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ARTICLE

Crypto and financial literacy of cryptoasset owners versus non-owners: The role of gender differences

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Abstract

We measure crypto and financial literacy using microdata from the Bank of Canada's Bitcoin Omnibus Survey. Our crypto literacy measure is based on three questions covering basic aspects of Bitcoin. The financial literacy measure we use is based on three questions covering basic aspects of conventional finance (the "Big Three"). We find that a significant share of Canadian Bitcoin owners have low crypto knowledge and low financial literacy. We also find gender differences in crypto literacy among Bitcoin owners, with female owners scoring lower in Bitcoin knowledge than male owners. We do not, however, find significant gender differences in financial literacy amongst Bitcoin owners. In contrast, non-owners show gender differences in both crypto and financial literacy.

Keywords: Bitcoin; cryptocurrency; crypto literacy; financial literacy; gender gap

JEL Codes: G53; D14; D91; C81; O51

1. Introduction

Introduced by Nakamoto (2008), Bitcoin was designed to function as a peer-to-peer electronic cash system outside the system established by central banks and intermediary financial institutions. Bitcoin was touted as both a payment method and a financial asset, attracting considerable attention and investment worldwide.[1] However, due to its inherent volatility and inefficiency as a payment method, Bitcoin has evolved into more of an investment product rather than a reliable means of payment (Balutel et al. 2024; Henry et al. 2019a; Stix 2021).

The Bank of Canada monitors and conducts research on Bitcoin and other cryptoassets for several reasons. One primary motivation is the exploration of these digital currencies in the context of potentially issuing a central bank digital currency (CBDC). This exploration necessitates careful consideration of two crucial conditions outlined in Lane (2020, 2021) that would lead the Bank to consider issuing a CBDC: if cash could no longer be used for a wide range of transactions or if private digital currencies make serious inroads

[1] The price of one Bitcoin reached an all-time high of over $63,000 USD in 2021 with an associated market capitalization of over $1T USD, based on data from CoinMarketCap.

as an alternative payment method. Further, the Bank of Canada's Financial System Review (2022) finds that: "Cryptoasset markets continue to evolve and grow rapidly, and price volatility remains high. While they do not yet pose a systemic risk to the Canadian financial system, the lack of a regulatory framework means they operate without many of the safeguards that exist in the traditional financial system. This exposes investors to risks such as large and sudden financial losses due to fraud, price declines, or a run on stablecoins."

Balutel et al. (2024) find evidence from survey data that in 2021, 25 percent of cryptoasset owners experienced price crashes. Other incidents reported include lost access to a wallet (11%), initial coin offering scams (7%), stolen funds (7%), and data breaches (6%).[2]

The Bank of Canada's Financial System Review (2023) adds that: "Cryptoasset markets do not currently represent a significant concern for the stability of the Canadian financial system. They remain small and mostly separate from the financial system. If they do become more interconnected, shocks in these markets could spread to the broader financial system and affect financial stability."

In July 2023, Canada's banking and insurance regulator (OSFI) set out its regulatory requirements for banks' and insurers' exposures to cryptoassets, to come into effect in 2025, replacing the interim OSFI advisory on cryptoassets that was released in 2022 (Office of the Superintendent of Financial Institutions 2023a, 2023b).

While constituting a relatively small market, understanding what drives the adoption of cryptoassets and the demographic profiles of their owners is valuable. The percentage of Canadians who own Bitcoin increased significantly from 5 percent in 2018–2020 to 13 percent in 2021 (Balutel et al., 2022a, 2024), with the highest concentration observed among men.[3] The surge in media attention and ease of access to cryptoassets, driven by the prevailing fear of missing out (FoMO), has likely influenced individuals who typically avoid high-risk investments to participate. As highlighted by Gerrans et al. (2023), FoMO is a widely acknowledged motivator for cryptocurrency investment. Therefore, it is important to have a solid foundation in crypto and financial literacy, as it can help individuals avoid impulsive decisions and cope with the risks and uncertainties in the dynamic world of cryptoassets.

Crypto literacy, as a proxy for digital literacy, is essential for investors to help them understand and navigate their engagement with such assets. In a recent survey, Ontario Securities Commission (2022) found that while 51 percent of Canadians knew the correct definition of cryptoassets, their average score on a related knowledge test was only 37 percent, indicating limited understanding of practical, legal, and regulatory aspects. Another U.S. study highlights a significant gap in crypto literacy, revealing that 91 percent of participants failed a crypto literacy test despite increased awareness fueled by media attention.[4] Additionally, Bannier et al. (2019) showed that respondents could correctly answer only 3 out of 6 crypto-related questions on average.[5] Their research also found a gender gap in crypto literacy and estimated that financial literacy alone accounted for approximately 40 percent of this observed gender gap in understanding characteristics of Bitcoin.

[2] The Canadian Securities Administrators identify four primary risks associated with investing in cryptoassets: significant price volatility, lack of liquidity, challenges in identifying intermediary entities, and susceptibility to cybersecurity threats.

[3] This trend of gender divide was documented in the United States (Schuh and Shy, 2016), Austria (Stix, 2021), Japan (Fujiki, 2020, 2021), and across all studies conducted in Canada (Henry et al., 2018a; 2019a; Balutel et al., 2022b, 2023a, 2024; Ontario Securities Commission, 2022).

[4] See CryptoLiteracy.org.

[5] This study incorporated some Bitcoin-related questions from the BTCOS conducted by the Bank of Canada Henry et al. (2018a).

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Financial literacy is another key characteristic of interest for this paper. Studies suggest that cryptoasset owners in Japan (Fujiki 2020) and Austria (Stix 2021) are more financially literate than non-owners. In contrast, Bitcoin ownership in Canada has historically been more common among those with low financial literacy, although there was an increased share of those with high financial literacy in 2021 (Balutel et al., 2022a, 2024). Further, Fujiki (2021) explored the heterogeneity of Japanese cryptoasset owners and found that those owners without investment experience in risky conventional assets display lower levels of financial literacy relative to both cryptoasset owners and non-owners with investment experience. In the context of the gender gap in financial literacy, a substantial body of literature emphasizes the widely recognized disparity in financial literacy between genders. This discrepancy carries significant implications for participation in financial markets and overall financial well-being (Bucher-Koenen et al. 2017, 2021; Lusardi and Mitchell 2011b, 2011c; van Rooij et al. 2011).[6]

Some proponents argue that blockchain technology has the potential to mitigate the digital divide and enhance financial inclusion, as indicated by Hydary (2019). However, Carmona (2022) contends that the anticipated benefits of cryptoassets for financial inclusion have not materialized. This represents a divergence of views on the actual impact of blockchain technology and cryptoassets in addressing financial inclusion. Koskelainen et al. (2023) explored financial behavior in digital environments, concluding that digital financial literacy is distinct from both financial and digital literacy, and its measurement is relatively underdeveloped.

This paper contributes to the literature discussed above by measuring both crypto and financial literacy in Canada using the Bank of Canada's Bitcoin Omnibus Survey (BTCOS). We utilize the crypto literacy measure proposed in Henry et al. (2018a), which assesses understanding of three basic facts about the Bitcoin system and the Big Three financial literacy questions of Lusardi and Mitchell (2011a). We explore the intersection of these measures for two distinct cohorts – Bitcoin owners and non-owners – with a specific focus on the gender gap. Our analysis is primarily descriptive, with an emphasis on presenting relevant statistics to elucidate the current landscape of financial and crypto literacy in Canada. This builds on previous research (Balutel et al., 2022a, 2024) which documented much broader key findings from the BTCOS related to the awareness, ownership, and use of Bitcoin by Canadians; analysis of crypto and financial literacy was only tangential to these earlier works.

Most closely related to the current paper is Bannier et al. (2019), which documented a similar gender gap in Bitcoin literacy. Aside from studying the U.S. (versus Canadian) Bitcoin landscape, their analysis concerns the overall US population, while our paper compares the crypto and financial literacy of both the overall population and the subpopulation of Bitcoin owners. Additionally, their approach is different from ours. A key assumption they make is that financial literacy can help explain crypto literacy – in particular, that the gender gap in financial literacy explains a sizable portion of the gender gap in crypto literacy. By contrast, we use a joint bivariate model to examine the two measures of crypto and financial literacy (and their potential gender gaps). This model allows us to capture the reciprocal influence between these two variables, rather than treating them as separate and independent. Our model assumes that there are both

[6] In addition, women are more likely than men to select "don't know" responses across measures of financial literacy (Bucher-Koenen et al., 2017), but they often choose the correct answer when the "don't know" option is unavailable (Bucher-Koenen et al., 2021). Hospido et al. (2024) further explore the gender gap in financial literacy, focusing on measurement aspects and proposing interventions to reduce response biases among survey respondents. Their study demonstrates that informing survey participants about the existing gender gap in choosing "I do not know" significantly reduces both the gender gap in selecting "I do not know" responses and the overall gap in financial literacy.

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observed factors (such as demographic characteristics) and, importantly, *unobserved* factors which may affect crypto and financial literacy simultaneously. Such unobserved factors could account for traits such as confidence in answering literacy questions, risk tolerance, or experience with conventional risky assets.

The key findings of our paper are as follows:

- *Crypto literacy*. We find that women performed worse than men on the crypto literacy measure. Notably, the gender gap is present among Bitcoin owners: women who own Bitcoin indicated a lower understanding of the key features of the cryptoasset compared to their male counterparts. This could be related to our subsequent finding that women tended to choose "don't know" responses to the crypto literacy questions more often than men, which is consistent with previous studies that have explored confidence as a possible source of the gender gap in literacy measures (Bucher-Koenen et al. 2017, 2021; Cupák et al. 2020; Hospido et al. 2024).
- *Financial literacy*. We find no significant gender differences in financial literacy among Bitcoin owners. However, women performed worse than men on the financial literacy measure non-owners. Just under a third of women in the sample of non-owners are classified as having a high level of financial literacy, compared to approximately half of men. Given the low rate of Bitcoin ownership in Canada, this could indicate broader trends in financial literacy, consistent with the existing literature on the gender gap (Lusardi and Mitchell, 2011a).
- *Joint crypto and financial literacy*. The joint conditional analysis empirically supports the existence of a gender gap in both crypto and financial literacy among non-owners but only in crypto literacy among Bitcoin owners. Secondly, it reveals that crypto and financial literacy are not independent. There exists a positive and statistically significant correlation between the two scores, which can be attributed to unobservable factors (*positive selection*). This implies that individuals who demonstrate higher levels of crypto literacy are more likely to exhibit higher levels of financial literacy and vice versa. Moreover, this effect is more pronounced among Bitcoin owners in comparison to non-owners.

The rest of our paper is organized as follows: Section 2 describes the data used in the analysis and the construction of the literacy measures; Section 3 presents the unconditional analysis related to crypto and financial literacy among Bitcoin owners and non-owners with a focus on gender differences; then Section 4 discusses the conditional analysis of crypto and financial literacy. Section 5 concludes and suggests future work.

2. Bitcoin omnibus survey

This paper uses data on cryptoasset ownership from the Bank of Canada's Bitcoin Omnibus Survey (BTCOS), specifically analyzing three waves conducted in 2018, 2019, and 2021.[7] The BTCOS is designed by the Bank of Canada, and fieldwork is conducted by the market research firm Ipsos. The survey uses an online and device-agnostic methodology, meaning that it can be completed on any device – computer, laptop, mobile phone, tablet, etc. – that can be used to access the internet. Quota-based sampling is used for recruiting respondents to the BTCOS to match nested population targets defined by age, gender, and region. The final sample sizes were 1,987 in 2018, 1,987 in 2019, and 1,974 in 2021. Among

[7] Financial literacy questions developed by Lusardi and Mitchell (2011a) were introduced in the BTCOS survey for the first time in 2018.

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these, there are 99, 89, and 121 Bitcoin owners each year, respectively. The data are cleaned and the sample is weighted using an iterative raking procedure (Deville et al. 1993) to produce survey weights that ensure it is representative along numerous demographic dimensions as measured by the 2016 Canadian census.[8]

2.1. Development of the BTCOS

The inaugural version of the BTCOS was conducted in 2016 as a pilot study, with a narrow focus on measuring levels of awareness and ownership of Bitcoin in Canada. With the exception of 2020, the survey has since been conducted annually during the month of December. Following the pilot, each subsequent version of the survey instrument contained additional content aimed at better understanding factors driving Bitcoin adoption. The BTCOS has served to inform the Bank of Canada's view of future cash demand and to assess whether private digital currencies are making inroads as viable alternative payment methods. The latter forms one of the criteria for potential issuance of a Central Bank Digital Currency (CBDC), as outlined in Lane (2020). For previous versions of the BTCOS, see also the following reports: Henry et al. (2017, 2018b, 2019b), and Balutel et al. (2022b, 2023a).

The survey instrument covered various aspects related to Bitcoin, such as awareness, ownership, reasons for ownership/non-ownership, use in payments or person-to-person transactions, holdings, beliefs about its future survival and adoption levels among Canadians, price expectations over the next month, and methods of purchasing. The BTCOS survey also included inquiries about altcoins, alternative cryptocurrencies to Bitcoin, and addressed security incidents or price crashes experienced by both Bitcoin and altcoin owners. Additionally, for both cryptoasset owners and non-owners, the BTCOS gathered information about their cash holdings. And finally, of particular relevance to this paper, it assessed their levels of crypto and financial literacy.[9]

2.2. Crypto and financial literacy measures

Exploring the intersection of finance and digitalization, three pivotal themes were outlined by Koskelainen et al. (2023): fintech, financial behavior in digital environments, and behavioral interventions. A key observation from the study is that the measurement of digital financial literacy has remained underdeveloped compared to the measurement of financial or digital literacy.

The BTCOS used separate measures to assess crypto and financial literacy, shown in Tables 1 and 2. The crypto literacy questions were developed by Henry et al. (2018a) and consist of three true-false statements concerning basic facts about the Bitcoin system. Bitcoin is the most well-known and market-dominant cryptoasset, and therefore knowledge of these facts reflects how well versed a person is in this domain. The questions are featured in a national library of financial literacy measures,[10] which supports the country's primary consumer protection agency in its efforts to monitor and improve Canadians' skills in navigating the financial marketplace (Financial Consumer Agency of Canada 2021). The measure has also been referenced in Bannier et al. (2019), and one of the questions used to assess digital financial literacy in OECD (2022) is similar to the true-false statement concerning government backing.

The Big Three questions developed by Lusardi and Mitchell (2011a) measure financial literacy by assessing understanding of compound interest, inflation, and risk

[8] A full description of the methodology for the BTCOS can be found in Balutel et al. (2022a).

[9] The full survey instrument used for the last wave, respectively 2021, can be found in the Appendix.

[10] See the Measures Library on the Financial Consumer Agency of Canada website.

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Table 1. Crypto literacy questions

Statements	Response options
The total supply of Bitcoin is fixed.	**True**
	False
	Don't know
Bitcoin is backed by a government.	True
	False
	Don't know
All Bitcoin transactions are recorded on a distributed ledger that is publicly accessible.	**True**
	False
	Don't know

Note: This table shows the three questions Henry et al. (2018a) used to test Bitcoin knowledge in the 2021 Bitcoin Omnibus Survey. Bitcoin is the most well-known and market-dominant cryptoasset; therefore, knowledge of these basic facts serves to measure crypto literacy. Respondents are asked to answer whether they think each statement is true or false; alternatively, they can answer "Don't know." Correct answers are shown in bold.

Table 2. Financial literacy questions

Question	Response options
Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have left in the account if you left the money to grow?	**More than $102**
	Exactly $102
	Less than $102
	Don't know
Imagine the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with this money in this account?	More than today
	Exactly the same
	Less than today
	Don't know
Please tell me whether or not this statement is true or false: Buying a single company's stock usually provides a safer return than a mutual fund of stocks.	True
	False
	Don't know

Note: This table shows the three financial literacy questions that were asked in the 2021 Bitcoin Omnibus Survey. Questions are taken from the "Big Three" of Lusardi and Mitchell (2011a). Correct answers are in bold.

diversification. These questions have been used in surveys across the world (Lusardi and Mitchell 2023) and have become standard in the literature.

In our paper, we compute a crypto and financial literacy score for each respondent as the number of correct answers minus the number of incorrect answers ("don't know" responses do not contribute to the score). Incorrect answers are deducted in order to penalize survey respondents who make guesses, potentially associated with their risk tolerance levels. Therefore, this score can take on integer values from -3 to 3. Crypto literacy is then classified as "high" (score $= 3$), "medium" (score$= 1, 2$), or "low" (score ≤ 0). Financial literacy categories are constructed in the same way.

Our scoring methodology diverges from the conventional approach found in the literature (Lusardi and Mitchell 2011c), which typically classifies individuals answering all three questions correctly as having high literacy and the rest as having low literacy.

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By assigning a value of zero to a "don't know" answer and −1 to "incorrect" answers, our approach yields comparable insights to the conventional method for the high category, but distinguishes between two different types for those not in the high category. The decision to give a zero weight to a "don't know" answer stems from the difficulty in distinguishing between a genuine lack of knowledge, a lack of confidence, or financial anxiety. Bucher-Koenen et al. (2021) identified that the use of "do not know" in response to financial knowledge questions by women is frequently linked to a lack of confidence, contributing to roughly one-third of the observed literacy gap, while Tinghög et al. (2021) suggest financial anxiety stemming from a stereotype threat for women in the financial domain, which also plays a role in contributing to the observed gender gap.

3. Unconditional analysis of crypto and financial literacy

In this section, we provide a descriptive analysis of crypto and financial literacy levels among Canadians by aggregating data from 2018, 2019, and 2021 waves of the BTCOS survey. Our primary focus is on exploring the landscape of crypto and financial literacy among distinct ownership groups: non-owners (individuals without Bitcoin holdings) and Bitcoin owners, specifically emphasizing gender differences. Additionally, our analysis delves into how demographic factors influence crypto and financial literacy. Lastly, we present the distribution of combined crypto and financial literacy levels among Bitcoin owners and non-owners.

3.1. Crypto and financial literacy: Overall results

In general, awareness of the term "Bitcoin" among the Canadian population is high and has remained stable at about 90 percent since 2018 (Balutel et al., 2022a, 2024; Henry et al. 2020). However, the left panel of Figure 1 shows that the level of understanding of how Bitcoin actually works – i.e., the level of crypto literacy – is still quite low. Just 5 percent of non-owners displayed high crypto literacy, while a substantial 64 percent were identified with low literacy. Among Bitcoin owners, the distribution of crypto literacy reflects varying levels of understanding. Surprisingly, 32 percent exhibit a low understanding of Bitcoin features, while conversely, 31 percent have a high level of crypto literacy. The remaining 37 percent fall in the middle, demonstrating a moderate level of crypto literacy.

The right panel of Figure 1 shows the distribution of financial literacy for the pooled data. Specifically among non-owners, 39 percent have a high level of financial literacy, 35 percent are in the medium category, and 25 percent are in the low category. In contrast, a clear polarization in financial literacy is evident within the cohort of Bitcoin owners. Specifically, 40 percent of Bitcoin owners are categorized as having low financial literacy, while 37 percent fall into the high financial literacy category.

An observed trend among Bitcoin owners, as reported by Balutel et al. (2023a) and Balutel et al. (2024), indicates a doubling percentage of individuals with low crypto literacy, climbing from 19 percent in 2018 to 40 percent in 2021. Conversely, the overall share of Bitcoin owners with high financial literacy has steadily increased. The price of Bitcoin soared during the COVID-19 pandemic, attracting investors looking for quick profits, but many jumped in without fully understanding the market complexities and risks involved. The 2021 BTCOS includes a novel question measuring the duration of Bitcoin ownership: "When did you first obtain Bitcoin?".[11] Figure 2 shows that long-term owners, commonly known as early adopters, generally demonstrate better performance on crypto

[11] Balutel et al. (2022a) reviewed numerous ways in which recent owners differ from long-term ones (see Section 5).

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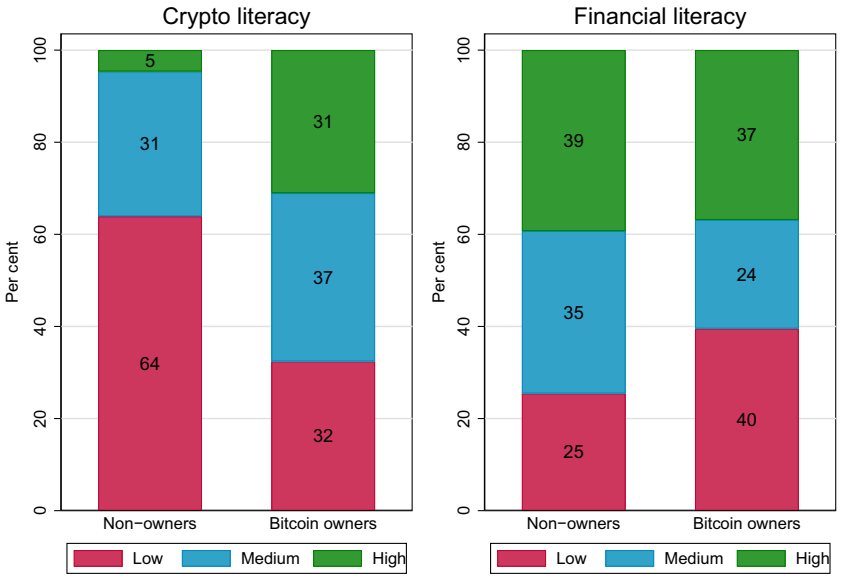

Figure 1. Crypto and financial literacy: Overall results.
Note: This figure shows the share of non-owners and Bitcoin owners in each category of crypto literacy (left) and financial literacy (right). The working sample size is 1,787 in 2018, 1,745 in 2019, and 1,778 in 2021. The sample comprises 99 Bitcoin owners in 2018, 89 in 2019, and 226 in 2021. All estimates are calculated using survey weights.

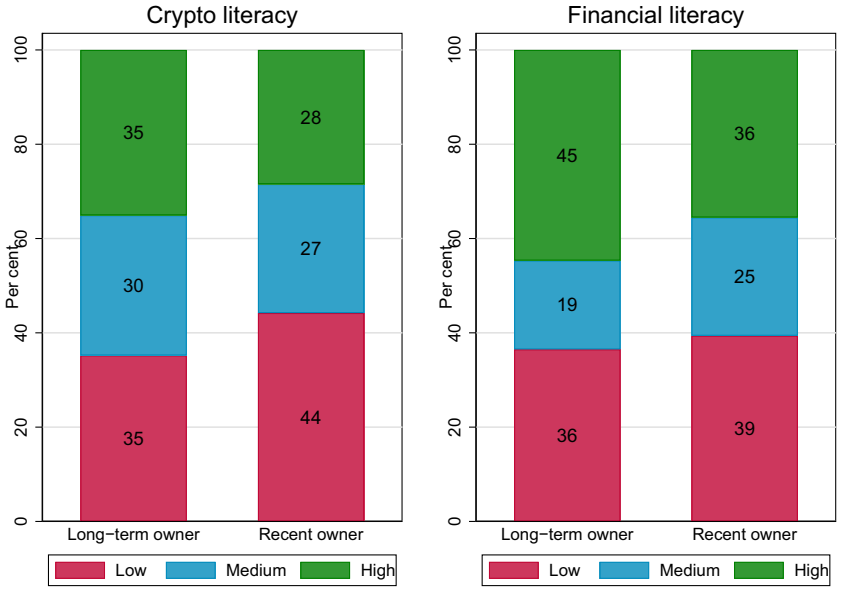

Figure 2. Crypto and financial literacy of Bitcoin owners: Long-term versus recent.
Note: This figure shows the share of long-term and recent Bitcoin owners in each category of crypto literacy (left) and financial literacy (right).Long-term owners, those who bought Bitcoin before 2020, and recent owners, who made purchases in 2020 or 2021, together form a sample of 226 (105 long-term, 121 recent). Data are from the Bank of Canada's 2021 Bitcoin Omnibus Survey, specifically from the wave where the question "When did you first obtain Bitcoin?" was included.

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Table 3. Demographics of Bitcoin owners by crypto and financial literacy

		Crypto literacy			Financial literacy		
	N	Low	Medium	High	Low	Medium	High
Overall	414	0.32	0.37	0.31	0.40	0.24	0.37
Male	286	0.28	0.35	0.37	0.38	0.25	0.37
Female	128	0.43	0.41	0.16	0.43	0.21	0.37
18–34	184	0.35	0.37	0.28	0.41	0.27	0.32
35–54	166	0.28	0.39	0.32	0.45	0.16	0.39
55+	64	0.35	0.26	0.39	0.13	0.37	0.50
High school	56	0.44	0.33	0.23	0.50	0.23	0.27
College	120	0.30	0.32	0.38	0.41	0.31	0.29
University	238	0.26	0.42	0.32	0.31	0.20	0.49
<30K	40	0.33	0.47	0.20	0.56	0.28	0.17
30K–69K	128	0.26	0.37	0.37	0.36	0.33	0.31
70K+	237	0.33	0.36	0.30	0.40	0.18	0.42
Unemployed	83	0.31	0.34	0.34	0.35	0.27	0.38
Employed	331	0.32	0.37	0.31	0.41	0.22	0.37
British Columbia	58	0.39	0.26	0.36	0.27	0.28	0.44
Prairies	86	0.31	0.36	0.33	0.43	0.21	0.36
Ontario	173	0.29	0.39	0.33	0.38	0.28	0.34
Quebec	71	0.35	0.45	0.21	0.51	0.13	0.36
Atlantic	26	0.32	0.24	0.44	0.33	0.27	0.40

Note: This table reports the shares of Canadian Bitcoin owners according to their level of crypto and financial literacy. The sample consists of 414 Bitcoin owners. Years: 2018, 2019, and 2021. The Prairies region includes Alberta, Saskatchewan, and Manitoba. The Atlantic region includes New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. All estimates are calculated using survey weights.

and financial literacy measures than recent owners (those who purchased Bitcoin starting in 2020), often referred to as late adopters. This difference could be attributed to the advantage early adopters have in terms of their more prolonged exposure and engagement in the market, while the entry of short-term owners may be characterized by hype and widespread media attention.

Table 3 presents the proportions of crypto and financial literacy among Canadian Bitcoin owners according to various demographic categories.[12] When examining the results of crypto literacy by gender, it is observed that females have a higher proportion in the low crypto literacy category (43%) compared to males (28%). Conversely, males have a higher proportion in the high category (37%) compared to females (17%). Additionally, low crypto literacy is prevalent among Bitcoin owners with high school diplomas.

The distribution of financial literacy tends to be split between the low and high categories across most demographic groups. When examining the results by gender, it shows that females have a slightly higher proportion of individuals with low financial literacy (43%) compared to males (38%). Nevertheless, both males and females exhibit a

[12] Some sub-groups have a small number of observations; therefore, evidence should be interpreted with caution.

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similar share in the high category (37%). When other demographic factors are examined, Bitcoin owners with a high school diploma or low income are more inclined to possess low financial literacy. In contrast, older owners with a university degree or high income tend to have higher financial literacy.

3.2. Crypto and financial literacy: Gender differences

This section explores unconditional gender-specific disparities in crypto and financial literacy within Bitcoin owner and non-owner cohorts. Revealing gender-specific patterns can help to ensure that various investors understand the risks they undertake when investing in cryptoassets.

Figure 3a presents crypto literacy distributions based on Bitcoin ownership and gender. Among non-owners, 56 percent of males and 71 percent of females fall into the low crypto literacy category, while 28 percent of males and 43 percent of females demonstrate low crypto literacy among Bitcoin owners. Additionally, a small percentage of non-owners (7% of males and 2% of females) exhibit high crypto literacy, while owners, particularly males (37%), surpass females (16%) in high crypto literacy. These results underscore the persistent gender gap in crypto literacy, with women consistently exhibiting a lower understanding of Bitcoin characteristics across both ownership categories. If financial literacy is associated with participation in asset markets, does this suggest that female Bitcoin owners have higher financial literacy levels than their female counterparts who do not own Bitcoin? If so, could this imply that the gender gap is narrower when comparing female Bitcoin owners with male Bitcoin owners?

As illustrated in Figure 3b, the distribution of financial literacy reveals interesting insights regarding gender differences among Bitcoin owners and non-owners. Among non-owners, a clear gender gap is evident in the low financial literacy category, where 32 percent of females fall into this bracket, compared to 19 percent of males. In contrast, among Bitcoin owners, the gender difference in low financial literacy is less pronounced, with 43 percent of females and 38 percent of males falling into this category. In the medium financial literacy category, gender differences are less significant for both non-owners (39% females, 31% males) and owners (21% females, 25% males).

The high financial literacy category displays a noteworthy gender shift. Among non-owners, males dominate the high financial literacy category, constituting 50 percent compared to 29 percent of females. Surprisingly, among Bitcoin owners, the gender gap in high financial literacy narrows, with 37 percent of both males and females falling into this category. Upon an examination across the two groups of Bitcoin owners and non-owners, the most noticeable contrast emerges among males, where Bitcoin owners exhibit lower financial literacy compared to non-owners.[13] Nevertheless, among females, there are no notable average differences in financial literacy test scores, despite the fact that female Bitcoin owners possess a higher proportion of individuals with advanced financial literacy. The results suggest a nuanced relationship between gender and financial literacy, with significant disparities among non-owners and a more balanced distribution among Bitcoin owners.

Table 4 further decomposes the demographic patterns among female Bitcoin owners.[14] According to the findings, women with the lowest levels of understanding when it comes to cryptocurrency are typically found within two particular age ranges: 18–34 and over 55. They tend to have either a high school diploma or a lower income. However, females who

[13] An analysis of the equality of financial literacy test scores between male Bitcoin owners and non-owners reveals that non-owners have a higher average score (2.33 out of 3) than Bitcoin owners, who score 2.1, and this disparity is statistically significant.

[14] Some sub-groups have a small number of observations; therefore, evidence should be interpreted with caution.

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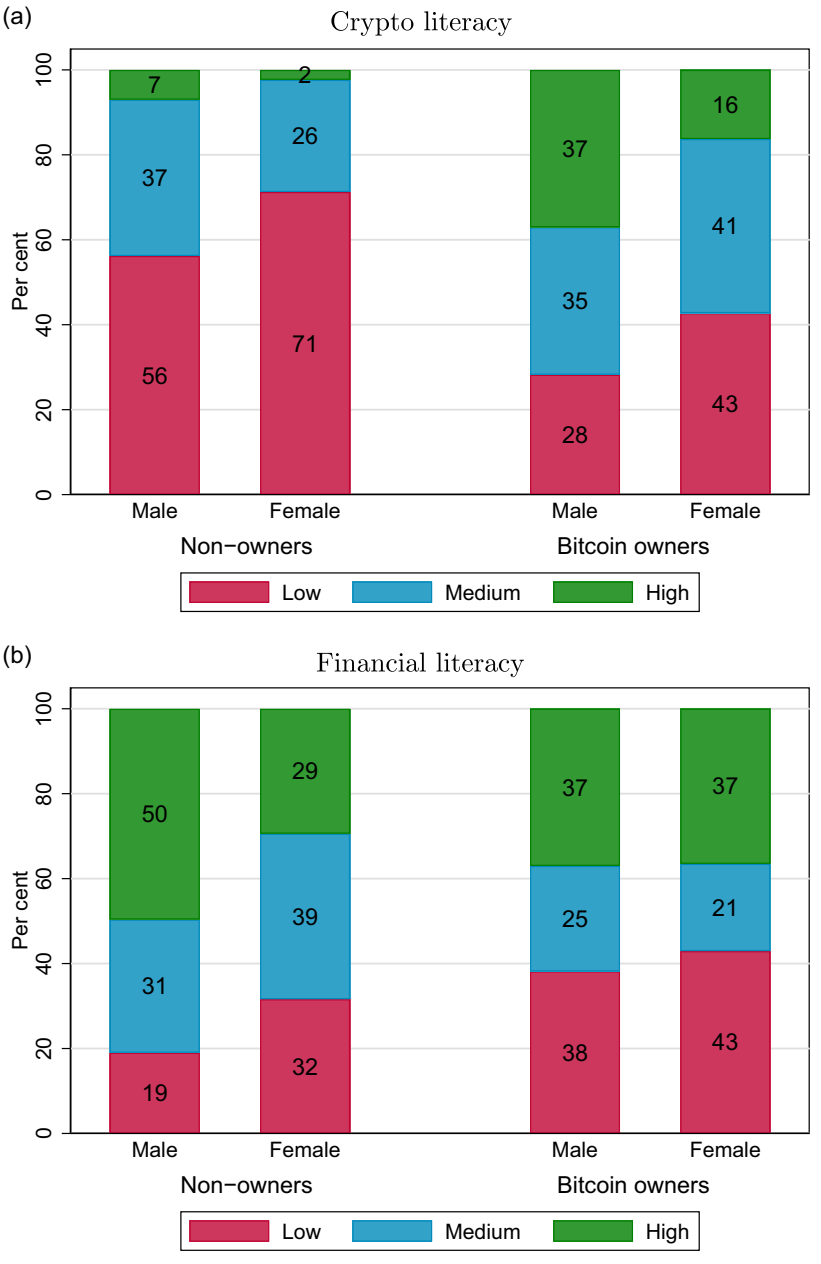

Figure 3. Crypto and financial literacy: Gender differences.
Note: This figure shows the share of respondents in each category of crypto literacy (panel a) and financial literacy (panel b). The left side of each figure shows the distributions among non-owners of Bitcoin, categorized by gender, while the right side shows the distribution among Bitcoin owners, also categorized by gender. Categories are constructed based on scores described in Section 2.2. Years: 2018, 2019, and 2021. The sample size comprises 2,846 females, with 128 owning Bitcoin, and 2,464 males, with 286 being Bitcoin owners. All estimates are calculated using survey weights.

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Table 4. Demographics of female Bitcoin owners by crypto and financial literacy

		Crypto literacy			Financial literacy		
	N	Low	Medium	High	Low	Medium	High
18–34	63	0.47	0.37	0.16	0.50	0.19	0.31
35–54	50	0.35	0.50	0.15	0.37	0.20	0.44
55+	15	0.51	0.23	0.26	0.23	0.38	0.40
High school	17	0.62	0.31	0.07	0.63	0.04	0.34
College	38	0.34	0.45	0.21	0.41	0.33	0.26
University	73	0.31	0.47	0.21	0.27	0.27	0.46
<30K	14	0.70	0.05	0.24	0.89	0.06	0.05
30K–69K	43	0.34	0.52	0.14	0.46	0.35	0.20
70K+	68	0.42	0.43	0.15	0.37	0.17	0.46
Unemployed	32	0.41	0.40	0.19	0.57	0.24	0.19
Employed	96	0.43	0.41	0.16	0.39	0.20	0.41

Note: Share of female Bitcoin owners by crypto and financial literacy category. The sample size consists of 128 female Bitcoin owners. Years: 2018, 2019, and 2021. All estimates are calculated using survey weights.

fall within the 35–55 age range, possess a university degree, or earn between CAD 30k and 69k annually are more likely to exhibit a moderate level of crypto literacy. With regard to the financial literacy of female Bitcoin owners, those who fall within the low literacy category are typically aged 18–34, with a high school diploma or a low income. On the other hand, those who fall within the high literacy category are aged between 35 and 54, possess a university degree, or earn a high income. While the sample size is small, the results align with findings from other surveys on general financial literacy, which show that financial knowledge is lowest among younger age groups and that it is correlated with educational attainment (Lusardi and Mitchell 2011c).

Existing literature indicates that women are generally less inclined to hold risky assets and tend to be more financially risk-averse than men (Almenberg and Dreber 2015; Charness and Gneezy 2012; Jianakoplos and Bernasek 1998). In addition, Alonso et al. (2023) found, in the case of Spain, that reduced female participation in the crypto market is influenced by factors such as a lack of investment experience in traditional assets, a general deficiency in knowledge about cryptocurrencies, and a limited understanding of concepts like blockchain. Building on these insights, a recent survey report from the Ontario Securities Commission adds a layer to the story (Ontario Securities Commission 2022). Compared to non-owners, crypto owners (holding either cryptoassets, crypto funds, or both) were more likely to hold a variety of investments, particularly individually held stocks or exchange-traded units. Another noteworthy finding is that individuals acquiring cryptoassets primarily relied on their friends, family, and colleagues as a source of information before making purchases. Notably, this reliance on personal networks is more pronounced among females.[15] This interconnected narrative suggests that financially literate women may have acquired their knowledge and skills in more conventional financial markets, and a desire for portfolio diversification or exposure to alternative assets might drive their decision to invest in Bitcoin. However, the specific nuances of the

[15] Balutel et al. (2022c) found that engaging with a broader community of Bitcoin users increases the likelihood that an individual will own Bitcoin.

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Table 5. Joint analysis of crypto and financial literacy: Non-owners and owners

		Non-owners			Bitcoin owners		
		Crypto literacy			Crypto literacy		
		Low	Medium	High	Low	Medium	High
Financial literacy	Low	18	6	1	16	15	8
	Medium	24	11	1	8	8	8
	High	22	15	3	8	13	15

Note: Share of non-owners and Bitcoin owners by crypto and financial literacy category. The sample size consists of 414 Bitcoin owners and 4,896 non-owners. Years: 2018, 2019, and 2021. All estimates are calculated using survey weights.

Table 6. Joint analysis of crypto and financial literacy: female non-owners and owners

		Female non-owners			Female Bitcoin owners		
		Crypto literacy			Crypto literacy		
		Low	Medium	High	Low	Medium	High
Financial literacy	Low	25	6	1	21	16	6
	Medium	28	10	1	10	7	4
	High	18	10	1	12	18	6

Note: Share of female non-owners and Bitcoin owners by crypto and financial literacy category. The sample size consists of 128 female Bitcoin owners and 836 female non-owners. Years: 2018, 2019, and 2021. All estimates are calculated using survey weights.

cryptocurrency market, including its technology, decentralized nature, and unique risks, might not be as familiar to them.

3.3. Joint analysis of crypto and financial literacy

The observed disparities in crypto and financial literacy among Bitcoin owners require a thorough examination of their interaction. Table 5 presents valuable insights into the distribution of non-owners and Bitcoin owners based on their combined financial and crypto literacy levels.

Non-owners aware of Bitcoin tend to have a significant percentage of people with low crypto literacy, regardless of their level of financial literacy. Specifically, 18 percent of individuals with low financial literacy, 24 percent with medium financial literacy, and 22 percent with high financial literacy have low crypto literacy. Moreover, only 3 percent of individuals have both high financial and crypto literacy.

Among Bitcoin owners, there is a diversity of literacy profiles. The share of owners with both low crypto and financial literacy (16%) is comparable to the share with high literacy across both dimensions (15%). The complexity of the relationship between financial and crypto literacy suggests that individuals may not uniformly apply their financial knowledge to the unique features of cryptocurrencies.

Table 6 presents the joint distribution of females based on their levels of both crypto and financial literacy and Bitcoin ownership. It indicates that females who do not own Bitcoin tend to have a limited understanding of cryptocurrencies, irrespective of their financial literacy. Among female Bitcoin owners, a larger percentage tends to fall into the low and medium categories of crypto literacy, irrespective of their financial literacy, with only 6 percent demonstrating high levels in both areas.

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3.4. Gender differences in crypto and financial literacy: A decomposition based on literacy questions and response distribution

Bucher-Koenen et al. (2017) have shown a significant gender gap in financial literacy worldwide, with women being more likely to answer "don't know" to all financial literacy questions than men are. To gain deeper insights into this phenomenon, we conduct a detailed analysis of the response distribution of both male and female Bitcoin owners and non-owners for each crypto and literacy question.[16]

3.4.1. Crypto literacy

Figure 4a compares the distribution of responses to each crypto literacy question. The percentage of correct answers is higher among owners than non-owners, irrespective of gender. Another finding is that the true/false statement "Bitcoin is backed by the government" has the highest prevalence of correct answers among both males and females, regardless of whether they own Bitcoin. On the other hand, the question about Bitcoin's use of distributed ledger technology (DLT) has the lowest correct response rate, closely followed by the question related to the limited supply of Bitcoin.

Male Bitcoin owners particularly outperformed their non-owner counterparts in the question about Bitcoin's use of distributed ledger technology (DLT), with owners answering correctly (61%) at over triple the rate (20%) of non-owners. Among women, Bitcoin owners performed best relative to non-owners in the question about the limited supply of Bitcoin, with female Bitcoin owners selecting the correct answer (42%) at nearly four times the rate of their non-owner counterparts (11%). These results confirm that Bitcoin owners are indeed more crypto-literate than non-owners, irrespective of gender.

Figure 4a also reveals a gender gap in crypto literacy. Men outperformed women in all questions and across both ownership categories.

Particularly in this regard, the questions related to the limited supply of Bitcoin and DLT produced the greatest gender difference in the percentage of correct answers for non-owners. Among non-owners, men answered correctly (20%) at over double the rate of women (11%). Among Bitcoin owners, the gender gap in response accuracy is generally consistent across the three questions, with men more likely to answer correctly compared to women. However, the most significant gender difference is observed in the questions related to Bitcoin's supply, where men answered correctly (61%), a rate 1.5 times higher than for women (42%).

Given that men correctly answer the crypto literacy questions more often than women, regardless of whether they own Bitcoin, does this also translate to fewer incorrect answers? Figure 4a shows that among Bitcoin owners, women relative to men tend to have a relatively lower percentage of correct answers and a higher percentage of incorrect answers for two of the three questions, with the exception being the DLT-related question, where the share of incorrect answers is higher among males.

Does this mean that women are more inclined to make an assertive guess even when they are unsure of the correct answer? Although this may be the case among Bitcoin owners, among non-owners the proportion of incorrect answers by men exceeds that of women to all questions. This is most evident in the DLT question, with men answering incorrectly (27%) at nearly double the rate of women (14%).

[16] The analysis presented here has limitations due to the small sample sizes involved in addition to sample selection. In particular, since men are much more likely than women to be Bitcoin owners, the number of women included in the analysis is lower than the number of men. With respect to the latter, comparisons between owners and non-owners should ideally consider other factors associated with the decision to own Bitcoin, e.g., income and labor force participation. While the conditional analysis in Section 4 addresses some of these limitations, a more detailed analysis is left for future work.

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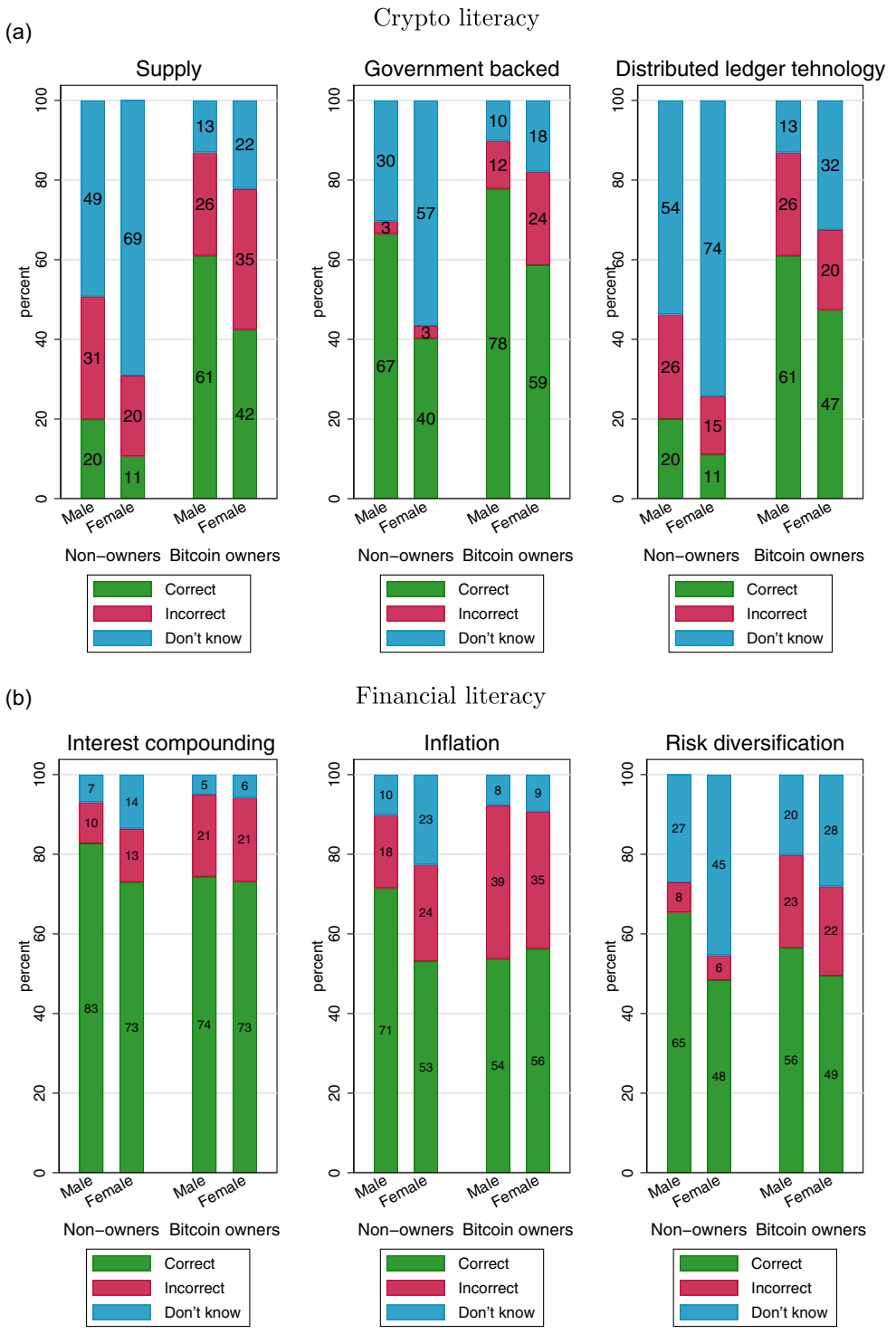

Figure 4. Crypto and financial literacy: Gender differences across literacy questions.
Note: Distribution of responses to crypto and financial literacy questions (see Tables 1 and 2) by gender and Bitcoin ownership. All estimates are calculated using survey weights.

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Notably, we find that women chose "don't know" more frequently than men in both ownership groups across all the three crypto-related questions. This is most evident in the distributions of answers to the DLT question showing that 32 percent of women selected "don't know" compared with just 13 percent of men. This suggests that confidence in one's answers may influence the measurement of crypto literacy, as is the case when measuring financial literacy (Bucher-Koenen et al. 2017). We formally explore the prevalence of "don't know" responses in a forthcoming paper (Balutel et al., 2023b).

3.4.2. Financial literacy

Figure 4b describes gender differences in the financial literacy of Bitcoin owners and non-owners by comparing the distribution of responses to each of the Big Three questions of Lusardi and Mitchell (2011a). The question related to interest compounding had the highest percentage of correct answers, while the question measuring knowledge of inflation had the largest share of incorrect answers, regardless of ownership status or gender.

Nevertheless, important gender differences are present. Among non-owners, women are less likely than men to answer financial literacy questions correctly. Similar to previous work that explored gender differences in financial literacy (Bucher-Koenen et al. 2017, 2021), the question measuring knowledge of risk diversification proved to be especially challenging for women, with men choosing the correct answer (65%) at over 1.4 times the rate of women (48%).

Figure 4b suggests that female Bitcoin owners correctly answered the financial literacy questions in similar proportions to their male counterparts, except for the risk diversification question. Relative to the distribution of correct answers among Bitcoin owners, the gender differences are much more pronounced among non-owners.

Further, comparing the proportions of incorrect answers reinforces the notion that female Bitcoin investors may be just as financially literate as their male counterparts. Male owners answered incorrectly more frequently than women to one of the three questions. The only exception is the question pertaining to risk diversification and interest compounding, where the proportion of incorrect answers is comparable across genders.

Further, Figure 4b shows that the proportion of "don't know" to the interest compounding and inflation questions among owners is comparable between men (5%, respectively 8%) and women (6%, respectively 9%). However, women were more likely than men to select "don't know" for the risk diversification question. In contrast, female non-owners appear less confident in their knowledge across all three questions.[17]

In sum, this analysis suggests that while the financial literacy gender gap is prevalent among non-owners of Bitcoin in Canada, female Bitcoin owners appear to be just as financially literate as their male counterparts. The lack of gender differences observed among crypto investors might also be attributed to a lower financial literacy score among male crypto owners when compared to their non-owner counterparts.

4. Conditional analysis of crypto and financial literacy

This section considers a comprehensive analysis aimed at unraveling the potential correlation between crypto and financial literacy. This investigation contributes to the discussion of Lyons and Kass-Hanna (2021), who underscored the nascent nature of research that defines and measures digital literacy while establishing connections to financial literacy to understand the pathways to financial behavior. Kass-Hanna et al. (2022) also delved into the combined impacts of financial and digital literacy. They

[17] In addition to the prevalence of "don't know" responses to the crypto literacy questions, this trend is further explored in Balutel et al. (2023b).

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constructed a composite index for digital and financial literacy (DFL), revealing that both financial and digital literacy are pivotal factors in shaping positive financial behaviors and ensuring long-term financial security.

Unlike Bannier et al. (2019), which documented a gender gap in Bitcoin literacy among the U.S. population assuming that financial literacy can help explain crypto literacy, we examine the interdependencies between crypto and financial literacy of Bitcoin owners and non-owners.[18] In light of a plausible bidirectional relationship between crypto and financial literacy (potential for simultaneous learning in both crypto and financial), we employ a bivariate ordered probit model (Greene and Hensher 2009; Sajaia 2008).[19]

Our model assumes that there are both observed factors (such as demographic characteristics) and, importantly, *unobserved* factors which may affect crypto and financial literacy simultaneously. Such unobserved factors could account for traits such as confidence in answering literacy questions, risk tolerance, or experience with conventional risky assets.

Table 7 provides the joint estimation results for the crypto and financial literacy scores for Bitcoin owners (Columns 2–3) and non-owners (Columns 4–5), accounting for demographic characteristics, province fixed effects, and time effects. In the realm of crypto literacy, being female among both Bitcoin owner and non-owner cohorts has a negative and statistically significant effect. This suggests that women, irrespective of ownership, are less likely than men to possess knowledge about Bitcoin.

Shifting our focus to financial literacy, our results indicate that being female is negative and statistically significant, particularly among non-owners. However, these coefficients are not statistically significant for the Bitcoin owners subsample. This indicates that women's financial literacy tends to lag behind men's among non-owners. However, there is no evidence suggesting a significant gender-based difference in financial literacy between female and male Bitcoin owners.

Further, we discuss other demographic characteristics that impact crypto and financial literacy of Bitcoin owners and non-owners. In this regard, age does not consistently impact crypto and financial literacy among owners and non-owners. Bitcoin owners aged 35–54 and above 55 years old tend to have higher levels of financial literacy and crypto literacy, although the results show statistical significance only for the financial literacy of those over 55. Non-owners in both of these age groups tend to have lower crypto literacy but a stronger understanding of financial literacy. It appears that older individuals have less knowledge about the features of cryptoassets compared to younger people. Nevertheless, if they do own cryptoassets, they usually exhibit better financial literacy than their younger counterparts. Attaining a university degree positively affects both crypto and financial literacy, irrespective of ownership status. However, while possessing a university degree positively impacts crypto literacy for Bitcoin owners, this impact is not statistically significant. High-income levels (>70K) do not affect crypto literacy but positively affect financial literacy regardless of ownership status.

Furthermore, we document that unobserved factors may simultaneously account for both crypto and financial literacy, with a more pronounced impact on the cohort of Bitcoin

[18] This departure is particularly relevant in the Canadian context, as highlighted by Balutel et al. (2022a), who documented that Bitcoin owners in Canada tend to be younger and possess lower financial literacy compared to non-owners.

[19] Fontes et al. (2023) show that recent crypto owners less frequently reported having a retirement account compared to recent stock market investors. Additionally, they indicated that cryptocurrency investments increased their interest in the stock market. In addition, Fujiki (2021) shows that cryptoasset owners without investment experience with conventional risky financial assets are less financially literate than both cryptoasset owners and non-owners with investment experience with conventional risky financial assets. Given these results, we suspect that there is a bidirectional relationship between crypto and financial literacy.

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Table 7. Conditional analysis of crypto and financial literacy

	Bitcoin owners		Non-owners	
Variables	Crypto literacy	Financial literacy	Crypto literacy	Financial literacy
Female	−0.612***	−0.049	−0.477***	−0.439***
	(0.141)	(0.172)	(0.049)	(0.044)
35–54	0.165	0.018	−0.125*	0.474***
	(0.146)	(0.165)	(0.067)	(0.060)
55+	0.006	0.704***	−0.321***	0.736***
	(0.256)	(0.232)	(0.067)	(0.062)
College	0.295	0.106	0.089	0.313***
	(0.219)	(0.222)	(0.063)	(0.054)
University	0.304	0.541**	0.331***	0.748***
	(0.195)	(0.227)	(0.065)	(0.056)
30K−69K	0.297	0.392	−0.019	0.322***
	(0.254)	(0.277)	(0.069)	(0.064)
70K+	0.070	0.482*	0.085	0.433***
	(0.256)	(0.286)	(0.071)	(0.067)
Employed	−0.219	−0.140	0.011	−0.055
	(0.211)	(0.225)	(0.056)	(0.051)
Province fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Athrho	0.257***		0.152***	
	0.076		0.028	
Observations	405		4,369	

Note: Estimates of crypto and financial literacy scores (low, medium, and high) using a joint order probability model (bivariate ordered probit) for Bitcoin owners subsample (Columns 2–3) and non-owners subsample (Columns 4–5). The base categories are male, aged 18 to 34 years, with high school education, low income (less than $30,000 per year), from British Columbia, and unemployed. Years: 2018, 2019, and 2021. *Athrho* represents the correlation for the two errors in the bivariate ordered probit model. All estimates are calculated using survey weights.

owners.[20] For example, if something drives an increase in financial literacy, it may also drive an increase in crypto literacy and vice versa. Crypto owners, typically young males influenced by FOMO or peer pressure, may initially have lower financial literacy. However, investing in crypto could improve their literacy and spark an interest in the stock market, further improving their financial literacy. Conversely, individuals with high financial literacy and stock market experience might want to diversify their portfolio by exploring cryptoassets, thereby enhancing their crypto literacy.

This exploratory work can form the basis of future empirical studies. In particular, accounting for selection into Bitcoin ownership would provide a relatively more accurate comparison of the differences in crypto and financial literacy between genders among

[20] In more precise terms, both the ($athrho = 0.257$) for the Bitcoin owners subsample and the ($athrho = 0.152$) for the non-owners subsample indicate a positive correlation between the errors of the crypto and financial literacy equations. However, when considering the magnitude of the two, the value for the Bitcoin owners subsample is higher compared to that of the non-owners subsample.

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cryptoasset owners – i.e., a more "apples-to-apples" comparison. This could be accomplished by matching the two samples of Bitcoin owners and non-owners using program evaluation techniques such as propensity score matching, inverse probability weighting, or regression adjustment, among others.

5. Conclusion and discussion

In this paper, we used survey data from a nationally representative sample of Canadians to reconcile low female participation in the cryptoasset market with the well-documented gender gap in financial literacy. Cryptoassets are complex products primarily used as investments, but their key features are sufficiently distinct from conventional assets that making informed decisions could require knowledge of concepts not typically captured by financial literacy measures (Bannier et al. 2019). We use a novel measure of crypto literacy in conjunction with a measure of financial literacy to assess this perspective.

We find that Canadian Bitcoin owners are more informed than non-owners about the asset and thus have higher levels of crypto literacy. They are heterogeneous with respect to financial literacy. We find that women who own Bitcoin are just as financially literate as their male counterparts but lag on crypto literacy. Moreover, the crypto literacy gender gap persists regardless of ownership status – women are generally less informed about cryptoassets.

These results indicate that measuring crypto literacy can usefully complement measures of financial literacy in the context of digital asset markets with complex investment products that may be less reliant on knowledge of traditional financial concepts. Better crypto knowledge and financial literacy, in turn, could help investors make better decisions and perhaps reduce the prevalence of FoMO as an investment motivation and might help decrease exposures in such markets.

The results for crypto and financial literacy discussed in this paper might suggest wider implications. For instance, in order for consumers to make informed decisions with regard to initiatives like open banking and new developments in mainstream financial technology more generally, an understanding of such products is required. However, according to a recent press release from the Financial Consumer Agency of Canada, only 9 percent of survey respondents had heard of open banking, and once this term was explained to them, only 15 percent said they would participate in open banking initiatives (Financial Consumer Agency of Canada 2023). At the same time, only 18 percent understood the consumer protection provisions for services offered by FinTechs.

Similarly, a recent report on payment preferences commissioned by the European Central Bank (ECB) revealed that some individuals have reservations about using banking apps and digital payments because of their limited technical knowledge and skills, which led to fears about making errors during transactions (European Central Bank 2022). Related considerations probably would apply to the potential issuance of a CBDC. In this regard, a recent public consultation by the ECB found that (European Central Bank 2022): "Among the general public and the tech-savvy, there was little awareness of the digital euro. As a result, participants expressed a need for more information about "why" it is needed, and "how" it differs from the euro kept in bank accounts and spent electronically via apps or bank transfers . . . . [P]articipants associated digital euro with a cryptocurrency, and/or believed this was a digital money designed to replace cash . . . . Some described it as a blockchain-based technology that would replace money" (pp. 51–52).

In sum, a key issue that probably deserves more attention concerns the significant scale of investment in public education that would be required to inform consumers about such a product.[21]

[21] Related considerations are raised in Henry et al. (2023).

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References

Almenberg, J. and A. Dreber. 2015. "Gender, Stock Market Participation and Financial Literacy," *Economics Letters* 137: 140–142.

Alonso, S. L. N., J. Jorge-Vázquez, P. A. Rodrguez, and B. M. S. Hernández. 2023. "Gender Gap in the Ownership and Use of Cryptocurrencies: Empirical Evidence from Spain," *Journal of Open Innovation: Technology, Market, and Complexity* 9: 100103.

Balutel, D., W. Engert, C. S. Henry, K. P. Huynh, and M. Voia. 2024. "Explaining Bitcoin Ownership in Canada: Trends from 2016 to 2021," *Canadian Journal of Economics*, forthcoming.

Balutel, D., W. Engert, C. S. Henry, K. P. Huynh, and M. C. Voia. 2022a. "Private Digital Cryptoassets as Investment? Bitcoin Ownership and Use in Canada, 2016-2021," Staff Working Paper 2022-44, Bank of Canada.

Balutel, D., M.-H. Felt, G. Nicholls, and M. C. Voia. 2022b. "Bitcoin Awareness, Ownership and Use: 2016-20," Staff Working Paper Series 2022-10, Bank of Canada.

Balutel, D., M.-H. Felt, G. Nicholls, and M. C. Voia. 2023a. "Bitcoin Awareness, Ownership and Use: 2016–20," *Applied Economics* 56: 33–58.

Balutel, D., C. S. Henry, K. P. Huynh, and M. C. Voia. 2023b. "Don't Know! Don't Care? We Should! "Don't Know" Responses in Crypto and Financial Literacy Questions," Working paper, Bank of Canada.

Balutel, D., C. S. Henry, J. Vásquez, and M. C. Voia. 2022c. "Bitcoin Adoption and Beliefs in Canada," *Canadian Journal of Economics/Revue canadienne d'économique* 55: 1729–1761.

Bannier, C., T. Meyll, F. Röder, and A. Walter. 2019. "The Gender Gap in 'Bitcoin literacy'," *Journal of Behavioral and Experimental Finance* 22: 129–134.

Bucher-Koenen, T., R. J. Alessie, A. Lusardi, and M. Van Rooij. 2021. "Fearless Woman: Financial Literacy and Stock Market Participation," NBER Working Papers 28723, National Bureau of Economic Research, Inc.

Bucher-Koenen, T., A. Lusardi, and R. Alessie. 2017. "How Financially Literate are Women? An Overview and New Insights," *Journal of Consumer Affairs* 51: 255–283.

Carmona, T. 2022. "Debunking Narratives about Cryptocurrency and Financial Inclusion," Report, Brookings.

Charness, G. and U. Gneezy. 2012. "Strong Evidence for Gender Differences in Risk Taking," *Journal of Economic Behavior & Organization* 83: 50–58.

Cupák, A., P. Fessler, J. W. Hsu, and P. R. Paradowski. 2020. "Confidence, Financial Literacy and Investment in Risky Assets: Evidence from the Survey of Consumer Finances," Finance and Economics Discussion Series 2020-004, Board of Governors of the Federal Reserve System (U.S.).

Deville, J., C. Sarndal, and O. Sautory. 1993. "Generalized Raking Procedures in Survey Sampling," *Journal of the American Statistical Association* 88: 1013–1020.

European Central Bank. 2022. "Study on New Digital Payment Methods," Report, Retrieved from the European Central Bank website, Accessed January 5.

Financial Consumer Agency of Canada. 2021. "Make Change that Counts: National Financial Literacy Strategy 2021-2026," Report, Retrieved from the Financial Consumer Agency of Canada website, Accessed January 5.

Financial Consumer Agency of Canada. 2023. "FCAC Survey Shows Canadians' Knowledge and Understanding of Open Banking is Low," Press release, Ottawa, Ontario, June 1.

Fontes, A., K. Meagher, B. Mulford, A. Bloomfield, R. Ganem, O. Valdes, and G. Mottola. 2023. "New Investors 2022: Entering the Market in Novel and Traditional Ways," Working Paper 2023-04, The Financial Industry Regulatory Authority.

Fujiki, H. 2020. "Who Adopts Crypto Assets in Japan? Evidence from the 2019 Financial Literacy Survey," *Journal of the Japanese and International Economies* 58: 101107.

Fujiki, H. 2021. "Crypto Asset Ownership, Financial Literacy, and Investment Experience," *Applied Economics* 53: 4560–4581.

https://doi.org/10.1017/flw.2024.2 Published online by Cambridge University Press

Gerrans, P., S. B. Abisekaraj, and Z. F. Liu. 2023. "The Fear of Missing out on Cryptocurrency and Stock Investments: Direct and Indirect Effects of Financial Literacy and Risk Tolerance," *Journal of Financial Literacy and Wellbeing* 1: 103–137.

Greene, W. and D. Hensher. *Modeling Ordered Choices: A Primer*. Cambridge University Press, 2009.

Henry, C. S., W. Engert, K. P. Huynh, A. Sutton-Lalani, S. Hernandez, and D. McVanel. 2023. "Unmet Payment Needs and a Central Bank Digital Currency," Staff Discussion Paper 2023-15, Bank of Canada.

Henry, C. S., K. P. Huynh, and G. Nicholls. 2017. "Bitcoin Awareness and Usage in Canada," Staff Working Paper 2017-56, Bank of Canada.

Henry, C. S., K. P. Huynh, and G. Nicholls. 2018a. "Bitcoin Awareness and Usage in Canada," *Journal of Digital Banking* 2: 311–337.

Henry, C. S., K. P. Huynh, and G. Nicholls. 2018b. "Bitcoin Awareness and Usage in Canada: An Update," Staff Analytical Note 2018-23, Bank of Canada.

Henry, C. S., K. P. Huynh, and G. Nicholls. 2019a. "Bitcoin Awareness and Usage in Canada: An Update," *The Journal of Investing* 28: 21–31.

Henry, C. S., K. P. Huynh, G. Nicholls, and M. Nicholson. 2019b. "2018 Bitcoin Omnibus Survey: Awareness and Usage," Staff Discussion Paper 2019-10, Bank of Canada.

Henry, C. S., K. P. Huynh, G. Nicholls, and M. Nicholson. 2020. "Benchmarking Bitcoin Adoption in Canada: Awareness, Ownership and Usage in 2018," *Ledger* 5.

Hospido, L., N. Iriberri, and M. Machelett. 2024. "Gender gaps in financial literacy: a multi-arm RCT to break the response bias in surveys," *Working Papers 2401, Banco de España*.

Hydary, M. 2019. "Reducing the Digital Divide Using Blockchain," Report, UNICEF.

Jianakoplos, N. A. and A. Bernasek. 1998. "Are Women More Risk Averse? *Economic Inquiry* 36: 620–630.

Kass-Hanna, J., A. C. Lyons, and F. Liu. 2022. "Building Financial Resilience through Financial and Digital Literacy in South Asia and Sub-Saharan Africa," *Emerging Markets Review* 51: 100846.

Koskelainen, T., P. Kalmi, E. Scornavacca, and T. Vartiainen. 2023. "Financial Literacy in the Digital Age – A Research Agenda," *Journal of Consumer Affairs* 57.

Lane, T. 2020. "Money and Payments in the Digital Age," Remarks to CFA Montréal FinTech RDV2020. Montréal, Quebec, February 25.

Lane, T. 2021. "Payments Innovation beyond the Pandemic," Remarks delivered virtually to the Institute for Data Valorisation, Montreal, Quebec, February 10.

Lusardi, A. and O. S. Mitchell. "Financial Literacy and Planning: Implications for Retirement Well-being," in *Financial Literacy: Implications for Retirement Security and the Financial Marketplace*, 17–39, Oxford University Press, 2011a.

Lusardi, A. and O. S. Mitchell. 2011b. "Financial Literacy and Planning: Implications for Retirement Wellbeing," *Journal of Pension Economics and Finance* 10: 497–508.

Lusardi, A. and O. S. Mitchell. 2011c. "Financial Literacy around the World: An Overview," *Journal of Pension Economics and Finance* 10: 497–508.

Lusardi, A. and O. S. Mitchell. 2023. "The Importance of Financial Literacy," *The Journal of Economic Perspectives*, 37, 137–154.

Lyons, A. and J. Kass-Hanna. 2021. "A Methodological Overview to Defining and Measuring "Digital" Financial Literacy," *Financial Planning Review* 4: 1–19.

Nakamoto, S. 2008. "Bitcoin: A Peer-to-peer Electronic Cash System," *Decentralized Business Review*, 21260.

OECD. 2022. "OECD/INFE Toolkit for Measuring Financial Literacy and Financial Inclusion 2022," Retrieved from the OECD website (Accessed January 5).

Office of the Superintendent of Financial Institutions 2023a. "OSFI guideline on the regulatory capital and liquidity treatment of crypto-asset exposures (Banking)," Press release, Ottawa, Ontario, July 26.

Office of the Superintendent of Financial Institutions. 2023b. "OSFI guideline on the regulatory capital treatment of crypto-asset exposures (Insurance)," Press release, Ottawa, Ontario, July 26.

Ontario Securities Commission. 2022. "Crypto Asset Survey – Final Report," Press release, Toronto, Ontario, October 19.

Sajaia, Z. 2008. "BIOPROBIT: Stata Module for Bivariate Ordered Probit Regression," Statistical Software Components. Boston College, Department of Economics.

Schuh, S. and O. Shy. 2016. "US Consumers' Adoption and Use of Bitcoin and Other Virtual Currencies," in DeNederlandsche bank, Conference entitled "Retail payments: mapping out the road ahead.

Stix, H. 2021. "Ownership and Purchase Intention of Crypto-assets: Survey Results," *Empirica* 48: 65–99.

Tinghög, G., A. Ahmed, K. Barrafrem, T. Lind, K. Skagerlund and D. Västfjäll. 2021 "Gender Differences in Financial Literacy: The Role of Stereotype Threat," *Journal of Economic Behavior & Organization* 192: 405–416.

van Rooij, M., A. Lusardi, and R. Alessie. 2011. "Financial Literacy and Stock Market Participation," *Journal of Financial Economics*. 101: 449–472.

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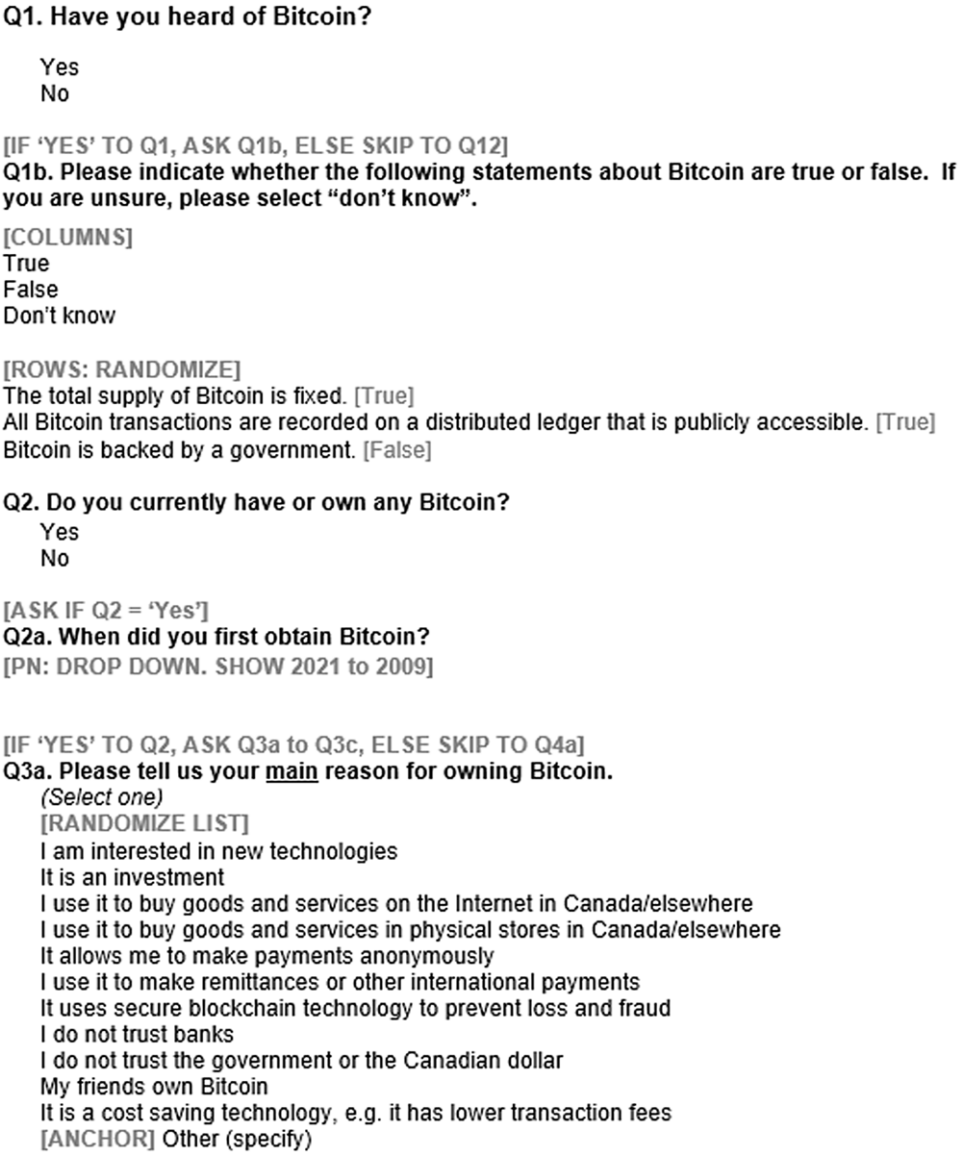
Appendix

Appendix A. 2021 BTCOS instrument

The 2021 BTCOS was completed by respondents entirely online through the web or on mobile devices. Below is a representation of the online survey instrument. Skip logic and other programming instructions are included between square brackets but were not shown to participants. Note that demographic questions and questions related to survey recruitment were also asked but are not shown here. Please cite Balutel et al. (2022a) if you wish to use these questions.



Q1. Have you heard of Bitcoin?

Yes
No

[IF 'YES' TO Q1, ASK Q1b, ELSE SKIP TO Q12]
Q1b. Please indicate whether the following statements about Bitcoin are true or false. If you are unsure, please select "don't know".

[COLUMNS]
True
False
Don't know

[ROWS: RANDOMIZE]
The total supply of Bitcoin is fixed. [True]
All Bitcoin transactions are recorded on a distributed ledger that is publicly accessible. [True]
Bitcoin is backed by a government. [False]

Q2. Do you currently have or own any Bitcoin?

Yes
No

[ASK IF Q2 = 'Yes']
Q2a. When did you first obtain Bitcoin?
[PN: DROP DOWN. SHOW 2021 to 2009]

[IF 'YES' TO Q2, ASK Q3a to Q3c, ELSE SKIP TO Q4a]
Q3a. Please tell us your main reason for owning Bitcoin.
(Select one)
[RANDOMIZE LIST]
I am interested in new technologies
It is an investment
I use it to buy goods and services on the Internet in Canada/elsewhere
I use it to buy goods and services in physical stores in Canada/elsewhere
It allows me to make payments anonymously
I use it to make remittances or other international payments
It uses secure blockchain technology to prevent loss and fraud
I do not trust banks
I do not trust the government or the Canadian dollar
My friends own Bitcoin
It is a cost saving technology, e.g. it has lower transaction fees
[ANCHOR] Other (specify)

Figure A1. 2021 BTCOS instrument.

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Q3b. What is the value, in Canadian dollars, of the Bitcoin you currently own? (Please round off to the nearest dollar)

$ [NUMERIC BOX]
Unsure/would rather not say

[IF Q3b=0, TERMINATE INTERVIEW]

Q3c. How do you obtain Bitcoin?
[RANDOMIZE LIST]
(Select all that apply)
Cryptocurrency exchanges through a mobile app
Cryptocurrency exchanges on a website
Bitcoin Automated Teller Machines (ATMs)
From a friend or family member
Mining Bitcoin
[ANCHOR] Other, please specify [PROVIDE TEXT BOX FOR RESPONSE] [DO NOT CODE]

[IF 'NO' TO Q2, ASK Q4a - Q4c, ELSE SKIP TO Q6a]
Q4a. Have you ever owned Bitcoin in the past?
Yes
No

Q4b. Please tell us your main reason for [PIPE IN "not" if Q4a =no; PIPE IN "no longer" if Q4a = yes] **owning any Bitcoin.**
[RANDOMIZE LIST]
A price crash caused my Bitcoin to lose substantial value [SHOW IF Q4A = 'Yes'; ANCHOR]
I lost access to my personal cryptocurrency wallet [SHOW IF Q4A = 'Yes'; ANCHOR]
I cashed out my Bitcoin for a profit [SHOW IF Q4A = 'Yes'; ANCHOR]
I do not understand/know enough about the technology
It is not widely accepted as a method of payment
My current payment methods meet all my needs
The value of Bitcoin varies too much
It is not easy to acquire/use
I do not trust a private currency that is not backed by the government
I am concerned about cyber theft
I am concerned about lack of oversight from regulatory bodies
I use alternative digital currencies instead (e.g. Ethereum, Tether, Litecoin, etc.)
I do not believe the Bitcoin system will survive in the future
[ANCHOR] Other (specify)

Figure A1. (continued)

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[ASK ONLY IF Q4A = 'Yes']
Q4c. How did you previously obtain Bitcoin?
[RANDOMIZE LIST]
(Select all that apply)

- Cryptocurrency exchanges through a mobile app
- Cryptocurrency exchanges on a website
- Bitcoin Automated Teller Machines (ATMs)
- From a friend or family member
- Mining Bitcoin
- [ANCHOR] Other, please specify [PROVIDE TEXT BOX FOR RESPONSE] [DO NOT CODE]

[ASK Q6a IF 'YES' TO Q1]
Q6a. How likely do you think it is that the Bitcoin system will survive for the next 15 years? Please use the sliding scale where 0 means that the system will certainly fail and 100 means the system will certainly survive.
[INSERT SLIDING SCALE WITH WORD ANCHORS 0=Will certainly fail, 50=Unsure, 100=Will certainly survive] [DO NOT PUT THE NUMBER 0, 50, OR 100 WITHIN THE WORD ANCHOR BOX]

[ASK Q6b IF 'YES' TO Q1]
Q6b. What percentage of Canadians do you think will be using Bitcoin 15 years from now? Please use the sliding scale where 0 means no Canadians will be using Bitcoin and 100 means all Canadians will be using Bitcoin. [INSERT SLIDING SCALE WITH WORD ANCHORS] [DO NOT PUT THE NUMBER 0 OR 100 WITHIN THE WORD ANCHOR BOX]

[ASK Q7a – Q7c IF Q1=YES, ELSE SKIP TO Q12]
Q7a. What is the current price of Bitcoin?

Please provide your best estimate in Canadian dollars. Please round to the nearest dollar.
[INSERT NUMERIC BOX]

1 BTC = $ _____ CAD

[SHOW Q7b AND Q7c ON SAME SCREEN]
Q7b. The price of one Bitcoin is around $[INSERT RELEVANT PRICE EACH MORNING WHILE THE SURVEY IS IN FIELD] Canadian, as of this morning.

In <u>one month</u>, what do you expect the price of Bitcoin to be?
Please provide your best estimate in Canadian dollars. Please round to the nearest dollar.
[INSERT NUMERIC BOX]

1 BTC = $_____ CAD

Q7c. In <u>one year</u>, what do you expect the price of Bitcoin to be?
Please provide your best estimate in Canadian dollars. Please round to the nearest dollar.
[INSERT NUMERIC BOX]

1 BTC = $_____ CAD

Figure A1. (continued)

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Q8a. Please indicate whether you have heard of any of the following digital currencies. (Select all that apply) [RANDOMIZE LIST]

Ethereum (ETH)
Bitcoin Cash (BCH)
Litecoin (LTC)
Tether (USDT)
USD Coin (USDC)
DAI (formerly known as Sai)
Binance Coin (BNB)
XRP (RIPPLE)
Diem (formerly known as Libra)
Polkadot (DOT)
Dogecoin (DOGE)
Chainlink (LINK)
Stellar (XLM)
Monero (XMR)
[ANCHOR] Other digital currency (please specify) [PROVIDE TEXT BOX FOR RESPONSE] [DO NOT CODE]
[ANCHOR] No, I have not heard of any other digital currencies

[PIPE IN RESPONSES FROM Q8a; SKIP Q8b IF THEY HAVE NOT HEARD OF ANY OTHER DIGITAL CURRENCIES]
Q8b. Do you currently own any of the following digital currencies? (Please check all that apply) [RANDOMIZE LIST]

[DISPLAY THOSE SELECTED IN Q8a]
[ANCHOR] Other (please specify) [PROVIDE TEXT BOX FOR RESPONSE] [DO NOT CODE]
[ANCHOR] No, I do not hold any other digital currencies

[ASK Q9 IF Q2=YES OR Q8b = 'Tether', ELSE SKIP TO INSTRUCTIONS ABOVE Q11]
Q9. Approximately how often do you use [PIPE IN 'Bitcoin' and/or 'Tether' based on Q2 and Q8b] **to pay for goods and services?** (Please select the most appropriate response) [ROWS]

Once a week or more
A few times a month
Once a month
A few times a year
Once a year
Less than once a year
Never

[COLUMNS; PIPE IN BASED ON Q2 AND Q8b]

Bitcoin
Tether

Figure A1. (continued)

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[ASK Q9a if Q9= "Once a week or more", "A few times a month", "Once a month" OR "A few times a year"]
Q9a. What was the name of the last business or website where you used [PIPE IN 'Bitcoin' and/or 'Tether' based on Q2 and Q8b] to pay for a good or service?

[ROWS]
[TEXT BOX]
Don't know / prefer not to say

[COLUMNS; PIPE IN BASED ON Q2 AND Q8b]

Bitcoin
Tether

[ASK Q10 IF Q2=YES, ELSE SKIP TO INSTRUCTIONS ABOVE Q11]
Q10. Approximately how often do you use Bitcoin to send money to other people?
(Please select the most appropriate response)

Once a week or more
A few times a month
Once a month
A few times a year
Once a year
Less than once a year
Never

[ASK Q11 IF Q2=YES OR Q4a=YES OR Q8b≠ "No, I do not hold any other digital currencies", ELSE SKIP TO Q12]
Q11. Have any of the following incidents happened to you?
(Select all that apply) [RANDOMIZE LIST]

I lost access to my personal cryptocurrency wallet
The cryptocurrency exchange holding my funds was hacked
I experienced problems with a purchase made using cryptocurrencies
I participated in an Initial Coin Offering and it turned out to be a scam
A price crash caused my cryptocurrency to lose substantial value
My personal data held by a cryptocurrency exchanges was compromised
The cryptocurrency exchange I was using stole my funds
None of the above [EXCLUSIVE]

Figure A1. (continued)

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[ASK ALL; SHOW Q12a and Q12b on same screen]
Q12a. Thinking now about regular Canadian currency, how much cash do you currently have in your purse, wallet, or pockets? (Please round to the nearest dollar)

$_____
I prefer not to not answer [EXCLUSIVE]

Q12b. How much cash do you currently have outside of your purse, wallet, or pockets, for example in your car, house or another safe place? (Please round to the nearest dollar)

$_____
I prefer not to answer [EXCLUSIVE]

Q13. Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think would have left in the account if you left the money to grow?

More than $102
Exactly $102
Less than $102
Don't know

Q14. Imagine the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with this money in this account?

More than today
Exactly the same
Less than today
Don't know

Q15. Please indicate whether or not this statement is true or false: "Buying a single company's stock usually provides a safer return than a mutual fund of stocks".

True
False
Don't know

Q16. Switching topics, about how long do you think you will live?

I think I will live until I am...

___ years old [RANGE >CURRENT AGE TO 150]

Figure A1. (continued)

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