Bitcoin Awareness and Usage in Canada*

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Abstract

There has been a tremendous discussion of Bitcoin, digital currencies, and FinTech. However, there is limited empirical evidence of its adoption and usage. We propose a methodology to collect a nationally representative sample via the Bitcoin Omnibus Survey (BTCOS) to track the ubiquity and usage of Bitcoin in Canada. We find that about 64 percent of Canadians have heard of Bitcoin, but only 2.9 percent own it. We find that awareness of Bitcoin was strongly associated with men and those with college or university education; additionally, Bitcoin awareness was also more concentrated among unemployed individuals. On the other hand Bitcoin ownership was associated with younger age groups and a high school education. Furthermore, we construct a test of Bitcoin characteristics to attempt to gauge the level of knowledge held by respondents who were aware of Bitcoin, including actual owners. We find that knowledge is positively correlated with Bitcoin adoption. We attempt to reconcile the difference in awareness and ownership by decomposing the transaction and store-of-value motive for holding Bitcoin. Finally, we conclude with some suggestions to improve future digital currency surveys, in particular to achieve precise estimates from the hard-to-reach population of digital currency users.

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1 Introduction

Media and press discussion of digital currencies such as Bitcoin has increased in prevalence over the last several years. During this time, Bitcoin in particular has also experienced a rather dramatic climb in value; for example, 1 Bitcoin was worth $360 CAD on November 1, 2014, compared to almost $8,800 as of November 1, 2017.[1] However, the usage of digital currencies as a payment method has not kept pace. In this paper, we explore determinants of awareness and ownership of digital currency in Canada. Focusing on Bitcoin, the most popular digital currency, we find that 64 percent of Canadians are aware of Bitcoin but only about 2.9 percent actually own Bitcoin.

Understanding developments in alternative payment methods is important for the Bank of Canada, the sole issuer of banknotes, so that it may undertake its role in an efficient manner, see Arango et al. (2012) and Fung et al. (2015). The Bank of Canada has conducted research on Canadian payments using survey data such as the 2009 and 2013 Methods-Of-Payment surveys, see Arango and Welte (2012) and Henry et al. (2015). These surveys provide rich micro data on the usage of cash, debit, and credit cards. The Bank of Canada also uses these surveys to collect data on newer payment innovations in order to conduct research and analysis which informs planning for the short run and long run of its currency function.

As a payment method Bitcoin offers some intriguing features. For example, while transactions are recorded on a publically available ledger they are often considered to be 'pseudonymous', in the sense that the address in the blockchain is not necessarily traceable to a particular individual. Additionally, no trusted third party is required to verify Bitcoin transactions which allows for direct transfer of value between two parties anywhere in the world, facilitated only by the internet. Therefore, as awareness of Bitcoin and other digital currencies continues to increase there is more demand to understand drivers behind their adoption and use, as well as the potential implications for cash.

A related question for central banks, including the Bank of Canada, concerns the possibility of issuing central bank digital currency (CBDC) - i.e. a digital form of cash. Fung and Engert (2017) provide a discussion of commonly cited motivations for issuing CBDC. For example, central banks could issue CBDC in order to preserve seigniorage revenue in a world where the use of cash is limited or nonexistent. Alternatively CBDC is sometimes touted as a vehicle for new monetary policy tools, for example by allowing for a direct transfer of central bank funds to businesses and individuals. Understanding digital currencies such as Bitcoin which are currently already available – the extent to which they are being used, how they are being used, and by whom – can help in making informed policy decisions in this area.

[1] Data are from https://ca.investing.com/currencies/btc-cad-historical-data.

Why do we focus on Bitcoin in our study as opposed to digital currencies more broadly? Historically Bitcoin was the first working example of a so-called 'crypto-currency', distinguishing itself from other electronic forms of payment in part by having a decentralized mechanism (mining) for clearing transactions. Perhaps due to this first-mover effect, the dominance of Bitcoin over other available digital currencies is notable. Currently, there are about 740 digital currencies available.[2] However, Bitcoin has twice the market capitalization in US dollars compared to its nearest competitor (Ethereum), and almost ten times that of the next biggest competitor (Ripple). A similar dominance is observed with respect to trading volumes.

Despite this dominance, empirical studies of Bitcoin remain somewhat limited. Central bank studies have often focused on Bitcoin usage by analyzing the history via the blockchain or distributed ledger to provide a topography of users, see for example Badev and Chen (2014), Bolt and van Oordt (2016), and Tasca et al. (2016). However, the characteristics of the Bitcoin users are not known since there is only transactional data on digital addresses owned by users to identify a transaction, but no personal characteristics of the users are available. A similar approach is also taken in Athey et al. (2016) where they try to overcome this problem by employing a range of heuristics to collapse digital address into entities, such as businesses accepting Bitcoin versus individual consumers.

Another approach along the lines of our work here has been to use survey methodology to study Bitcoin usage. In Canada, Technology Strategies International (2016) Canadian Payments Forecast obtained awareness and ownership numbers similar to our findings: 63.7 percent awareness with 3.4 percent ownership. However their study lacked sufficient detail - e.g. demographics, holdings of Bitcoin, stated reasons for ownership/non-ownership, etc – for understanding factors that drive awareness and ownership. The Federal Reserve Bank of Boston has conducted a detailed payments survey of the US population that includes questions on Bitcoin and other virtual currencies. In Schuh and Shy (2016) they find that in 2015, 40 percent of respondents had heard of Bitcoin, with only 1.1 percent aware of other virtual currencies. Finally, Polasik et al. (2016) conducted what they consider to be the first global survey of merchants to understand factors associated with Bitcoin acceptance and composition of sales.

This paper provides a discussion of Bitcoin awareness and ownership using data from the Bitcoin Omnibus Survey (BTCOS). The BTCOS is a short, online, nationally representative survey of Canadians with questions relating to Bitcoin, in addition to containing useful demographic information which allows us to identify factors associated with awareness and use. We begin in Section 2 with a discussion of the elements of survey design and an

[2]Source: https://coinmarketcap.com/ accessed on 20 November 2016. Gandal and Halaburda (2014) provide an extensive discussion of cryptocurrency competition.

explanation of how the BTCOS functions as a pilot study for future work on surveying digital currency. Section 3 provides a set of descriptive figures for the awareness and ownership of Bitcoin while section 4 contains a conditional analysis of the awareness and ownership of Bitcoin. Section 5 analyzes and reconciles the disparity between awareness and ownership. We finish by summarizing our results, discussing lessons learned from the pilot, and providing suggestions on how to proceed with future work in Section 6.

2 The Bitcoin Omnibus Survey

As part of the Bank of Canada's research agenda on e-money, the focus of this study is on adoption and use of Bitcoin specifically, as opposed to digital currencies more broadly, see Fung and Halaburda (2014).[3]

2.1 BTCOS as a pilot study

The Bitcoin Omnibus Survey (BTCOS) was initially conceived as a pilot study on the use of digital currency in Canada, and there are several reasons we consider it as such. First, evidence from both Schuh and Shy (2016) and Technology Strategies International (2016) suggests that digital currency users are a *hard-to-reach* population; that is, using traditional sampling methods it can be difficult to obtain a large sample. For example, assuming that Bitcoin use is at 3 percent in the population then to obtain a sample of 500 Bitcoin users would require a total sample size of well over $N = 16,000$. We did not consider this to be an efficient approach. Instead, we chose to limit our expectations and obtain a small sample of Bitcoin users from which we can begin to understand some of the factors influencing adoption and holdings. The trade-off is that we are required to use specialized econometric techniques (e.g. Firth rare events logit, see Section 4), and it is necessary to be qualified about the conclusions one can draw from such a small sample.

Additionally, we plan to utilize the BTCOS for informing a potential full-scale survey on digital currencies. A full-scale survey would entail a larger sample of digital currency users and more comprehensive set of questions on Bitcoin as well as other digital currencies. One potential solution for accessing hard-to-reach populations is to use innovative sampling schemes such as *respondent-driven sampling*, see Heckathorn (1997). However, such methods require careful preparation and execution to achieve the desired statistical properties. Analysis from the pilot study would be integral to implementing respondent-driven sampling.

[3]More information on the Bank of Canada's e-money research program is available at the following website: http://www.bankofcanada.ca/research/e-money/.

Furthermore, the range of responses from the pilot can be used in developing or refining questions for the full-scale survey. See Section 6 for a further discussion of lessons learned from the BTCOS and how it will inform a future full-scale study. Thus, the BTCOS pilot study is an important first step towards a more in-depth understanding of digital currencies in Canada.

2.2 Survey design

The BTCOS was conducted as an online omnibus survey by Ipsos, a well-known market research firm. The omnibus format is an ongoing survey that is updated weekly with various topics, and is purposely kept short so as to consistently obtain high response rates. The online methodology allows respondents to complete the survey on their computer or smart phone, and provides maximum flexibility in recruiting respondents of certain demographic profiles. Two waves of the survey were conducted, resulting in a sample size of N=1,997 Canadians aged 18 or older. Results are weighted with respect to age, gender, and region to be representative of the 2016 Canadian population. For more information on methodology, see Appendix A.

Questions in the BTCOS focused on broad measures concerning awareness and ownership of Bitcoin specifically, as opposed to digital currencies more broadly. An important lesson from Schuh and Shy (2016) is that ordinary consumers - as opposed to expert researchers studying the topic! - can easily become confused by the actual term *digital currency*, mistaking it for other payment technologies such as PayPal, or even sovereign currencies such as the Euro. Indeed, almost 10 percent of respondents who said they were aware of digital currency made such a mis-characterization in Schuh and Shy (2016). In addition, as our survey design was limited to a small set of questions (see below), we did not wish to impose additional burden on the respondent by introducing a definition of digital currency, in order that they could reasonably answer questions about the topic.

We refer the reader to Figure 1 for the content and programming logic of the survey questionnaire. Questions on the survey were as follows. The first question was asked to gauge awareness: "Have you heard of Bitcoin?" If they answered *YES* they proceeded onto the next question while a *NO* resulted in the respondent being directed to the question five or the last question of the survey. In the second question, respondents were asked if they currently had or owned Bitcoin. Next, Bitcoin owners were asked to provide their main reason for owning Bitcoin and the amount of Bitcoin they owned. Respondents who had heard of Bitcoin but did not own any were asked to provide their main reason for not owning Bitcoin as well as if they had owned Bitcoin in the past. Finally in question five, all respondents were asked to provide their preferred payment method for making online purchases.

To understand why there was such a low ownership rate despite high awareness of Bitcoin we added a knowledge test to Wave 2 of the BTCOS. This knowledge test is inspired by work on establishing measures of financial literacy using survey questions, see e.g. Lusardi and Mitchell (2011). Here we attempted to create a Bitcoin knowledge score derived from a set of five true/false questions (see Figure 2) addressing objective facts about Bitcoin. Such a score could potentially help to ascertain if there was a misclassification or misperception of Bitcoin as described in Schuh and Shy (2016), and measure the extent of knowledge among owners and non-owners. The results of the knowledge test was mixed, which we discuss in Section 3.3; see also Section 6 for a discussion of how to improve the knowledge score using lessons learned from the pilot.

3 Descriptive Statistics

The two initial questions on the BTCOS were "Have you heard of Bitcoin?" and "Do you currently have or own any Bitcoin?" From these, two populations are defined: those aware of Bitcoin and those who own Bitcoin. This section presents descriptive information about these two populations: demographic breakdowns, reasons for choosing to own or not to own Bitcoin, the amount of Bitcoin held by owners, the methods of payment preferred for online purchases, and an assessment of knowledge of the properties of Bitcoin. For consistency, any comparisons between groups are discussed only when the differences are statistically significant[4].

3.1 Awareness

Overall, 64 percent of Canadians aged 18 or older stated they had heard of Bitcoin. Figure 3 breaks down Bitcoin awareness by age group and gender. The group with the highest level of awareness were those aged 25 to 34, with 71 percent of respondents in this category having heard of Bitcoin. Men were more likely to be aware of Bitcoin across all age groups; overall, 75 percent of men and 54 percent of women stated they had heard of Bitcoin.

For the most part, Bitcoin awareness was increasing in both education and household income (Figure 4). For example, 72 percent of individuals with incomes of $100,000 or more were aware of Bitcoin, compared to 54 percent of those with incomes below $30,000. In fact, awareness among those earning below $30,000 was lower when compared with all other income categories. Those with university educations were more likely (75 percent) than those than those with college (59 percent) or high school (50 percent) educations to have heard

[4]For this section, differences are deemed statistically significant if the p-value from a non-paired, unequal variance t-test falls below the threshold of 0.05, i.e. a 95 percent significance level. Detailed results may be provided upon request.

of Bitcoin. However, there were no differences found between the college educated and high school educated groups.

Figure 5 breaks down awareness by labour force status and gender. Overall, unemployed individuals had the highest level of Bitcoin awareness at 73 percent. Compared to those not in the labour force (51 percent), awareness was also higher amongst employed individuals (67 percent) and retirees (63 percent). Trends in Bitcoin awareness across labour force status were similar for both men and women, but awareness was once again higher for men in all groups except the unemployed.

Figure 6 illustrates the geographical distribution of Bitcoin awareness. British Columbia proved to be the province most aware of Bitcoin at 78 percent. Quebec was the least likely to be aware, with less than half stating they had heard of Bitcoin. The remaining regions were in between, and fairly similar at about 63 to 68 percent. As with labour force status, trends in Bitcoin awareness across regions were similar for both men and women, but men were more likely to have heard of Bitcoin in all cases. This gender difference was particularly pronounced in Quebec, where 63 percent of men were aware of Bitcoin compared to just 35 percent of women.

3.2 Ownership

The number of individuals using Bitcoin remains small in Canada; 58 respondents or 2.9 percent were identified as current users of Bitcoin. Figure 7 illustrates that most Bitcoin users were in the younger age groups; specifically, 8.6 percent ($n = 31$) of those aged 25 to 34 owned Bitcoin, followed by 5.9 percent ($n = 9$) of those aged 18 to 24. Similar to awareness, there was a gender gap in ownership; 4.2 percent of men ($n = 38$) owned Bitcoin compared to 1.8 percent of women ($n = 20$). This gender difference was particularly noticeable in the 25 to 34 age group, where 13 percent of men ($n = 23$) stated they owned Bitcoin compared to just 4.0 percent of women ($n = 8$). The highest levels of ownership in terms of geography were observed in B.C. and Quebec, at 3.7 percent and 4.2 percent, respectively (Figure 8). This latter result is perhaps surprising given that Quebec residents were the least likely to have heard of Bitcoin.

3.3 Assessing Bitcoin knowledge

Wave 2 of the BTCOS added a set of five true or false questions[5] (Figure 2), each assessing knowledge of a particular aspect of Bitcoin. It would be expected, if the questions really do test Bitcoin knowledge, that Bitcoin users perform better than non-users. As can be seen in Table 3, this is indeed the case for questions 2, 3, and 5.

[5]Note that this section uses only the sample of 998 wave 2 participants.

However, users surprisingly did worse on the other two questions, 1 and 4. This difference is particularly pronounced for question 4, where 83 percent of non-users gave the correct answer, compared to 64 percent of holders of small amounts of Bitcoin and just 24 percent of holders of large amounts of Bitcoin. For this question, the trend is in the opposite direction of what one would expect. That being said, about 27 percent of non-users answered 'don't know' to all five questions, whereas all Bitcoin users in the sample answered at least one of the questions. Thus, it seems that *attempting* the questions was a good indicator of Bitcoin knowledge. In order to make appropriate comparisons between users and non-users, those who answered 'don't know' to all five questions will be excluded from the remaining analysis.

In the case of question 4 specifically, the intention was to determine if individuals knew whether Bitcoin was backed by a government or not. However, the current phrasing may have been interpreted as "Is Bitcoin in general similar to government-backed currencies?" rather than the intended "Is Bitcoin backed by a government?" It is possible that Bitcoin users are more likely to consider Bitcoin to be similar to standard currencies and so would be more likely to answer the question 'incorrectly.' Given the potential vagueness of question 4 and how badly Bitcoin users scored on it, it is excluded from the following analysis.

Using the remaining four questions, a score was developed to measure overall performance. For each question, a correct answer was given a score of +1 while an incorrect answer was given a score of -1. If the respondent did not know, they got a score of 0. The overall knowledge score is simply the sum of these values, resulting in an index taking values from -4 to 4.

Figure 11 shows the distribution of scores for users and non-users. As expected, Bitcoin users were more likely to get high positive scores. About 15 percent of users had the maximum score of 4 and 29 percent had a score of 2.[6] On the other hand, these figures were 0 percent and 8 percent for non-users. Additionally, users were more likely to get positive scores (49 percent compared to 31 percent) and less likely to get negative scores (25 percent compared to 32 percent).

Finally, we conducted two statistical tests to assess the reliability of our knowledge measure. An Epps-Singleton test rejects the hypothesis that the distribution of knowledge scores is the same between owners and non-owners (p-value of 0.01). This provides evidence that the score distinguishes between owners and non-owners. However, Cronbach's alpha score of 0.104 does not meet the suggested threshold of 0.7 for reliability. This indicates that further refinement of the questions as well as the derived knowledge measure is necessary in future work.

[6] A score of 3 was uncommon because the only way one could obtain this score would be to answer three correctly and leave the fourth unanswered.

3.4 Reasons for choosing to own or not own Bitcoin

Bitcoin users were asked to provide their main reason for owning Bitoin (Table 1), while non-users (who were aware of Bitcoin) were asked to provide their main reason for not owning it (Table 2). Investigating these two questions can potentially shed light on why adoption rates for Bitcoin remain low. For users, the most common primary reason given for owning Bitcoin was interest in new technology (29 percent). Other common reasons involved using Bitcoin for international payments, buying goods and services at physical stores, and investment (11-14 percent). Reasons associated with inherent properties of Bitcoin were actually less common; 7 percent cited using secure blockchain technology to prevent fraud as a main reason and 7 percent cited being able to make payments anonymously.

Table 1 also shows the stated reasons for ownership broken down by level of Bitcoin holdings. Given the small sample sizes of these sub populations it is difficult to make definitive conclusions, however we note some rough trends. First, among both low Bitcoin holders (≤ 1 BTC) and high Bitcoin holders (> 1 BTC), interest in new technologies remains the most prevalent reason for ownership. Additionally, high Bitcoin holders tend to state payment related reasons for ownership more often than low Bitcoin holders, for e.g. to make payments in Canada/elsewhere, or to make payments anonymously. Finally, only low Bitcoin holders report trust related concerns (not trusting banks/government/Canadian dollar) as motivation for owning Bitcoin.

Individuals who were aware of Bitcoin but did not own any were asked to provide their main reason for not owning Bitcoin. About 60 percent said that their current payment methods met their needs or that they did not understand or know enough about the technology. This provides a possible explanation for low adoption rates: consumers are largely content with their current state or unaware of the alternative's advantages or disadvantages relative to their current state. Other common primary reasons provided for not using Bitcoin were that it is not widely accepted (7 percent) and not easy to acquire or use (6 percent). Finally, it is interesting to note that many commentators often cite extreme price fluctuations as a reason that people avoid Bitcoin. However, we find that only 3 percent of respondents selected this option as their main reason for non-ownership.

There was a notable proportion of both users and non-users who expressed a level of distrust for the institutions involved with the alternative method of payment. On one hand, 6 percent of Bitcoin users stated they do not trust either the banks, the government, or the Canadian dollar; also, as discussed above, 14 percent mentioned wanting to avoid fraud or make payments anonymously. On the other hand, a combined 21 percent of non-users stated they did not trust a private currency that is not backed by a central government, were concerned about cyber theft, or were concerned about a lack of oversight from a regulatory body.

3.5 Bitcoin holdings

Bitcoin users were asked to provide how much Bitcoin they owned (Figure 9). About a third (32 percent) of Bitcoin users held just 0.1 Bitcoin or less, which was valued at less than $100 CDN at the time of the survey (note that 1 Bitcoin ≈ $1,000 CDN)[7]. A further 27 percent held between 0.1 and 1 Bitcoin (equivalent to between $100 and $1,000 CDN), while 32 percent held between 1.1 to 10 Bitcoins (equivalent to between $1,000 and $10,000 CDN). Holdings larger than this were rare; just 8 percent of users held more than 10 Bitcoins (greater than $10,000 CDN).

Data was collected in intervals, but mean and median Bitcoin holdings can be approximated by using the lower endpoint of each bin - this can be considered as a lower bound estimate. Under this assumption, it was estimated that Canadian Bitcoin owners had 1.2 Bitcoin on average, with the median Bitcoin owner holding 0.1. An alternative approach would be to assume an underlying distribution for the data. Utilizing a two-parameter gamma distribution yields a mean estimate of 2.9, with a median of 0.54 Bitcoin. These estimates should be considered very rough, and further work is required to both improve the estimates as well as validate them using external data.

3.6 Methods of payment for online purchases

All respondents were asked what their preferred choice for making online purchases was (Figure 10). Credit cards were by far the most commonly preferred method of payment, at 52 percent, while PayPal was second with 28 percent reported. Other methods of payment were rarely reported as the preferred method; indeed, not making online purchases at all was more likely (11 percent). Bitcoin was the least likely to be preferred, at just 1 percent.

4 Conditional Analysis

This section presents a conditional analysis of Bitcoin awareness and ownership using logistic regression. While the descriptive statistics presented in Section 3 are straightforward to understand and interpret, it is important to recognize that they do not tell the entire story. For example, while men show higher levels of awareness, it is not clear whether this relationship still holds after also controlling for the effects of income, age, education, etc. The logistic regression model allows us to measure the effects of various factors on awareness/ownership of Bitcoin *jointly* at the same time.

[7]Bitcoin-Canadian Dollar is $1,017.36 conversion rate as per Bitcoin Price Index, last updated at Dec 7, 2016 at 19:41 GMT on http://www.coindesk.com/price.

Our analysis considers a range of demographic variables (age, gender, education, income, labour force status, and region) as well as the knowledge score defined in Section 3.3. Coefficients from logit discrete choice models cannot be directly interpreted. As an alternative, we compute the odds ratio, that is, the probability of the event (awareness/ownership) conditional on that characteristic relative to its baseline characteristic; results are presented in Table 4.

Broadly, the coefficients in Table 4 should be read in comparison to 1: less than 1 indicates that the group is less likely to be aware/own relative to the base category, whereas greater than 1 indicates the group is more likely to be aware/own. To take a specific example, consider university educated respondents in the logit model for awareness; the conclusion drawn would be that the odds of being aware of Bitcoin are 2.6 times higher than that of the comparison group (those with a high school education or lower). Finally, the confidence intervals and significance stars in Table 4 gauge how certain we are about the estimates, and whether or not we may conclude based on statistical evidence that the odds ratio differs from 1; see the footnote for a more detailed explanation.

4.1 Awareness

Bitcoin awareness was lower among older age groups compared to the 15 to 24 age group. However, the only significant differences were found in the 45 to 54 age group. Specifically, compared to the youngest age group this group had 0.6 times the odds of having heard of Bitcoin. Gender was also a strong predictor of Bitcoin awareness; the odds of being aware of Bitcoin were 0.4 times less for women compared to men.

Bitcoin awareness increases with education. College education was associated with an odds of awareness 1.4 times that of the high school educated population. For those with a university education, this figure was 2.6. Household income, on the other hand, was not a statistically significant predictor of Bitcoin awareness.

As for labour force status, results were again similar to Section 3.1; in particular, the odds of having heard of Bitcoin were about 2.5 times higher for the unemployed population compared to those not in the labour force while comparisons to the employed and retired populations were not significant at 5 percent. This was followed by retirees (1.6 times the odds) and employed individuals (1.4 times the odds). Additionally, Quebec was again found to be the region least aware of Bitcoin while B.C. was the most likely. The remaining regions were in between and not significantly different from each other.

4.2 Ownership

Since the rate of ownership or usage of Bitcoin is low, a rare events or Firth logit, proposed by Firth (1993) is used to estimate the probability of ownership of Bitcoin. The Firth logit is used instead of a standard logit due to the rare occurrence of Bitcoin owners may result in extreme parameter estimates.[8] To understand this issue, think of the limiting case where there are no Bitcoin owners in a particular group; using a standard logit would lead to undefined parameter estimates since this group of Bitcoin owners would be dropped. To adjust for these rare events, the Firth logit adds a penalization term which results in less extreme estimates and avoids dropping categories. To illustrate this principle, we write out the likelihood function for the Firth logit. Let ℓ^{f} be the firth penalized log-likelihood, ℓ be the original log-likelihood, and the I is the Fisher information matrix then the resulting objective function is:

$$\ell^{\mathrm{f}}(\beta) = \quad \ell(\beta) + \log(\det(I(\beta))^{1/2}). \tag{1}$$

The intuition behind this penalization term is that the estimate of β cannot result in a singular information matrix since the logarithm of the determinant of the information matrix is negative infinity. Therefore, the estimate of β must result in a positive definite information matrix so that the second term is finite. This Firth logit is estimated among the population who are aware of Bitcoin.[9]

As expected, the older age groups (45 and older) were the least likely to own Bitcoin, while the younger age groups (18 to 34) were the most likely. For example, those in the 18 to 24 group had 10 times the odds of owning Bitcoin than those in the 55 to 64 group. The 25 to 34 age group was the most likely to own Bitcoin and this was significant compared to all age groups except the 18 to 24 group. Based on models 1 and 2, it seems that while all age groups are fairly similar in their awareness of Bitcoin, actual ownership is very concentrated towards the younger groups. Contrary to the findings in Section 3.2, the gender gap in Bitcoin ownership was not significant.

While higher education was associated with Bitcoin awareness, it seems the opposite is true for ownership; the odds of owning Bitcoin for those with college or university educations were both about 0.4 times smaller compared to this with a high school education or below. For income and labour force status, trends were similar to the awareness model (i.e.

[8] For comparison we also computed the standard logit model, and found that the results are qualitatively similar to those from the Firth logit.

[9] We use the sub-sample of users who are aware of Bitcoin since you can't own Bitcoin if you haven't heard of it. Including unaware respondents in the regression would mean that the parameters are measuring both the effect on ownership and the effect on awareness. By restricting the population to aware participants, the effects on ownership are isolated.

unemployed persons were more likely than other labour force statuses to own Bitcoin) but were no longer significant. Results by region were similar to Section 3.2; Quebec, despite having the lowest awareness, had the highest ownership. The remaining regions were similar to each other, with no statistically significant differences.

In this choice model, we also added a set of indicator variables for negative, zero, and positive Bitcoin knowledge scores (see Section 3.3). As expected, those with positive scores had the highest Bitcoin adoption (4.0 times the odds of those with zero scores) however this was not significant when compared to those with negative scores. Thus, a previous observation is reiterated here: simply attempting the questions was associated with Bitcoin ownership.

5 Reconciling High Awareness and Low Ownership

The BTCOS has found that many Canadians are aware of Bitcoin but few own it and if so, they hold few coins (median holding of 0.54 coins). To understand this disconnect, we review the evidence through the potential purposes of using Bitcoin i.e. transaction and store-of-value purposes.

5.1 Transactional motives

One possible motivation for holding Bitcoin would be as a means of payment for making retail purchases. However, we find that only 21 percent of owners stated that using Bitcoin to buy goods/services in a physical store (14 percent) or buy goods/services on the internet (7 percent) was their main reason for holding Bitcoin. A potential contributing factor for this low number is that retail payments are inherently a two-sided transaction. Consumers can only pay with Bitcoin where it is accepted by merchants, and conversely merchants will only offer to accept Bitcoin if many consumers want to pay with it; see for the example the discussion in Fung et al. (2017). A recent merchant survey by the Bank of Canada finds that only 1 percent of Canadian merchants accept Bitcoin, see Kosse et al. (2017). Given that few merchants accept Bitcoins it is perhaps not surprising that few consumers own Bitcoins for making retail type transactions.

Alternatively, consumers may hold Bitcoin in place of bank funds and utilize Bitcoin ATMs in a way similar to traditional ATMs, to obtain cash that can be used to make purchases. This would also be quite challenging however, as there were only 205 Bitcoin ATMs in existence as of 2017.[10] This pales in comparison to cash - there are over 65,000 bank

[10] As of 14 August 2017, Bitcoin ATMs: https://coinatmradar.com/country/38/bitcoin-atm-canada; Cash ATMs: Canadian Bankers Association: http://www.cba.ca/abm-market-in-canada.

machines in Canada, with 18,711 of these being bank-owned ABMs, having no associated in-network fees. Therefore, there are relatively few places/opportunities for Bitcoins to be withdrawn.

The other side of Bitcoin with respect to the transactional motive is that it may be used to participate in the shadow economy. Christin (2013) provides a comprehensive measurement of the Silk Road that uses Bitcoin as its exchange currency. Due to the complexity of measurement, there is no estimate for the size of Bitcoin-denominated shadow economy in Canada. However, Dunbar and Fu (2015) use Canadian micro data on consumption and income and estimate that 14 to 19 percent of Canadian GDP is under-reported. Their findings provide an estimate that the shadow economy is non-trivial in Canada. As a point of comparison, they bound their estimate with results from Statistics Canada using national accounts which finds about 3 percent and some macroeconomic studies which finds about 15 percent. It is hard to extrapolate from these studies what is the level of under-reporting of Bitcoin adoption and ownership. However, if we assume that respondents who engage in the shadow economy do not respond to surveys or understate their Bitcoin holdings then our survey estimates of ownership and holdings of Bitcoin holdings would be an underestimate.

Finally, to provide additional context to the discussion of the transactional motive we compare the profile of Bitcoin adopters to the adoption profiles of other payment innovations geared toward making transactions, both at the point-of-sale and online. Table 5 compares the logit analysis on Bitcoin ownership from Table 4 with that of selected payment innovations from the 2013 Methods-of-Payment (MOP) survey, using similar demographic categories (see Henry et al. (2015) for further details on the 2013 MOP survey). We report only the significant coefficients from the logit models and show the direction of the sign; '+' indicates groups more likely to adopt, whereas '-' indicates groups less likely, relative to the base category.

We see that the demographic profile of Bitcoin adopters is noticeably different from these other payment innovations. In particular, education and regional effects for contactless [11] and mobile payments are in fact opposite of those for Bitcoin adoption. More educated Canadians are more likely to adopt these payment technologies, compared to lower educated Canadians adopting Bitcoin. Relative to Quebec, all regions are less likely to adopt Bitcoin, however BC and Ontario are more likely to use contactless, and BC is more likely to use mobile payments apps. Finally, higher income is an important significant predictor especially of contactless adoption, whereas this variable does not appear as significant for Bitcoin. For online payment methods, regional and age predictors are similar to those of Bitcoin, whereas income and education factors show opposite effects.

[11] Fung et al. (2014) highlight the impact of contactless credits on cash usage especially for low value transactions.

It remains unclear – and a topic for future work – exactly what is driving these differences. It may suggest that Bitcoin is not being used primarily for transactional purposes, however it is also possible that a different profile of users choose Bitcoin to transact precisely because of its' unique properties, for example providing anonymity for online transactions. Indeed, we observe that 7 percent of owners state that making payments anonymously is their main reason for holding Bitcoin.

5.2 Store-of-value motives

From the 2013 Methods-of-Payment survey we observe respondents that hold physical currency (i.e. Canadian cash) as a store-of-value, for example for emergency scenarios or due to a lack of trust in banks. It is possible that respondents may use Bitcoin for the store-of-value motive as well. For example 3 percent of owners stated that a lack of trust in banks was their main reason for owning Bitcoin. Perhaps more relevant for Bitcoin, the store-of-value motive could also include speculation on the price of Bitcoin. Indeed, the CRA has explicitly recognized Bitcoin capital gains as taxable income.[12] Further, 12 percent of Bitcoin owners state their motivation for holding Bitcoin is as an investment.

Table 6 provides a comparison of demographic characteristics between those who have high precautionary cash holdings, i.e. other than in their wallets or on their persons, versus those who have high Bitcoin holdings. The definitions are standardized in terms of value i.e. high cash holdings is defined as holding above $1000 in cash; while high Bitcoin holding is defined as holding greater than 1 BTC $\approx$ $1000. The demographic profiles are strikingly different. For example, 70 percent of high Bitcoin holders are aged 18-34 compared to only 20 percent for high cash holders. For the older demographic group of age 55 plus, this pattern is reversed with 44 percent who are high cash holders versus 8 percent who are high Bitcoin holders. Other striking patterns are in terms of gender and education attainment. The proportion of high Bitcoin holders is 70 percent male versus cash which is almost equal. Of the high Bitcoin holders, 75 percent are University educated versus 26 percent proportion who are high cash holders. This demographic profile suggest that Bitcoin is a vehicle for younger, male, and high education to use Bitcoin as a store-of-value.

Next, we investigate two indirect measures of the speculative motive. First, Bolt and van Oordt (2016) build a model to decompose the transaction and speculative motive for holding Bitcoins, see Figure 1 of their paper. Their analysis finds that the speculative motive accounts for about 80 percent of the price of Bitcoin. The second measure is based on Google trends which is used to correlate the relative number of Google searches (proxy for Bitcoin trading

[12]The CRA regulations on barter and capital gains are available at the following URL:
http://www.cra-arc.gc.ca/E/pub/tp/it490/README.html
http://www.cra-arc.gc.ca/E/pub/tp/it479r/README.html

and speculation) with the growth rate of Bitcoin-Canadian Dollar exchange rate (proxy for price speculative motive), see Figure 12[13] Our analysis reveals a positive correlation of 0.23 of these two measures. Therefore, an increase interest in Bitcoins is associated with an increase in the price of Bitcoins. These two indirect measures provide evidence that the there is a speculative motive. This result plus the difference in demographic profile is consistent with the view that cash is stable in low inflation environment and used by older and lower educated respondents. Whereas the younger respondents see the Bitcoin price volatility related to higher returns and therefore useful for speculation.

6 Conclusions

We conclude with a discussion of our results and lessons learned from our pilot study.

6.1 Discussion of results

In order to obtain measurements on the use of digital currency in Canada, the Bank of Canada conducted the Bitcoin Omnibus Survey. From a sample of 1,997 Canadians, it was found that almost 64 percent stated they had heard of Bitcoin. However, adoption of Bitcoin remains low at just 2.9 percent overall (5 percent among those aware of Bitcoin). Conditional analysis shows that the awareness of Bitcoin was strongly associated with men and those with college or university educations. Additionally, Bitcoin awareness was more concentrated among those retired or in the labour force, as well as in B.C.

Bitcoin ownership, on the other hand, was associated with younger age groups and high school educations. Additionally, while Quebec had the lowest awareness, it had the highest adoption rates. We proposed a knowledge score for Bitcoin which had mixed results; the score distinguishes between owners and non-owners, however did not meet the required threshold to be considered 'reliable', see Section 3.3. Further analysis of the transactional and store-of-value motives for Bitcoin helps provide context for the high awareness and low ownership. Based on our findings, we are still in the early part of the S-curve of adoption of Bitcoin, especially for transactional purposes. Similar results are found in the United States by Schuh and Shy (2016). Even popular payment innovations such as contactless credit cards take time to penetrate the market, see Chen et al. (2017a).

The low rate of ownership of Bitcoin may be surprising to some, given all the media attention given to Bitcoin. However, a recent study by Catalini and Tucker (2016) provides additional context for the low Bitcoin ownership. In this study, they conducted an

[13]This analysis was inspried by the following article: https://www.coindesk.com/using-google-trends-detect-bitcoin-price-bubbles/ . The author uses Google trends to forecast price bubbles and inform trading strategies.

experiment where they "seeded the S-curve" to increase the adoption of Bitcoin by focusing on a highly educated and technical savvy population. In 2014, the MIT Digital Economy laboratory conducted an experiment where all incoming undergraduate MIT were given a Bitcoin wallet with $100 worth of Bitcoin. One of their main findings was that 11 percent of the students liquidated their Bitcoin wallets within two weeks of receipt. Given that the sample contained many of the characteristics we discussed earlier as being correlated with Bitcoin ownership, this suggests that there are still other relevant factors which need to be considered.

Finally, we provide a back-of-the-envelope calculation to situate our findings with respect to external network data. Using our lower-bound estimate of mean Bitcoin holdings (1.2), we extrapolate that there are currently 1,003,000 Bitcoins held in Canada. This amounts to roughly 6 percent of the total number of Bitcoins in circulation as of Q4 2016 when the BTCOS was conducted.[14] Further validation could potentially be performed using administrative data from Canadian Bitcoin exchange; Lohr (2017) discusses how to use survey data more efficiently by combining survey data with information from large data sources.

6.2 Lessons learned and future work

As discussed in Section 2.1, the BTCOS was intended to be a pilot study which could inform future surveys on digital currencies. What lessons do we draw from this pilot study? First, we have confirmed that Bitcoin owners are a hard-to-reach population, in the sense that it is difficult to obtain a large sample via stratified random sampling. A total sample size of 1,997 can be considered large in the realm of survey statistics. However, from a sample of only 58 Bitcoin users it is more challenging to conduct in-depth cross sectional analysis due to the inherently small cell sizes.

To address this we propose using a methodology called respondent-driven sampling (RDS) which has to the potential to be a more cost effective and efficient method for obtaining a sample of digital currency users. In RDS respondents are asked to recruit people they know to the survey. To motivate participation, respondents are given an incentive for their response to the survey as well as an additional incentive for each person they successfully recruit (see Heckathorn (1997)). RDS is similar to snowball sampling (a type of convenience sample), but aims to produce unbiased and efficient estimates by taking into account that individuals with more connections are more likely to be sampled and that different groups have different recruitment patterns. Liebau and Schonlau (2012) provides a Stata command for performing this analysis.

The BTCOS can inform an RDS study in several ways. Knowing the basic demographic

[14] Data are from https://www.statista.com/statistics/247280/number-of-bitcoins-in-circulation/; there were 16.08 million total Bitcoins in circulation in Q4 of 2016.

profile of Bitcoin users allows us to construct simulation studies. In these simulations we can vary relevant parameters such as the recruitment probability or network size and explore the resulting impact on the final sample size of digital currency users obtained via RDS. This helps us to better design the incentive structure for the study and hence understand the cost trade-offs involved. Work is already underway to experiment with these simulations using the data provided by the BTCOS in Chen et al. (2017b).

Further, a subset of Bitcoin owners who completed the BTCOS agreed to participate in a future study relating to digital currency. Hence we can tap these respondents to be part (or all) of the seed population, i.e. the initial respondents who start off the RDS procedure. Alternatively we may re-contact the respondents to obtain additional data which would better prepare us to conduct an RDS study. For example, since RDS relies on the recruitment of peers, it would be useful to know how many people a respondent typically knows who have Bitcoin. It is plausible that many Bitcoin users only know other users through online forums with varying degrees of anonymity. Thus, further questions on the nature of their relationships with other Bitcoin users could also be a good indicator of how successful RDS would be.

Additionally, results from the BTCOS will be useful for developing the questionnaire for a full-scale survey on digital currency. First, we would keep and improve on the knowledge score by sharing our results with academics and other experts studying digital currency, to obtain broad agreement about objectives facts concerning Bitcoin taking into account the considerations discussed in Section 3.3. Ideally an improved score would meet the reliability criterion determined by Cronbach's alpha measure, and could be used as a standardized test of Bitcoin knowledge in other surveys. Second, it is clear that estimates of Bitcoin holdings need to be more precise; this would allow us to calibrate our survey data to external network data as suggested above using the methodology proposed in Lohr (2017). This implies that we need to ask directly about the amount of Bitcoin holdings, or at least increase the number of bins that respondents can select from.

Third and final, discussion of the BTCOS results have helped us identify where to concentrate the focus of a future study, in particular by analyzing the main reasons for ownership. It is our contention, given the still early state of knowledge of digital currency use, that focus should be placed on identifying and classifying different types of users, for example casual users versus investors/speculators versus shadow economy participants. Understanding the composition of these types of users would be important for better understanding the future of digital currency use as well as the implications for the use of cash.

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Figure 1: Schematic of Survey (Wave 1/2)

1. Have you heard of Bitcoin?
Yes No
[IF YES TO Q1, ASK Q2, ELSE SKIP TO Q5]
2. Do you currently have or own any Bitcoin?
Yes No
[IF YES TO Q2, ASK Q3a and Q3b, ELSE SKIP TO Q4a]
3a. 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
[ANCHOR] Other (specify)

3b. How many Bitcoin do you own?
(Select one)
None, Less than 0.1, 0.1 to 1, 1.1-10, More than 10, Unsure/would rather not say

[IF NO TO Q2, ASK Q4a and Q4b, ELSE SKIP TO Q5]
4a. Have you owned or used Bitcoin in the past, but subsequently stopped using it?
Yes, No

4b. Please tell us your main reason for not owning any Bitcoin.
[RANDOMIZE LIST]
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 central 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. Dogecoin, Litecoin, Ripple,etc)
[ANCHOR] Other (specify)

[ASK ALL]
5. What is your preferred method of payment for making purchases online?
(Select one)
[RANDOMIZE LIST]
Credit card, PayPal, Interac online, Interac e-transfer, Bitcoin
[ANCHOR 2ND LAST] Other
[ANCHOR LAST] I do not make purchases online

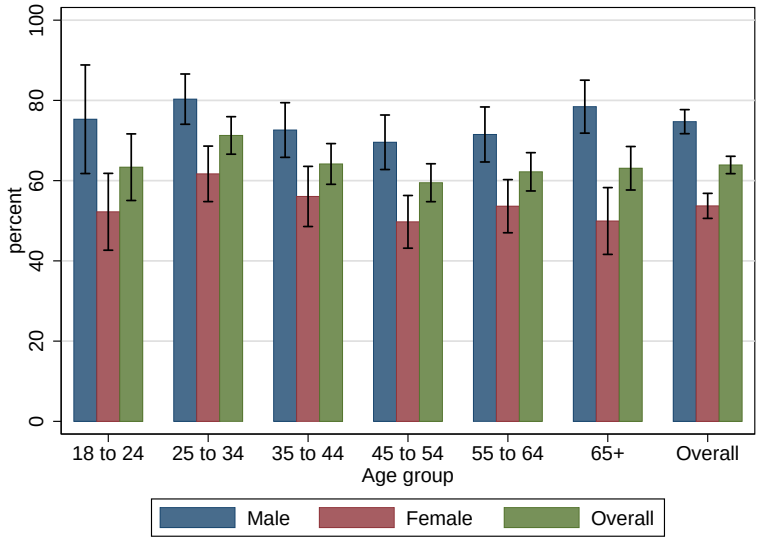
Figure 2: Bitcoin Knowledge Questions (Wave 2)

To the best of your knowledge, which of the following are features of Bitcoin? Please select any that apply.

1. Bitcoin allows for direct transactions between two parties, without a third party involved.
2. The total supply of Bitcoin is fixed.
3. All Bitcoin transactions are recorded on a distributed ledger that is publicly accessible.
4. Bitcoin is similar to other national currencies, such as the euro or peso, that are backed by the government.
5. Bitcoin transactions take place instantaneously.

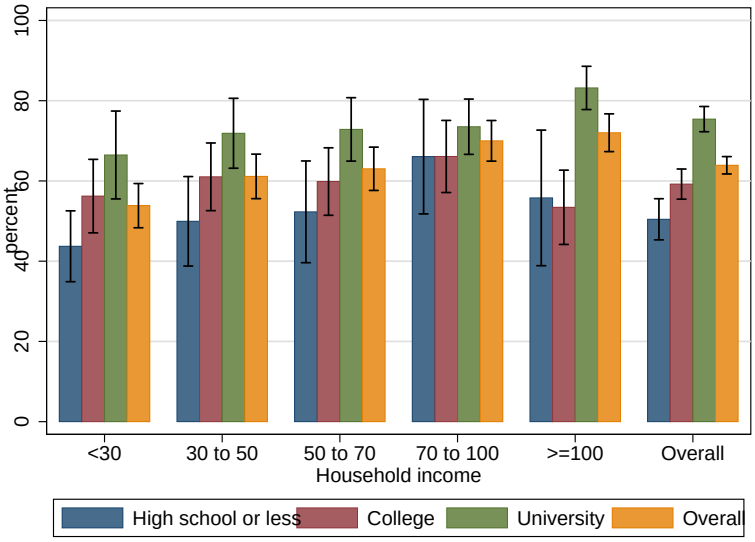
Note: This question was asked of wave 2 participants who said they had heard of Bitcoin. The items which are true features of Bitcoin are 1, 2, and 3. The items which are false are 4 and 5. The order of the features was randomized for each respondent.

Figure 3: **Awareness of Bitcoin by Age and Gender**



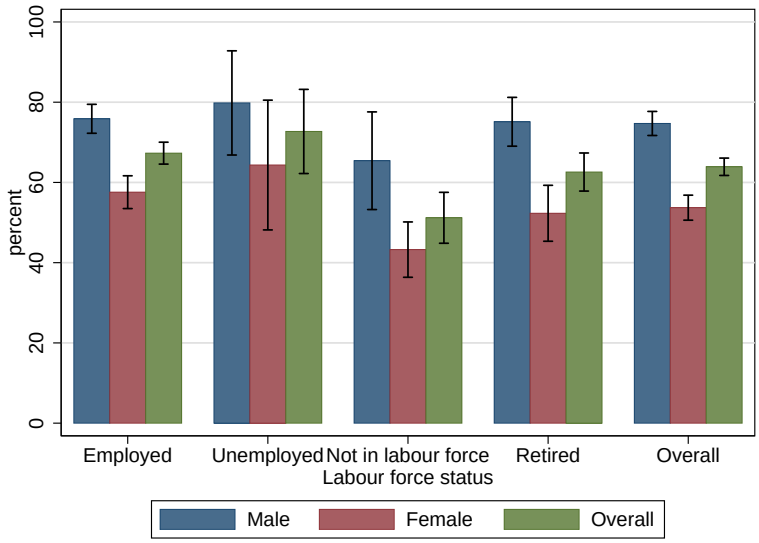
Note: This graph provides the percentage of individuals who answered "Yes" to the question "Have you heard of Bitcoin?" Results are broken down by age group and gender and are post-stratified by region, age, and gender. The sample consists of 1,997 Canadians aged 18 or older.

Figure 4: **Awareness of Bitcoin by Education and Income**



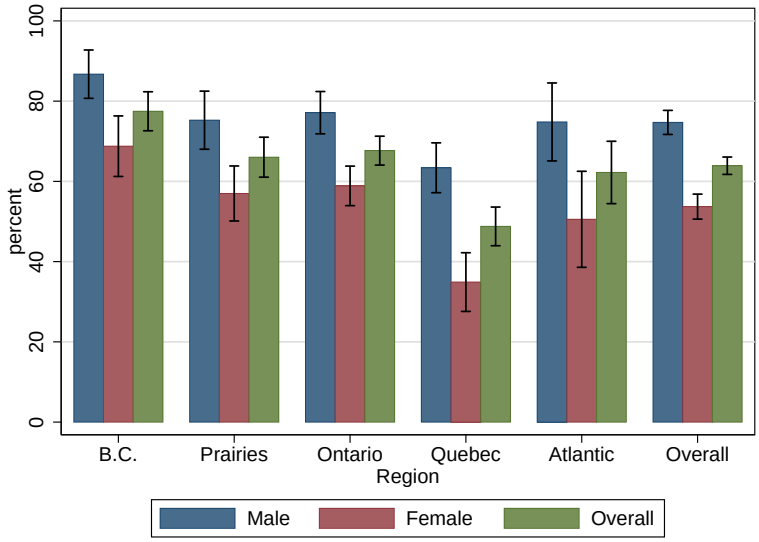
Note: This graph provides the percentage of individuals who answered "Yes" to the question "Have you heard of Bitcoin?" Results are broken down by household income and education and are post-stratified by region, age, and gender. Multiple imputation was used for 225 missing values for income. The sample consists of 1,997 Canadians aged 18 or older. College includes CEGEP and trades. Note that individuals only needed "some" education to be included in a category; they do not necessarily have a diploma/degree.

Figure 5: **Awareness of Bitcoin by Labour Force Status and Gender**



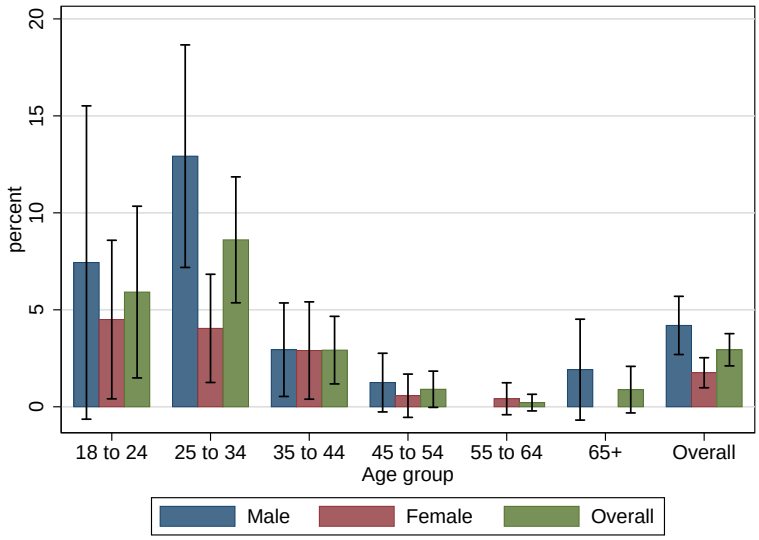
Note: This graph provides the percentage of individuals who answered "Yes" to the question "Have you heard of Bitcoin?" Results are broken down by labour force status and gender and are post-stratified with respect to region, age, and gender. Multiple imputation was used for 22 missing values for labour force status. The sample consists of 1,997 Canadians aged 18 or older. Employed includes full-time, part-time, self-employed, and military. Unemployed includes those looking for work. Not in labour force includes those not looking for work, long-term sick or disabled, full-time parents/homemakers, and students/pupils.

Figure 6: **Awareness of Bitcoin by Province and Gender**



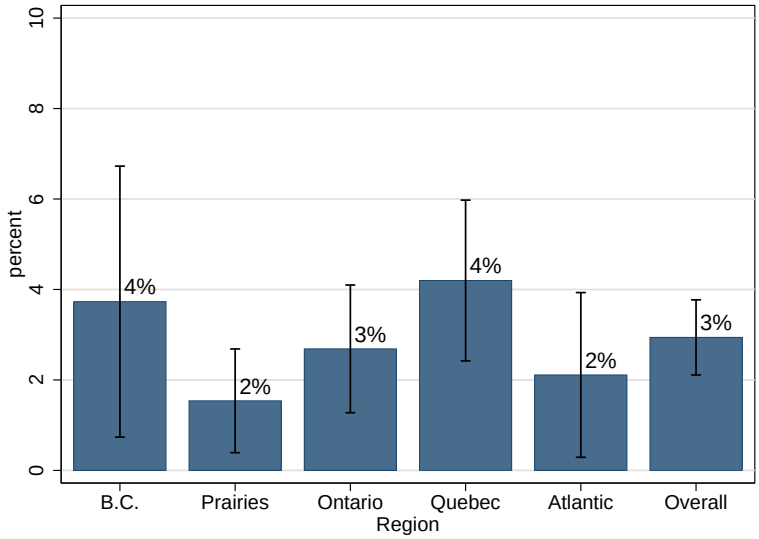
Note: This graph provides the percentage of individuals who answered "Yes" to the question "Have you heard of Bitcoin?" Results are broken down by region and gender and are post-stratified with respect to region, age, gender, and education. The sample consists of 1,997 Canadians aged 18 or older.

Figure 7: **Ownership of Bitcoin**



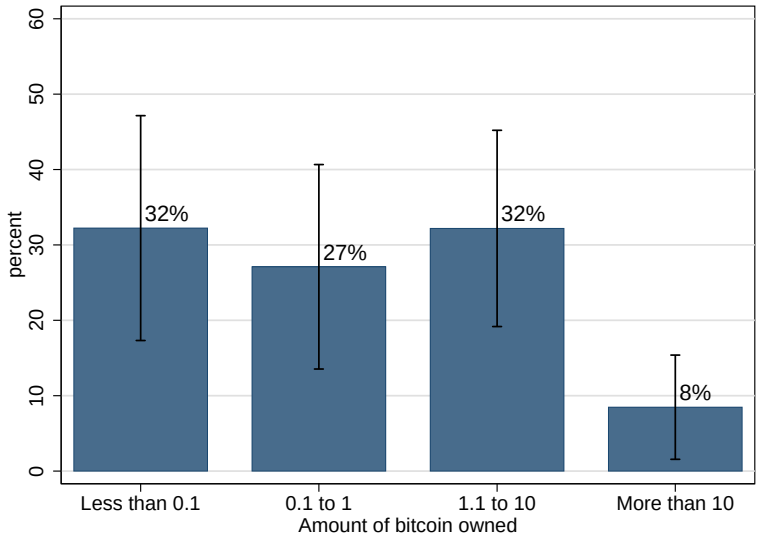
Note: This graph provides the percentage of individuals who answered "Yes" to the question "Do you currently have or own any Bitcoin?" Results are broken down by age group and gender and are post-stratified with respect to region, age, and gender. The sample consists of 1,997 Canadians aged 18 or older. Those who stated they have not heard of Bitcoin were assumed to not own any Bitcoin.

Figure 8: **Ownership of Bitcoin by Province**



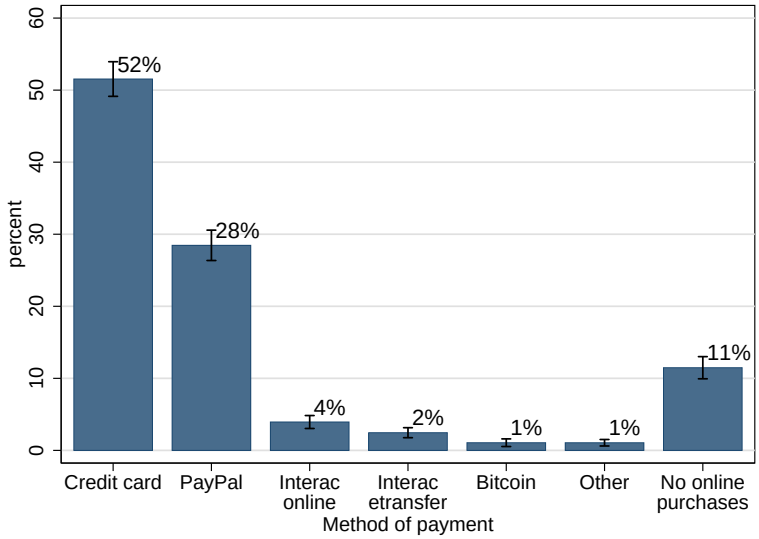
Note: This graph provides the percentage of individuals who answered "Yes" to the question "Do you currently have or own any Bitcoin?" Results are broken down by region and are post-stratified with respect to region, age, and gender. The sample consists of 1,997 Canadians aged 18 or older. Those who stated they have not heard of Bitcoin were assumed to not own any Bitcoin.

Figure 9: **Holdings of Bitcoin**



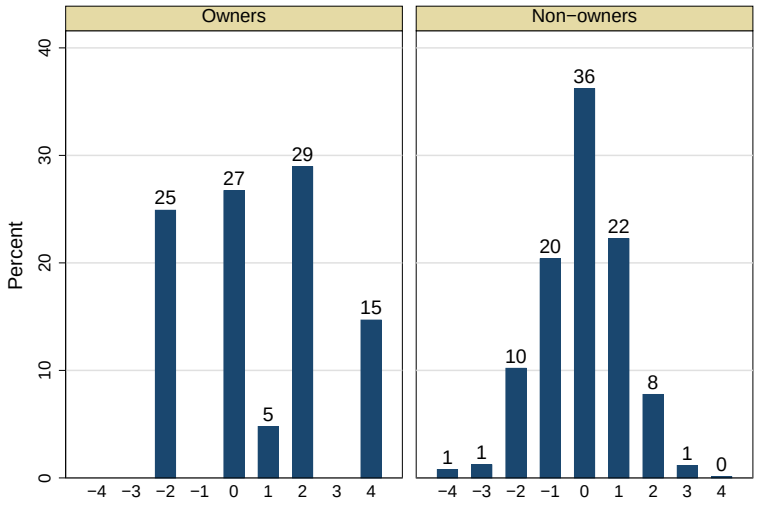
Note: This graph provides the distribution of responses to the question "How many Bitcoin do you own?" Results are post-stratified with respect to region, age, and gender. The sample consists of 57 Canadians aged 18 or older who said they have or own Bitcoin.

Figure 10: **Preferred Method of Online Payments**



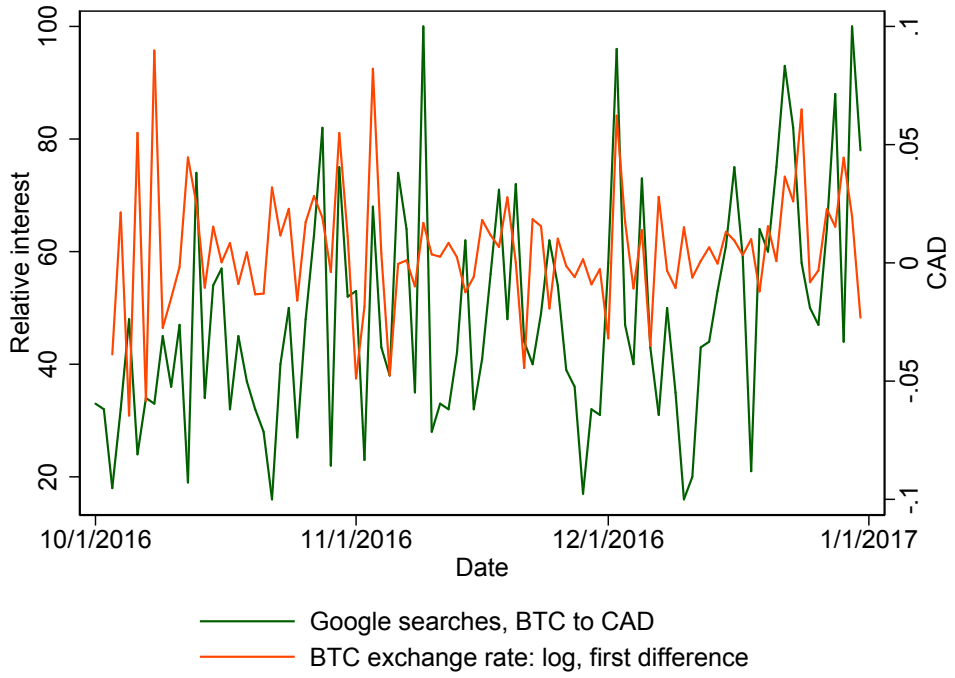
Note: This graph provides the distribution of responses to the question "What is your preferred method of payment for making purchases online?" Results are weighted with respect to region, age, gender, and education. The sample consists of 1,997 Canadians aged 18 or older.

Figure 11: **Bitcoin Knowledge Score by Ownership**



Note: This graph presents the distribution of awareness scores as defined in Section 3.3. Results are post-stratified with respect to region, age, and gender (note that only one wave of the survey (half the sample) received these questions, and so results are re-weighted with this smaller sample). The sample consists of 33 Bitcoin owners and 457 non-owners aged 18 or older who said they had heard of Bitcoin and who attempted to answer at least one of the five Bitcoin knowledge questions.

Figure 12: **Store-of-value Bitcoin users in Canada**



Note: This graph shows the Google trends analysis for the search "BTC to CAD" from the period of October 1 - December 31, 2016, along with the exchange rate during this period. The exchange rate time series has been transformed to a log scale, and we show the first differences. Google searches give a rough proxy for the number of Bitcoin users in Canada who are holding Bitcoin as speculation, or as a store-of-value. The BTCOS was held November 9-13, 2016 (Wave 1) and December 14-18, 2016 (Wave 2).

Table 1: Main reason for ownership

	≤1 BTC		>1 BTC		Total	
	No.	%	No.	%	No.	%
I am interested in new technologies	9	32	8	24	17	29
I use it to buy goods and services in physical stores in Canada/elsewhere	3	14	5	14	8	14
It is an investment	2	7	4	18	6	12
I use it to make remittances or other international payments	3	13	3	8	6	11
It uses secure blockchain technology to prevent loss and fraud	3	7	3	8	6	7
I use it to buy goods and services on the internet in Canada/elsewhere	1	2	3	15	4	7
It allows me to make payments anonymously	1	3	3	13	4	7
I do not trust banks	2	6	0	0	2	3
I do not trust the government or the Canadian dollar	2	4	0	0	2	3
Other	3	12	0	0	3	7
Total	29	100	29	100	58	100

Note: This table provides the distribution of responses to the question "Please tell us your main reason for owning Bitcoin." Results are post-stratified with respect to region, age, and gender. The sample consists of 58 Canadians aged 18 or older who said they have or own Bitcoin.

Table 2: Main reason for non-ownership

	No.	%
My current payment methods meet all my needs	390	32
I do not understand/know enough about the technology	340	28
I do not trust a private currency that is not backed by the central government	152	12
It is not widely accepted as a method of payment	89	7
It is not easy to acquire/use	70	6
I am concerned about cyber theft	58	5
I am concerned about lack of oversight from regulatory bodies	51	4
The value of Bitcoin varies too much	38	3
Other	22	2
I use alternative digital currencies instead (e.g. Dogecoin, Litecoin, Ripple, etc)	5	0
Total	1,214	100

Note: This table provides the distribution of responses to the question Please tell us your main reason for not owning Bitcoin. Results are post-stratified with respect to region, age, and gender. The sample consists of 1,214 Canadians aged 18 or older who said they have heard of Bitcoin, but do not have or own any.

Table 3: Knowledge questions by Bitcoin holdings

	Do not have	Have ≤1 Bitcoin	Have >1 Bitcoin	Overall
No third party (true)	91	69	83	90
Total supply fixed (true)	39	62	65	42
Recorded on public ledger (true)	46	75	71	50
Government-backed (false)	83	64	24	80
Instantaneous (false)	6	50	11	8

Note: This table provides the proportion of individuals who correctly answered each of the five true or false knowledge questions (defined in Figure 2). The correct answer of each is given in brackets.

Table 4: Bitcoin Awareness and Ownership

	Awareness		Ownership	
	OR	CI	OR	CI
25 to 34	0.9	0.6 - 1.5	1.4	0.6 - 3.2
35 to 44	0.8	0.5 - 1.2	0.6	0.2 - 1.5
45 to 54	0.6**	0.4 - 1.0	0.2***	0.0 - 0.5
55 to 64	0.7	0.4 - 1.1	0.1***	0.0 - 0.5
65+	0.7	0.4 - 1.2	0.1*	0.0 - 1.3
Female	0.4***	0.3 - 0.5	0.7	0.4 - 1.3
College	1.4**	1.1 - 1.8	0.4**	0.2 - 0.9
University	2.6***	1.9 - 3.4	0.4**	0.2 - 0.9
$30,000 to $49,999	1.2	0.9 - 1.8	1.3	0.5 - 3.5
$50,000 to $69,999	1.2	0.8 - 1.6	1.1	0.4 - 2.9
$70,000 to $99,999	1.3	0.9 - 1.9	1.5	0.6 - 3.9
$100,000 or more	1.3	0.9 - 1.9	1.3	0.5 - 3.4
Employed	1.4**	1.0 - 2.0	2.0	0.7 - 5.3
Unemployed	2.5***	1.3 - 4.6	2.8	0.8 - 10.3
Retired	1.6**	1.0 - 2.5	1.7	0.2 - 18.6
B.C.	3.8***	2.6 - 5.4	0.3**	0.1 - 0.9
Prairies	2.1***	1.6 - 3.0	0.2***	0.1 - 0.6
Ontario	2.3***	1.8 - 3.1	0.4***	0.2 - 0.8
Atlantic	2.0***	1.3 - 3.0	0.4*	0.1 - 1.1
Wave 1			1.2	0.6 - 2.7
Knowledge score <0			1.9	0.7 - 5.3
Knowledge score >0			4.0***	1.7 - 9.5
Constant	0.7	0.4 - 1.2	0.2***	0.0 - 0.6
Observations	1,997		1,272	

Note: For the Awareness regression, the baseline category is a respondent that is aged 15 to 24, male, has a high school education or below, has a household income below $30,000, is not in the labour force, and lives in Quebec. The Ownership regression, the baseline category is a respondent that is aged 15 to 24, male, has a high school education or below, has a household income below $30,000, is not in the labour force, lives in Quebec, and received a Bitcoin knowledge score of 0. OR denotes odds ratio or the the probability of the event (awareness/ownership) conditional on that characteristic relative to its baseline characteristic. We provide the the 95 percent confidence interval (CI) for the OR in the tables while ***, **, and * denote the marginal significance level (p-values) of 0.01, 0.05, and 0.10, respectively. Note that an OR greater than one denotes more likely to be either Aware or Own a bitcoin while OR less than one is less likely. For example, the OR for Female in Awareness is 0.4 which indicates that females are 60 percent less likely to be aware of Bitcoin relative to the baseline category. The model is estimated using the method by Firth (1993) which takes into account rare events to reduce bias. It is estimated among the population who said they had heard of Bitcoin. Also note that a dummy for wave 1 of the survey is included here in order to properly interpret the effects of the knowledge score, which was only asked among wave 2 participants.

Table 5: Bitcoin vs. other payment innovations

	BTC	CTC	Mobile	Paypal	Online - debit	Online - credit
25 to 34						
35 to 44			-		-	
45 to 54	-		-	-	-	-
55 to 64	-		-	-	-	-
65+	-		-	-	-	-
Female				-		-
College	-	+		+	+	+
University	-	+		+	+	+
Income 2				+		+
Income 3		+		+		+
Income 4		+		+		+
Income 5		+	+	+	+	+
Employed		+		+	+	+
Unemployed						
Retired			-			+
B.C.	-	+	+		-	-
Prairies	-			-	-	-
Ontario	-	+			-	-
Atlantic	-					
Adoption rate (%)	2.9	33.4	6.6	31.2	26.9	40.7
Observations	1,272	3,495	3,463	3,493	3,486	3,504

Note: BTC - Firth logit analysis from Table 4. CTC - contactless debit/credit; mobile - mobile payment application; Paypal - online payment account not associated with a bank, e.g. Paypal; Online debit - Interace online/e-transfer; Online credit - online payment using a credit card. Columns 2-6 are the results of logit analyis using data from the 2013 Methods-of-Payment study. Adoption is defined as use in the past year. We reports signs of statistically significant coefficients; '+' indicates more likely to adopt compared to base category, and '-' indicates less likely to adopt compared to base category.

Table 6: Demographic profile of high cash holders vs. BTC

	Cash	BTC
West	0.392	0.278
Central	0.540	0.648
East	0.068	0.074
18-34	0.190	0.687
35-54	0.369	0.235
55+	0.442	0.078
Male	0.529	0.701
Female	0.471	0.299
High School	0.329	0.214
College	0.407	0.041
University	0.264	0.745
<$45k	0.244	0.147
$45k - $84k	0.391	0.484
$85k+	0.365	0.37
Not in labour force	0.374	0.186
Employed	0.604	0.788
Unemployed	0.022	0.025

Note: Demographic profiles of high value cash and Bitcoin users. *Cash* is defined as respondents who hold $\geq$ \$1000 in 'other' cash, i.e. cash stored at home/elsewhere for precautionary/store-of-value purposes, from the 2013 MOP. *BTC* consists of respondents from the BTCOS who reported holding more than 1 BTC ($\approx$ \$1000) during the period considered.

A Technical Appendix

A.1 Methodology

A.1.1 Data

The Bitcoin Omnibus Survey (BTCOS) was conducted online in two waves in late 2016: one from November 9th to 13th and one from December 14th to December 18th. The two waves are combined under the assumption that they make up one simple random sample from a single data generating process. In total, 2,001 individuals were sampled. Four of these reported that they had or owned Bitcoin in Question 1, but then contradicted themselves by saying they do not own any Bitcoin in Question 3B. These are excluded from the analysis, leaving a sample of N = 1,997.

A.1.2 Post-stratification

The sample was post-stratified on age, gender, and province using population counts from the 2016 census.[15] Each dimension is grouped as follows:

Table 7: Post-stratification groups

Age	**Gender**	**Province**
18 to 24	Male	British Columbia
25 to 34	Female	Alberta
35 to 44		Saskatchewan & Manitoba
45 to 54		Ontario
55 to 64		Quebec
65+		Atlantic provinces

Thus there are 6*2*6 = 72 potential strata. However, to ensure each stratum had at least 10 observations, age groups were collapsed in a few instances. These collapsed groups are:

- 18 to 34, Male, British Columbia
- 18 to 34, Male, Alberta
- 18 to 34, Female, Atlantic provinces
- 55+, Female, Atlantic provinces

This has the benefit of removing the more severe outliers from the post-stratification weights. For variance estimation, the default method in Stata (linearization) is used.

[15] Statistics Canada Catalogue no. 98-400-X2016001. Note that population totals may not match exactly with those in the census data due to rounding. As an illustration, consider that the census reports 17,264,200 men and 17,887,530 women, suggesting that there are 35,151,730 Canadians. This is a (trivial) contradiction with the census estimate of 35,151,725 Canadians.

A.1.3 Imputation

There are two demographic variables of interest containing missing values for which imputation is desired: income (missing=225) and employment (missing=22). The methodology used is Multiple Imputation by Chained Equations (MICE), the choice of which is motivated by two sources. First, imputing multiple times (in this case 50) enables the computation of standard errors that take into account the uncertainty of imputation. Second, employment and income are related, so it is important to impute one using the other (and vice versa). MICE is able to do this by iterating between two regression models; on each step, the regression uses a current iteration of imputed values from one variable to predict new imputed values for the other. This is repeated until convergence is reached.

The two iterating models used here are both multinomial logits since income and employment are recorded as categorical variables. The variables used in these models to predict income and employment are:

- gender
- age
- province
- whether or not they have children
- education
- marital status

The imputation of income and employment using these variables (and each other) is justified by running multinomial models on the incomplete data. It was found that, based on the adjusted R^2, 14 percent of the variation in income can be explained and 39 percent of the variation in employment can be explained.

One final note on using multinomial logits with MICE; sometimes there are instances where no observations are found in a given category. To avoid this perfect prediction, a methodology called augmentation is used. Augmentation works by filling the empty categories with a few made up observations that have small weights.

A.2 Sample compositions

Table 8: Sample Composition

	Unweighted	Weighted	CIUS
GENDER			
Male	47	49	49
Female	53	51	51
AGE			
18 to 24	9	10	15
25 to 34	18	17	17
35 to 44	17	16	16
45 to 54	21	18	19
55 to 64	20	18	16
65+	16	21	18
REGION			
B.C.	12	14	13
Prairies	19	18	17
Ontario	36	38	39
Quebec	23	23	23
Atlantic	9	7	7
LABOUR FORCE STATUS			
Employed	59	56	64
Unemployed	4	4	5
Not in labour force	37	40	31
HOUSEHOLD INCOME			
Less than $25,000	15	16	13
$25,000 to $45,000	18	18	18
$45,000 to $65,000	21	21	18
$65,000 or more	45	44	51

Note: Weighted results are based on post-stratification by region, age, and gender in 2016. CIUS results are derived from tabulations from Statistics Canada; they represent figures from the 2012 Canadian Internet Use Survey which were weighted with respect to the 2011 National Household Survey. This table can thus be used to determine how representative the sample is of the Canadian population (with respect to these demographics) as of 2011.