

Department of Economics

Working Paper

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of Bitcoin**

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Working Paper 2013-09

College of Business Administration



MARQUETTE
UNIVERSITY

VIRTUAL CURRENCY AND THE FINANCIAL SYSTEM: THE CASE OF BITCOIN

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I. Introduction

Technological development and the increased use of the internet have led to the proliferation of virtual communities. Some of these communities have created and circulated their own currency for exchanging goods and services. Bitcoin is currently the most popular among these virtual or digital currencies and has been in news recently because of the wild fluctuations in its 'value' and also significant venture capital investment in entities associated with it.¹ Bitcoin is relevant in several areas of the financial system and is therefore of interest to central banks, consumers and investors.

Digital currencies are part of a broader group of virtual currencies that include credit card points, air miles, loyalty points and coupons (Chart 1). With the advent of the Internet, mobile devices and detailed consumer information, companies are increasingly using digital currencies as a marketing tool. As a result, there has been a sharp increase in the use of digital currencies, particularly for app-based coins and tokens, mobile coupons, and personal data exchanged for digital content. As these trends evolve, digital currencies have the potential to become more popular and compete with traditional currencies.

This paper aims to provide some clarity in particular on Bitcoin, its role and potential future use in the financial system and the risks associated with this form of digital currency.. It will begin by providing a short introduction to the Bitcoin network as well as describe the benefits of allowing the Bitcoin network to develop and innovate. It will highlight concerns for consumers, policymakers and financial regulators. Next it will analyze the role that Bitcoin could play in the financial system. The paper will conclude by providing recommendations to address policymakers' concerns while allowing for further innovation within the Bitcoin network. An initial comprehensive overview of this kind is absent from the existing literature. This paper intends to fill that gap in the literature.

¹ Bitcoin is not the only virtual currency on the Web. There are others, such as Ripple, a new currency from a startup called OpenCoin.com

II. Bitcoin Network

Bitcoin is the world's first completely decentralized peer-to-peer digital currency. A software developer pseudo-named Satoshi Nakamoto published the Bitcoin Protocol (Nakamoto, 2008) which outlined the theory of a decentralized currency. This was followed in January 2009 by the release of the open-source Bitcoin software, and the mining of the first Bitcoins. It rocketed to prominence in 2013, when the value of a Bitcoin soared more than 10-fold in a two-month period, from \$22 in February to a record \$266 in April (Chart 2).² The price of a Bitcoin again rose to a record \$710 on November 17, 2013, before falling to \$600 shortly thereafter. The nearly tripling of the price since early November was fueled by rising expectations that the virtual currency will continue to gain traction as an alternative to traditional methods of payment.³ At its peak, based on more than 11.8 million Bitcoins issued, the digital currency boasted a market value of over \$2 billion (Chart 3).⁴

Since its creation, Bitcoin has evolved from a mathematical proof of concept to a rapidly expanding economic network. It is now being used in business transactions around the world. Businesses big and small have shown interest in integrating the Bitcoin platform into their operations and providing new services within the Bitcoin economy. The momentum behind Bitcoin is coming from around the world, as amateur investors, venture capitalists and technology enthusiasts pump money into businesses that are trying to figure out how to use Bitcoin to buy and sell goods and (Chart 4).⁵ A growing number of

² Bitcoins come in whole or in fractional form. Each Bitcoin is subdivided into 100 million smaller units called satoshis, defined by eight decimal places.

³ The prices are as of the writing of this draft on the Tokyo-based Mt. Gox exchange and on the Slovenia-based Bitstamp Exchange.

⁴ The Bitcoin economy exceeded \$8 billion at one point in November, and investors and the U.S. Treasury are beginning to give the virtual currency legitimacy.

⁵ Sarah Needleman and Spencer Ante, "Bitcoin Startups begin to Attract Real Cash," *Wall Street Journal*, May 8, 2013.

merchants accept Bitcoin, because the transaction costs associated with the currency are generally lower than those for using credit or debit cards.

Instead of being made on a printing press or by a central authority, Bitcoins are generated by solving complicated algorithmic searches by powerful computers, a process known as mining.⁶ Most Bitcoin users do not mine, but purchase or trade for their Bitcoin. Mining doesn't affect the average Bitcoin user much, but is still a very important part of the Bitcoin ecosystem.

All newly mined Bitcoin, along with every transaction, are publicly recorded. This record is known as the blockchain. While the blockchain records transaction details, it does not record any personal identifying information about the senders or recipients. The blockchain is a critical feature to maintain the transparency of the Bitcoin system, and make counterfeiting or double spending impossible.

While Bitcoins are created through mining that pursuit is getting increasingly complicated and expensive, as companies and technology fans race to build the powerful computers required for Bitcoin production. There's a limit to the number of Bitcoins that can be mined. After the year 2140, no more Bitcoins will be created, and the total amount ever available is fixed at 21 million, more than half of which have already been mined (Chart 5). The Bitcoin scheme is technically designed in such a way that its supply will increase at a particular pace.

III. Theoretical Roots of Bitcoin

The theoretical roots of Bitcoin can be found in the Austrian school of economics and its

⁶ Mining is the calculation of a hash of a block header, which includes, among other things, a reference to the previous block, a hash of a set of transactions and a nonce (a 32-bit/4-byte field whose value is set so that the hash of the block will contain a run of zeros). If the hash value is found to be less than the current target (which is inversely proportional to the difficulty), a new block is formed and the miner gets 50 newly generated Bitcoins. If the hash is not less than the current target, a new nonce is tried, and a new hash is calculated. This is done millions of times per second by each miner.

criticism of the current fiat money system and interventions undertaken by governments and other agencies, which, in their view, result in exacerbated business cycles and massive inflation (ECB, 2012).

Friedrich A. Hayek of the Austrian School argued that governments should not have a monopoly over the issuance of money. He instead suggested that private banks should be allowed to issue non-interest-bearing certificates based on their own registered trademarks. These certificates (i.e. currencies) should be open to competition and would be traded at variable exchange rates. Any currencies able to guarantee a stable purchasing power would eliminate other less stable currencies from the market leading to a healthy and efficient monetary system. Following this line of reasoning, Bitcoin supporters believe that, inspired by the former gold standard, Bitcoin could end the money-creating monopoly of central banks. Although the theoretical roots of the scheme can be found in the Austrian School of economics, Bitcoin has also raised serious concerns among some of today's Austrian economists.⁷

IV. Why People Might Want to Use Bitcoins?

According to the supporters of Bitcoin, it holds much promise as a way to lower transaction costs for small businesses and global remittances, help alleviate global poverty by improving access to capital, protect individuals against capital controls and censorship, ensure financial privacy for oppressed groups, and spur innovation (Brito and Castillo, 2013).

Firstly, Bitcoin is attractive to cost-conscious small businesses looking for ways to lower the transaction costs of doing business. Since Bitcoin facilitates direct transactions without a third party, it removes costly charges that accompany say, for example, credit card

⁷ Their criticism covers two general aspects: a) Bitcoins have no intrinsic value like gold; they are mere bits stored in a computer; and b) the system fails to satisfy the "Misesian Regression Theorem", which explains that money becomes accepted not because of a government decree or social convention, but because it has its roots in a commodity expressing a certain purchasing power. See Matonis (2011).

transactions. And because transactions are cheaper, Bitcoin makes micropayments and other innovations possible.

Secondly, as an inexpensive funds-transfer system, Bitcoin also holds promise for the future of low-cost remittances. In 2012, immigrants to developed countries sent at least \$401 billion in remittances back to relatives living in developing countries (World Bank, 2013)⁸. The amount of remittances is projected to increase substantially in the near future. Most of these remittances are sent using traditional brick-and-mortar wire services such as Western Union and MoneyGram, which charge steep fees (9.0%) for the service and can take several business days to transfer the funds. In contrast, transaction fees on the Bitcoin network tend to be less than 1% of the transaction.⁹ This entrepreneurial opportunity to improve global money transfers has attracted investments from big-name venture capitalists. Bitcoin allows for instantaneous, inexpensive remittances, and the reduction in the cost of global remittances for consumers could be considerable.

Thirdly, Bitcoin also has the potential to improve the quality of life for the world's poorest by improving access to basic financial services.¹⁰ According to one estimate, 64 percent of people living in developing countries lack access to these services, perhaps because it is too costly for traditional financial institutions to serve poor, rural areas.¹¹ Because of the impediments to developing traditional branch banking in poor areas, people in developing countries have turned to mobile banking services for their financial needs.¹² Mobile banking services in developing countries can be further augmented by the adoption of

⁸ World Bank Payment Systems Development Group, *Remittance Prices Worldwide: An Analysis of Trends in the Average Total Cost of Migrant Remittance Services* (Washington, DC: World Bank, 2013),

⁹ In the first quarter of 2013, the global average fee for sending remittances was 9.05 percent (World bank, 2013). See, also, Andrew Paul, "Is Bitcoin the Next Generation of Online Payments?," *Yahoo!Small Business Advisor*, May 24, 2013,

¹⁰ Muhammad Yunus, *Banker to the Poor: Micro-lending and the Battle against World Poverty* (New York: Public Affairs, 2003).

¹¹ Oya Pinar Ardic, Maximilien Heimann, and Nataliya Mylenko, "Access to Financial Services and the Financial Inclusion Agenda around the World" (Policy Research Working Paper, World Bank Financial and Private Sector Development Consultative Group to Assist the Poor, 2011).

¹² The closed-system mobile payment service M-Pesa has been particularly successful in countries such as Kenya, Tanzania, and Afghanistan. See, for example, Jeff Fong, "How Bitcoin Could Help the World's Poorest People," *PolicyMic*, May 2013,

Bitcoin. As an open-system payment service, Bitcoin can provide people in developing countries with inexpensive access to financial services on a global scale.

Fourthly, Bitcoin might also provide relief to people living in countries with strict capital controls. The total number of Bitcoins that can be mined is capped and cannot be manipulated. There is no central authority that can reverse transactions or prevent the exchange of Bitcoins between countries. Bitcoin therefore provides an escape route for people who desire an alternative to their country's devalued currencies or frozen capital markets. For example, people in Argentina have adopted Bitcoin in response to the country's dual burdens of a 25% inflation rate and strict capital controls.¹³

Additionally, one of the most promising applications of Bitcoin is as a platform for financial innovation. The Bitcoin protocol contains the digital blueprints for a number of useful financial and legal services that programmers can easily develop. Since Bitcoins are, at their core, simply packets of data, they can be used to transfer, not only currencies, but also stocks, bets, and sensitive information.¹⁴ Some of the features that are built into the Bitcoin protocol include micropayments, dispute mediations, assurance contracts, smart property, etc.

V. Challenges Facing Bitcoin Users

Despite the benefits that it presents, Bitcoin has downside risks potential users should consider.¹⁵ Firstly, Bitcoin has weathered at least six significant price adjustments since 2011.¹⁶ These adjustments resemble traditional speculative bubbles: overoptimistic media coverage of Bitcoin prompts waves of novice investors to pump up Bitcoin prices.¹⁷ The exuberance reaches a tipping point, and the value eventually plummets (Brito and Castillo, 2013).

¹³ Jon Matonis, "Bitcoin's Promise in Argentina," *Forbes*, April 27, 2013,

¹⁴ Jerry Brito, "The Top 3 Things I Learned at the Bitcoin Conference," *Reason*, May 20, 2013.

¹⁵ It is also important to note that many of the potential downsides of Bitcoin are the same as those facing traditional cash.

¹⁶ Timothy B. Lee, "An Illustrated History of Bitcoin Crashes," *Forbes*, April 11, 2013 and authors' calculation.

¹⁷ Felix Salmon, "The Bitcoin Bubble and the Future of Currency," *Medium*, April 3, 2013,

If Bitcoins were only used as stores of value or units of account, the currency's volatility could indeed endanger its future. It does not make sense to manage business finances or keep savings in Bitcoin if the market price swings wildly and unpredictably. When Bitcoin is used as a medium of exchange, however, volatility is less of a problem. Merchants can price their wares in terms of a traditional currency and accept the equivalent number of Bitcoins. Customers who purchase Bitcoins to make a one-time purchase don't care about what the exchange rate will look like tomorrow; they simply care that Bitcoin can lower current transaction costs.

Secondly, Bitcoin presents some specific security challenges.¹⁸ If people are not careful, they can inadvertently delete or misplace their Bitcoins since the currency is virtual and not physical. Once the digital file is lost, the money is lost, just as with paper cash. Because of the pseudonymous nature of Bitcoins, it could also be used for illegal transactions. In October 2013, the U.S. Government accused Silk Road of making available a vast digital marketplace where one could mail-order drugs and other illicit objects.

Another concern is that Bitcoin can be used to launder money for financing terrorism and trafficking in illegal goods. Although these worries are currently more theoretical than evidential, Bitcoin could indeed be an option for those who wish to discreetly move ill-gotten money.¹⁹

VI. Is Bitcoin Money?

In its simplest form a traditional currency serves three purposes- medium of exchange, unit of account and store of value. Bitcoin serves a role as a peer-to-peer network and a digital currency. However, it is not a traditional currency in the strictest sense. As a medium of

¹⁸ Most of the security challenges concern wallet services and Bitcoin exchanges. The protocol itself has proven to be considerably resilient to hacking and security risks.. See Dan Kaminsky, "I Tried Hacking Bitcoin and I Failed," *Business Insider*, April 12, 2013,

¹⁹ Concerns about Bitcoin's potential to facilitate money laundering were stoked after Liberty Reserve, a private, centralized digital-currency service based in Costa Rica, was shut down by authorities on charges of money laundering. However, note that unlike Bitcoin, Liberty Reserve was a centralized currency service created and owned by a private company.

exchange, Bitcoin satisfies the condition of coincidence of wants; however, it lacks liquidity because it has not been widely accepted. Its high-volatility makes it hard to predict and thus can be a risky instrument to store value.²⁰ Finally, Bitcoin's role as a unit of account is still confined to a small group of businesses and individuals.

VII. Bitcoin Versus Conventional Currencies²¹

Bitcoin differs from conventional currencies in some very fundamental ways, as noted below (BBVA, 2013).

1. All functions such as Bitcoin issuance, transaction processing and verification are carried out collectively through peer-to-peer technology (P2P) by the Bitcoin network, without a central supervisor or agency to oversee operations. In contrast, a conventional currency is issued by a central bank as part of its mandate to manage national monetary policy. It is also the central authority that conducts monetary policy, supervises banks, maintains financial system stability, and provides financial services to depository institutions.
2. Although physical Bitcoins are available from companies such as Casascius and BitBills, Bitcoin has been designed primarily to be a digital currency. Conversely, conventional currencies exist primarily in physical form; the balances that an individual holds at a bank or online brokerage can be converted into physical units within minutes if so desired.
3. The total number of Bitcoins that will be issued is capped at 21 million and that limit will not be reached until 2040.²² While Bitcoin critics argue that the maximum limit is not large enough, supporters maintain that since each Bitcoin is divisible to eight

²⁰ In fact, the sharp buying and selling due to the Cyprus bail-in showed bitcoin's vulnerability to speculation and highlights how unpredictable its value can be.

²¹ This section is based on BBVA, 2013.

²² The Bitcoin "mining" process presently creates 25 Bitcoins every 10 minutes (the number created will be halved every four years), so that limit will not be reached until the year 2040.

decimal places, the number of fractional Bitcoins (called “satoshis”) – at 21×10^{14} – will be more than enough for all conceivable applications. Conventional currencies, on the other hand, can be issued without limit.

4. Bitcoin has limited acceptance so far and cannot be used at brick-and-mortar storefronts, although that may eventually change if it continues to gain traction. Conventional currencies, on the other hand, have near-universal acceptance. Moreover, a Bitcoin transaction can take as long as 10 minutes to confirm. Transactions are also irreversible and can only be refunded by the Bitcoin recipient. These limitations do not exist with conventional currencies, where debit and credit transactions are confirmed within seconds; certain transactions can also be reversed for valid reasons by the originator, without having to rely on the recipient's largesse.

5. If you lose your Bitcoins for any reason – for example, your hard drive crashes, or a hacker steals the digital wallet in which your Bitcoins are stored or the Bitcoin exchange where you held a balance went out of business – you have little recourse. Currency balances held at banks, on the other hand, are insured against certain events such as bank failure by legal agencies.

VIII. Bitcoin and the Financial System

Because of its drawbacks as a currency, Bitcoin's insertion in the financial system has not been smooth. The supply of Bitcoins cannot be controlled, regulated or supervised by any public authority and although businesses using Bitcoins can be regulated, Bitcoin transactions and mining cannot. It derives its value from decentralization and anonymity. Anonymity makes it difficult to manage credit, counterparty, liquidity, market, operational and legal risks. Therefore, Bitcoin, in its current format, is not compatible with banks and regulators' quest for transparency and accountability.

Consequently, the involvement of banks in the Bitcoin environment has been marginal and confined to banks servicing businesses that operate with Bitcoin. In most countries, banks

are required to know their customers and comply with anti-money laundering regulations, which are difficult to comply with in the Bitcoin network.²³

Ultimately, lack of government support and vulnerability to money laundering make it very difficult for Bitcoin to become a true competitor of benchmark currencies. Without the backing of governments and monetary authorities, Bitcoin's role in the global financial system will be limited to a niche currency or a digital commodity.

Despite its shortfalls to become a widely accepted currency, Bitcoin's limited supply and anonymity is an attractive option for supporters of a decentralized monetary policy system and people that have lost trust in the financial system after the recent global crisis. In addition, it could be attractive for individuals looking to hedge against unstable local currencies.

From an institutional perspective, even though today's money is increasingly moving in an electronic environment, it is still managed by the banking industry. However, in its purest form, digital peer-to-peer currencies eliminate the need of banking intermediation and sovereign guarantees. A decentralized digital currency challenges the entire monetary and banking system (BBVA, 2013).²⁴

²³ For example, the U.S. Department of Homeland Security seized Mt. Gox's bank account at Wells Fargo, alleging violations of anti-money laundering regulations. Likewise, Barclays and Royal Bank of Canada have frozen or shut down bank accounts tied to Bitcoin businesses.

²⁴ Ripple, created by a private company, was designed to serve a dual function as a currency and a payment system, allowing for faster processing times and lower fees.

For digital currencies to succeed they have to be trustworthy and that necessarily implies the recognition of governments and financial institutions. This is going to be hard for digital currencies like Bitcoin that are by design anti-establishment.²⁵

IX. Bitcoin and Monetary Policy

As discussed earlier, the Bitcoin scheme is designed as a decentralized system where no central monetary authority is involved. Bitcoins can be bought on different platforms. However, new money is created and introduced into the system only through mining activity, i.e. by rewarding the “miners” who perform the crucial role of validating all transactions made, with new Bitcoins.

Therefore, the supply of money does not depend on the monetary policy of any virtual central bank, but rather evolves based on interested users performing a specific activity. According to Bitcoin, the scheme has been technically designed in such a way that the money supply will develop at a predictable pace. The number of Bitcoins in existence will reach 21 million in around 2040. From this point onwards, miners are expected to finance themselves via transaction fees.

The fact that the supply of money is clearly determined implies that, in theory, it could not be changed by any central authority or participant wanting to “print” extra money. According to Bitcoin supporters, the system is supposed to avoid inflation, as well as the business cycles originating from extensive money creation. However, critics have suggested that the system leads to a deflationary spiral. The total supply of Bitcoins is expected to grow geometrically until it reaches a finite limit of 21 million. If, however, the number of Bitcoin users starts growing exponentially for any reason, and assuming that the velocity of money does not increase proportionally, a long-term appreciation of the currency can be expected. This would imply a depreciation of the prices of the goods and services quoted in

²⁵ In March, 2013 the U.S. Financial Crimes Enforcement Network (FinCEN) clarified rules set in 2008’s Bank Secrecy Act (BSA) which governs digital currencies. Under the BSA, exchanges and administrators of digital currencies are considered money-services business (MSB) which requires federal and state registration.

Bitcoin. People would have a great incentive to hold Bitcoin and delay their consumption, thereby exacerbating the deflationary spiral.

Brito and Castillo (2013) have, however, pointed out that the extent to which this could be a problem in reality is not clear. Firstly, as highlighted by the Economist (2011a), the deflation hypothesis entails an assumption which is not realistic at this stage, i.e. that many more people will want to receive Bitcoin in return for goods or in exchange for paper money. However, Bitcoin is still quite immature and illiquid which is a clear disincentive for its use. Secondly, Bitcoin is not the currency of a country or currency area and is therefore not directly linked to the goods and services produced in a specific economy, but linked to the goods and services provided by merchants who accept Bitcoin. These merchants may also accept another currency (e.g. U.S. dollars) and therefore, the fact that deflation is anticipated could give rise to a situation where merchants adapt the prices of their goods and services in Bitcoin.

X. Concluding Remarks

Successful virtual currencies must reach a balance between convenience and compliance (BBVA, 2013). Trust in the U.S. dollar comes from the strength of the U.S. economy and its institutions. Would people trust a currency that is backed by a private entity or an unknown developer? Would the average person hold their savings in a digital wallet rather than a bank account that is insured by a deposit guarantee fund? Who will be accountable for a failure in the systems that create the digital currencies? These and other serious questions will need to be considered by future developers of virtual currencies

On the other hand, governments and financial institutions should also recognize the fact that it is only a matter of time before new models of virtual currency like Bitcoin become more mainstream. So the challenge for policymakers will be to foster Bitcoin's beneficial uses while minimizing its negative consequences.

We conclude with some recommendations to help policymakers meet this future but fast closing challenge.

- Monitor market developments of Bitcoin, provide analyses, including payment statistics, act as “catalyst”
- Facilitate a social dialogue between Bitcoin stakeholders to:
 - develop a payments strategy and set work priorities,
 - set business requirements for specific payment instruments,
 - identify harmonization and standardization needs.
- Set challenging payments security requirements
- Regularly update the legal framework to:
 - provide clarity on responsibilities and liabilities,
 - remove obstacles that hinder innovation or competition,
 - facilitate market entry for new, innovative types of providers.

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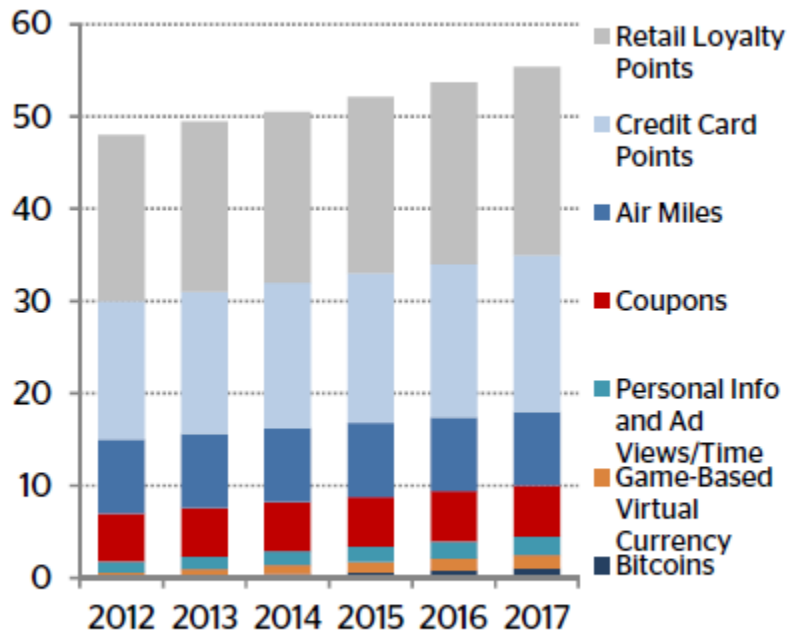
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Chart 1

Virtual Currency Growth US\$bn



Source: Yankee Group

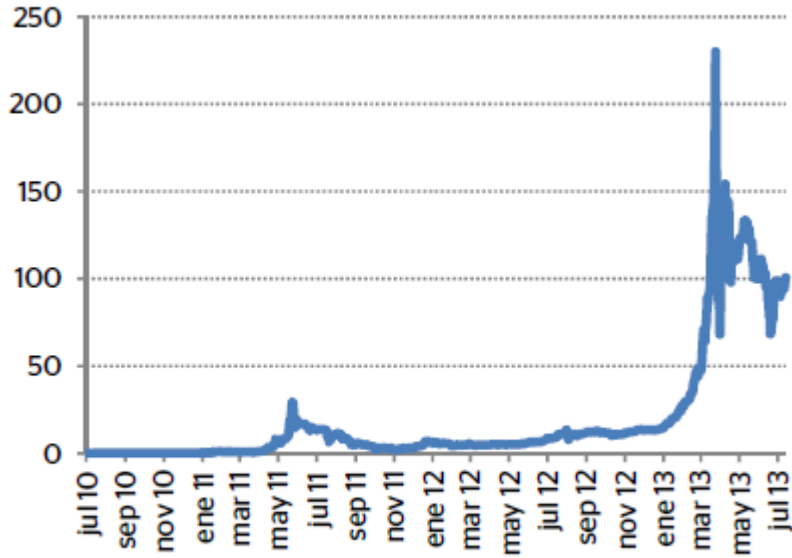
Chart 2



Source: <http://blockchain.info/charts> (accessed on November 20, 2013)

Chart 3

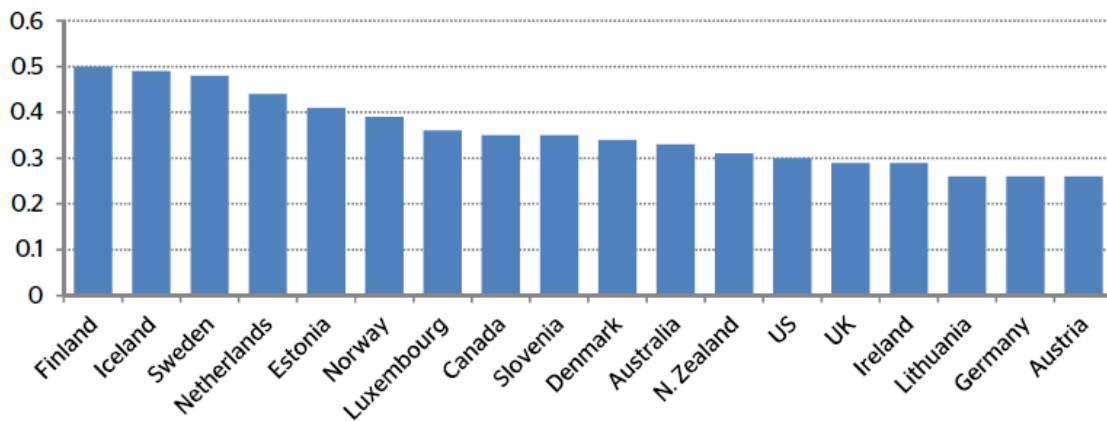
Bitcoin / USD Exchange Rate



Source: BBVA Research and Mt. Gox

Chart 4

Bitcoin Penetration, Downloads per Capita, %



Source: BBVA Research and Genesis Block

Chart 5: Total Bitcoins over Time

