obtain similar associations between crypto-asset ownership and demographic characteristics?

Despite legitimate policy concerns around crypto assets, the number of studies on the demographic characteristics of crypto-asset owners is small (see [Halaburda et al. \(2020\) Section 4](#) for a survey). Notable exceptions are studies from the US ([Schuh and Shy, 2016](#); [Hundtofte et al., 2019](#)), Canada ([Henry et al., 2018](#), [Henry et al., 2019](#), [2019b](#)), and Austria ([Stix, 2019](#)). These studies showed that crypto-asset owners are more likely to be young, male, and have lower educational levels than nonowners. [Henry et al. \(2019b\)](#) showed that Canadian crypto-asset owners have a lower level of financial literacy, while [Stix \(2019\)](#) showed that Austrian crypto-asset owners have higher levels of financial knowledge. Two studies investigated the demographic characteristics of owners of structured financial products related to crypto assets and those of owners of speculative assets including crypto assets. [Lammer et al. \(2019\)](#) found that European and US individuals who used a German online bank to invest in cryptocurrencies with structured retail products tend to be male, have a high monthly income, and are active traders who are prone to investment biases and hold risky portfolios. [Kawamura et al. \(2019\)](#) showed that Japanese investors making a speculative investment—who have experience investing in at least one of the following five financial assets: foreign exchange margin trading, equity margin trading, futures, options, and cryptocurrencies—tend to have a higher level of financial literacy and to be less loss-averse, less risk-averse, and overconfident (measured using the score obtained on the self-evaluation of one's financial literacy quiz and one's actual score) in their financial literacy. However, [Kawamura et al. \(2019\)](#) analyzed investors making a speculative investment who own at least one of the five financial assets, including crypto assets; therefore, these investors may include crypto asset nonowners. Outside Japan, there are no studies that provide detailed information on both financial literacy and financial behavior of crypto-asset owners.

To address this gap in the literature, this study uses data from

Japan's 2019 Financial Literacy Survey (FLS) to investigate—among Japanese adopters of crypto assets—demographic characteristics (e.g., age, gender, income, financial asset holdings, occupation, and educational attainment); financial literacy; financial behavior including the perspective of behavioral economics (e.g., overconfidence in one's financial literacy, see [Beshears et al. \(2018\)](#) for literature on behavioral household finance); three types of conventional risky financial asset holdings (stocks, investment trusts, and bank deposits and money market funds [MMFs] denominated in foreign currency); and the adoption of noncash payment methods.

The study applies both probit models and multinomial logit models in two ways. First, this study investigates the variables that distinguish Japanese crypto-asset nonowners from owners. In doing so, it also investigates the variables that distinguish the nonowners from owners belonging to two groups: a group according to their level of understanding of crypto assets, and a group according to the profitability of their investment in crypto assets. Second, this study investigates the variables that distinguish the owners belonging to each group from the rest of the owners. The second investigation focuses on four groups: owners' level of understanding of crypto assets, the profitability of their investment in crypto assets, their holdings of conventional risky financial assets, and their adoption of noncash payment methods. Previous studies had focused on comparisons between crypto-asset nonowners and owners as in our first analysis. The second analysis was possible because the FLS contains a relatively large number of crypto-asset owners (1622 persons).

Regarding the first analysis, which compares the average owners and nonowners, we find that 35 variables statistically significantly distinguish average Japanese crypto-asset owners from nonowners. Japanese crypto-asset owners are more likely to be male and be aged below 30 years, which is consistent with the findings for the US ([Schuh and Shy, 2016](#)), Canada ([Henry et al., 2019b](#)), and Austria ([Stix, 2019](#)). Owners tend to have higher pretax income, work in private or public companies, or be self-employed. Owners tend to be graduate-school graduates, which is consistent with [Henry et al. \(2019b\)](#) but opposite to the results of [Schuh and Shy \(2016\)](#) and [Henry et al., 2019](#). They are also more likely to have experience investing in at least one of three types of conventional risky financial assets, which is consistent with [Stix \(2019\)](#). We also find that Japanese owners tend to have higher financial literacy from two perspectives: a measure of objective financial literacy and the experience of financial education at school, and lower financial literacy from three perspectives: the experience of financial education about money management by parents at home, the experience of financial troubles, and knowledge about credit cards, than the average nonowner. A positive association of objective financial literacy and ownership is consistent with [Stix \(2019\)](#) and opposite to [Henry et al. \(2019b\)](#). Regarding information sources, average crypto-asset owners tend to obtain information on the economy and finance from mass media more frequently and have favorite knowledge and information sources when selecting financial products. Regarding financial behavior, owners tend to be overconfident about their financial literacy, be impatient, judge based on reputation in selecting financial products, lack self-control, and be less risk-averse than nonowners. Owners also tend to use noncash payment methods. We also find over 85% of the 35 variables that distinguish between nonowners and the average owner differentiate, in a similar manner, nonowners from crypto-asset owners grouped by their level of understanding of crypto assets and the profitability of their investment in crypto assets. Several exceptions apply to the characteristics of owners who do not understand crypto assets compared with nonowners. Unlike the average owner, they tend to have a lower value of objective financial literacy and they are less overconfident and risk-averse. They are not impatient and lacking in self-control.

Our second analysis investigates the variables that distinguish the owners belonging to each group from the rest of the owners. We propose two measures of heterogeneity among crypto-asset owners

classified by four subgroups.

First, if the owners are heterogeneous in some respect (say, owners are likely to be male), the proxy variable that statistically significantly distinguishes owners and nonowners (say, dummy variable of gender) should statistically significantly distinguish the owners belonging to a group (say, owners using noncash payments) and the other owners (say, owners not using noncash payments). We find that owners are heterogeneous in this respect because 40–60% of the variables that statistically significantly distinguish between the average owners and nonowners also distinguish owners belonging to three of the four groups, excluding the group that uses noncash payment methods, from the owners not belonging to the groups. However, among the noncash payment users, if we compare owners using mobile payments via smartphone with the other owners, they tend to have some similar demographic characteristics as the average owners compared with nonowners. Owners using mobile payments via smartphone tend to be aged below 40 years and positively associated with annual pretax household income above 15 million yen, obtain information from mass media more frequently, be overconfident about their financial literacy, follow reputation in making a financial decision, and be less risk-averse.

Second, if a variable that does not statistically significantly distinguish owners and nonowners turns out to statistically significantly distinguish the owners who belong to each group and the owners who do not belong to the group, we also find that owners are heterogeneous in those variables. We find that owners are also heterogeneous in this respect, however, at most 30% of the variables that do not statistically significantly distinguish owners and nonowners turn out to statistically significantly distinguish the owners belonging to four groups, apart from the group by the owners' level of understanding of crypto assets, from owners not belonging to the groups.

Taken together, these results suggest that financial inclusion policy and investor education for owners, if ever considered, should not only consider the average owner's characteristics but also the owners' heterogeneity. Regarding the owners' use of new crypto assets for day-to-day payment methods, we should note that even among crypto-asset owners, those who adopt new payment methods in Japan, such as mobile payments via smartphone, tend to be young owners. Thus, the regulators should not assume that all generations of crypto-asset owners would smoothly adopt new crypto assets simply because they have already adopted some type of crypto assets. Financial inclusion policy on the use of new crypto assets for day-to-day transactions, if ever considered, would be designed for elderly people and thus not target relatively young average crypto-asset owners. However, financial inclusion policy might be useful for relatively elderly crypto-asset owners, who are also unlikely to use mobile payments. Regarding the investors' use of crypto assets as a store of value, owners who do not understand crypto assets need different investor education programs suited for the average owner. Financial education programs targeted at the average owner, based on our results, should focus education on financial behavior such as overconfidence, impatience, and lack of self-control. However, owners who do not understand crypto assets would not benefit from this program but would benefit from investor education on objective financial literacy.

Before moving on to the details of our analysis, we summarize the related literature. Our paper closely relates to six studies that used microdata outside Japan: two in the US (Schuh and Shy, 2016; Hundtofte et al., 2019), three in Canada (Henry et al., 2018, Henry et al., 2019, 2019b), and one in Austria (Stix, 2019). In the results of the US studies, Schuh and Shy (2016) showed that a typical Bitcoin owner is more likely to be a younger, nonwhite male with a lower education level. Younger and lower-income consumers tend to make greater use of crypto assets. Consumers that use debit cards and prepaid cards relatively more often are less likely to use Bitcoin. Hundtofte et al. (2019) studied 1146 people who were surveyed by the May 2018 Survey of Consumer Expectations. They showed that the actual and potential ownership of cryptocurrencies is concentrated in

younger, wealthier demographics. Younger individuals are more likely, on average, to report greater knowledge of cryptocurrencies. Henry et al. (2019b) used Canadian surveys on crypto assets to show that younger people and men are most likely to own Bitcoin. Furthermore, higher education levels, higher income levels, and a lower level of financial literacy (as measured by the "Big 3" questions of Lusardi and Mitchell, 2014) are positively associated with Bitcoin ownership. The authors also used, as an indicator, a measure of Bitcoin knowledge scores. They found that those with positive scores show the highest levels of Bitcoin adoption. Henry et al., 2019 found that more-educated Canadians are more likely to adopt contactless debit or credit cards and mobile payment technologies, while less-educated Canadians are adopting Bitcoin. Higher income is an important predictor of contactless debit or credit card adoption, whereas this variable does not appear to be significant for Bitcoin. For online payment methods (debit and credit cards), regional and age predictors are similar to those for Bitcoin, whereas income and education factors show opposite effects. Through descriptive analysis, Stix (2019) showed that Austrian crypto-asset owners are younger and more likely to be male. The probit regression for adoption showed that owners are more risk-tolerant, more likely to be invested in other risky financial assets, and have higher levels of financial knowledge (measured by the quality of the newspapers they read), on average, than nonowners of crypto assets. However, to our knowledge, no other study has used Japanese data to investigate heterogeneity among owners. Unlike these studies, the FLS 2019 does not distinguish between the awareness and adoption of crypto assets. Instead, it focuses on the use of crypto assets and crypto-asset owners' understanding of their nature. Furthermore, the FLS includes data on the adoption of conventional risky financial assets and the use of other payment methods. We examine not only the relationship between the adoption of conventional risky financial assets and crypto-asset ownership similar to Stix (2019) but also compare owners according to the adoption of conventional risky financial assets. We also study not only the relationship between the use of noncash payment methods and crypto-asset ownership similar to Schuh and Shy (2016) and Henry et al., 2019 but also a comparison of the owners according to the use of noncash payment methods. Another strength of the FLS 2019 is the data gathered on financial literacy and financial behavior, which can be compared with the analyses by Stix (2019) and Henry et al. (2019b).

This paper also relates to two papers using Japanese data. First, Kawamura et al. (2019) found that investors who have experience of investing at least one of the five speculative financial assets tended to be male and to have a higher level of financial literacy. They also tended to be young, less loss-averse, less risk-averse, and overconfident in their financial literacy. However, Kawamura et al. (2019) did not report the results for crypto-asset owners separating ownership by the other four speculative assets. Unlike Kawamura et al. (2019), we examine crypto-asset ownership separately without combining the ownership of conventional risky financial assets. Moreover, Kawamura et al. (2019) did not examine heterogeneity among speculative asset owners. Fujiki (2019) used data from 2007 to 2017 to study consumer choice of payment methods. Fujiki showed that both frequent credit card users for day-to-day payments of over 10,000 yen and frequent electronic money users for day-to-day payments of below 1000 yen tend to have higher disposable incomes, greater financial assets, and better financial literacy, as measured by their understanding of the deposit insurance system. They also tend to be young, female, and not self-employed, as well as having higher educational attainment and live in large cities—in comparison with cash-only users. Nevertheless, Fujiki (2019) did not study the adoption of crypto assets, debit cards, and mobile payments via smartphones because of a lack of data.

The rest of this paper is organized as follows. Section 2 explains the data on crypto assets available in the FLS. Section 3 discusses the data on the adoption of conventional risky financial assets and the choice of payment methods available in the FLS. Section 4 discusses the

Table 1
Crypto-asset ownership, understanding of crypto assets, and profitability from investment in crypto assets.

	Observations	% of total	Observations	% of owners	% of total	Observations	% of owners	% of total
Nonowners	13,895	89.5	13,895		89.5	13,895		89.5
Owners	1622	10.5						
	Do not understand		203	12.5	1.3			
	Do not understand so well		422	26.0	2.7			
	Understand to some extent		719	44.3	4.6			
	Understand very well		278	17.1	1.8			
	Profit					329	20.3	2.1
	Break even					794	49.0	5.1
	Loss					499	30.8	3.2
Total	15,517	100	15,517	100	100	15,517	100	100

demographic variables obtained from the FLS, which are used as conditioning variables. Section 5 reports the results of the regressions comparing owners and nonowners. Section 6 uses the regression results to examine heterogeneity among owners. Section 7 presents our conclusions.

2. Crypto-asset data in the FLS

We begin by explaining the FLS data on the adoption, use, degree of understanding, and profit from investing in crypto assets. Because we are interested in the relationship among financial literacy, investment behavior of investors, and adoption of crypto assets, the following analysis focuses on a subsample of 15,517 observations among the 25,000 observations, who stated that they selected their financial products in one of the FLS questions.

Question 43 in the FLS first asks whether or not the respondents have adopted crypto assets during the past three years. Second, if the respondents have adopted crypto assets, then they are asked to choose their degree of understanding of the crypto assets they have adopted. They select their answers from among the following choices: I understand the product details well enough to be able to explain them to other people (hereafter, “understand very well”), I understand the product details to a certain extent (hereafter, “understand to some extent”), I do not understand the product details so well (hereafter, “do not understand so well”), and I do not understand the product details (hereafter, “do not understand”). Finally, the FLS asks the adopters of crypto assets whether they are making a profit or loss, or whether they are breaking even (including the cost of mining, purchase and sale, and capital gain or loss as of today) from their investment in crypto assets.

In Table 1, the third and fourth columns show the number and percentage of respondents who have not adopted crypto assets (the second row, labeled Nonowners) and the respondents who have adopted crypto assets (the third row, labeled Owners) among the 15,517 observations. Table 1 shows that 13,895 (89.5%) respondents, hereafter nonowners, had not adopted crypto assets. The remaining 1622 (10.5%) respondents, hereafter owners, had adopted crypto assets during the last three years.

In the US, from 2014 to 2015, crypto-asset owners constituted 1% of the population (Schuh and Shy, 2016). More recently, 5% of US respondents were found currently to own or to have previously owned cryptocurrency (Hundtofte et al., 2019). In Canada, it was also 5% (Henry et al., 2019b), while in Austria it was 1.5% (Stix, 2019). Japan's crypto-asset ownership rate of about 11%, according to the FLS, seems high in comparison to the rates presented in these foreign studies. However, two other Japanese data sources indicate that the country's crypto-asset ownership may be comparable with what is reported in these foreign studies.

First, the annual Internet survey by Nikkei Research, called Japan's Personal Assets Database “RADAR” (hereafter, RADAR), showed that 155 (or 5.1% of 3065 observations) and 179 (5.8% of 3112 observations) of those surveyed, in 2018 and 2019 respectively, had adopted

crypto assets (including those who had adopted crypto assets in the past but did not have them at the time of the survey).¹ Second, an Internet survey on crypto assets for 10,857 individuals—conducted by My Voice in March 2018—showed that about 80% of the respondents in Japan were aware of crypto assets and 2.2% were crypto-asset owners. Another 0.6% had held crypto assets in 2017 but not in 2018.² We do not know which of the data sets most closely represent the percentage of Japanese citizens who own crypto assets; nevertheless, we continue our examination of the FLS data.

The fourth through seventh rows of Table 1 show that among the 1622 owners, 203 owners (or 13% of owners and 1% of all observations, hereafter) do not understand crypto assets as shown in the fifth through seventh columns. Another 422 owners (or 26% and 3%) do not understand crypto assets so well, while 719 owners (or 44% and 5%) understand crypto assets to some extent; and 278 owners (or 17% and 2%) understand crypto assets very well.

The eighth through tenth rows of Table 1 show that among the 1622 owners, 329 owners (or 20% of owners and 2% of all observations, hereafter) earn profits as can be seen in the eighth through tenth columns. Another 794 owners (or 49% and 5%) break even, while 499 owners (or 31% and 3%) have losses.

In summary, Table 1 shows that about 40% of owners have purchased crypto assets without having a solid understanding of them and only 20% of owners have made a profit from their investment in them. The results urge us to examine which demographic characteristics correlate with such a risky investment decision—for example, lack of financial literacy, age, gender, or educational attainment.

Note that the FLS 2019 does not ask what motivated the respondents' use of crypto assets when it asks about the profitability of investment and understanding of crypto assets. Thus, one might well wonder whether the investment was the respondents' only reason for holding crypto assets. On this point, the 2018 edition of RADAR asked some of the respondents to provide their reasons for using crypto assets. The replies of the 72 respondents who had adopted crypto assets and wanted to use them indicated that 60% aimed to make a speculative investment, 38% wished to study crypto assets and blockchain technology, 31% wanted to buy goods and services on the Internet, 24% aimed to make international remittances, and 19% wished to buy goods and services in physical stores. Judging from the results of the 2018 edition of RADAR, the FLS 2019's focus on investment motivation does not seem to be problematic.

Note also that the FLS's questions on the profitability of investment

¹ RADAR surveys people aged 20–74 years but includes only those living in the Tokyo metropolitan area and its four surrounding prefectures: Ibaraki, Saitama, Chiba, and Kanagawa. If we focus on the subsample of the FLS 2019 that lives in the Tokyo metropolitan area and its four surrounding prefectures, as RADAR 2018 and 2019 do, then the FLS 2019 would contain only 660 crypto-asset owners (8.4% of 7,817 observations).

² See details on the My Voice website: https://myel.myvoice.jp/products/detail.php?product_id=23605. (Accessed September 18, 2020)

Table 2
Experience of investing in conventional risky financial assets and the choice of payment methods by ownership of crypto assets.

	Owners			Nonowners		
	Observations	% of owners	% of total	Observations	% of Nonowners	% of total
<i>s or i or f</i>	1308	80.6	8.4	8006	57.6	51.6
<i>sif</i>	746	46.0	4.8	1976	14.2	12.7
<i>s_i</i>	186	11.5	1.2	1911	13.8	12.3
<i>s_f</i>	59	3.6	0.4	433	3.1	2.8
<i>i_f</i>	38	2.3	0.2	472	3.4	3.0
<i>s_{only}</i>	192	11.8	1.2	1744	12.6	11.2
<i>i_{only}</i>	57	3.5	0.4	1077	7.8	6.9
<i>f_{only}</i>	30	1.8	0.2	393	2.8	2.5
Noncash payment users	1522	93.8	9.8	12,675	91.2	81.7
Credit card users	1367	84.3	8.8	11,305	81.4	72.9
Electronic money users	1142	70.4	7.4	8664	62.4	55.8
Debit card users	393	24.2	2.5	1004	7.2	6.5
Mobile payment users	651	40.1	4.2	2374	17.1	15.3

from crypto assets and about the understanding of crypto assets are both self-reporting—therefore, the responses could be biased. We also do not know to what extent the crypto-asset transactions made by the owners might have been related to illegal or shadow economy activities, and we do not know which currency exchanges were used by the owners.

3. Crypto-asset ownership, investment decision on three types of conventional risky financial assets, and choice of payment method

To study the storing of value and day-to-day payments function of crypto assets, we will examine the relationship between investment decisions on three types of conventional risky financial assets, choice of payment methods, and crypto-asset ownership.

Regarding the relationship between investment decisions on three types of conventional risky financial assets and crypto-asset ownership, we use Question 34 of the FLS on the experience of investing in three types of conventional risky financial assets: stocks (*s*), investment trusts (*i*), and bank deposits and MMFs denominated in foreign currency (*f*, hereafter called foreign currency denominated deposits and MMFs). We construct a dummy variable *s or i or f* that takes a value of 1 for those who have experience of investing in at least one of these risky financial asset types and otherwise 0. We also constructed dummy variables for all possible choices among the three types of risky financial assets for reference: *sif* for those who have experience investing in all three of these risky financial asset types; *s_i*, *s_f*, or *i_f* for those who have invested in two out of the three asset types; and *s_{only}*, *i_{only}*, and *f_{only}* for those who have invested in only one of these risky financial asset types.

Regarding the choice of payment method, we use Question 45 of the FLS: “How often do you use the following payment methods: credit cards, debit cards, electronic money, mobile payments via smartphones, cash? Choose only one answer from the following options: Almost every day; About once a week; About once a month; Scarcely or never; I have not adopted them.” In this question, mobile payments via smartphones can be prepaid or postpaid, QR-code based, or in the form of mobile wallets for credit cards, debit cards, or electronic money. Cash includes checks. We consider the respondents who chose the answers “Almost

every day,” “About once a week,” and “About once a month” to be the users of each payment method.

We use the following dummy variables to indicate the choice of payment methods. We construct a dummy variable *Noncash payment users* that takes a value of 1 for those who use at least one of the four noncash payment methods—credit cards, electronic money, debit cards, and mobile payments via smartphones—and 0 otherwise. We also construct four dummy variables: *Credit card users*, *Electronic money users*, *Debit card users*, and *Mobile payment users*. These four dummy variables take a value of 1 for the users of credit cards, electronic money, debit cards, and mobile payments via smartphones, and otherwise 0.

Question 45 aims to examine the effects of a policy made by the Ministry of Economy, Trade and Industry of Japan (METI), which aimed to subsidize cashless payments in some registered retail shops by June 30, 2020—following the increase in the consumption tax rate on October 1, 2019. The plan was to increase the cashless payment rate from 20% to 40% by 2025. The METI subsidized both users and registered shops that accepted cashless payments—including those carried out by credit cards, electronic money, debit cards, and mobile payments via smartphones from October 1, 2019 to June 30, 2020. Users of cashless payments received a discount of 2% or 5% on purchases made at registered retail shops. The registered retail shops received a 75% subsidy for the costs of introducing new registers and terminals that accepted cashless payments. These registered retail shops also enjoyed the upper limit of the merchant fee of 3.25% (with a 1.08% subsidy). As summarized in Fujiki (2019), Japanese people use credit cards for higher-value day-to-day transactions. They use electronic money (via contactless prepaid cards, which became available in Japan in 2001) for lower-value day-to-day transactions at convenience stores, train and subway stations, and supermarkets. The use of debit cards (including both cash withdrawal cards, accepted only within Japan, and internationally branded debit cards) was not as popular in Japan as electronic money, until recently. Major banks started issuing branded debit cards in 2013 and the volume of transactions made using branded debit cards increased substantially (Bank of Japan, 2019). Mobile payments via smartphones are new to Japan. It was only around the end of 2018 that many Japanese people became aware of the existence of these services. This was because many new payment companies—held by nonbanks, such as cell-phone carriers, Internet providers, and a social networking service company—offered discounts for their payment services using QR-code, anticipating METI’s policy. Hence, some FLS 2019 (conducted in March 2019) respondents may have known about these new services before they responded to the survey.

In Table 2, the third and sixth columns report the number of crypto-asset owners and nonowners that take a value of 1 for our dummy variables on the experience of investing in conventional risky financial assets and on the choice of payment methods. The fourth and seventh columns report the percentage of observations that take a value of 1 for each dummy variable for 1622 owners and 13,895 nonowners. The fifth and eighth columns report the percentage of observations that take a value of 1 for each dummy variable among the overall 15,517 observations. We note some differences between the percentage of observations that take a value of 1 among owners and nonowners.

First, the variable *s or i or f* shows that crypto-asset owners tend to have a higher probability of experience in investing in at least one of the three types of conventional risky financial assets (81% of owners) than nonowners (58% of nonowners). This difference mainly reflects a higher value of *sif* for owners (46% of owners) and a lower value of *sif* for nonowners (14% of nonowners).

Second, the variable *Noncash payment users* shows that owners use noncash payment methods slightly more frequently than nonowners do (94% of owners and 91% of nonowners). This result mainly reflects the fact that the proportion of *Credit card users* is similar among owners and nonowners (84% and 81%). The proportion of *Electronic money users* is

higher among owners than among nonowners (70% and 62%). The proportions of *Debit card users* and *Mobile payment users* are substantially higher among owners (24% and 40%, respectively) than among nonowners (7% and 17%, respectively).

Finally, conditional on the use of noncash payment methods, the ratio of crypto-asset owners among *Credit card users*, *Electronic money users*, *Debit card users*, and *Mobile payments users* is 11%, 12%, 28%, and 22%, respectively.³ Schuh and Shy (2016) showed that consumers who use debit cards and prepaid cards relatively more often are less likely to use Bitcoin. Our data show that consumers who use debit cards and mobile payments via smartphone are more likely to use crypto assets.

4. Demographic variables in the FLS

We use various demographic variables in the remaining analysis. Some of these demographic variables are proposed by Sekita et al. (2018) and Kadoya and Khan (2020), who used the FLS 2016, which used the same questions to construct these demographic variables as the FLS 2019. These include questions related to financial literacy, sources of information on finance, and financial behavior—together with standard demographic variables, such as pretax income, total household financial asset holdings, age, gender, employment status, educational attainment, and areas of residence—which we explain below.

First, we follow Sekita et al. (2018) in using a proxy for objective financial literacy. *Objective financial literacy* is defined as the number of correct answers to 11 questions in five categories of financial literacy.

First, “deposits literacy” is defined as the number of correct answers to two questions (Questions 18 and 19).

- Question 18: “Suppose you put one million yen into a savings account with a guaranteed interest rate of 2% per year. If no further deposits or withdrawals are made, how much would be in the account after one year once the interest payment is made? Disregard tax deductions. Answer with a whole number.”
- Question 19: “Then, how much would be in the account after five years? Disregard tax deductions.” Choose only one answer from the following options: 1. More than 1.1 million yen; 2. Exactly 1.1 million yen; 3. Fewer than 1.1 million yen; 4. Impossible to tell from the information given; 5. Do not know.

Second, “risk literacy” is defined as the number of correct answers to two risk literacy questions (Questions 21_3 and 21_4).

- Question 21_3: “Please indicate whether you think the following statement is true or false: An investment with a high return is likely to be high risk.”
- Question 21_4: “Please indicate whether you think the following statement is true or false: Buying a single company’s stock usually provides a safer return than a stock mutual fund.”

Third, “insurance literacy” is defined as the number of correct answers to two insurance literacy questions (Questions 25 and 26).

- Question 25: “Which of the following statements on the basic function of insurance is appropriate?” Choose only one answer from the following options: 1. Insurance is effective when a risk occurs with high frequency, causing a large loss; 2. Insurance is effective when a risk occurs with low frequency, causing a large loss; 3. Insurance is effective when a risk occurs with high frequency,

causing a small loss; 4. Insurance is effective when a risk occurs with low frequency, causing a small loss; 5. Do not know.

- Question 26: “When a 50-year-old man reviews his life insurance policy (whole life insurance) after his children have become financially independent, which of the following statements is appropriate?” Suppose that other circumstances have not changed. Choose only one answer from the following options: 1. He should consider increasing the death benefit; 2. He should consider decreasing the death benefit; 3. There is no need to review the policy, in particular; 4. Do not know.

Fourth, “debt literacy” is defined as the number of correct answers to four debt literacy questions (Questions 21_2, 30, 31, and 22).

- Question 21_2: “Please indicate whether you think the following statement is true or false: When compared, a 15-year mortgage typically requires higher monthly payments than a 30-year mortgage but the total interest paid over the life of the mortgage will be less.”
- Question 30: “Which of the following statements on mortgages is appropriate?” Choose only one answer from the following options: 1. It is far less costly to continue living in a rented house for your entire life than to buy a house with a mortgage; 2. Mortgages can be repaid by either the equal payment method or the equal principal payment method but the total repayment is the same for both methods; 3. Mortgages are offered with either a floating interest rate or a fixed interest rate and those with a fixed interest rate are always more advantageous than those with a floating interest rate; 4. To decrease the total mortgage repayment, it is advisable to obtain as large a down payment as possible and make advanced repayments to the extent possible; 5. Do not know.
- Question 31: “Suppose you owe 100,000 yen on a loan and the interest rate you are charged is 20% per year, compounded annually. If you did not pay anything off, at this interest rate, how many years would it take for the amount you owe to double?” Choose only one answer from the following options: 1. Less than 2 years; 2. At least 2 years but less than 5 years; 3. At least 5 years but less than 10 years; 4. At least 10 years; 5. Do not know.
- Question 22: “If interest rates rise, what will typically happen to bond prices?” Choose only one answer from the following options: 1. They will rise; 2. They will fall; 3. They will stay the same; 4. There is no relationship between bond prices and interest rates; 5. Do not know.

Fifth, “inflation literacy” is defined as the number of correct answers to two inflation literacy questions (Questions 20 and 21_1).

- Question 20: “Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After one year, how much would you be able to buy with the money in this account?” Choose only one answer from the following options: 1. More than today; 2. Exactly the same; 3. Less than today; 4. Do not know.
- Question 21_1: “Please indicate whether you think the following statement is true or false: High inflation means that the cost of living is increasing rapidly.”

We construct *Objective financial literacy* from the number of correct answers to the 11 financial literacy questions above.⁴ Besides *Objective financial literacy*, we follow Kadoya and Khan (2020) in using a dummy variable on the experience of financial troubles, such as bank transfer fraud or multiple debts (*Fraud1*), which takes a value of 1 for those who have such an experience and otherwise 0.

³ These percentages are the ratio of the numbers in the third column to the sum of the numbers in the third and sixth columns reported in the 12th through 15th rows in Table 2. For example, the ratio of crypto-asset owners among *Credit card users* is $(1,367 / (1,367 + 11,305)) = 0.1078$, or 11%.

⁴ Note that we can also construct the financial literacy index based on the standard “Big 3” questions on compound interest, inflation, and stock risk by Lusardi and Mitchell (2014) from Questions 18, 19, 20, and 21_4.

We extend Sekita et al. (2018) and Kadoya and Khan (2020) using dummy variables of experience of financial education at school, college, or workplace (*Fin. education school*) or experience of being taught about money management by parents at home (*Fin. education home*), debt holdings (*Debt*), and knowledge about credit cards (*Credit card literacy*). *Credit card literacy* is based on Question 5 of the FLS: “Which of the following statements about household management and credit cards is not appropriate? Choose one answer from the following options: 1. Credit cards should be used in a well-planned manner according to income; 2. Any unsettled credit card payment is practically a debt; 3. A credit card fee (interest) is charged for revolving payments but not for installment payments; 4. Failure to pay the credit card charge may cause credit card transactions to be declined; and 5. Do not know.” *Credit card literacy* is a dummy variable that takes a value of 1 for respondents selecting option 3, and otherwise 0.

Second, we prepare two variables related to information sources.

First, use the frequency of obtaining information on financial and economic conditions from mass media (*News*) following Kadoya and Khan (2020). *News* is based on Question 53 of the FLS: “How often do you get financial and economic information through newspapers, magazines, TV, and the Internet?” Choose one answer from the following options: 1. Almost every day; 2. About once a week; 3. About once a month; 4. Less than once a month; and 5. Never. *News* takes values of 4, 3, 2, 1, and 0 for a respondent who chooses the options 1 through 5, respectively.

Second, we use dummy variables on respondents’ sources for obtaining knowledge and information when selecting financial products. We use Question 35 of the FLS: “Where do you get your knowledge and information to help you choose financial products?” Choose up to three answers from the following options: 1. Consultation at financial institutions (asking the sales staff to explain); 2. Pamphlets provided at financial institutions; 3. Lecture meeting or a seminar; 4. Consultation with financial professionals/professional financial advisors; 5. Media reports (TV and radio programs, newspapers, magazines, etc.); 6. Websites; 7. Conversations with family members/friends; 8. Taking classes and/or attending lectures at schools (including those for adults); 9. Other information sources; 10. I am not sure what opportunities would allow me to acquire such knowledge or information; 11. I do not invest in financial products. Note that we begin our analysis by dropping the respondents who chose option 11. Thus, we constructed the following dummy variables using options 1 through 10 as follows.

We first create a dummy variable that takes a value of 1 for respondents who chose option 10 (*S_{do not know}*). Note that respondents who chose option 10 did not choose any other options.

Second, we create dummy variable *S_{fin inst}* for respondents who chose at least one option from options 1, 2, 3, 4, 8, and 9. Options 1 through 4 are grouped because Fujiki (2020) found that 81% of the respondents chose financial institutions and/or financial experts as their sources of financial knowledge, and those respondents tended to have a greater amount of financial asset holdings than the rest of the respondents using the Survey of Household Finances data from 2010 to 2017. Aggregation of options 1 and 2 makes sense because financial institutions, such as banks, security firms, and insurance companies, have traditionally provided financial knowledge in Japan. One may argue that we should separate options 3 and 4 because financially literate people tend to seek advice from financial experts (see the literature review in Fujiki (2020)). However, financial institutions employ fully half of all Japan’s certified financial planners and the sales staff in a financial institution are likely to be financial experts, thus the distinction between financial institutions and financial experts is not clear in Japan. Both options 8 and 9 are rarely chosen (1.5% and 1% of the sample) and thus we include them in *S_{fin inst}* to simplify the analysis.

Finally, we create dummy variable *S_{exclude fin inst}* that takes a value of 1 for respondents who select at least one option from options 5, 6, and 7 but did not choose any options from 1 through 4, 8, and 9. Note that the FLS is a web survey and given the importance of the Internet

today, we combine options 5 and 6. The respondents who have a value of 1 for *S_{exclude fin inst}* use family and friends, mass media, and websites as their information sources, but do not use formal information sources such as financial institutions or financial experts. In the remaining regression analysis, we use *S_{exclude fin inst}* as the base case.

Third, we follow Sekita et al. (2018) and use six variables that capture financial behavior. *Impatience* captures the person with a higher level of time preference. It is based on the following question: “If I had the choice of (1) receiving 100,000 yen now for sure or (2) receiving 110,000 yen in 1 year for sure, I would choose (1). Choose on a scale of 1 to 5, where 1 means ‘agree’ and 5 means ‘disagree’.” *Impatience* is defined as the difference between 5 and the answer to this question, so that higher values correspond to a respondent with a higher rate of time preference and thus who is impatient, assuming that the risk-free interest rate remains about zero as in the Japanese economy. *Reputation* is a proxy variable that shows whether a person judges based on reputation in making financial decisions. It is based on the following question: “When there are several similar products, I tend to buy what is recommended as the best-selling product rather than what I actually think is a good product.” *Self-control* is a proxy of the degree to which a person makes deliberate and thoughtful decisions. It is based on the following question: “Before I buy something, I carefully consider whether I can afford it.” *Overconfidence* captures one’s overconfidence regarding financial literacy through the difference between one’s subjective financial literacy (self-evaluation of one’s level of financial literacy in comparison to other people) and *Objective financial literacy*.⁵ We create two proxy variables for risk aversion. *Risk aversion 1* is a dummy variable that takes a value of 1 for a person who says “no” to the question “If you invested 100,000 yen, you would either get a capital gain of 20,000 yen or a capital loss of 10,000 yen at 50% probability.” *Risk aversion 2* is a proxy value for the extent to which a person is reluctant to take a risk on an investment. It is based on the following question: “I am prepared to take a risk when saving or making an investment.”⁶

Fourth, we use the following seven categories of dummy variables for demographic variables: annual pretax household income (*Income*) by ranges (in units of 10,000 yen, *Income_{x,y}* is annual pretax household income above x and lower than or equal to y , where the base case is *Income_{0,250}*); total household financial asset holdings (*Assets*) by ranges (in units of 10,000 yen, where *Asset_{x,y}* is financial asset holdings above x and lower than or equal to y and the base case is *Asset_{0,250}*); the gender of respondents (*Male* = 1 for men); the ages of respondents by ranges (*Age*: below 25, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 74–79, where the base case is below 25); the employment status of respondents (*Private* company, *Public* company, *Teacher*, *Self-employed*, *Part-time*, *House* [stay-at-home mum/dad], *Student*, *No Job*, and *Other Job*, where the base case is the sum of *No Job* and *Other Job*); the educational attainment of respondents (*Junior high or below*, *Senior high*, *Vocational college*, *Junior college*, *University*, *Graduate*, and *Other schools*, where the base case is the sum of *Junior high or below*, *Senior high*, and *Other schools*); and the nine areas of residence (*Hokkaido*, *Tohoku*, *Hokuriku*, *Kanto*, *Chubu*, *Kinki*, *Chugoku*, *Shikoku*, and *Kyushu*, where the base case is the *Kanto* region).

Table 3 reports the averages and standard deviations (hereafter as S.D.) of these variables by ownership of crypto assets. We note some differences between the averages of these two groups. Surprisingly, crypto-asset owners have lower objective financial literacy and credit

⁵ Note that *Overconfidence* is not measured using the gap between the self-perceptions of the score of *Objective financial literacy* and the actual score of *Objective financial literacy* as calculated by Anderson et al. (2017).

⁶ Sekita et al. (2018) use the variable names *Myopia*, *Herding*, *Risk aversion*, and *Loss aversion* for our variables *Impatience*, *Reputation*, *Risk aversion 1*, and *Risk aversion 2*.

Table 3
Mean and standard deviation of demographic variables by ownership of crypto assets.

		Owners		Nonowners		Differences in average
		Average	S.D.	Average	S.D.	
Financial literacy	Objective financial literacy	7.346	3.098	7.735	3.088	-0.389
	Fin. education school	0.212	0.409	0.084	0.277	0.128
	Fin. education home	0.259	0.438	0.244	0.430	0.015
	Fraud1	0.131	0.337	0.063	0.243	0.068
	Debt	0.393	0.489	0.309	0.462	0.084
Information sources	Credit card literacy	0.435	0.496	0.584	0.493	-0.149
	News	2.972	1.223	2.635	1.384	0.337
	S_do_not_know	0.036	0.186	0.084	0.277	-0.048
	S_fin_inst	0.606	0.489	0.605	0.489	0.001
Financial behavior	S_exclude_fin_inst	0.358	0.480	0.311	0.463	0.047
	Overconfidence	-5.326	3.068	-6.080	2.888	0.754
	Impatience	2.227	1.483	2.054	1.629	0.174
	Reputation	1.930	1.173	1.551	1.045	0.379
	Self-control	2.935	1.003	3.001	0.979	-0.066
Pretax income	Risk aversion 1	0.455	0.498	0.724	0.447	-0.269
	Risk aversion 2	0.850	0.357	0.897	0.304	-0.047
	Income_0	0.024	0.153	0.018	0.132	0.006
	Income_0_250	0.141	0.348	0.137	0.344	0.004
	Income_250_500	0.253	0.435	0.300	0.458	-0.047
	Income_500_750	0.221	0.415	0.193	0.395	0.028
	Income_750_1000	0.141	0.348	0.114	0.318	0.027
	Income_1000_1500	0.098	0.297	0.064	0.244	0.034
Financial assets	Income_1500_	0.043	0.203	0.021	0.145	0.022
	Income_NA	0.078	0.268	0.152	0.359	-0.075
	Asset_0	0.084	0.277	0.078	0.268	0.006
	Asset_0_250	0.202	0.401	0.151	0.358	0.050
	Asset_250_500	0.147	0.354	0.105	0.306	0.042
	Asset_500_750	0.094	0.292	0.055	0.228	0.039
	Asset_750_1000	0.070	0.256	0.058	0.234	0.012
	Asset_1000_2000	0.095	0.293	0.083	0.276	0.012
	Asset_2000_	0.155	0.362	0.177	0.382	-0.023
	Asset_NA	0.154	0.361	0.292	0.455	-0.139
Age	Age_25	0.095	0.293	0.045	0.207	0.050
	Age25_29	0.125	0.331	0.062	0.242	0.063
	Age30_34	0.112	0.315	0.070	0.256	0.041
	Age35_39	0.130	0.337	0.075	0.263	0.055
	Age40_44	0.113	0.316	0.082	0.274	0.031
	Age45_49	0.107	0.310	0.103	0.304	0.005
	Age50_54	0.079	0.270	0.081	0.274	-0.003
	Age55_59	0.075	0.263	0.086	0.281	-0.012
	Age60_64	0.065	0.246	0.120	0.325	-0.055
	Age65_69	0.046	0.209	0.101	0.302	-0.056
	Age70_74	0.039	0.195	0.125	0.331	-0.085
	Age75_79	0.015	0.121	0.050	0.218	-0.035
	Gender	Male	0.713	0.452	0.471	0.499
Employment status	Private	0.538	0.499	0.318	0.466	0.221
	Public	0.054	0.225	0.031	0.173	0.023
	Teacher	0.010	0.102	0.014	0.119	-0.004
	Self-employed	0.072	0.259	0.065	0.246	0.007
	Part-time	0.086	0.280	0.152	0.359	-0.067
	House	0.093	0.291	0.214	0.410	-0.121
	Student	0.062	0.241	0.031	0.174	0.030
	No Job	0.077	0.267	0.156	0.363	-0.079
	Other Job	0.008	0.089	0.019	0.136	-0.011
	Education	Junior high or below, Senior high, and Other schools	0.233	0.423	0.312	0.463
Vocational college		0.097	0.296	0.103	0.304	-0.006
Junior college		0.082	0.274	0.125	0.331	-0.043
University		0.512	0.500	0.417	0.493	0.095
Areas of residence	Graduate	0.076	0.265	0.043	0.204	0.033
	Hokkaido	0.033	0.178	0.040	0.196	-0.007
	Tohoku	0.060	0.238	0.069	0.253	-0.008
	Hokuriku	0.041	0.199	0.042	0.200	-0.001
	Kanto	0.374	0.484	0.340	0.474	0.035
	Chubu	0.142	0.349	0.142	0.349	0.000
	Kinki	0.159	0.366	0.169	0.375	-0.010
	Chugoku	0.062	0.241	0.058	0.233	0.004
	Shikoku	0.033	0.179	0.029	0.169	0.004
	Kyushu	0.096	0.294	0.111	0.315	-0.016
	Number of observations		1622		13,895	

Table 4
Averages of demographic variables for owners: Deviation from owners' average.

	Do not understand	Do not understand so well	Understand to some extent	Understand very well	Profit	Break even	Loss	
Number of observations	203	422	719	278	329	794	499	
% of owners	12.5	26.0	44.3	17.1	20.3	49.0	30.8	
Financial literacy								
Objective financial literacy	-0.824	0.334	0.681	-1.666	-0.084	-0.091	0.201	
Fin. education school	-0.109	-0.070	0.003	0.176	0.095	0.012	-0.082	
Fin. education home	-0.106	-0.027	0.000	0.119	0.176	-0.027	-0.073	
Fraud1	-0.037	-0.041	-0.001	0.092	0.055	-0.024	0.002	
Debt	-0.048	-0.044	0.022	0.046	0.036	-0.031	0.026	
Credit card literacy	0.009	0.065	0.035	-0.197	-0.055	-0.023	0.072	
Information sources								
News	-0.445	-0.156	0.197	0.054	0.375	-0.077	-0.124	
S_do_not_know	0.068	0.002	-0.009	-0.029	-0.024	0.001	0.014	
S_fin_inst	-0.054	-0.042	-0.030	0.182	0.072	0.019	-0.077	
S_exclude_fin_inst	-0.013	0.040	0.040	-0.153	-0.048	-0.019	0.063	
Financial behavior								
Overconfidence	0.326	-0.499	-0.553	1.951	0.414	0.072	-0.388	
Impatience	-0.055	-0.069	-0.026	0.211	0.171	-0.073	0.003	
Reputation	0.011	-0.061	-0.132	0.426	0.133	-0.001	-0.087	
Self-control	-0.034	-0.056	0.062	-0.050	0.107	0.007	-0.082	
Risk aversion 1	0.136	0.045	-0.027	-0.099	-0.121	0.035	0.024	
Risk aversion 2	0.022	0.046	-0.018	-0.037	-0.072	0.035	-0.009	
Investment experience	s or i or f	-0.122	-0.046	0.010	0.132	0.072	0.001	-0.049
Noncash payment users	Noncash payment users	-0.037	-0.005	0.016	-0.007	0.019	0.011	-0.031
Pretax income								
Income_0	0.030	-0.005	-0.010	0.012	0.000	0.004	-0.006	
Income_0_250	0.007	0.020	-0.013	-0.001	0.008	0.000	-0.005	
Income_250_500	-0.002	-0.024	0.026	-0.030	-0.041	-0.004	0.033	
Income_500_750	-0.029	0.011	0.005	-0.009	-0.009	-0.005	0.013	
Income_750_1000	-0.013	-0.020	0.008	0.021	0.002	0.021	-0.035	
Income_1000_1500	0.010	-0.006	-0.001	0.003	0.005	0.001	-0.006	
Income_1500_	-0.023	-0.005	0.004	0.014	0.042	-0.004	-0.021	
Income_NA	0.021	0.029	-0.019	-0.009	-0.008	-0.013	0.027	
Financial assets								
Asset_0	0.069	-0.022	-0.003	-0.008	-0.026	0.007	0.006	
Asset_0_250	-0.014	0.014	0.021	-0.065	0.011	-0.025	0.033	
Asset_250_500	-0.048	-0.014	0.001	0.055	-0.001	-0.002	0.004	
Asset_500_750	-0.020	-0.002	-0.004	0.028	0.015	-0.001	-0.008	
Asset_750_1000	-0.021	0.010	-0.010	0.027	-0.006	0.009	-0.010	
Asset_1000_2000	-0.031	-0.003	0.009	0.002	0.014	0.012	-0.029	
Asset_2000_	-0.007	-0.010	0.008	0.000	0.022	0.011	-0.033	
Asset_NA	0.073	0.027	-0.021	-0.038	-0.029	-0.011	0.037	
Age								
Age_25	-0.011	-0.017	-0.014	0.071	0.048	0.000	-0.031	
Age25_29	-0.041	0.005	-0.010	0.048	0.036	-0.007	-0.013	
Age30_34	-0.023	-0.022	0.025	-0.014	0.053	-0.021	-0.001	
Age35_39	-0.051	0.000	0.010	0.010	-0.002	0.003	-0.004	
Age40_44	0.005	-0.020	0.008	0.006	-0.034	0.016	-0.003	
Age45_49	-0.004	0.014	0.004	-0.028	-0.019	0.004	0.007	
Age50_54	0.025	0.011	-0.004	-0.025	-0.027	-0.001	0.019	
Age55_59	0.039	-0.015	0.002	-0.010	0.001	0.007	-0.012	
Age60_64	0.039	0.016	-0.016	-0.011	-0.031	0.001	0.019	
Age65_69	0.004	0.004	0.002	-0.013	-0.009	0.000	0.006	
Age70_74	0.025	0.022	-0.012	-0.021	-0.012	0.000	0.009	
Age75_79	-0.005	0.002	0.005	-0.011	-0.003	-0.001	0.003	
Gender	Male	-0.176	-0.076	0.064	0.078	0.089	-0.013	-0.038
Employment status								
Private	-0.055	-0.022	0.018	0.027	-0.028	0.010	0.003	
Public	-0.014	-0.020	0.020	-0.010	0.007	-0.001	-0.004	
Teacher	-0.001	-0.001	-0.005	0.015	0.002	0.001	-0.002	
Self-employed	-0.033	-0.015	0.022	-0.011	0.004	-0.005	0.006	
Part-time	0.047	0.021	-0.013	-0.032	-0.007	0.004	-0.002	
House	0.060	0.042	-0.029	-0.032	-0.026	0.001	0.015	
Student	-0.017	-0.010	-0.005	0.039	0.048	-0.002	-0.028	
No Job	0.012	0.008	-0.010	0.006	-0.001	-0.005	0.009	
Other Job	0.002	-0.003	0.002	-0.001	0.001	-0.002	0.002	
Education								
Junior high or below, Senior high, and Other schools	0.063	-0.001	-0.005	-0.032	-0.029	-0.004	0.025	
Vocational college	0.002	-0.023	0.002	0.029	0.010	-0.015	0.017	
Junior college	0.066	0.006	-0.019	-0.006	-0.046	0.006	0.020	
University	-0.103	0.018	0.016	0.006	0.041	0.017	-0.053	
Graduate	-0.027	0.000	0.006	0.003	0.024	-0.004	-0.010	
Areas of residence								
Hokkaido	-0.008	0.000	0.006	-0.011	0.001	0.004	-0.007	
Tohoku	0.013	0.004	-0.009	0.008	0.000	-0.006	0.010	
Hokuriku	-0.007	-0.001	0.005	-0.005	0.001	0.003	-0.005	
Kanto	-0.005	0.024	-0.010	-0.007	0.009	-0.001	-0.003	
Chubu	0.006	-0.030	0.020	-0.009	0.007	-0.003	0.000	
Kinki	-0.011	0.002	-0.006	0.021	-0.007	-0.002	0.007	
Chugoku	0.012	0.005	-0.005	-0.004	-0.025	0.011	-0.002	

(continued on next page)

Table 4 (continued)

	Do not understand	Do not understand so well	Understand to some extent	Understand very well	Profit	Break even	Loss
Shikoku	0.006	-0.005	0.000	0.003	0.000	-0.001	0.001
Kyushu	-0.007	0.002	-0.001	0.005	0.014	-0.005	-0.001

card literacy than nonowners, on average. However, the first result is consistent with the findings of Henry et al. (2019b, Table 4).⁷ Crypto-asset owners obtain information on the economy and finance from mass media more frequently, as seen in the higher average value of *News*. They are also more likely to know where to obtain information when selecting financial products, as seen in the lower average value of *S.do.not.know*. Regarding the variables related to financial behavior, crypto-asset owners are also more likely to be overconfident about their financial literacy, impatient, and judge based on reputation than nonowners, on average. They are less likely to show self-control and are less risk-averse than nonowners, on average. Regarding the other demographic variables, crypto-asset owners are biased toward younger generations—those aged below 50 years. They are also more likely to be male, work in private companies, and have graduated from university or graduate school. They are less likely to be part-time workers, stay-at-home mums/dads, and to have no job.

While previous studies have examined the heterogeneity between owners and nonowners as we have documented so far, this study goes one step further to examine the heterogeneity of crypto-asset owners. To this end, Table 4 compares the mean of the demographic variables of owners by their varying degrees of understanding of crypto assets and by their profit from their investment in crypto assets. Table 5 compares the mean of the demographic variables of owners by their experience of investing in at least one of three types of conventional risky financial assets, and by their adoption of noncash payment methods.

Columns 3 through 6 in Table 4 report the difference between the means by owner's degree of understanding and the means by all owners. We find a systematic relationship between the level of understanding and variables related to financial literacy (excluding *Objective financial literacy*), information source, investment experience, financial assets, gender, and education because the average values of these variables by the group of understanding tend to be higher (lower) for the group with a better (lower) understanding of crypto assets. For the rest of the variables, their relationships to the level of understanding of crypto assets vary by variable. For example, *Overconfidence* tends to be high for those who do not understand and for those who understand well. The proportion of *Noncash payment users* tends to be high for those who understand to some extent compared with the rest of the three groups.

Columns 7 through 9 in Table 4 report the difference between the means by the owner's profitability from their investment in crypto assets and the means by all owners. We find a systematic relationship between the levels of profitability and variables related to financial literacy, information source, investment experience, use of noncash payment methods, financial assets, gender, and education because the average values of these variables by group of profitability tend to be higher (lower) for the group with higher (lower) profitability from investment in crypto assets. For the rest of the variables, their relationship to the profitability from investment in crypto assets varies by variable. For example, *Impatience* tends to be low for owners with breakeven, but high for both owners with profit and with loss.

Column 3 in Table 5 reports the difference between the means by

⁷ Crypto-asset owners have lower objective financial literacy than nonowners even if we use the financial literacy index based on the standard "Big 3" questions by Lusardi and Mitchell (2014), which takes values of 1.692 for owners and 1.743 for nonowners. The correlation coefficients between Objective financial literacy and the financial literacy index based on the "Big 3" questions are 0.803 and 0.835 for owners and nonowners, respectively.

the owner's experience of investing in at least one of the three types of assets (*s or i or f* = 1) and means among all owners. Crypto-asset owners who have invested in at least one of the three types of assets tend to have a higher average value for some variables, including *Objective financial literacy*, *News*, *Asset_1000_2000*, *Asset_2000_*, *Age above 54*, *Male*, and *Private* compared with the average owner. They also tend to have a lower average value of *Credit card literacy*, *Overconfidence*, and *Age below 55* than the average owner.

Columns 4 through 8 in Table 5 report the difference between the means by the owner's adoption of noncash payment methods, credit cards, electronic money, debit cards, and mobile payments, and means among all owners. Crypto-asset owners who have adopted noncash payment methods, credit cards, and electronic money tend to have higher average values for some variables, including *Objective financial literacy*, *Credit card literacy*, and *News*, and tend to have a lower average value for other variables including *Overconfidence*, *Impatience* (excluding *Noncash payment users*), *Risk aversion 1* and *2*, and *Age below 29* (for *Credit card users*, *Age below 25*) compared with the average owner. *Electronic money users* live more in the *Kanto* area than the other regions because electronic money issued by train companies is widely used in this most highly populated area.

Columns 7 and 8 in Table 5 show that the average values for crypto-asset owners who have adopted debit cards and mobile payment tend to differ substantially from the corresponding average values for owners for the variables related to financial literacy, information sources, financial behavior, investment experience for three types of conventional risky assets, age, and gender. Interestingly, owners who have adopted debit cards and mobile payment tend to be young even among owners, who are relatively young compared with nonowners, which is similar to the empirical regularity that new payment methods are likely to be initially adopted by young people, not by old people (see Stavins (2017) or Fujiki (2019) for a review).

5. Regression analysis comparing owners and nonowners

Section 5 first investigates the variables that distinguish Japanese crypto-asset nonowners from owners as previous studies have examined. It also investigates the variables that distinguish the nonowners from owners belonging to two groups: a group according to their level of understanding of crypto assets, and a group according to the profitability of their investment in crypto assets.

5.1. Comparison between owners and nonowners

The third column of Table 6 reports the marginal effects, which are computed using the parameter estimates of a probit model that regresses a dummy variable, which takes a value of 1 for respondents adopting crypto assets and a value of 0 otherwise, on the variables reported in Table 3, *Noncash payment users*, and *s or i or f*. We use the probit Stata 16 command to estimate the parameters of the model, while we use the margin command to compute the marginal effects reported in Table 6. Although we do not report the standard errors of the marginal effects, we do include superscripts *, **, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.⁸

⁸ Standard errors are adjusted for intragroup correlation within the clusters formed by gender, age group, and prefecture. This is because the FLS

Table 5
Averages of demographic variables for owners: Deviation from owners' average.

	s or ior f	Noncash payment users	Credit card users	Electronic money users	Debit card users	Mobile payment users	
Number of observations	1308	1522	1367	1142	393	651	
% of owners	80.6	93.8	84.3	70.4	24.2	40.1	
Financial literacy	Objective financial literacy	0.196	0.159	0.250	0.338	-0.761	-0.039
	Fin. education school	0.027	0.000	-0.001	0.009	0.126	0.055
	Fin. education home	0.009	0.008	0.014	0.026	0.069	0.042
	Fraud1	-0.003	-0.001	-0.010	0.003	0.119	0.028
	Debt	-0.006	0.007	0.010	0.019	0.063	0.083
	Credit card literacy	-0.026	0.006	0.001	0.021	-0.101	-0.032
Information sources	News	0.135	0.055	0.099	0.133	0.186	0.187
	S_do_not_know	-0.015	-0.001	-0.005	-0.003	-0.015	-0.011
	S_fin_inst	0.016	0.005	0.012	0.018	0.104	0.024
	S_exclude_fin_inst	0.000	-0.004	-0.007	-0.015	-0.088	-0.013
Financial behavior	Overconfidence	-0.051	-0.127	-0.180	-0.271	0.959	0.192
	Impatience	0.013	0.004	-0.019	-0.035	0.218	0.054
	Reputation	0.050	-0.002	0.028	0.003	0.294	0.139
	Self-control	-0.007	0.010	0.003	0.005	0.055	0.043
	Risk aversion 1	-0.051	-0.008	-0.012	-0.022	-0.114	-0.108
	Risk aversion 2	-0.011	-0.002	-0.005	-0.003	-0.021	-0.008
Investment experience	s or i or f		0.008	0.025	0.019	0.069	0.042
Noncash payment users	Noncash payment users	0.010					
Pretax income	Income_0	-0.007	-0.004	-0.007	-0.008	-0.001	-0.012
	Income_0_250	-0.021	-0.005	-0.011	-0.012	0.004	-0.014
	Income_250_500	0.000	0.000	-0.005	-0.013	0.021	0.006
	Income_500_750	0.006	0.004	0.007	0.011	-0.025	0.008
	Income_750_1000	0.006	0.003	0.007	0.010	-0.014	0.014
	Income_1000_1500	0.012	0.005	0.010	0.007	0.004	0.008
	Income_1500_	0.003	0.002	0.005	0.007	0.031	0.008
	Income_NA	0.000	-0.005	-0.005	-0.002	-0.019	-0.018
Financial assets	Asset_0	-0.029	-0.008	-0.017	-0.013	0.003	-0.013
	Asset_0_250	-0.013	0.001	-0.007	-0.001	-0.026	0.010
	Asset_250_500	0.009	-0.002	0.000	-0.006	0.008	0.008
	Asset_500_750	0.008	0.002	0.005	0.004	0.020	0.019
	Asset_750_1000	0.004	0.003	0.007	0.006	0.004	0.010
	Asset_1000_2000	0.012	0.006	0.008	0.013	-0.001	0.003
	Asset_2000_	0.026	0.007	0.018	0.014	0.026	-0.010
	Asset_NA	-0.017	-0.009	-0.014	-0.017	-0.034	-0.028
Age	Age_25	-0.012	-0.006	-0.019	-0.001	0.048	0.026
	Age25_29	-0.004	-0.003	0.007	-0.004	0.033	0.036
	Age30_34	-0.007	0.001	0.003	0.000	-0.010	0.030
	Age35_39	0.011	0.003	0.003	0.001	-0.003	0.028
	Age40_44	-0.001	0.000	0.001	0.001	0.012	0.012
	Age45_49	0.001	-0.001	-0.002	0.006	-0.031	-0.003
	Age50_54	-0.002	0.002	0.001	0.005	-0.008	-0.027
	Age55_59	0.003	0.001	-0.002	0.004	-0.014	-0.021
	Age60_64	0.001	0.002	0.005	-0.005	-0.006	-0.026
	Age65_69	0.004	0.001	0.005	-0.002	-0.015	-0.024
	Age70_74	0.004	0.000	-0.001	-0.002	-0.001	-0.018
	Age75_79	0.002	0.000	0.001	-0.003	-0.005	-0.013
Gender	Male	0.033	0.007	0.001	0.012	0.055	0.067
Employment status	Private	0.035	0.006	0.022	0.021	0.006	0.067
	Public	0.003	0.002	0.004	0.005	-0.003	0.015
	Teacher	0.001	0.000	0.000	0.000	0.007	0.000
	Self-employed	-0.002	-0.001	-0.001	-0.005	0.017	-0.011
	Part-time	-0.015	-0.002	-0.004	-0.003	-0.007	-0.012
	House	-0.005	-0.002	-0.003	-0.006	-0.032	-0.044
	Student	-0.013	-0.002	-0.013	0.001	0.017	0.011
	No Job	-0.001	-0.002	-0.005	-0.014	-0.008	-0.028
	Other Job	-0.003	0.000	-0.001	0.000	0.002	0.001
Education	Junior high or below, Senior high, and Other schools	-0.014	-0.012	-0.026	-0.028	0.034	-0.012
	Vocational college	-0.010	-0.002	-0.007	-0.005	0.010	0.008
	Junior college	-0.006	-0.001	0.001	-0.003	-0.031	-0.030
	University	0.022	0.013	0.025	0.027	-0.014	0.027
	Graduate	0.008	0.002	0.007	0.009	0.001	0.007
Areas of residence	Hokkaido	-0.001	0.000	0.000	-0.001	-0.012	-0.003
	Tohoku	0.001	-0.001	-0.003	-0.002	0.001	0.003
	Hokuriku	0.001	-0.001	-0.002	-0.009	0.002	-0.001
	Kanto	0.000	-0.001	0.004	0.040	-0.028	0.024
	Chubu	0.007	0.001	-0.001	-0.010	0.006	-0.004
	Kinki	0.004	0.005	0.006	-0.003	0.029	0.001
	Chugoku	-0.002	0.001	-0.002	0.001	-0.001	-0.002
	Shikoku	0.002	-0.002	-0.002	-0.001	-0.003	-0.006
	Kyushu	-0.011	-0.001	0.000	-0.015	0.006	-0.011

Table 6
Comparisons of owners and nonowners (marginal effects).

		Probit	Multinomial logit				
		Owners	Do not have	Do not understand	Do not understand so well	Understand to some extent	Understand very well
Financial literacy	Objective financial literacy	0.01***	-0.009***	-0.004***	0	0.011***	0.001
	Fin. education school	0.042***	-0.034***	0	0.002	0.019***	0.013***
	Fin. education home	-0.012**	0.012**	-0.006**	-0.004	-0.007*	0.006**
	Fraud1	0.049***	-0.041***	0.002	0.007	0.021***	0.011***
	Debt	0	0.003	-0.002	-0.003	0	0.001
	Credit card literacy	-0.032***	0.033***	-0.003	-0.005	-0.015***	-0.01***
Information sources	News	0.006***	-0.007***	0	0	0.007***	0
	S_do_not_know	-0.04***	0.052***	0.002	-0.014**	-0.021**	-0.019*
	S_fin_inst	0.006	-0.007	0	-0.002	0	0.01***
Financial behavior	Overconfidence	0.017***	-0.016***	-0.002**	0.001	0.012***	0.005***
	Impatience	0.004***	-0.004***	0	0.001	0.002*	0
	Reputation	0.016***	-0.015***	0.003***	0.005***	0.003**	0.004***
	Self-control	-0.006**	0.007***	0	-0.003**	-0.001	-0.002*
	Risk aversion 1	-0.042***	0.039***	-0.005**	-0.012***	-0.015***	-0.006***
Investment experience	Risk aversion 2	0.003	-0.006	-0.002	0.009*	-0.001	0
	s or i or f	0.085***	-0.089***	0.01***	0.018***	0.031***	0.03***
Noncash payment	Noncash payment users	0.017*	-0.017*	0	0.002	0.015*	0.001
Pretax income	Income_0	0.005	0.007	0.011**	-0.004	-0.015	0.001
	Income_250_500	-0.024***	0.021***	-0.003	-0.014***	0	-0.004
	Income_500_750	-0.015*	0.013	-0.001	-0.007	-0.003	-0.002
	Income_750_1000	-0.014	0.013	0	-0.012**	-0.002	0.001
	Income_1000_1500	0.004	-0.004	0.004	-0.004	0.003	0.001
	Income_1500_	0.034**	-0.029*	-0.003	0.003	0.022*	0.007
	Income_NA	-0.022*	0.021*	-0.006	-0.001	-0.014	0
Financial assets	Asset_0	0.006	-0.006	0.005	-0.011*	0.007	0.004
	Asset_250_500	0.001	-0.002	-0.004	-0.003	-0.002	0.012***
	Asset_500_750	0.009	-0.01	0	0.002	-0.001	0.01**
	Asset_750_1000	-0.008	0.004	-0.005	0.002	-0.014*	0.014***
	Asset_1000_2000	-0.006	0.006	-0.006	-0.004	-0.004	0.007*
	Asset_2000_	-0.027***	0.022**	-0.004	-0.011*	-0.014**	0.007*
	Asset_NA	-0.037***	0.035***	-0.002	-0.015***	-0.017***	-0.001
Age	Age25_29	-0.019	0.019	-0.008	-0.001	-0.003	-0.007
	Age30_34	-0.035**	0.035**	-0.007	-0.016*	0.001	-0.014**
	Age35_39	-0.041***	0.041***	-0.01*	-0.01	-0.008	-0.012**
	Age40_44	-0.053***	0.049***	-0.006	-0.02**	-0.013	-0.011**
	Age45_49	-0.078***	0.073***	-0.009*	-0.017**	-0.028***	-0.019***
	Age50_54	-0.08***	0.076***	-0.006	-0.018**	-0.032***	-0.02***
	Age55_59	-0.091***	0.089***	-0.003	-0.03***	-0.035***	-0.02***
	Age60_64	-0.125***	0.124***	-0.008	-0.029***	-0.063***	-0.025***
	Age65_69	-0.134***	0.132***	-0.013**	-0.036***	-0.054***	-0.03***
	Age70_74	-0.162***	0.167***	-0.011*	-0.033***	-0.083***	-0.04***
	Age75_79	-0.169***	0.178***	-0.024**	-0.043***	-0.058***	-0.053***
Gender	Male	0.039***	-0.039***	0.001	0.005	0.023***	0.01***
Employment status	Private	0.022**	-0.021*	0.007**	0.01*	0.011	-0.007*
	Public	0.025*	-0.018	0.006	-0.002	0.024**	-0.01*
	Teacher	-0.035	0.043*	-0.001	-0.007	-0.033	-0.002
	Self-employed	0.027**	-0.021*	-0.003	0.004	0.026***	-0.007
	Part-time	-0.001	0.004	0.002	0.006	0.002	-0.013**
	House	0.017	-0.011	0.002	0.012*	0.001	-0.005
	Student	-0.004	0.004	-0.008	-0.004	0.015	-0.006
	Vocational college	-0.001	0.004	-0.002	-0.006	0	0.005
Education	Junior college	0.01	-0.007	0.004	0.001	-0.001	0.003
	University	0.007	-0.006	0	0.006*	-0.001	0.002
	Graduate	0.024**	-0.02*	0.002	0.01*	0.003	0.005
	Hokkaido	-0.008	0.007	-0.005	-0.002	0.007	-0.007
Areas of residence	Tohoku	-0.009	0.008	0	-0.002	-0.008	0.001
	Hokuriku	-0.004	0.004	-0.003	-0.004	0.006	-0.003
	Chubu	-0.004	0.003	-0.001	-0.009**	0.006	0.001
	Kinki	-0.008	0.008	-0.003	-0.004	-0.003	0.001
	Chugoku	0.009	-0.009	0.002	0.003	0.002	0.002
	Shikoku	0.014	-0.015	0.003	-0.003	0.008	0.007
	Kyushu	-0.008	0.009	-0.004	-0.003	-0.003	0.001
	Number of observations		15,517				15,517
Pseudo-R2		0.238				0.19	
LLR		-3962.691				-5883.919	

(footnote continued)

respondents are randomly chosen through cluster sampling—based on gender, six age groups, and 47 prefectures (2 × 6 × 47 = 564 clusters)—from among

(footnote continued)

the people who registered with an Internet survey company.

Concerning financial literacy, the relationship between crypto-asset ownership and the variables related to financial literacy differs by variable. The average owner is financially literate compared with nonowners judging from the positive and significant coefficient on *Objective financial literacy*, which is consistent with Stix (2019) and opposite to the finding of Henry et al. (2019b), and a positive and significant coefficient on *Fin. education school*. However, two negatively correlated variables, *Fin. education home* and *Credit card literacy* and a positively correlated variable, *Fraud1*, suggest that owners are financially illiterate compared with nonowners. The results for the differences in unconditional means between owners and nonowners on *Objective financial literacy* and *Fin. education home* in Table 3 are opposite to the results in this probit regression.

Concerning information sources, owners tend to get information more frequently and from various information sources compared with nonowners, as can be seen from the statistically significant positive association with *News* and negative association with *S_do_not_know*, which is expected given the results in Table 3.

Concerning financial behavior, the average crypto-asset owner is likely to be overconfident about their financial literacy, impatient, and judge based on reputation compared with nonowners. They are less likely to show self-control and are less risk-averse as measured by *Risk aversion 1*. These results are consistent with the results in Table 3 except for *Risk aversion 2*. The finding that owners are less risk-averse in comparison to nonowners in terms of *Risk aversion 1* is consistent with Stix (2019).

Concerning investment experience and choice of noncash payment methods, as expected from the results in Table 2, owners are more likely to have experience investing in at least one of three types of conventional risky financial assets and to adopt noncash payment methods. The first result is consistent with Stix (2019).

Next, we consider the results for the usual demographic variables. First, regarding owners' pretax income and financial asset holdings, owners are likely to have higher pretax income above 15 million yen, yet they are negatively associated with *Asset_2000_*. Second, regarding owners' age and gender, owners are more likely to be aged below 30 years and to be male, which is consistent with Schuh and Shy (2016), Henry et al. (2019b), and Stix (2019). Third, regarding employment status, owners are more likely to work in private companies or public companies, or more likely to be self-employed. Fourth, regarding educational attainment, owners tend to be graduate-school graduates, which is consistent with the result of Henry et al. (2019b) but opposite to the results of Schuh and Shy (2016) and Henry et al., 2019. Finally, regarding the area of residence, we do not see a clear relationship with crypto-asset ownership.

In the third column of Table 6, 35 of the 62 explanatory variables statistically significantly distinguish owners and nonowners. We hereafter call these groups of statistically significant variables the D variables. We also call the remaining 27 explanatory variables that do not statistically significantly distinguish owners and nonowners as non-D variables in the following analysis.

5.2. Comparison of owners and nonowners according to their understanding of crypto assets

Columns 4 to 8 of Table 6 report the marginal effects computed using the parameter estimates of a multinomial logit model regressing an indicator variable *Crypto understand* on the variables reported in Table 6. *Crypto understand* takes a value of 4 for households choosing "understand very well," a value of 3 for households choosing "understand to some extent," a value of 2 for households choosing "do not understand so well," a value of 1 for households choosing "do not understand," a value of 0 is applied for respondents who have not adopted crypto assets. We use the Stata 16 mlogit command to estimate the parameters of the model, while we use the margin command to compute the marginal effects reported in Table 6. Note that the sums of the

marginal effects reported in the third and fourth columns are close to zero. This means that the marginal effects for the respondents who have not adopted crypto assets from the probit model and those from the multinomial logit model are similar. Therefore, we should focus on the results in columns 5 to 8, which decompose the marginal effects for those respondents who have adopted crypto assets from the probit model reported in the third column according to the respondents' understanding of crypto assets.

We find that for 32 of the 35 D variables, the owners with a better understanding of crypto assets tend to be positively (negatively) and significantly associated with the D variables whose parameter signs in column 3 are positive (negative). Note that *Objective financial literacy* tends to be higher for owners who understand crypto assets to some extent, which is consistent with Stix (2019), and lower for owners who replied that they do not understand, which is consistent with Henry et al. (2019b). Among the three remaining D variables, *Fin. education home* and *Asset_2000_* are, on average, negatively correlated with ownership, however, the average relationship does not apply to owners who understand crypto assets very well because the coefficients of *Fin. education home* and *Asset_2000_* for this group are positive.

Regarding the 27 non-D variables, the parameter estimates for seven variables become statistically significant. These results suggest that owners who understand crypto assets very well tend to obtain information when selecting financial products from financial institutions or experts and to have large financial asset holdings, unlike the average owner.

Note that the results also show that owners who do not understand crypto assets tend to have a lower value of *Objective financial literacy*, and be less overconfident and risk-averse, unlike the average owner. They are also not impatient or lacking in self-control, unlike the average owner.

5.3. Characteristics of owners, according to the profitability of their investment in crypto assets

The fourth through seventh columns of Table 7 report the marginal effects computed using the parameter estimates of a multinomial logit model that regresses an indicator variable *Profitability* on the variables reported in Table 6. *Profitability* takes a value of 0 for nonowners (*Do not have*), a value of 1 for crypto-asset owners who have losses (*Loss*), a value of 2 for crypto-asset owners who break even (*Break even*), and a value of 3 for crypto-asset owners who earn profits (*Profit*). The third column reports the results of the probit model to compare the average owner and average nonowner reported in the third column of Table 6 for reference. Again, the sum of the marginal effects reported in the third and fourth columns is very close to zero. Therefore, we focus on the results in columns 5 to 7.

We find that for 30 of the 35 D variables, the owners with a higher value of *Profitability* tend to be positively (negatively) and significantly associated with the D variables whose parameter signs in column 3 are positive (negative). Among the remaining five D variables, none of the parameter estimates on *Self-employed* and *Graduate* for owners are statistically significant; however, the parameter estimates for nonowners are statistically significant. *Fin. education home* is, on average, negatively correlated with ownership; however, unlike the average relationship, the coefficient for owners who earn a profit is positive. For *Income_500_750* and *Public*, none of the parameter estimates for nonowners and owners are statistically significant.

Regarding the 27 non-D variables, the parameter estimates for six variables become statistically significant. In particular, *S_fin_inst* tends to be positively associated with *Profitability*. The remaining five variables do not have a clear relationship with *Profitability*.

6. Heterogeneity among crypto-asset owners

Do the results of Section 5 mean that the comparison of the average

Table 7
Comparisons of owners and nonowners (marginal effects).

		Probit	Multinomial logit			
		Owners	Do not have	Loss	Break even	Profit
Financial literacy	Objective financial literacy	0.01***	-0.009***	0.001	0.004**	0.004***
	Fin. education school	0.042***	-0.037***	0.002	0.026***	0.009***
	Fin. education home	-0.012**	0.014**	-0.012***	-0.012***	0.009***
	Fraud1	0.049***	-0.043***	0.016***	0.013**	0.014***
	Debt	0	0.003	0.003	-0.008**	0.001
Information sources	Credit card literacy	-0.032***	0.032***	-0.003	-0.021***	-0.008***
	News	0.006***	-0.007***	0.001	0.001	0.005***
	S_do_not_know	-0.04***	0.044***	-0.011	-0.017*	-0.016*
Financial behavior	S_fin_inst	0.006	-0.007	-0.005*	0.008**	0.005*
	Overconfidence	0.017***	-0.017***	0.002	0.008***	0.006***
	Impatience	0.004***	-0.004***	0.001	0.001	0.002**
	Reputation	0.016***	-0.015***	0.005***	0.007***	0.003**
	Self-control	-0.006**	0.007***	-0.004***	-0.002	0
Investment experience	Risk aversion 1	-0.042***	0.039***	-0.015***	-0.015***	-0.009***
	Risk aversion 2	0.003	-0.006	-0.005	0.014***	-0.004
	s or i or f	0.085***	-0.089***	0.022***	0.045***	0.022***
Noncash payment	Noncash payment users	0.017*	-0.019*	-0.009*	0.021**	0.006
Pretax income	Income_0	0.005	-0.005	-0.001	0.008	-0.002
	Income_250_500	-0.024***	0.022***	-0.005	-0.012**	-0.005
	Income_500_750	-0.015*	0.014	-0.003	-0.01	-0.001
	Income_750_1000	-0.014	0.016	-0.013*	-0.002	0
	Income_1000_1500	0.004	-0.003	0.001	-0.003	0.004
	Income_1500_	0.034**	-0.023	-0.006	0.009	0.02***
	Income_NA	-0.022*	0.022*	-0.001	-0.022**	0.001
	Asset_0	0.006	-0.008	-0.003	0.013*	-0.003
Financial assets	Asset_250_500	0.001	0.004	-0.003	0.007	0
	Asset_500_750	0.009	-0.01	-0.003	0.01	0.004
	Asset_750_1000	-0.008	0.002	-0.01	0.01	-0.002
	Asset_1000_2000	-0.006	0.007	-0.017**	0.009	0.001
	Asset_2000_	-0.027***	0.023**	-0.018***	-0.001	-0.003
	Asset_NA	-0.037***	0.035***	-0.014**	-0.012*	-0.008*
	Age25_29	-0.019	0.021	-0.008	-0.014	0
	Age30_34	-0.035**	0.039**	-0.011	-0.03***	0.001
Age35_39	-0.041***	0.042***	-0.013	-0.021**	-0.009	
Age40_44	-0.053***	0.054***	-0.017*	-0.021**	-0.016**	
Age45_49	-0.078***	0.077***	-0.021**	-0.039***	-0.017***	
Age50_54	-0.08***	0.08***	-0.016*	-0.042***	-0.023***	
Age55_59	-0.091***	0.092***	-0.03***	-0.044***	-0.019***	
Age60_64	-0.125***	0.129***	-0.026***	-0.066***	-0.037***	
Age65_69	-0.134***	0.138***	-0.034***	-0.07***	-0.033***	
Age70_74	-0.162***	0.167***	-0.041***	-0.084***	-0.042***	
Age75_79	-0.169***	0.176***	-0.045***	-0.091***	-0.04***	
Gender	Male	0.039***	-0.04***	0.008**	0.02***	0.012**
Employment status	Private	0.022**	-0.021**	0.011*	0.018**	-0.007
	Public	0.025*	-0.022	0.01	0.016	-0.004
	Teacher	-0.035	0.032	-0.012	-0.008	-0.011
	Self-employed	0.027**	-0.026**	0.01	0.016	0
	Part-time	-0.001	0.001	-0.006	0.006	-0.002
	House	0.017	-0.015	0.003	0.01	0.002
	Student	-0.004	0.011	-0.014	-0.003	0.007
	Vocational college	-0.001	0.003	0.002	-0.009	0.004
Education	Junior college	0.01	-0.006	0.008	0.007	-0.009
	University	0.007	-0.007	0	0.005	0.002
	Graduate	0.024**	-0.021*	0.006	0.009	0.007
	Hokkaido	-0.008	0.006	-0.012**	0.005	0.001
Areas of residence	Tohoku	-0.009	0.009	0	-0.008	-0.001
	Hokuriku	-0.004	0.004	-0.008	0.003	0.001
	Chubu	-0.004	0.003	-0.001	-0.003	0.001
	Kinki	-0.008	0.008	-0.001	-0.005	-0.002
	Chugoku	0.009	-0.006	-0.001	0.014*	-0.007
	Shikoku	0.014	-0.015	0.002	0.009	0.003
	Kyushu	-0.008	0.01	-0.006	-0.005	0.002
	Number of observations	15,517				15,517
Pseudo-R2	0.238				0.211	
LLR	-3962.691				-5424.534	

owner and nonowners would suffice and we might safely ignore the heterogeneity of owners? In the following analysis, we show which D variables and non-D variables are likely to distinguish the owners belonging to each group from the rest of the owners. We focus on four categories: varying degrees of understanding about crypto assets, profit

from their investment in crypto assets, experience of investing in at least one of three types of conventional risky financial assets, and adoption of noncash payment methods.

We check the heterogeneity among the owners in two ways: first, whether the number and proportion of the parameter estimates on the

Table 8
Comparison among owners (marginal effects).

		Probit	Multinomial logit				Multinomial logit		
		All sample	Owners only				Owners only		
		Owners	Do not understand	Do not understand so well	Understand to some extent	Understand very well	Loss	Break even	Profit
D-variables									
Financial literacy	Objective financial literacy	0.01***	-0.043***	-0.015	0.058***	0	-0.013	-0.005	0.018*
	Fin. education school	0.042***	-0.053**	-0.055*	0.053	0.054***	-0.1***	0.071*	0.029
	Fin. education home	-0.012**	-0.032	-0.012	-0.02	0.065***	-0.065**	-0.035	0.101***
	Fraud1	0.049***	-0.047*	-0.038	0.032	0.053**	0.021	-0.083**	0.062**
	Credit card literacy	-0.032***	0.011	0.043*	-0.007	-0.048**	0.069***	-0.049**	-0.02
Information sources	News	0.006***	-0.007	-0.025***	0.029***	0.003	-0.015	-0.028**	0.043***
	S_do_not_know	-0.04***	0.124***	0.016	0.002	-0.142	0.07	0.037	-0.107
Financial behavior	Overconfidence	0.017***	-0.038***	-0.027**	0.039***	0.026***	-0.024**	-0.002	0.026**
	Impatience	0.004***	-0.003	0.001	0.004	-0.002	0.003	-0.009	0.006
	Reputation	0.016***	0.009	0.01	-0.027**	0.007	0.014	-0.01	-0.004
	Self-control	-0.006**	0.002	-0.011	0.014	-0.005	-0.023*	0.013	0.009
	Risk aversion 1	-0.042***	0.008	-0.015	0.016	-0.009	-0.028	0.046*	-0.018
Investment experience	s or i or f	0.085***	-0.017	-0.06**	-0.058	0.135***	-0.051	0.002	0.05*
Noncash payment users	Noncash payment users	0.017*	-0.007	-0.024	0.05	-0.02	-0.131***	0.128**	0.003
Pretax income	Income_250_500	-0.024***	0.006	-0.071*	0.072*	-0.007	0.011	-0.004	-0.007
	Income_500_750	-0.015*	0.004	-0.031	0.025	0.002	0.015	-0.026	0.011
	Income_1500_	0.034**	-0.08	-0.074	0.091	0.062	-0.139*	-0.051	0.19***
	Income_NA	-0.022*	-0.028	0.053	-0.04	0.014	0.093	-0.129*	0.036
Financial assets	Asset_2000_	-0.027***	0.009	-0.024	-0.039	0.054*	-0.097**	0.109**	-0.013
	Asset_NA	-0.037***	0.029	-0.053	0.002	0.022	-0.05	0.066	-0.015
Age	Age30_34	-0.035**	-0.028	-0.055	0.142**	-0.059	0.003	-0.093	0.09
	Age35_39	-0.041***	-0.044	0	0.082	-0.038	0.002	0.005	-0.007
	Age40_44	-0.053***	-0.002	-0.058	0.094	-0.035	-0.01	0.056	-0.046
	Age45_49	-0.078***	0	0.034	0.047	-0.08*	0.017	0.017	-0.034
	Age50_54	-0.08***	0.02	0.013	0.035	-0.068	0.051	-0.01	-0.041
	Age55_59	-0.091***	0.059	-0.047	0.057	-0.069	-0.002	0.036	-0.034
	Age60_64	-0.125***	0.061	0.031	-0.026	-0.066	0.144**	-0.023	-0.121*
	Age65_69	-0.134***	0.027	-0.019	0.075	-0.084	0.085	-0.033	-0.051
	Age70_74	-0.162***	0.086*	0.125*	-0.042	-0.169**	0.127*	-0.004	-0.122
	Age75_79	-0.169***	-0.039	0.014	0.253*	-0.227*	0.124	-0.054	-0.07
Gender	Male	0.039***	-0.043**	-0.057**	0.052*	0.048**	-0.045	-0.003	0.048*
Employment status	Private	0.022**	0.046	0.017	0.034	-0.098***	0.04	0.058	-0.098**
	Public	0.025*	0.047	-0.085	0.159**	-0.121**	0.029	0.051	-0.079
	Self-employed	0.027**	-0.044	-0.024	0.15**	-0.083*	0.013	0.016	-0.029
	Graduate	0.024**	-0.005	0.047	-0.061	0.019	-0.009	-0.019	0.028
Non-D-variables									
Financial literacy	Debt	0	-0.015	-0.012	0.02	0.007	0.049**	-0.055**	0.006
Information sources	S_fin_inst	0.006	-0.002	-0.031	-0.03	0.063***	-0.056**	0.043*	0.013
Financial behavior	Risk aversion 2	0.003	-0.025	0.077**	-0.033	-0.019	-0.056*	0.098***	-0.042
Pretax income	Income_0	0.005	0.111**	-0.011	-0.118	0.018	-0.026	0.054	-0.028
	Income_750_1000	-0.014	0.014	-0.088*	0.043	0.031	-0.085*	0.06	0.025
	Income_1000_1500	0.004	0.033	-0.06	0.017	0.01	0	-0.047	0.047
Financial assets	Asset_0	0.006	0.036	-0.12**	0.049	0.035	-0.078*	0.097*	-0.019
	Asset_250_500	0.001	-0.035	-0.013	-0.034	0.082***	-0.043	0.055	-0.011
	Asset_500_750	0.009	-0.015	-0.015	-0.034	0.064**	-0.057	0.043	0.014
	Asset_750_1000	-0.008	-0.037	0.039	-0.116**	0.114***	-0.087	0.106*	-0.018
	Asset_1000_2000	-0.006	-0.03	0.001	-0.024	0.053	-0.131**	0.133***	-0.002
Age	Age25_29	-0.019	-0.05	0.038	0.041	-0.03	-0.022	-0.016	0.038
Employment status	Teacher	-0.035	0.027	0.012	-0.066	0.027	-0.025	0.023	0.002
	Part-time	-0.001	0.039	0.039	0.029	-0.107**	-0.051	0.08	-0.029
	House	0.017	0.021	0.056	-0.037	-0.041	-0.032	0.03	0.002
	Student	-0.004	-0.05	-0.069	0.18**	-0.061	-0.116	0.026	0.09
Education	Vocational college	-0.001	-0.021	-0.029	0.004	0.046	0.03	-0.071	0.041
	Junior college	0.01	0.014	-0.004	-0.047	0.037	0.05	0.03	-0.08*
	University	0.007	-0.011	0.051*	-0.044	0.004	-0.014	0.013	0.001
Areas of residence	Hokkaido	-0.008	-0.012	-0.005	0.098*	-0.082	-0.075	0.066	0.009
	Tohoku	-0.009	0.028	0.019	-0.066	0.02	0.027	-0.027	0
	Hokuriku	-0.004	-0.003	-0.007	0.045	-0.035	-0.074	0.072	0.002
	Chubu	-0.004	0.009	-0.066**	0.055	0.003	0.008	-0.017	0.008
	Kinki	-0.008	-0.005	-0.006	0.002	0.009	0.018	-0.011	-0.007
	Chugoku	0.009	-0.01	0.012	-0.001	-0.001	-0.043	0.091*	-0.048
	Shikoku	0.014	0.014	-0.056	0.017	0.025	-0.018	-0.002	0.019
	Kyushu	-0.008	-0.017	0	0.011	0.006	-0.024	-0.02	0.044

(continued on next page)

Table 8 (continued)

	Probit	Multinomial logit				Multinomial logit		
	All sample	Owners only				Owners only		
	Owners	Do not understand	Do not understand so well	Understand to some extent	Understand very well	Loss	Break even	Profit
Number of observations	15,517	1622				1622		
Pseudo-R2	0.238	0.172				0.118		
LLR	-3962.691	-1710.358				-1481.502		

D variables that statistically significantly distinguish the owners belonging to each group from the rest of the owners differ from zero; and second, whether the number and proportion of non-D variables that statistically significantly distinguish owners belonging to each group from the rest of the owners differ from zero. The first measure reflects the heterogeneity similar to that between owners and nonowners, especially when the parameter estimates of the D variables have the same sign from the regression to compare owners and nonowners reported in column 3 of Table 6. The second measure reflects the heterogeneity that is not present between owners and nonowners. If the non-D variables can explain the observed heterogeneity among crypto-asset owners regarding varying degrees of understanding about crypto assets and profit from their investment in crypto assets, the second measure should differ from zero.

6.1. Heterogeneity among crypto-asset owners according to their understanding of crypto assets

The fourth to seventh columns of Table 8 report the marginal effects computed using the parameter estimates of a multinomial logit model regressing *Crypto understand* on the variables reported in Table 6 using the data from owners. Table 8 first shows the results for the 35 D variables and then shows the results for the 27 non-D variables. The third column of Table 8 reports the results that compare average owners and nonowners reported in the third column of Table 6 as the reference case. We find the following results for the first and second measures.

First, we find 20 (or 57%) statistically significant parameter estimates for the D variables by counting the number of D variables whose marginal effects are significant for any choice in a multinomial logit model in the fourth to seventh columns of Table 8. Thirteen of these 20 D variables show that at least one of the two groups—the owners who understand very well or who understand to some extent—tend to be positive (negative) and statistically significantly associated with the D variables as indicated by the positive (negative) signs of the parameter estimates in column 3, except for *Age75_79* for owners who understand to some extent and *Public* and *Self-employed* for owners who understand very well.

Second, we find 13 (or 48%) statistically significant parameter estimates for the non-D variables by counting the number of D variables whose marginal effects are significant for any choice in a multinomial logit model in the fourth to seventh columns of Table 8. In particular, owners who understand crypto assets very well tend to have a greater amount of financial asset holdings, as shown in Section 5.2. Furthermore, owners who do not understand crypto assets tend to have a lower value of *Objective financial literacy*, are lacking in experience of financial education at school, and not know where to obtain information when selecting financial products compared with the rest of the owners.

6.2. Heterogeneity among crypto-asset owners according to the profitability of their investment in crypto assets

The eighth to 10th columns of Table 8 report the marginal effects computed using the parameter estimates of a multinomial logit model that regresses *Profitability* on the variables reported in Table 6 using the data from owners. We find the following results for the first and second measures.

First, we find 18 (or 51%) statistically significant parameter estimates for the D variables by counting the number of D variables whose marginal effects are significant for any choice in a multinomial logit model in the eighth to tenth columns of Table 8, including all five D variables on financial literacy. Eight of these 18 D variables show that owners with a profit from their investment in crypto assets tend to be positively (negatively) and significantly associated with the D variables as indicated by the parameter sign estimates in column 3 that are positive (negative). Seven of these 18 D variables show that owners with a loss from their investment in crypto assets tend to be negatively (positively) and significantly associated with the D variables as indicated by the parameter sign estimates in column 3 that are positive (negative). Note that we include *Overconfidence*, *Income_1500_*, and *Age60_64* in both eight D variables and seven D variables in the above calculations.

Second, regarding the non-D variables, we find nine (or 18%) statistically significant parameter estimates for the non-D variables by counting the number of non-D variables whose marginal effects are significant for any choice in a multinomial logit model in the eighth to tenth columns of Table 8. Among these nine variables, *S_fin_inst* and *Risk aversion 2* are negatively correlated with *Loss* and positively correlated with *Break even*. In contrast, *Debt* is positively correlated with *Loss* and negatively correlated with *Break even*.

6.3. Heterogeneity among crypto-asset owners according to other risky asset holdings

Which D variables and non-D variables are likely to distinguish the owners with at least one of the three conventional financial assets (hereafter owners whose *s* or *i* or *f* takes a value of 1) from the crypto-asset owners without ownership of any of the three conventional financial assets (hereafter owners whose *s* or *i* or *f* takes a value of 0)? The fourth column of Table 9 reports the marginal effects obtained from the parameter estimates of the probit regression using *s* or *i* or *f* as the dependent variable (base case is *s* or *i* or *f* = 0). We use the same independent variables as in Table 6, except *s* or *i* or *f*. Table 9 first shows the results for the 34 D variables and then shows the results for 27 non-D variables. The third column reports the results of the probit model reported in the third column of Table 6 for reference. We find the following results for the first and second measures.

First, we find 15 (or 44%) statistically significant parameter estimates for the D variables by counting the number of D variables whose marginal effects are significant in the fourth column of Table 9. Thirteen among these 15 variables have parameter estimates whose signs

Table 9
Comparison among owners (marginal effects).

		Probit All sample Owners	Probit Owners only s or i or f	Probit Owners only Noncash payment users	Probit Owners only Credit card users	Probit Owners only Electronic money users	Probit Owners only Debit card users	Probit Owners only Mobile payment users
D-variables								
Financial literacy	Objective financial literacy	0.01***	0.048***	0.017***	0.027***	0.019	0.004	0.02
	Fin. education school	0.042***	0.094***	-0.01	-0.04*	0.008	0.085***	0.032
	Fin. education home	-0.012**	-0.033*	0.02	0.03	0.045*	0.031	0.011
	Fraud1	0.049***	0.003	-0.001	-0.055**	0.051	0.161***	0.036
	Credit card literacy	-0.032***	-0.044**	0.003	-0.013	0.037	-0.008	-0.008
Information sources	News	0.006***	0.016**	0.009**	0.019***	0.036***	0.03***	0.036***
	S_do_not_know	-0.04***	-0.186***	0.024	-0.011	0.027	-0.062	-0.083
Financial behavior	Overconfidence	0.017***	0.044***	0.009	0.012	0.003	0.022**	0.024*
	Impatience	0.004***	0.001	0.002	-0.006	-0.007	0.013*	0.006
	Reputation	0.016***	0.023***	-0.001	0.022***	0.009	0.017*	0.018*
	Self-control	-0.006**	-0.015*	0.003	-0.007	-0.007	0.014	0.008
	Risk aversion 1	-0.042***	-0.094***	-0.003	0.01	-0.014	-0.051**	-0.095***
Investment experience	s or i or f	0.085***		0.004	0.041*	0.015	0.052*	0.034
Noncash payment users	Noncash payment users	0.017*	0.007					
Pretax income	Income_250_500	-0.024***	0.022	0.014	-0.035	0.002	0.039	0.057
	Income_500_750	-0.015*	0.01	0.009	-0.022	0.033	-0.017	0.027
	Income_1500_	0.034**	-0.019	0.059	0.035	0.058	0.154***	0.161**
	Income_NA	-0.022*	0.142***	0.019	0.029	0.094	-0.024	0.04
Financial assets	Asset_2000_	-0.027***	0.117***	0.016	0.082**	0.017	0.073*	0.002
	Asset_NA	-0.037***	-0.053*	-0.031	-0.025	-0.077*	0.03	-0.007
Age	Age30_34	-0.035**	-0.047	0.039	0.07	-0.048	-0.112**	-0.061
	Age35_39	-0.041***	0.043	0.041	0.036	-0.05	-0.067	-0.083
	Age40_44	-0.053***	-0.024	0.035	0.03	-0.046	-0.05	-0.114**
	Age45_49	-0.078***	-0.01	0.006	-0.002	-0.036	-0.144***	-0.164***
	Age50_54	-0.08***	-0.018	0.07**	0.04	0.018	-0.083	-0.274***
	Age55_59	-0.091***	0.052	0.026	-0.028	-0.017	-0.143**	-0.265***
	Age60_64	-0.125***	0.008	0.048	0.062	-0.11	-0.099	-0.287***
	Age65_69	-0.134***	0.087	0.031	0.136**	-0.066	-0.171***	-0.332***
	Age70_74	-0.162***	0.08	0.026	0.013	-0.062	-0.117*	-0.313***
	Age75_79	-0.169***	0.135	-0.012	0.082	-0.131	-0.19*	-0.655***
Gender	Male	0.039***	0.048**	0.005	-0.05**	-0.023	0.01	-0.005
Employment status	Private	0.022**	0.071**	-0.015	0.053	0.066	-0.054	-0.031
	Public	0.025*	0.042	0.02	0.072	0.101	-0.057	0.021
	Self-employed	0.027**	0.012	-0.028	0.031	0.027	0.042	-0.033
Education	Graduate	0.024**	0.036	0.022	0.081**	0.088*	-0.041	-0.033
Non-D-variables								
Financial literacy	Debt	0	-0.028	0.016	0.035*	0.021	0.031	0.097***
Information sources	S_fin_inst	0.006	-0.0058	0.021*	0.029	0.05**	0.024	-0.006
Financial behavior	Risk aversion 2	0.003	-0.013	0.006	-0.006	0.026	0.013	0.066**
Pretax income	Income_0	0.005	-0.03	-0.047*	-0.038	-0.129*	-0.085	-0.198**
	Income_750_1000	-0.014	-0.008	-0.006	-0.034	0.017	-0.025	0.054
	Income_1000_1500	0.004	0.063	0.069*	0.015	-0.003	0.012	0.075
Financial assets	Asset_0	0.006	-0.088***	-0.027	-0.026	-0.032	0.036	-0.013
	Asset_250_500	0.001	0.055**	-0.018	0.01	-0.039	0.016	-0.02
	Asset_500_750	0.009	0.076**	0.018	0.054	0.005	0.066*	0.05
	Asset_750_1000	-0.008	0.026	0.046	0.086**	0.028	0.049	0.019
	Asset_1000_2000	-0.006	0.093**	0.075**	0.058*	0.047	0.052	0.024
Age	Age25_29	-0.019	-0.046	0.016	0.088*	-0.061	-0.052	-0.051
Employment status	Teacher	-0.035	0.059	0.003	0.032	0.101	0.098	-0.017
	Part-time	-0.001	-0.014	-0.019	0.007	0.061	-0.02	-0.033
	House	0.017	0.042	-0.011	-0.031	0.047	-0.036	-0.109
	Student	-0.004	-0.038	0.031	-0.01	0.107	-0.018	0.001
Education	Vocational college	-0.001	-0.006	0.017	0.044*	0.042	-0.044	-0.006
	Junior college	0.01	0.012	0.02	0.073**	0.045	-0.114***	-0.094*
	University	0.007	0.01	0.028**	0.062***	0.048*	-0.058**	-0.044
Areas of residence	Hokkaido	-0.008	0.011	-0.005	-0.017	-0.107*	-0.088**	-0.044
	Tohoku	-0.009	0.016	-0.003	-0.021	-0.074	-0.002	-0.003
	Hokuriku	-0.004	0.018	-0.025	-0.026	-0.213***	-0.01	-0.069
	Chubu	-0.004	0.037	0.007	-0.002	-0.128***	0.028	-0.019
	Kinki	-0.008	0.047*	0.042**	0.031	-0.082***	0.056*	-0.006
	Chugoku	0.009	0.016	0.029	-0.002	-0.01	0.047	0.037
	Shikoku	0.014	0.064	-0.015	-0.027	-0.057	0.015	-0.054
	Kyushu	-0.008	-0.063**	0	0.013	-0.158***	0.024	-0.038
Number of observations		15,517	1622	1622	1622	1622	1622	1622
Pseudo-R2		0.238	0.259	0.201	0.155	0.087	0.143	0.112
LLR		-3962.691	-590.451	-300.053	-595.905	-899.587	-770.013	-969.685

are the same as the parameter estimates reported in column 3. An important exception is a positive association with *Asset_2000*. Regarding the variables related to financial literacy, owners whose *s* or *i* or *f* takes a value of 1 tend to have higher *Objective financial literacy*, are likely to obtain financial education at school but not home, and are less credit card literate than owners whose *s* or *i* or *f* takes a value of 0. Regarding information sources, they tend to obtain information from mass media more frequently and to know about information sources in selecting financial products. Concerning financial behavior, they tend to be overconfident about their financial literacy, tend to judge a financial decision based on reputation, lack self-control, and are less risk-averse. Finally, they tend to be male.

Second, we find six (or 22%) statistically significant parameter estimates for the non-D variables by counting the number of non-D variables whose marginal effects are significant in the fourth column of Table 9. Among these six variables, four variables on financial asset holdings are positively related with the ownership of *s* or *i* or *f*. Together with the positive association of *Asset_2000*, we conclude that owners whose *s* or *i* or *f* takes a value of 1 tend to have large financial asset holdings.

6.4. Heterogeneity among crypto-asset owners according to their use of noncash payment methods

Which D variables and non-D variables are likely to distinguish the owners using noncash payment methods from the owners not using noncash payment methods? We examine the demographic characteristics of crypto-asset owners who are also *Noncash payment users*, *Credit card users*, *Electronic money users*, *Debit card users*, and *Mobile payment users* compared with crypto-asset owners not using these noncash payment methods by running a probit model. We use the same independent variables as in Table 6, except for the variables related to noncash payment methods. The fifth to ninth columns of Table 9 report the marginal effects obtained from the parameter estimates of these probit regressions. We find the following results for the first and second measures for *Noncash payment users*, *Credit card users*, *Electronic money users*, *Debit card users*, and *Mobile payment users*.

Regarding *Noncash payment users*, we find statistically significant parameter estimates for three (9%) D variables and six (22%) non-D variables by counting the number of D variables and non-D variables whose marginal effects are significant in the fifth column of Table 9. Similar to the average owner, owners using at least one of the four noncash payment methods tend to have higher *Objective financial literacy* and tend to obtain information from mass media more frequently compared with the owners not using noncash payment methods. Unlike the average owner, they tend to have relatively high pretax income and a greater amount of financial asset holdings and tend to be university graduates.

Regarding *Credit card users*, we find statistically significant parameter estimates for 10 (29%) D variables and seven (26%) non-D variables by counting the number of D variables and non-D variables whose marginal effects are significant in the sixth column of Table 9. Similar to the average owner, owners using credit cards tend to have a higher value of *Objective financial literacy* and are positively correlated with *News*, *Reputation*, *s* or *i* or *f*, and *Graduate* compared with the owners not using a credit card. Unlike the average owner, owners using credit cards tend to have less experience of getting financial education at school and have less experience of financial troubles such as bank transfer fraud or multiple debts, have debt and financial asset holdings over 7.5 million yen, be aged 25 to 29 years or 65 to 69 years and be female, and have educations longer than or equal to vocational college.⁹

⁹Fujiki (2019) found frequent credit card users tend to be young while we find credit card users tend to be associated not only with *Age25_29* but also

Regarding *Electronic money users*, we find statistically significant parameter estimates for four (12%) D variables and eight (30%) non-D variables by counting the number of D variables and non-D variables whose marginal effects are significant in the seventh column of Table 9. Similar to the average owner, owners using electronic money tend to be positively correlated with *News* and *Graduate* compared with the owners not using electronic money. Unlike the average owner, they tend to be positively correlated with *Fin. education home*, obtain information on financial products from financial institutions or financial experts, be a university graduate, and live in high population density areas suggested by the negatively significant dummy variables for the five areas of residence. Note that the base case of the *Kanto* area is the most highly populated area and electronic money issued by train companies is widely used, as seen in Table 5.

Regarding *Debit card users*, we find statistically significant parameter estimates for 15 (47%) D variables and five (19%) non-D variables by counting the number of D variables and non-D variables whose marginal effects are significant in the eighth column of Table 9. Among the 15 D variables, the coefficients for 14 variables are statistically significant whose signs are the same as those of the average owner reported in the third column. Similar to the average owner, owners using a debit card tend to obtain information from mass media more frequently, be overconfident about their financial literacy, impatient, and less risk-averse, follow reputation in making a financial decision, be positively associated with *Income_1500_*, and be young, compared with owners not using a debit card. Unlike the average owner, they are also positively associated with *Asset_500_750* and *Asset_2000_*. They are also negatively associated with *Junior college* and *University*.

Regarding *Mobile payment users*, we find statistically significant parameter estimates for 13 (38%) D variables and four (15%) non-D variables by counting the number of D variables and non-D variables whose marginal effects are significant in the ninth column of Table 9. The coefficients for all 13 D variables are statistically significant, with signs the same as those of the average owner reported in the third column. Similar to the average owner, owners using mobile payments via smartphone tend to obtain information from mass media more frequently. They tend to be overconfident about their financial literacy, follow reputation in making a financial decision, and be less risk-averse. They also tend to be aged below 40 years, and positively associated with *Income_1500_*, compared with the owners not using mobile payments via smartphone. Unlike the average owner, they are positively related to *Debt* and *Risk aversion 2*.

7. Conclusion

In this study, we investigated the key characteristics of Japanese crypto-asset owners compared with nonowners and the heterogeneity among Japanese crypto-asset owners using three methods and obtained the following results.

We first compared the average owner and nonowners using 62 independent variables and a constant term. We found 35 D variables that statistically significantly distinguish owners and nonowners. Regarding the usual demographic variables, Japanese crypto-asset owners are more likely to be male and to be aged below 30 years, have higher pretax income, work in private companies or public companies, or be self-employed, and be graduate-school graduates. Regarding financial literacy, Japanese owners tend to have higher financial literacy from two perspectives: a measure of objective financial literacy and experience of financial education at school, and lower financial literacy from

(footnote continued)

Age65_69. While we do not know the reason for the second contrasting result, the distinction of frequent credit card users in Fujiki (2019) and owners including those who use a credit card once a month (he might not use a credit card frequently relative to other payment methods such as cash and electronic money) might yield this result.

three perspectives: experience of financial education about money management by parents at home, experience of financial troubles, and knowledge about credit cards, than average nonowners. Regarding information sources, average crypto-asset owners tend to obtain information on the economy and finance from mass media more frequently and have favorite knowledge and information sources when selecting financial products. Regarding financial behavior, owners tend to be overconfident about their financial literacy, be impatient, judge based on reputation in selecting financial products, lack self-control, and be less risk-averse than nonowners. Finally, they are also more likely to have experience investing in at least one of three types of conventional risky financial assets and tend to use noncash payment methods.

Second, we compared nonowners and owners according to the owners' value of *Crypto Understand* and *Profitability*. We found that 32 and 30 of the 35 D variables distinguish between owners and nonowners according to *Crypto Understand* and *Profitability*, respectively, in a similar manner to how these variables distinguish between the average owner and nonowners. For the 27 non-D variables, six variables statistically significantly distinguish between owners and nonowners both according to *Crypto Understand* and *Profitability*. We find some contrasting demographic characteristics for owners who understand crypto assets very well and owners who do not understand as below. Owners who understand very well tend to obtain information about financial products from financial institutions or experts and to have large financial asset holdings, unlike the average owner. Regarding the owners who do not understand crypto assets, unlike the average owner, they tend to have a lower value of objective financial literacy and are less overconfident and risk-averse. They are not impatient and do not lack self-control.

Third, by asking which D variables and non-D variables are likely to distinguish the owners belonging to each group from the rest of the owners, we examined the heterogeneity among crypto-asset owners classified by four groups: *Crypto understand*, *Profitability*, ownership of *s or i or f*, and their adoption of noncash payment methods. We identify the heterogeneity of owners in each group by two measures: whether the numbers (or proportions) of the parameter estimates on the D variables and non-D variables that statistically significantly distinguish the owners belonging to each group from the rest of the owners differ from zero. We find that 40–60% of the D variables distinguish owners belonging to three of the four groups, excluding the group that uses noncash payment methods, from the owners not belonging to the groups. We also find that at most 30% of the non-D variables statistically significantly distinguish the owners belonging to four groups, apart from the group by the owners' level of understanding of crypto assets, from owners not belonging to the groups. The details of our results are discussed below.

Regarding the results for the owners categorized by *Crypto understand*, the parameter estimates for 20 (57%) D variables and 13 (48%) non-D variables are statistically significant. Thirteen of these 20 D variables show that at least one of the two groups—the owners who understand very well or who understand to some extent—tend to be positively (negatively) and significantly associated with the D variables as indicated by the parameter sign estimates for the comparison of the average owner and nonowners, except for *Age75_79* for owners who understand to some extent and *Public* and *Self-employed* for owners who understand very well. We note that, unlike the average owner, owners who do not understand crypto assets tend to have a lower value of *Objective financial literacy*, be lacking in experience of financial education at school, and not know where to obtain information when selecting financial products compared with the rest of the owners.

Regarding the results for the owners categorized by the profitability of investment in crypto assets, the parameter estimates for 18 (51%) D variables and nine (18%) non-D variables are statistically significant. Eight of these 18 D variables show that owners with a profit from their investment in crypto assets tend to be positively (negatively) and

significantly associated with the D variables as indicated by the parameter sign estimates in column 3 that are positive (negative). Seven of these 18 D variables (including three variables already included in the eight D variables discussed above) show that owners with a loss from their investment in crypto assets tend to be negatively (positively) and significantly associated with the D variables as indicated by the parameter sign estimates in column 3 that are positive (negative).

Regarding the results for the owners categorized by the ownership of *s or i or f*, the parameter estimates for 15 (44%) D variables and six (22%) non-D variables are statistically significant. Thirteen of these 15 D variables show the same characteristics for the average owner and nonowners. Owners whose *s or i or f* takes a value of 1 tend to have higher *Objective financial literacy*, are likely to obtain financial education at school but not home, and are less credit card literate than owners whose *s or i or f* takes a value of 0. They tend to obtain information from mass media more frequently and to know about information sources in selecting financial products. They tend to be overconfident about their financial literacy, judge a financial decision based on reputation, lack self-control, be less risk-averse, have a large amount of financial asset holdings, and be male.

Regarding the results for the owners categorized by the use of noncash payment methods, the proportions of the parameter estimates on the D variables and non-D variables that statistically significantly distinguish the owners in each group and the rest of the owners are: 9% and 22% for *Noncash payment users*, 29% and 26% for *Credit card users*, 12% and 30% for *Electronic money users*, 47% and 19% for *Debit card users*, and 38% and 15% for *Mobile payment users*. We report key demographic characteristics of debit card users and mobile payment users among owners compared with the rest of the owners. First, *Debit card users* tend to obtain information from mass media more frequently, be overconfident about their financial literacy, impatient, and less risk-averse, follow reputation in making a financial decision, be positively associated with *Income_1500_*, and be young, which is similar to the average owner. Unlike the average owner, they are also positively associated with *Asset_500_750* and *Asset_2000_*. They are also negatively associated with *Junior college* and *University*. Second, *Mobile payment users* tend to obtain information from mass media more frequently. They tend to be overconfident about their financial literacy, follow reputation in making a financial decision, be less risk-averse, be aged below 40 years, and positively associated with *Income_1500_*, which is similar to the average owner. Unlike the average owner, they are positively related to *Debt* and *Risk aversion 2*.

Taken together, our results suggest that financial inclusion policy and investor education for owners, if ever considered, should not only consider the average owner's characteristics but also the owners' heterogeneity.

First, regarding the owners' use of new crypto assets for day-to-day payments, crypto-asset owners with relatively new payment methods, say mobile payments via smartphone, tend to be aged below 40 years compared with owners who do not use mobile payments via smartphone. Thus, the regulators should not assume that all generations of crypto-asset owners would also smoothly adopt new crypto assets, for example, Libra or Bank of Japan's digital currency, judging from the fact that they have already adopted some type of crypto assets. Financial inclusion policy on the use of new crypto assets for day-to-day transactions, if ever considered, should target old people who are slow to adopt new financial products, but not the average crypto-asset owner who tends to be young. Financial inclusion policy may also be useful to relatively old crypto-asset owners who are unlikely to use mobile payments via smartphone.

Second, regarding investors' use of crypto assets as a store of value, owners who do not understand crypto assets might not benefit from investor education programs designed for the average owner. Based on the results for the average owner, a regulator should create an investor education program that corrects financial behaviors such as overconfidence, impatience, and lack of self-control. However, owners who

do not understand would not benefit from this program targeted at the average owner, but instead would benefit from investor education on objective financial literacy because owners who do not understand crypto assets tend not to be overconfident, impatient, and lack self-control, but tend to have a lower value of *Objective financial literacy*.

Several reservations must be noted regarding our results. First, we used data from an Internet survey, which may not constitute a representative sample of all Japanese citizens. Second, our data do not report the value of crypto-asset holdings. Hence, it was not possible to perform a quantitative evaluation of crypto-asset investments, as other studies have done. Third, our results do not show causal relationships—instead, they show a statistical association. Consequently, we should be careful about making policy recommendations. Our results for the average owner, if taken literally, might lead to the conclusion that improving objective financial literacy would increase the number of crypto-assets' owners. However, if people want to invest in crypto assets and, thus, to study such assets more thoroughly and obtain a better understanding of them, then financial literacy would be positively associated with crypto-asset ownership, while the causation would lead from ownership to financial literacy.

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