Cryptocurrencies

Exploring the Application of Bitcoin as a New Payment Instrument

By Shinnecock Partners in association with Sophia Bak, Jimmy Yang, Peter Shea, and Neil Liu

About the Authors

Shinnecock Partners undertook this study of cryptocurrencies with the authors to understand this revolutionary payment system and related technology, explore its disruptive potential, and assess the merits of investing in it. Shinnecock Partners is a 25 year old investment boutique with an especial focus on niche investments offering higher returns with less risk than more traditional investments in long equities and bonds.

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Introduction

The first cryptocurrency was introduced in 2009 by the reclusive Satoshi Nakamoto in his white paper titled, "Bitcoin: A Peer-to-Peer Electronic Cash System." Cryptocurrency technology was presented as a breakthrough in computer science that allowed users to establish trust over an unsecured network without a third party.

Bitcoin's journey through the adoption cycle in the last five years is evidenced by the juxtaposition of evangelists hailing the technology as the future of currency and press headlines condemning its role in illicit drug trades. When the price of Bitcoins peaked in late 2013, Bitcoin seemingly took a step forward toward legitimacy as interest in the phenomenon gained traction. But the collapse of the largest exchange at the time due to fraud quickly sent Bitcoin two steps backward in the eyes of the public. As Bitcoin treks forward, it faces strong doubts, with well-respected minds such as Warren Buffett calling it a "mirage" and warning individuals to "stay away from it."[1]

Other historical inventions have initially faced similar ridicule and doubt, the most notable being the Internet. In 1995, Robert Metcalfe, founder of 3Com and inventor of the Ethernet protocol, predicted that the Internet "will soon go spectacularly supernova and in 1996 catastrophically collapse."[2] He was worried that the Internet was unreliable as a platform for e-commerce and other business applications and was not secure enough to mitigate cyber threats. These concerns are still valid today - there are still major cyber-attacks and the security of our Internet activity is more in question today than ever before. Furthermore, additional problems emerged that could never have been anticipated then, like the rapid inflation and subsequent collapse of Internet company stock prices known as the "Dot-com bubble". Nevertheless, the Internet has still managed to thrive and has grown exponentially, becoming an essential part of modern life for billions. Much like the Internet, we see Bitcoin's potential to transform the future of commerce despite some of the flaws and setbacks it has experienced and a host of new problems that could be still looming around the corner.

Venture capital investments in Bitcoin-related companies reached $180 million[3] in June 2014, a 100% increase from year end 2013. We believe this accelerated growth shows that cryptocurrency technology is still on the upswing of the adoption curve. Our goal is to educate potential users and investors on the features of cryptocurrency technology, a possible regulatory framework, and the

[1] "Bitcoin? Here's what Warren Buffett is saying." *CNBC*. N.p., n.d. Web. 28 Oct. 2014. <http://www.cnbc.com/id/101494937#>.

[2] "Imagining the Internet." *Imagining the Internet*. N.p., n.d. Web. 28 Oct. 2014. <http://www.elon.edu/predictions/prediction2.aspx?id=BSP-0009>.

[3] "Bitcoin Venture Capital Funding." *CoinDesk RSS*. N.p., n.d. Web. 05 Sept. 2014. <http://www.coindesk.com/Bitcoin-venture-capital/>.

developing ecosystem that can lead to the successful application of cryptocurrencies as a valid and acceptable payment system.

Chapter 1 defines cryptocurrencies and their role in commerce. At their core, cryptocurrencies are protocols that facilitate direct transactions between two unrelated parties over the Internet without traditional banking institutions. We compare cryptocurrencies to a wide range of fiat currency instruments and discuss their potential near-term integration in everyday life.

Chapter 2 considers the growth of the most popular payment instruments and discusses how cryptocurrencies may fit into a similar paradigm.

Chapter 3 uses Bitcoin as a model to discuss the benefits cryptocurrencies offer over traditional payment options: low cost, fast transfers, identity theft protection and minimal infrastructure.

Chapter 4 evaluates adoption challenges and examines the application of current financial regulations to cryptocurrencies. Our findings conclude that while regulations may introduce additional costs, an appropriate regulatory framework and a robust Bitcoin infrastructure can help alleviate user concerns related to money laundering, taxation, safety, resolution of disputes, price volatility, and increased competition.

Chapter 1. Defining Cryptocurrencies and their Role

When people imagine Bitcoins or other cryptocurrencies, most people envision something like a digital version of a traditional currency such as the Dollar or Euro. However, at their core cryptocurrencies are really protocols that facilitate transactions between two unrelated parties over the Internet in a manner that gives them confidence value has been safely transferred from one party to the other. Transactions are recorded in a public ledger and verified through cryptography by a network of decentralized computers. Because no single entity controls these computers, this technology eliminates the need for traditional financial intermediaries and enables the use of cryptocurrencies as a new direct payment option for consumers and merchants.[4] Similar to fiat currencies, cryptocurrencies can be traded on exchanges, managed in wallets, and spent via payment processors. However, unlike other forms of electronic payment, cryptocurrency transactions cannot be forcibly reversed (Exhibit 1).

[4] We define consumers as people or households that are the final users of goods and services and merchants as businesses who provide final goods and services to consumers.

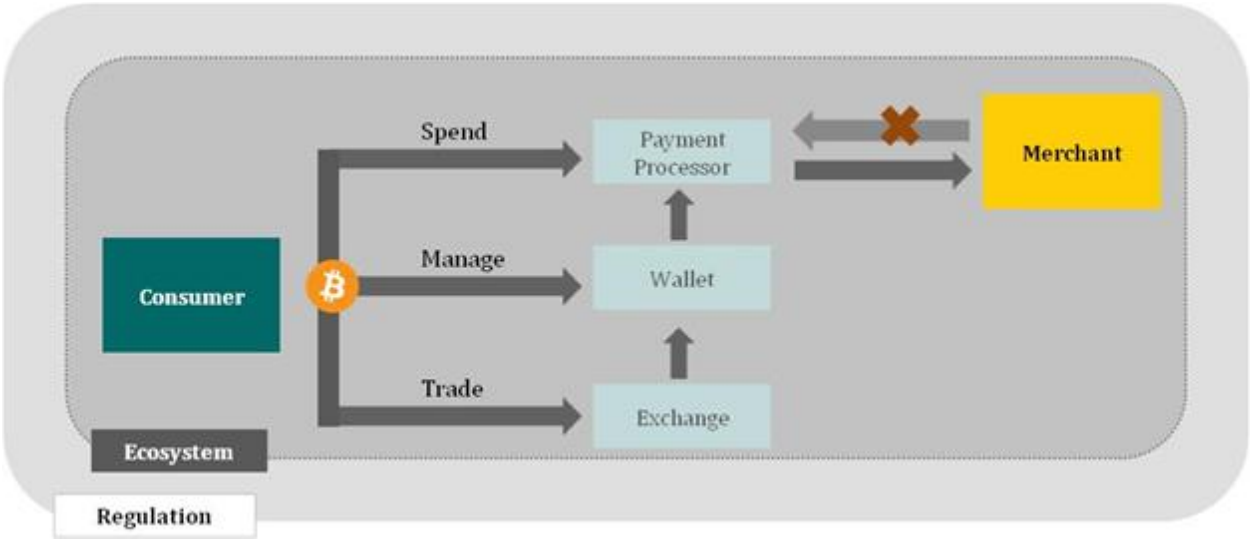


Exhibit 1. Ecosystem of Bitcoin
Source: Shinnecock Partners

More formally, we rely on the U.S. Treasury's definition of a virtual currency. According to the Treasury, a virtual currency is a "medium of exchange that operates like a [real] currency in some environments" but lacks the legal tender status of fiat monies. To further distinguish a cryptocurrency from other virtual mediums of exchange, the Treasury also notes that "(1) it has no central repository and no single administrator, and (2) persons may obtain [the virtual currency] by their own computing or manufacturing effort."[5]

Hundreds of different cryptocurrencies are currently in existence, with a total market capitalization of $5 billion.[6] However, we use Bitcoin to describe the features of cryptocurrencies because it represents over 92% of the market, with a valuation of $4.6 billion.[7]

Obtaining and transferring cryptocurrencies today is easier than ever before. Appendix 4 and 5 of the presentation herein discuss in much greater detail many of the most prevalent opportunities to gain access to Bitcoin as a user, investor, or both. Thanks in large part to the venture capital interest in this space, there are now dozens of options to help you instantly use cash, debit cards, credit cards, or wire transfers to obtain cryptocurrencies. Many of these services will also serve as a

[5] "FIN-2013-G001." *FIN-2013-G001*. N.p., n.d. Web. 5 Sept. 2014. <http://fincen.gov/statutes_regs/guidance/html/FIN-2013-G001.html>.

[6] See Appendix II for a summary of the top five cryptocurrencies.

[7] "Crypto-Currency Market Capitalizations." *Crypto-Currency Market Capitalizations*. CoinMarketCap, n.d. Web. 31 October. 2014. <http://coinmarketcap.com/>.

"wallet", allowing you to maintain your cryptocurrency balance there for future use. There are also services that specialize in serving as your "wallet", providing additional security protection or insurance. However, much like one has to give consideration to where their regular currencies and investments are held, there are significant security concerns to consider among the existing providers. As discussed in greater detail below, many of the largest setbacks for cryptocurrencies have occurred not due to failures within cryptocurrencies themselves, but the nascent companies that have risen around them. Finally, there are now several investment options associated with cryptocurrencies, allowing you to invest in them through a venture capital prospective, financing companies associated with the industry, or by gaining exposure to their price movements without physically holding the assets, much like a gold ETF.

From the merchant perspective, the ability to use and accept cryptocurrencies as a source of payment has also dramatically improved, with Bitcoins now accepted by over 75,000 merchants, a 350% increase from a year ago.[8] This includes prominent merchants such as Dell, Expedia, Dish Network and Overstock. Recently, Paypal has begun to accept Bitcoins as a form of payment for online gaming and music downloads. If it proves successful, Paypal may allow users to pay any of the 8 million merchants on its digital money transfer platform with Bitcoins.[9] Finally, cryptocurrencies are both a currency and a technology, and could eventually offer merchants the ability to transfer value across borders and instantly convert it back into their local currency without receiving significant exposure to any cryptocurrency price movements at lower costs compared to the current international banking system.

There are certainly other usages of cryptocurrencies outside of the consumer-merchant relationship.[10] However, we focus on payment transactions because it allows us to directly compare cryptocurrencies to a wider range of fiat currency instruments that people use on a daily basis. Hopefully, this will make our insights on how the technology can be integrated in the near future more meaningful.

Chapter 2. Critical Considerations

To understand the application of cryptocurrencies in payment transactions, we must review the current payments market and consider criteria that allow for comparison. Because cryptocurrencies

[8] Calculated via data from Coinbase and BitPay.

[9] "PayPal Takes Baby Step Toward Bitcoin, Partners With Cryptocurrency Processors." Forbes. Forbes Magazine, n.d. Web. 26 Sept. 2014.

[10] See Appendix for other applications.

are mediums of exchange and not legal tender, we focus our comparison on the most popular payment instruments that share the same status: cards, checks, credit transfers[11] and direct debits.

The global market for these non-cash payments has grown steadily over the past decade. In 2011, global volume grew 8.8% year-over-year to reach 306 billion transactions. Card services accounted for nearly 60% of the market, averaging compounded growth of 12% between 2007 and 2011. On the other end of the spectrum, check usage averaged a 7% decline per year over the same period and saw usage fall to just 10% of the market[12] (see Exhibit 2).

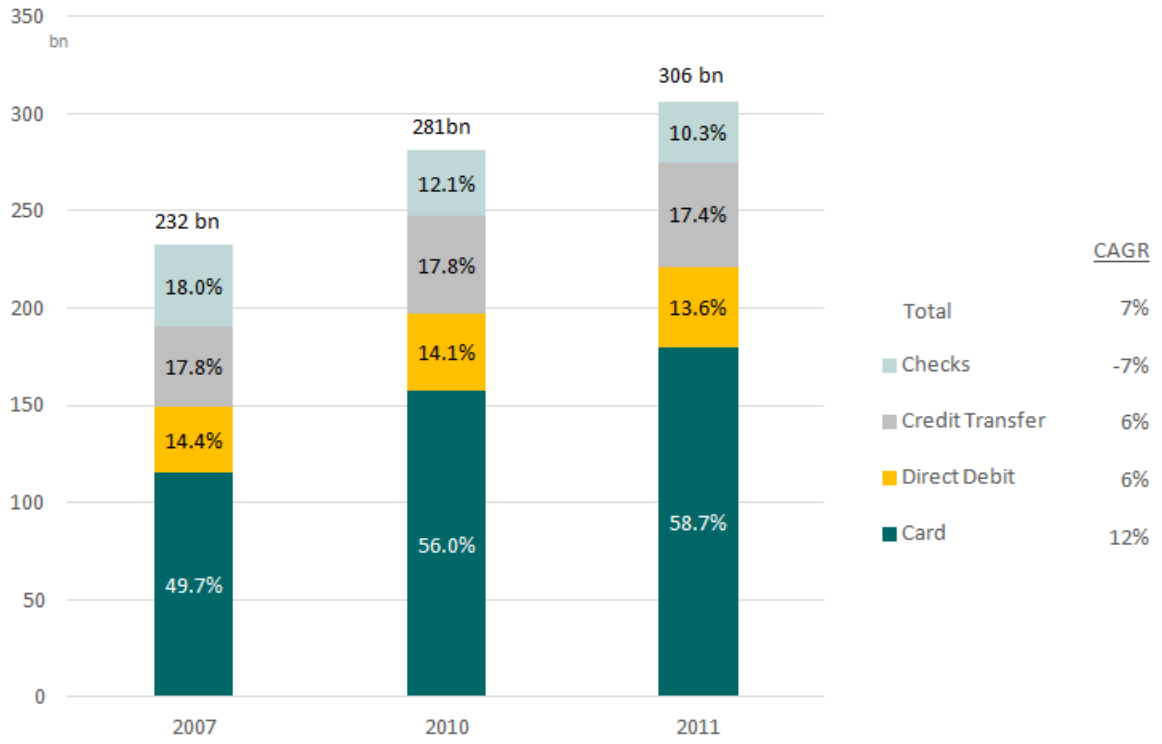


Exhibit 2. Global Payment Volume Growth by Payment Option in 2007, 2010, 2011
Source: Capgemini's 2013 *World Payments Report*

The success of card services is the best indication of current consumer and merchant preferences for non-cash payment. We believe these preferences also favor cryptocurrencies, so we need to understand the card services industry before we analyze the potential of the Bitcoin technology.

[11] Refers to electronic wire transfers.

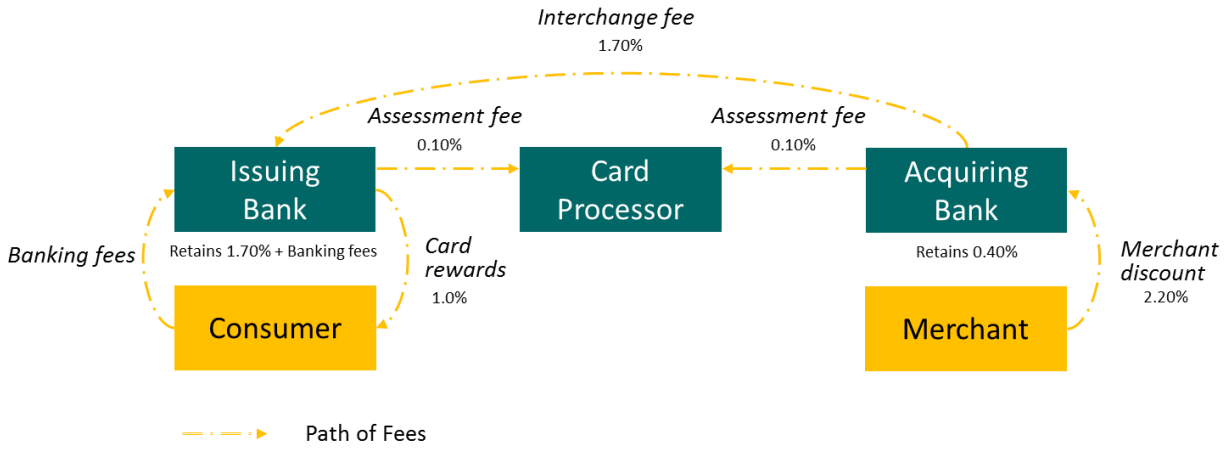
[12] Bansal, Aneet , Heather McKenzie, and Sonel Jakhar. "World Payments Report 2013." *Capgemini Worldwide*. Version 9. CapGemini, The Royal Bank of Scotland (RBS), n.d. Web. 7 Aug. 2014. <http://www.capgemini.com/resource-file-access/resource/pdf/wpr_2013.pdf>.

Card transactions typically involve three intermediaries, each with a specific responsibility in upholding the network:[13]

- Consumer's bank (known as the issuing bank)
- Card processor
- Merchant's bank (known as the acquiring bank)

Card processors such as Visa and MasterCard validate the transaction while the banks store and transfer the funds. This arrangement creates a system of checks and balances that promotes acceptance of the bank's card for consumers and merchants. It also reduces bank-to-bank inefficiencies by standardizing communication channels and associated fees.

[13] "A Practical Guide to Reducing Merchant Payment Card Processing Costs." *http://thecre.com/pdf/CRE%20Transaction%20Processing%20Cost%20Reduction%20Paper.pdf*. The Center for Regulatory Effectiveness, n.d. Web. 5 Sept. 2014. <http://thecre.com/pdf/CRE%20Transaction%20Processing%20Cost%20Reduction%20Paper.pdf>.



Assessment Fee: A fee paid by banks to the card processor to assess the integrity of the transaction.

Interchange Fee: A fee paid by the acquiring bank to the issuing bank for every transaction. These fees are standardized to avoid bilateral negotiations and to promote the acceptance of cards by merchants.

Merchant Discount: A fee charged by the acquiring bank to pass on the assessment and interchange fees to the merchant. The acquiring bank also charges additional fees based on the risk of the merchant's business.

Card Rewards: Usually part of a loyalty program that incentivizes use of the issuing bank's card.[14]

Exhibit 3: Summary of Visa and MasterCard
Source: Federal Reserve Board, Kellogg School of Management Case

There are variations to this model whereby the card processor also acts as the acquiring bank. With a network such as American Express, the card processor has more control over the fee structure, allowing them to charge higher fees and offer differentiated benefits to consumers and merchants.[15] However, the market heavily favors the model employed by Visa and MasterCard, as they process 87% of card transactions.[16]

[14] The CRE, Ibid.

[15] Prager, Robin A. , Mark D. Manuszak, Elizabeth K. Kiser, and Ron Berzekowski. "Interchange Fees and Payment Card Networks: Economics, Industry Developments, and Policy Issues."*http://www.federalreserve.gov/pubs/feds/2009/200923/200923pap.pdf*. The Federal Reserve, 13 May 2009. Web. 5 Sept. 2014. <http://www.federalreserve.gov/pubs/feds/2009/200923/200923pap.pdf>.

[16] Nilson Market Share Data

While the benefits provided by card networks to consumers and merchants are not to be understated, they come with unevenly distributed costs. We can see from the diagram (Exhibit 3) that this network is very consumer-centric. The issuing bank captures most of the profit and shares it with the consumer through card rewards while the merchant bears the majority of the transaction cost. Issuing banks are highly incentivized to provide attractive rewards because they must differentiate themselves to compete for customers. For example, American Express spent approximately 56% of its revenues or $6.8 billion on marketing and member rewards in 2013.[17] While consumers typically have access to many different cards, they tend to favor using one card for most of their purchases.[18] In our analysis of the benefits provided by cryptocurrencies in Chapter 3, we discuss areas of potential improvement including more even distribution of costs between consumers and merchants.

In performing this assessment of card services and cryptocurrencies we sought to analyze consumer and merchant preferences for a variety of different types of potential transactions. For the sake of expediency and reference we have developed two main dimensions to differentiate transactions – proximity and size.

The first dimension, proximity, refers to the distance between the two parties of the transaction. In this day and age the two main ways we conduct a transaction are face-to-face and over the internet. Due to the significant currency and banking complications associated with international transactions we have broken out international online transactions to highlight some of the benefits Bitcoins offer in this area of the market.

Transaction Proximity:

1. Face-to-Face: Brick-and-mortar purchases
2. Remote: Online purchases
3. Remote and International: Online cross-border purchases

The other key dimension was payment size. We have broken out extremely small and large transactions to allow us to focus on some of the unique qualities associated with these types of transactions.

[17] "Annual Reports." Investor Relations. American Express Company, n.d. Web. 20 Aug. 2014. <http://ir.americanexpress.com/FinancialDocs.aspx?iid=102700>.

[18] Prager, Ibid.

Payment Size:

1. Small ("micropayments"):[19] < $10 (e.g., convenience stores, digital content)
2. Mid-Size: Majority of transactions conducted, including those in consumer staple sectors (e.g., groceries, basic apparel, household products) and consumer discretionary sectors (e.g., lodging, leisure, luxury apparel)
3. Large: > $ 1,000 (e.g., major appliances, automobiles, rent, mortgage payments)

We also establish some of the key goals of an ideal transaction to evaluate the effectiveness of cryptocurrencies with consideration of the dimensions above. Specifically, we compare Bitcoin to "status quo" payment systems to analyze how cryptocurrencies can facilitate commerce between consumers and merchants more efficiently through the following goals:

a. *Low Cost*: Minimize fees paid by consumers and merchants
b. *Fast Execution*: Reduce the time necessary to send and receive funds
c. *Strong Theft Protection*: Provide protection from outside threats
d. *Easy Resolution of Transaction Disputes*: Handle consumer and merchant disputes within the system
e. *Minimal Infrastructure*: Provide convenient access to the payment instrument

Chapter 3. Benefits of Cryptocurrencies

Cryptocurrencies bring new features to the global payments industry. This chapter demonstrates the benefits of these features and compares them to those offered by existing systems — in particular, the cost savings, quick transfer, identity theft protection, and expansion opportunity attributed to the disintermediation of traditional financial institutions.

3.1. Low Cost

3.1.1. Transaction

When deciding which payment instruments to accept, merchants analyze the tradeoff between customer transaction volume and profit margins. Merchants are less likely to accept card payments when the transaction amount is small or large because fixed per-transaction fees can often exceed the value of small transactions and large nominal fees can be detrimental to the bottom line. Cryptocurrencies such as Bitcoin simplify that analysis by providing a consistent and competitive

[19] "What are micropayments?." *PayPal*. N.p., n.d. Web. 5 Sept. 2014. <https://www.paypal.com/us/webapps/helpcenter/helphub/article/?solutionId=FAQ664&topicID=&m=ARA>.

cost structure regardless of transaction size. Merchants pay virtually zero fees for accepting Bitcoins, enabling them to increase their margins without alienating consumers.

However, merchants have few opportunities to spend the Bitcoins they earn due to the current lack of adoption. Therefore, many merchants use exchange vendors such as BitPay and Coinbase to convert them into fiat currency. Although both provide merchant implementation solutions for free, Coinbase charges up to 1% for a conversion into fiat currency.[20]

Nonetheless, Bitcoins offer merchants significant cost savings. In 2013, U.S. merchants paid $71 billion in fees to accept $4.7 trillion in card purchases. The weighted average percentage fee ranged from a low of 0.68% for PIN debit[21] to a high of 2.37% for American Express. With the more expensive credit card options capturing 40.2% of the market and charging fees upwards of 2.1%, there is still room for Bitcoin to undercut the competition even if merchants need to pay small exchange fees to convert back to fiat currency.[22]

Small businesses in particular stand to benefit from a more favorable cost structure. Before the passage of Dodd-Frank in 2010, small businesses in the United States were not allowed to set minimums for credit and debit card purchases per their agreement with card processors.[23] Although the now familiar $10 minimum signs in front of stores help protect against less profitable transactions, small merchants still face considerable disadvantages compared to their larger counterparts.

Exhibit 4 highlights the expense disparity between small and large merchants under the current card services system. In this graph, not only do we see that smaller merchants, on average, pay more per transaction, but also that the gap has widened between 2004 and 2012. Two key factors skew this distribution: (1) there are economies of scale with large transaction volumes and (2) smaller merchants have less clout with rate negotiations. Armed with scale, large merchants can negotiate far more favorable discounts with acquiring banks than their smaller counterparts,[24] Because there are no traditional financial institutions involved in Bitcoin transactions, merchants are put on a more level playing field.

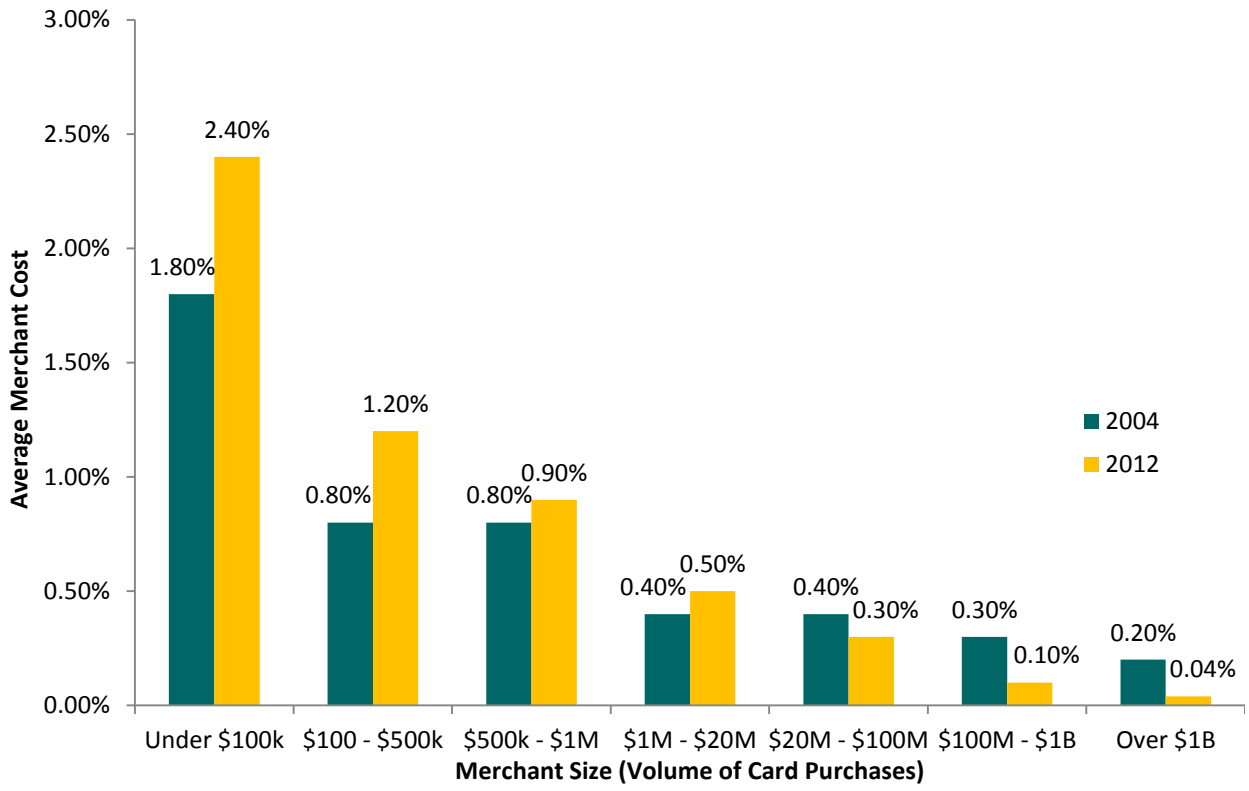
[20]"Coinbase." *Pricing*. N.p., n.d. Web. 5 Sept. 2014. <https://coinbase.com/docs/merchant_tools/pricing>.

[21] A debit card transaction that uses a personal identification number for authorization. The transaction is routed through the PIN Debit network instead of Visa or Mastercard and often carries lower fees. "PIN debit vs. Signature Debit Cost Calculator." *Credit Card Processing Insider*. N.p., n.d. Web. 18 Sept. 2014. <http://www.cardfellow.com/blog/pin-debit-vs-signature-debit/>

[22] Robertson, David. "The Nilson Report." *The Nilson Report* [Carpinteria] 30 May 2014, Issue 1041 ed.: 1-2. Print.

[23] Dwyer, Ben. "Minimum Credit Card Charge & Durbin Amendment." *Credit Card Processing Insider*. N.p., n.d. Web. 20 Oct. 2014. <http://www.cardfellow.com/blog/minimum-charge-credit-card-purchase/>.

[24] The CRE, Ibid.



$$Average\ Merchant\ Cost\ = \frac{Merchant\ Cost}{Sales\ Volume}$$

Exhibit 4. Cost by Merchant Size
Source: First Annapolis Consulting[25]

Because of high transaction costs, some merchants choose not to accept cards at all. According to estimates by Intuit, a financial software firm, 55% of small businesses in the U.S. accept cash only. This tradeoff prevents 15 million small businesses from capitalizing on $100 billion in revenue that goes to competitors accepting cards.[26] Bitcoin can help remedy this competitive disadvantage by allowing small businesses to cater to all consumers and capture new sales opportunities.

Consumers can also achieve material savings on banking fees related to overdraft and ATMs

[25] Wimsett, Tom. "Payment Card Acceptance What You and Your Clients Should Know."*http://www.asapnet.org/files/January2014/Presentations/ASAPJan14_Presentations05_Wimsett1.pdf*. American Society for Automation in Pharmacy, 16 Jan. 2014. Web. 8 Sept. 2014. <http://www.asapnet.org/files/January2014/Presentations/ASAPJan14_Presentations05_Wimsett1.pdf>.

[26] Maggie Overfelt, "Cash-only business owners risk $100 billion mistake." *CNBC*, Nov 12, 2013. <http://www.cnbc.com/id/101187512#>.

through Bitcoins. Similar to a physical wallet containing cash, Bitcoin wallets will only allow users to spend what is available. For the year ended June 2012, consumer overdraft fees in the U.S. were estimated to be $32 billion.[27] For Bank of America, the largest issuer of debit cards in the U.S., overdraft fees made up almost 16% of its $46 billion in non-interest income, 3% more than its revenue from card services.[28] Moreover, Americans spend $8 billion every year to withdraw cash from ATMs outside of their banks' networks.[29]

3.1.2. Chargebacks

Chargebacks represent another avenue of savings for merchants. Given the lack of a third-party administrator, transferred Bitcoins cannot be forcibly returned. In contrast, current consumer protection laws require payment systems with an intermediary to issue a chargeback to merchants when a fraudulent transaction is reported (see Chapter 4.1.2-2). A chargeback cycle in card services, which involves the issuing bank, the acquiring bank and a card processor such as Visa (if necessary) can be lengthy and expensive,[30] especially when merchandise cannot be recovered.

In order to ensure that the consumer's bank is properly paid when a chargeback is processed, the merchant's bank guarantees financial responsibility but charges the merchant $50~100 per chargeback for taking on that risk.[31] Bitcoin transactions can help reduce this cost for merchants by eliminating chargeback risk. Additionally, if the option to dispute a transaction is required, innovations enabling multi-signature transactions could help make it cheaper for merchants by passing some of the cost to consumers (see 4.1.2).

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[27] CFPB. "CFPB Study of Overdraft Programs." http://files.consumerfinance.gov/f/201306_cfpb_whitepaper_overdraft-practices.pdf. Consumer Financial Protection Bureau, n.d. Web. 5 Sept. 2013. <http://files.consumerfinance.gov/f/201306_cfpb_whitepaper_overdraft-practices.pdf>.

[28] "Bank of America Corporation 2013 Annual Report." http://media.corporate-ir.net/media_files/IROL/71/71595/AR2013.pdf. Bank of America, 14 Mar. 2014. Web. 5 Sept. 2014. <http://media.corporate-ir.net/media_files/IROL/71/71595/AR2013.pdf>.

[29] Chakravorti, Bhashkar, and Benjamin D. Mazzotta. "The Cost of Cash in the United States."http://fletcher.tufts.edu/CostofCash/~/media/Fletcher/Microsites/Cost%20of%20Cash/CostofCashStudyFinal.pdf. The Fletcher School Tufts University, n.d. Web. 5 Sept. 2014. <http://fletcher.tufts.edu/CostofCash/~/media/Fletcher/Microsites/Cost%20of%20Cash/CostofCashStudyFinal.pdf>.

[30] Disputes must be resolved between 40 and 180 days from the date of transaction.

Schamotta, Justin. "How to get cash back from chargeback." *Choose.net*, June 17, 2014, <http://www.choose.net/money/guide/features/chargeback-visa-mastercard.html>.

[31] "Understanding Chargebacks." : A Guide to Chargebacks for Online Merchants. N.p., n.d. Web. 5 Sept. 2014. <https://www.dalpay.com/en/support/chargebacks.html>.

3.2. Fast Transfers

Another aspect of transactions that is important to merchants is the speed at which they receive their funds. Quick transfer of funds can result in less financial risk, particularly with transactions involving goods that cannot be returned. Face-to-face transactions with cash guarantee the lowest risk because they are fast, free, and permanent.

However, with non-cash payments, faster transfers often incorporate higher costs. Merchants accepting digital payment options such as cards and direct debit have to wait one to two days before receiving their funds.[32] Checks require even longer wait times, although innovations in remote image depositing have sped up this process by eliminating a trip to a bank or ATM.[33] The quickest domestic payment option, the credit transfer, can complete a transaction in less than ten minutes, as transferred funds are immediately cleared upon receipt.[34] However, they require hefty one-time fees that discourage merchants unless the payment size is very large or the consumer is overseas. International payments can take one to two days and entail even higher fees.[35]

Bitcoin again simplifies this tradeoff for merchants and consumers by transferring funds instantly at zero cost. Computers in the Bitcoin network receive notification of a transaction immediately after it occurs and complete the first verification on average within 10 minutes. Several confirmations are required to ensure a transaction is irreversible. Transactions through Coinbase wallets require at least six confirmations (60 minutes) before the company recognizes them as permanent.[36] Bitcoin essentially operates at the speed of credit transfers but at a much lower cost, enabling its use for all transactions regardless of distance or payment size.

It is important to note, however, that this timeframe only applies if merchants keep their funds in Bitcoins. As previously mentioned, current opportunities for merchants to spend Bitcoins are limited, so conversion to fiat currency may be more useful. Conversion and deposit into the

[32] "How a visa Transaction Works." *Visa*, 2014, <http://usa.visa.com/merchants/become-a-merchant/how-a-visa-transaction-works.jsp>.

[33] "CheckImage Central." *CheckImage Central*. Electronic Check Clearing House Organization. Web. 1 Nov. 2014. <http://www.checkimagecentral.org/>.

[34] Marquit, Miranda. "Difference Between Wire Transfer and ACH." *Deposit Accounts*. N.p., n.d. Web. 5 Sept. 2014. <https://www.depositaccounts.com/blog/difference-between-wire-transfer-and-ach.html>.

[35] Deposit Accounts, Ibid.

[36] "Why Is My Bitcoin Transfer "Pending..." Coinbase. Web. 1 Nov. 2014. <https://support.coinbase.com/customer/portal/articles/593836-why-does-my-transaction-show-pending->.

merchant's account takes an additional two to three days,[37] which can limit the usefulness of Bitcoin's instantaneity. We discuss the exchange process in more detail in Chapter 4.

3.3. Identity Theft Protection

Security is another area where Bitcoin can offer improvements over the current system. Despite recent advances in cyber security, software loopholes such as Heartbleed[38] continue to plague the Internet, putting millions of people's financial information at risk. In 2007, clothing retailer TJ MAXX suffered a similar attack that compromised 45.7 million credit and debit card numbers. In addition, 450,000 Social Security and driver's license numbers were stolen because TJ MAXX maintained their own credit card system.[39] In 2013, Target was a victim of one of the largest cyber-attacks in history. Cyber criminals stole up to 70 million credit and debit card numbers, triggering costs of $202.6 million.[40] Even as merchants in the U.S. spend an estimated average of $11.6 million on security every year, these attacks are unpredictable and very costly to fix.[41] In 2012, global losses due to card fraud totaled $11.3 billion.[42]

Vulnerabilities are not limited to merchants storing financial information. Current payment systems attract cyber criminals because sensitive financial information is required in order for transactions to be processed. By transferring and storing large amounts of card information in a central server, merchants and banks can be fully exposed to cyber criminals. This was the case in August 2014 when attackers breached JPMorgan Chase's servers, compromising personal information from 83 million households and 8 million companies.[43] Although the financial impact was low, this breach uncovered new areas at risk and highlighted the need to improve current

[37] "Coinbase." *Merchants* -. N.p., n.d. Web. 15 Sept. 2014. <https://coinbase.com/merchants>.

[38] A recent exploit discovered in common internet encryption systems that could have potentially leaked everyone's credit card, bank account, and other financially sensitive information.

[39] Joseph Pereira, "How Credit-Card Data Went Out Wireless Door." *Wall Street Journal*, May 4, 2007, <http://online.wsj.com/news/articles/SB117824446226991797?mg=reno64-wsj&url=http%3A%2F%2Fonline.wsj.com%2Farticle%2FSB117824446226991797.html>.

[40] Tom Crosson, "Cost of Target Data Breach Exceeds $200 Million". *Consumer Bankers Association*, February 18, 2014, <http://www.cbanet.org/News%20and%20Media/Press%20Releases%202014/02182014_pressrelease.asp>.

[41] "2013 Cost of Cyber Crime Study: United States." *Ponemon Institute*, October 2013, <http://media.scmagazine.com/documents/54/2013_us_ccc_report_final_6-1_13455.pdf>

[42]"Nilson_Global_Card_Fraud_2013August.jpg."http://www.nilsonreport.com/upload/Nilson_Global_Card_Fraud_2013August.jpg. The Nilson Report, n.d. Web. 5 Sept. 2014. <http://www.nilsonreport.com/upload/Nilson_Global_Card_Fraud_2013August.jpg>.

[43] Levin, Adam. "The Real JPMorgan Data Breach Danger Is Still on Its Way."ABC News. ABC News Network, n.d. Web. 20 Oct. 2014.

security measures. If a merchant's server is compromised, it can reveal millions of users' account information. Checks suffer from the same vulnerability because consumer account numbers, routing numbers, and identities can potentially be compromised and used to steal from their respective accounts. Essentially, every non-cash transaction has the potential to expose the consumer to fraud.

Bitcoin transactions still require authorization credentials, but they are anonymized and not transferred to, nor stored with, the merchant. This relieves the merchant from having to secure the private keys[44] and other financial information. Because there is not enough information available for a criminal to take control of Bitcoin wallets, criminals are disincentivized to attack merchants.

3.4. Minimal Infrastructure

Bitcoin offers a highly accessible payment option for consumers and merchants all over the world by requiring only a telecommunications device. A merchant wanting to accept credit cards must negotiate with an acquiring bank and then purchase expensive point-of-sale equipment. Recent innovators such as Square, Inc. have targeted small businesses by bundling the backend banking and payment processing services into the flat rate of 2.75%.[45] They also provide businesses with a simple and inexpensive card reader that attaches to mobile devices to create an on-the-fly point-of-sale system. While these services have streamlined the process of accepting credit cards, they are not without their own set of issues and costs. Setting up with Bitcoin is just as simple, if not more so, and removes the traditional backend services altogether. Current Bitcoin vendors such as BitPay offer merchants free solutions to start accepting Bitcoins for face-to-face and online transactions.[46]

The relatively minimal infrastructure required by Bitcoin also enables the medium to target the "unbanked," people who rely strictly on cash transactions because they do not have access to a traditional banking system. In developed countries, people who live in poverty or who just do not trust banks usually fall into this category. In developing countries, banking infrastructure may not exist. Prepaid cards are currently one of the only payment options available for these populations. They piggyback off existing card infrastructure but do not require consumers to interact with a bank. However, these services are still expensive compared to Bitcoins because they require

[44] Alphanumeric credentials that provide access to Bitcoins. See Appendix I.

[45] "Free Credit Card Reader | Square Reader." *Square*. N.p., n.d. Web. 5 Sept. 2014. <https://squareup.com/reader>.

[46] "Unlimited payment processing, free forever." *Pricing*. N.p., n.d. Web. 5 Sept. 2014. <https://bitpay.com/pricing>.

consumers to pay a monthly, per transaction, or money transfer fee. A study in the U.S. showed that prepaid cards can cost consumers on average of around $300 annually.[47]

Exhibit 5 shows a significant gap in banking relationships between people in high-income economies and low-income economies. In high-income economies, 89% of adults report that they have an account with a formal financial institution while this figure is only 41% in low-income economies. The percent of account holders having a credit card is also higher in high-income economies.[48]

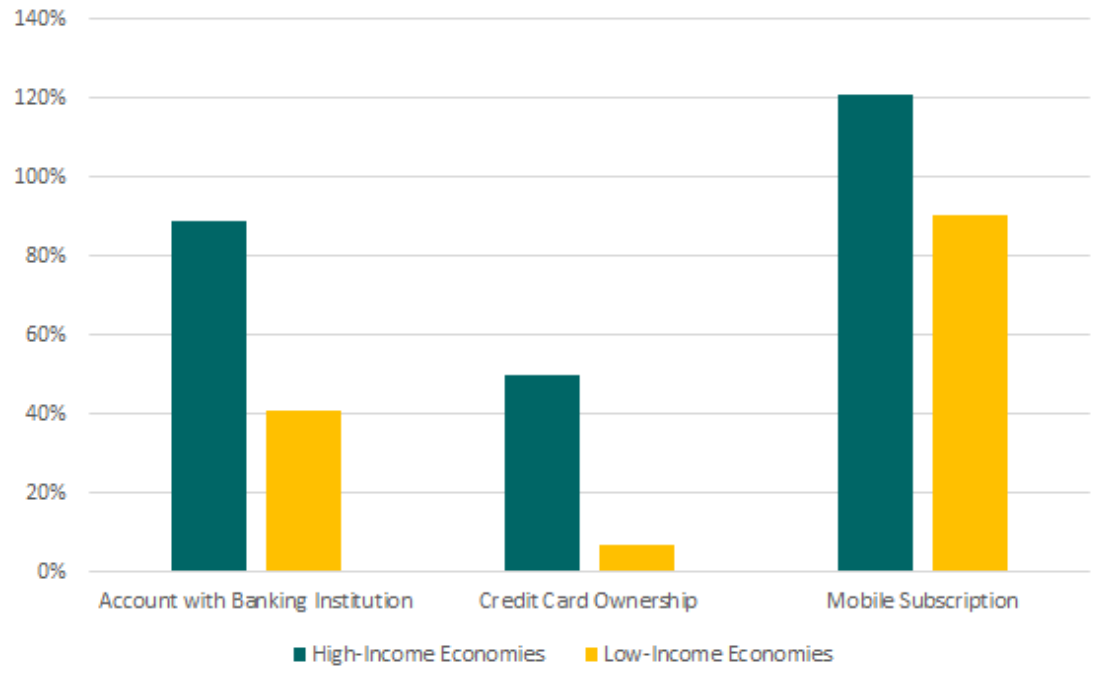

Exhibit 5. Financial Infrastructure: High- vs Low-Income Economies
Source: World Bank

The availability of financial infrastructure influences this gap in banking relationships as people in high income economies have more access to their banks. Compared to poorer parts of the world, developed countries have over 20 times more ATMs per capita.[49] Government-supported infrastructure development in low income economies will be needed to increase the reach of

[47] Sekar, Anisha. "NerdWallet Study: Average Prepaid Debit Card Can Cost Over $300 a Year - NerdWallet." *NerdWallet Credit Card Blog*. Nerdwallet, 25 Jan. 2012. Web. 24 Feb. 2015.
[48] "Measuring Financial Inclusion." World Bank. N.p., n.d. Web. 2 Sept. 2014. <http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2012/04/19/000158349_20120419083611/Rendered/PDF/WPS6025.pdf>

[49] "Automated teller machines (ATMs) (per 100,000 adults)." *Data*. N.p., n.d. Web. 5 Sept. 2014. <http://data.worldbank.org/indicator/FB.ATM.TOTL.P5>.

current payment options. This process is usually slow and expensive for these countries to undertake.[50]

In contrast, Bitcoins have the potential to reach the two and a half billion unbanked adults in the world through exchanges that do not require users to link a bank account.[51] One such exchange, Expresscoin, allows for alternative payment options including money orders, wire transfers, and cash deposits to buy Bitcoins.[52] Although it takes extra time and cost to complete the exchange, this option allows the unbanked to access the benefits of Bitcoins as a payment option when access to a traditional processing infrastructure is not available.

As mobile payment becomes a more viable option, mobile phones can also substitute for expensive fixed infrastructure. The startup, 37Coins, has created a universal Bitcoin wallet that enables payment from any mobile phone with a text messaging functionality. Anyone can set up a 37Coins wallet at the company's website, but those lacking web access can have a hosted wallet automatically created for them once a small amount of Bitcoin is sent to their mobile phone number. Bitcoins are sent by texting a command, an amount denominated in fiat currency or Bitcoin, and the receiver's phone number, to the wallet gateway.[53]

The 95.5% global mobile phone penetration rate suggests promise for this channel to reach the unbanked. Low-income economies only lag moderately behind at 90% penetration.[54] Indeed, the recent introduction of mobile money in Sub-Saharan Africa has been relatively successful, where 16% of adults and 31% of those with a bank account report having used a mobile money system in the past 12 months.[55] Because Bitcoin only requires a similar mobile connection, there is the potential for Bitcoins to reach the unbanked more quickly than other payment options.

[50] Capgemini, Ibid.

[51] *World Bank*, Ibid.

[52] Rizzo, Pete, "Expresscoin Launches to Become Coinbase for the Unbanked." *CoinDesk*, June 11, 2014, <http://www.coindesk.com/expresscoin-launches-become-coinbase-unbanked/>.

[53] Daniel Cawrey, "37Coins Plans Worldwide Bitcoin Access With SMS-Based Wallet." *CoinDesk*, May 20, 2014, <http://www.coindesk.com/37coins-plans-worldwide-Bitcoin-access-sms-based-wallet/>.

[54] "Global mobile statistics 2014 Part A: Mobile subscribers; handset market share; mobile operators." *MobiThinking*, May 2014, <http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/a#subscribers>.

[55] World Bank, Ibid.

Chapter 4. Obstacles to Cryptocurrency Adoption

Cryptocurrencies explore a relatively new technological space that invites obstacles to adoption. Aside from the general lack of knowledge, inadequate regulatory guidance leaves many potential users uncertain. First, the pseudo-anonymous nature of cryptocurrency technology makes illicit activities such as drug trafficking and money-laundering difficult to detect. Secondly, users face risks associated with fraud, transaction disputes, and the safety of the system. This chapter discusses the current regulatory landscape and comments on how a solid framework can move cryptocurrencies forward as a payment option. Additionally, we address the price volatility of Bitcoins and the exchange risk users assume. We also examine the infrastructure being built to provide solutions to these problems.

4.1. Regulatory Framework

4.1.1. Federal Anti-Money Laundering and Taxation

In the United States, financial institutions are heavily regulated to enforce anti-money laundering requirements. Bitcoins have given users the ability to easily circumvent many of the mechanisms in place. In response, the U.S. Treasury's Financial Crimes Enforcement Network (FinCEN) has revised its definition of a "money transmitter" to include firms handling decentralized virtual currencies such as Bitcoins.[56] If the Bank Secrecy Act of 1970 is enforced for Bitcoin operators such as exchanges, firms will need to register with FinCEN and actively support U.S. government anti-money laundering efforts. This would include keeping detailed records of customers and filing reports with the agency on any suspicious activities.[57] Recent amendments under the USA PATRIOT Act of 2001 have made improvements to these guidelines, such as offering immunity for voluntary disclosures.[58]

By extending current regulations governing financial services to firms in the Bitcoin ecosystem, the government can help legitimize the virtual currency and encourage consumer and merchant adoption. This will require the U.S. Treasury to clarify its guidelines and express intent to actively enforce compliance.

However, in contrast to the U.S. Treasury, the IRS issued a statement in 2014 classifying convertible cryptocurrencies as property, essentially identifying all holders of Bitcoins as investors

[56] FIN-2013-G001, Ibid.

[57] "FinCEN's Mandate From Congress." *Bank Secrecy Act,* Aug 29, 2014. <http://www.fincen.gov/statutes_regs/bsa/>.

[58] "USA PATRIOT Act." *USA Patriot Act*. N.p., n.d. Web. 5 Sept. 2014. <http://www.fincen.gov/statutes_regs/patriot/>.

regardless of the user's intent.[59] When a consumer "trades" her Bitcoins for goods or services, she generates a capital gain or loss. If the value of the goods or services exceeds the cost at which she acquired the Bitcoins, she must accrue a tax liability. If the difference is negative, she can deduct the loss. However, capital loss tax deductions are capped by the usual $3,000 annual limit while upside tax liability has no limit or a *de minimis* exception.[60]

Paying capital gains tax on everyday cryptocurrency transactions can be a burden for users. In order to pay the tax, users not only have to record the cost basis of the Bitcoins, but also analyze each Bitcoin transaction for possible tax liabilities or savings. Even though software can be implemented by Bitcoin service providers to keep track of transactions and report them to the IRS, it still represents a major inconvenience that introduces additional costs to the system. This ruling can also deter the use of Bitcoins for future payments as users exposed to exchange risk now have to deal with the tax implications.[61] Further revision to the tax code will be required to streamline this process if consumers and merchants are to adopt cryptocurrencies for everyday purchases.

4.1.2. Consumer Protection

While clear and comprehensive federal oversight is lacking, states have attempted to regulate decentralized currencies. In July 2014, the New York Department of Financial Services proposed a license requirement for all non-merchant businesses that handle Bitcoins.[62] The so-called "BitLicense" closely resembles banking regulations designed to promote transparency and financial stability. If enacted, this law would require Bitcoin businesses operating in New York to disclose risks in their advertised products and maintain capital requirements to ensure continuity. While opponents of the mandate claim that it will stifle innovation by introducing high barriers to new startups,[63] such regulations seek to mitigate risk for Bitcoin users.

Consumers trust card services because they are heavily regulated to minimize financial risk. Funds used to make payments are stored by banks, and insured by the Federal Deposit Insurance

[59] Aqui, Keith A. . "CC:PA:LPD:PR (Notice 2014-21) ." *http://www.irs.gov/pub/irs-drop/n-14-21.pdf*. Internal Revenue Service, n.d. Web. 5 Sept. 2014. <http://www.irs.gov/pub/irs-drop/n-14-21.pdf>.

[60] "Ten Important Facts About Capital Gains and Losses." *Ten Important Facts About Capital Gains and Losses*. N.p., n.d. Web. 5 Sept. 2014. <http://www.irs.gov/uac/Ten-Important-Facts-About-Capital-Gains-and-Losses>.

[61] Park, Lawrence. "Bitcoin's Futile Quest to Be a Currency." *The Wall Street Journal*. Dow Jones & Company, n.d. Web. 5 Sept. 2014. <http://online.wsj.com/articles/lawrence-parks-Bitcoins-futile-quest-to-be-a-currency-1401661605>.

[62] "New York Reveals BitLicense Framework for Bitcoin Businesses." *CoinDesk RSS*. N.p., n.d. Web. 5 Sept. 2014. <http://www.coindesk.com/new-york-reveals-bitlicense-framework-Bitcoin-businesses/>.

[63] CoinDesk, Ibid.

Corporation (FDIC) to protect consumers from bank failure.[64] Consumers are also protected by laws such as the Electronic Fund Transfer Act (EFT) and the Fair and Accurate Credit Transactions Act (FACTA). EFT limits the financial liability of consumers when they report lost or stolen cards to their institutions, and FACTA helps reduce the impact of fraud on consumers' credit by governing how credit ratings are reported.[65] The Consumer Financial Protection Bureau (CFPB) created in 2011 from the Dodd-Frank Act oversees and enforces these laws in the financial sector.[66] Although the agency has just started to accept complaints surrounding Bitcoin transactions, comprehensive oversight will require the Financial Stability Oversight Council (FSOC) to designate Bitcoins as posing significant risk to the overall financial system. However, given the current size of the cryptocurrency market compared to the financial market, such a ruling in the near term seems to be unlikely.[67] Beyond the consumer protections mandated by the government, credit card providers such as American Express offer additional consumer protection benefits, such as extended warranties for certain transactions.[68]

4.1.2-1. Theft and Security of Systems

An extension of the regulations governing cards to the virtual currency economy would inject much needed assurance to users. Bitcoin transactions suffer from many of the same vulnerabilities as current payment instruments, but they lack the financial security provided by regulation. For example, one of the ways a thief can compromise a consumer's card number is either through sophisticated keyloggers or by simply looking over her shoulder. Similarly, Bitcoins can be stolen by compromising the private keys from the user end of the transaction with malicious software. However, consumer liability in Bitcoin thefts is not limited by law as it is with cards. Once a thief gains access, or if the consumer simply forgets her credentials, those Bitcoins cannot be recovered.

Security breaches similar to those in the current financial system also exist within the Bitcoin

[64] The depositor's accounts up to $250,000 are insured by FDIC "When a Bank Fails - Facts for Depositors, Creditors, and Borrowers." *FDIC*, <https://www.fdic.gov/consumers/banking/facts/>.

[65] "Virtual Currency: Risks and Regulation." *The Clearing House, Independent Community Bankers of America*, 23 June 2014. Web. 5 Sept. 2014, <https://www.theclearinghouse.org/~/media/Files/Research/20140623%20TCH%20%20ICBA%20Virtual%20Currency%20White%20Paper%20June%20%202014%20Revised.pdf>.

[66] "CFPB Consumer Laws and Regulations." *Electronic Funds Transfer Act*. N.p., n.d. Web. 5 Sept. 2014. <http://files.consumerfinance.gov/f/201310_cfpb_updated-regulation-e-examination-procedures_including-remittances.pdf>.

[67] The Clearing House, Ibid.

[68] "EXTENDED WARRANTY - SHOP WITH MORE CONFIDENCE." American Express – Extended Warranty. American Express, n.d. Web. 03 May 2015. <https://www.americanexpress.com/us/content/card-benefits/extended-warranty.html>.

economy. The infamous breach at Mt.Gox,[69] a Bitcoin exchange pioneer, highlights the problems with storing Bitcoins in unregulated institutions. Investigations pointed to malpractices and lack of internal controls as major factors in causing the exchange's meltdown. As a result, users suffered losses amounting to some $620 million with almost zero compensation.[70] This incident stresses the significance of regulations regarding consumer protection and efficient exchange operation, which might have prevented such losses.

Cold storage — storing Bitcoins offline in vaults — is currently a solution among leading Bitcoin companies to mitigate such breaches and protect consumer assets. Coinbase, the vendor of choice for many large merchants,[71] stores 97% of its Bitcoin authorization keys offline in locked vaults.[72] Because only 3% of the Bitcoins are in circulation, cold storage helps minimize potential losses in a cyber-security breach. Additionally, all traded Bitcoins through Coinbase are insured through coverage brokered by Aon,[73] one of the largest insurance brokers in the world, to offer consumers protection similar to traditional banking institutions.

4.1.2-2. Resolution of Disputes

Consumers also need an avenue to settle disputes with merchants. Under the Truth in Lending Act, credit card holders are granted transaction reversal rights that guarantee refunds when a dispute is settled in their favor. Merchants accepting Bitcoins do not have to deal with the costs associated with chargebacks as Bitcoin transactions cannot be reversed (see 3.1.2). However, consumers are less likely to use Bitcoins over others that offer more protection, one of the main reasons consumers often choose to use their credit cards instead of cash. Therefore, the lack of reversal rights can be a risk for the consumer and an obstacle for adopting cryptocurrencies.

However, innovations in multi-signature transactions that allow for escrow-like properties can help

[69] Mt.Gox representatives claimed they were victims of a fraud in which Bitcoins were compromised by hackers through a malleability bug in the exchange. The exploit allowed hackers to transfer Bitcoins into their wallets while creating the illusion that it had failed. Thus, Mt.Gox would resend Bitcoins thinking that the original transfer never took place, essentially allowing malicious users to gain access to more Bitcoins than they had owned. Total losses amounted to some 850,000 BTC, 750,000 BTC of which belonged to exchange users. At the then-trading price of $827, this amounted to a loss of $620 million.

[70] "The Troubling Holes in MtGox's Account of How It Lost $600 Million in Bitcoins | MIT Technology Review." *MIT Technology Review*. The Physics arXiv Blog, 4 Apr. 2014. Web. 17 Aug. 2014. <http://www.technologyreview.com/view/526161/the-troubling-holes-in-mtgoxs-account-of-how-it-lost-600-million-in-Bitcoins/>.

[71] "Coinbase." *Bitcoin Merchants* -. N.p., n.d. Web. 8 Sept. 2014. <https://coinbase.com/clients>.

[72] "Coinbase." *Bitcoin Wallet*. N.p., n.d. Web. 5 Sept. 2014. <https://coinbase.com/>.

[73] Hajdarbegovic, Nermin. "Coinbase Insured Against Theft or Loss of Bitcoin." CoinDesk RSS. CoinDesk, 28 Aug. 2014. Web. 5 Sept. 2014. <http://www.coindesk.com/coinbase-names-aon-Bitcoin-insurance-broker/>.

provide a higher level of consumer protection. Bitrated is a company organizing independent arbitrators in a reputation-based community to provide consumers and merchants access to escrow services. In multi-signature transactions, a consumer sends a payment to a layered address rather than to a merchant directly. Approval of a majority (usually two out of three) between the consumer, merchant, and if necessary, an arbitrator, is required to send the final payment from the address to the merchant. If there are no disputes, arbitrators are not involved at all, and the payment will be processed and distributed to the merchant without fees. In case of disputes, an arbitrator is paid a fee to resolve the dispute. If both the consumer and merchant disagree over the arbitrator's decision, the two can enter into an agreement to send the funds to another multi-signature address with a different arbitrator. The drawback, however, is that the consumer can conspire with the arbitrator to split the funds and leave the merchant with nothing. Such an occasion would require the arbitrator to risk its reputation and future business. Through this process, multi-signature technology can pave the way for consumers to have the same level of protection as with other digital payment instruments, although it requires additional time and cost.[74] However, this cost can be evenly distributed between the consumer and the merchant as opposed to merchants bearing all the cost under card services. Payment processors like BitPay have already integrated multi-signature technology directly into their payment platform, allowing Bitcoin wallets easy access to this service.[75]

4.1.3. International Cooperation

Even as the U.S. regulatory landscape becomes less fragmented, international cooperation will be essential for effective enforcement of Bitcoin regulations. Because cryptocurrencies can traverse borders without friction, users can escape the jurisdiction of one region by moving their capital to another. Just as policies on tax evasion and money laundering have become an international effort, regulations regarding cryptocurrencies can also be more efficient with global reach.[76] However, global consensus in classifying cryptocurrencies is still lacking. For example, the central bank in China has banned Bitcoins as a medium of exchange and outlawed commercial banks from holding them as reserves. Additionally, Russia has banned its citizens and businesses from using Bitcoins. By contrast, Finland regulates Bitcoins as a commodity.[77] Although the U.S. cannot regulate cryptocurrencies outside of its jurisdiction, concrete domestic policies can set a powerful precedent for other countries.

[74] Buterin, Vitalik. "Bitrated: You Can No Longer Say Bitcoin Has No Consumer Protection." *Bitcoin Magazine*, December 10, 2013, <http://Bitcoinmagazine.com/8834/bitrated-you-can-no-longer-say-Bitcoin-has-no-consumer-protection>.

[75] Macheel, Tanaya. "BitPay Releases Beta for Open-Source, Multi-Signature Bitcoin Wallet", *CoinDesk*, July 9, 2014, <http://www.coindesk.com/bitpay-open-source-multi-signature-Bitcoin-wallet/>.

[76] "Tax." *Australia G20 2014*. N.p., n.d. Web. 5 Sept. 2014. <https://www.g20.org/g20_priorities/g20_2014_agenda/tax>.

[77] The Clearing House, Ibid.

4.2. Price Volatility

While regulation can help bolster consumer confidence, the price volatility of Bitcoin remains a concern for users. As discussed in Chapter 1, Bitcoins are not considered legal tender nor denominated in fiat currency. Conversion at an exchange exposes the asset to risks that also affect equities and foreign currencies. As a result, merchants can face pricing difficulties and consumers are discouraged from spending Bitcoins.

In order to gauge the volatility of Bitcoins, Exhibit 6 annualizes the monthly standard deviation of daily price returns. Although the annualized monthly standard deviation is still high, the volatility has been on average, steadily decreasing by 1.76% each month, or 21.12% every year.

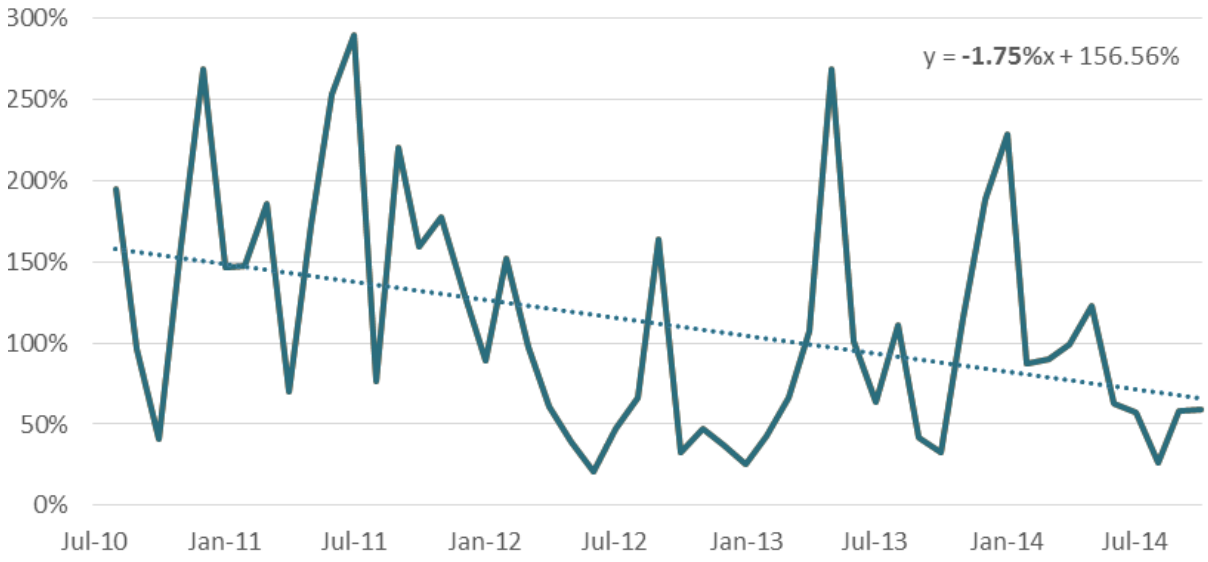

Exhibit 6. Annualized Monthly Price Volatility
Source: Coindesk BPI

Given that Bitcoin is relatively new and experiences low day-to-day trading volumes, high standard deviations in price change volatility should be expected. However, while Bitcoins have experienced high fluctuations in price, historically, much of the volatility can be attributed to upswings in price. Additionally, volatility associated with significant price drawdowns can be explained by major events distinct from any inherent flaws with Bitcoin. These events, such as the collapse of Mt.Gox represent human error and the growing pains of a nascent industry. Exhibit 7 highlights the most significant price drawdowns and the event corresponding with each decline.

Selected Drawdowns	Start	End	Duration (Days)	Decline
	December 4, 2013	December 7, 2013	3	-39.5%
	December 10, 2013	December 18, 2013	8	-47.2%
	January 6, 2014	March 2, 2014	55	-41.1%
	August 1, 2014	August 18, 2014	16	-22.6%

Exhibit 7. Bitcoin Price Index and Selected Price Drawdowns
Source: CoinDesk BPI

December 4, 2013 – December 7, 2013: China's Regulatory Stance
The first drawdown was caused by China's regulatory stance. The Chinese government banned banks from holding Bitcoins as reserves. Even though no news of a complete ban on lending to Bitcoin related companies was released, many feared that it would be the next logical step in China's Bitcoin crackdown. Fearing that their Bitcoins stored through these companies would become illiquid, users withdrew their assets causing a brief crash.[78]

December 10, 2013 – December 18, 2013: China's Regulation II
The second crash was caused by additional regulation from the Chinese government in an effort to prevent Bitcoins from being used. This time the government banned Bitcoins from being used in transactions for goods and services and banned third party payment processors from accepting them. This effectively barred all commercial Bitcoin transactions in the second largest Bitcoin

[78] "China's Central Bank Bans Some Bitcoin Transactions." *CNNMoney*. Cable News Network, 05 Dec. 2013. Web. 27 Oct. 2014.

market at the time, thus halting its expansion and ultimately causing the 8-day crash.[79] However, it is important to note that people in China can still hold Bitcoins and that China currently has the largest Bitcoin trading volume of any country.[80]

January 6, 2014 – March 2, 2014: Crash of Mt.Gox

The crash of Mt.Gox marked the first time a major Bitcoin exchange was compromised. From February 7 when Mt.Gox halted all Bitcoin withdrawals (presumably because many Bitcoins were missing) to February 28 when CEO Mark Karpeles filed for bankruptcy protection in Japan, prices on the exchange dropped from $577 to $135.[81] Although the price drop was not as extreme on other exchanges, it reflected the growing concern of unregulated Bitcoin institutions. However, despite Mt.Gox's insolvency, prices rebounded quickly as exemplified by other exchanges; on February 26, 2014 the cost to purchase a Bitcoin reached a high of $610 on BitStamp and $590 on BTC-E.[82]

August 1, 2014 – August 18, 2014: Bitcoin Flash Crash

According to quantitative research analyst Raffael Danielli, on August 14, 2014 a large sale of 500 BTC on Bitstamp in less than a minute pushed prices down to $525 per Bitcoin. As prices fell, traders who could not cover their margin began to liquidate their positions, creating a downward spiral in prices.[83] This outcome is not exclusive to the Bitcoin market. Even highly regulated equities markets are susceptible to such market forces. In the 2010 Flash Crash,[84] the Dow Jones Industrial Average dropped almost 1000 points and recovered nearly 600 points in under half an hour. High-frequency traders (HFTs) are suspected culprits of these crashes as unusually large algorithmic sell orders can trigger other automated sales. These sales, similar to those of the Bitcoin crash, create heavy downward momentum in the markets regardless of how well companies actually perform. This highlights yet another force unrelated to Bitcoin technology itself weighing on price volatility.

[79] "Bitcoin Crashes to $500 after Chinese Crackdown, but Dogecoin Is Going Strong." Digital Trends. N.p., n.d. Web. 27 Oct. 2014.

[80] Hajdarbegovic, Nermin. "Yuan Trades Now Make Up Over 70% of Bitcoin Volume." CoinDesk RSS. CoinDesk, 5 Sept. 2014. Web. 14 Nov. 2014. <http://www.coindesk.com/yuan-trades-now-make-70-Bitcoin-volume/>.

[81] "Mt. Gox (AUD)." Bitcoin Charts. Bitcoincharts.com. Web. 1 Nov. 2014.

[82] Bitcoin Charts. Bitcoincharts.com. Web. 1 Nov. 2014.

[83] Rizzo, Pete. "Did Margin Trading Crash the Price of Bitcoin?" CoinDesk RSS. CoinDesk, 15 Aug. 2014. Web. 28 Oct. 2014.

[84] "Findings Regarding the Market Events of May 6, 2010." *U.S. Securities and Exchange Commission*. U.S. Commodity Futures Trading Commission, U.S. Securities & Exchange Commission, 30 Sept. 2010. Web. 14 Nov. 2014. <http://www.sec.gov/news/studies/2010/marketevents-report.pdf>.

Merchants wishing to reduce volatility risk do have options. Payment processors and exchanges such as BitPay and Coinbase help merchants instantly convert their earned Bitcoins, at a predetermined rate, into fiat currency at the time of the transaction.[85] Ultimately, this protects merchants from losing money when the price of Bitcoins falls.

4.3. Increased competition from existing players

Competition with existing payment technologies, particularly mobile payments, can present a challenge to Bitcoin adoption. As shown in Exhibit 8, mobile payment (M-Payment) volume has grown 31% annually from 2009 to 2011[86] while electronic payment (E-Payment) volume has grown 12% annually over the same period. As E-Payment encompasses M-Payment, M-payment growth contributes to E-payment growth.

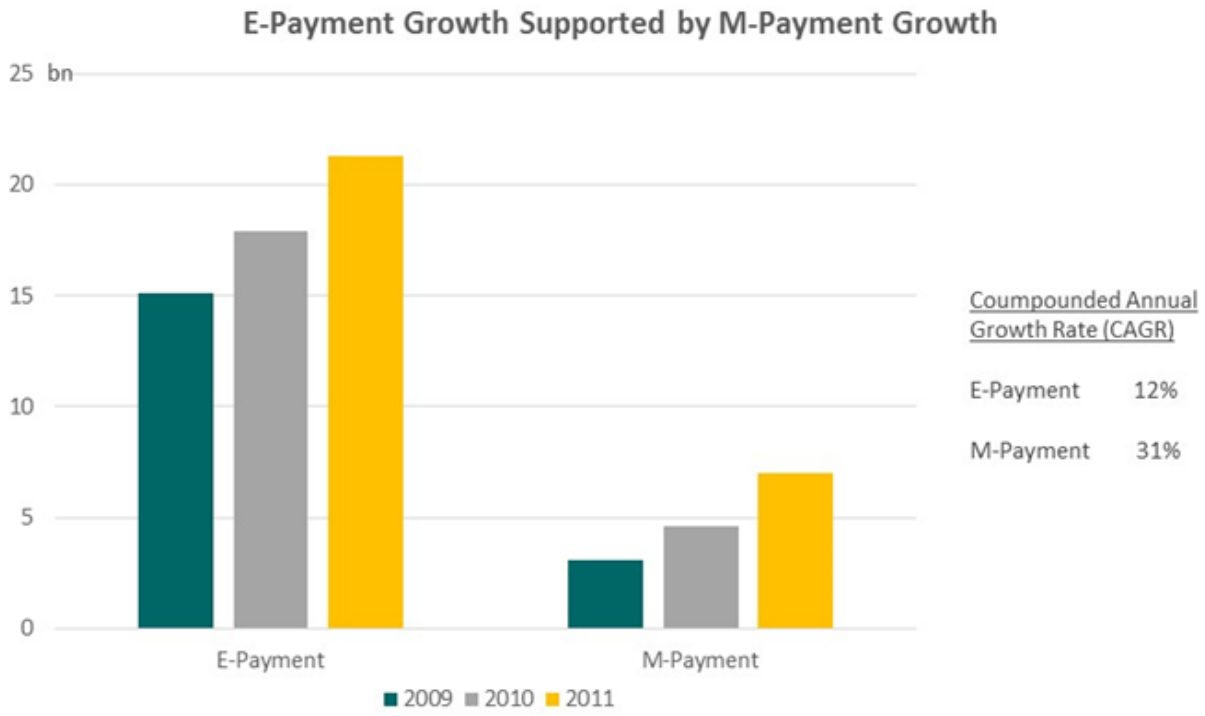

Exhibit 8. E-Payment Growth vs M-Payment Growth
Source: Capegemini

[85] Sardesai, Neil. "Bitcoin Payment Processor Bitpay Goes Free and Unlimited Forever." CryptoCoinsNews. N.p., 31 July 2014. Web. 5 Sept. 2014. <http://www.cryptocoinsnews.com/bitpay-goes-free-unlimited-forever/>.

[86] Capegemini, Ibid.

Mobile payment services, such as PayPal, Venmo,[87] Google Wallet,[88] and Apple Pay, offer convenient and cost effective options for consumers.[89] Their implementation of innovations such as Near Field Communication ("NFC") technology offers even more convenience for consumers. Users are able to make payments by simply tapping their phones against another compatible device or sensor. The global NFC market, valued at $1.07 billion in 2012, is expected to grow 43.7% annually from 2013 to 2019[90] as manufacturers include NFC features in more mobile phones. Since most of the existing tap-to-pay point-of-sale (POS) systems across the globe adhere to the NFC standard, the infrastructure is already in place for widespread adoption.[91]

In September 2014, Apple announced the inclusion of NFC technology to the new iPhone 6 as a component of Apple Pay. The new iPhone 6 will be capable of making fast, contactless payments. Credit card and debit card details along with airline boarding passes, movie tickets, and gift cards, will be stored on Passbook, an application that consolidates forms of mobile payment. They can then be used at any time simply by tapping the iPhone on a point-of-sale system.[92] Major card networks, including Visa, MasterCard, and American Express, as well as major banks such as Bank of America, CapitalOne, Chase, Wells Fargo and Citi, have all signed on to use Apple Pay. Users also can implement Apple Pay with their existing accounts, eliminating the need to create new accounts. Apple Pay can be used at more than 220,000 locations including Macy's, McDonald's, Bloomingdales, Disney, Nike, and Subway.[93] Moreover, Visa has developed its own Visa Token Service to support Apple Pay by giving users the ability to replace credit card account numbers with digital tokens. The tokens expire with each use, so the cardholder's actual card numbers are not shared with merchants nor can they be cloned and used for unauthorized purchases. Even if a user's iPhone is stolen, Apple Pay requires fingerprint authentication to activate and can be disabled remotely.[94]

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[87] "Fees & FAQ." *Venmo*, 2014, <https://venmo.com/info/fees>.

[88] "Fees, limits & transfer time." *Google*, 2014, <https://support.google.com/wallet/answer/3122600?hl=en>.

[89] Gerdes, Geoffrey R. , May X. Liu, Jason P. Berkenpas, Matthew C. Chen, Matthew C. Hayward, James M. McKee, Scott Dake, Patrick Dyer, Dave Brangaccio, and Nancy Donahue. "The 2013 Federal Reserve Payments Study."*http://www.frbservices.org/files/communications/pdf/general/2013_fed_res_paymt_study_detailed_rpt.pdf*. Federal Reserve System, n.d. Web. 5 Sept. 2014. <http://www.frbservices.org/files/communications/pdf/general/2013_fed_res_paymt_study_detailed_rpt.pdf>.

[90] "Research and Markets: Near Field Communication (NFC) Market - Global Industry Analysis 2013 - 2019." *Business Wire*, August 19, 2014, <http://www.sys-con.com/node/3152192>.

[91] Ibid.

[92] "iOS: Using Passbook." *Apple*. N.p., n.d. Web. 19 Sept. 2014. <http://support.apple.com/kb/HT5483>.

[93] "Your wallet. Without the wallet.." *Apple*. N.p., n.d. Web. 19 Sept. 2014. <https://www.apple.com/apple-pay/>.

[94] Rogers, Kate. "Apple wants to change the way you spend money." *CNBC*. N.p., n.d. Web. 19 Sept. 2014. <http://www.cnbc.com/id/102013363#.>.

The convenience of these alternative technologies, combined with the lack of exchange risk, could create further hesitation in consumer adoption of Bitcoins. These alternatives also fall under current consumer protection regulations that help mitigate financial risk for consumers. As competition in mobile payments increases, the Bitcoin ecosystem will need to find solutions to these risks while awaiting regulatory guidance.

Conclusion

Cryptocurrencies such as Bitcoin offer superior benefits regarding cost, speed, security, and infrastructure over traditional payment systems. Such innovations benefit small merchants and underbanked populations the most. However, adoption of cryptocurrencies in commerce still faces obstacles, including the lack of regulatory consensus regarding money laundering, taxation, and consumer safety.

For cryptocurrencies to be successful, current financial regulations should be extended to include this technology. This will likely improve public knowledge and confidence, leading to more widespread adoption. As cryptocurrencies move through the adoption curve, we see several problems solving themselves. Conversion to a fiat currency will no longer be required as more opportunities to spend Bitcoins will be available. Volatility will likely stabilize as liquidity improves, allowing everyday use to be practical. Lastly, a strong regulatory framework would support the rapidly developing environment and help cryptocurrencies develop into a viable platform for commerce.

As cryptocurrencies gain wider acceptance, consumers and small businesses will benefit from a more competitive payments industry. However, the application of cryptocurrencies in commerce only scratches the surface of possibilities. Global remittance and global business-to-business markets also stand to benefit from cryptocurrencies (see Appendix III). Moreover, the next generation of Bitcoin technology[95] can allow developers to easily create new products that have applications in trust-based markets such as real estate, insurance, voting, and even legal services, by utilizing the same decentralized verification network as Bitcoin.

For investors, "the possibilities are numerous once we decide to act and not react" (*George Bernard Shaw, Irish playwright and Nobel Prize winner)*. Understanding Bitcoin's journey up the adoption curve will present numerous investment opportunities. Holding Bitcoins may not be enough to take advantage of Bitcoin's ascent. A more strategic approach would be through investment funds such as Falcon Global Capital and Pantera Capital. In addition to providing

[95] "ethereum." *ethereum*. N.p., n.d. Web. 10 Sept. 2014. <https://www.ethereum.org/>.

access to larger Bitcoin positions, they also allow investors to capitalize on the growth of the ecosystem as a whole through Bitcoin-related investments. Long-term investment opportunities include a multitude of start-ups working to improve Bitcoin's technology to better suit the needs of users (Appendix V). Companies like Coinbase and Bitpay have significantly improved the Bitcoin payment infrastructure for both consumers and merchants. Investing in these start-ups early through funds can lead to lucrative exit opportunities as demand for Bitcoins grows. It is an exciting time to play a part in Bitcoin's development, and there is much to gain when we approach the top of the hill.

Appendix I. Bitcoin 101

Bitcoin, invented in 2009 by Satoshi Nakamoto, allows users to send digital currency through a decentralized peer-to-peer network over the internet. The Bitcoin denomination is abbreviated BTC and the smallest unit of Bitcoin is a Satoshi or one hundred millionth of a Bitcoin.

i. Transactions[96]

When a user accesses her Bitcoins, the software generates two keys: a public key and a private key. The private key, aptly named, is known only to its respective user and allows the user to access and spend her Bitcoins. The public key refers to the user's wallet, a physical address that the user's Bitcoins are stored at, and can be known to anybody. This dual key system is the basis of the asymmetric cryptography that serves as the user's digital signature, which establishes the legitimacy of a user and her Bitcoins.

When a user sends Bitcoins, her private key will sign the transaction acknowledging it. The recipient's public key will encode the amount transferred and record it to the designated address. This exchange, grouped along with others into a transaction block, is sent to the network of "miners" for verification. Miners expend computing power to record and verify transactions and blocks. They compete to generate a "hash," a unique string of characters that verifies a transaction block, by using the hash values of previously validated transaction blocks. However, the hash is incredibly difficult to solve and requires extensive computing power. Miners are incentivized to compete, because whichever machine first solves the hash receives a Bitcoin payout dictated by the protocol's inflation schedule (See Appendix I-ii.). Once solved, the hash is sent to the rest of the miners to verify. Assuming a majority of the miners are satisfied, the transaction block is assimilated into the public ledger, and the newly solved hash, along with all previous hashes, is used in future cryptographic processes to verify new blocks. This creates a growing chain of transaction blocks and corresponding hashes - the "blockchain" - and archives every single exchange ever transacted.

Thus, the blockchain prevents double spending by using a string of verified hashes in its cryptography. Assuming a user intends to double spend a Bitcoin, she would have to first legitimately send her Bitcoins to an address and then attempt to send the same Bitcoins to a different address. In the process, her first exchange would be legitimized and permanently locked into the blockchain by a verified hash. In order to spend the same Bitcoin again, the user would have to tamper with the legitimized block, changing its corresponding and already-verified hash,

[96] Entire section based off, the original whitepaper: Nakamoto, Satoshi. "Bitcoin: A Peer-to-Peer Electronic Cash System." Bitcoin - Opensource P2P Money. N.p., n.d. Web. 7 Aug. 2014. <https://Bitcoin.org/Bitcoin.pdf>.

which is virtually impossible to do.[97] Additionally, a miner running verification would instantly see that the new hash generated was different from the already-verified hash, thus exposing the block as fraudulent. If an entity were to control 51% of the mining power in the network, it could very possibly double spend Bitcoins (Appendix I-iii.); however, as explained later, it is in nobody's interest to do so. There are no other known methods to fraudulently spend Bitcoins, making Bitcoin's cryptography secure and dependable (Exhibit 9).

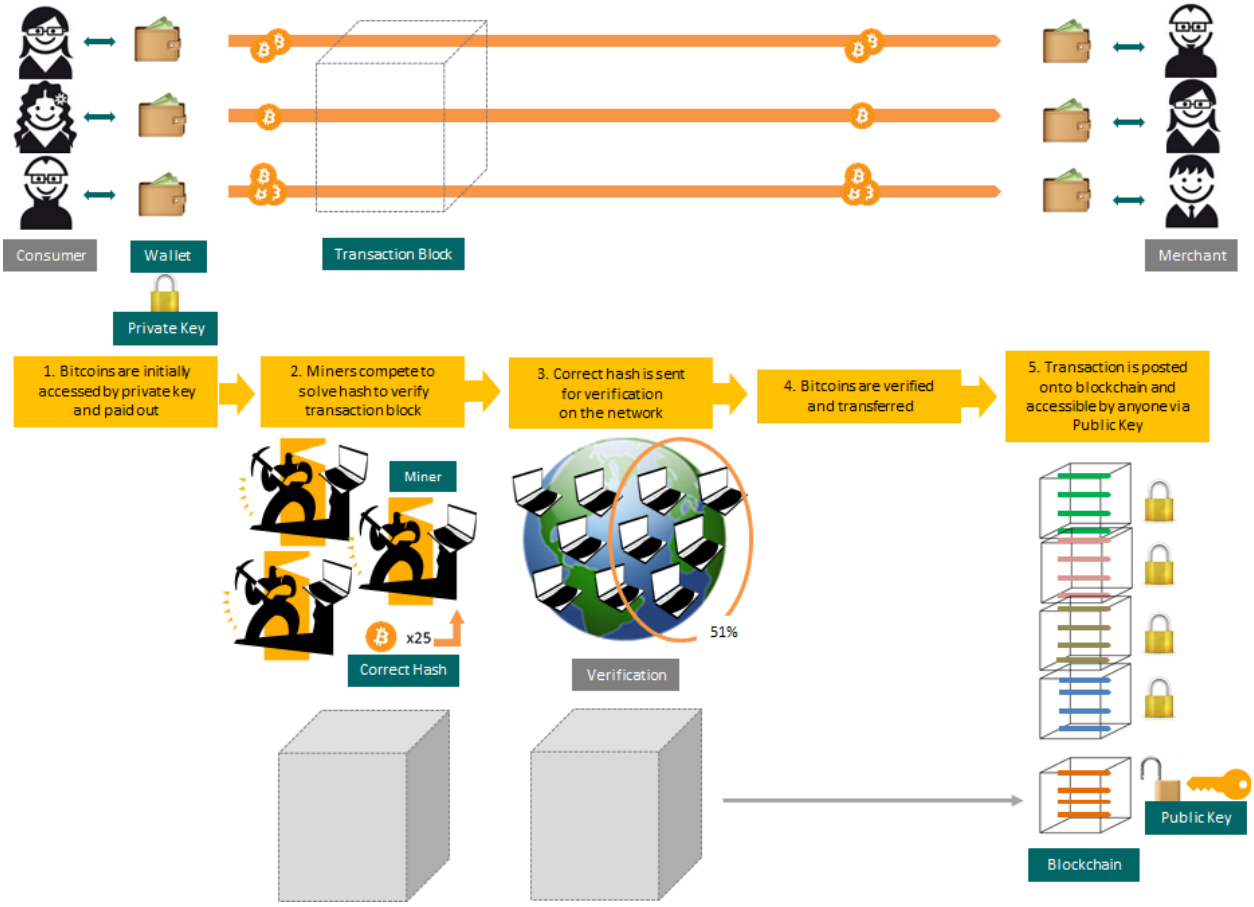

Exhibit 9. Bitcoin Transaction
Source: Shinnecock Partners

ii. The Inflation Schedule and Mining Pools

Bitcoin was designed so that there is a maximum established market cap for the amount of coins in existence. The protocol is self-adjusting so that the average time in which one transaction block is solved is roughly 10 minutes. For example, if the average time it takes for the network to solve

[97] Rosenfield, Meni. "Analysis of Hashrate-based Double-spending." (n.d.): n. pag. Web. 10 Sept. 2014. <https://bitcoil.co.il/Doublespend.pdf>.

for a hash continually exceeds 10 minutes, the protocol dynamically adjusts the complexity of the hash so that the average time reverts back to approximately 10 minutes. The same concept applies if hashes are being solved in less than 10 minutes. Miners and pools are paid a set amount of Bitcoins according to the inflation schedule. Miners are currently paid with 25 BTC, which halves every four years. With this payout minted every 10 minutes, it is projected that Bitcoin will reach its upper limit of 21 million BTC by the year 2140. At that time, miners will no longer receive Bitcoin payouts; however, they will continue to receive the minimal (< 0.001%) transaction fees, which would ideally cover the costs to secure the network.

Miners will typically group into mining pools to maximize their payouts. A single miner with no pool affiliations is most likely never able to solve for a hash. To put the size of the network in perspective, if someone were to invest $2 million into Bitcoin mining tools, they would have a 1.33% chance of outcompeting the network and receiving a payout by mining a Bitcoin.[98] In a mining pool, as long as the hash is solved, every participant in the pool will be given a payout relative to the amount of computing power they contribute. In this way, using a collective system, miners maximize their chances of receiving Bitcoins.

iii. Integrity of the protocol

The fundamental idea behind Bitcoin is that trust is established through its protocol. Nevertheless, the integrity of the protocol is challenged when the verification process is untrustworthy. As explained, transaction blocks are verified with a 51% agreement of the network and then added to the blockchain. However, if a mining pool were to possess 51% of the network's computing power, it would have the ability to dishonestly verify transaction blocks and double spend Bitcoins, which undermines the fundamental trust built into the protocol.[99] Ghash.IO, the largest mining pool at the time, happened to aggregate 51% of the network's computing power in June, 2014. Immediately, members left the pool to return Ghash.IO back to a non-controlling minority after realizing a controlling majority posed a serious threat to the stability of the Bitcoin network.[100] This majority rule exists but there is very little incentive for miners to collectively pool for the sole purpose of taking control of the network. Since miners are paid in Bitcoins, undermining the trust established by the protocol would devalue their own payout. Miners can preserve the value of their assets by creating a new pool to use its vast resources to mine additional Bitcoins honestly. As

[98] It assumes Bitcoins are mined every ten minutes. Source： "Bitcoin Mining Calculator." *Alloscomp :*. N.p., n.d. Web. 05 Sept. 2014. <https://alloscomp.com/Bitcoin/calculator>.

[99] "Bitcoin Miners Ditch Ghash.io Pool Over Fears of 51% Attack." *CoinDesk RSS*. N.p., n.d. Web. 05 Sept. 2014. <http://www.coindesk.com/Bitcoin-miners-ditch-ghash-io-pool-51-attack/>.

[100] Matonis, Jon. "The Bitcoin Mining Arms Race: GHash.io and the 51% Issue." *CoinDesk*. Web. July 17, 2014. <http://www.coindesk.com/Bitcoin-mining-detente-ghash-io-51-issue/>

stated by Satoshi himself, mining pools will find it "more profitable to play by the rules, such rules that favor him [the pool] with more new coins than everyone else combined, than to undermine the system and the validity of his own wealth."[101] Nevertheless, if regulatory guidance were present to help prevent future breaches of the 51% limit, such guidance might ease fears of an attack on the Bitcoin protocol.

Appendix II. Alternative Cryptocurrencies (Altcoins)

Although Bitcoin has capitalized on its first-mover advantage, there are many other alternative cryptocurrencies ("altcoins") that exist, each with its own payment scheme, market capitalization and inflation schedule. Included in Exhibit 10 are the top 5 altcoins with the highest market capitalizations.

Currency	Symbol	Max Cap	Market Cap ($ million)	Inflation Schedule	Additional Comments
Bitcoin	BTC	21,000,000 BTC	5,347	Initial payout of 50 BTC with payouts halved every 4 years	The first of its kind
Litecoin	LTC	84,000,000 LTC	137	Initial payout of 50 LTC with payouts halved every 4 years	Will have 4x amount of curreny units as Bitcoin while maintaining a similar inflation schedule
Peercoin	PPC	None	33	Limited release 1% decentralized inflation per year	Based on proof of work and proof of stake prevenging the 51% network attack by giving control to users who own Peercoins
Dogecoin	DOGE	None	27	Payouts are random gradually decreasing to 10,000 DOGE	Created partially as a parody of Bitcoin. Gained prominence from the popular internet "Doge" meme
Darkcoin	DRK	24,000,000 DRK	15	Payouts differed by difficulty according to the Moore's Law Algorithm	Darkcoin prioritizes anonymity and security

Exhibit 10. Altcoins and their characteristics
Source: www.coinssource.com *Last Updated 9/22/2014*

In addition to the five mentioned, there are approximately 463 other cryptocurrencies. Some of these cryptocurrencies provide better features than Bitcoin. However, as Bitcoin was first to market and has more infrastructure devoted to it, Bitcoins are the most widely-used by far, comprising 93.7% of the total market cap (approximately $7.3 billion) of all existing cryptocurrencies (see Exhibit 11).

[101] Nakamoto, Satoshi, Ibid.

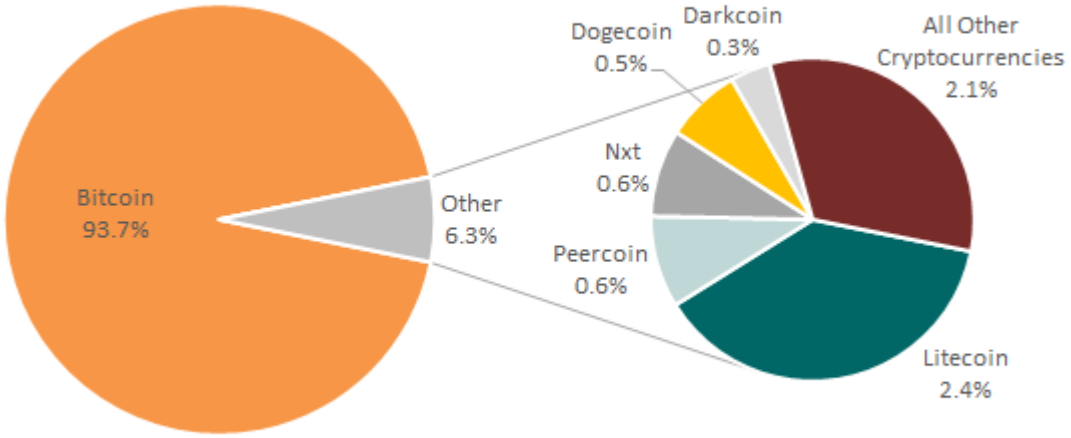

Exhibit 11. Market Share of Cryptocurrencies
Source: Coinmarketcap.com *Last Updated 9/22/2014*

Litecoin, the second largest altcoin in terms of market capitalization can only be easily bought with Bitcoins and is rarely traded with fiat currencies.[102] Thus, although it is necessary to mention that there are many other cryptocurrencies that exist, in the grand scheme of future payment markets and stores of wealth, Bitcoin will continue to control a substantial amount of the cryptocurrency market given the current state of the market.

Appendix III. Other Applications in Commerce

i. Global Remittances

In explaining cryptocurrencies, we primarily focus their application on transactions between consumers and businesses (C2B). Global remittances fall under a different category where a person transfers funds to friends or family in their home country (C2C). While the volume of global remittances is only a fraction of payment transactions, total value transferred still totaled $521

[102] "How to Buy Litecoin - What You Need to Know About Buying Litecoin."*CoinDesk RSS*. N.p., n.d. Web. 05 Sept. 2014. <http://www.coindesk.com/information/buy-litecoins/>.

billion in 2012 (see Exhibit 12).[103] Because Bitcoin features related to cost and speed are not restricted to commercial payments, Bitcoins have the potential to disrupt this market as well.

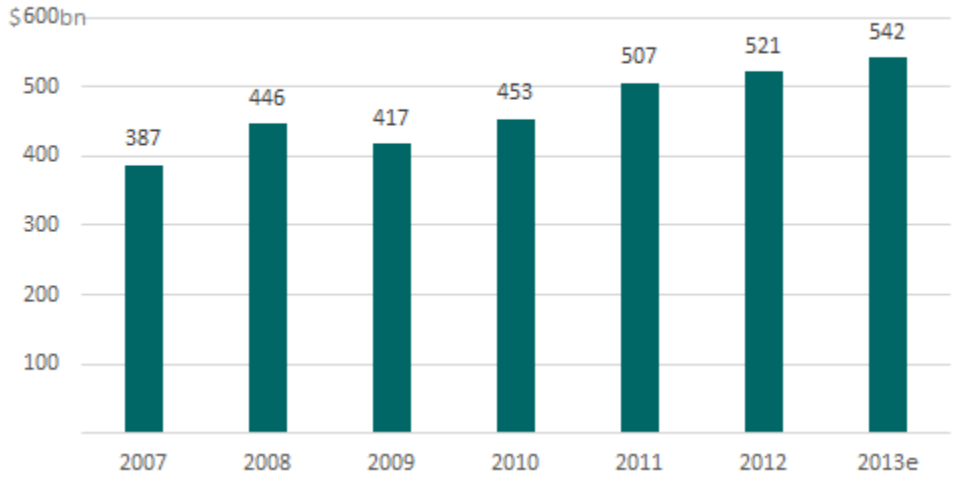

Exhibit 12. Global Remittance
Source: World Bank

The cost of sending remittances has declined, but the global average cost was at 8.14% in the first quarter of 2014. The most expensive way to send money was through commercial banks, with an average cost of 12.05%, while the most common way was using cash products (cash-to-cash), which is one of the most cost effective ways to send money, with an average cost of 6.60%.[104] For example, one in five dollars remitted globally passes through money transfer companies like Western Union or Moneygram.[105] Fees vary depending on the transaction amount, receiver's location, choice of transferring speed, funding method and transferring method (i.e., online or a walk-in agent). Western Union requires a sender to provide her debit/credit card information and pay a fee of $7 (including currency conversion cost) in order to send $100 online from the U.S. to a receiver in Guatemala. Although a money transfer can take as fast as 10 minutes, it is a hassle for receivers because they have to go to a branch location to collect their money on time and may have to pay a tax depending on the country in which they reside. A receiver in Guatemala, for

[103] "Migration & Remittances Data." *Prospects* -. The World Bank Group, n.d. Web. 20 Aug. 2014. <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:22759429~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html>

[104] "Remittance Prices." *World Bank*. N.p., n.d. Web. 15 Sept. 2014. <https://remittanceprices.worldbank.org/sites/default/files/rpw_report_june_2014.pdf>.

[105] Solutions, Anand Chandramouli Cognizant Technology. *Remittance Market: Ready and Waiting for Its 'Skype' Moment* (n.d.): n. pag. Web. 12 Sept. 2014. <http://www.cognizant.com/InsightsWhitepapers/Remittance-Market-Ready-and-Waiting-for-its-Skype-Moment.pdf>.

example, would have to pay a 1% tax on her withdrawal. Thus, for the $100 transferred, the recipient would only receive $92, losing 8% on the initial amount along with the time it took to physically retrieve the money.

On the other hand, Bitcoins can act as a replacement for current international remittance services because of their zero transaction cost and fast transactional speeds. For example, individual receivers or small merchants in the Philippines, the third biggest global market for remittances, can receive a small amount of money internationally using Bitcoins through a local exchange like BuyBitcoin.ph for free. The exchange converts between the Philippine Peso and Bitcoin and deposits the amount into the user's bank account.[106]

ii. International Commerce

Cryptocurrencies can also be used in global business-to-business (B2B) commerce. In 2013, Forrester Research sized the market for B2B e-commerce in the U.S. alone at $559 billion and the market for B2C e-commerce at $252 billion.[107] Not only is the size of the B2B market larger, but also the average shipment size is larger, so confirmation of shipment before payment is crucial. Bitcoin, integrating multi-signature technology, can be a reliable but cost effective payment solution providing escrow, so trust can be built more efficiently between merchants.[108]

Appendix IV. Getting Started with Bitcoins

A Bitcoin wallet is a consumer's gateway into the ecosystem. While special hardware wallets exist, typical wallet solutions are provided by software installed locally on an individual computer or by centralized services on the Internet. One is not necessarily better than the other, but consumers must consider the tradeoff between having full control over their Bitcoins and convenience when choosing one solution over the other. Using locally-installed open-source software such as Bitcoin Core on a Microsoft Windows machine will allow consumers to maintain sole access to their Bitcoins by keeping their private keys to themselves. Transactions will also require no third parties as the software will directly relay the transaction to the Bitcoin Network.[109]

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[106] Hajdarbegovic, Nermin. "Coinbase Insured Against Theft or Loss of Bitcoin." *CoinDesk RSS*. CoinDesk, 28 Aug. 2014. Web. 5 Sept. 2014. <http://www.coindesk.com/coinbase-names-aon-Bitcoin-insurance-broker/>.

[107] Sheldon, Peter, and Andy Hoar. "Forrester." *Research : Research : The Wave™: B2B Commerce Suites, Q4 2013*. N.p., n.d. Web. 15 Sept. 2014. <https://www.forrester.com/The+Forrester+Wave+B2B+Commerce+Suites+Q4+2013/fulltext/-/E-RES90821>.

[108] Interview with Falcon Capital, August 22, 2014.

[109] "Choose Your Bitcoin Wallet." *Choose Your Wallet*. Web. 10 Jan. 2015. <https://Bitcoin.org/en/choose-your-wallet#>.

However, the most popular solutions are web-based services such as Coinbase, Xapo, Coinkite, and Circle because they provide complete and easy-to-use solutions for non-tech-savvy consumers (Exhibit 13 compares several popular services). These vendors control the majority of the Bitcoins owned by their users and circulate them on their platform, only showing customers transactions related to their balances. They also allow consumers to fund their Bitcoin holdings within the same application by connecting their bank account information. Whereas users of separate wallet applications will have to obtain Bitcoins through centralized third-party exchanges or individual sellers, users of web wallets pay a premium to reduce counter-party risk.

After obtaining Bitcoins, consumers will need to secure their wallets to minimize the risk of theft. This includes basic security measures such as keeping computer software up-to-date and taking precaution when using online services. With a locally-installed wallet, creating multiple encrypted backups of private keys stored in different locations will help prevent malicious and accidental losses. Consumers using web wallets will not need to worry about backups. Instead, private keys are centrally held by the service provider. While accidental loss is not an issue, outside threats can still steal the credentials to the users' Bitcoins. To prevent this, consumers are encouraged to seek multi-signature-enabled wallets that require both the service provider and the user's keys to authorize the transfer of Bitcoins.[110] Some user Bitcoins can also be kept in cold storage, or offline in hard drives, to prevent loss from cybercrimes. However, when these security measures fail, an insurance policy on the Bitcoins can reduce the financial impact on consumers. Many centralized vendors insure their supply to reduce the risk for consumers.[111]

Bitcoin Wallets

Features	Coinbase	Coinkite	Circle	Xapo
Fund with bank account	x	x	x	x
Insured against loss	x		x	x
Multisignature-enabled	x	x	x	x
Cold storage	x	x	x	x
Issues Debit card		x		x
Mobile App	x	x	x	x
Fees	x	x		x

Exhibit 13: Comparing Web Wallets
Source: Coinbase.com, Coinkite.com, Circle.com, Xapo.com

In addition to web wallets and third-party exchanges, alternative methods exist for consumers to obtain Bitcoins. Bitcoin ATMs provide instant access and liquidity. First created by the company

[110] "Securing Your Wallet." - *Bitcoin*. Web. 10 Jan. 2015. <https://Bitcoin.org/en/secure-your-wallet>.

[111] Hajdarbegovic, Ibid.

Robocoin[112] and adopted by many companies afterwards, Bitcoin ATMs allow users to deposit money and send Bitcoins to designated public addresses. These ATMs are not as prolific and accessible, but they offer a simple and quick way to buy and send Bitcoins. Unfortunately, much like traditional cash ATMs many will charge a higher fee than more mainstream purchasing options. [113] Consumers can also get access by buying them from individual sellers on LocalBitcoins.com. Buyers and sellers post requests and accept a variety of payment options ranging from wires to in-person cash transactions. LocalBitcoins also attempts to reduce counter-party risk by implementing an escrow service to transfer the Bitcoins. [114]

For larger orders, users will normally turn to private brokers who are faster and offer protection from price slippage.[115] They act as intermediaries for over-the-counter Bitcoin transactions and create trust between interacting parties. For their services, brokers usually collect a commission and enforce a minimum amount.[116] #Bitcoin-otc (Bitcoin-otc.com) is a website that provides this service, but users are exposed to heavy counterparty risk. #Bitcoin-otc attempts to mitigate this by providing a service called the "OTC web of trust"[117] which establishes reputation among users of the site through reviews, much like Ebay or other platforms that directly connect consumers.

Appendix V. Bitcoin for Investors

i. Investment Funds[118]

Sophisticated investors can invest in the ecosystem as well as the currency without directly purchasing Bitcoins. Various investment vehicles have emerged in an attempt to capitalize on the growth of Bitcoin technology by investing in the cryptocurrency and Bitcoin related infrastructure.

[112] Biggs, John. "Robocoin Opens The First Bitcoin ATM In Vegas, Baby." *TechCrunch*. AOL Inc., 30 July 2014. Web. 14 Nov. 2014. <http://techcrunch.com/2014/07/30/robocoin-opens-the-first-Bitcoin-atm-in-vegas-baby/>.

[113] "Robocoin Invented the Bitcoin ATM. Now Reinventing the Bitcoin Wallet | Robocoin." Robocoin. Robocoin. Web. 14 Nov. 2014. <http://robocoin.com/>.

[114] "Setting up a Bitcoin Online Sale Advertisement." How to Sell Bitcoins Online on LocalBitcoins.com. LocalBitcoins.com, n.d. Web. 14 Nov. 2014.

[115] Wong, Joon Ian. "How Bitcoin Brokers Trade Millions Without an Exchange." CoinDesk RSS. CoinDesk, 5 Sept. 2014. Web. 14 Nov. 2014. <http://www.coindesk.com/Bitcoin-brokers-trade-millions-without-exchange/>.

[116] Ibid.

[117] "#Bitcoin-otc Web of Trust." #Bitcoin-otc Web of Trust. #Bitcoin-otc, n.d. Web. 14 Nov. 2014.

118 This document does not constitute an offer to sell or a solicitation of an offer to buy any security or investment product. Accredited individuals interested in investing in the firms or funds listed below should contact them directly for the official Offering Memoranda associated with their investment.

One of the premier Bitcoin investment firms at the moment is Pantera Capital, founded by Dan Morehead, formerly CFO and head of Macro Trading at Tiger Management. At one point Tiger Management was one of the largest hedge funds in the world, reaching $22B in assets in 1998, but ultimately closing in 2000. Its employees have formed a whole generation of hedge fund offshoots known in the industry as "Tiger Cubs".[119] From inception in 2003 to 2011, Pantera operated as a traditional Macro hedge fund, betting on the movements of sovereign countries' equity futures, index rates and other financial products. However, in 2011 it began to wholly shift its interest towards Bitcoins. In March 2014, it was announced Fortress Group, one of the largest publicly traded hedged fund and private equity firms with $67.5B in assets, would be making an investment into Pantera Bitcoin Partners.[120] Fortress was the first major Wall Street firm to make an investment into Bitcoins, revealing in its annual 2013 SEC 10-K filing it had taken a $20M position into Bitcoins.[121]

In its first regulatory filing in December, the Pantera Bitcoin fund was valued at $147M, significantly larger than the $39M currently in the Bitcoin Investment Trust, a vehicle setup by SecondMarket to allow investors to gain exposure to Bitcoins in a similar fashion to a gold ETF. The Bitcoin Investment Trust is a private open-ended trust that operates like many other mutual funds and allows an individual to obtain exposure to the price movements of Bitcoin without the risks associated with physically owning the assets. Further, it offers the protection of top tier service providers, with legal assistance provided by Sidley Austin and Ernst & Young serving as the fund's auditor.[122] Much like how there are likely far more individuals invested in financial products based on the price of gold than holding gold bullion in their basement, products such as these offer the opportunity to dramatically increase the accessibility of cryptocurrencies such as Bitcoin as an investment to the financial community.

Other investment options include Bitcoins Reserves, a hedge fund that invests purely in cryptocurrencies and looks for additional arbitrage opportunities using algorithmic trading between the numerous Bitcoin marketplaces to generate additional returns.[123]

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[119] "Robertson Stock Picker Singh Said to Become Newest Tiger Cub." Bloomberg.com. Bloomberg, 03 June 2014. Web. 03 May 2015. <http://www.bloomberg.com/news/articles/2014-06-03/robertson-s-stock-picker-singh-said-to-become-newest-tiger-cub>.

[120] Popper, Nathaniel. "Fortress, Benchmark and Ribbit Buy Stake in Pantera Bitcoin." DealBook Fortress Benchmark and Ribbit Buy Stake in Pantera Bitcoin Comments. New York Times, 18 Mar. 2014. Web. 03 May 2015. <http://dealbook.nytimes.com/2014/03/18/fortress-benchmark-and-ribbit-buy-stake-in-pantera-bitcoin/?_r=0>

[121] Hajdarbegovic, Nermin. "Fortress Investment Group Disclose $20m Worth of Bitcoin." CoinDesk RSS. CoinDesk, 28 Feb. 2014. Web. 03 May 2015 <http://www.coindesk.com/fortress-investment-group-reports-purchase-20m-bitcoin/>.

[122] Bitcoin Investment Trust. Bitcoin Investment Trust Fact Sheet March 2015. N.p., n.d. Web. 3 May 2015. <http://bitcointrust.wpengine.netdna-cdn.com/wp-content/uploads/2015/03/Fact-Sheet_Mar15.pdf>.

[123] "This Is Us." *Bitcoins Reserve*. Web. 15 Nov. 2014. <http://Bitcoinsreserve.com/about>.

ii. Bitcoin Companies

As the usage of Bitcoins becomes more prevalent, the opportunity for investment in Bitcoin related companies has grown rapidly. The amount of investments in companies providing Bitcoin-related services and infrastructure has grown from $91 million in 2013 to almost $180 million in 2014.[124]

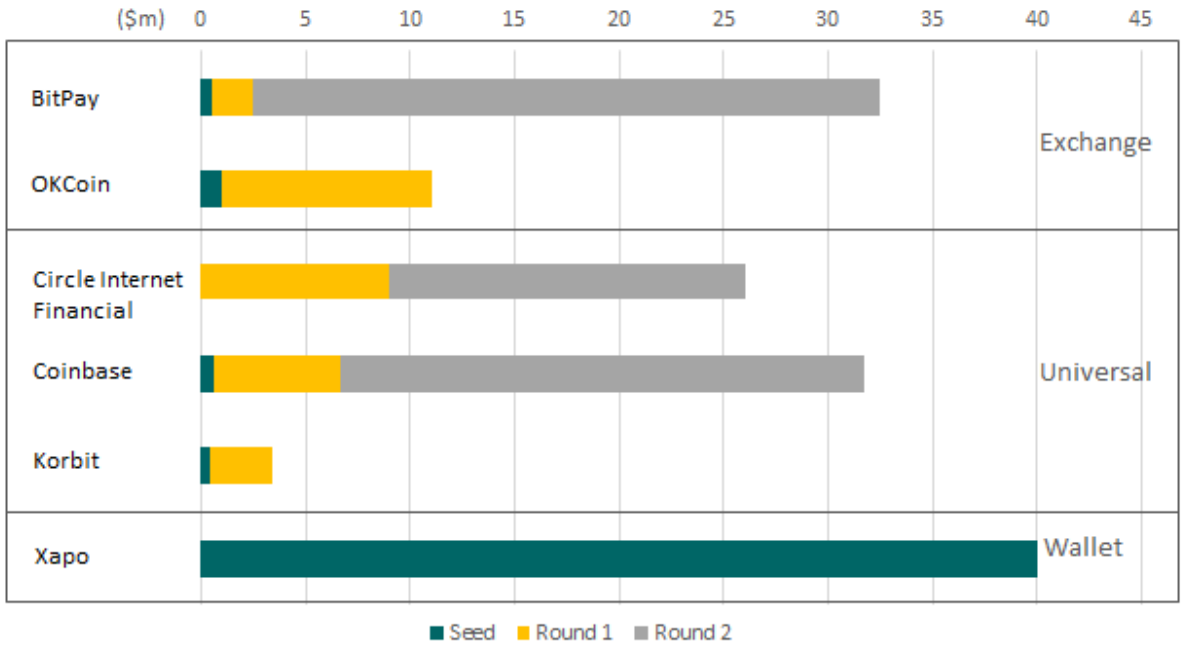

Exhibit 14: Size of Funding
Source: CoinDesk

Exhibit 14 examines the recent funding rounds for the largest Bitcoin companies and shows the growth in the funding received in successive rounds. These companies have provided intriguing new additions to the Bitcoin network: Bitpay (U.S.) and OKcoin (China) provide services to merchants by immediately converting accepted Bitcoins into fiat currency at point of sale (see section 4.2); Coinbase (U.S.) and Korbit (Korea) are universal providers which allow merchants to accept Bitcoin transactions and users to buy and sell Bitcoins; Xapo has developed debit cards that are connected to a Bitcoin wallet rather than a bank account; Circle Internet Financial allows users to buy and send Bitcoins through a user-friendly interface.

Bitcoin-related companies are diverse, encompassing six different types split into two major categories: payments (wallets, payment processors, exchanges, and universal providers that offer

[124] Coindesk, Ibid.

consolidated services of wallets, payment processors and exchanges) and miscellaneous (providers of mining tools, and providers of unique financial instruments that use Bitcoin). Exhibit 15 shows the percentage of funding received in each of the six types of Bitcoin companies. Companies that are receiving the most funding are universal providers as they are able to capture a larger audience by offering all-in-one packages, but need more technological support to provide their services. This all-encompassing role has put universal providers such as Coinbase into a central position within the Bitcoin system, allowing Coinbase to partner with multibillion dollar companies such as Paypal and Uber.[125] Through such partnerships and over 1.6 million wallets,[126] Coinbase has established itself as the go-to company for new Bitcoin users or new Bitcoin-accepting companies. Although universal providers have had the most funding, press, and partnerships, other Bitcoin companies are still intriguing investment opportunities since the required amount of investment may not be as large,[127] and such companies may be bought by universal providers who wish to expand.[128]

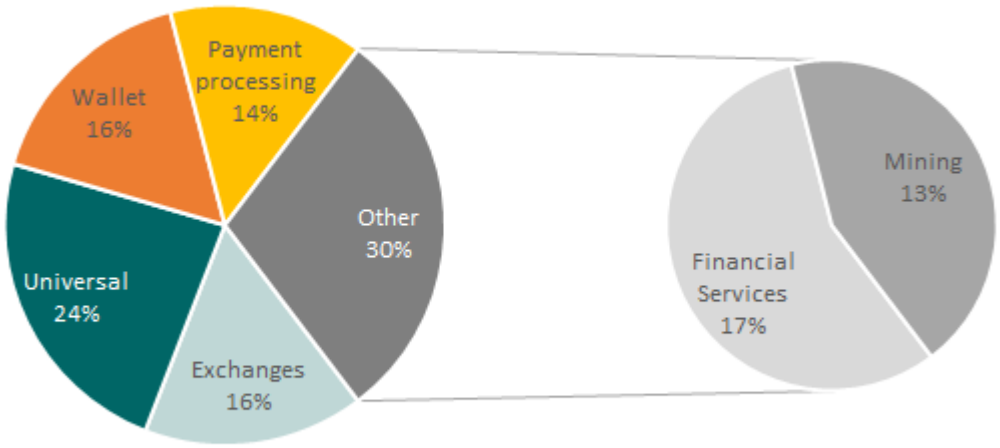

Exhibit 15. Funding for Every Sector
Source: CoinDesk

[125] "PayPal, AirBnB, Uber Will Accept Bitcoin Through BrainTree."Altcoinauthority. N.p., n.d. Web. 12 Sept. 2014. <http://altcoinauthority.com/2014/09/paypal-airbnb-uber-will-accept-Bitcoin-through-braintree/>.

[126] Ibid.

[127] Ibid.

[128] "State of Bitcoin Q2 2014 Report Reveals Expanding Bitcoin Economy." CoinDesk RSS. N.p., n.d. Web. 12 Sept. 2014. <http://www.coindesk.com/state-of-Bitcoin-q2-2014-report-expanding-Bitcoin-economy/>.

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