BITCOIN: A DISRUPTIVE CURRENCY

ARK INVEST IN COLLABORATION
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RESEARCH WHITE PAPER BY
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Bitcoin has the potential to be disruptive in a way not seen since the development of the Internet. While the Internet decentralized the dissemination of information, Bitcoin and its underlying "blockchain" are decentralizing the securitization of information. Bitcoin's potential use cases for securitizing information are far reaching, and could facilitate realms as disparate as real estate transfers to venture capital contracts to micro-transactions of less than a cent. While its most obvious use case is that of a currency— serving as a means of exchange, a store of value, and a unit of account— the young ecosystem is still weathering storms from its own flaws. That said, as an open source software platform it can evolve rapidly to address current shortcomings, and ARK Investment Management believes it can fundamentally fulfill all three use cases of a currency. In so doing, users can expect to benefit from the characteristic advantages of technology: lower cost, higher performance and greater accessibility.

The attached paper investigates whether bitcoin is a currency, serving the three main functions of money: a means of exchange, a store of value, and a unit of account. In order for bitcoin to take on the role of other currencies, it must satisfy all three functions.

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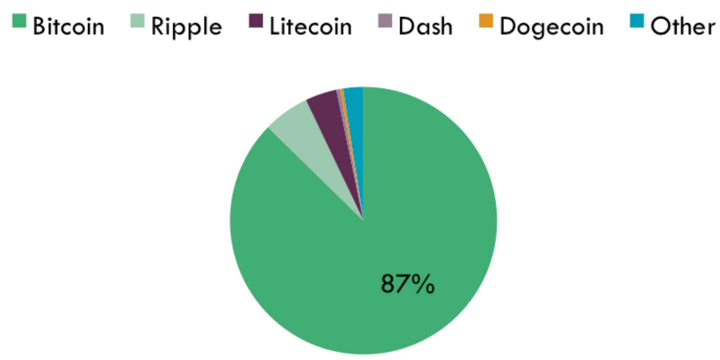
BITCOIN: A PRIMER

Few innovations have generated as much controversy and potential for worldwide economic transformation as have Bitcoin and bitcoin. Bitcoin is an open source, decentralized technology platform upon which bitcoin, the digital currency, depends. On August 1, 2015,[1] the digital currency was priced at $280 per bitcoin, with 14.5 million units in circulation, $4 billion in stored value, and a nearly 90% share of global digital currency market capitalization (market cap).[2,3,4]

FIGURE 1
Digital Currency Market Capitalization



SOURCE: ARK Investment Management LLC, Cointelegraph Media Partners
NOTE: As of August 1, 2015

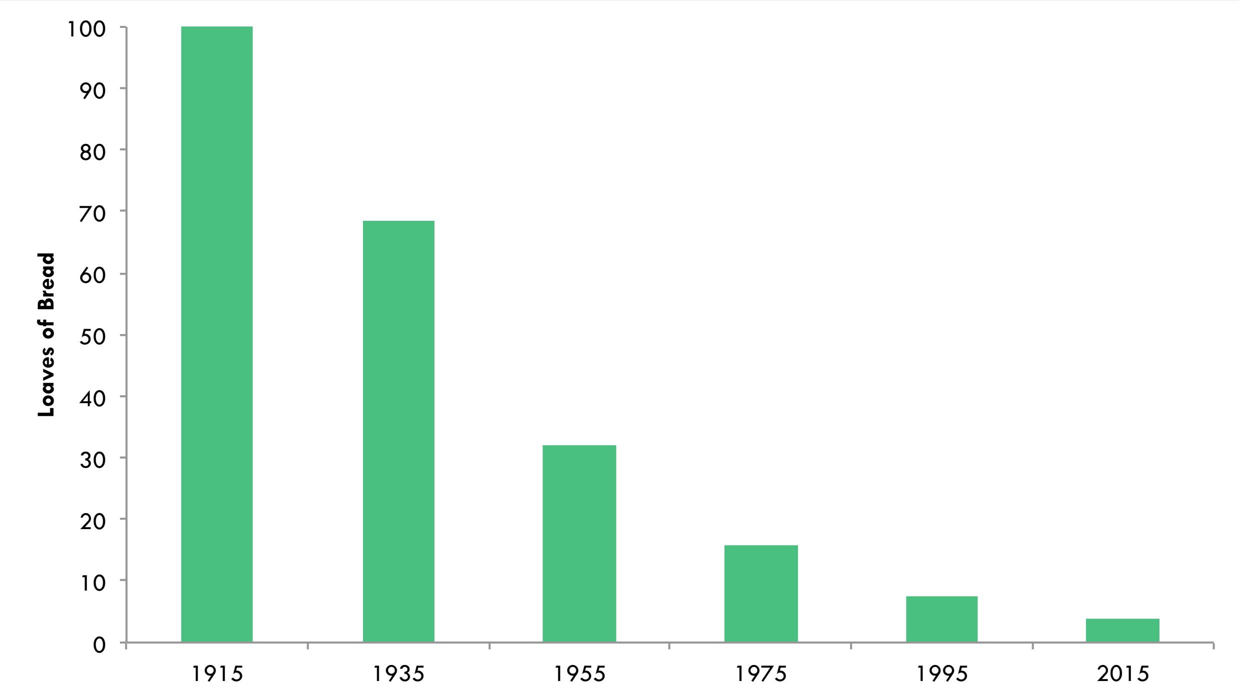
Bitcoin was birthed in the ferment of the 2008 financial crisis by Satoshi Nakamoto, a person or organization that, to this day, is anonymous.[5] The antithesis of a centralized banking system, Bitcoin is decentralized and does not require a central repository or single administrator to process transactions. Instead, it relies on the cryptographic security of mathematics and the computational power of distributed computers to create a digital ledger that is transparent to the world.

bitcoin's merit has gathered momentum as central banks around the world have capitulated to quantitative easing, bloating their balance sheets with reserves. Federal Reserve Chairman Bernanke was the first to pull out all stops in response to the financial collapse of 2008. European Central Bank President Draghi reacted to a relapse in the European sovereign debt crisis in 2011-2012 with a "whatever it takes" approach. Governor Kuroda of the Bank of Japan ("BOJ") assured investors in 2013 that the BOJ could go beyond purchasing government bonds and venture into corporate bonds or even stocks in support of newly elected Prime Minister Abe's stimulus program. If such fiat currency depreciation initiatives continue, investors seeking a hedge could turn to bitcoin.

1 Unless otherwise specified, information in this paper, including a price of $280 per bitcoin, is current as of August 1, 2015. The price of bitcoin fluctuates, but the fundamentals of this paper hold regardless of current price.
2 A digital currency is primarily an Internet based means of exchange, stored and transferred electronically via 0s and 1s.
3 ARK Investment Management LLC, data sourced from "Crypto-Currency Market Capitalizations," Cointelegraph Media Partners, accessed August 2015, http://arkinv.st/1fGGxAt.
4 Market cap of a digital currency refers to the units of the currency outstanding multiplied by the USD price per unit.
5 "Satoshi Nakamoto," Bitcoin Wiki, accessed August 2015, http://arkinv.st/1fGGC7s.

Inflation is one of the scourges of flawed monetary policies. Even in the "low inflation" environment of the last 25 years in the United States, the impact of inflation has been pernicious. Since 1990, inflation as measured by the Consumer Price Index has averaged 2.4% per year, pushing the purchasing power of a dollar down by roughly 50% over that period.[6] During the past 100 years, the decline in purchasing power has been tremendous. In 1915, ten dollars was enough to buy 100 loaves of white bread; today, it purchases only four loaves, as shown below.[7]

FIGURE 2
Loss of Purchasing Power: How Many Loaves of Bread did $10 Buy?



SOURCE: ARK Investment Management LLC, US Bureau of Labor Statistics

While traditional monetary policy has been organized regionally and managed by individuals with different or evolving monetary theories, the supply of bitcoin is disseminated mathematically in a highly decentralized, open source ecosystem. Consequently, the rules governing the quantity of bitcoin in circulation theoretically cannot be changed without approval by the ecosystem's economic majority.[8]

It's interesting to consider whether Milton Friedman would have blessed the Bitcoin movement had its technology enablers been in place during the last century. Friedman asserted that the best way to conduct monetary policy and control inflation over the long run was to limit the growth of the money supply. Based on the design of the software

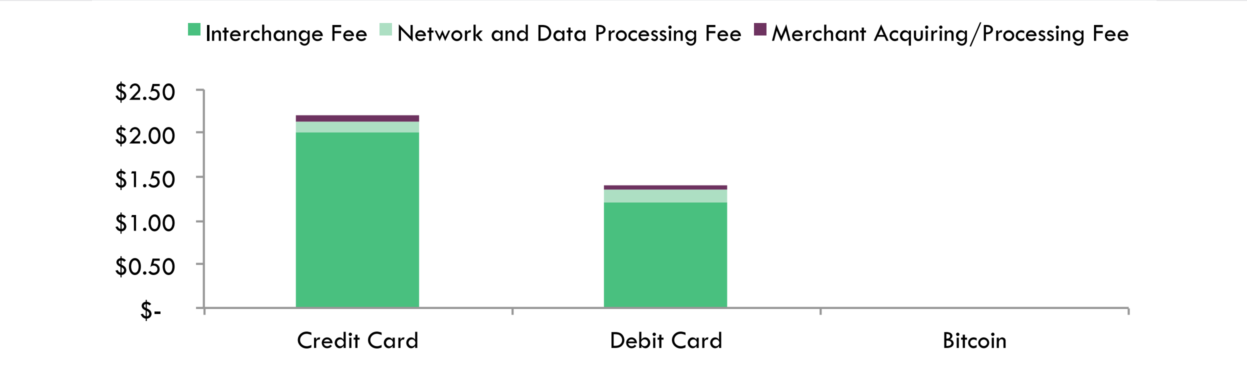
6 "CPI Inflation Calculator," Bureau of Labor Statistics, Accessed August 2015, http://arkinv.st/1J5SWtx/.
7 ARK Investment Management LLC, data sourced from "One Hundred Years of Price Changes," US Bureau of Labor Statistics," Accessed August 2015, http://arkinv.st/1fJma5O. Also assumes 800 grams to a loaf.
8 "Economic Majority," Bitcoin Wiki, Accessed August 2015, http://arkinv.st/1fbwt1R/.

supporting bitcoin, the growth in its supply will be approximately 10% per year in 2015 and 2016, after which it will decelerate to approximately 4% per year until 2021, and 2% or less thereafter.[9] Over the long term, growth in bitcoin's supply will decelerate to 0%, settling on a fixed 21 million units in 2140. During short term periods of time, however, if the demand for bitcoin were to increase relative to its supply, the adjustment would take place by an increase in its price. Concomitantly, if demand were to fall relative to the supply of bitcoin, it would find equilibrium at a lower price in the short run.

If the Bitcoin platform works according to its design, not only will it prevent inflation from reducing the purchasing power of a bitcoin, but it also will allow merchants accepting bitcoin to avoid onerous transaction fees.[10] For example, interchange fees as a percent of average transaction value on dual message networks range from 0.84% to 1.59% on major debit cards[11] and are typically 2% on credit cards, though can be as high as 2.95%. In addition, the fees for network and data processing for debit and credit card transactions range from 0.04% to 0.25%, not to mention a flat merchant acquiring/processing fee that ranges from $0.003 to $0.10.[12] These three fees add up, forcing many small merchants to require minimum purchase sizes for customers paying with debit or credit cards.

In contrast, as shown below, some bitcoin merchant interfaces, such as BitPay, currently charge merchants no fee.[13] Thanks to this favorable fee structure, merchants are beginning to gravitate to the Bitcoin payments platform. Recently, a Goldman Sachs survey of independent sales organizations and merchant acquirers found that 2% of US merchants already accept bitcoin, and 23% plan to start accepting it by 2017.[14]

FIGURE 3
Merchant Loss on $100



SOURCE: ARK Investment Management LLC, Quandl, PayPal, IMF, Goldman Sachs

For those interested in exploring the inner workings of Bitcoin, ARK Invest suggests the following resources: the first is a piece offering a simple explanation of bitcoin using an analogy to apples,[15] the second is a broad and digestible overview by bitcoin.org,[16] and the third is Bitcoin's foundational paper written by Satoshi Nakamoto.[17] As with Bitcoin, few people understood the workings of the credit card system at its inception. But, with early adoption and time, most people gravitated to it for the convenience that it offered and began to trust that "it just works." Some day the same might be said of Bitcoin.

9 Controlled Supply," Bitcoin Wiki, accessed August 2015, http://arkinv.st/1fbD2BF.
10 Merchant fees (i.e. "acceptors") are separate from the small fees miners can charge "senders" of bitcoin.
11 "Average Debit Card Interchange Fee By Payment Card Network," Federal Reserve, Accessed August 2015, http://arkinv.st/1fGHrgz.
12 "The Future of Finance: Redefining 'The Way We Pay' in the Next Decade," Goldman Sachs, March 2015, http://arkinv.st/1PjLoTQ.
13 "Why Bitcoin?" Bitpay, Accessed August 2015, http://arkinv.st/1GuyDku.
14 "The Future of Finance: Redefining 'The Way We Pay' in the Next Decade," Goldman Sachs, March 2015, http://arkinv.st/1PjLoTQ.
15 "Still Don't Get Bitcoin?" CoinDesk, January 2014, http://arkinv.st/1Uq2Ih3.
16 "Frequently Asked Questions," bitcoin.org, Accessed August 2015, http://arkinv.st/1Uq2TJ6.
17 "Bitcoin: A Peer-to-Peer Electronic Cash System," Satoshi Nakamoto, May 2009, http://arkinv.st/1GwV9ZS.

Again, Bitcoin is an open source, decentralized technology platform upon which bitcoin, the digital currency, depends. Other key terms associated with the platform are miner, blockchain and block. A miner is a person or organization that runs a set of computers, called mining machines, that create and secure Bitcoin's transactional network. The blockchain is the digital ledger of transactions that underlies Bitcoin and is transparent to the world. A block is a set of transactions that the miners put together, or "confirm," and append to the blockchain.

In the following white paper, ARK Invest will investigate whether bitcoin is a currency, serving the three main functions of money: a means of exchange, a store of value, and a unit of account. In order for bitcoin to take on the role of other currencies, it must satisfy all three functions.

Its adoption will be expedited if and when regulatory authorities agree on the classification of bitcoin. Because of the regulatory mandates of different authorities, such an agreement may not be possible. The U.S. Securities and Exchange Commission ("SEC") considers bitcoin to be a currency.[18] In contrast, the Internal Revenue Service ("IRS") has classified bitcoin as property,[19] and the Commodity Futures Trading Commission ("CFTC") as a commodity.[20]

As a **means of exchange**, money serves as a mutually agreed upon value that allows users to trade goods and services efficiently. It must be portable and divisible, facilitating transactions of any size, anywhere. Without a medium of exchange, the "coincidence of wants" in a bartering system would impede transactions.

As a **store of value**, money can be saved, retrieved and exchanged at a later time with predictable utility. It should be limited in supply and durable, with physical or virtual representations of ownership. Individual users of money cannot create more as needed, diluting the value of pre-existing units. Fiat currencies are limited in supply because they can be created only by regulated authorities, such as the Federal Reserve.

Money as a **unit of account** is possible only when it also is serving as a means of exchange and store of value. Then money can act as a measuring stick of assets and debts. To do so, it has to be a universal product, fungible into goods and services.

A much-cited danger to bitcoin as a currency is government regulation or prohibition, especially in the face of lobbying by banks threatened by the loss of their middleman status and economic power. In late 2013, for example, the People's Bank of China declared that bitcoin was not a currency with "real meaning," and banned notable companies like Baidu (BIDU) from accepting it.[21] However, Dax Hansen, partner at Perkins Coie, which has a well recognized decentralized virtual currency practice, states that it is "highly unlikely" that the US government would do anything similar, and that even China may be loosening its controls.[22]

Furthermore, few technologies have been able to engage Silicon Valley, New York City and Washington, DC, simultaneously, so soon after their inception. Buy-in from these powerful players suggests that innovation-crippling regulations are unlikely. Instead, a natural system of checks and balances has emerged to support Bitcoin.

18 "Investor Alert: Bitcoin and other Virtual Currency-Related Investments," U.S. Securities and Exchange Commission, May 2014, http://arkinv.st/1Guyc9P.
19 "IRS Virtual Currency Guidance," IRS, March 2014, http://arkinv.st/1fGGLrj.
20 "Regulating Bitcoin and Blockchain Derivatives," New York Law School, October 2014, http://arkinv.st/1fGGLaR.
21 "Baidu Stops Accepting Bitcoins After China Ban," Bloomberg, December 2013, http://arkinv.st/1fJlYnh.
22 "All About Bitcoin," Goldman Sachs, March 2014, http://arkinv.st/1fJl7mv.

bitcoin: A MEANS OF EXCHANGE

The software underlying Bitcoin enables bitcoin as an elegant means of exchange. Like cash, transactions processed on the Bitcoin network are fast, irreversible, peer-to-peer, and nearly frictionless. Superior to cash, they can be completed quickly at any distance, with precision out to the eighth decimal place. Consequently, evangelizers often describe bitcoin as cash brought into the digital age, a logical step for innovating civilization's means of exchange.

The *blockchain* supports Bitcoin and is the equivalent of a digital and transparent ledger that records every transaction ever made. Though a transaction can be propagated through the network near instantaneously, the first confirmation of its validity via incorporation into the blockchain takes about ten minutes. bitcoins can be transferred from one address to another without a central intermediary. As a result, all transactions, from those moving coins between smartphones, to others firing off large payments to vendors, can be rapid and efficient.

As is the case with cash, chargebacks are impossible after a bitcoin transaction, making them less vulnerable to fraud than other common payment mechanisms, like credit cards. The irreversible nature of bitcoin transactions, however, suggests that they lack the consumer protections provided by credit cards or other intermediated transaction mechanisms. While the US Consumer Financial Protection Bureau has alerted the public to risks associated with the use of bitcoin – including the lack of the kinds of protections provided by banks and credit cards[23]– there are tools for escrow, multi-signature bitcoin wallets, and other sources of protection can be built on top of the Bitcoin protocol.[24] bitcoin's consumer protection apps are opt-in, empowering individuals to choose whether or not to pay for these services, but also necessitating educated users.

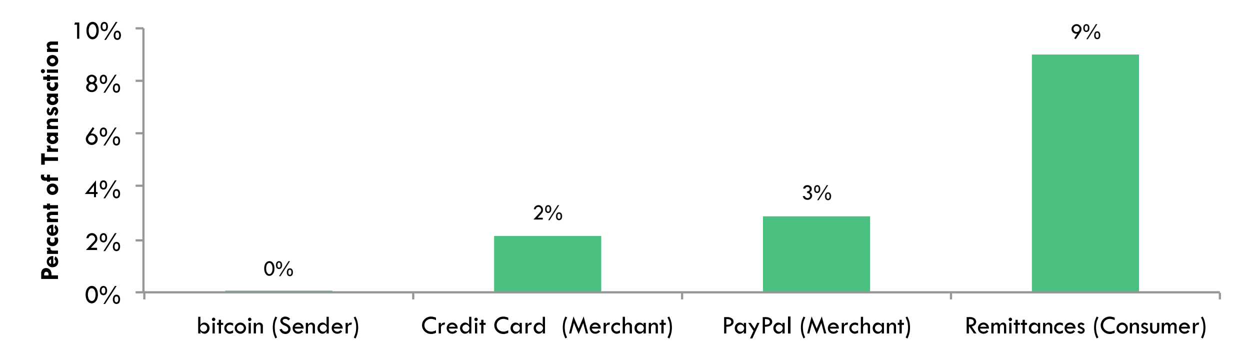
Currently, one of the most important advantages of bitcoin as a medium of exchange is its low transaction fee structure. The fee per transaction can vary because fees serve as an incentive for the machines underlying the Bitcoin network— which are maintained by *miners*— to prioritize a given transaction in their next "block".[25] Since early 2012, the average transaction fee has been a mere 0.01%,[26] with the bitcoin sender voluntarily electing to pay fees to miners to prioritize incorporation of their transaction into the blockchain.[27] In 2014, Bitcoin facilitated $23.4 billion in total transaction volume for only $2.5 million in fees.

THE SOFTWARE UNDERLYING BITCOIN ENABLES bitcoin AS AN ELEGANT MEANS OF EXCHANGE.

23 "Risks to Consumers Posed by Virtual Currencies," Consumer Financial Protection Bureau, August 2014, http://arkinv.st/1GuyltM.
24 "Bitcoin Multisig Wallet: The Future of Bitcoin," Bitcoin Magazine, March 2014, http://arkinv.st/1Guymhp.
25 A miner refers to an entity that maintains mining machines. People that make up the entity are not actively choosing which transactions to include in the blockchain, but instead their machines are algorithmically programmed for this process, including rules regarding transaction fees.
26 ARK Investment Management LLC, data sourced from "Bitcoin Currency Data," Quandl, Accessed August 2015, http://arkinv.st/1GuyqO2.
27 "Transaction fees," BitcoinWiki, Accessed August 2015, http://arkinv.st/1PjLj2D.

The chart below illustrates the direct 0.01% bitcoin transaction fee compared to the average fees incurred for other types of transactions.[28,29, 30]

FIGURE 4
Average Transaction Fees



SOURCE: ARK Investment Management LLC, Quandl, PayPal, IMF, Goldman Sachs

It is important to note, the fee included in this calculation is only the direct fee associated with bitcoin transactions carried out on the blockchain. On top of that fee could be another 1-2% for services like a bitcoin exchange or processor, such as Coinbase.[31] These costs are not inherent to the Bitcoin network, but a function of limited acceptance and the consequent need to exchange into and out of different currencies.[32]

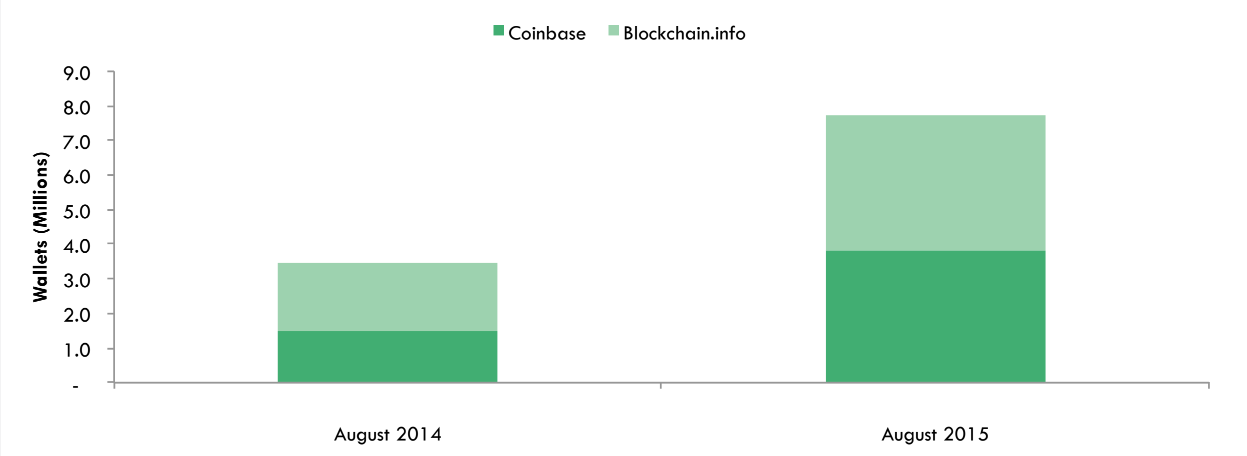
Despite speed, security and transaction fee benefits, bitcoin as a means of exchange is hampered by its limited acceptance. Currently, Bitcoin is suffering through the "chicken and egg" dilemma that many platform technologies experience while gaining traction. In short, customers will be more likely to try bitcoin when they see more merchants accepting it, while merchants will be incentivized to accept bitcoin when they experience high consumer demand.

BitPay and Coinbase offer some concrete numbers on the merchants accepting bitcoin. As of August 1, 2015, they claimed sixty thousand[33] and forty thousand[34] businesses on their respective platforms, while Spendbitcoins.com prominently places "Over 100,000 Merchants Accept Bitcoin" on its landing page.[35] A Goldman Sachs survey of independent sales organizations and merchant acquirers found that 2% of US merchants already accept bitcoin, and 23% plan to start accepting it by 2017.[36] According to Jack Dorsey, CEO of Square, 8 million merchants in the US accept credit cards.[37] This implies that 160,000 already accept bitcoin, and 1.8 million could accept it by 2017. Among the notable merchants that accept bitcoin today are Ebay (EBAY), Microsoft (MSFT), Overstock (OSTK), Expedia (EXPE), Dish Network (DISH), Dell and Reddit. Given the World Bank's estimate of 125 million "micro, small and medium enterprises" worldwide,[38] bitcoin's runway is massive.

28 "PayPal Fees," PayPal, Accessed August 2015, http://arkinv.st/1Guyqxy.
29 "Lowering the Cost of Sending Money Home," International Monetary Fund, June 2011, http://arkinv.st/1fGHiJV.
30 "The Future of Finance: Redefining 'The Way We Pay' in the Next Decade," Goldman Sachs, March 2015, http://arkinv.st/1PjLoTQ.
31 "What Fees Does Coinbase Charge for Merchant Processing?" Coinbase, Accessed August 2015, http://arkinv.st/1GuyyNx.
32 These fees are not the only source of miners' revenue, instead, the majority of revenue currently comes from block rewards. This will be discussed in ARK Investment Management LLC's "Bitcoin: Securing the Network" white paper.
33 "About," Bitpay, Accessed August 2015, http://arkinv.st/1GuyGN5.
34 "Merchants and Partners," Coinbase, Accessed August 2015, http://arkinv.st/1GuyJIB.
35 "Over 100,000 Merchants Accept Bitcoin," SpendBitcoins, Accessed August 2015, http://arkinv.st/1GuyKwh.
36 "The Future of Finance: Redefining 'The Way We Pay' in the Next Decade," Goldman Sachs, March 2015, http://arkinv.st/1PjLoTQ.
37 "1 out of Every 8 Merchants That Take Credit Cards Uses Square," Business Insider, December 2011, http://arkinv.st/1PjN6op.
38 "Micro, Small, and Medium Enterprises," International Finance Corporation, 2010, http://arkinv.st/1fGHF7c.

Consumer acceptance of bitcoin is on the rise as well. The two largest consumer bitcoin wallet hosts, Coinbase and Blockchain.info,[39] claim 3.8 million[40] and 3.9 million worldwide wallets,[41] respectively. Combined, they have grown more than 120% since August 2014.[42]

FIGURE 5
Number of bitcoin Wallets

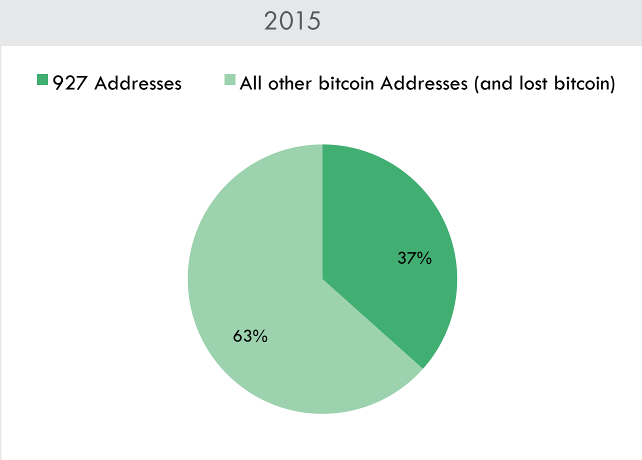


SOURCE: Coinbase, Blockchain.info

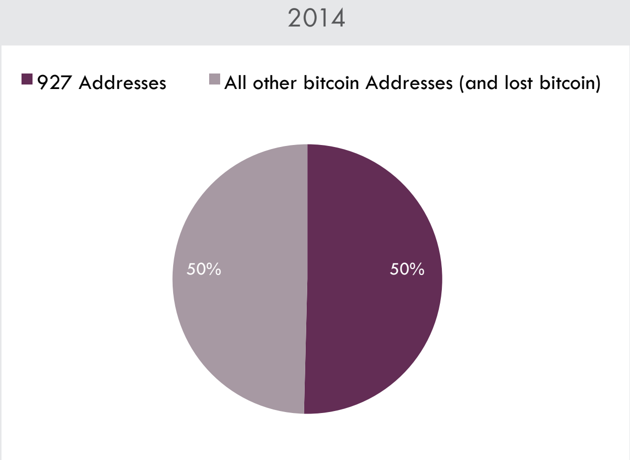
As of March 2014, roughly 90% of Coinbase's users were in the US,[43] suggesting at first blush that from Coinbase alone more than two million Americans have bitcoin wallets, or twenty consumers for every accepting merchant. More likely, however, is that many users have abandoned their wallets, and that bitcoin holdings are more concentrated. In early 2014, for example, CoinDesk reported only 927 addresses owned the majority of bitcoins.[44] Since then, the distribution of bitcoins has improved, as the top 927 addresses now hold a maximum of 37%.[45] With addresses composed of seemingly random letters and numbers, identities are largely unknown, and the same entity could hold multiple addresses. That said, the amount held by each address is transparent to the world via the blockchain.

39 "Blockchain.info" refers to a company offering bitcoin wallets, not the blockchain protocol itself.
40 "About Coinbase," Coinbase, Accessed August 2015, http://arkinv.st/1GuyRrA.
41 "My Wallet Number of Users," Blockchain.info, Accessed August 2015, http://arkinv.st/1fJlMnS.
42 "About Coinbase," Coinbase via Wayback Machine, Accessed May 16, 2014, http://arkinv.st/1fJlOfB, also accessed August 2015, http://arkinv.st/1GuyRrA.
43 ARK Investment Management LLC, data sourced from "All About Bitcoin," Goldman Sachs, March 2014, http://arkinv.st/1fJl7mv, and "About Coinbase", Coinbase, Accessed March 2014, http://arkinv.st/1PjPv2o.
44 "State of Bitcoin: 2014," CoinDesk, February 2014, http://arkinv.st/1GwTZgZ.
45 ARK Investment Management LLC, data sourced from "Top 500 Richest Bitcoin Addresses," BitcoinRichList, Accessed August 2015, http://arkinv.st/1J5ZwjB.

FIGURE 6
bitcoin Ownership Distribution



SOURCE: ARK Investment Management LLC, Bitcoinrichlist; as of August 1, 2015



SOURCE: Coindesk; as of February 26, 2014

Beyond this elite bitcoin echelon, the blockchain's ledger reveals a maximum of 400,000 users with more than $100 in their bitcoin wallets.[46,47] If $100 were the cutoff to classify a wallet user as an active bitcoin player, then no more than six percent of the bitcoin wallets between Coinbase and Blockchain.info are in active use. Compounding the difficulty in determining a wallet's meaning is the fact that a user can use a bitcoin wallet purely for investment purposes, rarely if ever using it for transactions. If all users were to hoard bitcoin, then bitcoin's role as a means of exchange could grind to a halt.

Those who do seek to pay with bitcoin must employ creative methods, underscoring that bitcoin does not yet function smoothly as a medium of exchange. For instance, to purchase items from Amazon (AMZN) or Whole Foods (WFM), neither of which directly accepts bitcoin yet, many users will work through Gyft, a startup that accepts bitcoin via BitPay and purchases gift cards redeemable at various stores or sites. Similarly, there is a proliferation of services and sites, like spendbitcoins.com, that identify businesses open to bitcoin purchases. The existence of these sites is confirmation that finding opportunities to spend one's bitcoins is not a trivial problem. Yet, the number of businesses accepting bitcoin continues to grow, gradually legitimizing bitcoin as a viable payment alternative to fiat currencies.

bitcoin: A STORE OF VALUE

If bitcoin is to function as a reliable store of value, owners must be able to hold them for months or years, trusting they will maintain or, even better, appreciate in value over time.

On May 22, 2010, Laszlo Hanyecz famously paid 10,000 bitcoins for two pizzas,[48] establishing its initial purchasing power at a quarter of a penny per bitcoin. After that initial marker, the price labored for a number of years before

46 ARK Investment Management LLC, data sourced from "The State of the Blockchain: Addresses," Let's Talk Bitcoin, January 2015, http://arkinv.st/1GwU2ti.

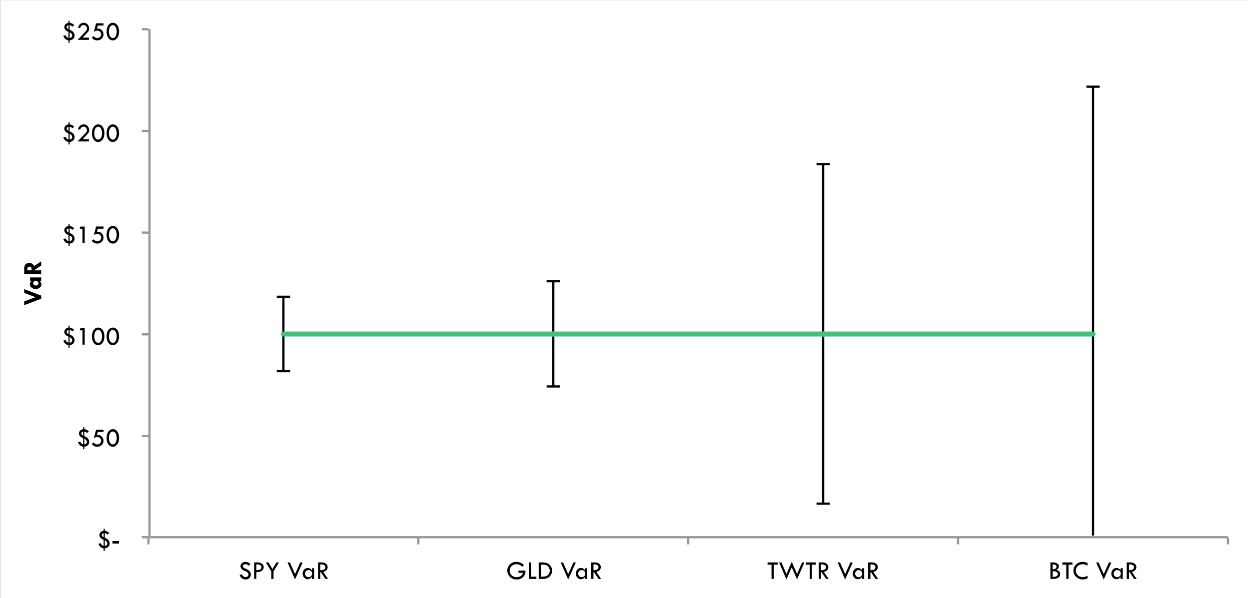
47 Maximum is used because 400,000 was derived from data about bitcoin addresses, and a wallet can have more than one address associated with it. Each wallet correlated with a single address implies the maximum.

48 "May 22nd is Bitcoin Pizza Day," Cryptocoins News, May 2014, http://arkinv.st/1GwUbwl.

soaring in 2013. On November 2013, it hit an intraday high of $1242,[49] higher than one could have purchased an ounce of gold for on the same day. If Hanyecz had offered 10,000 bitcoins for two pizzas at the August 1, 2015 price of $280, Hanyecz's pizzas would likely go down as the world's most expensive pizzas at the equivalent of $175,000 a slice.

While bitcoin has enjoyed enormous price appreciation over the longer term, it also has been highly volatile. Value at risk identifies the upper and lower bounds of expected price volatility. Using price action from May 2014 to May 2015, the graph below has error bars (per the definition of value at risk), that display with 95% probability what an investor might expect a $100 investment to be worth at the end of May 2016.[50] While a common financial statistical technique, it should be noted that value at risk assumes a normal distribution, which most assets do not strictly follow. At 95% probability it also says nothing about the potential magnitude of losses (or gains) in the remaining 5%.

FIGURE 7
One Year Value at Risk (VaR) Based on Trailing One year of Volatility

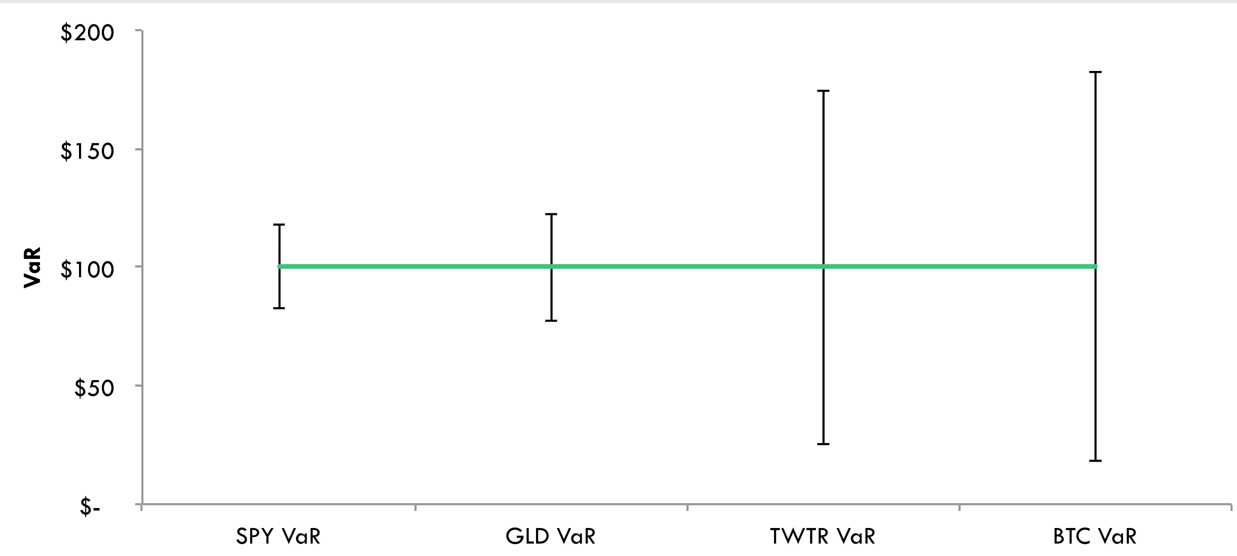


SOURCE: ARK Investment Management LLC.
NOTE: Using price action from May 2014 to May 2015, this is VaR out to May 2016

Although bitcoin's volatility has been extreme, it has stabilized somewhat after bitcoin's price hit $176 in mid January. For example, its one year value at risk out to May 2016, based off March, April and May 2015 volatility, improved to resemble that of Twitter's stock in the same period. While bitcoin differs from the three securities it is compared to below, ARK Invest believes such a comparison lends perspective to its positioning relative to the broader U.S. stock market.

49 "2013: Year of the Bitcoin," Forbes, December 2013, http://arkinv.st/1fJm2Dj.
50 bitcoin is compared to the SPY because the SPY is an ETF designed to measure the performance of the large-capitalization sector of the U.S. stock market. It is compared with the GLD because the GLD is an ETF that closely tracks gold, which is the commodity bitcoin is most often compared to. bitcoin is compared to TWTR because TWTR is a highly volatile stock that many investors have high hopes for, similar to bitcoin.

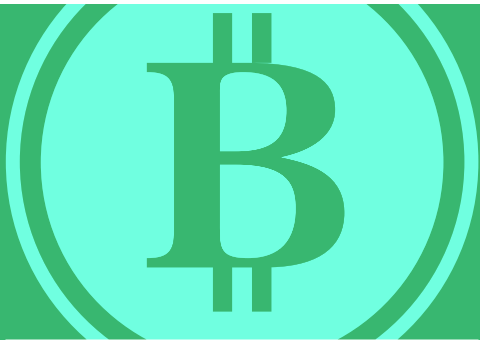
FIGURE 8
One Year Value at Risk (VaR) Based on Trailing Three Months of Volatility



SOURCE: ARK Investment Management LLC.
NOTE: Using price action from March, April, and May 2015, this is VaR out to May 2016

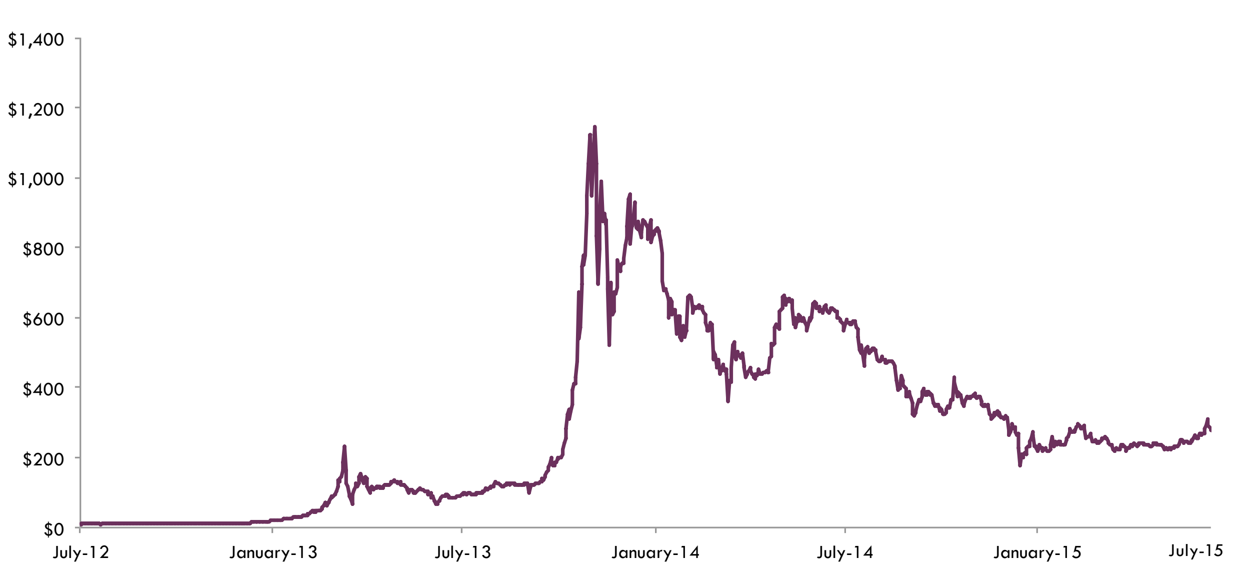
If bitcoin's volatility were to continue to diminish, investors might become more comfortable holding it as a store of value. That said, with increased risk comes increased potential return. From January 1, 2013 to December 31, 2013, the bitcoin rate of exchange increased by a factor of more than 55 from $13 to $750 per bitcoin, and volatility seemed like a good thing. By May 2014, however, six months after it hit its November 2013 high, the price of bitcoin had collapsed by two thirds. Among the reasons for the drop were two scandals, the biggest being the Mt. Gox exchange collapse, as well as fear of regulation following bitcoin bans in China and Russia.[51] By May 2015 the exchange rate had dropped another 50%, from the mid $400's per bitcoin in May 2014 to $230, per CoinDesk.[52]

51 "Bitcoin Crashes Again," The Exchange, February 2014, http://arkinv.st/1RM4eDy.
52 "Bitcoin Price Index Chart," CoinDesk, Accessed August 2015, http://arkinv.st/1GwUfMR.



FEW INNOVATIONS HAVE GENERATED AS MUCH CONTROVERSY AND POTENTIAL FOR WORLDWIDE ECONOMIC TRANSFORMATION AS HAVE BITCOIN

FIGURE 9
bitcoin Price

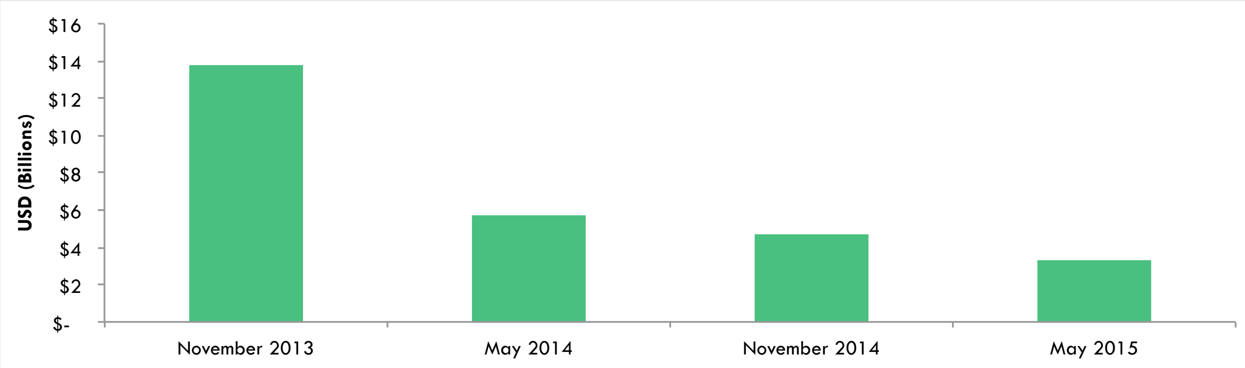


SOURCE: CoinDesk

NOTE: As of August 1, 2015. **Past performance is no guarantee of future results.**

As a result of the collapse, the value of bitcoins in circulation dropped $8 billion,[53] or nearly 60%, in the six months after November 2013, and another $1 billion in each subsequent six-month period, as shown below.[54]

FIGURE 10
Market Capitalization



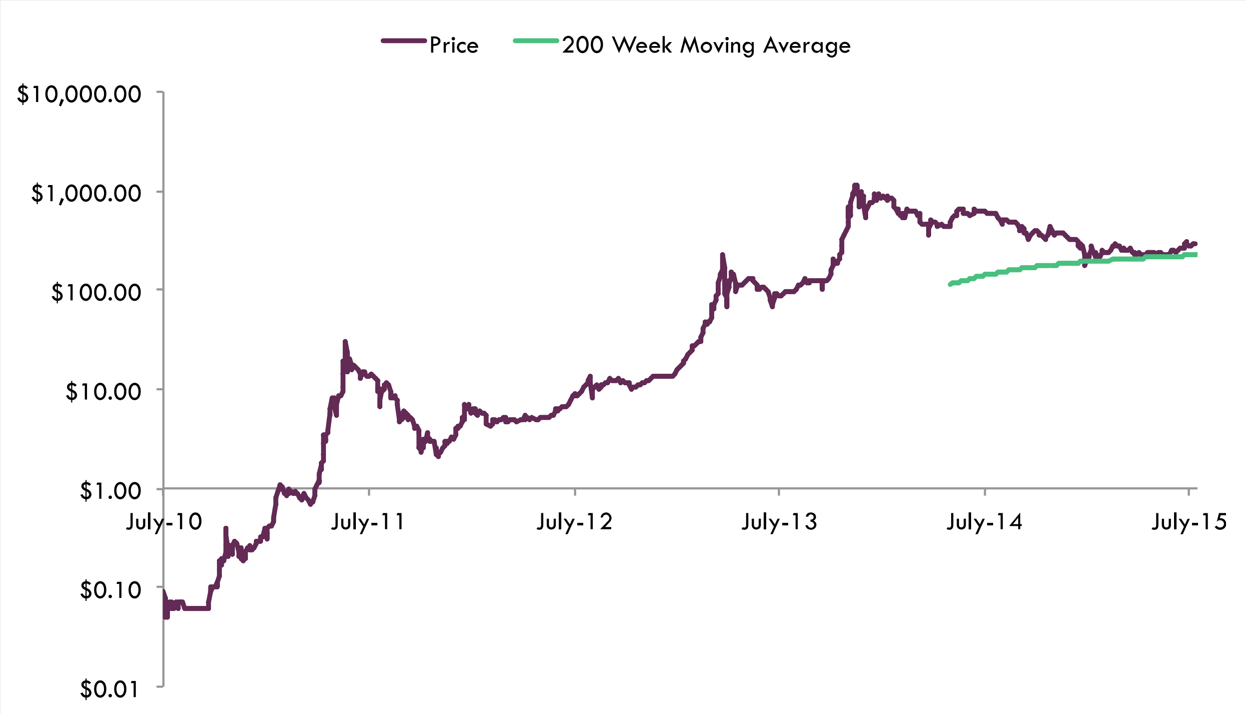
SOURCE: ARK Invest Research, CoinDesk, Blockchain.info

53 It's important to note, while the convention is to measure bitcoin's market cap in dollar terms, all other things equal, its diminishing supply growth is designed to protect its purchasing power irrespective of what happens to the dollar.

54 ARK Investment Management LLC, data sourced from "Bitcoin Price Index Chart," CoinDesk, Accessed August 2015, http://arkinv.st/1GwUfMR, and "Total Bitcoins in Circulation," Blockchain.info, Accessed August 2015, http://arkinv.st/1fJlMnS.

Every disruptive innovation must weather storms, and bitcoin's resilience at and since its bottom has been notable. After dropping below $200 in January of 2015, the bitcoin price broke through resistance and maintained strong support at its 200 week moving average, which as of August 1, 2015 is at $227.55. Nonetheless, its rapid and unpredictable moves have convinced many observers, including much of the media, that it cannot play money's role as a store of value, even though both the longest standing store of value – gold – and the dollar itself have seen more than their share of violent swings.

FIGURE 11
bitcoin Price (Log)



SOURCE: ARK Investment Management LLC, CoinDesk

NOTE: As of August 1, 2015. **Past performance is no guarantee of future results.**

Yet, bitcoin should benefit from a distinctive attribute, one that the media and other detractors appear to disregard, that could give it an advantage over all fiat currencies as a store of value: unlike fiat currencies, it is designed to be limited in supply. While individuals, institutions and governments can expect the dollar to remain fairly stable over short-term periods of months or even years, history exposes a chilling fiscal truth. Over periods of many years the dollar has lost and probably will continue to lose much of its value, as the expansion of its supply rises relative to that of its demand. In fact, the dollar is worth only 4% of what it was a hundred years ago.[56] Inflation is not isolated to the USD, but has damned every fiat currency in circulation. For example, the British pound, one of the longest-standing currencies, only retains 0.5% of its initial value.[57] Voltaire, famous French Enlightenment thought leader, is famous for saying: "Paper money eventually returns to its intrinsic value— zero."

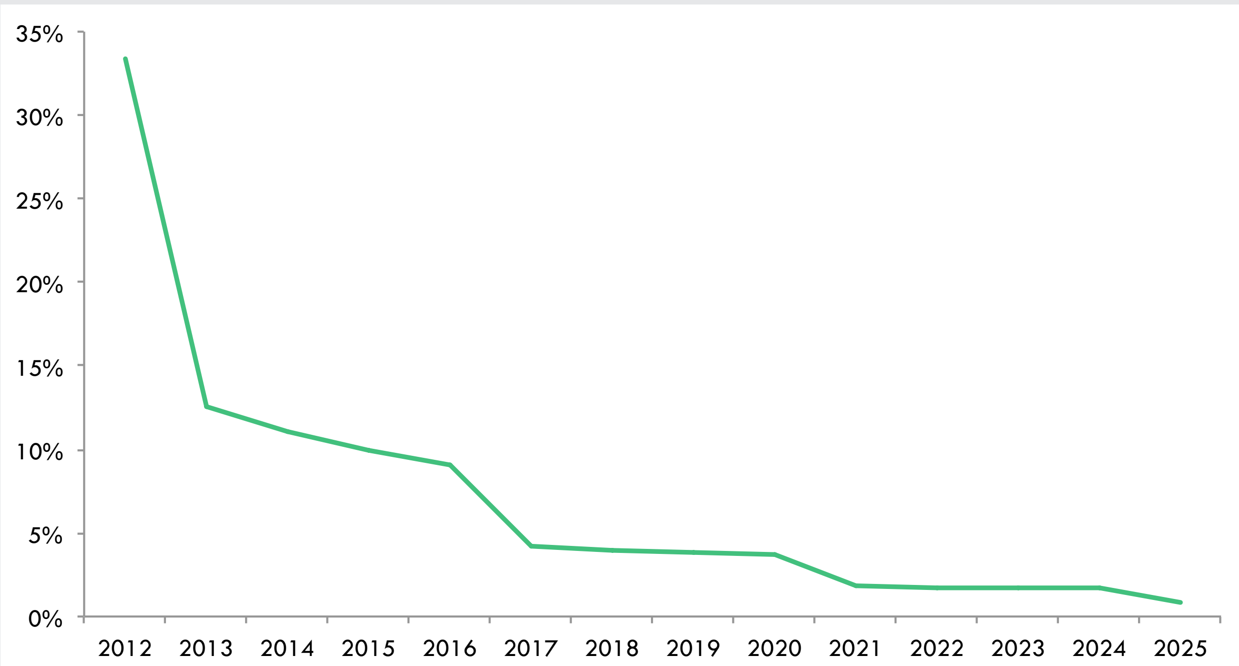
55 ARK Investment Management LLC, data sourced from "Bitcoin Price Index Chart," CoinDesk, Accessed August 2015, http://arkinv.st/1GwUfMR.

56 "CPI Inflation Calculator," Bureau of Labor Statistics, Accessed August 2015, http://arkinv.st/1Pmcslz.

57 "The Average Life Expectancy for a Fiat Currency," Washington's Blog, August 2011, http://arkinv.st/1GwUpEd.

bitcoin is designed so that over time it will suffer from less and less inflation because algorithms, developed by the Bitcoin community at large, mathematically meter its supply. New coins are minted through mining, a process during which miners verify and compile bitcoin transactions into blocks. Each block adds a record of transactions to the blockchain, and the Bitcoin software awards a fixed amount of new bitcoins to the miner who submits the block, regardless of the number of transactions in that block. These awards are referred to as “block rewards,” and are the only way new bitcoins can be created. The block reward started at 50 bitcoins in 2009, and will divide in half roughly every four years. Currently, a block reward is worth 25 bitcoins, or $7,000 at a rate of $280 per bitcoin. Total bitcoin supply will converge on its limit of 21 million coins by half steps, reaching that limit by 2140.[58] Such a progression will lead to a rapid deceleration in bitcoin supply expansion, and therefore a likely preservation of its buying power over time, as shown below.[59]

FIGURE 12
Expansion of bitcoin Supply (Mathematically Metered)



SOURCE: Bitcoin Wiki

Since its inception in 2008, bitcoin supply has expanded rapidly, and since the end of 2013 much more rapidly than the demand for it. This year, the growth in supply will be roughly 10% which, given its recent stabilization in price, could be close to the growth in demand for bitcoin. Assuming no change to the protocol, over coming years the growth in bitcoin supply will decelerate and eventually approach 0%. Given its predictable growth and ultimate fixed supply, bitcoin could become a store of value superior to fiat currencies in the long term. The trajectory of bitcoin’s supply growth will not change, unless the economic majority agrees to it.

58 “How to Mine Bitcoins on Your Own,” CNBC, January 2014, http://arkinv.st/1GwUqbg.
59 “Controlled Supply,” Bitcoin Wiki, Accessed August 2015, http://arkinv.st/1fbD2BF.

bitcoin's price volatility is a reflection of the birthing pains of this fundamentally sound platform. In particular, bitcoin's limited adoption is hampering liquidity. The behavior of a few large holders has caused wild swings in the price of bitcoin, while the decisions of occasional dabblers have caused tremors. Michael Moro of Genesis Trading, the largest over-the-counter bitcoin market maker, has noted extreme cases in which a $500 purchase (a little less than two bitcoins at August 1, 2015 price) has caused a 1% change in the bitcoin price on Bitfinex, one of the most liquid US dollar bitcoin exchanges.[60]

bitcoin has lots of headroom for its liquidity to improve, as its transaction volume averaged only $50 million per day from August 2014 to August 2015.[61] For example, global foreign exchange trading volume in 2013 was 100,000 times greater, at $5 trillion per day.[62] As bitcoin's liquidity increases and exchange volumes improve, its volatility should diminish. Then the combination of its open source network, its metered supply, and its global decentralization could earn it the role of a trusted store of value.

Ironically, bitcoin's attraction as a long-term store of value could hamper its adoption as a means of exchange, particularly if it were to appreciate in the face of limited supply gains. Economists and currency experts often posit that gradual inflation in the supply of fiat currencies is desirable, warding off deflation, depression, and hoarding. This line of thinking could convince the Bitcoin ecosystem to tolerate a whisker of inflation, with supply increasing slightly relative to the demand for bitcoin. Such a change would require approval from the economic majority and a protocol software update to mining machines.

Major financial institutions are sensing the disruptive potential of Bitcoin and its underlying blockchain to facilitate stores of value. In 2015 alone, the New York Stock Exchange invested[63] in Coinbase and created the first exchange-calculated bitcoin index (NYXBT[64]), while the Nasdaq partnered[65] with bitcoin startup, Noble Markets, and also declared that it will leverage the blockchain[66] for financial securities' transactions. Goldman Sachs co-led a $50 million dollar round in Circle,[67] a bitcoin based consumer finance company, and Blythe Masters, former global head of commodities at JP Morgan, decided to accept a position as Chief Executive of Digital Asset Holdings.[68] In April of 2015, Barry Silbert, a long time and well regarded Bitcoin venture capitalist, said at the Inside Bitcoins NYC conference that nearly a billion dollars have gone into Bitcoin startups in the last 24 months.[69] At the same conference, many longtime attendees commented on how many "suits" were in attendance this year.

bitcoin: A UNIT OF ACCOUNT

To satisfy the third and final property of money, bitcoin must become a "measuring stick" for assets and liabilities: in other words, it must be fungibile. bitcoin's digital equality within the blockchain does allow for mutual substitution, although its fungibility could diminish if alternative uses for the blockchain are employed irresponsibly.[70]

Aside from a few isolated examples in which prices are listed in bitcoin, the exchange rate has been too volatile, and acceptance too low, to allow bitcoin to be a useful unit of account. Exceptions typically are tied to the mining ecosystem, in which miners buy hardware for a fixed bitcoin price and receive bitcoin rewards for mining and building blocks. The revenue generated over the life span of mining equipment is tied fundamentally to bitcoin's value, so the price of the hardware can be as well.

60 Personal interview, Michael Moro, Genesis Trading, June 2015.
61 ARK Investment Management LLC, data sourced from "Bitcoin Activity," Quandl, Accessed August 2015, http://arkinv.st/1GuyqO2, and "Bitcoin Price Index Chart," CoinDesk, Accessed August 2015, http://arkinv.st/1GwUfMR.
62 "Table: Global FX Volume," Reuters, September 2013, http://arkinv.st/1fJmtO2.
63 "NYSE and Former Citigroup CEO Invest in Coinbase," Cryptocoins News, January 2015, http://arkinv.st/1fJmzoS.
64 "NYSE to Launch NYSE Bitcoin Index, NYXBT," Intercontinental Exchange, May 2015, http://arkinv.st/1fJmzVL.
65 "Nasdaq Trading Technology to Power Bitcoin Marketplace Noble," CoinDesk, March 2015, http://arkinv.st/1GwUNT9.
66 "Nasdaq Launches Enterprise-Wide Blockchain Technology Initiative," Nasdaq, May 2015, http://arkinv.st/1Pmesdv.
67 "Goldman Joins Bitcoin Startup Circle's $50M Fundraising," Bloomberg, April 2015, http://arkinv.st/1GwUS9b.
68 "Why March 10 was a Big Day for Bitcoin," Fortune, March 2015, http://arkinv.st/1GwUTds.
69 "The Currency Still Matters," InsideBitcoins NYC, attended April 2015.
70 Some companies are working to responsibly leverage the blockchain and bitcoin to securely identify and transfer a variety of assets. Monegraph is a great example, working to license photos, videos, music, and more via a blockchain based rights repository.

If bitcoin does gain broad acceptance as a trusted method of payment and its volatility tempers, the bitcoin unit could become a meaningful measure of value. If they were to be earned and spent consistently without passing through an intermediate exchange, bitcoins would have independent purchasing power, as noted above in the bitcoin mining ecosystem. Overstock serves as another example of "closing the loop," as it accepts bitcoin from customers and then, instead of converting to a local currency, uses it to pay expenses like employee bonuses.[71] Nonetheless, the amount paid is still measured in a local currency rather than in bitcoin itself. Overstock also has experienced limited customer adoption of bitcoin, as it projected reaching $10 to $15 million in bitcoin based sales last year, but achieved only $3 million.[72]

A potential way for bitcoin to quickly establish itself as a unit of account would be for a nation with a dysfunctional currency to endorse it. Instead of pegging its currency to the dollar, a nation could peg its currency to bitcoin. Argentina's burgeoning bitcoin ecosystem[73] and Ecuador's electronic money system[74] foreshadow more innovation to come in this space. Furthermore, ARK Invest believes bitcoin's price appreciation in July 2015 was in part due to the Greek debt crisis, as people flirted with the idea of it replacing the drachma.[75]

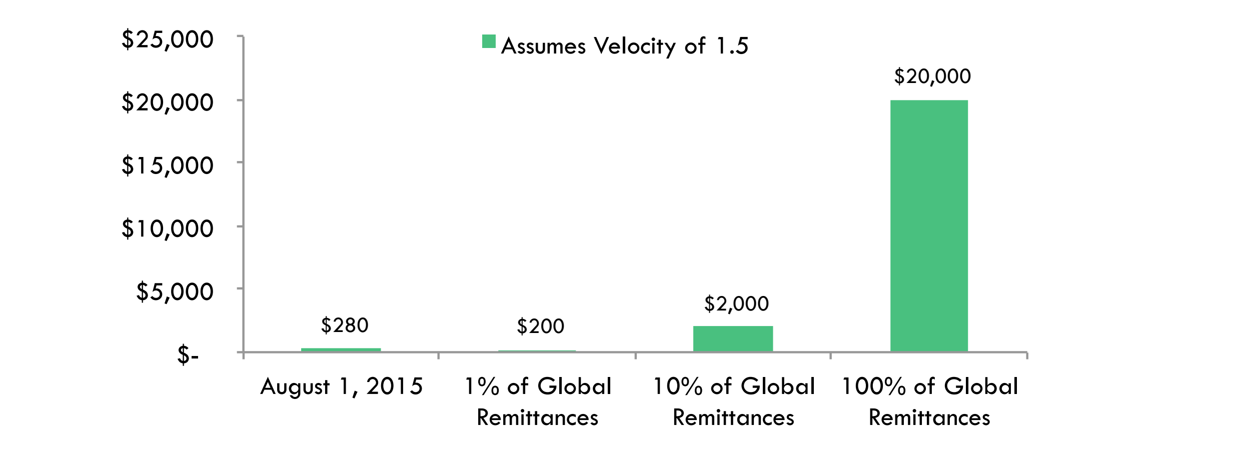
bitcoin: A CURRENCY

Technically, bitcoin could satisfy all three roles of money. Next come the questions of what would be the best use cases and how might the market for bitcoin scale. A few thought experiments follow.

Characterized by high fees and slow settlements, the remittances market for money sent to developing countries[76] could be most ripe for disruption by bitcoin. The World Bank estimates that money transferred to developing countries totaled $436 billion in 2014.[77] If its function were to serve only the remittances market, and bitcoin were to take 1% share with a velocity—the rate in which it turns over per year—equivalent to that of the USD (1.5),[78] it would be worth $200 per bitcoin. At a 10% share, or the equivalent of all remittances sent to Mexico and Nigeria, it would be worth $2000, more than seven times its price of $280 on August 1, 2015. With transaction fees a half to a third that of Western Union,[79] if bitcoin were to take 100% of the remittance market, it would be worth more than seventy times its August 1, 2015 price.[80]

71 "Overstock to Pay Employee Bonuses in Bitcoin," Mashable, July 2014, http://arkinv.st/1GwV4oY.
72 "The Future of Finance: Redefining 'The Way We Pay' in the Next Decade," Goldman Sachs, March 2015, http://arkinv.st/1PjLoTQ.
73 "Can Bitcoin Conquer Argentina," The New York Times Magazine, April 2015, http://arkinv.st/1fJmOAf.
74 While Ecuador's electronic money system is not tied to bitcoin, it nonetheless serves as a material example of currency innovation by a nation. "Ecuador Becomes the First Country to Roll Out Its Own Digital Cash," CNBC, February 2015, http://arkinv.st/1GwV8oR.
75 "Euro, drachma, bitcoin? Greece's currency options," CNBC, July 2015, http://arkinv.st/1Pmfztx.
76 A remittance refers to sending money to remove an obligation; in this case remittances sent to developing countries.
77 "Payment Systems and Remittances Overview," The World Bank, Accessed August 2015, http://arkinv.st/1fJn5Dl.
78 "Velocity of the M2 Money Stock," Federal Reserve Bank of St. Louis, Accessed August 2015, http://arkinv.st/1JRrSK1.
79 "Does Western Union Need to Watch out for Bitcoin?" Fortune, February 2014, http://arkinv.st/1GwVpYI. While companies like BitPesa charge a 3% transaction fee to aid in the remittance process, depending on the service they use the sender or receiver may have to pay an extra 1% to companies like Coinbase in order to exchange into or out of local currency.
80 Assumes August 1, 2015 bitcoin supply of approximately 14.5 million units and price of $280. ARK Investment Management LLC, data sourced from "Total Bitcoins in Circulation," Blockchain.info, Accessed August 2015, http://arkinv.st/1fJlMnS and "Bitcoin Price Index Chart," CoinDesk, Accessed August 2015, http://arkinv.st/1GwUfMR.

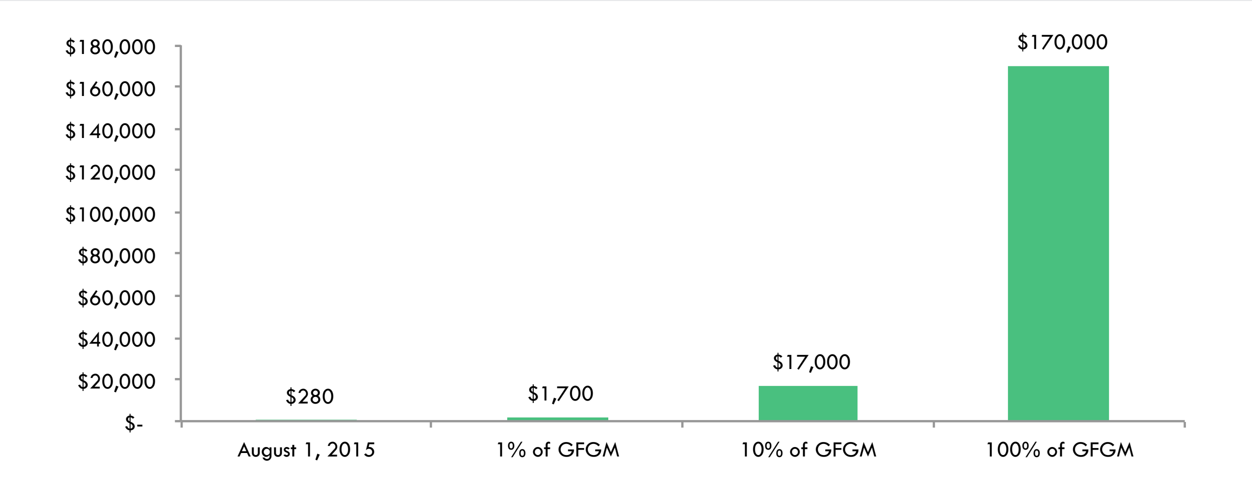
FIGURE 13
Hypothetical Value of One bitcoin in Remittances Market



SOURCE: ARK Investment Management LLC, The World Bank, Federal Reserve Bank of St. Louis

While bitcoin's success within the remittances market would catalyze its role as a means of exchange, taking share from gold would do the same for its role as a store of value. Gold as a private investment, or serving as official sector holdings, makes up 36% of gold above ground, or just shy of $2.5 trillion.[81] Usurping only 1% of gold's role, bitcoin would store $25 billion worth of value, more than six times its August 1, 2015 market cap. At 10% penetration of the gold market, bitcoin's price would soar.

FIGURE 14
Hypothetical Value of One bitcoin in Global Financial Gold Market (GFGM)



SOURCE: ARK Investment Management LLC, World Gold Council

81 "Liquidity in the global gold market," World Goal Council, April 2011, http://arkinv.st/1IRpltU. Excludes people that hold gold jewelry as a private investment.

Just like fiat currency, bitcoin should be able to play more than one role at a time. If bitcoin took 10% of both the remittances market and the gold market, it would be worth $19,000 a coin. If alternative uses for the blockchain also gain traction, like securing settlements, real estate, digital media, and more, bitcoin's price could rise further as its demand increases.[82]

Technocrats and libertarians in the US are not the only groups experimenting with bitcoin. Today, it can be exchanged into twenty currencies worldwide, [83] and underlies budding use cases on all continents, excluding Antarctica. If these use cases grow into mass adoption, bitcoin could transform transaction ecosystems, potentially providing much lower fees as well as more security, transparency and ease of use. Credit cards and banks should be on guard if the need for many fiat currencies is called into question.

If bitcoin were to proliferate, the unbanked population, or 50% of the world's population,[84] would have access to a secure means of exchange, a store of value and a unit of account. Developing countries would need minimal banking infrastructure, much in the way that cell phones made telephone poles unnecessary.

As more people understand and appreciate bitcoin's attributes as a currency, it has the potential to attain worldwide adoption. Much of what makes any form of payment "money" is trust that it *is* money. As with much of "consensus reality," money is a useful shared illusion, an agreed upon version of reality. Once the illusion is shared, Bitcoin as a platform could disappear beneath a robust infrastructure of applications, as was the case with the complex payment platform supporting credit cards.

Bitcoin is a fascinating and compelling phenomenon, yet one whose existence is unsurprising. The creation of a software-based virtual currency seems an inevitable outcome of the tech oriented and open source world we inhabit. We are witnessing the birth of a bold and sweeping new payments paradigm, a virtual child of our rapidly changing global digital economy. Both centralized payment processors and the central banks are confronting it, debating how to regulate it, and wondering if they can sustain their dominance over it.

82 These alternative uses will still rely on bitcoin to record transfers of ownership and will therefore drive demand.
83 "Bitcoin Price Index," BitcoinAverage, Accessed August 2015, http://arkinv.st/1Iwl9tf.
84 "Half the World is Unbanked," McKinsey, March 2009, http://arkinv.st/1GwVqvY.

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